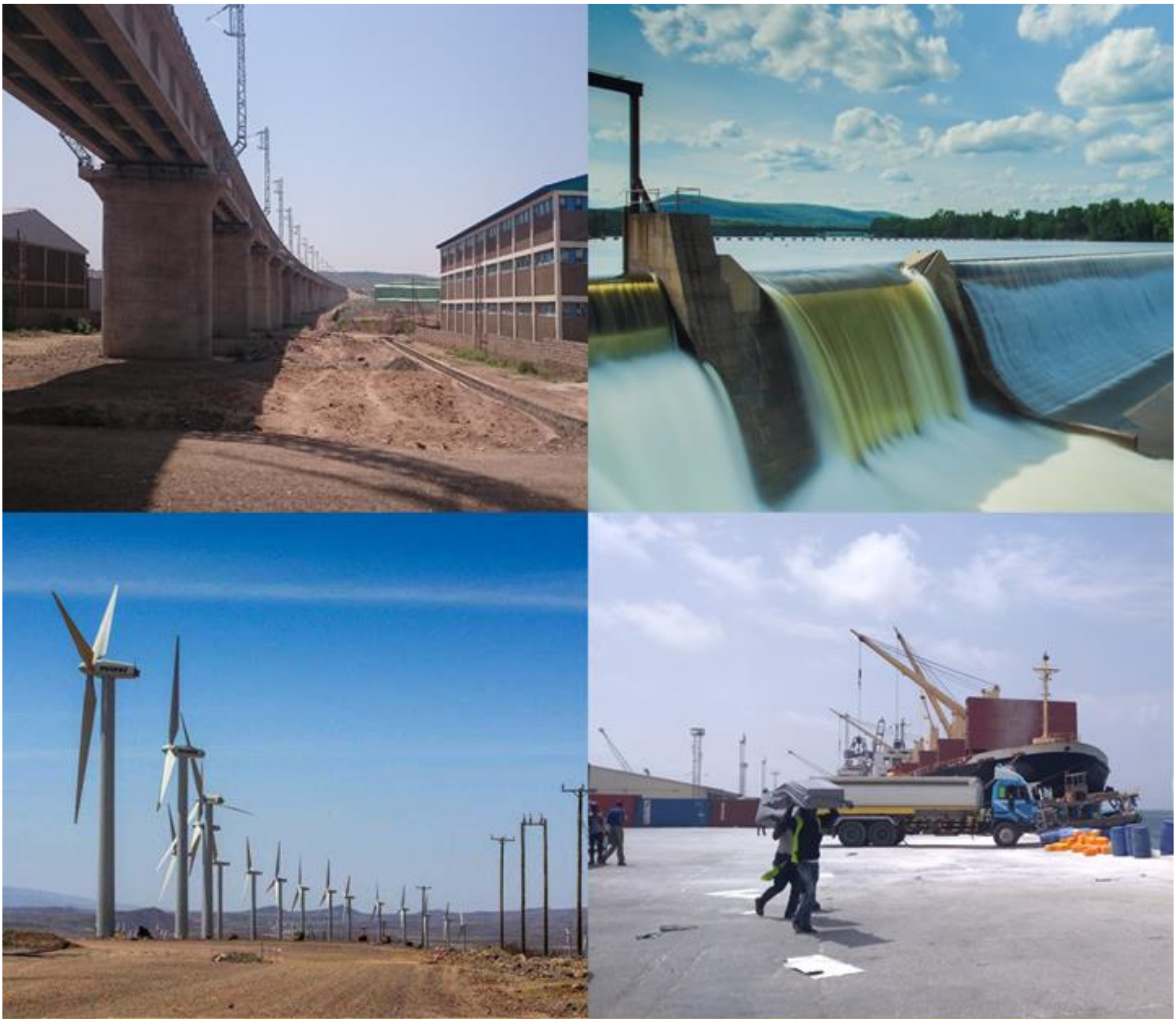

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Acronyms

AEEP	Africa-EU Energy Partnership
AfDB	African Development Bank
AIIM	Africa Infrastructure Investment Managers
AU	African Union
CAGR	Compound Annual Growth Rate
CBET	Cross Border Energy Trade
COMESA	Common Market for Eastern and Southern Africa
CRGE	Climate Resilient Green Economy
CSA	Central Statistical Authority, Ethiopia
DMIC	Delhi-Mumbai development corridor
EAC	East African Community
ECOWAS	Economic Community for West African States
EDRI	Ethiopian Development Research Institute
EU	European Union
FDI	Foreign Direct Investment
GDI	Gross Domestic Income
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan (Ethiopia)
HVA	High Value Added
IGAD	Intergovernmental Authority on Development
IRIMP	IGAD Regional Infrastructure Masterplan
IMF	International Monetary Fund
IRIMP	IGAD Regional Infrastructure Master-Plan
ITU	The International Telecommunication Union
LDP	Local Development Plan
LMI	Lower Middle Income
MEL	Monitoring Evaluation and Learning
MDG	Millennium Development Goals
MIGA	Multilateral Investment Guarantee Agency
MIC	Middle Income Country
MoFEC	Ministry of Finance and Economic Cooperation, Ethiopia
MoMFNG	Ministry of Mines, Fuel and Natural Gas, Ethiopia
MoT	Ministry of Transport, Ethiopia
MoWIE	Ministry of Water, Irrigation and Electricity, Ethiopia
MUDHo	Ministry of Urban Development and Housing, Ethiopia
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organisation
NDP	National Development Plan
OECD	Organisation for Economic Co-operation and Development
PIDA	Programme for Infrastructure Development in Africa
PPP	Public Private Partnership
REC	Regional Economic community

RISE	Regulatory Indicators for Sustainable Energy
SADC	Southern African Development Community
SDPRP	Sustainable Development and Poverty Reduction Plan
SREP	Sustainable Energy for All
SREP	Scaling Up Renewable Energy Programme
SEZ	Special Economic Zone
UNECA	United Nations Economic Commission for Africa
WB	World Bank
WUP	World Urbanisation Prospects

Contents

Executive Summary 1

Chapter 1 Introduction 13

Section 1.1 Purpose of the report 14

Section 1.2 Structure of the Report 14

Chapter 2 Strategic Context 17

Section 2.1 The need for the IRIMP 19

Section 2.2 Economic performance and targets 20

Section 2.3 Drivers of Trade and Integration in the IGAD Region 25

Section 2.4 The Importance of Trans-Border Development Corridors 41

Section 2.5 Lessons from the IGAD trans-border infrastructure case studies 64

Chapter 3 Broad Sector Overview 66

Section 3.1 Introduction 67

Section 3.2 Identifying the need for future trans-border infrastructure 67

Section 3.3 IRIMP base population growth projections 70

Section 3.4 IRIMP base economic growth projections 70

Chapter 4 The Transport Sector 72

Section 4.1 The Existing Transportation Networks 73

Aviation 88

Section 4.2 Pipeline of Trans-border Infrastructure Projects 92

Section 4.3 Ports Pipeline Projects 97

Section 4.4 The Enabling Environment for the Transportation Sector 103

Section 4.5 Transport Infrastructure Gap Analysis 109

Chapter 5 The Energy Sector 156

Section 5.1 Foundations of cross-border energy trade for IGAD 157

Section 5.2 Current cross-border energy infrastructure 166

Section 5.3 Pipeline of IGAD Cross-Border Energy Trade Initiatives 169

Section 5.4 Energy Demand 174

Section 5.5 Energy Infrastructure gap analysis 185

Section 5.6 The enabling environment 188

Section 5.7 Conclusion 201

Chapter 6 The Water Sector 203

Section 6.1: Situation and Trends in the Water Sector 204

Section 6.2 Trans-boundary Water Basins 207

Section 6.3 Pipeline of trans-boundary infrastructure and initiatives 225

Section 6.4 Policy Initiatives, Institutional Arrangements and Enabling Environment 226

Section 6.5 Framework for Water Demand Management 235
Section 6.6 IGAD Water Demand Analysis and Forecasting 242
Section 6.7 Gap Analysis 268
Chapter 7 The ICT Sector 276
Section 7.1 The importance of the ICT sector 277
Section 7.2 Current status of physical trans-border infrastructure 277
Section 7.3 Current Status of Cyber Security 294
Section 7.4 Pipeline of trans-border infrastructure projects 297
Section 7.5 The enabling environment 299
Section 7.6 Constraints and Barriers on ICT Development 303
Section 7.7 ICT Demand (2019-2050) 305
Section 7.9 ICT Gap analysis 311
Chapter 8 Trans-border project and policy prioritisation criteria 314
Section 8.1 Introduction 315
Section 8.2 Step 1: Inventory of Potential Projects 316
Section 8.3 Step 2: Screening: Eligibility for the Master Plan Project Pool 317
Section 8.4 Step 3: Sequencing Short, Medium and Long – Term Baskets 319
Section 8.5 Step 4: Inclusion in the Action Plan 321
Section 8.6 Plan to Implement: Commitment and Confidence are Essential 327
Report Appendix cccxxviii
Appendix 1. Estimating Transport Demand in the IGAD Corridors 329
Appendix 2: The Demand Methodology Energy 339

List of Tables

Table 2-1: Key macroeconomic indicators for IGAD member states and comparators 23
Table 2-2: IGAD member states' NDP targets 26
Table 2-3: Tariff structures of IGAD member states 37
Table 2-4: Ease of doing business in IGAD member states 40
Table 2-5: Corridor Assessment and Benchmarking Indicators 44
Table 2-6: Economic Corridors in the IGAD Region 46
Table 2-7: Learning from the benchmark countries: 60
Table 3-1: Projected IGAD population (thousands) 70
Table 4-1: List of IGAD Corridors 73
Table 4-2: Current IGAD Corridor Road Networks 74
Table 4-3: List of IGAD Border Posts and Status 76
Table 4-4: Current IGAD Railways Networks 77
Table 4-5: IGAD Rail Networks and Traction 79
Table 4-6: Rail Share of Container Traffic (2007 – 2018) 81
Table 4-7: Djibouti Ports Facilities 82
Table 4-8: Kenya Ports Facilities (Mombasa Port) 82
Table 4-9: Categories of Somali Ports 83
Table 4-10: Somalia Ports Facilities 83
Table 4-11: Sudan Ports Facilities (Port Sudan) 84
Table 4-12: Traffic in IGAD Ports 85
Table 4-13: Mombasa Port Traffic 2012 to 2017 85
Table 4-14: Port Sudan Traffic 2012 to 2017 86
Table 4-15: Status of Navigation in IGAD Inland Waterways 87
Table 4-16: Disposition of Shipping Lines in the IGAD Region 88
Table 4-17: IGAD International Airports 89
Table 4-18: IGAD International Airports Passenger Traffic (to be completed) 89
Table 4-19: IGAD Airlines Providing International Services 90
Table 4-20: Weekly Passenger Flights 2012 91
Table 4-21: Weekly Passenger Flights Frequencies 2018 91

Table 4-22: IGAD Countries Planned Road Projects 92
Table 4-23: IGAD Countries Planned Rail Projects 94
Table 4-24: Djibouti Ports Projects 97
Table 4-25: Kenya Pipeline Ports Projects 99
Table 4-26: Somalia Pipeline Ports Project 100
Table 4-27: Sudan Pipeline Ports 101
Table 4-28: Priority Pipeline Projects in Inland Waterways 101
Table 4-29: IGAD Planned Aviation Projects 102
Table 4-30: Road Regulatory Setups in IGAD Countries 103
Table 4-31: Rail Regulatory Setups in IGAD Countries 105
Table 4-32: Maritime Sector Regulatory Setups in IGAD Countries 107
Table 4-33: Aviation Sector Regulatory Setups in IGAD Countries 109
Table 4-34: Missing Road Links 110
Table 4-35: Missing Railway Links 111
Table 4-36: Planned OSBPs 112
Table 4-37: Planned port facilities 114
Table 4-38: Gaps in Inland Waterways 114
Table 4-39: Traffic Forecasts and Gap Analysis, Northern Corridor (Millions of Tonnes) 116
Table 4-40: Traffic Forecasts and Gap Analysis, LAPSSET Corridor (Millions of Tonnes) 121
Table 4-41: Traffic Forecasts and Gap Analysis, Berbera Corridor (Millions of Tonnes) 125
Table 4-42: Traffic Forecasts and Gap Analysis, Djibouti Corridor (Millions of Tonnes) 129
Table 4-43: Traffic Forecasts and Gap Analysis, Port Sudan Corridor (Millions of Tonnes) 133
Table 4-44: Traffic Forecasts and Gap Analysis, Massawa Corridor (Millions of Tonnes) 138
Table 4-45: Traffic Forecasts and Gap Analysis, Assab Corridor (Millions of Tonnes) 143
Table 4-46: Traffic Forecasts and Gap Analysis, Mogadishu Corridor (Millions of Tonnes) 147
Table 4-47: Traffic Forecasts and Gap Analysis, Kismayu Corridor (Millions of Tonnes) 152
Table 5-1: State of electricity access in IGAD countries 158
Table 5-3: Energy sector structure in IGAD countries 164
Table 5-4: Fossil based resources and reserves within IGAD states 166
Table 5-5: Existing cross-border energy projects 167
Table 5-6: EAC Regional refineries strategy 2008 168

Table 5-7: Planned cross-border electricity interconnects (Planned, but not implemented) 169
Table 5-8: AfDB-funded generation projects within IGAD 171
Table 5-9: Planned IGAD region petroleum pipelines 173
Table 5-10: Generating capacity of IGAD member countries 179
Table 5-11: Planned interconnectors for IGAD countries (including key external connectors) 180
Table 5-12: Proven oil reserves within IGAD region 181
Table 5-13: Oil Production within IGAD region 182
Table 5-14: Scenario projection of electricity demands 183
Table 5-15: Scenario Projection of Oil Demands 185
Table 5-16: Potential interconnectors and generators by 2024 185
Table 5-17: Infrastructure gap within selected IGAD member countries 187
Table 5-18: Committed generation in IGAD countries 188
Table 5-19: National energy mandates, bottlenecks and interventions 196
Table 5-20: Power Africa Support to IGAD Member States 200
Table 6-1: Rural and urban population (%) with access to safe drinking water, 2015 205
Table 6-2: Population (Million Persons) accessing improved water sources 206
Table 6-3: Aquifers in the IGAD region 209
Table 6-4: Existence of Information on Groundwater in the IGAD region 210
Table 6-5: Relevance of Irrigation in IGAD Region 223
Table 6-6: Irrigated Areas in IGAD region by country 223
Table 6-7: Summary of Issues and Threats in the IGAD Region 224
Table 6-8: List of Transboundary Water Projects and Status 225
Table 6-10: Showing different level of Domestic water supply access 245
Table 6-11: Domestic water Supply demand projected to the year 2024 of the IGAD countries 247
Table 6-12: Domestic water Supply demand projected to the year 2030 of the IGAD countries. .. 247
Table 6-13: Domestic water Supply demand projected to the year 2050 of the IGAD countries. 248
Table 6-14: Domestic water projected demand including water losses 248
Table 6-15: Projected Irrigated area 252
Table 6-16: Irrigation projected demand providing different water losses 252
Table 6-17: Projected livestock population and water demand of IGAD countries. 254
Table 6-18: IGAD livestock water demand including water losses 255

Table 6-19: Industrial (others) projected water demand for IGAD states 256

Table 6-20 Showing projected per capita industrial water demand (m3) in IGAD 256

Table 6-21: IGAD total projected water demand.. 257

Table 6-22: Domestic water withdrawals in trans-border basins. 258

Table 6-23: Relevance of Irrigation in IGAD Region 259

Table 6-24: Irrigated areas in the various countries obtained from FAO AQUSTAT-2013 260

Table 6-25: Projected Irrigation Water demand in IGAD river basins 261

Table 6-26: projected livestock water demand in IGAD river basins 263

Table 6-27: projected industrial water demand in IGAD river basins 264

Table 6-28: Projected total water demand in IGAD river basins 265

Table 6-29: Groundwater Resources in IGAD River Basins 266

Table 6-30: Summary of Annual Blue Water resources in IGAD River Basins 267

Table 7-1: IGAD member states IDI rankings and values, 2017 and 2016 278

Table 7-2: Mobile services sub-basket Price, 2016 285

Table 7-3 Mobile-broadband sub-basket, prepaid handset-based, 500 MB, 2016 286

Table 7-4: Mobile-broadband sub-basket, post-paid computer-based, 1 GB, 2016 286

Table 7-5: Fixed broadband sub-basket, 2016 288

Table 7-6: IGAD ICT Benchmarks and Targets 289

Table 7-7: Total laid Optical fibre and cost per Km in IGAD region. 291

Table 7-8: Submarine cables in the IGAD region 292

Table 7-9: Exiting Cross Border Links 293

Table 7-10: Policy and legislation in IGAD Region 295

Table 7-11: Table: Status of implementing cyber security in IGAD region 296

Table 7-12: Cross Border ICT Planned Links 297

Table 7-13: ICT policies in the IGAD region 302

Table 7-14: Level of Competition in IGAD Region 303

Table 7-15: Forecast for total International Traffic 307

Table 7-16: Forecast for International Internet bandwidth 308

Table 7-17: Percentage of expanding the international gateway network capacity 310

Table 7-18: Percentage of expanding the international bandwidth capacity 311

Table 8-1: CAGR for inter-continental and intra-regional trade, target GDP scenario 331

Table 8-2: CAGR for inter-continental and intra-regional trade, IMF GDP scenario 331
Table 8-3: CAGR for inter-continental and intra-regional trade, IGAD RIMP GDP scenario.............. 331
Table 8-4: Share of IGAD member state trade by port, 2017 332
Table 8-5: Share of IGAD member state trade by port, 2024 332
Table 8-6: Share of IGAD member state trade by port, 2030 332
Table 8-7: Share of IGAD member state trade by port, 2050 333
Table 8-8: Inter-continental Trade Forecasts (millions of tons) 334
Table 8-9: Intra-regional Trade Forecasts (millions of tons)... 335
Table 8-10: Distribution of forecast trade traffic by corridor (millions of tons) 336
Table 8-11: Djibouti Historical demand trends 342
Table 8-12: Future demand forecasts for Djibouti per consumer category 342
Table 8-13: Djibouti electricity system losses 343
Table 8-14: CADLF’s factors by consumer groups... 343
Table 8-15: Demand forecast – baseline case scenario 344
Table 8-16: Electricity sales in South Sudan... 345
Table 8-17: Short to medium term committed energy projects 346
Table 8-18: Electricity annual demand (TWh) for selected IGAD countries 348
Table 8-19: Potential interconnectors by 2020 349
Table 8-20: Electricity peak demand (GW) for selected IGAD countries 349

List of Figures

Figure 1-1: Key Project Goals 16

Figure 2-1: Population of IGAD Member States, 1990-2017 20

Figure 2-2: Population density, IGAD region, 2015 21

Figure 2-3: Night-time lights, IGAD region, 2013 22

Figure 2-4: GDP growth rates, African RECs, 2008-2017 22

Figure 2-5: GDP growth rates, IGAD member states, 2008-2023 23

Figure 2-6: Total Volume of Intra-regional trade in IGAD 25

Figure 2-7: Share of Intra-Regional Trade in IGAD and comparable RECs 31

Figure 2-8: Share of Intra-regional trade by country pairs, 2017 31

Figure 2-9: Intra-regional merchandise trade share, IGAD Member States, 2017 32

Figure 2-10: Composition of IGAD intra-regional merchandise trade, 2017 33

Figure 2-11: Composition of IGAD merchandise exports to the rest of the world, 2017 33

Figure 2-12: Composition of IGAD merchandise imports from rest of the world, 2017 34

Figure 2-13: Transport and Economic Development Corridors 42

Figure 2-14: The aspiration of the Northern Corridor 44

Figure 2-15 : Major Transport and Economic Development Corridors in the IGAD region 45

Figure 2-16: India's Economic Industrial Corridors 51

Figure 2-17: Maputo Development Corridor 55

Figure 2-18: Greater Mekong Sub-region Economic Development Corridors 57

Figure 2-19: The Walvis Bay Corridors 59

Figure 3-1: Stylised illustration of method used to identify trans-border infrastructure needs 68

Figure 3-2: Positive feedbacks and the demand for trans-border infrastructure 69

Figure 4-1: Holhol Bridge on the Addis Ababa-Djibouti Railway 78

Figure 4-2: The port facilities in Somalia 84

Figure 4-3: Maps of Current and Planned IGAD States Railway Networks 95

Figure 4-4: Djibouti Dolareh Container Terminal 98

Figure 4-5: Aerial View with Phase 1 of the Mombasa Container Terminal 2 while under Construction 100

Figure 4-6: Forecast traffic flows, 2024, Northern Corridor (Millions of Tonnes) 118

Figure 4-7: Forecast traffic flows, 2030, Northern Corridor (Millions of Tonnes) 119

Figure 4-8: Forecast traffic flows, 2050, Northern Corridor (Millions of Tonnes) 120
Figure 4-9: Forecast traffic flows, 2024, LAPSSET Corridor (Millions of Tonnes).......... 122
Figure 4-10: Forecast traffic flows, 2030, LAPSSET Corridor (Millions of Tonnes) 123
Figure 4-11: Forecast traffic flows, 2050, LAPSSET Corridor (Millions of Tonnes) 124
Figure 4-12: Forecast traffic flows, 2024, Berbera Corridor (Millions of Tonnes) 126
Figure 4-13: Forecast traffic flows, 2030, Berbera Corridor (Millions of Tonnes) 127
Figure 4-14: Forecast traffic flows, 2050, Berbera Corridor (Millions of Tonnes) 128
Figure 4-15: Forecast traffic flows, 2024, Djibouti Corridor (Millions of Tonnes) 130
Figure 4-16: Forecast traffic flows, 2030, Djibouti Corridor (Millions of Tonnes) 131
Figure 4-17: Forecast traffic flows, 2050, Djibouti Corridor (Millions of Tonnes) 132
Figure 4-18: Forecast traffic flows, 2024, Port Sudan Corridor (Millions of Tonnes) 135
Figure 4-19: Forecast traffic flows, 2030, Port Sudan Corridor (Millions of Tonnes) 136
Figure 4-20: Forecast traffic flows, 2050, Port Sudan Corridor (Millions of Tonnes) 137
Figure 4-21: Forecast traffic flows, 2024, Massawa Corridor (Millions of Tonnes).......... 140
Figure 4-22: Forecast traffic flows, 2030, Massawa Corridor (Millions of Tonnes).......... 141
Figure 4-23: Forecast traffic flows, 2050, Massawa Corridor (Millions of Tonnes).......... 142
Figure 4-24: Forecast traffic flows, 2024, Assab Corridor (Millions of Tonnes).......... 144
Figure 4-25: Forecast traffic flows, 2030, Assab Corridor (Millions of Tonnes).......... 145
Figure 4-26: Forecast traffic flows, 2050, Assab Corridor (Millions of Tonnes).......... 146
Figure 4-27: Forecast traffic flows, 2024, Mogadishu Corridor (Millions of Tonnes).......... 149
Figure 4-28: Forecast traffic flows, 2030, Mogadishu Corridor (Millions of Tonnes).......... 150
Figure 4-29: Forecast traffic flows, 2050, Mogadishu Corridor (Millions of Tonnes).......... 151
Figure 4-30: Forecast traffic flows, 2024, Kismayu Corridor (Millions of Tonnes) 153
Figure 4-31: Forecast traffic flows, 2030, Kismayu Corridor (Millions of Tonnes) 154
Figure 4-32: Forecast traffic flows, 2050, Kismayu Corridor (Millions of Tones) 155
Figure 5-1: Planned PIDA PAP electricity and oil pipeline projects 161
Figure 5-2: Global trans-border power flow by 2035, as envisioned by GEIDCO 162
Figure 5-3: Potential Future State of CBET Transmission Corridors in Africa 163
Figure 5-4: Proposed Ethiopian electricity interconnectors – 2050 169
Figure 5-5: Proposed and existing oil transmission pipelines within IGAD Region (Source: EIA).......... 173
Figure 5-6: IGAD countries under full integration scenario.......... 178

Figure 5-7: IGAD member states under alternative scenario (NP scenario) 179

Figure 5-8: Energy demand scenario for IGAD region (FI Scenario) 184

Figure 5-9: Infrastructure gap within selected IGAD member countries 187

Figure 5-10: State of unbundling in IGAD member states 194

Figure 5-11. Policies and Fiscal Incentives in Support of Renewables 195

Figure 6-1: Trans-boundary water Basins in the IGAD region 208

Figure 6-2: Location of key trans-border aquifers in the IGAD region 209

Figure 6-3: IGAD Hydrogeology Map 219

Figure 6-4: Water management zones in Uganda 234

Figure 6-5: Monthly flow distribution-Juba-Shebelle Basin 269

Figure 6-6: Monthly Flow distribution: Turkana-Omo 269

Figure 7-1: ICT development indicators 278

Figure 7-2: IDI groups by IDI value for the year 2017 279

Figure 7-3*:* Mobile penetration rates in IGAD region, 2016 280

Figure 7-4: Roaming traffic – Rwanda and Kenya 2014 281

Figure 7-5*:* Mobile Fixed Broadband penetration rates in IGAD region, 2016 282

Figure 7-6: Percentage of Individuals using Internet in IGAD Region 284

Figure 7-7: Broadband key countries 288

Figure 7-8: Cables and the African Continent 293

Figure 7-9: Proposal for Actions 304

Figure 7-10: IoT, cloud computing, big data and artificial intelligence 306

Figure 7-11: International Internet Bandwidth Growth – Sub-Saharan Africa 307

Figure 8-1: IRIMP Project Selection Process 316

Figure 8-2: Hitting the IGAD project selection 'sweet-spo 327

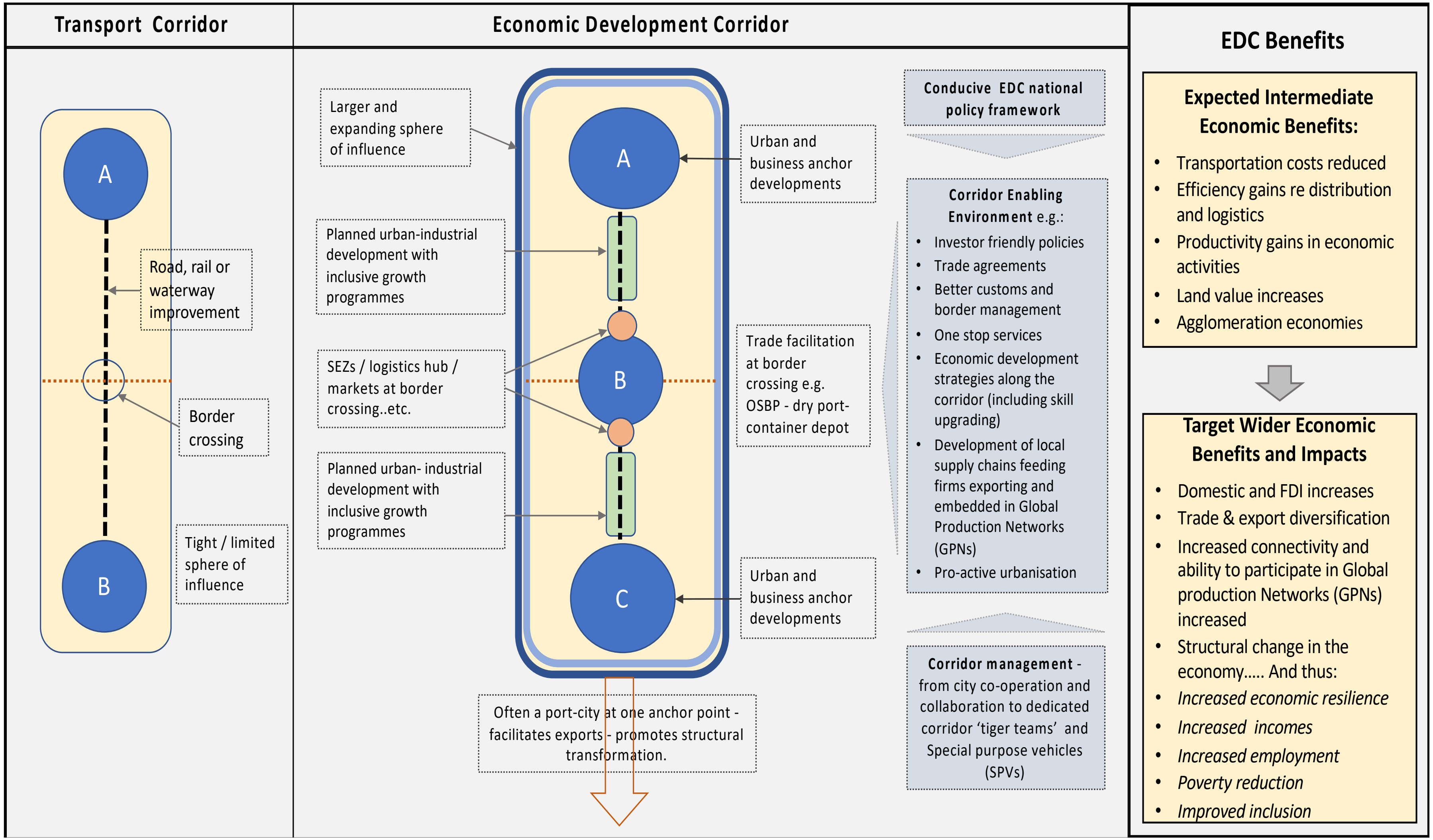
Figure 8-3: Inter-continental and intra-regional Trade: GDP multiplier trend, 1998-2017 329

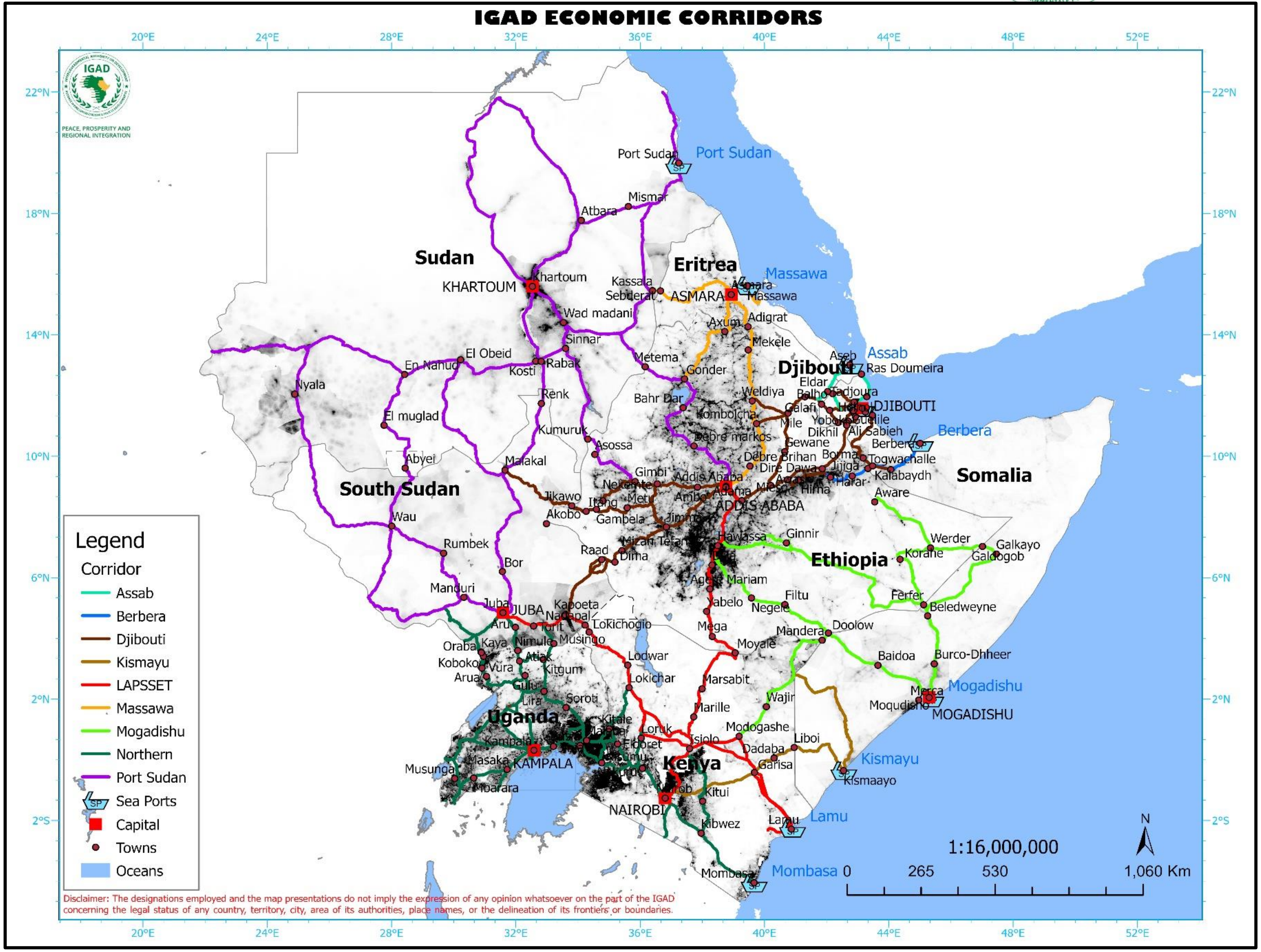
Executive Summary

The importance of IGAD trans-border infrastructure The time is right for significant investment in growth-inducing trans-border infrastructure investment to boost development, and secure peace and security across the IAGD region. Some IGAD members are emerging from war and conflict. Their economies, though fragile, seem to be poised to grow. Other members have, from a relatively low base, experienced remarkable growth (Ethiopia, for example, was recently the fastest growing economy in Africa for a number of years). All IGAD members need 'a trans-border infrastructure boost' to accelerate growth, and, importantly, enable and promote structural change and transformation. Transformation is associated with economic diversification and an increase in the sophistication of production, which is involves moving up value chains in regional, continental and global production networks. This movement is predicated on trade, and the flow of people, goods, services and ideas across borders. Trans-border infrastructure in needed for growth and prosperity – and growth and prosperity strengthen peace and security – which further encourages economic growth and transformation.

The importance of the IGAD Regional Infrastructure Masterplan (IRIMP) The IGAD regional infrastructure masterplan (IRIM) is an important instrument with which to plan for the 'right' type of trans-border infrastructure to be provided in the 'right' location in the IGAD region. IRIM maps out the provision of trans-border infrastructure and the implementation of related policy and regulatory initiatives from 2020 to 2050 which will facilitate and strengthen intra-IGAD trade, promote regional integration, and support the development and structural transformation of the economies of IGAD member states. An important principle guiding the selection of trans-border infrastructures is the degree to which an infrastructure project, and related policy and regulatory policies, promotes the development of trans-border transportation and, most importantly, economic development corridors (EDCs) that traverse the IGAD region. The potential for trans-border infrastructure to lie at the heart of EDCs and to be very significant drivers of regional growth and prosperity is enormous. The potential for IRIM to be the instrument by which this is achieved is correspondingly enormous.

Transport and Economic Development Corridors in the IGAD region It is the concept of the 'economic development corridor' that binds the various elements of the masterplan together. The EDC framework is widely used by international development organisations and national governments to direct resources to promote economic growth. An EDC most commonly contains a transportation corridor (generally a road, railway or waterway) but is much more than a linear area connecting two countries, regions or cities through which goods and people pass. An EDC is an instrument of development that is used to ensure that the transportation hard infrastructure generates important economic and social development impacts. Transforming a transport corridor into an EDC, however, is often not a straight-forward task. It demands political commitment and stakeholder involvement from all levels of government and can often require the establishment of a special purpose vehicle (SPV) to co-ordinate, direct and manage the infrastructure and policy-type initiatives required for the success of an EDC. It requires the implementation of an effective enabling environment. Currently there are eight major transport corridors in the IGAD region, each one potentially an economic development corridor All the corridors in the IGAD region are basic transportation corridors; none are fully fledged economic development corridors. It is one of the key objectives of the IRIMP to recommend how these corridors can become EDCs and become important drivers of growth, regional integration, and prosperity in the IGAD region.


Transport Corridor
Economic Development Corridor
EDC Benefits
A
B
Road, rail or waterway improvement
Border crossing
Tight / limited sphere of influence
Larger and expanding sphere of influence
Planned urban-industrial development with inclusive growth programmes
SEZs / logistics hub / markets at border crossing..etc.
Planned urban- industrial development with inclusive growth programmes
A
B
C
Urban and business anchor developments
Trade facilitation at border crossing e.g. OSBP - dry port- container depot
Urban and business anchor developments
Often a port-city at one anchor point - facilitates exports - promotes structural transformation.
Conducive EDC national policy framework
Corridor Enabling Environment e.g.:
• Investor friendly policies
• Trade agreements
• Better customs and border management
• One stop services
• Economic development strategies along the corridor (including skill upgrading)
• Development of local supply chains feeding firms exporting and embedded in Global Production Networks (GPNs)
• Pro-active urbanisation
Corridor management - from city co-operation and collaboration to dedicated corridor 'tiger teams' and Special purpose vehicles (SPVs)
Expected Intermediate Economic Benefits:
• Transportation costs reduced
• Efficiency gains re distribution and logistics
• Productivity gains in economic activities
• Land value increases
• Agglomeration economies
Target Wider Economic Benefits and Impacts
• Domestic and FDI increases
• Trade & export diversification
• Increased connectivity and ability to participate in Global production Networks (GPNs) increased
• Structural change in the economy..... And thus:
• Increased economic resilience
• Increased incomes
• Increased employment
• Poverty reduction
• Improved inclusion


IGAD ECONOMIC CORRIDORS
PEACE, PROSPERITY AND REGIONAL INTEGRATION
Sudan
Eritrea
Djibouti
Ethiopia
Somalia
South Sudan
Uganda
Kenya
KHARTOUM
ASMARA
DJIBOUTI
ADDIS ABABA
MOGADISHU
JUBA
KAMPALA
NAIROBI
Port Sudan
Massawa
Assab
Berbera
Mogadishu
Kismayu
Lamu
Mombasa
Legend
Corridor
Assab
Berbera
Djibouti
Kismayu
LAPSSET
Massawa
Mogadishu
Northern
Port Sudan
Sea Ports
Capital
Towns
Oceans
1:16,000,000
0 265 530 1,060 Km
Disclaimer: The designations employed and the map presentations do not imply the expression of any opinion whatsoever on the part of the IGAD concerning the legal status of any country, territory, city, area of its authorities, place names, or the delineation of its frontiers or boundaries.

Transport Sector: Trans-border infrastructure overview: *Quick facts*

Transport constitutes one of the primary pillars in economic growth and development as it provides the means by which goods and services are conveyed between producers and consumers and facilitates the movement of people within and across frontiers. In this regard, the development of transport infrastructure and the establishment of appropriate enabling environment has been accorded high priority by the African Union (AU) and the Regional Economic Communities (RECs). The PIDA programme, which is an AU flagship project, underscores the role of transport in facilitating production of goods and services hence raising the standards of living in the continent.

The study identifies eight primary corridors in the IGAD region that have trans-boundary coverage and are served by ports, roads and railways. These corridors pass cross through border posts which are important in transport facilitation as they are key choke points where .smooth flow of transport can be impeded. Five active corridors with available information have been comprehensively analysed in terms of current and projected capacities and capacity gaps identified over the three phases of the Masterplan

This report examines the current stock of infrastructure networks in roads, railways, border posts, maritime transport, inland waterways and civil aviation. Road transport is the primary mode of surface transport along the corridors having surpassed the rail several decades ago. The rail sector is however making a resurgence following the decision of IGAD Member states to upgrade their current narrow-gauge networks to standard gauge, and to enhance regional connectivity through network extensions. A list of planned projects in the subsectors as provided by member states is provided (see below). The inventory of existing infrastructure stock and planned projects provides an estimate of the capacity that is expected to be available over the coming years.

Traffic forecasts to provide information on the demand for infrastructure facilities have been prepared using a combination of factors including historical trends in trade, projected GDP growth rates and population density. The balance between the transport infrastructure capacities required to meet the demand for forecast traffic levels and the projected future infrastructure stocks provides the gap that would need to be closed by identifying additional projects.

Corridor	Section	Current Status / Gaps	Forecast Demand (MT)		
			2024	2030	2050
Northern Corridor	Mombasa Port	Port expansion programme to increase cargo handling facilities in place	49	79	172
	Mombasa-Nairobi	SGR line in operation Highway in good condition	64	103	223
	Nairobi-Nakuru (Naivasha)	SGR line to Naivasha under construction Existing MGR line in operation Highway in good condition	37	62	142
	Nakuru -Kisumu	MGR line exists but needs rehabilitation Financing being negotiated for construction of SGR (Naivasha/Kisumu) Highway in good condition	18	30	70
	Kisumu-Busia-Malaba	Financing being negotiated for construction of SGR Highway to Busia in good condition	18	30	70

	Nakuru-Eldoret	MGR network operational Highway in good condition	19	31	72
	Eldoret-Malaba	MGR network operational Highway in good condition	12	21	50
	Eldoret-Kitale	MGR network requires rehabilitation Highway in good condition	13	24	63
	Kitale-Lokichar	Road link under rehabilitation	8	16	47
	Malaba and Busia-Jinja	Financing being negotiated for SGR railway Highway in good condition	15	25	64
	Jinja-Kampala	Expressway in pipeline Financing being negotiated for SGR railway	25	43	109
	Tororo-Gulu	Financing being negotiated for SGR railway Highway in good condition	5	7	19
	Kampala-Gulu	Highway operational	3	4	11
	Gulu-Nimule	Feasibility study conducted for SGR railway Highway in good condition	1	2	5
	Nimule-Juba	Feasibility study conducted for SGR railway Highway in fair condition	1	2	6
Djibouti Corridor	Djibouti Port	Port expansion programmes to increase cargo handling facilities in place	33	47	104
	Djibouti-Dikhil	Road link in fair condition	16	23	50
	Dire Dawa-Awash	Road link under rehabilitation	27	45	106
	Dikhil-Galafi	Railway under construction Highway in good condition	16	23	50
	Galafi-Semera-Mekele	Railway under construction Highway in good condition	5	7	15
	Semera-Awash	SGR link completed Road link under construction	16	23	51
	Diwele-Dire Dawa	SGR link completed Highway in good condition	28	39	87
	Dire Dawa-Awash	SGR link completed Expressway in good condition	27	45	106
	Awash-Adama-Addis Ababa	Feasibility study conducted for SGR railway Highway in good condition	38	59	139
	Addis Ababa-Jima-Mizan	Feasibility study conducted for railway Highway in good condition	2	3	8
	Mizan-Dima	SGR railway planned Gravel road requires upgrading	2	3	7
	Dima-Raad-Boma	SGR line planned Earth road requires upgrading	2	3	7
	Boma-Kapoeta	Port expansion programmes to increase cargo handling facilities in place	0	0	2
LAPSSET Corridor	Lamu Port	First three berths under construction	10	22	98
	Lamu-Garissa-Isiolo	Feasibility study conducted for SGR railway	11	26	115

		Detailed design for road completed. Financing being under the LAPSSET project			
	Isiolo-Nairobi	Feasibility study conducted for railway Highway in good condition	5	12	59
	Isiolo-Marsabit-Moyale	Feasibility study conducted for SGR railway Highway in good condition	4	9	34
	Isiolo-Lokichar	Feasibility study conducted for SGR railway Detailed design for road completed. Financing being under the LAPSSET project	3	6	24
	Lokichar-Lokichoggio	Feasibility study conducted for SGR railway Gravel road requires upgrading	3	6	24
	Lokichoggio-Nandapal	Feasibility study conducted for SGR railway Road under construction through WB funding	3	6	24
	Moyale-Awassa-Modjo	SGR Feasibility study conducted Highway in fair condition	4	9	34
	Nandapal-Kapoeta-Juba	Planned SGR rail link Gravel road requires upgrading	2	5	20
Berbera Corridor	Berbera Port	Port expansion to increase cargo handling facilities planned	3	9	27
	Berbera-Hargeisa	Road Link under rehabilitation	5	14	41
	Hargeissa-Togochaale	Gravel road requires upgrading	4	12	35
	Togochaale-Jijiga	Gravel road requires upgrading	2	9	26
	Jijiga-Dire Dawa	Road link operational	2	9	26
Port Sudan Corridor	Port Sudan Port	Port expansion to increase cargo handling facilities planned	16	21	47
	Port Sudan-Haya	Feasibility study conducted for SGR railway Highway in fair condition	23	31	67
	Haya-Kassala	Feasibility study conducted for SGR railway Highway in fair condition	6	8	21
	Kassala-Al Quadarif	Feasibility study conducted for SGR railway Highway in fair condition	6	8	21
	Haya-Atbara	Feasibility study conducted for SGR railway Highway in fair condition	17	22	46
	Atbara-Khartoum	Feasibility study conducted for SGR railway Highway in fair condition	17	22	46
	Khartoum-Wadi Medan	Feasibility study conducted for SGR railway Highway in good condition	12	16	30
	Wadi Medan-Sennar	Feasibility study conducted for SGR railway Highway in good condition	12	16	30
	Sennar-Al Damazin	Feasibility study conducted for SGR railway	1	1	2

		Highway in good condition			
	Al Damazin-Kurmuk	Gravel road requires upgrading	1	1	2
	Wadi Medan-Al Quadarif	Feasibility study conducted SGR railway Highway in good condition	1	1	3
	Al Quadarif-Metema	Planned SGR rail link Highway in good condition	2	4	9
	Khartoum-Rabak	Road requires rehabilitation	7	9	14
	Rabak-Renk	Gravel road requires upgrading	7	9	14
	Malakal-Renk	Gravel road requires upgrading	7	9	14
	Waat-Malakal	Gravel road requires upgrading	7	9	14
	Bor-Waat	Gravel road requires upgrading	7	9	14
	Juba-Bor	Gravel road requires upgrading	7	9	14
	Addis Ababa-Gondar	Planned SGR rail link Highway in good condition	3	4	11
	Gondar-Metema	Planned SGR rail link Highway in fair condition	2	4	9
	Kurmurk-Asosa-Nekemte	Gravel road requires upgrading Feasibility study conducted for SGR railway	1	1	2
	Nekemte-Ambo-Addis Ababa	Feasibility study conducted for SGR railway Highway in good condition	2	3	7

Energy Sector: Trans-border infrastructure overview: *Quick facts*

IGAD energy sector had a peak demand of about 9.2 GW by 2015 which by 2020 is estimated to double to 24.89 GW and triple by 2025 to 30.38 GW[1]. By 2020 the size of electricity interconnectors will be 3.125 GW, with an additional of 11.6 GW added in the medium to long term. Bringing the total to 14.725 GW newly added connectors. This together with the existing potential of 6 GW will provide a total capacity of 32 GW against a peak demand of 61.60 GW by 2050. Current generating capacity of IGAD member countries is estimated at ~ 8 GW, this is projected to increase to almost 131.88 GW by 2050 mainly fuelled by interconnected in the North-south corridor.

Scenario	2020	2024	2030	2040	2050
Total peak Supply (GW)	3.13	14.73	14.73	14.73	14.73
Peak load (GW)	24.89	30.38	39.15	55.59	76.33
Optimistic scenario (FI) - infrastructure gap	21.77	15.65	24.43	40.87	61.60
Baseline Scenario	27.925	30.115	62.365	184.255	507.405
National policy Scenario	23.585	19.305	33.315	71.365	139.255

Based on empirical results, the plateauing of energy post 2040 is due changes in the key drivers including population growth, however it is expected that before that an increase will occur due to

[1] The 2020 and 2025 are future demand estimates. How they are arrived at is demonstrated in section on demand modelling. Normally the executive summary does NOT include references. Nonetheless the two references include:
[1] EAPP, EAPP regional power system master plan: Volume 1 - main report. 2014, East African Power Pool (EAPP).
[1] GEIDCO, *Africa Energy Interconnection Planning Research Report*. 2018, Global Energy Interconnection Development and Cooperation Organisation: Beijing, China.

demand for more energy related services (37%), construction (20%) and manufacturing (24%). These 3 will be the key drivers for energy demand, accounting for 81% of total energy demand by 2040. This is validated by a study showing that energy demand in Africa will increase at 3.5% per annum (p.a.) by 2040. Almost double the global average of 1.3% p.a. The study also estimates that by 2040, energy production in Africa will grow by 58%. A gap analysis reveals that the infrastructure gap for energy sector is slightly over 507.41 GW for Business as usual scenario, 139.26 GW for scenario where each country just pursues its own national policy for enhancing energy access and lastly 61.60 GW for a full integration based on existing and potential interconnectors. The study demonstrates that without regional integration – the interconnectors, the four major countries will require a huge outlay of capital in order to meet their energy demand up to 2050. However, regional integration helps overcome this gap.

In addition to the trans-border electricity transmission lines, there are potential oil pipeline transmission lines that could potentially alter the energy trade landscape. Probable and proven reserves of oil and gas for IGAD REC are mainly in Kenya, Uganda, South Sudan and Tanzania. However, contingent and prospective fossil resources are in Somalia, Ethiopia and Djibouti. For scale, this region's 10.754 billion barrels amounts to 22.23 per cent of Libya's endowment and a mere 0.63 per cent of all the proved global reserves. Currently South Sudan produces 118,000 barrels per day, while Kenya and Uganda aim to have full production at 80,000 and 60,000 barrels per day. Thus, Kenya's reserves will be depleted in just 25 years as compared to Uganda (296.8 years) and South Sudan (27 years). Based on the above statics, Uganda's 6.5 billion barrels may attract significant investments than Kenya, hence giving it a higher production rate than Kenya. Hence the establishment of a refinery may be a strategic investment in this region and development of pipelines and use of crude oil for domestic use will give better return on investment than exportation of the crude.

However, the possibility of a full integration may be hampered by several factors. These include general challenges in the enabling environment for IRIMP energy sector include competing institutional frameworks among the regional economic bodies (COMESA, EAC and IGAD). Further compounding this is the security-based challenges of internal and external conflicts with some states in a post conflict (Northern Uganda, Eritrea, Somaliland and Puntland) or active state of conflict for instance in South Sudan and South-Central Somalia. As Energy projects that could act as drivers for economic integration are developed, insecurity may prove a damper. Other challenges include weak institutional capacity, lack of internal democratic governance, poverty, lack of economic diversification, high dependency on agriculture and low domestic tax base and the need for collecting revenue from tariffs and poor infrastructure. In conclusion IGAD, COMESA and the EAC do not have a common regional policy that addresses the cross-border trade energy trade (CBET). IGAD is thus in a pivotal position to coalesce the various legislations, policy into one coherent and cohesive policy geared towards CBET.

Water Sector: Trans-border overview: *Quick facts*

There are six trans-boundary basins in the IGAD region which can be grouped as follows

- The dry basins (Ayesha, Danakil and Ogaden), with negligible surface water resources, important aquifers and low population
- The semi-arid to arid basins (Gash-Baraka and the Juba-Shebelle) characterised by notable irrigation developments.
- Turkana-Omo basin (part of the Great Rift Valley), which is the centre of considerable economic activities

The key trans-border initiatives are Building River Dialogue and Governance (BRIDGE) initiative, and (the Nile Basin Initiative (NBI) Strategy. Other important initiatives include the proposed IGAD region water protocol or legal instrument to be signed by the Member States agreeing on joint actions on the shared river basins.

The status of Pipeline of trans-boundary water infrastructure and initiatives is as follows:

Kenya/Ethiopia	sustainable management of Lake Turkana and its River Basin	Planned
Kenya/Tanzania/Uganda	Implementation of bilateral frameworks on Trans-boundary Water Resources	Planned
Kenya/Ethiopia/Uganda/Tanzania	Establishment of Hydro meteorological Network on Trans-boundary Waters Resources	Planned
Kenya/Ethiopia/Somalia	Implementation of the Integrated development and management plans of the Daua Trans-boundary water resources	Planned
Kenya/Uganda/Tanzania	Implementation of the trans-boundary Catchment management plans	Planned
Kenya/Uganda	Kocholia trans-boundary multipurpose water storage project	Concept stage
Kenya/Uganda	Maira Trans-boundary multipurpose water storage projects	Planned/ Feasibility
Kenya/Uganda	Sio-Malakisi-Malaba Transboundary Water Project	On-going
Ethiopia/Djibouti	Sio-Malakisi-Malaba Transboundary Water Project	On-Going

The bulk of the future water resources to meet the ever-increasing demand will come from pipeline projects earmarked for implementation on transboundary water courses or within trans-border water basins. The results of our demand and gap analysis indicate that two basins (Juba-Shebelle and Gash-Barka Basin) will be seriously short of water by 2050. In general, the domestic water demand for the IGAD countries grows from 939.4 Million m3 in 2017 to 1404.3 Million m3 in 2025 and 3754.3 Million m3 in 2050. *In the IGA region is adequate water resources to cover the demand. However, the necessary infrastructure would be required to harness this demand Hence trans-border projects and initiatives will be required*

ICT Sector: Trans-border infrastructure overview: *Quick facts*

The IGAD region has a distinct digital divide among the countries in terms of mobile-network coverage, internet and mobile phone penetration, broadband costs and access to international bandwidth. Of all the IGAD member states, Kenya has a developed and robust ICT sector followed by Uganda and Sudan. While other countries such as Djibouti and Ethiopia have a monopoly ICT market albeit with noticeable development in ICT infrastructure, more infrastructure is required to increase the access for mobile, internet and broadband services as well as mobile coverage.

Somalia and South Sudan on the other hand require the establishment of strong and independent regulatory authorities to regulate the ICT market and invest in back borne ICT infrastructure such as the national optic fibre network to connect all the major cities in the respective countries.

The IGAD secretariat has a unique role of facilitating the exchange of information and experience as the region is grappling with a regional digital divide in terms of national backbone development, access of ICT services and ICT skills capacity. This regional digital divide tends to create transfer of skills and experience opportunities between the IGAD member States as well as the exchange of information.

Broadband Penetration - The fixed broadband penetration in the region is very poor. Fixed last mile connectivity has been overlooked in most of the countries due to the high cost of operation and maintenance. However, it is vital for the member states to channel their focus in re-constructing the last mile cable network using the fibre to home due to its significance for broadband connectivity.

ICT and Mobile Pricing Analysis: ICT pricing is considered as one of the barriers to ICT access in the region and in Africa at large. A considerable percentage of users do not see the need for Internet services while some lack the knowledge of how to use it. This has continued to perpetuate the low levels of ICT uptake in region. In addition, challenges such as cyber security, privacy, cost and quality of services have served to stagnate the low levels of mobile users not using the internet. The general lack of information on the benefits of internet to improve the livelihoods of people, challenges of costs, knowledge, lack of awareness and access to smart phones is a major hinderance to the advancement of ICT in the region.

Cyber Security Policy and laws in the region – cyber security has gained global traction and IGAD member states have individually developed their cyber security policies and necessary legislations to tackle and curb cyber-crime and protect critical infrastructure information.

Kenya, Sudan and Uganda developed their policies, legislation and strategies using COMESA ICT and cyber-crime policy model. Ethiopia developed their own policies and legislations such as Certification Authorities without any guiding reference. Djibouti, Somalia and South Sudan on the other hand have poor policies and legislations on cyber security. The table below shows the status of development and implementation of policies, legislations and strategies in the IGAD Member States. Table below describes the status of cyber-crime policy and legislation by the IGAD member states

Country	Policy	Legislation	National Strategy
Djibouti	Yes	Yes	
Ethiopia	Yes	Yes	Yes
Kenya	Yes	Yes	Yes
Somalia	NA	NA	NA
South Sudan	Yes	Yes	
Sudan	Yes	Yes	Yes
Uganda	Yes	Yes	Yes

Of the IGAD member states, Kenya, Ethiopia, Sudan and Uganda are more advanced in implementing their cyber security policies and measures. These countries have established their National Cyber-security Incident Response Team (CIRTs). Kenya has the main national CIRT and supported by six local CIRTs owned by Government and private sectors. These CIRTs work in close cooperation with the national CIRT. Ethiopia on the other hand has developed a regulatory framework for Critical Infrastructure Information Protection. South Sudan has enacted laws to combat cybercrime. The IGAD Secretariat needs to establish a technical committee on cyber security to enhance the regional cooperation and develop the necessary regional instruments.

The Pipeline of planned cross-bounder ICT infrastructure is as follows

	Project	Capacity	Stakeholders
1	Africa One	Capacity depend on distance	France, Egypt, Sudan, Djibouti, Somalia, Kenya, South Africa, Emirates, Pakistan and India
2	The Djibouti Africa Regional Express (DARE)	60Tbps	Hormuud, Telesom and Golis in Somalia and Somtel, TeleYemen, Djibouti Telecom, Telkom Kenya and Africa Marine Express
3	Gulf to Africa (G2A)	20Tbps	Omantel, Ethiopia, /Telesom/Golis group Puntland,
4	Khartoum -Argeen Egypt borders	STM16	Zain-Sudan
5	Isolo-Mandera (Somalia border)	10G	Kenya Government Backbone
6	One Area Network		East Africa countries and open to other countries to join.
	Juba-Nairobi Fibre-optic		South Sudan Government
7	Juba-Kampala Fibre-optic Link (South Sudan section)		South Sudan Government
8	Nairobi –Juba Fibre-optic	10G	Kenya Government
9	Arta-Tajoura (Djibouti)	10G	Djibouti Telecom
10	Asia-Africa – Europe 1 (AAE1)	40Tbps	Djibouti Telecom, Itisalat, mobily, China Unicom, Omantel, Tele Yemen, Telecom Egypt,
11	AWE.	20Tbps	Alcatel-Lucent, and GoTo Networks, Djibouti Telecom
12	East African Internet Exchange Point (EAIXP)	Depends on Internet Exchanges in EAC	It is possible to identify with alternative and redundancy ones.
13	IXP South Sudan	10G	
14	IXP Somalia	10G	
15	South Sudan Fibre Optic Backbone System	STM1/10G	

Introduction

Section 1.1 Purpose of the report

The main purposes of this report are:

- **First, to present an inventory of trans-border infrastructures**. The inventory lists and describes the most important existing trans-border infrastructures, and those in the pipeline (under implementation and those planned for the future) for the four key sectors (transport, energy, ICT and water) in the IGAD region.
- **Second, to describe the enabling environment**. This is a review the policies and institutional arrangements that facilitate inter-regional trade, integration and development in the IGAD region, and allow the trans-border infrastructures to be effective in achieving these aims. The degree to which the enabling environment is effective is assessed.
- **Third, to estimate the future demand for trans-border infrastructures**. The demand for trans-border infrastructure projects and associated policy initiatives is estimated over the proposed lifetime of the IGAD regional infrastructure masterplan, IRIMP, (2020-2050), and is based on an assessment of the 'gap' between the capacity associated with existing and planned infrastructures and the capacity required to meet the future over the life of the masterplan.

This report is an important precursor to the preparation of a comprehensive infrastructure masterplan for the IGAD region, which will include the identification of priority projects and supporting policy-type initiatives to be presented as an Action Plan (2020-2030). These priority projects and supporting policy initiatives will include:

- **Pipeline projects**: A sub-set of those that are in the pipeline and are considered to be of primary importance (to be chosen through the use of the project prioritisation criteria recommended in this report).
- **Additional (new) projects**: Those required if estimates of the demand for trans-border infrastructures up to 2050 indicate that the trans-border infrastructure capacity represented by the existing and pipeline projects cannot match the demand for such infrastructure in 2050.

The IRIMP will consist of a strategy for the development of trans-border infrastructure which will include the priority projects and policy initiatives phased over the individual years of the Action Plan time period and additional projects and policy initiatives suggested for consideration during the latter years of the IRIMP, namely between 2031 and 2050. It is the Action Plan that gives life to the IRIMP; making a clear impact and a significance difference has to be the fundamental and ultimate purpose of IRIMP; this report is a step towards achieving that goal.

Section 1.2 Structure of the Report

Following this introductory chapter, the structure of this report is as follows:

- **Chapter 2: Strategic context**: An overview of the IGAD region economy and transportation corridors is presented. An important focus of this chapter is an assessment of the importance of trans-border development corridors to the prosperity of the IGAD region. A guiding principle of the masterplan preparation is that trans-border infrastructures and supporting policies should strengthen existing trans-border economic development corridors and as necessary lead to the establishment of new corridors.

- **Chapter 3: Broad sector overview**: this introduces the four sectors (transport, energy, water and ICT) in the IGAD region. The chapter describes how the need for additional trans-boundary infrastructures over the life of the IRIMP is identified, and outlines the base population and economic growth assumptions used in the trans-boundary infrastructure demand analysis,
- **Chapters, 4, 5, 6 and 7 focus on the individual sectors** (Transport, Energy, Water and ICT) for which the following is presented: (a) a description of the most important existing and planned trans-border infrastructures, (b) a review of the enabling environment for the sector in question that facilitates inter-regional trade, integration and development in the IGAD region., (c) an analysis of the demand for trans-border infrastructures related to the sector in question over the time period of the masterplan., and (d) a 'gap' analysis, which is the 'difference' between the trans-border infrastructure needed according the demand analysis and the trans-border infrastructure existing and planned.
- **Chapter 8: Trans-border project prioritisation criteria:** This chapter focuses on the criteria that is to be applied, following validation by the client, in order to select the priority projects for the IRIMP Action Plan.

A number of annexes have also been prepared.

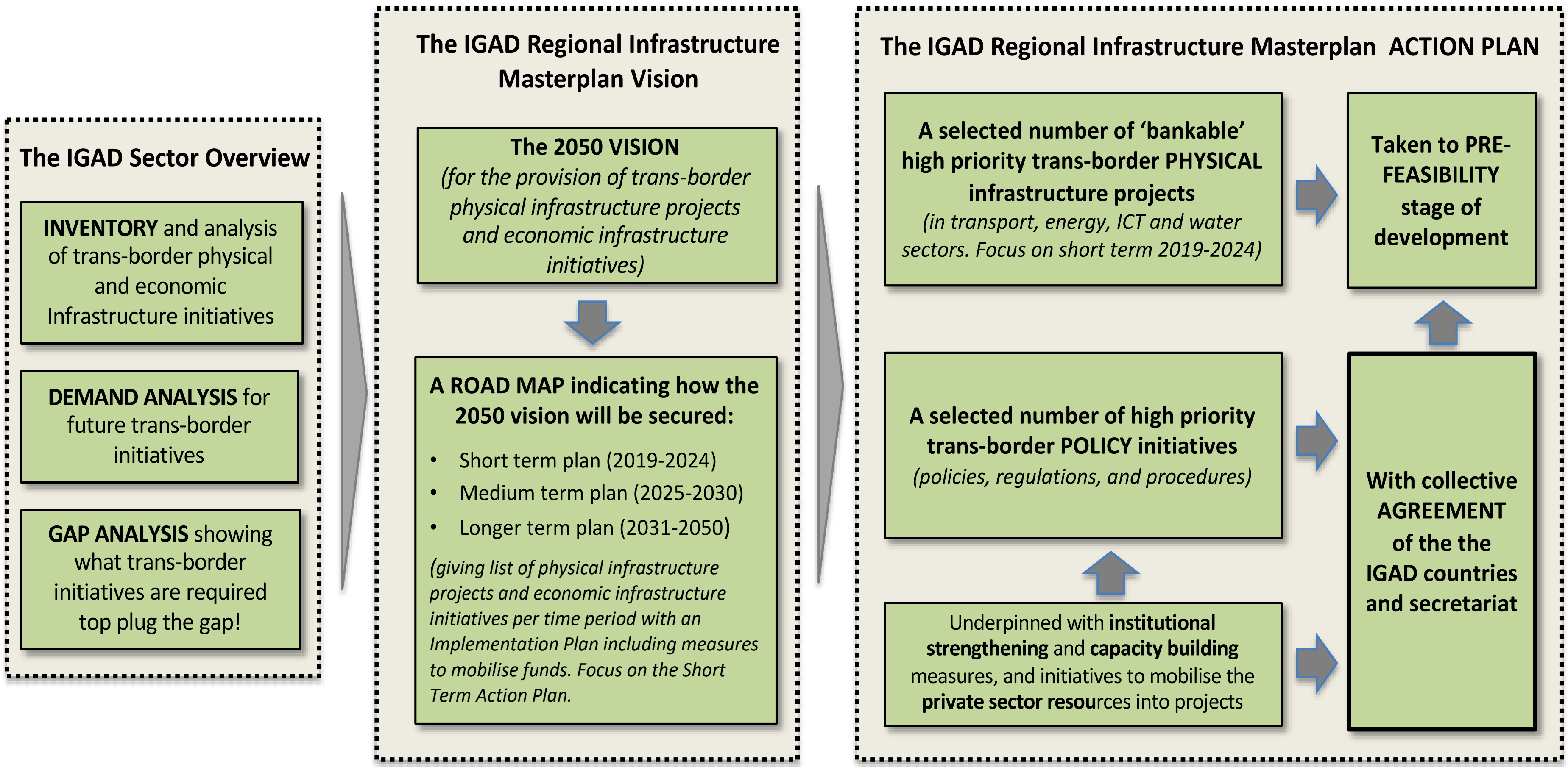
- **Annex 1: presents the data capture inventory forms**. There are descriptions of over 180 major projects that are in the pipeline. Some of these most likely will be features in the IRIMP action Plan. This annex is large, some 200 pages, and so is presented under separate cover.
- **Annex 2: is the collection of the case studies** of existing trans-border infrastructures and is also presented under separate cover.
- **Annexes 3, 4, 5 and 6 presents reviews of the four key sectors** (transportation, energy, water and ICT) in IGAD members states. These reviews do not repeat the information contained in the main body of the report, but describe the general nature, and prospects of the principle guiding the preparation of this report. These annexes are presents together under sperate cover.

The report is intended to be to be as concise as possible; all background information is placed in the annexes. Headline issues are highlighted so that discussion amongst the client group can be focused on what needs to happen to ensure that an effective Master Plan and Action Plan can be prepared which finds traction with the governments of all the IGAD member states and also with potential funders (both public and private).

This report is a step towards the ultimate aim of the IRIMP, namely the identification of infrastructure projects and policy-type initiatives that are attractive to financial backers, can be readily implemented, and can demonstrably improve intra-IGAD and inter-continental trade and regional economic development. It is valuable to repeat what was stated in the agreed Inception Report:

The IRIMP project must focus on identifying projects and initiatives that are feasible; high on the development agenda of the IGAD member states; likely to be 'bankable'; and, more specifically, characterised by a high propensity to attract private sector resources. The preparation of the regional infrastructure 'masterplan' is the strategic framework and rationale for these projects and policy-type initiatives. The masterplan is instrumented to achieve a key aim of the project – namely, projects and initiatives that can 'work', can be effectively and efficiently implemented, and can clearly and measurably enhance regional integration and economic development prospects (see Figure 1-1)

Figure 0-1: Key Project Goals



Strategic Context

Key Messages

Trade and integration:

- Intra-regional trade flows in IGAD are low compared to other RECs – but are increasing steadily and, on current trend, projected to reach $5 billion by 2030.
- Intra-regional trade is concentrated between country pairs with well-established connections, in particular the EAC countries. There is potential to boost trade between other partners – for example Ethiopia and Kenya – if trade barriers are addressed.
- Structural transformation of member states' economies will provide opportunities to produce and trade higher value-added products in the region. This potential will only be realised, however, if the barriers to trade are addressed

Barriers to trade and integration

- The key non-tariff barrier is the lack of adequate infrastructure; the IGAD region needs to strengthen and complete the basic trans-border hard infrastructure connectivity backbone as soon as possible.
- Other important non-tariff barriers include poor trade facilitation and logistics. Cargo clearance at the port of Mombasa, for example, had been plagued by inefficiencies; it often takes up to 5 days to clear cargo at the port and approximately 7 days for cargo to reach Kampala and 12 days to reach Juba in South Sudan. In addition, rules and regulations are not harmonised across the IGAD region.
- The relationship between trade and infrastructure is one of positive feedback: improving trans-border infrastructure will boost trade, at the same time increasing trade flows will increase demand for infrastructure.

The importance of economic development corridors (EDCs)

- There are eight major trans-border corridors in the IGAD region, plus the Nile River. All of them are basic transportation corridors; none are fully-fledged EDCs; none are clear drivers of economic development and structural transformation. It is one of the key objectives of the IRIMP to recommend how these corridors can become EDCs.
- The governments and private sector stakeholders of the every one of the benchmark countries want to turn existing transport corridors into EDCs as they recognise that it is an EDC rather that a basic transport corridor that would be the 'pathway' to achieving target economic development and social welfare goals
- The experience of the benchmark countries indicates that setting up a corridor organisation is very important if you want to turn a transport corridor into an EDC. (e.g. special purpose vehicle; 'corridor tiger team'; mayors' commitment). The IGAD region (members states) should consider setting up dedicated corridor institutional arrangements that have the full backing of respective governments.

Section 2.1 The need for the IRIMP

The lack of infrastructure is one the primary challenges facing IGAD member states and Africa as a whole. In particular, the deficit in trans-border infrastructure:

- is slowing the pace of regional integration;
- restricting the movement of goods, services and people within the region;
- increasing transaction costs and limiting the effective size of regional markets;
- reducing the competitiveness of regional products and making the region less attractive for inward investment; thus
- resulting in reduced economic growth.

As IGAD member countries aspire to attain higher levels of development, **the need to meet the increasing demand for infrastructure is therefore increasingly critical**. At the continental level, estimates for the PIDA project that demand will increase in each of the four sectors as follows:

- Power demand will increase from 590 terawatt hours (TWh) in 2010 to more than 3,100 TWh by 2040;
- Transport volumes will increase 6-14 times with port throughput rising from 265 million tonnes (2009) to more than 2 billion tonnes by 2040, the critical gateway sea ports need major improvements and productivity gains to meet trade ambitions;
- ICT demand will swell by a factor of 20 before 2020. Demand of 300 gigabits (2009) will reach 6,000 gigabits by 2018;
- The demand for irrigated agriculture will double and shared watercourse systems will be better managed ensuring water security across Africa.[2]

The level of financing required to meet this demand, however, is far **beyond the budget capacity of national governments**, with the partial exception of seaports which are much more amenable to private financing. The continent requires $130-$170 billion a year to address the stock insufficiency and guarantee high quality infrastructure which is critical in ensuring African countries achieve the SDGs and Agenda 2063 of the African Union.[3] To fully implement the PIDA will require $360 billion by 2040, while the Priority Action Plan (PAP) requires $68 billion, of which $23 billion is in the East Africa region, which includes IGAD countries. Energy accounts for 60% of the PAP, transport 37%, water 2.5%, and ICT less than 1%.

The **objective of the IGAD IRIMP is therefore to identify a pipeline of bankable trans-boundary infrastructure projects that are attractive to investors** – including donors, development banks and the private sector. Moreover, the IRIMP will produce a Vision for the IGAD region in 2050 and a Road Map for realising this Vision, including an Implementation Plan with institutional strengthening and capacity building measures, and initiatives to mobilise the private sector resources into projects. The IRIMP will ensure that all projects proposed for the IGAD region are aligned with continental initiatives, including the PIDA, and will recommend complementary 'economic infrastructure' initiatives – policies, regulations, and procedures – that maximise the impact of infrastructure investments and promote transformative growth and regional integration.

This chapter presents the strategic context for the IRIMP. The recent economic performance of member states and their medium-term objectives are described, as well as the drivers of trade and

[2] Programme for Infrastructure Development in Africa (PIDA) projections
[3] Africa Economic Outlook, 2018

integration and the potential to boost intra-IGAD trade. The barriers to this form of trade are listed; these barriers compromise the 'enabling environment' that is required for trans-border infrastructure investment to be effective and must be addressed.

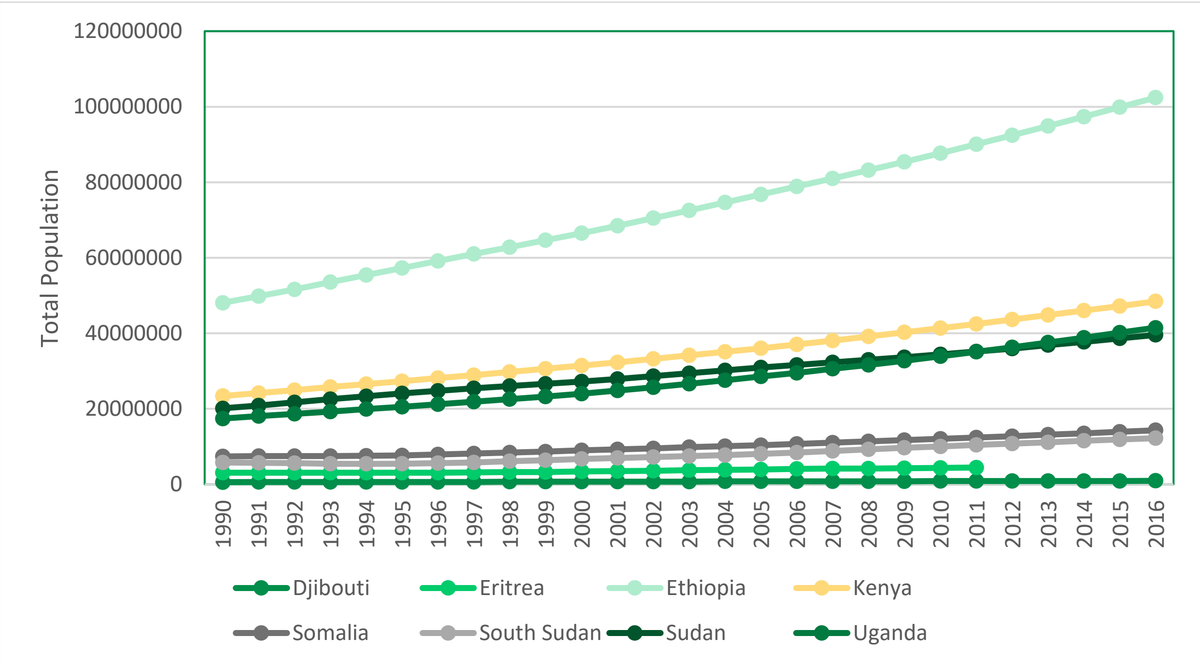
A number of benchmark countries are then reviewed and the way in which they provided trans-border infrastructure is assessed; in particular the way in which transport corridor were turned into fully-fledge economic development corridors is thrown into high relief and lessons for the IGAD region are presented. The potential for trans-border infrastructure to be a significant driver of regional growth, transformation and prosperity is enormous.

Section 2.2 Economic performance and targets

IGAD countries have a young and growing population, with around half of the population below the age of 30. The total population is expected to almost double to 500 million by 2050, from 278 million today, divided between the respective member states as follows: Ethiopia the most populous with 108 million; Kenya, 51 million; Uganda, 44 million; Sudan, 42 million; Somalia, 15 million; South Sudan, 13; Eritrea 5 million; and Djibouti 1 million.

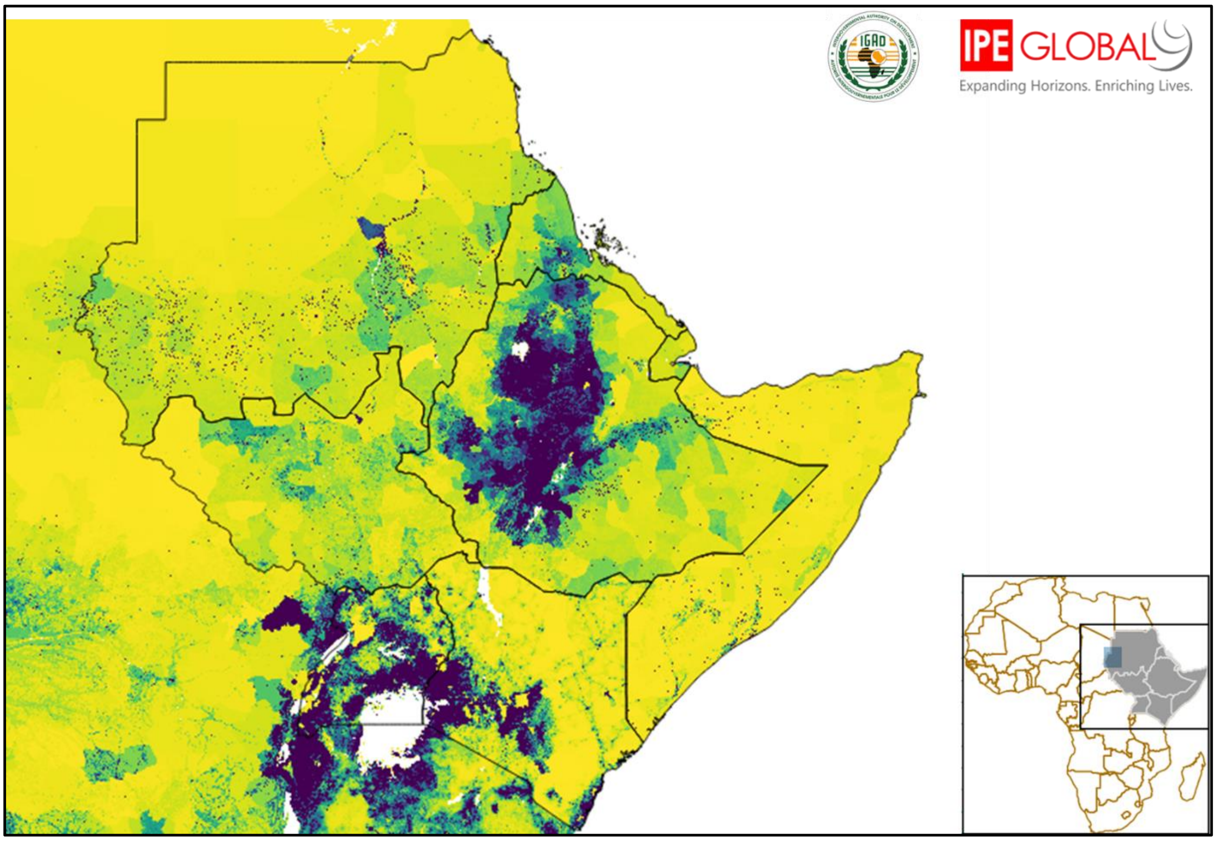
This rapid population growth provides the potential for a demographic dividend as growth rates slow down and the ratio of working age population to dependents increases. This dividend can only be realised, however, if the economic conditions are right to attract investment and create enough jobs.

Figure 0-1: Population of IGAD Member States, 1990-2017



As Figure 2-2 below shows, population is concentrated in two primary regions: Lake Victoria and Northern Rift Valley; and the Ethiopian Highlands; with secondary concentrations along the coast and the Nile River, while much of the rest of the region is sparsely populated. Figure 2-3 shows night-time lights satellite imagery from 2013, illustrating the concentrations of economic activity, located in the densely populated regions. At present these agglomerations are poorly connected to each other, and to the less densely populated hinterland areas. The objective of the IRIMP – and the key to unlocking the economic development potential of the IGAD region – is to connect and integrate these agglomerations.

Figure 0-2: Population density, IGAD region, 2015

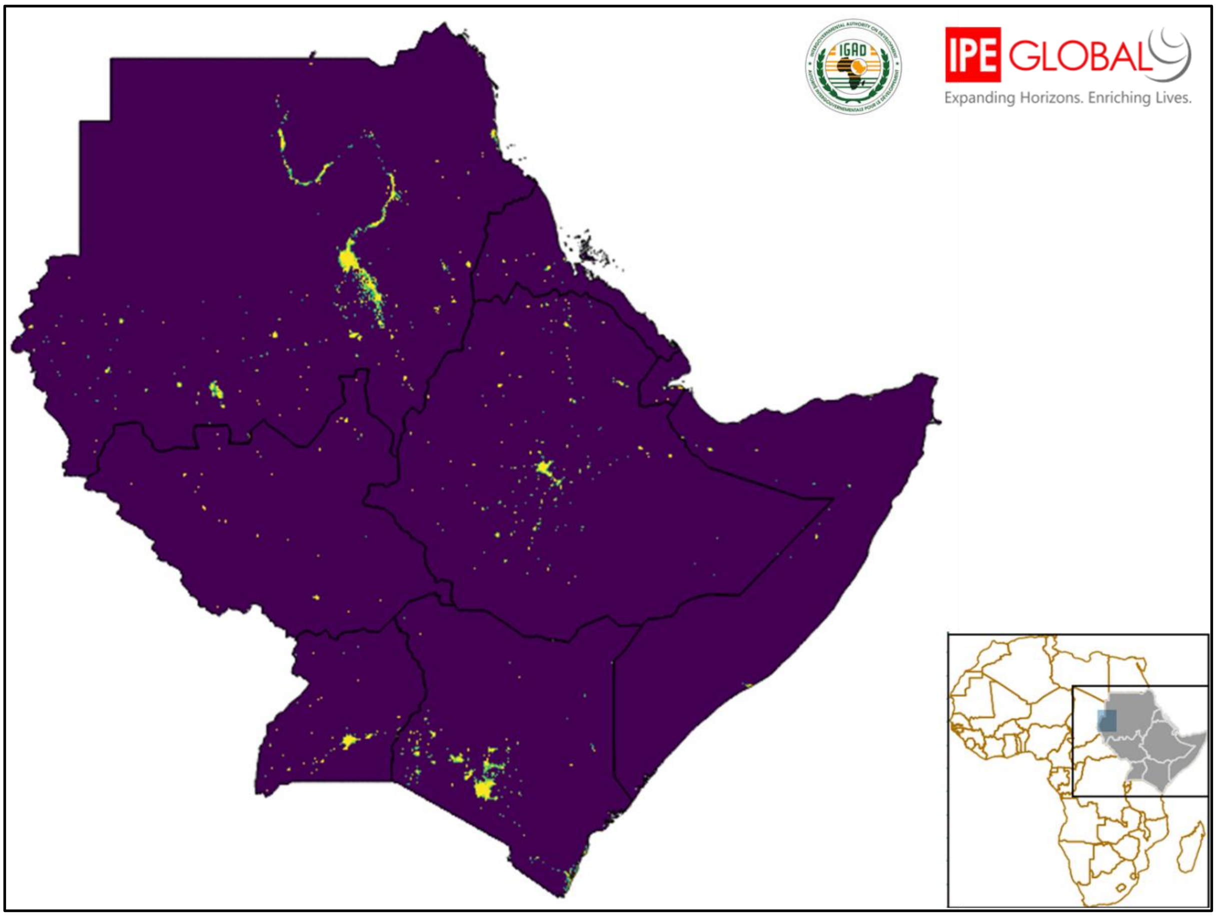


Source: World Pop, www.worldpop.org, blue indicates higher population density

The IGAD region has performed well in the last decade, with an average annual GDP growth rate of 5.1%, second only to EAC among the African RECs, above the African average 3.5% and the global average 2.4%. Within the region, however, performance has been more mixed, with Ethiopia growing rapidly at just over 10% per annum, while the fragile economies of Sudan, South Sudan and Eritrea have grown more slowly, and even contracted in some periods.

The IMF forecasts that growth will accelerate for five of the eight countries, Ethiopia will decline slightly but will remain the fastest growing at 7.9%. The fragile economies of South Sudan and Sudan are both expected to contract, at an average of 5.7% for South Sudan and 1.1% for Sudan. However, these forecasts are predicated on the instability and conflict in South Sudan and the impact of US sanctions on Sudan. As recent progress has been made to resolve both of these issues, a more optimistic forecast can be made for moderate growth in these two countries in the coming years.

Figure 0-3: Night-time lights, IGAD region, 2013



Source: NOAA, Nighttime Lights Time Series, https://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html

Figure 0-4: GDP growth rates, African RECs, 2008-2017

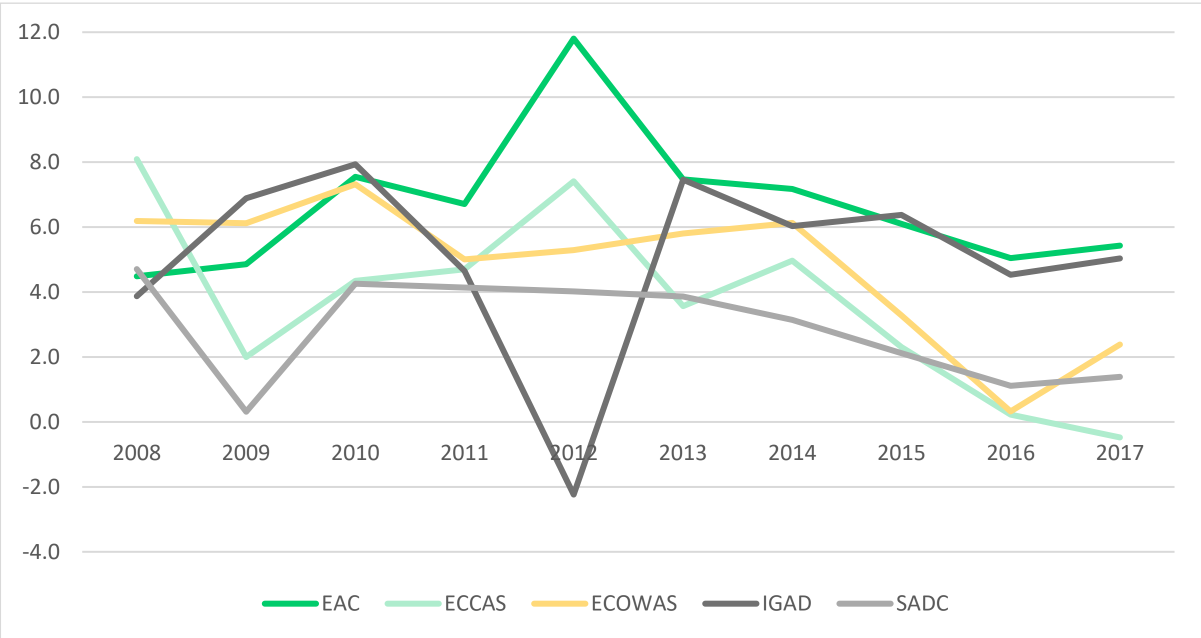
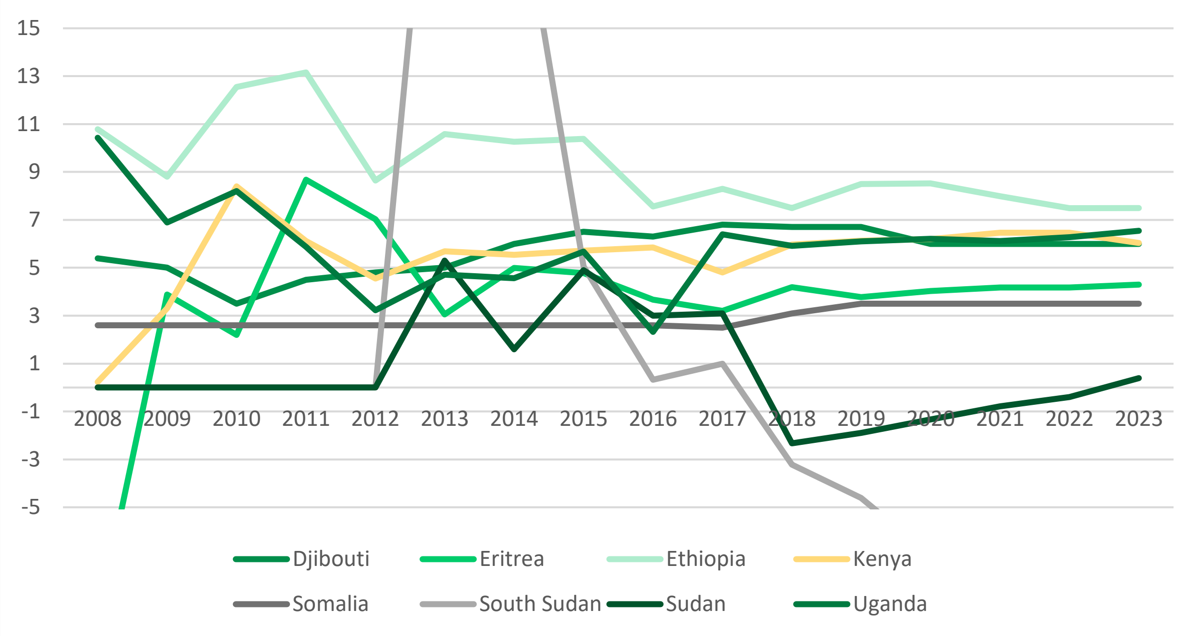


Figure 0-5: GDP growth rates, IGAD member states, 2008-2023



Despite this recent strong economic performance, the IGAD region still lags behind other African RECs in many key indicators (see Table 2-1); for example:

- GDP per capita, at $1,118, is the lowest of all RECs except EAC and significantly below the African average of $1,787
- Poverty is the highest of all RECs at 63% compared with 51% across the continent,
- The average Human Development Index (HDI) score is joint lowest with ECOWAS.
- A significant contributor to this overall poor macroeconomic situation is the lack of investment in the region, coupled with the lack of revenue from exports, reflected in the worst trade balance of all RECs, -5.9% of GDP compared with -3.5% for Africa, and the second lowest FDI per capita, $266 compared with $674 for Africa.

Table 0-1: Key macroeconomic indicators for IGAD member states and comparators

Member State	Population (m)	GDP ($bn)	GDP per capita	Poverty (%)	Trade Balance (% GDP)	FDI Stock ($bn)	FDI per capita ($)	HDI Score
Djibouti	0.97	1.6	1,572	35	-23.2	2	2,012	0.476
Eritrea	5	2.6	583	N/A	-3.4	1	192	0.440
Ethiopia	108	81	768	84	-7.2	19	172	0.463
Kenya	51	77	1,646	39	-6.3	12	234	0.590
Somalia	15	7.4	500	82	N/A	2	153	N/A
S. Sudan	13	6.9	605	92	-13.4	N/A	N/A	0.388
Sudan	42	107	2,694	52	-4.5	27	639	0.502
Uganda	44	26	679	57	-4.2	12	269	0.516
COMESA	548	687	1,286	46	-4.5	263	480	0.546
EAC	191	180	967	62	-5.5	46	242	0.495
ECCAS	192	268	1,435	54	-2.4	100	520	0.520

ECOWAS	377	550	1,496	60	-0.1	179	475	0.482
IGAD	**279**	**308**	**1,118**	**63**	**-5.9**	**74**	**266**	**0.482**
SADC	352	701	2,047	47	-2.3	292	832	0.545
Africa	1,287	2,241	1,787	51	-3.5	867	674	0.526
World	7,633	80,439	10,656	N/A	N/A	31,524	4,130	0.728

This brief overview demonstrates that economies of IGAD member states are all relatively small but growing and, given peace and security in the region, the IGAD economies are poised for further and perhaps significant growth over the coming years. The time is right for significant investment in growth-inducing (trans-border) infrastructure investment to boost development, and secure peace and security. Infrastructure investment is often wasted during war and conflict, and when insecurity prevails. Peace and security, on the other hand, allow infrastructure assets to bring people together, for commerce to flourish, and thus for development to proceed apace.

In enabling trade, integration and development, the provision of infrastructure assets, especially trans-border investments, will help to secure and strengthen peace and security in the region and, in turn, accelerate development. The positive feedbacks can be dramatic; infrastructure promotes development which strengthen security and peace which in turn provides a dramatically improve environment for trade to flourish and prosperity to be achieved.

More specifically, the urban sectors of the IGAD member states are growing at a significant rate; cities and towns are increasingly drivers of national economies and the IGAD region is no exception. Connecting the rapidly expanding cities and towns of the IGAD region, and their increasingly diversified and sophisticated economies, is ever more important in order to allow and accelerate intra-regional trade, integration, prosperity, and peace and security. **The IRIMP is an important instrument with which to plan for the right type of trans-border infrastructure, in the right place, operated in an effective and efficient manner and thus leading to development, and security and peace across the IGAD region.**

The IGAD secretariat has set a number of ambitious goals to promote economic development in the region, boost exports and address the challenges in attracting FDI. The current IGAD Regional Strategy (2016-2020) emphasizes the importance of infrastructure development to economic development through Pillar 2: Economic Cooperation, Integration and Social Development. The objective of the Infrastructure Development Programme Area is:

> *"Removing both physical and non-physical barriers to inter-state trade and communications, and developing essential infrastructure are essential to regional co-operation and integration. Although IGAD has had some successes in securing funding for its infrastructure and communications interventions, one of the lessons learned in the process is that most donors have shied away from financing large capital investment projects, such as major road and communications projects. IGAD will continue working with its member states to mobilise to identify potential funding sources for the vital missing links as well as other infrastructure interventions that will facilitate the movement of goods and people in the Region."*

The IRIMP will be a key tool to realise this objective through developing a vision and a clear roadmap for infrastructure development in the region to 2050 – and most importantly – identifying an Action Plan of bankable projects and sources of funding for those projects.

Individual member states have also set ambitious targets for growth and development, and several have identified specific infrastructure related targets through their respective National Development

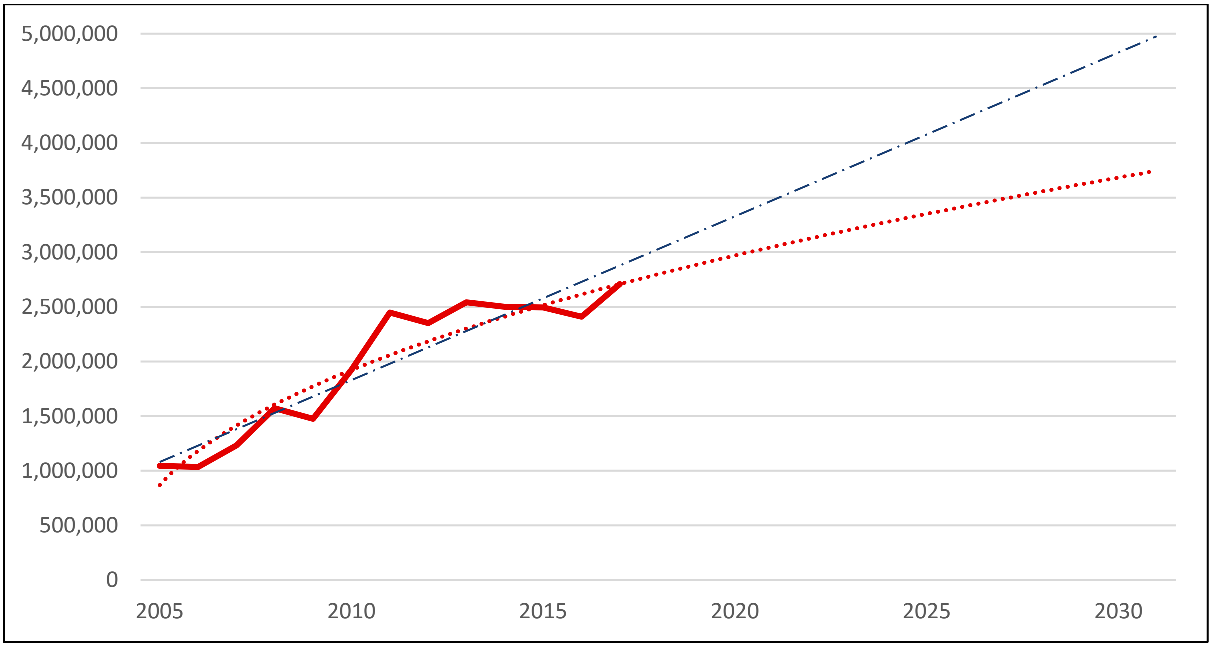
Plans (NDPs). These are summarised in the table below. The IRIMP will be aligned with the objectives of NDPs and its implementation will assist member states to secure their individual development targets.

Section 2.3 Drivers of Trade and Integration in the IGAD Region

Intra-Regional Trade in IGAD

Intra-regional trade flows between IGAD member states are relatively low in comparison to other RECs at around $2.7 billion compared to $9.15 billion for ECOWAS, and $33.9 billion for SADC, though higher than ECCAS at $1.4 billion[4]. As Figure 2-6 shows, the volume of intra-regional trade increased significantly between 2005 and 2011, though growth has since plateaued slightly, while Figure 2-2 shows that the share of trade between IGAD member states compared with trade outside the region has increased steadily from 10% in 2005 to 17% in 2016 and is projected to reach 28% by 2030.
Linear extrapolation projects future intra-regional trade of around $5 billion, while a more conservative forecast estimate is just less than $4 billion – either way this represents a significant increase.

Figure 0-6: Total Volume of Intra-regional trade in IGAD



[4] UNCTAD Data, 2017

Table 0-2: IGAD member states' NDP targets

Member State	NDP or Equivalent	Horizon	Target GDP Growth	Infrastructure Objectives and Targets
Djibouti	Yes	2035 (targets 2019)	10%	• Increase rate of access to electricity from 53% to 70% • Reduce average price of KWh from $0.3 to $0.18 • Share of households linked to the drinking water network increased from 67% to 85% • Increase density of fixed telephone lines (per 1,000) from 23.2 to 30.8 • Increase rate of access to mobile phones from 29% to 74% • Increase goods transit in south corridor (million tons) from 8.28 to 24 • Increase goods handled by Port of Doraleh (million tons) from 1.4 to 8.2 • Increase railway passengers from 0 to 804,000 • Increase share of asphalt road network from 41% to 82% • Increase paved road in good condition from 36% to 82%
Eritrea[5]	No	No plan	No plan	
Ethiopia	Yes	2025	11%	• Increase the logistics performance index from 2.59 to 3.07 or to improve its rank from 104th to 57th, reduce the import and export transit time by 50%, reduce the average waiting time at sea port from the current 40 days to 3 days, increase the national general cargo coverage through multi modal transport from 35 percent to 90 percent, increase export containerizable cargo from the current 7 percent to 100 percent • The Addis Ababa to Djibouti SGR railway is planned to provide transport services for 750,000 passengers and 7.5 million tons of cargo per annum by 2020. It is planned also to construct a

[5] Eritrea has no National Development Plan

Member State	NDP or Equivalent	Horizon	Target GDP Growth	Infrastructure Objectives and Targets
				total of 2,741km national railway network in five corridors and six routes: Mekele-Hara Gebeya (268 Km), Hara Gebeya-Assayta (229Km), Asayta-Tadjura Port (210Km), Awash-Hara Gebeya (389 Km), Addis Ababa/Sebeta-Ejaji-Jimma-Bedele-Tepi-Dima (740 Km), Mojo-Hawasa-Weyto-Moyale (905 Km). In addition to this, project studies will be conducted for five different corridors railway projects and financial resources will be sought for Weldya-Wereta-Fenote Selam (500Km), Wereta-Metema (224Km), Mekele-Shire (368 Km), Ejaj Kumruk (460Km) Eteya-Ginir (248 Km) • Total road length is planned to increase from 110,414 km in 2014/15 to 220,000 km by 2019/20. It is planned to upgrade 560 km trunk roads, 3,765km of link roads and 15,000km of rural roads. As a result, the average time that takes to reach the nearest all-weather road is planned to decline from 1.5 hour in 2014/15 to 0.8 hour by 2019/20, reduce the proportion of areas further than 5km from all-weather roads from 36.6% to 13.5%, increase road density from 100.4km/1000km2 to 200km/1000km2, increase roads in acceptable conditions (fair to good) from 70% in 2014/15 to 80% by 2019/20. Besides, it is planned to increase the ratio of asphalt (paved road) roads from 13% in 2014/2015 to 16% by 2019/20. • Increase air passengers handling capacity from 5 million per year in 2014/15 to18 million by 2019/20; Increase the number of airports from 20 in 2014/15 to 25 by 2019/20; Increase cargo services to 503.7 thousand tons by 2019/20 • During the GTP II period, it is planned to increase the share of Berbera Transit Corridor to 30% and the share of Port Sudan transit Corridor from 2% to 10% • Increase the power generating capacity of the country from 4,180MW in 2014/15 to 17,208MW by 2019/20; of which, 13,817MW is planned to be generated from hydro-power, 1224MW from wind power, 300MW from solar power, 577MW from geothermal power, 509MW from reserve fuel (gas turbine), 50MW from wastes, 474MW from sugar and 257MW from biomass • Increase the energy production capacity of the country from 9,515.27GWH in 2014/15 to 63,207GWH by 2019/20

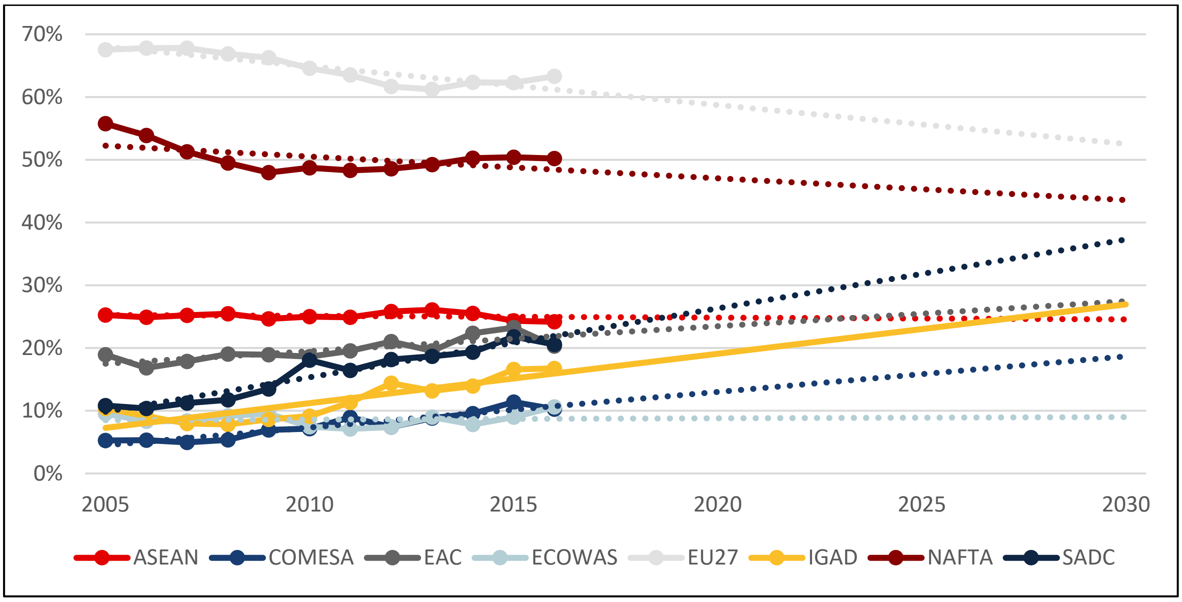
Member State	NDP or Equivalent	Horizon	Target GDP Growth	Infrastructure Objectives and Targets
				• In the telecom sub-sector, it is planned to increase mobile subscribers, broadband internet and data users, narrowband internet and data subscribers of fixed telephone from 38.8 million, 1.91 million, 7.53 million and 0.838 million in 2014/15 to 103 million, 39.1 million, 16.9 million and 10.4 million by 2019/20, respectively. It is also planned to increase mobile service penetration rate from 43.9% to 100%, increase telecom density from 10.5 % to 54%, increase internet and data density from 3.3% to 10%, increase international link capacity from 27.9 Gbs to 1485 Gbs, maintain mobile service coverage at its current level of 81% during the same period • Ground water exploration coverage will increase from 13% to 25% during the same period. Integrated catchment and degraded land rehabilitation will expand from 922,520.7ha to 2,304,801ha during the plan period. Moreover, basins and hydrological information systems is planned to increase from 25% to 63% and hydrological mapping coverage will reach 95% • Medium and large-scale irrigation development feasibility studies and designs on 250,000 ha and construction on 280,385ha will be undertaken by the Ministry of Water, Electricity and Irrigation. Similarly, 322,573 ha will be developed by the Sugar Corporation. In the regional states, specifically, Tigray, Amhara, Oromia and Southern Nations, Nationalities and Peoples Regions, about 330,307ha will also be developed for production of sugarcane and other crops
Kenya	Yes	2030	10%	• Expansion of Nairobi JKIA airport providing for a second runway and terminal building • Upgrading of the Kisumu Airport through reconstruction and extension airport runway from 30m to 45m and extension from 2km to 3.3km and the construction of a new passenger terminal • Development of the LAPSSET Corridor through construction of 3 berths at Lamu port, a new road network, a railway line to link with South Sudan and Ethiopia networks, construction of an oil pipeline and an oil refinery at Lamu • Upgrading the railway network to Standard Gauge Railway (SGR) between Mombasa and Malaba through Kisumu. Phase 1 of the SGR line i.e. Mombasa – Nairobi SGR line completed in 2017, construction of phase 2 between Nairobi and Naivasha ongoing.

Member State	NDP or Equivalent	Horizon	Target GDP Growth	Infrastructure Objectives and Targets
				• Generate and distrubte 5000+MW from renewable energy resources and bring down the cost of power to manageable levels for industrial and domestic consumers. This will be supplemented by the construction of coal powered 3x320MW power plant at Kilifi/Lamu • Improvement of the quality of life of Kenyans by ensuring the availability of accessible, universal, affordable, modern and high-quality ICT facilities and services within the country • Increase in ICT interconnectivity in the country through the construction of 1600 km National Optic Fibre Backbone Infrastructure to supplement the already existing 4300 km laid in phase • Increasing irrigated farmland from 140,000 to 300,000 hectares
Somalia	Yes	2019	6%	• Revitalise, operate and maintain essential infrastructure and services to improve stability and set foundations for social, economic and sustainable development • Improve mobility and connectivity throughout Somalia and to the neighbouring region with a strong focus on rehabilitation and maintenance of existing transport infrastructure • Improve access to clean energy systems and equitable access to safe and affordable drinking water and sanitation • Encourage development of telecommunication networks that ensure free and rapid flow of information
South Sudan	Yes	2040	No target	• To construct a good inter-state and intra-state network of roads • To build a railway network connecting production areas to markets and neighbouring countries • To renovate the Nile River transport particularly dredging of the main channel • To upgrade all existing airports and air-strips in the capitals of the 10 States in conformity with the International Air Transport Association (IATA) standards • To develop hydro-electric power

Member State	NDP or Equivalent	Horizon	Target GDP Growth	Infrastructure Objectives and Targets
Sudan[6]	No	No plan	No plan	
Uganda	Yes	2040	8.2%	• Develop adequate, reliable and efficient multi modal transport network in the country • Complete the Standard Gauge Railway (SGR) and pave 1,500Km of roads • Develop adequate, reliable and efficient air transport network in the country • Promote safe, adequate and efficient transport services • Increase power generation capacity to drive economic development • Expand the electricity transmission grid network • Promote use of alternative sources of energy • Increase cumulative storage of water for production from 27.8 MCM in 2012/13 to 55 MCM in 2019/20 • Improve the ICT Development Index from 1.81in 2012 to 3.5 in 2020 • Improve access to ICT from 1.96 in 2012 to 3.5 in 2020 • Increase infrastructure Usage of ICT from 0.75 in 2012 to 2.5 in 2020 • Increase ICT Skills Development from 3.69 in 2012 to 5.5 in 2020

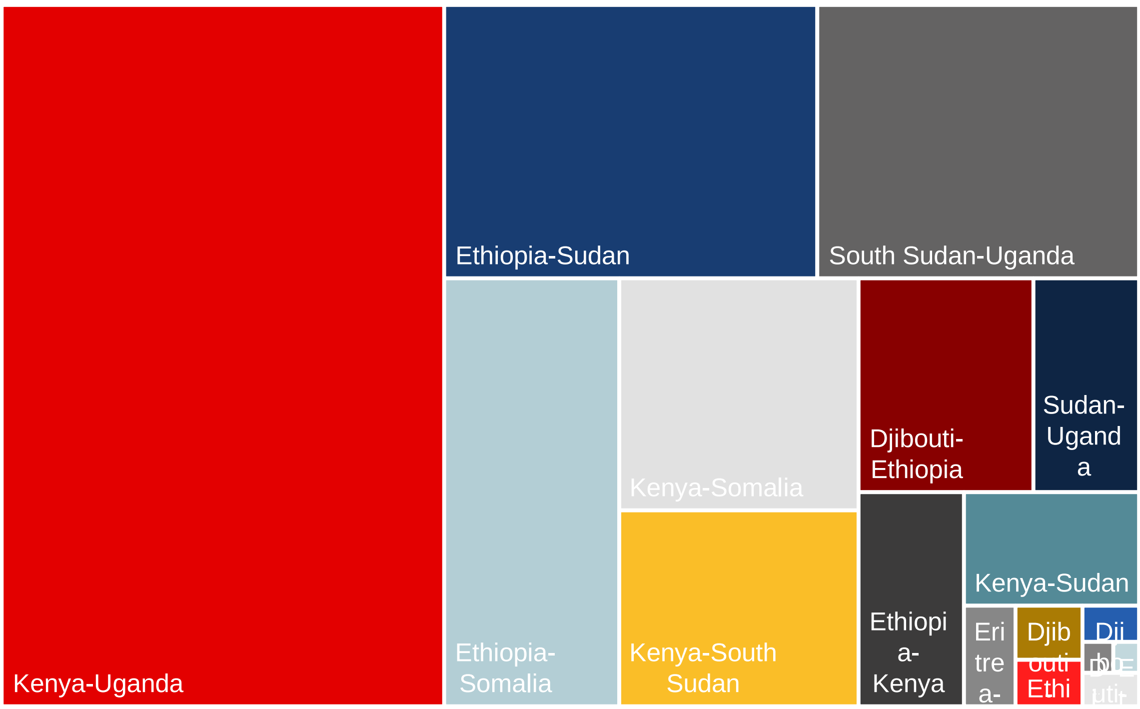
[6] Sudan only has the Sudan National Comprehensive Master Plan which was done during the period 2008 - 2010, before the separation with South Sudan. The National Comprehensive Master Plan was not approved by the Council of Ministers hence never adopted as a National Development Plan for Sudan.

Figure 0-7: Share of Intra-Regional Trade in IGAD and comparable RECs



Moreover, there remains significant potential to increase intra-regional trade further, as at present trade is concentrated between country pairs with well-established ties rather than flowing freely across the region. The barriers to intra-regional trade are discussed below. Trade between Kenya and Uganda accounts for 39% of total intra-regional trade, followed by Ethiopia and Sudan with 13% and South Sudan and Uganda with 11% (see Figure 2-8). Trade between Ethiopia and Kenya – the second and third largest IGAD economies and neighbours – represents just 3%.

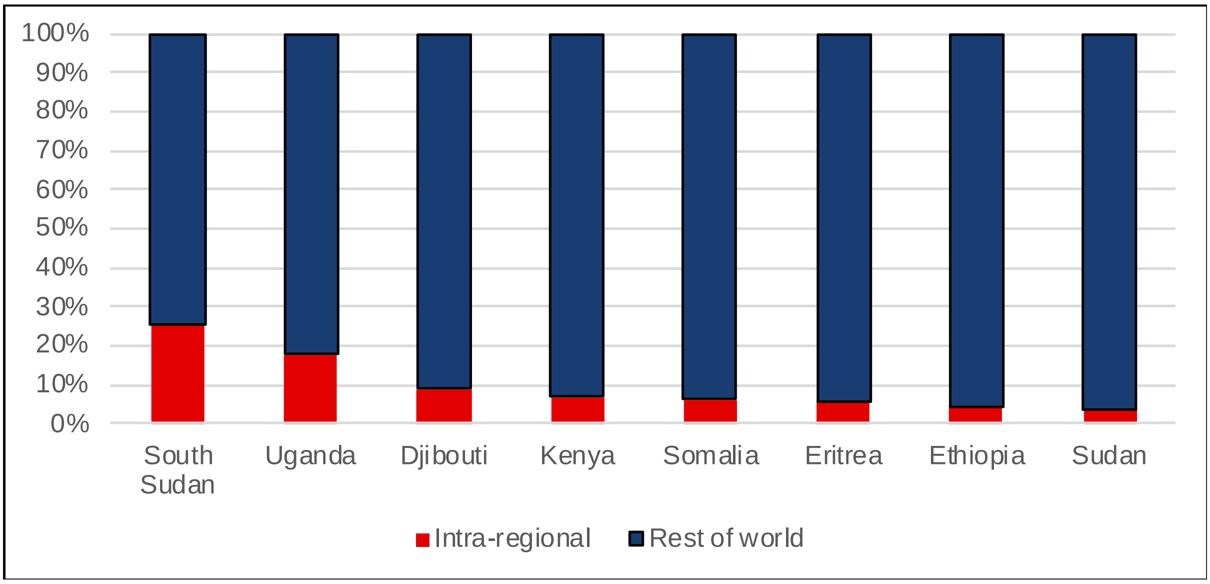
Figure 0-8: Share of Intra-regional trade by country pairs, 2017



A measure of the openness of trade between two countries is total value of trade as a percentage of GDP, or the ratio of the country pair's share of intra-regional trade to share of regional GDP. Where this ratio is low – and especially when two countries share a border – there is likely the potential to increase trade between them if barriers are removed. Kenya-Uganda have a ratio of 1.17, South Sudan-Uganda is 1.05 and Kenya-Somalia is 0.84 – indicating well-established trade relationships between these countries. In contrast, Ethiopia-Kenya is 0.06, Kenya-South Sudan is 0.22 and Ethiopia-Sudan is 0.21, despite these country pairs all sharing a border – indicating poorly established trade relationships, most likely caused by barriers (tariff, non-tariff or physical), but also untapped potential to increase trade in future.

Kenya, South Sudan and Uganda, are also in EAC where a free trade area has been established and steps made to remove tariffs and non-tariff barriers to trade. Consequently, these three countries have strong trade relationships and a high share of intra-regional trade. In contrast, the two largest IGAD economies, Sudan and Ethiopia, have the lowest share of intra-regional trade with merchandise trade with their IGAD neighbours accounting for just 4% of their totals. This demonstrates the importance of removing both tariff and non-tariff barriers to trade, which is discussed further below.

Figure 0-9: Intra-regional merchandise trade share, IGAD Member States, 2017



The composition of intra-regional merchandise trade is illustrated below in Figure 2-10, while merchandise imports and exports from the rest of the world are in Figures 2-11 and 2-12. At present, intra-regional trade is concentrated in food and live animals' products; exports to the rest of the world are concentrated in primary products including food and live animals, crude materials, mineral fuels, and commodities; imports from the rest of the world are concentrated in higher value-added products including machinery and transport equipment, manufactured goods, and chemicals and related products.

In general, the IGAD region has limited capacity to utilise its resource endowments and remains erratic in terms of economic performance, sluggish economic transformation, and weak regional economic integration. The main challenge of the export sector of IGAD member countries is that most of the region's exports are based on primary commodities with little value added. This has led to low value of the exports and also primary commodities that are directly affected when demand in the importing countries slows down (HESPI, 2017).

As the IGAD member states transition from mainly rural agriculture and primary resource driven to urban industrial economies, this presents an opportunity to produce more higher value-added products within the region – thus increasing the volume, but also the value and composition of trade. This potential will only be realised, however, if the barriers to trade are addressed and logistics costs are reduced to enable firms in the region to compete against those from overseas. This is discussed in the following section.

Figure 0-10: Composition of IGAD intra-regional merchandise trade, 2017

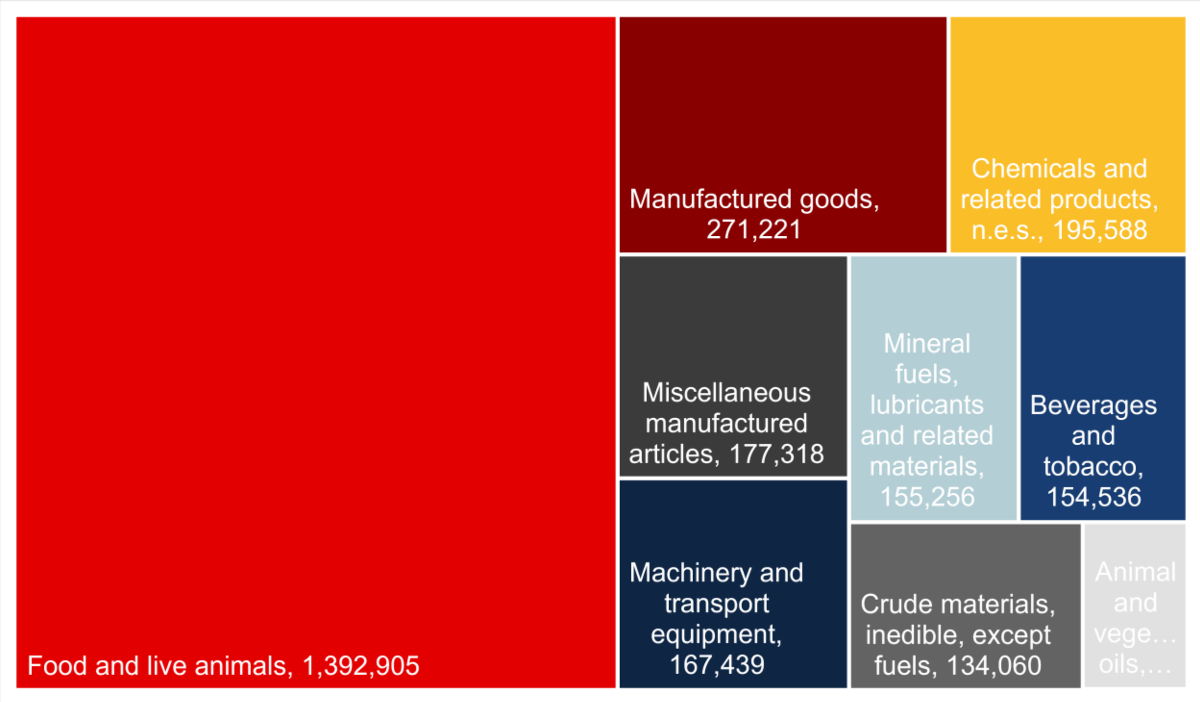


Figure 0-11: Composition of IGAD merchandise exports to the rest of the world, 2017

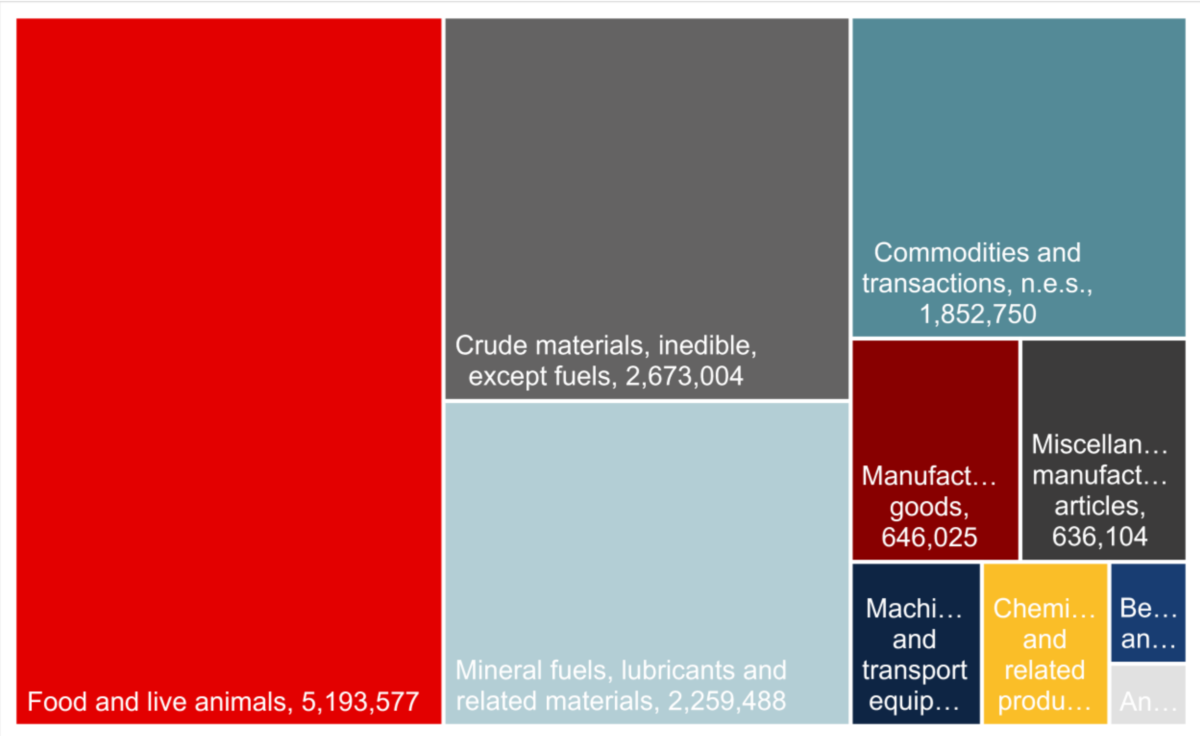


Figure 0-12: Composition of IGAD merchandise imports from rest of the world, 2017

Regional and Continental Trade and Integration Policy Frameworks

The IGAD REC does not possess a policy on formal trade relations between the member states[7]; the only relevant policy framework in place is that which relates to cross border informal trade in the region. Trade and economic integration within the IGAD region has been low as cooperation amongst member states has gathered pace only recently, and the region is characterised by relatively small and undiversified economies that are distant from major regional and global markets.

Trade and integration policies of member states in the IGAD region are aligned to and guided by harmonisation of continental trade agreements that form the basis of policy formulation and frameworks. These agreements are developed by the African Union Commission (AUC) and lay down the standard rules and procedures for regulating trade between signatory countries with the aim at promoting trade and integration in the continent. These are:

- **Africa Continental Free Trade Agreement (AfCFTA)**: IGAD member states with the exception of Eritrea are signatories to the AfCFTA with aim of leveraging their resources to promote trade and investment in their countries. The AfCFTA principally promotes the elimination of tariff and non-tariff barriers to trade through establishment of customs union and an African Economic Community. AfCFTA advocates for construction of development corridors in Africa as the key drivers of trade in the continent and emphasizes on Special Economic Zones which take different forms depending on their intended purpose.
- **Boosting Intra-Africa Trade (BIAT):** The AU formulated a framework of promoting intra-Africa trade through the RECs by principally highlighting the key issues affecting trade and providing a

[7] The IGAD Member States Ministers in-charge of trade in July 2018 adopted a policy framework On Informal Cross Border Trade that is aimed at transforming the conduct of Informal Cross Border Trade (ICBT) within the IGAD region and improving cross border security governance.

framework for fast tracking the continental free trade area. The main stay of this strategy is to expand intra-African trade by breaking down tariffs and non-tariffs barriers and enhancing mutually advantageous commercial relations through trade liberalisation schemes.

- **Tripartite Free Trade Area (TFTA):** TFTA is an initiative of COMESA, SADC and EAC RECs to develop a Free Trade Area with the aim of promoting intra-regional trade in Africa through liberalisation of trade in goods, services and other trade related matters. Over the last few decades, several initiatives had been accelerated towards boosting intra-regional trade by the 3 RECs which have the potential of inching closer the ambition of the AU of having in place the African Economic Community. TFTA has in place a formal framework on harmonisation of trade policies between the member states of whom 3 countries in the TFTA belong to the IGAD i.e. Kenya, Uganda and South Sudan. This framework guides the procedures of trade and elimination of trade barriers between the TFTA signatories.
- **Programme for Infrastructure Development in Africa (PIDA**): IGAD individual member states are guided by PIDA, which is a framework developed to guide and promote the development of infrastructure necessary for more integrated transport, energy, ICT and transboundary water networks to boost trade, spark growth and create jobs. It comprises of a long-term strategic vision for the continent to 2040 and a Priority Action Plan (PAP) of around 50 programmes to be implemented in the period 2012–2020. A number of infrastructural projects within the IGAD region are highlighted in the PIDA that will promote cross border trade and interconnectivity in the region.
- **Agenda 2063:** Agenda 2063 is the continental blue print framework for development comprising of aspirations that are geared to propel individual member states in the African continent to higher levels of development. Agenda 2063 advocates for the development of essential and critical infrastructure to support Africa's accelerated integration and growth, technological transformation, trade and development. The infrastructure development accompanied by trade facilitation will see intra-African trade growing to 50% by 2045. Of particular to note is Aspiration 2 which envisions an integrated continent and politically united. This aspiration will be achieved through focusing on trade related priority areas such as intra-African trade, liberalisation of air transport and full implementation of Yamoussoukro Decision, development of communications and connectivity infrastructure among other priority areas.

Key Non-Tariff Barriers to Intra-IGAD Trade

The slow growth in intra-regional IGAD trade and integration is attributed to a range of tariff and non-tariff barriers including the following barriers:

- **Inadequate Infrastructure** – Trade competitiveness is low due to infrastructural deficit across all the key core infrastructure sectors i.e. transport, telecommunications and energy. The impact of infrastructure deficit has more often resulted in high costs of doing business in the region. For trade to flourish, there is need to scale up the levels of investment in trade-related infrastructure in the region. While some IGAD member states such as Kenya and Ethiopia have undertaken massive infrastructure development, these have been found to be infrastructural linkages primarily to member states who are mostly their trading partners e.g. Kenya-Uganda transport network, Ethiopia-Djibouti Corridor etc. Infrastructural deficits indirectly induce a fall in the extent to which a country/region trades with its neighbors.
- **Lack of Trade Facilitation and Logistics** – About a quarter of delays along a major transport corridor in IGAD are as a result of poor transport infrastructure, while the rest are mainly as a

result of poor trade facilitation and logistics. Trade is greatly hampered because it takes time to conduct trans-border commerce due to poor trade facilitation mechanisms and unreliable logistical services. Each additional day that a product is delayed at the border/port due to institutional and regulatory bottlenecks before being shipped reduces trade by more than one percent. This effect is significantly larger for time-sensitive goods which reduce a country's relative exports of such products by six percent.

- **Difficult political environment of the region** - IGAD region has been synonymous with political instability which has restricted trade between countries and ultimately integration of the region. Political instability widely affects economic potential of a country which depends on investments from both local and foreign investors. Foreign investors are less willing to invest in a country and or region where political instability and conflicts are evident. The IGAD Secretariat has been instrumental in advocating and fostering peace initiative between warring factions where peace agreements have been signed by leaders in South Sudan and Somalia and continue to advocate for unity of the countries for the stability and integration in the region.

A thriving intra-IGAD trade hinges on two critical issues that need to be addressed:

- **Competitive services markets** - Services provide innovative and dynamic opportunities for exports while opening up to imports of services and foreign direct investment and is a key mechanism to increase competition and drive greater efficiency in the provision of services in the domestic economy
- **Removal of Non-Tariff Barriers to Trade** - Non-Tariff Barriers impose unnecessary costs on producers hence limit trade and raise prices for consumers, undermine the predictability of the trade regime, and reduce investment in the region

Non-Tariff Barriers impose unnecessary costs on producers thereby limiting trade and raise prices for consumers, undermine the predictability of the trade regime, and reduce investment in the region. While the region experiences a lot of informal small-scale trade between its populace, lack of enabling environments such as Simplified Trade Regimes (STRs) has made trade in low value consignments (below $1000) expensive to undertake. Since most IGAD countries produce and export raw materials of agriculture in nature rather than processed goods or manufactured goods, there is little that IGAD member states are importing from each other.

The low level of trade in the IGAD region is further exacerbated by incentives offered by other international markets such as Quota Free and Duty Free, Everything But Arms[8] and African Growth Opportunity Act (AGOA) which make it appear more lucrative to export to developed countries such as EU and USA instead of trading with other African countries. Many of the key non-tariff barriers to trade are associated with regulatory and competition issues which have emerged as a result of countries bringing down their tariffs hence a web of rules, fees and expensive services tend to inhibit intra-IGAD trade.

[8] Everything But Arms (EBA) is an initiative by EU Nations to grant duty free and quota free access for all goods from the Least Developed Countries with the exception of arms

Table 0-3: Tariff structures of IGAD member states

Country	WTO	EAC FTA	COMESA FTA	Non-agricultural tariff	Agricultural goods tariff
Djibouti	Yes	No	Yes		
Eritrea	No	No	No		
Ethiopia	Observer	No	No		
Kenya	Yes	Yes	Yes	11.64	20.21
Somalia	No	No	No		
South Sudan	No	Yes	No		
Sudan	Observer	No	Yes	20.26	30.26
Uganda	Yes	Yes	Yes	11.50	20.27

Intra-IGAD trade is constrained by the following Non-Tariff Barrier to trade:

- **Inadequate information about trade requirements and import/export opportunities** in the region. While other RECs such as COMESA have adopted Simplified Trade Regimes (STR) that offer information on trade requirements for small scale and informal traders, Intra-IGAD trade is hampered by lack of information on trade requirements or Simplified Trade Regimes that would facilitate more trade interactions between the member states.
- **Intricate and inconsistent non-tariff requirements at points of entry or exit** and border crossing points. This is further aggravated by multiple documentation requirements by different administrative agencies and structures in the member states resulting from lack of harmonisation of import/exports documentation procedures which emphasizes the need for port efficiencies and infrastructures to improve operations of ports and points of entry in handling imports and exports.
- **Inefficiencies in transport, customs and logistics raise trade costs**. The time duration to clear cargo from the port and through borders is one of the major sources of delays to the movement of freight/trade in the region. The delays derive from the need to comply with the formalities associated with the movement of trade, logistics and transport traffic. They include; examination, inspection, approval of documents, customs shipment process as well as handling cargo at the terminals. Cargo clearance at the port of Mombasa had been plagued by inefficiencies in cargo clearances that Dwell Time[9] at the port would take up to 5 days to clear cargo at the port and approximately 7 days for cargo to reach Kampala and 12 days to reach Juba in South Sudan[10]. In addition, regulatory measures by the member states such as varying procedures for issuance of certification marks, inspection and testing hampers the flow of goods and services as many institutions are involved in approving imports and exports, with varied certification and testing procedures and inspection of certificates of conformity to international standards. For intra IGAD trade to flourish and bring about integration in the region, it is critical that trade be able to move unhindered. Kenya and Uganda have adopted the Regional Electronic Cargo Tracking (RECT) to facilitate efficient movement of freight from the port to Kampala.

[9] Dwell Time is the measure of time that elapses from the time cargo arrives at the Port to the time it leaves the Port premises.
[10] According to Transport Observatory Report 2016

- **Road toll charges** have a huge impact on trade in the region in that it makes imports and exports expensive particularly for landlocked countries members of IGAD whose trade has to pass through countries to ports. According to TMEA, Kenya charges Ugandan truckers $1200[11] from the Mombasa Port to Malaba and the charge is even higher for trucks transporting cargo to South Sudan who have to part with a fee both on the Kenyan and Ugandan sides. The toll charges coupled with corruption generally makes the cost of trade in the region high and member states must devise ways of reducing the cost of trade by passing in through non IGAD states. Besides the road toll charges, the presence of several weighbridges with varying axle loads specifications from the port/point of entry to the final destination of the imports/exports prolongs the period of transporting imports/exports to their intended destinations.
- **Adoption of restrictive economic policies and practices by some IGAD member states** is detrimental to intra-IGAD trade. The economics of some IGAD member states is not very 'open'; they have adopted a policy of promoting economic development through supporting domestic industries and financial institutions. As such, their economies are often closed to foreign companies and foreign competition, which can have the beneficial effect of improving services in the said countries and contributing to the growth of the economy. For example, Ethiopia's economy has been in the past relatively inward looking as exemplified by the fact that country only supported domestic financial institutions; the new regime in the country, may, however, increase the openness of the economy.
- **The cost of cross-border payments and money transfers** is another important element of the total cost of trading across borders in the IGAD region. Where financial instruments and institutions are unavailable, traders incur the often-high costs of exchanging currencies at the border; furthermore, carrying cash exposes traders to the risk of theft and predatory behaviour by customs and border officials.
- **The impact of informal markets** in some of the IGAD member states tend to destabilise trade in the region. For example, the devaluation of the Sudanese currency against the dollar created economic instability where it became expensive to purchase goods in local currency. This in turn created a huge demand for dollars against the local currency which was met though the black market. In Ethiopia, the demand for forex is high and is related to the need to finance key national projects such as the Grand Renaissance Dam. Considering most of the trade in the region is informal cross border trade, the demand for dollars by the countries (e.g. Sudan and Ethiopia) creates a situation where informal trade becomes very difficult based on the local currencies as dollars are difficult to obtain.
- **Enroute Road Inspections** often hold up cargo transportation and hampers trade in that time lost in inspecting the trucks and going through the various certification required tends to consume the time taken for imports/exports to reach their intended destinations. This coupled with corrupt tendencies raises the cost of doing business in the region.
- **Political instability** is a key non-tariff barrier to trade in the IGAD region. Some of the member states have witnessed and continue to witness armed conflicts, and political disturbance in other member states have often impacted negatively on the economies of neighbouring member and non-member IGAD countries. For example, the 2007 post-election chaos in Kenya disrupted the flow and movement of imports mainly petroleum products and exports to and from neighbouring Uganda, Rwanda, DRC and South Sudan. Ethiopia which relied on the Port of Massawa and Assab Port in Eritrea, was forced to shift focus to Port of Djibouti after the conflict. Political instability

[11] Kenyan Surface Transport Rates Per Route, Logistics Cluster Kenya

and chaos have necessitated landlocked countries in the IGAD region to explore alternative routes to access ports through neighbouring countries thereby minimising and hampering trade in the region.

- **Poor business environment**: IGAD member states are at varying levels in terms of nurturing a conducive enabling environment in order to promote trade globally and within the region. According to the World Bank report on the Ease of Doing Business, the Distance To Frontier (DTF) ranking of the IGAD member states is generally high which goes some way to explaining the low level of intra-IGAD trade (see Table 2.4). Kenya, which scores 106 out of some 190 nations) is leading in IGAD in terms of its DTF score for trading across borders. This was achieved by reducing the time for import documentary compliance and implementing its single window system, which allows for electronic submission of customs entries. Uganda' score is close to that of Kenya in terms of doing business across borders by complementing Kenya's reduction on the time for export documentary and border compliance by allowing for electronic document submission and processing of certificates of origin and by further developing the Malaba One-Stop Border Post. This may partly explain why Kenya and Uganda trade more compared to other IGAD country pairs. Eritrea and Sudan on the other hand provide two cases of the worse across border trading scores in the World.

A look at the costs incurred in facilitating exports and imports shows evidence that the region does not have a harmonised standard policy for costs on documentary and border compliance for both imports and exports. Each country is guided by its own trade policy which determines the cost of compliance for movement of trade. For example, while it would cost Ethiopian traders $172 for border compliance on exports, the same cannot be said for Djibouti traders who must pay $944. These costs are then transferred to consumers of the destined export country making the trade expensive. These statistics compared to the costs in countries in the European Union or the ASEAN shows a glaring disparity in terms of regional policies that promote trade between countries which is also complimented by efficient infrastructure.

From Table 2-4, it can be concluded that non-tariff barriers to trade have impacted significantly on the ability of the IGAD member states to conduct trade in the region and this is highly aggravated by infrastructure deficits in the individual member states that is necessary to facilitate smooth flow of trade in the region

Table 0-4: Ease of doing business in IGAD member states

									Comparators				
	Djibouti	Ethiopia	Eritrea	Kenya	Sudan	South Sudan	Somalia	Uganda	Hong Kong	Malaysia	Vietnam	China	Singapore
Trading Across Borders[12]	159	167	189	106	185	178	160	127	31	61	94	97	42
DTF[13] score for trading across borders (0-100)	52	45.34	No Practice	68	19	26	52	62	94	83	71	70	90
Time to Export													
Documentary Compliance (hours)	72	76	No Practice	19	190	192	73	51	1	10	50	21.2	2
Border Compliance (hours)	109	51	No Practice	21	162	146	44	64	2	45	55	25.9	10
Cost to Export													
Documentary Compliance (US$)	95	175	No Practice	191	428	194	350	102	57	45	139	85	37
Border Compliance (US$)	944	172	No Practice	143	950	763	495	209	0	321	290	484	335
Time to Import													
Documentary Compliance (hours)	50	194	No Practice	60	132	360	76	138	1	10	76	65.7	3
Border Compliance (hours)	78	166	No Practice	180	144	179	85	154	19	69	56	92	33
Cost to Import													
Documentary Compliance (US$)	100	750	No Practice	115	420	350	300	296	57	60	183	171	40
Border Compliance (US$)	120	738	No Practice	833	1,093	781	952	412	266	321	373	745	220

[12] Trading Across Borders measures the time and cost to export a product of comparative advantage and import auto parts (out of 190 nations)

[13] Distance To Frontier refers to the distance of each economy to the "frontier," which represents the best performance observed on each of the indicators across world economies.

Section 2.4 The Importance of Trans-Border Development Corridors

Transport and economic corridors as instruments of development

The IGAD Regional Infrastructure Master Plan (IRIMP) study maps out the provision of trans-border infrastructure and the implementation of related policy and regulatory initiatives from 2020 to 2050 which will facilitate and strengthen intra-IGAD trade, promote regional integration and support the development and structural transformation of the economies of IGAD member states. The principle guiding the selection of trans-border infrastructures is the degree to which a trans-border infrastructure promotes the development of transportation and, most importantly, key economic corridors that traverse the IGAD region.

The implementation of the IRIMP is to result in the development and strengthening of key economic corridors connecting IGAD member states. It is the concept of the 'economic corridor' that binds the various elements of the masterplan together.

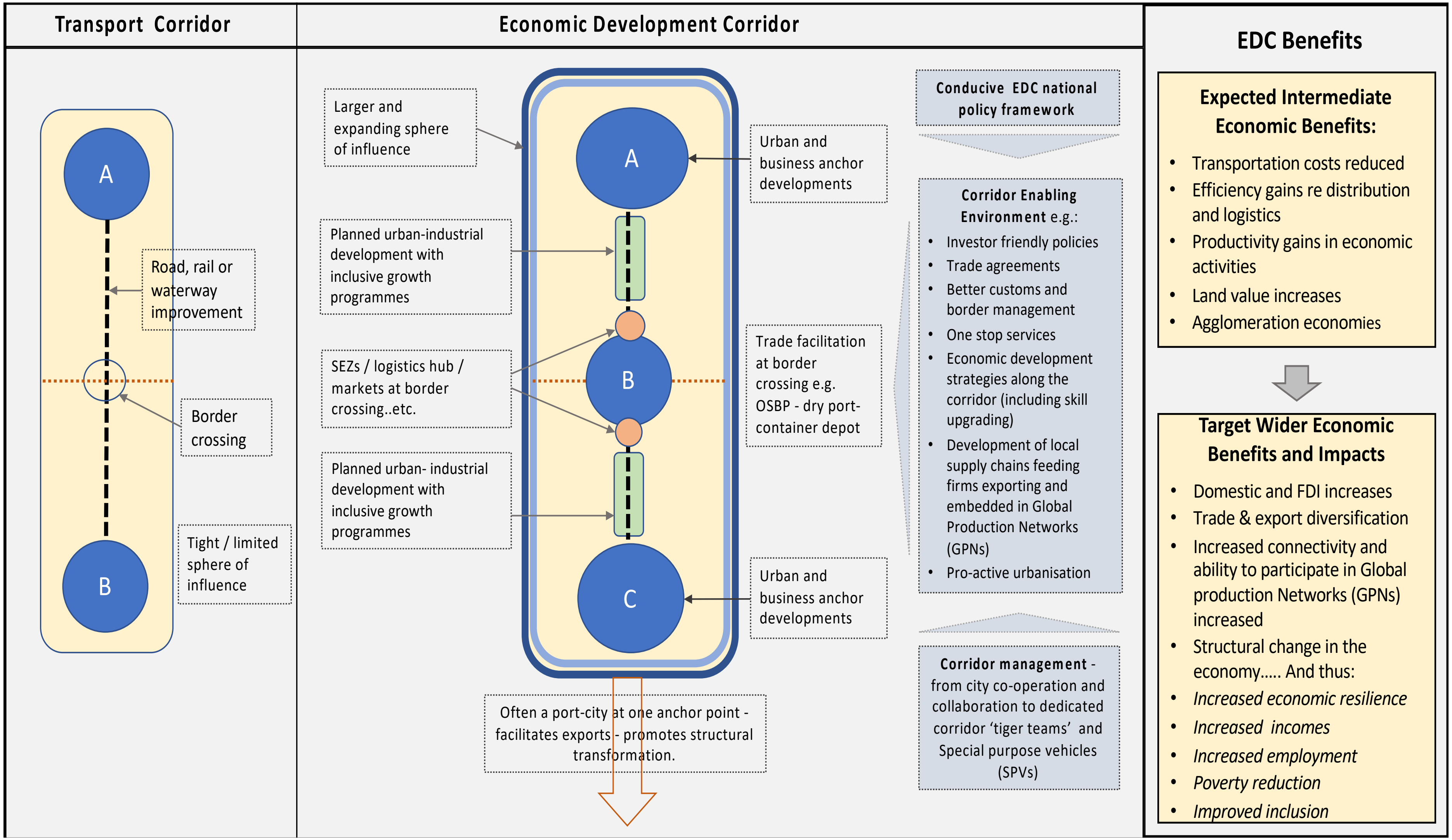
The economic corridor framework (often referred to as an economic development corridor, EDC, framework) is widely used by international development organisations and national governments to marshal and direct resources to promote economic growth and structural transformation. An EDC most commonly contains a transportation corridor (generally a road, railway or waterway) but is much more than a linear area connecting two countries, regions or cities through which goods and people pass. An EDC is an instrument of development that is used to ensure that the transportation hard infrastructure generates important economic and social development impacts (often called 'wider economic benefits', WEBs); see Figure 2-13.

Policies, programmes and projects to facilitate trade, improve the business environment, and encourage urban-economic investment turn a transport corridor into an EDC. A transport corridor is the first step towards an EDC. It is the backbone of an EDC; it defines the geographical space of the corridor and facilitates the flow of goods services and people. On its own, however, a transport corridor rarely leads to wide-spread development and the structural transformation of an economy.

The right enabling environment is critical for a transport corridor to become an EDC. Indeed, as demonstrated by experience (and the benchmark country case studies presented in this section), the success of an EDC critically depends on supportive institutional arrangements, and policy and regulatory frameworks that directly stimulate investment, facilitate trade and encourage inclusive economic growth – and thus allow the transport corridor to become a fully-fledged EDC.

Transforming a transport corridor into an EDC is often not, however, a straightforward task. As also demonstrated through experience (and the benchmark country studies presented in this section) it demands considerable political commitment and stakeholder involvement from all levels of government and can often require the establishment of a special purpose vehicle (SPV) to co-ordinate, direct and manage the infrastructure and policy-type initiatives required for the success of an EDC.

Figure 0-13: Transport and Economic Development Corridors



The status of transport and economic corridors within IGAD

Currently there are eight major transport corridors in the IGAD region, each one potentially an economic development corridor (see Figure 2-14)

- Northern Corridor (Mombassa-Nairobi-Kamala-Juba)
- LAPSSET Corridor (Lamu-Isiolo-Juba-Addis)
- Kismayo Corridor
- Mogadishu Corridor
- Berbera Corridor
- Djibouti Corridor
- Massawa Corrdior
- Port Sudan Corridor

A number of these corridors are important for the region wider than IGAD. For example, the Northern Corridor has the port of Mombasa in Kenya serving as the lifeline for Uganda, Eastern DRC and also Rwanda and Burundi. Other major corridors may stimulate growth throughout the heart of IGAD; the Lamu Port-South Sudan-Ethiopia Transport Corridor (LAPSSET) will provide South Sudan and Ethiopia with additional access to the Indian Ocean. This ambitious corridor will include a port as well as rail and road transportation hubs linking Lamu to the interior. In addition, a critical aspect of the Lamu Corridor is the proposed South Sudan-Lamu pipeline which is expected to provide an alternative crude oil transportation network.

The eight IAGD corridor were assessed against four recognised stages of corridor development (See Table 2-5).

- **Stage 1: Basic Transport Corridor**: characterised by infrastructure (e.g. a road, rail or waterway) physically linking two points of economic importance across a national border.
- **Stage 2: Multi-Modal Transport Corridor**: characterised by the integration of modes of transport (e.g. combined road and rail) and the limited provision of logistics facilities such as dry-ports or warehousing along the route designed to facilitate the movement of traded goods
- **Stage 3: Functional Logistics Corridor**: characterised by a clearly defined institutional arrangement, such as a committee of the elected representatives of cities along the corridor or a SPV, and which oversees and/or implements the corridor's regulations and cross-border trade agreements; and plans for the establishment and operation of related services, such as storage, warehousing, trucking, insurance, and freight management.
- **Stage 4: Economic Development Corridor**: characterised by multi-modal transportation infrastructure, the attraction of domestic investment and FDI, and the generation of economic activity and benefits in surrounding regions through a clearly defined spatial development initiative (SDI) focused on pro-active urbanisation and economic growth.

As can be seen from Table 2-5, all corridors in the IGAD region are at stage one or two; none are fully fledged economic development corridors; none are, at present, clear drivers of economic development and structural transformation (though the Northern Corridor has taken steps to becoming an EDC). It is one of the key objectives of the IRIMP to recommend how these corridors can become EDCs and provide important drivers of growth, regional integration, and prosperity in the IGAD region

Table 0-5: Corridor Assessment and Benchmarking Indicators

Progress	Infrastructure	Investment	Harmonisation
Stage 1	**Basic transport corridor -** Single trans-boundary infrastructure (e.g. road, rail, or waterway) linking two economic points	**Corridor attracts limited local investment** in the form of shops, cafes etc.	▪ **No harmonisation** of regulations or policies between the constituent countries. ▪ Little recognition of the corridor as an instrument for economic development
Stage 2	**Multi-modal transport corridor –** Such as a road-rail combination connecting two areas or regions.	**Corridor begins to attract new investment** as a result of improved transport linkages in the form of manufacturing facilities, hotels etc.	▪ **Limited harmonisation.** Creation of cross-border trade agreements between constituent countries. ▪ Recognition of the importance of the corridor for trade and economic development
Stage 3	**Logistics corridor-** Multiple-modal tans-border infrastructure and basic logistics functions (e.g. warehousing; cold storage; trucking facilities)	**International investment (FDI) attracted** in manufacturing, tourism, tradable services etc., either clustered in specific locations or spread along the corridor	▪ **Active harmonisation** of regulations covering the movement of goods, services and people as well as investment and tax, regulations specific to key corridor sectors etc. ▪ **Establishment of institutional framework** to manage the corridor and active promotion of investment / mention of the corridor as a magnet for investment (e.g. mayor's committee / SPV/ 'corridor tiger teams')
Stage 4	**Economic Development Corridor - **Provision of full range complementary infrastructure and facilities organised through a SDI including e.g. one-stop border posts, warehousing, industrial zones and pro-active urbanisation	**Further DI and FDI attracted. Forward and backward linkages established; local value chains developed.** from the new investment sectors with spill-overs into the wider economy. Complementary services and linked sectors develop	▪ **Removal of all barriers** to the flow of goods, services and people ▪ **Full harmonisation of regulations, policies**, tax etc. ▪ **Free trade area** established covering the corridor

Figure 0-14: The aspiration of the Northern Corridor

Source http://www.ttcanc.org/page.php?id=12 (accessed January 2019)

Figure 0-15 : Major Transport and Economic Development Corridors in the IGAD region

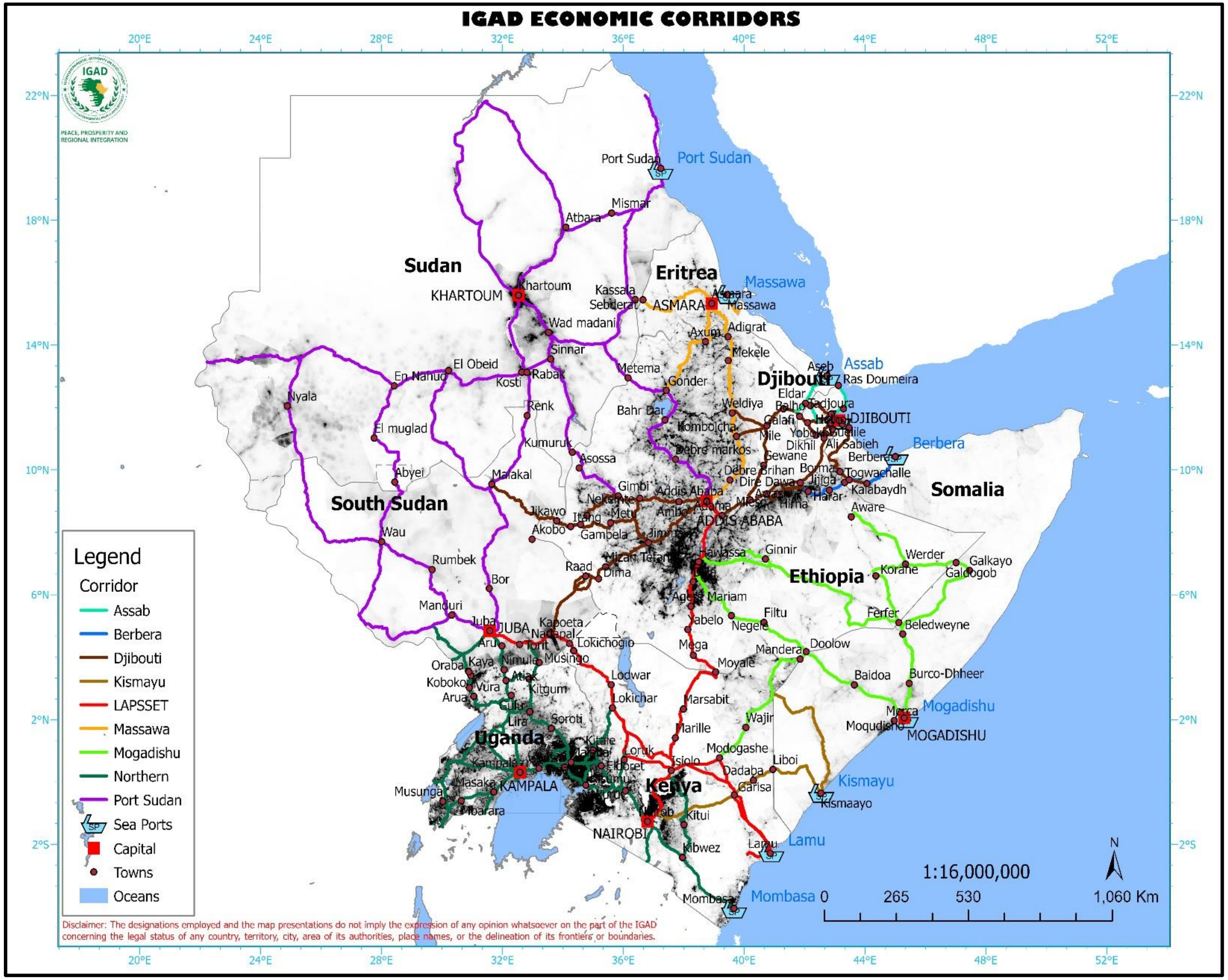


Table 0-6: Economic Corridors in the IGAD Region

Corridor and countries served	Status	Stage of Development: Infrastructure	Stage of Development: Investment	Stage of Development: Harmonisation	Overall Assessment	Key gaps that need to be addressed
Djibouti Corridor **ETHIOPIA** **DJIBOUTI** **SOUTH SUDAN**	PIDA Phase 1, railway completed, road upgrading ongoing	**Stage 2** • Railway: Addis Djibouti Railway complete • **Port**: o Expansion of the Modjo Dry Port in Ethiopia complete o Expansion of Port of Djibouti ongoing o Doraleh port expansion complete • **Roads**: Upgrading of the major highways such as Dire Dawa to Dewele, Meiso – Dire Dawa on the Ethiopian side complete.	**Stage 2 to 3** • Corridor has attracted development of dry ports e.g. Semera and Modjo • Ethiopia has created the Dry Port Services Enterprise for the development of strategically placed dry ports. • Elevating Galifi and Dewele-Guelle Border posts into OSBP	**Stage 2** 2002 Agreement between Djibouti and Ethiopia allows permanent access to the sea for Ethiopian Customs to conduct inspections at the port and for goods to move inland without escort or transit fee.	**Stage 2**	• Sections of the road in Djibouti and Ethiopia are not paved • Sections of road network in Djibouti (Dikhil –Garafi Section) require rehabilitation • Djibouti – Ethiopia Corridor has no formal institution framework to deal with the transit and transport issues; currently dealt with through ad hoc bilateral committees • Setting up of Corridor Management Group or committees needed to o Facilitate removal of non-physical barriers in customs clearance procedures in Djibouti port o Advocate infrastructure improvement (Railway sector) o Monitoring corridors` performance o Setting up stakeholders' networks and forums • Ethiopia to automate its procedures for a more seamless clearance procedure[14]
Addis Ababa – Juba – Kampala	IGAD currently completing missing links and	**Stage: 1** **Road:** Following sections of the road upgrading/rehabilitation yet to be complete	**Stage 1** Corridor has promoted the previously existing local investments	**Stage 2** • Uganda and South Sudan using EAC harmonisation regime for the development of the	**Stage 1**	• No study undertaken to develop an SDI between Juba and Addis Ababa • Following missing links along the corridor require construction. They are:

[14] PMAESA, Study for the Establishment of a Permanent Regional Corridor Development Working Group in Pmaesa Region

Corridor and countries served	Status	Stage of Development: Infrastructure	Stage of Development: Investment	Stage of Development: Harmonisation	Overall Assessment	Key gaps that need to be addressed
	constructing OSBPs Part of the Road between Kampala and Juba designated as Norther Corridor routes	○ Kampala and Juba (Gulu – Atiak – Nimule - Juba) ○ Juba – Addis Ababa (Juba-Kapoeta-Raad-Dima-Addis Ababa) **Railway:** Railway complete from Djibouti to Addis Ababa. Old gauge railway between Gulu and Kampala through Tororo **OSBP:** Works to upgrade the border posts along the route to OSBP, with only Nimule OSBP complete.	along the route between Kampala and Juba.	Kampala Juba section of the corridor • Ethiopia and Djibouti have elaborate road transport bilateral agreements • Study undertaken to develop an SDI between Kampala and Juba		○ Dima to Raad, ○ Raad to Kapoeta, ○ Kapoeta to Juba, ○ Asosa to Kurmuk
Berbera Corridor **ETHIOPIA** **SOMALIA**	Addis Ababa – Berbera is part of the Berbera Corridor providing an alternative route for exports and imports to Ethiopia	**Stage 1** Roads: Roads on the Ethiopian section complete up toTogochale. Berbera/Hargeisa road being rehabilitated while Hargeisa Togochaale link is being upgraded Railways: Railway not developed as it reaches Dire Dawa. There is no	**Stage 1** No Spatial Development Initiative to guide investments on anchor projects along the corridor	**Stage 2** • The Berbera Corridor Development & Management Authority is to be created by end of 2018 by virtue an agreement that effectively extends the operations of the current Joint-Operating Committee (JOC) with a specific focus on the improvement of infrastructure and logistic services, trade facilitation	**Stage 1**	• The Berbera Corridor is yet to reach the level of a basic corridor in terms of functionalities. Priority interventions are necessary on the Somaliland side and coordination between the countries (Ethiopia and Somalia) • Construction of Hargeisa by-pass • Setting up of private sector associations, implement capacity building for monitoring and reporting of NTBs[15]. • Missing links in Jijiga

[15] TMEA, Berbera Corridor Diagnostic and Intervention Plan – Investor Presentation, December 2017

Corridor and countries served	Status	Stage of Development			Overall Assessment	Key gaps that need to be addressed
		Infrastructure	Investment	Harmonisation		
		existing railway line in Somalia		and stimulating economic development along the corridor.		• Professionalisation of Somaliland Customs Department, involving primarily capacity building[16].
Mogadishu Corridor **ETHIOPIA** **SOMALIA** Kenya	Road part of the Mogadishu Corridor	**Stage 1** Corridor has segments done on the Ethiopian section, to be complete on the Somali section	**Stage 1** No Spatial Development Initiative to guide investments on anchor projects along the corridor	**Stage 1** No Harmonisation done	**Stage 1**	• Total road construction on the Somali section • Rehabilitation and upgrading of the road sections on the Ethiopia side to be complete • SDI to be developed
Mogadishu – Nairobi (via Afgove – Kismayo – Liboi)	This is a proposed corridor. Road not paved on the Mogadishu side	**Stage 1** Port: Mogadishu port under rehabilitation by Turkey Roads: No good road on the Somalia side	**Stage 1** No investment as yet	**Stage 1** • No harmonisation of regulations or policies between the constituent countries. No recognition of the corridor as an instrument for economic development	**Stage 1**	• Harmonisation of regulations • Investments on the road construction on the Somalia section • Setting up of Nairobi Mogadishu SDI
Kismayu Corridor SOMALIA KENYA	This is a proposed corridor. Road not paved on the Somalia side	**Stage 1** Port: Kismayu Port under rehabilitation by Turkey Roads: No roads on the Somalia side and upgrading of Garissa/Liboi road in Kenya	**Stage 1** No investments as yet	**Stage 1** • No harmonisation of regulations or policies between the constituent countries. • No recognition of the corridor as an instrument for economic development	**Stage 1**	• Harmonisation of regulations • Investments on the road construction on the entire Somalia links and the Garissa/Liboi section in Kenya • Setting up of Nairobi/Kismayu SDI

[16] TMEA, Berbera Corridor Diagnostic and Intervention Plan – Investor Presentation, December 2017

Corridor and countries served	Status	Stage of Development: Infrastructure	Stage of Development: Investment	Stage of Development: Harmonisation	Overall Assessment	Key gaps that need to be addressed
Port Sudan Corridor **ETHIOPIA** **SUDAN**	Part of Trans-African Highway Number 4 (Cairo-Gaborone-Cape Town)	**Stage 1** **OSBP:** Engineering designs complete for the Metema Galabat border point **Railway:** Available ends at Al Gadarif	**Stage 1** No Spatial Development Initiative to guide investments on anchor projects along the corridor	**Stage 2** • Sudan and Ethiopia have a trade agreement which allows for facilitation of preferential tariff rates • Simplified Trade Regime (STR) is in place on all border points between Ethiopia and Sudan	**Stage 1**	Railway to be rehabilitated from meter gauge to SGR from Gadarif to Port Sudan
Northern Corridor **KENYA** **UGANDA** **RWANDA** **BURUNDI** **SOUTH SUDAN**	PIDA Phase 1 and Trans-African Highway Number 8 (Lagos-Mombasa)	**Stage 2** Railways: Mombasa Nairobi SGR 100%. Nairobi Naivasha section under construction OSBP: Busia and Malaba OSBPs complete and operational Roads: Road from Juba to Mombasa port complete. Capacity expansion between Jinja and Kampala in Ugandan planned	**Stage 2** The Northern Corridor Transit and Transport Coordination Authority aims to turn Northern Corridor into an *Economic Development Corridor* (EDC), through Spatial Development Initiative (SDI).	**Stage 2** • Adoption of uniform Regional Electronic Cargo Tracking System (RECTS) by Kenya, Uganda and Rwanda to expediate the movement of cargo • NCTTCA already established as a corridor institution to oversee the development of infrastructure and transport facilitation along the corridor	**Stage 2** as the corridor is based on the existing infrastructure network has a corridor management institution which has already initiated an SDI programming	• Technical Assistance to align legal and regulatory processes to facilitate the implementation of PPP projects in the transport sector in the NCTTCA member countries • Setting standards for infrastructure development
LAPSSET Corridor **KENYA** **ETHIOPIA**	LAPSSET Corridor Development Authority (LCDA) formed and construction started	**Stage 1** Roads: Isiolo – Marsabit – Moyale Road construction 100% complete Airports: Construction of Isiolo Airport complete.	**Stage 1** • A Special Economic Zone designated within the Lamu Port City with a master plan guiding development	**Stage 2** • Kenya and Ethiopia have developed a regional coordination framework for the delivery of the SGR • Formation of a steering committee or the	**Stage 1**	• Completion of the Lamu Port berths • Synchronisation of the Lamu Special Economic Zone planned investment with the Lamu Port City Plan and Lamu County Spatial Plan • Isiolo Garissa Lamu highway to be constructed

Corridor and countries served	Status	Stage of Development – Infrastructure	Stage of Development – Investment	Stage of Development – Harmonisation	Overall Assessment	Key gaps that need to be addressed
SOUTH SUDAN		Ports: Berth 1 of the port to be complete by end of 2018 Port: Construction of the 3 berths ongoing **OSBP**: Moyale OSBP complete and commissioned	• Private Sector interests have been registered by DBSA Consortium for operations of the 1st three berths and construction of the next batch of berths i • Provision of infrastructural services in the resort city regions of Lamu, Isiolo and Turkana	coordination LAPSSET activities amongst the 3 partner states i.e. Kenya, Ethiopia and South Sudan		• Upgrading of the Manda Airport to an International Airport yet to be complete • Isiolo-Lokichar-Lokichogio-Nadapal section yet to be constructed • Railway line from Isiolo to Lamu, Isiolo to Moyale, Isiolo to Nadapal yet to be constructed
Massawa Corridor **ETHIOPIA** **ERITREA**	Corridor not being used at the moment by both countries	**Stage 1** Road in dire need of rehabilitation Feasibility studies to be undertaken for the railway line between Ethiopia and Port of Massawa[17] Massawa Port has 6 operating berths of which 2 are container terminal berths	**Stage 1** No investments dedicated towards the development of the corridor Italian firm to finance the construction of the railway line linking Ethiopia to Port of Massawa	**Stage 1** Currently no harmonisation of policies by both countries towards development and utilisation of the corridor	**Stage 1**	• The corridor infrastructure is in dire need of revival through rehabilitation, upgrading and construction of new infrastructures. • A corridor development authority is to be established to manage the development of the corridor.

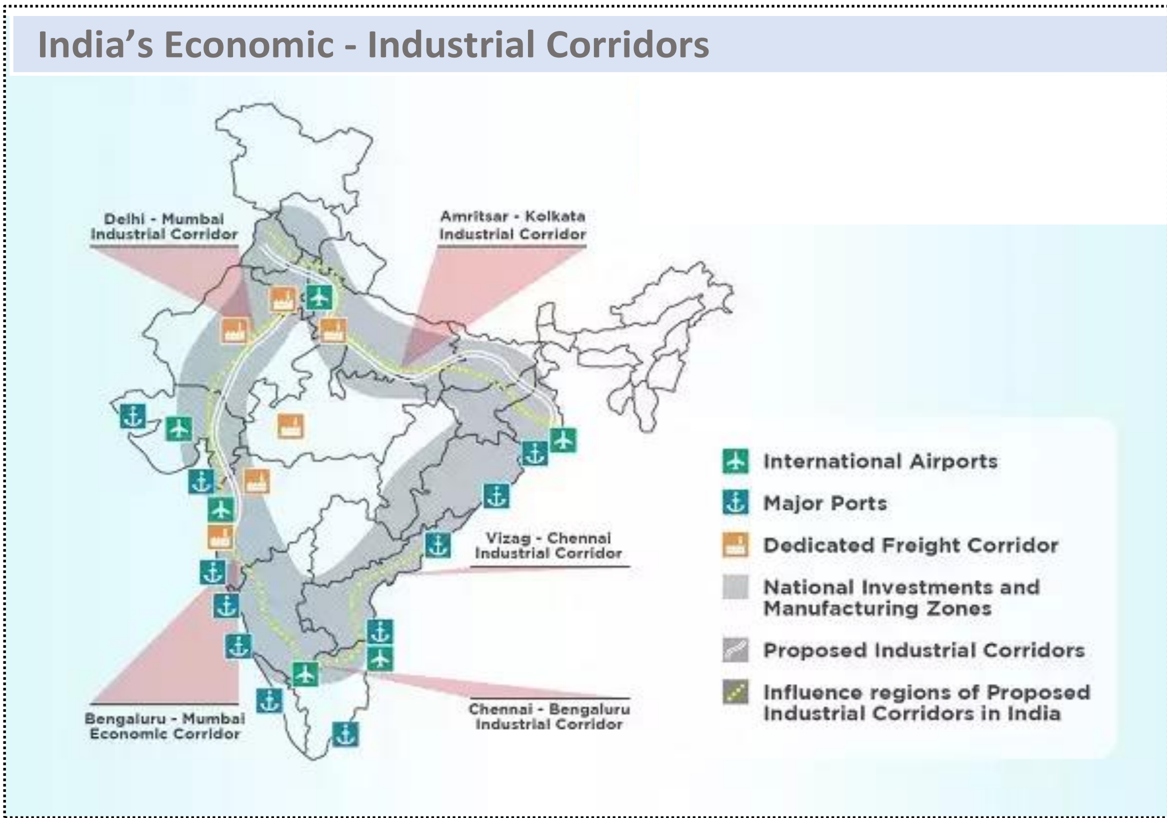
[17] https://constructionreviewonline.com/2019/01/italy-to-finance-ethiopia-eritrea-railway-line-project/ (accessed on 1st March 2019)

Development Corridors in Benchmark Countries

Economic corridors in four benchmark countries were examined. The difficulties encountered, and the critical success factors are highlighted as learnings for the way the IRIMP can propose that IGAD corridors are developed.

- **The Indian Economic Industrial Corridors** - The Indian experience is relevant to IRIMP because Indian states are like quasi-nations with their own jurisdictions and elected legislatures. They are some seven major economic corridors in India (see Figure 2-16). They have evolved from the accelerated national highways development programme and the accelerated freight rail development programme.

Figure 0-16: India's Economic Industrial Corridors



In 2001, special national highway development programmes (NHDPs) were rolled out for connecting many of the major industrial, agricultural and cultural centres of India and port cities. Over the last decade these programmes has become among the largest highway development programmes in the world and were the fore-runner of modern economic corridor planning in India. The first flagship programmes under NHDP, popularly known as the Golden Quadrilateral and the North-South East and East-West Corridors, involved national highway running from the capital city to key centres and edges of India. The programme was implemented through a specially created National Highway Authority of India (NHAI) that had jurisdiction on a pan India basis. NHAI initially faced several difficulties such as delay in land acquisition, difficulties shifting of utilities, problems with forest clearances, slow approval for bridges as well as shortage of skilled and semiskilled manpower to implement projects. These were addressed over time as NHAI moved up the learning curve (e.g.: Special Land Acquisition units were set up to expedite land acquisition; and regional offices headed by senior level officials were delegated powers to expedite forest clearances and monitor land acquisition, as well as the implementation of projects). In addition to managing the above the key learnings of the NHAI experience include the following:

large scale planning and procurement for infrastructure development takes time; as does

engaging with contractors and engineering firms- both national and international,

developing long term PPP and EPC contracting frameworks is necessary and

significant attention must be paid to raising funds from capital markets, designing of complex project structuring arrangements, and dealing with vendor disputes including contract re-negotiations, scope changes etc.

Following the accelerated national highways development programme was the accelerated freight rail development programme. The long-term strategic plan of the Ministry of Railways was prepared in 2006 and committed to construct six high capacity, high-speed corridors along the Golden Quadrilateral and its diagonals. The first phase envisaged two Freight corridors, namely the Western and Eastern Dedicated Freight Corridors. The former is described in this sub-section. The Western Dedicated freight corridor (WDFC) covered 1500 km from the outskirts of Delhi to Mumbai and traverses six states (and in close proximity with the Delhi-Mumbai National Highway road already widened and strengthened under the Golden Quadrilateral NHDP Programme, completed in 2012). Implementation progress has been slow but has accelerated in recent years.

The Ministry of Railways established a wholly owned special purpose vehicle (SPV), the Dedicated Freight Corridor Corporation of India Limited (DFCCIL), with the avowed purpose to undertake planning and development, mobilisation of financial resources and construction, maintenance and operation of all Dedicated Freight Corridors including the first phase WDFC. The SPV was allowed to access the capital markets (debt finance may be supportable by sovereign guarantee, if required). DFCCIL proposed to implement the project through a combination of lumpsum (FIDIC) contracts and public-private participation (PPP); but so far this has been primarily through the former, with various packages being tendered out to various Indo-Japanese consortiums.

According to the independent government audit (2017), the delay in completing the project was mainly due to lack of effective planning and implementation due to procedural wrangles, land and acquisition and clearances problems Delays in land acquisition, in particular, increased the cost of the project. More specifically, a key learning is that planning is dynamic. For example, there is a greater need for further multimodal connectivity from the main Dedicated Freight Corridor's intersection points with warehousing and other facilities (this is easier in the Highway road planning and execution that automatically accelerated demand and support for commercial, industrial, and urban activities resulting in possible concerns of ribbon developments and the need for access-controlled expressways). Despite these problems DFCCIL is nearing completion; though new challenges have emerged, such as the need to develop feeder networks.

The economic-industrial corridors of India evolved out of the highway and freight development. The classical example is the Delhi Mumbai Industrial Corridor (DMIC), planned as India's first mega corridor project with an initial estimated investment of USD $100 billion and spanning across seven states (Uttar Pradesh, Delhi, Haryana, Rajasthan, Gujarat and Maharashtra and Madhya Pradesh). DMIC was conceived in 2008 to be developed as a Model Industrial Corridor of the best in international standards with emphasis on expanding the manufacturing and services base—the project aims to develop the corridor as a "*global manufacturing and trading investment hub and destination" and create smart, sustainable industrial cities"*.

The project is expected to cover 24 designated industrial regions anchored with 24 smart cities and envisaged to include two international airports, five power projects, two mass rapid transit systems, and two mega logistical hubs. Policy makers envisaged that DMIC would be the platform to bring in higher quality and technologically advanced infrastructure management practices including green and circular economy principles that would have spin off and replication impact in the rest of the country. DMIC was planned to increase the share of manufacturing in GDP to 25% from base levels of 16%, greatly enhance FDI including through leveraging DFC and other support infrastructure to reduce the cost of logistics for industry from an estimated 14-16% down to 10%; 3 million new manufacturing jobs have been projected from the project, and over 30 million additional jobs are envisaged to be indirectly supported when the project becomes fully operationalised.

Progress has been slow but has recently shown improvement. The project is being planned and implemented through a specifically created central level SPV (DMIC Development Corporation Ltd. or DMICDC) which has established joint ventures with SPVs at the state level across the seven states. The Central level SPV is focussed on master planning, trunk infrastructure planning and procurements and funding.

The Sates offer land, while the Centre releases funds matching the land's worth for its development. Once land is developed, it is to be allotted to investors and from the funds secured from such sales, DMICDC acquires further land holdings and initiates further development. The DMIC management concept was designed in 2008 but it took until 2011 to secure cabinet clearance and was supposed to be completed in three phases over a nine-year period.

The first two years saw rapid progress with international consultants appointed to prepare masterplans for each state, after which the pace of developments, including translating the plans into project development, slowed down. Presently, completion is envisaged to be undertaken by 2037-40, with the four of the first phase investment nodes to be ready by 2020-22 (out of the total of 24 investment regions planned for DMIC as a whole and eight investment destinations planned under phase 1).

There have been several reasons for the slow progress including; (i) delays in land acquisition. Unlike NHAI or DWFC, DMIC does not directly acquire land. Furthermore, some states did not have the resources to acquire land for the project and in some states, acquisition efforts led to protracted litigation. Managing a project of this scale and magnitude has been a new learning experience for the DMIC administration; (ii) different States exhibited different levels of commitment, and capabilities and capacities to participate and deliver the project. Further, each State has a different legal framework relating to land acquisition, spatial development guidelines, and regional development; (iii) political dilution of support because some states have felt excluded from the corridor initiative. As such the Government of India has begun to promote corridor initiatives outside the seven states covered by DMIC; (iv) delays in completion of the DFC has adversely affected the attractiveness of DMIC; to date manufacturing investment has not been as extensive as hoped. Furthermore, intended incentives for attracting investment could not be taken forward as policy makers realised that they are non-WTO compliant.

To date Rs 15000 crore has been spent, four investment nodes have shown accelerated development, and investors have started showing interest in manufacturing as well as infrastructure development projects in these locations. On their part, policy makers are realising that infrastructure development needs to be complemented by serious marketing effort to attract anchor private sector investment and the strengthening of manufacturing clusters (linked with their domestic and international value chains). This requires the implementation of an appropriate and comprehensive business enabling environment. Further, the design of WTO compliant incentive package, competitive corporate tax regimen matching other major investment locations (e.g.: ASEAN) need to be undertaken.

Based on the learnings from NHAI and Railways/DFC, the Indian government is in the process of setting up a centralised authority - the National Corridor Development Authority (NCDA), with similar powers for directly acquiring land, undertaking coordination and control of infrastructure development across the states reducing their dependence on state level agencies. There are some concerns about the ability of the NCDA to operate effectively. The NHAI took about fifteen years to emerge as a powerhouse institution driving the largest ongoing programme of national highways development globally. The Government of India, however, expects that in due course the empowered NCDA will similarly drive the DMIC and various other national and regional economic-industrial corridors.

In summary, the DMIC appears to be on track to achieving target objectives -- but in a gradual manner. It has taken time to fully understand and address the several complex project implementation and funding difficulties, and coordination issues. Learning over the last 14 years include for example that developing logistics corridors and hubs is much than merely ensuring that trunk railways and highways are built.

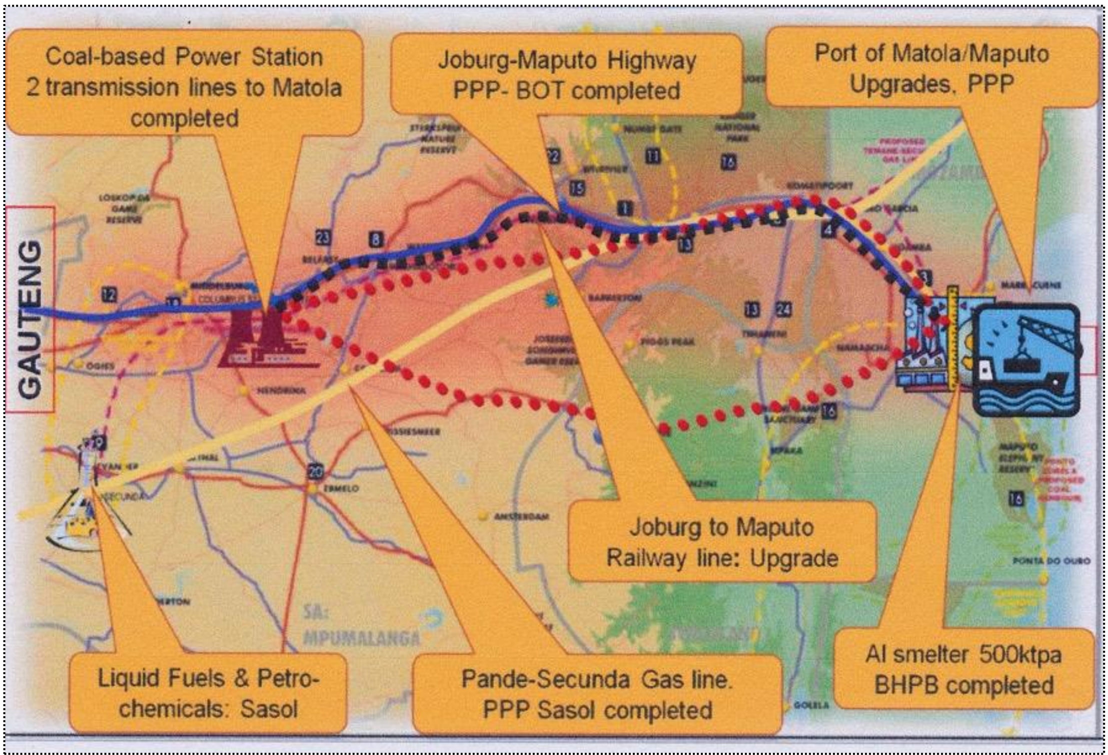
Establishing smooth last-mile link connectivity is a critical factor in this regard. Further the range of organisations to be involved in the development of the corridor are considerable and co-ordination issues complex (e.g. there are: State level departments of civil aviation and industry, State industrial infrastructure development corporations, the NHAI), and Central Government agencies responsible for railways, airports and housing and planning — all have logistics policies, conventions, and projects that need to be streamlined into a single (or at least mutually compatible and harmonious) integrated logistics policy and legal framework—in order to provide an integrated system/solution for transportation and logistics including warehousing and other physical infrastructure projects.

The Indian Government has, in the last few years, initiated steps to press States (through inter-state comparisons and rankings) to improve their position on the Ease of Doing Business index (World Bank based index), and more recently the Logistics Ease Across Different States (LEADS) Index, a framework established by the Government led by the Commerce Ministry. States are being vigorously encouraged to strive for improved performance improvement across the range of logistics activities supporting business.

An area needing further attention and improvement relates to structured public disclosure and discussions on planning and progress for both enhanced accountability and public support for the economic-industrial corridors. There has been little consultation with civil society groups and elected bodies on the development of the economic-industrial corridors. DMIC can be regarded as a 'passion' project of the government and has been shrouded in secrecy (for a government view of the corridor see the video: *www.youtube.com/watch?v=lriM1hlmS14&feature=youtu.be*). A report by the Japan Centre for a Sustainable Environment and Society (2016) stated that '*in none of the areas in the influence zone (*around the corridors), *have democratically elected local government institutions or elected representatives been consulted at any step of the project design, implementation or finalisation'.* For popular support of the corridor initiative to be secured and strengthened, and in order to develop mechanisms of 'inclusive growth' local citizen stakeholder participation is increasingly seen as important to achieve.

- **Maputo Development Corridor**: Arguably the most successful economic corridor in Africa, the corridor connects the Gauteng Province, and mines and agricultural districts to the east, with the deep-water ports of Maputo and Matola on the Mozambique coast. (see Figure 2-11) The corridor comprises roads - including the new N4 highway - and railways, ports, and border facilities at Komatipoort. The corridor originated in 1994 as part of the Spatial Development Initiatives in southern Africa, with more than $5 billion invested in infrastructure in the corridor to date. Critical to the success of the corridor has been the Maputo Corridor Logistics Initiative, a PPP that operates in both South Africa and Mozambique to manage the development of the corridor and provides a platform for all stakeholders to engage.

Figure 0-17: Maputo Development Corridor



Anchor projects have been important for the success of the corridor. Two have been particularly emblematic: the MOZAL Aluminum smelter, and the Pande / Temane gas fields and South Africa pipeline. In addition to the linkages with transport, there was a high degree of connection between the anchor projects (e.g., the MOZAL smelter inputs are alumina and coal, imported through the port, and electricity, imported from South Africa, the smelter being a major tenant of the Beluluane Park). The provision of electricity from South Africa is part of a larger agreement between the two countries on energy, where SASOL was granted the rights to exploit gas in Pande and Temane field (piped to South Africa where it was used for generating electricity) and high voltage lines were built between Duhva and Maputo.

The involvement of the private sector in the rehabilitation and management of the corridor from the very early stages was another important success factor. The goal was for the private sector to engage in targeted investments that would reduce transport costs and promote a model of trade-led regional growth. The role of the public partner was to realise the investments in soft infrastructure needed for the corridor to generate the volumes that would make the private concessions attractive. The public-private partnerships (PPP) established in the early 2000s for the Maputo Port and the Ressano Garcia Railway fell, however, short of delivering the intended results:

- First, in overly optimistic forecasts of demand for transport services in the corridor, and misinformation on the actual state of disrepair of the rail and port infrastructure when the contracts were signed, decreased the private sector's willingness to fulfil its contractual obligations'
- Secondly, the private parties to the contracts maintain that they were poorly designed, prioritizing immediate revenue flows to government in the form of fixed fees paid by the private concessioneers relative to the variable fees that would be contingent on the actual volumes handled; and
- Lastly, an inherent tension in the first wave of transport PPPs was created by a clear conflict of interests in the management of the concessions: the public authorities, in the form of CFM, was simultaneously the regulator, the concessionaire and the concessionee in the partnership.

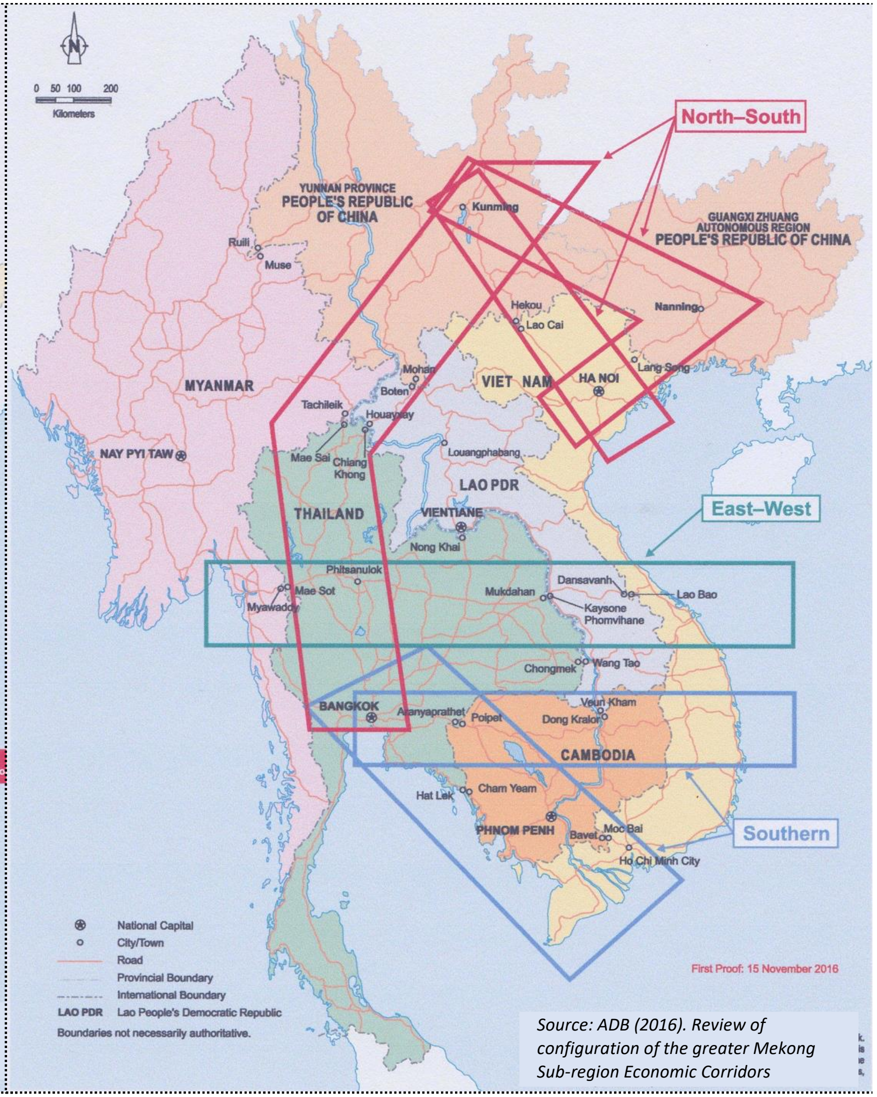
Ensuring the alignment of regional and national strategies over time is important, and getting the institutional arrangement 'right' was critical. One of the key lessons of the Maputo development corridor is the need to establish an efficient corridor institutional arrangement such as a corridor secretariat, or mayor's committee or SPV. Furthermore, the institutional arrangements must be capable of dealing with the diverse range of activities from urban planning to investment promotion and the co-ordination to improving corridor logistics. Such activities require different skill sets; all require political commitment from the public and private sector stakeholders and country governments involved. The corridor has experienced growth spurts and slow-downs and has had to cope with different demands on the abilities of the governing institutions. The corridor is still evolving, and it ability to deal with past challenges bodes well for the future.

Lastly, it is important to note that the governments of South Africa and Mozambique have taken deliberate efforts to connect communities along the corridor, and have sought to implement policies that support disadvantages groups. Estimates are that more than 15,000 direct jobs have been created in transport, logistics, agricultural and mining operations along the corridor.

- **Greater Mekong Sub-Region (GMS) Corridor(s):** The GMS Economic Cooperation Programme comprises a series of corridors linking Cambodia, China, Laos, Myanmar, Thailand and Vietnam: the North-South Economic Corridor (NSEC); East-West Economic Corridor (EWEC); and Southern Economic Corridor (SEC) See Figure 2-12 The corridor approach was adopted in GMS in 1998 and around $US15 billion has been invested, mostly in transport and connectivity infrastructure.

Figure 0-18: Greater Mekong Sub-region Economic Development Corridors

Source: ADB (2016). Review of configuration of the greater Mekong Sub-region Economic Corridors



Source: ADB (2016). Review of configuration of the greater Mekong Sub-region Economic Corridors

An economic development strategic framework and related SDI underpin the development of the GMS corridors. For each corridor, there a plan for investments aimed at strengthening urban development, upgrading logistics, improving the network of feeder and rural roads, and developing other transport modes. These investments are reflected in regional master-plans. Transport and trade facilitation (TTF) initiatives were seen as crucial to be success of the corridors. In addition, private sector investment through supply chain developments and in the special economic zones or industrial parks that have been established at the borders or along the corridors were encouraged.

A holistic approach to corridor development was taken to try to ensure that the easily built transport corridors evolved into sustainable fully fledge EDCs; this, however, remains a challenge. Indeed, at a more basic level, the increased connectivity embodied in the improved transport corridors has not yet translated into significant increases in trade between the countries along some of the corridors[18]. The use of trade flows as the sole criteria for designating certain routes as GMS economic corridors is now considered to be too narrow and inadequate. Cross-border flows of tourism and other types of trade in services such as health and education services are substantial, and hence have been used as a clear justification for the designation of certain economic corridors.

Assessments of GMS economic corridors have highlighted a range of critical success factors and challenges, most prominent of which include the following: (i) political support and alignment of national and regional development plans are vital; (ii) success largely depends on the corridor having at least two important centres of economic activity that stimulate and generate the movement of goods and people, (iii) border crossing still remain barriers to the seamless movement of freight, people and vehicles within the GMS; important trade and transport facilitation measures have yet to be fully implemented by the member countries[19;] (v) regulatory issues have still to be addressed; according to Martin, trade liberalisation and facilitation have advanced, but with considerable delays in the implementation of sub-regional agreements, characterised by an unwillingness to change national laws to meet international commitments[20]; and (v) data required to make investment decisions is still lacking.

Comprehensive data on international trade traffic flows moving along the various GMS corridors and other routes is not available. The GMS secretariat recognise that work is needed to improve data collection practices, determine the nature of traffic "demand", the potential volumes and numbers of transit movements along specific corridors, and address challenges related to the estimated ratios of imports to exports.

- **Walvis Bay Corridor(s)**: **The city of Walvis Bay is the terminus for four transport corridors** that benefit from the deep water harbour and the city's status as a free trade zone: the Trans-Kalahari Corridor; the Walvis Bay-Ndola-Lubumbashi Development Corridor (previously known as the Trans-Caprivi Corridor); the Trans-Cunene Corridor; and the Trans-Oranje Corridor (see Figure 2-13). Between them these corridors cover Namibia, Botswana, Angola, South Africa, Zambia, Zimbabwe and DR Congo. The corridor is managed by the Walvis Bay Corridor Group which is a PPP established to promote the use of the corridors and pool resources and

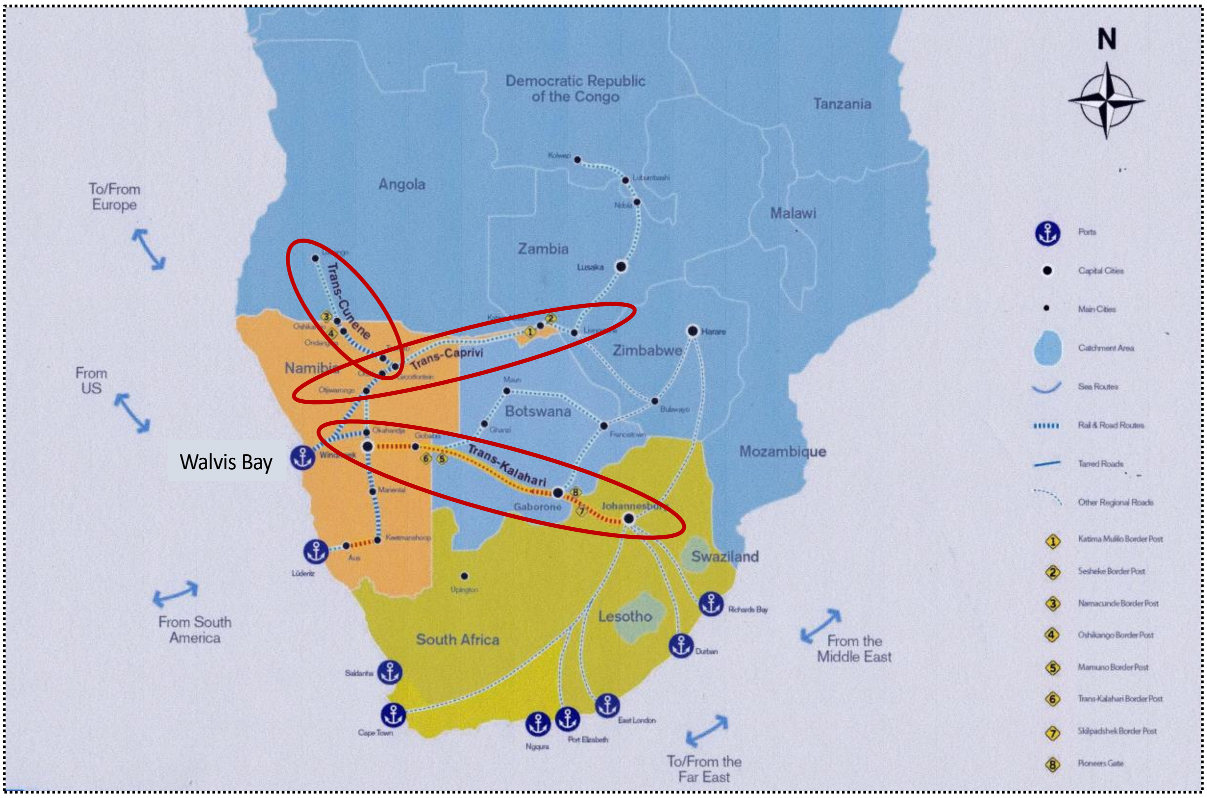
[18] Brunner, H. (2013) What is Economic Corridor Development and What Can It Achieve in Asia's Sub-regions?, ADB Working Paper Series on Regional Economic Integration

[19] Banomyong, R (2014) *Benchmarking Economic Corridors logistics performance: a GMS border crossing observation* World Customs Journal Vol 4 No 1 2014

[20] Martin, D. (2014) Trade and Transport Facilitation in the Greater Mekong Sub-region. *Summary findings and recommendations of the Mid Term Review of the Trade and Transport* Facilitation Action Plan (TTF-AP) and TA-7851 (REG)

authorities of both transport regulators and transport operators, thus effectively serving as a facilitation centre and one-stop shop coordinating trade and linking Namibia and its ports to the rest of the southern African region. Key logistics hub is envisaged at Walvis Bay. The corridor had evolved from a transport corridor into a development-oriented EDC as part of Namibia's "*Growth At Home Strategy*". The corridor was able to coordinate investment and infrastructural investments, but also prioritised anchor projects directed at particular industries such as, for example, agricultural growth poles along the route

Figure 0-19: The Walvis Bay Corridors



The Walvis Bay corridors are seen as important instruments of development and in particular as part of the plan to transform Namibia into the preferred logistics and distribution centre for landlocked SADC. Given the important commercial port at Walvis Bay, Namibia plays an increasingly important role in trade in the SADC region, linking global markets to some 300 million consumers in southern Africa. In order to prepare for the further development of Namibia as a Logistics Hub, the Government of Namibia commissioned the preparation of a master-plan for developing an International Logistics Hub (ILH) for SADC countries in the country. This master-plan was completed in 2015.

If developed and operated successfully, a Namibian ILH, with the Walvis Bay corridors playing a key role in the development of the hub, could prove to be the catalyst for increased trade leading to the economic and social advancement of the whole country. However, as recognised by the Government and private sector stakeholders in Namibia, the development of an ILH, does not guarantee a concomitant improvement in business productivity or the economy. There is concern that proven demand for the ILH has not be clearly confirmed.

Many stakeholders have warned that if not approached in a realistic, structured and comprehensive manner investment in an ILH could turn out to be a costly error. The lesson is clear – make sure that the (latent) demand for the infrastructure that is planned can be realised and put in place a comprehensive range of measures to ensure that demand can be realised.

Lessons from Benchmarking Countries

A review of transport and economic development corridors in the benchmark countries demonstrates that it is difficult to transform a transport corridor into a fully-fledged EDC. It is very costly but relatively easy to 'pour concrete' and build a basic transportation corridor. It is, however, much more difficult to design, and then successfully implement, the economic and investment policies, programmes and incentives, the trade facilitation measures, and the bi-lateral and sometimes multi-lateral trade agreements need to turn a transportation corridor into, first, a logistic corridor, and then a fully-fledged EDC.

Furthermore, **most successful EDCs are spatial development initiatives (SDIs**) characterised by pro-active planning for urban-industrial development along the corridor, and the development of local businesses, particularly local supply chains embedded in global production networks. The skills involved in designing and implementing an EDC exceed those required for the construction of a transport corridor and the need to orchestrate political commitment (across borders) and marshal a comprehensive range of stakeholders, and potential funders and investors, behind a EDC project are generally considerable. Building an EDC is as much a political construction as it is a physical project.

Nevertheless, the governments and private sector stakeholders of the every one of the benchmark countries wanted to establish EDCs (and turn existing transport corridors into EDCs) as all recognised that it is an EDC, rather that a basic transport corridor, that would be the 'pathway' to achieving target economic development and social welfare goals. Furthermore, all recognised that the construction of a transportation corridor was a necessary first step towards a fully-fledged EDC. For regional trade, integration and development to proceed, be accelerated and become successful, some if not all of the main transport corridors in IGAD should become EDCs. Indeed, a guiding principle of IRIMP is to put in place a plan that strengthens trans-border connectivity and transportation so allowing key transport corridors to effectively and efficiently become logistics corridors and subsequently fully-fledged EDCs.

Given below in Table 2-7 is a summary of the critical success factors and challenges that characterised the establishment and operation of transport corridors and EDCs in the benchmark countries together with lessons for the development of such corridors and EDCs in the IGAD region.

Table 0-7: Learning from the benchmark countries:

Critical Success Factors (CSFs) and Challenges in the benchmark corridors	Potential Lessons for IGAD
Fundamentals • ***Building an effective connectivity backbone (transport corridors) is a necessary step to developing successful*** *EDCs.* India's economic-industrial corridors 'work' only because of the success of the accelerated national highways and freight rail development programmes which laid down the basic hard infrastructure and allow time for the design and testing of trade facilitation and subsequently economic development initiatives; a necessary precursor to the establishment and successfully operation of the economic-industrial corridors. • ***An effective 'enabling environment' is crucial for a transportation corridor to succeed and subsequently become an EDC.*** Hard infrastructure	• ***The IGAD region needs to strengthen and complete the basic trans-border connectivity backbone as soon as possible.*** Currently there are some nine transport corridors in various stages of development (but most are in the early stage of development with important sections of the hard infrastructure incomplete). It is important to complete these corridors and ensure that the basic trade facilitation mechanisms are working well (as a precursor to the establishment and successfully operation of first logistic and then the economic-industrial corridors). • ***The IGAD region (member states and the IGAD secretariat) should consider developing***

Critical Success Factors (CSFs) and Challenges in the benchmark corridors	Potential Lessons for IGAD
is, of course, required to build a transport corridor. But such corridors cannot become first a logistics corridor and then an EDC without the appropriate institutional arrangements and policy, regulatory and trade facilitation frameworks in place and working smoothly. • ***Political commitment is required for an effective enabling environment to be designed, agreed and implemented*.** Building a comprehensive enabling environment takes times, discussion and agreement amongst the governments (national and local) involved. This demands commitment, which must be sustained through the early life of the EDC via, for example, SDI initiatives that have been designed to ensure that the wider economic benefits (WEBs) of the EDC are clearly identified, targeted and as far as possible achieved. Ensuring the alignment of national and regional development plans (that encompass the EDC) is also vital as demonstrated in the GMS case study. • ***Realistic agendas for EDC Implementation are required at the beginning*.** It takes time to gear up to define and successfully implement an EDC. For example, in India it took 14 years of the accelerated highways and freight development programmes to enable a relatively smooth transitioning into planning EDCs. It should also be remembered that Africa has an extensive architecture of regional political and technical bodies, but these often face problems because of overlapping memberships, limited technical capacity and limited enforcement power. There are gaps between Continental and regional treaties and strategies, and specific country level development strategies and policies. Thus, the emphasis of institutions such as IGAD and the proposed IGAD corridor SPVs perhaps should shift to more focused, facilitative and realistic agenda based on lesson sharing and learning. • ***Ensure that there is a strong business case for the corridor development.*** Getting the demand projections that underpin the developmentx plans for an EDC correct avoids costly mistakes. For example, as regards the Walvis Bay corridors there is concern that proven demand for the international logistics hub (ILH) has not be clearly confirmed. Many stakeholders have warned that if demand does not materialise an ILH could turn out to be a costly error. The lack of required data has also bedevilled the development of the GMS. Comprehensive data on international trade traffic flows moving along the various GMS corridors and other routes is not available and elated data required to make public and private investment decisions in the corridors is still lacking.	***a common 'IGAD-wide enabling framework';*** an IGAD-wide template that can be considered and applied by the member states to key transport corridors; those corridors targeted to be EDCs. Better to think now about the type of comprehensive enabling environment required to turn transport corridors into EDCs over the coming 5-10 years, and to have a commonly agreed IGAD certified template for the design and implementation of an enabling environment that promotes and accelerates the transition from transport corridor to EDC. There is indeed a 'regulatory deficit' that characterises many of the corridors in the IGAD region; the need to harmonise rules and regulations and trade facilitation actions is apparent. • ***The IGAD region secretariat should focus on ensuring political commitment of all members states to the development of key EDCs.*** Effective trade facilitation measures and further actions to ensure the implementation of an enabling environment that allows for the development of a fully-fledged EDC can only be agreed at a national government level – political backing for the harmonisation of rules and regulations is absolutely necessary, but rarely straight-forward. It takes time and if often to be achieved in an incremental manner. Key EDCs need to be identified and agreed by the governments responsible for the EDC, and then careful negotiations should commence to define and agree on the right institutional arrangement (and delivery body) for the EDCs and the enabling environment required to ensure that the EDCS can operate effectively and efficiently. • ***The IGAD region secretariat should be a repository of data needed to plan for the development of the corridors;*** including data which is required by private sector investors considering investment in infrastructure (on their own or via PPPs) or in productive / commercial operations. The issue of data porosity is frequently raised by the private sector; it is perhaps not a case of the lack of finance but the lack of bankable projects with political backing that goes beyond a normal 5 year political tenure, that hinders the development of EDCs. Investment require significant information and are associated with relatively long pay-back periods (15-20 years).

Critical Success Factors (CSFs) and Challenges in the benchmark corridors	Potential Lessons for IGAD
Institutional and funding arrangements	
• ***Setting up a corridor organisation is very important if you want to turn a transport corridor into an EDC.*** (e.g. special purpose vehicle; 'corridor tiger team'; mayors commitment) Given the multiple problems associated with cross-border functional cooperation, the variety of state and non-state actors involved, and the nature of potentially conflicting stakeholders in trans-border border settings, particular attention should be given to special purpose organisations or sectoral technical bodies that can command the trust of governments and stakeholders and can focus on regional or cross-border multi-stakeholder problem solving, facilitation and knowledge development.	• ***The IGAD region (members states) should consider setting up dedicated corridor institutional arrangements that have the full backing of respective governments.*** These institutional arrangements could be pan-IGAD or specific to each corridor (and thus could be bi-or trilateral in nature depending on how many borders the corridor traversed). Their powers are for discussion amongst the national governments involved, but the case studies clearly indicate that whatever type of corridor institutional arrangement is adopted it must have 'teeth' and be adequately funded.
• ***Getting the stakeholders involved is important*:** spreading development benefits from transport corridor and EDC investments more widely requires dedicated efforts by public authorities and non-state private sector actors. This is increasingly keenly felt in for example India. For popular support of the Indian corridor initiative to be strengthened, and in order to develop mechanisms of 'inclusive growth' local citizen stakeholder participation is increasingly seen as important.	• ***The IGAD region (members states) should not forget the importance of involving local people in the planning and implementation of the corridors and in particular in planning for a transport corridor to become an EDC.*** The recommended corridor institutional arrangement should set up a unit and associated procedures for engaging with local communities and businesses and discussing how the development of a transport to EDC can be of direct benefit to them and how they can contribute to the success of the corridor. There needs to be more structured public disclosure and discussions on planning and progress for both enhanced accountability and public support for the economic-industrial corridors.
• ***Getting finance is crucial. Every case study shows the importance of securing finance*** (e.g. Public sector and PPPs for key infrastructure, which should lever in or trigger private sector investment funds). The involvement of regional financial institutions (e.g. IDC and DBSA), for example, was vital to secure funds for the development for the Maputo Corridors. The successful use of PPPs to finance the Maputo Corridor has proved that this mechanism is effective for financing the transport corridors infrastructure sector. It demonstrates that fiscally constrained countries can successfully harness PPPs in this way to achieve similar initiatives in the future**.**	• ***At the earliest possible time, the IGAD secretariat should be discussing with members states and interested private sector investors the range of possible investments to be associated with the IRIMP***. IGAD should be presenting at various investor forum and conferences the subject of which is infrastructure and development in the IAGD region and adjacent countries. The IRIMP will only 'work' if the identified projects are implemented and implementation requires finance and financers.
• ***Capacity building facilitating project preparation and Trans- border finance*** Trans-border project preparation is costly and time-consuming. Benefits, income, profits may only be visible or generated over longer periods of time. Given the relatively poor record of the fragmented Project Preparation Facilities sufficient resources have to be set aside for process facilitation in preparation of investment dossiers, especially when the public sector is seeking to partner with private sector interests. Timely and careful attention needs to be given to credible confidence building measures and capacity building. External partners need to prioritise African institutions through or with which to work**.**	• ***The IGAD secretariat should be able to discuss and assist potential investors identify, define and fund projects.*** The recommended corridor institutional arrangement should set up a unit specifically designed to help expedite project financing and trans-border financing of projects.
Planning and Policy	• ***The IRIMP should be extended to cover***

Critical Success Factors (CSFs) and Challenges in the benchmark corridors	Potential Lessons for IGAD
• ***A holistic approach to corridor development underpins successful EDCs.*** In all the case studies the governments sought to take a holistic planning approach to the development of an EDC. This is particularly the case for GMS, where a SDI underpins the development of each GMS corridors; for each corridor there a plan for investments aimed at strengthening urban development, upgrading logistics, improving the network of feeder and rural roads, and developing other transport modes. In general, the case studies show that if properly planned by using a spatial development initiative (SDI) approach EDC can have a marked development impact on the area around the corridor • ***Policy co-ordination at the national, regional and local levels is important.*** There are numerous gaps between the regional treaties and strategies on the one hand and the country level development strategies and policies on the other hand. Thus, the emphasis of regional institutions may have to shift from the all-embracing, comprehensive and ambitious REC agendas to include a more focused, facilitative and realistic agenda based on lesson sharing and learning. ! But this requires an agenda setting that involves key stakeholders and actors that may not yet be roped in. The example of the South African National Planning Commission (with support from the Development Bank of Southern Africa) may be illustrative for the types of facilitation and multi-stakeholder platforming required. The National Planning Commission has taken • ***Anchor projects are generally important for the success of an EDC.*** This was particularly the case for the Maputo Corridor where two key anchor projects kick-started the economic development of the corridor. Sequiera (2013) noted that having a viable anchor project with significant backward and forward linkages in the economy was critical to the success of the Maputo development corridor[21]. Similarly, reviews of the success of the GMS highlighted the importance of having at least two important centres of economic activity along the corridor that stimulate and generate the movement of goods and people. • ***Aligning donor support with existing incentive mechanisms for regional cooperation along an EDC.*** The implementation gaps, institutional constraints and lack of synergies at the various regional and national levels are problems that can be compounded by ill-considered external support mechanisms and strategies. Poorly calibrated aid can create disincentives for key organisations or stakeholders to cooperate and coordinate**.**	***development plans for key EDCS in the IGAD region that members states and the IGAD Secretariat have targeted to become EDCs.*** For example, a development strategy and plan is required to turn LAPSSET from a transport corridor into a fully-fledged EDC. At present the emphasis is on the provision of hard infrastructure (and in particular the port of Lamu) • ***When selecting and prioritising projects for the IRIMP ACTION PLAN alignment (strategic fit) with national and local development plans and the aspirations of stakeholders is extremely important***

[21] Sequiera, S. (2013) "Transport corridors and Economic growth in Africa: Evidence form the Maputo Corridor" World bank Sub-Saharan Africa Transport Policy Program Washington DC.

Section 2.5 Lessons from the IGAD trans-border infrastructure case studies

As part of this project case studies of existing trans-border infrastructure investment were completed (given in Annex 2, presented under sperate cover). The key lessons from these case studies are as follows:

- **Joint participation in project packaging is essential** – Successful trans-border projects have been as a result of effective co-operation between the participating countries.
- **Joint Infrastructure fundraising can work** – joint lobbying for infrastructure funding has been a crucial element in securing funds on favourable terms for the implementation of a number of trans-border infrastructure projects. The Ethiopia Djibouti Railway line, for example, was funded by Ethiopia and Djibouti working together to secure funding from the Exim Bank of China
- **Project alignment to the National Develpment Plans (NDP)** – projects that are featured in or directly aligned with a NDP are more likely to be prioritised and attract private sector financial resources.
- **Vetting of Private Sector actors in infrastructure management** – Lessons from the Kenya-Uganda Railways Concession indicates that choosing the 'right' private sector partners for a PPP is crucial. On the other hand, the Turkana Wind Power project is an example of difficulties encountered in the structuring of private sector agreements, which can lead to government incurring losses.
- **Systematic demand forecasting** – Systematic forecasting analysis for all infrastructure sectors is crucial. Forecasting analysis aids in ascertaining the type of infrastructure to be developed, whether to rely on the old transport route for transport sector of the amount of generating plants to be constructed. This further helps to meet the demand for critical infrastructure
- **Participation and coordination of stakeholders** – Development of core infrastructure projects requires the participation and efficient coordination of all key national and local stakeholders. Stakeholder participation is further facilitated by clear frameworks with a road map up to the end of project implementation
- **Favourable diplomatic relations are necessary** – favourable diplomatic relations is vital to support the development of key infrastructure projects and agreeing on key initiatives that are aimed at protecting shared resources. Diplomatic relations tend to sustain and strengthen gains made in developing the infrastructures
- **Lack of sufficient skilled personnel can severely hinder the design and implementation of trans-border infrastructure** – lack of sufficient skilled personnel in terms of sector advanced engineers such as electricity, rail, roads, technicians, operators, planners and managers is a challenge to the development of infrastructure locally. This often resulted in reliance on foreign know how which incapacitates the local labour and may not meet the infrastructure specifications of the host country
- **Favourable Polices** – investments in the infrastructure projects require favourable and conducive policies that will attract investors to develop infrastructures. Favourable policies provide for sustainable development of infrastructures and exploitation of resources
- **Political will and support by governments to develop cross border infrastructure projects** – political will is necessary for the development of projects. Political will enables the governments involved in developing cross border infrastructure projects to fast track the process by creating the necessary enabling environments and policies to support the infrastructure
- Many of these lessons are similar to those that can be drawn from the benchmark country analyses. Both sets of lessons should, as appropriate, inform the selection, prioritisation and improvement (as necessary) of projects and policy-type initiatives to be chosen for the IRIMP Action Plan. The following should be considered:
- **Coordination of projects** – IGAD Secretariat should to emphasize to the member states the

importance of coordinating potential interstate projects from design, resource mobilisation and construction in order benefit from the willingness of funding agencies or potential (PPP) off-takers who may be more willing to participate when they are convinced of the commitments by neighbouring states.

- The IGAD secretariat should also focus on **ensuring political commitment of all members states to the development of key infrastructures which are cross border in nature**. Game changing infrastructure projects which uphold trade and integration objectives of IGAD should be agreed at a national government level and political backing for the harmonisation of regulations be spearheaded by the secretariat.
- **IGAD should push for the amendment of land laws and general laws where they are restrictive to infrastructure development** – The issue of rights of way should be addressed by law to avoid speculators cashing on compensation for properties that are not worth what such speculators demand to be paid as this tends to inflate the cost of the project
- **The IGAD secretariat should be advocates for capacity building** - Capacity building for local personnel in the IGAD member states should be made a priority so that such personnel will be available before or soon after project completion in order to avoid dependence on hired external managements. Knowledge transfer and skills development of IGAD member state workers should be written into the terms of the contract with the developer, and regional agencies should work with national universities to develop training and certification staff
- **The IGAD Secretariat should formulate guidelines on PPP for adoption by the member states** to manage issues covering safety, infrastructure financing, regional level certification requirements for freight and passenger services and provision of common infrastructure statistics.
- The IGAD Secretariat should consider spearheading the establishment of integrated technical standards and system for the region and comprehensive guidelines for infrastructure sector policies
- **The IGAD secretariat should advocate local economic developments strategies for key EDC**, which create opportunities for the local communities in the member states where infrastructure projects are being undertaken. Infrastructure projects tend to develop economic enclaves with few linkages and employment opportunities being created for the local economy. As such, the local population tend to be skeptical of the project and the impact that it will have on their community.

Broad Sector Overview

Section 3.1 Introduction

A description of the existing and planned trans-border infrastructures associated with the four sectors is given in the following four chapters. Each sector overview also includes an assessment of the enabling environment affecting the provision and impact of the trans-border infrastructure associated with the sector in question. The enabling environmental consist of the prevailing policy and regulatory regimes and institutional arrangements that promote inter-regional trade, integration and development and thus ensure the effectiveness of the trans-border infrastructures. This broad sector overview highlights the trans-border infrastructure *capacity* at the present and as expected in the near future. If this capacity is not sufficient to meet expected demand over the life of the masterplan, to 2050, then additional trans-border infrastructures will be required. This issue is examined in depth in each of the chapters in which is presented the demand forecasts and gap analysis, namely the gap between the prevailing *capacity* and the trans-border infrastructure required to meet *demand* up to 2050

Section 3.2 Identifying the need for future trans-border infrastructure

The fundamental rationale for the IRIMP is to guide the provision and development of trans-border infrastructure in the IGAD region, and in a manner that promotes trade, integration and development. The identification of the trans-border infrastructures needed in the future (to the end date of the masterplan period, namely 2050) is a crucial component of the IRIMP. The way that future infrastructure needs are estimated is as follows:

- **First, the demand for trans-border infrastructure (2019-2050) is estimated:** The demand estimates are undertaken in a slightly different manner for each sector and are described in each chapter. Each method of demand estimation has been tailored to the sector in question. However, the base population and economic growth estimates are common for each sector and are described in sections 3.2 and 3.3 respectively.
- **Second, the capacity to meet the demand (2019-2050) is estimated:** For each corridor of the IGAD region, the carrying capacity of existing, pipeline (schedule to be built) and planned trans-border infrastructure is added up or aggregated.
- **Third, calculating the 'gap':** If this 'aggregated capacity' is less the that required as estimated through task one described above then there is a 'gap' – existing and pipeline capacity cannot satisfy demand (up to 2050) and thus there is a clear rationale for additional trans-border infrastructures to be built (see Figure 3.1)

It should be noted that there are to be expected significant 'positive feedback' mechanisms at play when demand is being estimated. The provision of trans-border infrastructure in response to demand, and in the context of an expanding population, growing economies and a political will to improve intra-regional trade and integration (as is the case with the vast majority of IGAD member states), is most likely to lead to the expansion of the economy and an additional increase in demand for trans-border infrastructure. What is likely to happen is that a virtuous pathway of development is initiated by the provision of trans-border infrastructure (see Figure 3.2). Our demand projections, particularly in the later years of the Master Plan may be under-estimates because of this positive feedback mechanism. Fortunately, this is not a sign of failure but of success; of the virtuous pathway of development at work

Figure 0-1: Stylised illustration of method used to identify trans-border infrastructure needs

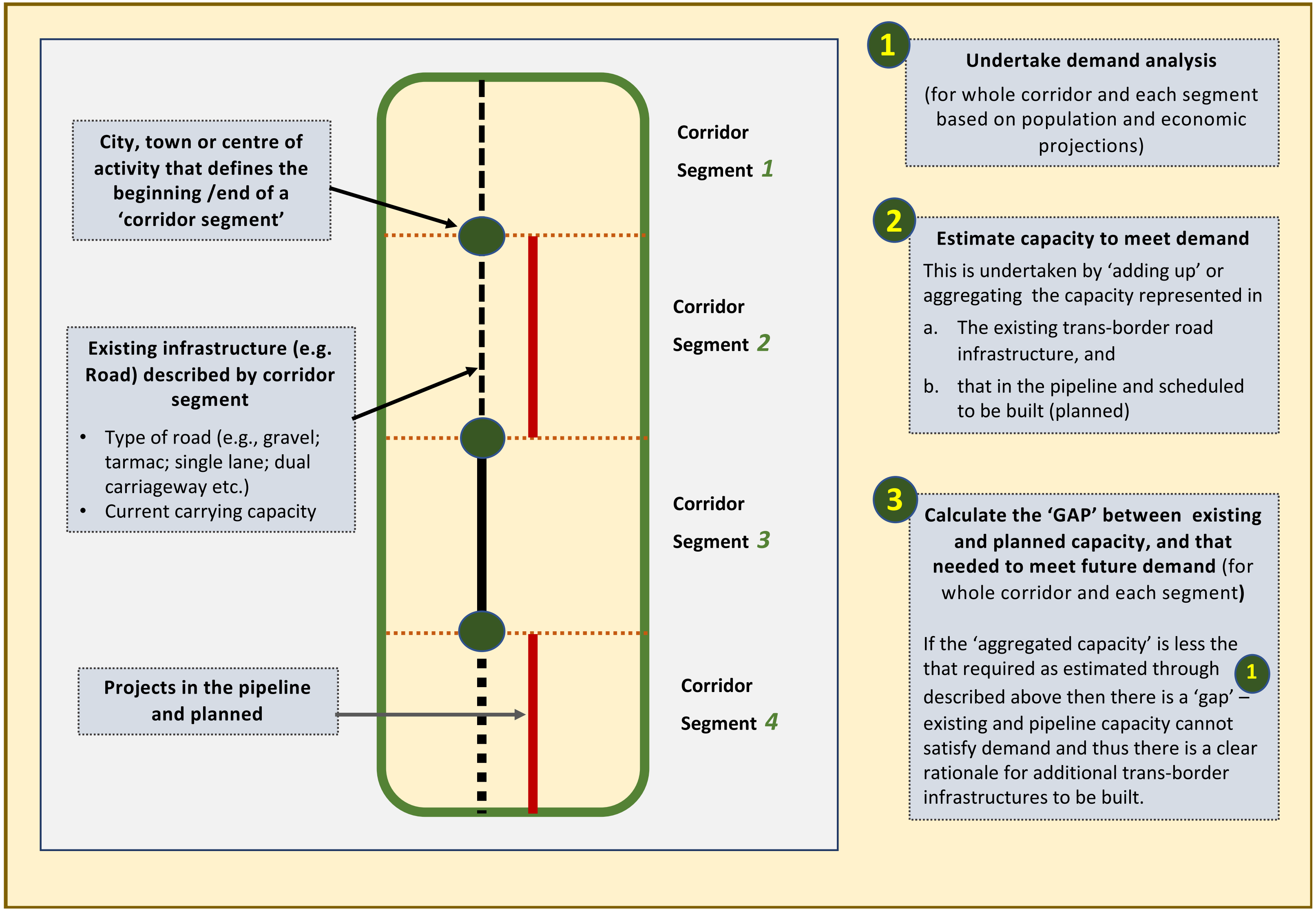
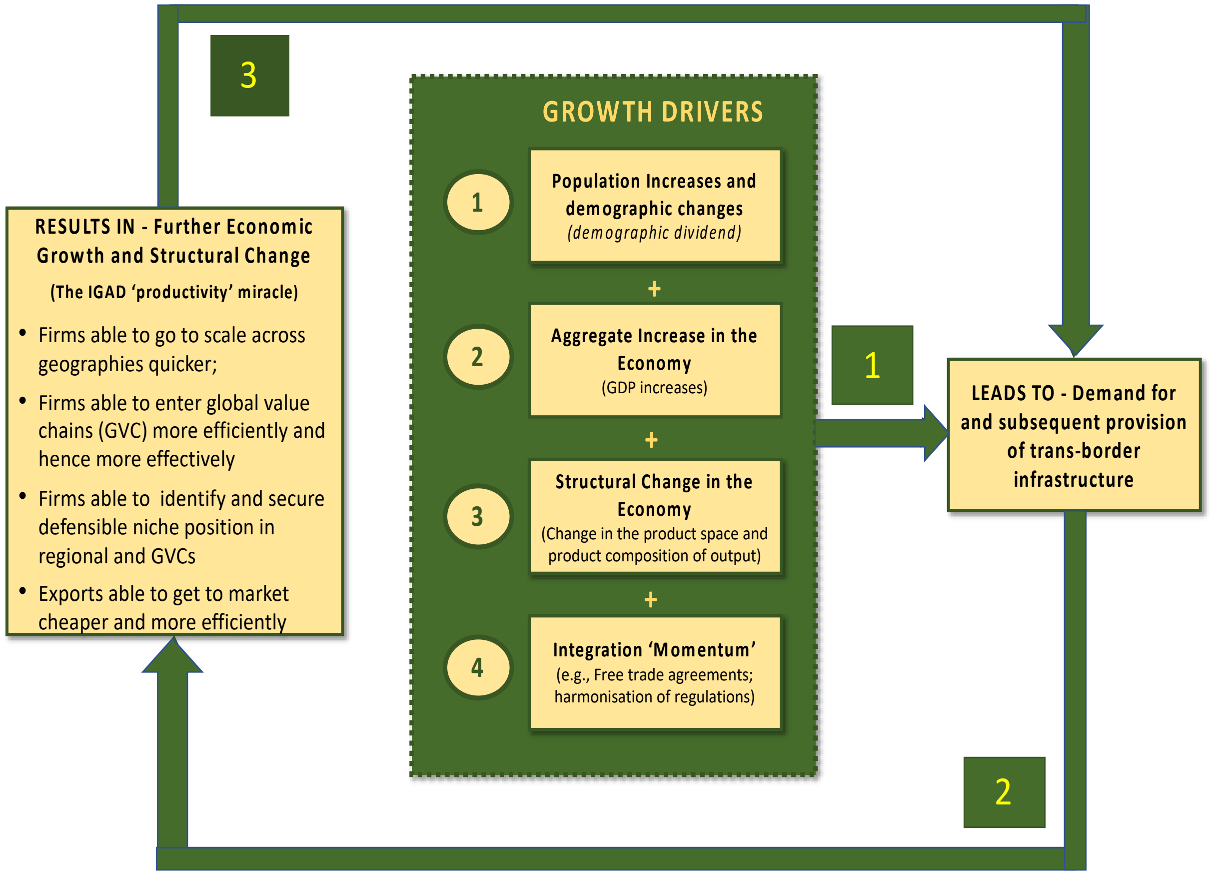


Figure 0-2: Positive feedbacks and the demand for trans-border infrastructure



Positive feedback 1:

- Economic growth leads to demand for infrastructure which enables further economic growth

Positive feedback 2:

- Economic growth improves peace and security which enables further economic growth which strengths peace and security

Section 3.3 IRIMP base population growth projections

Population forecasts underpin the demand forecasts for each sector. The assumptions are based on the UN World Population Prospects 2017, “medium variant”.

Table 0-1: Projected IGAD population (thousands)

Member State	Pop. 2019	CAGR 2019-2024	Pop. 2024	CAGR 2024-2030	Pop. 2030	CAGR 2030-2050	Pop. 2050
Djibouti	986	1.38%	1,056	1.18%	1,133	0.72%	1,308
Eritrea	5,310	2.23%	5,929	2.10%	6,718	1.80%	9,607
Ethiopia	110,136	2.31%	123,428	2.08%	139,620	1.58%	190,870
Kenya	52,215	2.38%	58,722	2.21%	66,960	1.79%	95,467
Somalia	15,636	3.00%	18,128	2.91%	21,535	2.58%	35,852
South Sudan	13,263	2.54%	15,032	2.32%	17,254	1.95%	25,366
Sudan	42,514	2.40%	47,872	2.29%	54,842	1.93%	80,386
Uganda	45,712	3.17%	53,436	3.01%	63,842	2.55%	105,698

Source: United Nations Department of Economic and Social Affairs Population Division. World Population Prospects: The 2017 Revisions, Key Findings and Advance Tables

Section 3.4 IRIMP base economic growth projections

Three forecasting scenarios using different GDP growth rates to 2030, but same conservative growth rate for all countries and scenarios used for 2030-2050 (4.5%):

- **Target GDP growth scenario**: IGAD economies grow at the target rates specified in NDPs[22];
- **IMF forecast GDP growth scenario**: IGAD economies grow at the rates forecast by the IMF[23];
- **IGAD RIMP GDP growth scenario**: IGAD economies grow at rates based on authors’ estimates (a mid-level scenario between IMF and target growth rates).

Member State	CAGR 2024	CAGR 2030	CAGR 2050
Target GDP Growth Scenario			
Djibouti	10	10	4.5
Eritrea	6	6	4.5
Ethiopia	11	9	4.5
Kenya	10	10	4.5
Somalia	6	6	4.5
South Sudan	6	6	4.5
Sudan	6	6	4.5
Uganda	6.2	8.2	4.5
IMF Forecast GDP Growth Scenario			
Djibouti	6.2	5.4	4.5
Eritrea	4.1	4.7	4.5
Ethiopia	7.9	6.3	4.5
Kenya	6.2	6.8	4.5
Somalia	3.4	3.7	4.5
South Sudan	-5.7	2.0	4.5
Sudan	-1.1	0.8	4.5

[22] Where member states have not set target growth rates we have used an optimistic estimate based on recent trends
[23] Using data from the IMF World Economic Outlook dataset

Uganda	6.2	7.6	4.5
IGAD RIMP GDP Growth Scenario			
Djibouti	7.5	6.0	4.5
Eritrea	5	6.0	4.5
Ethiopia	9	7.0	4.5
Kenya	7.5	8.0	4.5
Somalia	4.5	6.0	4.5
South Sudan	4	6.0	4.5
Sudan	2	4.0	4.5
Uganda	6.2	8.0	4.5

The Transport Sector

This chapter is structured as follows:

- Section 4.1: presents a description of the key IGAD corridors followed by an assessment of the state of the existing road, rail, maritime and aviation networks.
- Section 4.2: presents a description of the transportation projects in the pipeline.
- Section 4.3: outlines the enabling environment governing the sector.
- Section 4.4: presents the transportation infrastructure gap analysis.

Section 4.1 The Existing Transportation Networks

The principal objective of IRIMP is to identify cross-border transport infrastructures required in order to promote regional economic integration and development. As in other Regional Infrastructure Master Plans (COMESA, TCS/PIP and SADC Infrastructure Masterplan and PIDA), the concept of the "Corridor" will be applied to the surface modes of transport (road and rail) and the maritime ports and inland waterways will be mainstreamed along existing or proposed transport/economic corridors. Table 4-1 below shows the list of the IGAD region corridors with the ports of origin and the principal cities that they traverse through.

Table 4-1: List of IGAD Corridors

Corridor Name	Countries Served	Primary Modes of Inland Transport
Port Sudan Corridor	Sudan, Eritrea, Ethiopia and South Sudan	Road, Rail and Pipeline
Massawa Corridor	Eritrea, Ethiopia, Sudan	Road and Rail
Assab Corridor	Eritrea, Ethiopia	Road
Djibouti Corridor	Djibouti, Ethiopia, South Sudan, Uganda, Sudan and Somalia	Road and Rail
Berbera Corridor	Somalia, Ethiopia	Road
Bossaso Corridor	Somalia and Ethiopia	Road
Mogadishu Corridor	Somalia, Ethiopia, Kenya	Road
Kismayu Corridor	Somalia, Ethiopia, Kenya	Road
LAPSSET Corridor	Kenya, Ethiopia, South Sudan	Road, Rail and Pipeline[24]
Northern Corridor	Kenya, Uganda, South Sudan	Road, Rail and Pipeline
Vic-Med Corridor	Kenya, Uganda, South Sudan, Sudan, and Ethiopia	Inland waterways

Existing IGAD Road Networks

As in the rest of Africa, road transport currently conveys the bulk of both freight and passenger traffic. The IGAD region is served by three of the nine Trans-African Highways (TAHs) which were selected during the two African Transport Decades to enhance continental connectivity. These three TAH links are (i) Cape to Cairo, (ii) Mombasa to Lagos, and (iii) Djibouti to Ndjamena. The Djibouti-Libreville link

[24] These are the planned LAPSSET modes of transport.

passing through Nairobi-Kampala and Kinshasa has also been added as the tenth Trans-African highway.

The development of the roads sub-sector in IGAD Member States varies considerably:

- Ethiopia, Kenya, Uganda and Djibouti are in the forefront with higher density of regional roads
- Sudan, Eritrea, Somalia and South Sudan, however, are characterised by medium to low levels of road infrastructure development.

IGAD member states have seen the continued development of road networks, under the auspices of COMESA, involving the construction of missing regional inks, and the upgrading and the rehabilitation of existing ones. Recent road transport corridors in the region include the Djibouti Corridor, Lamu Corridor, the Northern Corridor, and the North/South Corridor among others. A summary of current existing and planned trans-border projects in the IGAD region are given in Table 4-2 below:

Table 4-2: Current IGAD Corridor Road Networks

Country	Existing Interstate Infrastructure Links	Corridor	Length in Kilometers	Inter State Connectivity
Djibouti	Djibouti – Galafi	Djibouti	220	Bitumen standard linking Djibouti to Ethiopia
	Djibouti – Al Sabieh - Guelile	Djibouti	100	Bitumen standard linking Djibouti to Ethiopia
	Djibouti -Loyada	Djibouti	100	Bitumen standard linking Djibouti to Somalia
Eritrea	Massawa-Asmara	Massawa	115	Bitumen standard linking Eritrea to Ethiopia and Sudan
	Assab/Bure/ Addis Ababa	Assab	853	Bitumen standard linking Eritrea to Ethiopia
Ethiopia	Gonder-Shire-Adawa-Adirgat	Djibouti	490	
	Wikro-Adigrat-Zela Abessa	Djibouti	100	Bitumen link to Eritrea
	Bure -Semera- Addis Ababa	Assab	853	Assab port serves Ethiopia foreign trade.
	Galafi-Semera- Awash-Moijo - Addis Ababa	Djibouti	863 •	Major link to Djibouti and Assab
	Bahir Dar-Gonder-Metema	Djibouti	351	Bitumen link to Sudan
	Gonder-Humera	Djibouti	244	Northerly link to Sudan
	Ambo-Nekemte-Gambela	Djibouti	595	Link to South Sudan
	Awash-Harar-Jijiga-Togochaale	Berbera	455	Bitumen standard link to Somalia
	Dodola-Ginir-Gode	Mogadishu	730	Bitumen standard link to Somalia
	Gode-Kelafo	Mogadishu	135	Gravel link to Somalia
	Wendo-Negele		268	Gravel link to Somalia & Kenya

	Moidjo -Awassa-Yobelo-Moyale	LAPSSET	721	Bitumen standard link to Kenya
Kenya	Isiolo-Marsabit Moyale	LAPSSET	520	Bitumen standard link to Ethiopia
	Mombasa-Nairobi-Nakuru-Malaba	Northern	920	Bitumen standard link to Uganda and South Sudan
	Nakuru-Kisumu	Northern	230	Bitumen standard link to Uganda and South Sudan
	Kisumu- Busia	Northern	120	Bitumen standard link to Uganda and South Sudan
	Eldoret-Kitale-Lodwar	Northern	367	Link to South Sudan (needs rehabilitation)
	Kitale Suam	Northern	77	Bitumen standard link to Uganda
	Lokichar – Lodwar – Nandapal	LAPSSET	338	Link to South Sudan (needs rehabilitation and upgrade)
	Isiolo-Mandera	Mogadishu	740	Link to Somalia (needs rehabilitation and upgrade)
	Garissa-Liboi	Kismayu	179	Link to Somalia (needs rehabilitation and upgrade)
Somalia	Berbera-Hargessa-Togochaale	Berbera	243	Bitumen but between Berbera and Hareisa needs rehabilitation and upgrade from Haregeisa link to Ethiopia
	Mogadishu- Jowhar-Ferfer	Mogadishu		Gravel /DBST link to Ethiopia link to Ethiopia link to Ethiopia
	Mogadishu–Afgoye–Baidoa–Beled Hawa	Mogadishu	520	Gravel link to Kenya
	Kismayu – Liboi	Kismayu	220	Gravel link to Kenya
South Sudan	Malakal/Nasir/Akobo	Djibouti	270	Gravel link to Ethiopia
	Kapoeta-Boma	Djibouti	170	Missing link
	Juba-Torit-Kapoeta-Nandapal	Northern/ LAPSSET	345	Gravel link to Ethiopia
	Juba-Nimule	Northern/ Djibouti	190	Bitumen standard link to Uganda
	Juba-Yei-Kaya	Northern/ Djibouti	245	Gravel link to Uganda
	Juba – Mundri-Yambio	Northern	432	Gravel Road
	Juba-Kajo Keji	Northern	120	Gravel link to Uganda
	Juba -Bor - Malakal	Mixed	520	Gravel link to Sudan
	Mundri – Rumbek-Wau	Northern/Port Sudan		Gravel link to Sudan
	Wau-Gogrial-Abyei	Port Sudan	225	Paved Road
	Malakal-El Renk	Mixed	300	Gravel link to Sudan
	Malakal-Nasr/Jikou	Djibouti	270	Feasibility study completed in 2014

Sudan	Kassala-El Lafa	Port Sudan	30	Bitumen standard link to Eritrea
	Dongola-Argeen	Port Sudan	365	Bitumen standard road
	Tokar-Garora	Port Sudan	179	Eritrea
	El Gadarif-Doka-Gallabat	Djibouti	156	Major road and railway services for Djibouti
	Showak - Lukdi - Humara	Port Sudan	92	Gravel/earth link to Ethiopia
	Damazini-Kurmuk	Djibouti	150	Unpaved link to Ethiopia
	Damazin-Renk	Djibouti	200	Link to South Sudan
	Rabak - Joda	Djibouti	104	Gravel link to South Sudan
	El Mujlad-Abeyei	Port Sudan	200	Gravel link to South Sudan
	Buram-El Radoan	Northern	145	Gravel
Uganda	Malaba-Bugiri-Jinja (NCR)	Northern	136	Bitumen standard
	Jinja- Kampala	Northern	80	Bitumen standard
	Kampala- Karuma Falls-Gulu	Northern	21	Bitumen standard
	Kamdini-Gulu-Atiak-Nimule	Northern	171	Bitumen joins with
	Tororo-Soroti-Lira	Northern	224	Bitumen standard
	Lira-Kitugum- Kidepo	Northern	169	Gravel to South Sudan border
	Kamdini-Pakwach-Arua-Koboko	Northern		Bitumen standard leading to border with South Sudan
	Acholibur - Kitgum-Musingo	Northern	86	Bitumen standard leading to border with South Sudan

One Stop Border Posts

The border posts are important components of trade and transportation links, especially with respect to the road sector (see Table 4-3). The IGAD region has a large number of border posts along its existing interstate road links, along the designated corridors and even at other crossings that are at the moment only of cross border movement. In order to reduce the time spent at border posts, the One Stop Border Post approach has been adopted all over the continent and is one of the methods of addressing a host of non-tariff barriers (NTBs).

Table 4-3: List of IGAD Border Posts and Status

Country Pairs	Border Post	Corridor	Status
Kenya/Uganda	Malaba	Northern	OSBP operational
	Busia	Northern	OSBP operational
Kenya /South Sudan	Nandapal	Northern/LAPSSET	Design completed
Kenya/Ethiopia	Moyale	LAPSSET	Construction of OSBP facilities completed

Djibouti/Ethiopia	Galafi	Djibouti	Design stage
	Balho/Eli Dar	Djibouti	Concept stage
	Guelile/Dewele	Djibouti	Advanced stage of development
Ethiopia/Somalia	Togochaale	Berbera	Concept stage
Ethiopia/Eritrea	Humera-Oum Hajer	Massawa Corridor	Concept Stage
	Adigrat/Guna-Guna	Massawa Corridor	Concept Stage
	Bure	Assab Corridor	Concept Stage
Ethiopia/South Sudan	Raad/Boma	Djibouti	Designs completed
	Akobo/Gambella	Djibouti	Concept stage
Ethiopia/Sudan	Kurmurk	Djibouti	Concept stage
	Metema/Galabat	Mixed	Designs completed
Sudan/South Sudan	El Fil/Bunj	Port Sudan	Concept stage
	Renk	Port Sudan	Concept stage
	Takoi	Port Sudan	Concept stage
	Abyei	Port Sudan	Concept stage
Sudan/Eritrea	Tessenei	Port Sudan	Concept stage

Existing Rail Networks

Information on the current rail networks in the IGAD region was collected including coverage, operational efficiency, and the state of the tracks. The analysis covered the existing railway networks in seven IGAD members states namely, Djibouti, Ethiopia, Kenya, Sudan, South Sudan, Somalia and Uganda. In Somalia, the railways built by the Italians prior to and during the Second World have been decommissioned.

The current rail networks in The IGAD region have four-gauge categories which include three narrow gauges and the standard gauge. The SGR networks have been recently constructed in Djibouti, Ethiopia and Kenya, and programmes are in the pipeline to extend SGR to the rest of the countries in the IGAD region. Djibouti, Ethiopia, and Kenya have both the SGR and meter gauge railway lines. Eritrea has the 950mm gauge while South Sudan and Sudan has the Cape gauge network. A summary of the rail networks comprising both the legacy and new networks in the IGAD region is provided is provided in Table 4-4 below:

Table 4-4: Current IGAD Railways Networks

No.	Country	Existing Interstate Infrastructure	Corridor	Length in Kilometers	Cross Country
1	Djibouti	Djibouti - Guelile (Ethio/Djibouti)	Djibouti	93	Part of Ethio-Djibouti SGR managed by a joint Ethio/Djibouti company
		Djibouti - Guelile (Ethio/Djibouti)	Djibouti	100	Meter gauge and part of Ethio/Djibouti railway
2	Ethiopia	Dewele/Addis Ababa segment part of Addis Ababa-Djibouti SGR, in operation since Jan 2018	Djibouti	666	SGR link connecting Ethiopia to Djibouti

		Awash -Weldiya/Gebeya (Under construction)	Djibouti	•	Extensions to be made to Mekele and Samera
		Dewele Addis Ababa (Ethio/Djibouti)	Djibouti	680	Meter gauge and part of Ethio/Djibouti railway
3	**Eritrea**	Asmara (Red Sea Port) to Massawa (95mm) gauge	Massawa	317	No interstate links
4	**Kenya**	Mombasa- Nairobi SGR	Northern	472	Part of Northern Corridor rail network
		Nairobi – Naivasha of SGR, (Under Construction)	Northern	120	Part of Northern Corridor rail network
		Legacy Meter gauge rail	Northern	2,541	Part of Northern Corridor rail network
5	**Somalia**	No active rail infrastructure	NA		
6	**South Sudan**	South Sudan (Agok- Wau)	Port Sudan	248	Connects South Sudan to Sudan
7	**Sudan**	Cape gauge network linking Egyptian border to Darfur on the west, Port Sudan on the Red Sea coast and Wau in South Sudan	Port Sudan	5,475	Sudan is linked to South Sudan. Link to Eritrea no longer active
8	**Uganda**	Meter gauge network from Malaba/Kampala/Kesese and Tororo/ Pakwach. Only Tororo/Kampala segment active.	Northern	1,235	Connects to Kenya network

Figure 0-1: Holhol Bridge on the Addis Ababa-Djibouti Railway

It should be noted that all the three countries namely, Djibouti, Ethiopia and Kenya have dual rail gauges after the construction of the SGR rail facilities. In terms of traction, both Djibouti and Ethiopia have the SGR powered by electricity while all the other railways have diesel electric traction. Table 4-5 shows the rail networks key parameters including track their lengths, track gauges, rolling stock disposition and modes of traction.

Table 0-5: IGAD Rail Networks and Traction

Country	Network Description	Network Length	Traction	Rolling Stock		Capacity
				Locos	Wagons	
Ethio/Djibouti	SGR	759	Electrified	51	1,100	24.9 million
	MGR	780	Diesel Electric			
Eritrea	NGR	450	Diesel electric and steam			
Kenya	SGR	472	Diesel Electric	56	940	
	MGR	1,080	Diesel Electric	32	32	
Somalia	NIL	Nil				
South Sudan	Cape Gauge	248	Diesel Electric			
Sudan	Cape Gauge	5,475	Diesel Electric			
Uganda	MGR	1,235	Diesel Electric			

Summary of the State of Railways in the IGAD Region

Railways in Djibouti: Djibouti and Ethiopia had a jointly owned and operated rail network that stretched from Djibouti port to Addis Ababa. This was a meter gauge that was constructed by France under a Franco-Ethiopian agreement that also covered its operation and maintenance of the network. Following the construction of the Djibouti Addis Ababa SGR, which was launched in 2017, the old meter gauge has largely been abandoned in Djibouti.

The SGR network now stretches from the port of Doraleh to Galile/Dewele on the Ethiopian border. The rail transport both freight and passengers most of the traffic originating from or destined to Ethiopia. The railway is also like the previous one operated jointly with Ethiopia although each currently is now responsible for maintenance on the segments of the network within its territory.

Railways in Ethiopia: Ethiopia was initially served by a metre-gauge railway which was built by the French between 1894 and 1971. The railway which was 780 long ran from Addis Ababa to the Red Sea port of Djibouti. The railway deteriorated primarily in the 1980s from deferred maintenance, lack of new investment and poor management. This line was replaced in 2017 by the SGR 666 km long from Addis Ababa to Galile/Dewele (border with Djibouti). The line proceeds to Doraleh port in Djibouti. The new line is a single-track SGR and runs roughly parallel to the old metre gauge railway.

A total of 666km of the line runs in Ethiopia with the remaining 93 km in Djibouti. The line is designed for an operating speed of 120 km/h for passenger and 80 km/h for freight on electric powered locomotives. The line has been in operation since January 2018. It is being managed by a joint bi-national public company owned by Ethiopia and Djibouti governments.

A new section off the SGR is currently under construction from Awash to Weldiya (390 km) through to Mekelle. At Weldiya the line will connect with future line to east to the new port of Tadjoura in neighbouring Djibouti, providing Ethiopia with a second outlet to the Red Sea.

Railways in Eritrea: The railway network in Eritrea was built by the Italians during their colonial rule. The line of 950 mm gauge runs from Red sea port of Massawa to the capital Asmara. The government of Eritrea intends to extend the line to Agordat, Biscia and Tessenei towards the border with Sudan. After closure for almost 30 years during the war, the Government of Eritrea began rehabilitating the tracks in 2002. The rehabilitation of the line from Massawa to Asmara.

Railways in Kenya: Kenya was being served by a metre gauge railway network of 2,500 km which was built during the colonial period. The line runs from Mombasa port to the capital Nairobi through to Malaba border with Uganda with main branch lines to Magadi, Kisumu, Nanyuki and Kitale.

Over the years the railway network deteriorated due to lack of maintenance, lack of new investments in track and rolling stock and poor management. The lines are still operational but at low capacity. Some of the lines have been abandoned.

The performance of rail transport in Kenya over the last decade is provided in Table 4-6 below:

Table 0-6: Rail Share of Container Traffic (2007 – 2018)

Details	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TEUs by Road	415,780	432,437	422,849	420,857	489,945	699,258	730,603	799,827	875,069	945,347	978,353
TEUs by Rail	37,285	32,494	21,668	24,478	25,268	24,997	26,653	21,672	21,642	21,902	19,571
Total TEUs	**453,065**	**464,931**	**444,517**	**445,335**	**515,213**	**724,255**	**757,256**	**821,499**	**896,711**	**967,249**	**997,924**
						Percentage Share					
Road	91.8%	93.0%	95.1%	94.5%	95.1%	96.5%	96.5%	97.4%	97.6%	97.7%	98.0%
Rail	**8.2%**	**7.0%**	**4.9%**	**5.5%**	**4.9%**	**3.5%**	**3.5%**	**2.6%**	**2.4%**	**2.3%**	**2.0%**

Source: Kenya Ports Authority, Annual Review and Bulletin of Statistics, Various Issues

A new SGR was constructed in 2015 -2017 from Mombasa to Nairobi. The line is 472 km long and is designed to operate at a speed of 120 km/h for passenger and 100 km/h for freight. It operates diesel electric locomotives and has provisions for electrification in future. Currently construction is going on for an extension of 120 km from Nairobi to Naivasha and to be later extended to Kisumu and through to border with Uganda at Malaba.

The SGR has in its short period of operation taken up over 20% of the freight market share that had shrunk to as low as 2% under the RVR prior to the termination of its concession. This compares well with the objective to have the railway lifting over and above 40% of the total transport share along its backbone routes. Depending on preferences for mode of transport or its convenience some commodities have been captive for rail in Kenya with bulks such as mineral and agricultural products achieving as high as 50% of market share in the past.

The future for rail transport in Kenya is on a positive turn-round with the now close to one-year operating SGR on the Mombasa – Nairobi segment. The proposed LAPSSET Corridor railway will be dependent on traffic from the landlocked Ethiopia and South Sudan and also Kenyan coal in Kitui with deposits estimated at 400 million tonnes and limestone in the same area.

Railways in South Sudan: The current railway network is South Sudan is part of the Sudan network running from Babanousa in Sudan to Wau in South Sudan. It consists of a 466 km section of 1,067mm gauge single line track which only 248 km is in South Sudan. Services on this line were interrupted during the civil war 1984 -1992. South Sudan has planned to upgrade the line and extend it southwards via Rumbek and Juba to Nimule on the Ugandan border.

Railways in Sudan: Sudan was once home to Africa's largest railway network, with more than 5,000 of track running from the Egyptian border to Darfur in the west, Port Sudan on the Red Sea coast and to the border with South Sudan. The network was built between 1897 and 1962, The track is 1,067mm gauge and operates on diesel electric locomotives. Although Sudan is still operating its current Cape gauge network, a national railway masterplan has been prepared to upgrade it to SGR in line with the continental policy.

Railways in Uganda: Uganda is currently being served by a meter gauge rail network which is part of the old East African railway network. The network total length amounts to about 1,100 km stretching from Malaba to Kampala and further west to Kasese with a branch line to Port Bell. The second link runs from Tororo to Pakwach through Gulu. The only active section is the mainline from Malaba to Kampala with a link to Port Bell. Construction of a new SGR track 273 km from Kampala to Malaba is expected to commence in 2018 and will connect with the Kenyan SGR at Malaba border. Uganda has also prepared a masterplan to upgrade its entire network to SGR.

Existing Ports Infrastructure in IGAD

The following sections provide information on the existing port facilities in the five IGAD coastal states namely, Djibouti, Eritrea, Kenya, Somalia and Sudan.

Djibouti Ports: The republic of Djibouti has coastline of about 116 kilometers in length which is on the Indian Ocean with a small segment on the Red Sea. It has one major port (Djibouti) and the smaller ones at Tadjourah and Obok. The port of Djibouti is located close to the Straits of Bab el Mandeb, a very strategic location for global container and general cargo shipping routes linking Asia to Europe, North America. It also serves major oil trade routes since it is on the crossroad of major shipping lanes passing through the Arabian Gulf, Red Sea, Suez Canal and into the Mediterranean Sea.

The port also offers an ideal location providing access to the Horn of Africa region and especially for Ethiopia, South Sudan, and Somalia. In addition to serving a large hinterland, it also has great potential for global transshipment services and may also provide cargo consolidation as well as strategic storage facilities. Table 4-7 below shows the port facilities in Djibouti

Table 4-7: Djibouti Ports Facilities

Facility	Number	Total Quays Length (Meters)	Max Draft (Meters)	Design Capacity
Doraleh Container Terminal Berths	1	1,050	18	1.25 Million TEUs
Old Container Berths	2	400	9.5 to 12.5	
Conventional Berths				
Dry Bulk Berths				
Oil Terminals	1			
RORO Berth	1			

Kenyan Ports: Kenya has coastline of about 539 kilometers in length which lies along the Indian Ocean. It has one major port (Mombasa port) and the smaller one at Lamu. There are several other smaller scheduled ones along the coastline. In addition to the Mombasa port, Kenya is also developing Lamu as a deep-sea port on the LAPSSET Corridor which serve eastern and northern parts of Kenya, Ethiopia and South Sudan. Table 4-8 below shows the port facilities in Kenya.

Table 4-8: Kenya Ports Facilities (Mombasa Port)

Facility	Number	Total Key Length (Meters)	Max Draft (Meters)
Container Berths	8	1,580	12.5
Conventionl Berths	12	3,284	Above 10
Dry Bulk Berths	2	315	10.5
Oil Terminals	2	N.A.	9.8 and 13.4
RORO Berths	1	N.A.	

Somali Ports: Somalia has coastline of about 3,300 kilometers in length and the longest among the coastal states in mainland Africa. It has four major ports and several smaller ones. The four major ports are Mogadishu, Berbera, Kismayu and Bossaso. The port of Mogadishu is the largest port facility and is managed by the Albayrak Group, a Turkish company that was given a twenty-year concession in 2014. The port of Berbera on the other hand has been concessioned to DP World a UAE based port management company. Table 4.9 below shows the port categories in Somalia. New corridors may develop from some existing ports such as Baraawe and Bossaso in Somalia

Table 4-9: Categories of Somali Ports

Port Category	Number	Port name/location
Major Ports	4	Mogadishu, Berbera, Kismayu, Bosasso
Jetties	2	Merca, Las Qorey
Other minor ports	9	Lughaya and Mait; Candala, Aluula, Hafun, Eyl, Garad and Hobyo; and El Maan

Table 4-10: Somalia Ports Facilities

Facility	Mogadishu			Berbera		
	Number	Total Quay Length (Meters)	Max Draft (Meters)	Number	Total Quay Length	Max Draft (Meters)
Container Berths	1	200	9.0	0	NA	NA
Conventional Berths	4	640	10.0	6	650	13.0
Dry Bulk Berths	1	100				
Oil Terminals						

Figure 0-2: The port facilities in Somalia.

An Arial View of Berbera Port

Sudan Ports: Sudan has coastline of about 853 kilometers in length which lies on the Red Sea.

It has one major port (Port Sudan) and two smaller ones namely; Suakin and Oseif. Port Sudan is the largest port facility and is managed by the Sudan Seaport Corporation a government owned undertaking. Table 4-11 below shows the port facilities in Port Sudan.

Table 4-11: Sudan Ports Facilities (Port Sudan)

Facility	Number	Total Quay Length (Meters)	Maximum Draft (Meters)
Container Berths	• 5	• 1,356	• 16
Conventional Berths	• 9	• 1,454	• 11
Dry Bulk Berths	• 4	• 1,126	• 14.6
Oil Terminals	• 1	• 310	• 14.6
Other Liquid Bulk Terminals	• 2	• 373	• 13.3

Traffic Evolution in IGAD Ports

Traffic handled in the major ports of countries in the IGAD region has been growing over the last five years in both tonnage and the number of containers handled. The largest port is Mombasa where traffic rose from about 22 million in year 2012 to 30 million Deadweight Tonnes (DWT) and container volume rose from 0.9 million to about 1.19 million TEUs. The port of Djibouti has experienced a sustained annual increase in traffic rising from about 0.8 million TEUs in 2012 to nearly 1.0 million TEUs in 2017.

The number of vessels calling in Djibouti has also increased steadily confirming an increased level if trans-shipment traffic. Traffic for Port Sudan rose from approximately 5.7 million to in 2012 to 7.8

million Deadweight Tonnes (DWT) in 2017 while container traffic rose from 394.2 thousand TEUs to 487.3 thousand TEUs during the same period. Table 4-12 below provides a summary of port traffic statistics for the various port in the IGAD region is provided below.

Table 4-12: Traffic in IGAD Ports

Country	Units	2012	2013	2014	2015	2016	2017
Djibouti	Cargo in 000 DWT		11,718	14,594	15,517	17,682	15,936
	Containers in 000TEUs	793	795	856	910	987	867
	Number of Vessels	1,577	1,644	1,694	1,903	1,841	1,768
Kenya	Cargo in 000 DWT	21,920	22,307	24,875	26,732	27,364	30,345
	Containers in 000 TEUs	904	894	1,021	1,076	1.091	1,190
	Number of Vessels	1,763	1,768	1,832	1,694	1643	1661
Sudan	Cargo in 000 DWT	5,706	6,612	6,580	6,457	6,167	7,747
	Containers in 000 TEUs	394	448	435	482	465	487

Djibouti Port Traffic: The port of Djibouti serves primarily the trade for Djibouti and over 90% of Ethiopian seaborne trade. The port used to be a significant trans-shipment base prior to the closure of the Suez Canal in 1967-1975. This traffic moved to the Persian Gulf and ports, the Indian Subcontinent and to Singapore. The port has continued to invest in facilities to attract back trans-shipment traffic and is gradually positioning itself to capture a substantial share of this traffic that today is handled primarily in ports in the Mediterranean ports, Persian Gulf ports, Salalah, Jeddah, Port Said and further Colombo and Singapore.

Mombasa Port Traffic: The port of Mombasa is the second largest port on the western board of the Indian Ocean after Durban. Mombasa has a large hinterland served by the Northern Corridor and serves Kenya, Uganda, Rwanda, Burundi, South Sudan and Eastern Democratic Republic of Congo (DRC). The traffic for Mombasa port is shown in Table 4.13 below

Table 4-13: Mombasa Port Traffic 2012 to 2017

Category	Units	2012	2013	2014	2015	2016	2017
Imports	000 DWT[25]						
Domestic	000 DWT	12,531	12,954	14,086	15,513	15,899	17,701
Transit	000 DWT	6,201	6,196	6,691	7,167	7,217	7,903
Total	000 DWT	18,732	19,150	20,777	22,680	23,116	25,604
Exports	000 DWT						
Domestic	000 DWT	2,620	2,470	2,858	3,034	3,128	3,060
Transit	000 DWT	425	513	508	500	531	734

[25] DWT – Deadweight Tonnes

Total	000 DWT	3,045	2,983	3,366	3,534	3,659	3,794
Total Tran	000 DWT	6,626	6,709	7,199	7,667	7,748	8,637
Total Dom	000 DWT	15,151	15,424	16,944	18,547	19,027	20,761
T/shipment	000 DWT	143	174	732	518	589	874
GRAND TOTAL	000 DWT	21,920	22,307	24,875	26,732	27,364	30,345
Containers	'000 TEUs	903.5	894.0	1,021.0	1,076.1	1.091.4	1,189.9
Number of Vessels	No	1,763	1,768	1,832	1,694	1643	1661

Source: Kenya Ports Authority, Annual Review and Bulletin of Port Statistics

Sudan Port Traffic The primary port for Sudan is Port Sudan and it serves Sudan, South Sudan and Ethiopia. The ports of Suakin and are smaller ports that serve domestic trade. The traffic volumes for Port Sudan are provided in Table 4-14 below:

Table 4-14: Port Sudan Traffic 2012 to 2017

Cargo Type	Routing	Units	2012	2013	2014	2015	2016	2017
General Cargo	Exports	000 DWT	72.5	178.7	62.3	77.3	72.6	86.2
	Imports	000 DWT	1,626.0	1,689.0	1,316.0	2,208.4	2,001.2	1,875.6
Dry Bulk Cargo	Exports	000 DWT	103.3	333.9	234.4	239.8	158.7	447.0
	Imports	000 DWT	2,556.4	2886.9	3136.4	2127.2	2108.5	2784.1
Bulk Liquids	Exports	000 DWT	250.6	117.7	99.9	48.8	60.2	60.6
	Imports	000 DWT	1,098.1	1,405.7	1,730.5	1,755.6	1,765.5	2,486.8
Total Cargo	Exports	000 DWT	426.2	630.2	396.6	365.8	291.6	593.8
	Imports	000 DWT	5,280	5,981.6	6,182.9	6,091.2	5,875.7	7,146.5
	T/shipment	000 DWT	0					6.7
	Grand Total	000 DWT	5,706.2	6,611.8	6,579.6	6,457.0	6,167.4	7,747.1
Containers		000 TEUs	394.2	447.6	434.5	481.8	465.4	487.3
Number of Vessels		No.						

Existing Inland Water Transport network in IGAD

Inland water transport in the IGAD region is provided in the navigable lakes and waterways. The navigable lakes include Lake Victoria and Lake Albert. The navigable international waterways are the River Nile and its tributaries such as the Sobat and to some limited extent the Blue Nile.

Lake Victoria which is shared by Kenya, Uganda and Tanzania has been used for transporting both inter-lake trade among the communities in the three countries and for onward transport of transit cargo coming from or destined to the ports of Mombasa and Dar es Salaam. There are several ports on Lake Victoria which include Jinja and Port Bell in Uganda and Kisumu in Kenya. The three ports have piers that provide link spans for rail wagon ferries that transport goods from the rail networks in Kenya, Uganda and Tanzania. With the decline of rail traffic in the three countries, the volume of long-distance freight moved through the lake ports has also declined and many of the wagon ferries have been decommissioned.

With respect to river transport, South Sudan has the longest stretches of the navigable segments of the Nile and its navigable tributaries. The main river ports include Juba, Malakal, Nasir in South Sudan, Gambella in Ethiopia and Kosti, Khartoum, Atbara and Wadi Halfa in Sudan. The Nile River countries are currently promoting the development of a River Nile Corridor that will endeavour to enhance navigation along the river and its tributaries by dredging its fairways where possible, building modern port facilities and promoting the use of overland trans-shipment of cargo on stretches that are not navigable.

Table 4-15 below provides the status of navigation on the Inland waterways in the IGAD region.

Table 4-15: Status of Navigation in IGAD Inland Waterways

Water Body	Port Facilities	Current Status of Services
Lake Victoria	Kisumu, Port Bell and Jinja	Interstate services and rail wagon ferries
White Nile	Juba, Malakal, Renk, Kosti and Khartoum	Limited services
Sobat River	Nasir and Gambella	Limited services
Blue Nile	Damazin, Gezira and Khartoum	Limited services
River Nile	Atbara, Wadi Halfa	Services ongoing

Existing Shipping Services in the IGAD Region

The IGAD region is connected to the rest of the world through its ports on the Indian Ocean and the Red Sea. The region is served by a large number of shipping lines providing regional and global services

The capacity in the IGAD region in shipping has had a clear disadvantage in terms of ship owning and provision of services. While a number of countries already have or have had shipping lines in the past, their capacity has been limited.

The IGAD region trades with the rest of the world through six major trade routes that link it to Southern Africa region to the global shipping markets:

- Indian Sub-continent. Persian Gulf and Red Sea;
- South East Asia, Far East and Australia;
- North America, South America and Central America;
- East Africa, South Africa and Indian Ocean Island;
- West Africa, North Africa and Black Sea; and
- Mediterranean, UK and North West Continent.

Currently, the IGAD countries that have shipping lines include Ethiopia, Kenya and Sudan. The only country with foreign going vessels is Ethiopia that has merchant navy providing services to the Middle East and the Far East. Sudan has had some vessels that provided services in the region, but these have recently been decommissioned.

Kenya and Uganda used to own a joint shipping line together with Tanzania and Zambia, but the line was disbanded in the early 1980's. Kenya established a shipping line in 1990 but the line operates through slot chartering in the main lines such as MSC that provide services in the region.

The current status of shipping services provided by IGAD member countries is provided in Table 4-16 below.

Table 0-16: Disposition of Shipping Lines in the IGAD Region

Country	Shipping Lines	No of Vessels	Route Served
Ethiopia	Ethiopian Shipping Lines	11	Middle Est and Far East
Kenya	Kenya National Shipping Line	No vessels	Europe and East Coast of Africa
Sudan	Sudan Shipping Line	2	Red Sea and Persian Gulf

Aviation

Aviation is a global industry which transcends continents, expands access to foreign markets for goods and services and hence provides valuable opportunities for economic growth through transportation of passengers and freight and promoting cultural and social exchanges. In addition, it enhances emergency and humanitarian response capabilities during crisis and public health emergencies. It is in this context that the aviation sector should be analyzed and assessed within IGAD.

The Industry High Level Group (IHLG) established by the International Civil Aviation Organisation (ICAO) comprising leaders from ICAO, IATA, CANSO, ICCAIA and ACI has identified a check list or template of seven benefits that will accrue to the states and stakeholders for the aviation industries[26]..

In Africa and IGAD, the prevailing mood is to establish a Single Africa Air Transport Market (SAATM) within the framework of the Africa Continental Free Trade Area (ACFTA) complete with a Customs Union and the Unified African Airspace to be managed within the ICAO CNS/ATM SARPS. Currently only Kenya and Ethiopia have signed into the SAATM which was endorsed by 26-member states of the AU in January 2018. Both COMESA and the EAC are working on the concept of a Single African Sky and all the eight IGAD member states are also members of COMESA, and the SAATM and the Unified Africa Airspace are included in the PIDA PAP priority projects.

The Africa Airlines Association (AFRAA) in collaboration with IATA have also asked member States and Governments of the AU, to enable African Airlines to improve intra Africa connectivity by unlocking the barriers to it through embracing the Yamoussoukro Decision (YD) of 1999 and the SAATM.

For air transport, trans-border infrastructure facilities include the following:

- International Airports;
- Air Navigation Equipment and Services; and
- International and Regional Airlines

Airports

The IGAD region has over twenty airports that take international flights. These airports comprise all the capital cities airports plus others in the regions which serve maritime ports, major tourist areas or areas with large industrial and commercial interests.

There is at least one international airport with sufficient runway length and equipped with modern air navigation instruments and other aviation infrastructure. Table 4-17 below summarises the major IGAD international expects below.

[26] Report of the IHLG of ICAO.

Table 0-17: IGAD International Airports

RFF	Country	Airports	Runway Capacity (m)	Terminal Buildings	Airlines
1	**Kenya**	Nairobi (JKIA) Nairobi (Wilson) Mombasa Eldoret Kisumu	4,200 1,500 & 1,540 3,350 & 1,260 3,400 3,300	4 1 2 2 1	Kenya Airways African Express Fly 540
2	**Uganda**	Entebbe	3,000	2	-
3	**Ethiopia**	Addis Ababa (Bole) Dire Dawa	3,700 & 3,800 2,679	3 1	Ethiopian Airlines
4	**Sudan**	Khartoum Port Sudan	2,980 2,460	3 1	Sudan Airways Badr Airlines
5	**South Sudan**	Juba Malakal	3,100 2,000	1 1	-
6	**Somalia**	Mogadishu Kismayo Berbera	3,000 3,688 4,140	1 1 1	Jubba Airlines
7	**Djibouti**	Djibouti	3,150	2	Air Djibouti
8	**Eritrea**	Asmara Assab Masawa	3,000 3,515 3,500	2 1 1	Eritrean Airlines

Air traffic in the IGAD region has been increasing steadily over the last ten years in both the passenger and freight traffic and also in the number of aircrafts landings.

Table 4-18 below shows the evolution of air transport in terms of numbers of passengers.

Table 0-18: IGAD International Airports Passenger Traffic (to be completed)

Country	Airport	2012	2013	2014	2015	2016	2017
Djibouti[27]	Djibouti	N/A	N/A	N/A	N/A	N/A	N/A
Eritrea	Asmara	N/A	N/A	N/A	N/A	N/A	N/A
	Assab	N/A	N/A	N/A	N/A	N/A	N/A
	Massawa	N/A	N/A	N/A	N/A	N/A	N/A
Ethiopia	Addis A	6,500,000	6,451,896	6,931,000	7,100,524	8,730,600	8,925,000
	Dire Dawa	N/A	N/A	N/A	N/A	N/A	N/A
Kenya	NBO JKIA	6,271,922	5,946,967	6,386,456	6,480,425	7,111,501	7,270,842
	NBO Wilson	294,892	326,729	324,462	330,500	413,100	528,153
	Mombasa	1,347,908	1,279,110	1,366,504	1,231,971	1,325,251	1,340,899

[27] Data on passenger trafficfrom airports not provided by the member countries i.e. Djibouti, Eritrea, Ethiopia (Dire Dawa), South Sudan and Somalia

	Eldoret	103,729	123,360	161,258	187,735	235,053	233,133
	Kisumu	289,320	265,579	356,905	353,966	389,862	358,390
Somalia	Mogadishu	N/A	N/A	N/A	N/A	N/A	N/A
	Berbera	N/A	N/A	N/A	N/A	N/A	N/A
	Kismayu	N/A	N/A	N/A	N/A	N/A	N/A
S/ Sudan	Juba	N/A	N/A	N/A	N/A	N/A	N/A
Sudan	Khartoum	2,903,132	2,866,544	3,191,408	3,668,880	3,881,242	3,865,336
	P Sudan	108,948	111,374	131,519	160,951	186,410	220,299
Uganda	Entebbe	1,238,536	1,343,963	1,332,499	1,390,000	1,420,000	1,530,000

IGAD Airlines

The IGAD region has a number of airlines that provide both regional and international services. The largest two namely, Ethiopian Airlines and Kenya Airways provide services in all the IGAD countries and have international services across Africa, Europe, Asia and North America. Ethiopian Airlines further provides services to South America.

The other airlines that provide regional and international services are Sudan Airways, Jubba Airlines, East African, Fly 540 and African Airlines. Table 4.19 below shows the main airlines with their fleet sizes and the regions they operate.

Table 0-19: IGAD Airlines Providing International Services

Country	Airlines	Fleet Sizes	IGAD Countries Served
Djibouti	Air Djibouti	3	Addis Ababa, Hargeissa, Mogadishu
Eritrea	Eritrean Airlines	2	Addis Ababa, Khartoum
Ethiopia	Ethiopian Airlines	108	All IGAD countries
Kenya	Kenya Airways	40	All IGAD countries
	African Express	2	South Sudan and Uganda
	Fly 540	7	Entebbe
Somalia	Jubba Airlines		Djibouti, Hargeissa, Nairobi, Mogadishu
South Sudan	None		
Sudan	Sudan Airways	4	Addis Ababa, Asmara
	Badr Airlines	14	Addis Ababa, Juba, Wau
Uganda[28]	None		

[28] Uganda Airlines is expected to be relaunched in 2019

Table 0-20: Weekly Passenger Flights 2012

	JKIA	Entebbe	Bole	Khartoum	Asmara	Djibouti	Mogadishu	Juba
JKIA		28	19	8	-	4	2	-
Entebbe	28		7	-	-	-	-	-
Bole	19	7		10	-	13	-	-
Khartoum	8	-	8		-	-	-	-
Asmara	-	-	-	-		2	-	-
Djibouti	4	-	13	-	2		-	-
Mogadishu	2	-	-	-	-	-		-
Juba	-	-	-	-	-	-	-	

Table 0-21: Weekly Passenger Flights Frequencies 2018

	JKIA	Entebbe	Bole	Khartoum	Asmara	Djibouti	Mogadishu	Juba
JKIA		86	42	5	-	3	10	15
Entebbe	86		27	-	-	-	-	19
Bole	42	27		22	14	12	-	14
Khartoum	5	-	22		-	-	-	7
Asmara	-	-	14	-		-	-	-
Djibouti	1	-	14	-	-		7	-
Mogadishu	10	-	-	-	-	7		-
Juba	15	19	14	7	-	-	-	

Air Navigation Services

Air navigation services in the IGAD region are normally provided by the CAA authorities that run them as a separates service provider in addition to their regulatory and oversight roles. The air navigation services have associated air navigation infrastructure which requires communication, navigation, surveillance and air traffic management (CNS/ATM) in line with the global ICAO standards and guidelines for aviation safety and security.

Among the countries that provided information, Ethiopia, Kenya, Sudan and Uganda had already prepared national masterplans containing plans and implementation strategy for development of the ATM/CNS/AIS/SAR/MET procedures, facilities and equipment for the next 20 years. All the masterplans were developed in accordance with the ICAO Global Plan.

Continental and RECs Aviation Programmes

There are a number of aviation sector programmes that have been developed both at continental and regional levels to promote the development of air transport in Africa and at RECs levels. At the continental level, the flag ship programmes deal the liberalisation of air transport and the development of a unified airspace for air navigation management.

The air transport liberalisation programme is referred to as Single African Air Transport Market (SAATM) by the African Union advocates for the removal the restrictions imposed by Bilateral Air Services Agreements (BASAs) that limit the grants of 5th freedoms, frequencies and impose aircraft capacity restrictions. It is based on the Yamoussoukro Decision.

At the regional levels, similar initiatives have been adopted various RECs (COMESA, EAC, ECOWAS and SADC) to fast track the liberalisation of the air transport services among their as the basis for implementing the continental programme. The second continental flagship project is the Unified Airspace which seeks to optimise on the use of airspace through provision of coordinated satellite-based navigation services hence providing seamless airspace across countries.

Section 4.2 Pipeline of Trans-border Infrastructure Projects

Road Sector Pipeline Projects

The survey of road transport infrastructure provided the pipeline projects that the member states had identified for development in order to provide connectivity along the designated interstate links along the major corridors. These projects are at various stages of development and include those that were intended for upgrading, major rehabilitations of capacity expansion. These pipeline projects and their status towards implementation are shown in Table 4-22 below.

Table 0-22: IGAD Countries Planned Road Projects

Country	Project Title	Corridor	Length (Km)	Connecting with Country	Condition	Status
Djibouti	Tadjoura/ Balho	Djibouti	112	Ethiopia	Gravel	Road construction is on the last stages of completion
	Dikhil-Galafi	Djibouti	98	Ethiopia	Paved	Extensive rehabilitation to commence in 2019
Ethiopia	Asosa/Kurmuk	Djibouti	96	Sudan	Gravel	Design for upgrading complete
	Mizani Teferi - Dima -Raad	Djibouti	260	South Sudan	Gravel/earth	Under construction
	Dire Dawa/ Kebridar	Mogadishu	428	Somalia	Gravel/earth	Project preparation stage
	Kebridar/Kelafo - Ferfer	Mogadishu	410	Somalia	Gravel/earth	Project preparation stage
	Wendo-Negele	Mogadishu	250	Somali/Kenya	Gravel	Feasibility studies already undertaken
Kenya	Lamu/ Garissa/Isiolo	LAPSSET	530	Ethiopia, South Sudan	Gravel/earth	Feasibility study completed, financing

Country	Project Title	Corridor	Length (Km)	Connecting with Country	Condition	Status
						arrangements, expected 2018
	Isiolo/Modogashe/ Mandera upgrading	LAPSSET	740	Somalia	Gravel/earth	Ekwak-Mandera (135km) section under construction
	Isiolo-Lokichar	LAPSSET	380	South Sudan	Missing link	Feasbility Study and Designs ongoing
	Lokichar-Nandapal	LAPSSET	338	South Sudan	Paved/Gravel	Construction ongoing
	Garissa-Liboi	Kismayu	179	Somalia	Gravel/earth	Designs completed
South Sudan	Juba-Kapoeta-Nandapal	LAPSSET	345	Kenya and Ethiopia	Gravel	Financing arrangements
	Juba-Yei-Kaya	Northern	245	Uganda and Kenya	Bitumen	Feasibility study completed in 2014
	Malakal-Jikou	Port Sudan	270	Ethiopia and Djibouti	Gravel/earth	Feasibility study completed in 2014
	Malakal- Renk	Port Sudan	300	Sudan	Gravel/earth	Feasibility study completed in 2014
	Wau-Gogrial-Abyei	Port Sudan	225	Sudan	Gravel/earth	Feasibility study completed in 2015
	Kapoeta-Boma-Raad	Djibouti	270	Ethiopia and Djibouti	Gravel/earth	Feasibility study completed in 2016
	Juba-Kajo Keji	Northern	120	Uganda	Earth/gravel	Completed in 2014
Sudan	Dongola-El Eiweinat	Port Sudan	620	Libya	Earth/Gravel	Plan for 2018 for study and design
	Fashir-El Ewainat	Port Sudan	990	Libya	Earth/Gravel	Under design
	Halfa-Ashkail	Port Sudan	30	Egypt	Bitumen	Design completed
	Doongola-Argeen	Port Sudan	365	Egypt	Bitumen	Design completed
	Showak - Lukdi - Humara	Port Sudan	92	Ethiopia	Bitumen	Under financing process
	Damazini-Kurmuk	Port Sudan	150	Ethiopia	Gravel	Under design
	Rinaid El Birdi-Um Dafoog	Port Sudan	128	Central Afriva	Bitumen	Financing Procedures
	Tokar-Garora	Port Sudan	179	Eritrea	Bitumen	Under construction
	El Mujlad-Abeyei	Port Sudan	200	South Sudan	Gravel	Under construction
	Buram-El Radoan	Port Sudan	145	South Sudan	Gravel	Under design
	Damazin- Renk	Port Sudan	200	South Sudan	Gravel	Design completed
Uganda	Jinja-Kampala	Northern	80	Kenya	Bitumen	Design for capacity expansion complete
Somalia	Berbera-Hargeisa	Berbera	160	Ethiopia	Bitumen	Rehabilitation ongoing
	Hargeisa-Togochaale	Berbera	83	Ethiopia	Gravel/earth	Upgrading ongoing
	Kismayo–Liboi	Kismayu	220	Kenya	Gravel/earth	Upgrading

Railway Priority Pipeline Projects

The priority projects identified may be with respect to new links, rehabilitation of existing infrastructure or the expansion of capacity for current facilities. The railway priority projects were provided by the railway authorities during the field missions. They are contained in their masterplans, government development plans or in policy documents.

In cases where the projects have a cross-border impact they may have already been identified and prioritised individually by states, bilaterally by two states or by a group of states with a common desire to provide for interstate rail networks. Table 4-23 below shows the identified planned priority IGAD railway projects by country.

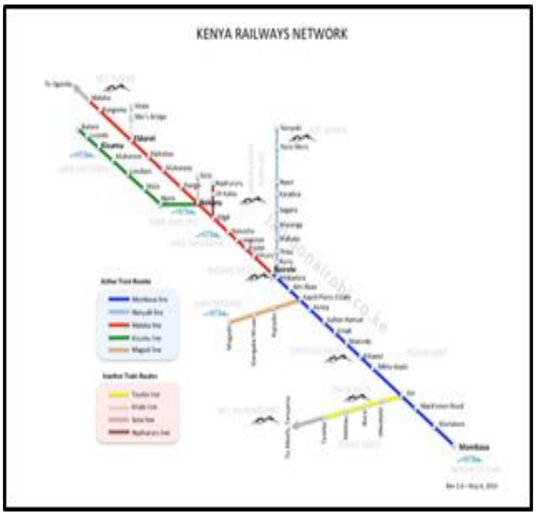
Table 4-23: IGAD Countries Planned Rail Projects

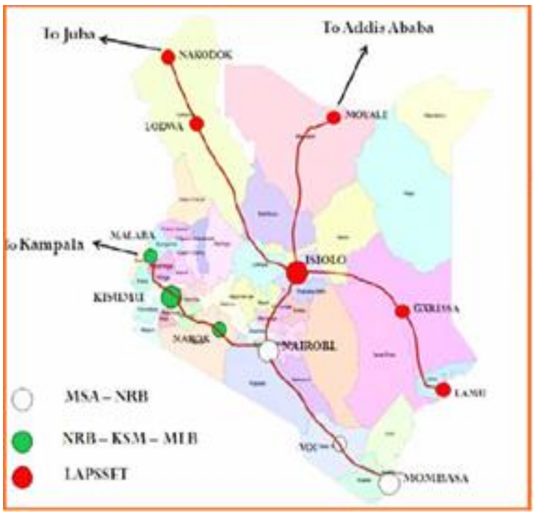
Country	Proposed Trans-border Lines	Corridor	Length (Km)	Estimated Cost (US$)	Project Status	Cross Country
Djibouti	Tadjourah Port -Semera	Djibouti	296		Preliminary Design	Second link to Ethiopia
Ethiopia	Hara Gebeya – Mekele	Djibouti	256		Design completed	
	Hara Gebeya – Semera-Djibouti border	Djibouti	380		Preliminary Design	Second link to the Red Sea through Tadjoura port (Djibouti)
	Modjo-Awassa-Moyale	Djibouti	905		Planned	Connection to Kenya
	Addis – Bedelee-Jimma-Dimma	Djibouti	700		Design completed	Connection to South Sudan border
	Ambo – Nekemte–Asosa–Kurmuk	Djibouti	520		Planned	Connection to Sudan border
Eritrea	Masawa – Asmara-Agordat - Tessenei	Massawa	450		NA	Connection to Sudan border
Kenya	Nairobi- Naivasha Phase 2A	Northern	120	1,483	Construction ongoing	Section of Nairobi/Malaba link
	Naivasha – Kisumu (Phase 2B)	Northern	263	3,664	Preliminary Design	Section of Nairobi Malaba link
	Kisumu Port/ Kisumu – Malaba ((Phase 2C)	Northern	108	1,229	Preliminary Design	Section of Nairobi-Malaba link
	Lamu -Isiolo	LAPSSET	544		Preliminary Design	Connection to South Sudan
	Isiolo - Nandapal	LAPSSET	738		Preliminary design	Connection to South Sudan
	Isiolo - Moyale	LAPSSET	455		Preliminary design	Connection to Ethiopia
	Isiolo – Nairobi	LAPSSET	275		Preliminary Design	Link to network
Somalia	Berbera -Hargeissa-Togochaale	Berbera	250		Project idea	Connection to Ethiopia
	Berbera -Burao – Kalabaydh-Qoriley	Berbera			Project idea	Connecting Somalia and Ethiopia
	Mogadishu – Jowah-Beledwene-Ferfer	Mogadishu	340		Project idea	Connecting Somalia and Ethiopia
	Mogadishu – Baidoa - Dollo/Mandera	Mogadishu	475		Project idea	Connecting Somalia and Kenya

Country	Proposed Trans-border Lines	Corridor	Length (Km)	Estimated Cost (US$)	Project Status	Cross Country
South Sudan	Juba- Nimule	Northern	190			Connection to Ethiopia
	Juba-Kapoeta- Nandapal	Northern	345			Connection to Kenya (LAPSSET)
	Kapoeta-Boma/Raad	Djibouti	200			Connection to Ethiopia and Djibouti
	Wau- Rumbek – Juba-	Port Sudan	645		NA	Connection to Sudan
Sudan	Port Sudan- Haya -Atbara-Khartoum	Port Sudan				Mainline to Khartoum
	Haya-Kassala-Gedarif - Metema	Port Sudan			Planned	Connection to Ethiopia
	Gedarif – Metema	Port Sudan	160		Planned	Connection to Ethiopia
	Ad-Damazin - Kurmuk	Port Sudan	200		Planned	Connection to Ethiopia
Uganda	Malaba/Kampala	Northern	273	2,300	FS conducted	Connection to Kenya
	Kampala/Kasese	Northern	333		FS conducted	Internal
	Tororo/Gulu	Northern	342		FS conducted	Internal
	Gulu -Nimule	Northern	140		FS conducted	Connection to Juba South Sudan

The rail maps for existing and proposed rail network configurations are shown in Figure 4-3 below

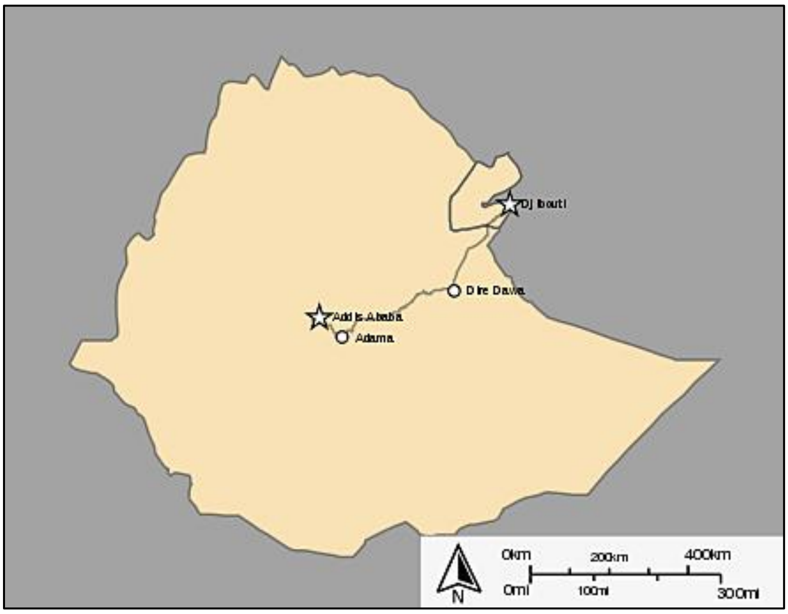
Figure 0-3: Maps of Current and Planned IGAD States Railway Networks



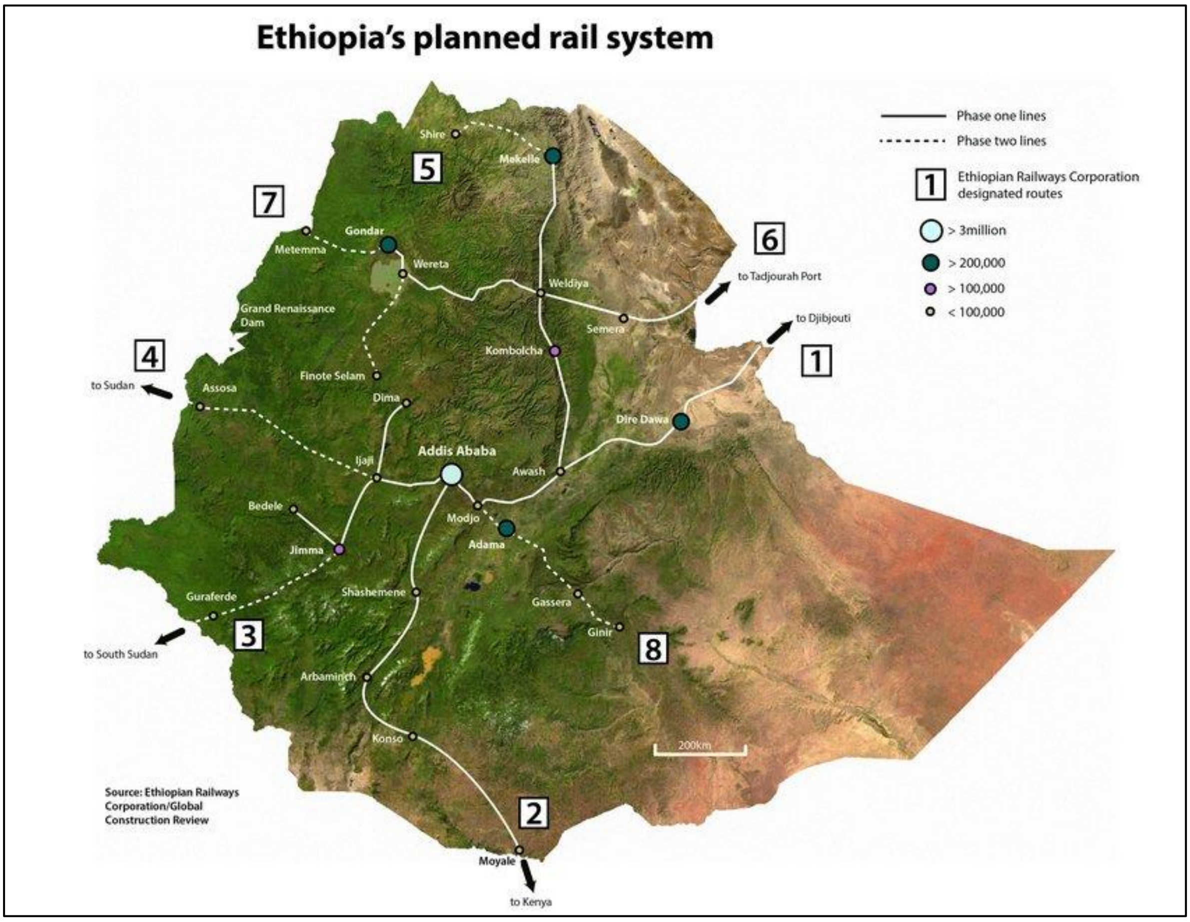


Kenya Original Network

Kenya Planned Network



Ethiopian Original Network



Sudan Current Network[29]

Sudan Planned Network

Section 4.3 Ports Pipeline Projects

The following section provides the physical projects containing location, dimensions, cost estimates and their stages towards implementation. The priority projects identified may be with respect to new links, rehabilitation of existing infrastructure or the expansion of capacity for current facilities. The planned priority ports infrastructure projects proposed or ongoing are provided in the accompanying summaries covering each port.

Djibouti Ports Projects

The port of Djibouti has greatly expanded its capacity in the last ten years following a concession agreement with DP World. The expansion includes the construction of a modern Container Terminal at Doraleh and the establishment of the Djibouti Port and Free Zone Authority (DPFZA). Although the concession with DP World has been terminated, expansion of the port is ongoing and there are several projects earmarked for implementation both at the port and in nearby port of Tadjourah. The planned projects earmarked for development in Djibouti are provided in Table 4-24

Table 4-24: Djibouti Ports Projects

Project Title	Corridor	Intervention Area	Cost (Us$ M)	Sources of Finance	Promoter/ Owner
Development of the Tadjoura port	Djibouti	Development of new port	70	Joint Ethio/ Djibouti	Djibouti/ Ethiopia
Doraleh Terminal Extension	Djibouti	Extension of facilities	590	Govt of Djibouti	DPFZA[30]

[29] Wikipedia source
[30] Djibouti Ports & Free Zones Authority

Djibouti International Container Terminal (DICT)		Development of a container terminal with a annual capacity of 2.5 mill. TEUs	654		DPFZA/ CMA
Development of Damerjog Multipurpose and Livestock Port	Djibouti	Crude/product crude oil jetty (2 berths; 1x 100,000 DWT and 1x 50,000 DWT)		N.A.	DPFZA
		Multi-purpose port on reclaimed land with a 270m quay	78		
Liquefied Natural Gas (LNG) Terminal Doraleh,	Djibouti	Feasibility studies	1	N.A.	

Figure 0-4: Djibouti Doraleh Container Terminal

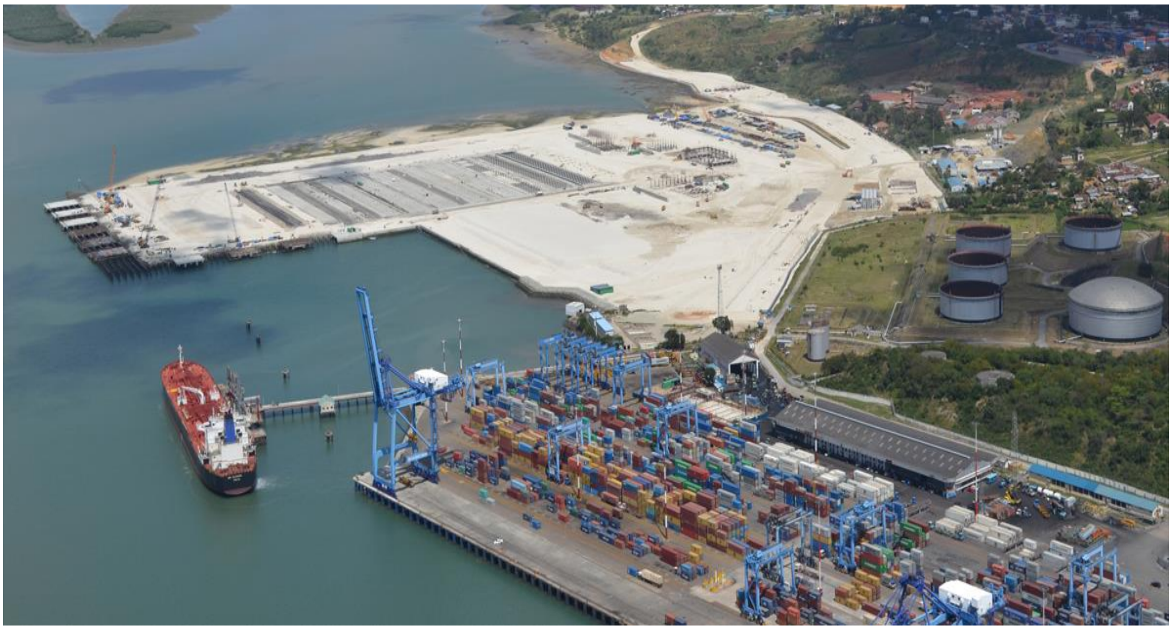
Kenya's Ports Projects

The primary port in Kenya is Mombasa port which through the Northern Corridor serves a large hinterland. Mombasa is served by the old narrow-gauge Kenya Uganda Railway and the newly constructed Standard Gauge Railway (SGR). Kenya is also developing the Lamu port which is the originating port for the LAPSSET Corridor and is planned to be served by an SGR that will link it to Ethiopia and South Sudan. It is also earmarked for the development of a crude oil pipeline. The priority pipeline ports projects for Kenya are provided in Table 4-25 below.

Table 4-25: Kenya Pipeline Ports Projects

Project Title	Corridor	Intervention Area	Cost (Mill Us$)	Sources of Finance	Promoter/ Owner
Mombasa Port Second Container Terminal	Northern	New Construction	250	JICA	KPA
Construction of a new Crude Oil Terminal	Northern	New Construction			KPA
Construction of Special Economic Zone in Dongo Kundu	Northern	New Construction			KPA and SEZ Authority
Construction of a Crude Oil Terminal	LAPSSET	New Construction			Ministry of Energy
Lamu Port (3 berths)	LAPSSET	New Construction	480	GOK	KPA
Lamu Crude Oil Terminal	LAPSSET	New Construction			KPA

Figure 0-5: Aerial View with Phase 1 of the Mombasa Container Terminal 2 while under Construction



Somali Ports Projects

Somalia has three major deep-sea ports comprising Mogadishu, Berbera, and Kismayu. Traffic in both Mogadishu and Kismayo declined substantially following civil strife in the early 1990's. However, following the return to civil order, the port of Mogadishu has been concessioned to a Turkish firm and a programme of rehabilitation is ongoing. The port of Berbera which serves Somaliland was less affected and today DP World is expanding its facilities to provide services to both Somalia and Ethiopia.

A blueprint for the development of port facilities and other transport infrastructure was prepared in 2016 through the African Development Bank funded Transport Needs Assessment Study for Somalia that prepared a Transport Sector Investment Programme (TSIP).

The priority pipeline projects for the Somali ports are provided in Table 4-26 below.

Table 0-26: Somalia Pipeline Ports Project

Project Title	Corridor	Intervention Area	Cost (Mill US$)	Sources of Finance	Promoter/ Owner
Development of 4 new berths in Mogadishu port	Mogadishu	Construction		Turkey	
Upgrading of the oil import facilities at Mogadishu	Mogadishu	Feasibility study, construction	20		
Construction of a 400 meters-long Container Quay	Berbera	Construction	341	DP World	
Construction of a 250,000 M³ port yard	Berbera	Construction	101	DP World	

Sudan Planned Ports Projects

Sudan has one major port (Port Sudan) and the two small ports of Suakin and Oseif all located on the Red Sea. Port Sudan handles the bulk of cargo destined for Sudan with transit traffic for Ethiopia, South Sudan and Chad.

Port Sudan is connected to its hinterland by road, rail, and by products and crude oil pipelines. The priority pipeline port projects for Sudanese ports are provided in Table 4-27.

Table 0-27: Sudan Pipeline Ports

Project	Corridor	Intervention Area	Cost (Mill US$)	Sources of Finance	Promoter/ Owner
Rehabilitation of Berth No1 (Grain Terminal) – Phase 1	Port Sudan	Quay rehabilitation and dredging		NA	Sudan Seaport Corporation
Rehabilitation of 5 general cargo berths – Phase 2	Port Sudan	Quay rehabilitation and dredging		NA	Sudan Seaport Corporation
Rehabilitation of 2 general cargo berths - Phase 3	Port Sudan	Quay rehabilitation and dredging		NA	Sudan Seaport Corporation
Development of deep berths at Suakin port	Port Sudan	Construction		NA	Sudan Seaport Corporation

Projects Planned in Inland Waterways

A number of projects have been identified for the development of ports facilities and for the improvement of navigation in the inland waterways. While Uganda and Kenya have identified projects to rehabilitate ports facilities on Lake Victoria, South Sudan and Sudan have projects for enhancing river transport through improving the waterways and rehabilitating the various river ports.

Table 4-28 below provides the pipeline projects for the Inland waterways in the IGAD region.

Table 0-28: Priority Pipeline Projects in Inland Waterways

Project Title	Water Body	Country	Intervention Area	Cost (Mill Us$)	Source of Funding
Rehabilitation of Kisumu Pier	Lake Victoria	Kenya	Rehabilitation		GoU
Rehabilitation of Port Bell Facilities	Lake Victoria	Uganda	Rehabilitation		GoU
Rehabilitation of Jinja Port Facilities	Lake Victoria	Uganda	Rehabilitation		GoU
Construction of a new port	Lake Victoria	Uganda	New Construction		GoU
Improvement of Navigation Aids on Lake Victoria	Lake Victoria	Kenya and Uganda	New works		France
Improvement of port facilities (Juba, Bor, Malakal and Renk) on the White Nile	White Nile	South Sudan	Rehabilitation		GoSS
Improvement of port facilities at Kosti on the White Nile	White Nile	Sudan	Rehabilitation		GoS
Rehabilitation of facilities for ports on Sobat River	Sobat	South Sudan and Ethiopia	Rehabilitation		GoSS and FDRE
Provision of Navigation Aids on the White Nile	White Nile	South Sudan and Sudan	Construction/ Installation		GoSS and GoS
River Nile Transport Corridor Project	Nile and Lakes Victoria and Lake Albert	Nile River Countries	Project Identification and Feasibililty Studies		AfDB

Projects Planned in Civil Aviation

The civil aviation subsector projects which were planned for development in the short and medium terms were provided by the civil aviation authorities and airports operators in the IGAD region. Table 4-29 below lists the projects provided for both airports and air navigation authorities in the region.

Table 0-29: IGAD Planned Aviation Projects

Country	Project Title	Intervention Area	Cost (Mill Us$)	Sources of Finance	Promoter/ Owner
Continental	SAATM/PIDA	Policy/ Regulation	NA[31]		AUC
Continental	SAS/PIDA	Development of Air traffic management in line with ICAO Global Aviation Plan	NA[32]		AUC
Djibouti	Djibouti Airport Expansion of the Terminal building facilities	Capacity expansion			Ministry of Transport
Ethiopia	Construction of a new Addis Ababa Airport	New Construction			Ethiopian Airports Enterprise
	Upgrade and expansion of airport facilities in Dire Dawa, Semera, Makele, Gondar, Gambella	Expansion of runway and terminal building			Ethiopian Airports Enterprise
Kenya	Construction of Greenfield Terminal in JKIA	New construction	560.0		KAA
	Construction of Lamu Airport	New construction			KAA
	Expansion of Isiolo Airport	Expansion of runway and terminal building			KAA
South Sudan	Expansion of Juba Airport facilities	Expansion of runway and terminal building			
	Construction of Malakal International Airport	Expansion of runway and terminal building			
	Construction of new airports in Rumbek and Wau	New construction			
Sudan	Construction of New Khartoum Airport	New construction			Sudan Airports Authority
	Expansion of other existing airports (Port Sudan, El Obeid, Nyala, Al Fasha Dongula and Wadi Halfa	Upgrade and expansion of both runways and terminal buildings			Sudan Airports Authority
Uganda	Expansion of Facilities at Entebbe Airport	Expansion of runways and terminal buildings			
	Development and upgrade of airports at Hoima, Gulu, Kasese	New construction and upgrade			CAA

[31] AFCAC/AUC to undertake relevant studies to determine resource requirements
[32] AFCAC/AUC to undertake relevant studies to determine resource requirements

Section 4.4 The Enabling Environment for the Transportation Sector

The Road Sub-sector

Roads in the IGAD regions remain the major mode of transport for both freight and passengers and large budgetary resources are expended every year to provide for maintenance, rehabilitation and new construction. In all the IGAD countries, policy on road development and services falls under the ministries responsible for roads and these are the ministries of transport. The policy articulates national positions with respect to the development of physical infrastructure, financing, management, maintenance and capacity building. Regarding regulatory issues, the road sector has been regulated by governments and in the recent past.

Arising from the reforms that followed the structural adjustments imposed on many African countries, dedicated road transport authorities have been set up to undertake road infrastructure development, technical and economic regulatory agencies were established. Ethiopia, Kenya and Sudan have dedicated transport regulatory agencies. In Kenya, the oversight agency is the National Road Transport and Safety Agency (NATSA) which intended to provide regulatory oversight on railways.

In order for the road sector to perform effectively and fulfil the expected public policy objectives of serving the economy and the public, it must be coupled with strong institutions that develop and maintain road infrastructure and also oversight its functioning. In addition, it is necessary to have institutions such as road boards which collect fuel and other road levies hence housing dedicated funds that that have regular availability to undertake regular and ad hoc maintenance of road infrastructure.

The road sector reforms adopted by the governments of the IGAD region under the SSATP programmes have resulted in the establishment of institutions that have enabled the road sector to benefit from the assignment of functions covering governments, road development agencies, road boards and oversight agencies such as road transport and safety agencies.

The road boards collect road funds from fuel levy, road user charges and other charges and distribute the funds for use in various interventions in the road sector the primary one being road maintenance and road safety.

Capacity building for road sector personnel is crucial in order to develop the human capital necessary to undertake design of road networks and infrastructure contractors to undertake construction and maintenance, consulting and relevant regulatory and oversight personnel. Other areas where human capital is required include research in road matters including construction materials testing labs.

In order to build capacity, most of the IGAD countries have training facilities directly owned by states or provided through agreements with research institutions including universities that provide for tertiary technical training and skills development. These institutions also provide for peering opportunities for experts from counterparts from other countries.

Table 0-30: Road Regulatory Setups in IGAD Countries

Country	Regulatory Agency	Location
Djibouti	Ministry of Transport	Djibouti
Eritrea	Ministry of Transport	Asmara
Ethiopia	Federal Transport Authority	Addis Ababa

Kenya	National Road Transport and Safety Agency	Nairobi
Somalia	N.A.	
South Sudan	Ministry of Transport	Juba
Sudan	Ministry of Transport	Khartoum
Uganda	Ministry of Transport	Kampala

Challenges in the Road Subsector

The road network in any country is one of the most important assets usually developed with substantial use of public resources. Due the high costs of road development and maintenance to ensure preservation of the road assets, states endeavour adopt appropriate strategies to ensure the optimal allocation of public resources in the road sector. The strategies need to give priority to sections of the road network that provide the maximum economic and social benefits to the public. The main challenges facing the road sector in the IGAD region are:

- **Institutional constraints where road t**ransport facilities under public ownership and management have weak and ineffective institutional structures with lack of capacity with poor corporate governance, sound decision making and efficient management;
- **There are capacity issues at** institutional levels with lack of technical know-how and also at within other relevant stakeholders who include financiers, consultants and contractors;
- **Inadequate funds for road infrastructure development and maintenance. This not peculiar to the road mode but also to** nearly all modes of transport modes;
- **Road development is encumbered by rights of way issues leading to high costs in land acquisition for road construction.** This makes the cost of land a substantial proportion of the asset development compared to the cost of road construction budget;
- The participation of the private sector in road development and management is a major challenge arising primarily from lack of proper legal frameworks to enlist the private sector into PPPs and to effectively supervise their operations; and
- Delays in procurement of contractors for design, construction and maintenance of road networks

The Railway Sub-sector

At the continental level, the Programme for Infrastructure Development (PIDA) advocates for the expansion of rail transport through the construction of new lines and modernisation of existing ones. It estimates that the continent requires the construction of 12,000 kilometers of new track and the modernisation of 17,500 kilometers of existing track[33].

In all the IGAD countries, policy on rail development and services is usually under the ministries responsible for railways and are usually the ministries of transport. The policy articulates national positions with respect to the development of physical infrastructure, financing, management, maintenance and capacity building.

On regulatory front, government departments have also traditionally taken both technical and economic regulation of railways. This is unlike in maritime and civil aviation where dedicated

[33] Study on Programme for Infrastructure Development in Africa (PIDA)

autonomous regulatory authorities have been the rule. With the development of the standard gauge railways in Djibouti, Ethiopia and Kenya, the need for independent rail regulator has been accepted and the three countries have already developed legislation to establish independent regulators for railways or to mandate existing multisectoral regulators to carry out the functions. Ethiopia has already established a rail regulatory authority while Kenya intends to mandate the National Road Transport and Safety Agency (NATSA) to provide regulatory oversight on railways.

In order to strengthen institutions and build their capacity to effectively and efficiently guide and regulate the railway sector with due regard to a common IGAD railway transport market, it will be necessary to develop common railway standards and specifications for infrastructure and energy, equipment and operating systems and procedures to support connectivity, interoperability and safety management.

Harmonised standards/specifications for rail infrastructure to facilitate interoperability; and harmonised safety regulations are lacking in the IGAD region. Appropriate policy framework is lacking to guide joint development of appropriate instruments (legal, regulatory or administrative instruments) to be used in implementation.

There is need for the establishment of national railway safety and economic (access) regulatory authorities lacking and carryout capacity building, training to carry out regulatory functions or comply with regulatory requirements and to establish within IGAD a Regional Safety and Interoperability Oversight Agency to carry out coordination and oversight functions in respect of safety, cross border train operations and trade.

Kenya and Ethiopia have already developed draft bills for their parliaments to establish an open access regime after accomplishing a legal and regulatory framework study for the railway subsector. Djibouti, Eritrea and South Sudan will need to develop similar legislations to provide for appropriate regulatory and institutional framework.

The Kenyan Draft Bill provides for a regime of open access with a network owner and the relevant institutions that are necessary to administer it. These include asset holder/manager, infrastructure capacity manager (track access fees), safety regulator, economic regulator (access and tariff setting), development of regulations and standards for the national authorities. It is evident from the findings out of the visits to member countries that a capacity building programme will need to be drawn in advance for the establishment of an effective integrated regional rail network.

In terms of the training of rail personnel for management and operation, it was noted that Ethiopia and Kenya were revitalising their railway training schools to meet the needs of the SGR networks. They had also procured scholarship to train technical and managerial personnel in China, Europe and Russia.

Ethiopia Railways Corporation had also initiated cooperation with the University of Addis Ababa to provide post graduate training for rail engineers and management staff. Sudan and Uganda still retain their railway training facilities but they will need to be revitalised.

Table 0-31: Rail Regulatory Setups in IGAD Countries

Country	Regulatory Agency	Location
Djibouti	Ministry of Transport	Djibouti
Eritrea	Ministry of Transport	Asmara
Ethiopia	Federal Transport Authority	Addis Ababa

Kenya	Kenya Railways Corporation	Nairobi
Somalia	N.A.	
South Sudan	Ministry of Transport	Juba
Sudan	Ministry of Transport	Khartoum

Challenges in the Rail Sector

In each of the IGAD countries, the transport sector has faced myriad challenges which have hindered the sector in stimulating the national economic growth as envisaged in the country's economic plans.

The management of railway services has been a challenge in most of the IGAD countries and even with reforms and adoption of contracting through concessioning, the rail sector has not produced encouraging outcomes. While Kenya, Tanzania and Uganda had an interconnected common rail network since 1948 where services were provided by a single operator, the East African Railways Corporation (EARC), there was a separation made in 1977 and each country proceeded to run its own services.

Over the years, the networks in both Kenya and Uganda experienced progressive deterioration primarily due poor maintenance and lack of investment in new infrastructure in both the rail network and rolling stock.

In 2006, the operations in the two countries were concessioned to Rift Valley Railways (RVR) under a 25-year concession agreement. The concessionaire made little progress in improving the rail services and share of rail freight declined even further. The concession was finally terminated by the Kenya and Ugandan governments in late 2017.

Concessioning attempts were made for the Ethio/Djibouti network but negotiations with various potential off takers did not yield any agreements. Sudan has attempted to grant open access to the private companies to operate the freight services but the rail share of traffic has not improved much.

Various studies undertaken in the past identified the shortage of funds, institutional and technical capacity, legal and regulatory framework as key challenges to railway transport development and sustainability.

At the regional level, challenges identified as inhibiting sustainable rail transport include; lack of interstate connectivity, aging tracks and rolling stock, insufficient resources for maintenance, poor tracking of rolling stock (locomotives and wagons), lack of effective intermodal integration and environment related issues such as pollution.

As the IGAD countries endeavour to overcome the railway challenges faced at national levels, they will further need to develop appropriate frameworks in order to successfully implement cross-border rail services to serve the region. The following issues will be addressed:

- Harmonisation of technical standards for interoperability in terms of infrastructure technology, standards and operating systems;
- Obstacles that may impede regional integration of the rail transport and related transit and trade facilitation issues;
- Integration with other transport modes as a vital part of the full service offered;
- Development of a harmonised environment within which the transport service is provided across the IGAD countries and within each country railway network;

- Enhancing regional competition policy for the provision of competitive services by separation of network owner from the operators of rail services;
- Harmonisation of business and pricing policy for a freight transport whose income covers operating, overheads, capital costs and make a return on the investment;
- Harmonisation of policies, rules and regulations to forestall barriers to cross-border transport flows and /or inhibit sub-regional trade integration; and
- Developing and equipping the railways training schools in each country to the required standards and considering the establishment of a regional centre of excellence in rail research, operations and management.

The Maritime Transport Sub-sector

In all the IGAD countries, policy on shipping, ports and inland waterways is usually under the ministries responsible for maritime transport. These in most cases the transport ministries. The policy articulates national positions with respect to physical infrastructure development, financing, management, maintenance and capacity building.

The regulation function in the maritime sector is usually under an autonomous maritime authority that exercises both port and flag state control and is also responsible for oversight on matters of marine pollution under the Maine Pollution Control (MARPOL Convention). Where no dedicated autonomous agencies are not in place, the state exercises the regulatory functions either directly or through departments established within the port authorities. Kenya and Ethiopia have autonomous agencies while Sudan and Djibouti have delegated the regulatory functions to their port authorities. Table 4-32 below shows the setups of the regulatory functions in the five coastal states:

Table 0-32: Maritime Sector Regulatory Setups in IGAD Countries

Country	Regulatory Agency	Location
Djibouti	Port Autonomie de Djibouti	Djibouti
Eritrea	Ministry of Transport and Communications	Asmara
Ethiopia	Ethiopian Maritime Affairs Authority	Addis Ababa
Kenya	Kenya Maritime Authority	Mombasa
Somalia	Ministry of Ports and Marine Transport	Mogadishu
South Sudan	Ministry of Transport	Juba
Sudan	Maritime Administration Directorate (Sea Ports Corporation)	Port Sudan

Institutional and Capacity Building in the Maritime Subsector

In order for the maritime sector to function efficiently and safely, it is necessary to have in place effective institutional structures in the form of regulatory/ oversight agencies and in capacity building. The regulatory agencies should be well structured and resourced in terms of funding and qualified manpower in order to meet the IMO standards for flag state and port state control.

In addition, training facilities need to be available for building capacity for both the regulatory agencies, sea going personnel and for all other personnel in the maritime transport industry. In the IGAD region, the necessary dedicated institutions to undertake oversight and for capacity building are not available in many countries. Training institutions for ports personnel are available in Djibouti, Kenya and Sudan while Ethiopia has a training school for sea going personnel but at the level of ratings. Training facilities for deck officers and engineers are not available.

Challenges in the Maritime Subsector

The maritime sector faces a number of challenges across its three subsectors. The challenges which may be specific or common across the board are summarised according to each subsector below.

In shipping, the main challenges relate to the capacity to establish robust shipping lines which can compete in the global shipping markets. In the past, most local shipping lines were state owned and there were cargo reservation schemes for national shipping lines. Following structural adjustments in the late 1980' most governments divested in shipping lines and most of them were wound up.

The capacity to acquire vessels, crewing them and running competitive services is not easy because of high capital costs and lack of global network for local shipowners to access sufficient cargo volumes to generate adequate freight earnings to make investment in ship operations profitable.

In the port sector, the main challenges arise from low port efficiencies resulting in port congestion, delays to vessels and delivery of cargo. Most of the IGAD ports are operated by government owned and controlled port authorities where decisions are centralised. The other major challenge to the ports is the lack of efficient counterpart facilities such as poor roads and rail infrastructure and service providers needed to evacuate or deliver cargo in the ports promptly once it is discharged or required for shipment. It also the case that whereas the ports serve both national and transit traffic, government policies reserve national cargo to national ports making it impossible to provide competition between ports in adjoining states.

The inland transport modes such as roads, railways and pipelines also make it difficult for transit trade to have a wider choice of ports within the various coastal countries. In this regard transit trade often have favourable ports because of the limited availability of efficient inland transport facilities. The other major challenges in ports relate to investment in port infrastructure capacities for maintenance of equipment and generally the human capital needed to provide efficient services.

In the inland waterways, the subsector is encumbered by lack of investments in facilities such as lake and river ports, dredging of waterways and provision of navigation aids. Most of the lake services are provided by the railway companies that have lost their share of cargo to road. In the case of river transport, the lack of navigation aids restricts their operations to daylight hours and hence they cannot optimise their operations. The technical challenges in inland waterways pertain to improving navigation by removing obstructions in the river fairways, straightening curves, widening, and deepening riverbeds and construction of navigation locks as required.

The Aviation Sub-sector

The civil aviation sector being heavily involved in transport passenger is one where clear policy and regulatory oversight are given the highest level of attention. The IGAD region follows generally the ICAO guidelines and the other standards set by regional bodies such as the AFCAC, COMESA, EAC and SADC Tripartite and the relevant air traffic control and air service providers such as IATA. Usually the ministries responsible for transport formulate policy while the civil aviation authorities are responsible for regulatory matters. The policy initiatives that have been put in place so far to facilitate frictionless intra-IGAD and international air transport. Table 4-33 below shows the Civil Aviation regulatory authorities in the IGAD states:

Table 0-33: Aviation Sector Regulatory Setups in IGAD Countries

Country	Regulatory Agency	Location
Djibouti	Djibouti Civil Aviation Authority	Djibouti
Eritrea	Ministry of Transport and Communications	Asmara
Ethiopia	Ethiopian Civil Aviation	Addis Ababa
Kenya	Kenya Civil Aviation Authority	Mombasa
Somalia	Ministry of Ports and Marine Transport	Mogadishu
South Sudan	South Sudan Civil Aviation Authority	Juba
Sudan	Sudan Civil Aviation Authority	Khartoum
Uganda	Uganda Civil Aviation Authority	Entebbe

Institutional and Capacity Building in Aviation Subsector

As the IGAD region advances and the demand for aviation services increases, there will be need for enhanced capacity at all levels and areas including infrastructure, manpower to manage the various skill requirement needed. The development of capacity in service provision by airports, airlines and other agencies on one side and conducting the necessary regulatory oversight on the other will require the availability of institutions to provide training of personnel to undertake highly skilled and technical functions to meet the international industry needs. Many IGAD member states have also developed their own internal capacity building institutions to support the anticipated demand for services.

Challenges in Aviation Subsector

The aviation sector in the IGAD region faces challenges due to both internal and external factors. These challenges will need to be addressed so as to meet industry needs during the period of the Masterplan. Some challenges caused by internal circumstances include the cases in Somalia and South Sudan which have been affected by the breakdown of law and order for Somalia since 1991 and the conflict in South Sudan in the last four years. Due to conflict the aviation industry has suffered, and the issue is ensuring its revival in both Somalia and South Sudan. In the case of Somalia, the UN Civil Aviation Caretaker Authority had been managing the Somali airspace from a base in Nairobi since the 1990's until relocation to Mogadishu.in 2018.

The other vexing challenge is the maintenance of bilateral air service agreements (BASAs) which restrict the market access for airlines. Under these BASAs, airlines are denied 5th Freedom, restricted on the number of frequencies and the capacity of equipment to operate with. The failure to remove the restrictions denies operators to realise economies of scale hence resulting in high costs of operations inability to make enough returns on investment and provide sustainable services. Challenges also arise because of the lack of human capital to manage the industry efficiently from service provision to the regulatory and oversight responsibilities. External challenges may arise due to requirements by other parties outside a region that (a) impose restrictions on the type of aircraft and more restrictive safety, security and environmental conditionalities for less developed countries and (b) demand traffic rights over and above those allowed by the AU SAATM arrangements.

Section 4.5 Transport Infrastructure Gap Analysis

The transport infrastructure gap analysis assesses the capacity of infrastructure to meet forecast traffic demand (measured in millions of tons) in each section of the IGAD corridors during the three time periods, 2024, 2030 and 2050. The detailed demand forecasting methodology is explained in Appendix 1. Demand for each section of the corridor is comprised of five components:

- **Direct intra-IGAD trade**: Direct trade between the countries comprising the corridor (sum of exports and imports between Country A and Country B);
- **Transit intra-IGAD trade**: Trade between non-neighboring countries that transits through a third country(ies) (sum of exports and imports between Country A and Country C, where Country B is in between);
- **Direct inter-continental trade**: Inter-continental trade flows along a segment of the corridor that do not cross IGAD borders;
- **Transit inter-continental trade**: Trade from landlocked countries that transits through a third country(ies) (sum of exports and imports between Country C and non-Africa, where country B is in between);
- **Domestic trade:** Internal domestic trade that flows along the corridor (e.g. goods passing from point A in Country A to point B in Country A).

Current capacities are estimated based on the data collected in the inventory. Gaps are considered that arise from two sources:

- Infrastructure links and facilities that are **currently missing**; and
- Increase in the volume of traffic leading to insufficient capacity.

The gap assessment covered road, rail, border posts, seaports, and inland waterways for each of the IGAD corridors. However, due to lack of data, the second source could (increase in traffic volume) could only be estimated for five of the eight corridors (no data was available for Massawa, Mogadishu or Kismayu). In the aviation sector, the capacity requirements have been taken as provided by the national aeronautical authorities. The adoption of the projects provided by the aeronautical authorities was made owing to the fact that very detailed technical studies had already been conducted by these aeronautical authorities taking into account projections made by international organisations such as ICAO and IATA, the projections made and the projects proposed in their masterplans for sector development are adequate.

Assessment of Gaps due to Missing Infrastructure Links

Currently, all the corridors are served by road networks that are largely transboundary though there may be missing links due to unpaved segments or where only non-motorable tracks exist. The details of missing road links along the designated IGAD corridors including their current status is shown in Table 4-34 below.

Table 0-34: Missing Road Links

Corridor	Country	Missing Road Segments	Status
Northern Corridor	Kenya	Lokichar/Lokichoggio	Gravel requires upgrading
		Lokichoggio/Nandapal	Gravel requires upgrading
	Uganda	None	
	South Sudan	Nandapal/Kapoeta/Juba	Gravel requires upgrading
		Juba/Mundri/Rumbek/Wau	Earth requires upgrading
		Mundri/Yambio	Earth requires upgrading
		Juba -Bor – Malakal	Gravel requires upgrading

LAPSSET Corridor	Kenya	Lamu/Garissa/Isiolo	New road
		Isiolo/Lokichar/Nandapal	Gravel requires upgrading
	South Sudan	Nandapal/Kapoeta/Juba	Gravel requires upgrading
Kismayu Corridor	Somalia	Kismayu/Liboi	Earth requires upgrading
	Kenya	Liboi/Garissa	Gravel requires upgrading
Mogadishu Corridor	Somalia	Mogadishu/Jowhar/Ferfer	Earth requires upgrading
		Mogadishu/Baidoa/Beled Hawa	Gravel requires upgrading
	Ethiopia	Fefer/ Dodola/Ginir/Gode /Kelafo	Gravel requires upgrading
	Kenya	Beled Hawa/Mandera	Gravel requires upgrading
		Mandera/Isiolo	Gravel requires upgrading
Berbera Corridor	Somalia	Hargeissa/Togochaale	Gravel requires upgrading
	Ethiopia	Togochaale/Jijiga	Gravel requires upgrading
Djibouti Corridor	Djibouti		
	Somalia	Loyada border/Borama/Hargeisa	Gravel requires upgrading
	Ethiopia	Asosa/Kurmurk	Gravel requires upgrading
		Dima/Raad/Boma	Gravel requires upgrading
	South Sudan	Boma/Kapoeta	Earth requires upgrading
		Kapoeta/Juba	Gravel requires upgrading
		Akobo/Nasir/Malakal	Earth requires upgrading
Massawa Corridor	Eritrea	Akordat/Tessenay	Gravel requires upgrading
	Ethiopia	Guna Guna/Adigrat	Gravel requires upgrading
	Sudan	Kassala-El Lafa	Gravel requires upgrading
Port Sudan Corridor	Sudan	Damazin/Kurmuk	Gravel requires upgrading
		Sennar/Rabat/Kosti	Gravel requires upgrading
		Damazin-Renk	Gravel requires upgrading
	Ethiopia	Humora/Gondar	Gravel requires upgrading
		Kurmurk/Asosa	Gravel requires upgrading
	South Sudan	Malakal- Renk	Gravel requires upgrading
		Wau-Gogrial-Abyei	Gravel requires upgrading
		Buram-El Radoan	Earth requires upgrading

Currently, there are three rail networks that interconnect IGAD countries. The interconnected countries are Kenya and Uganda, Ethiopia and Djibouti plus Sudan and South Sudan. In a programme to enhance rail interconnections among the countries, there are planned projects designated as priorities for development to interconnect Kenya with Ethiopia, Kenya and South Sudan, Ethiopia and South Sudan, and Ethiopia and Sudan. The proposed interconnection rail links are shown in Table 4-35 below

Table 0-35: Missing Railway Links

Corridor	Country	Rail Segments	Status
Northern Corridor	Kenya	Nairobi/Kisumu (SGR)	Financing being negotiated
		Kisumu/Malaba (SGR)	Financing being negotiated
	Uganda	Malaba/ Kampala (SGR)	Financing being negotiated
		Tororo/Gulu/ Pakwach (SGR)	Financing being negotiated
		Gulu/Nimule	Feasibility Study conducted
	South Sudan	Nimule/Juba	Feasibility Study conducted
		Juba/Mundri/ Rumbek/Wau	Project idea
LAPSSET Corridor	Kenya	Lamu/Garissa/ Isiolo	Feasibility Study conducted
		Isiolo/Nandapal	Feasibility Study conducted
		Isiolo/Marsabit/Moyale	Feasibility Study conducted
	Ethiopia	Moyale/Awassa/Modjo	Feasibility Study conducted
	South Sudan	Nandapal/ Kapoeta	Project idea

		Kapoeta/Torit/ Juba	Project idea
Djibouti Corridor	Djibouti	Tajoura/Elidar	Feasibility Study conducted
	Ethiopia	Hara Gebeya/Semera/Elidar	Feasibility Study conducted
		Weldiya/Wereta/ Gondar	Feasibility Study conducted
		Addis Ababa/Ejaji	Feasibility Study conducted
		Ejaji/Nekemte/ Kurmurk	Feasibility Study conducted
		Ejaji/Jimma	Feasibility Study conducted
		Jimma/Bedele	Feasibility Study conducted
		Jimma/Mizan Mizan/Dima	Project idea
		Dima/Raad/ Boma	Project idea
	South Sudan	Boma/Kapoeta	Project idea
		Akobo/Nasir/ Malakal	Project idea
Massawa Corridor	Eritrea	Asmara/Akordat/ Tessenay	Project idea
	Ethiopia	MekeleAdigrat	Project idea
		Mekele/Adwa	Project idea
	Sudan	Kassala-El Lafa	Project idea
Port Sudan Corridor	Sudan	Port Sudan/Atbara (SGR)	Feasibility Study conducted
		Atbara/ Khartoum	Feasibility Study conducted
		Khartoum/ Gedarif	Feasibility Study conducted
		Gedarif/Gallabat	Project idea
		Damazin/ Kurmuk	Project idea
		Khartoum/ El Obeid	Feasibility Study conducted
	Ethiopia	Kurmuk/Assosa	Project ide
		Metema/Gondar	Project idea

The regional policy is to provide standard border posts along the designated corridor routes. The policy is to speed up the border operations through the establishment of One Stop Border Posts (OSBPs). The planned OSBPs are in Table 4-36 below.

Table 0-36: Planned OSBPs

Corridor	Countries	Border Posts	Status
Northern Corridor	Kenya/Uganda	Suam	Designs prepared
	Uganda/South Sudan	Nimule/Elegu	Uganda completed and South Sudan designs prepared
		Kaya	Project idea
LAPSSET Corridor	Kenya/South Sudan	Nandapal	Designs prepared
Kismayu Corridor	Somalia/Kenya	Liboi	Project idea
Mogadishu Corridor	Somalia/Ethiopia	Ferfer	Project idea
	Somalia/Kenya	Beled Hawa/Mandera	Project idea
Berbera Corridor	Somalia/Ethiopia	Togochaale	Project idea
Djibouti Corridor	Djibouti/Ethiopia	Galile/Dewele	Project in progress
		Galafi	Designs prepared
		Balho/Elidar	Project idea
	Djibouti/Somalia	Loyada	Project idea
	Ethiopia/South Sudan	Raad/Boma	Designs prepared
		Akobo	Project idea
Assab Corridor	Eritrea/Ethiopia	Bure	Project idea
Massawa Corridor	Eritrea/Ethiopia	Guna Guna	Project idea
		Adwa/Mekele	Project idea

	Eritrea/Sudan	Tessenay	Project idea
Port Sudan Corridor	Sudan/Ethiopia	Gallabat/Metema	Designs prepared
		Kurmuk	Project idea
		Humora	Project idea
	Sudan / South Sudan	Renk	Project idea
		Takoi	Project idea
		El Radoan	Project idea

Maritime transport conveys the bulk of IGAD countries international trade that passes through their major seaports located on the Indian Ocean and the Red Sea.

Arising from the increasing trade, there are planned port projects covering berths for container, general cargo, dry bulks and bulk liquids cargoes. Some of these projects are already ongoing while others are planned for development to meet projected traffic levels. Some of the projects are also intended to provide increased capacities for transshipment and for planned free port economic zones.

The main port facilities planned for implementation are in the ports of Mombasa, Lamu, Mogadishu, Berbera, Djibouti and Port Sudan.

The planned seaport projects are shown in Table 4-37 below.

Table 0-37: Planned port facilities

Port	Container Berths	General Cargo Berths	Dry Bulk Berths	Liquid Bulk Berths	Other Berths[34]
Mombasa	4	3		2	
Lamu	4	6	2	1	1
Kismayu					
Mogadishu					
Berbera	2	3	1		
Djibouti	2	3		1	1
Assab					
Massawa[35]					
Suakin	1	2			1
Port Sudan	2	3		2	

The main navigable inland water bodies in the IGAD region consist of Lake Victoria and the River Nile and its various tributaries. Lake Victoria has no serious gaps in terms of deep-water fairways since it is sufficiently deep for the size of vessels that ply on it. However, the lake ports such as Kisumu, Jinja and Port Bell require dredging and constant removal of hyacinth which is endemic along the lake shores.

The other bottleneck on Lake Victoria is the lack of navigation facilities which means that for near shore navigation, pilots must rely on capability and hence vessel movements are restricted to daylight hours. On the Nile River and its navigable tributaries, there are constraints both in ports/landing points and also on the river fairways. Due to historical conditions in South Sudan, river transport facilities including ports, fairways and vessels are currently in a dilapidated state and will require extensive rehabilitation. Table 4-38 shows the main gaps in the Inland water transport subsector.

Table 0-38: Gaps in Inland Waterways

Corridor Segment	Facilities	Condition	Required Interventions
Lake Victoria	Lake Ports	Kisumu	Dredging and rehabilitation
		Jinja	Dredging and rehabilitation
		Port Bell	Dredging and rehabilitation
		New Port	Construction
	Navigation Facilities	Not installed	Installation, commissioning and maintenance
River Nile	River Ports	Juba, Mangala, Bor, Shambi, Ashkol, Dyham Dyham , Renk, Malut, Kosti and other dilapidated state	Rehabilitation and maintenance
	Navigation Facilities	Not installed	Hydrographic Surveys and Charting together with installation, commissioning and maintenance of Navaids
	Vessels	Not installed	Installation, commissioning and maintenance

[34] Livestock berths for Djibouti port and Suakin ports
[35] Not available

The civil aviation sector in the IGAD region comprises its various airports and the associated air navigation facilities. Each of the IGAD member states has at least one international class airport usually at the capital city that has a runway and terminal buildings to provide services to standard long-haul aircrafts. The larger countries such as Ethiopia, Kenya and Sudan have other regional airports that are also large enough to handle long-haul aircrafts and hence receive international flights. In the light of the global nature of civil aviation, the aeronautical authorities in the IGAD countries have developed comprehensive masterplans where they have listed the priority projects for implementation.

The priority projects in the civil aviation sector are well documented and are prepared after conducting studies that are informed by reputable aviation authorities that include ICAO, IATA and regional airlines associations. Due to this unique position of the aviation sector, the Consultant adopted the priority projects provided by the aeronautical authorities.

Gaps Arising from Growth in the Volume of Traffic

In addition to the existing gaps due to missing transport infrastructure, there will be gaps that will arise from the increase in traffic volumes over the duration of the IGAD Infrastructure Masterplan under preparation. The gaps arising from increased traffic volumes will need to be addressed through additional transport infrastructure together with optimising on the current stock of infrastructure. The following section provides detailed analysis of gaps in ports and surface transport along the IGAD corridors, showing the gaps between the planned capacity from member states development plans and the capacity expected in order to meet the forecast traffic volumes

Table 0-39: Traffic Forecasts and Gap Analysis, Northern Corridor (Millions of Tonnes)

Corridor Section	Member State	Mode	2024			2030			2050		
			Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap
Mombasa Port	Kenya	Port	60	49	No	80	79	No	NA	172	Yes
Mombasa-Nairobi	Kenya	Road	30	39	Yes	60	62	Yes		133	Yes
		Rail	30	25	No	60	51			90	
Nairobi-Nakuru	Kenya	Road	40	22	No	40	37			85	
		Rail	30	15	No	30	25			77	
Nakuru-Kisumu	Kenya	Road	30	11	No	30	18			42	
		Rail	30	7	No	30	12			28	
Kisumu-Busia	Kenya	Road	30	11	No	30	18			42	
		Rail	30	7	No	30	12			28	
Nakuru-Eldoret	Kenya	Road	40	9	No	40	19			43	
		Rail	30	7	No	30	12			39	
Eldoret-Malaba	Kenya	Road	40	12	No	40	12			30	
		Rail	30	7	No	30	8			20	
Eldoret-Kitale	Kenya	Road	40	8	No	40	14			38	
		Rail	30	4	No	30	10			25	
Kitale-Lokichar	Kenya	Road	40	8	No	40	10			28	
		Rail	30	0	No	30	6			19	
Malaba-Jinja	Uganda	Road	40	9	No	40	15			38	
		Rail	30	6	No	30	10			26	

Jinja-Kampala	Uganda	Road	40	15	No	40	25	66
		Rail	30	10	No	30	17	43
Tororo-Gulu	Uganda	Road	40	3	No	40	4	11
		Rail	5	2	No	5	3	8
Kampala-Gulu	Uganda	Road	20	2	No	20	2	7
		Rail	0	1	No	0	2	4
Gulu-Nimule	Uganda	Road	20	1	No	20	1	3
		Rail	0	0	No	0	1	2
Nimule-Juba	South Sudan	Road	20	1	No	20	1	4
		Rail	0	0	No	0	1	2

According to the planned projects in Mombasa port serving the Northern Corridor, the port capacity will be sufficient for traffic levels in Phase I (2019 – 2024) but expansion of port facilities will be required during the subsequent periods.

With a cargo share ratio of 60:40 between road and rail, the surface transport capacity in rail will be adequate but there will be a shortfall on road for the Mombasa/Nairobi segment.

The other surface transport capacities will be adequate for the other segments along the entire corridor.

Figure 0-6: Forecast traffic flows, 2024, Northern Corridor (Millions of Tonnes)

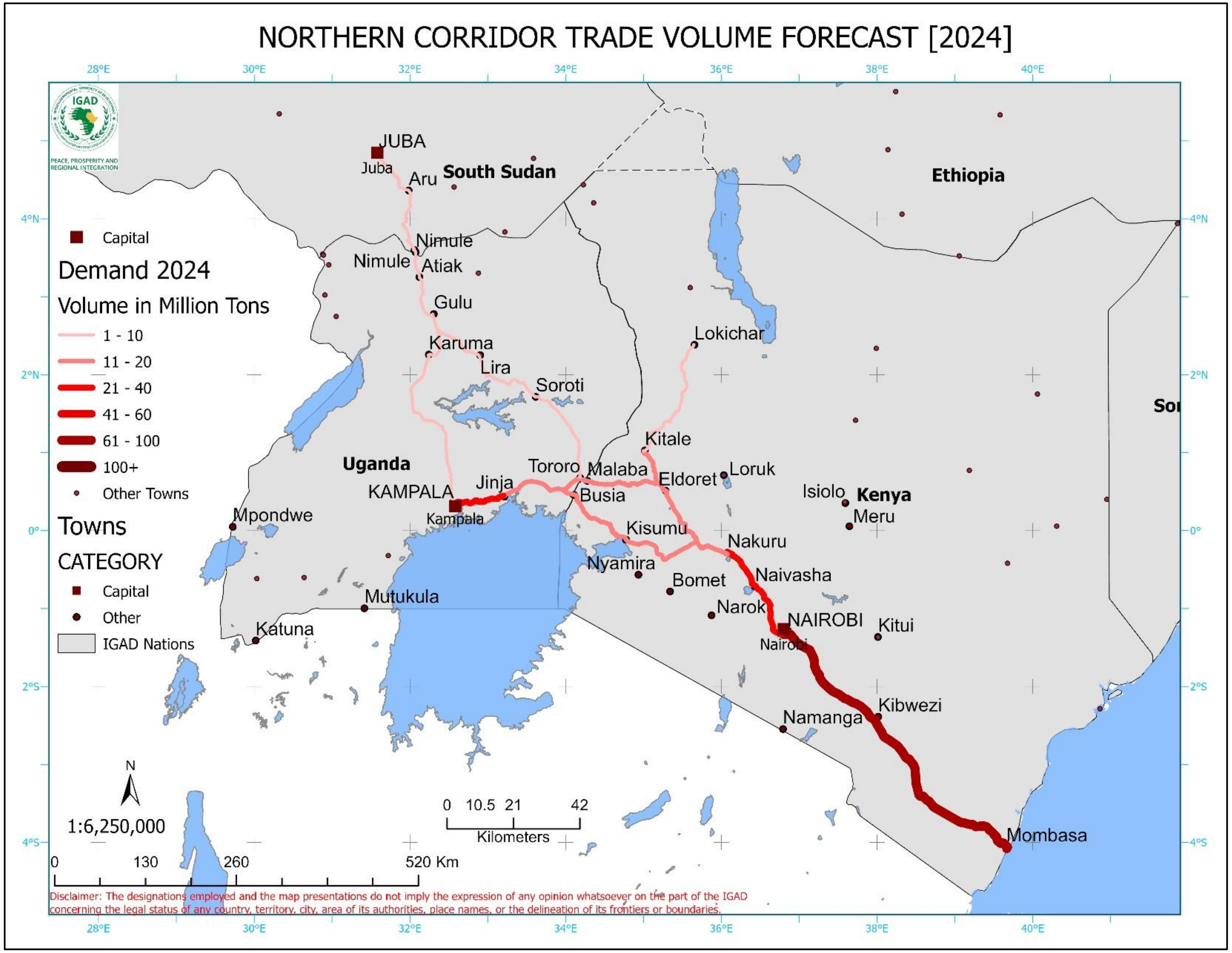


Figure 0-7: Forecast traffic flows, 2030, Northern Corridor (Millions of Tonnes)

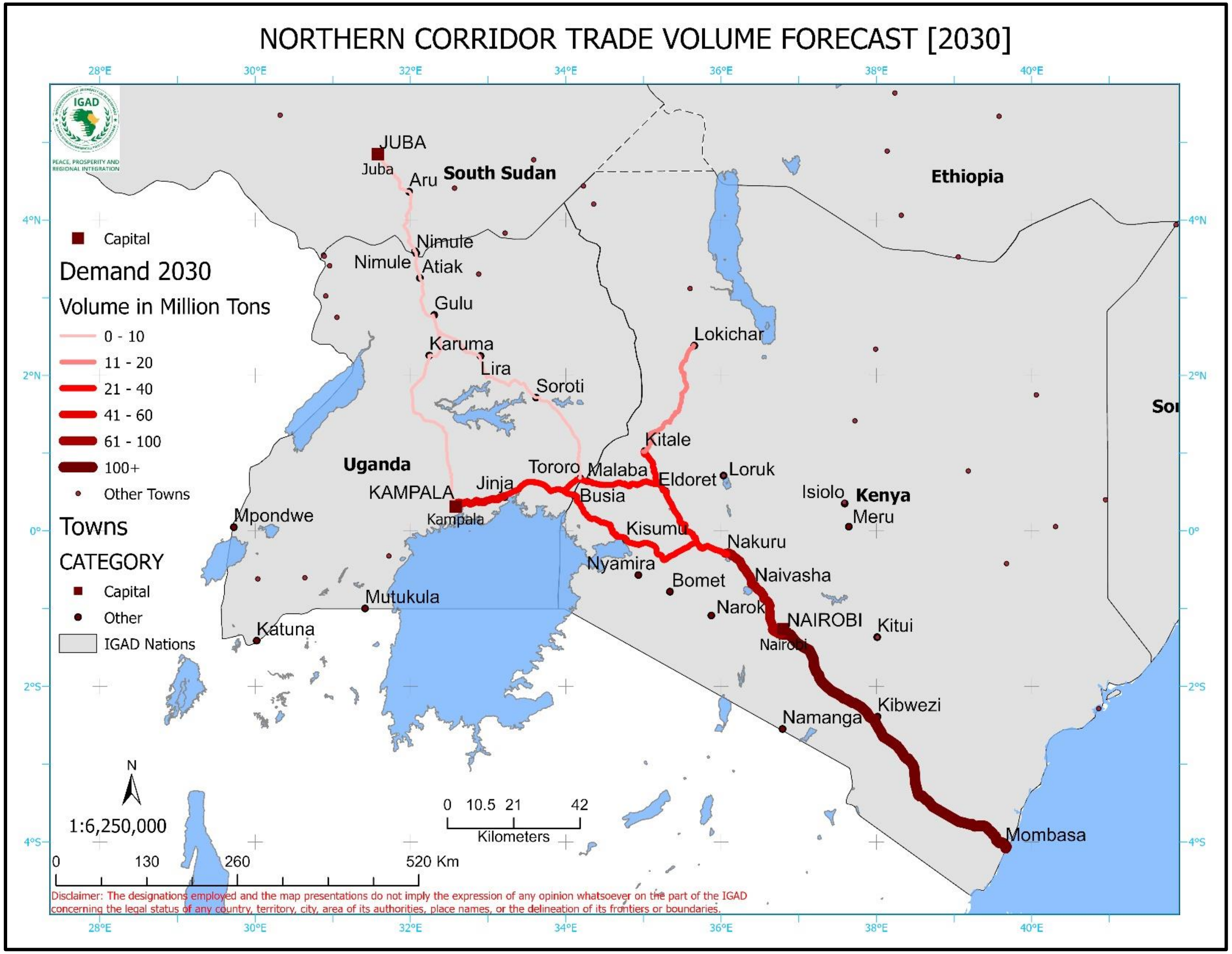


Figure 0-8: Forecast traffic flows, 2050, Northern Corridor (Millions of Tonnes)

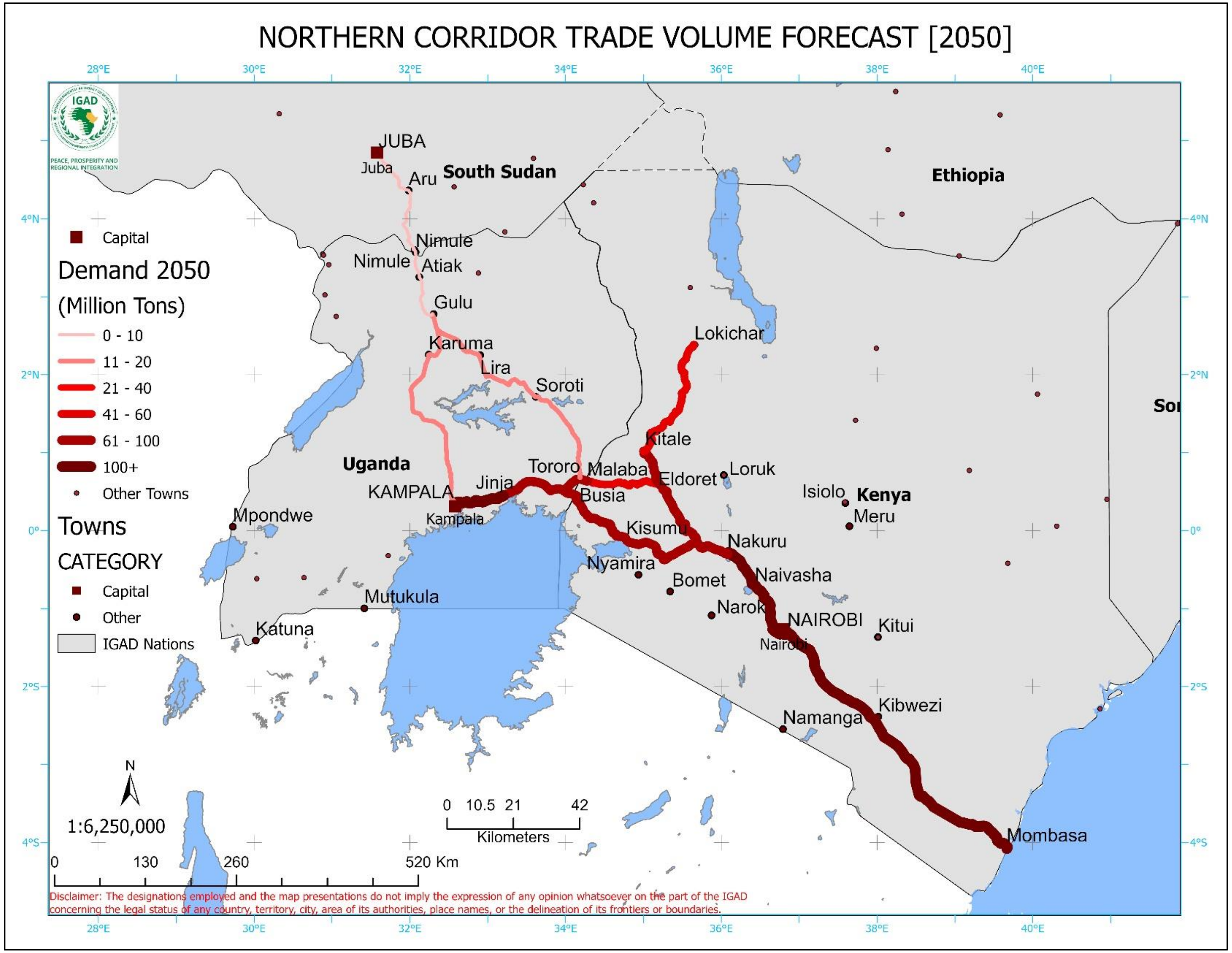


Table 0-40: Traffic Forecasts and Gap Analysis, LAPSSET Corridor (Millions of Tonnes)

Corridor Section	Member State	Mode	2024			2030			2050		
			Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap
Lamu Port	Kenya	Port	14	11	No	23	22	No	100	98	No
Lamu/Garissa/ Isiolo	Kenya	Road	25	13	No	25	16	No	25	69	Yes
		Rail	0	0	No	30	10	No	30	46	Yes
Isiolo-Nairobi	Kenya	Road	25	6	No	25	7	No	25	35	Yes
		Rail	0	0	No	30	5	No	30	24	No
Isiolo-Marsabit-Moyale	Kenya	Road	25	5	No	25	5	No	25	20	No
		Rail	0	0	No	30	5	No	30	14	No
Isiolo-Lokichar	Kenya	Road	25	3	No	25	4	No	25	14	No
		Rail	0	0	No	30	2	No	30	10	No
Lokichar-Lokichoggio	Kenya	Road	25	3	No	25	4	No	25	20	No
		Rail	0		No	30	2	No	30	14	No
Lokichoggio-Nandapal	Kenya	Road	25	3	No	25	4	No	25	12	No
		Rail	0	0	No	30	2	No	30	8	No
Moyale-Awassa-Modjo	Ethiopia	Road	25	5	No	25	6	No	25	20	No
		Rail	0	0	No	30	3	No	30	14	No
Nandapal-Kapoeta-Juba	South Sudan	Road	25	2	No	25	3	No	25	12	No
		Rail	0	0	No	30	2	No	30	8	No

According to the planned projects for the Lamu port, the LAPSSET Corridor port capacity will be sufficient for traffic levels in 2024 but expansion and in the subsequent periods. On the surface transport modes, the road links are expected to be completed during the Phase I of the Masterplan while the railway is expected to be completed before Phase II (2030).

With a cargo share ratio of 60:40 between road and rail, the surface transport capacity in rail will be adequate but there will be a shortfall road and road for the Lamu/Isiolo segments in Phase III and for Isiolo/Nairobi road segment. The other surface transport capacities will be adequate for the other segments along the entire corridor.

Figure 0-9: Forecast traffic flows, 2024, LAPSSET Corridor (Millions of Tonnes)

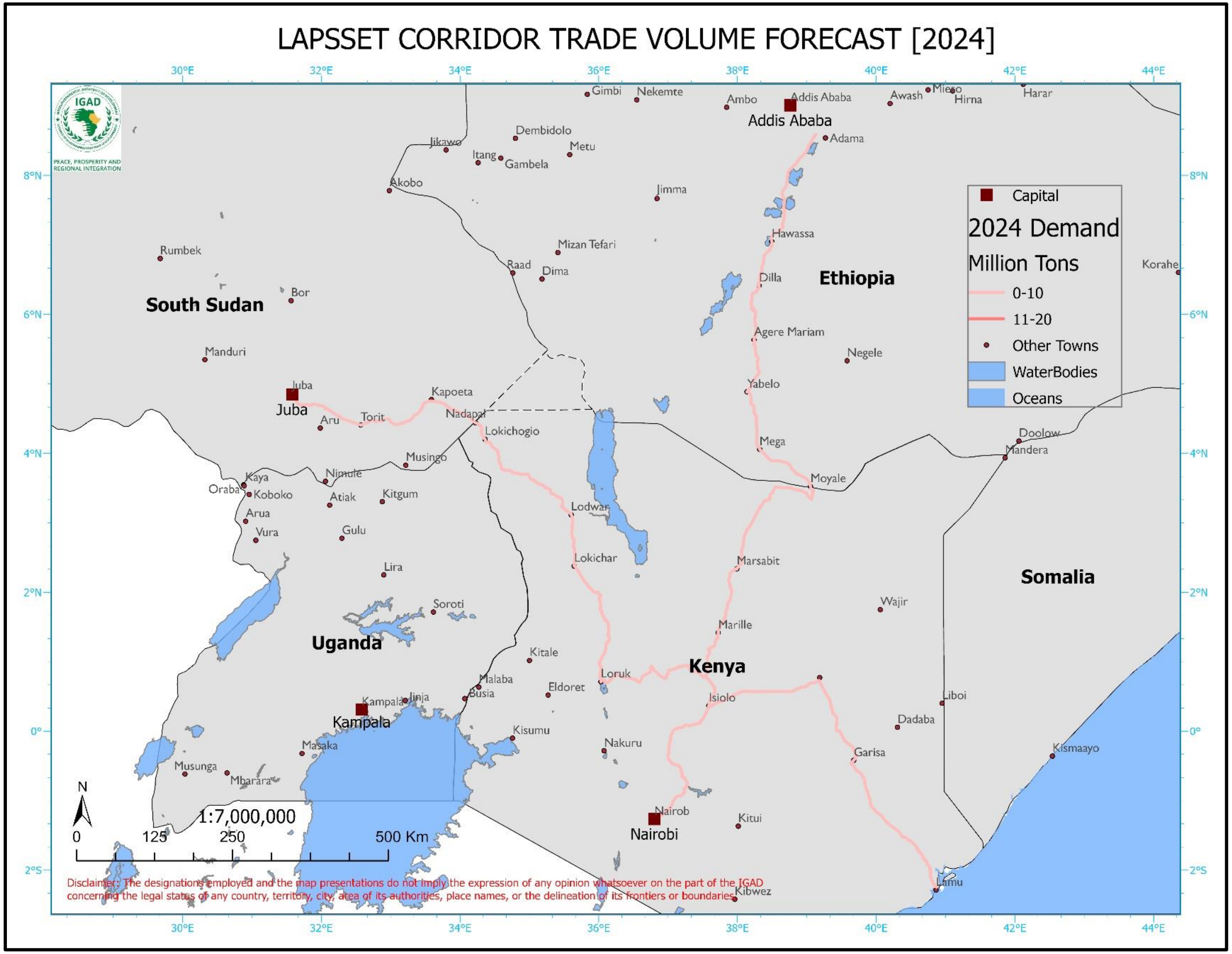


Figure 0-10: Forecast traffic flows, 2030, LAPSSET Corridor (Millions of Tonnes)

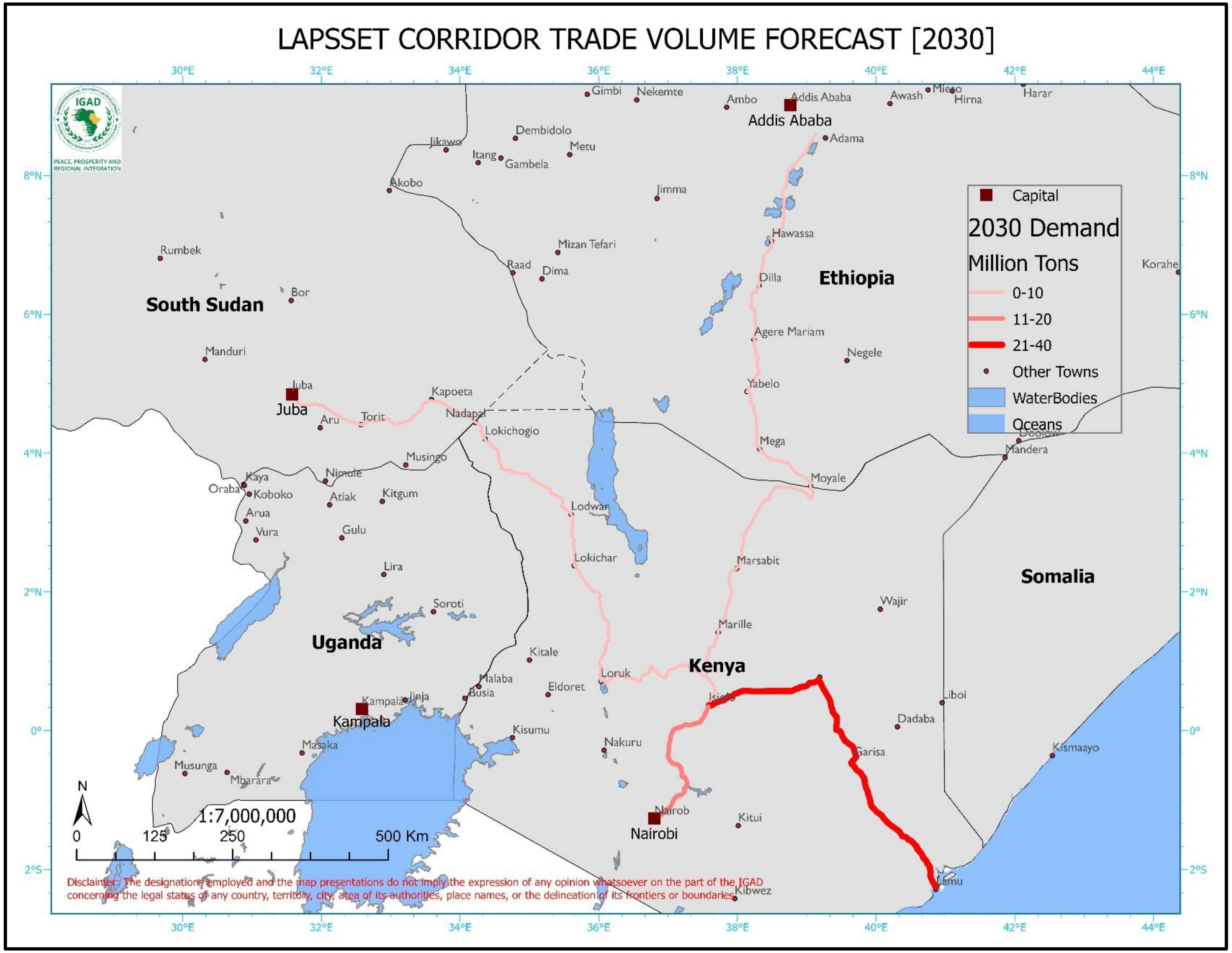


Figure 0-11: Forecast traffic flows, 2050, LAPSSET Corridor (Millions of Tonnes)

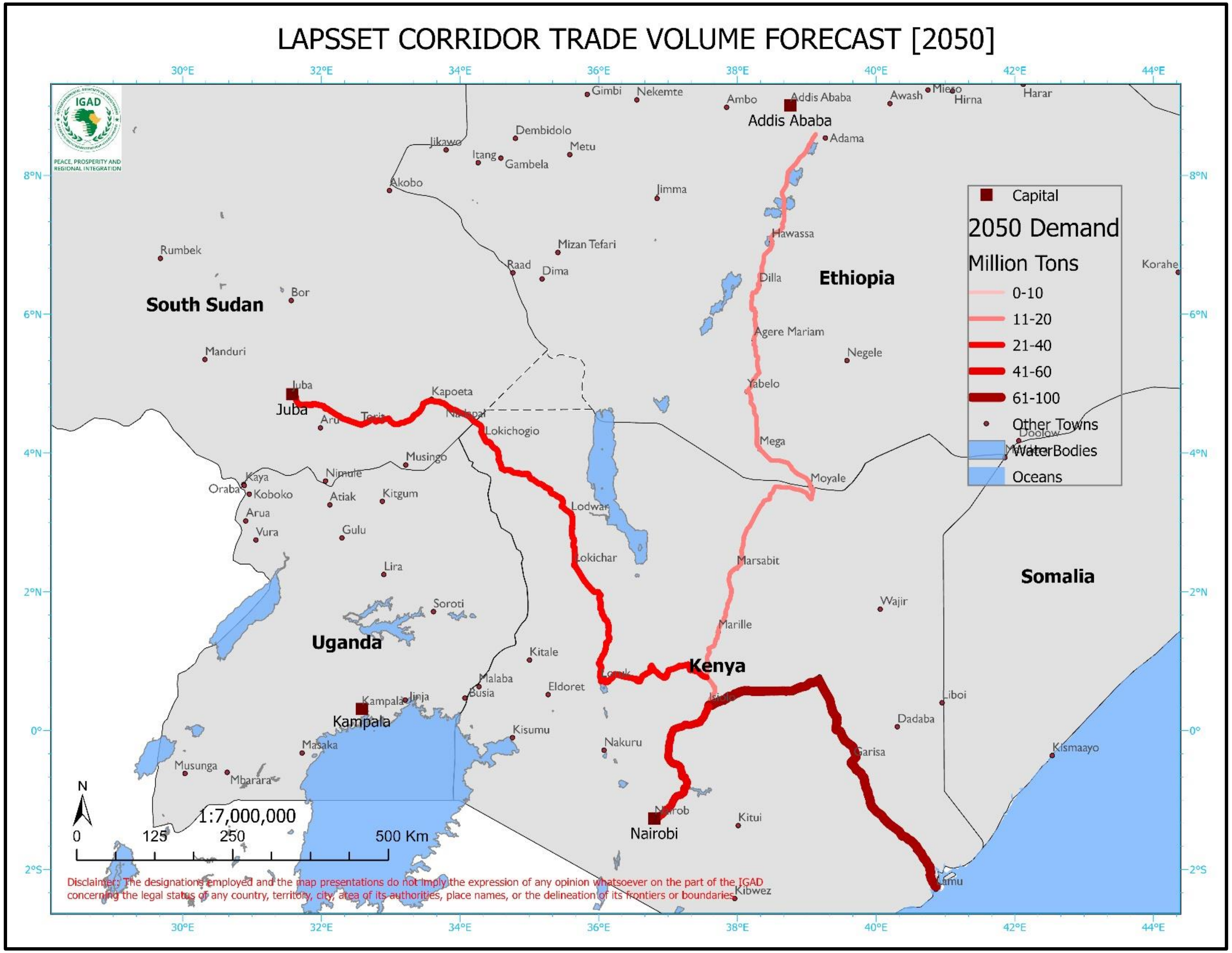


Table 0-41: Traffic Forecasts and Gap Analysis, Berbera Corridor (Millions of Tonnes)

Corridor Section	Member State	Mode	2024			2030			2050		
			Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap
Berbera Port	Somalia	Port	15	10	No	15	22	Yes	15	27	**Yes**
Berbera-Hargeisa	Somalia	Road	25	11	N	25	26	Yes	25	41	**Yes**
		Rail	0			0			0		
Hargeissa-Togochaale	Somalia	Road	25	5	No	25	12	No	25	35	**Yes**
		Rail	0			0	0		0		
Togochaale-Jijiga	Ethiopia	Road	25	4		25	9	No	25	26	**Yes**
		Rail	0			0	0		0		
Jijiga-Dire Dawa	Ethiopia	Road	25	3		25	6	No	25	26	**No**
		Rail	0	0		0	0		0		

The planned facilities for Berbera port will be sufficient to handle the forecast traffic for Phase I but will require expansion in the two subsequent phases.

On the surface transport facilities serving Berbera, road has been considered the only option as there was no information on the desire to build a railway line.

The road will handle the forecast traffic along all the segments of road transport during Phase I. There will be gaps in both the port and road in Phase III which will need to be addressed.

Figure 0-12: Forecast traffic flows, 2024, Berbera Corridor (Millions of Tonnes)

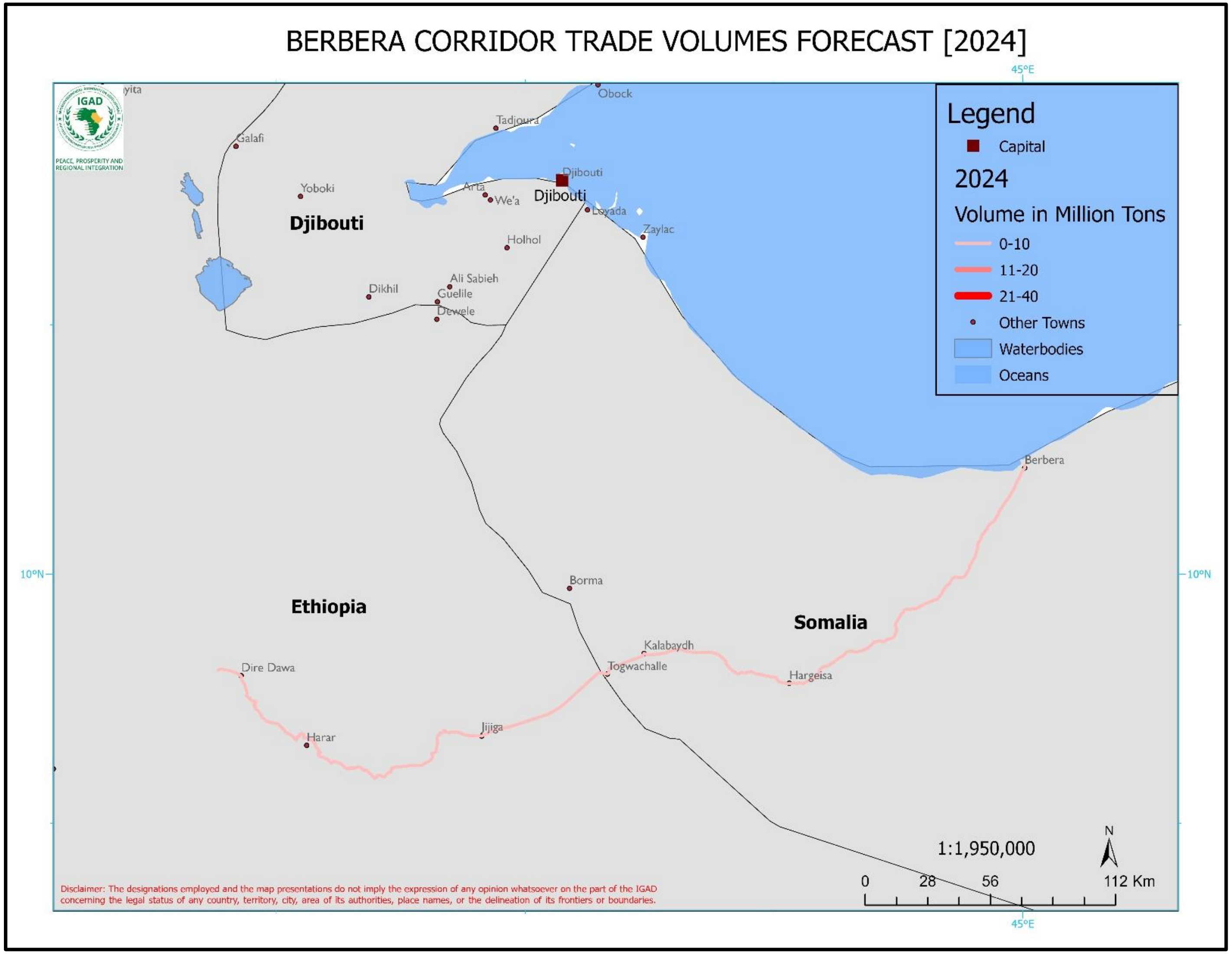


Figure 0-13: Forecast traffic flows, 2030, Berbera Corridor (Millions of Tonnes)

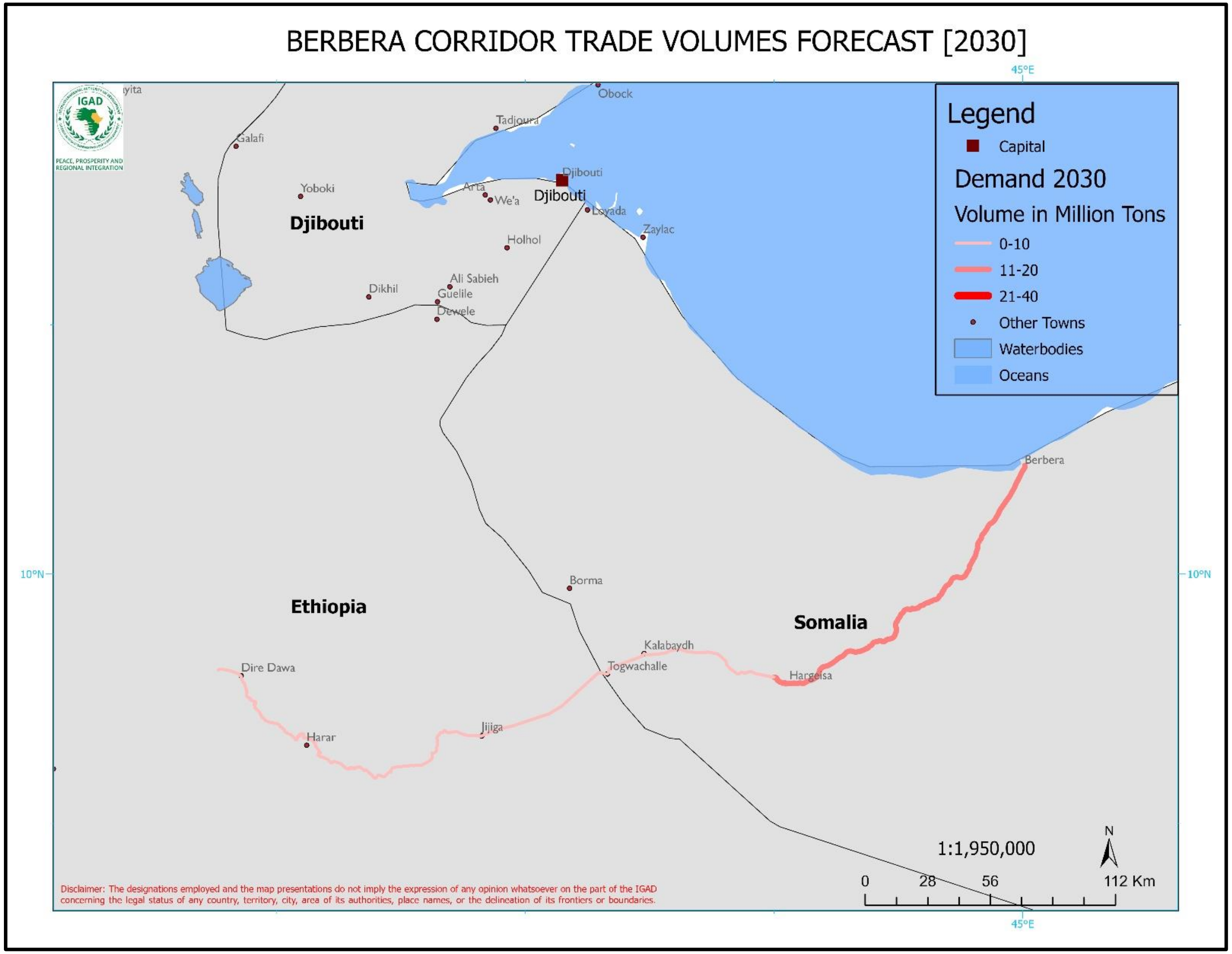


Figure 0-14: Forecast traffic flows, 2050, Berbera Corridor (Millions of Tonnes)

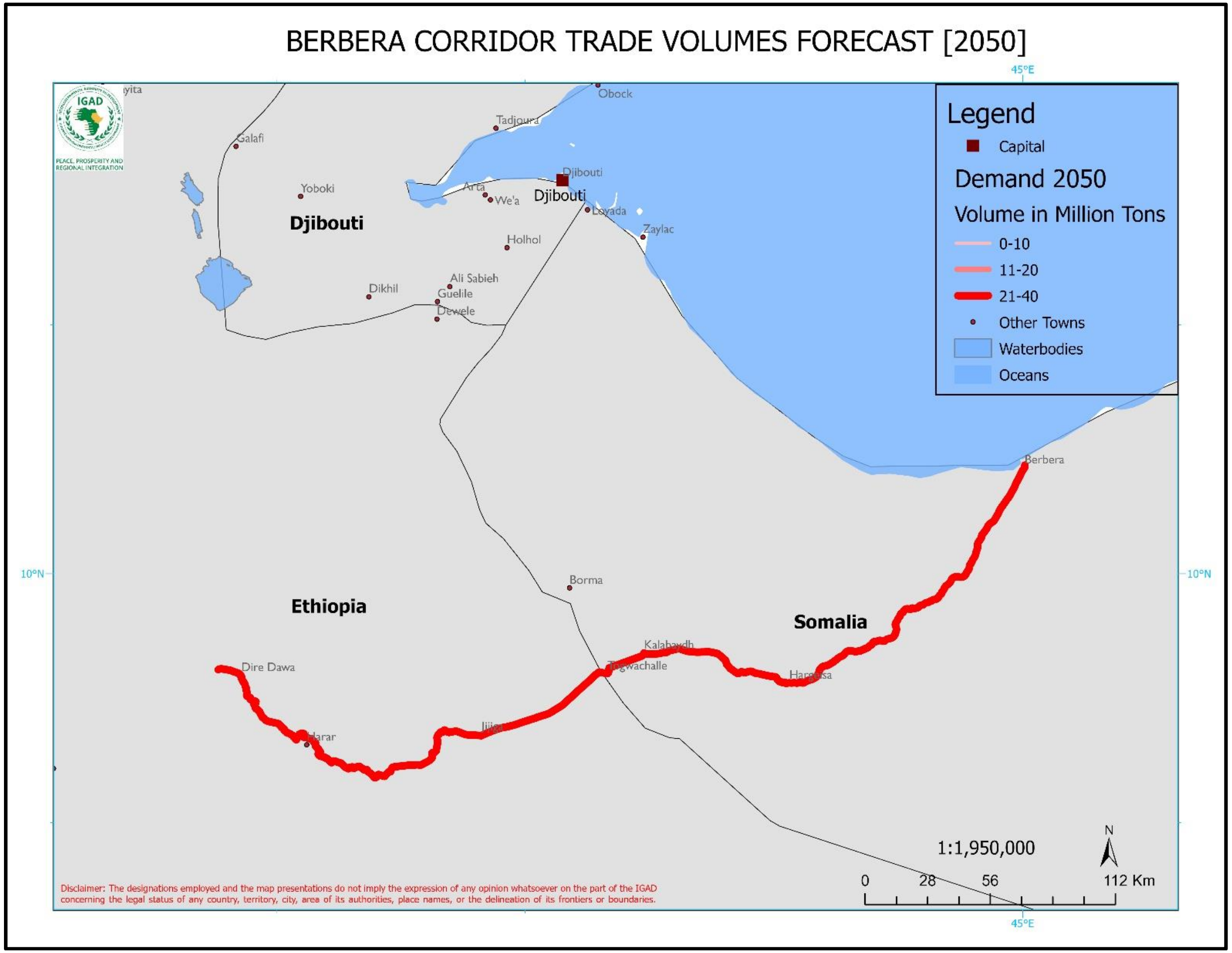


Table 0-42: Traffic Forecasts and Gap Analysis, Djibouti Corridor (Millions of Tonnes)

Corridor Section	Member State	Mode	2024			2030			2050		
			Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap
Djibouti Port	Djibouti	Port	40	33	No	50	47	Yes		104	Yes
Djibouti-Dikhil	Djibouti	Road	25	16	No	30	23	No	30	50	Yes
		Rail	0	0	No	0		No			
Djibouti-Galile	Djibouti	Road	30	9	No	30	14	No	30	30	Yes
		Rail	30	15	No	30	20	No	30	46	
Dikhil-Galafi	Ethiopia	Road	30	16	No	30	23	No	30	50	Yes
		Rail	0	0	No	0	0	No	0		
Galafi-Semera-Mekele	Ethiopia	Road	30	5	No	30	7	No	30	15	No
		Rail	0	0	No	0	0	No	0	0	No
Semera-Awash	Ethiopia	Road	30	16	No	30	23	No	30	51	Yes
		Rail	0	0	No	0	0	No	0	0	No
Dewele-Dire Dawa	Ethiopia	Road	30	12	No	30	14	No	30	40	Yes
		Rail	30	16	No	30	25	No	30	47	
Dire Dawa-Awash	Ethiopia	Road	30	11	No	30	15	No	30	42	Yes
		Rail	30	16	No	30	27	No	30	64	Yes
Awash-Adama-Addis Ababa	Ethiopia	Road	30	15	No	30	23	No	60	56	No
		Rail	30	23	No	30	36	Yes	60	83	Yes
Addis Ababa-Jima-Mizan	Ethiopia	Road	30	2	No	30	5	No	30	3	No
		Rail	0		No	30	6	No	30	5	No
Mizan-Dima	Ethiopia	Road	30	2	No	30	3	No	30	3	No
		Rail			No	0	0	No	30	5	No
Dima-Raad-Boma	Ethiopia	Road	30	2	No	30	3	No	30	3	No
		Rail			No	0		No	30	4	No
Boma-Kapoeta	South Sudan	Road	30	2	No	30	3	No	30	2	No
		Rail	0	0	No	0	0	No	30	3	No

According to the planned projects for the Djibouti port, the port capacity will be sufficient for traffic levels in 2024 but expansion of port facilities will be necessary in the subsequent periods. Regarding the surface transport modes, the Ethio/Djibouti SGR railway will be operational and will be able to handle its share of cargo up to the end of Phase I of the masterplan. More capacity in both and rail will need to be developed in Phases II and III.

Figure 0-15: Forecast traffic flows, 2024, Djibouti Corridor (Millions of Tonnes)

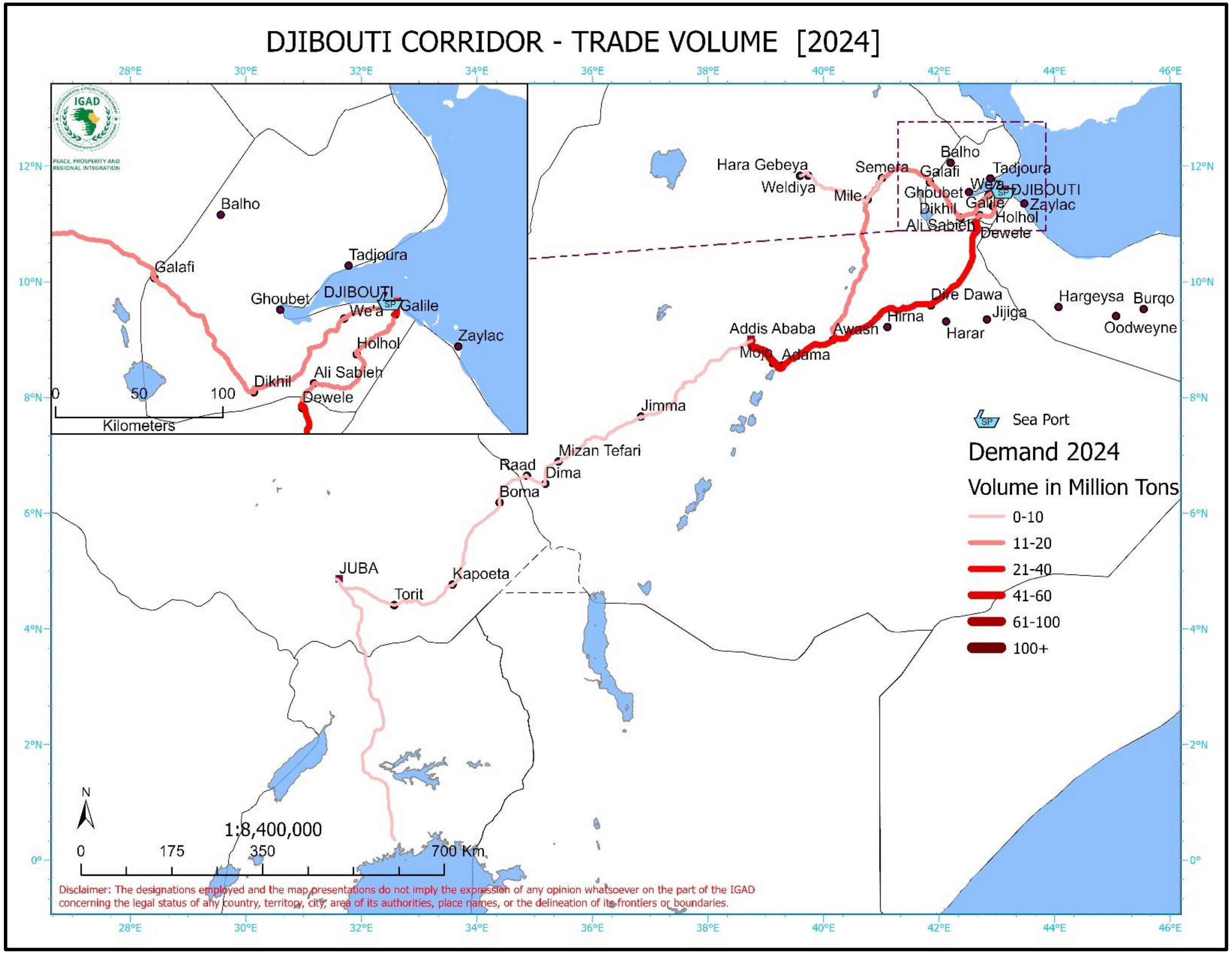


Figure 0-16: Forecast traffic flows, 2030, Djibouti Corridor (Millions of Tonnes)

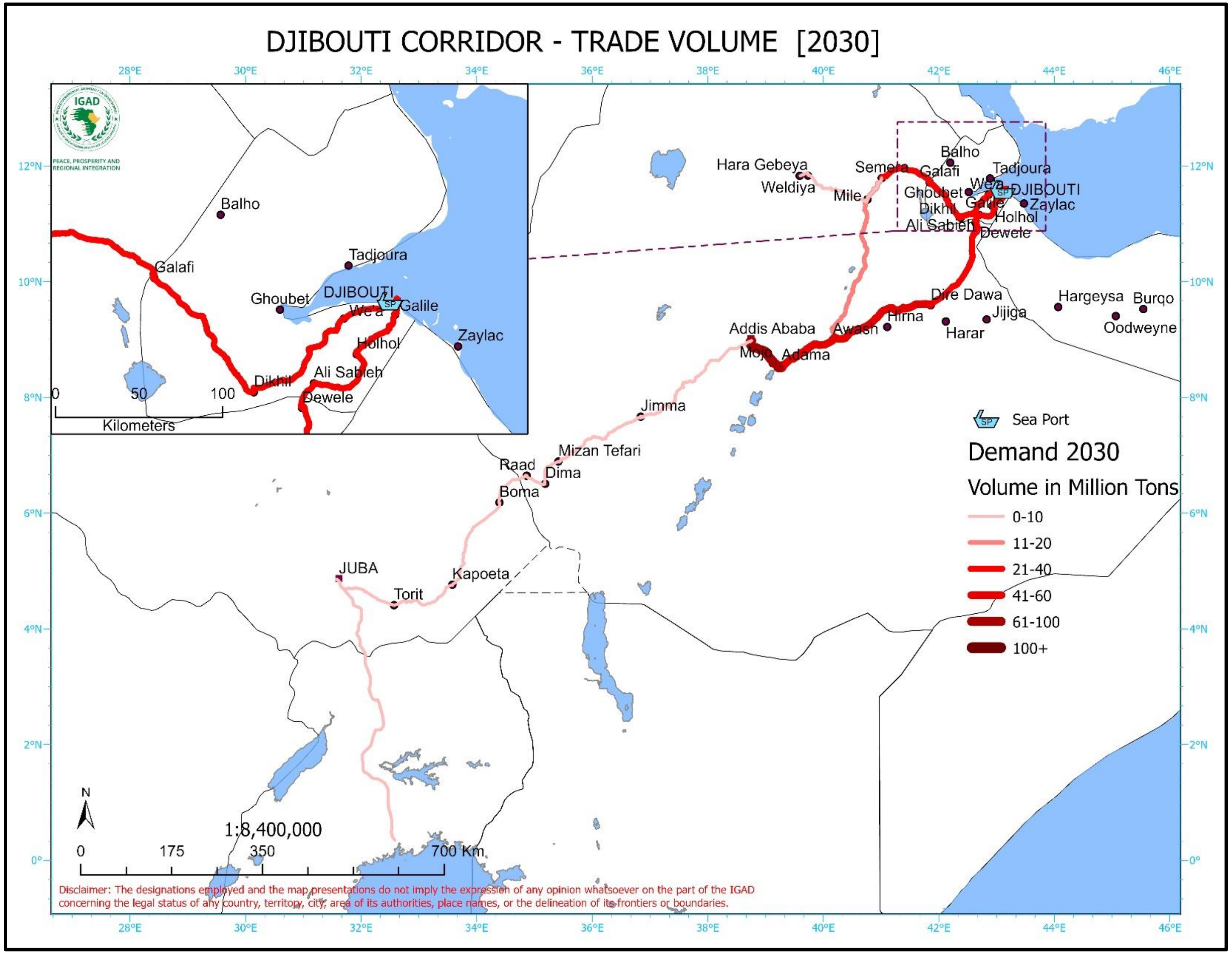


Figure 0-17: Forecast traffic flows, 2050, Djibouti Corridor (Millions of Tonnes)

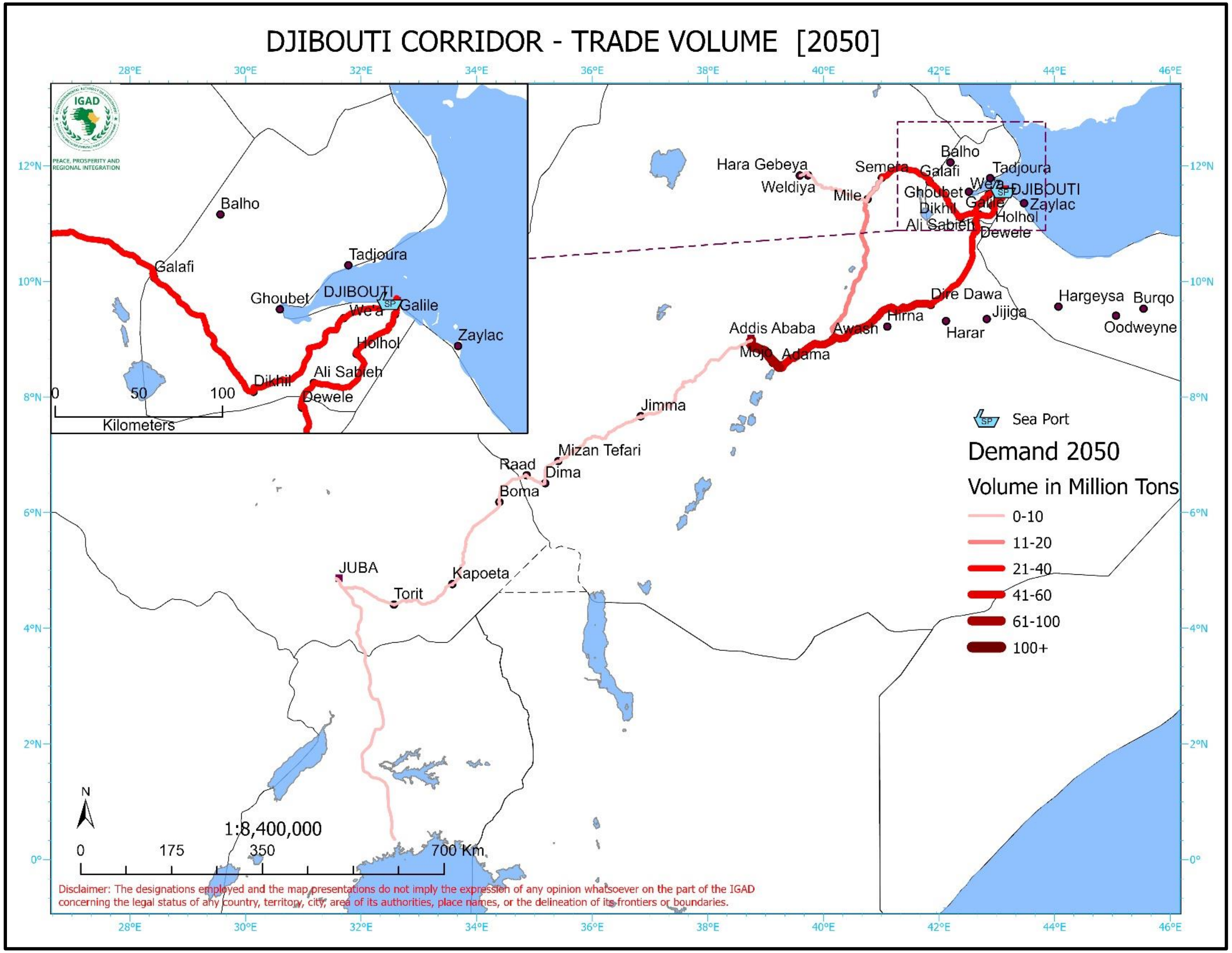


Table 0-43: Traffic Forecasts and Gap Analysis, Port Sudan Corridor (Millions of Tonnes)

Corridor Section	Member State	Mode	2024			2030			2050		
			Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap
Port Sudan	Sudan	Port	25	16	No	25	21	No	25	47	Yes
Port Sudan-Haya	Sudan	Road	30	14	No	30	19	No	30	40	Yes
		Rail	30	9	No	30	12	No	30	27	No
Haya-Kassala	Sudan	Road	30	4	No	30	5	No	30	12	No
		Rail	30	2	No	30	3	No	30	9	No
Kassala-Al Quadarif	Sudan	Road	30	4	No	30	5	No	30	12	No
		Rail	30	2	No	30	2	No	30	9	No
Haya-Atbara	Sudan	Road	30	10	No	30	14	No	30	28	No
		Rail	30	7	No	30	8	No	30	18	
Atbara-Khartoum	Sudan	Road	30	10		30	14	No	30	28	No
		Rail	30	7	No	30	8	No	30	18	No
Khartoum-Wadi Medan	Sudan	Road	30	7	No	30	10	No	30	18	
		Rail	30	5	No	30	6	No	30	12	No
Wadi Medan-Sennar	Sudan	Road	30	7	No	30	10	No	30	18	No
		Rail	30	5	No	30	6	No	30	12	No
Sennar-Al Damazin	Sudan	Road	30	1	No	30	1	No	30	1	No
		Rail	0	0		0	0		0	1	No
Al Damazin-Kurmuk	Sudan	Road	30	1	No	30	1	No	30	1	No
		Rail	0			0	0		0	1	No
Wadi Medan-Al Quadarif	Sudan	Road	30	1	No	30	1	No	30	2	No
		Rail		0			0		30	1	No
Al Quadarif-Metema	Sudan	Road	30	2	No	30	4	No	30	5	No
		Rail		0			0		30	4	No
Khartoum-Rabak	Sudan	Road	30	7	No	30	6	No	30	8	No

		Rail	0			0	3		30	6	No
Rabak-Renk	Sudan	Road	Gravel	7	Yes	30	9	No	30	8	No
		Rail	0	0		0			30	6	No
Malakal-Renk	South Sudan	Road	Yes	7	Yes	30	9	No	30	8	No
		Rail	0	0		0			30	6	No
Waat-Malakal	South Sudan	Road	Gravel	7	Yes	30	9	No	30	8	No
		Rail		0					30	6	No
Bor-Waat	South Sudan	Road	Gravel	7	Yes	30	9	No	30	8	No
		Rail	0	0		0			30	6	No
Juba-Bor	South Sudan	Road	Gravel	7	Yes	30	9	No	30	8	No
		Rail	0	0		0			0	6	No
Metema – Gondar	Ethiopia	Road	10	2	Yes	30	4	No	30	5	No
		Rail	0	0		0			30	4	No
Kurmurk-Asosa-Nekemte	Ethiopia	Road	Gravel	1	Yes	30	1	No	30	1	No
		Rail	0	0		0			30	1	No
Nekemte-Ambo-Addis Ababa	Ethiopia	Road	Gravel	3			2		30	7	
		Rail	0	0					30		

According to the planned projects for the Port Sudan Corridor, the port capacity will be sufficient for traffic levels up to 2030 but further expansion will be necessary to meet the capacity requirements for the period to 2050.

Regarding the surface transport modes, the planned rail and road projects will suffice to meet the traffic levels projected up to 2030 but thereafter, road expansion will be necessary in some of the busy segments. The railway network once upgraded to standard gauge to interconnect with the Ethiopian and proposed South Sudan links will also meet the traffic demand projected for the Port Sudan Corridor.

In order to serve the traffic with South Sudan effectively, it will be necessary to upgrade the current gravel and earth roads to bitumen standard and to make the proposed railway extensions.

Figure 0-18: Forecast traffic flows, 2024, Port Sudan Corridor (Millions of Tonnes)

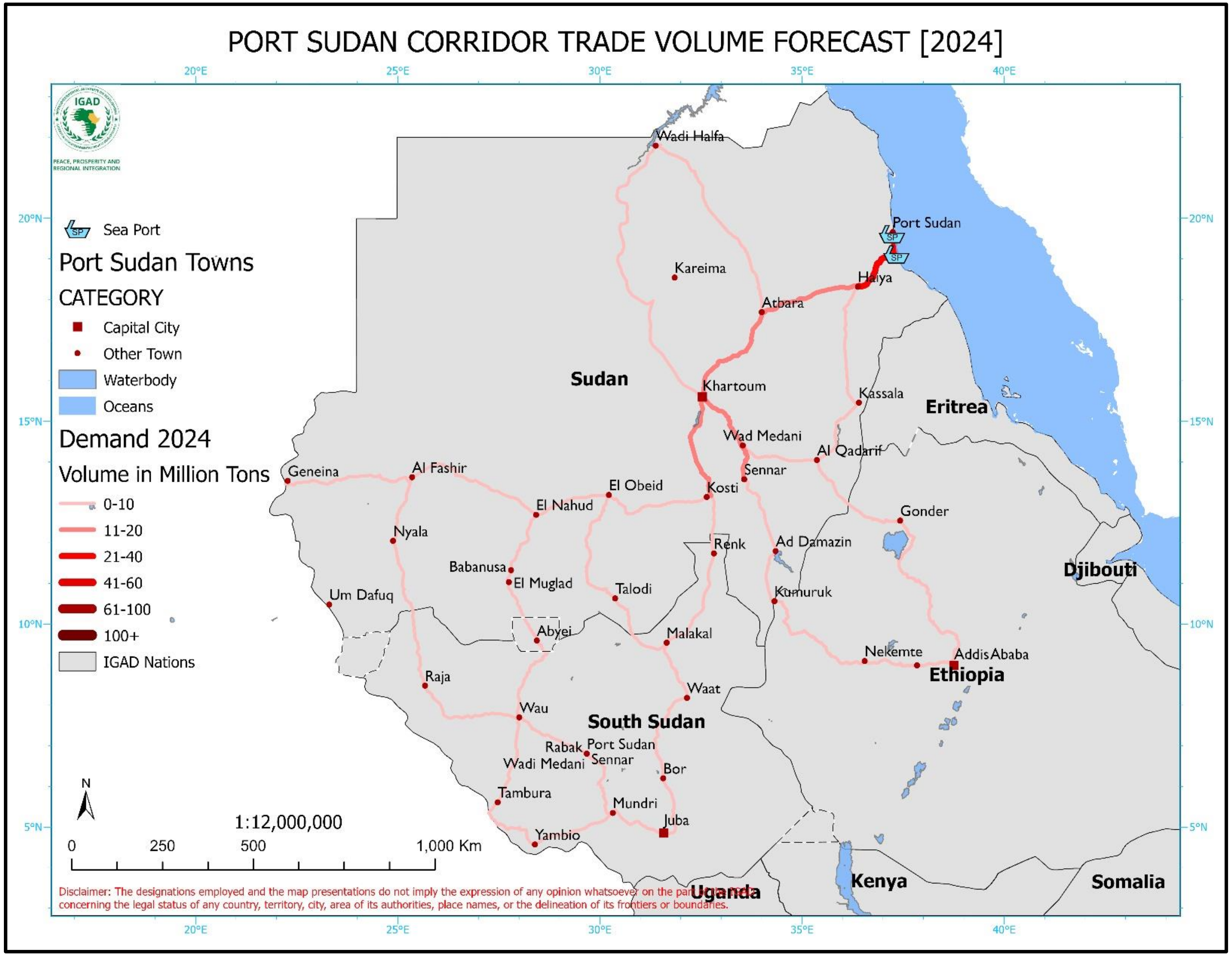


Figure 0-19: Forecast traffic flows, 2030, Port Sudan Corridor (Millions of Tonnes)

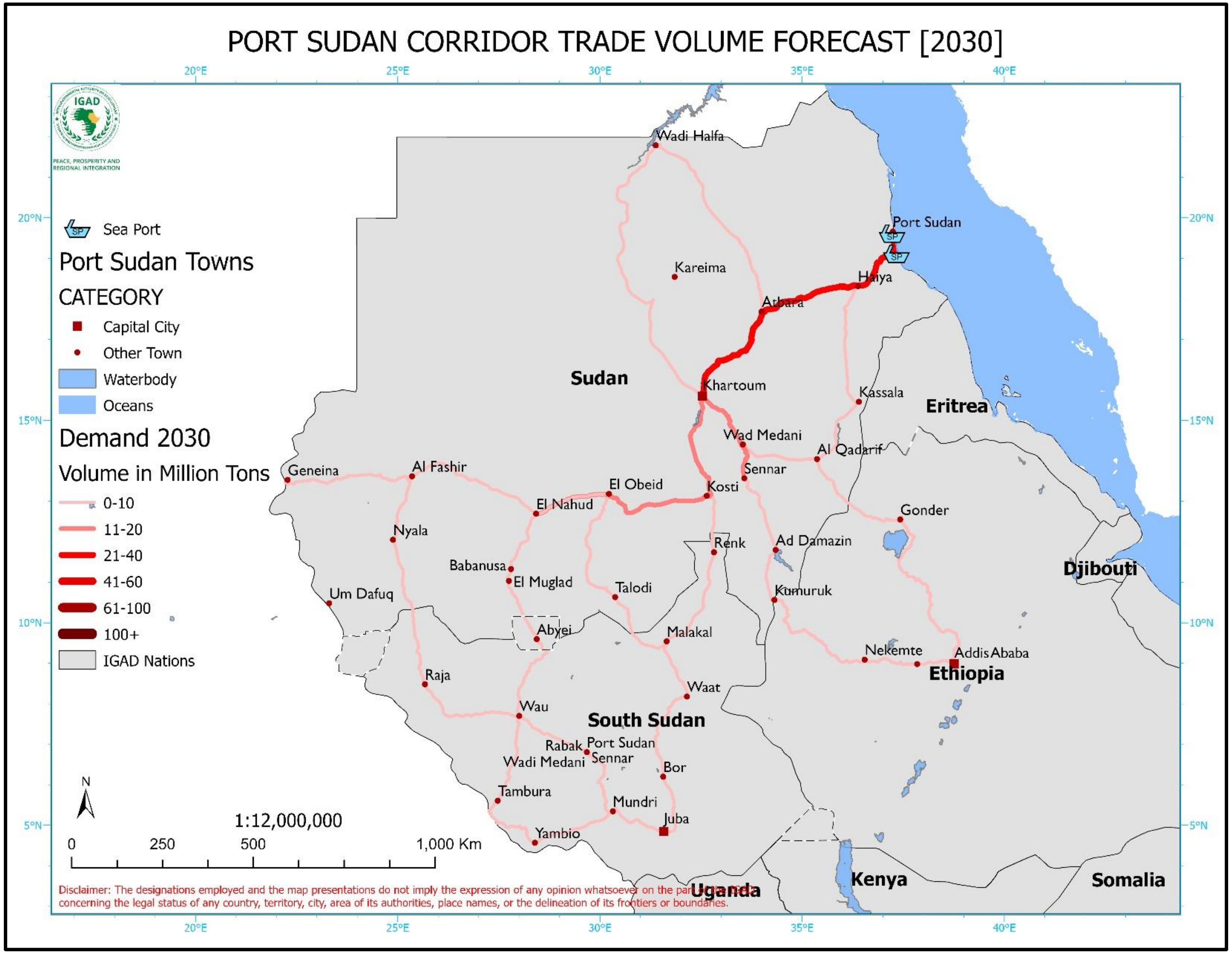


Figure 0-20: Forecast traffic flows, 2050, Port Sudan Corridor (Millions of Tonnes)

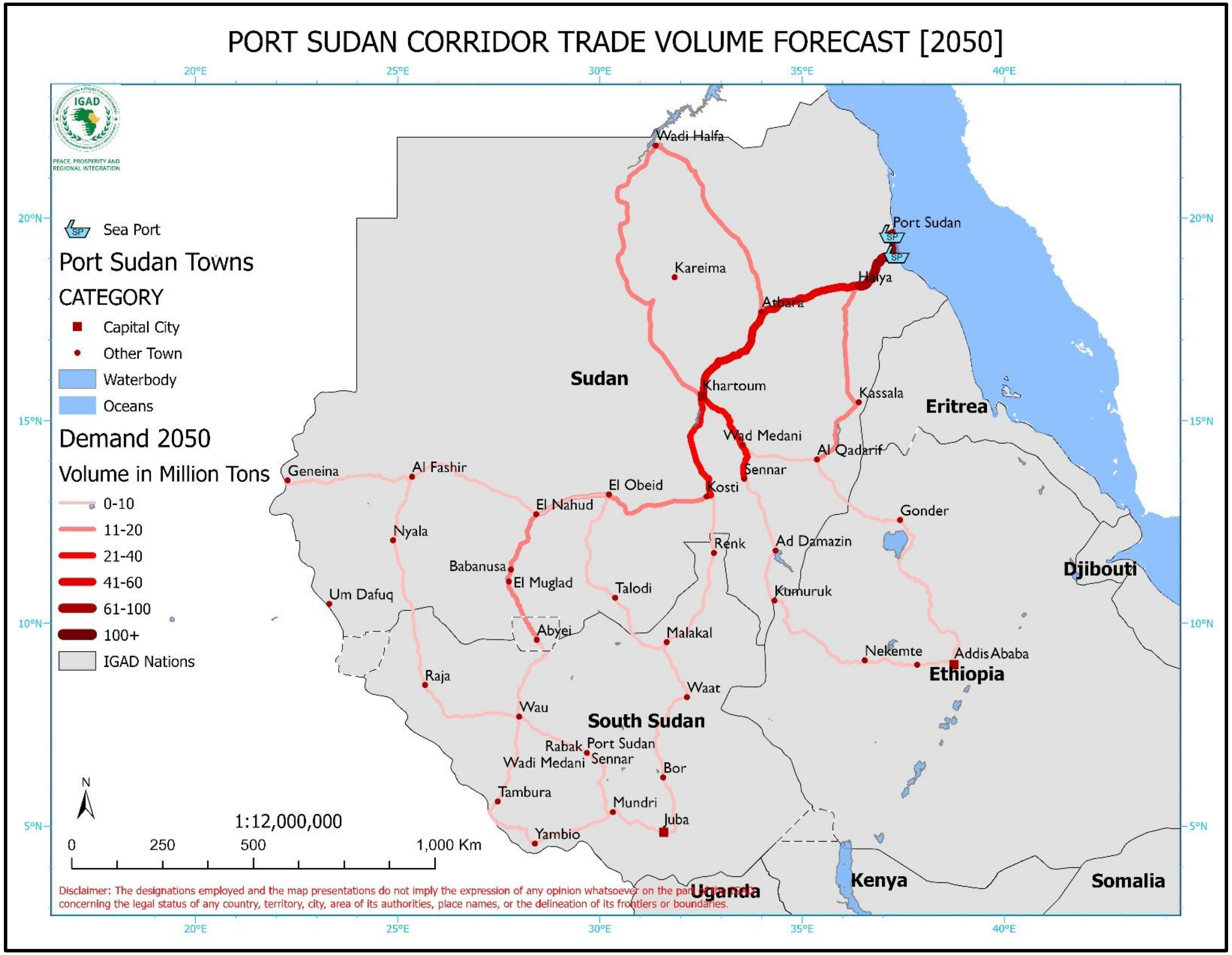


Table 0-44: Traffic Forecasts and Gap Analysis, Massawa Corridor (Millions of Tonnes)

Corridor Section	Member State	Mode	2024			2030			2050		
			Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap
Massawa Port	Eritrea	Port	15	5.04	No	15	9.53	Yes	15	14.5	Yes
Massawa - Nefasit	Eritrea	Road	25	4	No	25	6	Yes	25	12.5	No
		Rail	5		NA	5	3	NA	5	3	NA
Nefasit - Asmara	Eritrea	Road	25	4	No	25	6	Yes	25	12.5	No
		Rail	5		NA	5	3	NA	5	3	NA
Nefasit - Dekemhare	Eritrea	Road	30	4	No	30	9	Yes	30	22	No
		Rail	0		No	0		Yes	0		No
Asmara - Zalambesa	Eritrea	Road	25	5	No	25	10	No	25	15	Yes
		Rail	0		NA	0		NA	0	0	NA
Dekemhare - Gunaguna/Zalambessa	Eritrea	Road	25	4	No	25	9	No	25	10	Yes
		Rail	0			0		NA	0		NA
Gunaguna/Zalambessa - Adigrat	Eritrea	Road	25	4	No	25	9	No	25	10	Yes
		Rail	0			0		NA	0		NA
Adigrat - Mekele	Ethiopia	Road	25	4	No	25	9	No	25	10	Yes
		Rail	0			0		NA	0		NA
Mekele - Weldiya	Ethiopia	Road	25	3	No	25	6	No	25	20	No
		Rail	0		No	0		No	0	0	NA
Weldiya - Awash	Ethiopia	Road	25	3	No	25	6	No	25	20	No
		Rail	0		No	0		No	0	0	NA
Weldiya – Debre Birhan	Ethiopia	Road	25	3	No	25	6	No	25	20	No

		Rail	0		No	0		No	0	0	NA
Debre Birhan – Addis Ababa	Ethiopia	Road	25	3	No	25	6	No	25	20	No
		Rail	0		No	0		No	0	0	NA

The planned facilities for Massawa port will be sufficient to handle the forecast traffic for Phases I and II but will require expansion in Phases III. On the surface transport facilities serving Massawa, road will be primary mode with rail second between the pot and Asmara. Road will handle the forecast traffic along all the other segments.

Figure 0-211: Forecast traffic flows, 2024, Massawa Corridor (Millions of Tonnes)

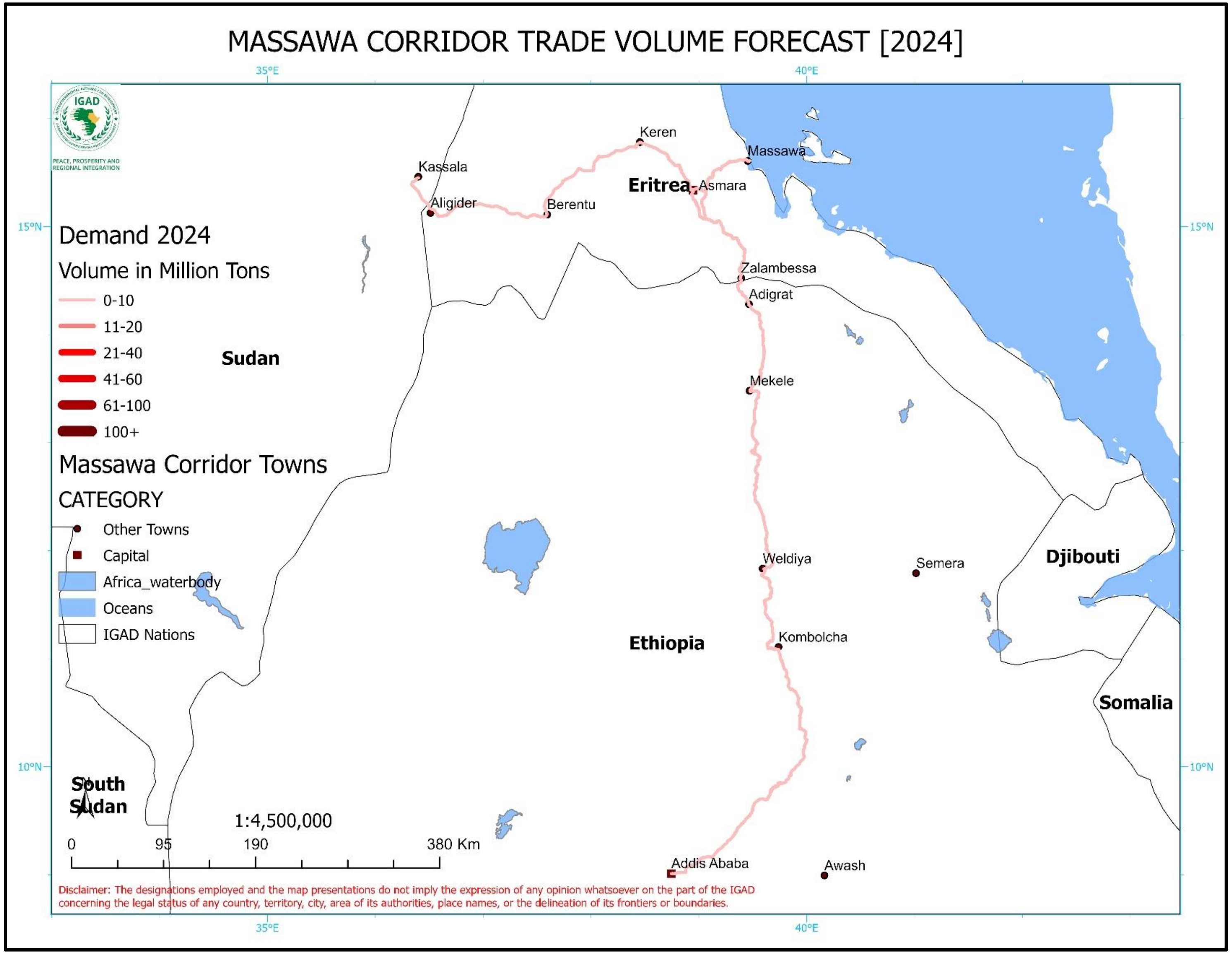


Figure 0-222: Forecast traffic flows, 2030, Massawa Corridor (Millions of Tonnes)

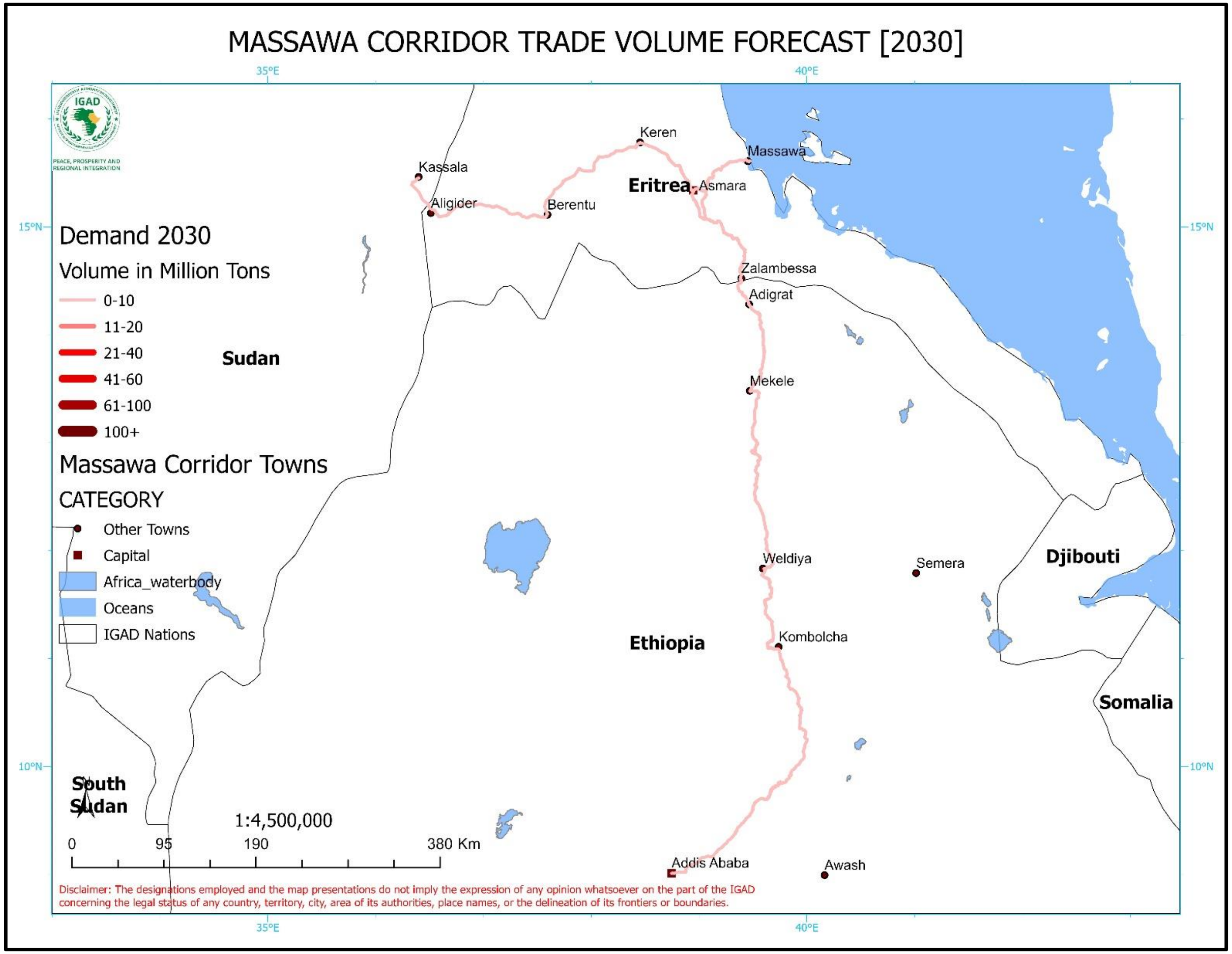


Figure 0-233: Forecast traffic flows, 2050, Massawa Corridor (Millions of Tonnes)

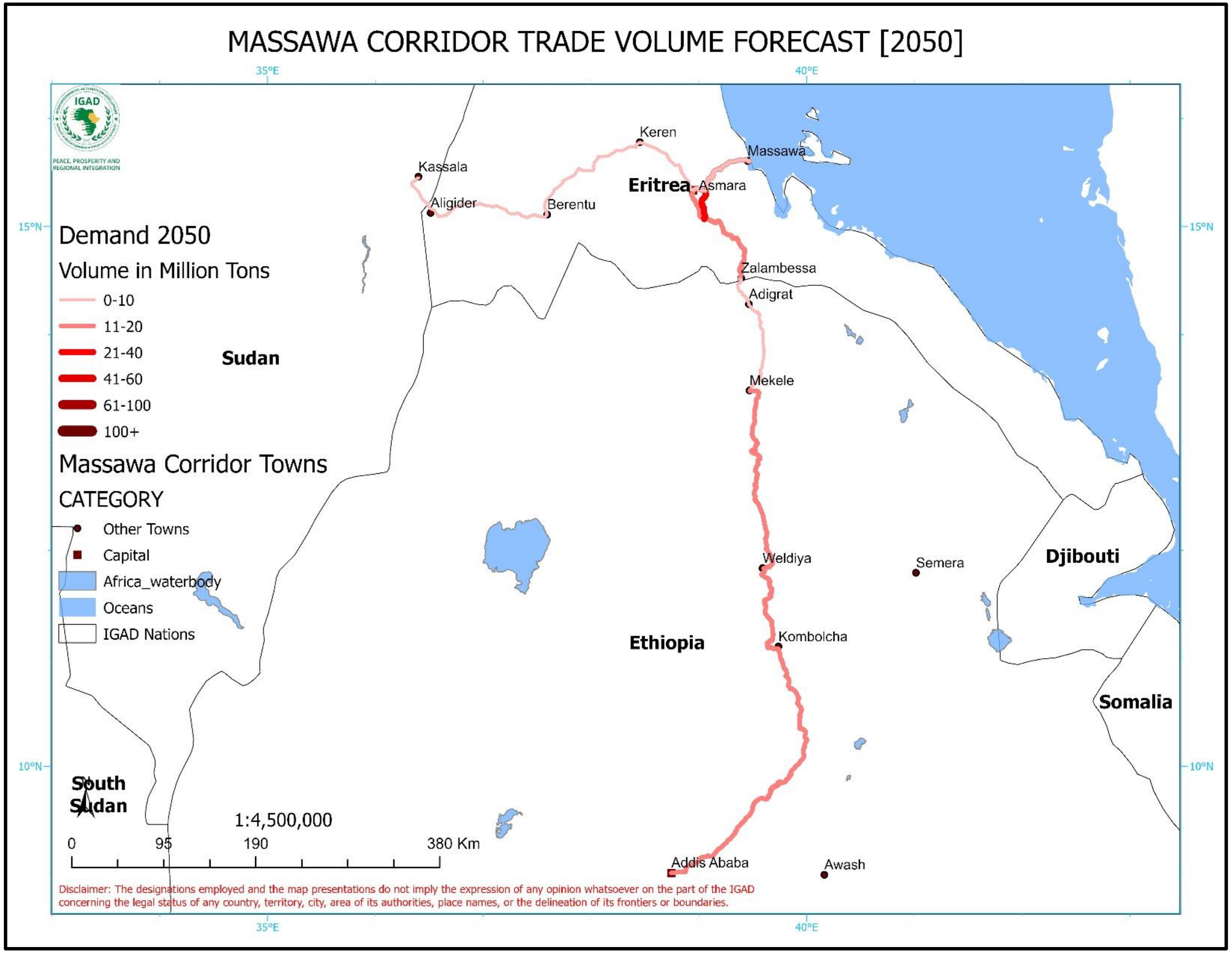


Table 0-455: Traffic Forecasts and Gap Analysis, Assab Corridor (Millions of Tonnes)

Corridor Section	Member State	Mode	2024			2030			2050		
			Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap
Assab Port	Eritrea	Port	3	2	No	5	3	No	10	8	Yes
Assab - Bure	Eritrea	Road	25	1.5	No	25	7.5	No	25	8.5	Yes
		Rail	0	0	No	0	0	No	0	0	No
Bure - Manda - Semera	Ethiopia	Road	25	5	No	25	12	No	25	15	Yes
		Rail	0	0		0	0		0	0	
Semera Awash	Ethiopia	Road	25	4		25	9	No	25	15	**Yes**
		Rail	0	0		0	0		0		
Awash - Addis Ababa	Ethiopia	Road	25	3		25	6	No	25	20	**No**
		Rail	0	0		0	0		0		

The planned facilities for Assab port will be sufficient to handle the forecast traffic for Phase I but will require expansion in the two subsequent phases. On surface transport, Assab port will be served by road only that will link with Djibouti Corridor at Semera and proceed to Addis Ababa. The road will handle the forecast traffic along all the segments of road transport during Phase I.

Figure 0-244: Forecast traffic flows, 2024, Assab Corridor (Millions of Tonnes)

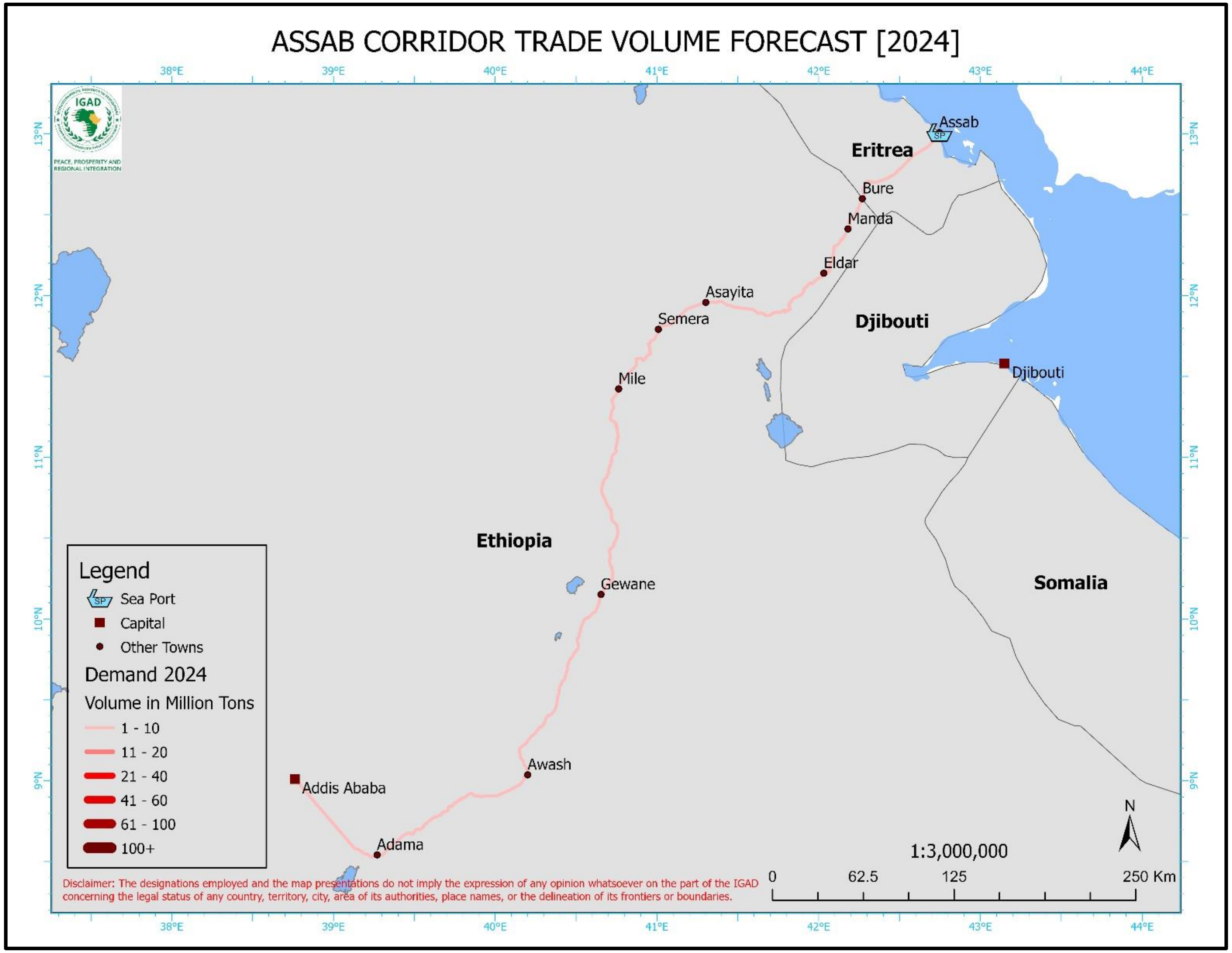


Figure 0-255: Forecast traffic flows, 2030, Assab Corridor (Millions of Tonnes)

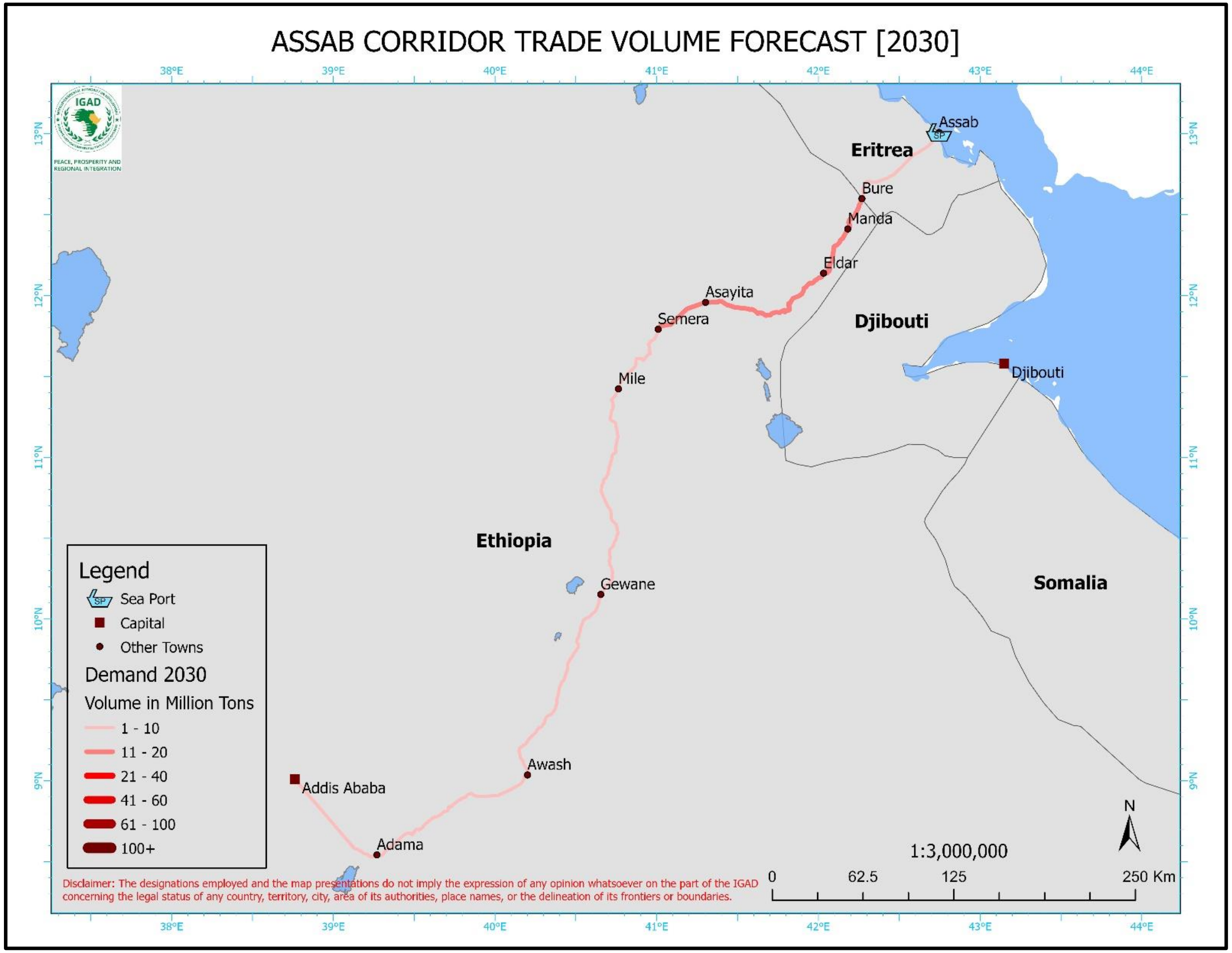


Figure 0-266: Forecast traffic flows, 2050, Assab Corridor (Millions of Tonnes)

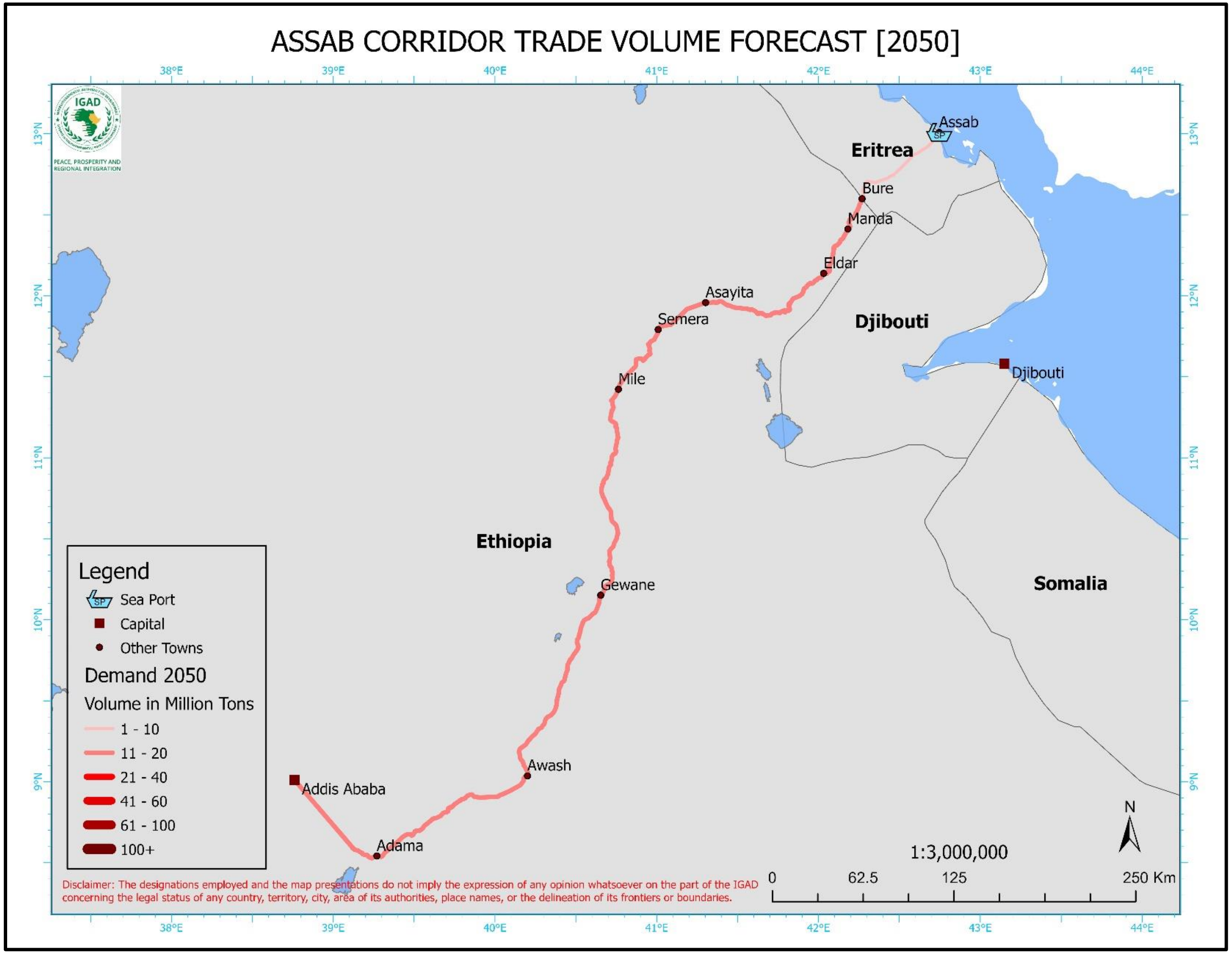


Table 0-466: Traffic Forecasts and Gap Analysis, Mogadishu Corridor (Millions of Tonnes)

Corridor Section	Member State	Mode	2024			2030			2050		
			Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap
Mogadishu Port	Somalia	Port	10	3.1	NA	15	4.6	Yes	20	11.5	**Yes**
Negele – Filtu – Siftu - Dollow	Ethiopia	Road (Gravel)	30	5	No	30	9	No	30	23	No
		Rail	0	0	No	0	0	No	0	0	No
Mogadishu - Afgoi – Baidoa	Somalia	Road	25	3	N	25	4	Yes	25	12	**Yes**
		Rail	0	0	0	0	0	0	0	0	**No**
Baidoa - Luuq	Somalia	Road	25	5	No	25	4	No	25	10	**No**
		Rail	0			0	0		0		
Luuq - Mandera	Somalia	Road	25	4		25	9	No	25	15	**No**
		Rail	0			0	0		0		
Luuq - Dollow	Somalia	Road	5	4		25	8	No	25	15	No
		Rail	0	0		0	0		0	0	0
Kebri Mengest - Negele	Ethiopia	Road	2	NA		5	8	Yes	25	5	0
		Rail	0	0		0	0		0		
Isiolo – Wajir – El Wak - Mandera	Kenya	Road	25	3		25	6	No	25	26	**No**
		Rail	0	0		0	0		0		
Ginir – Gode	Ethiopia	Road	30	5	No	30	9	No	30	23	No
		Rail	0	0	No	0	0	No	0	0	No
Mogadishu - Jowhar	Somalia	Road	10	10	Yes	25	4	No	25	6	Yes
		Rail	0	0		0	0	0	0	0	NA

Jowhar – Beledweyne – Ferfer	Somalia	Road	10	6		25	4	No	25	6	Yes
		Rail	0	0		0	0		0		NA
Turdibi/Galdogobi – Gaalkacyo	Somalia	Road (Gravel)	30	5	No	30	9	No	30	23	No
		Rail	0	0	No	0	0	No	0	0	No
Kebridahar – Warder – Turdibi	Ethiopia	Road (Gravel)	30	5	No	30	9	No	30	23	No
		Rail	0	0	No	0	0	No	0	0	No
Ferfer - Raaso	Ethiopia	Road	10	2	No	25	5	No	25	10	No
		Rail	0	0	0	0	0	0	0	0	No
Ferfer – Warder – Aware	Ethiopia	Road (Gravel)	30	5	No	30	9	No	30	23	No
		Rail	0	0	No	0	0	No	0	0	No

The planned facilities for Mogadishu port will be sufficient to handle the forecast traffic for Phase I but will require expansion in the two subsequent phases. On the surface transport facilities serving Mogadishu, road has been considered the only option as there was no information on the desire to build a railway line. The road will handle the forecast traffic along all the segments of road transport during Phase I. There will be gaps in both the port and road in Phase III which will need to be addressed.

Figure 0-277: Forecast traffic flows, 2024, Mogadishu Corridor (Millions of Tonnes)

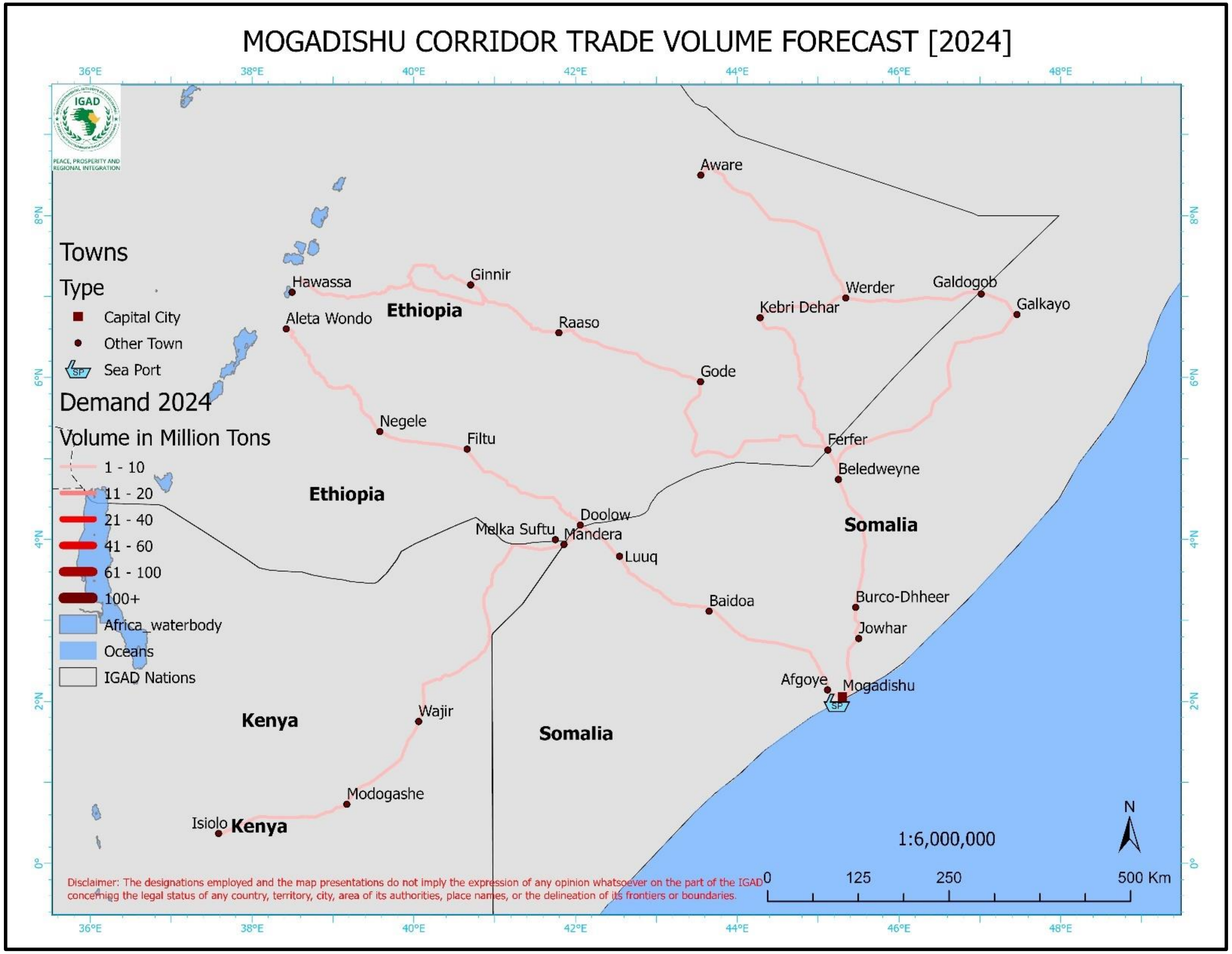


Figure 0-288: Forecast traffic flows, 2030, Mogadishu Corridor (Millions of Tonnes)

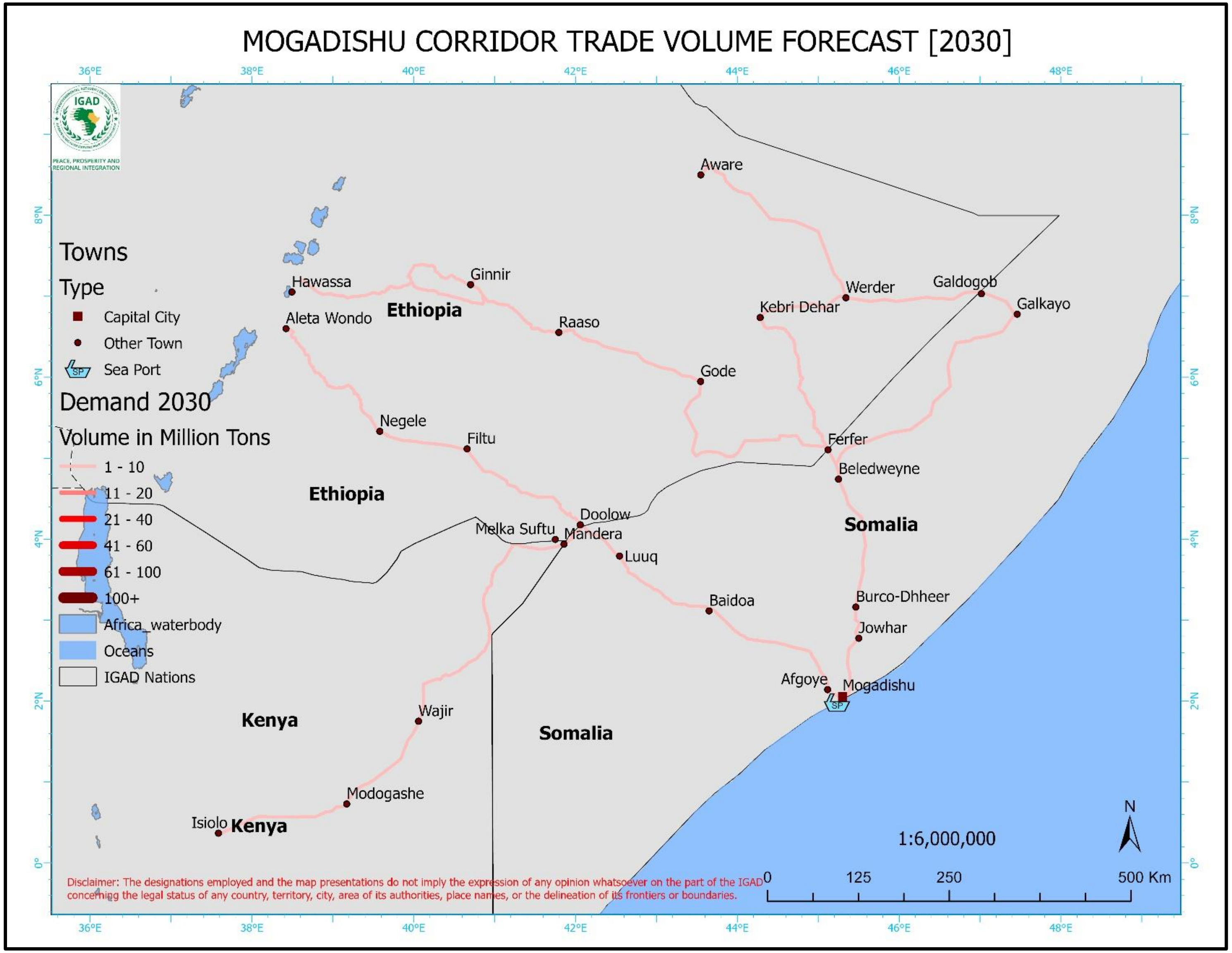


Figure 0-299: Forecast traffic flows, 2050, Mogadishu Corridor (Millions of Tonnes)

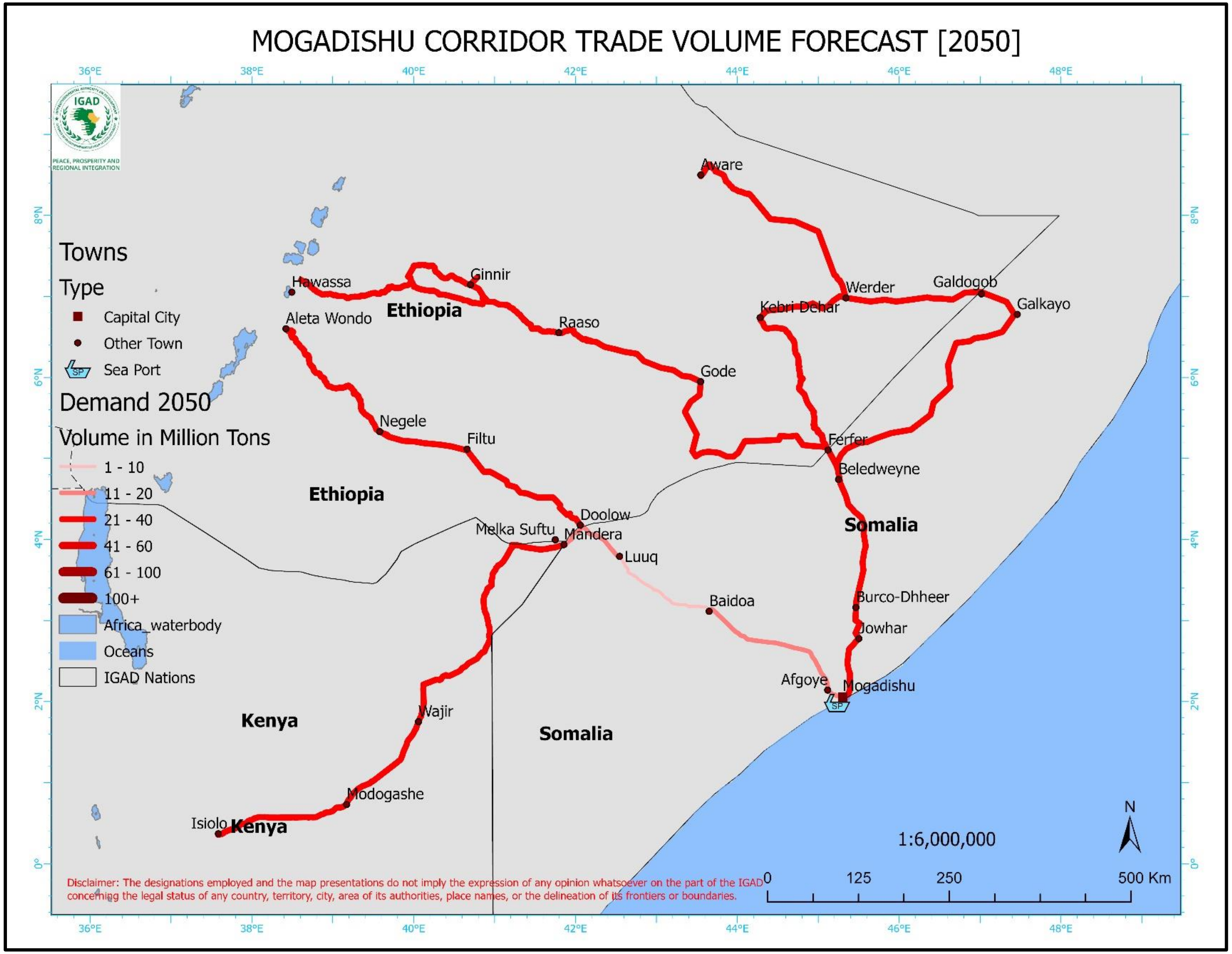


Table 0-477: Traffic Forecasts and Gap Analysis, Kismayu Corridor (Millions of Tonnes)

Corridor Section	Member State	Mode	2024			2030			2050		
			Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap	Capacity (MT)	Traffic (MT)	Gap
Kismayu Port	Somalia	Port	5	0.4	None	10	0.75	No	15	2.55	**No**
Kismayo – El Wak	Somalia	Road (Gravel)	1	0.2	No	25	2	No	25	5	No
		Rail	0	0	No	0	0	No	0	0	No
Kismayo-Bilis Qooqaani - Liboi	Somalia	Road	30	5	Yes	30	9	No	30	15	**No**
		Rail	0	0	NA	0	0	NA	0	NA	**NA**
Liboi - Dadaab - Garissa	Kenya	Road	25	5	No	25	12	No	25	8	**No**
		Rail	0	0	NA	0	0	NA	0	0	**NA**
Garissa/Nairobi	Kenya	Road	25	4	No	25	9	No	25	15	**No**
		Rail	0	0	No	0	0	N	0	NA	**NA**

The planned facilities for Kismayu port will be sufficient to handle the forecast traffic for Phase I but will require expansion in the two subsequent phases. On the surface transport facilities serving Kismayu, road has been considered the only option as there was no information on the desire to build a railway line. The road will handle the forecast traffic along all the segments of road transport during Phase I. There will be gaps in both the port and road in Phase III which will need to be addressed.

Figure 0-30: Forecast traffic flows, 2024, Kismayu Corridor (Millions of Tonnes)

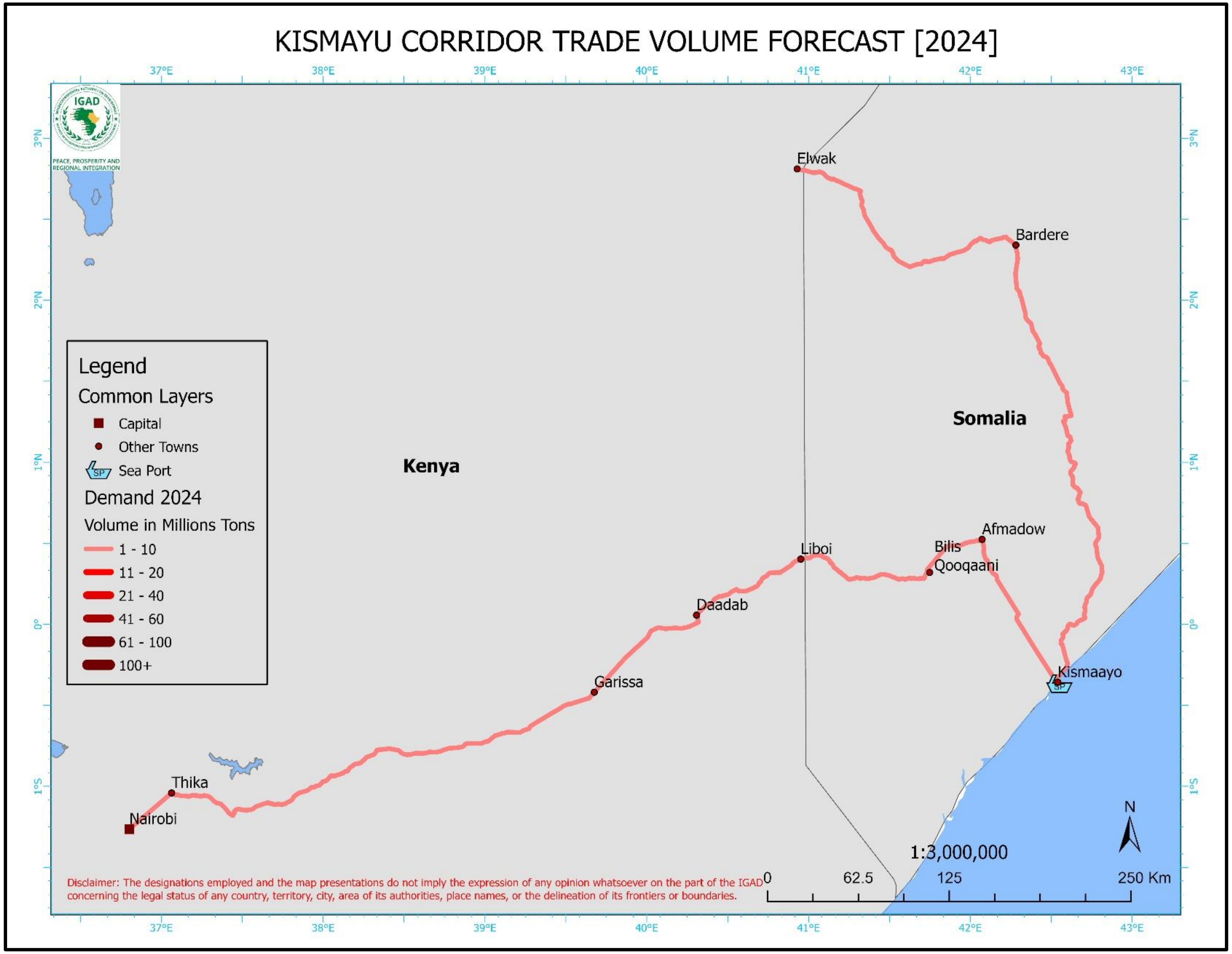


Figure 0-311: Forecast traffic flows, 2030, Kismayu Corridor (Millions of Tonnes)

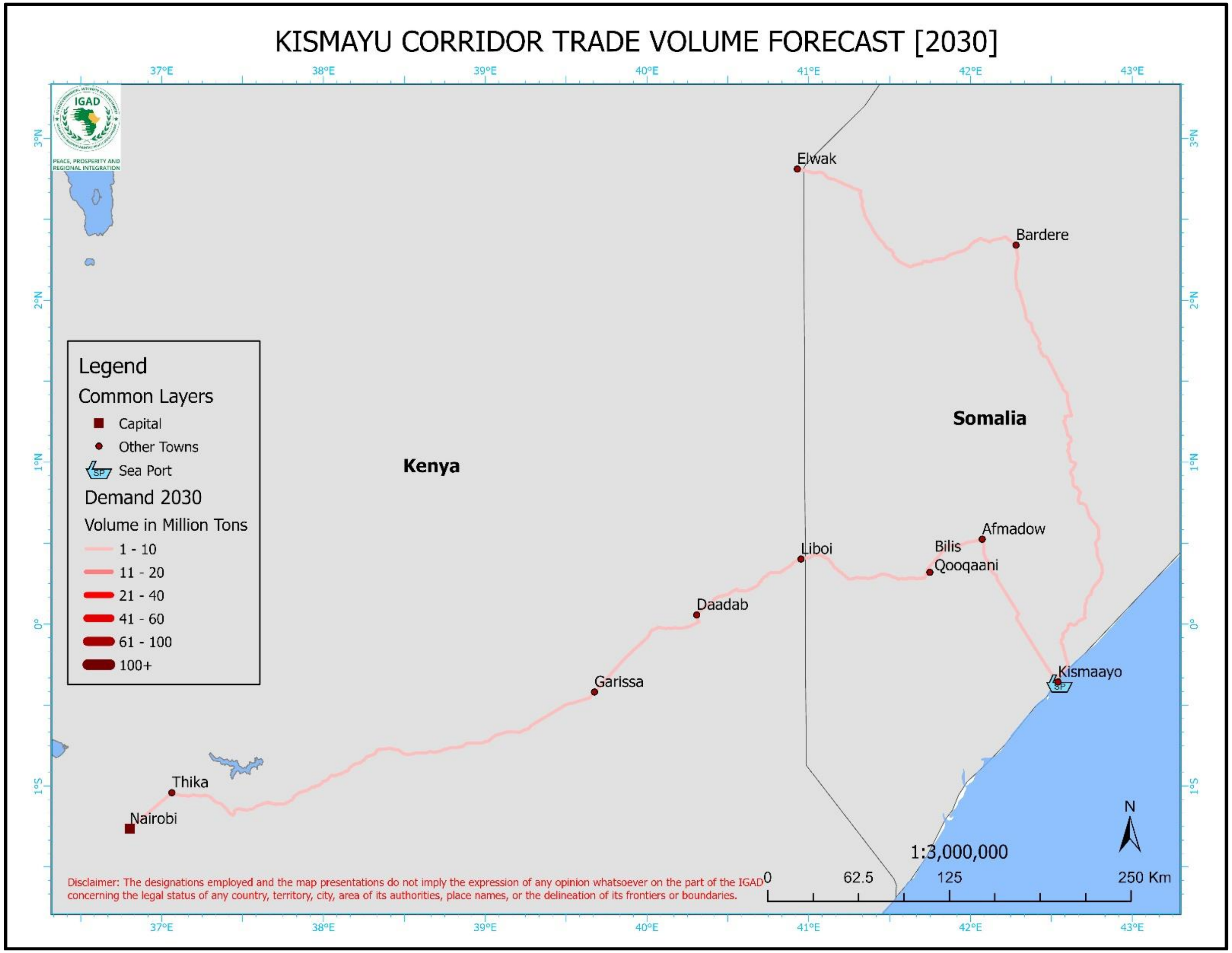
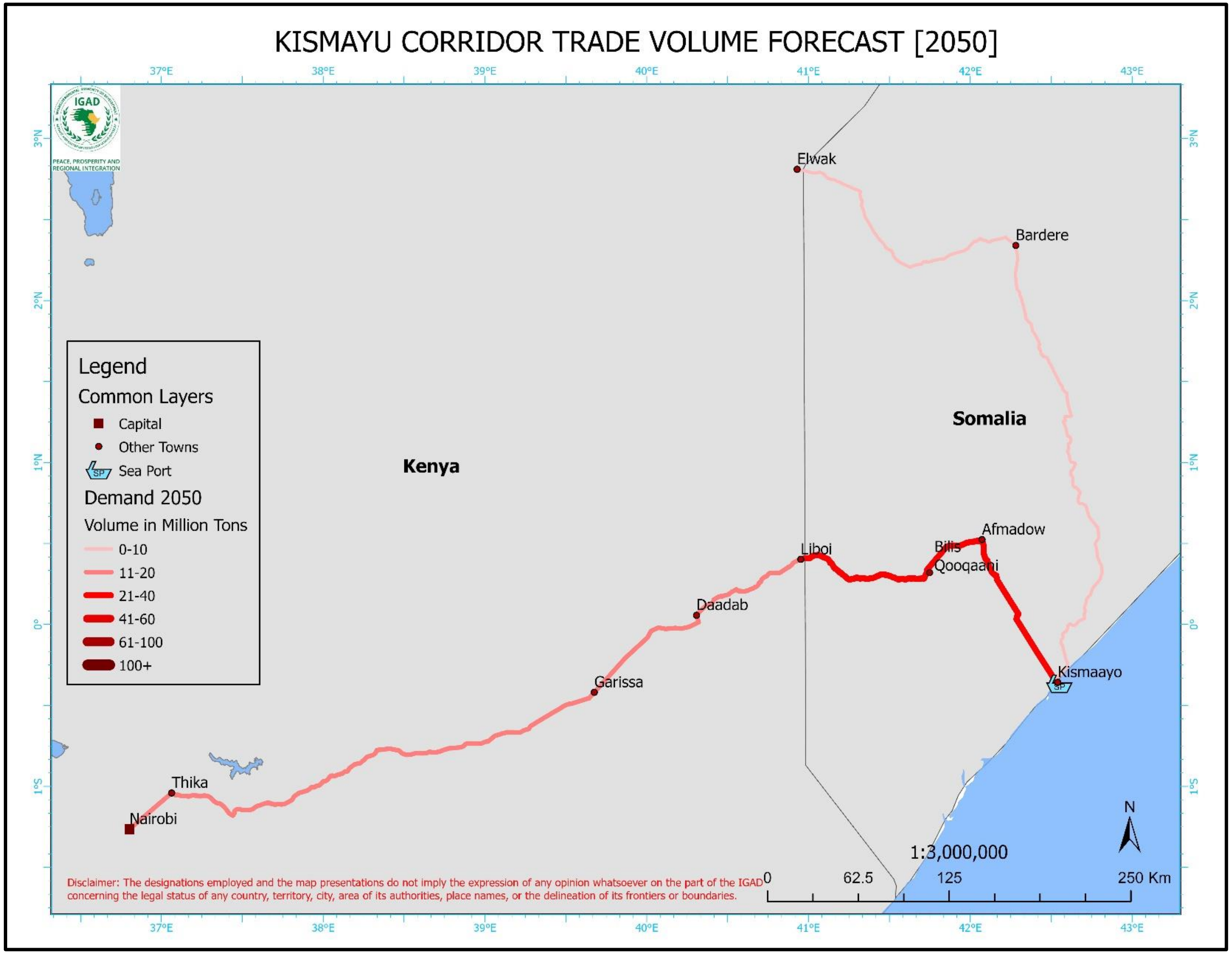


Figure 0-322: Forecast traffic flows, 2050, Kismayu Corridor (Millions of Tones)



The Energy Sector

This chapter is structured as follows:

The energy sector report is structured as follows:

- A high-level introduction and discussion of cross border trade in energy services
- IGAD current energy sector status: Overview of IGAD member country energy sectors, including installed capacity and market structure
- Planned energy infrastructure
- Modelled energy demand for the IGAD region over the short, medium and long term
- Demand gap analysis
- Enabling environment overview covering relevant global policy frameworks; regional and country policies, and legislative and institutional structures

Section 5.1 Foundations of cross-border energy trade for IGAD

The IGAD regional energy mix is characterised by relatively high levels of renewable energy assets and potentials, with Ethiopia, Kenya, Uganda and Sudan all operating majority renewable energy systems, based predominantly on hydropower with additional substantial geothermal generation, and an increasing amount of wind and solar. Thermal assets, however, are still a relevant subsector particularly in those countries with severely underdeveloped electricity systems such as South Sudan, Somalia, Djibouti and Eritrea.

In terms of oil and gas, the IGAD region has substantial potential to be an important player in the global petroleum sector. Sudan and South Sudan are established and mature producers, although political instability and civil strife have reduced output in both countries over the past decade. Uganda and Kenya have confirmed deposits and are currently developing their production capacity, while also negotiating transit routes. All other countries in the region have suspected deposits, some with active exploration underway. Furthermore, Sudan, Kenya and Djibouti are or will be important transit routes for regional oil and gas producers.

Grid Penetration and Energy Access

IGAD member countries are at varying levels of economic development and governance capacity. Insecurity and instability has been a predominant focus of governments of some member countries, with economic and infrastructure development receiving less focus and funding. However, the IRIMP aims to help IGAD realise ambitions of regional economic integration and cooperation, based on trade in energy and energy services, among other things.

Throughout the region, energy access rates vary from a high of ~38%% in Djibouti to a low of ~5% in South Sudan (Table 5-1), indicating substantial scope for increased access via domestic grid extension, regional interconnection and off-grid approaches.

Table 0-1: State of electricity access in IGAD countries

Country	Installed capacity	Electricity access rate			Households without power
		Rural	Urban	Nationwide	
Eritrea	Fossil thermal (41.5MW)	11.90%	43%		data not available
Ethiopia	Hydro (4206 MW), Wind (337 MW), Fossil thermal (126 MW), Geothermal (7 MW)	29%	85%	40%	12.6 million
Kenya	Hydro (820.7 MW), Wind (337 MW), Geothermal (627), Fossil thermal (816.2 MW), cogeneration (28MW)	6.7	58.2	64.5%	3.5 million
Somalia	Diesel (100 MW), Solar/Wind (3.9 MW)	1%	35%	15%	2.4 million
South Sudan	Fossil thermal (30 MW)	3.5	12.5	5.1	data not available
Sudan	Hydro (1560 MW),	22.2%	70.21%	38.53%	data not available
Uganda	Hydro (645 MW), fossil thermal (101.5 MW)	12%	52%	22%	31 million
Djibouti	Fossil thermal (126 MW), 90 MW imported from Ethiopia and 300 kW peak solar system	1%	54%	42%	110,000

Source: IRENA (2015). Africa Power Sector: Planning and prospects for renewable energy - Synthesis report. Abu Dhabi, IRENA: 44,

USAID-Power Africa, UNEP document repository (wedocs.unep.org), country data

While national expansion plans and electrification programs are critical for expanding access to electricity, cross-border energy trade (CBET) can form an important component of electricity sector strategy helping to promote reliable supply, increased access and affordability across the region. CBET offers benefits separate to national expansion plans, including lower costs of electricity supply through least cost development of region's energy potentials; lower costs through economies of scale (i.e., larger projects to serve larger systems); reduction of costs and increased reliability through shared generation reserve margins, and reduced environmental costs by increasing access to and use of cleaner sources of supply[36]). Further, in the case of hydropower, larger electricity markets can enable development of projects in areas with abundant potential, but with insufficient domestic demand to justify the investment, as well as help to smooth out seasonal and time of day variability often associated with hydropower and other variable renewables. Additional benefits include potential revenue from wheeling services for those countries that serve only as transit territories.

Furthermore, cross-border electricity trade in the form of bilateral connections can be a pre-cursor to the establishment or expansion of regional power pools. IGAD is not currently planning a regional power pool, however the East African Power Pool, established in 2005 but not yet fully operational, includes five of the nine IGAD countries (Kenya, Uganda, Sudan, South Sudan and Ethiopia), and so will be an important actor in the regional energy mix once operational. Over time, and as CBET expands in the region, IGAD may also choose to establish a regional power pool, increase trade with established regional power pools, or otherwise cooperate more closely with existing power pool groupings in the region.

[36] WB, Timilsina, 2015 - http://pubdocs.worldbank.org/en/271291458180265540/South-Asia-Electricity-Trade.pdf

Reflective of the growing awareness of the potential for CBET in the region, there are several regional and international initiatives relevant to the IGAD region aiming to support and promote power trading between countries and regions:

- The **Programme for Infrastructure Development in Africa (PIDA)**[37]: a joint work of the AUC, AfDB and UNECA endorsed by the AU summit in January 2012. It is dedicated to facilitating continental integration, socio-economic development, and trade, through improved regional infrastructure.
- The **Africa-EU Energy Partnership (AEEP)** – that aims to stimulate addition of 10,000 MW of new hydropower plants by 2020.
- The **East African Regional Geothermal Programme**, with USD 140 million mobilised for the Geothermal Risk Mitigation Facility, to encourage public and private investors in geothermal energy development by providing grants throughout eastern Africa.
- The **Power Africa** initiative,[38] a five-year United States of America Presidential initiative aimed at supporting economic growth and development by increasing access to reliable, affordable, and sustainable power in Africa. As part of their latest strategy, they have increased emphasis on CBET across the whole of the program, including production of transmission roadmaps.
- The **Global Energy Interconnection Development and Cooperation Organisation (GEIDCO)**, which is a China-based research and strategy organisation promoting regional and international electricity system interconnection and integration.

Of the above initiatives, two are briefly considered below as they provide a useful summary and vision of existing and potential cross border projects both from a generation as well as interconnection perspective. They include the Program for Infrastructure Development in Africa – Priority Action Plan (PiDA-PAP) and GEIDCO.

The PIDA-PAP initiative

The PIDA program, in conjunction with the African Development Bank, note that development of the power sector in the whole of Africa will require infrastructure spending of USD 40.8 billion / year[39]. As part of a continent-wide priority infrastructure planning initiative, PIDA has developed the PIDA priority action plan (PAP), which sets out top priority regional infrastructure up to 2040 for the power sector (among other sectors). The first phase of the PIDA-PAP identifies priority projects through 2020, including a selection of projects in the IGAD region, which are identified in Table 5-2. A second phase for PIDA-PAP will cover the period 2020-2040. As the PIDA-PAP is widely considered to be the primary vehicle for promoting infrastructure needs across the continent, as well as engaging with potential investors, any IGAD infrastructure planning will necessarily need to be coordinated with the PIDA-PAP initiative.

Table 5 2: Committed PIDA CBET projects in the IGAD region

Project	Description	Countries
Ethiopia – Sudan Transmission interconnector (Ethiopiasection)	Construction of a transmission line (2909 km / 500 kV) that connects the power networks of Ethiopia and Sudan to facilitate trading in	Ethiopia, Sudan

[37] http://www.au-pida.org/

[38] https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Power%20Africa%20Initiative%20Brochure.pdf

[39] Bissoonauthsing, V. *Regional Infrastructure development in the eastern and southern africa and Indian ocean (ESA-IO) region*. in *11th EDF regional meeting (East Africa) of the ACP-EU joint parlimentary assembly*. 2014. Port Louis, Mauritius.

Project	Description	Countries
	electricity and promote power systems stability. The interconnector will have a transmission capacity of 4000 MW. The Project also includes two new, 500 kV capacitated substations at Rabak and Jebel Aulia (both in Sudan), and power line bay extensions at the following existing substations: Grand Renaissance (500kV Ethiopia), Rabak (220kV, Sudan) and Jebel Aulia (220kV, Sudan).	
Ethiopia – Sudan Transmission Interconnector (Sudan section)	Construction of a 500kV high voltage transmission line and associated Substation or Converter station that connects the power networks of Egypt and Sudan to facilitate trading in electricity and promote power systems stability. The project comprises the update of project studies.	Ethiopia, Sudan, Egypt
Zambia-Tanzania-Kenya[40] (ZTK) Interconnector[41] (Kenya Section)	Construction of a transmission line that connects the power networks of Zambia, Tanzania and Kenya. This project includes the section of 96km Kenyan section of the 2,800km ZTK interconnector from Arush in Tanzania to Isinya in Kenya. In Kenya, the line will be linked to the High Voltage Direct Current Interconnector between Kenya and Ethiopia.	Kenya, Zambia,Tanzania
Uganda-Kenya petroleum products pipeline (Uganda section)	Construction of a petroleum pipeline between Eldoret, Kenya and Kampala, Uganda. This involves the section from Eldoret to the border with Uganda.	Kenya, Uganda

[40] this interconnector joins the EAPP power pool (EAPP) to the Southern Africa Power Pool (SAPP) as part of the North-South corridor]

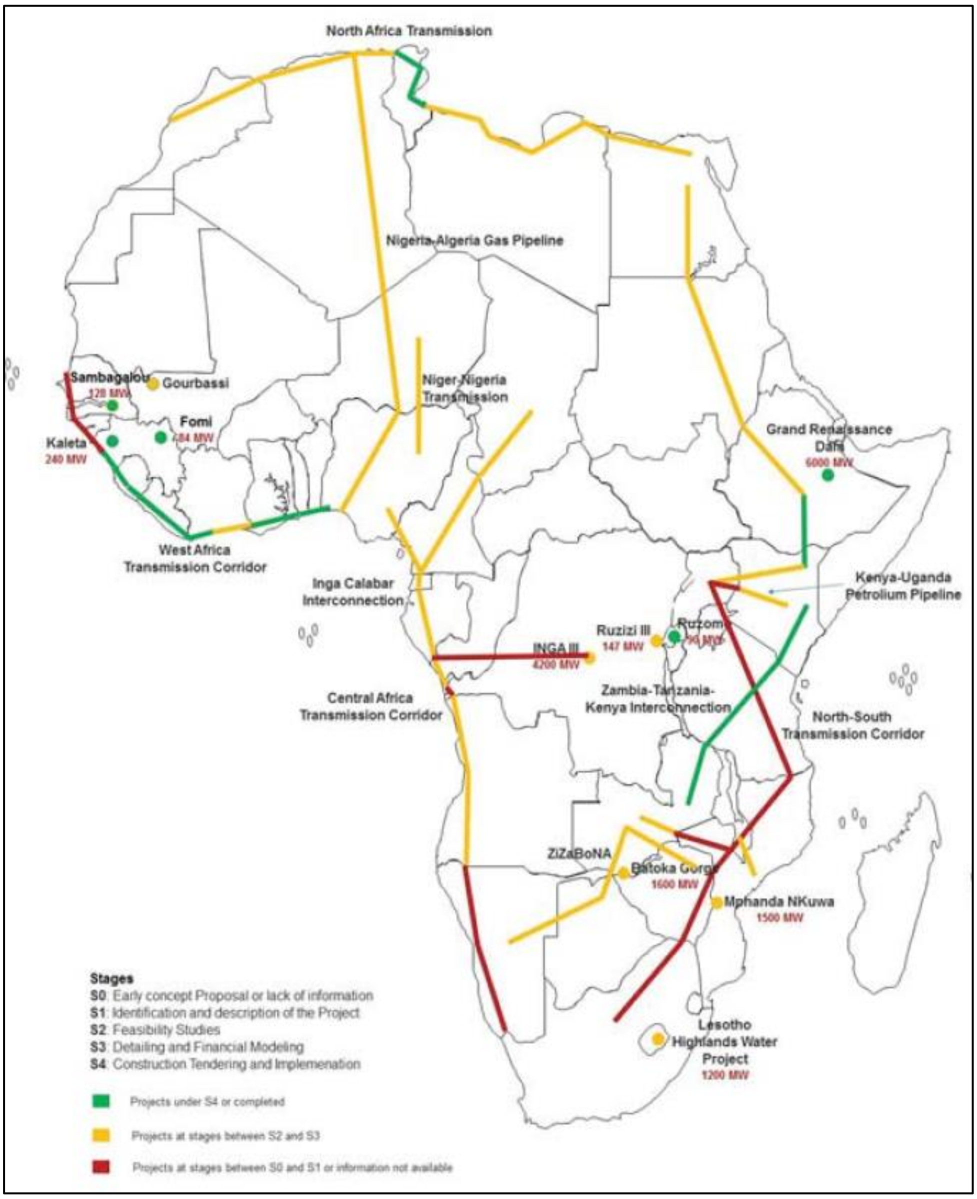
[41] Tanzanian Section, has 4 components (continued on next page)
- Namanga-Singida 414km, 400 kV double circuit transmission line UA 91 million, under construction
- Singida – Iringa, 670km, 400 kV double circuit, under construction
- Iringa-Mbeya – 292 km, 400 kV double circuit, Cost USD 110 million, funding being sought
- Mbeya-Tunduma – 100km, 400kV double circuit connection Tanzania with Zambia at the border towns of Tunduma and Nakonde, under feasibility

Project	Description	Countries
Uganda-Kenya petroleum products pipeline (Kenya section)	Construction of a petroleum pipeline between Eldoret, Kenya and Kampala, Uganda. This involves the section from the border with Kenya to Kampala, Uganda.	Kenya, Uganda

Source: *PIDA Project Status Dashboard*, *http://www.au-pida.org/pida-projects/* *Accessed 11 February 2019.*

In addition to electricity interconnectors, PIDA is also considering other oil and gas pipeline infrastructure to transport oil and gas across the region, including the Sudan-Ethiopia pipeline.

Figure 0-1: Planned PIDA PAP electricity and oil pipeline projects



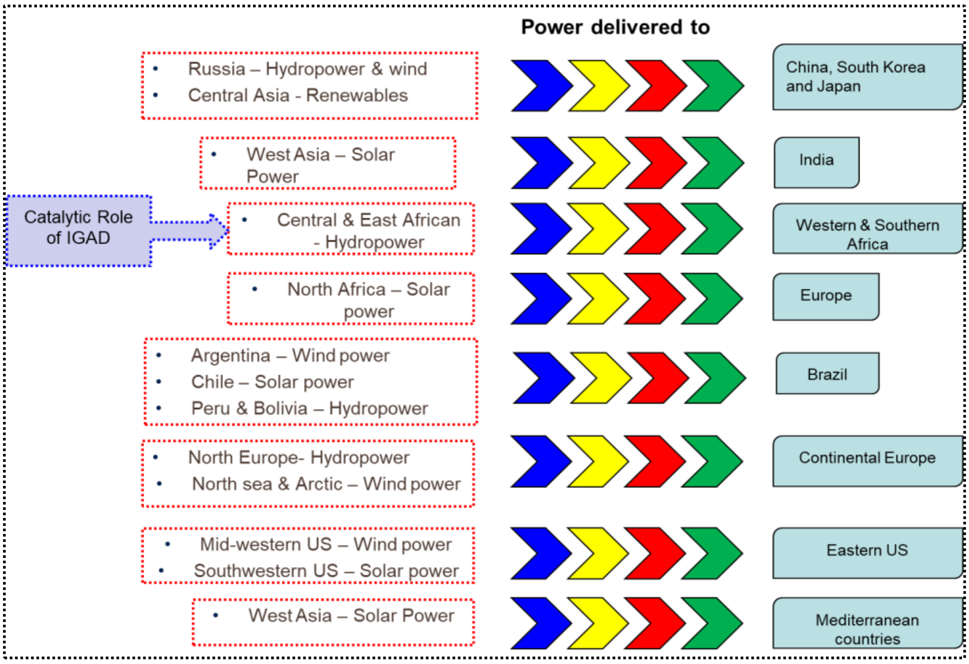
Source: PIDA, *PiDA progress report 2017*. 2017, NEPAD: Addis Ababa, Ethiopia.

While the current tranche of PIDA planned projects are a critical component of expanded energy sector integration across the continent, they do not fully address the needs of the IGAD region over the next decades. For example, South Sudan and Somalia are not covered by any of the PIDA projects. Also, while PIDA establishes some critical interconnections, the planned interconnects are not unified in a ring format, which would provide system redundancy, which in turn improves reliability. Additionally, the planned interconnects have small power exchange capacity. This indicates further scope for a broader range of infrastructure development to truly connect the region through CBET.

The GEIDCO initiative

Headquartered in Beijing China, the Global Energy Interconnection Development and Cooperation Organisation (GEIDCO) is an international organisation that seeks to promote the establishment of a Global Energy Interconnection System. Its main purpose is to meet the global demand for electricity in a clean and green way. In a 2018 study on Africa interconnection opportunities,[42] GEIDCO projects that by 2035 global power energy flow will be mainly inter-regional and trans-border power exchanges within and across continents. It envisions eight main power trans-border power flow systems globally (Figure 5-3).

Figure 0-2: Global trans-border power flow by 2035, as envisioned by GEIDCO



Source: GEIDCO, Africa Energy Interconnection Planning Research Report. 2018, Global Energy Interconnection Development and Cooperation Organisation: Beijing, China

Within Africa and particularly for IGAD, the Central (DRC-sourced) and East African (Ethiopia-sourced) hydropower loop for delivering power to western and southern Africa is pivotal. Over time, the loop may also eventually provide a linkage to Northern Africa, under the Nile Basin initiative, to feed power to Europe and Asia. While GEIDCO is not an official plan for the region, it does provide important insights into the possible future state of CBET across the continent. A future vision of the trans-border infrastructure projects and initiatives identified by GEIDCO[ibid] are indicated in **Error! Reference source n**

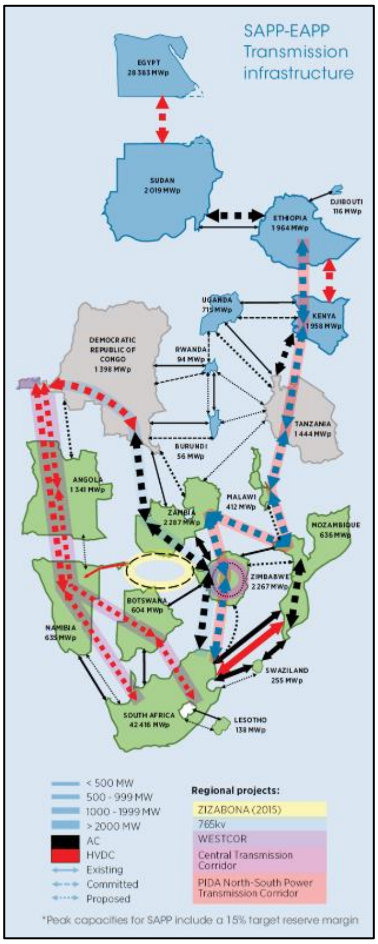
[42] GEIDCO, *Africa Energy Interconnection Planning Research Report*. 2018, Global Energy Interconnection Development and Cooperation Organisation: Beijing, China. p. 122

ot found.. The GEIDCO model envisions a progressive growth of the interconnectors in a decade-by-decade manner (**Error! Reference source not found.** a, b, and c):

- By 2030, the North-South interconnect is developed.
- By 2040, an interconnect to Somalia and under the Red Sea to the Arabian Peninsula is developed.
- By 2050, a double circuit 764 kV completes the North-South Corridor.

The GEIDCO study projects that on a continental basis a total of 146 GW installed of trans-border energy projects will exist by 2050[43]. The major source areas of these trans-border energy flows will be mainly Central Africa (the Congo river basin) and Ethiopia, along a north-south orientation as depicted in Figure 5-4. Over the longer term, the study further projects that 59 GW of hydropower will be evacuated to Europe, 11GW will be transmitted from West Africa to North Africa and 8 GW of power exchanged between West Asia and East Africa.

Figure 0-3: Potential Future State of CBET Transmission Corridors in Africa



Source: GEIDCO, *Africa Energy Interconnection Planning Research Report*. 2018, Global Energy Interconnection Development and Cooperation Organisation: Beijing, China

[43] GEIDCO, *Africa Energy Interconnection Planning Research Report*. 2018, Global Energy Interconnection Development and Cooperation Organisation: Beijing, China.

IGAD energy sector status

As with most regional economic communities, IGAD member countries have differing energy market structures and are at various stages of reform and liberalisation of their electricity sectors, which is a complicating (albeit typical) factor in cross-border electricity trade. Table 5-3 provides a high-level summary of the market structure and institutional landscape for each IGAD member country, with a more detailed analysis of the energy sector of each IGAD member state found in the Energy Sector Annex.

Table 0-2: Energy sector structure in IGAD countries

	Energy Mix	Market Structure	Main Institutional Stakeholders
Djibouti	Installed capacity: 120 MW (thermal), 120MW thermal 300 kW peak solar system. 90 MW imported from Ethiopia	Vertically integrated	Ministry of Energy and Natural Resources International Hydrocarbon Company Directorate for Rural Electrification in the Agence Djiboutienne de Developement Sociale (ADDS) Djiboutian Agency for Energy Management The Geothermal Energy Development Office National Energy Commission Electricité de Djibouti (EdD)
Eritrea	Installed capacity 149 MW, thermal	Vertically integrated	Ministry of Energy and Mines Renewable Energy Centre Eritrean Electricity Authority Eritrea Petroleum Corporation (EPC)
Ethiopia	Installed Capacity: 4,206 MW. The Hydroelectric: 3,743 MW (89%), Wind: 337 MW (8%) and Thermal: 126 MW (3%) form the mix	Vertically unbundled into: • Ethiopian Electric Utility (EEU) • Ethiopian Electric Power (EEP)	Ministry of Water, Irrigation and Energy (MWIE) Ministry of Mines Rural Electrification Executive Secretariat (REES) Regional Energy Agencies Ethiopian Rural Energy Development and Promotion Centre (EREDPC)
Kenya	Installed Capacity: 2,351 MW Hydroelectric: ~36%, Thermal: ~33%, Geothermal: 29%, Other Renewables: Wind (1.12%), Solar (0.03%), Biomass (1.04%)	Vertically unbundled: Kenya Generating Company (KENGEN) Kenya Transmission Company (KETRACO) Kenya Power and Lighting Company (KPLC)	Ministry of Energy and Petroleum (MOEP) Rural Electrification Authority (REA) Geothermal Development Company (GDC) Energy Regulatory Commission.
Somalia	Installed Capacity: 103.9 MW Diesel: 100 MW Solar/Wind: 3.9 MW	Vertically integrated	Ministry of Mining, Energy and Water Resources Somaliland Energy Commission Transitional Federal Government Energy Authorities in Puntland and Somaliland
South Sudan	Installed capacity: ~ 36 MW (all thermal)	Vertically integrated	Ministry of Energy and Dams Ministry of Petroleum

	Energy Mix	Market Structure	Main Institutional Stakeholders
	*Note: 14 MW is not currently available, mainly due to lack of spare parts		South Sudan Electricity Regulation Authority South Sudan Electricity Corporation
Sudan	Installed capacity: 2,985 MW Hydro: 1585 MW Thermal: 1400 MW *Note there are about 384 MW of hydro and 1,005 MW thermal under construction.	Vertically unbundled: Merowe Dam Electricity Company Ltd; Sudanese Hydropower Generation Company Ltd; Sudanese Thermal Power Generation Company Ltd; Sudanese Transmission Lines Company Ltd Sudanese Electricity Distribution Company Ltd	Ministry of Electricity and Dams Ministry of Petroleum and Mining
Uganda	Installed Capacity: 947 MW Hydro: 645 MW Thermal: 101.5 MW	Vertically unbundled with some aspect of horizontal unbundling: Uganda Electricity Generation Company limited (UEGCL) Uganda Electricity Transmission Company Ltd (UETCO) Uganda Electricity Distribution Company (UEDCL) – distribution network is leased to UMEME (distribution concessionaire).	Ministry of Energy and Mineral Development Petroleum Authority National Oil Company Rural Electrification Agency Electricity Regulatory Authority

***Source:* USAID-Power Africa, UNEP document repository (wedocs.unep.org)**
UNEP (2008). Global trends in Sustainable Energy Investment 2008: Analysis of trends and issues in the financing of Renewable Energy and Energy Efficiency. Nairobi, Kenya: 71.
UNEP (2017). Djibouti: Energy Profile, WEDOCS UNEP.
UNEP (2017). Kenya: Energy Profile, WEDOCS UNEP.
UNEP (2018). South Sudan: First State of Environment and Outlook Report 2018, United Nations Environmental Program (UNEP): 329.
USAID (2018). Power Africa Fact Sheet.

Beyond the electricity sector, known or suspected oil and gas deposits exist all IGAD countries, although Sudan and South Sudan are the only countries currently producing in commercial quantities. Beyond current production, probable and proven[44] oil and gas for IGAD REC are mainly in Kenya, Uganda, Sudan and South Sudan. However, contingent and prospective fossil resources[45] are in

[44] *Proved reserves* are those with a "reasonable certainty" (a minimum 90% confidence) of being recoverable under existing economic and political conditions. While *Probable reserves* are petroleum and gas quantities with a 50% confidence level of recovery [Society of Petroleum Engineers].
[45] *Contingent resources* are quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations, but the projects are not yet considered mature enough for commercial development due to one or more contingencies. While *Prospective resources* are quantities of petroleum estimated to be potentially recoverable from undiscovered accumulations by application of future development projects.

Somalia, Ethiopia and Djibouti. Table 5-4 identifies the proven fossil fuel reserves of IGAD member states.

Table 0-3: Fossil based resources and reserves within IGAD states

Country	Proven Oil or gas reserves	Prospective resources
Uganda – Lake albert Basin	~1.7 billion barrels of oil	2 billion barrels of oil (other sources put it at 6.5 billion barrels[46] (Aderibigbe 2014))
South Sudan (operational)	3.5 billion barrels of oil	
Kenya	~600 million barrels of oil	~4 billion barrels
Sudan [47](operational)	1.5 billion Barrels of oil	
Sudan (natural gas)	84.95 billion cubic meters of natural gas –	Associated with oil fields and thus flared or reinjected
Source: Stratfor (2013) "East African Infrastructure Development, Part 4: Pipelines." Technology, H. (2018) "Horn of Africa Pipeline." Technology, H. (2018) "Kenya-Uganda pipeline ". Technology, H. (2018) "Melut Basin Oil Project." Aderibigbe, N. (2014) "East Africa's fate as oil crisis worsens."		

For scale, the IGAD's region's 10.754 billion barrels amount to 22.23 per cent of Libya's endowment and a mere 0.63 per cent of all the proved reserves in the world (IEA 2018). Currently South Sudan produces 118,000 barrels per day, while Kenya and Uganda aim to have full production at 80,000 and 60,000 barrels per day. Thus Kenya's reserves will be depleted in just 25 years as compared to Uganda (296.8 years) and South Sudan (27 years) (IEA 2018).

Based on the above statics, Uganda's 6.5 billion barrels may attract significant investments than Kenya, hence giving it a higher production rate than Kenya. Hence the establishment of a refinery may be a strategic investment in this region.

The oil and gas sector is quite different from the electricity sector due, with different fiscal regimes including contract types, tax and royalties, with licensing of oil blocks, state ownership or participation, price volatility, and extensive involvement of multinationals – particularly in African Countries. However, it is worth noting that international trade in petroleum products is significantly higher than trade in electricity .

Section 5.2 Current cross-border energy infrastructure

The energy self-sufficiency of IGAD member states ranges from severely constrained (in the case of IGAD denoted by thermally dominant energy mixes) to moderately constrained systems to excess capacity given current and predicted future demand. To address this, most IGAD countries have in place detailed national plans for expansion of their power grids to serve domestic markets, as well as

[46] Aderibigbe, N. (2014) "East Africa's fate as oil crisis worsens.

[47] A field processing facility is to be constructed at Moleeta which is part of Melut basin. All oil in the Melut basin will be channeled to the facility to remove 10% of the water from the heavy crude oil (3,300 centipoise) and stabilize it before transportation. The Moleeta field will also produce 50,000 barrels per day in addition to the 500,000 barrels from the basin. This will push the country into the same production levels as Qatar Technology, H. (2018) "Melut Basin Oil Project.".

related off-grid initiatives to reach communities unlikely to acquire grid access in the near to medium term.

However, given the substantial differences in domestic demand as well as governance capacity across the region, and taking account of the vast hydropower and geothermal resources concentrated within individual countries in the region, there is significant opportunity for cross-border electricity trade within and outside of the IGAD region. Furthermore, oil production in land-locked countries in the region (e.g., South Sudan) necessitates cross-border trade in order to access international markets, while also enabling diversification of energy generation assets throughout the region.

Ethiopia, which has by far the highest hydropower potential among all IGAD countries, is at the forefront of pursuing a strategy of developing domestic generation potential in order to export to regional trading partners (cite strategy, report or public statement). Ethiopia currently has 3,810MW of installed hydropower, with a further 8,864MW under development, including the Grand Ethiopian Renaissance Dam, which will be Africa's largest hydropower station once completed. Ethiopia has a further 17 identified hydropower sites ranging in size from 60MW to 2,000MW (IHA, 2018). Other countries with large resource potentials include Uganda (hydropower), Kenya (geothermal), and potentially Sudan (hydropower). Furthermore, all countries in the region experience an abundance of solar radiation. For a more detailed discussion of regional resource potentials, please see the Energy Chapter Annex.

Building on from individual country ambitions and plans, and in line with its broader remit to promote regional cooperation and economic growth, IGAD now seeks to promote cross-border energy projects to enable a least cost development strategy, taking advantage of abundant and diverse primary energy sources in different locations across IGAD member states. The following provides a discussion of existing cross-border electricity interconnectors, followed by oil and gas pipelines.

Existing cross-border energy projects

There are currently 5 operational cross-border electricity interconnects within the IGAD region (not including connectors *from IGAD countries to non-IGAD countries*). A sixth project, the East African Power Pool – although not fully realised - is also included in the discussion of current cross-border projects (Table 5-5).

Table 0-4: Existing cross-border energy projects

	Countries involved	Brief description	Status
Ethiopia – Djibouti Interconnector (230kV)	Ethiopia, Djibouti	Construction of a 230KV power interconnector from the Dire Dawa substation to the PK-12 substation in Djibouti. A 90 MW capacity interconnect.	Operational
East African Power Pool	Uganda, Kenya, Ethiopia, and possibly South Sudan	Studies and modelling done for establishment of a trans-border energy systems (generation, transmission and consumption).	Actualisation of study not yet.
Ethiopia-Djibouti interconnect	Ethiopia, Djibouti	Existence of a 220 kV (150 MW) line between Ethiopia and Djibouti.	Operational
Ethiopia – Sudan interconnect 1	Ethiopia, Sudan	Existence of a 100 MW interconnector between Ethiopia and Sudan	Operational
Kenya-Uganda interconnect	Kenya, Uganda	Lessos (Kenya)-Tororo (Uganda) 127 km, 400 kV; 250MW	Operational

	Countries involved	Brief description	Status
Ethiopia – Sudan interconnect 2	Ethiopia, Sudan	a 230 kV, 250 MW cross -border interconnect	Operational
Source: GEIDCO, Africa Energy Interconnection Planning Research Report. 2018, Global Energy Interconnection Development and Cooperation Organisation: Beijing, China Hamouda, E. and K. Ramadan (2016). "The Impact of Grand Ethiopian Renaissance Dam on Sudan Electric Network Supply & Stability. AFrElec (2017). Sudan agrees to boost elecricity imports from Ethiopia, Newsbase PIDA, PiDA progress report 2017. 2017, NEPAD: Addis Ababa, Ethiopia. Government, E. (2018). "AFrica Energy Market place (AEMP)." from https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/AEMP/AEMP_-_Ethiopian_Government_presentation.pdf. Note: There may be some smaller scale cross-border projects undertaken by civil society organisations and other stakeholders, these are unfortunately not captured in national statistics.			

As expected, Ethiopia is the primary source of electricity generation for existing CBET in the region. This has benefited the region in multiple ways. For example, the 230kV line from Ethiopia to Djibouti earns Ethiopia at least USD 1.5 million in revenue per month and has eased Djibouti's reliance on fossil fuel power plants and generators.48

With respect to oil and gas pipeline across borders, there is currently one operational cross-border pipeline within the IGAD region: the Greater Nile Oil Pipeline, which transports crude oil from two blocks in South Sudan through Sudan to the Red Sea for export. In addition, the EAC has developed a regional strategy for oil refineries and related infrastructure (Table 5-6).

Table 0-5: EAC Regional refineries strategy 2008

Strategy	Description	Status
Refinery development	Development of a refinery near the oil fields in Uganda	Modular refinery being built. First module ready for commissioning
	Upgrading of Mombasa refinery	Refinery turned into storage facility. New Refinery planned to be built in Lamu
Storage facilities	Additional storage facilities in Uganda	Storage facilities planned on Western part of Kampala and linked to Eldoret-Kampala products pipeline
Pipeline	Eldoret – Kampala pipeline be constructed	Feasibility study done, currently funds are being sought for
	Capacity enhancement of Mombasa - Nairobi pipeline	Done
	Parallel pipeline Nairobi-Eldoret	Done
	Development of natural gas pipeline Dar es Salaam-Tanga-Mombasa	Planned
Port Facilities	Development of second oil jetty in Mombasa	Contact for Construction awarded, work to soon start on the USD 400 million offshore Kipevu oil terminal in
	Development of jetty at Kisumu port	Done
Future projects	Oil pipeline from South Sudan to East African Coast	Planning
Source: EAC (2008). Strategy for the development of regional refineries. Tanzania, EAC		

[48] Afrika, J.-G.K. and G. Ajumbo, *Informal cross border trade in Africa: Implications and policy recommendations*. 2012, African Development Bank. p. 13

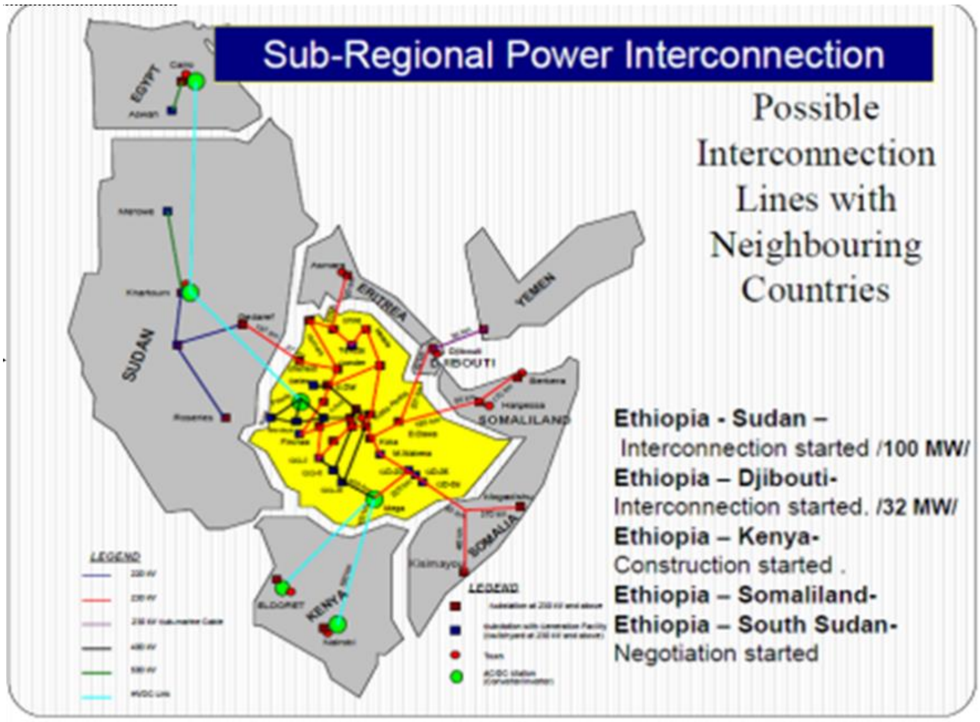
Section 5.3 Pipeline of IGAD Cross-Border Energy Trade Initiatives

As previously discussed, through PIDA-PAP as well as national-level initiatives, IGAD member states are already planning further cross border projects including electricity, gas and oil pipelines as well as refineries, oil storage facilities and oil jetties.

Planned CBET Electricity interconnectors

In terms of electricity, and in line with its export strategy, Ethiopia is central to current and proposed IGAD interconnectors with its planned 45 GW of power generation which will need to be evacuated beyond domestic markets. The target markets in the short term are Sudan, South Sudan, Djibouti, Somalia and Kenya (Figure 5-5)

Figure 0-4: Proposed Ethiopian electricity interconnectors – 2050



Source: GEIDCO, *Africa Energy Interconnection Planning Research Report*. 2018, Global Energy Interconnection Development and Cooperation Organisation: Beijing, China

Through project-team interviews with relevant planning entities in each of the IGAD member states, 12 planned cross-border electricity transmission projects have been identified (see Table 5-7). The 12 projects are included in national plans, but are not yet operational nor are they under construction. Detailed descriptions of each of these projects are provided in a collection of project data sheets provided in the Energy Sector Annex.

Table 0-6: Planned cross-border electricity interconnects (Planned, but not implemented)

	Project Name	Countries involved	Description	Status
i	Kenya – Uganda – Rwanda Interconnector (400kV)	Uganda, Kenya, Rwanda	Construction of 400kV double circuit transmission line and associated substation upgrades (Uganda section)	Planned

	Project Name	Countries involved	Description	Status
ii	Eritrea – Sudan Interconnector (230KV)	Eritrea, Sudan	230kV Sudan-Eritrea Interconnector (Kesela-Tesene-Barentu-Akordat-Keren-Asmara)	Planned
iii	Ethiopia – Eritrea Interconnector (230KV)	Eritrea, Ethiopia	230kV, Ethiopia-Eritrea (Enda Silasie-Asmara) Interconnection	Planned
iv	Ethiopia – Somalia Interconnector (230KV)	Ethiopia, Somalia	230 KV Ethiopia-Somalia Interconnection (Jijiga-Hargesa)	Planned
v	Ethiopia – Somalia Interconnector (500KV)	Ethiopia, Somalia		Planned
vi	Ethiopia – South Sudan Interconnector (230KV)	Ethiopia, South Sudan	230kV Ethiopia-S.Sudan Interconnection (Gambella-Malakal (Phase 1), 230kV of 357 km)	Planned
vii	Ethiopia – South Sudan Interconnector (400KV)	Ethiopia, South Sudan	400kV, Ethiopia – South Sudan Tepi-Bor) Interconnector (Ethiopia (Dedesa-Tepi) – South Sudan (Bor) Power TL -Juba, 500 kV of 700 km)	Planned
viii	Ethiopia-Sudan-Egypt (500KV HVAC & 600 KV HVDC) (Sudan section)	Ethiopia, Sudan, Egypt	Construction of a 500kV high voltage transmission line and associated Substation or Converter station that connects the power networks of Egypt and Sudan to facilitate trading in electricity and promote power systems stability. The project comprises the update of project studies.	Planned
ix	Kenya – South Sudan Interconnector	Kenya, South Sudan	Kenya – South Sudan Interconnection (Lokichog – Tiorit – Kapoeta)	Planned
x	Sudan – Eritrea Interconnector (230 KV)	Sudan Eritrea	Power interconnector between Sudan and Eritrea with a capacity of 230 KV.	Planned
xi	Sudan – Ethiopia Interconnector (220 KV)	Sudan, Ethiopia	Power interconnector between Sudan and Ethiopia with a capacity of 230 KV.	Planned
xii	Uganda – South Sudan Interconnector (400kV)	Uganda, South Sudan	400kV Uganda-South Sudan Interconnector. (Uganda segment)	Planned

Source: Project Data Sheets as compiled by project team.

Planned IGAD region generation projects

It is important to note that expanding the number of interconnectors will necessarily require sufficient energy generation and domestic transmission lines to feed into them. Consequently, several related energy generation and transmission projects have also been proposed across the region with some having received funding from the AfDB. Table 5-8 provides an illustrative list of planned generation projects receiving funding from AfDB in the region. Further projects are planned at country-level with separate sources of funding (e.g., Ethiopia’s Grand Ethiopian Renaissance Dam).

Table 0-7: AfDB-funded generation projects within IGAD

Country	Project title	AfDB Reference number	Funding status
Ethiopia	Mekele-Dalol & Semera Afdera power supply for industrial development and access scale-up	P-ET-FA0-011	On-going
Ethiopia	Assela wind farm – scaling-up renewable energy program (SREP) project preparation grant	P-ET-FE0-002	On-going
Djibouti	Geothermal exploratory drilling project	P-DJ-FA0-001	On-going
Kenya	Steam gathering system Menengai, 60 MW	P-KE-FZ0-008	Lending
Kenya	ADF - PRG Menengai – letters of credit to address KPLC's inability to take power generated and ready to be evacuated by the IPPs or the IPPs' inability to generate power due to GDC's default under the Project and Steam Supply Agreements e.g. by non-completion of transmission line to evacuate power on time[49].	P-KE-F00-001	Approved
Kenya	Last mile connectivity project - 2	P-KE-FA0-013	Ongoing
Kenya	Kenya - last mile connectivity project	P-KE-FA0-010	Ongoing
Kenya	Lake Turkana wind power	P-KE-FZ0-007	Ongoing
Kenya	African Development Fund Partial Risk Guarantee for Turkana Transmission -Line	P-KE-FA0-006	Approved
Kenya	Lake Turkana wind power project	P-KE-FZ0-004	Operational
Kenya	Lake Turkana wind power project - sub debt tranche	P-KE-FZ0-005	Ongoing
Kenya	Menengai geothermal development project	P-KE-FZ0-003	Ongoing
Kenya	Thika thermal power project	P-KE-FAA-001	Ongoing
Uganda	Bujagali energy limited	P-UG-FAB-008	Approved
Uganda	Decentralised renewables development program	P-UG-F00-002	Approved
Uganda	Achwa ii hydropower plant	P-UG-FAB-007	Approved
Uganda	Uganda rural electricity access project	P-UG-FA0-006	Ongoing
Uganda	Buseruka hydropower project	P-UG-FAB-006	Ongoing
Uganda	Mbarara-Nkenda & Tororo - lira transmission lines project	P-UG-FA0-004	Ongoing
Uganda	Buseruka hydropower project	P-UG-FAB-005	Ongoing
Uganda	Bujagali hydropower project	P-UG-FAB-004	Ongoing

Source: AfDB (2018). African Development Bank (AfDB), Project portfolios from different funders. online, African Development Bank Group

Planned cross-border oil pipelines

Similar to other regions in Africa, IGAD, whilst having the lowest energy consumption base, will have the highest compound annual growth rate (CAGR) for both oil and gas consumption in the next 20 years as opposed to the rest of the world. On a global level, Africa is expected to remain a net exporter of oil and gas by 2035. Further the IGAD member states are expected to continue exporting oil to China, India and Europe (Paton and Sullivan 2015). While not the subject of this report, it may be in the interest of IGAD member countries to consider further localisation along the oil value chain. This means considering opportunities where more value can be extracted in the construction and operation of the oil and gas infrastructure, as well as the increased foreign exchange this would bring in.

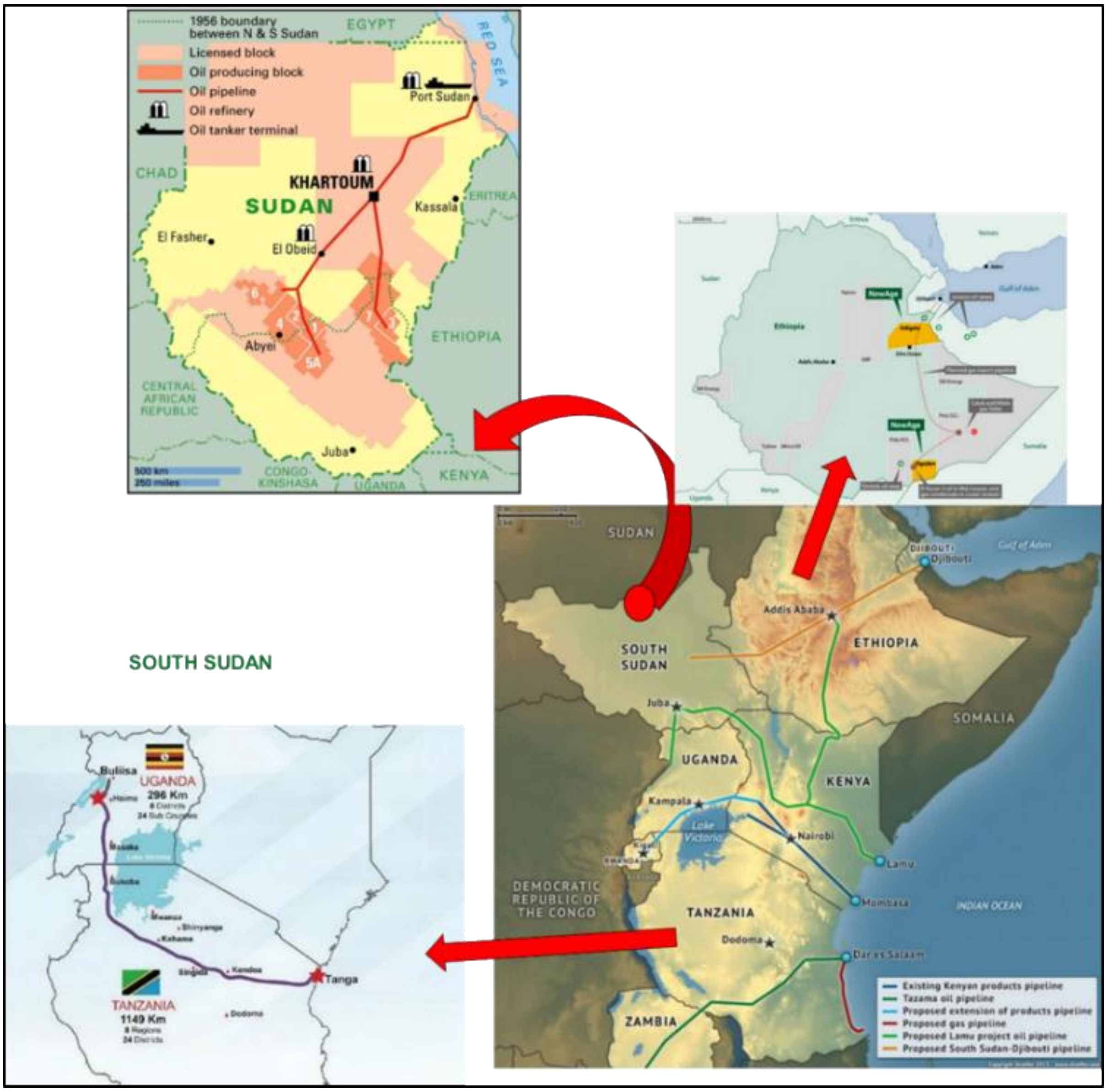
[49] By mitigating the risk of non-payment to the IPPs, the Program will increase the bankability of each IPP project and will contribute to an increase access to clean energy a decrease in end-user tariffs in the medium to long term, and an increase the national electrification rate. It will also enable further development of renewable energy projects

While the oil that is found in Kenya, Sudan, South Sudan and Uganda needs to be heated in order to be transported, it is now clear that this oil's waxy low sulphur characteristic may prove to be an advantage. This is because by 2030 global interventions for stricter carbon emission targets and environmental concerns, the region's less than <3% sulphur content oil may make the oil from this region more attractive. Subsequently, investments in this direction may in turn bring a higher return on investment (RoI).

In addition to the trans-border electricity transmission lines, there are a handful of planned oil pipeline transmission lines that could significantly alter the energy trade landscape in the region [50] (Figure 5-7). South Sudan is seeking new trade routes in order to export its oil without passing through Sudan, with whom it is in frequent conflict over oil-related revenues. Current plans for alternate export routes include two pipelines: one routing through Northern Kenya along the LAPSSET corridor to the Lamu port, and a second via Djibouti. Uganda, with newly proven commercial oil reserves, has recently made the decision to route a planned pipeline for its oil via Tanzania, rather than linking up with the proposed South Sudan- Northern Kenya pipeline. Ethiopia is also in discussions with Djibouti and Eritrea to build pipelines from Ethiopia into the two countries to enable access to regional shipping lanes in the Gulf of Aden and the Red Sea.

[50] EIA (2018). Country analysis brief: Sudan and South Sudan. Washington, United States EIA: 15

Figure 0-5: Proposed and existing oil transmission pipelines within IGAD Region (Source: EIA)



Source: EIA (2018). Country analysis brief: Sudan and South Sudan. Washington, United States EIA

Table 5-9 below provides the current list of planned cross-border petroleum products pipelines within the IGAD region, gathered during interviews with relevant officials within each IGAD country. For further information on these projects, please see the project data sheets provided in the Annex.

Table 0-8: Planned IGAD region petroleum pipelines

	Project Name	Countries involved	Description	Status
i	Sudan-Ethiopia Petroleum Pipeline	Sudan, Ethiopia	Extending the 12-inch pipeline from the Haya region to Gedaref, Alglabat and then to Ethiopia to supply Ethiopia with petroleum products.	Planned
ii	Kenya-Ethiopia crude oil pipeline	Kenya, Ethiopia	Product Oil Pipeline: from the Lamu Port – Isiolo, Nakuru – Isiolo and Isiolo – Moyale – Hawassa – Adddis Ababa	Planned

	Project Name	Countries involved	Description	Status
iii	Kenya-South Sudan crude oil pipeline	Kenya, South Sudan	The crude oil pipeline in Kenya will be constructed in three phases consisting of Lamu-Isiolo (540km) $1,480 million, Isiolo-Nakodok (780 km) $1,240 million, and Lamu Port Area $340 million. It is planned to link up with a pipeline to Jonglei at the South Sudan border	Feasibility
iv	Ethiopia-Djibouti LPG pipeline	Ethiopia, Djibouti	500km Multiproduct pipeline from port of Djibouti to Awash, Ethiopia. It will transport 240,000 barrels a day. Project is estimated to cost USD 1.55 billion	Feasibility study completed
v	Uganda-Kenya petroleum products pipeline - Kenya Section (PIDA project)	Kenya, Uganda	300 km long pipeline for a lower cost mode of transport of petroleum products. It will cost about USD 0.15 billion	Planned
vi	Uganda-Kenya petroleum products pipeline - Uganda section (PIDA project)	Kenya, Uganda	Eldoret-Kampala-Kigali	Planned
vii	Sudan to South Sudan Petroleum Pipeline	Sudan, South Sudan	Construction of Oil Products Pipeline. Extending the 12-inch pipeline (approx. length 320 km) from the Madani region to Algabalian through Rabak. Algabalain is located near to the border of South Sudan.	Planned
viii	Kenya to Ethiopia Product Oil Pipeline:	Kenya, Ethiopia	The project runs from Lamu – Isiolo – Moyale – Addis Ababa (Ethiopia), a distance of 987km.	Planned
ix	South Sudan to Djibouti crude oil pipeline	South Sudan, Djibouti		Planned
x	Horn of Africa Pipeline	Djibouti		Planned

Source: Project Data Sheets as compiled by project team.

Section 5.4 Energy Demand

Introduction

This section provides an analysis for the demand for the electricity and fossil fuel in the short term (up to 2024), medium term (2025-2030) and long term (2031-2050). While several models exist for such analysis, the challenge of data paucity within the IGAD region makes the application of common demand models difficult to apply. Generally, for electricity and oil and gas interconnectors market dynamics will influence their demand projections. In the following paragraphs, the key market dynamics are explained followed by an analysis of demand models and demand projections.

In developing demand projections, energy consumed becomes a key parameter in the projections made regarding the demand for energy-related infrastructure. The energy consumed is however impacted by several varied factors including projected GDP growth, projected population growth rates and available energy resources, among others. The following then provides a preamble on the modelling process of the energy demand.

Relationship between GDP and energy demand

Energy in the form of electricity for CBET is a derived demand, that is: its consumption does not yield utility by itself, rather it used as an input into other processes to give utility, which is known as energy services. Such services include lighting, cooling, industrial production, productive energy use like irrigation and transportation among others.

Thus, the primary purpose for electricity demand analysis is the acquisition of income and price elasticities estimates[51]. This is mainly done in an ex-post situation, for which various estimation methodologies exist. Of these, a 2011 study[52] showed that a comparison of six different techniques, despite showing different long-run income and price elasticities ranging from 1-2 and 0 to -0.6 respectively, produced fairly similar future demand forecasts up to the year 2025. The study concludes that the major determinants for electricity demand in almost all countries are (i) energy output, (ii) real GDP, (iii) price of electricity and (iv) temperature.

In order to calculate the elasticities, relating the evolution of relative electricity growth consumption to that of the economy suffices[53]. Specifically, energy consumption elasticity in relation to gross domestic product (GDP) is mathematically equal to 1 in a static system (an economy with a stable structure of the GDP unit or quasi-homothetic evolution) or diverges from unity but has tendency to return to it. Consequently, the modelling of future energy demands is normally based on electricity sales, utilizing an econometric model and to avoid non-linearities the electricity demand is undertaken for a particular year.

Relationship between population and energy demand

The IGAD member states projected population between the period 2015 to 2050 (Table 3-6) depicts Djibouti with lowest growth while Uganda and Somali have the highest. Higher population growth implies a need for increased investment in infrastructure to service a growing population and enable economic development. Further data on population growth in the IGAD region is provided in the Annex.

Demand forecast model used

Energy demand modelling is in this work undertaken as function of two characteristics[54]

- The evolution of the socio-economic system – this refers to fundamental characteristics of population per capita and GDP
- Technological evolution (energy output) – This refers to efficiency of the energy systems and its penetration to into the potential markets (existing and planned transboundary energy systems)

Within the IGAD region, member states tend to utilise the *Model for Analysis of Energy Demand* (MAED-2). Some countries have *also utilised an econometric regression model (ERM) such as the Regression* Analysis Load Forecast (RALF) model[55] used in Djibouti. Subsequently, to enable specific

[51] Jamil, F., & Ahmad, E. (2011). Income and price elasticities of electricity demand: Aggregate and sector-wise analyses. *Energy Policy, 39*(9), 5519-5527. doi:https://doi.org/10.1016/j.enpol.2011.05.010
[52] *ibid*
[53] Ramain, P. (1986). The energy demand elasticity in relation to gross domestic product: A relevant indicator? *Energy Economics*, *8*(1), 29-38. doi:https://doi.org/10.1016/0140-9883(86)90023-X
[54] International Atomic Energy Agency (IAEA), Model for analysis of Energy Demand (MAED-2). Computer Manual Series No. 18. Available at https://www-pub.iaea.org/MTCD/publications/PDF/CMS-18_web.pdf
[55] Shodhganga, Electricity demand projection, Page 19. Available at http://shodhganga.inflibnet.ac.in/bitstream/10603/8179/9/09_chapter%2002.pdf

year determination, this study employs the ERM model and validates the results using the Balmorel/EAPP projections as well as with GEIDCO projections. The aspect of sectoral contribution to energy demand is intuitively figured into the demand analysis by consideration of total energy sales across different customers (industrial, commercial and households)

The ERM model considers the relationships between historical electricity sales for each consumer category and economic drivers for consumption such population, per capita gross domestic product (GDP) or sector specific GDP. The relationship derived is then used to forecast sector sales of electricity in the future. Knowing the future sales (in GWh) one can then be able to intuitively derive the required installed capacity for that time in future based on coincident after diversity load factors (CADLFs[56]) and power losses.

For the purposes of this IGAD analysis, a modified 3 parametric ERM model can be employed.

$$\boldsymbol{E_{d/t} = \ C + \ PoP^{\alpha} + GDP^{\beta} + CoN^{\gamma} + \varepsilon_D} \ldots$$

Where:

$E_{d/t}$	Electricity demand and supply in year t, i.e. Sector sales of electricity (GWh)
C	Constant estimated by respective sectors using regression models. It may be considered to be the current installed capacity
α, β, γ	Coefficients of elasticities of demand
ε_D	Error or disturbance term i.e. random variable summarizing the effects of omitted factors including future changes in energy demand & supply
PoP, GDP, CoN	Independent driving parameters used population, GDP, and number of consumers for domestic, commercial and other sectors

The future predictions are further analysed to ensure that the growth rate is sensible within the expected energy sales and show limited volatility. The model assumes that historical relationships will remain valid in the future. Hence the results have carefully considered to identify relationships which would yield forecasts that are not credible.

Input data required for the ERM model

- Historical economic and demographic data, and GDP broken down by economic activity sectors.
- Forecasts of economic and demographic data – namely population forecasts, GDP forecasts for each economic sector.
- Historical consumer data – namely historical sales data by consumer category, historical consumer data by consumer category and historical tariff data by consumer category.
- Historical system data – namely historical generations (sent out), and historical system peaks

Each of these input factors have assumptions built into them. For instance, the occurrence of a civil war or unrest will affect GDP growth as well as possibly destroy infrastructure. Such factors should be taken into consideration where possible.

[56] The CADLF is the load factor that relates energy sales to demand at time of system peak. Therefore, it includes the effects of both diversity (the maximum demand of a group of consumers is less than the sum of the individual demands) and coincidence (the peak demand of a group of consumers may not be at the time of system peak).

Validation of the ERM model

The results of the demand forecast model are validated statistically and by comparisons with results to other models (though other models may have different core assumptions). Nevertheless, a statistical validation utilises three metrics:

- Correlation coefficient (R^2): R^2 indicates correlation between historical sales (dependent variables) and the economic drivers (independent variables) selected in the regression. With $R^2 = 1$ denoting perfect correlation and $R^2 = 0$ indicating no correlation
- Coefficients (α, β, γ): These determine the impact of the economic drivers' historical sales. Regressions will only be accepted if the coefficients appear to be of the correct sign (positive or negative). For instance, a negative price coefficient would indicate a fall in price hence an increase in sales. Further the coefficients should be of the correct size e.g. economic driver coefficient should not be too large, such that they indicate that a small change in the economic driver would result in an enormous change in the level of sales.
- P values: These identify whether an economic driver is adding anything to the regression. A p-value close to zero indicates that it is very likely that the particular economic driver in question plays a very significant role in the determination of sales.

Thus, only those regressions with very high R2 values, coefficients of reasonable magnitudes and sign, and low p-values should be accepted. Despite these criteria the future predictions should be further analysed to ensure that the growth rate is sensible within the expected energy sales and show limited volatility. The model assumes that the historical relationships will remain valid in the future. Hence the results should be carefully considered to identify relationships which would yield forecasts that are not credible.

With regard to validation of our approach using other models, three are of interest:

i. The Balmorel model (used to model the East African Power pool):

- The Balmorel model[57] is a partial equilibrium model that seeks the least cost energy generation and transmission solution. It in part attempts to solve the ERM equations using the General Algebraic Modelling System (GAMS). This is a high-level modelling system for mathematical programming and optimisation. Subsequently, the Balmorel model is written in the GAMS modelling system.
- To run the Balmorel model the GAMS model, a solver (like a linear programming solver) is required. The output is handled using MS office 2007 tools (MS Access, MS Excel, MS Word and MS PowerPoint). The Balmorel model is a partial equilibrium model.

ii. Global Energy Interconnection Development and Cooperation Organisation (GEIDCO) study results:

- The GEIDCO study results provide a useful view of global energy interconnectors. However, the results are less useful at a more granular IGAD-level, due to relatively low nodal representation, low technological representation and limited locational data representation[58].

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[57] Analyses, E. (2018). *Balmorel - Energy System model - User guide* Retrieved from Denmark: http://ea-energianalyse.dk/papers/Balmorel_UserGuide.pdf

[58] Brinkerink, M., Deane, P., Collins, S., & Gallachóir, B. Ó. (2018). Developing a global interconnected power system model. *Global Energy Interconnection, 1*(3), 330-343.

iii. Member state projections where available[59]

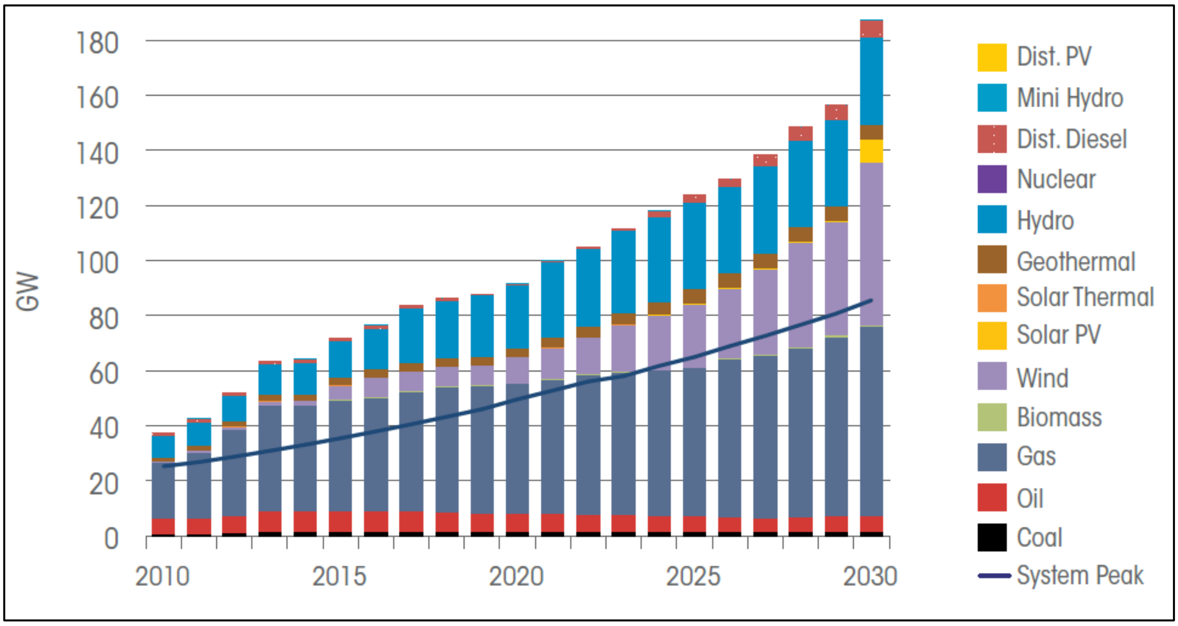
Scenario analysis of energy demand

In developing the gap analysis, three scenarios are utilised: full regional integration (optimistic scenario); business as usual (baseline scenario); and the alternative (national policy scenario).

Scenario 1: Full Regional Integration – Optimistic Scenario

Increased regional integration based on renewables would encourage countries with inexpensive hydro resources, such as Ethiopia and Uganda, to export to those more dependent on fossil fuels. Each country could have a surplus above 20% of domestic demand. Under such a renewables-promotion scenario, approximately 10% of generated electricity would be traded within the region, with considerable benefits for both importers and exporters. Uganda and Ethiopia would be the major exporters and Egypt, Kenya and Sudan the primary importers. Smaller economies such as Djibouti would also benefit from importing from neighbours to meet considerable shares of their demand [60].

Figure 0-6: IGAD countries under full integration scenario



Source: IRENA. "Africa Power Sector: Planning and Prospects for Renewable Energy - Synthesis Report." 44. ABu Dhabi: IRENA, 2015.

Scenario 2: Business as usual - Baseline scenario

In the business as usual (BAU) scenario, a current policy and practice of generation, transmission and distribution continues. Unlike the NP scenario, where extra efforts are made to prioritise generation, transmission and distribution, under BAU, the energy sector is treated similarly to all other sectors.

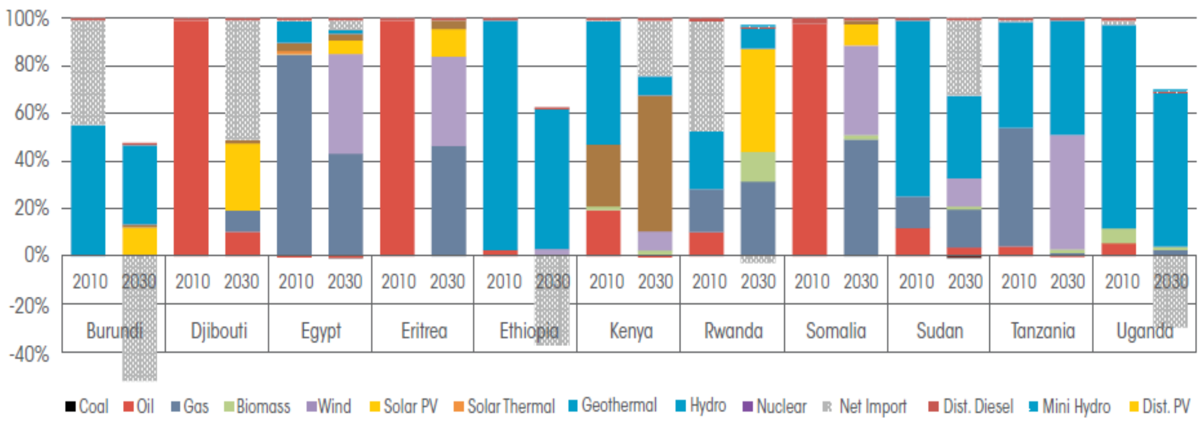
Scenario 3: Alternative - National Policy Scenario (with limited CBET)

[59] Mawia, M. A. (2013). *Elasticity of demand for electricity in Kenya from Timer series data.* School of Economics, University of Nairobi

[60]

In the alternative scenario, in which cross-border transmission options are limited, Ethiopia and to a lesser extent Uganda would have fewer export opportunities, and hydropower in those two countries would mainly serve domestic needs. In Kenya, geothermal would still play significant role in the generation mix. But without policy-driven cost reductions for renewables, some investment in those two areas would be diverted to gas-fired projects.

Figure 0-7: IGAD member states under alternative scenario (NP scenario)



Source: IRENA. "Africa Power Sector: Planning and Prospects for Renewable Energy - Synthesis Report." 44. ABu Dhabi: IRENA, 2015.

Determination of the baseline conditions

This section seeks to identify the need for additional planned projects (more infrastructural investments) for electricity interconnects and oil pipelines. To undertake the gap analysis, high, medium and low scenarios are developed, thereafter the baseline situation is delineated after which modelling occurs. The difference between the scenarios and the baseline situation then provides the gap. From the analysis, it is estimated that the future committed generated capacity is 18.797 GW[61] for different technology types (Table 0-9).

Electricity Generating Capacity within IGAD

From the EAPP study[62], it is noticed that the total peak load for the IGAD member countries is ~7.986 GW (Table 5-10). This approximates quite well with the GEIDCO study[63], which estimates that in 2015 the demand was 7.8GW.

Table 0-9: Generating capacity of IGAD member countries

Country	Hydro	Wind	Diesel	Geothermal	CCGT	OCGT	Cogen	STPP	Country totals (MW)
Djibouti			122						122
Eritrea			139						139
Ethiopia	1,934	171	78	5					2,188

[61] EAPP, EAPP regional power system master plan: Volume 1 - main report. 2014, East African Power Pool (EAPP).
[62] EAPP, EAPP regional power system master plan: Volume 1 - main report. 2014, East African Power Pool (EAPP).
[63] GEIDCO, *Africa Energy Interconnection Planning Research Report*. 2018, Global Energy Interconnection Development and Cooperation Organisation: Beijing, China. p. 122

Country	Hydro	Wind	Diesel	Geothermal	CCGT	OCGT	Cogen	STPP	Country totals (MW)
Kenya	820	25	816	627				26	2,314
Somalia									
South Sudan			33						33
Sudan	1,565				340	34		428	2,367
Uganda	691		100				32		823
Technology type totals (MW)	5,010	196	1,288	632	340	34	32	454	7,986

Source: Author

Note: Countries with no entries indicates a lack of available data

Electricity Interconnection Capacity

As previously discussed, a total of 9 electricity interconnectors currently exist among IGAD member states (insert table reference), transferring about 3.125 GW by 2020. However, based on EAPP and GEIDCO modelling, which are looking at a wider picture, the interconnects are likely to be closer to 13 in number (Table 0-10), which will provide 11.6 GW by 2024 (this includes an additional four key interconnects that form part of the broader economic case for investment in regional interconnects even though the connect outside of the IGAD region: one for DRC-Uganda; two for Egypt -Sudan and Kenya-Tanzania, totalling 4.9 GW).

The capacities of these interconnections are indicated in **Error! Reference source not found.**. Further, t he EAPP for selected IGAD member states several additional pipeline transboundary projects have come online. By 2020 the number of interconnectors will exist among various IGAD countries, these will total 3.125 GW by 2020 (Table 0-10) and 11.6 GW by 2024. These long-distance interconnectors will transfer of about 11.6 GW (Table 0-10)[64] by 2024.

Table 0-10: Planned interconnectors for IGAD countries (including key external connectors)

To/From	From/To	Type (AC/HVDC)	Voltage (kV)	Distance (km)	Capacity (MW)	Construction time (years)
DRC East	Uganda	AC	220	352.2	600	4
Egypt	Sudan	AC	500	775	1000	4
Egypt	Sudan	HVDC	600	1665	2000	4
Ethiopia	Djibouti	AC	220	283	300	3
Ethiopia	Kenya	HVDC	500	1068	2000	4
Kenya	Tanzania	AC	400	508	1300	3
South Sudan	Ethiopia	AC	220	300	300	3

[64] Ibid

To/From	From/To	Type (AC/HVDC)	Voltage (kV)	Distance (km)	Capacity (MW)	Construction time (years)
South Sudan	Uganda	AC	400	200	1000	3
Sudan	Ethiopia	AC	500	550	1200	4
Sudan	South Sudan	AC	220	400	300	4
Uganda	Kenya	AC	400/220	254	600	3
Uganda	Rwanda	AC	220	172	600	3
Uganda	Tanzania	AC	220	271	400	4
Total installed interconnectors by 2030					11, 600	
Source: Author						

Oil pipeline interconnectors

For oil pipeline the current reserves are shown in Table 5-12.

Table 0-11: Proven oil reserves within IGAD region

Country	Proven oil or gas reserves	Prospective resources	Potential revenue
Uganda – Lake Albert Basin	~1.7 billion barrels of oil	2 billion barrels of oil	Over USD 2 billion per year for 20 years
South Sudan (operational)	3.5 billion barrels of oil	n/a	n/a
Kenya	~600 million barrels of oil	~4 billion barrels	
Sudan (operational)	1.5 billion barrels of oil		
Sudan (natural gas)	84.95 billion cubic meters of natural gas	Associated with oil fields and thus flared or reinjected	

Source: Stratford (2013) "East African Infrastructure Development, Part 4: Pipelines."

Technology, H. (2018) "Horn of Africa Pipeline."
Technology, H. (2018) "Kenya-Uganda pipeline ".
Technology, H. (2018) "Melut Basin Oil Project."
Aderibigbe, N. (2014) "East Africa's fate as oil crisis worsens."

In term of capacity (daily production) the current production of IGAD country refineries is given in 5-13

Table 0-12: Oil Production within IGAD region

Country	Capacity ('000 barrels per day)	Status
Khartoum (al-Jaili), Sudan	10 (Its proposed to increase capacity to 100)	Full refinery, operational
Port Sudan, Sudan	21.7 (it is proposed to increase capacity to 100	Full refinery, Operating
El Obeid, Sudan	10	Topping plant, operational
Shajirah, Sudan	10	Topping plant, not operating
Abu Gabra, Sudan	2	Topping plant, not operating
Unity state (Bentiu), South Sudan	5	Full refinery, Under construction
Upper Nile (Thiangria)	10	Full refinery, Suspended
Hoima, Uganda	30	Full refinery, under construction
Lamu, Kenya	120	Full refinery, suspended
Source: Author		

Energy projections / modelling

The ERM model has been used to undertake a prediction for the demand for power (MW) and Oil (Gtoe) in the future, a fundamental requirement when developing an energy master plan65. By considering the demand for additional power, a comparison can be made between the required peak demand (GW) and the committed projects (Table 0-13). The national forecasts cover different periods that do not always cover the entire projection period of the current study, i.e. until 2040. To extrapolate the forecast of 2040, the individual country forecasts have been linearly adjusted from their last year of projection to exhibit a 5% to 6% annual demand growth rate towards 2030, and a 3% annual growth rate in between 2030 and 2040.

This assumption reflects the assumed decrease in demand growth rate as electricity access is provided to a larger share of the population of the EAPP. Thus, ERM model was applied to determine the projections under the 2 scenarios for up to 2050 projections for both electricity (GW) and oil (Gtoe) (Table 5-14 and 5-15). Note, countries which did not provide sufficient data have not been included in the modelling.

[65] For the East African power pool – the Balmorel model has been used to simulate the entire power system of the EAPP. The task of the model is simple: Based on a set of inputs including future electricity demand, cost of any possible generation technology, and the costs of possible transmission projects, to compute a least-cost expansion plan for the region.

Table 0-13: Scenario projection of electricity demands

Optmistic scenario (FI)	2020	2024	2030	2040	2050
Kenya	6.27	7.61	9.85	14.23	19.40
Eritrea	0.26	0.30	0.37	0.51	0.67
Ethiopia	13.23	16.03	20.73	29.88	40.68
Sudan	5.03	6.04	7.72	10.97	14.78
Djibouti	0.10	0.40	0.48	0.575.9	0.80
Total peak Demand (GW)	24.89	30.38	39.15	55.59	76.33

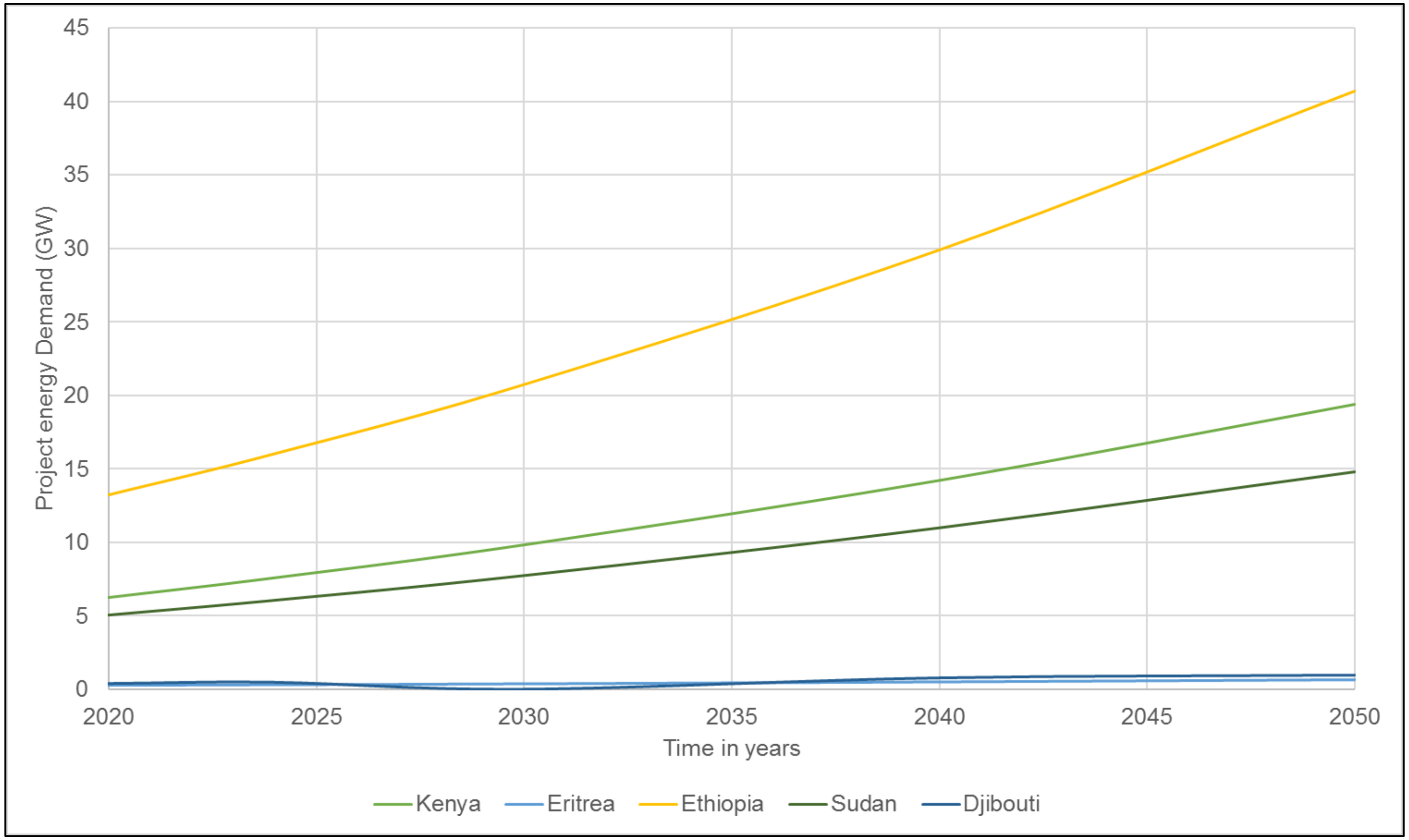
Baseline scenario	2020	2024	2030	2040	2050
Kenya	7.85	9.31	10.45	13.47	16.94
Eritrea	0.36	0.55	1.07	3.14	9.12
Ethiopia	16.55	25.41	47.77	133.39	363.88
Sudan	6.29	9.57	17.80	48.98	132.19
Total Peak Demand (GW)	31.05	44.84	77.09	198.98	522.13

NP scenario	2020	2024	2030	2040	2050
Kenya	6.76	7.73	8.67	10.76	13.04
Eritrea	0.28	0.36	0.53	0.98	1.79
Ethiopia	14.25	18.84	28.30	54.38	102.07
Sudan	5.42	7.10	10.54	19.97	37.08
(Total Peak Demand (GW)	26.71	34.03	48.04	86.09	153.98

Source: Author

Looking more closely at the Full Implementation Scenario, an analysis for future demand can be achieved as shown using Figure 5-10

Figure 0-8: Energy demand scenario for IGAD region (FI Scenario)



Source: Author

From Figure 5-10 Ethiopia under full implementation scenario will seek to achieve the 45 GW plan. The model projects 41 GW. Kenya follows next with 20 GW then Sudan (15GW) and lastly Eritrea and Djibouti. South Sudan, Somalia and Uganda are not included in the prognosis for lack of sufficient long time series data (GDP and population). Unlike electricity, the amount of oil consumed depends on a number of factors including: (a) Current energy mix (whether predominantly thermal); (b) Future planned generator types; and (c) Availability of local fossil fuels resource

Table 0-14: Scenario Projection of Oil Demands

Optmistic scenario (FI)	2020	2024	2030	2040	2050
Kenya	0.21	0.36	0.78	2.26	8.5
Eritrea	0.04	0.04	0.04	0.04	0.04
Ethiopia	0.39	0.61	1.18	3.38	9.36
Sudan	0.14	0.15	0.17	0.2	0.23
Total peak Demand (Gtoe)	0.78	1.16	2.17	5.88	18.13
NP scenario	2020	2024	2030	2040	2050
Kenya	0.17	0.19	0.21	0.27	0.32
Eritrea	0.05	0.06	0.08	0.13	0.2
Ethiopia	0.38	0.6	1.18	3.68	11.42
Sudan	0.15	0.19	0.25	0.41	0.67
Total Peak Demand (Gtoe)	0.75	1.04	1.72	4.49	12.61
Baseline scenario	2020	2024	2030	2040	2050
Kenya	0.2	0.23	0.26	0.33	0.42
Eritrea	0.06	0.08	0.15	0.38	0.99
Ethiopia	0.35	0.5	0.83	1.97	4.66
Sudan	0.18	0.26	0.46	1.19	3.09
(Total Peak Demand (Gtoe)	0.79	1.07	1.70	3.87	9.16

Source: Author

Section 5.5 Energy Infrastructure gap analysis[i]

Gap for electricity interconnectors

According to the EAPP Master Plan, by 2020 several interconnectors will exist among various IGAD countries, totalling 3.125 GW while our projections indicate a required total of 76.517 GW by 2050. Considering the expected demand for additional power, a comparison was made between the required peak demand (GW) and the committed projects. This is the infrastructure gap for electrical interconnection as demonstrated in Table 5-16

Table 0-15: Potential interconnectors and generators by 2024

Interconnecting countries	Size	Status
Ethiopia Djibouti	180 MW	An AC line, existing
Kenya – Ethiopia	2000 MW	A DC line, to be commissioned by 2017
Ethiopia – Sudan	200 MW	An AC line, existing
Sudan – South Sudan	300 MW	An AC line, existing
Kenya – Uganda	445 MW	An AC line, 145 MW existed before, additional 300 MW was to be commissioned by 2015
Ethiopia – Sudan Transmission interconnector	4,000 MW, 500kV, 583 km	

Zambia-Tanzania-Kenya[66] (ZTK) Interconnector[67]	2000MW, 400kV double circuit, 96km for Kenyan section	
Total capacity	**14.73 GW**	
Source: Author		

Based on the ERM model forecast can be made and an infrastructure gap identified by removal from the total capacity of 15.125 GW. The national forecasts cover different periods that do not always cover the entire projection period of the current study, i.e. until 2040. To extrapolate the forecast to 2050, the individual country forecasts have been linearly adjusted from their last year of projection to exhibit a 6% annual demand growth rate towards 2030, and a 3% annual growth rate in between 2030 and 2040. This assumption reflects the assumed decrease in demand growth rate as electricity access is provided to a larger share of the population of the EAPP

The infrastructure gap refers to the difference between the current status and the projected demand in the year 2050. In all scenarios the demand reduces as one moves from the worst-case scenario (do nothing, i.e., business as usual) to the more optimistic fully integrated East African Power Pool scenario. It will be noted that in line with the fact that Ethiopia will have more net energy resources - its infrastructural demands will be higher since it must export power to its neighbours. On the other side Eritrea, Kenya and Sudan which are net importers will find less need for national infrastructure due to the use of interconnectors.

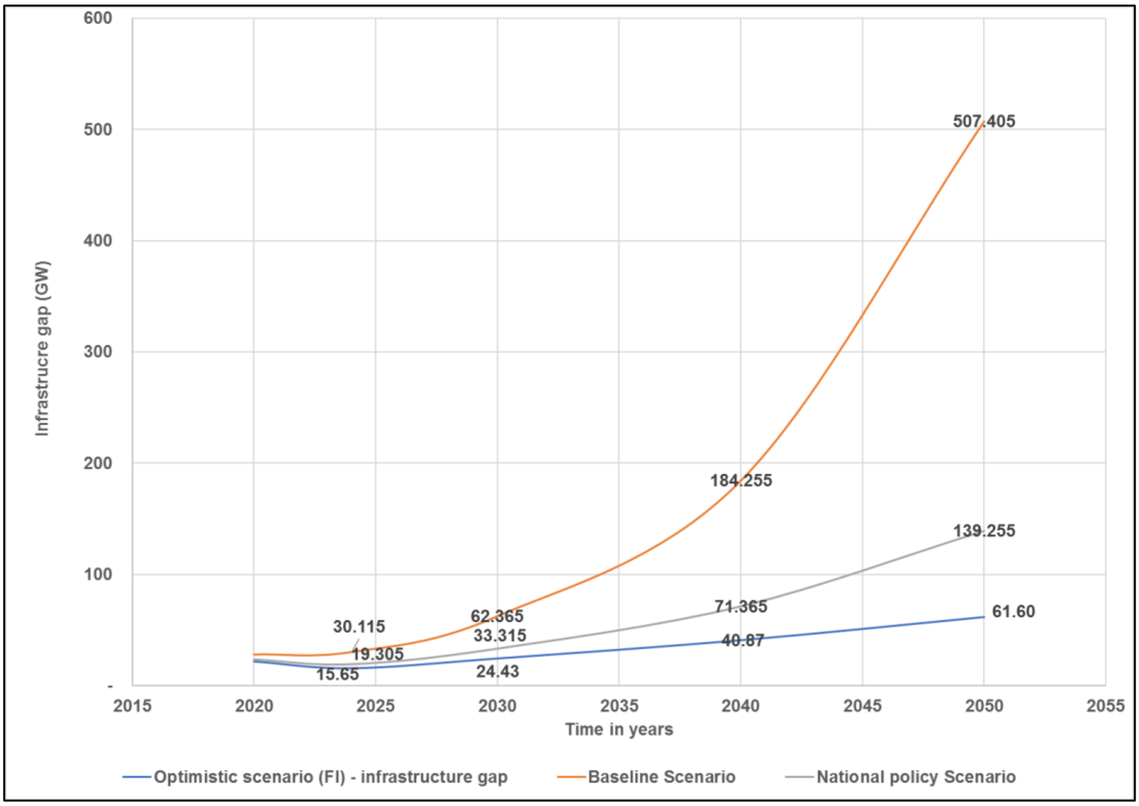
The infrastructure gap over the short, medium and long-term period is thus shown in Figure 0-9.

[66] this interconnector joins the EAPP power pool (EAPP) to the Southern Africa Power Pool (SAPP) as part of the North-South corridor]

[67] Tanzanian Section, has 4 components (continued on next page)

- Namanga-Singida 414km, 400 kV double circuit transmission line UA 91 million, under construction
- Singida – Iringa, 670km, 400 kV double circuit, under construction
- Iringa-Mbeya – 292 km, 400 kV double circuit, Cost USD 110 million, funding being sought
- Mbeya-Tunduma – 100km, 400kV double circuit connection Tanzania with Zambia at the border towns of Tunduma and Nakonde, under feasibility

Figure 0-9: Infrastructure gap within selected IGAD member countries



Source: Author

The different scenarios presented in Figure 0-9 refer to differences in approaches to regional integration, based on political choices. For instance, the Optimistic (FI) scenario refers to a scenario in which regional actors opt to pursue a strategy of extensive regional integration. With the Optimistic scenario the individual infrastructure demands for individual countries is less than for a situation like in Somalia where no potential in-country infrastructure nor regional cross-border infrastructure is effected. Scenario 2 is the baseline, or business as usual scenario, whose results indicate the highest infrastructure gap by far. This scenario assumes each country continuing on its current path with no significant efforts to extend domestic capacity. The third scenario - the National Policy Scenario – represents a median outcome where in the country pursues its national electrification plan but with minimal regard to partnerships with its neighbours. The total infrastructure gap can be substantially addressed under a FI scenario, while if allowed to continue with the current business as usual scenario, the infrastructure gap will be huge (Table 5-17)

Table 0-16: Infrastructure gap within selected IGAD member countries

Scenario	2020	2024	2030	2040	2050
Optimistic scenario (FI)	21.77	15.65	24.43	40.87	61.60
Baseline Scenario	27.925	30.115	62.365	184.255	507.405
National policy Scenario	23.585	19.305	33.315	71.365	139.255

Source: Author

The above infrastructure gap implies further need for a regional cross border energy infrastructure.

Validation using Balmorel Demand Model

The Balmorel model as used in the EAPP, gives the following future energy demand (Table 5-18) for generation up to 2030 for electricity. It suggests a total of 18.797 GW of both generation and interconnection. Our model suggests 11.6 GW by that period for interconnectors only. If the GERD hydropower system is added to this, then our peak power is 17.6 GW, a ± 6% deviation with a confidence level of 95%. Thus demonstration of our base model for power in 2030 is valid.

Table 0-17: Committed generation in IGAD countries

Country	Hydro	Wind	Diesel	Waste to energy	STPP	Geothermal	Cogen	CCGT	OCGT	PV	Country totals (MW)
Djibouti						50					50
Eritrea											
Ethiopia	8,124		5	20	594	70					8,813
Kenya		631	163	960	960	1,737	18	700	358		5,527
Somalia											
South Sudan	42										42
Sudan	320	20			1,385			900		10	2,635
Uganda	1,535		50		33	50	42			20	1,730
Technology type totals (MW)	10,021	651	218	980	2,972	1,907	60	1,600	358	30	18,797

Source: Author

Section 5.6 The enabling environment

A conducive enabling environment is a critical requirement for cross-border energy trade, especially so in the case of power trade. The following discusses the current enabling environment and highlights key constraints to CBET (mainly non-technical factors). While bilateral trade is already happening in the region and is likely to continue to grow even under existing enabling environment arrangements, there is significant scope for reform and joint regional initiatives to further enable CBET. The following provides a broad discussion on the relevant global and regional policy drivers, and regional institutions and national legal and regulatory environment relevant to CBET in IGAD.

Global Policy Drivers

While energy policy is inherently national (and in the case of CBET, there is a spectrum of harmonisation at the regional level), there are relevant global drivers which are increasingly influencing national energy policies. The key global policies and initiatives relevant to IGAD are discussed below:

- **United Nations Framework Convention on Climate Change (UNFCCC) –** The UNFCCC is a global environmental treaty, entered into force in 1994, which compels signatory nations to address and combat climate change. Under the treaty, developed countries bear the primary burden of combatting climate change, and are also committed to funding mitigation and technology transfer to developing countries. Related treaties under the framework include the Kyoto Protocol (1997) and the Paris Agreement (2015). Taken together, these treaties set international targets for global warming, require regular emissions inventories, and, more recently, require each signatory country to outline its intended nationally determined contributions (INDCs), which are specific national commitments and related plans for how each country will address climate mitigation in its national policies. All IGAD nations have ratified the treaty.

- UNFCCC and related protocols and agreements have been a key policy driver in promoting renewable energy development through national policy and investment (citation). While the treaty does not require phasing out of fossil fuels in any one nation, many of the INDCs have identified a strategy of promoting renewables, influencing the energy mix across the globe. This is especially relevant in much of Africa, where the electricity sector is not yet fully developed and therefore, can develop in favor of renewables over fossil-fuel dominant development.
- **United Nations Sustainable Development Goals (SDGs) –**The SDGs are a collection of 17 goals focused on development which have been adopted by 193 member states of the United Nations. Countries are expected to be guided by the SDGs in the development and implementation of national policies, plans and projects. The SDGs have received widespread international attention, and donor (and related) funding is often linked to or justified by the SDGs.
- SDG Goal number 7 - Ensure access to affordable, reliable, sustainable and modern energy. SDG 7 includes the following key targets that interlink with cross-border energy corridors:
  a) By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing states, and land-locked developing countries, in accordance with their respective programmes of support

  b) By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology

  c) By 2030, increase substantially the share of renewable energy in the global energy mix

  d) By 2030, ensure universal access to affordable, reliable and modern energy services

  e) By 2030, double the global rate of improvement in energy efficiency

  - The IGAD member states can make progress against points (a), (b), (c) and (d) by undertaking cross-border electricity interconnectors as well as oil and gas pipeline interconnectors. This will be particularly beneficial to land-locked countries like South Sudan, Uganda and Ethiopia. I
  - The SDGs, along with the UNFCCC, are among the drivers of renewable energy policies and plans in many countries and have or likely will influence the chosen energy mix going forward. These may driver further support for development of Ethiopia's and Uganda's hydropower resources, along with geothermal in Kenya, as well as other sources of wind and solar power.
- **International Energy Charter** – The IEC aims to strengthen energy cooperation between the signatory states, however, it does not bear any legally binding obligation or financial commitment. Signing of the IEC is a voluntary declaration of political intent related to energy cooperation. The IEC particularly addresses:
  a) the role of enhanced energy trade for sustainable development
  b) the role of regional integration of energy markets
  c) the need for diversification of energy sources and routes
  d) the need to promote access to modern energy services, energy poverty reduction, clean technology and capacity building

- However, the IEC is widely considered to be a pre-cursor to signing of the Energy Charter Treaty, a legally binding instrument designed to promote investment protection for private sector investors . The energy charter treaty (ECT) as contrasted to the IEC, establishes a legal framework for energy trade, transits and investments between member states. Part III of the ECT contains **substantive protections** for investors, and also allows investors to file claims against ECT member states before international arbitration tribunals for violations of substantive ECT rights.
- The East African community (EAC) become a signatory on 25th November 2016 of the International Energy Charter (IEC) as an observer. As such, the IGAD region will have indirect linkages to the IEC through the countries it shares with EAC. It may therefore be necessary for IGAD member states, or IGAD itself, to critically analyse the charter and its implications for the region, including analysis of risks associated with the ECT's international arbitration tribunals.

Regional Bodies and Related Initiatives

There are three Regional Economic Communities relevant to the IGAD countries: IGAD, COMESA, and EAC. Beyond the three RECs there are several regional initiatives, strategies, and related groupings that are relevant to regional cooperation and trade. Taken together, these RECs and related regional bodies play a critical role in enabling regional trade by bringing together political actors to commit to cross-border cooperation in a variety of sectors; identifying and promoting enabling policy, legal and regulatory reforms; and providing a platform for technical cooperation relevant technical actors to oversee and manage CBET activities.

Other roles include:

- Providing a platform for co-financing the energy interconnectors. For instance, the total committed investment by the PiDA PAP is USD 14.5 Billion which could be a challenge for a single country, or even REC, to raise alone.

  - Bringing international blended co-finance and expertise that would be difficult for a single REC would be find it untenable to acquire.
  - Strengthened advocacy to encourage individual member states to adopt policies and legislation enabling CBET.
  - The leveraging of resources (financials and skills) provides a better project bankability due to spread of risk among many multi-lateral and regional institutions.
  - Providing a platform for dispute resolution.
- Intergovernmental Authority on Development (IGAD)

  - IGAD does not currently have a published joint energy policy nor does it have any active working groups or similar bodies to address regional energy cooperation.
  - Further, as currently constituted, no regional body exists to regulate the trans-border energy trade. In addition, the key challenges (See **Error! Reference source not found.**) to trans-border e nergy trade are not being addressed in a holistic and integrated manner. Most IGAD member states are working towards dealing with energy barriers mainly from a national level
- Common Market for Eastern and Southern Africa (COMESA)

COMESA is a regional free trade areas comprising several Eastern and Southern African states. COMESA is faced with an electricity supply deficit of 20% as demonstrated by the low energy access rates (Table 5 1). Consequently, to deal with such low access the COMESA treaty in Chapter 13 of its

Africa Power Sector study explores the need for cooperation in the development of energy, suggesting the following:

- Article 106 – Joint exploration and exploitation of hydro and fossil fuels as well as creation of more favourable investment climate to encourage public-private investment in energy. In addition to suggests cooperation in research and training facilities.
- Article 107 – Development of a mechanisms to facilitate trade in energy fuels like coal, natural gas, petroleum and electricity. In this regard the treaty explicitly states that the member states agree to cooperate in (a) Joint procurement of petroleum products and (b) Interconnecting of national electricity grids
- Article 108 – Efficient use of energy in Transport

- East African Community (EAC)

The EAC is a regional intergovernmental organisation of 6 Partner States, including countries also belonging to IGAD: Kenya, Uganda, Sudan, South Sudan and Ethiopia. Its main focus is on regional political, economic and social integration. Article 101 on Energy of the East African Community Treaty (EAC) (Treaty 2007) provides that:

- The Partner States shall adopt policies and mechanisms to promote the efficient exploitation, development, joint research and utilisation of various energy resources available within the region.
- The Partner States shall promote within the Community:
  a. the least cost development and transmission of electric power, efficient exploration and exploitation of fossil fuels and utilisation of new and renewable energy sources;
  b. the joint planning, training and research in, and the exchange of information on the exploration, exploitation, development and utilisation of available energy resources;
  c. the development of integrated policy on rural electrification;
  d. the development of inter-Partner State electrical grid inter-connections;
  e. the construction of oil and gas pipelines; and
  f. all such other measures to supply affordable energy to their people taking cognisance of the protection of the environment as provided for by this Treaty.

This then lays the framework for cross border energy projects from a legislative point. The IGAD region, however, does not have a comparable policy or legal basis at the regional level (although bilateral agreements exist to facilitate bilateral trade).

- **Cross Border Electrification Program of EAC**: This programme enables border towns to connect from the neighbouring Partner State at distribution voltage when it is more economical than connecting with the grid within its own country. The EAC Cross-Border Electrification Policy governs the implementation of this programme as well as development of shared renewable energy resources such as small hydro power projects. To further facilitate expeditious conclusion of cross-border electrification contracts between power utilities, a Model Power Supply Agreement template has been adopted.

IGAD, COMESA and the EAC do not have a common regional policy that addresses the cross-border trade energy trade (CBET), thus making it difficult for local and/or private sector players to play an integral role in CBET. IGAD thus could be pivotal in bringing together the relevant political and technical actors to harmonise the various policies and regulations in a manner that supports towards CBET. CBET faces several key challenges for IGAD member states. These include the enabling environment, the actual energy trade and technical aspects:

- Enabling environment – Competing REC block priorities, Insecurity and mistrust, Poor regulation, poor support for cross border energy trade and corruption
- Energy Trade – Deficit regulation and energy strategies supporting energy trade, data paucity
- Technical – Challenging topography for infrastructure development, weak electricity grids, insufficient critical mass of professionals
- Finance – lack of co-finance or blended financing for energy infrastructure projects, it takes long time before financing contract is finalised to risks and lack of clarity

Other Regional Initiatives and Related Bodies

In addition to the RECs discussed above, there are several related regional initiatives and bodies supporting CBET initiatives in the IGAD region:

- East Africa Regional Integration Strategy paper (EARIS)The EARIS lays out the roadmap to accelerated regional integration through joint infrastructure development, and covers regional transport connectivity, energy infrastructure, ICT connectivity, and management of transboundary water resources. Key objectives of this four-year strategy are fast-tracking structural transformation, increasing trade and promoting financial sector integration and inclusion. The funding programme also covers Djibouti, Eritrea, Ethiopia, Seychelles, Somalia, and Sudan. Projects funded under EARIS include:
    a) The Lake Turkana Wind Power Project, the largest wind farm project in Africa.
    b) 600-kilometre 500kv Ethiopia-Kenya interconnector line Interconnection: Phases I and II: The Regional power Interconnection
    c) the second phase of the last-mile connectivity, which is expected to receive $150 million
    d) The Djibouti-Ethiopia Power Interconnection: Hydro-Powering East Africa
    e) new geothermal installations in Kenya taking an additional $40 million
    f) The Harar Water Supply and Sanitation Project: Improving Livelihoods and Enhancing Water Security in Ethiopia.
    g) Part of consortium to provide Bujagali Refinancing to Reduce Ugandan electricity costs.
    h) Zambia-Tanzania-Kenya (ZTK) power interconnector
- East African Power Pool (EAPP) – The EAPP is a specialised institution of COMESA focused on electrical power trading within Eastern Africa. The overall objective is to facilitate regional integration and realise sustainable growth and development. The EAPP includes Burundi, DRC, Egypt, Kenya, Rwanda, and Sudan. The EAPP has made slow progress since its establishment in 2005, however it has developed the following:

    - **East Africa Power Master Plan** (developed by EAPP) - The East African Power Master Plan is a strategic least cost power development plan for the East African Community. It identifies a least cost generation and transmission expansion plan to meet the region's growing power demand from 2013 to 2038.
    - **The Interconnection Code** developed by EAC and EAPP guides the design and operation of electricity interconnections in the region. The EAPP has developed a gap analysis tool to assist member power utilities assess their compliance to the Interconnection Code.
- **Nile Basin Initiative (NBI)** - NBI is a partnership of the riparian states dating from 1999. It seeks to develop the river in a cooperative manner, share substantial socioeconomic benefits, and promote regional peace and security through its shared vision. Sudan, Uganda and Ethiopia are members of NBI while Eritrea is an observer.

NBI runs two programs **Nile Equatorial Lakes Subsidiary Action Program (NELSAP)** and **Eastern Nile Subsidiary Action Program (ENSAP)**. NELSAP promotes investments in power development and trade, among other sectors. The following power sector projects are linked to the NBI:

i. Regional Rusumo Falls Hydro-Electric Project (RRFP);
ii. The Interconnection of Electric Grids of the NEL Countries Project (5 NEL Countries);(NELSAP 2018)
iii. Tanzania-Zambia Power Interconnection Study (NBI 2018)
iv. Kenya–Tanzania Interconnection Project;
v. Iringa–Mbeya Power Transmission line Project;
vi. Uganda–DR Congo Power transmission Line Project

Projects (ii), (iii) and (iv) are currently being implemented within the IGAD region.

National enabling environments: mandates, barriers and interventions

In addition, national energy master-plans need to be aligned or integrated in a manner the maximises the benefits of trans-border energy flows and projects depending on type and quantity of fuel. (Table 0-18). The adoption of appropriate technological standards, and the harmonisation of grid codes is required in order to facilitate and promote energy exchange projects and thus generate efficiency gains from balancing energy shortages and excess across the IGAD region.

Since the 1980s and 1990s a majority of the IGAD member states instituted reforms in the electricity sector that affected market structures, regulatory environment and private participation. A core aspect of the reform was unbundling to allow competition as well as private entities to participate in the electricity sector (see Table 0-2 for market structure of IGAD region energy sectors).

However, the envisaged reform efforts in not only IGAD countries but also many other developing countries have in many cases either stalled, or even been reversed due to their perceived negative impacts. Consequently, many of these energy entities in these countries still have incomplete unbundling – which may continue to be so in the foreseeable future, and have continued to post poor operational and financial performance results, creating a potential obstacle to CBET and private sector participation.

Figure 0-10: State of unbundling in IGAD member states

Unbundling generally takes 5 different forms / types

- Accounting unbundling – the least drastic form, entails separation of the accounts of network and generation activities to prevent cross-subsidization
- Functional / management unbundling – it undertakes accounting unbundling in addition to separation of operational activities and management
- Legal unbundling – it establishes transmission and generation as separate legal entities, owned by different or same company
- Ownership unbundling – most drastic form of unbundling – it requires generation and transmission to be owned by independent entities confined to operate in one segment of the industry.

State of unbundling in IGAD region

- Vertically integrated – the traditional centralized structure where one entity is in charge of generation, transmission, distribution and supply of both public utilities and IPPS. The IPPs work under build, operate and transfer contracts or concessions and operate off-grid systems. Example countries include Somalia, South Sudan, Djibouti and Eritrea
- Partial vertical disaggregation – Mainly a form of functional or legal unbunding of the public entity that then operates as a single buyer, with only generation opened to private participation. Examples include Ethiopia and Eritrea
- Vertically disaggregated – Here several companies work in all sectors. The IPP's feed into the grid Example include Uganda,
- Locally disaggregated -Here generation, transmission and distribution are fragmented by locality. Example include Kenya
- Hybrid – here a combination of the above is undertaken.

Source: UNEP (2008). Global trends in Sustainable Energy Investment 2008: Analysis of trends and issues in the financing of Renewable Energy and Energy Efficiency. Nairobi, Kenya

Consequently, it may be necessary to revisit the unbundling issue among member states. This will be very important for the formation of cooperative and symbiotic partnerships in building capacity, accessing finance and improving the enabling environment. In addition, leeway to allow for innovation, diversification and experimentation in establishment of energy generating sites and incorporation of different models of trans-border energy projects has not been fully realised.

Furthermore, in terms of the choice of energy mix in each country, several of the IGAD countries have addressed climate change and low-emissions development in their national development policies. Several countries have in place policies itend to support renewable energy development including feed-in-tariffs, production tax credits and reduced import duties, many of which simultaneously encourage private sector investment in the sector (Figure 0-11).

Figure 0-11. Policies and Fiscal Incentives in Support of Renewables

	Enabling environment framework	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Regulatory policies	Feed in Tariff (incl. premium payment)				√				√
	Auctions				√				√
	Heat obligation mandate				√				
	Biofuel obligation mandate			√				√	
Fiscal incentives & Public financing	Capital subsidy, grant or rebate								√
	Investments or production tax credits								
	Reduction in sales, energy, CO2 or other taxes	√	√	√	√	√	√	√	√
	Production payment				√				
	Public investment loans or grants.			√	√				√

Source: Author's compilation

Table 0-18: National energy mandates, bottlenecks and interventions

Countries	Enabling national mandates	Bottlenecks that mandates should address	Potential interventions
Ethiopia	Enabling policies ▪ National Energy Policy 1994, Ethiopian Electric Power Strategy, Rural Electrification Fund, Off - grid Rural Electrification Master Plan, Alternative Energy Development and Promotion Programme Enabling legislation ▪ Electricity Proclamation No. 86/1997 of June 1997 established the EAA, Proclamation number 691/ 2010 establishing the Ministry of Water and Energy (MWE), Electricity Operations Regulations (49/1999), Letter of power sector policy (2003), Investment proclamation (280/2004) encouraging IPP, Electricity Feed-in-Tariff Bill, 2012	1. Transaction advisory assistance, development of IPP tender documents, and improvement of the enabling environment to lower risk for private sector investment 2. Development of the grid code, system integration modelling, and updating the demand forecast 3. Establish a process that reduces distribution commercial losses and increases the rate of meter installation 4. Capacity development for sustainability of the utilities and regulator 5. Macroeconomic forces, particularly hard currency shortages needed to pay IPP tariffs 6. Generation planning and procurements synchronised with demand 7. New connections increased to prevent over-generation with take-or-pay IPPs	i. Transaction advisory assistance, development of IPP tender documents, and improvement of the enabling environment to lower risk for private sector investment ii. Development of the grid code, system integration modelling, and updating the demand forecast iii. Establish a process that reduces distribution commercial losses and increases the rate of meter installation iv. Capacity development for sustainability of the utilities and regulator
Djibouti	Enabling Policies ▪ 10-year National Strategy and 5-year Action Plan for the electricity sector; Djibouti National Energy Master Plan; Renewable Energy Fund	1. No energy policy 2. no robust or clear legislative and regulatory framework to govern electricity production. 3. No supporting mechanism for transborder trade and private sector incentives like FiTs, net metering, competitive bidding and standardised and bankable PPA's ▪ Slow implementation of IPP law ▪ Reliance on electricity imports 4. Technical losses; weak supply infrastructure	i. Develop laws and regulations ii. Transaction advisory support iii. Planning, operation and maintenance of generation iv. Geothermal test drilling, financing, and data management
Uganda	Enabling legislations The Petroleum (Refining, Gas conversion, Transmission and Midstream Storage) Act 2013, the Petroleum	1. Lack of integrated power sector planning 2. Lack of fully functional financial ecosystem	i. Development of master plans ii. Transaction advisory services iii. Support to off-grid actors

Countries	Enabling national mandates	Bottlenecks that mandates should address	Potential interventions
	(Exploration, Development and Production) Act 2013 and the Public Finance Management Act 2015		iv. Development of digital finance services
Kenya	Enabling policies: ▪ Sessional Paper No. 4, 2004 on Energy, Feed-in-Tariff s (FiT) Policy, Least Cost Power Development Plan (LCPDP) 2011-2030, National Energy and Petroleum Policy 2015, Draft Electricity Grid Code 2016 and National Petroleum Sector Master Plan Enabling legislations include ▪ Energy Act of 2006, Energy Bill 2015, Petroleum (Exploration, Development and Production) Bill, 2015, Energy (Local Content) Regulations, 2014, Energy (Energy Management) Regulations, 2012, Petroleum Exploration, Development and Production (Local Content) Regulations, 2014, Environmental management and Coordination Act (EMCA), 1999	**1.** Inadequate access to project financing, especially early stage risk capital. **2.** Land risks, right of way, and community engagement (impacts both generation & transmission). 3. Long procedures and inconsistency in approval of Power Purchase Agreements (PPAs). 4. Lack of clear off-grid regulatory framework.	i. Development and harmonisation of various laws to enable community engagement for power projects to ensure full community support for power projects and avoidance of costly delays in project development ii. Capacity development for state owned power sector entities iii. Pursuance of new financing structures including SPV level financing for non-recourse project finance.
Sudan	▪ Enabling policies ▪ National Strategic Plan for Sudan 2007-2011, Sudan Renewable Energy Master Plan 2005 Enabling legislations ▪ Petroleum Wealth Act, 1998 • Regulations for Protection of the Environment in the Petroleum Industry 2001	▪ Inadequate access to project financing, especially early stage risk capital.	i. Development and harmonisation of various laws to enable community engagement for power projects to ensure full community support for power projects and avoidance of costly delays in project development ii. Capacity development for state owned power sector entities iii. Pursuance of new financing structures including SPV level financing for non-recourse project finance.

Countries	Enabling national mandates	Bottlenecks that mandates should address	Potential interventions
South Sudan	Enabling policies ▪ Interim constitution of South Sudan section 41(4), National electricity sector policy 2007, Draft South Sudan Petroleum policy paper Enabling Legislations ▪ Petroleum Act 2012, Environment bill	1. Current oil reserves are projected to last until 2035 2. Oil pipeline and export infrastructure are in the Sudan	i. Development and harmonisation of various laws to enable community engagement for power projects to ensure full community support for power projects and avoidance of costly delays in project development ii. Capacity development for state owned power sector entities iii. Pursuance of new financing structures including SPV level financing for non-recourse project finance.
Somalia	Enabling policies Somaliland Electrical Energy Act of 2013	**1.** Limited regulation & oversight of the sector **2.** Monopoly distribution control in some areas **3.** Acute shortage of qualified staff **4.** Generation and distribution losses due to poor infrastructure and collection (up to 40%) 5. High tariffs due to energy company inefficiencies 6. Insecurity and political instability	i. Institutional capacity building for public energy agencies and associations ii. Technical assistance to improve efficiency and operations of private sector energy companies iii. Technical assistance to improve access to alternative energy solutions for targeted industries iv. Demand/generation studies
Eritrea	Enabling policies ▪ Energy Policy 2009, Rural Electrification Programme, Energy development initiatives in its long-term program, up to 2015, National Power Development Master Plan (under development) Enabling legislations ▪ Proclamation No. 141/2004 on promoting efficiency, safety, environmental protection and private sector involvement, Proclamation number 142/2004 reforming the electricity sector	1. Acute shortage of qualified staff 2. Generation and distribution losses due to poor infrastructure and collection (up to 40%) 3. High tariffs due to energy company inefficiencies	i. Institutional capacity building for public energy agencies and associations ii. Technical assistance to improve efficiency and operations of private sector energy companies iii. Technical assistance to improve access to alternative energy solutions for targeted industries iv. Demand/generation studies

Countries	Enabling national mandates	Bottlenecks that mandates should address	Potential interventions

***Source*: USAID – Power Africa, UNEP document repository (wedocs.unep.org)**
UNEP (2017). Djibouti: Energy Profile, WEDOCS UNEP.
UNEP (2017). Kenya: Energy Profile, WEDOCS UNEP.
UNEP (2018). South Sudan: First State of Environment and Outlook Report 2018, United Nations Environmental Program (UNEP): 329.
USAID (2018). Power Africa Fact Sheet.
IRENA (2015). Djibouti : Renewable Readiness Assessment. Abu Dhabi, International Renewable Energy Agency.

Capacity Building and External Support Programs

Beyond the capacity of regional bodies to plan, execute and manage CBET in the IGAD region, there is also a lack of appropriately trained electricity engineers, grid developers and operators, and community workers to support CBET and related grid extension. The Power Africa program, among others, has identified several capacity gaps within the IGAD regions for which it is offering support (Table 0-190).

Table 0-19: Power Africa Support to IGAD Member States

Member states	Gaps identified	Progress so far
Djibouti	Develop laws and regulations; Transaction advisory support; Planning, operation and maintenance of generation; Geothermal test drilling, financing, and data management	For Djibouti Power Africa aims to close deals for newly installed 1,860 MW by 2030, but this has not been achieved yet.
Uganda	Development of master plans; Transaction advisory services; Support to off-grid actors; Development of digital finance services	Power Africa New MW to Date Reached Financial Close: 68 MW Power Africa 2030 Pipeline: 188 MW
Kenya	Under the Power Africa/KenGen Cooperation Framework, Power Africa helped KenGen pursue new financing structures, including SPV-level financing of non-recourse project finance. Power Africa has developed a Guide to Community Engagement for Power Projects to assist developers in working with communities to ensure full support for projects and avoid costly delays in project development while promoting responsible investment, and also supports legal/regulatory reform, including development of new distribution and transmission grid codes.	Power Africa New MW to Date Reached Financial Close: 537 MW Power Africa 2030 Pipeline: 3,234 MW
Somalia	Institutional capacity building for public energy agencies and associations Technical assistance to improve efficiency and operations of private sector energy companies Technical assistance to improve access to alternative energy solutions for targeted industries Demand/generation studies	For Somalia Power Africa aims to close deals for newly installed 500 MW by 2030, but this has not been achieved yet.
Ethiopia	Transaction advisory assistance, development of IPP tender documents, and improvement of the enabling environment to lower risk for private sector investment Development of the grid code, system integration modelling, and updating the demand forecast Establish a process that reduces distribution commercial losses and increases the rate of meter installation Capacity development for sustainability of the utilities and regulator	For Ethiopia Power Africa aims to close deals for newly installed 3,878 MW by 2030, but this has not been achieved yet.
Sudan, South Sudan and Eritrea	Power Africa doesn't run any programs in this regard	
Source: USAID-Power Africa, UNEP document repository (wedocs.unep.org)		

Role of private sector in CBET

To address the infrastructure gap, inclusion of the private sector will be necessary. In addition, the facilitative role of IGAD in including private sector in trans-border energy trade can be addressed in two ways: (a) development of institutional and regulatory environment framework and (b) enhanced support in provision of funding for Capital expenditures (CAPEX) and operational expenditures (OPEX) in the initial phases of the energy project operation.

It will be realised that private sector plays a catalytic role to provide electricity to the existing national and trans-border projects. As noted, several recent generation projects have been initiated mainly within the private sector or under public-private-partnerships (PPP) (See Report Annex 1 and 2) Participation of the private sector in energy projects that can impact the trans-border energy trade has however, been mainly limited to Kenya, Ethiopia and Uganda.

However, different IGAD member states have diversities as regard access to finance, enabling environment status, historical and current debt-income ratios among others, which significantly impact private players in CBET inclusion. Regional bodies can play a role in building involvement of the private sector and supporting reform programs that address private sector concerns and perceived risks.

Section 5.7 Conclusion

General challenges in the enabling environment for the IRIMP energy sector include competing institutional frameworks among the regional economic bodies (COMESA, EAC and IGAD). Further compounding this is the security-based challenges of internal and external conflicts with some states in a post conflict (Northern Uganda, Eritrea, Somaliland and Puntland) or active state of conflict for instance in South Sudan and South-Central Somalia. As Energy projects that could act as drivers for economic integration are developed, insecurity may prove a damper. Other challenges include weak institutional capacity, lack of internal democratic governance, poverty, lack of economic diversification, high dependency on agriculture and low domestic tax base and the need for collecting revenue from tariffs and poor infrastructure.

Based on a high-level review, the basic building blocks for cross-border energy trade exist. These include some level of trade in energy products through CBET, vast but unevenly distributed energy resources (fossil fuels, renewable energy resources including geothermal and hydropower resources), and some level of data on energy trade for products. In addition, certain technical plans and legal and institutional frameworks to allow for cross border sale of electricity do exist, for instance the East African Power Pool. Further, certain countries like Ethiopia have taken a lead in mega investment in generating capacity with a view to exporting to neighbouring countries.

However, certain key challenges remain, including: - data paucity and institutional lethargy in sharing information mainly due to policies, regulations and administrative procedures. Furthermore, there are specific challenges related to electricity power pools, which are the most optimal approach to deal with the “unevenly distributed “energy resources within the IGAD region. For operationalisation of power pools within the IGAD region, certain pre-conditions will need to be met. These include – the IGAD country members to have fairly developed grid interconnections, adequate generating capacity to meet demand of the pool, a legal framework for cross-border electricity exchanges, trust and mutual confidence among pool members and lastly regional regulation and mechanism for dispute resolution. At the moment a number, if not majority, of the IGAD members do not meet these requirements.

Furthermore, barriers to the electricity trade have been identified which the IGAD master plan and project choice will seek to resolve. These include: poor performance of many state owned utilities making them unattractive to private investors, long distances and challenging geography for electricity transmission infrastructure, weak national grids which will require strengthening in order to optimise trading, deficient energy strategies that rely on self-sufficiency, difficulty in obtaining finance for cross-border transmission inter-connections, lack of a commercial/regulatory framework for transactions to take place, lack of agreement on the systems of tariffs for use of transmission infrastructure, demand-resources mismatch wherein countries with resources not necessarily being those with the highest demand, lack of energy infrastructure and regional trading institutions including legal framework for energy trade and lack of trading mechanisms in the energy sector which is more complex than other goods or services.

Considering the foregoing the following is recommended:

- Strengthening the policy commitment to cross-border energy trade.
- Mobilise investments in renewable energy;
- Build institutional, technical and human capacity to support cross-border energy trade;
- Enhance regional engagement and international cooperation on cross-border energy trade

The Water Sector

IGAD region faces a myriad of sustainable development challenges. One such challenge is the sustainable management of its water resources which is the foundation upon which the socioeconomic development of the region depends. Associated challenges include:

- The need for effective planning for water resources;
- The need to evaluate water availability in watersheds;
- The need to balance equity, efficiency and ecosystem services in water use;
- The inadequacy of legislative and institutional frameworks covering water resources; and
- The increasing financial burden of ageing infrastructure.

With the growth in population and economic activities the demand for water has increased rapidly in the region, and will continue to increase. Urgent action is needed to improve access to sustainable water resources. Despite this, IGAD member states appear to be unable to prioritise water storage infrastructure development, largely because of competing and urgent calls on national budgets for a range of other development and investment projects. This has led to prevalence of dilapidated water storage infrastructure and the provision of only few modern ones like the Gibe III and the Grand Renaissance hydropower dam in Ethiopia.

Additionally, water resources are unevenly distributed across the IGAD region with some countries like Eritrea, Kenya, Djibouti and Somalia experiencing significant water scarcity. Furthermore, by the year 2025 Ethiopia and Uganda, which presently have adequate water, will be water stressed (1000-2000 m3/person/year) while Djibouti, Eritrea, Kenya, Somalia and Sudan will hit a 'water barrier situation' of 500 m3/person/year. This means water will be the main limiting factor to sustainable development. The challenge to ensure that adequate water is available to all will require concerted effort in joint planning, management and development of water resources across the IGAD region.

Section 6.1: Situation and Trends in the Water Sector

Although six of countries of the IGAD region share one of the greatest rivers in the world, many inequities over this common resource exist. Studies show that the Nile River Basin has enough water to sustain its population. Furthermore, if rainfall were evenly distributed over the basin, the per capita water share of the basin population would be more than 10,000m3 per capita per year, ten times the water scarcity limit of 1,000 m3 per capita per year downstream. Increased cooperation among affected member states is required in indoor to realise the tremendous opportunity and benefits associated with the exploitation of the Nile Basin water resources.

The same argument holds for cooperation in the utilisation of the countries' wetland resources and other freshwater bodies in the region. The state and integrity of the fresh water resources in the region continues to play a major role in the livelihoods of many communities. The role played by freshwater as sources of energy, food and human well-being is a major contribution to national economies. However, knowledge gaps exist in quantitative estimates of the region's freshwater and wetlands resources. Given that the IGAD region is expected to be water-stressed by 2025, there is need to be a proper exploration and assessment of its current freshwater reserves so as to better formulate appropriate integrated water resources management plans. Over-exploitation of water resources in some parts of the IGAD region has led to undesirable effects such as lowering of the water table and saline seawater intrusion.

Water Access

The freshwater resources of the IGAD region are made up of surface water, groundwater and open water bodies. The region also has sizeable wetland areas, particularly in Uganda, Ethiopia and Sudan which act as storage for water, and filters for polluted water, among others. Freshwater availability is vital for social and economic development. Freshwater and wetland ecosystems support multiple functions ranging from water for drinking, sanitation, agriculture, energy generation, manufacturing, transport, and habitat for species as source of food and trade.

Furthermore, none of the IGAD member states has at the present time available water resources necessary for planned industrial development (2400 m3/day). This lack of adequate water is severely constraining food production, ecosystem maintenance and economic development. Access to water and sanitation by some member states is especially limited. A high percentage of the population of the IGAD region (42%) still uses unimproved drinking water sources.

The situation in some IGAD members states is alarming; in Southern Sudan only 25-30% of the rural population has access to safe potable water. Only 4% of the rural population have piped water on their premises Table 6-1 shows the rural and urban population (%) in the IGAD Region who had access to safe drinking water in 2015. It is noted that there are no population figures with access to water for Somalia probably due to political instability in the country during that period.

Table 0-1: Rural and urban population (%) with access to safe drinking water, 2015

Country/Year	Rural	Urban
Djibouti	64.7	97.4
Eritrea	53.3	73.2
Ethiopia	48.6	93.1
Kenya	56.8	81.6
Somalia	8.8 (2011)	69.6 (2003)
South Sudan	56.9	66.7
Sudan	50.2	66
Uganda	75.8	95.5

Source: FAO Aquastat

Fortunately, in recent years, the IGAD region has seen more than 23 million people gain access to piped water on premises. This is a 4% increase which, though seemingly modest, is impressive since piped water on premises represents the highest rung of the drinking water ladder where health gains are maximised. Nevertheless, the picture of water available in the IGAD region is of great concern; significant number of people to do have access to potable water, and the pressure on available water resources are increasing at an alarming rate.

Coverage of Domestic Water Supply

Access and coverage are important targets and are defined in terms of the percentage of the population within reach of an improved water source. Access standards in the IGAD countries vary between 0.2 Km and 0.5 Km in the urban areas and between 1 Km and 1.5 Km in the rural areas. This definition relates primarily to “access” and should not be taken as evidence that 20 litres per capita per day is a recommended quantity for domestic use. Access and coverage are spatial dimensions and therefore the information is subject to (i) changes in the number of watering points and (ii) changes in population size.

WHO/UNICEF categorises the following water supply sources for the purpose of monitoring and evaluating progress towards meeting the SDG on clean drinking-water:

Improved drinking water source	Unimproved drinking-water source
• Piped water into dwelling, yard or plot • Public tap or standpipe • Tube well or borehole • Protected dug well • Protected spring • Rainwater collection	• Unprotected dug well • Unprotected spring • Cart with tank or drum • Tanker truck • Surface water (river, lake, dam, pond, stream, canal, irrigation channel) • Bottled water

An improved drinking-water source adequately protects the source from outside contamination (WHO/UNICEF JMP 2010). Improvement encompasses three dimensions of water security: proximity, quantity and quality. Some progress has been made towards greater access to improved water sources in the IGAD sub-region, with a 15% increase in the population accessing improved sources of water in recent years.

Despite this, the IGAD region lags behind the rest of the world, with only 58% of the population having access to improved sources of drinking water compared to the access of 87% and 84% respectively for the world and for the developing countries (WDI, 2017). Although the population data (Table 6-2) had been projected to the year 2050, the level access to water was up to 2016 and was thus projected to the year 2050 based on the trends observed in the last ten years.

Table 0-2: Population (Million Persons) accessing improved water sources

Country/Year	2017	2025	2050
Djibouti	0.96	1.07	1.31
Eritrea	5.11	5.90	8.37
Ethiopia	104.96	126.12	190.87
Kenya	49.70	60.06	95.47
Somalia	14.74	18.67	35.85
South Sudan	12.58	15.40	25.37
Sudan	40.53	49.00	80.39
Uganda	42.86	55.09	105.70

Sanitation coverage

An improved sanitation facility is one that hygienically separates human excreta from human contact. Sanitation coverage is presented as a four-step ladder that includes the proportion of the population: (i) practicing open defecation; (ii) using an unimproved sanitation facility; (iii) using a shared sanitation facility; and (iv) using an improved sanitation facility (WHO/UNICEF JMP 2015). In the IGAD sub-region only 29% of the population has access to improved sanitation, compared to 31% of the population in Sub-Saharan Africa. Djibouti has the highest access at 61.67% and Ethiopia the lowest at 8%.

Urban versus rural domestic water supply coverage

The IGAD region is characterised by urban-rural discrepancies in access to improved drinking-water. While about 80% of the urban population has access to improved water sources, only 45% of the rural population has access. The rural-urban discrepancies are particularly high in Uganda, Ethiopia and Djibouti, where in recent times, the proportion of the population that had access was between 93.1 -

97.4% in 2015 for urban areas compared to 48.6 – 75.8% in the rural areas. In Kenya it was between 81.6% in urban areas while in rural areas it was 56.8%, in Sudan, Eritrea and Somalia urban areas had 66-73.2% with rural areas having less than 54%. On the whole, in urban areas the increase in coverage is barely keeping pace with population growth. Furthermore, some retrogressive developments have occurred in some countries. In Kenya for example, while the proportion of the rural population accessing improved water sources increased from 32% in 1990 to 60% in 2017, there was a decrease in the proportion of urban populations having access to improved water sources, from 91% in 1990, to 80% in 2017. This is attributed to the aging and poorly maintained water delivery infrastructure and high urban population growth.

In the last decade, access to improved sources of drinking-water in Sudan declined from an average of 65% to 57% in 2017. Sudan is among the few countries to have experienced declining safe water access levels in the past decade. In the North, there is great variation: 79 and 47 percent of the population have improved water access in urban and rural areas, respectively. Approximately 40 percent of urban and 60 percent of rural populations do not have access to a minimum of 20 litres of water per person per day within a distance of 1,000 metres, and the differential between access in rural and urban areas has increased considerably.

Indeed, use of unimproved sources of drinking water in rural and urban centres has declined since 1990. The proportion of the urban as well as rural population using unimproved sources of water has also been declining over the years. Sudan is the only country that did not register any improvements in this area. The proportion of people using unimproved sources of water actually showed an increase in recent past. In Kenya, although there was marked improvement in rural areas, the situation has worsened in urban centres since 1990.

Progress in meeting SDG sanitation targets:

The IGAD sub-region as a whole is not on track to meet the SDG goal 6 that is to ensure availability and sustainable management of water and sanitation for all. With the exception of Djibouti where the proportion of the population that has access to improved sanitation is within the 50-75% range, the rest of the IGAD countries are below the 50% mark. Though Djibouti has had the highest proportion of population with access to improved sanitation, coverage has declined from 66% in 1990 to 47.4% in 2015. Progress in the use of improved sanitation is undermined by high population growth, especially in urban centers. Despite this progress, the report finds significant challenges remaining on the world's progress towards the SDGs.

Section 6.2 Trans-boundary Water Basins

Surface Water

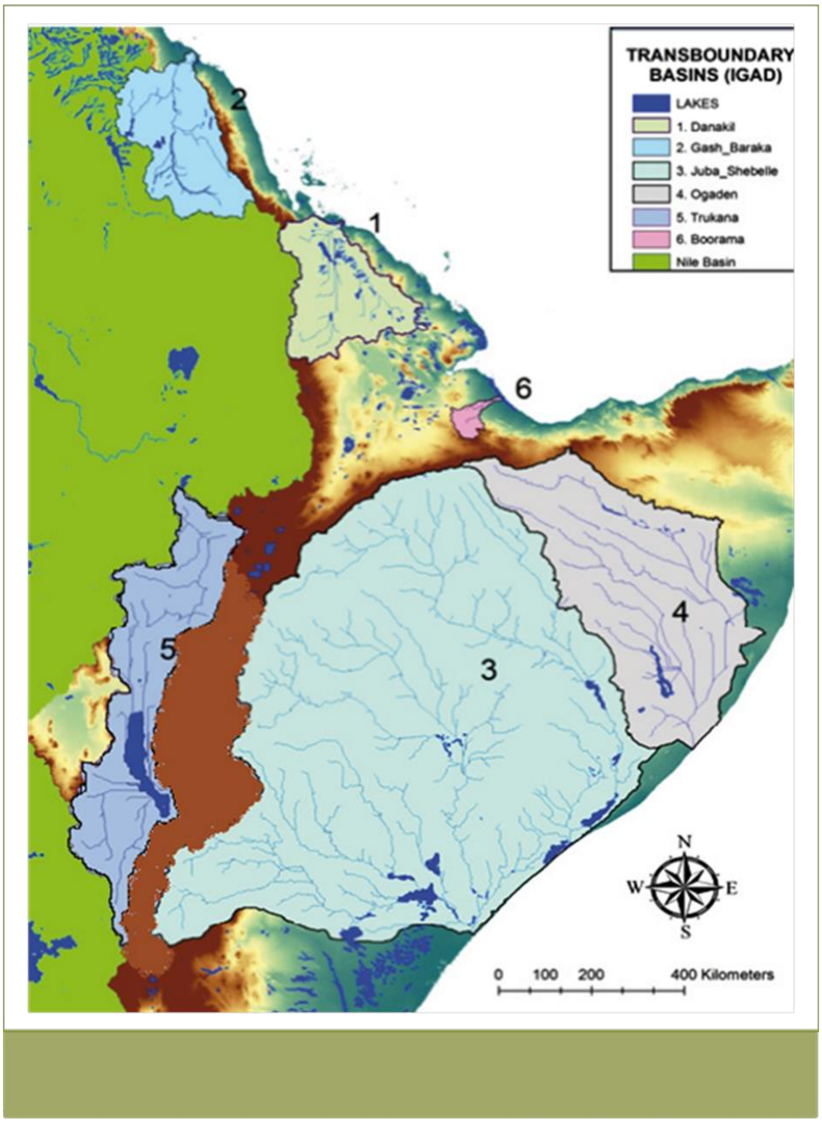
Water resources link the IGAD Member states internally and externally with adjacent regions. There are six trans-boundary basins occupying 1.35 million Km2 or about 26% of the total area of the IGAD region. About 94% of the total area of the transboundary basins lies in three countries that include 45% in Ethiopia, 25% in Somalia and 24% in Kenya. The basis are grouped together into three types:

- **The dry basins** (Ayesha, Danakil and Ogaden), with negligible surface water resources but high potential aquifers and low population due to mainly the prevalence of the harsh environment, remoteness from the main centres of economic activities, and poor economic and social infrastructure. The populations of these basins are mainly nomadic, and the dominant form of agriculture is pastoralism;

- **The semi-arid to arid basins** (Gash-Baraka and the Juba-Shebelle) having some notable irrigation developments. The population of the Gash practices agro-pastoralist, tenant and horticultural farming systems, while the flood plains of the Juba and Shebelle rivers in Somalia provide the highest agricultural potential. The Juba-Shebelle basin has the highest population of all the six basins, about 44%, and is thus one of the most important trans-border basins in the region along with the Turkana-Omo basin;

- **Turkana-Omo basin** forms a part of the Great Rift Valley, which is the centre of considerable economic activities among the riparian states (except Uganda and Sudan which have only very small portions of the basin) and is the next largest basin with a population that is 36% of the total six basins.

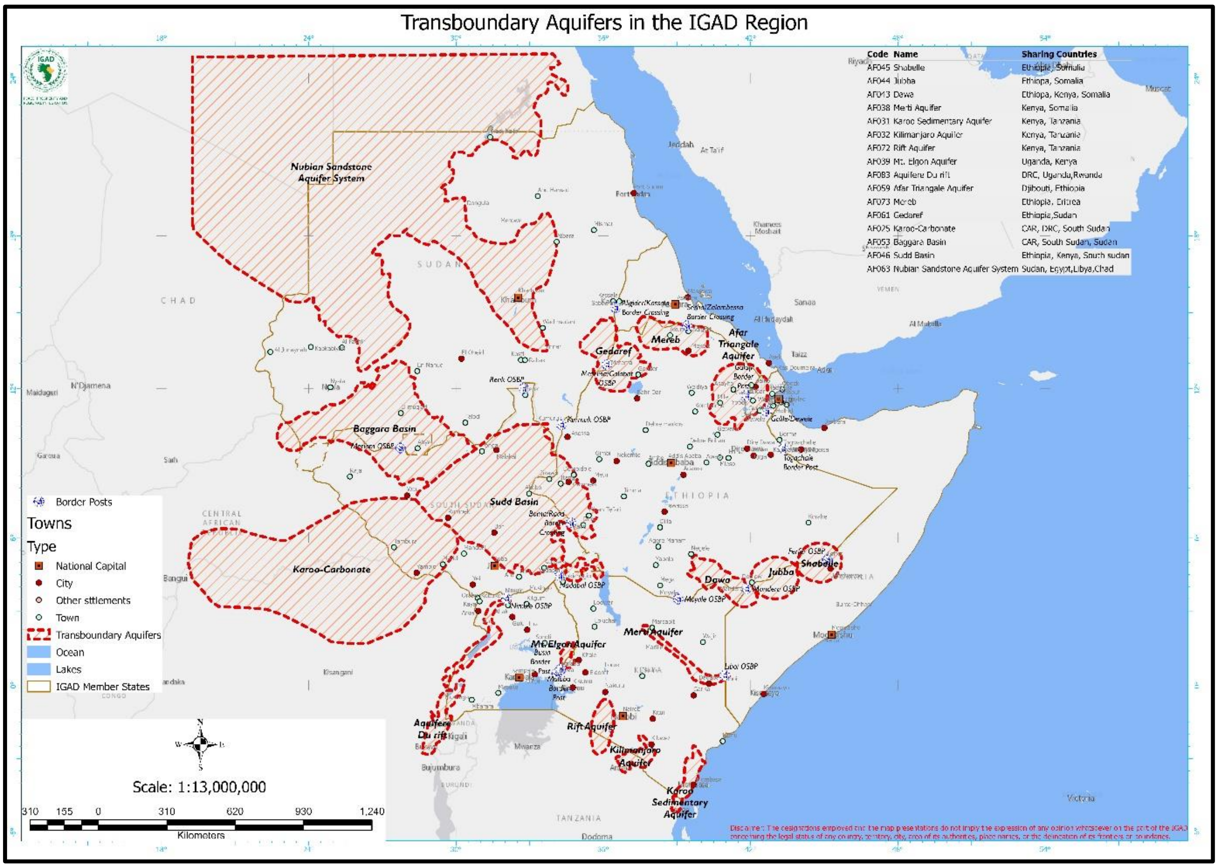
Figure 0-1: Trans-boundary water Basins in the IGAD region



Ground Water

There are a number of trans-border aquifers in the IGAD region that require careful management. The map below show their location and extent.

Figure 0-2: Location of key trans-border aquifers in the IGAD region



In general, there is limited groundwater data available in the IGAD region. However, a summary of some groundwater data available from the British Geological Surveys using global datasets is available at UNESCO. A general summary of the aquifer properties within the IGAD area are summarized in the table below.

Table 6-3 show Groundwater resources and aquifer properties in the IGAD sub-basins and Table 6-4 lists the information available on groundwater.

Table 0-3: Aquifers in the IGAD region

Basin	Aquifer Yield Classification	Aquifer Productivity (l/s)	Mean annual Productivity (m^3/yr)	Aquifer saturated Thickness (m)	Aquifer storage and Flow Types
Danakil	Moderate	1 – 5	88,301	25 - 100	Fracture flow
Gash- Barka	Low	0.1 - 0.5	7,884	< 25	Fractured flow within weathered material
Juba-Shebelle	Moderate	1 – 5	78,840	25 - 250	Intergranular and fracture flow
Ogaden	High	5 – 20	394,200	100 - 250	Intergranular and fracture flow
Turkana-Omo	Moderate to High	1- 20	315,360	25 - 100	Fracture flow
Ayesha	Low to Moderate	0.5 – 1	23,652	25 - 100	Fracture flow

Table 0-4: Existence of Information on Groundwater in the IGAD region

Activity	Remarks
Transboundary Groundwater assessments:	• Groundwater assessment has been done substantially in the region although mostly country-based. Most of these assessments are project-based targeting specific areas, for example the hydrological assessment conducted Northern Ethiopia (Raya, Tigray) and South Eastern Ethiopia (Ogaden), Northern and central Sudan, through the Nubian Sandstone aquifer System shared between Sudan, Egypt, Libya, Chad. The Gadrief Basin (Sedimentry and Basalt) shared between Sudan and Ethiopia. The Bagara groundwater basin shared between Sudan and South Sudan. Eastern Sudan and Western Ethiopia and Eritrea, the Atbra – Tekezee Basin. Northern and Eastern Kenya (Merti aquifer) and the central highlands of Eritrea. Shallow groundwater in the region are found in the unconsolidated alluvial sands of sedimentary deposits where water level are 10-50m deep. Shallow groundwater are also found at laggas/wadis with considerable lengths in the region (Ethiopia over 30,000km). For example water depth level at wadi Howas . Sudan has more than 26 big alluvium shallow aquifers along the wadi deposits and also along the banks of Nile Rivers. These alluvium shallow aquifers are estimated to cover an area of about 600000 square km. The water depths are between 3 to 25m, Examples are Al Gash alluvium basin and Barrka and Toker Alluvium basin shared between Sudan and Ethiopia. • Results of assessments have shown that the groundwater storage in Sudan, for example the Nubian sandstone and Umm Ruaba formations at Baggara basin is 2.5 trillion cubic meters, In Gedarif basin is 0.4 trillion cubic meters and in all groundwater basins in Sudan the storage is around 14.7 trillion cubic meters. In South Sudan Where Sudd and Bagara basins are the most Sedimentry basins the total groundwater storage is around 2.8 trillion square meters • Transboundary aquifer assessments have also been on project- basis (e.g. Merti aquifer, lotikipi, Dawa). However, Sahel and Sahara observatory (OSS) carried out transboundary water resources modelling in the IGAD region in 2015. The greatest and the most important groundwater assessment was done for the Nubian Sandstone Regional Aquifer System(1987, 2002, 2015) through the joint Nubian Aquifer Committee between , Sudan, Egypt, Chad and Libya. The Nubian Aquifer is one of the most potential aquifers to be developed for irrigation by big agricultural investment schemes for the benefit of IGAD to attain food security. • There is limited region-wide assessment of groundwater. IGAD carried out some studies at country level, for example the assessment of water development projects in pastoral and agro-pastoral areas of Kenya, a lot of country small scale projects were done in Ethiopia, Uganda, the assessment is mostly conducted within bilateral projects, example is the WADS, WAPS and WRM groundwater projects by The Netherlands Government in Gash , Nyala, Geninna in Sudan. Also, some small scale (site location) was done by UNICEF, UNEP and other partners especially for the location of suitable sites for drinking water supply wells through WES and WASH program, in Ethiopia, Somalia, South Sudan, Kenya, Uganda and Sudan. • Project mapping, assessment and monitoring of shared water resources in the IGAD subregion- IGAD operated in Djibouti, Kenya, Sudan and Uganda (2007-2012). The project executed by OSS was funded by the African Water Facility (AWF / AfDB). It has developed a shared vision of collaborative management of transboundary water resources to support sustainable development in the IGAD subregion. The results of the project support cross-border water resources

	management policies in East Africa and water-related development activities in a regional integration process led by IGAD.
Geological maps	• The geological maps available include BGS Geological map and OSS geological maps for the region. There are also country-based geological maps (Ethiopia Geological Survey, Kenya Mines and Geology Department). The BGS and OSS maps are of scale 1:5milion while the latter are mostly ranging from 1:100,000 to 1:2 million. The Sudan and South Sudan Geological maps, regional map of scales, 1;4000000 and 1;2000000 produced, 196th and 1973, by Sudan Geological Authority , updated 2007 and 2015, Also Sudan Geological Authority in cooperation with Robenson Research established in 1987 the Sudan Geological map of scale 1:1000000 that come in 16 sheets to cover all Sudan and South Sudan. Maps in scales 1:500000, 1:250000 and 1:100000 cover small parts of Sudan. • In all IGAD country maps of small areas are available to cover in detail these limited areas for limited purposes, e.g. mining or water assessment
Hydrogeological maps	• Hydrogeological maps at regional level are available from BGS and OSS both at scales of 1:5million showing the various hydrogeological environments and their corresponding parameters e.g. productivity and storage. There are also country-based hydrological maps of various scales and various parameters including piezometric levels, transmissivity and depth (Kenya Groundwater Mapping Programme, Ethiopian Geological Survey ,Sudan, Hydrogeological map of Sudan and South Sudan, Different Scales, 1;4000000 Hydrogeologic and water quality map, Hydrogeological map of Sudan and South Sudan 1989, Scale 1:2000000, indicating groundwater potential groundwater level depths , groundwater flow and groundwater quality, also groundwater basins of Sudan and Hydrogeological maps in GIS layers for hydrogeologic characteristics and water wells distribution in the aquifers etc.) • There are 6 main hydrogeological environments in the IGAD region. They are: unconsolidated rocks with very low to very high productivity, consolidated sedimentary (fractured) with very low to very high productivity, consolidated sedimentary (intergranular) with very low to very high productivity, consolidated sedimentary (intergranular/fractured) with very low to very high productivity, Precambrian basement rocks with very low to very high productivity, and igneous (largely volcanic) rocks with very low to moderate productivity. • The above hydrogeological environments together with the mode and amount of recharge to groundwater, the depths to aquifers and water , the quality of the water determine the availability of groundwater in the IGAD region.
Aquifer characteristics	• No dedicated and systematic mapping of aquifer characteristics for the whole region have been done. However, country-based studies have been targeting specific areas/aquifers with specific objectives/goals. In these studies detailed information is available on some of the aquifers e.g. yield, hydraulic properties, hydraulic conductivity, aquifer transmissivity, specific yield, storativity, groundwater level, groundwater flow and recharge, examples of these aquifers include: Kenya (Nairobi, Tiwi, Merti, Baricho), Sudan (Nubian sandstone, Gash basin) and Ethiopia (Raya valley, Tigray highlands and Ogaden). • The aquifer characteristics of many of the aquifer are not adequately known. There is need to carry out a comprehensive assessment of these aquifers including the transboundary ones in order to build the knowledge base for better decision making. Aquifer characteristics to be considered include but not limited to, abstraction over time, recharge levels, vulnerability to pollution, vulnerability to depletion, groundwater dependent ecosystem, transmissivity, hydraulic conductivity, storage coefficient, surface area, rainfall, natural discharge, soil type

	and thickness, natural land cover, surface water interaction, susceptibility to irreversible degradation, groundwater user and uses, analysis of use and pollution drivers and water quality assessment.
Water balance and recharge assessment	• The availability of groundwater in the region mainly depends on the geology (stratigraphy and structure), history of weathering faults and recharge (direct rain fall, rivers, lakes) • The groundwater potential in the region is high given that some of the hydrological environments identified have high productivity and there are cases where boreholes recorded yields of up 400m^3/hr (e.g. Nubian sandstone in Sudan). The groundwater storage in Baggara basin is 2.5 trillion cubic meters, in Gedarif basin is 0.4 trillion cubic meters. The annual recharge in Bagara , Gedarif, Nubian Nile and Al Gash basins is 450, 360, 800 and 222 million cubic meters respectively. • The Sudd basin shared between South Sudan, Ethiopia and Sudan has storage of 1800 billion cubic meters and annual recharge in Southern Sudan and Sudan is 540 million cubic meters • The Lotikipi basin aquifer covers 4,146 sq km in NW Kenya and holds a total storage of 200 billion cubic meters; and has a recharge capacity assessed at 3.42 billion cubic meters/yr. • There are some localised studies, for example in the Tigray highlands of Ethiopia where the water balance was investigated in a small basin (2 sq km) for the period 1995-2006. From field measurements discharge mechanism was identified and the recharge quantified. • Estimation of Water Balance was done in some basins at national and regional levels, Examples are the Shared Nubian basin, Al Gash basin. The estimations consider the in (recharge, sub-basin flow, etc) and the out (abstraction, evapotranspiration, out basin subflow) parameters. The use of groundwater flow models is applied in some basins to estimate the present and future groundwater balance. Therefore, careful estimations of all these parameters is very important. • The application of environmental isotope was widely used in Ethiopia, Sudan, Uganda and Kenya for the identification and the assessment of the mode, type and amount of the groundwater recharge. These works were supplied and conducted by the International Atomic Energy Agency (IAEA) through regional and national projects. • The bulk of the information available on water availability and recharge is country-based and it would be more valuable to have a comprehensive regional assessment. The recently established UNESCO supported regional centre for groundwater resources, education training and research in Eastern Africa could be encouraged to support this work. The work would include mapping recharge zone and assessment of water balance in the region. The IAEA and other UN interested organisations can help in such studies.
Groundwater levels and depths.	• There is no systematic assessment of groundwater levels in the region. Country-based efforts exist and where these are project based there is no follow up at the conclusion of the project. In a number of member states (Kenya, Uganda) groundwater levels are provided during drilling of boreholes as part of the licensing requirement. These are part of the completion records. Some of the assessments on groundwater are based on these records. In Sudan m South Sudan and in Ethiopia these water levels are collected during the construction of the production wells as part of the well information records. The groundwater

	levels in some countries of the IGAD are collected periodically or even continuously through the monitoring networks from each basin. Examples are Nubian shared basin and Gash basins in Sudan. The countries use manual methods, automatic loggers (down loaded or telemetric) to measure the water levels. The IGAD-HYCOS is a regional project to monitor the water levels in including the groundwater, in Sudan and South Sudan, Kenya, Eritrea, Ethiopia and Uganda this network use automatic (telemetric) which enables sending continuous water level data and received on the IGAD and national servers. In Sudan the IGAD-HYCOS project 21 loggers distributed now in four basins. The water levels of Gedarif basin is between 30 to90 m, Bagarra basin 30 to 110 m, Sudd basin 10-25 m, Nubian Nile basin 5 to 95 m, Gash alluvial basin 3 to 25 and **Barra**ka basin is between 10 to 20 m. The periodic monitoring of the groundwater levels in Gash from the years 1980 to the year 2017 shows a decline trend from 3 to 7 meters, while in the big sedimentary transboundary aquifer the long –term groundwater level decline is negligible.
Groundwater quality	• Data and information on water quality in the region is limited. From the limited data available, quality is shown to be highly variable ranging from clean freshwater in springs and the annually rechargeable aquifers to brackish and saline water in the rift valley and the consolidated carbonate sedimentary formations in the plains. Geothermal in the rift valley has influenced the groundwater with high fluoride levels in Eritrea, Djibouti, Ethiopia and the basaltic aquifers in the Gedarif basin in Sudan. In Afar region for example TDS> 2000 mg/l is common. The high salinity is located in the aquifers of the Sudd basin in Sudan, Ethiopia and South Sudan, the TDS reaches 3500 mg/lit. There is also high sodium chloride reported in the Ogaden region of Ethiopia. Groundwater is generally vulnerable to contamination by the nature of the geological formation and also by human practices like pollution by septic tanks or pit latrines in shallow aquifers, irrigation practices (irrigation returns, pest sides or fertilisers and by industrial heavy metal pollutions. • Excellent, very Good and good groundwater quality is located in many shallow aquifers in Ethiopia (200 mg/l,) Uganda and South Sudan (200-500 mg/l) and also in Sedimentary basins in Sudan (200-600mg/l). The availability of good quality groundwater to be used for drinking purposes is high. The quality is also suitable for irrigation such as the case of Sudan, Ethiopia where groundwater is used in large investments projects to produce crops and also for other purposes including industry, energy and roads and buildings. • Locating good quality groundwater is a challenge in many parts of the region. Statistical analysis and graphical plots of 94 hydrochemical data of groundwater were used in the Daua basin of Ethiopia as a tool to acquire insight into the key process that determine groundwater chemistry. • Groundwater quality is a challenge in cities. For example, a comprehensive hydrochemical study of the Addis Ababa area has shown that many wells, springs and rivers are polluted by heavy metals and nitrate. Ecoli was also detected. Excessive pumping and lack of attention on issues of wellhead protection is also causing groundwater pollution. Deterioration of groundwater quality either by national or human bad practices, agricultural practices or any other misuse is an issue that should be considered to have safe IGAD groundwater
Groundwater dependent ecosystems	• There is limited knowledge of groundwater dependent ecosystem. The region is facing increasing degradation of natural resources. The population has increased fourfold in the last 50 years increasing the demand for food, shelter and energy and putting pressure on the quality and quantity of land and water resources. The groundwater dependent ecosystem together with its biodiversity is facing serious

	threats impacting negatively on the hydrological, social, economic and cultural services provided by these ecosystems. • Recent studies in the region indicate that 95 percent of the original ecosystems have been altered with only 5 percent remaining intact. These ecosystems have either been converted to other land uses or degraded. The drivers are frequent droughts, climate change, overgrazing, population increase, land degradation and desertification. The result is the inability of the ecosystem to provide the necessary conditions for survival of living things in the region. • Various assessments done indicate the number of wetlands in aquifer basins are receding or disappearing altogether. Examples are the recharge areas of Nairobi aquifer system and the Lorian swamp in Kenya. In Sudan some of the Oases developed in the past by groundwater rise to the land surface are turn dry now due water level drop (North western Sudan oases in the desert). The dryness of some springs in Ethiopia, Djibouti, Sudan and Eritrea. • Sudan has started a programme to reclaim and stop the desertification and the dune sand expanding to fertile land by using groundwater to establish green belts in the desert and semi-desert lands. Also now exist a huge and rapidly growing large investments in agricultural schemes irrigated by groundwater, this beside its importance in providing food security and cash crop, develop a good ecosystem and stop desertification and land deterioration • The management of the groundwater dependent ecosystem is very important. There is need to establish coordination between national experts from member states, ramsar Secretariat and international experts in this area. This should enable the region to carry out hydrogeological assessment of the ecosystem dependent on groundwater in the region with identification of current and potential threats and identification of the scope of management intervention. UNEP conducted a lot of assessments regarding the issue in Kenya, South Sudan, Ethiopia and Sudan.
Groundwater data collection, acquisition, storage and dissemination.	• Most of the groundwater data collection is done at the country level. Generally, data is collected during drilling of boreholes where borehole completion records are provided. The licensing system for drilling a borehole or abstracting groundwater is a good procedure for data collection, where the licensee is required by regulations the complete records for groundwater wells or the used aquifer. Countries applying this system use it as a procedure for data collection as well as groundwater control and management, Kenya, Uganda, Ethiopia, and Sudan are now applying the licensing system. • Some data is obtained through periodic monitoring and also from groundwater assessments. This is currently done routinely in Kenya, Ethiopia, Uganda, and Sudan. There are existing databases in these countries, for example the Sudan groundwater database contains data for more than 14,000 water boreholes and wells, 28,000 dug wells, 20,000 hand pumps, aquifers characteristics, water quality, abstraction, recharge etc., all these in form of table databases or spatial database using GIS. • USGS is currently redesigning the Ethiopian National Groundwater database (ENGDA). USGS is also developing a database for the Combined Joint Task Force-Horn of Africa (CJTF-HoA) water resources for Djibouti/ Ethiopia/Kenya. This water resource database will store geological maps, hydrogeological maps, topo-maps, satellite images, vegetation and weather maps, documents and other relevant hydrogeological data in a form that can easily be retrieved by users. • Since 2011 IGAD has been implementing an Inland Water Resources Management Programme. It is also in the process of developing /supporting regional and national database of water resources. In all the IGAD countries there is need to

	standardise data collection and storage and to develop a central repository with digitised data that can be accessed easily. The IGAD-HYCOS project is designed to promote regional cooperation and collaboration in the collection, analysis, dissemination and exchange of hydrological and hydro-meteorological data and information for water resources. So far most of the work undertaken is on surface water and for it to be beneficial to this project it was extended to include groundwater resources data and information. In Sudan, the IGAD-HYCOS project provides 21 loggers distributed now in four basins.
GW monitoring network	• Generally, groundwater monitoring network is country-based with no regional monitoring network. In 2012 UNESCO and its affiliates together with African Ministerial Conference on Water (AMCOW), International Association of Hydrologists (IAH) and African Groundwater Network (AGN) launched the Global Groundwater Monitoring Network (GGMN) programme. The first workshop was held in Nairobi for the IGAD region. The objective was to assess regional groundwater trends using in-situ monitoring combined with information obtained through proxy (remote sensing observations in this case) to provide a reliable basis for decision making on groundwater issues. GGMN developed a web-based tool to assist groundwater monitoring. However, this has not been fully embraced in the region so far. Hence, there is no systematic monitoring of groundwater on regional scale. • AMCOW also developed the water and sanitation report which includes groundwater data and information for all Africa including the IGAD region now and reports where obtained up to the year 2016. Now the reports are prepared and accessed online from the Africa water report website • At country levels, there are responsible institutions undertaking the groundwater monitoring. The level of monitoring is diverse with little monitoring like Somalia to countries like Kenya and Uganda where monitoring networks exists since 1992 and 1999 respectively with the activity being undertaken periodically. There are however, serious gaps in this area regionally and there is need to standardise the parameters to monitor locations frequently and provide dedicated boreholes for monitoring. Inadequate groundwater monitoring network can lead to over exploitation of the groundwater resources resulting in serious adverse effects. • The periodic monitoring of the groundwater levels in Gash from the years 1980 to the year 2017 shows a decline trend from 3 to 7 meters, while in the larger sedimentary transboundary aquifers the long –term groundwater level decline is negligible.
Groundwater uses	• Generally, groundwater uses are concentrated in the Arid and Semi-Arid areas of region which comprises about 70% of the land area. These are the areas where surface water is less available. Additionally, water is increasingly being used to argument urban water supplies for example in cities (Nairobi, Addis Ababa, Nakuru), even in City like Khartoum (Between two Niles) groundwater is used to supply 45% of the domestic water supply of great Khartoum. Groundwater resources are used for livestock, irrigation, domestic use, industrial and commercial purposes in the region with the major uses in the region being domestic and livestock. Although the major use of groundwater is to support Rural and urban areas with drinking water, but most of the amount abstracted from groundwater is used for agriculture. In Sudan 65% of the groundwater is used for agriculture while only 33% are used for drinking.

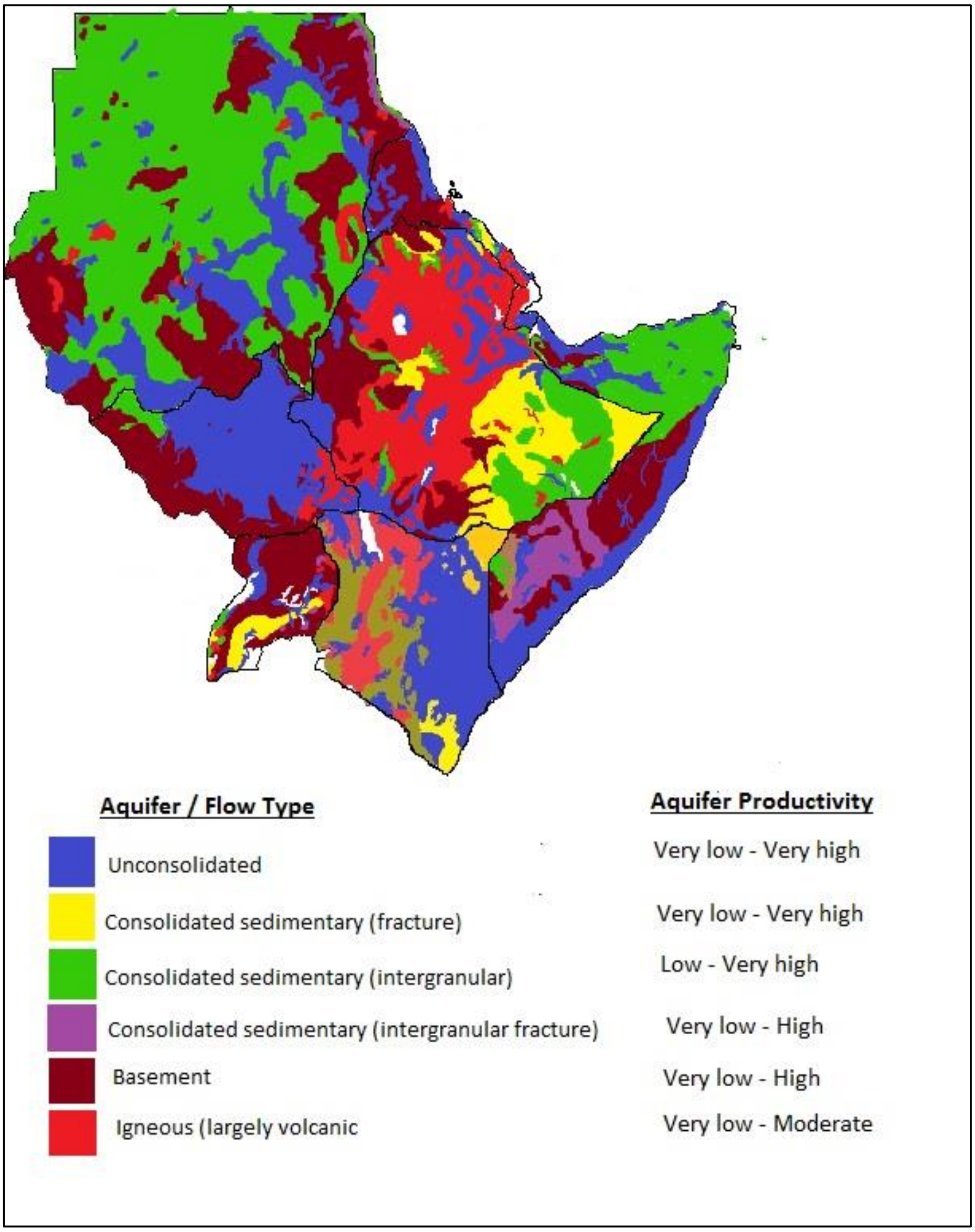
	• The stresses on groundwater in countries like Sudan and Kenya are controlled by laws and regulation that demands a license for groundwater abstractions especially for big agricultural use. • For Energy and transportation sectors, the groundwater is used for services, cooling, and also hydrothermal power generation. Ethiopia, Kenya are good examples for using groundwater to produce thermal power generation, Djibouti is also a country with good hydrothermal potential. Sudan With KENGEN company from Kenya were conducting an assessment of Geothermal energy potential in Byuoda, Sudan. • This increased climate variability in the region is up scaling the demand for groundwater use. There are generally no specific and accurate proportions of the uses available.
Climate Change Impact	• IGAD is one of the most vulnerable regions to climate change and variability in the world. Droughts and flood are common occurrences with devastating effects. IGAD has in response developed; the regional climate change strategy, drought and disaster resilience and sustainability initiative (IDDRSI) and established the climate change prediction and application center (ICPAC). There is considerable work being undertaken under these initiatives. • Population growth coupled with extreme climate variability has caused water resources to be more vulnerable and water stress is being experienced in cities (Nairobi, Addis Ababa) and in the river basins of Athi (Kenya), Awash (Ethiopia) and Abay (Ethiopia). This impacts negatively on food security, energy security, water security and human livelihood. • ICPAC in collaboration with its African affiliates regularly make climatic assessments and regularly release climate prediction products that provide timely warning for disaster risk reduction. • Some of the IGAD member states have developed strategies for dealing with climate change, for example Kenya has developed the National Climate Change Response Strategy (NCCRS), Sudan is developing a climate change strategy and action plans which outlines how the water sector addresses adaptation and mitigation measures. • Although the climate change will negatively affect the groundwater resources availability in aquifers highly depending on annual replenishment from rainfall or infiltration from rivers, but groundwater is considered one of the tools of the climate change adaptation especially the paleo- water in the big sedimentary aquifers like Nubian, Bagara basins in Sudan and Adigrat in Ethiopia.
Groundwater licensing and permits	• Groundwater licensing and permits are common features in a number of countries in the region e.g. Kenya, Ethiopia, Uganda and Sudan. The regulations relating to groundwater require that water rights be acquired through permits which indicate user and amounts for which rights are to be acquired (Kenya Water Act 2002, Ethiopian Proclamation 197/2000, Sudan Water resources Act, 1995, Groundwater Abstraction regulation 2016). Licensing is obtained for intention to drill borehole under the existing rules in several of these countries. These permit and licensing systems contribute positively to the enhancement of knowledge base in ground water development and management.
How is knowledge applied to enhance the groundwater availability/	• A number of programmes have been undertaken using technology to enhance water availability that will sustain livelihoods during drought. For example, in 2016 IGAD carried an assessment of water development project in pastoral and agro-pastoral areas of Kenya. This was to look at significance of water in this arid area, document best practice and explore reason for water facility failures. This study found out that the reason for failure of project was due to limited

condition and promotion of sustainable use of GW in relation to drought.	knowledge base. There was no proper geophysical investigation, monitoring, data collection or technology transfer for operation and maintenance. • In 2014 IGAD commissioned a project on managed aquifer recharge (MAR) on Merti aquifer. The study has shown that there was potential for MAR interventions for shallow and deep groundwater. Shallow MAR interventions identified included land surface infiltration, direct aquifer infiltration, surface water storage and on-stream water storage such as sand dams and sub-surface dams. For deep MAR interventions, injection wells were found to be the best techniques. • There are also various water harvesting techniques used in member states as a strategy for resilience during drought. These are subsurface dams, sand dams and water pans directing feeding from wadis/laggas in the arid and semi-arid (ASALs) of the region. These structures are used to enhance groundwater recharge to aquifers (artificial recharge), The Water Shed Management project implemented in Ethiopia and Sudan 2009-2015, is one of good examples. • The development of hitherto unknown aquifers enhances drought resilience as shown by the recent discovery of a huge aquifer in Northern Kenya (Turkana County) through the support of UNESCO. The aquifer covering 4,146 sq km holds a volume of 200 billion cubic meters of groundwater. • There are a number of case studies carried out by the Global water partnership (EA) under the Integrated Drought Management Programme (IDMP) in the HoA reported in "Building resilience to drought: learning from experience in the HoA." Report. The case studies have shown how resilience to drought was built through innovative drought and water security projects undertaken by communities and partners in Kenya, Ethiopia and Uganda. • There are other examples of country based and managed water programmes that are building resilience to drought e.g. water harvesting programme in the arid and semi-arid (ASALs) areas of Kenya. The Atbra –Tekezee basin, recharge study in Sudan and Ethiopia and the modelling of groundwater in Gash basin Sudan – Eritrea are also good examples of using modelling knowledge and remote sensing technology in groundwater management • Application of improved hydrogeological, geophysical, remote sense, drilling techniques, geophysical well logging methods, isotope techniques applied in all most all IGAD states are highly improved the groundwater assessment. The water completion techniques improve the groundwater development. The modelling techniques applied to groundwater like groundwater flow and solute transport models together with GIS applications enable future forecasting for aquifers and hence enhance groundwater management. • The developments in computers and ICT assist in improving the groundwater data acquisition, monitoring, storing, updating, data dissemination, analysis and presentation and therefore in groundwater development and management. • Development in energy especially the new and renewable energy like Solar energy and wind energy improve the groundwater abstraction and delivery and hence reduce the cost of using groundwater. Good examples are in Tigray Region in Ethiopia and also in Northern and western Sudan Solar and Wind energy projects
Main shortcomings or impacts of not having data	• The effective development and management of groundwater is highly dependent on reliable data and information. These data and information should be comprehensive and accessible. Lack of data will therefore result in poor development and management of groundwater and generally inability to make correct decisions on ground water issues. This is likely to result in over abstraction, failure of the water facility, pollution and loss of livelihoods. Data is

	obtained from assessment, basic survey, well inventory, groundwater monitoring, storing, updating, exchanging of data, failure in these will cause failure in analysis and of data using, therefore good assessment, development and management of groundwater depend solely on data. • The IGAD- states are far below the other countries as far availability of data on groundwater sharing is concerned
Best practices	• Case studies have been carried out in Kenya, Uganda and Ethiopia on projects aimed at building drought resilience. These case studies exemplify best practices in coping with drought situations. These projects include the Makueni county community water harvesting project using simple technologies, sand dams in Kitui county (Kenya), and building water harvesting structures in Aswa-Agago (Uganda). • There are other best practices, for example the managed aquifer recharge project in the Merti aquifer where interventions to build drought resilience were identified. This included on-stream storage, sub-surface dams and sand dams. • Best practices in improving recharge situation in aquifers in Sudan and Ethiopia by application of water harvesting techniques to artificially recharge the groundwater through the Water Shed management project. • Best practices were obtained from the Bilateral Netherland project in Sudan in Gash, Wadi Nyal alluvium basins, the project started since 1982 with assessment phase, development Phase and finally ended in 1994 with groundwater management phase. One of the side outputs is the establishment of a computerised database since 1983. The other output is the enactment of the Gash Basin Groundwater Act and establishment of a board.

There are a number of trans-border aquifers in the IGAD region that require careful management. The map below shows their location and extent.

Figure 0-3: IGAD Hydrogeology Map



Current status of trans-boundary initiatives

Building River Dialogue and Governance (BRIDGE)

IUCN and IGAD with financial support from the Swiss Agency for Development and Cooperation (SDC) is implementing a global project, Building River Dialogue and Governance (BRIDGE), the aim of which is to improve trans-boundary cooperation between riparian countries, BRIDGE focuses on strengthening hydro diplomacy at multiple levels of government, and strengthening capacities for the governance of shared water resources. The project is being implemented in one the IGAD region basins of Sio-Malaba-Malakisi between Kenya and Uganda. BRIDGE's activities are also co-financed by the U.S. Department of State funded project "Strengthening trans-boundary water governance in the IGAD region" and implemented in partnership by IUCN, UNECE, IGAD Secretariat and the IGAD Member States.

One of the activities these projects are supporting is the finalisation of the IGAD Regional Protocol on Water Resources. The provisions in the draft IGAD Regional Protocol on Water resources are mainly derived from the International Water Law i.e. the UN Watercourses Convention of 1997 and the 2008 draft Law on Trans-boundary Aquifers.

To this end, the projects through training are deepening the hydro-diplomacy understanding of the IGAD Technical Advisory Committee (TAC) members and senior government officials who are engaged in the Negotiation for the Protocol. The training covers important concepts, processes and institutional frameworks provided for in the International Water Law. The skills acquired has so far improved their abilities to effectively engage in the Negotiations.

Nile Basin Initiative (NBI) Strategy 2017 – 2027

The 10-year Strategy document identifies the overall strategic directions for NBI over the 2017-2027 period. The strategy addresses three main issues: What basin challenges the Nile member states expect NBI to address over the next 10 years; and how the NBI as an institution should position itself to effectively discharge its mandate. The strategy takes a medium (10 yrs) term outlook of the basin; factors in basin dynamics and trends in water use and availability; and on that basis defines strategic water resources development and management priorities within the ambit of NBI's mandate.

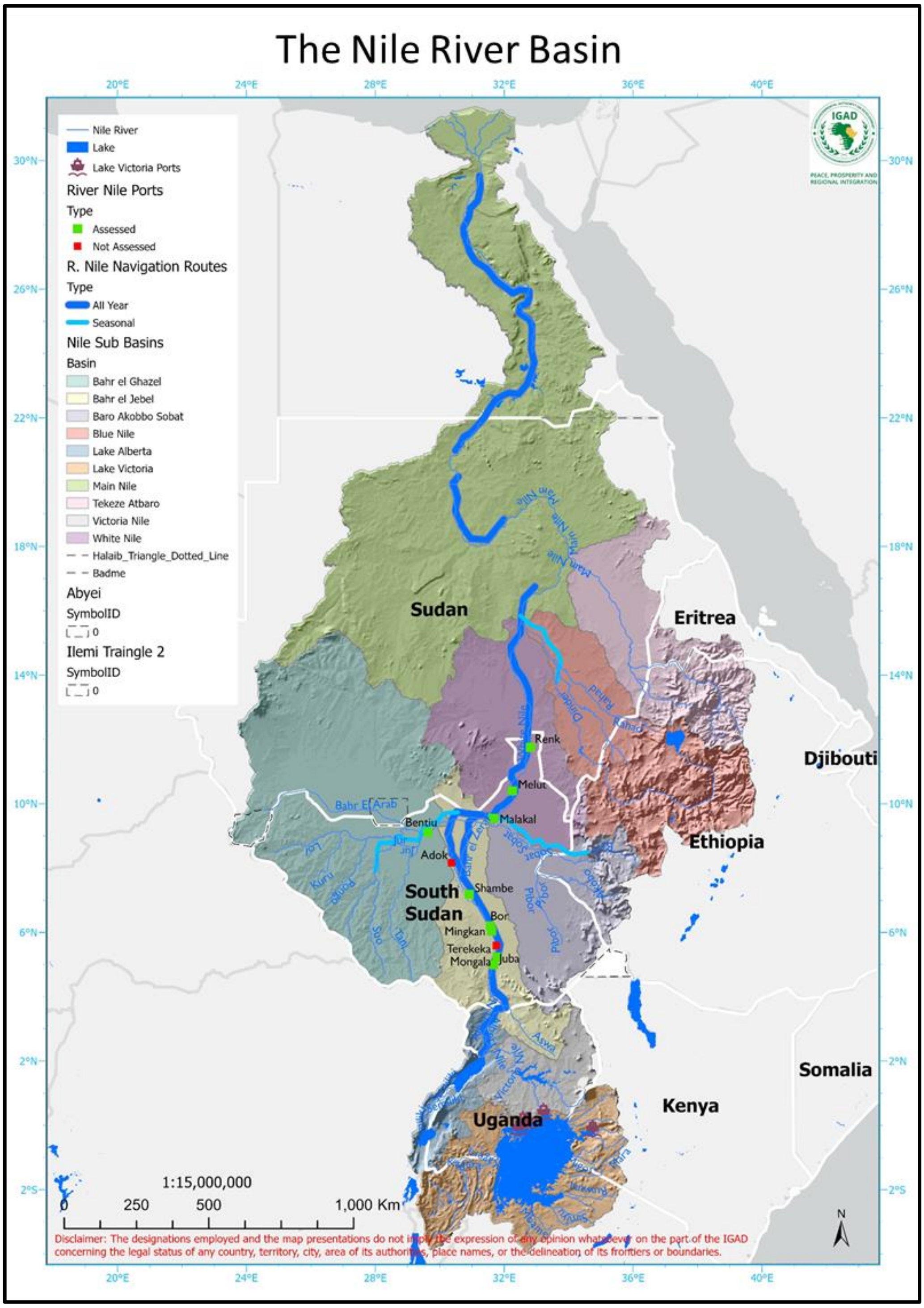
Six basin challenges were identified as strategic priorities of the basin countries to which NBI can meaningfully contribute. Strategic priorities in this case refers to what the NBI needs to focus on and pay attention to in order to achieve its shared vision objective as mandated by the countries. Under each basin challenge, strategic directions, that will help bring about a more optimal and sustainable development of the basin within the mandate of NBI are articulated. Underpinning all the strategic priorities is the increase in cooperation between member states and dialogue with NBI's broader stakeholders as well as regional actors in the basin. The figure below shows the Nile River Basin**.**

Other Initiatives

The proposed IGAD region water protocol or legal instrument to be signed by the Member States agreeing on joint actions on the shared river basin will operationalize the monitoring, collection, generation, and sharing and exchange of data and information. Information and data for compilation, analysis, consolidation, and entry into database will flow from the Field Stations, through the National Basin Coordination Units (NBCU) to the Regional Basin Coordination Unit (RBCU) for transmission to the Regional Transboundary Basin Coordination Secretariat[68] (RTBCS) located in IGAD Secretariat, before they can be disseminated to the clients and third parties.

Flow of information and directives at policy level will move from the Summit of the Heads of State, through the Council of Ministers to the Commissioners and down through the RTBCS in IGAD Secretariat to the RBCU and to the NBRU and then to the Field Stations. All agents operating in the river basin shall report to the Field Stations. Categories of information and data for transmission include those on water resources, climate and atmosphere, ecology and environment, land use and cover, socio-economy, recreation and tourism, infrastructure, natural resources, and agriculture and farming.

[68] Lake Victoria Basin Commission (LVBC) and Nile Equatorial Lakes Subsidiary Action Program (NELSAP) spirit borrowed in the idea of TRBO, RBO still exist but all development jointly agreed by sharing member states.



The policies of the Governments in the IGAD region is to promote industrial development including irrigation and to increase access to safe drinking water to majority of the population make freshwater, whether surface or underground, a focal issue in government strategies. The IGAD region water resources policy has proposed measures to be undertaken and investments to be targeted to reduce the problems in the deficit areas of Ethiopia, Kenya, Somalia, Djibouti, Eritrea, Sudan, and Uganda. The private sector will become a key player in the water sector as realistic values are attached to freshwater.

Common vision, mission, broad objectives, policies, and strategies for the development and management of areas of common interest have been developed so that the following issues can be overcome or avoided: (i) lack of a coordinated cross-sectoral and integrated approaches to problems and solutions at individual governments levels, (ii) increased conflict of interest among institutions and states, and (iii) duplication of efforts and waste of resources both at domestic and sub-regional levels.

The Shared Vision statement is as follows: “*Economically prosperous, socially just and environmentally sound transboundary basins for the benefits of the present and future generations in the IGAD region.”*

The Mission: statement is *“To promote and coordinate sustainable development, conservation, utilisation, and management of water and related resources of the transboundary water basins for the mutual benefits of the people of the Sub-Region by implementing strategic programmes, projects and activities, and generating scientific data and information to guide policy decision making and implementation of any development programmes.”*

Implementation of IWRM Principles in the IGAD Region

The international Conference on Water and Environment held in Dublin in 1992 formulated the Integrated Water Resources Management (IWRM) principles otherwise known as the Dublin principles. The purpose of these principles is to encourage a paradigm shift in the concepts and practices in the management of water resources. The principles as follows:-

- Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment;
- Water development and management should be based on a participatory approach, involving users, planners and policy makers at all levels;
- Women play a central part in the provision, management and safeguarding of water; and
- Water has an economic value in all its competing uses and should be recognised as an economic good.

These principles have gained support and have been adopted as the guiding principles that underpin IWRM. These principles recognise that water is multifaceted covering economic, social, cultural, environmental, physical, political, infrastructural, gender and institutional dimensions. The application of the principles of IWRM therefore requires a paradigm shift from control to a consultative process, from top-down to stakeholder driven approaches, from sectoral to integrated management, and from supply fix approach to demand management.

The implementation of IWRM principles has been a challenge in the region as it requires a break with the past. The interpretation of the principles depends upon the framework within which it is planned. The wide range of difference in development and the weak institutional framework in the IGAD Region makes the application of the principles more challenging. Learning from successful application of the principles elsewhere e.g. Nile Basin is crucial in enhancing the application in the region.

Irrigation Potential and Current Status

All the countries of the IGAD region recognise the potential of irrigation as a means to substantially raise agricultural productivity and improve their food security situations. Yields from irrigated agriculture can be higher than non-irrigated agriculture by a factor of three or more times. This has been demonstrated in Ethiopia, Kenya and Sudan. In Sudan, for instance, output from irrigation constitutes about 60% of total agricultural output, while in Kenya it is about 18% of total agricultural output. Most of the countries have plans for expanding irrigated agriculture as well as rain-fed agriculture.

The attractions of irrigated agriculture are, however, tempered by a number of limiting factors: (i) the high cost of developing modern irrigation systems (especially infrastructure) which would deliver water efficiently; (ii) the poor performance of public irrigation systems, most of which have had their infrastructure run-down; (iii) resulting from this, the high losses of water (low irrigation efficiencies) in almost all the irrigation schemes; and (iv) weak institutional and policy frameworks for effective irrigation development. Thus, the realisation of this potential will be severely constrained not only by the financial and human resource costs but also by inadequate water to meet the needs of additional irrigation expansion. The relevance of irrigation in the region is given in the Table 6-5:-

Table 0-5: Relevance of Irrigation in IGAD Region

Country/ies	Characteristics	Relevance of Irrigation
Djibouti, Eritrea, Somalia, Sudan	Mainly arid. Recurrent droughts	High/ Inland and trans boundary
Ethiopia, Kenya, Uganda	Mainly Arid and Semi-arid lands, erratic rainfall and water scarcity. Recurrent droughts. Exception, humid southern part of Uganda.	High/ Inland and trans boundary
South Sudan	The region is well endowed with rainfall and water resources	High in semi-arid local parts/ Mainly rain fed.

The irrigated areas in the various countries obtained from FAO AQUASTAT-2013 is given below:-

Table 0-6: Irrigated Areas in IGAD region by country

Country	Total irrigated area (ha)	Irrigated area by basin (ha)					
		Turkana-Omo	Juba-Shabelle	Ogaden	Gash-Baraka	Ayesha	Danakil
Ethiopia	292,384	46,953	48,783	1,721		0	4,756
Kenya	101,706	9,720	7,134				
Uganda	9,041						
Sudan	1,863,099				13,677		
Djibouti	859						
Eritrea	19,590				5,057		4,756
Somalia	196,753		142,814	23,429		0	
S Sudan							
Total	**2,483,432**	**56,673**	**198,731**	**25,150**	**18,734**	0	**9,512**

Environment

One of the major challenges facing the IGAD region is the severe degradation of the natural resources and the environment. This is compounded by recurrent droughts and under-development which cause further degradation. A summary of some of the common threats are given in the table below:-

Table 0-7: Summary of Issues and Threats in the IGAD Region

Thematic Area	Issues and Threats
1. Land	• Drought, desertification, population pressure, land pressure, land clearing and • degradation, soil erosion, invasive species, sand dunes, land mines
2. Wetlands and Water	• Increasing demand for domestic, irrigation, industrial, urban use, overstocking, pollution, • sedimentation, invasive species
3. Biodiversity	• Overuse, land clearance, pollution, climate change, invasive species, management • capacity
4. Forests	• Deforestation, woodland conversion, unsustainable harvesting, climate change, • decrease in natural forests, poverty, political pressure, invasive species, pollution
5. Invasive Species	• Extinction of native species, affects economic activities like transport, impacts • ecosystems and industries and agriculture, management capacity
6. Coastal and Marine Ecosystems	• Coastal erosion, clearing for agriculture, flooding and siltation, pollution, human activities • and dumping of wastes, climate change, invasive species
7. Climate Change	• Coral reef bleaching, melting glaciers, sedimentation, rising sea levels and flooding, • advantage to invasive species, a risk to delicate species unable to adapt to change, • health, socio-economic
8. Cross border Management	• Lack of dialogue across political borders, unplanned upstream activities affects • downstream, cooperation, capacity to manage
9. Biosafety, biodiversity and plant genetic resources	• Pollution, species extinction, trade issues, intellectual property rights, climate change, • GMOs, ABS, technology transfer
10. Ecosystem services	• Ecosystem functions, processes, goods, benefits, valuations, value in economic planning
11. Land tenure and access	• Mixed tenure, uncertain tenure, tenure preventing access, uneven access, ABS
12. Gender mainstreaming	• Gender issues needed in all aspects of environmental management
13. Waste dumping and pollution	• Toxic wastes dumped at sea, on coasts, POPs, toxic waste disposal
14. Conflicts	• General degradation of environment, overuse of natural resources by local, transient • and refugee people as well as returnees after conflict
15. Trade and Environment	• Market forces causing unsustainable natural resource use, movement of species including IAS, pollution
16. Natural disasters	• Floods, droughts, storms, earth movements and sea changes, tsunamis
17. Nile Basin	• Water use allocation, proposal for water diversions, watershed pollution, agricultural chemicals and invasive species
18. Lake Victoria	• Population pressures, pollution from raw sewage, eutrophication of lake, invasive • species, over-fishing, watershed mismanagement
19. Pastoralism	• Excessive livestock numbers, water and pasture scarcities and conflicts with agricultural

Section 6.3 Pipeline of trans-boundary infrastructure and initiatives

There are many planned or on-going transboundary water development initiatives in the IGAD region. These include Grand Renaissance hydropower between Ethiopia and Sudan, Angolo Multipurpose Dam Between Uganda and Kenya, Integrated development and management project of the Daua Trans-boundary water resources between Kenya, Ethiopia and Somalia, Cross border integrated project for sustainable peace and socio-economic development between Kenya and Ethiopia Borana Marsabit sustainable development.

The other initiatives are the Project on sustainable development of Lake Turkana and its river Basin between Kenya and Ethiopia, Kocholia transboundary Multipurpose project between Uganda and Kenya and Maira multipurpose dam between Kenya and Uganda. Rainwater harvesting, surface water harvesting, flood water harvesting, run-off river schemes, sub-surface-sand dams, protection of catchment areas of existing dams and pans, groundwater recharge, rehabilitation of dams and catchment protection are also earmarked for implementation in the region. The key transboundary infrastructure projects in the IGAD region are given in table 6-8 below:

Table 0-8: List of Transboundary Water Projects and Status

S/No.	COUNTRIES	PROJECT/PROGRAMME	STATUS
1	Kenya/Ethiopia	sustainable management of Lake Turkana and its River Basin	Planned
2	Kenya/Tanzania/Uganda	Implementation of bilateral frameworks on Trans-boundary Water Resources	Planned
3	Kenya	Detailed Mapping of Trans-boundary Water Aquifers	Planned
4	Kenya/Ethiopia/Uganda/ Tanzania	Establishment of Hydro meteorological Network on Trans-boundary Waters Resources.	Planned
5	Kenya/Ethiopia/Somalia	Implementation of the Integrated development and management plans of the Daua Trans-boundary water resources	Planned
6	Kenya/Uganda/Tanzania	Implementation of the trans-boundary Catchment management plans	Planned
7	Kenya/Uganda	Kocholia trans-boundary multipurpose water storage project	Concept stage
8	Kenya/Uganda	Maira Trans-boundary multipurpose water storage projects	Planned/Feasibility
9	Kenya/Uganda	Sio-Malakisi-Malaba Transboundary Water Project	Ongoing
10	Ethiopia/Djibouti	Ethiopia-Djibouti Transboundary Water Supply Project	Ongoing
11	Sudan/South Sudan	The Assessment and management of Bagara Transboundary groundwater aquifer	Planned
12	Sudan	Zero Thirst Water Supply Project	Under implementation
13	Sudan/South Sudan	Establishment of Monitoring Network for the Nubian Sandstone Aquifer System	Concept
14	Sudan/Egypt/Chad/Libya	Enabling implementation of the Regional Strategic Action Plan (SAP) for the rational and equitable management of the Nubian Sandstone Aquifer System.	Planned

Section 6.4 Policy Initiatives, Institutional Arrangements and Enabling Environment

The IGAD region is moving towards good water governance which is a significant prerequisite for the positive outcomes of sustainable development at all levels. The IGAD member states have been progressively taking tangible steps towards improving water governance systems both at the national and regional levels by strengthening water structures and institutions in all water sub-sectors and their respective inter-linkages by ensuring coherence, integrating policies, minimizing duplication of efforts and wastage of resources, and strengthening institutional capacities.

The region has realised commendable economic performance through improvements in transparency and accountability, decentralisation and empowerment, social inclusiveness and democratisation. Nevertheless, some challenges remain which require continued and deepening institutional reforms and creation of an enabling environment as well as capacity development

Policy Initiatives

Many Governments in the IGAD region plan to promote both industrial and agricultural development as well as increasing access to safe drinking water for their populations. These plans will require the provision and appropriate management of water resources. The IGAD region water resources policy has proposed measures to be undertaken and investments to be targeted to reduce the problems in the deficit areas of Ethiopia, Kenya, Somalia, Djibouti, Eritrea, Sudan, and Uganda. It is expected that the private sector will become a key player in the water sector.

Institutional Arrangements

The IGAD countries have a range of institutions focused on the development and management of water resources through the development and reforms in national policies, strategies, laws, and water master plans. Many national policies and legal frameworks related to the water sector were updated and revised in the late 1990s and in 2000s as water issues became the subject of increasing national and international concern and debate. Besides environmental concerns and commitment to regional and international organisations to which each country subscribes, the IGAD member states appear willing and ready to collaborate on the development and management of their transboundary water resources. The policy, legal, and institutional frameworks as well as the protocols for information and data sharing and exchange, are similar to that for the joint Transboundary River Basin Organisation[69] (TRBO), and can be applied to a single or more shared river basin resources in the IGAD Sub-Region.

The development of a TRBO includes the setting up of a transboundary consultative mechanism, the RPSC and the related Working Group at the IGAD level. The proposed framework will be implemented in two stages. Initially, its Coordinating Secretariat will be housed within IGAD Secretariat as a dedicated mechanism for the development and management of the shared river basin resources. The Directorate will gradually be transformed into an independent functioning body, the “Commission” or “Organisation” outside of IGAD Secretariat but within IGAD framework, after a period of five years.

The evolutionary process of the institutional framework will also aim at having one single Sectoral Council of Ministers for the TRBO to deal with all projects and programmes in any of the shared river basins. At the national level in all countries there is a government ministry or agency with responsibility for water resources development and management. The following are major institutions in each country.

[69] Lake Victoria Basin Commission (LVBC) and Nile Equatorial Lakes Subsidiary Action Program (NELSAP) spirit borrowed in the idea of TRBO, RBO still exist but all development jointly agreed by sharing member states.

Djibouti:

The government of Djibouti is aware of the water critical situation and has placed water and sanitation sector policy development and implementation among its priorities. This has translated into important institutional reforms such as the Water Code publication (1996), the establishment of a unified Water Directorate (1999), and a ministries coordination body. The major water actors are;

- **Ministry of Agriculture, Livestock Production, and Marine Affairs-Water Resources** (MAEM-RH), in charge of policy development and investment planning for water supply throughout Djibouti. The Hydraulic Directorate of the Ministry is responsible of water Resources. The ministry's departments are responsible for rural water supply, village pumping systems and maintenance, and well construction.

- **Djibouti National Water and Sanitation Office (ONEAD)** is responsible for water supply management and coordination in Djibouti City and other towns. It is also responsible for sewerage and wastewater treatment as well as storm water drainage.

- **The Ministry of Health** has mandated the Direction de l'Epidémiologie et de l'Information Sanitarian (DEIS) to implement the Ministry's hygiene and sanitation policy.

- **The Ministry of Finance, Economy and Planning** is in charge of privatisation, and is responsible for investments and the allocation of financial resources.

The key measures to improve the institutional arrangements are (a) strengthening the capacities of the public water and sanitation utility, ONEAD, so it can exercise its mandate, and (b) defining a clear action plan and responsibilities for hygiene and sanitation promotion.

Current projections for sector finance suggest that substantial increases are necessary to sustain present coverage levels. This is due to a number of governance problems such as insufficient decentralisation combined with unsatisfactory budgeting processes and financial management difficulties. Despite efforts made in recent years, there is still no effective decentralisation because of the lack of political and institutional mechanisms and financial resources at the district level. Some progress has been made with the law on decentralisation that defines regions as local government units. But the sector still lacks appropriate budget allocations to cover investment needs and to fund recurrent expenses [Country Sector Assessments: UNDP GoAL WaSH Programme | Volume 2 | Djibouti 8]

In the urban sector, the financial situation of ONEAD, is problematic. This situation results from a lack of financial and management autonomy; technical and commercial weaknesses; huge governmental agencies' deficits and over-staffing. The merger of water supply and sanitation utilities has resulted in a greatly increased number of responsibilities for ONEAD. Unfortunately, the company does not have corresponding human and financial resources. A strategic roadmap for the restructuring of ONEAD is necessary if it is to improve its financial performance and to take on its additional duties in providing sanitation services.

At the national level, a move towards a programmatic approach with the development of a Medium-Term Expenditure Framework (MTEF) for the sector, detailing operating and investment expenditure needs, would gain donor and finance ministry visibility and help ensure that sufficient resources are allocated to the sector.

In terms of global development assistance, Djibouti receives approximately US $100 m. annually from donors. Currently, the WSS sector's main development partners are:

- The Arab Fund for Economic and Social Development (AFESD), helping with water supply rehabilitation works;
- China, financing a new desalination plant for Djibouti City;
- The European Union, providing institutional support and sanitation facilities, together with the AfDB.
- The following are key measures to improve water sector financing:
- Develop a programmatic approach e.g., a MTEF.
- Draw up a strategic roadmap for ONEAD.
- Increase project management capacity and the efficiency of procurement procedures.
- Recognition of the importance of operational and maintenance cost recovery.

Ethiopia:

The key water Institutions are:

The Ministry of Water and Energy (MWE) is the major institution responsible for water and water resources and has powers and duties on the water sector. The supervising body shall be responsible for the planning, management, utilisation and protection of water resources. It shall also have the necessary power for the execution of its duties under the provisions of this proclamation.

Environmental Protection Authority (EPA). By Article 6 of Proclamation No. 9/1995, for example, the EPA became responsible for protecting the water resources of the country. There still appears to be some overlap between the water-sector regulatory tasks stipulated for MWE and those stipulated for the EPA.

A review of the current institutional responsibilities strongly suggests that distinction between the tasks assigned to different institutions must be clarified or the incompatible articles repealed.

Regional Governments Proclamation No. 41/1993 Grants Regional Governments regulatory powers that includes small-scale hydropower. In addition, the provisions of the proclamation empower the Regions to:

- Supervise the implementation within the regions, of purity and sanitation standards prescribed in relation to the water used for various services and sewerage purposes.

- Supervise the balanced distribution and utilisation of region's water resources to various types of services; and

- Ensure the implementation of law, regulations and directives issued in relation to the protection, conservation and utilisation of water in the region.

Other Federal institutions directly or indirectly involved in the management of water resources are: Ethiopian Electric Power Corporation (EEPCo), Ethiopian Electric Light and Power Authority, Ministry of Works and Urban Development, Ministry of Health, the Water Supply and Sewerage Authority (WSSA) of Addis Ababa, and the Addis Ababa Municipality.

Subsidiary organisations of the MWE that are engaged in different aspects of water resources planning, development and management, namely: Ethiopian Water Works Construction Enterprise (EWWCE), Water Well Drilling Enterprise (WWDE), Water Works Design & Supervision Enterprise (WWDSE), and the Awash Basin Authority.

Most Regional Governments have established bureaus of water, mines and energy or bureaus of water resources development. All bureaus have branch offices or departments. Some Regions have established such specialised institutions as waterworks construction enterprises, commissions for sustainable agriculture and environmental rehabilitation, and/or irrigation authorities. The Ethiopian water-resources management policy specifies that urban water-supply services be recognised as autonomous entities. Currently, however, some are autonomous and others are organised under bureaus or branch offices.

Donors finance numerous projects in water supply and sanitation in Ethiopia – some through the Federal Government and some directly to regions, towns and communities. The donors have established a technical working group (TWG) on water as part of a core donor group called the Development Assistance Group. A Multi-Stakeholder Forum is also supported through the European Union Water Initiative. Despite improved coordination, donors still use different implementation arrangements. Important donors in the sector are the African Development Bank, CIDA, China, the British DFID, the EU, FINIDA, AFD from France, Germany (through GTZ and KfW), JICA, the Netherlands, UNDP, UNICEF and the World Bank. There are also about 500 local and foreign NGOs, many of which are active in water supply and sanitation

Eritrea

Currently, Eritrea is focusing on strengthening its economy by way of harnessing its natural resources. Top priority given to the development of water resources is evidenced by the fact that most development projects are related to water; food security, economic development, drought and flood mitigation. Accordingly, policies pertaining to water resources, food security, environment, and water and drought calamities mitigation have been formulated and put into effect. It is also worth mentioning the remarkable achievements that have been made in terms of water conservation including construction of water storage and diversion structures and groundwater explorations for different uses. For instance, water harvesting structures such as dams, ponds, and wells constructed from 1992 – 2003 were 84, 314 and 228, respectively.

In Eritrea water is allocated to users without proper procedures and regulatory instruments. Decisions on water allocation, particularly the determination of the water resources development sites has been made by non-water management bodies because of the absence of legal and regulatory frameworks. In addition, inadequate decisions related to surface and groundwater abstractions were made without adequate data and information and this leads to the depletion of pockets of groundwater in the highlands.

This implies that the root causes of water related problems in Eritrea include highly uneven distribution of water availability, extreme catchment degradation, low investments on water storage and infrastructure, increasing water demand, pollution of freshwater. Others include improper procedures and regulatory instruments, absence of water costs, lack of monitoring, assessment and evaluation of water resources, absence of enacted water resources policy, insufficient legislative and legal framework, inefficient institutional framework, weak financing mechanisms and inadequate professional and technical capacity.

In addition, inadequate water conservation practices, inefficiency in water use, water reuse, prevalent system of water rights which gives unlimited ownership of groundwater to the landowner despite the fact that groundwater is a shared resource from common pool aquifers and disassociation of communities in water resources management are also prevalent challenges.

Water Institutions, Policies and Laws

In an attempt to address the water related challenges, the Government of Eritrea established the Water Resource Department (WRD) under the Ministry of Land, Water and Environment. This was followed by development of national policies pertinent to water resources as reported in the Action Plan for Integrated Water Resources Management (AP-IWRM) viz. draft on Eritrean Water Resources Policy, Interim Poverty Reduction Strategy (I-PRSP), Food Security Strategy (FSS), Agricultural Policy, National Environmental Management Plan (NEMP-E), National Action Program under United Nations Convention to Combat Desertification (NAP-UNCCD). Others are the National Environmental Impact Assessment Procedures and Guidelines (NEAPG), Coastal Policy and its Guidance Document, and National Adaptation Programme of Action (NAPA).

Eritrea is also a member of the Global Water Partnership (GWP) programme that aims at contributing to sustainable development and poverty reduction through Integrated Water Resources Management (IWRM) approach. In order to implement these policies on the ground the WRD established a central body with full mandate to study, develop, manage and protect all the national water resources and introduced integrated water resources management approach progressively.

WRD has three divisions and three supporting units: The Water Resources Assessment and Information Division have three units - Hydrogeology, Hydrometeorology and Geophysics. Water Resources Management and Use Division have three units - development, Water-use management and Water quality control. Water Supply Division has three units Rural Water Supply, Urban Water Supply, and Operation and Maintenance. The supporting units within Legal Service and Water Resource Information Center. Moreover, the ministry is working to establish an integrated water resources management (IWRM) with an adequate institutional framework and capacity to introduce modern water harvesting technologies, efficient and effective water supply systems, and effective water protection and quality control systems.

Kenya:

The Ministry of Water and Sanitation provides policy guidance, capacity building, resource mobilisation, coordination and oversight for the following statutory institutions.

Water Services Regulatory Board (WASREB) is established under the Water Act, 2016 to regulate water and sewerage services provision, including issuing of licenses, setting service standards and guidelines for tariff and prices.

Water Resources Authority: The Authority is established under the Water Act 2016 to regulate the management and use of water resources including water allocation, source protection and conservation, water quality management and pollution control as well as collaboration on international waters. WRA is the successor of Water Resources Management Authority (WRMA).

The Water Sector Trust Fund is established under the Water Act, 2016 to provide conditional and unconditional grants to Counties, in addition to the Equalisation Fund and to assist in financing the development and management of water services in marginalised and underserved areas. This includes community level initiatives for the sustainable management of water resources, development of water services in under-served rural areas, development of water services in the under-served poor urban areas, and research activities in the area of water resources management, water services, sewerage and sanitation. Water Sector Trust Fund is the successor of Water Services Trust Fund (WSTF) under the Water Act, 2002

Water Tribunal (WT): The Tribunal is established under the Water Act, 2016 to hear and determine any dispute concerning water resources or water services. WT is the successor of Water Appeals Board (WAB) that was enacted under Water Act, 2002.

National Water Harvesting and Storage Authority (NWHSA) is established under the Water Act, 2016 to undertake the development of national public water works for water resources storage and flood control on behalf of the national government; and maintain and manage national public water works infrastructure for water resources storage. The Authority is the successor of National Water Conservation and Pipeline Corporation (NWCPC) under the Water Act 2002. The Transition from NWCPC to NWHSA is still in progress.

Eight (8) Regional Water Services Boards (WSBs): The 8 WSBs were established under the Water Act, 2002 to manage water and sewerage service provision in their respective areas of jurisdiction. The eight Water Services Boards are: Tana, Athi, Tanathi, Lake Victoria South, Lake Victoria North, Rift Valley, Coast and Northern Water Services Boards. The Water Services Boards will be transformed to Water Works Development Agencies in line with Water Act, 2016, once the ongoing studies have been finalised and public consultation undertaken as per the Act.

Kenya Water Institute (KEWI): KEWI was transformed into a semi-autonomous institution in July 2002 through the Kenya Water Institute Act, 2001. KEWI provides training, research and consultancy services in the water and irrigation sector.

Regional Centre on Ground Water Resources Education, Training and Research (Legal Notice No.252 of 18th December, 2015. The institution works to build knowledge and information on ground water potential. The institution also undertakes training and research on ground water resources.

South Sudan

Institutional framework in South Sudan National States Ministry of Water Resources and Irrigation (MWRI) in charge of managing water resources and trans-boundary water issues. This includes water policies, legislations and strategies, planning and designing of water projects, it is concerned with water-trans-boundary issues and the regional and international surface and groundwater cooperation coordination and management

- States Ministries of Water Resources in charge of development of water resources and water utlisation, including states water supply;
- Urban and Rural Water Supply and Sanitation Authorities: Responsible for provision of drinking water supply and sanitation services, WASH programme works under these Authorities;
- Universities are responsible for water Knowledge and research;
- Private Sector is responsible for consultancy and contracts on water such as water well drilling and completion, constructions of dams, irrigation canals, rehabilitation and maintenance of water structures, constructions of water harvesting structures; and
- Other actors are UN organisations such UNICEF, UNE, UNDP and regional and non-governmental organisations

Sudan

Institutions responsible for water include the Ministry of Water Resources, Irrigation and Electricity. The water bodies as described below are responsible for surface and groundwater assessment, development and management, they are satisfactorily equipped with instruments for field studies, laboratories, computers and analysis techniques and also with water experts and staff to conduct their responsibilities.

State Water Corporations (15) are responsible for rural and urban water supplies in states (drinking water), they use surface and ground water resources to supply their clients. Others include Meteorological Corporation, responsible for rain and climate forecasting and institutes which are concerned with hydro- power generation, construction of dams and water harvesting structures and also for the implementation with drilling of water wells to supply drinking water through the water supply projects.

The private sector is actively participating in the drilling and construction of dams, reservoirs, water canals, water stations, wells, the storages and the water networks. The Universities and the research institutions are considered the main source providing the required knowledge and staff required for the conduction and progress in the groundwater industry. Research and studies and applied research conducted by the Universities and Research institutions are essential for water development and management in the country.

Regional and global organisations active in water and also resources including the trans-boundary are UNICEF, UNEP, WMO, IAEA, Nile Basin Imitative (NBI,), Joint Nubian Aquifer Committee UNDP, WB FAO, ACSAD, IGAD, AMCOW and Arab Water Association. The water institutional setup in Sudan is:

- The Ministry of Water Resources, Irrigation and Electricity (MWRIE) is responsible of the assessment, development and management of water resources in the country;
- The Technical Organ of Water Resources Responsible for water policies, legislations and strategies, this is body concerned with water-trans-boundary issues and the regional and international surface and groundwater cooperation coordination and management;
- The States Ministries responsible for water and Irrigation;
- State Water Corporations is responsible for state rural and urban drinking water supply provision;
- Universities and Research institutes: responsible for water Knowledge and research;
- Private Sector: Responsible for consultancy and contracts on water such water well drilling and completion, constructions of dams, irrigation canals, rehabilitation and maintenance of water structures, constructions of water harvesting structures; and
- Other actors are ministry of Agriculture and Forestry at federal and state level, Ministry of Investments, Geological Survey, Ministry of Environment, Ministry of Oil and Mining, Etc.

Somalia

In pre-conflict Somalia, all water resources were regulated and managed by the public sector although inadequately operated due to limited financial capacity in the sector. Currently most of the water infrastructure is dilapidated and poorly maintained. The lack of proper water governance and the limited funding has resulted in inadequate services and poor access. Most of the existing institutions are operational in the urban areas with private sector providing the services and the government authorities providing limited regulation.

The rural areas are generally underserved mainly as a result of the security challenges and the intermittent communal conflicts to control scarce water resources. Humanitarian agencies, NGO's and the donor agencies are in the forefront in scaling up water access in the rural areas.

Table 6.9: Water Institutional Framework in Somalia

INSTITUTION	RESPONSIBILITY
The Ministry of Mineral and Water Resources	Overseeing management of water resources
The Ministry of Water and Mineral Resources, Somaliland	Somaliland ministry overseeing management of water resources.
Consortium of Somaliland NGOs, Somaliland	NGO coordination in Somaliland.
The Ministry of Local Government and Rural Development	Puntland ministry overseeing rural development.
Mumin Global Service Company	Operates water system serving section of Baidoa.
Golden Utilities Management Company	Operates the Bossaso Water System
Farjanno Water Company	Operates the Jowhar water System

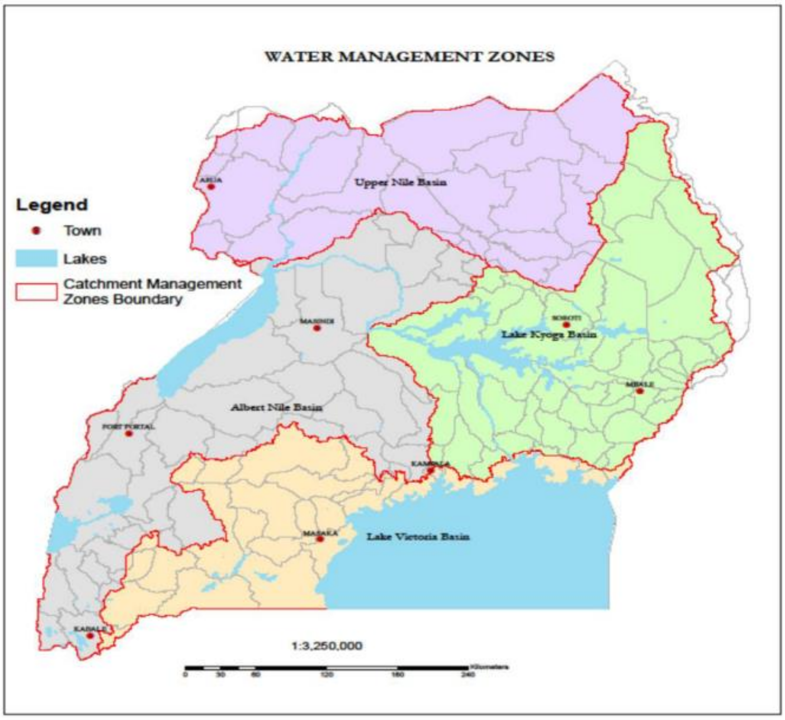
Uganda

The Ministry of Water Resources and Environment is responsible for the entire water issues in Uganda including the trans-boundary water development and management. Under this institutional frame work, the Directorate of Water Development (DWD) and the Directorate of Water Resources Management (DWRM) under the Ministry of Water and Environment are mandated to respect develop & manage water resources in the country.

The DWD is responsible for water development and water service regulation in urban and rural areas. DWRM is responsible for Implementing National water laws, policies, plans and regulations, monitoring water quality and quantity and management of trans-boundary water resources. Since 2012 DWRM is implementing catchment-based water resources Management within the four regional water management zones in the country.

- Victoria Water Management Zone;
- Kyoga Water Management Zone;
- Albert Water Management Zone; and
- Upper Nile Water Management Zone

Figure 0-4: Water management zones in Uganda



The Nile Basin Initiative (NBI) is a regional intergovernmental Partnership among 10 countries namely Egypt, Sudan, South Sudan, Ethiopia, Kenya, Uganda, DR.Congo, Rwanda, Burundi and Tanzania. The objective of the NBI is 'To achieve sustainable socio-economic development through equitable utilisation of, and benefit from, the common Nile Basin Water resources. TheCooperative Framework Agreement (CFA**) is** aimed at establishing a permanent institutional mechanism to promote and facilitate cooperation among the Nile Basin States in the conservation, management and development of the Nile River Basin and its waters:

Council of Ministers - Nile-COM

Technical Advisory Committee - Nile-TAC

NBI Secretariat - Nile-SEC

ENTRO - Eastern Nile Region (Egypt, Ethiopia and South Sudan)

NELSAP - Nile Equatorial Lakes region (Tanzania, Kenya, Uganda, Rwanda, Burundi, DR Congo and South Sudan)

NBI Core Functions

- Facilitating Basin Cooperation (Nile-SEC): to facilitate dialogue, support and nurture cooperation amongst the Nile Basin countries so as to promote timely and efficient joint actions. It focuses on providing and nurturing the Platform for Cooperation; Strengthening Member States Capacity; Strategic Planning as well as Strategic Communication and Media engagement.
- Water Resources Management (Nile-SEC): The overall Goal is to strengthen cooperative water resources management in the Nile Basin. Key activities under this core function include:
- Water Resources Analyses, Knowledge Services, Water Resources Assessment, Trans-boundary Policies and Program Technical Support (core).
- Capacity development
- Water Resources Development (Led by ENTRO and NELSAP): focuses on promoting multi-country investments with the primary objective of developing the Nile Basin water resources in an equitable, efficient and sustainable manner to reduce poverty, promote economic growth and integration among countries, increase resilience to climate and water related disasters and reverse environmental degradation.

NBI Strategy - To achieve the Shared Vision Objective, NBI prepared a 10-year strategy 2017-2027. The 10-year strategy identifies six strategic priorities

- Goal 1: Water Security,
- Goal 2: Energy Security,
- Goal 3: Food Security,
- Goal 4: Environmental Sustainability,
- Goal 5: Climate Change adaptation,
- Goal 6: Strengthening Transboundary Water Governance.

Section 6.5 Framework for Water Demand Management

A strong institutional and legislative framework at all levels of transboundary water resources management is key to successful implementation of integrated water resources management and can help to promote political and economic cooperation between riparian states, transparency and create trust. It is also clearly demonstrated that the role of the river basin organisations is crucial to ensure the proper design, planning, management and development of transboundary water resources. However, cooperation on transboundary water management is a long process that needs strong political commitment and should include the collection of reliable data and monitoring

Although the existing trans-boundary water basins is often seen as a source of conflict and tension between and among riparian countries, in reality the development of trans-boundary water basins can also serve as a unique vehicle for promoting sub-regional and regional co-operation and thus promote peace, harmony and social and political stability across the region. - Transboundary water management is a great opportunity to promote and implement the great objectives and ideals of regional initiatives like the NEPAD or the Millennium challenge account.

Policies, strategies, and objectives of cooperation and how to achieve them shall be set out in the proposed IGAD Regional Water Resources Protocol (legal instruments) to be signed by the riparian Member States of IGAD to the agreement. This will include agreements on (a) the Status of the water resources, (b) exchange and sharing of information and data, (c) investment policies, (d) establishment of transboundary organisation(s) for water resources development and management, (e) service providers and IWRM, (f) regulations for water quality, (g) regulations for water quantity, and (h) regulations on environmental standards. The success of the proposed institutional framework will depend upon the Member States' enactment of legislative and policy changes, approval and refining the frameworks, provision of political support, involvement of stakeholders, and guiding the provision of support by development partners.

Table 0-10: Framework for Water management in IGAD region

Framework	Instrument	Status and Impact to date
IGAD Regional Water Protocol	Regional Legal on framework on water resources	Yet to be finalised
IGAD Policy and Protocol on Water Related Data sharing and Exchange	Regional Policy and legal framework on data sharing	Not yet implemented
2012: IGAD Water Programme (INWRMP)	Regional water Programme	Many IGAD region citizens capacity built on water issues
Regional Water Resources Policy	Endorsed by water ministers of member states 21 January 2015	Not yet implemented
River basin / aquifer agreements	None binding Agreement among IGAD member states	Not yet completed
Nile Basin Initiative Cooperative Framework Agreement (CFA)	Framework agreement	Signed by six countries and ratified by 4 countries that aim at establishing River Nile basin Commission (NBC) Ratification yet to be completed
Memorandum of understanding (MoU) between Kenya and Uganda on Sio-Malaba-Malakisi (SMM)	Bilateral MoU for the integrated management of the SMM river basin	Implementation is ongoing
Transboundary Water Policy (Kenyan)	Policy providing for the cooperative and joint approach in the management of transboundary waters	It is at the cabinet level for approval before it goes to parliament
Legal framework for the implementation of transboundary water policy (Kenyan)	Legal framework for the implementation of transboundary water policy	Yet to be completed

The policies and legal frameworks for the IGAD countries are given below:

Djibouti:

The government of Djibouti is aware of the critical water situation and has placed water and sanitation sector policy development and implementation among its priorities. This has translated into important institutional reforms such as the Water Code publication (1996), the establishment of a unified Water Directorate (1999), and a ministries coordination body. The National Water Master Plan (SNDE), prepared and approved in 2000, is currently being updated.

With the adoption in 2006 of a national integrated water and sanitation policy, centered on the creation of a sole operator — ONEAD — the government of Djibouti addressed the main constraints to the sector development. In order to solidify progress and achieve reform, economic growth and poverty reduction, the government of Djibouti has developed a (US$341m.) programme for economic and social development for the period 2006–2010. This programme will translate the priorities Identified in the Le Cadre Stratégique de Lutte contre la Pauvreté (CSLP — equivalent to Poverty Reduction Strategy Paper (PRSP)) into sector projects. Water supply and sanitation are the first priority with a funding allocation of US$151.4m.

In 2007 the Government of Djibouti (in the form of ONEAD) began to implement the Water Supply Master Plan to address weaknesses in the city's water supply, and to boost its supply capacity through to 2030. As part of the Master Plan, studies were conducted of all aspects of the city water supply, including a comprehensive assessment of the production, storage and distribution facilities, as well as an inventory of water sources and the building of new facilities to ensure that supply will meet projected demands.

In the case of the rural water supply, Government of Djibouti water policy has given priority to thirst reduction. Both National Water Master Plan (SNDE) and the rural water action plan, prepared by the Ministry of Agriculture, Livestock Production, and Marine Affairs-Water Resources (MAEM-RH) and the technical water secretariat, give a high priority to proper management and development of water facilities, to satisfy — in order of priority — (i) domestic needs — especially drinking water, (ii) livestock needs, and (iii) other agricultural needs (such as irrigation). In addition, the Master Plan followed up on previously implemented institutional reforms.

Eritrea

The Ministry of Land, Water and Environment (MoLWE), through its Water department is responsible for the Establishment of the water policy, strategies and legislations necessary for the development and management of the water sector and the water resources.

The Government issued a proclamation on water resources management in 2010 with the aim of enhancing and promoting all national efforts towards establishing and maximizing the available potential of the national water resources of Eritrea in an integrated and sustainable manner to secure and provide water of adequate quantity and quality for all social and economic needs and ecosystem stability with the full participation of all stakeholders. The Government has also prepared Integrated Water Resources Management Plan by involving all key national and regional stakeholders.

The action plans that can strengthen the active involvement of the country in trans-boundary water issues are outlined in the AP-IWRM. These actions target to strengthen the regional networking, improve knowledge on international conventions, treaties and improving collaborative IWRM by incorporating interests of transnational stakeholders. In respect of this, the WRD has committed itself to develop the human and institutional capacity particularly on the newly established Trans-boundary Water Unit. This unit is entrusted to conduct a comprehensive study on regional, bilateral and international agreements, treaties, conventions and negotiations on trans-boundary water issues.

In Eritrea decisions on water allocation, particularly the siting of the water resources development sites have been made by non-water management bodies because of the absence of legal and regulatory frameworks. The proclamation of 2010 is yet to be fully implemented. In addition, Researches of the water resource department show that the utmost fear facing Eretria is that of unregulated drilling and digging of water wells especially for irrigation purposes in areas such as Ala and Hagaz. Overexploitation of underground water for different purposes combined with recurrent drought led to a fall in water tables and in some coastal areas intrusion of sea water. Subsidies that discourage the efficient use of water, for example, none or too little pricing of water, are common in the agricultural sector. Therefore, this calls for a need to introduce an appropriate legal and regulatory framework, improving the knowledge level of the resources, the existing and projected demand and strengthen the capacity of water management institutions.

Ethiopia

The basic water related policy document in Ethiopia is the Ethiopian Water Resources Management Policy issued by the Ministry of Water Resources in July 2000. This document sets out management policy on water resources in general and those that relate to water supply and sewerage, irrigation, and hydropower. It also describes policy on various crosscutting issues, including those dealing with groundwater resources, watershed management, water-rights allocation, trans-boundary concerns, and technology, among others.

The overall goal of Water Resources Policy is to enhance and promote all national efforts towards the efficient, equitable and optimum utilisation of the available Water Resources of Ethiopia for significant socioeconomic development on sustainable basis. The policy focus in improving the causes of adverse impacts among which the following stand out as significant: -

- The lack of a sustainable and reliable water resources management strategy.
- Lack of efficient utilisation of water resources.
- Prevalence of unrealistic and unattainable plans and programs
- Non-objective oriented programs and projects.
- Uncertainties and ambiguities in planning
- Prevalence of intensive centralism of management that does not focus on rural development.
- Lack of institutional sustainability
- Lack of operation and maintenance activities of water schemes.
- Adhoc development practices lacking coherent objectives and continuity

Proclamation No. 197/2000 declares that “All water resources of the country are the common property of the Ethiopian people and the State.” It gives Ministry of Water Resources (MoWR) the authority to allocate and apportion water to all regions regardless of the origin and location of the resource. The proclamation lists a wide range of regulatory tasks among MoWR powers and duties

The water sector is identified as one of the three sectors that will be supported during the current Country Strategy for Development Cooperation with Ethiopia (2013-2016).

There is strong national water supply and sanitation policies and key agencies have clear roles and strategies. National policies are set by the Ministry of Water and Energy (MWE), formerly the Ministry of Water Resources (MWR), for water supply, and by the Ministry of Health for sanitation. In 2006 the government adopted a Universal Access Plan (UAP) to achieve 98% access for rural water supply and 100% access for urban water supply and sanitation by 2012.

Kenya:

National Policy on Water Resource Management, and Development, is the principal policy framework for Kenya’s water sector reform process. The National Water Policy sets out four policy objectives:1)to preserve, conserve and protect available water resources and allocate it in a sustainable, rational, and economic way; 2)to supply good quality water in sufficient quantities to meet the various water needs, including poverty alleviation, while ensuring safe wastewater disposal and environmental protection;3)to establish an efficient and effective institutional framework to achieve a systematic development and management of the water sector; and 4)to develop a sound and sustainable system for effective water resources management, water supply, and sanitation development. The policy's implementation measures have implications for groundwater management as it relates to: a) identifying the availability and vulnerability of groundwater resources; b) developing the institutional, capacity, and financing arrangements for groundwater management; c) supporting integrated water resources management; and d) considerations for groundwater quality management.

Although the National Water for the Mara River Basin between Kenya and Tanzania (including the establishment of a trans-boundary water resources users association) and for the Sio-Malaba-Malakisi River Basin Policy recognises that Kenya has shared water resources, no specific proposals for the management of shared groundwater resources are included in the policy objectives. In 2009, the Ministry formulated a draft policy paper on shared water resources (MoWI 2009d) that did not give particular prominence to shared groundwater resources. Currently, there are efforts to develop cooperative frameworks between Kenya and Uganda. In both these cases, the catchment area has been defined on the basis of surface water catchment areas, and not on the basis of groundwater basins. There are no arrangements under way to develop a cooperative framework for the management of shared groundwater resources, such as the Merti, which is shared with Somalia.

As this review of policies and laws shows, the Water Act and the Water Resources Management provides guidelines together with other sectoral laws, such as the Physical Planning Act, include specific groundwater provisions. Notwithstanding that the common law has dealt with groundwater as a private resource. On the contrary, the Water Act has dealt with it as a public resource vested in the state and subject to control by the minister, as is the case with surface water. Legislation specifically regulates the construction of wells and boreholes. There are rules regulating wastewater discharges insofar as it affects groundwater and groundwater pollution.

These provisions form a sound basis for managing groundwater resources. However, the key weakness is that GCAs have not been designated anywhere in the country (except for NAS, which dates from before the enactment of the Water Act). There are, however, significant weaknesses in the implementation and enforcement of the legal provisions and guidelines. In a number of cases, the guidelines duplicate each other, particularly those made under the Water Act and the ones made under the Environmental Management and Coordination Act. The implementing agencies lack the institutional capacity to discharge their statutory mandate adequately. Furthermore, the priority given to groundwater, in contrast to that given to surface water, has been low. At the same time, there are limited inter-sectoral coordination mechanisms. This limits opportunities for cooperation, coordination and information sharing between the various implementing agencies.

In summary, Kenya's policy framework recognises groundwater as an important land-based resource. However, the treatment of groundwater in policy statements is cursory. Groundwater is dealt with under the general umbrella of water resources, and its significance is muted. No specific policy statements are made that would facilitate the sustainable use and management of groundwater resources. These shortcomings are reflected in the priority given to groundwater in the actual management of land-based resources, where surface water has a far higher profile.

South Sudan:

Policy and legal framework in South Sudan

- Ministry of Water Resources and Irrigation (MWRI) in charge of developing and applying policies, stratigies and legisilations of water resources

- Water Policy 2007: Formulated by MWRI, it outlines South Sudan vision for equitable and sustainable future utilistion of Surface and Groundwater resources and adoption and application of IWRM.
- WASH strategic framework 2011: Sustainable harnessing and management of water resources in response to public-health issues and livelihood
- Draft Water Bill: Regulatory provisions; Issuing permits; guides Water Basin boards in pricing for abstraction, effluent discharge and environmental services

The policy water resources of South Sudan builds on a number of basic principles including: recognition that water has social, economic and ecological value in all its competing uses; integration of decision making processes relating to water resources management on the basis of hydrological boundaries; separation of institutional roles relating to water resources management from those relating to resource development and service delivery; decentralisation of responsibility to the lowest appropriate administrative level; and participation of water users in decision –making processes surrounding planning, development and management of Water resources ,delivery of water and provision of sanitation services on equitable and sustainable basis. The policy document addresses specific issues in relation to three main sub-areas of water policy, i.e. Water Resources Management (WRM), Rural Water Supply and Sanitation (RWSS), and Urban Water Supply and Sanitation (UWSS) and establishes guiding principles and objectives in relation to each.

As such it represents an important first step towards the establishment of a comprehensive regulatory framework for rational management and utilisation of water resources in Southern Sudan; and provides a foundation for future development of more detailed strategies, setting out the institutional, administrative, technical and financial arrangements for policy implementation.

The GOSS recognises the scale of the challenge ahead, because effective management and use of water resources requires: Significant investment of financial and human resources; in addition to sensitisation of the population on the importance of water, including equipping them with the necessary knowledge and skills to manage it properly. Intensive efforts are required to build capacities in different areas such as water resource assessment and monitoring, research and development of appropriate technologies, disaster management, environmental protection and trans-boundary co-operation.

Water issues affect each and every one and the development of this policy ensured extensive consultation among a wide range of stakeholders at different levels of government including those from other sectors, as well as private businesses, nongovernmental actors and community groups. However, conclusion of a policy document is just a beginning; and the next step is to develop detailed Strategies and Acts to enable implementation of this Policy. Successful implementation will depend on continued collaboration among different arms of government; coordination between government and non-governmental partners; and active involvement of communities/beneficiaries.

Sudan

The national water resources policy encourages the assessment, development and the management of the surface water and groundwater including the trans-boundary as a major water resource to be utilised for the secio-economic development of the country. The policy addresses issues of wise use, water conservation, trans-boundary Rivers and aquifers, water pollution, and the water information management and exchange, the introduction of the integrated approach in water management especially in ground and surface water relations and interactions. For water utilisation and water supply and sanitation strategy and policy (2012 -2018) are formulated, updated and now ready for endorsement. They addresses issues regarding water utilisation for use in drinking purposes.

The Integrated Water Resources Management (IWRM) policy and strategy are in process and they consider water as major factor for the integrated natural resources management. To apply the IWRM approach the government with assistance from UNEP, UNICEF, UNESCO-Chair of water, JICA and the academia and research institutes are applying several projects that apply the IWRM approach including some groundwater basins in Darfur, Gash basin, Bara basin and others.

The Water Resources Act 1995 covers the required legal issues required for water. Also, regulations such as the Groundwater Abstraction Regulations 2017, the Surface water Abstraction 2017 and the Irrigation and Drainage Water regulations,2017 is established and applied to control the groundwater development and management. The water allocations, permits licensing system for abstraction, construction and use is applied to regulate and organise the water abstraction and use for all beneficiaries' especially for big agricultural schemes and water supply fields to ensure equity, regulate completion avoid conflicts also to avoid water mis-use, groundwater mining and water pollution.

Somalia Somalia's policy and legal framework for the water sector is limited. Somalia has a water policy, national water strategy and water Act 2004. Generally South-Central Somalia has no effective institutional or oversight authority. Policy and regulation on water is limited. The Programme of Action for climate change adaptation which was crafted in 2015 proposed the development of policy and institutional framework for the water sector in Somalia. This is awaiting funding by the donor community.

Uganda The two key pieces of legislation governing water management in Uganda are; The Water Act, Cap 152, and The Environment Act. Others are; The Water Policy. The main regulations under The Water Act are: **(a)**Water Resources Regulations (1998) **and (b) ,**Waste Discharge Regulations (1998)**.** The main regulations under The Environment Act are: **(a)** Environmental Impact Assessment Regulations (1998), (b) The National Environment (Standards for Discharge of Effluent into Water or on Land) Regulations (1999) and **(c) ,**The National Environment (Waste Management) Regulation (1999).

Other Frameworks

The Nile Basin Cooperative Framework Agreements has been signed by six member countries that include Kenya, Ethiopia, Tanzania, Rwanda, Uganda and Burundi. Sudan, Egypt and Democratic Republic of Congo have not. Four out of the six countries that have signed, have also ratified it. It is worth noting here that six IGAD member countries that include Kenya, Uganda, Ethiopia, Sudan, South Sudan and Eretria are members of the Nile Basin Initiative and therefore bound by the provisions of the Nile Basin Cooperative framework Agreement.

This framework deals with the rights and obligations arising from the principle of equitable and reasonable utilisation and lists the factors that would be used in determining the equitable and reasonable entitlement. This framework came into being through negotiations from June 2005. The Nile River Basin Negotiation Committee was established by the Nile Council of Minister. The negotiation Committee negotiated all the 39 articles presented in the Nile River Basin Cooperative Framework Agreement.

The detailed outcomes of the negotiations lays emphasis on the importance of the Nile river to the economic and social well-being of the peoples of the states of the Nile River Basin; desire to strengthen co-operation in relation to the Nile River, a great and vital resources that binds the nations of the Nile together; realisation that the Nile River, its natural resources and environment are assets of immense value to all the riparian countries; a framework agreement is necessary to govern the member states relationship in regard to the Nile River Basin in order to promote integrated management, sustainable development and harmonious utilisation of the water resources of the Nile river basin; mutual interest to establish an organisation to assist the member states in the management and sustainable development of the Nile River Basin for the benefit of all; and the existence of the global initiatives for promoting co-operation on integrated management and sustainable development of water resources.

Description of Progress and Challenges

Capacity building is a continuous process reflecting the need of the society to respond to new ideas and technologies and changing social and political realities. The inadequate institutional capacities in the water sector in some of the IGAD countries, for joint development and management of shared water resources, is imposing severe limitation to water resources development and management. The proposed capacity building strategic plans for water resources development and management will help the member states of IGAD to redefine their capacity building strategies, detailed programs, and required funding.

The strategic plan must cover a sufficiently long period of implementation to deliver meaningful benefits. It will be designed as a medium-term action plan, broken down into annual action agendas and investment and recurrent budgets. Sometimes in a regional set up like IGAD where there are seven (7) countries and six (6) shared river basin resources among them in the Sub-Region, the riparian countries of one or more river basins could decide to strike cooperative arrangements while others might not have the desire to cooperate. Under such circumstances, contingency plans of preparing separate institutional arrangements for the riparian countries of different shared river basins are in order.

Section 6.6 IGAD Water Demand Analysis and Forecasting

Background

The IGAD sub-region represents one of the marginal regions of the world in terms of available rainfall. About 80% of the IGAD sub-region is arid and semi-arid with low levels of water use. IGAD has a population estimated at **286 million in 2019** and projected to reach 545 **million in 2050** in an area of **5.2 million km2**. The populations derive their livelihoods from water and land based primary production activities such as nomadic pastoralism and subsistence agriculture in a region where rainfall variability is high.

Agricultural investments projects are highly expanding in the region especially in Sudan, Ethiopia and South Sudan, due to the great need for attaining food security for the region. The sub-region is the home of the greatest numbers of pastoral communities estimated to be about **17 million in 2010**. Dependable water availability is therefore vital to the development of the region. The mounting concerns over water scarcity in the IGAD sub-region have focused into several socioeconomic challenges of water resource management.

Firstly, as the sub-region expects to advance economically and socially, the demand for water will increase as a result of population growth, rising incomes, changing dietary patterns, urbanisation, agricultural and industrial development. While demand will increase in all sectors, agriculture will account for the bulk of the water (food security) and will therefore be the most important point for the adjustment of demand pressure. In Sudan, the water consumed by agriculture, accounts for more than 90% of rivers water withdrawal and 67% of the groundwater withdrawal.

Secondly, is the IGAD sub-region have enough water to meet the food security needs of a rapidly growing population. Along with food security, water security has also become a fundamental issue for human development in the sub-region

Although the water is the vital input for any development in the IGAD sub-region, none of the **member countries has adequate information** to manage their water resources for the attainment of economic efficiency and equity in water allocation for different uses. Yet, four IGAD countries namely **Eritrea, Kenya, Djibouti and Somalia** are in the category of those experiencing water scarcity i.e. with **less than 1000 m3 per person per year** or less.

Estimations show by the year 2025 even Ethiopia ,South Sudan and Uganda which are presently with adequate water will be water stressed (1000-2000 m^3/person/year) while Djibouti, Eritrea, Kenya, Somalia and Sudan will be in water barrier situation «500-900 m^3/person/year » and therefore water will be limiting any sustainable development.

None of the IGAD Member States has at the present time water per capita necessary for industrial development (2400 m^3/day). This lack of water will severely constrain food production, ecosystem maintenance and economic development among other needs and uses.

Water resources link the IGAD Member states internally and externally with adjacent regions. Six transboundary river basins and fourteen (14) trans-boundary aquifer systems have been identified in this stage in IGAD sub-region. **The ratio of water demands to available supply averages which is 9% in 2011 will increase to 15% in 2031** as projected by previous study which is known as "*Mapping, Assessment and Management of transboundary Water Resources in the IGAD Sub-region Project*". Therefore, there is need for adequate knowledge of surface and ground water available and future resources and the existing and the projected water demands for short (2019-2024), medium (2025-2030) and long (2031-2050) periods

The most significant of the drivers of water demand in all sectors is population, which in the sub-region is projected to increase by 165% between 2010 and 2030, and by 136% between 2030 and 2050. The previous study demonstrates that these increases will create significant increases in water withdrawals for domestic supply and for industry. The other significant sector is agriculture, which combines irrigation and livestock, where population is also the most important parameter of change, driving the demand for food and hence the need to raise agricultural productivity through irrigation development.

The regional assessment has highlighted a reported **low level of water use** and hence of water security currently estimated as about 3- 40 % of the annually renewable water resources as a basic indicator of the overall lack of water infrastructure development to ensure water security for the social and economy and environmental use. The IGAD region is one of the most vulnerable areas to climate variability, recurrent droughts and climate change.

The previous study "implemented by the Sahara and Sahel Observatory (SSO), has highlighted some basic understandings ,such as the environmental situation and consolidate IGAD capacities to monitor the linkages between climate and the water system along with identification and mapping of the water resources and the major risks associated with degradation, pollution and water quality deterioration. There is need to further understand in depth the present and future water resources, the present and projected water demands for all users, infrastructures, Policies, strategies, and objectives of cooperation and how to achieve them should be should be also understood to assist in establishing the IGAD-IRIMP. More specifically there is an urgent need to understand

- The socioeconomic condition of the region with specific regard to factors that drive the pressures on water resources; and
- The demand and uses of water for various socioeconomic purposes, including a preliminary quantified assessment of water use for domestic supply, industry, and agriculture.

The countries of the IGAD Region are facing some serious water shortages, which raises the threat of looming water insecurity and the prospect of increased competition for water in the future. The main challenge for the region is how the water resources will be managed to meet rising food demand while at the same time protecting access of the poor and vulnerable people to the water that sustains their well-being.

In meeting this challenge the two-way causal relationship between water resources (supply and demand) on the one hand, and the processes of socioeconomic development on the other must be fully understood. This understanding forms the basis of the demand management strategy that will be an important aspect of the component of IRIMP.

Water Demand Analysis

To estimate the projected water demand of the IGAD sub-region the following major assumptions are used (a) Time periods for analysis: short term to 2024; medium term to 2030; long term to 2050 (b) Population assumptions are based on UN World Population Prospects 2017 as given in chapter three. Three forecasting scenarios using different GDP growth rates to 2030, but same conservative growth rate for all countries and scenarios used for 2030-2050 (4.5%):

- **Target GDP growth scenario**: IGAD economies grow at the target rates specified in NDPs[70];
- **IMF forecast GDP growth scenario**: IGAD economies grow at the rates forecast by the IMF[71];
- **IGAD RIMP GDP growth scenario**: IGAD economies grow at rates based on those given in Chapter Three

Domestic water supply:

Domestic water supply may therefore be divided into two elements: (i) the basic requirement to sustain life and health; and (ii) the additional requirement for sustaining livelihoods (including poverty reduction) and improving the quality of life. Thus, water is not only a source of life but it is also an economic resource that is subject to scarcity and therefore to demand management. Domestic demand for water is determined by several factors which include household size, family income, water-using technology (e.g. appliances), lifestyles, consumption patterns, and water prices, amongst others. These factors are important in assessing current and future water demands.

Water withdrawals for domestic supply are given a very high priority by all the countries in the IGAD region. According to available evidence, the quantity of water used by a household is primarily dependent on access as determined by distance and/or time for collection. The WHO/UNICEF considers reasonable access to domestic water supply as being the “availability of at least 20 litres per person per day (annual per capita of 7.3 m3) from a source within one kilometre from the user’s dwelling.” Accessibility is, however, a function of service levels which are categorised below. This categorisation is useful for evaluation of current and future withdrawals.

The different levels of access may be interpreted in terms of household water security: the no access level corresponds to no water security; the basic access level to basic household water security; the intermediate access level to effective water security; and the optimal level to optimal water security, with quantity, quality and continuity of supply all likely to be adequate for domestic water needs (table 6-10).

[70] Where member states have not set target growth rates we have used an optimistic estimate based on recent trends
[71] Using data from the IMF World Economic Outlook dataset

Table 0-9: Showing different level of Domestic water supply access

Service level	Access measure	Needs met	Level of health concern
No access: (quantity collected often below (l/c/d)	More than 1000 m or 30 minutes total collection time	No water security Consumption – cannot be assured Hygiene – not possible (unless practiced at source)	Very high
Basic access: (average quantity unlikely to exceed 20 l/c/d - the minimum quantity required to sustain health)	Between 100 and 1000 m or 5 to 30 minutes total collection time	Basic household water security Consumption – should be assured Hygiene – hand washing and basic food hygiene possible; laundry/ bathing difficult to assure unless carried out at source	High
Intermediate access: (average quantity about 50 l/c/d – the basic requirement)	Water delivered through one tap on plot (or within 100m or 5 minutes total collection time	Effective water security Consumption – assured Hygiene – all basic personal and food hygiene assured; laundry and bathing should also be assured	Low
Optimal access: (average quantity 100 l/c/d and Above – optimal requirement)	Water supplied through multiple taps continuously	Optimal water security Consumption – all needs met Hygiene – all needs should be met	Very low

Present Water withdrawals for domestic supply:

Current water withdrawals for domestic supply in the region are estimated at about 2.29 billion m^3 (2.29 km^3), constituting about 4.5% of the total withdrawals. Across the IGAD region, the average annual per capita water withdrawal for domestic supply is about 11.1 m3 which is equivalent to 30 litres per capita per day. There are, however, wide variations between countries:

- Two countries – Djibouti (21.1 m^3) and Sudan (27.8 m^3) – have annual per capita withdrawals that are or about twice the regional average. These are, respectively, equivalent to about 58 litres and 76 litres per person per day and above the intermediate access level.
- In Kenya (10.6 m^3) and Uganda (10.4 m^3) annual per capita withdrawals are close to the regional average and above the basic access level of 7.3 m3, but still far below the intermediate access level of 18.3 m^3.
- Three countries – Eritrea (6.4 m^3), Ethiopia (4.2 m^3) and Somalia (3.5 m^3) – have annual per capita withdrawals that are well below the average for the region. These countries are almost on the border line between no or very low access on the one hand, and basic access on the other.

Projections of domestic water demand

Projections of domestic water withdrawals for the short term (2019-2024), medium term (2025-2030) and the long term (2031-2050) were made based on certain rules-of-thumb assumptions as follows:

- The population growth rate developed for IGAD –RIMP population assumptions which is based on UN World Population Prospects 2017 as mentioned above.
- The differentiation between the urban and rural domestic water needs .this is natural and logic where the mode of water services differs(for example in towns water served on house taps while in villages it is provided on wells, hand pumps, water yards or stand pipes) and the mode of life differs.
- The adopted and used water per person per day rate is that of the WHO/UNICEF accepted rate (80 liter/c/d for urban and 20 liter/c/d for rural water needs.

The domestic water supply demand for the urban and rural areas is projected and estimated in the IGAD states for the short term(2024), medium term(2030) and long term(2050). As population being the major water demand driver, the lowest population recorded for the year 2019 is in Djibouti and Eretria is 986 thousands and 5,310 thousands respectively. The medium population is in Kenya, Uganda and Sudan (52,213 ,45,712 and 42,514 thousands). Ethiopia being the highest with population reaches 110,136 thousands. The population of each states is increased by the years 2024, 2030 and 2050 as shown in the tables, and hence the domestic water demand increases for both urban and rural uses.

The total IGAD population is 285 million in the year 2019, increases in the short-term(2024) to become 323 million(81 urban,242 million rural) , and ,the domestic water needs rises by 13 % from 3.65 km^3 in 2019 to reach 4.14 km^3(2.4 km^3 urban, 1.74 km^3 rural) in 2024.

In the mid-term(2030) the population of IGAD increases to reach 372 million(93 urban,279 million rural) , and ,the domestic water needs rises by 30 % from 3.65 km^3 in 2019 to reach 4.741 km^3(2.702 km^3 urban, 2.039 km^3 rural) in 2030.

In the long-term(2050) the population of IGAD increases to reach 545 million(136 urban,409 million rural) , and ,the domestic water needs rises by 90 % from 3.65 km^3 in 2019 to reach 6.94 km^3(3.96 km^3 urban, 2.99 km^3 rural) in 2050.

To consider water system losses we assume improve from current losses (30%) to be 25% in 2019 and the short-term to be improved in the mid-term and long-term to 20% and 15% respectively. The total domestic water supply is then estimated for each country (table 6-11).

The IGAD total domestic water demand including the water system losses (25%), increases in the short-term (2024) rises by 14 % from 4.558 km^3 in 2019 to reach 5.174 km^3 in 2024. In the mid-term (2030), the domestic water needs including water systems losses rises by 25 % from 4.558 km^3 in 2019 to reach 5.69 km^3 in 2030. In the long-term (2050), the domestic water needs rises by 75 % from 4.558 km^3 in 2019 to reach 7.99 km^3 in 2050.

Table 0-10: Domestic water Supply demand projected to the year 2024 of the IGAD countries

Member State	Pop. 2024	Urban areas 20-24		Rural areas -2024		total-country demand-2024
	Country pop.(tho	Pop(tho)	Demand(Km^{3})	Pop(tho)	Demand(Km^{3})	Demand(Km^{3})
Djibouti	1056	792	0.023	264	0.002	0.025
Eritrea	5929	2,014	0.059	3,915	0.029	0.087
Ethiopia	123428	25,426	0.742	98,002	0.715	1.458
Kenya	58722	16,279	0.475	42,443	0.310	0.785
Somalia	18128	7,614	0.222	10,514	0.077	0.299
South Sudan	15032	2,999	0.088	12,033	0.088	0.175
Sudan	47872	16,879	0.493	30,993	0.226	0.719
Uganda	53436	9,150	0.267	44,286	0.323	0.590
Total	323603	81,153	2.370	242,450	1.770	4.140

Table 0-11: Domestic water Supply demand projected to the year 2030 of the IGAD countries.

Member State	Pop. 2030	Urban areas -2030		Rural areas-.2030		total-country demand-2030
	Country pop.(thou	Pop(thou)	Demand(Km^{3})	Pop(thou)	Demand(Km^{3})	Demand(Km^{3})
Djibouti	1056	850	0.025	283.25	0.002	0.027
Eritrea	6,718	2,282	0.067	4,436	0.032	0.099
Ethiopia	139,620	28,762	0.840	110,858	0.809	1.649
Kenya	66,960	17,878	0.522	49,082	0.358	0.880
Somalia	21,535	9,045	0.264	12,490	0.091	0.355
South Sudan	17,254	3,442	0.101	13,812	0.101	0.201
Sudan	54,842	19,337	0.565	35,505	0.259	0.824
Uganda	63,842	10,932	0.319	52,910	0.386	0.705
Total	371,904	92,527	2.702	279,377	2.039	4.741

Table 0-12: Domestic water Supply demand projected to the year 2050 of the IGAD countries.

Member State	Pop. 2050	Urban areas-2050		Rural areas-2050		total-country demand-2050
	Pop. 2050	Urban areas -2050		Rural areas-.2050		total-country demand-2050
	Country pop.(thou	Pop(thou)	Demand(Km$^{3)}$	Pop(thou)	Demand(Km$^{3)}$	Demand(Km$^{3)}$
Djibouti	1,308	981	0.029	327	0.002	0.031
Eritrea	9,607	3,263	0.095	6,344	0.046	0.142
Ethiopia	190,870	39,319	1.148	151,551	1.106	2.254
Kenya	95,467	25,490	0.744	69,977	0.511	1.255
Somalia	35,852	15,058	0.440	20,794	0.152	0.591
South Sudan	25,366	5,056	0.148	20,310	0.148	0.296
Sudan	80,386	28,344	0.828	52,042	0.380	1.208
Uganda	105,698	18,099	0.528	87,599	0.639	1.168
Total	544,554	135,609	3.96	408,945	2.985	6,945

Table 0-13: Domestic water projected demand including water losses

losses	25%	25%	20%	15%
country	Total demand	Total demand	Total demand	Total Demand
	Year-2019	Year-2024	Year-2030	Year-2050
Djibouti	0.0293	0.0313	0.0323	0.0357
Eritrea	0.0979	0.1092	0.1188	0.1628
Ethiopia	1.6230	1.8223	1.9789	2.5926
Kenya	0.8581	0.9815	1.0564	1.4434
Somalia	0.3310	0.3738	0.4263	0.6802
South Sudan	0.1936	0.2193	0.2416	0.3403
Sudan	0.7953	0.8989	0.9886	1.3887
Uganda	0.6299	0.7381	0.8465	1.3432
Total	4.5580	5.1744	5.6895	7.9868

Coverage of domestic water supply

Access and coverage are important targets and are defined in terms of the percentage of the population within reach of an improved water source. Access standards in the IGAD countries vary between 0.2 Km and 0.5 Km in the urban areas and between 1 Km and 1.5 Km in the rural areas. This definition relates primarily to "access" and should not be taken as evidence that 20 litres per capita per day is a recommended quantity for domestic use. Access and coverage are spatial dimensions and therefore the information is subject to (i) changes in the number of watering points and (ii) changes in population size. WHO/UNICEF categorises the following water supply sources for the purpose of monitoring and evaluating progress towards meeting the SDG on clean drinking-water.

Sources of domestic water supply.

Improved drinking water source	Unimproved drinking-water source
Piped water into dwelling, yard or plot	Unprotected dug well
Public tap or standpipe	Unprotected spring
Tube well or borehole	Cart with tank or drum
Protected dug well	Tanker truck
Protected spring	Surface water (river, lake, dam, pond, stream, canal, irrigation channel)
Rainwater collection	Bottled water

An improved drinking-water source is one that by the nature of its construction adequately protects the source from outside contamination, in particular with fecal matter. Improved encompasses three dimensions of water security: proximity, quantity and quality. Technology broadly defines whether the source meets the criteria of being improved.

Issues of inequality and inequity

The urban-rural discrepancies in access to improved drinking-water are particularly striking: While 82% of the urban population has access to improved water sources, only 45% of the rural population has access. The rural population without access to improved sources is over five times that in the urban areas. The rural-urban discrepancies are particularly striking in Uganda, Ethiopia and Djibouti, where the proportion of the population that had access was between 91 -100% in 2008 compared to 50 – 75% in the rural areas. In Kenya it was between 76 -90% in urban areas compared to 50 - 75% in rural areas, while in Sudan, Eritrea and Somalia it was between 50 -75% in urban areas compared to less than 50% in rural areas, except Eritrea which had rural access of between 50 -75%. On the whole, in urban areas the increase in coverage is barely keeping pace with population growth.

Piped water on premises and other improved sources: Only 4% of the rural population has piped water on their premises. In contrast, in urban areas 46% of dwellers use water piped to their households. Between 1990 and 2008, more than 23 million people in the IGAD-region gained access to piped water on premises. This is a 4% increase which, though seemingly modest, is impressive since piped water on premises represents the highest rung of the drinking water ladder where health gains are maximised. However, the growth in the population with access to other improved sources was double the growth in the population with piped connections on premises.

A large segment of the population (42%) still uses unimproved drinking water sources: Unimproved water sources constitute the lowest rung of the drinking water ladder. Forty-two percent of the IGAD population (86 million people) consumes water from unimproved sources. However, though this figure is still large, it represents a 10% reduction since 1990, that is, from 52% to 42% in 2008 **(Recent figures not available).**

Proximity: Time to collect drinking-water: The available evidence indicates that the quantity of water that households collect and use is primarily dependent on accessibility (as determined by both distance and time). Research has shown that those spending more than half an hour per round trip progressively collect less water, and eventually fail to meet their families' minimum daily drinking-water needs. Additionally, the economic costs of having to make multiple trips per day to collect drinking water are enormous. This is compounded by over-crowding at the water collection points.

In the IGAD region, more than a quarter of the population spends more than half an hour per round trip to collect water, as one third of drinking-water sources that are not piped on premises need a collection time of more than 30 minutes. The proportion of the population spending half an hour or less, or more than half an hour, to collect water from an improved source, or using water from an improved source, is indicated in the table below.

Country	% people who use improved drinking water source more than 30 minutes away		
	Urban	Rural	Total
Uganda	28	43	41
Ethiopia	12	15	18
Kenya	2	17	14
Somalia	9	6	7

Source: WHO, UNICEF Progress on Sanitation and Drinking Water, 2017 Update.

% of urban and rural populations using improved drinking water sources over 30 minutes away (Round trip)

Water Source	Urban %	Rural %	Total %
Unimproved source	18	55	42
Improved source >30 min water collection	10	18	17
Improved source <30 min water collection	26	23	19
Piped on premises	46	4	22

Source: WHO, UNICEF Progress on Sanitation and Drinking Water, 2017 Update

Proportion of population spending half an hour or less or more than half an hour, to collect water from an improved source, or using water from an improved source (IGAD Region).

Agricultural Water Demand:

Irrigation potential and current withdrawals

All the countries of the IGAD region recognise the potential of irrigation as a means to substantially raise agricultural productivity and improve their food security situations. Yields from irrigated agriculture can be higher than non-irrigated agriculture by a factor of three or more times. This has been demonstrated in Ethiopia, Kenya and Sudan. In Sudan, for instance, output from irrigation constitutes about 60% of total agricultural output, while in Kenya it is about 18% of total agricultural output. Most of the countries have therefore plans for expanding irrigated agriculture as well as rain-fed agriculture.

These attractions of irrigated agriculture are, however, tempered by a number of limiting factors: (i) the high cost of developing modern irrigation systems (especially infrastructure) which would deliver water efficiently; (ii) the poor performance of public irrigation systems, most of which have had their infrastructure run-down; (iii) resulting from this, the high losses of water (low irrigation efficiencies) in almost all the irrigation schemes; and (iv) weak institutional and policy frameworks for effective irrigation development. Thus, while irrigation has a high potential, the realisation of this potential will be severely constrained not only by the financial and human resource costs but also by inadequate water to meet the needs of additional irrigation expansion.

Projections of irrigation withdrawals

Three scenarios were considered under the short –term (2024), medium-term (2030) and the long-term (2050) projections. The scenarios are meant to provide food for thought about future water needs of the sector. The population growth, change in irrigated area, possible growth in irrigated area, the current crops and irrigation technology. These factors affect the water requirements by hector and also the water losses due in-efficient irrigation or water storage and delivery. They are not the only scenarios that may be considered; other may be applied where data is available: for instance, different scenarios of population trends, crop yields, changes in dietary habits, etc.

Irrigation scenario for 2024

It uses the IGAD RIMP GDP growth rates as presented in table 2 above for the year 2024 to calculate the projected increase in irrigated areas in each state. It assigns a crop water requirement of 9000 m3 per hectare (to fulfill the requirements of crops produced in IGAD. This factor is considered as a reasonable average for group of crops with different water requirement under different irrigation methods and practices. Assuming slight change in the present irrigation effectiveness in terms of water losses equal to 25%. The projected irrigation areas and the irrigation water requirements per country and for enter IGAD region is shown in table (6-15). Total projected irrigated areas increase by 23% from 3.35 million hectare in 2019 to 4.121 million hectare in 2024, where irrigation withdrawals in 2024 under this scenario are 46.364 Km3, an increase of 23% from the current 37.717 Km^3 (2019).This reflects the increase in the irrigated area since we use the crop water requirements per hectare and assuming the same water losses of the year 2019(25%).. In addition, low cost technologies for rain-water harvesting and management, including smallholder drip irrigation systems, improved soil and water management practices, can be employed to reduce risks due to the unpredictability of rainfall.

Irrigation Scenario for 2030

It also uses the IGAD RIMP GDP growth rates as presented in table 2 above for the year 2030 to calculate the projected increase in irrigated areas in each state. It also assigns the crop water requirements of 9000 m3 per hectare (to fulfill the requirements of crops produced in IGAD. Assuming a moderate change in the present irrigation effectiveness in terms of water losses equal to 20%. The projected irrigation areas and the irrigation water requirements per country and for enter IGAD region is shown in table (8, 9). Total projected irrigated areas increase by 72% from 3.35 million hectare in 2019 to 5.745 million hectare in 2030, where irrigation withdrawals in 2030 under this scenario are 62.05 Km3, an increase of 65% from the current 37.717 Km^3 (2019).This reflects the increase in the irrigated area and improvement of causes leading to water losses, where we use the same crop water requirements per hectare but assuming water losses of only 20%.

Irrigation Scenario for 2050

It assumes the IGAD RIMP GDP growth rates fixed for all countries equal to 4.5 as presented in table 2 above for the year 2050 to calculate the projected increase in irrigated areas in each state. It also assigns the crop water requirements of 9000 m3 per hectare (to fulfill the requirements of crops produced in IGAD. It assumes a great change in the present irrigation effectiveness in terms of water losses equal to 15%. This means in the long- term (2030-2050) the modern irrigation methods and facilities will improve. The projected irrigation areas and the irrigation water requirements per country and for enter IGAD region is shown in table (6-15, 6-16). Total projected irrigated areas increase by 322% from 3.35 million hectare in 2019 to 14.13 million hectare in 2050, where irrigation withdrawals in 2050 under this scenario are 146.26 Km3, an increase of 288% from the current 37.717 Km^3 (2019).This reflects the huge increase in the irrigated area and improvement of water efficiency leading to small water losses, where we use the same crop water requirements per hectare but assuming water losses of only 15%

Table 0-14: Projected Irrigated area

country	Year 2019		Year 2024		Year 2030		Year 2050	
	area in hectare (thousand)	Demand ($Km^{3)}$	area in hectare (thousand)	Demand ($Km^{3)}$	area in hectare (thousand)	Demand ($Km^{3)}$	area in hectare (thousand)	Demand ($Km^{3)}$
Djibouti	1.012	0.009	1.472	0.013	2.111	0.019	5.191	0.047
Eritrea	21.590	0.194	27.722	0.249	39.735	0.358	97.732	0.880
Ethiopia	470.000	4.230	737.107	6.634	1121.848	10.097	2759.301	24.834
Kenya	160.000	1.440	232.799	2.095	376.220	3.386	925.352	8.328
Somalia	180.000	1.620	225.418	2.029	323.098	2.908	794.694	7.152
South Sudan	250.000	2.250	305.351	2.748	437.668	3.939	1076.490	9.688
Sudan	1950.000	17.550	2155.083	19.396	2739.648	24.657	6738.446	60.646
Uganda	320.000	2.880	436.296	3.927	705.087	6.346	1734.234	15.608
Total	3352.602	30.173	4121.248	37.091	5745.415	51.709	14131.440	127.183

Table 0-15: Irrigation projected demand providing different water losses

country	loss 25%	loss 25%2	loss 20%	loss 15%
	dem-2019	dem-2024	dem-2030	dem-2050
	km3	km3		
Djibouti	0.011	0.017	0.023	0.054
Eretria	0.243	0.312	0.429	1.012
Ethiopia	5.288	8.292	12.116	28.559
Kenya	1.800	2.619	4.063	9.577
Somalia	2.025	2.536	3.489	8.225
South Sudan	2.813	3.435	4.727	11.142
Sudan	21.938	24.245	29.588	69.743
Uganda	3.600	4.908	7.615	17.949
Total	37.717	46.364	62.050	146.260

LIVESTOCK WATER REQUIREMENTS LIVESTOCK WATER REQUIREMENTS

- The livestock population of the IGAD region is characterised by large herds and a wide variety of species (cattle, sheep, goats, camels, equines, pigs). The combined number of the various species is almost twice the human population. The impacts of the livestock sector on the water resources of the region can therefore be very large indeed. Livestock water use and contribution to the trend of water depletion is high and growing. An increasing amount of water is therefore required to meet growing water requirements in the livestock production process, from feed production to product supply.
- An evaluation of various data sources was made, starting with the national reports. It was clear that accurate and up to date data on livestock numbers and distribution was not adequate to support a comprehensive assessment of water withdrawals. In fact, water withdrawals for livestock is normally not reported separately but is included in the irrigation or domestic withdrawals.
- In these circumstances, a reassessment of the water requirements for livestock was made which simplifies the parameters for assessing water requirements for the different species of animals. These are summarised as follows:
- The used Livestock biological demands is*:*

  -35 l/c/d for camel

  -25 l/c/d for cattle

  -12 l/c/d for sheep or goat

  -15 l/c/d for equine (donkey / horse)
- The water services in terms of water delivery, storage and transportation are continually improved, and water losses decreases gradually, assumed to 25% for the year 2019 and 2024, to reach 20% and 15% in the year 2030 and 2050 respectively.

Livestock:

Livestock is considered one of the major water consumers in the IGAD region, where countries like Djibouti have livestock population of only 1.4 million in the year 2019, which increases with small rate to reach 1.45 million, 1.7 million to 2.4 million by the years 2024, 2030 and 2050 respectively. Countries such as Ethiopia, Sudan and Kenya host a big number of livestock resources which account for 137 million, 158 million, 188 million and 335 million for Ethiopia for the years 2019, 2024, 2030 and 2050 respectively.

In Sudan the number is 104 million, 142 million, 170 million and 306 million for the years 2019, 2024, 2030 and 2050 respectively. In Kenya the number is 78 million, 88 million, 102 million and 170 million for the years 2019, 2024, 2030 and 2050 respectively (table 10). In Ethiopia the water needed for livestock increases from 1.423 Km^3 , 1.63 Km^3 , 1.835 Km^3 to 3.004 Km^3 for the years 2019, 2024, 2030 to 2050 respectively(table 10,11). In Sudan the water needed for livestock increases from 1.155 Km^3, 1.323 Km^3, and 1.497 Km^3 to 2.501 Km^3 for the years 2019, 2024, 2030 to 2050 respectively.

Ethiopia and Sudan are examples of states hosting a big number of livestock resources and hence required a big amount of water to be used by their animal resources. State like Djibouti is hosting small number of livestock requires only 0.011 Km^3, 0.013 Km^3, and 0.014 Km^3 to 0. 019 Km^3 for the years 2019, 2024, 2030 to 2050 respectively. Other countries stay in between with moderate water requirements to supply the drinking demands for their livestock.

The livestock (cattle, sheep, goat, camel and equines) total number in IGAD countries for the year 2019 are 461million consuming about 4.403Km^3 of water. The number increases by 14%, 33%, 122% to reach about 525million, 614million million and 1046 million by the year 2024, 2030 and 2050 respectively.

The water demand for IGAD states livestock increase by 13%, 32% and 120 to reach about 4.987 Km^3, 5.566 Km^3 and 8.896 Km^3.

Table 0-16: Projected livestock population and water demand of IGAD countries.

Country	year 2019		year 2024		Year 2030		Year 2050	
	Pop. (million)	Demand (Km^3)	Pop .(million)	Demand (Km^3)	Pop .(million)	Demand (Km^3)	Pop .(million)	Demand (Km^3)
Djibouti	1.37	0.009	1.50	0.010	1.67	0.012	2.37	0.017
Eritrea	11.01	0.077	12.23	0.086	13.87	0.097	21.13	0.147
Ethiopia	137.88	1.138	158.63	1.301	188.00	1.529	335.32	2.647
Kenya	78.17	0.576	88.51	0.648	102.80	0.747	170.04	1.208
Somalia	38.86	0.149	26.33	0.163	29.61	0.183	44.00	0.268
South Sudan	29.40	0.310	45.92	0.340	51.42	0.381	74.96	0.556
Sudan	104.13	0.924	142.86	1.058	169.99	1.247	306.09	2.175
Uganda	60.14	0.339	48.73	0.382	56.46	0.442	92.60	0.719
Total	460.97	3.523	524.73	3.990	613.82	4.638	1046.51	7.736

Table 0-17: IGAD livestock water demand including water losses

Country	Column2	Column3	Column4	Column5
	Losses 25%	Losses 25%	Losses 20%	Losses 15%
	demand-19	demand-24	demand-30	demnd-50
	(Km^3)	(Km^3)	(Km^3)	(Km^3)
Djibouti	0.011	0.013	0.014	0.019
Eretria	0.097	0.107	0.116	0.169
Ethiopia	1.423	1.627	1.835	3.044
Kenya	0.720	0.810	0.897	1.389
Somalia	0.186	0.204	0.220	0.308
South Sudan	0.387	0.426	0.457	0.639
Sudan	1.155	1.323	1.497	2.501
Uganda	0.424	0.478	0.530	0.826
Total	4.403	4.987	5.566	8.896

Industrial Water Demand and others

Industrial water use applies to manufacturing, mineral extraction processes, oil exploration and exploitation, cooling and thermal energy production. Cultural activities, tourism and other small uses are also considered in this section. This can be estimated from data on the production of various industrial commodities using standards such as water–product ratios, or the ratio of water use to the population engaged in manufacturing, amongst others. Water-product ratios are highly variable among industrial plants depending, among other things, on the particular plant processes, costs of water, and recycling. The ratio of water use to the population engaged in manufacturing is also used to estimate the requirements.

Almost all the national reports reviewed concluded that reliable data was not available to enable an accurate and systematic assessment of industrial water use in the region. Data on current water withdrawals have been sourced and gleaned from various sources (FAO, World Bank, UNESCO, etc.). These show that current total withdrawals for industry are about 0.83 Km^3. The highest withdrawals are indicated for Sudan (0.38 Km^3) and Kenya (0.241 Km^3). Annual per capita withdrawals in these countries are respectively 9.3 m^3 and 4.7 m^3, which are above the region's average of 3.1 m^3. Per capita withdrawals for Eritrea (0.2 m^3), Ethiopia (0.3 m^3), Somalia (0.2 m^3) and Uganda (1.6 m^3) are extremely low and reflect the very low levels of industrialisation in these countries.

In projecting withdrawals for the short, medium and long-term, a basic annual requirement is assumed to be 5% of the total country irrigation withdrawal. The current is equal to about 3% of the irrigation consumption; Therefore, we assume progress rate of 5% from the improved irrigation to account for demand for development in industry and hence in industrial water demand.

Total annual water withdrawals for the industrial sector in the region are projected to increase from about 1.89 Km^3 in 2019 to 2.32 Km^3 in 2024 to reach about 3.1 Km^{3}in 2030, with an increase of 64%

from that of the year 2019. Between 2030 and 2050, withdrawals are projected to reach 7.31 Km^3, an increase of 288%. The countries demands are presented for the short, mid and long-term in table (4.4.12). Annual per capita withdrawals (Table 12, 13) in IGAD region will increase from 3.1 m^3 in 2010 to 6.6 m^3 in 2019, to 7.2 m^3 in 2024 , to 8.3 m^3 in 2030 and to 13.4 m^3 in 2050. Thus, by 2050 the minimum annual per capita target of 10 m^3 will be reached by the region as a whole. But Somalia (11.5 m3), Uganda (13.4), South Sudan (22) and Sudan (43.4 m3) will have exceeded the target. Ethiopia, Kenya, Eretria and Djibouti are still below the target.

The development of the per capita water requirements is directly proportional to the growth in irrigation and indirectly proportional to population. This explains the high values for Sudan, Somalia and South Sudan and the low values for Ethiopia and Kenya. Low industrial water withdrawals are partly associated with low energy especially electricity usage since, as countries develop, electricity sector increasingly dominates industrial water use.

High water withdrawals in Sudan and South Sudan are mainly related to more usage of thermal rather than hydro-power plants in electricity production. The low values for Ethiopia may also related to high use of hydro power than thermal power.

Table 0-18: Industrial (others) projected water demand for IGAD states

Column1	loss 25%	loss 25%2	loss 20%	loss 15%
Country	dem-2019	dem-2024	dem-2030	dem-2050
	km3	km3		
Djibouti	0.0006	0.0008	0.0011	0.0027
Eritria	0.012	0.016	0.021	0.051
Ethiopia	0.264	0.415	0.606	1.428
Kenya	0.090	0.131	0.203	0.479
Somalia	0.101	0.127	0.174	0.411
South Sudan	0.141	0.172	0.236	0.557
Sudan	1.097	1.212	1.479	3.487
Uganda	0.180	0.245	0.381	0.897
Total	1.886	2.318	3.103	7.313

Table 0-19 Showing projected per capita industrial water demand (m3) in IGAD

	d-pc-19	d-pc-24	d-pc-30	d-pc-50
Djibouti	0.6	0.8	1.0	2.1
Eritrea	2.3	2.6	3.2	5.3
Ethiopia	2.4	3.4	4.3	7.5
Kenya	1.7	2.2	3.0	5.0
Somalia	6.5	7.0	8.1	11.5
South Sudan	10.6	11.4	13.7	22.0
Sudan	25.8	25.3	27.0	43.4
Uganda	3.9	4.6	6.0	8.5
Total	6.6	7.2	8.3	13.4

IGAD Region Total Projected Water Demand

The total IGAD region water demand as projected for the short (2024), mid (2030) and long-term (2050) is presented in table 6-21 for the domestic water demand, livestock water demand, irrigation water demand and the industrial demand. It is obvious from the estimates that the irrigation water requirements is very big for example in the year 2024 it is(46.364) it accounts for 79% of total water demand(58.844) .The domestic demand,8.7 % of the total , the livestock demand is 8.3 % and industrial water demand accounts for 4 % from the total IGAD water demand. In the mid-term (2030), the irrigation water requirements is (62.05) it accounts for 81.2% of total water demand (76.409).

The domestic demand,7.4 % of the total, the livestock demand is 7.3 % and industrial water demand accounts for 4.1 % from the total IGAD water demand. In the long-term (2050), the irrigation water requirements is (146.26) it accounts for 85.8% of total water demand (170.459). The domestic demand,4.7 % of the total , the livestock demand is 5.2 % and industrial water demand accounts for 4.3 % from the total IGAD water demand.

Table 0-20: IGAD total projected water demand

	2019	2024	2030	2050
Population (tho)	**285,772**	**323,603**	**371,904**	**544,554**
Domestic demand(Km^3)	**4.556**	**5.174**	**5.69**	**7.99**
livestock(Km^3)	**4.403**	**4.987**	**5.566**	**8.896**
Irrigation (Km^3)	**37.717**	**46.364**	**62.05**	**146.26**
Others (indus. Tour. Etc)(Km^3)	**1.886**	**2.3187**	**3.103**	**7.313**
IGAD-Total(Km^3)	**48.562**	**58.8437**	**76.409**	**170.459**

Water Demand in Trans-boundary River Basins in The IGAD

Domestic water projected demand in trans-border River basins

The Table 6-22 below shows estimates of domestic withdrawals for each trans-border basin for the years 2019, 2024 2030 and 2050 as products of the population in those years and the respective per capita water needs as defined by WHO/UNICEF (80 liter /c/d in urban areas and 20 liter/c/d in rural areas.

The Table shows that the total current (2019) population is 222 million, and the annual water withdrawals for the domestic sector are 3.285 Km3 across the basins. The domestic water withdrawals from the basins constitute about 72% of the region's domestic sector in 2019, 77% in 2024, 83% in 2030 and 88% in 2050. Total withdrawals for domestic requirements will increase from 3.974 Km3 in 2024 to 4.735 Km3 in 2030 and to 7.9895 Km3 in 2050.The table (1) also shows demands of domestic water for each river basins projected to the short (2025), mid (2030) and long-term (2050).

The Nile being the biggest basin area (table 6-22) is the most important basin in the IGAD region (cover 6 countries), the demand for domestic water use is 2.88 km3 in the year 2019 which account for 88% of all basin requirements, the Juba-Shebelle the second account for 6% while Aeyesha the smallest accounts for only 0.03% of the all basins demand. The Nile River basin, which is the main contributor to the region's water resources, also its inhabitants are the main consumer for region domestic water

Table 0-21: Domestic water withdrawals in trans-border basins.

Basin	2019 demand (25% water losses)			2024 water demand	(15% water losses)	
	Popn Millions	Annual demand million m³	Per capita m³yr	pop million	demand-million (m³	per capita
Ayesha	0.22	1.090	4.955	0.256	1.368	5.344
Gash-Baraka	1.41	15.100	10.709	1.644	22.550	13.717
Danakil	1.71	9.450	5.526	1.994	14.080	7.061
Juba-Shebelle	28.05	186.000	6.631	32.724	276.000	8.434
Ogaden	8.7	41.990	4.826	10.149	54.600	5.380
Turkana-Omo	22.87	144.820	6.332	26.688	241.150	9.036
Nile	159.5	2887.535	18.104	186.361	3365.021	18.090
Total IGAD	**222.46**	**3285.985**	**8.155**	**259.816**	**3974.769**	**9.580**

Basin	2030 demand(20% water losses			2050 demand(15% water losses)		
	Popn Millions	demand-million (m³	Per capita m³/yr	Popn Millions	demand-million (m³	Per capita m³/yr
Ayesha	0.370	2.610	7.054	0.580	11.960	20.621
Gash-Baraka	2.000	31.260	15.630	3.910	78.230	20.008
Danakil	2.780	23.480	8.446	4.540	48.150	10.606
Juba-Shebelle	46.130	471.340	10.218	72.290	900.000	12.450
Ogaden	14.300	100.020	6.994	22.520	203.760	9.048
Turkana-Omo	37.660	428.600	11.381	58.830	868.790	14.768
Nile	212.933	3677.862	17.272	298.355	4925.689	16.509
Total IGAD	316.173	4735.172	10.999	461.025	7036.579	14.858

Irrigation potential and current status

All the countries of the IGAD region recognise the potential of irrigation as a means to substantially raise agricultural productivity and improve their food security situations. Yields from irrigated agriculture can be higher than non-irrigated agriculture by a factor of three or more times. This has been demonstrated in Ethiopia, Kenya and Sudan. In Sudan, for instance, output from irrigation constitutes about 60% of total agricultural output, while in Kenya it is about 18% of total agricultural output. Most of the countries have therefore plans for expanding irrigated agriculture as well as rain-fed agriculture.

These attractions of irrigated agriculture are, however, tempered by a number of limiting factors: (i) the high cost of developing modern irrigation systems (especially infrastructure) which would deliver water efficiently; (ii) the poor performance of public irrigation systems, most of which have had their infrastructure run-down; (iii) resulting from this, the high losses of water (low irrigation efficiencies) in almost all the irrigation schemes; and (iv) weak institutional and policy frameworks for effective irrigation development. Thus, while irrigation has a high potential, the realisation of this potential will be severely constrained not only by the financial and human resource costs but also by inadequate water to meet the needs of additional irrigation expansion; see table below:-

Table 0-22: Relevance of Irrigation in IGAD Region

Counties	Characteristics	Relevance of Irrigation
Djibouti, Eritrea, Somalia, Sudan	Mainly arid. Recurrent droughts	High/ Inland and trans boundary
Ethiopia, Kenya, Uganda	Mainly Arid and Semi-arid lands, erratic rainfall and water scarcity. Recurrent droughts. Exception, humid southern part of Uganda.	High/ Inland and trans boundary
South Sudan	The region is well endowed with rainfall and water resources	High in semi-arid local parts/ Mainly rain fed.

Table 0-23: Irrigated areas in the various countries obtained from FAO AQUSTAT-2013

Country	Total irrigated area (ha)							
		Nile	Turkana-Omo	Juba- Shabelle	Ogaden	Gash-Baraka	Ayesha	Danakil
Ethiopia	292,384		46,953	48,783	1,721		0	4,756
Kenya	101,706		9,720	7,134				
Uganda	9,041							
Sudan	1,863,099					13,677		
Djibouti	859							
Eritrea	19,590					5,057		4,756
Somalia	196,753			142,814	23,429		0	
S Sudan								
Total	**2,483,432**		**56,673**	**198,731**	**25,150**	**18,734**	0	**9,512**

Irrigation Water Demand IGAD River Basin

Table 0-24: Projected Irrigation Water demand in IGAD river basins

Basin	Water demand							
	area-19	25% losses	area24	dem-24	area-30	dem-30	area-50	dem-50
	Hc	km3	hc	km3	hc	km3	Hc	km3
Ayesha	0	0						
Gash-Baraka	23,782	0.407	29,728	0.50875	40,429	0.71225	47,564	0.814
Danakil	17,978	0.219	22,473	0.27375	30,563	0.38325	35,956	0.438
Juba-Shebelle	187,872	3.316	234,840	4.145	319,382	5.803	375,744	6.632
NILE basin	2,582,000	27.976	2,934,000	33.008	3,995,000	43.145	9,826,000	101.699
Ogaden	16,608	0.414	20,760	0.5175	28,234	0.7245	33,216	0.828
Turkana-Omo	108,181	0.99	135,226	1.2375	183,908	1.7325	216,362	1.98
Total	2,936,421	33.321561	3,377,026	39.690556	4,597,516	52.500957	10,534,842	112.391

The key parameters used in basin level irrigation water demand projections are summarised below:

Projections were made based on the following assumptions:

- To obtain the irrigated area per the seven river basins we use the percentage area of the river basin in each country to calculate the irrigated area per state and sum the area per countries considering the countries sharing each basin.
- The demand is estimated by multiplying the area in hectare by the crop water requirements, 9000 m3 per hectare to indicate the average of all possible irrigated crops produced in the basins.
- The water irrigation system losses are considered to be improved with time by reducing the water losses (leakage, from storage, transportation, delivery) and by improving irrigation efficiency. The water losses are assumed 25% in the short-term 2024), improved to reach 20% in the mid-term (2030) and reach only 15% in the long-term (2050).

The results of the estimates are presented in table 6-25. The increase of the water demand to irrigate the increased irrigated areas are presented for each river basin for the short (2024), mid (2030) and long-term (2050)

The Table reveals the following:

- The IGAD region total River basin level irrigation water demand would increase from 33.32 Km^3(area 2,94 million hc) in 2019 to 39.7 Km^3 (area 3.4 million hc)in 2024 , to 52.6 Km^3 (area 4.6 million hc) in 2030 and to 112.39 Km^3 (area 10.53 million hc)in 2050.
- The River Nile Basin with biggest amount of area and water demand. The total basin level irrigation water demand would increase from 27.98 Km^3(area 2.6 million hc) in 2019 to 33.01 Km^3 (area 2.93 million hc)in 2024 , to 43.15 Km^3 (area 3.99 million hc) in 2030 and to 101.7 Km^3 (area 9.83 million hc)in 2050 (NBI,2016, (HRC,2015.
- The Juba-Shebelle basin comes the second with total basin level irrigation water demand would increase from 3.32 Km^3(area 0.19 million hc) in 2019 to 4.15 Km^3 area 0.235 million hc)in 2024 , to 5.8 Km^3 (area 0.319 million hc) in 2030 and to 6.63 Km^3 (area 0.375 million hc)in 2050.
- The Gash-Baraka basin being the lowest with total basin level irrigation water demand would increase from 0.407 Km^3(area 0.029 million hc) in 2019 to 0.509 Km^3 (area 0.029 million hc)in 2024 , to 0.712 Km^3 (area 0.04 million hc) in 2030 and to 0.814 Km^3 (area 0.048 million hc)in 2050.
- The Ayeash basin being dry area with practically no irrigation projects
- There is an implied expansion of irrigation areas in the basins. Main expansions are expected in Nile basin, Juba-Shebelle and Turkana-Omo.
- The contribution of the trans-border basins to the overall regional irrigation withdrawals is about 90%,86% , 85% and 77% in the current(2019), short(2024), mid(2030) and long-term(2050) respectively. The contribution to the total irrigation area is also about 88%, 83% , 80% and 75% in the current(2019), short(2024), mid(2030) and long-term(2050) respectively

Livestock Water Demand in IGAD River Basins:

LIVESTOCK WATER REQUIREMENTS

- The livestock population of the river basins of the IGAD region is characterised by large herds and a wide variety of species (cattle, sheep, goats, camels, equines, pigs). Livestock water use and contribution to the trend of water depletion is high and growing. An increasing amount of water is therefore required to meet growing water requirements in the livestock production process, from feed production to product supply (IGAD, 2016).
- An evaluation of various data sources was made, starting with the national reports to calculate the projected number of livestock per each river basin. It was clear that accurate and up to date data on livestock numbers and distribution was not adequate to support a comprehensive assessment of water withdrawals.
- In these circumstances, a reassessment of the water requirements for livestock was made which simplifies the parameters for assessing water requirements for the different species of animals. These are summarised as follows:
- The used Livestock biological demands is*:*
  -35 l/c/d for camel
  -25 l/c/d for cattle
  -12 l/c/d for sheep or goat
  -15 l/c/d for equine (donkey / horse)
- The water services in terms of water delivery, storage and transportation are continually improved, and water losses decreases gradually, assumed to 25% for the year 2019 and 2024, to reach 20% and 15% in the year 2030 and 2050 respectively.

Livestock demand within the river basins:

The livestock (cattle, sheep, goat, camel and equines) total number in the seven river basins of IGAD for the year 2019 are 250 million consuming about 2.004Km^3 of water. The number of herd increases by 17%, 39%, 119% to reach about 297million, 348 million and 593 million by the year 2024, 2030 and 2050 respectively. The water demand increase by 13%, 32% and 119 to reach about 2.27 Km^3, 2.639 Km^3 and 4.4 Km^3 in the year 2024,2030 and 2050 respectively(table 6-26). The total number of the livestock in the river basins account to 57% of the total number in all the region, while the livestock water demand within the river basins account to about 47% of the total demand within the enter region. The livestock are therefore distributed within the region not only restricted to river basins. The 43% of the livestock may depend on water resources outside the river basins surface or groundwater resources (groundwater outside the river basins or rain water).

Table 0-25: projected livestock water demand in IGAD river basins

Basin	area-19	dem-19	area24	dem-24	area-30	dem-30	area-50	dem-50
	pop million	km3	pop		Pop	km3	Pop	km3
Ayesha	0.878	0.007	1.045	0.008	1.222	0.009	2.083	0.015
Gash-Baraka	1.976	0.016	2.351	0.018	2.750	0.021	4.687	0.035
Danakil	1.537	0.012	1.828	0.014	2.139	0.016	3.645	0.027

Juba-Shebelle	15.372	0.123	18.285	0.140	21.388	0.162	36.455	0.271
NILE basin	219.600	1.761	261.210	1.995	305.540	2.319	520.780	3.867
Ogaden	1.318	0.011	1.567	0.012	1.833	0.014	3.125	0.023
Turkana-Omo	9.223	0.074	10.971	0.084	12.833	0.097	21.873	0.162
Total	249.905	2.004	297.257	2.270	347.705	2.639	592.648	4.401

Industrial water demand in River basins:

In projecting withdrawals for the short, medium and long-term, a basic annual requirement is assumed to be 5% of the total river basins irrigation withdrawal. The current is equal to about 3% of the irrigation consumption; Therefore we assume progress rate of 5% from the improved consumption to account for demand for development in industry and hence in industrial water demand.

Total annual water withdrawals for the industrial sector in the basins area are projected to increase from about 1.669 Km^3 in 2019 to 1.99 Km^3 in 2024 to reach about 2.635 Km^{3}in 2030, with an increase of 58% from that of the year 2019. Between 2030 and 2050, withdrawals are projected to reach 5.64 Km^3, an increase of 237%. The countries demands are presented for the short, mid and long-term in table (6-27).

The water demand for industrial development inside the basins areas accounts for about 88%, 86%, 85% and 77% of the total industrial demand for 2019, 2024, 2030 and 2050 respectively ,of the entire IGAD region requirements

Table 0-26: projected industrial water demand in IGAD river basins

Basin	dem-19	dem-24	dem-30	dem-50
	km3	km3	km3	km3
Ayesha	0.003	0.009	0.010	0.020
Gash-Baraka	0.020	0.025	0.036	0.041
Danakil	0.011	0.014	0.019	0.022
Juba-Shebelle	0.166	0.207	0.290	0.332
NILE basin	1.399	1.650	2.157	5.085
Ogaden	0.021	0.026	0.036	0.041
Turkana-Omo	0.050	0.062	0.087	0.099
Total	1.669	1.994	2.635	5.640

Summary of IGAD projected total water demand:

The total projected water demand for the IGAD river basins is presented for the short (2024), mid (2030) and long-term (2050) is shown in table 6-28. The water demand for domestic use is 3.26, 3.98, 4.735 and 7.04 for the current (2019), short (2024), mid (2030) and long-term respectively.

The water demand for livestock use is 2.0004 Km^3, 2.27 Km^3, 2.639 and 4.401 Km^3 for the current (2019), short (2024), mid (2030) and long-term respectively.

The water demand for irrigation use is 33.32 Km^3, 39.7 Km^3, 52.5 Km^3 and 112.4 Km^3 for the current (2019), short (2024), mid (2030) and long-term respectively.

The water demand for industrial use is 1.67 Km^3, 1.99 Km^3, 2.6 Km^3 and 5.64 Km^3 for the current (2019), short (2024), mid (2030) and long-term respectively.

The water demand for all water uses in the IGAD river basins is 40.29 Km^3, 47.93 Km^3 , 62.51 Km^3 and 129.47 Km^3 for the current (2019), short (2024), mid (2030) and long-term respectively.

It is found that the irrigation demands is high relative to domestic and livestock demands, while the industrial demand is very low. For example the irrigation demands in the short (2024) term, mid (2030) and long-term (2050) accounts to 70 %, 84 % and 87%of the total demand respectively.

The domestic demands in the short (2024) term, mid (2030) and long-term (2050) accounts to 8.1%, 7.5 % and 5.4%of the total demand respectively.

The livestock demands in the short (2024) term, mid (2030) and long-term (2050) accounts to 4.8 %, 4.2% and 3.4 %of the total demand respectively.

The industrial demands in the short (2024) term, mid (2030) and long-term (2050) accounts to only 4.2 %, 4.2 % and 4.4 %of the total demand respectively.

Table 0-27: Projected total water demand in IGAD river basins

Basin	2019	2024	2030	2050
population(million)	222.46	259.816	316.173	461.025
livestock pop.(million)	249.905	297.257	347.705	592.648
Irrigation area (hc)	2,936,421	3,377,026	4,597,516	10,534,842
Domestic demand(km3)	3.286	3.975	4.735	7.037
livestock demand(km3)	2.004	2.27	2.639	4.401
Irrigation demand(km3)	33.321	39.690	52.500	112.391
Industrial demand(km3)	1.669	1.994	2.635	5.64
Total water demand(km3)	40.281	47.93	62.51	129.47

Availability of Water resources in River basins:

The water requirements for all water users in the region should be supplied by the available water resources in the region. The blue water resources including both surface water and groundwater are abundant in the river basins areas. Although water abundance, but it is amount varies from a basin to another. Tables (6-29 and 6-30) presented the water resources in each basin. The Nile basin with the biggest surface and groundwater (245 Km3), Jubba-Shebelle(108 Km3) with moderate, while Ayesha (0.177 Km3), Ogaden (3.3 Km3) and Gash-Barka (4.2 Km3) are the lowest (NBI,2015, Salama,1976). Looking to the demand, the surface water and groundwater available in the basins are abundant enough to supply the current and projected demand. The picture is more optimistic where the rain water is available in each basin.

Table 0-28: Groundwater Resources in IGAD River Basins

Basin	Column2	Column3	Column4
	Aquifer	storage(km3)	Recharhe (km3)
Ayesha	Awash	0.15	0.034
	Total	**0.15**	**0.034**
Gash-Barka	Gash alluvium	0.46	0.222
		0.41	0.26
	Total	**0.87**	**0.482**
Juba-Shebelle	Shebelle	18.54	0.75
	Merti	3.45	0.0033
	Dawa	35	1.2
	Ogaden	25.7	0.3
	Total	**82.69**	**2.2533**
Danakil	Afar rift	65	0.195
	Awash	0.15	1
	Adagrat	540	1.43
	Total	**605.15**	**2.625**
Nile basin	Sud	1800	0.865
	Gadarief	400	0.66
	B. Nile	550	0.75
	Atbra	280	0.16
	Nubiain Nile	5000	0.8
	Adgrat	360	0.43
	Rift valley	17	1
	alluvium	50	2.85
	fractures	35	2.3
	Total	**8492**	**9.815**
Ogaden	Ogaden-juba	25.7	0.12
			10.265
	Total	**25.7**	**0.12**
Turkana-Omo	Mt.Elegon	12	0.42
	Rift valley	7	0.8
	Total	**19**	**1.22**

Table 0-29: Summary of Annual Blue Water resources in IGAD River Basins

annual water resources km3						
				annual	GW	blue water
		Groundwater	Groundwater	surface water	Available	total
Basin		storage(km3)	Recharhe(km3			m3
Ayesha	Total	0.15	0.034	0.126	0.054	0.180
Gash-Baraka	Total	0.87	0.482	4.5	1.4	5.9
Juba-Shebelle	Total	82.69	2.2533	5.5	43.7	49.2
Danakil	Total	605.15	2.625	2.5	0.6	3.1
Nile basin	Total	10992	10.265	207.2	22.26	229.46
Ogaden	Total	25.7	0.12	3.6	2.7	6.3
Turkana-Omo	Total	54	2.24	28.1	7.3	33.4
Total IGAD basins		**11760.56**	**18.0193**	**268.026**	**78.014**	**344.04**

Estimated Increase in Capacity

The bulk of the future water resources to meet the ever-increasing demand will come from pipeline of projects earmarked for implementation on transboundary water courses or within transboundary water basins. This includes new supply sources, transboundary water transfers of water, conjunctive use of surface water and groundwater, more efficient delivery and use, and control over demand through pricing and education. Table 6-30 and Table 6-31 show the total demand by country and the increase in water demand using 2019 as the reference respectively. The second table shows significant increase of water demand in the IGAD region.

These increases will create significant increase in water withdrawals for domestic supply, agricultural and for industry. At present, the high population growth is outstripping the pace at which water resources are being developed to meet the various socioeconomic needs of the sub-region. Associated with this is the low and unbalanced funding of the water and sanitation sector, with the tendency to concentrate on water infrastructure in the urban centres and giving lower priority to rural areas.

Due to the spatial and temporal variability of water resources and demand, significant investment in water storage and bulk conveyance infrastructure will be required to meet demand. It is also important to note that some of this infrastructure could be transboundary. It will also require improvements in agricultural water use efficiencies to save water resources since agricultural withdrawals are the largest.

Table 6-31: Increase in Water Demand with 2019 as reference

Country/Year	2024	2030	2050
Djibouti	0.0102	0.0284	0.595
Eritrea	0.0943	0.2349	0.9449
Ethiopia	3.5583	7.9379	27.0256
Kenya	1.0734	2.7513	9.4203
Somalia	0.5978	1.6663	6.9812
South Sudan	0.7184	2.127	9.1437
Sudan	2.6936	8.5673	52.1344
Uganda	1.5352	4.5386	16.1813

Section 6.7 Gap Analysis

The Gap Analysis was undertaken in three stages:

- First, the extend of available water resources in the water basins covering and serving the IGAD region was estimated; this is the 'water supply estimation' (see section xxx above). The water basins are as follows:
  - Juba-Shebelle Basin (which includes the Dauwa basin)
  - Turkana-Omo Basin
  - Danakil Basin
  - Ogaden Basin
  - Ayesha Basin
  - Gash-Barka Basin
  - Nile Basin

- Second, demand projections were made for each water basins for the agreed IRIMP short, medium and long-term time periods of 2024 2030 and 2050, using the following assumptions:
  - The number of people benefitting from the basin water resources is proportional to the size of the population in the delineated area in the country that falls within the basin;
  - The population growth rates were as given in Chapter three and used in the demand projections for each of the four sectors.; and
  - The domestic water demand was based on the population figures and a per capita demand of 80 litres for urban and 20 litres for rural. This figure translates to about 30 and 7.5 cubic meters per capita per annum for urban and rural respectively.

- Third, if the demand projections exceeded the estimated availability of water then a water deficit or gap was assumed to arise requiring action to overcome involving improved water management, irrigation efficiency improvements and/or water infrastructure development.

Water Demand

The water demand by transboundary basin is given below:

Table 6-32 Total water Demand by Basin.

Basin	Water demand			
	2019km3	2024 km3	2030 km3	2050km3
Ayesha	0.011	0.0183	0.019	0.035
Gash-Baraka	0.458	0.5745	0.800	0.968
Danakil	0.2514	0.3161	0.4414	0.5351
Juba-Shebelle	3.791	4.768	6.726	8.135
NILE basin	34.023	40.018	51.298	115.576
Ogaden	0.488	0.6096	0.874	1.096
Turkana-Omo	1.259	1.624	2.344	3.109
Total	40.281	47.928	62.502	129.454

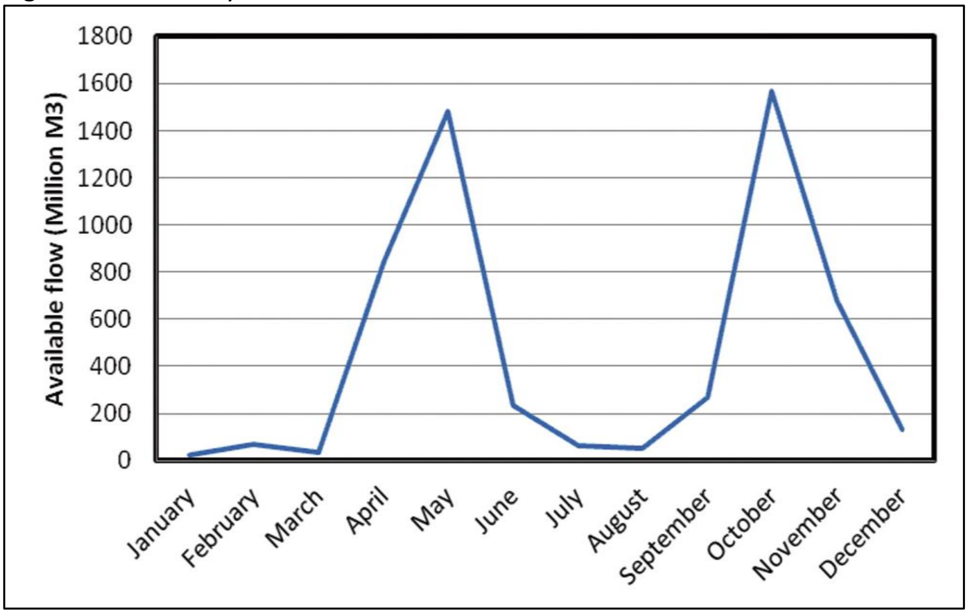
Water Availability

The available water resources in each transboundary basin in the IGAD region is given below:-

Juba-Shebelle Basin

The annual available water resources in the Juba-Shebelle basin is 5.5 Billion cubic meters. The monthly distribution is given below:-

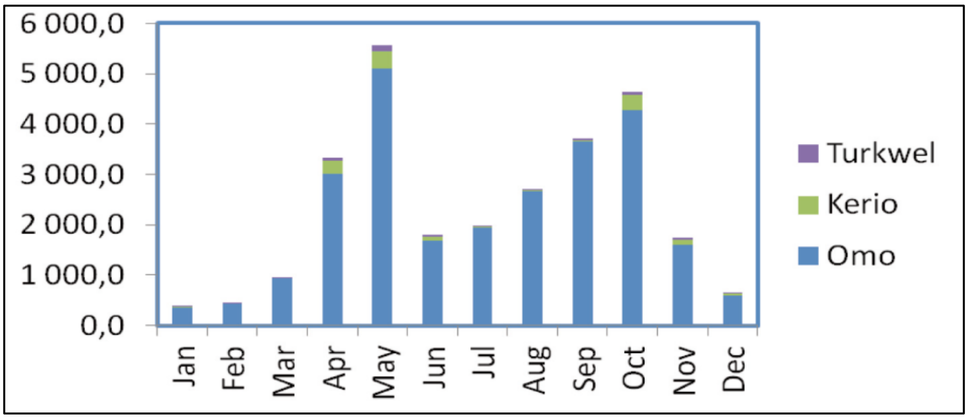
Figure 0-5: Monthly flow distribution-Juba-Shebelle Basin



Turkana-Omo

The annual available water resources in the Turkana-Omo basin is 28.108 Billion cubic meters. The monthly distribution is given below: -

Figure 0-6: Monthly Flow distribution: Turkana-Omo


6 000,0
5 000,0
4 000,0
3 000,0
2 000,0
1 000,0
0,0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Turkwel
Kerio
Omo

Danakil Basin

The annual available water resources in the Danakil basin is 2.5 Billion cubic meters. The monthly distribution is given below:-

River	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Annual Total**
River 1	0.3	0.0	0.0	0.0	10.7	34.2	409.8	605.3	207.4	67.2	13.5	2.9	**1,351.3**
River 2	11.8	4.1	1.9	11.1	63.2	59.9	349.3	404.4	143.3	77.7	23.8	18.2	**1,168.8**
Total	12.1	4.1	1.9	11.1	73.9	94.1	759.1	1,009.8	350.7	144.9	37.3	21.2	**2,520.1**

Ogaden Basin

The annual available water resources in the Ogaden Basin is 3.6 Billion cubic meters. The monthly distribution is given below:-

River	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Annual Total**
River 1	29.7	27.3	59.2	42.0	185.1	216.7	422.4	509.7	632.4	437.9	229.1	83.0	**2,874.6**
River 2	4.6	15.0	9.1	122.1	176.0	47.4	24.9	20.6	40.4	177.6	77.8	16.3	**731.8**
Total	34.3	42.3	68.3	164.1	361.0	264.1	447.3	530.3	672.9	615.5	306.9	99.4	**3,606.4**

Ayesha Basin

The annual available water resources in the Ayesha basin is 126 Million cubic meters. The monthly distribution is given below:-

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Flow	0	0	0	0	0.3	1.6	34.8	67	18.9	2.9	0.3	0	125.7

Gash-Barka Basin

The annual available water resources for the Gash-Barka basin is 4.5 Billion cubic meters. The monthly distribution is given below:-

River	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total

River Anseba	2.7	1.0	0.3	0.5	4.6	2.6	16.1	35.6	8.6	5.4	2.3	2.7	82.2
River Gash	2.7	0.5	-	0.5	6.7	10.4	117.8	184.8	36.3	13.4	3.1	2.7	378.9
Tributary	22.8	4.8	0.8	15.6	131.2	147.7	1,210.6	1,722.2	500.3	203.6	47.7	35.6	4.9
Total	28.1	6.3	1.1	16.6	142.5	160.7	1,345	1,943	545.1	222.3	53.1	41.0	4,504.0

The annual available water resources in the Nile basis for the IGAD region is 207.2 Billion cubic meters. The distribution to the IGAD member states is given in the table below:-

Table 0-33: Water resources and water Availability in the Nile Basin

Country	Available Water Bill CM	Dependency %	% of Country in Nile Basin	Water Res/inhabitant CM/Capita
Eritrea	2.8	68.2	20.5	815
Ethiopia	110	0	32.4	2059
Kenya	20.2	33.1	7.9	739
Sudan	35	77.3	79	1279
Uganda	39.2	40.9	98	1891

Water Demand in the Basin Context

The tables below show the water demand aggregated in the basin context. This simplifies the comparison of demand deficits with the available water resources in the seven transboundary basins considered in the region.

Table 0-34: Country population (%) served by Basin

Country	Juba-Shebelle	Turkana-Omo	Gash-Barka	Danakil	Ogaden	Ayesha	Nile
Djibouti	-	-	-	-	-	-	-
Eritrea	-	-	32	5.2	-	-	20.5
Ethiopia	17.6	15.7	-	1	1.3	Neg	32.4

Kenya	10.2	8.2	-	-	11.1	-	7.9
Somalia	30	-	-	-	-	o.8	-
South Sudan	-	Neg*	-	-	-	-	79
Sudan	-	-	0.3	-	-	-	79
Uganda	-	0.2	-	-	-	-	98

Table 0-35: Juba-Shebelle

Country	% population in basin	Domestic (Mill m^3)			Industrial (Mill m^3)			Agricultural (Mill m^3)		
		2017	2025	2050	2017	2025	2050	2017	2025	2050
Ethiopia	18	121	183	470	4	7	63	996	1945	8527
Kenya	10	47	68	163	10	14	41	186	258	612
Somalia	30	45	75	216	-	-	-	246	282	282
Total		213	326	849	14	21	104	1428	9421	9421

Table 0-36 Turkana-Omo

Country	% population in basin	Domestic (Mill m^3)			Industrial (Mill m^3)			Agricultural (Mill m^3)		
		2017	2025	2050	2017	2025	2050	2017	2025	2050
Ethiopia	16	108	163	419	3	6	57	889	1735	7607
Kenya	8	38	55	131	8	12	33	149	208	492
South Sudan	Rel Neg	-	-	-	-	-	-	-	-	-
Uganda	0	1	1	3	0	0	0	0	5	1
Total		147	219	553	11	18	90	1038	1947	8100

Table 0-37 Gash-Barka

Country	% population in basin	Domestic (Mill m^3)			Industrial (Mill m^3)			Agricultural (Mill m^3)		
		2017	2025	2050	2017	2025	2050	2017	2025	2050
Eritrea	0.3	0.1	0.2	0.6	0.3	0.3	0.4	1.0	1.2	1.6

Sudan	32	131	186	480	26	42	176	8291	8291,2	8291
Total		131	186	481	26	42	176	8292	8292	8293

Table 0-38 Danakil

Country	% population in basin	Domestic (Mill m^3)			Industrial (Mill m^3)			Agricultural (Mill m^3)		
		2017	2025	2050	2017	2025	2050	2017	2025	2050
Eritrea	5	2	4	9	4	5	6	16	18	25
Ethiopia	1	7	10	27	0	0	4	57	111	485
Total		9	14	36	4	5	10	73	130	74

Table 0-39 **Ogaden Basin**

Country	% population in basin	Domestic (Mill m^3)			Industrial (Mill m^3)			Agricultural (Mill m^3)		
		2017	2025	2050	2017	2025	2050	2017	2025	2050
Ethiopia	1.3	9	14	35	0.3	0.5	4.7	74	144	630
Somalia	11.1	17	27.8	80	-	-	=	91	104	104
Total		26	41	115	0.3	0.5	4.7	165	248	248

Table 0-40 **Ayesha Basin**

Country	% population in basin	Domestic (Mill m^3)			Industrial (Mill m^3)			Agricultural (Mill m^3)		
		2017	2025	2050	2017	2025	2050	2017	2025	2050
Ethiopia	0.01	0.1	0.1	0.3	0.002	0.004	0.4	0.6	1.1	4.8
Somalia	0.8	1.2	2	5.8	-	-	-	6.6	7.5	7.5
Total		1.3	2.1	6.1	0.002	0.004	0.4	7.2	8.6	12.3

Table 0-41 **Nile Basin**

Country	% population in basin	Domestic (Mill m^3)			Industrial (Mill m^3)			Agricultural (Mill m^3)		
		2017	2025	2050	2017	2025	2050	2017	2025	2050
Eritrea	21	8	14	35	16	19	25	64	72	98
Ethiopia	32	224	337	865	7	13	117	1834	3580	15,698
Kenya	8	36	53	126	8	11	32	144	200	474
South Sudan	79	63	111	308	182	253	656	198	268,6	695
Sudan	79	324	458	1185	63	103	435	2047	2047	2047
Uganda	98	284	431	1235	49	59	167	167	235	608
Total		939	1404	3754	325	457	1430	4452	6403	19,620

The ICT Sector

Section 7.1 The importance of the ICT sector

The Information and Communications Technology (ICT) sector is important for the lives of all IGAD Citizens. ICT is cross-cutting and can contribute to reduced poverty, increased productivity, economic growth, and improved administrative accountability and governance. It facilitates trade, business, education, health, agriculture, banking, knowledge sharing and enhances the efficiency of the infrastructure sub-sectors. The IGAD member states are of one accord; their respective digital economies should be strengthened. Although the promotion of ICT and the digital economy are important for each IGAD member state there are, however, clear difference between them, as to network coverage, internet and mobile penetration, the costs of broadband, and access to international bandwidth:

- **Kenya** has a very developed ICT sector; followed by **Uganda** and **Sudan**
- **Djibouti** and **Ethiopia**, although they have recently experienced noticeable development in their respective ICT industries and digital economies still require significant investment in ICT infrastructure in order to increase access to mobile and internet services, and improved broadband services and mobile coverage.
- **Somalia** and **South Sudan** both require strong and independent regulatory authority to be established in order to regulate the market. A clear ICT policy needs to be developed in order to support the development of a competitive market. South Sudan, in particular, has a regulatory authority which needs to be strengthened in order to effectively regulate the market. Furthermore, both countries need to develop a national optical fibre network in order to connect the major cities in each country. They also need to set up a universal service fund to enhance the rural connectivity.

Section 7.2 Current status of physical trans-border infrastructure

The International Telecommunication Union (ITU) has developed an ICT Development Index (IDI) the main objectives of which is to measure the ICT development in countries over time including the digital divide. The indicators are grouped into three: (a) ICT access; (b) ICT use; and (c) ICT skills. ICT development for a country can be evaluated using three stages (see Figure 7-1)

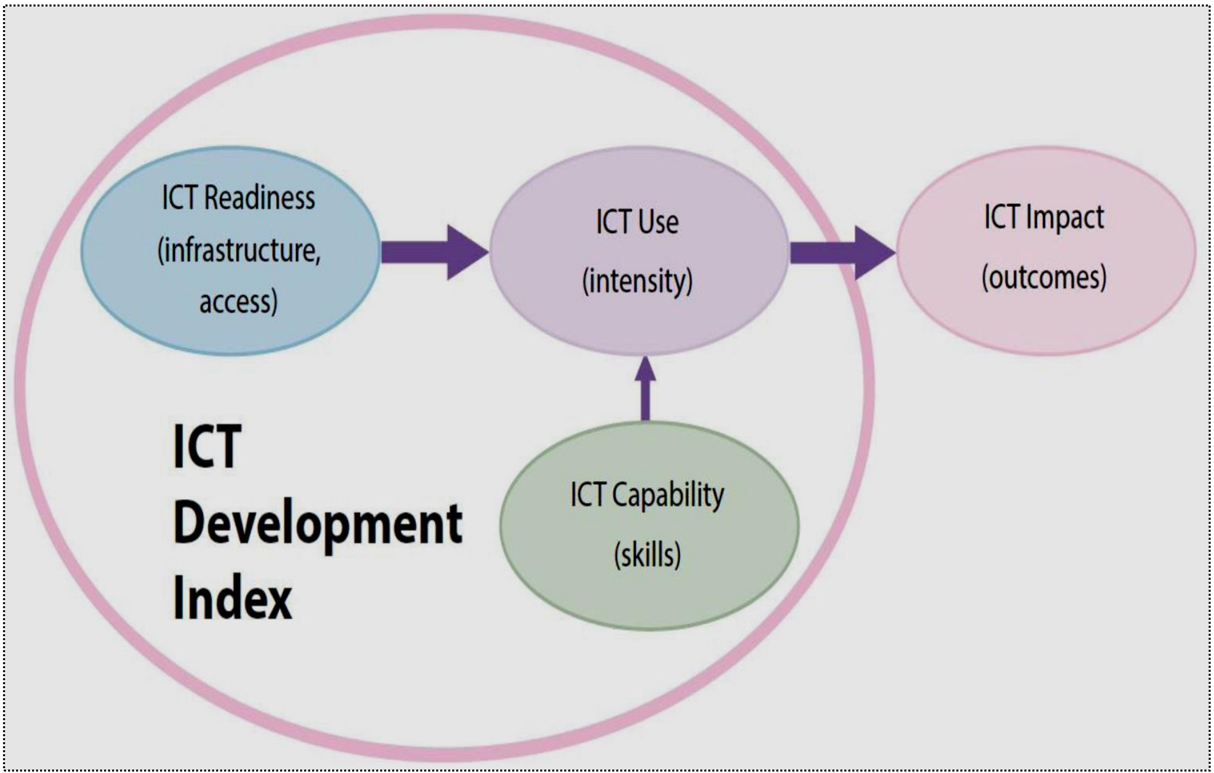
- **Djibouti** and **Ethiopia**, although they have recently experienced noticeable development in their respective ICT industries and digital economies still require significant investment in ICT infrastructure in order to increase access to mobile and internet services, and improved broadband services and mobile coverage.
- **Stage one focuses on the ICT infrastructure networks and access to ICT services**. It includes the national infrastructure backbones and cross border ICT interconnectivity as well as the coverage of the services geographically and by population.
- Stage two focuses on the density of ICT usage in the society.
- **Stage three concentrates on the positive impact of the ICT** and particularly on the development of skills which are so important in order to maximise the benefits of ICT. Skilled people are essential to leverage the ICT potential for social and economic development. It is important for IGAD Member States to include the ICT in the school syllabus and focus on ICT at university level to reduce the digital illiteracy in their countries which is very high at the moment.

The highest mark of the IDI is 10. All African countries scored below 5 out of 10. South Africa scored highly; 4.91 and 4.96 for the years 2016 and 2017 respectively. Eritrea is the last country in the list of

IDI and scored only 0.96 for 2016 and 2017. Its ICT infrastructure and industries is one of the least developed in the World.

Countries are also ranked (Iceland was ranked 1 in 2017, while Republic of Korea was ranked 1 in 2016). Mauritius was ranked 75 in 2016 and 71 in 2017, the highest ranked IGAD country, Kenya, is ranked at number 138 in the IDI for the year 2017. The details of the IGAD member states in the IDI are shown in the Table 7-1.

Figure 0-1: ICT development indicators



Source: ITU (http://www.itu.int/net4/itu-d/idi/2017/index.html, accessed November 2017)

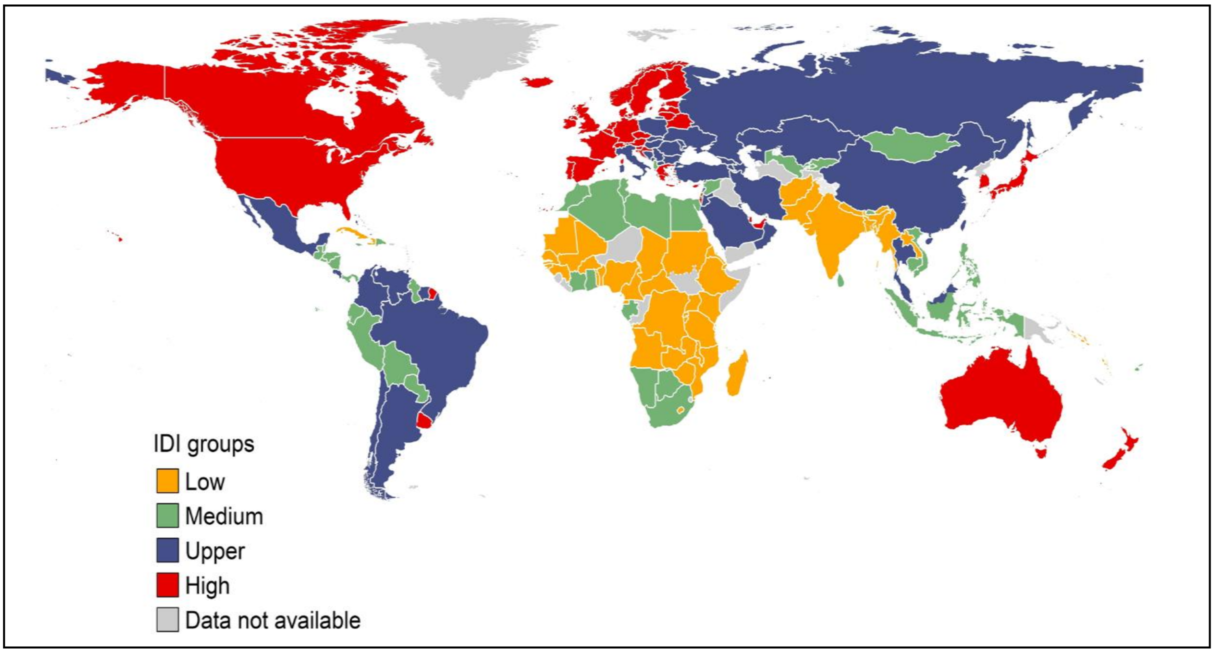
Table 0-1: IGAD member states IDI rankings and values, 2017 and 2016

Country	Rank 2017	IDI score 2017	Rank 2016	IDI 2016 score
Kenya	138	2.81	137	2.61
Sudan	145	2.55	141	2.56
Uganda	152	2.19	158	1.9
Djibouti	158	1.98	161	1.8
Ethiopia	170	1.65	171	1.42
Eritrea	176	0.96	176	0.96

The IDI is divided into four groups based on the digital divide. These four groups are high, upper middle, lower middle and low IDI scores. The low group is referred to as the least connected countries by the ITU. There are 44 LCC. The LDCs in LCC group are 37 which show the strong relation between the two groups. There are seven Non-LDCs in the LCC group namely are India, Zimbabwe, Cuba, Kenya, Nigeria, Pakistan and Cameroon. All IGAD Member States are in LCC as shown in figure 7-2 below. The

IGAD Member States are behind the developing and developed countries. ICT development is insufficient in terms of deployed infrastructure, access, internet usage, and skills. The IGAD countries have low level of economic development compared to the developed world. Some countries have suffered from political instability and insecurity due to the war which impacted negatively on the ICT development.

Figure 0-2: IDI groups by IDI value for the year 2017



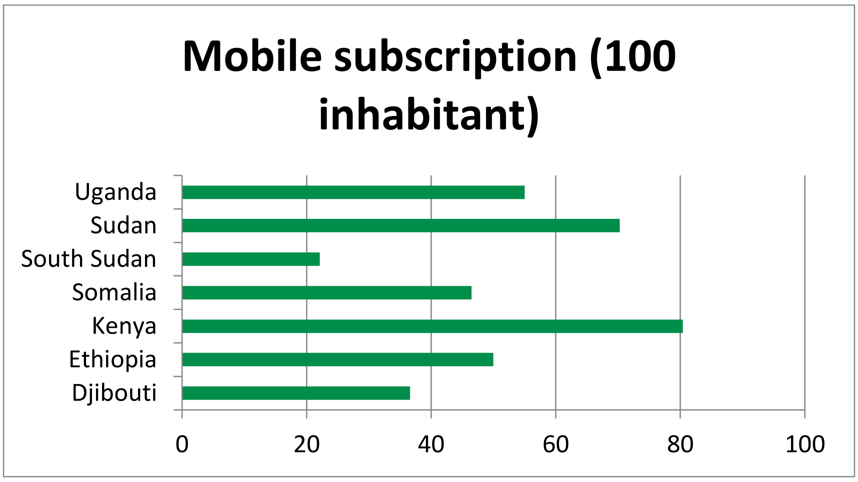
The IGAD regional Digital Divide

There is a huge digital divide in infrastructure, access of services, Internet usage, broadband connectivity and skills between rural and urban areas but also there is a Gender Digital Divide. Fewer women use ICT services and applications than men. Bridging the Gender Digital Divide is important to empower women to use ICT services and applications, and to enhance their productivity in the workplace. There is also a regional digital divide between IGAD member states in terms of national backbone development, access of ICT services and skills of people. These situations create opportunities of exchange of expertise and experience among IGAD member states, Potentially IGAD has a key role to play in the exchange of information and experience.

Access Analysis

The mobile networks are relatively well developed in the IGAD region especially in liberalised markets such as Kenya, Sudan and Uganda. The networks are not well developed in Djibouti and Ethiopia in part due to the fact that monopoly telecommunications companies dominate these countries. The network is fairly well developed in Somalia, driven by the private sector, but is unregulated. Somalia has performed significantly poorer, however, than properly regulated competitive markets such as Kenya, Sudan and Uganda. Somalia has also a lower GDP per capita than these countries which contributed to the poor performance. Recent conflict in South Sudan is a major reason for the poor development of its mobile network. Mobile penetration rates for 2016 is shown in figure 7-3. IGAD member states have more than one mobile operator with the exception of Djibouti and Ethiopia which each have only one telecommunication company. The Africa average mobile penetration rate for 2016 is 80.8 per hundred inhabitants; while the corresponding figure for the world is 99.7. Kenya has the same average for Africa. The rest of the IGAD member states has less than the Africa average. The region needs to expand mobile services, especially in rural and underserved areas.

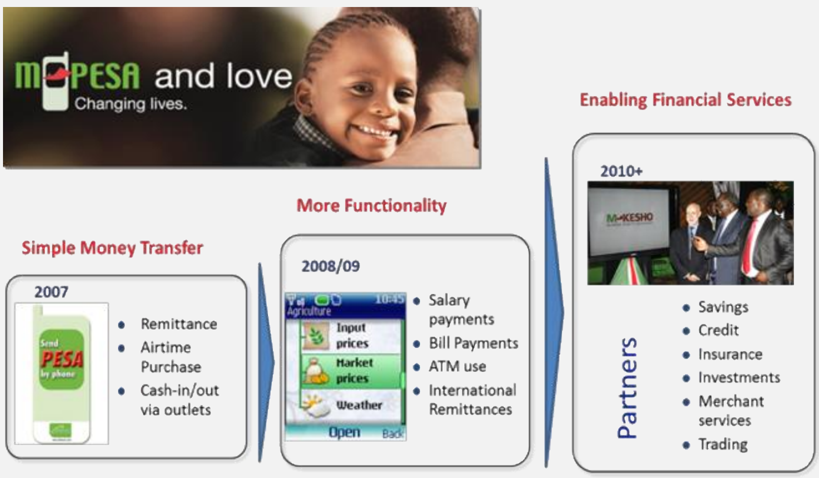
Figure 0-3*:* Mobile penetration rates in IGAD region, 2016



Source: ITU

The mobile networks provide a lot of services such as mobile money, Internet, e-payment and mobile banking. The users in IGAD region used the mobile financial services to conduct their business especially the one for the money transfer. Example for such services is M-PESA in Kenya which is a success.

Evidence Box 7.2: Safaricom's M-PESA, has changed Kenya's economy and reduced poverty: ICT and the digital economy in action. In early 2007, the leading mobile operator in Kenya, Safaricom (part of the Vodafone Group) launched M-PESA, which has become one of the most successful implementations of a mobile money transfer service. M-PESA is a SMS-based system that enables users to deposit, send, and withdraw funds using their mobile phone. Customers do not need to have a bank account and can transact at any of the country's over 11,000 agent outlets. Registration and deposits are free and most other transactions are priced based on a tiered structure to allow even the poorest users to be able to use the system at a reasonable cost. A 2016 study found that increased access to mobile money via M-PESA has lifted an estimated 2% of Kenyan households (some 194,000) out of extreme poverty, particularly among female-headed households. It has also enabled around 185,00 women to move out of subsistence farming and into business[72]



[72] Suri, T. and Jack, W (2016) The long-run poverty and gender impacts of mobile money. Science, Vol 354.

The IRIMP proposed targets for IGAD region for the mobile subscription are 60%, 80% and 100% for the years 2025, 2030 and 2050 respectively

One Area Network (ONA) Mobile Roaming Initiative

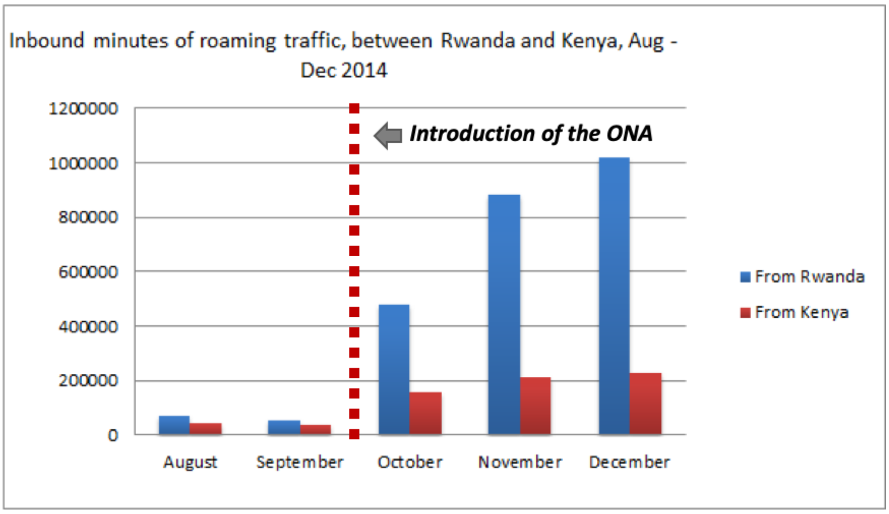
Africa hosts just five per cent of the world's global roaming market with 16.6 per cent of the world's population. Roaming use and its relevance as a service for mobile users varies significantly across the Continent. Although a low per cent of the sub-Saharan Africa's population travels abroad, research has shown up to 67 per cent of roaming traffic from the region are international calls to mobile user's home country

From June 15, 2017, mobile roaming charges were banned across the European Union. With a few exceptions, mobile operators in the EU can no longer charge additional fees to their customers for using their phones anywhere else in the region. It's a huge win for customers, getting rid of 'bill shock' after returning from a vacation or business trip, and saving time and hassle buying local SIM cards in each country. This rule is applied in thirty-one countries.

One Network Area (ONA): The East African Community (EAC) made a joint commitment in 2014 to create One Network Area (ONA) for Burundi, Kenya, Rwanda, Tanzania, and Uganda with the benefits also being extended to South Sudan. Specifically, for cross-border traffic originating in those countries, rates have been capped, mobile roaming charges eliminated and SIIT abolished. The early results have been remarkable: Inbound roaming calls to Kenya from Rwanda increased by over 950 per cent, from 63'483 minutes in September 2014 to over a million minutes by December 2014 (see Figure 7-4). Furthermore, the main traffic increase occurred on 8th October, the same day the changes were implemented, suggesting consumers are not only price sensitive but also well informed.

In Uganda, one of the most highly taxed countries in Africa, retail roaming rates were cut from US$0.93 to US$0.10 per minute. It is expected that the benefits of creating the ONA will include increased trade, enhanced regional integration and reduced costs of doing business, as well as increased revenues to the operators and the governments. Success with mobile voice traffic should also encourage operators to cut data roaming charges, perhaps without regulatory intervention. There are three Member States of IGAD who are part of the ONA. Therefore it is recommended that the IGAD Secretariat proposes that its members adopt the ONA

Figure 0-4: Roaming traffic – Rwanda and Kenya 2014

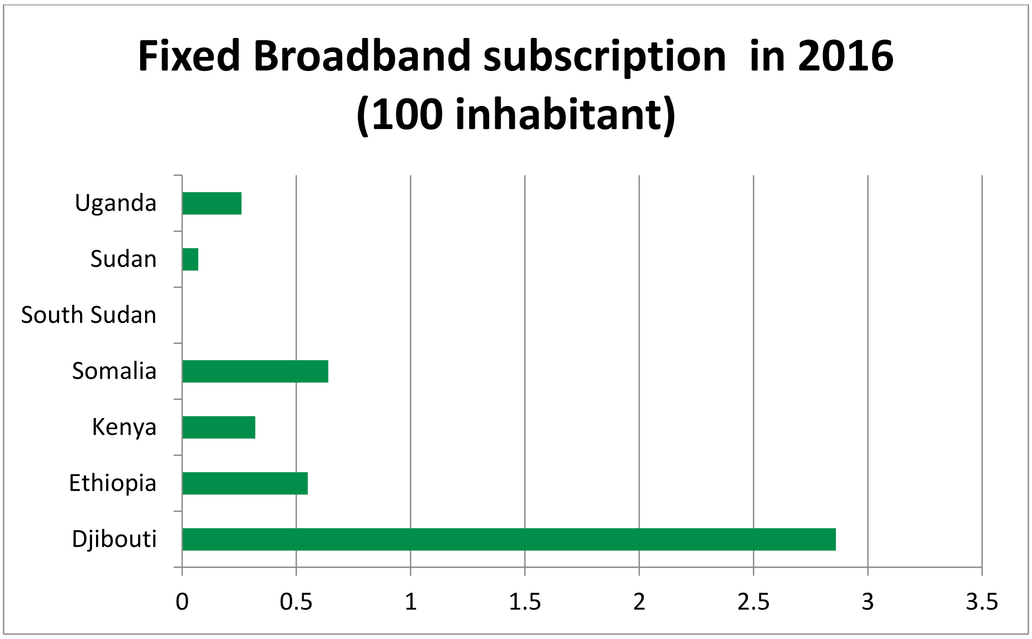


Source: World Bank (2016) Statistics www.itu.int

Broadband penetration

Figure 7-5 shows the fixed broadband penetration in the IGAD region, which is very poor. Fixed last mile connectivity has been ignored in most of the countries due to the high cost of operation and maintenance. However, it is important to re-construct the last mile cable network using fibre to the home due to its significance for the broadband connectivity. Most of the countries have one fixed telecommunications operator except Sudan which has two, Canar and Sudatel. These two operators have started deploying fibre to the home in order to provide broadband services. Broadband connectivity in Sudan, however, as of today remains very poor.

Figure 0-5: Mobile Fixed Broadband penetration rates in IGAD region, 2016



Source: ITU Statistics www.itu.int

The challenges associated with broadband deployment include its high cost, lack of awareness, market immaturity, and poor utilisation of ICT by SMEs and other businesses. The fixed broadband penetration rate for Africa is 0.7 while it is 11.9 for the world. These figures demonstrate that Africa has poor fixed broadband services. All of the IGAD Member States are less than the Africa average with exception of Djibouti.

IGAD Member States Governments should prioritise the development of broadband connectivity in order to create an effective enabling environment for the expansion of the digital economy. Fortunately, the governments in IGAD region are supporting the development of software applications and their usage especially for promoting trade, financial services, and enhancing the productivity of SMEs. IGAD member states have also established innovative centres for the youth with ICT for the development of software and other ICT applications. Some of the IGAD member states have gone further and have developed policies to promote the manufacture and assembly of ICT equipment including smart phones.

Some IGAD member states have also organised regular meetings with the private sector to address their challenges and problems and encourage them to utilise ICT services and applications. Such government initiatives will increase the access to the broadband connectivity and Internet services. To promote broadband connectivity the following recommendations should be considered:

- Raise the awareness of businesses of the benefits of using software and other applications;
- Raise the awareness of using the broad band connectivity;
- Establish more innovative centres for ICT applications and software development and their customisation at national levels particularly for the youth in major urban areas;
- Incentivise the private sector to invest in the ICT development;
- Enhance the development of e-government and other e-applications (e.g., e-Commerce, e-investor e-business, e-health, e-education) and encourage use of these applications;
- Promote of local content development and exchange with neigbhouring countries;
- Develop a regional backbone to exchange the content and broadcasting programmes;
- Implement the transport intelligent system (ITS) and other ICT infrastructure applications such as tracking of containers and vehicles, toll gates connectivity, and railway signaling and communications, and automation systems;
- Develop e-waste strategy.

Access to broadband has the potential to generate enormous social and economic benefits (e.g., economic growth, job creation, and growth of investment opportunities, access to online government services, improved education and training services, and improved national safety and security services). It is important for IGAD member states to work with the private sector in order to strengthen broadband connectivity in urban and rural areas and thereby bridge the digital divide. The fixed broadband connectivity in the region, however, is expensive. In Uganda, the fibre to the home fixed-broadband is sold at over USD 600 a month whilst ADSL based broadband is sold at USD 300 making it very expensive and unaffordable by the majority of the population. The average cost of the world for 2015 was US $25. The high prices are due to insufficient infrastructure, private sector monopoly and the lack of sharing infrastructure policy guidelines as well as the cost of providing submarine landing points and associated connections to the landlocked countries.

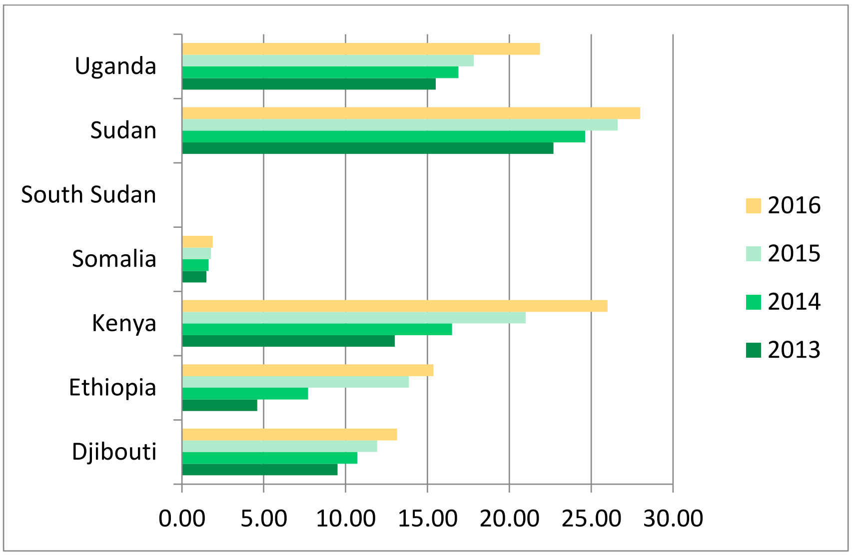
The proposed IRIMP targets for IGAD region on the broadband subscription are 5%, 10% and 20% for the years 2025, 2030 and 2050 respectively.

Internet use

The percentage of individuals using the Internet in Africa is 25.1 which is very low compared to the world average of 47.1. One of the main reasons for this low average is the high cost of the Internet and the poor infrastructure in rural areas. Figure 7-6 shows the percentage of individuals using Internet in IGAD region is lower than the African average, except for Sudan (note: there isn't any date for South Sudan). Although, the IGAD region has many submarine landing points, the cost of the bandwidth for internet is high, especially for the landlocked countries. It is also surprising to note that the cost of the bandwidth from USA or Europe to the East Africa coast is cheaper than the cost of the bandwidth from the East Africa coast to Uganda. It is similar to the container cost from Japan or Europe to East Africa coast is cheaper than the container cost from the East Africa coast to Uganda or Burundi. The cost of bandwidth of per month in Kenya is $ 46.79 and in Uganda is $68.73. Djibouti Telecom will finalise the construction of Djibouti City network of 300G capacity and the national network will be of 100G capacity. Figure 7-6 below shows the percentage of individuals using Internet in IGAD Region.

The IRIMP proposed targets for IGAD region on the Internet individual usage percentage are 20%, 30% and 60% for the years 2025, 2030 and 2050 respectively.

Figure 0-6: Percentage of Individuals using Internet in IGAD Region



Source: ITU

Pricing Analysis

The supply and demand for ICT services has changed over the last two decades. There is a growing demand for data and a decrease in traditional voice and short messages. The innovation of new handsets phones and lower prices has increased the penetration rate for mobile services. However, prices are considered as one of the barriers to access in Africa. The majority of mobile phones users do not use smart phones. A considerable percentage of the users do not see the need for Internet services and some lack the knowledge of how to use it. In addition to that the cyber security, privacy, cost and quality of services increased the number of mobile users not using Internet. Therefore, there is poor knowledge of Internet benefits. The challenges are cost, knowledge, lack of awareness and access to smart phones.

Mobile prices

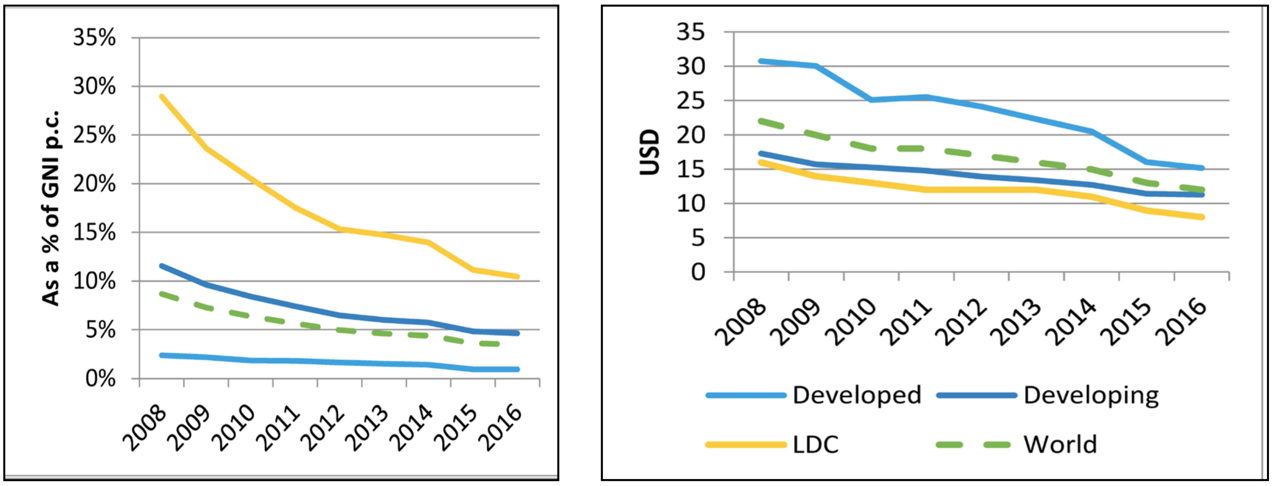
The price basket comprises 30 calls (equating to approximately 50 minutes) and 100 SMS messages per month, and includes on-net and off-net pricing, as well as peak, off-peak and weekend pricing variations. In Africa the mobile services sub-basket declined to 9 per cent of GNI per capita in 2016, from 28 per cent in 2008. The most expensive country in Africa is Cabo Verde with a basket value of USD 23.8. As percentage of the GNI per capita Mauritius has the lowest percentage in Africa of 0.6 per cent of the national GNI per capita. The two figures below show that Africa has cheaper mobile services in USD but Africa is the highest when compared in the percentage of the GNI per capita.

The price of the mobile services basket ranges from USD 1.47 for South Sudan to USD 12.67 for Djibouti. Djibouti is the most expensive country in IGAD region and above the African average by 33.4% as shown in Table 7-2. The Africa average value is USD9.5/month. South Sudan is cheaper country not in IGAD region but in the whole world. However, when analyzed as a percentage of GNI per capita, the range for IGAD region is from 1.89 for Sudan to 25.12 for Somalia. The other countries have high percentage of GNI per capita are Uganda, 9.95, and Djibouti, 7.28. In terms of US Dollars, the prices are less than the average cost for Africa with exception of Djibouti. This means that the mobile services in IGAD region cost is affordable to the majority of the citizen. The prices can sustain by increasing the access to mobile services and may go down. The factors affect the prices are the penetration rate, network development, coverage, income of individual hard currency availability among other factors.

Table 0-2: Mobile services sub-basket Price, 2016

Country	as% of GNI p.c.	USD	Tax rate included	GNI p.c.,USD,2015*
Djibouti	7.28	12.67	10	289
Ethiopia	6.47	3.18	15	590
Kenya	2.3	2.57	26	1340
Somalia	25.12	2.91	10	139
South Sudan	2.24	1.47	13	790
Sudan	1.89	3.03	31.3	1920
Uganda	9.95	5.78	18	700

Figure 7-7: Mobile services sub-basket Price



Mobile broadband prices

The growth rate for mobile-broadband was approximately 17 per cent from 2015 to 2016 which was driven by the increased affordability of smart phones and the rise in the use of applications that provide a more cost-effective alternative to traditional voice and SMS, and those that provide local content among others. Africa has low mobile-broadband prices in USD which is less than the world average at approximately USD 8 and USD 15 for the prepaid handset-based and post-paid computer-based sub-baskets respectively as shown in the Figures 7-8 below. Africa is high when compared with the average world for the GNI per capita percentage.

In terms of affordability, the IGAD Member States with the most significant reduction in price as a percentage of GNI per capita in prepaid handset-based mobile-broadband sub-basket are Sudan, Kenya and Ethiopia which they also have the lower prices in USD. The table below shows the details of the mobile broadband cost in IGAD region for the two baskets.

Figure 0-8: 500 MB handset-based (left) and 1 GB computer-based (right) sub-basket, as a % of GNI per capita (top) and in USD (bottom), 2013-2016

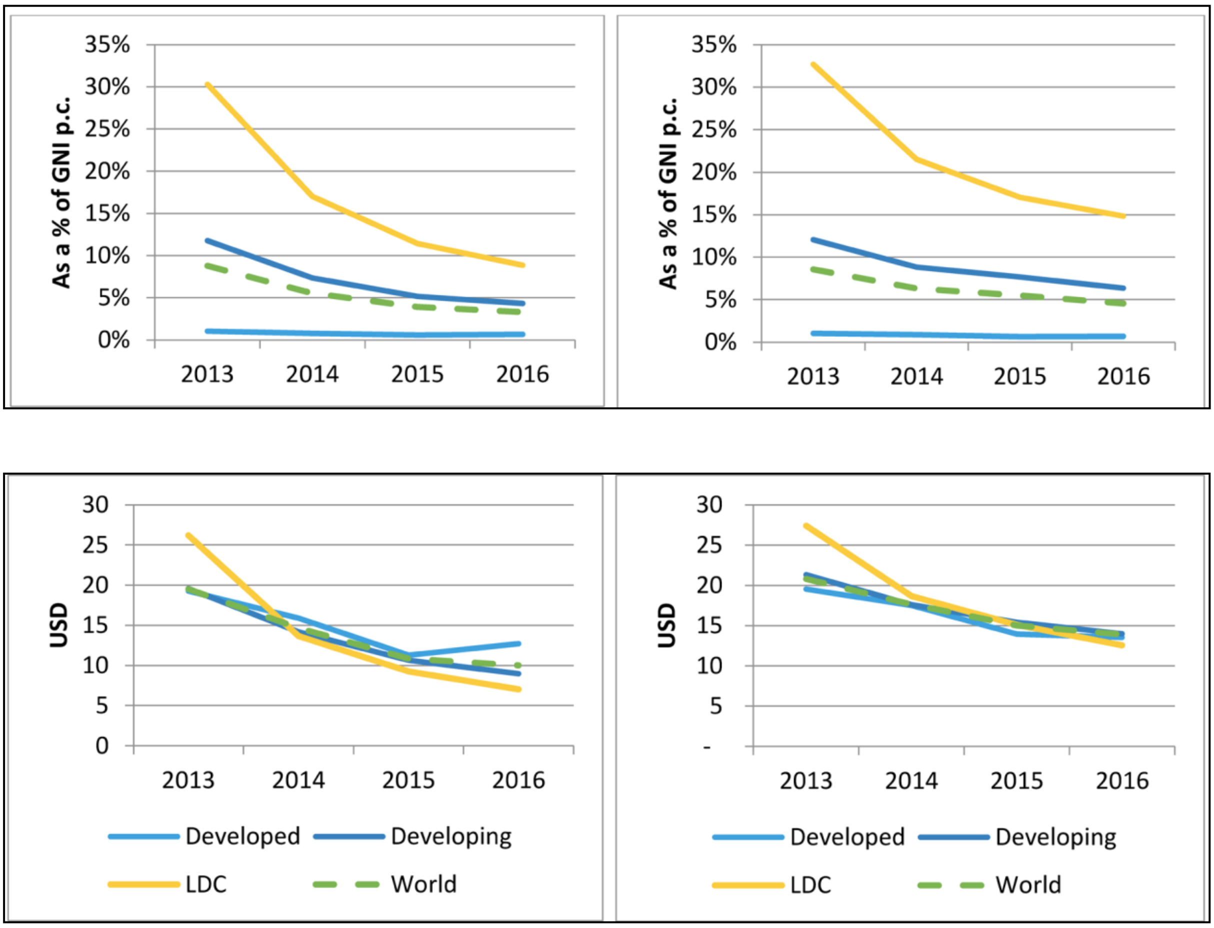


Table 0-3 Mobile-broadband sub-basket, prepaid handset-based, 500 MB, 2016

Country	Mobile-broadband, prepaid handset-based (500 MB)		Monthly data allowances (GB)	Tax rate included	GNI p.c.,USD,2015*
	as% of GNI p.c.	USD			
Djibouti	16.16	28.13	500	10	2089
Ethiopia	8.58	4.22	500	15	590
Kenya	4.41	4.93	700	26	1340
Somalia	129.5	15	600	10	139
South Sudan	14.14	9.31	500	13	790
Sudan	1.3	2.07	500	30	1920
Uganda	10.02	5.85	500	18	700

Table 0-4: Mobile-broadband sub-basket, post-paid computer-based, 1 GB, 2016

Country	Mobile-broadband, prepaid handset-based (500 MB)	Monthly data allowances (GB)	Tax rate included	GNI p.c.,USD,2015*

	as% of GNI p.c.	USD			
Djibouti	N/A	N/A	N/A	N/A	N/A
Ethiopia	16.66	8.19	1	15	590
Kenya	4.41	4.93	1	26	1340
Somalia					
South Sudan	26.13	17.2	1	13	790
Sudan	5.46	8.74	2	30	1920
Uganda	17.54	10.23	1	18	700
Unltd: Unlimited					
Note: * Data correspond to the GNI per capita (Atlas method) in 2015 or latest available year adjusted with international inflation rates.					

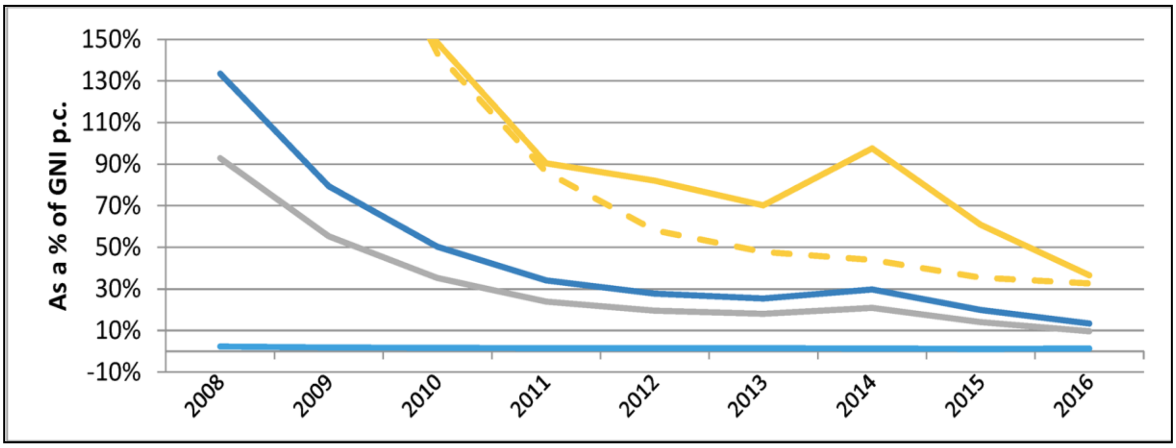
Fixed-broadband prices

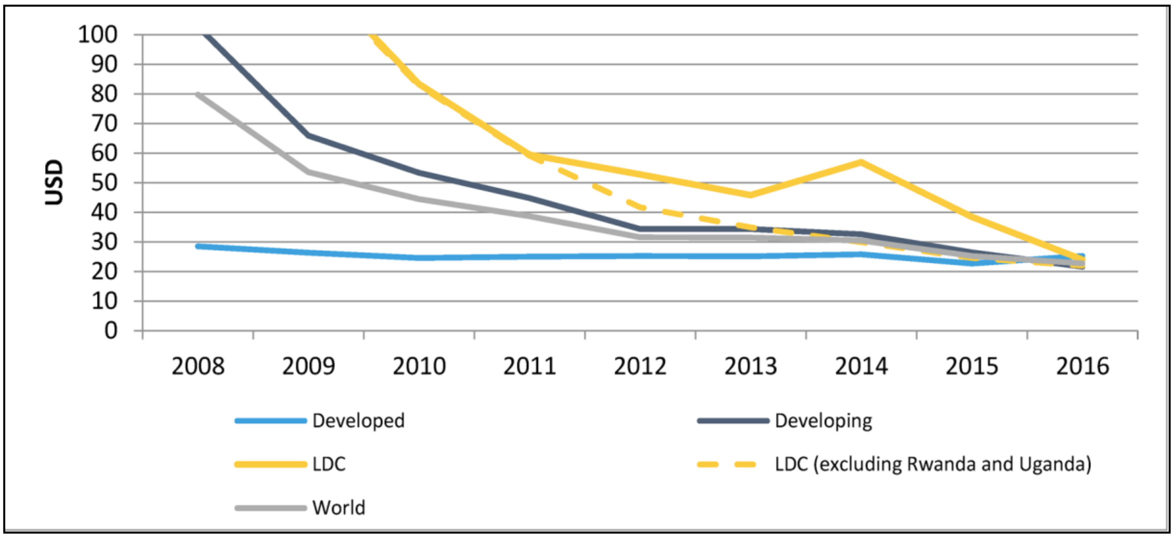
The fixed-broadband services have been on the decline since 2008 in Africa. Most African countries have fixed-broadband prices that are less than 5 per cent of GNI per capita. However Africa has higher prices than the world average as shown in Table 7-5 and Figure 7-8. In IGAD region the Member States that provide the lowest price in USD for the fixed broadband are Uganda, Sudan and Ethiopia as well as the lowest GNI per capita percentage.

Table 0-5: Fixed broadband sub-basket, 2016

Country	Mobile-broadband, prepaid handset-based (500 MB)		Cap per month in GB	Tax rate included	GNI p.c.,USD,2015*
	as% of GNI p.c.	USD			
Djibouti	32	55.71	50	10	2089
Ethiopia	25.24	12.41	2	15	590
Kenya	39.69	44.32	unlimited	26	1340
Somalia	258.99	30	10	10	139
South Sudan	25.83	17	20		790
Sudan	7.22	11.55	15	30	1920
Uganda	10.02	5.85	1	18	700
Unltd: Unlimited					
Note: * Data correspond to the GNI per capita (Atlas method) in 2015 or latest available year adjusted with international inflation rates.					
Source: ITU. GNI p.c. and PPP$ values are based on World Bank data.					

Figure 0-7: Broadband key countries





Note: Simple averages. Based on 142 economies for which data on fixed-broadband prices were available for the years 2008-2016. It should be noted that the 2014 price hike in the LDCs is partially the result of very substantial price increases in only two countries (Uganda and Rwanda), which had a sizeable impact on the LDC average (especially because complete price data for the period 2008-2016 are only available for 25 LDCs). The dotted line in the chart shows the evolution of the average in LDCs without these two countries. *Source: ITU.*

IGAD ICT Goals and Targets

It is highly important to state targets and benchmarks for master plans and strategies to measure the progress will be made by their implementation. A number of ICT targets and benchmarks have been identified and proposed in the table below. The targets will also assist in the monitoring and evaluation of the IRIMP implementation.

Table 0-6: IGAD ICT Benchmarks and Targets

	item	2025	2030
	Growth - enable and foster access to and increase the utlisation of ICT services and applications & Bridge the digital divide		
1	Mobile penetration per 100 inhabitants	60%	80%
2	Mobile geographical coverage	70%	85%
3	Fixed broadband penetration per 100 inhabitants	5%	10%
4	Percentage of Individuals using Internet	25%	40%
5	Affordability and Reduction of tariffs by	15%	25%
6	The rural areas mobile coverage	85%	95%
7	Percentage of household having access to Internet	15%	30%
8	Gender equality among Internet Users		
9	Enabling environement ensuring accessabiity ICT services and applications for persons with persons with disability	60%	70%
	Sustainability - Manage challenges emerging from ICT development		

10	Cyber security policy and legislations	0	
11	Establishment of National and Regional CIRTs by	0	
12	Develop PKI regulations, infrastructure and insttutions by		0
13	Develop Regional Cooperation framework by	0	
14	Volume of redundant e-waste to be reduced by	30%	50%
15	greengas emmision generated by ICT sector to reduced by	20%	40%
	Technology transfer and Innovation		
16	Enabling environment conducive to technology transfer	0	
17	Enabling environment conducive to Innovation	0	
18	Smart partnerships of stakeholders in ICT development	0	
	ICT Infrastructure Interconnectivity		
19	National Broadband connectivity increased to	300G	500G
20	Expand and increase the cross border ICT infrastructure connectivity by	20%	40%

Regional Network Analysis

ICT infrastructure development varies across IGAD member states. Somalia and South Sudan are at the lower level since they do not have a national optical fibre backbone. There is a digital divide between these countries and the rest of the IGAD member States. South Sudan is linked to the region and the world via satellite communications while Somalia is linked via EASSY landing point at Mogadishu and the optical fibre from Djibouti landing point to Hargesa. South Sudan has two optical fibre projects to connect to Kenya and Uganda. Sudan has three optical fibre links crossed the border of South Sudan. Hence South Sudan can be easily connected to the regional optical fibre backbone. Somalia is already connected to Djibouti by Optical fibre and Kenya has two optical fibre links at the border of Somalia ready for interconnectivity. Eritrea can be easily connected to Sudan by terrestrial links or to any of the landing points in the region.

Terrestrial Fibre Networks

Most of the optical fibre infrastructure networks in the region are used by mobile operators. Because the fixed network has a very low density since they have a costly operation and management as well as lack of using the new technology. The laying of optical fibre varies from country to another due to the terrain and the civil work cost. The total length of optical fibre in operation in Sudan is 32,636 km. Sudan has four operators and each operator has a backbone network. The total number of laid optical fibre per country is show in the table below.

Deploying a denser coverage of terrestrial fibre networks from the submarine landing points to the countries are crucial for improving access to the international bandwidth which will bring down the cost of voice and data services. It is important for Governments in IGAD region to think of implementing infrastructure sharing by putting together all national optical fibres networks under one entity or open the access to these networks to other operators on a competitive price. Hence, the cost of voice and data services will be reduced.

The other point to reduce data services cost is to implement Internet exchange points in each country and encourage the Internet Services Providers (ISPs) to join it to keep the local traffic exchange with the country. Djibouti, Kenya, Sudan and Uganda have Internet Exchange points. The one in Kenya is used by the ISPs from and outside Kenya and can be easily upgraded to a regional one. The Internet Exchange points in Sudan and Uganda are not used by all national ISPs. Djibouti has twenty African countries using Internet bandwidth to connect to the world. Most of these Internet connectivity passes via Ethiopia, Therefore, It is recommendable to IGAD to develop a framework to establish a Regional Exchange point in Addis Ababa.

IGAD Member States established data centres especially for the government information are in Djibouti, Kenya, Sudan and Uganda. The Centre in Djibouti is used by many international operators such as China Telecom, France Telecom, Google and facebook. It can be also the regional centre for IGAD member States

IGAD Member States established data centres especially for the government information are in Djibouti, Kenya, Sudan and Uganda.

Table 0-7: Total laid Optical fibre and cost per Km in IGAD region.

Member States	Laid optical fibre in Km	Cost per km in $	Remarks
Djibouti	Hundreds	14,000-17,000	There is only one link from Djibouti to Arta and then to Ali Sabeih
Ethiopia	21000	15,000-18,000	The optical fibre is two to three years old. The national backbone is ring topology and redundancy
Kenya	30,000	14,000-17,000	Government has a backbone as well as Telkom Kenya, Safaricom, Liquid Telecom and Airtel.
Somalia	hundreds	18,000-20,000	Due to the security situation in the country the operators use microwave.
South Sudan	0	0	There a concept on the optical fibre national backbone.
Sudan	32,638	10,000-15,000	The rocky and mountain places are more costly. Sudan Telecom has 14000 km in operation.
Uganda	5110	13,000-16,000	Government has a backbone as well as MTN, Uganda Telecom and Airtel.

Source: IGAD member States. Personal communication with IRIMP project

Current Submarine Cables in the region

The region has a good number of submarine cables landing points which provide international connectivity with enough capacity. It will enhance competition and ensure affordable prices for international connectivity which will contribute to the reduction of the ICT services prices at national level. Djibouti has seven landing submarine cables. They are connected to two submarine landing points. The submarine landing points are 5km apart for redundancy.

Djibouti submarine landing points can be redundancy for the Mombasa and Port Sudan ones for the strategic location and the enough capacity. The submarine landing points in Mombasa and Port Sudan be redundancy for each other for Djibouti ones as well as for the Somali submarine landing point. Djibouti soon will connect tow more submarine cables which are DARE and AWE. Somalia has the opportunity to have more submarine cable landing points.

There are twenty countries purchased Internet capacity from Djibouti Telecom which can qualify her to be the EAST Africa Internet Gateway. This Internet connectivity will also facilitate establishment of Internet Regional Internet Exchange point.

The ICT operators finance most of their projects from their own resources. Their challenges include difficult financial institutions conditions, guarantees, liberalisation of the market when a country is not ready, and delays of regional projects when there are many stakeholders.

Table 0-8: Submarine cables in the IGAD region

Member States	Submarine Cables	Capacity	Owners	Countries Linked	Remarks
Djibouti	EASSY	4.72 Tbps	Djibouti Telecom Company	-Djibouti -Ethiopia -Somalia	Djibouti has strategic position to have more landing points
	EIG	3.84 Tbps			
	SEACOM	1.28 Tbps			
	SEA-ME-WE-3	1.33 Tbps			
	SEA-ME-WE-5	24 Tbps			
	Aden-Djibouti	160Gbps			
	AAE1	40Tbps			
Kenya	EASSY	10 Tbps	TEAMS Kenya Gov Private sector	-Kenya -Uganda	Kenya Government will join the DARE project. The DARE cable will be redundancy for TEAMs since it has a different route.
	LION2	1.28 Tbps			
	SEACOM	1.28 Tbps			
	TEAM	1.28 Tbps			
Somalia	EASSY	30Gbps	Dalkom	Somalia	Somalia can have more landing points. Somali also uses the Djibouti submarine landing point.
Sudan	EASSY	30Gbps/ 9.5 STM1	-Sudan Telecom - Canar	- Sudan -Ethiopia -Chad	• The operators are connected to two landing points for redundancy • SAS2 is redundancy for SAS1.
	SAS1	60Gbps			
	SAS2	60Gbps			
	Flag	64 STM1			

Note: SAS-stand for Saudi Arabia Sudan (SAS) submarine Cable

Figure 0-8: Cables and the African Continent

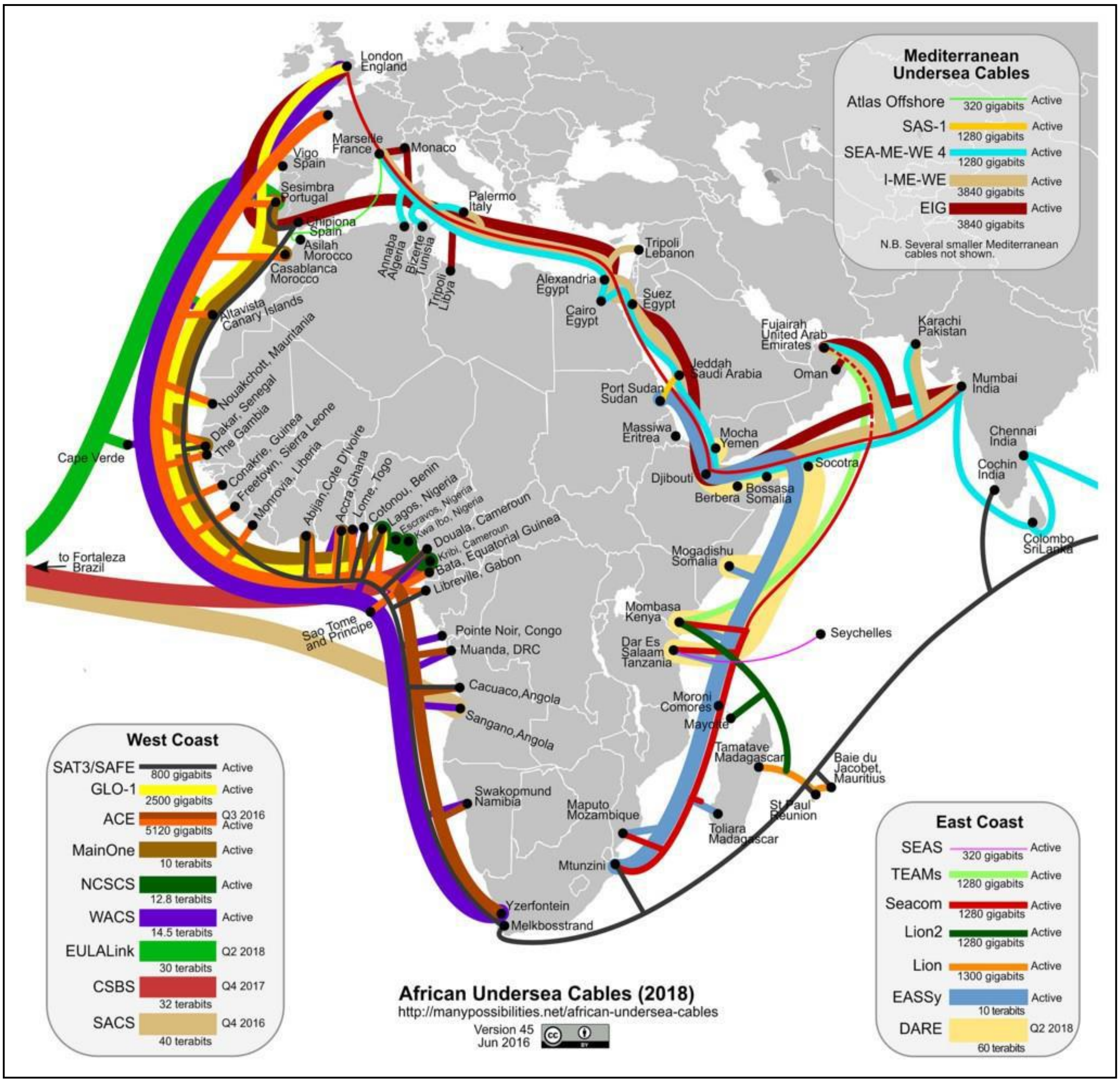


Table 0-9: Exiting Cross Border Links

	Destinations	Length	Capacity	Redundancy	Remarks
1	Addis Ababa-Djibouti		STM16/10G	There are three cables. Two terrestrial and the third on is over electricity transmission power as redundancy	The connectivity is to the country and to the submarine landing points.
2	Djibouti-Hargesa		STM16/10G	No redundancy	
3	Addis Ababa-Khartoum	Addis Ababa-border 913Km Gadarif – Galabat 170KM	STM-16 10G Sudan link 40G Ethiopia Link	There are three cables. Two terrestrial and the third on is over electricity	The link from Port Sudan landing points capacity is 10G. Ethiopia side capacity is 40G. Ethiopia has a link with

				transmission power as redundancy	Khartoum for data and voice
4	Nairobi - Somalia		STM1	No redundancy	The Somalia side is Microwave for security reasons
5	Nairobi-Kampala		10G 10G	There 3 cables	-Airtel -Kenya Telkom -Liquid Telecom
6	Nairobi-Khartoum	Via Ethiopia	10G	No redundancy	Liquid Telecom exchange traffic with Sudatel by leasing fibre from ETC
7	Nairobi-Moyali Ethiopia border	780	10G	two cables	Ethiopia has a cable at the border but no connectivity
8	Addis Ababa-Moyali		10G		No connection with Kenya
9	Khartoum-Bantu (South Sudan)		STM16	No redundancy	It is in operation providing services in petrol region
10	Khartoum-Cairo	1200	STM16	Redundancy be will constructed	It is in operation.
11	Khartoum-Ndjamena	Ndjamena-Border 1300Km Adri-Fashir	STM16	Discussion on going to construct redundancy link on power line.	
12	Bahir Dar-Matema		40G	Using ring topology	
13	Bole- Dewelle		40G	Using ring topology	
14	Bole-Galafi		40G	Using ring topology	
15	Dire Dawa-Dewelle		40G	Using ring topology	
16	Nandapal – Eldoret Fibre Optic Cable		10G	Redundancy exist	

Section 7.3 Current Status of Cyber Security

Background

The rapid development of the internet and other information systems in IGAD member states constitutes the beginnings of the digital economy. ICT technology development, however, has opened up many possibilities for criminals and terrorists. A pattern of criminal activities launched against the internet, or with the use of ICT systems as a criminal tool, is clearly discernible. These criminal activities are constantly evolving, and legislation and law enforcement have obvious difficulties in keeping pace.

Cyber security issues have gained global prominence. The United States of America has taken great strides to develop legislation, response teams for cybercrimes, and end-user education on cyber security. Furthermore, on an international level, a increasing number of nations are becoming aware of how cyber security can affect their critical information and communication infrastructure and their relations with other countries. In international conventions on cyber security, such as the Council of Europe Convention on Cybercrime and the World Summit on the Information Society, cyber security is commonly associated with national security due to an increase in the use of digital technology for the management of critical infrastructure, for military operations, and for intelligence gathering/management, mandating the creation of comprehensive national cyber security policies and strategies.

The ISO 2701 defines information as an asset that exists in many forms such as printed or written on paper, stored electronically, transmitted by post or by using electronic means, shown on films, or spoken in conversation. Information is an asset which is essential to an organisation's business and consequently needs suitable protection especially in the interconnected business environment.

Cyberspace is important to the people in their day life. Therefore, a secure cyberspace will give confidence and trust to the people of a nation to use Internet. New technologies and policies and their effective implementation can make cyberspace safer and more secure. Confidence and security in using ICTs are fundamental in building an inclusive, secure and global information society. Confidence and security are vital to use ICTs effectively, as acknowledged by the World Summit on the Information Society (WSIS).

Cyber Security Policy and Laws in IGAD Region

The African Union has orchestrated a number of cyber security conventions. The main goals of the conventions are:

- Protection of institutions against cyber-threats and attacks**;**
- Protection of individual rights in digital space, and establishing counter-measures against the threats and attacks capable of compromising such rights; and
- Establishing the legal and institutional mechanisms to guarantee normal exercise of human rights in cyber space.

Many Regional Economic Communities (RECs) developed regional model on policy, legislations and strategy such as Common Market for Eastern and Southern Africa (COMESA). The regional models are important for harmonisation and establishment of regional cooperation measures. IGAD with other regional economic communities (RECs) work on harmonisation of the cyber security legislations and policies. RECs may need to develop regional cooperation legal frameworks to tackle the cyber-crime, exchange of information and best practices, and protect the critical infrastructure information protection (CIIP). The regional cooperation framework is a must since the cybercrime has no borders.

Kenya, Sudan and Uganda developed policies, legislation and strategies using COMESA model. Ethiopia developed policies and legislations such as Certification Authorities. Djibouti, Somalia and South Sudan have poor policies and legislations on cyber security. The table below shows the status of development and implementation of policies, legislations and strategies in the IGAD Member States.

Table 0-10: Policy and legislation in IGAD Region

Country	Policy	Legislations	National Strategy
Djibouti	Yes	Yes	
Ethiopia	Yes	Yes	Yes
Kenya	Yes	Yes	Yes
Somalia			
South Sudan	Yes	Yes	
Sudan	Yes	Yes	Yes
Uganda	Yes	Yes	Yes
Uganda	Yes	Yes	Yes

Source: IRIMP assessment based on personal communication with IGAD members states

Technical Measures

Most of the IGAD Member States have e-government projects to provide the e-services such as e-payment, e-health, e-agriculture, e-educations and e-banking to the nationals in affordable, reliable and sustainable and easy access. E-government can be described as an information heavy project. All Member States have e-government projects except Djibouti and South Sudan. Hence the governments have to ensure that all information exchanged via electronic transactions are fully protected against any theft of cyber-crime. It is a challenge to get the nationals confidence in e-government for public services, hence governments have to use robust and advanced technologies, policies and regulations and strong administrative control.

Kenya is most advance IGAD country in implementing cyber security as well as Ethiopia, Sudan and Uganda. These countries established national Cyber-security Incident Response Team (CIRTs). Kenya has main national CIRT and six local CIRTs owned by Government and private sectors. These CIRTs work in close cooperation with the national one. They also implemented the protection of the critical infrastructure protection (CIIP) by establishing the necessary regulatory authorities and development of regulations and standards. Ethiopia developed the regulatory framework for CIIP.

There is no information on cyber security from Djibouti and Somalia. South Sudan has laws to tackle the cyber-crime. The table below shows the status of implementing the cyber security in the IGAD region. IGAD may need to establish a technical committee on cyber security to enhance the regional cooperation and develop the necessary regional instruments. The CIRT play important role in responding to cyber-attacks, raising awareness of the people and capacity building. There is a need to establish IGAD Regional CIRT to enhance the cooperation, exchange of information and experience and capacity building.

Table 0-11: Table: Status of implementing cyber security in IGAD region

Country	CIRT	Regulatory Authority for CIIP	Certification Authority establishment	Digital signature	e-government project
Djibouti					
Ethiopia	Yes		Under process		Yes
Kenya	Yes	Yes	Yes	Yes	Yes
Somalia					
South Sudan					
Sudan	Yes	Yes	Yes	Yes	Yes
Uganda	Yes	Yes			Yes

Source: IRIMP assessment based on personal communication with IGAD members states

Organisational Measure

The technical standards development process should involve the public and private sectors. The organisational measures include procedures and processes used in the operation and implementation of cyber security national strategy. The cyber security infrastructure should be developed to ensure the protection of the infrastructure. The ICT sector is characterised by rapid technology development; cyber security development needs to respond accordingly. Kenya, Sudan and Uganda could lead the development of the technical standards and procedures for the IGAD region. They can also help other countries in IGAD develop cyber security measures.

Capacity Building

Cyber security requires professionals who are trained in cyber security and related computer operations. The availability of well-trained professionals on cyber security policies and strategies can set the platform to develop the cyber security institutions and structure to respond to the cyber threats and attacks and cyber-crimes. The national universities have to include the cyber security in their syllables to ensure the availability of the necessary professionals. In some countries such as Kenya training was done to judges, prosecutors and police officer. There are international organisations, such as ITU and ISO that have standards in aiding and developing capacities on cyber security. The RECs such as IGAD can develop and implement a capacity building programme on cyber security including raising the awareness of the public.

Regional and International Cooperation

Cyber-crime has no borders. It can be done from outside the country where regional technical and judiciary cooperation will be highly required. IGAD needs to develop and create awareness programme on the impact of cyber security. The Cooperation process should include the private sector, regional and international organisations with the objective of countering cyber threats. Therefore, it is necessary to develop regional frameworks on technical and judiciaries systems based on the African Union cyber Convention. The cooperation is also required at the national level to ensure save cyber space. The cooperation is required among governments' institutions and agencies as well as with the private sector.

Section 7.4 Pipeline of trans-border infrastructure projects

The region has cross border interconnectivity except Somalia and South Sudan. South Sudan depends on satellite communications. Somalia has a submarine landing point and terrestrial cable to Djibouti. Somalia can easily accommodate more landing points in future since it has a long coast. The Ethiopia-Kenya terrestrial optical link is part of the Trans-African Information Highway (TAIH) from Cape to Cairo. The Trans-Africa ICT highway can be expanded as a safeguard if the submarine cables on the East of Africa are cut. Uganda wants to enhance the regional connectivity by completing the NBI at the border points of Oraba with South Sudan, Vurra and Mpondwe with DR Congo. These are two projects which require funding. See Table 7-11

Table 0-12: Cross Border ICT Planned Links

	Project	Length	Capacity	Cost	Stakeholders	Remarks
1	Africa One	22000 Km submarine cable	Capacity depend on distance	$450 million. The cost per one landing point is $30m	France, Egypt, Sudan, Djibouti, Somalia, Kenya, South Africa, Emirates, Pakistan & India	The project has reached advanced stage. The operation and maintenance agreement will be signed on 5th Dec 2018.
2	The Djibouti Africa Regional Express (DARE)	4,763 km	60Tbps	$230million	Hormuud, Telesom and Golis in Somalia and Somtel, TeleYemen, Djibouti Telecom Telkom Kenya and Africa Marine Express	-The Owner is Djibouti Telecom. -Kenya consider it as redundancy for TEAMs. -Private sector considers Djibouti as redundancy for Mombasa landing points.

3	Gulf to Africa (G2A)		20Tbps	200 million	Omantel, Ethiopia, /Telesom/Golis group Puntland,	ETC is one of the owners. The contract of laying the cable signed by Omantel and Xtera Communications. The cable was laid by Xtera Company. Telesom does not have permission to construct the landing point and connect with Ethio Telecom.
4	Khartoum - Argeen Egypt borders	1400Km	STM16	Estimated cost $19m	Zain-Sudan	Second cable to link with Egypt; is a redundancy for the submarine cables in the red sea and Sudatel cable with Egypt. Zain will connect with Egypt Telecom.
5	Isolo-Mandara (Somalia border)	420km	10G	35m	Kenya Government Backbone	It is financed by the World Bank (WB). Financing agreement signed.
6	One Area Network	N/A		N/A	East Africa countries and open to other countries	
7	Juba-Nairobi Fibre-optic				South Sudan Government	
8	Juba-Kampala Fibre-optic Link (South Sudan section)				South Sudan Government	
9	Nairobi –Juba Fibre-optic	600km	10G	$25 million	Kenya Government	The project in both countries financed by WB. Financing agreement signed
10	Arta-Tajoura (Djibouti)	180km	10G	$6 million	Djibouti Telecom	The exiting link is a microwave which will be redundancy for the optical fibre when constructed.
11	Asia-Africa – Europe 1 (AAE1)	25,000 km	40Tbps	560 million	Djibouti Telecom, Itisalat, mobily, China Unicom, Omantel, Tele Yemen, Telecom Egypt,	Connects Hong Kong, Vietnam, Cambodia, Thailand, with Malaysia and Singapore, then onwards to Myanmar, India, Pakistan, Oman, UAE, Qatar, Yemen, Djibouti, Saudi Arabia, Egypt, Greece, Italy & Fr

12	AWE.	10100	20Tbps	270 million	Alcatel-Lucent, and GoTo Networks, Djibouti Telecom	It connects Australia to Africa and Middle East
13	East African Internet Exchange Point (EAIXP)	Not applicable	Depends on Internet Exchanges in EAC	Minimal	It is possible to identify with alternative and redundancy ones.	IXP has low cost. The challenges is to convince the ISPs to use it.
14	IXP South Sudan	Not applicable	10G	50,000		
15	IXP Somalia	Not applicable	10G	50,000		
16	South Sudan Fibre Optic Backbone System		STM1/10G			It is at pre-feasibility stage.

Source: IRIMP assessment based on personal communication with IGAD members states

Section 7.5 The enabling environment

The ICT sector reform started in 1990s by privatizing the incumbent operator. Example Sudan privatised the incumbent operator in 1993. The new Company, named Sudan Telecommunications Company, (Sudatel) started business in the first quarter of 1994. Then the ICT sector started witnessing liberalisation and the attraction of the private sector investment and knowledge. The ICT sector in most of the African countries is partially or fully with the exception of few countries under monopoly. This development is due to the right climate of political, proper enabling environment, strategy, and planning. The ICT market in IGAD region is competitive with the exception of Djibouti and Ethiopia which they are under monopoly.

The ICT services can be used to enhance the productivity of other sectors such as transport and energy. Many ICT applications have been developed for the transport sector such as Intelligent Transport system (ITS), tracking, and automation. More applications can be developed by the youth for other sectors to enhance the product and management. Innovations centres can be established for the youth to develop and innovate technology and applications. The software development needs enabling environment to build the capacity of the innovators and resolve their problems. There is a United Nation organisation dealing with Standards related to ICT. This organisation is the International Telecommunication Union (ITU). All the countries in the world participate in the process of adopted the standards.

Role of Regional Economic Communities in Promoting ICT sector Development

The Regional Economic Communities (RECs) such as COMESA, EAC and IGAD have played a great role in promoting and facilitating the ICT development. COMESA and EAC have technical and ministerial committees which provide the guidance and make decision on the development and implementation of the ICT programmes and physical ICT infrastructure projects.

The RECs developed policy and regulatory frameworks since the year 2000 to fast track the implementation of the sector reforms. The ICT sector has been liberalised in many countries and regulatory authorities have been established. The liberalisation opened the sector for the private sector investment. The private sector investment has contributed positively to the development of the ICT sector. Some of the RECs such as COMESA went further and established regional associations for the ICT regulatory authorities with the following objectives:

- Exchange ideas and share experiences among members on all aspects relating to facilitating and regulating the development and application of ICT services;
- Promote sustainable development and provision of efficient, adequate and cost-effective ICT services in the ESA sub-region;
- Coordinate cross-border regulatory issues on ICT services;
- Contribute to the achievement of sub-regional and regional integration;
- Promote the optimum utilisation of scarce resources in the ICT services sector.

The RECs enhanced the harmonisation of the ICT policy and regulations across the Eastern and Southern Africa region. The Box 7.2 provides a brief about the success story of the ICT sector reform and development by RECs.

The RECs also undertaken physical cross border telecommunication interconnectivity projects such as COMTEL and Digital Transmission Network which implemented by COMESA and EAC respectively.

Success Story Box 7.2: Supporting the ICT sector in Africa. In recognition of the importance of the ICT sector to the development and diversification of the economy every REC in Africa has devised and is implementing key support policies. **COMESA**, for example, has focused on strengthening the ICT enabling environments in order to reduce the cost of doing business and trade between members in the REC and thereby stimulate economic growth and reduce poverty. The enabling environments established by COMESA to promote ICT among the member states are as follows:

- Adoption of a Common Policy and Model Legislation which includes all ICT subsectors namely telecommunications, broadcasting and postal
- Adoption of policy guidelines and model regulations in specialised areas of regulation, e.g. licensing and universal service, interconnection, frequency management, pricing, competition (fair-trading), wireless and satellite technology and consumer protection
- The establishment of an association of the region's Regulatory Authorities
- National Implementation of the Common Policy, Model Legislation and Guidelines
- Capacity building for government policy development officials and regulators as well as operators and other ICT stakeholders
- Cyber security policy, model bill, transaction law, regulations and capacity building
- Information society measurement and e-government framework

EAC also developed policies and regulations and participated in implementation of regional ICT projects funded by the European Union (EU). EAC achievements includes:

ICT Strategy

Establishment of EAPTO

ICT standards and e-government framework

E-transaction law

Cyber security legislation

SADC has also been at the forefront of promoting the uptake and use of ICT services by its member states by implementing regional support ICT policies aimed at fostering regional integration and growth SADC has impressed upon its member states to prioritise ICTs for national and regional socio-economic development and has gone ahead to develop priority action plans focusing on:

- The regulatory environment for ICT;
- Infrastructure for ICT development;
- Community participation and governance in ICT development;

- ICT in Business Development;
- Human resource capacity for ICT development.

To implement the SADC ICT master plan, the SADC Secretariat works in collaboration with the member states to:

- Develop the regional ICT frameworks and policies
- Establish the legal and regulatory conditions for regional ICT infrastructure;
- Identify, develop and involve all ICT actors in regional infrastructure projects;
- Promote optimisation of ICT investments in regional infrastructure by sharing costs between sectors (ICT, transport, energy) and operators;
- Carry out studies and establish guidelines for each of the different ICT infrastructure environments and infrastructure corridors.

Member States on the other hand have been tasked with:

- Implementation of the ICT policy and model bill
- Promoting the e-transformation of their countries and implementing policies to support for national ICT strategies in alignment with nationaldevelopment objectives;
- Provide budgetary support for e-applications development and systems integration within line ministries;
- Be responsible for the incorporation of regional institutional directives into national legal and regulatory frameworks;
- Support the reform of the ICT market sector to encourage competitive and open-access serviceprovision at all levels – international, national and local;
- Provide co-ordinated support for land use planning involving ICT aspects – i.e. also theministries in charge of other infrastructure (transport and energy), as well as metropolitan andrural district authorities;
- Facilitate transboundary infrastructure deployment and cost-based access to rights of way;
- Facilitate access to alternative/complementary infrastructure (transport/energy).
- Development of the cyber security policy, strategy, legislations, establishment of CIRT and institutional set up.

Policy and Regulatory Frameworks

Most of the countries in Africa have completed the ICT sector reform process which started in 1990s. The ICT liberalised and opened for the private sector. The sector attracted the private sector investment, management and knowledge. The countries developed policies with clear and specific vision. The main issues addressed by the policy are:

- Separation of government, regulatory and operator duties;
- Establishment of independent regulatory institutions;
- Universal service and access to basic and value-added telecommunications services;
- Creation of conditions for investor friendly telecommunications environment such as transparency and clarity in the decision-making process;
- Development of local communications industry towards global competitiveness;
- Fair competition;
- Preparation for convergence of technologies;
- Liberalisation and encouragement of private investment in the sector.

IGAD developed regional ICT policies and strategies which are important for the harmonisation. The policy was updated in the year 2013. The IGAD Regional ICT Policy objectives are:

1) To develop interconnected, high-capacity and efficient regional telecommunications infrastructure in order to position IGAD as a hub of industrial, commercial and financial services in Africa
2) To ensure efficient management and utilisation of telecommunications resources for sustainable socio-economic development
3) To further strengthen a legal and regulatory environment that supports development of a neutral and competitive IGAD's Telecommunications sub-sector
4) To promote value added services, access to information and service needs to all sectors of society especially the marginalised sections of society (rural or low income communities, women and people with disabilities)
5) To promote and strengthen ICT research and development, innovation and manufacturing activities within the region.

The interconnection of the ICT networks is essential on both national and regional levels. The ICT operators are interconnected on national level with the ICT regulatory authorities' facilitation. On regional level the operators negotiate the interconnection agreement which paves the way for their networks integration. But governments and RECs have to develop regional policy guidelines on interconnection and infrastructure sharing to fast track the integration of the cross borders ICT networks and to maximise the the utilisation by opening networks for access by existing and new entrant. Table 7-13 below shows the implementation of policies and regulations in IGAD region.

Most national ICT policies and strategies identified capacity building as a priority; however, most countries fall short on implementation. Building capacity can reduce the capital cost of the ICT infrastructure projects by designing, installing, testing and commissioning using the national experts. It will also ensure efficient and effective operation and maintenance of the ICT networks. IGAD countries needs a coherent strategy for capacity development at all levels, and this strategy needs to look first at ICTs as a discipline and secondly as a cross-cutting enabler of other disciplines.

Table 0-13: ICT policies in the IGAD region

Country	Policy	Law	Licensing Regulation	Interconnection Regulation	Pricing Regulation	Competition Regulation
Djibouti	Yes	No	No	No	No	No
Ethiopia	Yes	Yes	No	No	Yes	No
Kenya	Yes	Yes	Yes	Yes	Yes	Yes
Somalia	Yes	Yes	No	No	No	No
South Sudan	Yes	Yes	Yes	Yes	Yes	Yes
Sudan	Yes	Yes	Yes	Yes	Yes	Yes
Uganda	Yes	Yes	Yes	Yes	Yes	Yes

Source: IRIMP assessment based on personal communication with IGAD members states

Institutional Arrangements

The governments operate providers some of which have been privatised, and new companies have been established by the private sector. At present Kenya, Sudan, Uganda and Somalia have many ICT operators. The regulatory authorities have been established in Kenya, Somalia, South Sudan, Sudan and Uganda. The main objective of the regulatory authority is to regulate the ICT sector ensuring affordable, reliable and sustainable services with high quality.

Djibouti and Ethiopia ICT sectors have not been liberalised, and they as run as monopolies. The ministries responsible for ICT are regulating the market. Ethiopia is in the process of finalising a proclamation to establish and independent regulatory authority. It will be finalised by the end of 2018. The regulatory authority will report to parliament and not to any ministry to ensure transparency and accountability, and create an effective enabling environment designed to attract investment.

Competition

Competition in the ICT sector has increased (see Table 7-14). Most of the regulatory authorities established in IGAD region are independent and regulate the market. All ICT services opened for full competition in Kenya, Somalia, South Sudan, Sudan and Uganda. Djibouti and Ethiopia are under monopoly. Ethiopia government established committees to privatise the Ethiopia Telecommunications Company (ETC). ETC will open very soon for the private sector investment. After completing the privatisation process, the ICT sector will be liberalised and opened for competition. The table below shows the competition in IGAD region.

The stakeholders for any infrastructure sub sectors are policy makers, regulators, and operators. Normally the policy makers are government which they should operate any network or provide any services. Governments should focus on the policy issues and create enabling environment for new entrants and for regional connectivity. The governments may not have the adequate knowledge of operating and managing the networks. It is healthy for competition government should not be an operator. The ICT regulator has to make research on ICT market and competition maturity. It should not allow private monopoly or protection by opening the market for new entrant.

Table 0-14: Level of Competition in IGAD Region

Service	Djibouti	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Local Fixed Line Services	M	M	C	C	N	C	C
Domestic fixed long distance	M	M	C	C	N	C	C
International Fixed Long Distance	M	M	C	C	N	C	C
Mobile	M	M	C	C	C	C	C
Fixed Wireless Broadband	M	M	C	N	N	C	C
Leased Lines	M	M	C	N	N	C	C
International Gateways	M	M	C	N	C	C	C
Internet Services	M	M	C	C	C	C	C
M: Monopoly							
P: Partial competition (year when competition was introduced)							
C: Full competition (year when competition was introduced)							
N: N/A							

Section 7.6 Constraints and Barriers on ICT Development

Efficient information and communications technology (ICT) services contribute to the achievement of IGAD's objectives of enhancing regional integration, sustainable growth and development. However, the ICT sector is still characterised by poor infrastructure and services associated with limited participation of the private sector in policy formulation and investment. There are challenges face the sector development. These challenges include:

- Lack of regional policy and legislation as well as regulatory framework

- Poor business environment and no incentive
- Regulatory authorities capacity needs to be strengthened
- Lack of information on the ICT sector performance at national level.
- Inadequate deployment of broadband infrastructure especially the last mile connectivity
- Low internet penetration, especially in the rural areas.
- The high cost of the ICT services
- Limited sharing of the ICT infrastructure by the operators in both passive and active infrastructure
- Insufficient uptake of ICT by SMEs and businesses;
- Poor implementation of cyber security in some Member States

Figure 0-9: Proposal for Actions

Summary of Policy and Institutional Options	
Development of Regional ICT and Cyber security policy and regulatory frameworks	Establish a Committee for Regulatory Authorities as well as operators and ISPs
Development of Regional cooperation agreement on cyber security	Setting up of Regional CIRT Establishing a regional mechanism for recognition Certificate Authorities
Create an enabling environment for infrastructure competition	Stimulate roll-out in underserved and rural areas
Remove regulatory obstacles to investment and competition • *Remove limits on the number of network licenses* • *Encourage the entry of alternative infrastructure providers* • *Remove constraints on the backbone services market* • *Improve the regulation of backbone networks* **Reduce the cost of investment** *Facilitate access to passive infrastructure. Promote infrastructure-sharing. And unbundling* **Reduce political and commercial risks** *Risk guarantees and political risk insurance* *Demand aggregation* **Promote effective competition in the downstream market** *Promote downstream competition through effective regulation.*	**Competitive subsidy models** *Provide operator(s) with subsidy to build and operate a network in currently underserved areas of the country. Services provided in these areas on a non-discriminatory basis.* **Shared infrastructure/consortium models** *Provide operators with incentive to cooperate in the development of backbone infrastructure in currently undeserved areas of the country where infrastructure competition is not commercially viable* **Incentive-based private-sector models** *Provide operators with an incentive to build networks in currently underserved areas through reductions in USF contributions or sector levies.*

Source: IRIMP assessment based on personal communication with IGAD members states

Section 7.7 ICT Demand (2019-2050)

Demand Technology Drivers

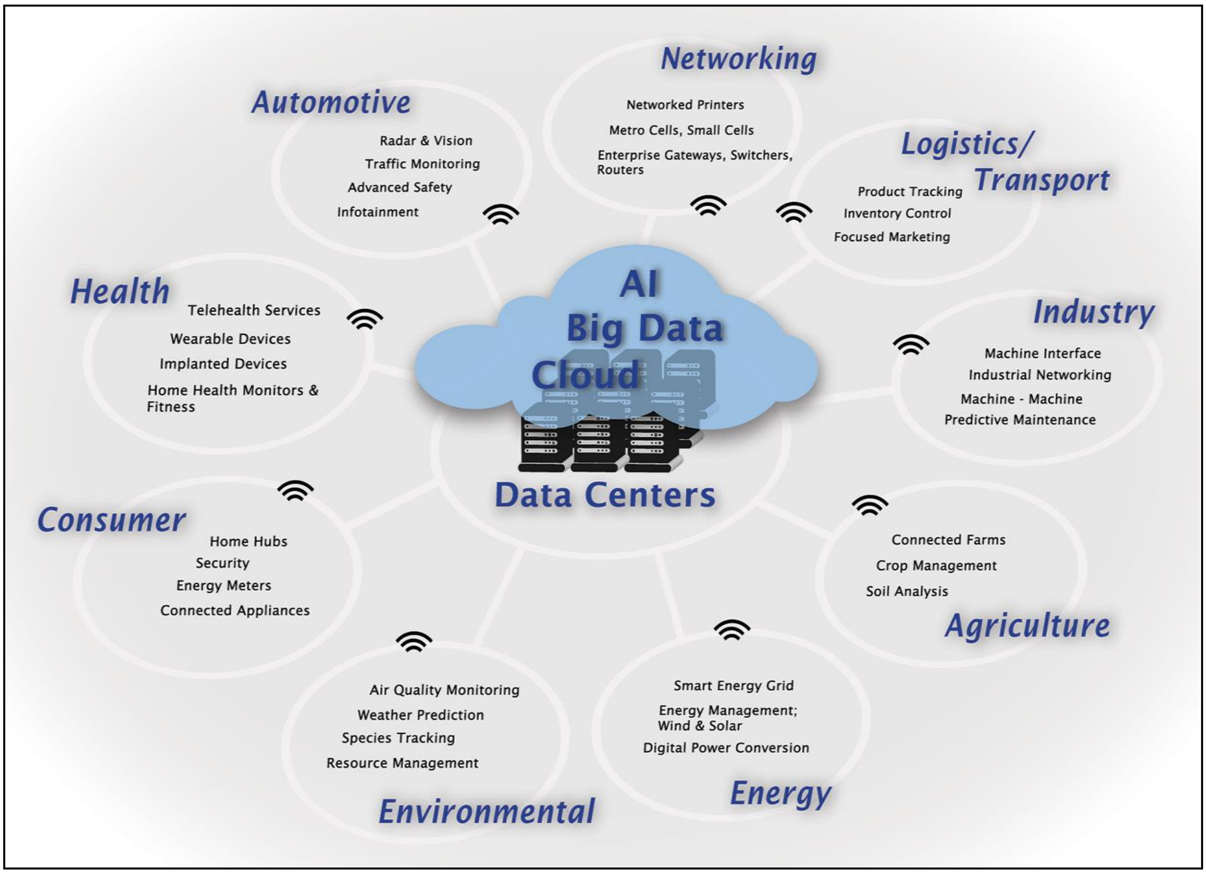
The ICT demand is driven by the growth of voice traffic and data volume. The growth of voice is going down due to the usage of Voice over IP applications such as skype, viper and imo. The data volume growth increases due to the expansion of the Internet and broadband services. The demand for bandwidth needs to be estimated and projected into the future to design the regional and national backbone network for adequate capacity. This task is particularly difficult in some countries such as Somalia and South Sudan because there is very little reliable data available that could be used in a forecasting model. With help of the regulatory authority the telecommunications operators can provide information to estimate the growth rate per year which will be used to calculate the demand and the expansion capacity of the existing network.

The demand for bandwidth will definitely need to be increased to provide capacity for internet and broadband services as well as international and regional capacities. When reviewing demand and ICT cross border connectivity redundancy has to be taken into account. The redundancy concept is the duplication of links which should be physically separated from each other.

It is important to ensure the availability and sustainability of the services. When two or more operators build ICT infrastructure along the same route and lease capacity on each other's infrastructure as a backup redundancy has been achieved. The policy of infrastructure sharing can contribute significantly to redundancy and optimise infrastructure cost. The most effective redundancy concept on the network topology level is the creation of ring structures. In the event of a local failure in a ring structure, almost any point along the ring can continue to be served by routing traffic the other (longer) way around the ring.

The data volume demand will be influenced by the development of new technologies and innovations which will make a huge transformation. The transformation will come with opportunities, challenges and implications that are not yet fully known. The excepted technology development main products are the Internet of Things (IoT), cloud computing, big data analytics and artificial intelligence as shown in the figure below. When these technologies are deployed new services and products developed for the use of the people which definitely will generate more data volumes and requires more bandwidth and high speed. ICT has a great role in enhancing technology, businesses and society interaction. This development requires access to the infrastructure, software and availability of skilled persons.

Figure 0-10: IoT, cloud computing, big data and artificial intelligence



International Traffic Analysis

The world has witnessed development of many applications for voice communications using voice over IP (VoIP) such as imo, whatsapp and skype. These applications have negative impact on the telephone traffic growth because in most of the countries the voice traffic growth has a negative growth rate if not zero. These applications will attract more voice traffic in future from the normal voice channels due to the cost of the international services, quality improvement and technology development.

The IGAD member states have also witnessed a negative growth rate or expansion with a very minimum rate. The international voice traffic growth rate fluctuations have been seen in the Djibouti, Kenya, Sudan and Uganda which is an international trend. There is no data from Somalia and South Sudan however estimation has been made take into account the population, network condition and the fixed network. The assumptions for traffic forecasting are:

- **Cluster one includes Kenya, Sudan and Uganda**. They have open market with national network backbone infrastructure. The forecasting will be 3% for the short term planning and 2% for the medium and long term planning.
- **Cluster two includes Djibouti and Ethiopia**. Monopoly with good national backbone network infrastructure the forecasting will be 5% for the short term planning and 3% for the medium and long term planning.
- **Cluster three includes Somalia and South Sudan** which have open market with poor infrastructure for the national optical fibre backbone infrastructure and low penetration rate. The growth rate will be

6% for the short term planning and 4% for the medium and long term planning.

The traffic forecast for the short, medium and long term is shown in the table below.

Table 0-15: Forecast for total International Traffic

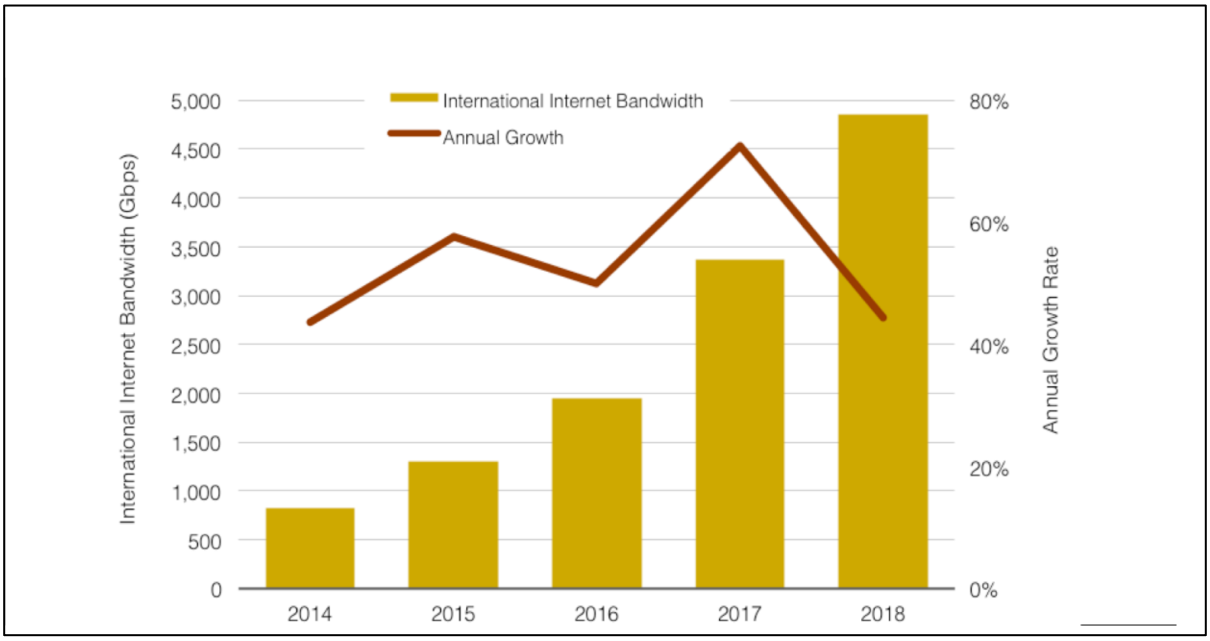
	Short Term Plan		Mid Term Plan		Long Term Plan	
Country	2016 (million minute)	2024 (million minute)	2025 (million minute)	2030 (million minute)	2031 (million minute)	2050 (million minute)
Djibouti	56.337	83.23541	87.39718	105.37	108.5311	190.3099
Ethiopia	372.1*	523.5821	570.8492	688.2415	708.8887	1243.041
Kenya	1053.421	1334.442	1414.509	1640.125	1672.927	2437.139
Somalia	230**	366.5851	388.5802	491.6779	511.345	1077.327
South Sudan	160**	255.0157	270.3166	342.0368	355.7182	749.4447
Sudan	2502.77	3170.434	3265.547	3677.537	3751.087	5464.626
Uganda	639.788	810.46	834.7782	940.0959	958.8978	1396.933

*data is for 2017 ** Estimation

International bandwidth Analysis

The international internet bandwidth has a high rate especially in Africa. In Africa Internet bandwidth is, growing at a compound annual rate of 44 percent between 2013 and 2017 according to TeleGeography . The Middle East was just behind Africa, rising at a 42 percent compound annual rate during the same period. The international Internet bandwidth has a rate of around 50% for Uganda for the year 2016. Kenya bandwidth growth rate is low which may not be correct. It is difficult to calculate the international Internet bandwidth for the other country in the absence of data. Estimation has been proposed for some countries taking into account the population, national backbone infrastructure, penetration rate, pricing and competition

Figure 0-11: International Internet Bandwidth Growth – Sub-Saharan Africa



The clustering mentioned above will be used for proposing the growth rate. The growth rate for the short and medium trams planning will be high compared to the one for the long-term planning. It will be similar to the mobile growth rate which very high six or seven years ago but now is at lower growth rate.

The assumption for the international Internet growth rate is as follows:

- **Cluster one includes Kenya, Sudan and Uganda**. The forecasting will be 25% for the short and medium terms planning and 15% for the long term planning.
- **Cluster two includes Djibouti and Ethiopia**. The forecasting will be 16% for the short term planning, 21 for the medium term planning and 18% for the long term planning.
- **Cluster three includes Somalia and South Sudan**. The growth rate will be 12% for the short term planning, 20 % for the medium and 16% long term planning.

The forecasting for the international Internet bandwidth is shown in the table 7-15 below.

Table 0-16: Forecast for International Internet bandwidth

	Short Term Plan		Mid Term Plan		Long Term Plan	
Country	2016 Gbps	2024 Gbps	2025 Gbps	2030 Gbps	2031 Tbps	2050 Tbps
Djibouti	47	166.0404	192.6069	599.4872	0.725379	16.83928
Ethiopia	285*	805.4726	934.3482	2908.15	3.518862	81.6884
Kenya	877.775	2877.711	3223.036	8185.084	9.412846	133.9615
Somalia	23*	56.94715	63.78081	190.4485	0.228538	3.834075
South Sudan	17*	42.09137	47.14234	140.7663	0.16892	2.833881
Sudan	560*	1835.912	2129.658	4926.029	5.664933	80.62204
Uganda	61.585	201.9012	234.2054	541.7313	0.622991	8.866265

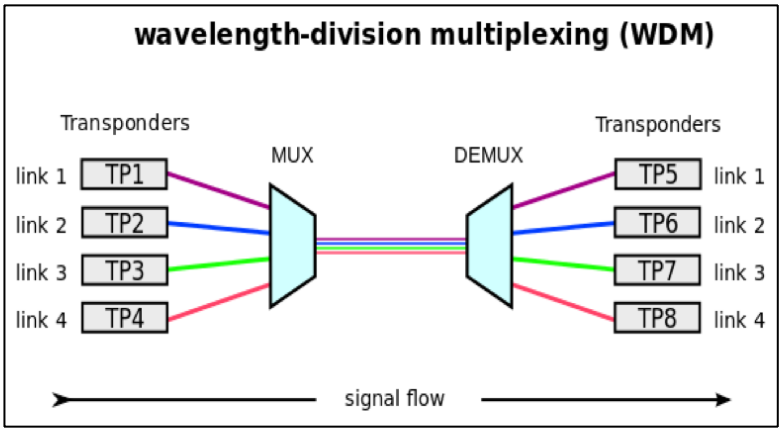
Note* Estimation for Ethiopia, Somalia, South Sudan and Sudan

Estimated increase in capacity based on current pipeline

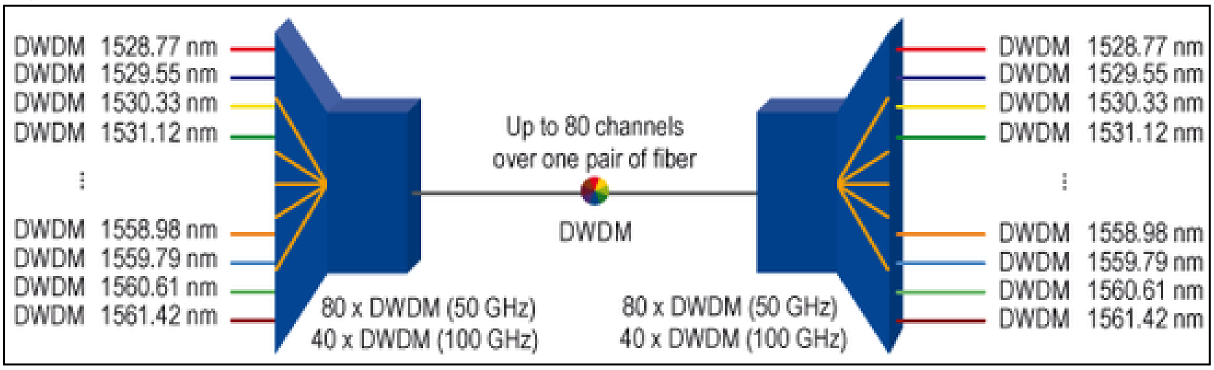
The estimation will also be used to design the necessary national and cross border optical fibre interconnectivity. Regional and international bandwidth is the bandwidth available at an international gateways be at satellite earth station, cross border optical fibre or/and submarine landing points. The total international bandwidth of a country is the sum of all international bandwidth at all the gateways in the country. The expansion and reviewing of the national backbone will generate ICT infrastructure projects. The implementation of these projects will put the region on the eve of the digital economy and maximise the utilisation of the submarine cable available capacity. It will promote balanced economic development and reduce the digital divide.

Dense Wavelength Division Multiplexing (DWDM)

In fibre-optic communications, wavelength-division multiplexing (WDM) is a technology which multiplexes a number of optical carrier signals onto a single optical fibre by using different wavelengths of laser light. The technique allows bidirectional communications and multiplication of capacity over one strand of fibre. A Wavelength Division Multiplexing (WDM) system uses a multiplexer at the transmitter to join the signals together and a de-multiplexer at the receiver to split them apart. It is possible to have a device that does both simultaneously, and can function as an optical add-drop multiplexer.



DWDM – wavelengths are more expensive compared to CWDM caused by the need of more sophisticated transceivers.



Theoretically available DWDM channels in the C and L-band depending on the channel spacing

Channel spacing in GHz	200	100	50	25	12,5
Channel spacing in nm	1.6	0.8	0.4	0.2	0.1
Number of available channels (C-Band)	22	45	90	180	360
Number of available channels (L-Band)	35	70	140	280	560

WDM System

WDM systems operate on single mode fibre optical cables, which have a core diameter of 9 µm. Certain forms of WDM can also be used in multi-mode fibre cables (also known as premises cables) which have core diameters of 50 or 62.5 µm.

WDM systems are divided in three main different wavelength patterns as shown in the table below.

	WDM System	Description

1	Conventional WDM	Provide up to 16 channels in the 3rd transmission window (C-band, around 1550 nm) of silica fibres.
2	DWDM	Uses the 3rd transmission window (C-band) with denser channel spacing. Channel plans can be: 40 channels at 100 GHz spacing, 80 channels with 50 GHz spacing or of 25 GHz spacing. The system with 25 GHz called ultra dense WDM. A system of 320 channels is also present (12.5 GHz channel spacing). Distances over 1,000 km can be achieved with the use of optical amplifier
3	Coarse WDM (CWDM)	In contrast to conventional WDM and DWDM uses increased channel spacing to allow less sophisticated and thus cheaper transceiver designs. To provide 16 channels on a single fibre CWDM uses the entire frequency band between 2nd and 3rd transmission window (1310/1550 nm respectively) including both windows (minimum dispersion window and minimum attenuation window) but also the critical area where OH scattering may occur, recommending the use of OH-free silica fibres in case the wavelengths between 2nd and 3rd transmission window shall also be used. Avoiding this region, the channels 31, 49, 51, 53, 55, 57, 59, 61 remain and these are the most commonly used.

WDM, DWDM and CWDM are based on the same concept of using multiple wavelengths of light on a single fibre, but differ in the spacing of the wavelengths, number of channels, and the ability to amplify the multiplexed signals in the optical space. WDM systems are well known by telecommunications companies because they allow them to expand the capacity of the network without laying more fibre. Capacity of a given link can be expanded by simply upgrading the multiplexers and de-multiplexers at each end

Current Pipeline Capacity Expansion

The expansion of the existing network has been calculated assuming the current capacity is at the maximum or near to the maximum. The percentage of expanding the network calculated based on the existing capacity. There is no need to deploy new optical fibre for the expansion. It is easy to expand the current network by adding cards to the multiplexing and de-multiplexing equipment since the network is based on the DWDM. The explanation of the DWDM shows the expansion of the networks will not be costly. Therefore, the operators should have a threshold for expansion. The procurement can be notified if the traffic capacity occupied 60% of the total available capacity. Installations can be upgraded when the traffic capacity reaches 70% of the available capacity. The percentage of expansion is shown in the table below.

Table 0-17: Percentage of expanding the international gateway network capacity

	Short Term Plan Expansion % based on existing capacity	**Mid Term Plan Expansion % based on 2024 capacity**	**Long Term Plan Expansion % based on 2030 capacity**
	2024	2030	2050
Djibouti	50	38	150
Ethiopia	40	45	149
Kenya	30	26	75
Somalia	60	54	254
South Sudan	60	54	254
Sudan	26	21	71
Uganda	26	21	71

The method above for expanding the traffic is applied to the international Internet bandwidth. The bandwidth and percentage of expansion was calculated as shown in the table 7-17 below.

Table 0-18: Percentage of expanding the international bandwidth capacity

Country	Short Term Plan Expansion % based on existing bandwidth	Mid Term Plan Expansion % based on 2024 bandwidth capacity	Long Term Plan Expansion % based on 2030 bandwidth capacity
Djibouti	311	311	2321
Ethiopia	311	311	2321
Kenya	254	254	1423
Somalia	299	299	1678
South Sudan	299	299	1678
Sudan	231	231	1423
Uganda	231	231	1423

Optical fibre life cycle

The life cycle of the optical fibre can be around twenty years. It is also important to take into account the environment and the condition of laying the fibre which may affect the life cycle of the optical fibre negatively. Preparation to change the optical fibre cabling should start approximately 15 years after it has been laid. The laying of new fibre should commence start approximately 20 years after it has been laid.

Section 7.9 ICT Gap analysis

It is essential when considering the gap analysis to take into account the ICT cross border links infrastructure sustainability, quality, reliability and availability. The usage of the ring topology in the national optical fibre backbone will ensure the achievement of the sustainability and reliability. It is also important to have redundancy for the cross-border ICT infrastructure links and it will be proper if it is on the power transmission lines. It is also important to have different towns or cities for the cross border interconnectivity for example all the three optical fibres between Ethiopia and Sudan pass through or near Matema and Galabat. It is important for Ethiopia and Sudan to construct links via Humera-Kassal and Gambela-Damazeen.

The assumption for bridging the gaps is that the short-term planning will be for the completion of the planned projects and expansion of the existing network. However, the Eritrea interconnectivity projects should be implemented in the short- term planning. Eritrea can be connected to Sudan and Ethiopia as well as to submarine cable landing points to Port Sudan or Djibouti depending on the cost.

Short-term Planning Projects, to 2024

As stated above, expansion of ICT networks for data or voice is not costly, because the technology used is DWDM. Multiplex and interface equipment are required which is not costly. Therefore, the short-term planning will include the expansion of the existing networks which don’t require high investment. It will also include the projects which are currently in the pipeline.

Medium-term Planning Projects, to 2030

Most of the ICT networks in the liberalised and competitive market is owned by the operators. The operators normally work to a comprehensive business or strategic plan, which is not in the public domain. The business of strategic plan contains the operator network expansion including new links for the next five years.

The second organisation of importance when considering the development of an ICT network development is the regulatory authority or the ICT ministry where there is no regulator. The regulator plans for the network and usually takes into consideration the operator's business plan in identifying the projects for the medium-term planning.

The ownership of new projects and the regional ring of optical fibre links by the IGAD member states, especially the ICT operators and regulators, is essential in order to ensure the implementation of these projects. The lack of these institutions means the new projects will remain merely a 'wish list'.

The ICT equipment has backup systems. For the optical fibre networks, ring topology should be taken into consideration when planning for medium and long terms to ensure redundancy and reliability of the network. The current national networks in IGAD Member States are based to some extend on ring topology with the exception of networks in Djibouti, Somalia and South Sudan. It will also be better to apply ring topology on the cross-border connectivity. The proposed regional rings are:

- Ethiopia, Sudan, South Sudan, Uganda, Kenya and back to Ethiopia
- Ethiopia, Djibouti, Somalia and back to Ethiopia.
- Kenya, South Sudan, Uganda and back to Kenya,
- Djibouti, Ethiopia and Sudan including the submarine cables

Currently there are cross borders optical fibre links which can be facilitated by policy and negotiation of necessary agreements to establish rings on IGAD regional level such as the one for Djibouti, Ethiopia and Sudan including the submarine cable. The other proposal is to have cross border optical fibre links redundancy by area. The proposed cross borders links based on geographical locations are:

- Ethiopia and Sudan link currently pass through Metema and Galabat, hence the redundancy links can be via Humera-Hamdyeed-Kassala and also a second one via Gambella-Kurumk-Damazin
- Ethiopia and Djibouti current optical fibre inks via Galafi. The redundancy can be via Ali Sabieh and also the usage of the Standard Gauge Railway optical fibre;
- Kenya and Uganda current links are via Malaba. The redundancy can be via Busia and Kusumo
- Ethiopia and Somalia have no cross border optical fibre but they can have more than one in terms of geographical locations;
- Uganda and South Sudan have no currently cross border optical fibre but they can have more than one in terms of geographical locations;
- South Sudan and Sudan have no currently cross border optical fibre but they can have more than one in terms of geographical locations;
- Djibouti and Somalia have one optical fibre link but they can have a second one in terms of geographical location and another one by submarine cables.
- Ethiopia and Kenya currently can be linked via Moyale but they can have a second one in terms of geographical location and another one by submarine cables (Ethiopia-Djibouti-Kenya using DARE system)

New projects can be derived from the proposals above for the redundancy and ring topology. The new projects may need policy and regulatory interventions therefore, the involvement of the regulatory authorities and ICT ministries is crucial and to some extend the ICT operators. There is also a need to have information from the stakeholders to complete the inventory sheets for the new projects.

Long- term Planning Projects, to 2050

The long-term planning is not appropriate for ICT projects due to the technology rapid development. The introduction of Internet, GIS, e-applications especially the e-government and mobile money has contributed tremendously to the society transformation. By means of the Internet, people are able to acquire any information and digitally communicate with anyone, anywhere and at any time. The various information systems that governments have developed over the past years can now be extended to reach businesses and citizens with the help of the Internet, no matter where they are located. Hence, besides providing a public information service to businesses and citizens, government can also provide various online public services to business and citizens through the Internet. In addition, the Internet can help government in improving its interactions with businesses and citizens, while providing a sound basis for establishing a new type of partnership relationship among these three bodies in the information age. The applications of ICT to the infrastructure projects enhanced the efficiency, productivity, and increase the projects lifecycles.

Therefore, all the ICT ministries and operators plan for a maximum of five years due to the technology new development and innovation. The big operators have their research and technology centres to track the development of technology and implement pilot projects to assess the new technology practicality.

The projects for the long-term planning will depend on the new technology developed, demand and gap analysis, redundancy and ring topology.

Trans-Border Project and Policy Prioritisation Criteria

Section 8.1 Introduction

The purpose of this section is to briefly describe the IRIMP project screening and selection methodology. Governments and their respective ministries, departments and agencies (MDAs) face the daunting task of choosing which infrastructure projects to prioritise and implement from among a long list of possibilities and often subject to major funding constraints. Good practice in public investment management suggests applying full social cost-benefit analysis (SCBA) in order to provide a transparent and empirical basis for project prioritisation, typically using net present value (NPV) estimates to rank projects.

In the IGAD context of highly constrained technical capacity among Member States, lack of data and political pressures to act fast, poor project selection and low likelihood of sustainable implementation are major risks to achieving target development outcomes. Demand for infrastructure investment is high, the gap between demand and supply is a constraint on growth – across Africa and in IGAD - and yet there appears to be an ample supply of investment capital. There is an investment gap in infrastructure, a big one. Breaching the investment gap requires a smart combination of sector wide reforms – creating enabling policy and regulatory environments – and much improved project preparation and selection / prioritisation business processes (Box 8.1).

Box 8.1 MIND THE GAP

The B20 task force on infrastructure confirms "the investment gap in infrastructure is not the result of a shortage of capital. Real long-term interest rates are low, there is ample supply of long-term finance, interest by the private sector is high, and the benefits are obvious." … a number of factors hold back investment in terms of financing and funding.

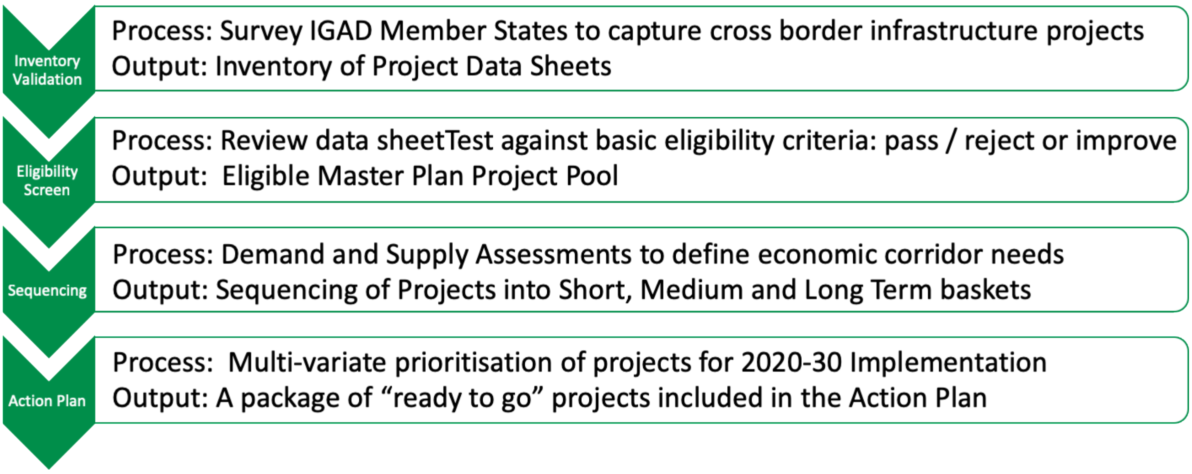
"The main challenge is to find bankable and investment-ready projects."

Workshop Feedback

A defensible, practical and low-cost approach is needed for project screening, preparation and prioritisation. The initial screening and prioritisation framework described in the Draft Broad Sector Overview & Project Prioritisation Criteria Report was presented and tested during the stakeholder workshop held in December 2018 in Mombasa Kenya. Overall, the basic screening and project selection approach was endorsed at the workshop and in subsequent comments received. However, two key messages clearly emerged during the workshop: keep it simple and segment projects into three baskets representing short, medium and long-term implementation sequencing (allowing projects of varying degrees of readiness to be considered in the pipeline). Further, the African Development Bank noted that "the eventual criteria may need to be tweak[ed] or to allow for some level of flexibility dependent on the pool of projects that available and / or those that may qualify out of the proposed criteria."

Our approach is to set out a simple process that can be suitably modified to be relevant and flexible enough to adapt to IGAD Member State priorities and meet acceptable standards of project preparation. The proposed approach to project identification, screening and prioritisation follows four basic steps – Figure 8.1.

Figure 0-1: IRIMP Project Selection Process



The basic process of screening and prioritisation is as follows:

Step 1: Create an inventory of potential projects (primarily captured from the IGAD member states' various plans and pipelines) – this was one of the key tasks of the sector overview market research presented in this report. Project Data Sheets have been prepared to capture

Step 2: Undertake an initial screening process to create a pool of "eligible" projects that will likely form part of the Master Plan and Action Plan.

Step 3: The eligible projects will then be reviewed against and then sequenced into short, medium and long term baskets feeding into the strategic corridor development plan.

Step 4: Prioritise the first tranche of projects that will be a part of the Action Plan covering the period 2020-30. The initial tranche of projects in the Action Plan will then feed into the implementation plan.

Section 8.2 Step 1: Inventory of Potential Projects

The first step is to validate the status and validity of the inventory of potential projects to be included in the analysis. The situational analysis has identified about 200 projects with sufficient definition and data to be included in the potential pool of projects to be included in the IRIMP / AP. A data sheet was designed and used to capture about potential projects. Data capture was through a combination of desk based / web research, field visits and selected key informant interviews across the target countries and sectors. The potential pool source is exclusively drawn from official sources, primarily national development and sector plans. The quality of the project preparation varies considerably depending on the stage or maturity of the project and thus the data in the sheets is of varying completeness. In populating the data sheets and creating the inventory of potential projects key considerations included:

- Is the project sheet inventory complete? Are we capturing the most important projects?
- Is the information in the data sheets reliable?
- Are the data sheets capturing the best available information on project status? If not, what are the material gaps?

The Mombasa December Workshop was used to validate the project data sheets and critically, to confirm that the most important projects are included in the inventory. Based on feedback, the project data base was expanded. Widening the source pool will be considered on the merit of the case – there will be on-going monitoring of the potential project pool.

Section 8.3 Step 2: Screening: Eligibility for the Master Plan Project Pool

The way in which trans-border infrastructure projects and associated policy-type initiatives are identified and prioritised must be evidenced based, aligned to IGAD member states development priorities and clearly understood. The latter is critical. Transparency of selection is central to credibility of the process and a key input to securing ownership among member states of the specific projects that will be the backbone of the Action Plan and thus the Master Plan more generally. The objective of the eligibility screening is to ensure projects meet basic minimum requirements consistent with the Master Plan intent.

Minimum Eligibility Criteria

There are three minimum standards that are necessary to go forward at this stage:

- Cross-border Integration: The project involves – or will materially impact on – two or more IGAD member countries. This is a Yes / No criterion.
- Strategic fit: The project is located on, integral to, one of the priority IGAD Corridors – this is a Yes / No criterion.
- Ownership: The project is in an IGAD member state National Development Plan or equivalent. Other supporting criteria include Memoranda of Understandings among participating member states and letters of intent which are highly desirable but not necessary at this step to be eligible for the Master Plan Project Pool – this is a Yes / No criterion.

To be eligible all three minimum standards must be satisfied: 3 x Yes! Project that do not meet these minimum standards will be discussed on the merit of the case with the client group.The Master Plan is meant to be demand driven. In institutional terms, this means project eligibility and subsequent selection must be closely aligned to the development agenda of the participating member states: we believe this is a key success factor. Thus, the screening criteria are designed to guide filtering of towards this key success factor: projects are relevant to the IGAD mission and there is strong evidence of ownership among member states. Evidence of developmental impact – multipliers – is also beneficial but cannot be a simple binary scoring but will require some thresholds and more depth of analysis. Thus, this key criterion will be more fully considered later in the project selection process.

Extending the Sources of Potential Projects

It is recognised that the Master Plan project pool may be expanded if new projects are identified that meet these criteria but were not in current NDPs. In addition, it is further recognised that in exceptional circumstances non-NDP projects may also be eligible if they meet a strategic growth requirement within one of the corridors; this may be include new public projects as well as private initiatives.

Exhibit 8.1 Project Data Sheets

Data Capture Form for Inventory (v5; 08/11/18)

Organisation(s) visited for data collection / validation	Enter the name of the organisations / stakeholders from which the data was collected and validated
Name of consultant	Name of the person who conducted interview
Date of visit(s)	Date of interview
Project ID	
Project / Intervention title	Enter the name of the project
Type	Choose an item.
Sector	Choose an item.
Sub-sector	Choose an item.
Project status	Choose an item.
Stage	Choose an item.
Is the project part of a wider programme / corridor?	Choose an item.
Name of programme / corridor	Indicate if not applicable
Project sponsor	
Implementing authorities	
Executing agent	
Other key actors	
Project funding source	
Financing model	Choose an item.
Total project value	Enter in dollars
CAPEX cost	dollars
Preparation cost	dollars
Annual O&M cost	dollars

Project location	**Give the project location, e.g. if it is a road indicate which settlements it passes through, e.g. Isiolo – Marsabit – Moyale**
Participating country/countries	
Project description	Include a description of the project with key information such as, physical attributes (e.g. length), expected impact, detail on progress so far etc.
Infrastructure capacity	What is the carrying capacity of the infrastructure? Please add in most suitable measurement
Is the project on PIDA list?	Choose an item.
Planned / actual year of commencement	If the planned year of commencement has passed and project has not started, please update with the new expected year.
Planned / actual year of completion	If the planned year of commencement has passed and the project has not started, please update with the new expected year. At minimum indicate according to the IGAD RIMP timeframe (by 2024, by 2030, by 2050)
Next steps to be taken in the project	Indicate next steps, e.g. conduct full feasibility, determine financing arrangements, find funders, start construction etc.
Spatial data available (to be collected separately)	Choose an item.
Available project documentation (to be collected separately)	Choose an item.

Section 8.4 Step 3: Sequencing Short, Medium and Long – Term Baskets

The IRIM is the strategic framework and primary rationale for the selection of projects and policy-type initiatives that clearly and measurably must be seen to enhance regional trade, integration and economic development. The driver of project investment sequencing is the demand and supply analysis of the economic corridors infrastructure requirements: gap filling and meeting future demand projects across the target sectors as they are needed. Projects will sequenced into Short, Medium and Long-Term planning horizons based on the need for the project as evidenced through the capacity / demand gap analysis given in sector overviews and situational analysis. Projects are included (or added) based this analysis notwithstanding their stage of development or maturity (for example, early concept vs full feasibility and business case status). Exhibit 8.2 illustrates the structure of the infrastructure data collated for each economic corridor, the data points are derived from the Project Data Sheets as well as being validated / modified based on key informant interviews.

Defining the Sequencing Time Lines

The Master Plan, and thus project sequencing baskets, will cover the periods

Short Term: 2019-2024;

Medium Term: 2025-2030; and

Long Term: 2031-2050.

Projects will be "mapped" by corridor segment – spatial and sector based – to match demand growth and demand – supply gap filling with the aim of building out the full corridor infrastructure to enable growth and integration. The output of this exercise, sequenced eligible projects, m will be a core input to the *Strategic Corridor Infrastructure Development Plan* (which in turns is a central component of the Master Plan.

An Integrated Package of Interventions to Encourage Efficiency

While the emphasis is on projects contributing to the target corridor development it is also recognised that the Master Plan and SCIDP must address not only physical constraints and requirements but also "soft" constraints: indeed, policy, regulation and institutional factors are often greater binding constraints to growth and investment as we have seen. If the enabling environment is not considered to be effective and acceptable improvements will be devised via the IRIMP and submitted for validation to IGAD and the national stakeholders alongside the much needed physical investments (this is particularly evident in the case of water resources, aviation and ICT). Thus, complementing the investments in asset creation are interventions to align incentives and risks with efficient infrastructure delivery and life-cycle asset management. The Master Plan and Action Plan will be an integrated package of intervention, hard and soft, designed to drive economic corridor efficiency and thus unlock growth and trade potential of the Member States.

Exhibit 8.2 Mapping Corridor Infrastructure Demand and Supply: Djibouti Illustration *(data is subject to further validation)*

Segment	Route	Sub-sector type	Current infrastructure status	Design Capacity	Demand 2017	Demand 2024	Demand 2030	Demand 2050	Project ID	Stage	Sequencing	Cost	New capacity
D-01	Djibouti Port	Sea Port				33	47	104	TSPD01	S2B Feasibility			
	Tadjourah Port	Sea Port	Potash handling system capable of 2,000 tons per hour; 435-metre long linear platform, and a 190-metre ro-ro platform										
	Ghoubet Port	Sea Port	A linear quay of 400m length and 15m draft accommodating for 100,000 DWT Vessels. A storage area located approximately 800m to the west of the Terminal. 4 dukes storage cargo. Capable of handling 5m tons / year										
D-02	Djibouti-Dikhil	Road	Standard bitumen road in good condition			16	23	50					
		Railway	None planned										
D-03	Djibouti-Galile	Road	Standard bitumen road in good condition			24	34	76					
		Railway	SGR										
		Petroleum /Gas Pipeline	None currently, but proposed						EPPD02	S1 Project Definition			

Section 8.5 Step 4: Inclusion in the Action Plan

Without the Action Plan the IRIMP is just another document most likely destined for the proverbial shelf. Equally, the IRIMP must avoid being a "wish list" of projects that have a remote chance of being funded, financed and implemented – a common affliction that marks many such master planning exercises. The Master Plan will pay particular attention to the short-term Action Plan (2019-2024) period and be less detailed for the medium and longer term periods. Critical to the accelerated Action Plan process is clarity and simplicity of projects to ensure minimum execution complexity and risk – see Box 8.2.

Box 8.2 PIDA Project Screening Thresholds

Keep it Simple: Plain Vanilla Please

- Project Data Availability and Quality: Data must be available and of sufficient quality to review.
- Project Environment: To fast track projects need a stable environment, political support an a reliable fiscal position for the project partners.
- Project Complexity: Projects should be of limited complexity.

Primary Filtering Criteria: Aligning Priorities and Project Readiness

Making things happen is critical – planning to implement is the clarion call. Thus there is a need to carefully select a set of projects that are:

- ***Market Demand Justified:*** *High priority in terms of meeting corridor investment requirements of bringing supply into the market to ensure efficient corridor performance – our short-term basket eligibility.*
- ***High Developmental Impact:*** *In line with wider AU / REC screening processes, including PIDA, a fundamental consideration is the overall developmental impact of the proposed investment. In principle priority is given to projects where the balance between benefits and costs is weighted strongly in favour of benefits. Poverty reduction is central. Of specific concern is potential job creation – direct, indirect and induced – and the distribution of those jobs between vulnerable/excluded groups and gender mix. The contribution to achieving the SDGs and Paris Agreement is a benchmark against which projects need to be measured.*
- ***IGAD Value – Added:*** *Selected projects should be those where IGAD is the most appropriate REC to champion investment and delivery. IGAD may well have a role in advocating and influencing other projects where other RECs have a comparative advantage and/or jurisdictional preferences.*
- ***Committed to Implementation:*** *Demonstrated to have a high level of buy-in among the participating member states responsible for the investments – there needs to be clear evidence of the level of buy-in and commitment as manifest by the existence of MoUs or Letters of Intent covering the proposed investments, funding commitments in national budgets and institutional readiness to take the project forward within the Action Plan planning horizon. International MoUs can take a considerable period time to execute – perhaps 2-3 years from start to finish depending on priorities and wider political relationship – and thus their existence or otherwise will have a material impact on timing and sequencing.*
- ***"Ready to Go" – Fine Tuning:*** *The Action Plan will focus on those projects that fulfill the two previous criteria and are sufficiently defined to attract at least initial financing interest – thus, the maturity and quality of project preparation is sufficient for an initial go / no go – requires provide*

further project preparation detailing. The essential ingredients of "bankable" will require agreement but are likely to require substantial progress against the checklist at Exhibit 8.3 and potentially for some the of projects meet the basic requirements of a bankable Pre-Feasibility Study – Exhibit 8.4.

This multi-variable method filters the long list of potential projects and gets down to a more manageable list of projects that are most likely to move forward and be included in the Action Plan and enter into development partner and or private finance investment pipelines. Project preparation quality is critical and the requirements fairly standard across IFIs and financiers – Box 8.3

Box 8.3 Meeting the Project Preparation Standard: Quality is Job One!

- Technical Screening
- Economic Screening
- Financial Screening
- ESIA
- Institutional Assessment
- Funding Sources Identified / Agreed
- Risk
-

Strategic Portfolio Considerations

In addition to the criteria above there are a further set of criteria that need to be considered as part of the Master Plan and Action Plan:

- ***Portfolio Balance:*** The Action Plan must respond to the collective of Member States and what matters most to them in terms of their regional economic development priorities and peace and stability. Thus, the final Action Plan project selection will likely reflect a balance between Member States and across the sectors. The IRIMP is an instrument of regional integration to promote peace, stability and prosperity through trade and shared investment decision-making.
- ***Economies of Scale and Transaction Costs:*** The scope, nature and scale of projects may vary considerably and with this variation transaction costs. It is anticipated that project selection and intervention packaging need to find the right balance between "stand alone" projects and bundling into more programmatic packages or integrated project interventions with multiple sub-components (for example on a sector basis)
    - Segment projects according to scale thresholds – establish minimum project scales aligned to potential investor requirements.
    - Design projects / interventions to align with potential investor requirements – minimum "ticket" sizes.
    - Does the project meet the minimum scale (e.g. $50m)? If not, can it be packaged with other projects that also meet the criteria in order to meet this scale? Can the projects be logically bundled to create an efficient and effective programme?

Private Sector Participation: No Easy Solution

The infrastructure requirements in the IGAD region generally outpace the capacities of the Member States plan, investment and delivery of the much needed assets and services in transport, energy, communications and water resources. Current backlogs not to mention future demand needs may well not be met under a business as usual public investment driven infrastructure delivery model. Thus, the IRIMP / AP emphasizes sector wide reform to improve overall investment and operational performance in the key target sectors. A key part of this reform to attract private sector capital and expertise into the infrastructure investment "market". To date experience has been mixed at best and what is clear is that the private sector is not a dumping ground for poorly conceived projects and cannot secure public funding. Public – Private Partnerships (PPPs) are not a quick fix to the infrastructure investment deficits characteristic of many emerging and frontier markets – Box 8.4.

The IRIMP project selection process will place particular emphasis on identifying projects *characterised by a high propensity to attract private sector financial resources. The check – list at Exhibit 8.3 captures many of the key success factors that private investors pay attention to, such as:*

Box 8.4 Private Sector to the Rescue?

PPP's are complex to execute

- Indonesia: 1/54 of 2011/2 pipeline PPPs implemented
- Philippines 14 / 50 of the 2010-5 pipeline implemented
- Nigeria 1/18 of 2013 pipeline awarded

Source: Castalia Advisory Research

Market need: Is there a clear demand and supply gap?

Revenue / Cash Flow: Is there clearly defined and robust revenue streams?

Is government commitment clearly evident and projects funded?

Risk: Is the policy, regulatory, legal and institutional context stable, fair, transparent and predictable?

The fundamental point is that attracting private risk capital will require high standards of project planning and preparation: this basic reality requires discipline and the willingness to make tough choices in terms of projects destined for the market.

Put another way, project preparation processes, templates and thresholds / standards need to respond to / comply with investor criteria and decision – making parameters; public sector, IFIs and / or private sector. Quality and flexibility are both needed.

Exhibit 8.3: Bankability Checklists

Criteria		Description / Indicator	Score
A. Accountability and Commitment			
A1.	Is / are the organisation (s) implementing and responsible for the project clearly stated?	**Basic** The organisation directly responsible for the project is clearly stated – including preparation and implementation. Evidence of ownership is provided. Relevant supporting MDAs can also be listed. **Advanced:** • Is there evidence of cross border collaboration / co-ordination among the relevant parties to ensure projects are effective? • Is there a MoU among the participating members states? • Is the project sponsor, the financier and the operator identified?	Yes Advanced = 2 Yes Basic =1 No = 0
A2	Project Data Sheet complete and validated	The IGAD IRIMP data sheets are completed, with supporting documentation and validated as being fair and reliable.	Complete = 2 Partially validated = 1 Not complete or validated = 0
A3	Maturity of the project	**Basic** The project owner / sponsor retains a commitment to the project - the check here is how old the project is and how long it has been in the pipeline. **Advanced** What stage of project identification / preparation has the proposal achieved? • Preliminary Concept • Pre-feasibility / Feasibility • Prepared / Business Case	Within 1 year = 2 Between 1 and 3 years = 1 Greater than 3 years = 0
B. Project Rationale			
B1.	Does the project clearly identify the ***regional and national*** opportunity / problem it is aiming to respond to?	The project proposal must clearly describe the issues / problems the region / sponsoring nation is facing and how the proposed project will address these - emphasis is on cross border challenges / opportunities. The project must have sound and achievable *demand and supply projections* – particular attention should be on the demand projections.	Strong = 2 Partial = 1 Weak = 0
B2.	The objectives of the project are clear.	The objective of the proposed project needs to be clearly addressed and how to measure success specified, preferably with quantitative indicators. Specific target groups who benefit from this project should be identified.	Multiple objectives = 2 Single objectives = 1 Unclear objectives = 0
B3.	The scope of the project is clear and feasible.	The proposal requires a description of the project and its components and supported by an explanation of how these represent a value for money solution. The scope and location of the proposed activities should capture all the expenditure needed to deliver the project outputs and achieve the intended objectives and outcomes.	Clear and comprehensive scope = 2 Partial = 1 Poorly defined = 0
B4.	Is the objective of the project consistent with regional and national goals?	**This is a minimum requirement.** The relevant policy fit should be specified – with specific reference to growth, poverty reduction and wider SDGs. If the project demonstrates a logical case for intervention and adequate demand but is not a policy priority it will not go forward as an Action Plan component.	Strong = 2 Partial = 1 Weak = 0

Criteria		Description / Indicator	Score
	Does the project contribute to the SDGs?		
B5	Is the project preparation status up to date?	The project description and supporting evidence are relevant, valid and are up to date. The intent here is to ensure projects entering more detailed assessment are current and not “dated” such that key analysis requires substantial updating.	< 1 year = 2 Between 1 - 3 years = 1 > 3 years = 0
C. Affordability and Sustainability			
C1	Financial and Economic Appraisal included	Basic financial and economic analysis is included in proposal – indicative. Project volume and pricing assumptions are clearly defined and deemed achievable. Sensitivity tests have been undertaken to assess key success factors and risks.	Yes = 1 No = 0
C2.	Does the project present estimated costs and budget per year until completion?	**Basic** The proposal sets out capex and opex over the life of the project. **Advanced** The proposal should set out the budgetary requirement per year until the project completion in current price.	Total and estimated cost/year = 2 Total cost / partial breakdowns = 1 No estimates = 0
C3.	Does the project have a reasonable timeline for implementation?	Timeline for the project implementation must be adequate for the scale and complexity of the project and allow to carry out as plan.	Timeline reasonable = 2 Timeline risk = 1 Not clear = 0
C4.	Is the source of financing clearly identified?	**Basic** To ensure sustainable funding for the project, the proposal should clearly identify the expected sources of funding for the project. **Advanced** Evidence of funding partners commitment to implementation	Clearly defined = 2 Partial = 1 Not defined = 0
C5.	Does the project clearly specify requirements for sustainability including operation and maintenance costs?	The proposal should demonstrate initial requirements for operational sustainability, particularly in relation to affordable funding for sustainable operations and maintenance.	Clearly defined = 2 Partial = 1 Not defined = 0
C6	Sources of revenues are specified and quantified	The revenue sources and estimate contributions should be specified. Where policy, regulation and / or major changes to tariffs are required these should highlighted.	Clearly defined = 2 Partial = 1 Not defined = 0
C7	Climate Change	Climate change impacts are described. The projects contribution to Mitigation and / or Adaptation are clearly described and measured. Eligibility for climate finance assessed.	Clearly defined = 2 Partial = 1 Not defined = 0
C8	Safeguards	Relevant safeguards are documented and assessed against agreed benchmarks / potential financing partner requirements (e.g IFIs). Red Flags / Red Line thresholds clearly defined.	Clearly defined = 2 Partial = 1 Not defined = 0
C7	Risk Assessment / Register / Management Plan included	**Basic** The material risks of the project should be included in the proposal – indicatively at a minimum. **Advanced** Risk register and management plan	Clearly defined = 2 Partial = 1 Not defined = 0

Exhibit 8.4. IRIMP: Indicative Pre-Feasibility Study Core Components: Addressing Investor Requirements

1. Project Data
- 1.1. Project Name
- 1.2. Project Reference Number
- 1.3. Sector
- 1.4. Location country(ies)
- 1.5. Project proponent
- 1.6. Project owner
- 1.7. Location plan
- 1.8. More detailed or schematic plan

2. Project Description
- 2.1. Summary of existing situation
- 2.2. Options to address project need
- 2.3. Contribution to IRIMP Implementation.
- 2.4. Technical description of project
- 2.5. Estimated design life

3. Costs
- 3.1. Capital cost
  - 3.1.1. Civil works & Equipment
  - 3.1.2. Land acquisition
  - 3.1.3. Preparation cost
- 3.2. O&M Cost
- 3.3. Total life cost

4. Financing
- 4.1. Type of financing proposed
- 4.2. Loan amount
- 4.3. Contribution by national or subnational government
- 4.4. Contribution by project proponent
- 4.5. Other contributions
- 4.6. Outline financing plan
- 4.7. Proposed cost recovery
- 4.8. Tariffs applied
- 4.9. Affordability to government
- 4.10. Affordability to users

5. Benefits & Safeguards
- 5.1. Summary of quantifiable and qualitative benefits
- 5.2. Financial benefits
- 5.3. Economic benefits
- 5.4. Environmental Impact Summary
- 5.5. Climate Change Impact
- 5.6. Social Impact Summary
- 5.7. Land acquisition requirements
- 5.8. Resettlement or loss of livelihoods

6. Construction
- 6.1. Procurement Type
- 6.2. Number of packages
- 6.3. Timing for procurement and construction
- 6.4. Contract awarding agency
  - 6.4.1. Experience of similar projects
- 6.5. Supervision agency
  - 6.5.1. Experience of similar projects

7. Institutional Arrangements
- 7.1. Project executing agency
- 7.2. Project implementing agency
  - 7.2.1. Experience of similar projects
- 7.3. Project management agency
  - 7.3.1. Experience of similar projects
- 7.4. Proposed operation and maintenance arrangements
- 7.5. Policy or regulatory actions required for project implementation or operation

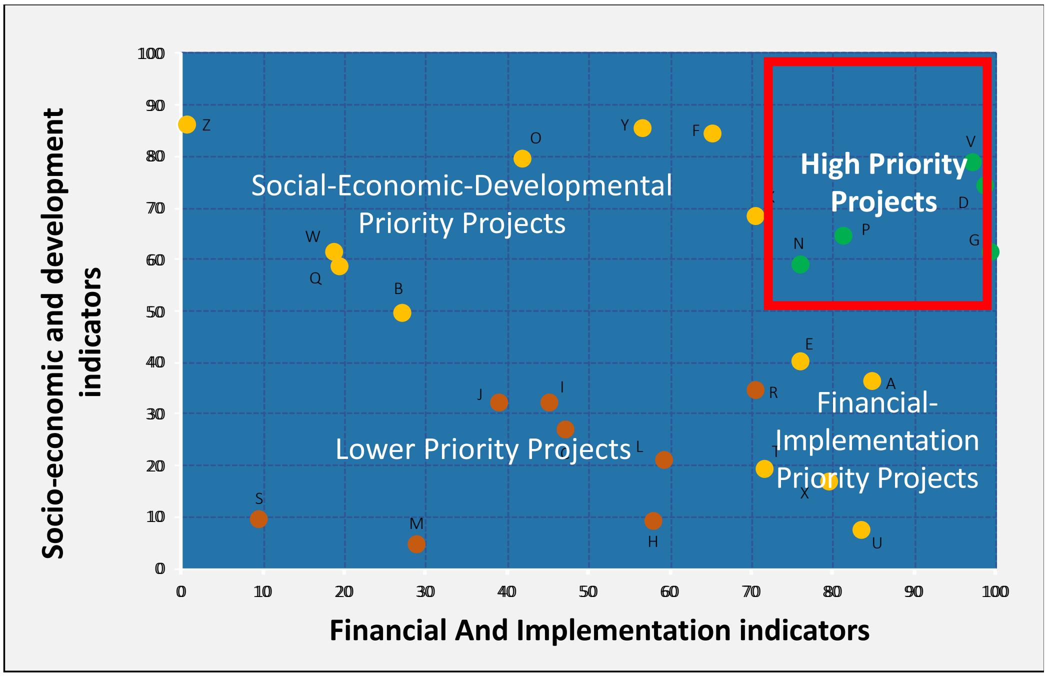
8. Summary of major risks and proposed mitigation measures
- 8.1. Technical, financial, policy, political, institutional, environmental, social

9. Next Steps and Implementation Plan

Section 8.6 Plan to Implement: Commitment and Confidence are Essential

Fundamentally, the screening and project selection process is designed to identify a package of projects and supporting enabling environment reforms necessary to implement the strategic development corridors that will drive economic transformation, peace and stability in the IGAD region. The recommended screening and selection methodology will identify a list of robust and bankable projects with significant regional and national importance for the IGAD member states. The method identifies projects which are fully aligned with national and local development plans and aspirations, and which are associated with a *high impact* in terms of trade, connectivity, integration and development in the region – hitting the "sweet spot" in Figure 8.2. The methodology will be implemented in a participatory and transparent manner where IGAD member states will be consulted to identify, screen and ultimately select projects to take forward. It is for the client group to validate whether the screening process, tools and thresholds are sufficient and whether a more detailed assessment is required. Due diligence in project screening and transparency are critical as this gives the Member States, IFIs and the private sector (financiers and construction companies) confidence that appropriate, feasible and bankable projects have been correctly identified and prioritised. The latter is important if funding through the private sector, via PPPs, is sought.

Figure 0-2: Hitting the IGAD project selection 'sweet-spo



Source: based on World Bank unpub presentation Sept 2018 "Prioritizing infrastructure investments"

Report Appendix

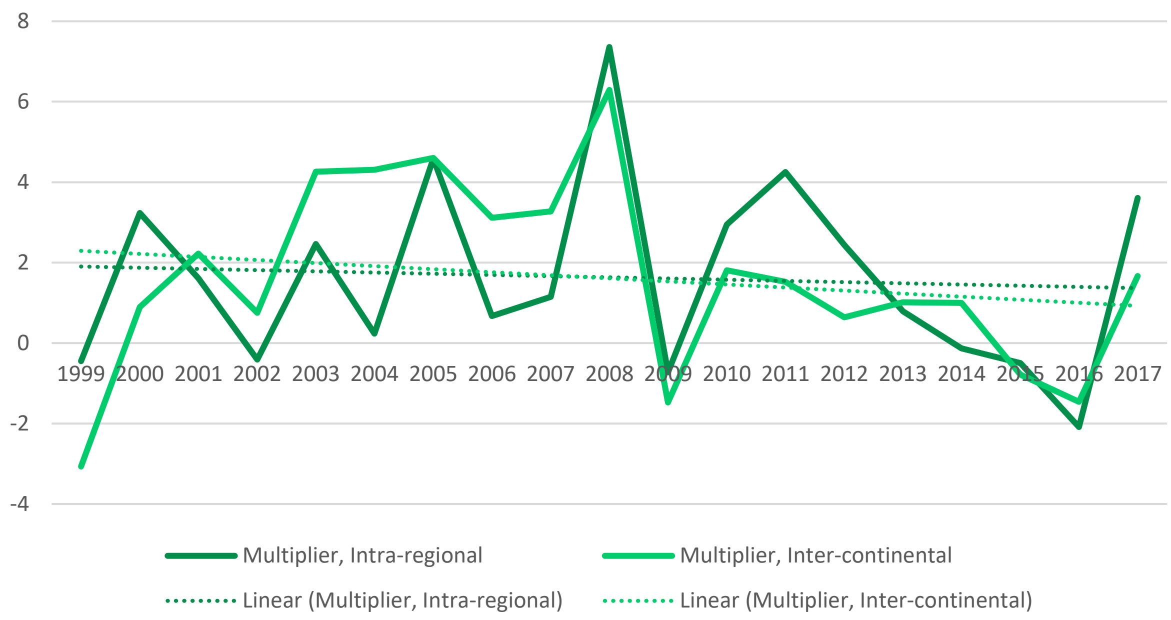
Appendix 1. Estimating Transport Demand in the IGAD Corridors

To forecast future demand for transport infrastructure along the trans-border IGAD corridors we use a Trade: GDP multiplier to estimate the growth in future trade flows in the IGAD member states that comprise the corridor, which is then converted into freight traffic volume (measured in tons). To estimate the Trade: GDP multiplier, we use UNCTAD data on total trade flows for IGAD member states for the two-decade period from 1998 to 2017. Two multipliers are estimated: inter-continental trade; and intra-regional trade.

$$multiplier = \Delta trade_{it}/\Delta GDP_t$$

The CAGR of GDP for the IGAD region between 1998 and 2017 was 5.44%. The CAGR for inter-continental trade was 8.98%, giving a multiplier of 1.65. The CAGR for intra-regional trade was 7.75%, giving a multiplier of 1.42.

Figure 0-1: Inter-continental and intra-regional Trade: GDP multiplier trend, 1998-2017



However, as Figure 8-5 above shows, the multiplier was variable – largely due to the inherent instability of the IGAD economies over this period – and is declining over time. The trend to a declining Trade:GDP multiplier is one that is also observed in the global economy over the same period, and studies have also shown that the multiplier declines as GDP increases.

Consequently, in our forecasting to 2050 we have used a declining multiplier over time as follows.

Multiplier	2020 – 2024	2025 – 2030	2031 – 2050
Inter-continental	1.25	1.15	1.05
Intra-regional	1.40	1.30	1.20

To estimate the growth rate for inter-continental and intra-regional trade over the short-term (to 2024), these multipliers are applied to the forecast / target GDP growth rates for each IGAD member state. For the medium (2030) and long-term (2050) horizons we use more conservative GDP growth estimates to reflect the slow-down in growth that economies experience as they mature and reach higher-income status. The growth rate for inter-continental trade is then used to forecast growth in inter-continental trade for each IGAD member state. The intra-regional growth rate is used to forecast growth in trade between each pair of IGAD member states.

In addition to international freight traffic, transport infrastructure will also have to handle traffic carrying internal domestic freight. In the absence of baseline data for internal trade flows or freight traffic, we have made an assumption of the domestic traffic share for each corridor section based on the domestic population that the corridor serves and assumed that this will remain constant over time.

For example, for the Northern Corridor sections, which traverse (relatively) densely populated regions, we have assumed a domestic traffic share of 30%; for LAPSSET, which traverses (relatively) sparsely populated regions, we have assumed a domestic traffic share of 15%.

Demand for each section of the corridor is thus comprised of five components:

1. **Direct intra-regional trade**: Direct trade between the countries comprising the corridor (sum of exports and imports between Country A and Country B);

2. **Transit intra-regional trade**: Trade between non-neighbouring countries that transits through a third country(ies) (sum of exports and imports between Country A and Country C, where Country B is in between);

3. **Direct inter-continental trade**: Inter-continental trade flows along a segment of the corridor that do not cross IGAD borders;

4. **Transit inter-continental trade**: Trade from landlocked countries that transits through a third country(ies) (sum of exports and imports between Country C and non-Africa, where country B is in between); and

5. **Domestic trade:** Internal domestic trade that flows along the corridor (e.g. goods passing from point A in Country A to point B in Country A).

For example, the total trade flow of the Ugandan Section of the Northern Corridor comprises of: 1) direct trade between Uganda-Kenya and Uganda-South Sudan; 2) trade between Kenya-South Sudan transiting through Uganda; 3) Uganda's inter-continental trade which flows along the corridor towards / from the port in Mombasa; 4) South Sudan's inter-continental trade which transits through Uganda towards / from the port in Mombasa; and 5) internal trade (e.g. cargo from Kampala to Gulu).

The demand for infrastructure is estimated for each section of the corridor, as well as the port. Demand is forecast for the short-term (2024), medium-term (2030) and long-term (2050). Three alternative scenarios are estimated:

- **Target GDP growth scenario**: IGAD economies grow at the target rates specified in NDPs[73];
- **IMF forecast GDP growth scenario**: IGAD economies grow at the rates forecast by the IMF[74];
- **IGAD RIMP GDP growth scenario**: IGAD economies grow at rates based on authors' estimates (a mid-level scenario between IMF and target growth rates).

[73] Where member states have not set target growth rates we have used an optimistic estimate based on recent trends
[74] Using data from the IMF World Economic Outlook dataset

Table 0-1: CAGR for inter-continental and intra-regional trade, target GDP scenario

Member State	2020 – 2024		2025-2030		2031-2050	
	Inter-continental	Intra-regional	Inter-continental	Intra-regional	Inter-continental	Intra-regional
Djibouti	12.5	14.0	11.5	13.0	4.7	5.4
Eritrea	7.5	8.4	6.9	7.8	4.7	5.4
Ethiopia	13.8	15.4	10.4	11.7	4.7	5.4
Kenya	12.5	14.0	11.5	13.0	4.7	5.4
Somalia	7.5	8.4	6.9	7.8	4.7	5.4
South Sudan	7.5	8.4	6.9	7.8	4.7	5.4
Sudan	7.5	8.4	6.9	7.8	4.7	5.4
Uganda	7.8	8.7	9.4	10.7	4.7	5.4

Table 0-2: CAGR for inter-continental and intra-regional trade, IMF GDP scenario

Member State	2020 – 2024		2025-2030		2031-2050	
	Inter-continental	Intra-regional	Inter-continental	Intra-regional	Inter-continental	Intra-regional
Djibouti	7.8	8.7	6.2	7.0	4.7	5.4
Eritrea	5.1	5.7	5.4	6.1	4.7	5.4
Ethiopia	9.9	11.1	7.2	8.2	4.7	5.4
Kenya	7.8	8.7	7.8	8.9	4.7	5.4
Somalia	4.3	4.8	4.2	4.8	4.7	5.4
South Sudan	-7.1	-8.0	2.3	2.6	4.7	5.4
Sudan	-1.4	-1.5	0.9	1.1	4.7	5.4
Uganda	7.8	8.7	8.8	9.9	4.7	5.4

Table 0-3: CAGR for inter-continental and intra-regional trade, IGAD RIMP GDP scenario

Member State	2020 – 2024		2025-2030		2031-2050	
	Inter-continental	Intra-regional	Inter-continental	Intra-regional	Inter-continental	Intra-regional
Djibouti	9.4	10.5	6.9	7.8	4.7	5.4
Eritrea	6.3	7.0	6.9	7.8	4.7	5.4
Ethiopia	11.3	12.6	8.1	9.1	4.7	5.4
Kenya	9.4	10.5	9.2	10.4	4.7	5.4
Somalia	5.6	6.3	6.9	7.8	4.7	5.4
South Sudan	5.0	5.6	6.9	7.8	4.7	5.4
Sudan	2.5	2.8	4.6	5.2	4.7	5.4
Uganda	7.8	8.7	9.2	10.4	4.7	5.4

These estimates are based on 'business as usual' and do not take into account the feedback effect of improving trans-border infrastructure between two countries – otherwise known as supressed demand. Where possible, however, we have attempted to estimate the share of trade that emerging corridors can capture – in particular the LAPSSET Corridor. Though it has not been possible to model at this stage the potential Assab and Massawa Corridors between Eritrea and Ethiopia, due to non-existent data to measure trends. Estimates of the share of inter-continental trade allocated to each corridor are provided in the tables below. It is also assumed that, for example, trade between Kenya and South Sudan, which currently transits through Uganda along the Northern Corridor, will shift to LAPSSET once infrastructure is complete.

During the planning phase of the IGAD RIMP study, we will adapt the Transport Demand Model to test in-depth scenarios for each corridor, for example to predict the impact that developing additional corridors (e.g. Massawa, Mogadishu, Kismayo etc.) will have on demand for existing and planned infrastructure.

Table 0-4: Share of IGAD member state trade by port, 2017

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	100%	0%	10%	0%	98%
Lamu	0%	0%	0%	0%	0%	0%	0%	0%
Djibouti	100%	0%	95%	0%	0%	0%	0%	0%
Port Sudan	0%	0%	2%	0%	0%	90%	100%	0%
Berbera	0%	0%	3%	0%	35%	0%	0%	0%
Kismayo	0%	0%	0%	0%	10%	0%	0%	0%
Mogadishu	0%	0%	0%	0%	40%	0%	0%	0%
Massawa	0%	100%	0%	0%	0%	0%	0%	0%
Assab	0%	0%	0%	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**85%**	**100%**	**100%**	**98%**

Table 0-5: Share of IGAD member state trade by port, 2024

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	90%	0%	5%	0%	85%
Lamu	0%	0%	10%	10%	0%	20%	0%	5%
Djibouti	100%	0%	80%	0%	0%	1%	0%	2%
Port Sudan	0%	0%	5%	0%	0%	74%	100%	0%
Berbera	0%	0%	5%	0%	35%	0%	0%	0%
Kismayo	0%	0%	0%	0%	10%	0%	0%	0%
Mogadishu	0%	0%	0%	0%	40%	0%	0%	0%
Massawa	0%	100%	0%	0%	0%	0%	0%	0%
Assab	0%	0%	0%	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**85%**	**100%**	**100%**	**92%**

Table 0-6: Share of IGAD member state trade by port, 2030

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	85%	0%	5%	0%	85%
Lamu	0%	0%	12.5%	15%	0%	30%	0%	8%
Djibouti	100%	0%	70%	0%	0%	2%	0%	2%
Port Sudan	0%	0%	5%	0%	0%	63%	100%	0%
Berbera	0%	0%	12.5%	0%	35%	0%	0%	0%
Kismayo	0%	0%	0%	0%	10%	0%	0%	0%
Mogadishu	0%	0%	0%	0%	40%	0%	0%	0%
Massawa	0%	100%	0%	0%	0%	0%	0%	0%
Assab	0%	0%	0%	0%	0%	0%	0%	0%

Total	**100%**	**100%**	**100%**	**100%**	**85%**	**100%**	**100%**	**95%**

Table 0-7: Share of IGAD member state trade by port, 2050

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	70%	0%	5%	0%	83%
Lamu	0%	0%	20%	30%	0%	50%	0%	10%
Djibouti	100%	0%	60%	0%	0%	5%	0%	2%
Port Sudan	0%	0%	5%	0%	0%	40%	100%	0%
Berbera	0%	0%	15%	0%	35%	0%	0%	0%
Kismayo	0%	0%	0%	0%	10%	0%	0%	0%
Mogadishu	0%	0%	0%	0%	40%	0%	0%	0%
Massawa	0%	100%	0%	0%	0%	0%	0%	0%
Assab	0%	0%	0%	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**85%**	**100%**	**100%**	**95%**

Results

Table 0-8: Inter-continental Trade Forecasts (millions of tons)

	Target Growth Scenario				IMF Growth Scenario				IRIMP Scenario			
	2017	2024	2030	2050	2017	2024	2030	2050	2017	2024	2030	2050
Djibouti	3	6	12	30	3	5	7	17	3	5	8	19
Eritrea	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ethiopia	17	41	74	187	17	32	49	124	17	35	56	141
Kenya	20	47	90	226	20	35	54	137	20	38	65	164
Somalia	3	5	8	20	3	4	5	14	3	5	7	18
South Sudan	6	10	14	36	6	3	4	10	6	8	12	31
Sudan	7	12	17	44	7	6	7	17	7	8	11	27
Uganda	7	11	19	49	7	11	19	47	7	11	19	48
Total	**63**	**132**	**235**	**592**	**63**	**97**	**145**	**365**	**63**	**111**	**178**	**448**

Table 0-9: Intra-regional Trade Forecasts (millions of tons)

	Target Growth Scenario				IMF Growth Scenario				IRIMP Scenario			
Country Pairs	2017	2024	2030	2050	2017	2024	2030	2050	2017	2024	2030	2050
DJ/ER	0.01	0.03	0.05	0.14	0.01	0.02	0.03	0.09	0.01	0.02	0.04	0.10
DJ/ET	0.13	0.33	0.66	1.89	0.13	0.24	0.38	1.08	0.13	0.27	0.44	1.26
DJ/KE	0.01	0.02	0.04	0.11	0.01	0.01	0.02	0.06	0.01	0.01	0.02	0.07
DJ/SO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DJ/SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DJ/SD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DJ/UG	0.00	0.01	0.01	0.04	0.00	0.01	0.01	0.03	0.00	0.01	0.01	0.03
ER/ET	-	0.00	0.00	0.00	-	0.00	0.00	0.00	-	0.00	0.00	0.00
ER/KE	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.02
ER/SO	-	0.00	0.00	0.00	-	0.00	0.00	0.00	-	0.00	0.00	0.00
ER/SS	-	0.00	0.00	0.00	-	0.00	0.00	0.00	-	0.00	0.00	0.00
ER/SD	0.02	0.03	0.05	0.14	0.02	0.02	0.03	0.07	0.02	0.02	0.04	0.10
ER/UG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ET/KE	0.08	0.20	0.40	1.15	0.08	0.15	0.24	0.69	0.08	0.16	0.29	0.82
ET/SO	0.25	0.56	0.97	2.78	0.25	0.43	0.63	1.80	0.25	0.48	0.78	2.22
ET/SS	0.00	0.01	0.01	0.03	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.02
ET/SD	0.35	0.76	1.34	3.82	0.35	0.48	0.63	1.81	0.35	0.58	0.88	2.53
ET/UG	0.01	0.02	0.04	0.12	0.01	0.02	0.03	0.10	0.01	0.02	0.04	0.11
KE/SO	0.19	0.40	0.72	2.07	0.19	0.30	0.44	1.27	0.19	0.33	0.56	1.61
KE/SS	0.16	0.34	0.61	1.75	0.16	0.16	0.23	0.66	0.16	0.28	0.46	1.33
KE/SD	0.07	0.14	0.26	0.74	0.07	0.09	0.12	0.33	0.07	0.11	0.17	0.48
KE/UG	1.06	2.24	4.38	12.55	1.06	1.89	3.24	9.29	1.06	2.01	3.63	10.40
SO/SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SO/SD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SO/UG	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.02
SS/SD	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
SS/UG	0.30	0.53	0.90	2.59	0.30	0.31	0.44	1.27	0.30	0.49	0.82	2.35
SDUG	0.08	0.14	0.23	0.67	0.08	0.10	0.14	0.39	0.08	0.11	0.18	0.52
TOTAL	**2.72**	**5.76**	**10.70**	**30.63**	**2.72**	**4.24**	**6.63**	**18.97**	**2.72**	**4.92**	**8.38**	**23.99**

Table 0-10: Distribution of forecast trade traffic by corridor (millions of tons)

		Target Growth			**IMF Forecast**			**IGAD RIMP**		
Corridor	**Section**	**2024**	**2030**	**2050**	**2024**	**2030**	**2050**	**2024**	**2030**	**2050**
Northern Corridor	Mombasa Port	57	103	221	45	69	149	49	79	172
	Mombasa-Nairobi	75	134	287	58	89	194	64	103	223
	Nairobi-Nakuru	42	75	172	35	54	126	37	62	142
	Nakuru-Kisumu	21	37	85	17	27	62	18	30	70
	Kisumu-Busia	21	37	85	17	27	62	18	30	70
	Nakuru-Eldoret	21	38	87	17	27	63	19	31	72
	Eldoret-Malaba	14	24	58	12	19	46	12	21	50
	Eldoret-Kitale	16	31	81	11	17	42	13	24	63
	Kitale-Lokichar	10	20	58	6	11	29	8	16	47
	Malaba and Busia-Jinja	15	27	68	14	23	59	15	25	64
	Jinja-Kampala	26	45	115	24	40	100	25	43	109
	Tororo-Gulu	5	8	20	4	6	16	5	7	19
	Kampala-Gulu	3	5	12	2	3	8	3	4	11
	Gulu-Nimule	1	2	5	1	1	2	1	2	5
	Nimule-Juba	2	2	6	1	1	3	1	2	6
Djibouti Corridor	Djibouti Port	39	64	143	31	41	91	33	47	104
	Djibouti-Dikhil	19	31	69	15	20	44	16	23	50
	Dire Dawa-Awash	32	59	140	25	39	92	27	45	106
	Dikhil-Galafi	19	31	69	15	20	44	16	23	50
	Galafi-Semera-Mekele	6	9	20	5	6	13	5	7	15

	Semera-Awash	19	30	66	15	20	43	16	23	51
	Diwele-Dire Dawa	33	52	114	26	34	74	28	39	87
	Dire Dawa-Awash	32	59	140	25	39	92	27	45	106
	Awash-Adama-Addis Ababa	44	78	184	34	52	120	38	59	139
	Addis Ababa-Jima-Mizan	3	4	11	2	3	6	2	3	8
	Mizan-Dima	2	3	9	2	2	5	2	3	7
	Dima-Raad-Boma	2	3	9	2	2	5	2	3	7
	Boma-Kapoeta-Juba	0	0	2	0	0	1	0	0	2
LAPSSET Corridor	Lamu Port	11	29	128	8	17	76	10	22	98
	Lamu-Garissa-Isiolo	13	34	151	9	20	89	11	26	115
	Isiolo-Nairobi	6	16	81	4	10	49	5	12	59
	Isiolo-Marsabit-Moyale	5	11	46	4	8	30	4	9	34
	Isiolo-Lokichar	3	7	27	1	3	11	3	6	24
	Lokichar-Lokichoggio	3	7	27	1	3	11	3	6	24
	Lokichoggio-Nandapal	3	7	27	1	3	11	3	6	24
	Moyale-Awassa-Modjo	5	11	46	4	8	30	4	9	34
	Nandapal-Kapoeta-Juba	2	6	23	1	2	8	2	5	20
Berbera Corridor	Berbera Port	4	12	35	3	8	23	3	9	27
	Berbera-Hargeisa	6	18	52	5	12	35	5	14	41
	Hargeissa-Togochaale	4	16	46	3	10	31	4	12	35
	Togochaale-Jijiga	3	12	35	2	8	23	2	9	26
	Jijiga-Dire Dawa	3	12	35	2	8	23	2	9	26
Port Sudan Corridor	Port Sudan Port	21	30	67	11	12	27	16	21	47
	Port Sudan-Haya	30	43	96	15	17	39	23	31	67
	Haya-Kassala	8	12	31	5	6	15	6	8	21
	Kassala-Al Quadarif	8	12	31	5	6	15	6	8	21
	Haya-Atbara	22	31	66	10	11	24	17	22	46
	Atbara-Khartoum	22	31	66	10	11	24	17	22	46

	Khartoum-Wadi Medan	15	21	41	7	7	14	12	16	30
	Wadi Medan-Sennar	15	21	41	7	7	14	12	16	30
	Sennar-Al Damazin	1	1	3	0	1	2	1	1	2
	Al Damazin-Kurmuk	1	1	3	0	1	2	1	1	2
	Wadi Medan-Al Quadarif	1	1	4	1	1	2	1	1	3
	Al Quadarif-Metema	3	5	12	2	3	8	2	4	9
	Khartoum-Rabak	8	11	17	3	3	5	7	9	14
	Rabak-Renk	8	11	17	3	3	5	7	9	14
	Malakal-Renk	8	11	17	3	3	5	7	9	14
	Waat-Malakal	8	11	17	3	3	5	7	9	14
	Bor-Waat	8	11	17	3	3	5	7	9	14
	Juba-Bor	8	11	17	3	3	5	7	9	14
	Addis Ababa-Gondar	3	6	15	2	4	9	3	4	11
	Gondar-Metema	3	5	12	2	3	8	2	4	9
	Kurmurk-Asosa-Nekemte	1	1	3	0	1	2	1	1	2
	Nekemte-Ambo-Addis Ababa	2	4	9	1	2	6	2	3	7

Appendix 2: The Demand Methodology Energy

Country Synopsis

Country	Energy mix	Unbundling	Main stakeholders
Djibouti	installed capacity of 120 MW (thermal), with additional 90 MW imported from Ethiopia and 300 kW peak solar system. The country expects to have a peak demand of 300 MW by 2020.	The main electricity company, Electricité de Djibouti (EdD) is vertically integrated. To create an enabling environment, the country has enacted two key legislations	Main institutional players within the energy sector: Ministry of Energy and Natural Resources, International Hydrocarbon Company, Électricité de Djibouti (EDD), Directorate for Rural Electrification in the Agence Djiboutienne de Developpement Sociale (ADDS), Djiboutian Agency for Energy Management, The Geothermal Energy Development Office, and the National Energy Commission
Kenya	Installed Capacity: 2,351 MW Hydroelectric: 36% Thermal: 33% Geothermal: 29% Other Renewables: 2%	vertically unbundled its power sector into the 3 main companies Kenya Generating Company (KENGEN), Kenya Power and Lighting Company (KPLC) and Kenya Transmission Company (KETRACO)	The key institutional players are Ministry of Energy and Petroleum (MOEP), Rural Electrification Authority (REA), Geothermal Development Company (GDC) and the energy regulatory commission.
Uganda	Installed Capacity: 947 MW Hydro: 645 MW Thermal: 101.5 MW		

Sudan		The National Electricity Corporation (NEC) was the sole generator, transmitter and distributor of electric energy in Sudan. It was been unbundled in 2010 into the following companies: Merowe Dam Electricity Company Ltd Sudanese Hydropower Generation Company Ltd Sudanese Thermal Power Generation Company Ltd Sudanese Transmission Lines Company Ltd Sudanese Electricity Distribution Company Ltd	Merowe Dam Electricity Company Ltd • Sudanese Hydropower Generation Company Ltd • Sudanese Thermal Power Generation Company Ltd • Sudanese Transmission Lines Company Ltd • Sudanese Electricity Distribution Company Ltd Sudanese Petroleum Cooperation (SPC)
South Sudan			Ministry of Energy and Dams, Ministry of Petroleum, South Sudan Electricity Regulation Authority, South Sudan Electricity Corporation
Somalia	Installed Capacity: 103.9 MW Diesel: 100 MW Solar/Wind: 3.9 MW	Vertically integrated	Ministry of Mining, Energy and Water Resources • Somaliland Energy Commission • Transitional Federal Government: There are Energy Authorities in Puntland and Somaliland.
Ethiopi	Installed Capacity: 4,206 MW Hydroelectric: 3,743 MW (89%) Wind: 337 MW (8%) Thermal: 126 MW (3%)	Vertically unbundled into • Ethiopian Electric Utility (EEU) • Ethiopian Electric Power (EEP)	Ministry of Water, Irrigation and Energy (MWIE), Ministry of Mines Rural Electrification Executive Secretariat (REES), Regional Energy Agencies, Ethiopian Rural Energy Development and Promotion Centre (EREDPC)
Eritrea		Vertically integrated electricity sector	Ministry of Energy and Mines, Renewable Energy Centre, Eritrean Electricity Authority, Eritrea Petroleum Corporation (EPC)

RALF model analysis for Djiboutian case

The RALF model considers the relationships between historical electricity sales for each consumer category and economic drivers for consumption such population, per capita gross domestic product (GDP) or sector specific GDP. The relationship derived is then used to forecast sector sales of electricity in the future. Knowing the future sales in GWh) one can then be able to intuitively derive the required installed capacity for that time in future based on coincident after diversity load factors (CADLF's[75]) and power losses.

Demand forecast model

For our case a modified 3 parametric RALF model can be employed

$$S = C + x_1^{\alpha} + x_2^{\beta} + x_3^{\gamma} + \cdots$$

Where :

S	Sector sales of electricity (GWh)
C	Constant
α, β, γ	Coefficients of elasticities of demand
x_1, x_2, x_3	Independent driving parameters e.g. population, per capita GDP, etc

The results of the demand forecast model are validated by three metrics / statistics:

- Correlation coefficient (R2) :- R2 indicates correlation between historical sales (dependent variables) and the economic drivers (independent variables) selected in the regression. With R2 = 1 denoting perfect correlation and R2 = 0 indicating no correlation.
- Coefficients (α, β, γ): - These determine the impact of the economic drivers historical sales. Regressions will only be accepted if the coefficients appear to be of the correct sign (positive or negative). For instance a negative price coefficient would indicate a fall in price hence an increase in sales. Further the coefficients should be of the correct size e.g. economic driver coefficient should not be too large, such that they indicate that a small change in the economic driver would result in an enormous change in the level of sales.
- P values :- these identify whether an economic driver is adding anything to the regression. A p-value close to zero indicates that it is very likely that the particular economic driver in question plays a very significant role in the determination of sales.

Thus only those regressions with very high R^2 values, coefficients of reasonable magnitudes and sign, and low p-values should be accepted. Despite these criteria the future predictions should be further analysed to ensure that the growth rate is sensible within the expected energy sales and show limited volatility. The model assumes that the historical relationships will remain valid in the future. Hence the results should be carefully considered to identify relationships which would yield forecasts that are not credible.

Input data required for the RALF model

- Historical economic and demographic data :- population and GDP broken down by economic activity sectors
- Forecasts of economic and demographic data – namely population forecasts, GDP forecasts for each economic sector

[75] The CADLF is the load factor that relates energy sales to demand at time of system peak. Therefore, it includes the effects of both diversity (the maximum demand of a group of consumers is less than the sum of the individual demands) and coincidence (the peak demand of a group of consumers may not be at the time of system peak).

- Historical consumer data – namely historical sales data by consumer category, historical consumer data by consumer category and historical tariff data by consumer category
- Historical system data – namely historical generations (sent out), and historical system peaks

Each of these input factors will have assumptions built into them. For instance the occurrence of a civil war or unrest will definitely affect GDP growth as well as possibly destroy infrastructure. Such factors should be taken into consideration. The following provides the historical and future energy demands.

Djibouti demand forecasts using RALF model

For Djibouti six consumer segments are identified (Social, Domestic, LV Djibouti, Public Lighting, Chantier and MV Djibouti), these are then put into the RALF model to provide demand forecasts. The general historical demand trends for the country are provided in Table 0-11

Table 0-11: Djibouti Historical demand trends

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Generation Sent Out (GWh)	**202.49**	**196.14**	**146.47**	**184.39**	**226.32**	**234.31**	**247.64**	**260.66**	**274.36**	**297.98**	**307.48**	**322.97**	**325.62**
Energy Losses (%)	18.2%	13.9%	16.0%	20.9%	21.1%	16.3%	19.4%	17.6%	17.9%	23.4%	22.2%	21.1%	22.7%
Maximum Demand (MW)	**41.90**	**40.80**	**32.80**	**38.10**	**39.70**	**41.34**	**42.70**	**45.98**	**48.15**	**53.49**	**52.90**	**55.70**	**56.92**
Load Factor (%)	55.2%	54.9%	51.0%	55.2%	65.1%	64.7%	66.2%	64.7%	65.0%	63.6%	66.4%	66.2%	65.3%

Table 0-12: Future demand forecasts for Djibouti per consumer category

Year	Social	Domestic	LV Djibouti	Public Lighting	Chantier	MV Djibouti	Total
2008	25.0	69.1	63.0	2.7	2.3	80.5	242.6
2009	24.4	76.3	58.9	2.7	1.8	99.0	262.9
2010	24.8	79.6	61.3	2.8	1.9	103.2	273.6
2011	25.2	83.1	63.9	2.9	2.0	107.6	284.6
2012	25.7	86.7	66.5	3.0	2.1	112.0	296.0
2013	26.1	90.5	69.2	3.1	2.2	116.6	307.7
2014	26.5	94.5	71.9	3.2	2.4	121.3	319.7
2015	26.9	98.7	74.7	3.3	2.5	126.0	332.1
2016	27.3	103.0	77.6	3.4	2.6	130.9	344.8
2017	27.7	107.5	80.5	3.5	2.8	135.9	358.0
2018	28.2	112.2	83.5	3.6	3.0	141.0	371.5
2019	28.6	117.1	86.5	3.8	3.1	146.2	385.4
2020	29.0	122.3	89.7	3.9	3.3	151.6	399.7
2021	29.5	127.5	93.3	4.0	3.5	157.8	415.5
2022	29.9	132.9	97.0	4.2	3.7	164.1	431.8
2023	30.4	138.6	100.8	4.3	3.9	170.6	448.6
2024	30.9	144.5	104.6	4.4	4.1	177.2	465.8
2025	31.4	150.6	108.6	4.6	4.4	184.0	483.6
2026	31.8	156.7	112.5	4.7	4.6	190.7	501.1
2027	32.3	163.0	116.5	4.9	4.8	197.6	519.0
2028	32.7	169.5	120.6	5.1	5.1	204.5	537.5
2029	33.2	176.3	124.7	5.2	5.3	211.7	556.4
2030	33.7	183.3	128.9	5.4	5.6	218.9	575.9
2031	34.1	190.2	133.0	5.5	5.9	226.0	594.8
2032	34.5	197.4	137.2	5.7	6.2	233.2	614.1
2033	35.0	204.8	141.5	5.9	6.4	240.5	634.0
2034	35.4	212.5	145.8	6.1	6.7	247.9	654.4
2035	35.8	220.5	150.2	6.2	7.0	255.5	675.3

The total consumer sales forecast is seen to grow from 243 GWh in 2008 to 1,145 GWh in 2035, an average annual increase of 5.9%. The consumer sales forecasts is then modified by the energy losses and CADLF's

Table 0-13: Djibouti electricity system losses

	Unit	2005	2006	2007	2008
Energy Delivered	GWh	286,364	294,927	308,795	313,381
Asymmetrical Technical Losses	GWh	32,159	34,536	37,241	37,762
	%	11.23	11.71	12.06	12.05
Non-technical Losses	GWh	42,296	42,145	33,782	46,850
	%	14.77	14.29	10.94	14.95
Total Losses	GWh	74,455	76,681	71,023	84,613
	%	26.00	26.00	23.00	27.00

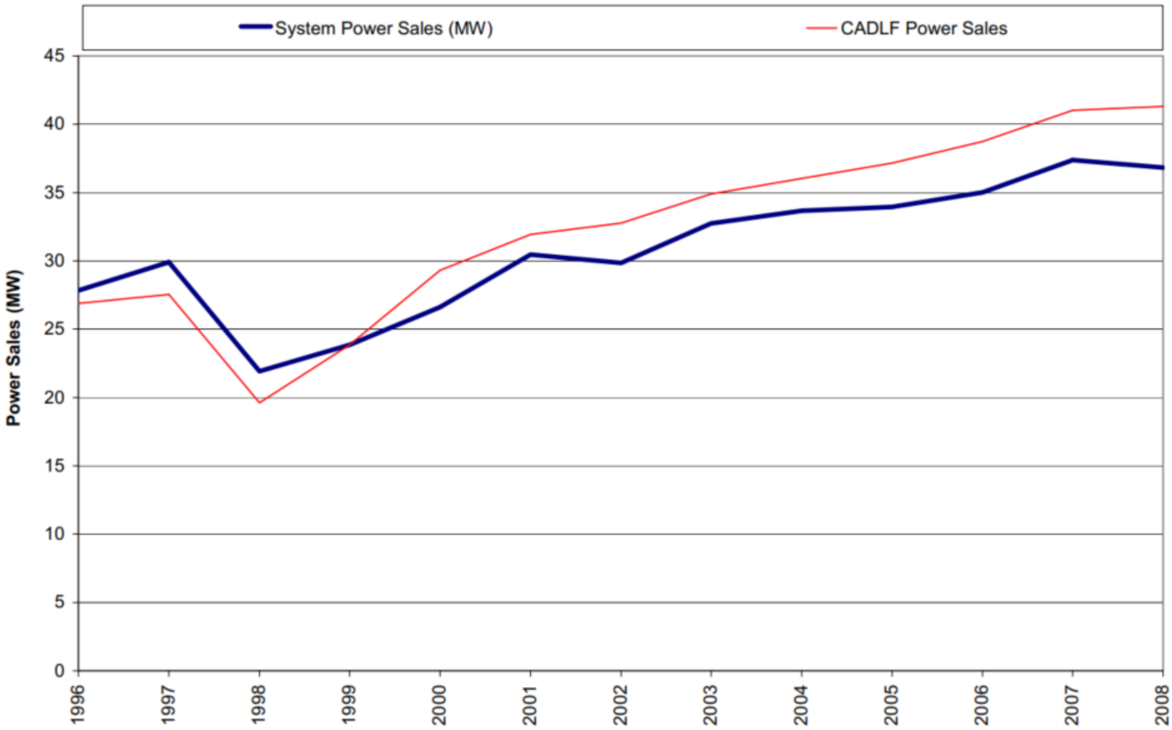
"The CADLF is the load factor that relates energy sales to demand at time of system peak. Therefore, it includes the effects of both diversity (the maximum demand of a group of consumers is less than the sum of the individual demands) and coincidence (the peak demand of a group of consumers may not be at the time of system peak). We have estimated these demands before losses are taken into account. This is because power losses are higher than energy losses. If CADLFs are measured after losses then any change in losses will change the CADLFs, even though the underlying consumer behavior may not have changed"

From the foregoing the CADLF factors used and the relationship between the CADLF and the actual sales are shown in Table 0-14 and Fig 1

Table 0-14: CADLF's factors by consumer groups

Consumer Category	CADLF (%)
Social	60.0%
Domestic	65.0%
LV Djibouti	60.0%
Public Lighting	50.0%
Chantier	80.0%
MV Djibouti	80.0%
Desalination Plant	60.0%

Fig 1: System power sales v. CADLF based power sales



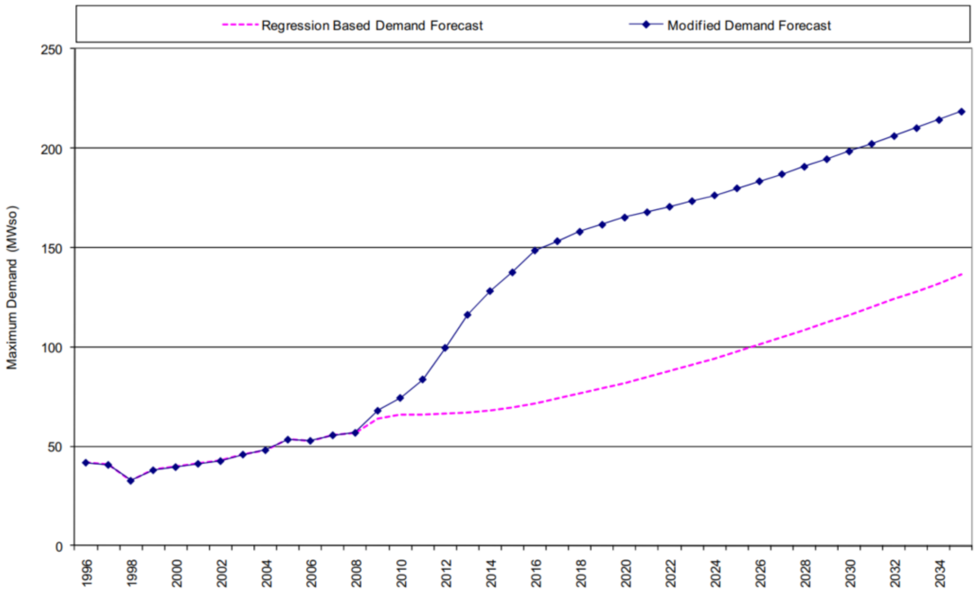
From the foregoing then, the demand forecast for Djibouti can be shown in Table 0-15

Table 0-15: Demand forecast – baseline case scenario

Year	Total Sales (GWh)	Energy Losses: Technical Losses (%)	Energy Losses: Non-Technical Losses (%)	Energy Losses: Total Losses (%)	Total Losses (GWh)	Generation Sent Out (GWh)	Max Demand at Consumer Level (MW)	Consumer Level Load Factor (%)	Power Losses (%)	Maximum Demand (MW)	Power Load Factor (%)	Maximum Demand Growth (%)
2008	242.6	15.0%	10.5%	25.5%	83.0	325.6	36.8	75.2%	35.3%	56.9	65.3%	2.2%
2009	282.7	15.0%	10.5%	25.5%	96.7	379.4	47.2	68.3%	30.6%	68.0	63.7%	19.5%
2010	314.4	14.8%	10.5%	25.3%	106.5	420.8	52.0	69.0%	30.2%	74.5	64.5%	9.5%
2011	368.3	14.6%	8.0%	22.6%	107.5	475.8	60.8	69.1%	27.4%	83.8	64.8%	12.5%
2012	455.9	14.4%	6.0%	20.4%	116.8	572.7	74.7	69.6%	25.0%	99.7	65.6%	18.9%
2013	542.0	14.2%	4.0%	18.2%	120.6	662.6	89.7	69.0%	22.9%	116.3	65.0%	16.7%
2014	610.5	14.0%	2.0%	16.0%	116.3	726.8	101.7	68.5%	20.7%	128.2	64.7%	10.3%
2015	660.6	13.8%	1.0%	14.8%	114.7	775.3	110.7	68.1%	19.5%	137.6	64.3%	7.3%
2016	711.0	13.6%	1.0%	14.6%	121.6	832.6	119.9	67.7%	19.3%	148.6	64.0%	8.0%
2017	735.5	13.4%	1.0%	14.4%	123.7	859.2	124.1	67.7%	19.1%	153.3	64.0%	3.2%
2018	760.4	13.2%	1.0%	14.2%	125.8	886.3	128.3	67.6%	18.8%	158.1	64.0%	3.1%
2019	780.0	13.0%	1.0%	14.0%	127.0	907.0	131.6	67.6%	18.5%	161.6	64.1%	2.3%
2020	800.0	12.8%	1.0%	13.8%	128.1	928.1	135.0	67.6%	18.3%	165.2	64.1%	2.2%
2021	815.8	12.6%	1.0%	13.6%	128.4	944.2	137.7	67.6%	18.0%	167.9	64.2%	1.6%
2022	832.1	12.4%	1.0%	13.4%	128.8	960.9	140.4	67.7%	17.7%	170.6	64.3%	1.6%
2023	848.9	12.2%	1.0%	13.2%	129.1	978.0	143.2	67.7%	17.5%	173.5	64.4%	1.7%
2024	866.2	12.0%	1.0%	13.0%	129.4	995.6	146.1	67.7%	17.2%	176.4	64.4%	1.7%
2025	883.9	12.0%	1.0%	13.0%	132.1	1016.0	149.0	67.7%	17.2%	179.9	64.5%	2.0%
2026	901.4	12.0%	1.0%	13.0%	134.7	1036.1	151.9	67.7%	17.2%	183.4	64.5%	2.0%
2027	919.3	12.0%	1.0%	13.0%	137.4	1056.7	154.9	67.7%	17.2%	187.0	64.5%	2.0%
2028	937.8	12.0%	1.0%	13.0%	140.1	1077.9	158.0	67.8%	17.2%	190.8	64.5%	2.0%
2029	956.7	12.0%	1.0%	13.0%	143.0	1099.7	161.2	67.8%	17.2%	194.6	64.5%	2.0%
2030	976.2	12.0%	1.0%	13.0%	145.9	1122.1	164.4	67.8%	17.2%	198.5	64.5%	2.0%
2031	995.1	12.0%	1.0%	13.0%	148.7	1143.8	167.6	67.8%	17.2%	202.3	64.5%	1.9%
2032	1014.5	12.0%	1.0%	13.0%	151.6	1166.1	170.8	67.8%	17.2%	206.2	64.6%	1.9%
2033	1034.3	12.0%	1.0%	13.0%	154.6	1188.9	174.1	67.8%	17.2%	210.2	64.6%	1.9%
2034	1054.7	12.0%	1.0%	13.0%	157.6	1212.3	177.5	67.8%	17.2%	214.3	64.6%	2.0%
2035	1075.6	12.0%	1.0%	13.0%	160.7	1236.3	181.0	67.8%	17.2%	218.5	64.6%	2.0%

Table 0-15 provides the base line situation without additional pipeline projects, and shown in Fig 2

Fig 2: Djiboutian demand forecast - baseline



South Sudan

There is no transmission back-bone or any interconnected grid network in South Sudan. The supply system consists of 3 isolated distribution networks in the state capitals of Juba, Wau and Malakal totaling about 15 km of 11 kV lines plus some electrified commercial centers (mini-grids implemented by communities and donors). As a result, electricity sales over the recent past years have been very low (Table 0-16).

Table 0-16: Electricity sales in South Sudan

Table 2: Electricity sales performance in South Sudan						
Year	2000	2001	2002	2003	2004	2005
Grid sales (GWh)	1,408	1,489	1,757	1,928	2,496	2,730
Off-grid sales(GWh)	82	63	80	89	106	140
Total sales(GWh)	1,490	1,552	1,837	2,017	2,602	2,870

The country is investing in Oil refineries to avoid dependency on Sudan. These committed energy projects include:

- The first South Sudan refinery in Melut, in Upper Nile State, aims at refining 10,000 barrels a day of the Thar blend and will mainly cater for the domestic needs. This refinery is expected to be commissioned by end of July or first week of August 2013.
- A second refinery in Bentiu, Unity State will refine the Nile blend – a better quality blend which is also much more marketable than the other two. A third refinery has been approved by the council of ministers, and is yet to be launched in Akon for the Thar blend. South Sudan has created the first oil company known as Imatongas Petroleum Company.
- The Thangrial refinery in Melut will produce enough products to meet the current demand and have surplus for export – but the refinery is designed to produce more of HFO (to be used as an alternative for the costly diesel generators), less of gasoil (currently 70% of the demand) and might not produce

lighter products like petrol. The refinery could produce excess HFO for export, but – depending on the demand – South Sudan might still have to import lighter products like petrol and probably diesel.

The current demand for electricity is estimated at 300MW which is expected to rise to over 1400MW by 2030. According to the 2007 power master plan for Sudan, Juba Regional Grid maximum expected demand will be 94 MW in 2020 and 304 MW in 2030. It is important to note that the last power master plan study was prepared for the whole Sudan by PB Power UK for NEC Utility in Khartoum in 2007 and the Study had no demand survey work undertaken in South Sudan. Hence, there is a need to undertake a power master plan for the new nation, taking into account the recent developments.

The demand for electricity has been steadily increasing with new economic opportunities in the post-independence era. The growth of the electricity sector in South Sudan is not restrained by demand but lack of supply. In the major cities there is a substantial amount of suppressed demand and captive generation used by the private sector will increase the load as a step function if supply sources are made available.

Based on current economic development plans and assuming they will be implemented, South Sudan will have a total of load demand of nearly 100 MW by 2016 with energy sales of nearly 200 GWh by 2016.

Energy sector in South Sudan is fully subsidised. Fuel to run the generators and spare parts are bought by the Ministry of Finance and Economic Planning. Salaries of staff of the Electricity Corporation are also paid through the GoSS budget. Even before all the power pants were shut down, the utility was not able to collect revenues from customers. The main customers including government buildings, military camps, hospitals, water supply utility, airport, etc do not pay electricity bills, although they are supposed to pay. In addition to that, 80% of the little collected revenues are deposited in the Ministry of Finance and Economic Planning.

The current tariff of electricity is not cost reflective. The production cost is around USD 0.70/kWh. There are three types of customers with different tariffs. Commercial category pays SSP 70 cts (USD 0.21), Domestic category pays SSP 50 cts (USD 0.15) while the Government establishment should pay SSP 80 cts (USD 0.24). Although the government establishments are expected to pay higher prices, they are the most defaulters.

Committed energy projects

The committed energy projects in the short to medium term are shown in Table 0-17

Table 0-17: Short to medium term committed energy projects

Project	Construction period	Project status
Import of 50-100MW from Ethiopia	2-3 years	The feasibility study has been completed; an Environmental Impact assessment study still in progress
40 MW Fula hydro project (short term project)	2-3 years	The feasibility study is completed, Environmental Impact assessment study is completed, The project is financially supported by the Norwegian Government. It will cost around 150$ million and 75% of the costs will be met by Norfund, a Norwegian agency with the South Sudan government meeting 25%. The public- private partnership will also have Norfund manage the whole

		process with South Sudan government set to get a finished product
200-300 MW Tharjath crude fired power plant	2-3 years	Terms of Reference (TOR) for feasibility study prepared
Upgrading of the 2 MW Kinyeti hydro project	16 months	Contract expired, Feasibility study completed , GoSS is sourcing for finance for construction and commissioning
12-15MW Sue Hydro power project	2-3 years	Feasibility study completed, funding not yet secured
540 MW Beden hydro power project	6-7 years	Feasibility study completed, Environmental Impact assessment completed, EPC contract signed with CGGC, It will cost around $1.5bn and the Chinese Government agreed in principle to fund it. On January 20th, 2013, CGGC and the Ministry of Electricity and Dams of South Sudan signed an EPC contract in Beijing for the Project. The project is expected to fundamentally remove the power supply bottleneck in South Sudan after completion
410 MW Lakki hydro project	5-7 years	Feasibility study completed, Environmental Impact assessment completed, no contractor yet identified. Project is located it is located 77 km downstream of Uganda border
230 MW Shukoli hydro project	5-7 years	Feasibility study completed, Environmental Impact assessment completed, no contractor identified yet. it is located 46 km downstream of Uganda border at the upstream end of the Yeroba
890 MW Grand Fula hydro project	6-7 years	Feasibility study completed, Environmental Impact assessment completed, contract awarded to AAE Systems
16 Mini – hydro power sites ranging in size from 3 to 11 MW installed capacity	2 to 3 years	An additional 16 mini hydro power sites have already been identified and detailed feasibility and design works have been completed for eight small hydroelectric power plants ranging from 3 to 11 MW of installed capacity

The GoSS is planning to import power from Ethiopia and Uganda in the short term, but also to export to the East African power pool (EAPP) once its planned hydropower projects are onboard. This is to be achieved by the GoSS signing the Intergovernmental Memorandum of Understanding and its utility SSEC signing an Inter Utility Memorandum of Understanding.

In addition there is the planned interconnection of Ethiopia-South Sudan consists of a 335 km of 230 kV transmission line from Gambela to Malakal and a 700 km of 500 kV transmission line from Dedesa to Juba via Tepi. Another option to be considered is the interconnection with Uganda. Currently, Uganda has expanded its transmission network at 220 kV towards its northern border up to Gulu which is only 75 km from the border town of Nimule, which is 200 km from Juba. Although Uganda is currently facing power shortfalls, the Bujagali power plant is expected to be fully commissioned shortly. In addition, other hydro projects such as Karuma 200 MW and Isimba 120 MW are in pipeline for construction.

The ongoing interconnections between Uganda and Kenya as well as Kenya and Ethiopia can enable the wheeling of power from Ethiopia if a Uganda-South Sudan interconnection is available. Furthermore, the major hydropower sites in South Sudan are concentrated close to Nimule at the Ugandan border. An interconnection between Juba and Gulu with intermediate stations for the new hydro power plants can allow for limited power flows to South Sudan in the initial years and power export to Uganda in the longer term. Currently, discussions are ongoing on such an interconnection under the Nile Equatorial Lakes Subsidiary Action Programme (NELSAP) which is part of the Nile Basin Initiative (NBI). It is important to note that these interconnections will not only be used to import or export power to or from South Sudan but will also ensure stability of the interconnected network.

In addition to the above, the GoSS and the Egyptian governments have agreed to the establishment of four power plants in four south sudan cities. These are to be achieved in 2 stages

Stage I: Establishment of a power plant with a capacity of 2x1 Megawatts, and its necessary distribution networks in Wau city on the western bank of the Jur River.

Stage II: Establishment of three power plants in three cities: Yambio (West Equatorial State), Bor (Jonglei State), Rumbek (Lakes State) with capacity of each is 2x1.4 Megawatts each. South Sudan committed to construct electricity distribution networks in the three mentioned cities. It was agreed that after the completion of each project, its administration will be handed over to the South Sudanese side. The projects are still under implementation.

Work started on Jur River in Wau city, Northern Bar Gazar State, by adding two additional generating units 2*1MW to the two already installed generating units that had stopped functioning completely in 2003, in addition to installing distribution networks to feed governmental facilities and households. After the success of this project, the two governments agreed to replicate this experience in three other cities that lack access to electricity; Bor, Rumbek and Yambio. Before determining the targeted cities in the second stage, the two governments agreed that the GoE would establish three power plants in three cities while the GoSS establishes their distribution networks.

Demand forecasts for other IGAD countries using Balmorel model

Electricity demand in TWh (including losses) for selected IGAD countries obtained from the EAPP master plan are shown as below in Table 0-18

Table 0-18: Electricity annual demand (TWh) for selected IGAD countries

Country	2000	2010	2015	2020	2025
Djibouti		0.3	0.8	0.9	1
Ethiopia	1.6	5.6	14.7	35	53.2
Kenya	4.7	9	13.3	41.6	61.3
South Sudan			0.7	2	3.2
Sudan	2.4	7.2	14.7	24.5	32
Uganda	1.3	3	4.8	7.8	12.1

Electricity systems in Eastern Africa have been developed almost exclusively according to a local and/or national focus. Today, only small interconnectors exist between the countries (in most cases below 200 MW). Therefore, exchange of power has been limited, as have Three other benefits from cooperation, such as sharing of reserves and balancing dry and wet years. From 2017, strong interconnectors will connect Ethiopia, Kenya and Tanzania, and several other projects will make regional trade possible. Realisation of the committed transmission projects will secure that each EAPP member country will have cross-border power exchange capabilities towards 2020

Gap analysis

In this section, the impact of the additional pipeline projects is considered for either the EAPP or the Djiboutian case. For the Djibouti case Fig 3 shows comparisons of various scenarios

Under the EAPP for selected IGAD member states a number of additional pipeline transboundary projects have come online. By 2020 a number of interconnectors will exist among various IGAD countries, these will total 3.125 TW (Table 0-19)

Table 0-19: Potential interconnectors by 2020

Interconnecting countries	Size	Status
Ethiopia Djibouti	180 MW	An AC line, existing
Kenya – Ethiopia	2000 MW	A DC line, to be commissioned by 2017
Ethiopia – Sudan	200 MW	An AC line, existing
Sudan – South Sudan	300 MW	An AC line, existing
Kenya – Uganda	445 MW	An AC line, 145 MW existed before, additional 300 MW was to commissioned by 2015
Total interconnectors size (MW)	3,125	An AC line

Considering the demand for additional power, a comparison can be made between the required peak demand (GW) and the committed projects

Table 0-20: Electricity peak demand (GW) for selected IGAD countries

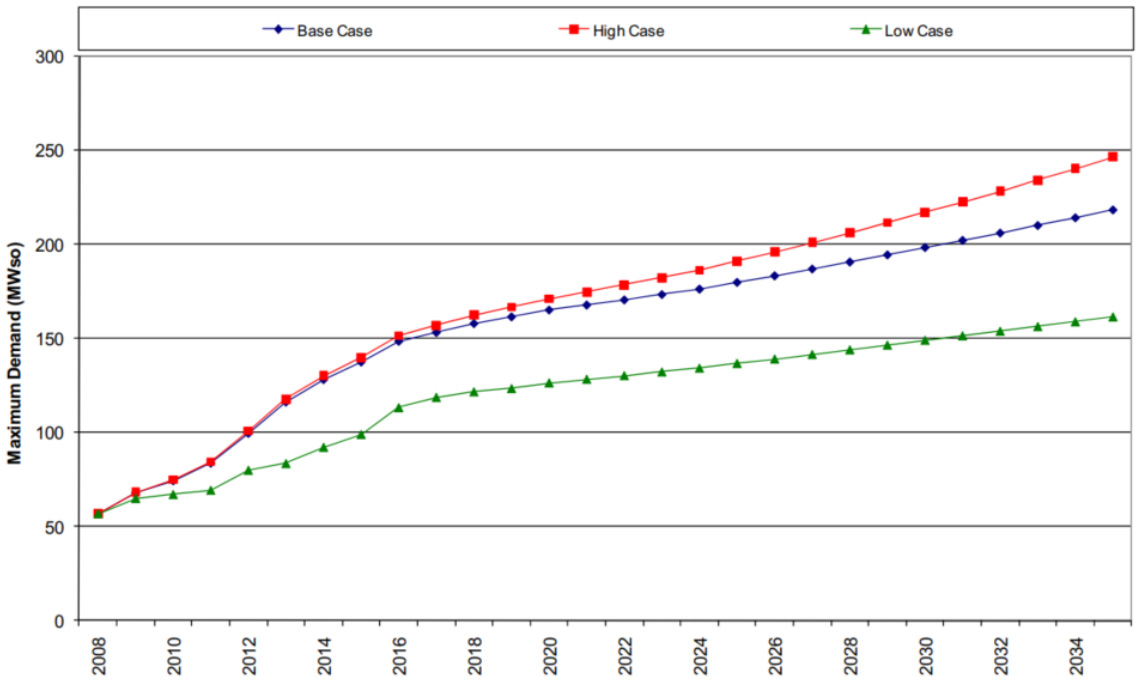
Country	2015	2020	2025
Djibouti	0.1	0.2	0.2
Ethiopia	3	6	9
Kenya	2	7	10
South Sudan	0.1	0.4	0.6
Sudan	3	4	6
Uganda	1	1	2

The national forecasts cover different periods that do not always cover the entire projection period of the current study, i.e. until 2040. To extrapolate the forecast to 2040, the individual country forecasts have been linearly adjusted from their last year of projection to exhibit a 6% annual demand growth rate towards 2030, and a 3% annual growth rate in between 2030 and 2040. This assumption reflects the assumed decrease in demand growth rate as electricity access is provided to a larger share of the population of the EAPP

The following analysis for Djibouti considers the potential use of the RALF model to assess demand and gap analysis

Djibouti

Fig 3: Djiboutian demand forecast comparisons



The high case demand forecast does not include the pipeline projects while the low demand case includes the pipeline committed projects. These committed pipeline projects include:

Power plant	Existing installed capacity	Committed planned capacity (MW)
Marabout power station	6 medium speed diesel generating units with a total capacity of 14.4 MW	
Boulaos power station	13 medium speed diesel generating units with a total of 90.9 MW	Two new medium speed diesel to be added with a total capacity of 9.4 MW
Ethiopia – Djibouti interconnector		Provide between 180 GWh to 300 GWh

The above are shown graphically as below

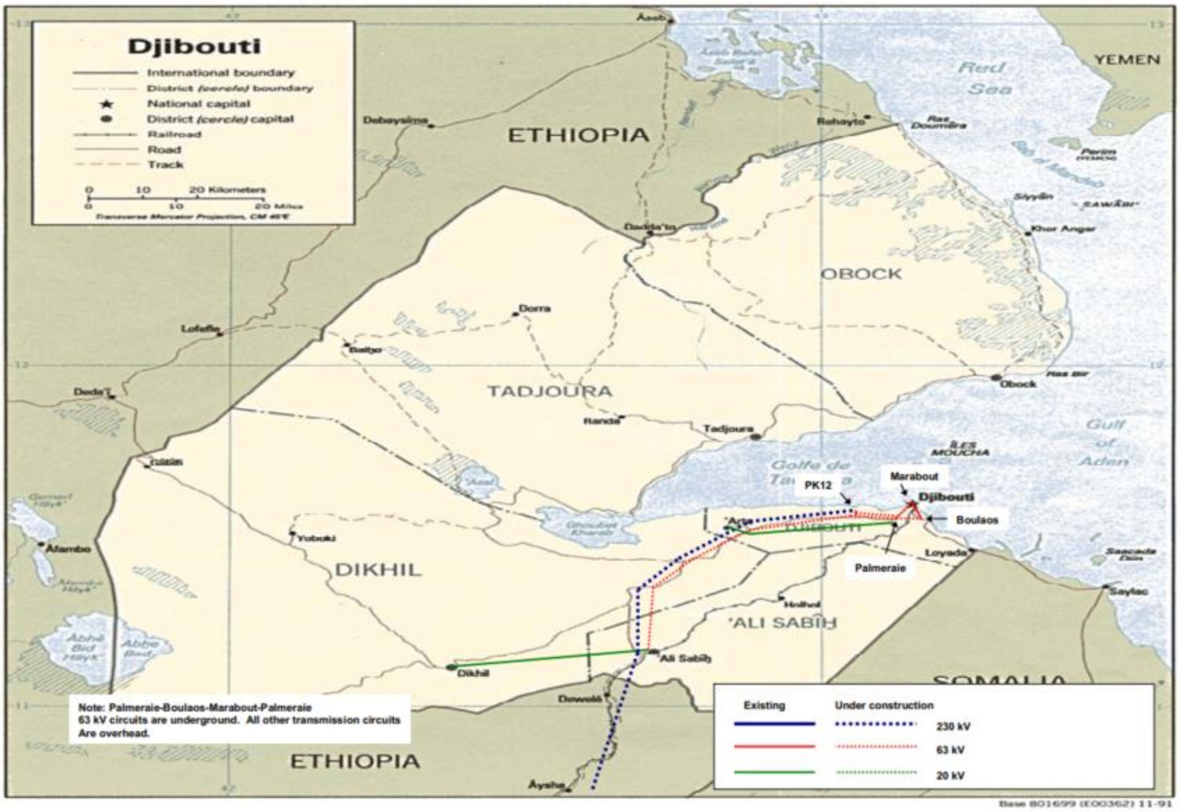


Fig 4: Existing and committed power transmission system

Currently Djibouti has a sent capacity of 98.8 MW, by 2014 it is estimated that the total system capacity will be 122.6 MW. 85% of energy needs in Djibouti is based on imported hydrocarbon products with the remaining 15% based on indigenous wood and charcoal. For this reason, Djibouti seeks to develop its geothermal (20 MW) and wind (45.9 MW installed) energy capacity as well as utilise the Ethiopian-Djibouti interconnector.

The ANNEXES

(under separate cover)

[i] Future demand for energy with respect to energy infrastructure (interconnectors) has been done. In this such a modelling, the emphasis is not on the different sources, but more on the total contributory sum of the developed and viable planned to be developed resources. This will then provide the regional energy demand for the energy interconnectors infrastructure.

It is also noted that based on the current energy mix the major supplies of excess energy are those with hydro. At the time of doing the study, no specific or big enough thermal, nuclear or RE system was in plan to feed specifically feed interconnectors. The Ethiopian GEDI is however specifically set up for that. While the the Kenyan Wind power is too small at 300 MW while the thermal coal power plant is facing uncertainty due to environmental issues and land repatriation.

For these reasons, such a projection suggested is at this stage of the study not feasible nor desirable. Since we are looking at interconnectors not Energy mix and not undertaking an Energy resource planning used at national level to track energy consumption, production and resource extraction for future demand projections.

To undertake the kind of energy project so suggested requires we do an energy modelling for planning of national infrastructure. For such a resource planning modelling the data needs are extremely huge and its normally done by Ministries using models like LEAP. Note that the EAPP did not use LEAP, since like explained it was not doing resource modelling but infrastructure modelling. Consequently, in our study use has been made of EAPP BALMROLE model as well as ERM models.