


IGAD Regional Infrastructure Master Plan

ANNEXES

March 2020

Document Control

Document title	IGAD Regional Infrastructure Mater Plan: Draft Final Report Annexes
Reference no.	IPE IGAD IRIMP Report No 3
Prepared by	Dr. Nicholas Miles, Mr. Matthew Crighton, Mr. Gilbert Maeti, Eng. Nathan Mwema, Dr. Abusufian Dafalla, Mr. Francis Xavier, Mr. Danson Maina
Additional inputs	Eng. George Matheri, Mr. Stephen Mwai, Mr. Neil Pinto, Mr. Don Webster, Ms. Tracy Lane, Mr. Johan Krueger
Checked by	Mr. Jamie Simpson, Eng. Abdulrazaq Ali
Date	6th March 2020

Contents

Annex One:
Demand Forecasts and Gap Analysis

Annex One: Demand Forecasts and Gap Analysis

Transport Sector

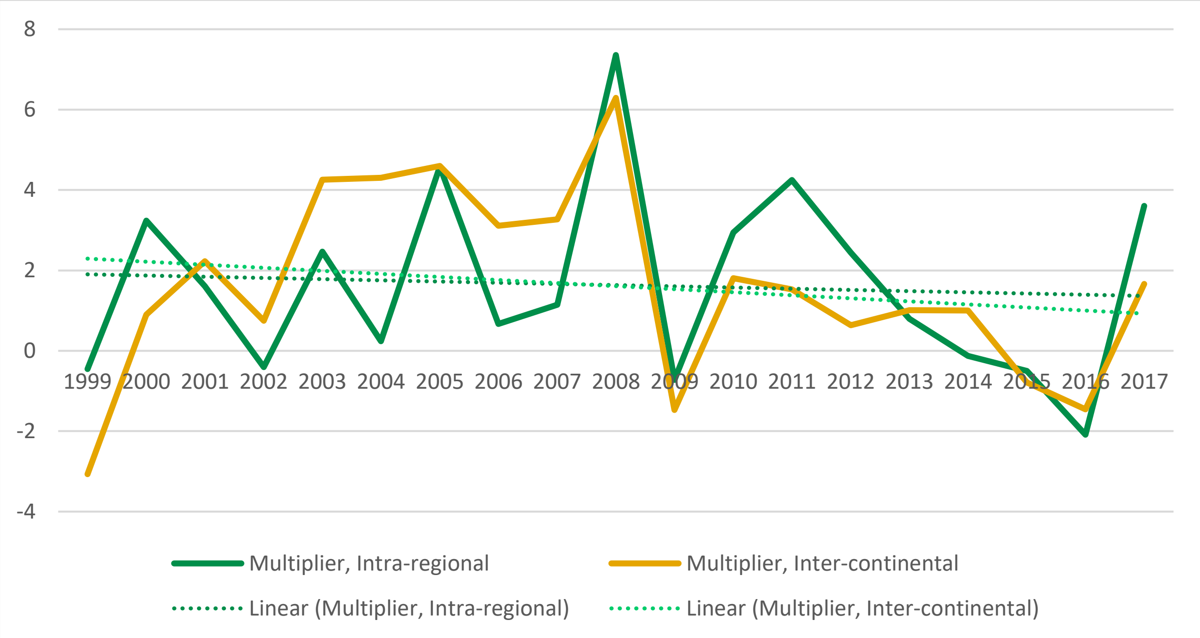
Estimating Transport Demand / Trade Volume Forecasts for the IGAD Corridors

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 A1: Inter-continental and intra-regional Trade: GDP multiplier trend, 1998-2017



Source: UNCTAD data

However, as Figure A1 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.

Table A1: Multipliers used in trade volume forecasts

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 consistent 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:

- **Direct intra-regional trade**: Direct trade between the countries comprising the corridor (sum of exports and imports between Country A and Country B);
- **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);
- **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).

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).

Growth Scenarios

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[1];
- **IMF forecast GDP growth scenario**: IGAD economies grow at the rates forecast by the IMF[2];
- **IRIMP GDP growth scenario**: IGAD economies grow at rates based on authors' estimates (a mid-level scenario between IMF and target growth rates).

Table A2: 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 A3: 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

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

Table A4: CAGR for inter-continental and intra-regional trade, IRIMP 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

Trade Shares by Corridors

The model also estimates the share of inter-continental trade that emerging corridors can capture, known as the hinterland share. Three scenarios for hinterland share are modelled based on alternative pathways of corridor development for the IGAD region:

- **Concentrated Corridor Development**: Given the significance of the Port Sudan, Djibouti and Northern corridors, they currently account for 92% of inter-continental and 73% of intra-regional trade combined, these will be the focus for development and investment in infrastructure, with less emphasis on developing additional corridors. It is anticipated that intra-regional trade will grow faster between country pairs on focus corridors and will be suppressed in country pairs located on the other corridors.
- **Dispersed Corridor Development**: All nine major sea port corridors in the region will be prioritised for development, with investment in infrastructure dispersed between them. It is anticipated that intra-regional trade growth will grow rapidly between all country pairs.
- **Phased Corridor Development**: The Port Sudan, Djibouti and Northern corridors will continue to function as the primary conduits for inter-continental and intra-regional trade in the medium term (to 2030), and the forecast increase in trade volume will require significant investment in infrastructure to meet demand. The development of the remaining corridors will be phased to maximise the impact of investments.

Table A5: Share of IGAD member state trade by port, 2017, all scenarios

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%	40%	0%	0%	0%
Kismayo	0%	0%	0%	0%	3%	0%	0%	0%
Mogadishu	0%	0%	0%	0%	55%	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%**	**98%**	**100%**	**100%**	**98%**

Table A6: Share of IGAD member state trade by port, 2024, concentrated scenario

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	95%	0%	10%	0%	95%
Lamu	0%	0%	3%	5%	0%	10%	0%	3%
Djibouti	100%	0%	90%	0%	0%	0%	0%	0%
Port Sudan	0%	0%	2%	0%	0%	80%	100%	0%
Berbera	0%	0%	5%	0%	40%	0%	0%	0%
Kismayo	0%	0%	0%	0%	3%	0%	0%	0%
Mogadishu	0%	0%	0%	0%	55%	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%**	**98%**	**100%**	**100%**	**98%**

Table A7: Share of IGAD member state trade by port, 2030, concentrated scenario

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	95%	0%	10%	0%	95%
Lamu	0%	0%	3%	5%	0%	10%	0%	3%
Djibouti	100%	0%	90%	0%	0%	0%	0%	0%
Port Sudan	0%	0%	2%	0%	0%	80%	100%	0%
Berbera	0%	0%	5%	0%	40%	0%	0%	0%
Kismayo	0%	0%	0%	0%	3%	0%	0%	0%
Mogadishu	0%	0%	0%	0%	55%	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%**	**98%**	**100%**	**100%**	**98%**

Table A8: Share of IGAD member state trade by port, 2050, concentrated scenario

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	95%	0%	10%	0%	95%
Lamu	0%	0%	3%	5%	0%	10%	0%	3%
Djibouti	100%	0%	90%	0%	0%	0%	0%	0%
Port Sudan	0%	0%	2%	0%	0%	80%	100%	0%
Berbera	0%	0%	5%	0%	40%	0%	0%	0%
Kismayo	0%	0%	0%	0%	3%	0%	0%	0%
Mogadishu	0%	0%	0%	0%	55%	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%**	**98%**	**100%**	**100%**	**98%**

Table A9: Share of IGAD member state trade by port, 2024, dispersed scenario

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	75%	0%	10%	0%	85%
Lamu	0%	0%	5%	18%	0%	20%	0%	10%
Djibouti	100%	0%	60%	0%	0%	10%	0%	0%
Port Sudan	0%	0%	5%	0%	0%	60%	95%	0%
Berbera	0%	0%	10%	0%	40%	0%	0%	0%
Kismayo	0%	0%	0%	5%	10%	0%	0%	0%
Mogadishu	0%	0%	0%	2%	45%	0%	0%	0%
Massawa	0%	90%	10%	0%	0%	0%	5%	0%
Assab	0%	10%	10%	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**95%**	**100%**	**100%**	**95%**

Table A10: Share of IGAD member state trade by port, 2030, dispersed scenario

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	68%	0%	10%	0%	80%
Lamu	0%	0%	10%	25%	0%	30%	0%	15%
Djibouti	100%	0%	45%	0%	0%	10%	0%	0%
Port Sudan	0%	0%	5%	0%	0%	50%	90%	0%
Berbera	0%	0%	15%	0%	35%	0%	0%	0%
Kismayo	0%	0%	0%	5%	15%	0%	0%	0%
Mogadishu	0%	0%	0%	2%	45%	0%	0%	0%
Massawa	0%	90%	10%	0%	0%	0%	10%	0%
Assab	0%	10%	15%	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**95%**	**100%**	**100%**	**95%**

Table A11: Share of IGAD member state trade by port, 2050, dispersed scenario

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	53%	0%	13%	0%	75%
Lamu	0%	0%	15%	40%	0%	40%	0%	20%
Djibouti	100%	0%	30%	0%	0%	12%	0%	0%
Port Sudan	0%	0%	5%	0%	0%	35%	80%	0%
Berbera	0%	0%	20%	0%	35%	0%	0%	0%
Kismayo	0%	0%	0%	5%	15%	0%	0%	0%
Mogadishu	0%	0%	0%	2%	40%	0%	0%	0%
Massawa	0%	90%	10%	0%	0%	0%	20%	0%
Assab	0%	10%	20%	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**90%**	**100%**	**100%**	**95%**

Table A12: Share of IGAD member state trade by port, 2024, balanced scenario

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	90%	0%	5%	0%	90%
Lamu	0%	0%	3%	10%	0%	20%	0%	5%
Djibouti	100%	0%	80%	0%	0%	1%	0%	0%
Port Sudan	0%	0%	3%	0%	0%	74%	98%	0%
Berbera	0%	0%	7%	0%	35%	0%	0%	0%
Kismayo	0%	0%	0%	0%	5%	0%	0%	0%
Mogadishu	0%	0%	0%	0%	58%	0%	0%	0%
Massawa	0%	90%	7%	0%	0%	0%	2%	0%
Assab	0%	10%	0%	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**98%**	**100%**	**100%**	**95%**

Table A13: Share of IGAD member state trade by port, 2030, balanced scenario

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	85%	0%	5%	0%	85%
Lamu	0%	0%	5%	15%	0%	30%	0%	10%
Djibouti	100%	0%	65%	0%	0%	2%	0%	0%
Port Sudan	0%	0%	3%	0%	0%	63%	97%	0%
Berbera	0%	0%	10%	0%	33%	0%	0%	0%
Kismayo	0%	0%	0%	0%	7%	0%	0%	0%
Mogadishu	0%	0%	0%	0%	58%	0%	0%	0%
Massawa	0%	90%	10%	0%	0%	0%	3%	0%
Assab	0%	10%	7%	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**98%**	**100%**	**100%**	**95%**

Table A14: Share of IGAD member state trade by port, 2050, balanced scenario

Port	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Mombasa	0%	0%	0%	70%	0%	5%	0%	83%
Lamu	0%	0%	7%	30%	0%	50%	0%	12%
Djibouti	100%	0%	50%	0%	0%	5%	0%	0%
Port Sudan	0%	0%	3%	0%	0%	40%	95%	0%
Berbera	0%	0%	15%	0%	30%	0%	0%	0%
Kismayo	0%	0%	0%	0%	10%	0%	0%	0%
Mogadishu	0%	0%	0%	0%	55%	0%	0%	0%
Massawa	0%	90%	10%	0%	0%	0%	5%	0%
Assab	0%	10%	15%	0%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**95%**	**100%**	**100%**	**95%**

Traffic Volumes for Corridor Segments

The following section presents the full transport infrastructure demand forecasts for each of the nine corridors under the Phased Development, IRIMP growth rate scenario. The full model is presented in an accompanying Excel spreadsheet.

Table A15: IRIMP Trade Volume Forecasts – Phased Corridor Development Scenario

Corridor	Section	Demand (millions of tons)			
		2017	2024	2030	2050
Northern Corridor					
Northern Corridor	Mombasa Port	31	50	79	172
Northern Corridor	Mombasa-Nairobi	40	65	103	223
Northern Corridor	Nairobi-Nakuru	24	38	62	142
Northern Corridor	Nakuru-Kisumu	12	19	30	70
Northern Corridor	Kisumu-Busia	7	11	19	44
Northern Corridor	Nakuru-Eldoret	12	19	31	72
Northern Corridor	Eldoret-Malaba	7	11	19	44
Northern Corridor	Eldoret-Kitale	3	8	17	48
Northern Corridor	Kitale-Lokichar	3	8	17	48
Northern Corridor	Malaba and Busia-Jinja	10	16	25	64
Northern Corridor	Jinja-Kampala	17	26	43	109
Northern Corridor	Tororo-Gulu	4	5	7	19
Northern Corridor	Kampala-Gulu	2	3	4	11
Northern Corridor	Gulu-Nimule	1	1	2	5
Northern Corridor	Nimule-Juba	1	1	2	6
Djibouti Corridor					
Djibouti Corridor	Djibouti Port	19	33	44	92
Djibouti Corridor	Djibouti-Dikhil	9	16	21	44
Djibouti Corridor	Djibouti-Galile	13	24	32	66
Djibouti Corridor	Dikhil-Galafi	9	16	21	44
Djibouti Corridor	Galafi-Semera	8	13	22	60
Djibouti Corridor	Semera-Weldiya	2	3	4	9
Djibouti Corridor	Semera-Awash	6	10	18	51
Djibouti Corridor	Diwele-Dire Dawa	11	20	26	52
Djibouti Corridor	Dire Dawa-Awash	15	28	41	96
Djibouti Corridor	Awash-Adama	20	39	59	152

Djibouti Corridor	Adama-Addis Ababa	23	44	68	174
Djibouti Corridor	Addis Ababa-Jima-Mizan	1	2	3	7
Djibouti Corridor	Mizan-Dima	1	2	2	6
Djibouti Corridor	Dima-Raad-Boma	1	2	2	6
Djibouti Corridor	Boma-Kapoeta	0	0	0	2
LAPSSET Corridor					
LAPSSET Corridor	Lamu Port	0	7	18	80
LAPSSET Corridor	Lamu-Garissa-Isiolo	0	8	21	95
LAPSSET Corridor	Isiolo-Nairobi	0	5	12	59
LAPSSET Corridor	Isiolo-Marsabit-Moyale	0	1	4	13
LAPSSET Corridor	Isiolo-Lokichar	0	3	7	25
LAPSSET Corridor	Lokichar-Lokichoggio	0	3	7	25
LAPSSET Corridor	Lokichoggio-Nandapal	0	3	7	25
LAPSSET Corridor	Moyale-Awassa-Modjo	0	1	4	13
LAPSSET Corridor	Nandapal-Kapoeta	0	2	5	20
LAPSSET Corridor	Kapoeta-Juba	0	2	5	22
Berbera Corridor					
Berbera Corridor	Berbera Port	2	4	8	26
Berbera Corridor	Berbera-Hargeisa	3	6	12	39
Berbera Corridor	Hargeissa-Togochaale	2	5	10	35
Berbera Corridor	Togochaale-Jijiga	1	3	7	26
Berbera Corridor	Jijiga-Dire Dawa	1	3	7	26
Port Sudan Corridor					
Port Sudan Corridor	Port Sudan Port	13	15	20	43
Port Sudan Corridor	Port Sudan-Haya	18	22	29	63
Port Sudan Corridor	Haya-Kassala	3	5	7	17
Port Sudan Corridor	Kassala-Al Quadarif	3	5	7	17
Port Sudan Corridor	Haya-Atbara	15	17	22	46
Port Sudan Corridor	Atbara-Khartoum	16	19	24	51

Port Sudan Corridor	Khartoum-Wadi Medan	9	11	14	24
Port Sudan Corridor	Wadi Medan-Sennar	9	11	14	24
Port Sudan Corridor	Sennar-Al Damazin	0	0	1	2
Port Sudan Corridor	Al Damazin-Kurmuk	0	0	1	2
Port Sudan Corridor	Wadi Medan-Al Quadarif	0	1	1	2
Port Sudan Corridor	Al Quadarif-Metema	1	1	2	6
Port Sudan Corridor	Khartoum-Rabak	9	10	13	24
Port Sudan Corridor	Rabak-El Obeid	7	8	10	18
Port Sudan Corridor	El Obeid-En Nahud	7	8	10	18
Port Sudan Corridor	En Nahud-Babanusa-El Mujlad	6	7	9	15
Port Sudan Corridor	Babanusa-El Mujlad-Abyei	6	6	8	13
Port Sudan Corridor	Abyei-Wau	1	1	1	1
Port Sudan Corridor	Wau-Rumbek-Mundri	1	1	1	1
Port Sudan Corridor	Mundri-Juba	1	1	1	1
Port Sudan Corridor	Rabak-Renk	1	1	1	1
Port Sudan Corridor	Renk-Malakal	1	1	1	1
Port Sudan Corridor	Malakal-Waat	1	1	1	1
Port Sudan Corridor	Waat-Bor	1	1	1	1
Port Sudan Corridor	Bor-Juba	1	1	1	1
Port Sudan Corridor	Addis Ababa-Gondar	1	2	3	7
Port Sudan Corridor	Gondar-Metema	1	1	2	6
Port Sudan Corridor	Kurmurk-Asosa-Nekemte	0	0	1	2
Port Sudan Corridor	Nekemte-Ambo-Addis Ababa	0	1	1	2
Massawa Corridor					
Massawa Corridor	Massawa Port	2	5.04	9.53	14.50
Massawa Corridor	Massawa-Nefasit	2	4	6	12.5
Massawa Corridor	Nefasit-Asmara	2	4	6	12.5
Massawa Corridor	Asmara – Guna Guna/Zalambessa	2	5	10	15
Massawa Corridor	Nefasit-Dekemhare	0	4	9	10
Massawa Corridor	Dekemhare - Guna Guna/Zalambessa	0	4	9	10

Massawa Corridor	Guna Guna/Zalambessa - Adigrat	0	4	9	10
Massawa Corridor	Adigrat-Mekele	0	4	9	10
Massawa Corridor	Mekele-Weldiya	3	3	6	20
Massawa Corridor	Weldiya-Awash	3	3	6	20
Massawa Corridor	Weldiya-Debre Birhan	1	3	6	20
Massawa Corridor	Debre Birhan-Addis Ababa	1	3	6	20
Massawa Corridor	Massawa-Keren	0	1	1	4
Massawa Corridor	Keren-Barentu	0	1	1	3
Massawa Corridor	Barentu-Teseney	0	1	1	3
Massawa Corridor	Teseney-Aligider	0	0	1	2
Massawa Corridor	Aligider-Kassala	0	0	0	2
Assab Corridor					
Assab Corridor	Assab Port	2	2	3	8
Assab Corridor	Assab Port - Bure	0	1.5	7.5	8.5
Assab Corridor	Bure – Manda - Semera	2	5	12	15
Assab Corridor	Semera - Awash	4	4	9	15
Assab Corridor	Awash – Adama – Addis Ababa	4	3	6	20
Mogadishu Corridor					
Mogadishu Corridor	Mogadishu Port	2	3.1	4.6	11.5
Mogadishu Corridor	Negele – Filton – Siftu – Dollow	1	5	9	23
Mogadishu Corridor	Mogadishu – Afgoi – Baidoa	1	3	4	12
Mogadishu Corridor	Baidoa - Luuq	0	5	4	10
Mogadishu Corridor	Luuq – Mandera	0	4	9	15
Mogadishu Corridor	Kebri Mengest - Negele	0	0	8	5
Mogadishu Corridor	Isiolo – Wajir – El Wak - Mandera	2	3	6	26
Mogadishu Corridor	Ginir – Gode	1	5	9	23
Mogadishu Corridor	Mogadishu - Jowhar	0	10	4	6
Mogadishu Corridor	Jowhar – Beledweyne – Ferfer	0	6	4	6
Mogadishu Corridor	Ferfer - Raaso	0	2	5	10
Mogadishu Corridor	Turdibi/Galdogobi – Gaalkacyo	1	5	9	23

Mogadishu Corridor	Kebridahar – Warder – Turdibi	1	5	9	23
Mogadishu Corridor	Ferfer – Warder – Aware	0	5	9	23
Kismayo Corridor					
Kismayu Corridor	Kismayo Port	0	0.4	0.75	2.55
Kismayu Corridor	Kismayo – El Wak	0	0.2	2	5
Kismayu Corridor	Kismayo - Bilis Qooqaani - Liboi	2	5	9	15
Kismayu Corridor	Liboi - Dadaab - Garissa	2	5	12	8
Kismayu Corridor	Garissa – Nairobi	2	4	9	15

Energy Sector

A key objective of IRIMP is to identify and prioritise potential transmission interconnections between IGAD countries and to thus facilitate electricity trade to the mutual advantage of IGAD members. A strategy and masterplan are required that will:

- Facilitate easy intra and interconnectivity within the region;
- Simulate regional economic growth and thereby contribute to poverty reduction;
- Reduce isolation and promote regional integration and stability.

The main thrust of the project, in terms of the energy sector, is therefore to promote transmission interconnections between the member countries in the IGAD region. The received wisdom is that such interconnections have multiple benefits. These benefits are elaborated in a subsequent sub-section but can briefly be summarised as: i) developing the region's energy resources on an economic least-cost basis, and thus at optimum economic efficiency; ii) sharing reserve capacity and ancillary services such as reactive power and voltage control, black start capability, system balancing, etc., iii) promoting dialogue and cooperation between neighbouring countries, etc. In practice, the full range of benefits has been difficult to realise in developing countries. Africa has several regional power pools aimed at trading electricity for mutual benefit: WAPP, EAPP, CAPP and SAPP. SAPP has been operating for almost 25 years, has established various markets for trading electricity, and has provided an excellent model for the other regional power pools. Sadly, the volume of trade in these markets is extremely small since virtually all the countries typically have capacity deficits and there are few surpluses available for trading.

In addition, the power sector in one country—South Africa—is larger than all the others combined, and that country has been reluctant to support new coal, gas and hydropower generation projects in the other countries. The other power pools in Africa are similarly finding that the development of generation projects that will provide surpluses available for export can be an extremely protracted process. In SE Asia, RPTCC has been operating for 13 years, with support from the World Bank and the Asian Development Bank, with the objective to promote electricity trade in the six countries comprising the Mekong Basin Subregion. Progress in that region has also been slow, and the trading of electricity has almost exclusively been limited to specific export IPPs that export power to a single offtaker using dedicated transmission lines that do not form part of the exporting country's national grid. Large hydropower projects in Lao PDR and Myanmar provide the surpluses for export, and there remains considerable hydropower potential available for exploitation. Importing countries such as the PRC, Thailand and Vietnam consider that the national grids in the exporting countries are insufficiently reliable or stable to be interconnected with their own grids, and that is largely the reason that the transmission infrastructure is project-specific. Neighbouring networks are thus not synchronised. Lao PDR and Myanmar have ambitions to upgrade their networks to facilitate regional synchronisation, but this will require considerable investment throughout these national grids.

The IRIMP needs to be articulated around priorities, complementarities and over the short, medium, and long-term horizons, and prepare an implementation strategy and processes including the improvement of institutional arrangements (such as regulatory and administrative processes); priority infrastructure projects; and financing options including measures for promoting, attracting and sustaining private sector participation in infrastructure development. The prioritisation of projects and facilitation interventions needs to recognise associated risk profiles and to strike appropriate balances.

An important objective—one that underpins interconnectedness—is increasing the effectiveness and competitiveness of Member States' economies by making use of comparative advantages through trade, and, by promoting efficient use of physical energy infrastructure and related services. Economic expansion is highly dependent on electricity tariffs for industry and commerce that are regionally and internationally competitive. Multinational garment and footwear manufacturers carefully consider the cost-base of candidate sites for their production facilities, and the cost and reliability of electricity is a key element in these considerations. A significant challenge, however, is in overcoming vested interests in the incumbent national institutions dealing with electricity. For example, some IGAD countries are very dependent on diesel generation and have long-established links with generator manufacturers and fuel suppliers.

Other objectives generally centre on policy-setting, such as having established policies on RE, EE, promotion of PSP and facilitation of IPPs, etc. These are largely covered elsewhere in the IRIMP report but there are several issues that can be construed as having a non-policy dimension, as follows:

a) It is a requirement to consider expanding pan-IGAD cooperation in the energy sector, recognising "*the importance of infrastructure projects as a vehicle of integration of the IGAD sub-region and as a necessary catalyst of economic growth and development of IGAD Member States*". In this respect, one suggestion would be for Kenya to offer capacity-building support—possibly in the form of twinning arrangements—to the other IGAD countries on promoting PSP in the power sector, particularly in relation to off-grid solutions including mini-grids. Kenya's recent track record in this regard would appear to be exemplary, having facilitated consortia of national and international entrepreneurs, venture capital and other financiers, renewable energy technology manufacturers, etc., to deliver energy access for previously unserved areas.

b) It is a requirement to recognise that: "*Infrastructure investments should also be made in water and energy sectors to address water storage, energy production and power transmission in the region. This will lead to improvement in water availability and management of peak loads and increase power trading as well as provide employment opportunities for large sections of the region's populations that live in areas with inadequate power. Diversification of energy sources and enhanced interconnectivity in the region will improve availability and reduce cost of power which is currently an impediment to growth of businesses in the region*." Similarly, "*Investment should also be made to ensure reliable and sustainable provision, utilisation of water considering the hydrological and climatic variability in region*." Intermittent RE sources such as wind and solar PV can work conjunctively with hydropower, and thus help to conserve water and provide a degree of diversification to the energy mix, without increasing GHG emissions. There is considerable hydropower resource remaining in several of the IGAD countries, most notably Ethiopia, Uganda and South Sudan. Whilst it is in the interests of these countries to consider the further development of wind and solar capacity to help conserve water, especially where the water resource has multipurpose merits, it may be that the wind and solar capacity is more cost-effectively located in one of the other IGAD member countries, due to wind/insolation characteristics, land values, other cost advantages, etc.

c) It is a requirement to recognise that: "*Information and Communication Technologies (ICTs) are important in modern day economic development. Proper utilisation of ICT is crucial in poverty reduction. ICTs help promote economic growth, expand economic and social opportunities, make institutions and markets more efficient and responsive, and enable the poor to obtain access to resources and services*." In an increasing number of countries—albeit largely limited to relatively advanced countries at present—ICT-related technologies are being applied in conjunction with the disruptive technologies—especially solar and solar+storage—to provide economically advantageous energy solutions to end users. Where a jurisdiction's regulatory regime permits, utilities rooted in conventional technologies such as coal and gas are being out-manoeuvred by—predominantly—fleet-footed start-up companies that have harnessed the disruptive technologies (e.g. solar PV and solar+storage) with innovative financing mechanisms. In some instances, these market entrants are consolidating the management of rooftop solar, home battery systems, EV charging, etc., forming virtual microgrids within existing grids, and using software technologies such as 'blockchain' to out-compete the incumbent utilities. Examples of such inroads can be found in the USA, the UK, Germany and Australia. In developing countries, combinations of solar PV, wind and battery storage are being utilised by innovative private sector investors to provide commercially viable electricity supplies to remote communities, and thus providing benefits in the form of access to modern energy for households, poverty reduction, employment provision, etc., and are increasingly competitive with grid-based solutions. The lead-time for such ventures can also be relatively short in comparison with grid-based solutions. As will be outlined further below, Powerhive and Enel Green Power are aiming to build and develop scalable solar mini-grids in 100 villages in the Western part of Kenya, each with an installed capacity of 1MW and will bring clean power to remote communities. The micro-grids are to be powered by First Solar's solar PV technology and operated with Powerhive's control technology. The ICT context is that these mini-grids will be linked to an advanced mobile payment or billing systems, utilising a mobile phone prepayment app.

d) It is a requirement to be mindful that providing universal access to secure energy services is part of the SDG targets and one of the key elements in the objective of reducing poverty. As will be detailed below, some IGAD countries—notably Ethiopia and Kenya—have ambitious targets for the provision of universal access within a relatively short timescale relative to the progress made in recent decades. The strategy being pursued by Ethiopia is focused on grid-connection, but with an interim solution of—public utility provided—mini-grids, solar lanterns, etc., in the areas least accessible to the existing grid. Kenya's approach is similar, except that the mini-grids and solar lanterns are to be provided through the private sector and unlikely to be as temporary a solution as proposed in Ethiopia. Some of the other IGAD member countries, however, are rather slow to harness the potential of innovative approaches to accelerate energy access. There is therefore a strong case that a balance needs to be struck between major generation projects that will create capacity surpluses in some countries, combined with transmission interconnection projects that will export those surpluses to countries that have deficits or much higher costs of energy, and addressing the issues that are inhibiting the rapid expansion of energy solutions such as rooftop solar, mini-grids, etc.

e) It is a requirement to make an inventory of all projects under implementation, preparation and those envisaged for future development.

f) It is a requirement to establish the outlook for the future for the development of regional energy infrastructures and associated services by 2050 and assess the challenges that the region will have to face in the sector. Such an outlook should serve as a basis for the formulation of realistic long-term objectives, to be targeted by policies and programmes at the regional level in order to anchor infrastructure development into regional integration and trade co-operation in the IGAD region. This assessment needs to start with the supply/demand balances, and preferably in more than one scenario. The main scenario would be one that maximises the exploitation of resource and cost differentials. One could be based on importing countries not being reliant on imports for more than 10% (say) of their energy needs. And a third might hypothesise high levels of RE capacity due to future constraints on GHG emissions.

g) On the basis of substantiated assumptions and parameters, it is a requirement to make projections of potential regional energy needs (making explicit such options as: (i) access and connection rates, (ii) objectives related to access to modern forms of energy, (iii) energy mix,

(iv) the trade potential by form of energy, in relationship with independence and energy security objectives, (v) energy conservation objectives, etc). This exercise is, however, highly dependent on the quality of information available.

h) It is a requirement to analyse the implications on sources of energy, energy demand, regional energy trade and level of investments required of various projection options; and shall analyse the implications in terms of infrastructure and services of each selected option.

i) From (a) the review of regional infrastructures and (b) the formulation of the outlook for the future, it is a requirement to present an outline infrastructure development programme for the development and management of energy infrastructure and associated services to the 2050 horizon, in which the following shall be highlighted:

- Investment projects by status (under execution, in current pipeline, new idea);
- Institutional and legal framework/policies and other soft interventions that are required;
- Relevant implementation stakeholders;
- First cost quantifications and estimated deadlines;
- Specific choice and decision-making issues, in particular regarding projects for which bankability is uncertain.

j) It is a requirement to formulate a strategic framework, infrastructure development programme, and implementation strategy for the energy sector. In carrying out this task, the Consultant will, inter alia, address:

- The coherent functioning of the different energy sub-sectors;
- Improving access to modern energy for the majority of the IGAD population;
- Addressing environmental and climate change issues, notably through incorporating elements of sustainable development in energy policy;
- Energy efficiency and security for the region;
- The financing mechanisms and options available;
- Opportunities available for private sector participation and incentives to stimulate participation;
- Effectiveness of the institutional and regulatory frameworks;
- Healthy competition between the different forms of energy;
- Harmonisation of norms and standards;
- Capacity building requirements.

Benefits of Interconnection

The theoretical benefits of interconnecting power systems across a broad region are widely recognised and include the following:

a) Sharing reserve margin. Instead of each national system investing in surplus capacity to safeguard an optimum level of supply security—against eventualities such as unscheduled outages, etc.—the surplus capacity can be provided on a regional basis and thus saving each country the fixed costs of full, independent reserve provision.

b) Sharing ancillary service provision. In addition to sharing reserve, interconnected countries can also share the provision of ancillary services. As with most of the benefits outlined here, this is subject to contractual arrangements, equipment provision and conformity to harmonised technical and operational standards.

c) Exploitation of scale economies. Regionally integrated networks essentially create a *de facto* system that is much larger than any of the individual national systems, and thus opening the opportunities for developing mega generation projects, such as Renaissance in Ethiopia.

d) Fuel mix diversification. As exemplified by the IGAD member countries, the indigenous energy resources in a region can be considerably more diverse than in individual countries. Ethiopia, South Sudan and Uganda have untapped hydropower resource. Djibouti, Somalia, Ethiopia and Eritrea have geothermal resources. South Sudan and Uganda have petroleum resources. And most member countries have indigenous wind resources, especially those with a coastline or territory in the Rift Valley, and solar energy resources. Hydropower affords most of the capacity potential for the region over the next 20 years or so, but this resource is exposed to hydrological variation and climate change. Diversifying the fuel mix across the region is therefore a prudent measure to mitigate this risk.

e) Exploitation of complementarity. As noted above, all the IGAD countries would appear to have good VRE resources in the form of wind and solar. The intermittency of VRE is a significant drawback, as is the fact that most IGAD countries have their peak demand during the early evening, when the output of solar PV installations is zero.[3] Nevertheless, hydropower works well, conjunctively, with VRE sources such as wind and solar. When the VRE is generating, hydropower can be throttled-back, thus conserving water in the reservoir for generation at some point in the future.

f) Lower financing costs. If a region not only interconnects their networks but also establishes markets for trading capacity, energy, ancillary services, etc., many of the risks considered by would-be financiers are diminished, resulting in lower financing costs.

g) Market competition. A larger market—such as a regional power pool—increases competition, which helps to drive-down costs for end-users.

Review of Previous Regional Interconnection Assessments

General

Although the EAPP is understood to have made progress in building institutional capacity, progress with facilitating actual energy trade through the Power Pool has been slow. According to EAPP's Updated Regional Power Status in the Africa Power Pools Report of November 2016, the issues obstructing progress with trade across the region include:

- Lack of interconnections;
- Weak alignment of national development plans with the regional Master Plan;
- Weak incentives for private sector participation; and

3 Strictly, there is a small degree of geographical diversification of the solar resource, from east to west.

- Inadequate and unreliable data.

Egypt dominates the EAPP grouping in economic terms, and in terms of installed capacity and electricity production (both gross and per capita). Ethiopia and the DRC have considerable untapped hydropower resource that makes them potentially significant players within the EAPP.

Deloitte

The Deloitte study of the EAPP region covers just five of the IGAD countries and, published in 2014, is dated somewhat. Nevertheless, quoting a 2011 report from the East African Community forecast for the regional power sector in 2030 is of interest.

Country	Existing Capacity, 2012 (MW)	Future Capacity Additions, 2013-2030 (MW)	Total Capacity, 2030 (MW)	Demand in 2030 (MW)	Surplus in 2030 (MW)
Burundi	49	422	471	385	86
Djibouti	**123**	**187**	**310**	**198**	**112**
East DRC	74	1,117	1,191	179	1,012
Egypt	25,879	46,570	72,449	69,909	2,540
Ethiopia	**2,179**	**13,617**	**15,796**	**8,464**	**7,332**
Kenya	**2,051**	**6,288**	**8,339**	**7,795**	**544**
Rwanda	103	411	514	484	30
Sudan	**3,951**	**11,310**	**15,261**	**11,054**	**4,207**
Tanzania	1,205	4,881	6,086	3,770	2,316
Uganda	**822**	**2,531**	**3,353**	**1,898**	**1,455**

The details of the EAC figures have not been confirmed by the Consultant but it is unlikely that the "surplus" figures in the right-hand column should be interpreted as the capacity available for export. As the GMSP study highlights, all national systems require a capacity margin to provide a good degree of supply security. For an all-thermal system with reasonably high levels of generation reliability, the reserve may be as low as 10% of peak demand. However, where the plant mix contains seasonal hydropower and/or VRE such as wind and solar PV, the capacity margin needs to be considerably higher. The "No Exports" scenario for 2030 in the GMSP has a peak demand of 9,614 MW and an installed capacity of 15,915 MW, which computes to a margin/surplus of 6,301 MW, or 65%. In other words, even with a "surplus" of 65%, Ethiopia could not reliably export power without compromising the reliability of domestic supplies.

Considering the EAC's underlying figures, however:

Ethiopia's installed capacity in 2030 is similar to that in the GMSP, whereas the peak demand is around 12% lower than in the GMSP.

Kenya's peak demand in 2030 is 4,244 MW, according to both ERC and EAC. ERC has an installed capacity of 8,339 MW in 2030, whereas ERC forecast that it will be 8,524 MW, which is similar. The ERC figures include imports.

Uganda's UETCL Grid Expansion Plan has a total installed capacity of around 3,600 MW in 2030, which is around 7% greater than the ERC figure of 3,353 MW. However, the fallacy of ERC's "surplus" figures is once again exposed, since UETCL recognise that the total available capacity in 2030 is actually 2,612 MW. Since UETCL puts 2030 demand at 2,529 MW, which is appreciably greater than ERC's figure, the capacity available for export in 2030 is set at 48 MW by UETCL.

ERC's figures for Djibouti are considerably at variance with those of Tractebel. In terms of total installed capacity in 2030, ERC has 310 MW and Tractebel 850 MW, and on peak demand in 2030, ERC has 198 MW and Tractebel has 450 MW. It may be that Tractebel has included the net transfer capability of the Ethiopia interconnector in its installed capacity figures which, at 314 MW, would mean that Djibouti would retain a small reserve margin to meet peak demand using solely domestic capacity, whilst also maximising fuel savings opportunities from the interconnector.

EAPP Master Plan

The EAPP Master Plan was prepared by Danish consultants in 2014. It represented an update of the Master Plan prepared in 2011, and was extended in scope to include Libya, the whole of the DRC, and South Sudan. Its aim was to analyse the benefits of regional cooperation and to recommend a set of new transmission interconnections. A sophisticated least-cost expansion planning software package—the Balmorel model—was used in the analysis and led to a recommendation for six new transmission lines with a combined capacity of 3,400 MW, to be commissioned by 2020. The 2011 Master Plan did not include Somalia, Eritrea or South Sudan—the latter only gaining independence in that year. Eritrea does not participate in the EAPP and consequently the 2014 Master Plan makes no reference to Eritrea whatsoever.

The Balmorel modelling was wide-ranging and covered a Main scenario plus 20 alternative scenarios that explore sensitivities on the various central parameters. It is important to note, however, that the focus of the Master Plan was on the short- to medium-term, i.e. 2020 and 2025, whilst also providing a long-term perspective towards 2040.

The Master Plan was predicated on the strong demand growth experienced prior to 2014 continuing into the immediate future, and effectively doubling over the subsequent 10 years. Demand projections for individual countries is understood to have been provided by individual countries. For the IGAD member states, the projections adopted were as follows.

Yearly electricity demand (TWh) and peak demand (GW)

	2015		2020		2025	
	TWh	GW	TWh	GW	TWh	GW
Djibouti	0.8	0.1	0.9	0.2	1.0	0.2
Ethiopia	15	3	35	6	53	9
Kenya	13	2	42	7	61	10
South Sudan	0.7	0.1	2.0	0.4	3.2	0.6
Sudan	15	3	24	4	32	6

Uganda	5	1	8	1	12	2

The following table summarises the expected generation capacity of the IGAD member countries in 2025, according to the Master Plan.

Total Installed Capacity by 2025 (MW)

Country	Natural Gas	Hydro	Geotherm.	Coal	Oil	Wind	Solar	Bagasse + Other
Djibouti	-	-	50	24	122	-	-	-
Ethiopia	-	15,475	75	-	78	324	-	614
Kenya	3,440	934	4,000	1,920	391	636	-	44
South Sudan	-	1,937	-	-	346	-	-	-
Sudan	-	2,665	-	2,121	1,525	20	10	100
Uganda	-	2,226	250	-	150	-	20	107

In the intervening 5 years since the Master Plan was published, some of these projections have been overtaken by events. An updated overview is considered below. One example, however, is that South Sudan's hydropower implementation may be appreciably slower than was anticipated in 2014.

Although gas-fired generation in Egypt is dominant, EAPP saw hydropower as having the greatest potential for facilitating energy trade within the region. The Master Plan recognised, however, that hydro-dominated countries—such as Ethiopia—may experience difficulties in supplying electricity in dry years. The Balmorel modelling took hydrological variations into account to ensure that supply reliability criteria are met.

In the period to 2020, the committed interconnections with the greatest capacities are the Ethiopia-Kenya-Tanzania interconnectors, with 2,000 MW and 1,300 MW capacities, respectively. The Master Plan recommended extending this corridor by 2018, and adding two new corridors, to be completed between 2020 and 2025:

- From Ethiopia to Egypt via Sudan; and
- From DRC to Kenya via Uganda

Of major importance is that these recommendations are premised on the evidence that the marginal generating costs are highest in the fossil-fuelled north (Egypt, Libya and Sudan) and lowest in the hydro-abundant south (DRC, Ethiopia, Uganda, etc.), and where good geothermal sites are available.

Excluding links involving purely non-IGAD countries, the projects to 2020 can be summarised as follows:

Recommended Transmission Projects by 2020

Project	Capacity (MW)	Type	Length (km)	Cost (US$m)
Sudan-Ethiopia	1,600	AC, 500kV	550	373
Uganda-South Sudan	600	AC, 400kV	200	77
Kenya-Uganda	300	AC, 400/220kV	254	44

Note: The capacities are rounded to 100 MW. Costs are expressed in millions USD 2013 real values.

Considering the entire period to 2025, the similar list of projects is as follows:

Recommended Transmission Projects by 2025

Project	Capacity (MW)	Type	Length (km)	Cost (US$m)
Sudan-Ethiopia	1,600	AC, 500kV	550	373
Uganda-South Sudan	600	AC, 400kV	200	77
Kenya-Uganda	600	AC, 400/220kV	254	100
Sudan-South Sudan	300	AC, 220kV	400	163

Note: The capacities are rounded to 100 MW. Costs are expressed in millions USD 2013 real values.

An important point made in the Master Plan is that the recommended north-south and east-west corridors, and the different generation technologies along these corridors, provides robust security against hydrological variation and fuel price and supply risks.

Important conclusions associated with the recommendations include:

1. Facilitation of 9% more hydropower and geothermal capacity, and less coal-fired capacity, with attendant implications on GHG emissions; and
2. Savings in operational costs.

An important caveat in the Master Plan, however, is that "*sequencing risk may be significant. If investment in generation or transmission is delayed, this will influence the economy of the new lines, e.g. the Sudan – Egypt line is dependent on the Ethiopia – Sudan line, and several lines are dependent on the materialisation of the hydro investments in e.g. South Sudan and DRC.*" From the evidence over the past 5 years since 2014, these fears appear to have been well-founded and generation project implementation has generally been slower than anticipated.

To a large extent, the 2014 Master Plan pre-dates the explosion of interest in wind and solar energy globally. The Master Plan makes no reference to the potential for conjunctive operation of conventional generation with VRE, nor the scope for geographical diversification of VRE capacity across the EAPP countries. The Master Plan did not consider the economic cost of externalities such as GHG emissions, although it does comment that the deployment of coal-fired capacity may have been appreciably lower if they had been.

Although the Master Plan's focus was on the periods to 2020 and 2025, it also analysed the periods to 2030, 2035 and 2040, although it acknowledged the high degree of uncertainty attached to key input parameters such as demand and fuel prices. The analysis indicates a marked increase in the coal-fired generation capacity after 2025 and would appear to rise from around 5% of the regional total to around 50%, and around 70% of energy generated in 2040. Wind and solar capacity barely feature. This is entirely inconsistent with the direction of travel in both the relative economics of generation technologies and global priorities in terms of limiting GHG emissions and climate change.

Transmission interconnections in the region are affected markedly by assumptions for the development of the Grand Inga project in the DRC. This project has been attracting interest for several decades and all regions in Africa have ambitions to access the relatively low-cost and low-carbon energy from it. Power utilities in Europe and the Middle East have also shown interest. The high cost and the significantly adverse social and environmental impacts have been an inhibiting factor. However, the principal issue with this project is continuation of the political instability that has plagued the country since independence almost six decades ago. It would not therefore be prudent for the IRIMP to make recommendations on future transmission interconnections dependent on Grand Inga or other major projects in the DRC.

The long-term analysis—beyond 2025—is perhaps more valid in respect of how the existing and recommended interconnectors may change over time. These include:

- The lines between Ethiopia, Sudan and Egypt will have a reduced flow in 2035 and 2040.
- The Kenya-Ethiopia link would see an increasing utilisation rate up to 2040.
- Ethiopia, with a projected net export of around 20% of national demand in 2020 to 2030, would be importing some of its need by 2040, although this may not be the case if the economics of the least attractive hydropower projects improves over time.
- Uganda is a strong net exporter in 2020, in balance in 2025, and a net importer by 2040.

Events since 2014 are such that some of these projections are off target.

Power Africa Roadmap

The Power Africa Transmission Roadmap to 2030, supported by USAID, was published in 2018. This is a pan-SSA study that considered only a sub-set of the IGAD member countries: Ethiopia, Kenya and Uganda. The aim of the study was to identify key interconnection linkages that would facilitate trade between energy resource rich countries and those facing critical supply shortages, and thus providing more efficient supply and enhanced energy security. The Roadmap notes that Power Africa’s 2.0 Strategy commits to increase access to electricity in SSA by increasing focus on transmission. In this IRIMP, this strategy is stress-tested in terms of whether striking a balance between grid-connection and non-grid solutions such as mini-grids, may be the most cost-effective and speediest solution to delivering universal access to modern energy.

The main aims of the Roadmap are:

to enhance cooperation between major stakeholders by identifying transmission projects that are critical to cross-border electricity trade and highlighting bottlenecks/risks of delay (this focus would also include domestic projects with the potential to support regional trade, e.g., by connecting new generation capacity to cross-border lines); and

to support priority projects by highlighting the contributions development partners can make to their completion, to complement government-led initiatives.

The Roadmap recommends 10 projects across SSA, based on existing or projected supply/demand imbalances. Of these, only the Ethiopia-Kenya-Tanzania line would involve the IGAD countries.

The Roadmap prepared supply/demand forecast for two timeframes: 2018-2025, and 2025-2030. Peak demand was estimated for each country and scaled-up by 15% to account for reserve margins and system losses. Immediately, this assumption is questionable for countries such as Ethiopia with seasonal hydropower capacity, which translates to a reserve margin in excess of 50% of peak demand. Supply data was based on planned commissioning and decommissioning dates between 2018 and 2025. Experience in the region would suggest that completion of some projects would slip beyond the planned dates.

Power Africa's analysis indicates that Ethiopia, Uganda and Kenya would have surpluses of power:

Ethiopia's surplus of around 1,200 MW in 2018, according to Power Africa, is expected to grow to around 1,900 MW by 2025, due to hydropower projects such as Baro, Gilgel Gibe IV/Koysha, Karadobi and Renaissance.

Ethiopia was exporting 200 MW to Djibouti and Yemen in 2018, and with additional exports to Sudan will increase the total to 1,200 MW by 2022, followed shortly thereafter with exports to Egypt/North Africa.

Uganda has a surplus of 112 MW in 2018 and Kenya just 52 MW. Uganda's surplus should remain at around 100 MW by 2025, whist Kenya's should rise to around 700 MW by the same time.

It should be noted, however, that the GMSP suggests that the earliest year for Karadobi to be commissioned is 2029, and that this project has a capacity of 1,900 MW. By this fact alone, Ethiopia's surplus of 1,900 MW in 2025, according to Power Africa, is suspect. Other candidate hydropower projects could be completed before 2025, however, provided that financial closure can be reached within the next 1 to 2 years. Some of these projects have linkages to others in the same hydrological basin and are subject to sequenced construction and commissioning.

At the end of 2017, Uganda's installed capacity was just 50 MW greater than the peak demand in that year. Due to the high dependence on seasonal hydropower, this is not the same as having a surplus available for export, for reasons explained above. The situation was improved appreciably in March 2019, when Isimba was commissioned, and further capacity is due on-line in 2020 when the 600 MW Karuma project is commissioned. Other significant projects are in the pipeline, so although the claim of a 112 MW surplus in 2018 may be exaggerated, surpluses are set to be sustained from 2019.

Kenya may have had a slightly higher installed capacity in 2017/18 than peak demand but, as in Uganda and Ethiopia, this does not translate to export potential. A considerably higher surplus, with export potential, may be available when 1,000 MW of coal-fired generation is commissioned at Lamu, in 2024, which may support the Power Africa claim.

Generally, as far as the East African countries are concerned, the Consultant does not place any faith in the Power Africa analysis, which is simplistic. At best, the document is indicative rather than representing bankability.

GMSP/Nexant

The Ethiopia GMSP study, published in January 2019, is perhaps the most recent and most thorough expansion planning study undertaken in the IGAD region in recent years.[4] Although specific to Ethiopia, the key regional relevance is that Ethiopia is planning to export to at least 4 countries by 2023: Djibouti, Sudan, Kenya and Tanzania. It already exports significant capacity—100 MW each—to two IGAD countries: Djibouti and Sudan. Detailed modelling was undertaken by Nexant, using the sophisticated PLEXOS expansion planning tool, with the inclusion of exports to four different countries. This study for USAID was considered by them to be a *de facto* update to the 2014 Master

4 Nexant. Grid Management Support Program: System Integration Study, Power Africa. January 2019.

Plan. Unless there is specific news on expansion projects since January 2019, the Nexant report for USAID is likely to be the definitive source for supply and demand projections for Ethiopia. For these reasons, the Consultant places greater weight on this individual study than any of the others reviewed above, or the2014 Master Plan prepared by Parsons Brinkerhoff for Ethiopian Electric Power (EEP).5 Although the development of hydropower capacity in South Sudan and Uganda, coal capacity in Kenya, and geothermal capacity in Ethiopia, Djibouti and Kenya will also influence power trade opportunities in the period to 2030, as will the development of wind and solar capacity in individual countries, it is the hydropower potential in Ethiopia that has greatest weighting in the potential power flows in the region. For this reason, key details from the GMSP study are worth further discussion in the IRIMP.

The GMSP presents the following table detailing existing generating stations in Ethiopia, together with details of hydropower projects under construction.

Characteristics of Existing and Hydropower Plants Under Construction

Name	Status	Commissioning Year	Capacity (MW)	Rated Flow (m^3/s)	Rated Head (m)
Awash II	Existing	1966	32 (16)		
Awash III	Existing	1971	32 (16)		
Beles	Existing	2010	460	160	330
Finchaa	Existing	1974	133	27.8	550
Genale Dawa 3	Under construction	2018	255	115.7	255
Gilgel Gibe I	Existing	2004	184	97	212
Gilgel Gibe II	Existing	2010	420	98	485
Gilgel Gibe III	Existing	2017	1870	1020	263
Koysha	Under construction	2022	2160		175
Koka	Existing	1960	42 (17)	1000	
Maleka Wakana	Existing/Refurbished	1988/2014	153 (90)		
Neshe	Existing	2013	97	18.72	588
GERD	Under construction	2020-2024	6448 *		155
Tekeze I	Existing	2009	300 (120)	220	155
Tis Abay I	Existing	1964/2000	12 (0)	29	46
Tis Abay II	Existing	2001	72 (12)	150	55

5 Parsons Brinkerhoff. Ethiopian Power System Expansion Master Plan Study. 2014.

Chemoga Yeda 1&2	Under negotiation	2023	280	24.6	761/561

In 2020, only 2 of the 16 units will enter service, and at reduced head. A further 8 units will be added in 2023 and the remaining 6 units in 2024. The Consultant estimates the capacity over time of GERD as follows:

- 2020, 403 MW
- 2021, 564 MW
- 2022, 725 MW
- 2023, 4030 MW
- 2024, 6448 MW

The GMSP recognises that there is up to around 5,000 MW of geothermal potential capacity in Ethiopia. The lead-time for geothermal energy is quite long, however, since extensive exploration and testing is required at each site. At present, however, the only existing capacity is 9.5 MW at Aluto Langano.

A 25 MW waste-to-energy plant was completed in 2018. Additional waste-to-energy capacity is unlikely before 2030, however. The 46 MW of oil-fired diesel generation at Dire Dawa is scheduled for decommissioning at the end of 2022.

Ethiopia has two operational wind farms—Adama 1, 51 MW, Adama 2, 153 MW, and Ashegoda, 120 MW.

Solar PV farms are under development at Gad and Dicheto, each with a capacity of 125 MW and scheduled for completion by mid-2020. A 100 MW PV project is under development at Metehara, for completion at the end of 2020.

The Consultant's calculations, based on data in the GMSP, indicate that the installed capacity of the Ethiopian power system in 2018 was 4,467 MW.

The Ethiopia-Sudan Interconnector was fully commissioned at the end of 2013 and has been used to export surplus hydropower from Ethiopia to Sudan.

The GMSP report divides future capacity additions into "committed" and "other", and their base case expansion programme suggests that around 75% of the capacity additions are in the former category. The definition of "committed" is a matter that ought to be of key interest to the IRIMP, since there are political and legal interpretations of the terms. The political interpretation is where a government is committed to developing a project, although for a variety of reasons it is at liberty to change its mind. In the legal interpretation, a project is not committed until financial closure has been reached and all the conditions in the security package have been attained, including environmental clearances. Globally, there are many instances of projects being cancelled or postponed indefinitely due to late-stage obstacles, despite several years of preparatory efforts. Ethiopia has a history of dropping committed projects and committing to new projects not previously appearing in long-term plans.

It is notable that although large hydropower projects account for most new capacity additions to 2030, other RE sources such as geothermal, wind and solar make a significant contribution. The expansion programme developed by GMSP does not include any conventional thermal capacity.

GMSP's generation candidates were initially developed using screening curve analysis.

GMSP expressed caution in the addition of variable RE (VRE) in the future. The reasons for this are:

- Wind and solar regimes may be better in the neighbouring countries, which implies lower LCOE for VRE in these countries and thus an incentive to develop the capacity domestically rather than importing from Ethiopia;
- Developing domestic capacity, rather than importing from Ethiopia, and thus locating generation closer to demand centres, reduces the need for investment in transmission and distribution (T&D) infrastructure, and associated operations and maintenance (O&M) costs; and
- Neighbouring countries have system peaks during the early evening, after the sun has set and solar PV output is unavailable, and wind energy may also have limited availability.

The first two points are influential in the Consultant's proposal for an alternative scenario for power development in IGAD.

GMSP recognise, however, the advantages of conjunctive operation of hydropower and VRE, and the potential for Ethiopian hydropower to provide balancing services to VRE development in the other IGAD countries.

Although the intermittency of VRE capacity can be a source of concern to lenders, the system operator and other stakeholders, Nexant's PLEXOS modelling determined that the planned system can carry sufficient reserves for the integration of intermittent wind and solar generation above the Base Case level.

A key motivation of the GMSP study is to bring cleaner and more efficient electricity generation capacity to SSA, and to increase electricity access to more households and businesses.

Since the GMSP was confined to Ethiopia and ultimately did not include fossil fuel solutions, greenhouse gas (GHG) emissions did not feature in the analysis. The Consultant is surprised to note, however, that other economic externalities were not factored into the analysis. Whilst many of the environmental and social costs associated with generation projects can be internalised (i.e. monetised), there are others that cannot, e.g. loss of biodiversity.

The candidate hydropower projects considered by the GMSP are tabulated below.

Candidate Hydropower Projects

Name	Earliest Available Year	Capacity (MW)	Construction Cost (m US$)	Interconnection Costs (m US$)	Total Capital Cost (US$/kW)
Beko Abo	2030	935	1,260	161.0	1,520
Geba 1&2	2023	372	572	22.2	1,597
Genale 6	2023	246	588	47.1	2,582
Genale 5	2023	100	298	3.7	3,017
Dabus	2023	798	763	150.2	1,144
Birbir	2023	467	1,231	37.0	2,715

Halele Werabesa	2024	436	886	69.7	2,192
Baro 1&2	2023	645	1,596	100.0	2,207
Genji	2023	214	200	With Baro	
Tams	2025	1700	3,242	202.1	2,026
Wabi Shebele	2023	87	888	12.1	10,344
Karadobi	2029	1600	2,576	151.1	1,704
Upper Mendaya	2031	1700	2,436	49.7	1,462

The earliest available year for several of these projects is presented by Nexant as 2023. However, in the Consultant's opinion, unless steps have been taken to commence construction of these projects, a COD before the beginning of 2024 is highly improbable for projects of this size.

Nexant recognised the following linkages between projects:

- Baro 1&2 and Genji
- Geba 1&2
- Halele & Werabesa
- Chemoga Yeda 1&2
- Tams should be constructed after both Baro/Genji and Birbir projects
- Further details of existing, committed and candidate hydropower plants are presented in the following table.

Details of Existing, Committed and Candidate Hydropower Plants

Plant Name	Installed Capacity (MW)	Firm Energy (GWh/Year)	Average Energy (GWh/Year)	Average Plant Factor (%)
Awash II	32	149	183	65.45
Awash III	32	150	184	65.86
Baro 1	166	506	652	44.92
Baro II	507	1550	1955	44.12
Beko Ab	935	4445	6617	80.92
Beles	460	1357	2749	68.21
Birbir	467	1949	2717	66.41
Dabus	798	2695	3433	49.10
Finchaa	128	422	615	54.82
Geba 1	214	462	952	50.76

Geba 2	157	488	753	54.85
Genale 3	254	1124	1691	76.12
Genale 5	100	361	573	65.55
Genale 6	246	1039	1528	71.06
Genji	214	620	909	48.52
Gilgel Gibe I	210	610	882	48.08
Gilgel Gibe II	420	1400	2030	55.33
Gilgel Gibe III	1870	3285	5348	32.77
Halele	96	247	450	53.63
Karadobi	1600	5084	7831	56.02
Koysha	2160	4760	6460	34.14
Koka	43	94	133	35.58
Maleka Wakana	153	325	555	41.56
GERD	6448	10,322	14,684	26.00
Tams	1700	5671	5714	38.37
Tekeze I	300	782	1399	53.41
Tis Abay II	68		10	1.69
Upper Mendaya	1700	5552	8554	57.59
Wabi Shebele	88	477	690	89.76
Werabesa	340	778	1516	51.05
Yeda 1	162	408	627	44.23
Yeda 2	118	299	460	44.59

The Aluto Langano 2 geothermal project is under construction, with an installed capacity of 70 MW, and is due to become operational from 2023. Committed geothermal projects include: Corbetti and Tulu Moye.

- Corbetti has a total capacity of 470 MW, of which 20 MW from 2020, 50 MW from 2022, 200 MW from 2024, and the remaining 200 MW from 2026.
- Tulu Moye has a total capacity of 500 MW, of which 50 MW from 2021, 100 MW from 2022, 100 MW from 2023, and the remaining 250 MW from 2025.

Other geothermal sites have a combined potential of 450 MW but the GMSP only considered 100 MW to be achievable within the planning horizon to 2030, but after 2023 and at several locations.

GMSP identified five existing bagasse plants with a combined installed capacity of 496 MW, almost half of which is at Omokuaz.

GMSP identified a 137 ME biomass candidate plant at Melka Sedi.

Generic reciprocating, OCGT and CCGT units were considered as candidate plants, although GMSP recognised the current government policy is to not build thermal capacity before 2030. Coal and nuclear were not considered, either.

ESMAP resource mapping indicates that there is good wind energy potential in several areas, but further wind speed data is required, which extends the lead-time. Two wind farms are under development: Aysha, with a capacity of 120 MW by 2020, and Assela, with a capacity of 100 MW by mid-2020.

The GMPS identifies several candidate wind farms, as tabulated below.

Location	Capacity (MW)	Capacity Factor (%)	First Available Year
Iteya	150	35.2%	2022
Aysha	310	35.2%	2022
Debre Birham	100	35.2%	2022
Adama	300	35.2%	2023
Sure	200	31.3%	2023
Denbel	300	31.3%	2023
Dire Dawa	300	31.3%	2023
Gode	200	31.3%	2023
Idabo	200	31.3%	2023
Adigala	300	31.3%	2023
Mekele	300	31.2%	2023
Ashengoda	300	31.2%	2023

GMSP acknowledges that the sustained drop in the price of solar PV technology, combined with favourable insolation levels in Ethiopia of between 1500 and 2000 kWh/m2, makes the technology worthy of consideration. Numerous candidate projects have been identified, as tabulated below.

Location	Capacity (MW)	Capacity Factor (%)	First Available Year
Jijiga	200	26.0%	Mid-2021
Barhdar	200	23.9%	2022
Adigrat	100	24.4%	2022
Mekele	200	24.8%	2022
Welenchiti	200	25.0%	2022
Humera	200	25.7%	2022

Metehara	100	24.4%	Mid-2021
Awash	200	24.4%	2022
Hurso	200	24.5%	2022
Dire Dawa	200	24.5%	Mid-2021
Harar	200	24.7%	2022
Metema	200	25.6%	2022
Weranfo	200	24.5%	2022

GMSP's modelling parameters for wind and solar candidates is tabulated below.

Plant Type	Total Capacity (MW)	Variable O&M Cost (US$/MWh)	Fixed O&M Cost (US$/kW/yr)	Planned Maintenance (%)	Forced Outage (%)
Wind	100	0.0	46.0	1.5%	3.0%
Solar PV	100	0.0	21.0	1.5%	3.0%

Plant Type	Total Capacity (MW)	Construction Cost (m US$)	Interconnection Cost (m US$)	Total Capital Cost ($/kW)	Plant Life (Years)
Wind	100	160	10.0	1,700	20
Solar PV	100	100	10.0	1,100	20

The GMSP considered the likely decrease in the cost of wind and solar, based on information from IRENA. This indicates that solar cost will decrease to 1000 US$/kW by 2025, and wind will decrease to 1500 US$/kW, in constant 2018 US$ terms.

Ethiopia's approach to the financing of large hydropower projects has changed in recent years. Previously, such projects were developed by the government using traditional public financing mechanisms, e.g. concessional loans from multilateral and bilateral development agencies. However, in recent years the norm is to develop these projects as IPPs. This limits the necessity for the government to underwrite the borrowing for multiple, high capital cost, mega projects.

The GMSP used screening analysis with a discount rate of 10% to screen generation candidates. Their results show that:

- The levelised generation cost for many hydropower candidates is lower than for other technology options.
- Wind and solar are becoming more competitive—on a per kWh basis—than traditional options such as OCGT, CCGT and even geothermal and biomass.
- The competitiveness of wind and solar projects is very dependent on the capital cost and resource assumptions.

These latter two conclusions influence the selection of an alternative regional development scenario for the IRIMP study.

GMSP used these observations to determine that the most promising candidates to include in the optimal plan are the lowest cost hydropower plants, with the possible addition of solar PV capacity during the interim before hydropower units are available.

The PLEXOS modelling considered a number of scenarios and of particular interest to the IRIMP are:

- Base Case
- Base Case with High Wind
- Base Case with No Exports
- Base Case with Delayed (Base Case) Exports to Kenya

A fresh and detailed demand forecast was performed for each customer category and sub-category. The GMSP study took 2017 as the base year and projected demand from 2018 to 2030.

Electricity sales plus distribution losses are forecast to rise at an annual average rate of 13.0%, which is an incredibly steep rate of increase over a sustained period, although only slightly greater than the 12.7% historical growth rate between 2001 and 2017. A ten-fold increase in electricity exports (i.e. an annualised rate of 21.5%) is anticipated. Transmission losses are expected to fall from 4.0% of total demand in 2017 to around 3.4% in 2030. Total demand itself is forecast to rise at an annualised rate of 14.3% over the same period. For the purposes of determining supply and demand balances, exports need to be excluded from the figures.

The GMSP demand forecast adopted a comprehensive and thorough methodology, with sales forecasts in each of the principal LV customer categories produced using regression analysis, with distribution losses added to sales. Bottom-up approaches were adopted in customer categories connected to the transmission voltages. Total System Demand was obtained by adding total demand at the distribution level to the sales forecast of customers connected to the transmission system, and transmission losses. System losses are estimated to occur 75% in the distribution system and 25% in the transmission system. The Peak Demand forecast took account of estimated coincidence and load factors. The GMSP forecast is understood to be for (Gregorian) calendar years.

The historical record between 2001 and 2017 was used for the analysis, and it should be noted that this was a period of strong and sustained economic growth in Ethiopia. The highlights include:

- The population increased at an annualised rate of 2.55%, from 59.9 million in 2001 to 89.6 million in 2017.
- The number of households increased at an annualised rate of 2.72%, from 12.3 million in 2001 to 18.9 million in 2017. The average number of persons per household thus declined slightly, from 4.85 in 2001 to 4.73 in 2017.
- The number of domestic customers increased at an annualised rate of 9.2%, from almost 512,000 in 2001 to almost 2,100,000 in 2017.
- The electrification rate thus increased at an annualised rate of 6.40%, from 4.1% of the population in 2001 to 11.05% in 2017. Despite the rapid rate of electrification over this extended period, the proportion of electrified households remains relatively low by international standards. However, the GMSP refers to the 2011 Household Survey, which estimated that the actual number of connected households is actually 2.73 times higher than

the number of registered customers, due to shared connections. This would increase the electrification rate to around 30% in 2017.

- Total (national) consumption per unit of GDP rose at an annualised rate of 4.08% between 2001 and 2017.
- Total domestic consumption per connection rose at an annualised rate of 3.41% between 2001 and 2017.
- Total domestic consumption per shared connection rose at an annualised rate of 3.34% between 2001 and 2017.
- Per capita consumption rose by an annualised rate of 10.1%, from 30 kWh/capita in 2001 to 140 kWh/capita in 2017.
- Per capita residential consumption rose by an annualised rate of 10.0%, from 8.5 kWh/capita in 2001 to 39.2 kWh/capita in 2017.
- GDP (in 2011 Birr) per capita rose at an annualised rate of 6.5% between 2001 and 2017.
- System Peak Load rose from 352 MW in 2001 to 2,202 in 2017, an annualised rate of 12.1%.
- System Load Factor increased from 57.8% in 2001 to 65.0% in 2017, probably reflecting increased industrialisation and a ownership of broader range of household electrical appliances. A load factor of 65% remains relatively low by international standards, however.

After considering a range of dependent variables, GMSP settled on the following assumptions for their demand forecasting model. Although GMSP considered Base, High and Low scenarios, only the Base figures are reproduced here.

Total GDP Growth Rate Assumptions, 2018-2030

Period	Base Case
2018-2020	10.0%
2021-2025	9.0%
2026-2030	8.0%

Industrial Sector GDP Growth Rate Assumptions, 2018-2030

Period	Base Case
2018-2020	16.0%
2021-2025	11.0%
2026-2030	8.0%

Services Sector GDP Growth Rate Assumptions, 2018-2030

Period	Base Case
2018-2020	9.5%
2021-2025	9.0%

2026-2030	8.0%

Agricultural Sector GDP Growth Rate Assumptions, 2018-2030

Period	Base Case
2018-2020	5.2%
2021-2025	6.9%
2026-2030	8.0%

These growth rates appear to be rather high for such a sustained period.

Total Population Growth Rate Assumptions, 2018-2030

Period	**Base Case**
2018-2020	2.5%
2021-2025	2.3%
2026-2030	2.1%

Base Case Customer Growth Rate Assumptions, 2018-2030

Period	**Domestic**	**Commercial**	**LV Industrial**	**HV Industrial**	**Street Lighting**
2018-2020	11.9%	10.0%	10.0%	10.0%	13.0%
2021-2025	10.0%	8.0%	8.0%	8.0%	12.0%
2026-2030	8.0%	7.0%	7.0%	7.0%	11.0%

Nexant has assumed an accelerated rate of growth for street lighting electricity consumption, which suggests that Ethiopia is not inclined to adopt PV lighting.

Distribution and Transmission Loss Assumptions, 2018-2030

Year	Distribution Losses	Transmission Losses
2017	16.2%	5.4%
2018	15.7%	5.3%
2030	9.0%	3.5%

GMSP's assumptions for loss reduction targets are based on recent studies and targets. Reducing losses whilst demand is increasing at the rates summarised above would require substantial and sustained investment in the T&D infrastructure, and experience across SSA is that loss reduction can be extremely challenging to achieve.

GMSP's regression-based econometric model for domestic sales is based on the number of domestic customers and GDP growth per capita. It is interesting that the electricity tariff is not one of the parameters in the model, which implies the assumption that tariffs remain constant in real terms. This is also interesting in view of, once again, the substantial and sustained investment in generation and T&D infrastructure, and in connecting new households.

An alternative demand forecast for the residential sub-sector was produced by Nexant, using a different approach based on electrification targets and consumption goals set by the government. The results of the forecast based on this approach were very similar to those based on the regression model and, as a result, Nexant adopted the forecast based on regression analysis.

GMSP's regression-based econometric model for commercial sales is based on the number of commercial customers and GDP growth per capita. An annualised growth rate in energy demand of 10.3% resulted.

GMSP's regression-based econometric model for LV industrial sales is based on the number of LV industrial customers and Industrial GDP. An annualised growth rate in energy demand of 11.4% resulted. It is interesting to note that, in developing the High and Low Case demand scenarios for this sub-sector, there is considerably greater uncertainty than for the other sub-sectors. Apparently, this relates to the continued development of new industrial parks for the globally competitive industrial sectors such as garments, footwear, etc.

The regression model for street lighting is simply based on the number of street lighting customers. No reference is made to PV street lighting. An annualised growth rate in energy demand of 5.3% resulted.

GMSP's Base Case distribution system forecast is presented in the following table. The 2017 figures are actual values.

Base Case Total Distribution Forecast, 2018-2030

Year	Domestic (GWh)	Commercial (GWh)	Street Lighting (GWh)	Low Voltage Industrial (GWh)	Distribution Losses (GWh)	Total, including Losses (GWh)
2017	3,509	2,240	47	2,155	1,290	9,240
2018	3,853	2,360	39	2,739	1,408	10,398
2019	4,307	2,593	42	3,242	1,539	11,723
2020	4,770	2,884	45	3,700	1,659	13,058
2021	5,294	3,209	49	4,092	1,770	14,414
2022	5,880	3,571	52	4,453	1,876	15,832
2023	6,531	3,974	56	4,806	1,981	17,348
2024	7,255	4,422	61	5,254	2,096	19,088
2025	8,059	4,922	65	5,782	2,217	21,045
2026	8,884	5,442	70	6,310	2,324	23,029
2027	9,776	6,003	75	6,858	2,422	25,134

2028	10,751	6,617	80	7,437	2,516	27,402
2029	11,823	7,292	86	8,057	2,605	29,862
2030	13,001	8,035	92	8,723	2,687	32,537
2017-2030 Growth Rate (%)	10.6%	10.3%	5.3%	11.4%	5.8%	10.2%

GMSP's HV industrial sales forecast is largely based on sales for new industrial parks. 17 industrial parks were identified for either new development or expansion. Total new industrial park demand between 2018 and 2024 totals 1,534 MW and is elaborated in the following table. GMSP assumed that in the Base Case, all new industrial parks will be developed by 2023 and continue that basis in subsequent years. The peak demand of 1,534 MW translates to sales of 8,735 GWh on the assumption of two-shift operation being the norm. Night shifts are uncommon in Ethiopia and Africa generally.

Base Case New Industrial Park Development Assumptions

Year	Base Case	
	No. of Factory Premises	Peak Demand (MW)
2018	107	170
2019	215	341
2020	419	665
2021	609	947
2022	779	1196
2023	1007	1534
2024	1007	1534

Other HV industrial customer demand is forecast as a function of industrial GDP, adjusted for the contribution of the new industrial parks.

Total HV Industrial Sector Demand, 2017-2030

Year	Base Case (GWh)
2017	1,603
2018	2,855
2019	3,945
2020	5,920
2021	7,615
2022	9,130

2023	11,155
2024	11,344
2025	11,548
2026	11,708
2027	11,878
2028	12,057
2029	12,246
2030	12,447
2017-2030 Growth Rate (%)	17.1%

The irrigation sales forecast is based on the area of irrigable land and consumption rates varying from 0.34-5.4 kW/ha across different regions, and the assumption that irrigation would commence in 2019. Demand is forecast to rise steeply from 102 GWh in 2018 and 253 GWh in 2019, to 4,389 GWh in 2030. GMSP's forecast is distributed across 8 regions.

GMSP's forecast of sales in the transportation sector primarily relate to the electrification of railway lines: the Addis-Djibouti line, other railway lines, and the Addis light rail system. It is interesting that no provision is made for electric vehicles (EVs), even though some leading manufacturers are setting deadlines for ending the production of conventional, internal-combustion vehicles, typically by 2030 or 2040. EVs are currently featuring in Europe, East Asia and North America, and their market penetration is expected to become quite rapid in these regions. The market penetration of EVs in Africa is uncertain but it would be unwise to discount it altogether.

Total Electricity Sales for the Addis-Djibouti Line, 2017-2030

Year	Electricity Sales (GWh)	Peak Demand (MW)
2017	62	26
2018	176	43
2019	289	60
2020	402	77
2021	515	93
2022	628	105
2023	704	116
2024	779	127
2025	855	138
2026	930	150

2027	1006	168
2028	1130	186
2029	1254	205
2030	1379	223

GMSP's forecast for "other railway lines" is estimated to be 50% that for the Addis-Djibouti line.

The forecast for the Addis Light Rail System is reproduced in the table below.

Year	Sales Forecast (GWh)	Peak Demand (MW)
2018	175	31
2023	350	62
2028	526	92
2033	736	129

Sales to sugar factories are estimated to total 101 GWh in 2018 and to remain constant through to 2030.

The Consultant's approach is to net-out the exports from the GMSP forecast in order to make a fresh estimate of export potential. It is therefore essential to understand the GMSP's export forecast. GMSP's forecast is based on current sales to neighbouring countries, in 2018, and export agreements currently signed or negotiated, as well as potential contracts. Key issues include:

- Current agreements (100 MW to Sudan and 100 MW to Djibouti) to continue through to 2030.
- Kenya 1st Phase exports based on the existing agreement and the expected COD of the new Ethiopia-Kenya DC interconnector.
- Exports to Tanzania align with expected COD for new large hydropower projects and availability of surplus energy for export.
- Additional exports to Sudan depend on energy surpluses from new large hydropower projects and the COD of a new Ethiopia-Sudan interconnector.
- Kenya 2nd Phase based on availability of surpluses and Kenya's energy needs.

GMSP's Base Case total non-coincident electricity peak demand exports to the EAPP and beyond are worth reproducing if full, below.

Base Case Export Forecast to 2030, by Country (MW)

Year	Djibouti (existing)	Sudan (existing)	Sudan (new)	Kenya (1st Phase)	Kenya (2nd Phase)	Tanzania	Total
2018	100	100	0	0	0	0	200
2019	100	100	0	0	0	0	200

2020	100	100	0	400	0	0	600
2021	100	100	0	400	0	0	600
2022	100	100	0	400	0	0	600
2023	100	100	0	400	0	412	1012
2024	100	100	0	400	100	412	1112
2025	100	100	1000	400	100	412	2112
2026	100	100	1000	400	100	412	2112
2027	100	100	1000	400	200	412	2212
2028	100	100	1000	400	300	412	2312
2029	100	100	1000	400	300	412	2312
2030	100	100	1000	400	400	412	2412

The estimated annual load factors are:

- Kenya 1st Phase – 85%
- Sudan (existing) – 100%
- All other exports – 75%

On this basis, the energy exports are as follows:

Base Case Export Forecast to 2030, by Country (GWh)

Year	Djibouti (existing)	Sudan (existing)	Sudan (new)	Kenya (1st Phase)	Kenya (2nd Phase)	Tanzania	Total
2018	657	876	0	0	0	0	1,533
2019	657	876	0	0	0	0	1,533
2020	657	876	0	0	0	0	4,511
2021	657	876	0	2,978	0	0	4,511
2022	657	876	0	2,978	0	0	4,511
2023	657	876	0	2,978	0	2707	7,218
2024	657	876	0	2,978	657	2707	7,875
2025	657	876	0	2,978	657	2707	14,445
2026	657	876	6570	2,978	657	2707	14,445
2027	657	876	6570	2,978	1,314	2707	15,102
2028	657	876	6570	2,978	1,971	2707	15,759
2029	657	876	6570	2,978	1,971	2707	15,759

2030	657	876	6570	2,978	2,628	2707	16,416

The Base Case Total System Forecast, including exports, is presented in the following table, with year 2017 indicating actual values.

Base Case Total System Forecast, including exports, 2018-2030 (GWh)

Year	Total Distribution System	HV Industrial + Sugar	Irrigation	Transport	Total In-Country + Dist. Losses	Total Exports	Transm. Losses	Total Demand
2017	9,240	1,327	0	168	10,735	1,305	499	12,540
2018	10,398	2,956	0	351	13,704	1,533	802	16,040
2019	11,723	4,046	101	499	16,369	1,533	916	18,818
2020	13,058	6,021	253	647	19,979	4,511	1,217	25,708
2021	14,414	7,716	507	826	23,463	4,511	1,349	29,323
2022	15,832	9,231	760	1,030	26,853	4,511	1,467	32,831
2023	17,348	11,256	1,016	1,217	30,837	7,218	1,724	39,779
2024	19,088	11,445	1,441	1,432	33,406	7,875	1,809	43,090
2025	21,045	11,649	1,866	1,680	36,240	14,445	2,147	52,832
2026	23,134	11,809	2,291	1,963	39,093	14,445	2,189	55,727
2027	25,134	11,979	2,716	2,252	42,080	15,102	2,254	59,436
2028	27,402	12,158	3,141	2,599	45,299	15,759	2,317	63,375
2029	29,862	12,347	3,566	2,934	48,709	15,759	2,351	66,819
2030	32,537	12,548	3,991	3,261	53,337	16,416	2,406	71,159
2017-2030 Growth Rate (%)	10.2%	18.9%			13.0%	21.5%	12.9%	14.3%

GMSP's total interconnected system peak demand forecast assumes historical coincidence factors and adds coincidence peak demand for exports. Their coincidence factor for exports is based on the corresponding export load factors.

Base Case Total System Forecast, including exports, 2018-2030 (MW)

Year	Total In-Country + T&D Losses	Total Exports	Total Peak Demand
2017	1,973	175	2,148

2018	2,548	175	2,723
2019	3,036	175	3,211
2020	3,723	515	4,238
2021	4,358	515	4,873
2022	4,974	515	5,489
2023	5,718	865	6,584
2024	6,185	950	7,135
2025	6,742	1,700	8,442
2026	7,250	1,700	8,950
2027	7,786	1,785	9,571
2028	8,362	1,870	10,233
2029	8,967	1,870	10,838
2030	9,614	1,955	11,569
2017-2030 Growth Rate (%)	13.0%	20.4%	13.8%

GMSP's total interconnected system peak demand forecast assumes historical coincidence factors and adds coincidence peak demand for exports. Their coincidence factor for exports is based on the corresponding export load factors.

Base Case Total System Forecast, including exports, 2018-2030 (MW)

Year	Total In-Country + T&D Losses	Total Exports	Total Peak Demand
2017	1,973	175	2,148
2018	2,548	175	2,723
2019	3,036	175	3,211
2020	3,723	515	4,238
2021	4,358	515	4,873
2022	4,974	515	5,489
2023	5,718	865	6,584
2024	6,185	950	7,135
2025	6,742	1,700	8,442
2026	7,250	1,700	8,950
2027	7,786	1,785	9,571
2028	8,362	1,870	10,233
2029	8,967	1,870	10,838
2030	9,614	1,955	11,569
2017-2030 Growth Rate (%)	13.0%	20.4%	13.8%

Although the GMSP Base Case demand forecast may appear to be optimistic in some respects, GMSP compared this forecast with that in the 2014 Master Plan, which indicated that the GMSP forecast is appreciably lower, largely due to slower than expected demand growth in the period to 2017.

Essentially, Nexant's GMSP analysis indicates that Ethiopia, in addition to satisfying sustained rapid domestic growth with improved levels of supply security, can increase exports from 200 MW to a total of two countries in 2018, to 2,412 MW to four countries in 2030. Whilst this has positive implications for regional trade in power, various caveats and numerous risk factors apply, and will be discussed at length below. One of these factors is delays to major generation projects and, as discussed later, some delayed commissioning is likely. At the same time, however, greater levels of export could be achieved by accelerating the development of hydropower construction, since Ethiopia has several candidate hydropower plants that could, in theory, be commissioned well before 2030. Acceleration itself would represent an additional risk factor, however.

Summary

The GMSP for Ethiopia identifies 600 MW of exports in 2020, 2,112 MW in 2025, and 2,412 MW in 2030. All these figures are sensitive to delays in the commissioning of several hydropower plants. Due to the wide range of risk factors that impinge on hydropower plants—most notably geotechnical risks—it would be extremely fortunate if all projects were commissioned in accordance with the planned schedule. Nevertheless, Ethiopia has a long list of candidates available for introduction to the expansion programme, if required. The Power Africa and EAPP MP export figures for 2018 and 2020, respectively, now appear to have been overly-optimistic. The figures for 2025 are not too dissimilar, however, with EAPP suggesting 1,600 MW and Power Africa suggesting 1,900 MW. Deloitte's export figure of 7,352 MW for 2030 is three-times the GMSP figure of 2,412 MW, although Deloitte did not distinguish clearly between surplus of capacity over demand and surplus available for export. Although risks apply, the GMSP assumptions for the commissioning of new interconnections beyond the existing interconnections to Djibouti and Sudan and the 400 MW Phase 1 interconnection to Kenya that is currently under construction, appear to be reasonable. These projects include:

- Sudan, 1,000 MW, from 2025;
- Kenya Phase 2, 100 MW, from 2024; and
- Tanzania (via Kenya), 412 MW, from 2023.

The GMSP makes no reference to interconnections between Ethiopia and South Sudan. Presumably this is because there is more logic to interconnecting South Sudan with its northern and southern neighbours, Sudan and Uganda, respectively. South Sudan has a need for relatively small imports in the short- to medium-term, which need to be coordinated with the expansion of the indigenous transmission and distribution networks. In the longer-term, South Sudan may have significant surplus hydropower capacity available for export to neighbours with higher marginal costs, such as Sudan. Sudan may also import surplus hydropower from Uganda, wheeled through South Sudan. The EAPP MP has a 600 MW interconnector between South Sudan and Uganda by 2020 and a 300 MW interconnector between South Sudan and Sudan by 2025. Each of these dates appears to be overly-optimistic at the present time, as does EAPP MP's estimate of South Sudan having a 1,400 MW surplus of capacity over peak demand by 2015.

The regional studies do not discuss Sudan in any detail. The EAPP MP suggests that supply and demand in 2025 are reasonably well-balanced. The Deloitte study has Sudan having a supply surplus of 4,207 MW in 2030, whilst the GMSP has Sudan importing 1,100 MW from Ethiopia from 2025 to 2030. Fossil fuel generation accounts for almost a third of Sudan's capacity and energy generated, which suggests that the marginal costs are high for a significant proportion of the time, and thus encouraging imports from lower cost sources of energy.

Of the four regional studies reviewed, only the EAPP MP envisaged a Uganda-South Sudan interconnector, a 400kV line with a capacity of 600 MW and available by 2020. As things have turned-out, neither Uganda would have been able to supply nor South Sudan able to receive by this time.

The Deloitte study suggests that Kenya would have a surplus of capacity over demand of 544 MW by 2030. With the system having a significant level of hydropower capacity and likely to also have significant levels of VRE capacity by 2030, it is unlikely that this surplus would translate to capacity available for export. The Power Africa Roadmap, however, indicates 700 MW of exports by 2025, presumably based on the coal-fired capacity to be commissioned in 2024.

The regional studies reviewed for the IRIMP have few references to Djibouti but the consensus between the Deloitte study, the EAPP MP and the GMSP is that Djibouti will probably be content with the interconnections that it already has with Ethiopia until after 2030.

Eritrea and Somalia can both be discounted from consideration as far as interconnections are concerned, which is probably why the various regional studies did not consider either of them.

Determination of Surpluses and Deficits

An assessment of the potential for surpluses and deficits of individual countries is a potentially complex task. National demand for power (MW) and energy (GWh) is readily forecast, although actual outturns are often at variance with forecasts for a variety of reasons. For example, there was a global downturn in economic growth following the financial crisis in 2008, with marked reductions in economic output—and hence electricity production—in most counties and for several years.

Although demand forecasts are subject to uncertainties arising in both the national and international economies, projecting surpluses and deficits is an extremely complex task that ideally requires a regional least-cost expansion planning exercise, as explained below. It is wholly inappropriate, for example, to simply take the installed capacity in a given year, to subtract the estimated peak demand in that year, and to declare the difference as a surplus. Firstly, each national system should ensure a “plant margin”, i.e. a surplus of capacity over the peak demand, to cover the possibility/likelihood of scheduled and unscheduled plant outages that will reduce the peak power output capability. In an all-thermal system, a plant margin in the region of 10-20% may be adequate, depending upon the age and reliability of the plant portfolio. However, a predominantly hydropower system such as Ethiopia’s is not only subject to the demands of scheduled and unscheduled outages, it is also exposed to hydrological factors, such as seasonality, drought conditions, or even multiple consecutive dry years. Consequently, Ethiopia’s required reserve margin is well in excess of 50%. Although Ethiopia is actively diversifying its plant mix with solar and wind energy, these are intermittent renewable energy sources that cannot be depended upon to be available at any given point in time, and therefore the plant margin may yet rise further.

The solution is to specify export quantities along with other demands and, using a sophisticated system expansion models, develop the least-cost expansion plan that will satisfy the system demand, the export commitments, and the system reliability criteria (plus other constraints). This is the approach adopted by Nexant in the 2019 GMSP study for Ethiopia.

In an ideal situation, a fresh regional power development plan (PDP) for the entire IGAD region ought to be undertaken using a model like Balmorel[6] or PLEXOS[7]. There are, however, a few challenges with

[6] As applied for the 2014 EAPP Master Plan study.

[7] As applied for the 2019 GMSP study for Ethiopia.

this: primarily logistical problems such as data gathering for meaningful model runs, but also the issue of defining the 'region' to be modelled. As previously advised, Egypt ought to be included since it probably represents a more bankable offtaker for the exporting countries than some of the energy deficit IGAD countries. The DRC could possibly be included in the 'region' since low-cost energy from Inga is a potential exporter to the IGAD countries but, at the same time, all the major power pools in Africa and the Middle East have expressed an interest in importing from Inga.

For the IRIMP study, however, an approach that is simpler but robust is proposed.

Approach Adopted

Across the eight IGAD countries, the available information is extremely varied. As noted above, of the four regional studies reviewed, two are relatively dated (Deloitte and the EAPP MP), one is judged to be overly simplistic the Power Africa Roadmap), and just one is contemporary and extremely thorough (the GMSP). Moreover, the Deloitte study only considered five IGAD countries, the EAPP MP considered six, the Power Africa Roadmap considered just three, and the GMSP only considered exports to three other IGAD countries, albeit with exports to Tanzania passing through an interconnection with Tanzania.

Except for the GMSP, which is the equivalent of a power sector master plan study for Ethiopia, the equivalent information is not available for some of the countries and—where it is available—is already quite dated. Expansion plans change for a variety of reasons—higher or lower demand than previously forecast, changes in technology or fuel prices, waxing and waning interest in projects from IPP developers, etc.—and that is why master plans need to be updated at least every five years. With the increasingly rapid penetration of the disruptive technologies, the useful life-span of expansion plans has perhaps never been shorter.

With a full regional least-cost expansion study beyond consideration, the adopted approach is to extrapolate from the information available, taking account of available information on progress with committed generation plant, and being guided by the findings of the most through and relevant study available: the GMSP.

Inherent Risks

Simply by comparing the regional studies prepared over the past five years, and the wide differences between them, it should be apparent that there is considerable risk associated with forecasting a future economic case for an interconnection between two countries. These include:

- One or other country may become a politically or economically unstable trading partner for what may be a significant capital investment for both partners.
- The previously forecast demand in the country with the expected supply deficit may be lower than anticipated due to either lower demand—on account of civil unrest or financial distress—or faster than expected supply—due to accelerated commissioning of new capacity.
- The previously forecast supply in the country with the expected supply surplus may be lower than anticipated due to delays during construction or a failure to reach financial closure, or maybe due to demand being higher than expected due to an economic boom or lower tariffs.
- Major disruption to the power sector due to the harnessing of low-cost technologies with innovative delivery mechanisms, that leapfrog the conventional generation, transmission and distribution model of the power sector. This has happened to the telephony sector in many

developing countries, with consumers buying mobile phones and eschewing fixed landlines. In some countries and some small ways, this is also happening in the power sector. However, if the cost of wind, solar and storage continue to plummet relative to conventional technologies, the disruption to the incumbent power utilities will accelerate.

Delays to project completion rank as a commonplace risk which, where capacity additions are generally in the form of mega projects, is a significant hazard for interconnection projects centred on exporting the surplus power from such projects. This is closely followed by the risk of a slowdown in demand growth in the importing market which, in a region that is no stranger to civil unrest, is not uncommon.

The risk of technology leapfrogging is a more speculative and uncertain form of hazard for the power sector. Nevertheless, global trends over the past five years or so are such that these developments should not be dismissed outright and require careful monitoring by policymakers.

Country-by-Country Projections

General

Of the IGAD member countries, Ethiopia, Kenya and Uganda are—with intermittent setbacks in some instances—racing ahead with economic growth and the implementation of policies to provide modern energy systems to all citizens within a reasonably short timescale. All three countries are potentially significant regional players in regional electricity over the short-, medium- and long-term.

Of the remaining IGAD members, Sudan has a reasonably sound economy and a range of energy resources available to it, but there are security concerns, a lack of openness to private sector investors, and a power sector with good human capacity encumbered by slow-moving institutions.

Djibouti has, within a very short timescale, successfully leveraged its geographically strategic location to attract significant inward investment. Whilst initially dependent on expensive diesel generation, Djibouti has recently started to generate from geothermal energy, and has further potential available for exploitation. It is also looking to develop wind and solar capacity. Although Djibouti plans to maintain full independent capacity of its own, it has an interconnector with Ethiopia through which it can import surplus hydro energy, and thus benefit from fuel cost savings in its conventional thermal units.

South Sudan has considerable indigenous energy resources in the form of hydropower, geothermal, wind and solar energy. It is also a significant producer and exporter of oil and natural gas, the revenue from which has the potential to support strong economic growth and human welfare. Unfortunately, the country is still in its infancy and needing considerable human and institutional capacity building before it can fully exploit the opportunities available to the country. Nevertheless, South Sudan is a potentially strong market for medium-term imports through interconnectors and, in the longer-term, a potentially significant exporter once it can develop its hydropower and other resources.

Eritrea is an enigmatic country. It is extremely insular and does not have strong links with the other IGAD countries. Intuitively, Eritrea is potentially an importer from regional countries with low-cost surpluses, since its generation portfolio is largely petroleum-based—and hence quite expensive—despite having geothermal, wind and solar potential. The information available on the country is extremely limited and consequently Eritrea is discounted as far as the IRIMP is concerned, as either a significant exporter or importer of energy.

Somalia has endured more than two decades of civil strife and although the situation is improving, AfDB considers that it may take at least two decades for the country to develop the human and institutional capacity, economic and political stability, and the physical infrastructure required to become—most likely—an enthusiastic importer of electricity from IGAD neighbours.

Ethiopia

Ethiopia's National Electrification Program-Implementation Road Map (NEP-IRM) of 2017 highlights the objectives to attain middle-income country status by 2025, and to achieve 100% electricity access in both rural and urban areas by the same year. In his foreword to the NEP-IRM, the Minister acknowledged that, "*The traditional way of expanding energy access—increasing electricity generation capacity and extending the grid—is still vital. But it is slow and grid expansion alone is not sufficient.*" The key operational action elements of the NEP-IRM target are as follows:

- Fast-paced ambitious grid connections rollout program implemented by Ethiopian Electric Utility (EEU) starting in 2018;
- Enhanced design and reach of an off-grid access rollout program alongside grid connections for the achievement of universal access by 2025; and,
- Explicit cross-sectoral linkages with the productive and social services sectors.

Public sector investment, to 2022, was broadly in proportion to the split between grid-connected and off-grid customers. Consistent with Ethiopia's record of development over the past two decades, the NEP-IRM acknowledges that NEP-IRM cannot simply be a set of targets, but needs to bring together technical and planning, with institutional, policy, and financing frameworks in a sustained manner, to enable the efficient and timely achievement of the connection targets and related outcomes.

Overall capital expenditure for network densification and expansion to 2030 is estimated at about US$19 billion.

It is interesting to note that although 100% access is to be achieved by 2025, with 65% of households connected on-grid and the remaining 35% off-grid. Network densification and expansion is set to continue beyond 2025, such that by 2030 97% of households will be on-grid and only 3% off-grid. The implication of these figures is that the off-grid solutions provided in the period to 2025 will have almost entirely been superseded by 2030. A consequence of this is that investors in off-grid solutions will require a very short payback period. If, as appears likely, the off-grid solutions are provided through the public utility, they are likely to be left with considerable stranded assets.

Sourcing of the considerable capital investment requirements to 2030 requires careful consideration. The NEP-IRM acknowledges that Ethiopia's tariffs are amongst the lowest in Africa and that the retail tariffs have not been revised since 2006. The NEP-IRM is hopeful that the investment requirements can be met by operational efficiency improvements, but this would appear to be overly optimistic. Unless government subsidies to the sector can sustain the inevitable increases, retail tariffs may need to rise appreciably. Tariff increases will unavoidably dampen the growth in demand and the take-up of new connections.

Specifically, on retail tariffs, the NEP-IRM notes that a draft tariff framework was prepared in January 2017, for full cost-reflective tariffs with adjustments every four years. Under the draft framework, the average domestic tariff would be set at US$0.06/kWh. In 2017, this proposal was under review by the management of the EEU, EEP, and the sector regulator, the Ethiopian Energy Authority (EEA).

By 2025, 5.7 million households will either be supplied by new mini-grids or provided with solar systems of 10-watt peak (Wp) and above. The NEP-IRM appears to be keeping an open mind on the specifics of the mini-grid technology, institutional framework, and business model, pending pilot testing. Ethiopia is drawing from experience in countries such as Kenya, Bangladesh, Peru, and Argentina. The Rural Electrification Fund (REF) has been operating in Ethiopia for around 20 years but the scale of ambition is such that the REF will need to be redesigned.

Private market-based off-grid delivery in rural areas is under consideration but, as remarked above, plans to rapidly supersede mini-grids with on-grid electrification will probably be viewed negatively by potential investors. The commercial viability of mini grids in low-income, remote rural communities is fragile and investment payback periods can be quite long.

The GMSP provides the most recent generation expansion programme for Ethiopia and has been reviewed in great detail above. However, the risks to this programme and the implications for cross-border interconnections needs to be explored. In the period to 2030, just six hydropower stations—Koysha, GERD, Chemoga Yeda 1&2, Geba 1&2, Dabus and Birbir—add over 10,500 MW of new capacity, with the first two of these, alone, adding over 8,600 MW. Delays to any of these projects would impact detrimentally on either commitment to export power or supply security in Ethiopia's own system. According to one source, GERD is already 5 years behind schedule.[8] As recently as 2018, reservoir filling was due to commence in that year, but this is now unlikely before 2020.[9]

Sudan

The electrification rate in Sudan was a relatively modest 32.6% in 2016, according to the World Bank.

In 2013, Sudan had no wind generation capacity and no grid-connected solar capacity, despite good wind and solar resource regimes, as detailed below. However, Sudan's Intended Nationally Determined Contributions (INDC) commitments in 2015 include for 20% RE in the national power system by 2030. This will involve:

- Wind energy: 1,000 MW (grid connected);
- Solar PV energy: 1,000 MW (on- and off-grid);
- Solar CSP technology: 100 MW (grid connected);
- Waste to Energy: 80 MW (grid connected);
- Biomass: 80 MW (grid connected);
- Small Hydro Plants: 50 MW (grid connected).

In 2014, UNDP and GEF prepared a report on Promoting Utility Scale Power Generation from Wind Energy in Sudan, which followed the Ministry of Water Resources and Electricity's (MWRE) Renewable Energy Master Plan 2013 (REMP). The REMP aims to reduce Sudan's dependence on fossil fuel. Sudan's generation is currently around two-thirds hydropower and almost all the remainder from thermal generation using fossil fuels. In total, renewable sources contributed 70.1% of electricity generation in 2012, according to the World Bank.

Facilitation of PSP in the power sector has been very slow to evolve in Sudan. Consequently, it would appear that the development of wind energy capacity in Sudan will be undertaken by the public sector

---

8 Marc Champion and Nizar Manek. Death on the Nile Haunts Ethiopia's Rebirth. Bloomberg. August 2, 2019. https://www.bloomberg.com/graphics/2019-nile-river-ethiopia-dam/

9 Agrilinks. Ahead of the Completion of the Grand Ethiopian Renaissance Dam, the Upper Blue Nile River Flow Is Expected to be Average in 2019. June 3, 2019. https://www.agrilinks.org/post/ahead-completion-grand-ethiopian-renaissance-dam-upper-blue-nile-river-flow-expected-be-average

and, since indigenous capacity in wind energy development has had to grow organically, the speed of implementation may be relatively slower than if PSP had been adopted.

Sudan has some hydropower potential that has yet to be exploited. It also has significant oil and gas resource, much of which is located close to the border with South Sudan. There is good wind energy potential, particularly along the Red Sea coast, and sizeable wind energy IPPs have already been developed. Similarly, the mean solar insolation in the country is 6.1 kWh/m^2/day, which implies good potential for solar energy, and some progress has been made with exploiting this potential within very recent years.

Studies suggest that there is around 400 MW of potential geothermal capacity in Sudan.

The total technically feasible potential for hydropower generation is 4,920 MW (or 24,132 GWh/year), which suggests that, in the long-term, most new generation capacity will come from sources other than hydro. Sudan's long-term development plan notes that 8,675 MW of additional thermal power plants will be needed by 2030.

South Sudan

South Sudan is a newly independent country and although it has considerable oil reserves and untapped hydropower resource it remains an extremely poor country. Per capita incomes are very low; most of the population are subsistence farmers, and only around 1% of the population have access to grid electricity, which is one of the lowest levels in the world. South Sudan is a significant oil producer and—despite producing electricity at a high cost—thermal power plants are a major focus in the short to medium-term.

Although South Sudan receives extensive support from the MDAs (AfDB, World Bank Group, UNDP, etc.) and various NGOs, governance and institutional capacity are inadequate for the high levels of need and activity. Also, periods of civil disturbance since independence have hindered both economic growth and infrastructure development.

In 2013, a strategy paper produced by the World Bank recommended a series of short-, medium- and long-term strategic measures in the power sector: [10]

In the short-term, and "as a new nation, RSS (Republic of South Sudan) needs to embark on a process of technical and institutional capacity building. GRSS (Government of the Republic of South Sudan) should focus on laying the foundation of growth for (the) future";

In the medium-term, "GRSS should focus on implementing identified strategic projects"; and

In the long-term, "GRSS should focus on (the) scaling-up of expansion projects".

A major energy sector investment plan has been under implementation for the past several years. Although considerable capital investment was included in this plan, the World Bank noted that it "did not include plans for other important interventions needed urgently in the sector, such as: reforms in the institutional arrangements, legal and regulatory framework, capacity building, off-grid access expansion, etc."[11]

---

10 World Bank. Republic of South Sudan: Electricity Sector Strategy Note for South Sudan: Electricity Sector Strategy Note. Report No: ACS3585. April 1, 2013.

11 Ibid.

World Bank also noted the high disparity between generation costs and retail tariffs which, when combined with high system losses (30%) and low bill collection rates (40-50%), have caused "high financial losses for the national utility and an increasing burden on the GRSS budget."[12] In turn, this has led to difficulties with securing timely fuel supplies, leading to supply shortages.

GRSS's Ministry of Electricity and Dams prepared a Strategic Plan for the period 2013- 2018. This document was premised on an overall policy of provision of electric power in South Sudan consisting of a mix of public and private sector service providers that engage in electricity generation, transmission, and distribution enterprises. This requires the intervention of the Ministry as a regulatory body, whose key role is to balance the interests of the service providers and the consumers. The Ministry will also undertake Monitoring and Evaluation (M&E) of strategic plan implementation. A keystone of the Strategic Plan is the facilitation of PPPs and IPPs. However, the strategic plan does not hide the major challenges confronting the sector. These include the severe shortage of indigenous capacity in most key areas such as technical, administrative, financial management, etc. Also, a notable issue for the sector is lack of respect for the rule of law, with electricity theft and non-payment being commonplace. The main achievement of the strategic plan is establishing institutional responsibilities, reporting lines, priorities for the sector, and the M&E framework for plan implementation.

South Sudan's near-total dependence on fossil fuel generation is at odds with international concerns about global warming, especially since the country has considerable RE potential, notably hydropower and solar energy. The imperative for the country, however, has been to rapidly expand the supply of electricity so as not to unduly impede economic growth. The lead-time for diesel generation, for example, is considerably shorter than for major hydropower projects, and are also less demanding on enabling frameworks, institutional capacity, etc. An ideal solution for South Sudan would be cross-border interconnections facilitating reasonably inexpensive electricity in the medium-term, and subsequently facilitating exports to neighbouring countries in the longer-term, once the major hydropower resource can be exploited.

The installed capacity in South Sudan is understood to be around 130 MW at present, with around 60 MW of this capacity owned by IPP firms. This capacity is essentially fuelled by diesel and heavy fuel oil, which are extremely expensive. Consequently, the cost of generation is also extremely high and estimated by the World Bank to be around US$ 0.70/kWh.[13]

Briefly, the electricity sector currently comprises:

- Generation and distribution systems confined to the commercial centres in the main cities of Juba, Malakai and Wau;
- Rural mini grids in Yei, Kapoeta and Maridi;
- Upper-income residential and some business customers.
- Industry and business largely rely on their own diesel generators, since the utility has insufficient capacity to meet demand.

Back in 2013, World Bank recognised that, "since the development of large hydropower plants will take many years to complete, the supply scenario in the coming five years (short term targets) will

12 Ibid.

13 Ibid.

continue to be limited to thermal sources". Interconnections with Sudan and Ethiopia were priorities, even though several donors were showing interest in supporting hydropower developments in South Sudan.

The country's hydropower potential is comparatively large, at around 2,500 MW—principally on the Nile and its major tributaries—and the wind and solar PV characteristics are promising, too. There is also geothermal and biomass potential in the country. Unfortunately, South Sudan is hampered by a low population density and the transmission network is under-developed. Grid development is being addressed with assistance from AfDB. An interconnector with Uganda is extremely important if the hydropower resource is to be developed.

Although South Sudan's post-independence power sector has endured an impoverished beginning and challenging evolution there is good reason to be optimistic about the long-term future, provided that all the legal, regulatory, institutional and governance frameworks can be established. The country is well-positioned to develop a diversified and reasonably low-cost generation mix, featuring:

i. Indigenous hydropower, both large and small;
ii. Indigenous VRE in the form of wind and solar;
iii. Geothermal energy;
iv. Gas-fired peaking capacity fuelled by indigenous natural gas;
v. Imports from near neighbours such as Ethiopia; and
vi. Potential for exporting surpluses to IGAD countries and beyond.

A major constraint on the development of large generation projects and cross-border interconnections is the lack of a transmission network capable of taking advantage of the diverse supply opportunities and delivering power to all the major demand centres in the country.

A Sudan-South Sudan interconnector has been viewed as a priority project for the country, but a potential weakness of this is that Sudan also experiences power shortages. An Ethiopia-South Sudan interconnector is also proposed, although Ethiopia itself is highly dependent on the commissioning of new hydropower plant before it can supply surpluses. A Uganda-South Sudan interconnector is also mooted but, once again, Uganda experiences supply shortages of its own and is awaiting the commissioning of major hydropower capacity.

The 100 MW Ezra IPP power plant near Juba was recently commissioned.

The Grand Fula hydropower scheme will have a capacity of 1,080 MW but will have a very high investment cost. Consequently, it has been proposed that a near-term solution is to develop the 40 MW Fula Rapids hydropower project.

Although RE-based off-grid electrification in rural areas is proposed, transmission interconnection with EAPP neighbours is also a priority, especially a link with Uganda.

A hydropower expansion and regional integration plan of South Sudan was issued in August 2015.[14] Its horizon spans 2015 to 2045. Three alternative plans are considered:

14 "Hydropower Expansion Plan and Regional Integration Plan of South Sudan into Regional Electricity Grid – Final Report". Hatch and Artelia. October 6, 2015.

1) Maximise hydro development.
2) Develop only committed hydro projects and supplement with thermal options and imports.
3) Rely mostly on imported energy with thermal support.

The first of these alternatives (Option 1) is chosen as the reference plan. It includes the phased construction of all large hydropower plants located along the Bahr el Jebel river: Bedden in 2028, Lakki in 2033 and Shukole in 2040, following demand growth forecast, with conventional thermal generation needed to cover peak demand. All scenarios include Fula Rapids hydroelectric project (49 MW), in 2021. The long lead-time of hydropower and major thermal projects requires imports to be considered in the interim, ideally through a Uganda-South Sudan interconnection. The expansion plan indicates that a maximum 100 MW of imports are required, starting in 2021. Karuma in Uganda is due to enter service before the end of 2019.

The study concludes that developing South Sudan hydroelectric projects provides energy at a substantially lower rate than current local production and lower rates than could be envisaged through interconnections with neighbouring countries. Forecast demand growth appears to match the project development schedules, with some imports and minimum exports. The report recommendation for transmission expansion is to then adapt to demand growth across the country, instead of concentrating on developing further regional interconnections.

The hydropower alternative (Option 1) is found to be robust under risks on validity of input data, as well as political, technical, financial, economic, environmental and social risks. Suggestions made in the report include updating data on the Bahr El Jebel cascade, initiating a nationwide census for confirmation of demand forecasts (the largest study uncertainty), negotiating with Nile Basin nations located downstream of the proposed Bahr El Jabel projects—to avoid possible use-of-water related conflicts—and providing support to the Government of South Sudan in obtaining financial partners for developing this cascade. Projects comprising the cascade are run-of-the-river and therefore minimise potential water management conflicts with downstream countries and helping to facilitate international negotiations with Nile basin countries.

The thermal options considered in the plan are low- and medium-speed reciprocating units powered by light and heavy oil and, in later years, combined cycle units fired by light oil or, if available, by local natural gas. Gas turbines are needed for peaking duty and for capacity reserve.

As noted above, the hydropower projects—Bedden, Lakki, Shukoli, Fula and Kinyeti—are run-of-river with limited storage, implying moderate environmental impacts but higher vulnerability to droughts. Project Sue (10.5 MW) is the only one with storage. At a cost of 244 US$/MWh for average energy, it is the most expensive hydropower project, but it has multipurpose benefits, including irrigation.

The import scenario (Option 3) replaces hydropower projects in the Bahr el Jebel cascade by imports, most likely coming from Ethiopia, starting at 100 MW in 2032 and increasing 50 MW annually, to reach 700 MW by 2045. Imports tariff is assumed at 80 $/MWh, including costs of the transmission lines.

The Net Present Values (NPV) and Levelised Cost of Energy (LCOE) obtained for the reference plan under each of the three planning scenarios is provided in the table below.

Levelised Cost and Net Present Value of Three Generation Development Alternatives

Plan	LCOE (US$/MWh	NPV (US$ billions)
Maximum Hydropower	165	4.93
Thermal	212	6.32
Maximum Imports	194	5.79

Source: "Hydropower Expansion Plan and Regional Integration Plan of South Sudan into Regional Electricity Grid – Final Report". Hatch and Artelia. October 6, 2015.

The total cost of the reference scenario including associated transmission is US$ 5,994 million and the LCOE is 201 $/MWh.

On the transmission side, instead of developing a 500 kV HVDC line linking hydro projects on the Bahr el Jebel River directly to Sudan, the study recommends developing a 400 kV AC and a 220 kV network, becoming the transmission backbone to be used mainly for internal power distribution purposes. The main reason is that projects on the Bahr el Jebel River would be used to satisfy internal demand and not for exports. Regional interconnections considered are:

- Ethiopia – South Sudan at 230 kV; (phase 1) and at 400-500 kV (Phase 2);
- Uganda – South Sudan at 400 kV or 220 kV;
- Kenya – South Sudan (220 kV);
- South Sudan – Sudan at 220 kV

The Uganda–South Sudan interconnection project at 400 kV, AC, has regional importance, since it will enhance power exchange between Ethiopia, South Sudan and Uganda, plus creating a loop of interconnections with Eastern DRC (Democratic Republic of Congo). The authorities of both Uganda and South Sudan have expressed that it is a priority and an MOU was signed on December 2015.

The report includes a detailed environmental impacts study and mitigation measures, for generation and transmission options. It uses a simplified annual deterministic dispatch implemented in Excel, initially working with average hydro energies. It does not take account of hydrological variability and uncertainty. Pure run-of-river hydro units are dispatched in the base. Hydro units with some storage are dispatched during peak hours, as long as their reservoirs allow storing sufficient energy. Thermal units are dispatched in merit order, from the cheapest to the most expensive, to cover the peak. Peaks are expected to last 4 hours per day. A 30% reserve is assumed. The dispatch algorithm accounts for technical characteristics of thermal plants for covering the peak and for reserve. A further dispatch is performed using firm energies to check the reliability of system supply under dry conditions.

According to a senior South Sudan official, the following hydro projects have feasibility studies.[15] Annual average and firm energies, as well as project total and levelised costs are taken from the most recent expansion plan.[16]

15 "Power Sector in South Sudan". Hon. Lawrence Loku Mo'Yu, Subsecretary, Ministry of Energy and Dams, South Sudan. Presentation at South Sudan Oil & Power 2017 Conference.

16 "Hydropower Expansion Plan and Regional Integration Plan of South Sudan into Regional Electricity Grid – Final Report". Hatch and Artelia. October 6, 2015.

Basic Information on Candidate Hydroelectric Plants

Hydropower Project	Installed Capacity (MW)	Average Energy (GWh)	Firm Energy (GWh)	Capital Cost (US$m)	Cost of Average Energy (USc/kWh)
Grand Fula	890-1080	3,370	2,147	1,569	5.0
Beden	540-780	2,067	1,350	1,295	6.7
Lakki	410	1,181	744	658	5.9
Shukoli	235	n/a	n/a	n/a	n/a
Fula Rapids	40	281	219	143	5.4
Sue Multipurpose	10.4	59.4	29.7	138	24.4

Of these projects, according to the presentation from the Ministry, Grand Fula has the highest priority. Its feasibility study has been prepared by the Consultant but has not been delivered for lack of payment.

The expansion plan incorporates, between 2016 and 2025, 546 MW of generic medium-speed diesels (MSD) plants, as well as 320 MW of LSD plants. Between 2026 and 2030, additional 66 MW of MSD and 170 MW of low-speed diesels (LSD) are installed. The candidate diesel plants are:

- Palouge, 250 MW;
- Tharjath, 240 MW.

The plan mentions that there are no studies for these projects.

The generation expansion plan for the 2015 – 2030 period is provided below.

Generation Expansion Plan, 2015 – 2030

Year	**Projects**	**Hydro Installd Capacty (MW)**	**MSD LFO (MW)**	**LSD HFO (MW)**	**CCGT LFO (MW)**	**OCGT LFO (MW)**	**Cum. Dep. Cap. (MW)**	**Peak Dmd. (MW)**	**Total Import (MW)**	**Total Export (MW)**	**Total Demnd minus net import (MW)**	**Res. Margin (%)**
2014	Existing MSD		27.6				26					
2015							26	172	11	0	161	-84%
2016							26	226	11	0	215	-88%
2017							26	258	11	0	247	-90%
2018	MSD		364				368	291	11	0	280	32%
2019	MSD		44				409	323	11	0	312	31%
2020	MSD, Palouge, Tharjath		21	200			617	356	11	0	346	79%
2021	Fula Rapids, Wau Dams, MSD	49	19				684	394	80	0	314	118%
2022	MSD, Palouge, Tharjath		19	60			758	433	90	0	344	121%
2023	MSD		23				780	475	101	0	375	108%
2024	MSD, Palouge, Tharjath		25	60			860	520	111	0	409	110%
2025	MSD		31				889	568	111	0	458	94%
2026	MSD, Palouge, Tharjath		30	60			974	620	111	0	509	91%
2027	MSD		36				1007	676	111	0	565	78%
2028	Bedden 496	522					1529	736	100	0	636	140%
2029	Palouge, Tharjath			60			1586	803	100	0	703	126%
2030	Palouge, Tharjath			50			1633	875	100	0	775	111%

Source: "Hydropower Expansion Plan and Regional Integration Plan of South Sudan into Regional Electricity Grid – Final Report". Hatch and Artelia. October 6, 2015.

No new plants are introduced or retired until 2033, when Lakki is incorporated into the system.

The investment requirements for the power sector, which is just one of many needy sectors of the economy in South Sudan, are likely to be substantial for years to come. Grants and concessional loans from bilateral and multilateral donors are expected to feature prominently. PSPs in the form of IPPs are likely, provided that enabling frameworks are introduced to the satisfaction of private investors. The power utility is unlikely to be a bankable off-taker for IPPs, for the foreseeable future, and therefore GRSS should expect to be called upon to provide sovereign guarantees. GRSS subsidy to electricity consumers accounted for around 4% of the national budget in 2013 and was expected to rise to 8% by 2015. As the power sector grows, the total subsidy will continue to rise unless GRSS and the utility can take measures to make the sector more self-sufficient. Accordingly, GRSS and the utility need to urgently address fundamental issues such as the efficiency of the distribution networks, reducing technical and non-technical losses, improving revenue collection and revising the tariff structure. Best practice in the industry is to limit the tariff subsidy to a very low level of consumption.

Around 15 kWh/month is considered enough to provide a household with basic lighting in the evening and early morning, provided that low-energy lighting is available, such as LEDs or CFLs.

The current situation on electricity demand is quite complex. Whilst sales through the grid are only around 30 MW, if suppressed demand—including that from commercial and industrial operations that rely on their own diesel generators—is included, demand is probably in the region of 300 MW. Demand is expected to grow by around 9.1% and thus likely to exceed 900 MW by 2030, although there is a high degree of uncertainty attached to this forecast.

Electricity tariffs impact on demand. As noted above, the cost of generation is around US$ 0.70/kWh and this does not include the cost of transmission, distribution, metering, billing, etc. Consequently, despite being heavily subsidised, retail tariffs are extremely high, at an average of around US$ 0.25/kWh (in 2013).

Although South Sudan is well-endowed with hydropower resources, as well as oil and natural gas, the expansion plan requires sustained injections of considerable capital resources, for generation, transmission, distribution, billing systems, etc. The sums required may prove a challenge for both the public and the private sector, in view of the various risk factors applying in the country. PSP projects have been implemented but, generally, private investment is hampered by security issues, shortcomings in the legal, regulatory and institutional frameworks, and a power utility that is financially weak.

Although South Sudan is an oil producing nation and aspires to develop domestic refining capacity, there is an opportunity cost associated with using domestic fuels for electricity generation. The use of reciprocating diesel engines has historically been confined to relatively small systems with few other indigenous energy resources. In view of the sustained falls in wind and solar costs over recent years, it is curious that the authorities have not considered solar PV and wind. The GMSP for Ethiopia included wind and solar PV, in addition to reciprocating plant, and the VRE sources were considerably lower. VRE, by definition, is non-firm, but using battery storage to firm these sources is understood to add around 50% to the basic energy cost. VRE has other advantages over thermal plants, including the likelihood that MDA support for these will be more forthcoming than for reciprocating units. Ethiopia and Kenya have both included wind and solar PV in their expansion plans, and Uganda has included wind.

Although South Sudan should be able to develop lower-cost sources of electricity in the medium-term, the investment in interconnections, transmission networks, distribution systems, metering, billing and collection systems are such that financial stresses and strains will be sustained on the electricity utility and central government. In parallel with developing such infrastructure, therefore, GRSS ought to develop strategies for satisfying demand for modern energy services in remote communities. A wide range of options are available for consideration including: RE-based mini-grids, solar home systems, solar lanterns, etc. World Bank has made a range of recommendations to promote these opportunities, including:[17]

- Adopting Comprehensive RE and EE Legislation;
- Establishing an RE and EE Agency;
- Preparing RE and EE Strategies and Action Plans; and,

17 World Bank. Republic of South Sudan: Electricity Sector Strategy Note for South Sudan: Electricity Sector Strategy Note. Report No: ACS3585. April 1, 2013.

- Development of Financing Mechanism for RE and EE.

World Bank advocated that GRSS should strike a balance between investment in grid expansion and RE-based, off-grid solutions, in order to more rapidly provide affordable access to modern energy systems and to thus reduce poverty. The balance proposed was for 90% investment in grid expansion and 10% for off-grid solutions.

Djibouti

Until the first Ethiopia-Djibouti interconnector was commissioned and commenced importing Ethiopian hydropower to Djibouti in 2011, electricity generation in Djibouti was almost entirely based on diesel generation and therefore highly dependent on international prices for petroleum products, which are typically volatile. This dependence has a negative impact on the cost of electricity supply and the country's balance of payments. The high price of electricity is also considered to be one of the main factors limiting economic growth in Djibouti. However, it is important to note that the interconnector cannot be used at its full potential due to voltage limitations.

A feasibility study for a second interconnector between Ethiopia and Djibouti was completed by Tractebel in 2017. In brief, this would comprise:

- a new 230 kV double circuit Transmission Line from Semera to Nagad;
- an extension of the existing Semera Substation (in Ethiopia);
- an extension of the existing 230/63/20kV substation Nagad (in Djibouti).

In order to securely operate the new interconnection, a few internal reinforcements need to be put in place by both countries.

Tractebel's economic analysis indicated considerable economic benefits of the "with" project scenario over the "without" scenario.

According to Tractebel, the project will be financed by the Saudi and Kuwait fund, with EEP and EDD acting as the Project Implementation Unit.

Tractebel's supply-demand analysis considered the forecasts for both countries. The quantities were only presented graphically and can be approximated as follows:

Year	**Ethiopia Installed Capacity (MW)**	**Ethiopia Peak Demand (MW)**	**Ethiopia Generation (TWh)**	**Ethiopia Demand (TWh)**	**Djibouti Installed Capacity (MW)**	**Djibouti Peak Demand (MW)**	**Djibouti Generation (TWh)**	**Djibouti Demand (TWh)**
2020	13,000	5,000	45	32	420	290	3.0	1.5
2025	20,500	9,800	80	60	650	380	4.6	1.9
2030	28,500	13,000	125	82	850	450	6.1	2.4

Tractebel indicate a radical change in the generation mix for Djibouti, with the previously dominant diesel capacity remaining constant and all new capacity coming from gas-fired thermal plant, geothermal energy, and from wind and solar energy.

The Ethiopia demand figures are considerably higher than those in Nexant's forecast.

Tractebel's conclusions from the supply-demand analysis are as follows:

"It can be seen that no scarcity is to be expected both in terms of power capacity and in terms of energy. Moreover, surplus capacity and energy will be available in both countries even without considering flows between them. The figures also show the high installed capacity and available energy within Ethiopia resulting from planned hydro resources. Additionally, the share of geothermal energy is also gaining importance. A steep increase in geothermal energy resources is also foreseen for Djibouti. Additionally, Djibouti expects a large share of gas-based capacity in the generation mix."

This analysis appears to take an optimistic perspective on supply and demand in both countries.

Tractebel used dynamic simulations to determine the net transfer capacity with the new interconnector, and these are summarised in the following table.

Year	Net Transfer Capacity, with new interconnector (MW)
2020	180.8
2025	313.9

The logic for the additional interconnector is that although Djibouti would maintain independent generation capacity to meet domestic demand, imports of hydropower energy from Ethiopia could be used to reduce generation from the relatively expensive diesel and gas-fired capacity, and thus reducing Djibouti's operating costs.

With funding from the World Bank, Parsons Brinkerhoff prepared a Least Cost Electricity Master Plan for Djibouti in November 2009. This report has probably been overtaken by events, however.

Somalia

Somalia has endured almost three decades of civil strife and insecurity, and public infrastructure has been badly neglected for much of this period. Occasional outbreaks of insecurity impede progress with rectifying the infrastructure situation.

The Ministry of Public Works, Reconstruction and Housing in Somalia published a Short, Middle and Long-term Somali Infrastructure Strategy in June 2018, and this document provides some basic information on the status of the electricity sector in the country.

Electric power generation, almost all of which is diesel-fuelled accounts for a very small percentage of total energy production in the country. For cooking and lighting, households and small businesses turn to fuels such as biomass/charcoal, kerosene, etc. Dilapidated grids exist in several cities (Garowe, Hargeisa, Bosaaso, Berbera, Qardo) but these are not always in use. The total installed and operational generating capacity in Somalia is estimated to be between 80 to 85 MW, and the remaining grids have an estimated 250,000 connections. Supply quality and security are poor, and supply is typically limited to just 5 or 6 hours per day. The LV system is often stretched over long distances, which leads to reduced voltages and high technical losses.

RE potential is abundant. The solar energy potential ranges from 5 to 7 $kWh/m^2/day$ with over 310 sunny days in a year or 3,000 hours of sunshine per annum. Somalia is also characterised by strong wind regimes with annual average speeds of 1.5 to 11.4 m/s. There is also potential for small hydro power along the Shabelle and Juba rivers, estimated at between 100 and 120 MW. Security and funding are the main impediments to harnessing these resources. However, some investments have been made in solar PV by the MDAs, aid agencies and other NGOs.

A critical impediment to revitalising the power sector is weak institutional frameworks. Moreover, there has only been slow progress to remedy this, to develop and enforce harmonised policies and regulatory frameworks at the federal and local levels of government. MDA's have been reluctant to provide funding for improving the situation, and it would also appear that there is a dearth of qualified personnel. Land ownership issues impede projects in most infrastructure sectors.

Access to affordability is an extremely important catalyst for both the creation of economic growth and reducing poverty. The situation in the country is such, however, that developing cross-border interconnections together with a national transmission network to distribute electricity to the major cities and towns will probably require many years of capacity building and the development of legal and institutional frameworks. Power systems may need to develop organically from urban-based municipal systems, each with their own generation. These isolated systems could combine VRE generation such as wind and solar with diesel generation and battery storage. Transmission systems and interconnections, leading to larger scale and lower cost generation plant supplying the interconnected network. This would mirror the development of power systems in many parts of the world, towards the end of the 19th century. One lesson to take from the 19th century, however, is to ensure harmonisation of standards in order to avoid unnecessary stranded assets as the isolated systems become interconnected.

An Energy Sector Needs Assessment and Investment Programme was prepared for Somalia by AfDB in November 2015.18 This needs assessment was prepared in order to understand the needs in the energy sector and to establish a pipeline of projects for the Federal Government of Somalia to plan and implement, with assistance from AfDB and the broader donor community. A key objective is, "*To improve welfare, productivity and security by expanding access to grid-supplied electricity in cities (based on hybrid power generation, i.e. conventional fuels and renewables, mainly solar/photovoltaic) and promoting non-grid modern energy services and products to poor rural and nomadic people*." A key limitation recognised in the report, however, is the acute lack of human and institutional capacity.

In recent years, although traditional centralised electricity distribution systems are almost non-existent in the country, individuals and businesses have often provided their own generation systems—typically based on diesel generators—and sometimes supplying segments of their local communities. In some towns and cities, the private sector has established technically sophisticated generation and distribution systems, in the absence of any provision from the public sector.

The proposed power expansion programme, over the ten-year period, would target the installation of close to 200 MW of power generation capacity, of which 40–50 MWp of renewable energy (mainly solar PV), the creation/repair of 18 city grids (regional capitals plus Mogadishu and Hargeisa), and a pilot project consisting of ten rural hybrid mini-grids. The programme also contemplates the electrification of as many as 20 other urban centres. The increased scale and efficiency would help reduce costs of supply and reduce average tariffs by about 50% (from around US$ 1/kWh to about US$ 0.50/kWh). It might be noted that this lower tariff is still several times higher than the average retail tariff for connected customers in Ethiopia.

The envisaged off-grid energy products/services programme could help as many as 1.8 million individuals with improved lighting and other domestic and productive uses of modern energy (battery charging; recharging of mobile phones and other appliances, etc.).

18 AfDB. Somalia: Energy Sector Needs Assessment and Investment Programme. November 2015.

The 2015 Energy Sector Needs Assessment proposed an aggregate energy sector action/investment programme (ESAIP) of US$ 803 million, with US$ 580m allocated to expansion of electricity supply, and a further US$ 60m to the provision of modern energy to rural/nomadic communities. However, the proposed programme is acknowledged to be both ambitious and farsighted: "*US$ 803 million over a 10-year period, making allowance for the difficulty of getting things done in Somalia and for the inevitable delays to be expected from a country emerging from conflict and long-term chaos*."

The AfDB-led Somalia Infrastructure Fund concedes that, "*The scale of the problems and the means required to address them mean that only a partial answer can be given through this pipeline. In fact, fully relaxing the energy constraint to production and households will require decades*." The Fund's project pipeline for the energy sector is largely aimed at human and institutional capacity building, but the pipeline also includes several grid construction projects.

As noted above, there are several isolated systems operating in some of the cities in Somalia, but there is no interconnected network. Total installed and operational generating capacity in all of Somalia was estimated at about 100 MW in 2014, with an estimated 250,000 connections. There has been some progress since that time.

The 2015 Energy Sector Needs Assessment recognised that there is significant potential in all Somali areas in terms of renewable and alternative sources of energy, such as solar and wind power, but so far, due to both security and funding problems, only very small, tentative experiments have been conducted with solar and wind power. A systematic, in-depth evaluation of these resources needs to be conducted before large-scale projects can be designed to use these renewable resources for power generation.

Realistically, it may take a couple of decades for Somalia's power sector to have evolved to a position where bulk electricity can be imported and transmitted to the major towns and cities through a national grid, and for power utilities to have evolved to a point where they are a dependable off-taker for exports from other IGAD countries.

It is difficult to imagine a scenario wherein Somalia has surplus electricity to export to its neighbours.

Uganda

Uganda has had a strong economy for several years, although growth has been constrained by electricity supply deficits. Despite having considerable hydropower potential on the River Nile, development of this resource has been relatively slow, and the country has periodically resorted to expensive emergency diesel generation to partially bridge the supply gap.

Uganda has been one of the leaders in facilitating PSP in the power sector, and enabling frameworks were established more than 20 years ago. IPPs have not been wholeheartedly welcomed by everyone, however; project development has been very slow and the resulting cost of energy considerably greater than originally anticipated.

Uganda is one of only three IGAD countries included in the Power Africa analysis.

UETCL's Grid Development Plan, 2018-2040 is an authoritative source of information on the anticipated expansion programme for the Uganda power sector.

According to UETCL, the majority of Uganda's current installed capacity comes from four large hydropower projects: Kiira and Naluabale (the Owen Falls complex), Bujagali and—since March 2019—Isimba. Before the end of 2019 the first two 100 MW should be commissioned, with a further four 100 MW units operational from 2020. The remainder of the capacity is comprised of numerous relatively small units.

In 2017, the total hydropower installed capacity, after unit de-ratings, was 590 MW. Thermal projects added 86 MW and wind a further 10 MW. Biomass added 30 MW. Total installed capacity was therefore 716 MW.

Due to a short delay to the Isimba hydropower project, the capacity in 2018 was slightly higher than in 2017, at 755 MW, due largely to the addition of several small/mini hydropower units.

Total installed capacity should be appreciably higher from 2020, with the commissioning of 600 MW of Karuma capacity in 2019 and 2020, and 183 MW at Isimba in 2019, bringing the total installed capacity to around 1744 MW. 53 MW is also due to be added at Agago/Achwa in 2020. 50 MW of thermal capacity is set to be added in 2021. The Karuma project has been delayed slightly, due in part to delays in completing the 400kV transmission line from the project.

Of notable interest, substantial solar PV capacity will be added from 2021, bringing the total VRE capacity in 2021 to 885 MW. Around 30 MW of other RE capacity, in the form of biomass, will be added in 2020.

Two other large hydropower projects are due to be commissioned before 2030: the 392 MW Oriang hydropower project in 2022, and the 499 MW first phase of Ayago in 2025.

Additional hydropower potential exists on the River Nile, but this is unlikely to be developed until after 2030.

The UETCL Grid Development Plan indicates a total installed capacity of 4083 MW, which is almost six times the capacity in 2017. This represents an annualised growth rate in capacity of 14.3%, which is comparable with that in Ethiopia.

Uganda’s track record in implementing generation expansion plans has been relatively poor over the past 20 years. If there is a cause to be optimistic about the current plan, however, it is that Uganda has largely abandoned the PSP approach that was used to develop the Bujagali hydropower project and has turned instead to the Chinese development model. The Ayago hydropower project was originally awarded to a Turkish contractor before switching to Chinese finance and Chinese contractors.

The UETCL Grid Development Plan reports a domestic demand of 566 MW in 2017. The capacity margin is therefore 26.5% in this year. Peak domestic demand, excluding proposed industrial loads, is estimated to rise to 958 MW by 2030; an annualised rate of 4.1%, which is less than half of the 10.6% rate forecast for Ethiopia over the same period.

According to Power Africa, Uganda had a peak surplus of 112 MW in 2018. As with Ethiopia, hydropower seasonality is a factor and this surplus may only apply to parts of the wet season. They suggest that the peak surplus should remain at around the 110 MW level through to 2025.

Kenya

Kenya Power’s Grid Development and Maintenance Plan 2016/17-2020/21 is an important document for the IRIMP since it covers several areas of key interest to IRIMP: demand forecasting, generation expansion, transmission and distribution expansion, etc.

Kenya‘s peak demand increased from 899 MW in 2004/05 to 1,585MW in 2015/16, while the number of electricity consumers increased five-fold from 735,144 in 2004/05 to 4,890,373 in June 2016. The effective installed capacity is 2,341 MW and hydropower accounted for around 35% of the total generation. The network has undergone considerable expansion and improvement, and the LV reticulation has greatly expanded to reach more households. Kenya Power has been tasked with responding to the Government's ambitious goal of electrifying 70% of households by 2017 and universal access to electricity by 2020.

It is important to note that Kenya is a regional leader in terms of having established a restructured, disaggregated, reasonably-liberal, regulated power sector with legal, regulatory and institutional frameworks consistent with the needs of the 21st century. PSP is enabled and encouraged. Until the first quarter of 2017, RE such as wind and solar was facilitated through a FiT scheme that had operated since 2010. Subsequently, however, an auction system was introduced for large grid-connected generation. This auction system has been used for geothermal projects in Kenya for some time. The generation mix is diversified, with no individual fuel source or technology exercising undue influence. The Energy Bill of 2015 provides the basis for policy in the sector, and the basis for implementing that policy and guiding expansion planning, rural electrification, energy efficiency, renewable energy, etc.

A very useful source of information on the Kenyan power sector is ERC's Updated Least Cost Power Development Plan: 2017-2037, prepared in June 2018.

The Kenyan power system is fully-unbundled and PSP is permitted in the generation sub-sector. KPLC is the sole buyer, and the sector is regulated by the ERC. ERC regulates retail electricity tariffs.

Kenya has been a leader in the development of geothermal energy in Africa over the past 30 years, and has considerable indigenous human and technical capacity, in addition to several operational geothermal plants.

Until an auction system was introduced in 2017, private sector investment in other RE capacity was incentivised through a Feed-in Tariff (FiT) scheme, and up to June 2017 this had produced 696 MW of qualifying capacity, which accounts for around 28% of the country's installed capacity. From 2017, IPPs will be subject to a reverse auction tender system, where—subject to the suitability of the bidder—the lowest offer for the supply of power wins the PPA contract.

Kenya already has a diversified plant mix and the generation expansion programme to 2030 looks to diversify this even further, with geothermal, wind, solar PV, coal… A significant level of intermittent capacity is set to be introduced over the period.

The system load factor is around 70% and there remains a pronounced daily peak in the early evening.

Kenya has an ambitious target of achieving universal access to electricity by 2030 and is now exploring mini grids for electrifying remote rural communities distant from the grid. These localised electricity networks will typically harness solar energy, mini/micro-hydro and some biomass energy. The Rural Electrification Authority is also developing around 25 rural solar/diesel hybrid micro grid-connected systems in 2017 plus solar PV for up to 15,000 primary schools and 10,000 secondary schools, police posts, medical centres, and community buildings.

Kenya is one of only three IGAD countries included in the Power Africa analysis.

ERC report Kenya's installed generating capacity as 2,333 MW in June 2017: hydro, 824 MW (36%); thermal, 803 MW (34%); geothermal, 652 MW (28%); wind, 26 MW (1%), biomass/cogeneration, 28 MW (1%); and, solar, 0.55 MW (<1%). In terms of energy production, however, the mix proportions are quite different: hydro, 3,341 GWh (33%); thermal, 2,156 GWh (22%); geothermal, 4451 GWh

(44%); wind, 63 GWh (0.6%), biomass/cogeneration, 0.7 GWh (-); and, solar, 0.54 GWh (-) which, excluding imports, totalled 10,021 GWh. These statistics exclude the capacity of the LTWP (see below).

Kenya has long been an SSA leader in many fields and an early-adopter of technological and delivery mechanisms. Several developing countries such as the USA, the UK, Australia and Germany are producing fleet-footed start-up companies that have harnessed the disruptive technologies (e.g. solar PV and solar+storage) with innovative financing mechanisms. In some instances, these market entrants are consolidating the management of rooftop solar, home battery systems, EV charging, etc., forming virtual microgrids within existing grids, and using software technologies such as 'blockchain' to out-compete the incumbent utilities. Kenya is a developing country that demonstrated an openness towards such innovations and was a world-leader in using mobile phones to make routine payments and monetary transfers. Some recent projects in the power sector are summarised below.

The Lake Turkana Wind Power Project (LTWP), completed within the past 2 years, is Kenya's largest single private investment. The wind farm is providing 310MW of wind power to Kenya's national grid, equivalent to approximately 15% per cent of the country's current installed electricity generating capacity. It comprises 365 wind turbines, each with a capacity of 850 kW. The developer consortium included Kenyan and international entities and they have a 20-year PPA to supply power at a fixed price to Kenya Power.

USA-based Powerhive and Enel Green Power (EGP) of Italy are aiming to build and develop scalable solar mini-grids in 100 villages in the Western part of Kenya. The solar mini grids will have an installed capacity of 1MW and will bring clean power to remote communities and serve a total of 90,000 people. The micro-grids are to be powered by First Solar's solar PV technology and operated with Powerhive's control technology. The mini-grids will be linked to an advanced mobile payment or billing systems, utilising a mobile phone prepayment app, not unlike those pioneered in Kenya for several years. The system will use solar power panels, battery storage, and local distribution facilities. Powerhive became the first company to receive a utility concession from ERC in 2015.

Several emerging markets are seeing greater mini grid penetration as more private companies continue to invest in off-grid power alternatives, and Kenya is in the vanguard of these developments. Since January 2016, Caterpillar Ventures, Total Energy Ventures, First Solar, Tao Capital Partners, Pi Investments and a few other firms joined Prelude Ventures and Powerhive in their US$ 20m Series A financing round to support Powerhive's expansion of its micro-grid energy portfolio in Africa and the Asia Pacific.[19]

The ERC report documents many committed projects for the period through to 2024. It is noticeable that these will maintain the diversity of the plant mix. RE projects such as geothermal, wind and solar PV are prominent, although there 89 MW of additional hydropower capacity. In 2024, however, almost 1000 MW of coal capacity is due to be commissioned at Lamu. ERC indicate that the 400 MW HVDC link with Ethiopia would be commissioned in 2019, but the consultant understands that there are delays to the implementation of this line. The total capacity of the committed projects to 2024 is 4,419 MW, which is considerably greater than the increase in domestic demand to 2024.

It is very relevant to the IRIMP project to understand the ERC's assumptions that lead to a considerable increase in wind and solar PV capacity in the period to 2030. On wind: Kenya has an area of around 90,000 square kilometres with very promising wind speeds of 6m/s and above, with much of this area

---

19 Amatka Insight Africa Services and The Finnish Funding Agency for Innovation. Energy Sector Insights: Kenya. January 2017

being close to demand centres. On solar PV: Kenya has excellent insolation levels of 4-6 $kWh/m^2/day$ (up to 2400 $kWh/m^2/year$) and, again, much of this resource is close to demand centres.

ERC appears to have focused on the resource levels rather than cost comparisons.

Kenya aims to add 4,000 MW of nuclear power capacity by 2033, but this is beyond the 2030 planning horizon of the current assignment.

ERC has total installed capacity growing at an annualised rate of 9.4%, from 2,235 MW in 2019 to 7,214 MW in 2030. In terms of changes to the plant mix in the Kenyan system:

- Geothermal will reduce slightly but at around 26% will continue to make a significant contribution;
- Coal, is a new entrant and the capacity contribution will approach 14%;
- Hydropower will decline significantly, to 21%, due to limited available sites;
- Wind and solar will each rise appreciably, from negligible levels to around 11% apiece.

In comparison with neighbouring Ethiopia, Kenya will neither be dependent on one particular technology—hydropower—and exposure to hydrological and climate change risk factors, nor to mega projects.

Installed Capacity in MW	**2017**		**2030**	
	MW	%	MW	%
Geothermal	651	29.1	1869	25.9
Hydropower	805	36.0	1522	21.1
Coal	0	0.0	981	13.6
Nuclear	0	0.0	0	0.0
Natural Gas	0	0.0	0	0.0
Diesel	698	31.2	4.8	5.8
Gasoil	54	2.4	0	0.0
Imports	0	0.0	400	5.5
Cogeneration	2	0.1	220	3.1
Generic Backup	0	0.0	160	2.2
Wind	26	1.1	861	11.9
Solar	0	0.0	782	10.8
TOTAL	**2235**	**100**	**7214**	**100**

Although there is a diverse mix planned for the next 10-12 years, there are some concerns about the balance. At over 20%, the VRE capacity may cause stability issues. The coal capacity may be under-utilised and is not ideally suited to load-following or stop/start cycles.

At 5.5%, the level of imports is manageable from system security considerations.

Kenya Power's short- to medium-term demand forecast applied the Model for Analysis of Energy Demand (MAED) software package. A GDP growth rate of 5.7% was assumed, consistent with the target of Vision 2030. The electrification targets of 70% by 2017 and universal access by 2020 were factored-in. The planning horizon of the forecast was to 2020/21.

The energy demand forecast and the peak load forecast are reproduced in the following table.

Year	Energy Demand (GWh)	Peak Load (MW)
2015/16	9,817	1,585
2016/17	10,341	1,750
2017/18	10,895	1,959
2018/19	11,478	2,205
2019/20	12,093	2,494
2020/21	12,740	2,834

In order to meet peak demand, installed capacity was set to rise to 5024 MW by 2020/21. Medium-speed diesels and geothermal energy account for most of the capacity additions to 2020/21.

Actual figures for the period to 2017/18 were slightly lower than forecast for these years, as noted below.

- Total sales in the year to June 2017 totalled 8,272 GWh. Energy consumption, including losses, rose by 52% to 10,205 GWh in the 7 years to June 2017.
- Peak demand in the year to June 2017 was 1,656 MW. The average annual growth rate between 2012 and 2017 was around 6%, which is partly due to accelerated electrification and provision of new connections.
- KPLC's losses are quite high, at around 18-19%, and do not show signs of reducing.

ERC's demand forecast covers the period from 2017 to 2037. The key drivers of future demand are assumed to be:

- GDP growth;
- Population growth and urbanisation; and
- Vision 2030 Flagship projects.

GDP growth of 10% per annum is assumed.

ERC's Reference or Base Case demand forecast used an econometric approach and considered population growth/urbanisation, electrification/ connectivity, consumption trends, GDP and flagship projects assessment. Sales were forecast by customer category. Railway projects accounted for a large proportion of the demand from flagship projects. Loss reduction assumptions are relatively unambitious, reducing from 19.0% in 2017 to 16.5% or 16.6% from 2022 through to 2037.

The Reference forecast to 2030 is reproduced below.

Year	Electricity Consumption (GWh)	Peak Demand (MW)
2017	10,465	1754
2018	11,169	1866
2019	11,820	1978
2020	12,546	2103
2021	13,312	2234
2022	14,334	2421
2023	15,293	2586
2024	16,327	2764
2025	17,750	2989
2026	19,098	3224
2027	20,393	3441
2028	22,082	3720
2029	23,593	3974
2030	25,195	4244

The annualised growth rate of consumption between 2017 and 2030 is 6.5%, and for peak demand it is 7.0%.

Between 2013 and 2017, the total generated capacity rose from 8,087 GWh to 10,205 GWh, while the net supply increased from 6,581GWh to 8,272 GWh. However, losses increased by 28% over the same period, from 1,507 GWh in 2013 to 1,933 in 2017. The increase in losses is attributed to accelerated connection of remote, low-consumption customers.

Kenya has been trading electricity with its neighbours for many years and this is likely to expand significantly in the future. In recent years, Kenya has imported from Uganda, Ethiopia and Tanzania, and has exported to Uganda and Tanzania. Imports are significantly greater than exports.

According to Power Africa, Kenya had a peak surplus of 52 MW in 2018. Hydropower seasonality is less of a factor than in Ethiopia and Uganda, since it largely derives from geothermal sources. They suggest that the peak surplus should increase to around 700 MW by 2025.

The Ethiopian Electric Power Company and Kenya Power have a PPA for the export of 400 MW to Kenya through a 500kV HVDC line spanning over 1,100 km. The line has been delayed. Also, Kenya Power has signed a PPA with the Rwanda power utility Rwanda Energy Group Limited (REG) for export of 30-50MW through the Ugandan transmission line. The Kenya-Ethiopia 500 MW HVDC transmission line is at an advanced stage of construction and should facilitate trade between the two countries and beyond, particularly for importing hydropower energy from Ethiopia to Kenya.

To assess the options and the opportunities for privately-operated mini-grids in Kenya, ERC requested IFC support to:

- Identify the demand for, and costs of, commercially sustainable mini grids,
- Assess the level and structure of any needed financial support and incentives, and
- Identify key legal and regulatory requirements for private participation in the sector.

The consultants engaged by IFC reported in 2015. Across Kenya, 21 sites were identified and subjected to detailed analysis. Key findings included the following:

- Mini-grid electricity would likely displace the existing sources of energy, which include kerosene, batteries, solar lanterns, and generators that are used for between 3 and 8 hours per day.
- The frequency of electricity bill payment is a potential issue. In these low-income communities, income and energy expenditure is most often contracted weekly or more frequently. It is only contracted monthly for institutions. Mini-grid payment systems would need to take this into consideration.
- Up-front payment for an electricity connection is an issue for many households and spreading the payments would be preferred.
- The level of service provision needs to take account of affordable issues, although even modest provision will improve living standards.

The study modelled 5 mini-grids supplied by hybrid systems, each consisting of solar PV, battery storage and diesel backup gensets. The solar PV could be augmented by wind energy and/or micro-hydro in some of the mini-grid sites. Key findings from the analysis included:

- Appropriately sized mini-grid systems 40 kWp to 400 kWp, would have the ability to serve between 30 and 1000 households.
- Flexibility is required to allow for the rate of take-up of connections and growth in demand.
- "Anchor load customers", such as a tourist lodge, can positively impact the economic viability of a mini-grid system, although these are not available at all sites. Where these are not available, a larger number of customers may be needed to ensure that the site is viable.
- Remote sites can prove more commercially viable due to the high cost of alternatives such as kerosene.
- Generally, the commercial potential of a mini-grid at a particular site will depend on developer-specific costs, the proposed business delivery model, grid extension plans[20] (where known) and the tariff that can be charged compared with the willingness/ability to pay of customers.

IFC noted that more than 10 private and community mini-grid developers were either active in or targeting Kenya, back in 2015. These developers include larger established companies and small entrepreneurs such as IPS Kenya, PowerGen, Powerhive, RVE.SOL, SteamaCo, Wind for Prosperity Kenya (which is a consortium of Vestas, Frontier Investment Management and Maara Energy), Greenpower Engineering, Ofgen, KMR Infrastructure and Skynotch Energy Africa. A variety of business models have been applied.

According to Wood Mackenzie Power & Renewables, around 400 million people have gained electricity access through off-grid solar between 2010 and 2017, and by 2022 this will have risen to 740 million. For remote communities, off-grid solar is the cheapest and most viable solution and, in addition, off-grid solar projects attract investment from fossil fuel majors and venture capital funds.

20 Unconnected households may prefer to hold-out for a grid extension rather than signing-up to a mini-grid.

The Kenya Off-Grid Solar Access Project (K-OSAP) was launched in 2017 to accelerate progress with, inter alia:

- Mini-grids for Community Facilities, Enterprises, and Households
- Standalone Solar Systems for Households

K-OSAP supports the electrification—through PPP arrangements—of areas where electricity supply through mini-grids represents the least cost option from a national perspective. Standalone solar systems will be similarly supported where these are the most appropriate technology to deliver energy services.

Eritrea

Eritrea is the second smallest country, after Djibouti, in the IGAD region, and has a population of around 5.3 million. It is one of the poorest countries in the world and around 80% of the population are subsistence farmers. GDP Annual Growth Rate in the country averaged 4.85% between 1991 and 2018. Economic growth has been volatile, however; it was 21.25% in 2001 and -13.12% in 2000.

Very little information is available for the Eritrea power system. A National Power Development Master Plan is understood to be in preparation but has not been made available to the IRIMP team. Eritrea does not actively participate in the EAPP. The power sector is known to be poorly-developed, however. The electricity sector is partially unbundled and the private sector is allowed to participate in generation only.

The EAPP MP of 2014 makes no reference to Eritrea, whatsoever, and nor does the Power Africa Roadmap of 2018.

Eritrea is understood to have few indigenous resources, apart from wind, solar and geothermal energy potential, and is currently a net importer of electricity.

A 230kV interconnector between Sudan and Eritrea is notionally planned.

Eritrea is understood to have had an installed capacity of 139 MW in 2015, and 149 MW in 2019. It has been estimated that the capacity will rise to 244 MW by 2030. It is also understood that the existing capacity is entirely thermal (diesel).

Currently, it is understood that the supply situation lags well behind demand, and that extensive supply curtailments are endured by customers.

Summary of Power Balances

In this sub-section a summary of supply and demand balances is developed and presented. A few strong caveats need to be attached to this summary, however. The sources of information upon which this analysis is based are varied and there is no standardised approach to the presentation of data.

Figures for system peak demand ought to be straightforward but some sources focus on peak demand from the indigenous system, whilst others include export commitments. The sources do not always make this distinction.

Figures for capacity are even more complex. Some sources include the capacity of imports, whilst others exclude these. The installed capacity of individual plants is of limited utility, for various reasons:

- The maximum output from a unit is often downrated from the original installed capacity due to wear and tear over time.

- Hydropower units are subject to additional caveats. Firstly, they are subject to seasonality and fluctuations in reservoir and tailwater levels. The unit output at reservoir minimum operating level—which is often the case towards the end of a dry season—is considerably lower than at maximum operating level. Units in a plant such as Owen Falls in Uganda, with several similar units, will have a higher output when a single unit is operating than when multiple units are operating because in the latter case the tailwater is appreciably higher than in the former case, which reduces the water pressure differential across the unit.

Summating the individual installed capacities is therefore of little merit. Similarly, designing system expansion using plant margin as a system reliability criterion in a hydro-thermal or predominantly hydropower system is inappropriate. More appropriate would be to use a probabilistic reliability criterion such as loss of load probability (LOLP), loss of load expectation (LOLE) or energy not served (ENS) that can be established by total system modelling in software such as PLEXOS or Balmorel. Deloitte's approach of adding 15% to the peak annual demand to cover losses and reserves was therefore overly simplistic and undermines the credibility of their conclusions. To further underline this point, it is useful to refer to recent studies for Uganda and Ethiopia. In UETCL's Grid Development Plan, 2015-2030, the total installed capacity required in 2030 was 3,605 MW to meet a peak demand of 2,529 MW—a margin of 42.5%. This is because UETCL's assessment of the total 'available' capacity from all units was just 2,612 MW. Most of the differential occurred in the fleet of hydropower plants. In the GMSP for Ethiopia, in which a No Export case was modelled, the forecast of demand in 2030 is 9,614 MW and the total installed capacity to meet this demand is 15,915 MW. The plant margin was thus almost 67%.

The degree to which a country's surplus of installed capacity over the peak domestic demand is available for export is therefore highly dependent on a range of factors, of which the plant mix and the details of the hydropower fleet are extremely relevant.

Subject to the above caveats, the following table of supply-demand balances has been developed.

Country	Total Capacity in 2030 (MW)	Demand in 2030 (MW)	Surplus in 2030 (MW)	Plant Margin (%)
Ethiopia[1]	15,915	9,614	6,301	66.5%
Ethiopia[2]	18,635	11,569	7,066	61.1%
Sudan[3]	-	-	-	-
South Sudan[4]	1,633	875	758	111%
Djibouti[5]	850	450	400	88.9%
Somalia[6]	-	-	-	-
Uganda[7]	3,605	2,529	1,076	42.5%
Kenya[8]	6,840	4,732	2,108	44.5%
Kenya[9]	5,640	4,732	908	19.2%
Kenya[10]	7,214	4,244	2,970	70.0%
Eritrea[11]	-	-	-	-

Notes:

1. Data from the 2019 GMSP, No Exports Case. Demand does not include any exports.
2. Data from the 2019 GMSP, Base Case. 2030 Demand includes exports of 2,412 MW (factored for coincidence to 1,955 MW) to Djibouti, Sudan, Kenya and Tanzania.
3. No reliable information located for power sector expansion in Sudan.
4. Data from Hatch and Artelia, 6 October 2015. 2030 capacity is defined as "dependable capacity". Reserve margin assumes 100 MW of imports are netted from the demand figure.
5. Data from Tractebel, 2017. Figures are taken from a graphic in the Tractebel report and are approximate.
6. No studies for Somalia have advanced projections for the power sector to 2030. There are too many uncertainties.
7. Data from the UETCL Grid Development Plan, 2015-2030. Figures in the table are base on installed capacity. If UETCL's "available capacity" figures are applied, the surplus is just 83 MW and the plant margin is 3.3%.
8. Data from Kenya Master Plan 2015-2035, Reference Case. Total capacity figure is defined as "Net Capacity Installed Effective".
9. Data from Kenya Master Plan 2015-2035, Reference Case. Total capacity figure is defined as "Firm Capacity".
10. Data from ERC. Total Capacity is "Installed Capacity".
11. No reliable information located for power sector expansion in Eritrea.

Summary of Interconnection Opportunities

*Uganda-South Sudan**

The 2014 EAPP MP included a 400kV interconnector between Uganda and South Sudan. It was to have a capacity of 600 MW and to have been constructed before 2020. Although no feasibility studies have been undertaken for this interconnector, both governments have made a tentative commitment—in a 2015 MOU—to the project. Donor funding of this project does not appear to be an issue and the critical issue relates more to the timing of when the South Sudan grid would be technically adequate to support interconnection.

Ethiopia-Kenya

In addition to the interconnector currently under construction, GMSP makes the case for a Phase 2 interconnector that would add 100 MW of capacity from 2024. GMSP also has an interconnector with Tanzania—presumably passing through Kenya—from 2023, with a capacity of 412 MW.

*Ethiopia-Sudan**

The 2014 EAPP MP included a 500kV interconnector between Ethiopia and Sudan, with a capacity of 1,600 MW. The basis of this interconnector is to export Ethiopian hydropower surpluses to North Africa, and specifically Egypt. The EAPP MP had the line operational before 2020. However, the delays to various Ethiopian hydropower projects—notably the 5-year delay to the GERD—has meant that there have not been the capacity surpluses available for this interconnector. The GMSP also included a 1,000 MW interconnector with Sudan being commissioned by 2025. Raising the capacity of this interconnector to 1,600 MW would require several hydropower and geothermal projects to be accelerated in the Ethiopian generation expansion programme. It is not clear from the GMSP what proportion of exports through the proposed interconnector would be split between Sudan and Egypt.

A feasibility study by CESI in 2016 has confirmed the viability of a 500kV double circuit interconnector, which would complement the existing 230kV interconnector. The new line would run from the Renaissance (GERD) project and would have a capacity of 3,000 MW, which is almost twice the flow modelled in the GMSP.

Sudan-South Sudan

The 2014 EAPP MP included a 220kV interconnector between Sudan and South Sudan, with a capacity of 300 MW. This interconnector was to be completed before 2025. However, neither country appears to have progressed this concept over the intervening five years.

Kenya-Uganda

The 2014 EAPP MP included a 400kV or 220kV interconnector between Uganda and Kenya. It was to have a capacity of 300 MW and to have been constructed before 2020. In the event, the timescale for this project would not have made sense since neither country would have had surpluses to export.

Ethiopia-Djibouti

Although recent projections suggest that Djibouti would not have a capacity deficit in 2030, the differential between the marginal cost of hydropower energy from Ethiopia and thermal capacity in Djibouti is such that the second Ethiopia-Djibouti interconnector, as studied by Tractebel in 2017, is a sound economic proposition. It would reduce the cost of generation in Djibouti, which should also be reflected in lower electricity tariffs and, due to price elasticity effects, would boost demand slightly. In addition, the economy of Djibouti would benefit from reduced imports of fossil fuels. There would also be GHG emissions savings.

Ethiopia-South Sudan

None of the recent regional studies appear to have contemplated a link between Ethiopia and South Sudan. However, the South Sudan Electricity Corporation Strategic Plan, 2013-2020 proposed an interconnection corridor in two phases: the first at 230kV, and the second at 500kV from the GERD project. More recently, the plans for this corridor appear to have been downgraded to Ethiopia simply supplying some of the border areas of South Sudan.

Although South Sudan might benefit from low-cost Ethiopian exports in the short- to medium-term, whilst South Sudan develops hydropower capacity of its own, South Sudan does not immediately have a T&D network with which to distribute imports to the various demand centres and, importantly, Ethiopia does not have surpluses available for export within the medium-term. There is a stronger case for a Uganda-South Sudan, in the medium-term.

Non-Policy Opportunities for Region-wide Advancement of Energy Access and Affordability

Only 1 in 8 households in rural Africa has access to electricity. In Ethiopia the rate is a little over 10%. Bringing electricity supplies to rural communities may only have limited impacts, however, since connection charges levied by utilities are often beyond the means of households in these communities. World Bank has successfully applied output-based aid (OBA) in Ethiopia to reduce connection costs to within affordability limits of many rural households. Essentially, the scheme involved the phasing of the US$75 cost of connection over 5 years, in monthly instalments.

As noted above in the section on Kenya, numerous companies and consortia of national and international entities are harnessing technological innovations—including the "disruptive technologies" of solar and solar storage—and innovative financing mechanisms to bring affordable electricity to remote rural communities. Although Kenya is a leader in this type of development in SSA, they are by no means unique to Kenya. Kenya has virtually the full range of enabling factors for PSP-developed mini grids. Kenya is not without some of the governance shortcomings that inhibit private sector investments in SSA but has the advantage of an extensive cohort of indigenous entrepreneurs able to bridge these solutions in partnership with international investors. To some degree, Ethiopia and Uganda also have similar entrepreneurs, and these countries are not far behind Kenya in adopting innovative solutions to the provision of rural power. The remaining IGAD countries, to a greater or lesser degree, have various obstacles inhibiting these developments.

ICT Sector

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.

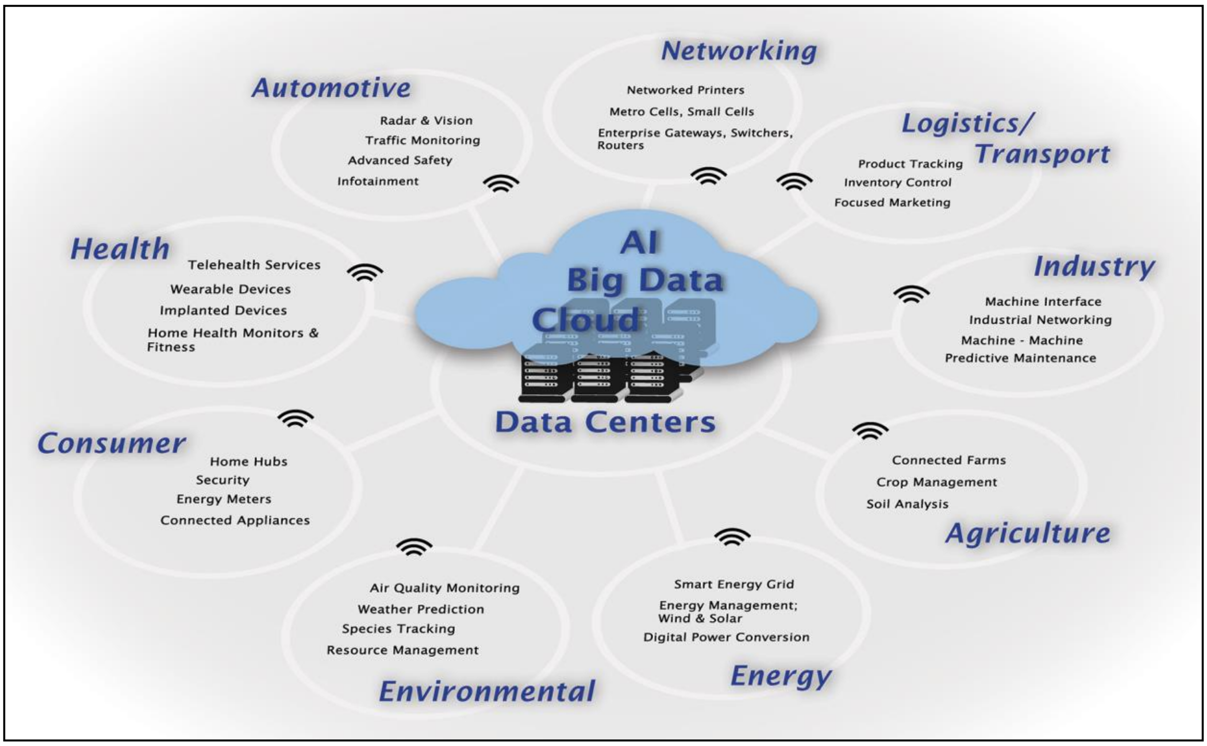
The demand for bandwidth needs to be estimated and projected into the future to design the regional and national backbone network for adequate capacity. This task is particularly difficult in some countries such as Somalia and South Sudan because there is very little reliable data available that could 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 0-1: 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 0-1: Forecast for total International Traffic

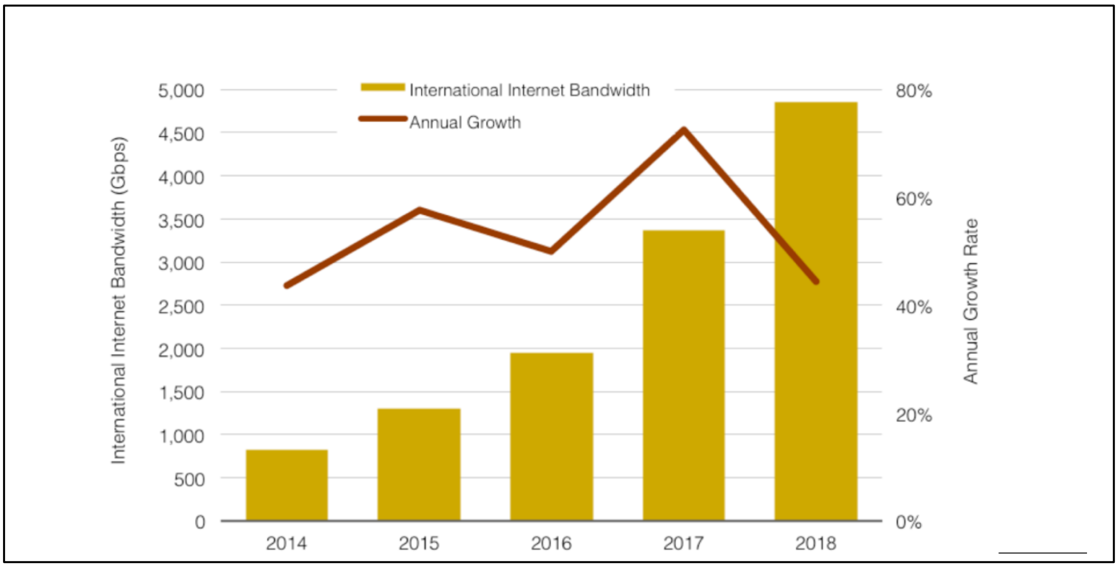
	Short Term Plan		Mid Term Plan		Long Term Plan	
Country	2016 (million minute)	2024 (million minute)	2025 (million minute)	2030 (million minute)	2031 (million minute)	2050 (million minute)
Djibouti	56.337	83.23541	87.39718	105.37	108.5311	190.3099
Ethiopia	372.1	523.5821	570.8492	688.2415	708.8887	1243.041
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

Source: IGAD Member States

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 Tele-Geography . 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 0-2: International Internet Bandwidth Growth – Sub-Saharan Africa



Source: Tele-Geography

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 below.

Table 0-2: 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

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 gateway 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. Therefore, It is not costly to expand the current optical fibre networks. The capital investment will be required for the green ICT links.

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 starts when the traffic capacity reaches 70% of the available capacity. The percentage of expansion is shown in the table below.

Table 0-3: 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 below.

Table 0-4: Percentage of expanding the international bandwidth capacity

	Short Term Plan	Mid Term Plan	Long Term Plan
Country	Expansion % based on existing bandwidth	Expansion % based on 2024 bandwidth capacity	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 for the high-quality ones. 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 of changing the optical fibre should start when its life reaches 15 years. The construction and laying should be when the optical fibre life around 20 years.

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

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

Most of the ICT networks in the liberalised and competitive market is owned by the operators. The operators normally have a business or strategic plan, but they keep it as confidential due to competition. The strategic plan contains the operator network expansion including new links for the next five years.

The second organisation concerned of the ICT network development is the regulatory authority or the ICT ministry where there is no regulator. The regulator plans for the network as well as the operator's business plan should be considered in identifying the projects for the medium-term planning.

The ownership of new projects and regional ring of optical fibre links by the IGAD Member States especially the ICT operators and regulators is highly essential which will ensure the implementation of these projects. The lack of these institutions means the new projects will be a wish list.

The ICT equipment has backup systems., 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 borders 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 fiber links redundancy by locations, 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 fiber 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 fiber but they can have more than one in terms of geographical locations;
- Uganda and South Sudan have no currently cross border optical fiber but they can have more than one in terms of geographical locations;
- South Sudan and Sudan have no currently cross border optical fiber 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. The projects for the medium term will be identified from the proposal above.

Long Term Planning Projects

The long-term planning projects will be based on the analysis in the previous section. Some projects from the proposed redundancy and ring topology will be classified as long-term projects depending on factors such as plan for industry and agriculture development, networks sustainability and population growth.

It is also important to agree with the stakeholders in IGAD Member States on these projects and they should provide the information to complete their inventory sheets.

Annex Two: Infrastructure Development Programme by Sector

Annex Two: Infrastructure Development Programme by Sector

Transport Sector

Table A2.1: Transport Infrastructure Projects to be Implemented 2020-2024

Project ID	Name	Sub-sector type	Corridor	Description	Stage	Cost ($m)	Financing	Implementing agency	Next steps
TSPN01	Mombasa Port Second Container Terminal, Phase 3	Sea Port	Northern	The second container terminal is being built on 100ha at Kilindini Harbour to relieve congestion at the main port. The project is being built in 3 phases, phase 1 was completed in 2016, the second is ongoing and the third will commence upon completion. Phase 3 will add a further 500,000 TEUs of capacity, bringing the total capacity of the second container terminal to 1.5m TEUs.	S2B Feasibility	300	Concessional finance – loan from JICA	Kenya Ports Authority (KPA)	Completion of Phase 2
TRDN02	Mombasa – Nairobi Expressway	Road	Northern	The planned Nairobi-Mombasa Expressway will feature four lanes, which will be expandable to six lanes. The road starts at Gitaru along the Nairobi–Nakuru Highway, approximately 24 km northeast of Nairobi City centre. It continues in a general southeasterly direction, through Ngong, Ongata Rongai, Kisaju and Isinya to rejoin the existing Nairobi–Mombasa Road, just north of Konza. The highway passes through nine Kenya counties to end in the city of Mombasa at the Changamwe Roundabout, a total distance of about 525 km.	S3B Transaction Support & Financial Close	2,180	PPP – loan from US Exim Bank	KeNHA	Finalise contracts and commence construction work
TRAN03	Naivasha – Kisumu (Phase 2B) SGR	Railway	Northern	Phase 2B of the Kenyan SGR line, measuring 262 km, passes through Naivasha, Narok, Bomet, Nyamira to end at Kisumu. The design of the project includes upgrading the port of Kisumu.	S3A Project Structuring	3,700	Concessional finance – loan from Chinese Exim Bank	Kenya Railways Corporation (KRC)	Financing modalities to be addressed between China Exim Bank and GoK
TRDN05	Kampala – Jinja Expressway	Road	Northern	The Kampala–Jinja Expressway, also known as the Jinja–Kampala Expressway, is a proposed	S3B Transaction	1,000	PPP and loan AfDB	UNRA	Award of contract

				four-lane toll highway in Uganda, linking Kampala, the capital and largest city of Uganda, with the town of Jinja 77 km to the east. The project will contribute to key strategic transport priorities for the region and help meet the objectives of regional integration, socio-economic development and investment in transportation infrastructure outlined in key national policies such as the Uganda Vision 2040, the National Development Plan II (2015/16 – 2019/20) and National Transport Master Plan.	Support & Financial Close				
TRDN06	Kampala – Jinja Highway	Road	Northern	Rehabilitation of 75 km of existing Kampala-Jinja road to widen and strengthen the carriageway. The road forms a critical section of the Northern Corridor, linking landlocked East African countries with the Port of Mombasa.	S2A Pre-Feasibility	7	Government funds	UNRA	Review the feasibility of the project alongside the Expressway
TRDN07	Kampala Outer Beltway	Road	Northern	The Kampala Outer Beltway, also known as the Kampala Outer Ring Road, is a planned 101 km road circumnavigating Kampala.	S3A Project Structuring	1250	PPP	UNRA	Review recently completed feasibility study, structure financing modalities
TRAN08	Rehabilitation of Meter Gauge Rail Between Tororo and Gulu	Railway	Northern	Rehabilitation of the 375 km meter gauge line between Tororo and Gulu. The line is not currently operational.	S3B Transaction Support & Financial Close	40	Donor grant – EU grant of $26.8m	Uganda Railways Corporation	Work due to commence in 2019
TDPN09	Gulu Logistics Hub	Inland Container Depot	Northern	The proposed developments include the container yard; railway siding; container freight station; warehousing complex; vehicle holding area and traffic flows; access roads, truck stop (parking); administration building; container light repair workshop; customs office; perimeter wall; security gate and guardhouse.	S2B Feasibility	9	Donor grant – funding from DFID and EU	TradeMark East Africa	Feasibility study to be conducted in 2019 and work to start in 2020

TRDN10	Nimule – Juba Road Rehabilitation	Road	Northern	This 192 km road was originally paved and upgraded to regional corridor standards by USAID in 2011. However, due to the civil war and a lack of maintenance the road is now dilapidated and requires rehabilitating.	S1 Project Definition	73	Donor grant	South Sudan Roads Authority	Full feasibility and detailed costing to be undertaken
TIWN11	Rehabilitation of Jinja Port Facilities	Inland Port & Waterway	Northern	Rehabilitation of the Jinja Port Facilities. Jinja port is in very poor condition with most of the rail wagon link span planking deteriorated and fendering systems completely decayed. The water depth was said to be 4m. The general cargo berth mooring facilities (quay wall and bolders) are damaged and the quay pavement is very poor.	S1 Project Definition	3	Government funds	Ministry of Works and Transport Uganda	Full feasibility and detailed costing to be undertaken
TIWN12	Rehabilitation of Kisumu Pier	Inland Port & Waterway	Northern	The rehabilitation and renovation of the port is meant to allow bigger vessels to dock in Kisumu to enhance trade with neighbouring countries. The work being undertaken include construction of 1,000-capacity container yard and rehabilitation of the Kisumu pier by Kenya Ports Authority to make the port the hub of trade in East Africa.	S2A Pre-Feasibility	30	Government funds	Kenya Ports Authority	Full feasibility
TIWN13	Rehabilitation of Port Bell Facilities	Inland Port & Waterway	Northern	Rehabilitation of the Port Bell facilities. Port Bell has a Roll on - Roll Off (RoRo) rail wagon link-span and a general cargo berth. Its meter gauge rail infrastructure is in poor state but still functional; however, the port has no rail accessibility, as encroachment on the connecting rail line prohibits trains from entering the port.	S1 Project Definition	3	Government funds	Ministry of Works and Transport Uganda	Full feasibility and detailed costing to be undertaken
TIWN14	Improvement of Navigation Aids on Lake Victoria	Inland Port & Waterway	Northern	Establishment of navigational aids such as light houses, lightships, buoys and radar beacons on the Lake to improve the safety of shipping.	S1 Project Definition	25	Donor grant	Kenya Ports Authority	Funding to be identified
TSPD01	Liquefied Natural Gas (LNG) Terminal, Demadjorg	Sea Port and Petroleum	Djibouti	The project includes the construction of an 803-km pipeline that will connect the gas extraction areas in Ethiopia's Ogaden Basin to	S2B Feasibility	2,800	Private sector	China Merchant Holding	Review project for feasibility

		/Gas Pipeline		the coast of Djibouti, as well as a gas liquefaction plant and export terminal, which is close the main Djibouti port of Doraleh.				International (CMHI)	
TRDD03	Djibouti City - Hol Hol - Ali Sabieh - Galile Highway (Horn of Africa Initiative)	Road	Djibouti	This 71km road starts from western part of Djibouti city and passes through the town Hol Hol ending in Al Sabieh city. The road will be upgraded, widened and paved.	S2B Feasibility	129	Blended finance – AfDB, JICA and UAE have expressed interest	ADR of the Ministère del'Equipement et des Transports	Undertake full feasibility
TBPD04	Balho One Stop Border Post	Border Post	Djibouti	The border post will facilitate the movement of cargo between Djibouti and Ethiopia and supplement the newly constructed 127 km road linking Tadjourah Djibouti to the border with Ethiopia at Balho.	S3B Transaction Support & Financial Close	10	Concessional finance	Djibouti Customs Authority	Financing has been secured, check to ensure construction has commenced
TRDD05	Dikhil-Galafi Highway - Djibouti (Horn of Africa Initiative)	Road	Djibouti	Rehabilitation of 100km Dikhil – Galafi road on the main corridor connecting the port in Djibouti to the border with Ethiopia.	S2B Feasibility	70	Concessional finance – Saudi Fund for Development	ADR of the Ministère del'Equipement et des Transports	Undertake full feasibility
TBPD06	Galafi One Stop Border Post	Border Post	Djibouti	Proposed one stop border post at Galafi on the Djibouti-Ethiopia border to be constructed with the road rehabilitation.	S2A Pre-Feasibility	10	Donor funds	Ethiopian Revenues and Customs Authority (ERCA)	Undertake full feasibility
TBPD07	Galile/Dewele One Stop Border Post	Border Post	Djibouti	Proposed one stop border post at Galile (Djibouti) / Dewele (Ethiopia) on the Djibouti-Ethiopia border. The Dire Dawa -Dewele toll road has been completed and needs an associated OSBP.	S1 Project Definition	10	Donor grant	Ethiopian Revenues and Customs Authority (ERCA)	Undertake full feasibility
TRDD08	Adama-Awash Expressway (Horn of Africa Initiative)	Road	Djibouti	The project consists of the construction of a 260 km 4-lane expressway section from Adama to Awash. It is proposed to build the expressway in phases, with phase 1 the first 60 km stretch.	S3B Transaction Support & Financial Close	540	African Development Fund (ADF) grant for $98m and	Ethiopian Roads Authority (ERA)	ADF grant was recently approved and phase 1 of the project is due to start

							government funds for the remainder		
TRDD09	Dima-Raad Highway	Road	Djibouti	Construction of a new road from Dima in Ethiopia to the border with South Sudan at Raad / Boma	S2A Pre-Feasibility	40	Government funds	Ethiopian Roads Authority (ERA)	Undertake full feasibility
TBPD10	Raad/Boma One Stop Border Post	Border Post	Djibouti	Proposed one stop border post on the Ethiopia-South Sudan border to be constructed with the road (TRDD13).	S2A Pre-Feasibility	10	Donor grant	Ethiopian Revenues and Customs Authority (ERCA)	Undertake full feasibility
TRDD11	Raad-Boma-Kapoeta Highway	Road	Djibouti	Construction of a new road from Kapoeta in South Sudan to the border with Ethiopia.	S2A Pre-Feasibility	336	Donor grant	South Sudan Roads Authority (SSRA)	Undertake full feasibility
TSPD19	Doraleh Terminal Extension Phase 2	Sea Port	Djibouti	Phase 2 expansion of the Doraleh Container Terminal to increase capacity by 3 million TEUs.	S1 Project Definition	600	Private Sector	Djibouti Ports & Free Zones Authority	Phase 2 of the Doraleh Container Terminal is uncertain due to termination of the DP World concession.
TBPD20	Loyada One Stop Border Post	Border Post	Djibouti	The Loyada-Djibouti link has recently been rehabilitated with funding from the Islamic Bank for Development.	S3B Transaction Support & Financial Close	10	Islamic Bank for Developmen t	Somalia Customs Authority, Djibouti Customs Authority	Financing has been secured, check to ensure construction has commenced
TSPP01	Development of Deep-Water Berths at Osama Digna Port (Suakin)	Sea Port	Port Sudan	In March 2018, the governments of Sudan and Qatar agreed to a proposed $4billion development at the port of Suakin, the first phase of which is development of deep-water container handling berths totalling 800m and costing $500m.	S3B Transaction Support & Financial Close	500	Qatar (51% owned by GoS; 49% by GoQ)	Sudan Ports Authority; GoQ	Commence construction works
TRDP02	Al Damazin-Kurmuk Highway	Road	Port Sudan	Rehabilitation and upgrading of the 93 km road from Al Damazin to Kurmuk to paved regional corridor standards.	S3B Transaction Support &	40	Donor funds - Multi Donor Trust	Sudan National	The contracts for the Damazin – Kurmuk road (Sections 1 and 2) have

					Financial Close		Fund for Sudan National Secretariat (MDTF-NS) (WB funded)	Highways Authority	been suspended since September 2011 due to conflict and insecurity in the project area (Blue Nile State). The government and the contractors are monitoring the situation for indications that the situation has normalised and would allow the contractors to resume works.
TRDP03	El Mujlad-Abyei Highway	Road	Port Sudan	Upgrading of 229 km of road from El Mujlad to Abyei on the South Sudan border, from gravel to paved regional corridor standards. Will join with associated project TRDP10 at the South Sudan border to connect the city of Wau (second largest in South Sudan) to the Port Sudan Corridor.	S3B Transaction Support & Financial Close	120	Government funds	Sudan National Highways Authority	Check status as some work may have commenced, but is currently on hold due to security situation in Sudan
TRDP04	Wau-Gogrial-Abyei Highway	Road	Port Sudan	Upgrading of 225 km of road linking Wau, the second largest city in South Sudan, to the border with Sudan at Abyei, from gravel to paved regional corridor standards.	S2B Feasibility	360	Concessional finance – AfDB	South Sudan Roads Authority	Feasibility to be undertaken
TBPP05	Metema - Galabat One Stop Border Post	Border Post	Port Sudan	Upgrading of the border post facilities between Galabat, Sudan and Metema, Ethiopia to OSBP standards.	S2B Feasibility	3.5	Government funds	Sudan Revenue Authority, Ethiopia Revenue and Customs Authority	Feasibility to be undertaken
TSPL01	Lamu Port Phase 2: Berths 4 to 7	Sea Port	LAPSSET	Construction of berths four to seven of the Lamu Deep Sea Port. Berths four to six will be financed by the private sector. The project is part of the overall Lamu Port project to construct a 32-berth port at an estimated	S3B Transaction Support & Financial Close	500	PPP	LAPSSET Corridor Development Authority;	Undertake negotiations with private sector for operations and next phase construction

				cost of $5billion, which forms the anchor project of the LAPSSET Corridor programme.				Kenya Ports Authority	
TRDL02	Lamu – Garissa – Isiolo Highway (Horn of Africa Initiative)	Road	LAPSSET	Construction of a new 530km highway from Lamu to Isiolo. Forming part of the inter-regional highways constructed under the LAPSSET Corridor programme. Detailed Engineering Design completed in 2016; Project Agreement signed between GoK and DBSA Consortium on 29th November 2017 for construction of the road.	S3A Project Structuring	700	PPP	Kenya Highways Authority (KeNHA); LAPSSET Corridor Development Authority	DBSA has agreed to finance but transaction needs to be concluded
TRDL04	Isiolo-Lokichar Highway	Road	LAPSSET	Construction of a new highway from Isiolo to Lokichar. Forming part of the inter-regional highways constructed under the LAPSSET Corridor programme. The Isiolo – Lokichar section is under Feasibility Study and Detailed Engineering Design stage.	S2B Feasibility	402	Blended finance	Kenya Highways Authority (KeNHA); LAPSSET Corridor Development Authority	Survey of realigned route
TBPL05	Nadapal One Stop Border Post	Border Post	LAPSSET	One-Stop Border Post (OSBP) facility at Nadapal border between South Sudan and Kenya, on the LAPSSET Corridor. Implement concurrently with the Juba-Torit-Kapoeta-Nadapal road upgrading project.	S3A Project Structuring	10	Donor grant	Kenya Revenue Authority (KRA); South Sudan Customs and Revenue Authority	Identify potential funders and secure financing
TRDL06	Juba-Torit-Kapoeta-Nadapal Road	Road	LAPSSET	Upgrading of 365 km Juba-Torit-Kapoeta-Nadapal single carriageway road in South Sudan. The road links with the proposed South Sudan/Kenya OSBP project at Nadapal. The objective of the proposed project is to enhance interstate and regional connectivity, through upgrading a priority road section along a critical national and international corridor. The proposed project contributes to the overarching goal of integrating South	S3A Project Structuring	294	Concessional finance - AfDB	South Sudan Roads Authority	Project structuring and secure financing

				Sudan to the regional markets and supporting the state of South Sudan to function as a nation as well as enhancing trade and socio-economic development in the region.					
TRDL07	Modjo – Hawassa Expressway	Road	LAPSSET	The Modjo – Hawassa Highway Project (209km) will be implemented in two phases. Phase 1 consists of the construction of 93 km of a new asphalt surfaced 4-lane dual carriageway road between Modjo and Zeway towns. Phase 2 will be from Zeway to Hawassa.	S3A Project Structuring	420	Concessional finance - AfDB	Ethiopian Roads Authority (ERA)	Phase 1 is underway, need to conclude financing agreement for Phase 2
TCDL11	Isiolo Inland Container Depot	Inland Container Depot	LAPSSET	Construction of a new inland container depot / dry port at Isiolo	S2A Pre-Feasibility	100	Concessional Finance	Kenya Highways Authority (KeNHA); LAPSSET Corridor Development Authority	Undertake feasibility study
TRAL12	LAPSSET Railway Detailed Design	Railway	LAPSSET	The LAPSSET Standard Gauge Railway (SGR) lines will run from Nairobi to Isiolo (270 km), Lamu to Isiolo (533 Km), Isiolo to Nakodok (738 Km) Nakodok to Juba, South Sudan (368 km) and from Isiolo to Moyale (448 Km), Moyale to Addis Ababa, Ethiopia (905 km). The railway project preliminary designs are complete for the Kenyan and Ethiopian route and expected to proceed to the Detailed Engineering Design stage. The Government Kenya and the Government of Ethiopia have signed a Bilateral Agreement to jointly pursue the development of the LAPSSET Standard Gauge Railway. A Memorandum of Understanding (MoU) has been signed between LCDA and Inter-Governmental Authority on Development (IGAD) to facilitate	S2B - Feasibility	4000	Donor funding	LAPSSET Corridor Development Authority	Undertake project structuring and financial structuring plan.

				the financing of this stage though an Infrastructure Project Preparatory Fund (IPPF) available through the New Partnership for African Development (NEPAD).					
TSPB01	Berbera Port Upgrade Phase 2	Sea Port	Berbera	The first phase of the upgrade, which is ongoing, consists of extending the quay length by 400m, construction of a new port yard, expanding by 250,000 sq. m, and modernisation of facilities including purchase of new equipment. The second phase will comprise of construction of a new container port terminal and a petroleum terminal.	S2B Feasibility	341	Private Sector – DP World	Dubai Port World; Somaliland Ports Authority	The second phase of the upgrade will take place after the first phase is complete and sufficient demand for the port has been demonstrated
TRDB02	Berbera – Hargeisa - Kalabaydh– Togachale Road (Horn of Africa Initiative)	Road	Berbera	Upgrading of the 90km of road from Hargeisa to Togachale to the standard required for a regional corridor. This is the final missing road link on the Berbera Corridor, with work ongoing to upgrade the road from Berbera to Hargeisa, and on the Hargeisa By-pass.	S2A Pre-Feasibility	35	Donor grant	Somaliland Roads Development Agency	Undertake a full feasibility and identify potential funders and financing arrangements
TBPB03	Togachale OSBP	Border Post	Berbera	Construction of a One Stop Border Post facility on the border between Ethiopia and Somalia at Togachale.	S1 Project Definition	10	Donor grant	Ethiopia Revenue and Customs Authority (ERCA); Somalia Customs Authority	Undertake a full feasibility and identify potential funders and financing arrangements
TDPB04	Jigjiga Dry Port	Inland Container Depot	Berbera	Construction of a dry port at Jigjiga to process Ethiopian cargo transiting through the port in Berbera, in order to reduce congestion on port facilities.	S1 Project Definition	100	Concessional finance	Ethiopian Shipping & Logistics Services Enterprise (ESLSE)	Undertake a full feasibility and identify potential funders and financing arrangements
TRDM01	EU Road Rehabilitation	Road	Massawa	The project will rehabilitate the road connections in Eritrea, between the port of Massawa and the border with Ethiopia at	S3B Transaction Support &	23	Donor Grant - EU Trust Fund for Africa	United Nation's Office for Project	Finalise contracting and commence work

				Serha (Eritrea) / Zalambessa (Ethiopia), 245 km or road	Financial Close			Services (UNOPS)	
TRDM02	Rehabilitation of road between Adigrat and Zalambessa	Road	Massawa	Rehabilitation of the 35 km of road from Adigrat to the border with Eritrea at Zalambessa	S2B Feasibility	10	Government funds	Ethiopian Roads Authority (ERA)	Feasibility study
TBPM03	Zalambessa / Serha One Stop Border Post	Border Post	Massawa	One Stop Border Post infrastructure at the main crossing point between Eritrea (Serha) and Ethiopia (Zalambessa). At present there is no customs infrastructure at the border crossing	S1 Project Definition	10	Donor grant	Ethiopian Revenues and Customs Authority (ERCA); Eritrean Customs Authority	Detailed project definition and pre-feasibility study
TBPM04	OSBP infrastructure and upgrading of border road at Aligider	Border Post	Massawa	One Stop Border Post infrastructure at the main crossing point between Eritrea and Sudan (Aligider) and upgrading of the road from Kassala.	S1 Project Definition	25	Donor grant	Sudan Revenue Authority; Eritrean Customs Authority; Sudan Roads Authority	Detailed project definition and pre-feasibility study
TRAM05	Rehabilitation of Massawa – Asmara – Aligider Narrow Gauge Railway line and upgrading of gauge	Railway	Massawa	Rehabilitation of the dilapidated Narrow-Gauge Railway line from Massawa to Aligider through Asmara and upgrading of the gauge from NGR to SGR	S1 Project Definition	702	Donor grant and government funding	Eritrea Railroad Authority	Detailed project definition and pre-feasibility study
TRDM06	Upgrading of Kassala – Aligider – Berentu road	Road	Massawa	Upgrading of the Kassala – Aligider – Berentu road which links Eritrea to Sudan	S1 Project Definition	10	Donor grant and government funding	Eritrea Roads Authority and Sudan National Highways Authority	Detailed project definition and pre-feasibility study
TRDMo01	Construction of the Isiolo – Modogashe	Road	Mogadishu	The project will construct, upgrade and rehabilitate the road sections within Kenya	S4A Tendering	995	Government of Kenya and	Kenya National	Designs and negotiation of annuities

	– Wajir – El Wak – Rhamu – Mandera Highway (Horn of Africa Initiative)			from Isiolo – Modogashe – Wajir – El Wak – Rhamu to Mandera, covering a distance of 776 km			annuities, Donor funds (World Bank)	Highways Authority (KeNHA)	
TRDK01	Construction of Liboi – Daadab/Hagadera - Garissa road (Horn of Africa Initiative)	Road	Mogadishu	The total distance of the road is 207 km which has neither been paved or tarmacked. The project will entail construction of a new road linking Garissa to Kismayo on Somali side.	S3A Project Structuring	278	Government funds	Kenya National Highways Authority (KeNHA)	Transaction Support & Financial Close
TBPK03	Construction of Liboi OSBP	Border Post	Kismayo	Construction of new One Stop Border Post at Liboi between Kenya and Somalia	S1 Project Definition	20	Concessional Finance	Kenya Revenue Authority	Detailed project definition and pre-feasibility study

Development of physical infrastructure in the IGAD Region, 2020-2024

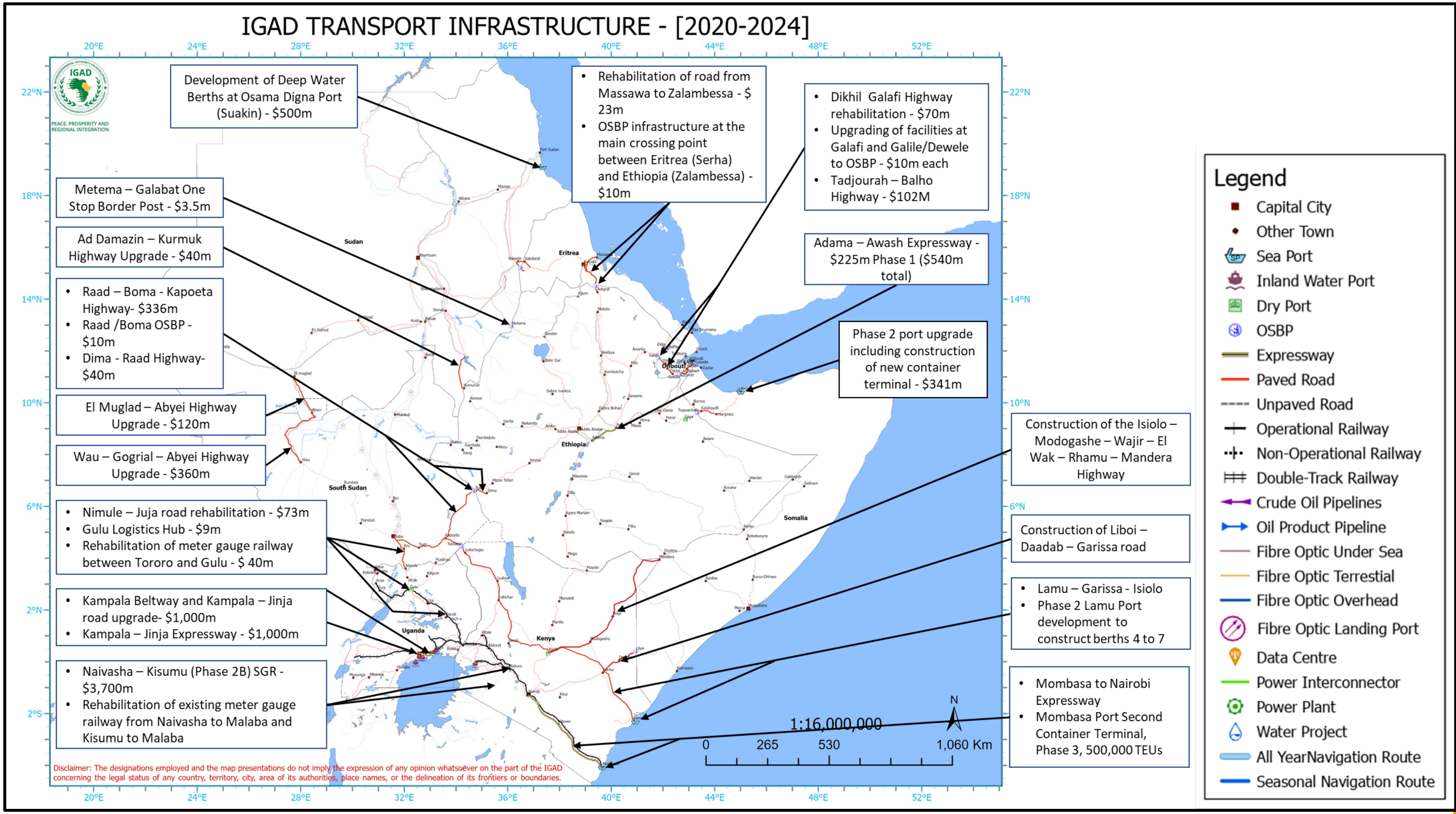


Table A2.2 Transport Infrastructure Projects to be Implemented 2025-2030

Project ID	Name	Sub-sector type	Corridor	Description	Stage	Cost ($m)	Financing	Implementing agency	Next steps
TRAN23	Kisumu – Malaba (Phase 2C) SGR	Railway	Northern	The 107 km line will stretch from Kisumu to the border with Uganda at Malaba via Yala and Mumias.	S3A Project Structuring	1,230	Concessional finance – China Exim Bank	KRC	Financing and construction for the project is predicated on co-construction with the Malaba – Kampala section in Uganda
TRAN24	Malaba – Kampala SGR	Railway	Northern	Also referred to as the Eastern Line, would stretch from the border with Kenya at Malaba, through Tororo and Jinja, to end at Kampala. The total distance is approximately 215 km.	S3A Project Structuring	2,638	Concessional finance – China Exim Bank	URC	To be constructed at the same time as the Kisumu – Malaba section in Kenya
TIWN25	Construction of a New Bukasa Port Facilities	Inland Port & Waterway	Northern	The construction of Bukasa port will not only see the construction of a port terminal, but also intermodal rail and road infrastructure to create an East African interstate logistics hub	S2A Pre-Feasibility	180	Government funds	URC	Feasibility study
TRDD21	Dire Dawa-Awash Expressway	Road	Djibouti	Upgrade of the 236 km road from Dire Dawa to Awash to 4-lane expressway.	S1 Project Definition	1,000	Blended finance	Ethiopian Roads Authority (ERA)	Undertake feasibility study
TRDD22	Musingo-Tsertenya – Ikotos - Torit Road	Road	Djibouti	Construction of the Musingo-Tsertenya-Ikotos-Torit Road	S1 Project Definition	210	Concessional Finance	South Sudan Roads Authority	Feasibility study and detailed designs for the road segment
TFZD25	Expansion of Djibouti Free Zone Phase 2	Port/Free Zone	Djibouti	The project has been co-financed with China Marshal/Exim Bank and the Djibouti Govt. The	S3B Transaction Support & Financial Close	3,500	Donor Financing	Djibouti Ports and Free Zones Authority	Financing has been secured, check to ensure construction has commenced

				first phase of this project, launched on Thursday, include a zone of 240 Ha. Once completed, this 10-year project worth $3.5Billion will be cover 4800 Ha, which will make it the largest free zone in Africa.					
TRAD27	Loyada – Borema – Hargeisa – Berbera Highway (Horn of Africa Initiative)	Road	Djibouti	Construction of Loyada – Borama – Berbera highway linking the Berbera Corridor with the Djibouti Corridor. Partial feasibility studies conducted for Kalabydh – Berbera section.	S1 Project Definition	1096	Concessional Finance	Djibouti Ministry of Equipment and Transport and Somaliland Roads Development Agency	Feasibility studies
TRDD28	Hargeisa – Burao (Burco) Highway	Road	Djibouti	Construction of a new 155km missing link connecting Hargeisa to Burao (Burco). The road is an extension from Djibouti through Loyada – Borema – Kalabydh – Hergeisa and extends to Laascanood in the Berbera Corridor.	S0 Enabling Environment and Needs Assessment	310	Donor Financing	Ministry of Transport, Somalia	Undertake feasibility studies
TRAP08	Port Sudan- Haya -Atbara-Khartoum SGR	Railway	Port Sudan	This is a new 813 km SGR railway line to be built between Port Sudan and Khartoum through the towns of Haya and Atbara to replace the old NGR.	S2B Feasibility	1,400	Concessional finance -China Exim Bank	Sudan Railways Corporation	Undertake feasibility

TRAP09	Weldiya-Gondar-Metema – Al Qadaref SGR	Railway	Port Sudan	Construction of a standard gauge railway from the Weldiya junction via Gondar to the border with Sudan at Metema. Will connect to both the Massawa and Djibouti Corridors at Weldiya.	S2A Pre-Feasibility	2,900	Concessional Finance	Ethiopia Railways Corporation	Undertake feasibility
TBPP12	South Sudan/Sudan (Renk) One Stop Border Post	Border Post	Port Sudan	Construction of OSBP associated with the Juba-Bor-Malakal-Renk-Sudan Border Road project.	S1 Project Definition	10	Concessional Finance	Sudan Revenue Authority; South Sudan Revenue Authority	Define project and undertake feasibility
TRDP13	Juba-Bor-Malakal-Renk-Sudan Border Road	Road	Port Sudan	Upgrading of the road from Juba through Bor, Malakal and Renk to the Sudan border to paved regional corridor standard. The road sections are as follows: Juba-Bor 205 km; Bor-Malakal 400 km; Malakal-Renk 330km; Renk-border 30km.	S1 Project Definition	200	Concessional Finance	South Sudan Roads Authority (SSRA)	Define project and undertake feasibility
TBPP14	Kurmuk One Stop Border Post	Border Post	Port Sudan	Upgrading of the border post facilities between Kurmuk, Sudan and Asosa, Ethiopia to OSBP standards.	S1 Project Definition	3.5	Government funds	Sudan Revenue Authority, Ethiopia Revenue and Customs Authority	Detailed project definition and feasibility to be undertaken
TRDP15	Asosa-Kurmuk Highway	Road	Port Sudan	Upgrading the 99 km of road from Asosa in Ethiopia to Kurmuk on	S2B Feasibility	900	Government funds	Ethiopian Roads Authority	Undertake feasibility

				the border with Sudan to paved regional corridor standard.					
TIWP16	Improvement of port facilities (Juba, Bor, Malakal and Renk) on the White Nile	Inland Port & Waterway	Port Sudan	Rehabilitation of port facilities at Juba, Bor, Malakal and Renk on the White Nile	S1 Project Definition	900	Concessional Finance	South Sudan Ministry of Transport and Roads	Detailed project definition and feasibility to be undertaken
TIWP17	Improvement of port facilities at Kosti on the White Nile	Inland Port & Waterway	Port Sudan	Rehabilitation of port facilities at Kosti on the White Nile	S1 Project Definition	150	Government funds	Sudan Ports Authority	Detailed project definition and feasibility to be undertaken
TIWP18	Rehabilitation of facilities for ports on Sobat River	Inland Port & Waterway	Port Sudan	Rehabilitation of port facilities on Sobat River	S1 Project Definition	1804	Concessional Finance	South Sudan Ministry of Transport and Roads	Detailed project definition and feasibility to be undertaken
TIWP19	Provision of Navigation Aids on the White Nile	Inland Port & Waterway	Port Sudan	Construction/ Installation of navigational aids such as light houses, lightships, buoys and radar beacons on the White Nile to improve the safety of shipping	S1 Project Definition	200	Donor grant	Sudan Ports Authority; South Sudan Ministry of Transport and Roads	Detailed project definition and feasibility to be undertaken
TRDP20	El Showak-Kono-Sabarna- El Homara	Road	Port Sudan	Upgrading of the Road that links Sudan to Northern Ethiopia	S1 Project Definition	1200	Concessional Finance	Ethiopian Road Authority	Detailed project definition and feasibility to be undertaken
TRDP21	El Fasher – Kabkabiya – El Geneina-Adri	Road	Port Sudan	Upgrading of the Road that links Sudan to Chad	S1 Project Definition	900	Concessional Finance	Sudan National Highways Authority	Detailed project definition and feasibility to be undertaken
TRDP22	Nyala - Rihaid El Birdi – Om Dafuq	Road	Port Sudan	Upgrading of the Road that links Sudan to Central Africa	S1 Project Definition	900	Concessional Finance	Sudan National Highways Authority	Detailed project definition and feasibility to be undertaken
TIWP25	Dredging of River Channel (Juba to Renk) and	Inland Water Ways	Port Sudan	Dredging of the Nile to improve the navigability of the river and enhance	S2B Feasibility	102.5	Donor funding;	South Sudan Ministry of Transport	Project structuring

	Rehabilitation of 11 ports and Provision Navigation Aids			the utilisation of the inland water way as a main route for evacuation of cargo and movement of people between South Sudan and the Sudan			Government funding		
TRAL14	Nairobi to Isiolo SGR	Railway	LAPSSET	Nairobi-Isiolo phase of the SGR, 270 km in length. The LAPSSET Standard Gauge Railway (SGR) lines will run from Nairobi to Isiolo (270 km), Lamu to Isiolo (533 Km), Isiolo to Nakodok (738 Km) Nakodok to Juba, South Sudan (368 km) and from Isiolo to Moyale (448 Km), Moyale to Addis Ababa, Ethiopia (905 km).	S2B Feasibility	1,500	Concessional loan	Kenya Railways Corporation; LAPSSET Corridor Development Authority	The railway project preliminary designs are complete for the Kenyan and Ethiopian route and expected to proceed to the Detailed Engineering Design stage
TCDL17	Moyale Inland Container Depot	Inland Container Depot	LAPSSET	Construction of a new inland container depot / dry port at Moyale	S1 Project Definition	100	Concessional Finance	Kenya Highways Authority (KeNHA); LAPSSET Corridor Development Authority	Undertake feasibility study
TCDL18	Lokichogio Inland Container Depot	Inland Container Depot	LAPSSET	Construction of a new inland container depot / dry port at Lokichogio	S1 Project Definition	100	Concessional Finance	Kenya Highways Authority (KeNHA); LAPSSET Corridor	Undertake feasibility study

								Development Authority	
TSPL20	Lamu Special Economic Zone	Special Economic Zone	LAPSSET	Development of a Special Economic Zone at Lamu adjacent to the port. The Transactional Advisory consultancy has been procured for both the Port and the Lamu SEZ and is currently at market sounding stage	S2B Feasibility	500	PPP	LAPSSET Corridor Development Authority (LCDA)	Undertake detailed Master Planning and role out the investors priming
TRDL22	Construction of Moyale – Banisa – Rhamu road	Road	LAPSSET	The project is a 330 km road linking Moyale to Rhamu on to Mandera. The road is a missing link connecting the LAPSSET corridor with Mogadishu corridor	S1 Project Definition	330	Concessional finance	KeNHA	Undertake feasibility study
TSPM08	Massawa Port Expansion Phase 1	Sea Port	Massawa	Expansion of the port facilities at Massawa to accommodate the increase in trade from Ethiopia, in particular expansion of the container terminal	S1 Project Definition	100	PPP	Massawa Port Authority	Detailed project definition and pre-feasibility study
TSPA01	Rehabilitation and upgrading of Assab Port	Sea Port	Assab	The Assab port has not been functioning as an international port since 1998. It will require rehabilitation and upgrading.	S1 Project Definition	100	Private sector	Eritrean Ports Authority	Project definition and pre-feasibility study
TRDA02	Construction of Bure – Assab Port road (Horn of Africa Initiative)	Road	Assab	The project entails construction of the Bure – Assab Port road that would provide an additional route for	S1 Project Definition	163	Concessional Finance	Eritrean Roads Authority	Undertake feasibility studies

				Ethiopia to access the international market through the Port of Assab					
TRDA03	Rehabilitation of the Mellondi – Manda – Bure – Assab Road	Road	Assab	The project entails rehabilitation of the main route in Ethiopia leading to Bure and on to Assab Port	S1 Project Definition	700	Concessional Finance	Ethiopia Roads Authority	Undertake feasibility studies
TRDMo07	Upgrading and rehabilitation of the Negele – Filtu – Siftu highway (Horn of Africa Initiative)	Road	Mogadish u	The project will upgrade and rehabilitate the road sections within Ethiopia between Negele – Filtu - Mekele Siftu, covering a distance of 340 km. The highway connects to Somalia at Dollow border crossing	S1 Project Definition	393	Government funds	Ethiopian Roads Authority (ERA)	Feasibility study and detailed designs
TRDMo08	Upgrading and rehabilitation of the Ginir – Gode - Ferfer highway (Horn of Africa Initiative)	Road	Mogadish u	The project will upgrade and rehabilitate the road sections within Ethiopia from Ginir – Gode - Ferfer. The highway connects to Somalia at Ferfer border crossing	S1 Project Definition	253	Government funds	Ethiopian Roads Authority (ERA)	Feasibility study and detailed designs
TRDMo09	Rehabilitation of the Mogadishu – Afgooye – Baidoa – Dollow highway (Horn of Africa Initiative)	Road	Mogadish u	Rehabilitation of the 475 km highway from Mogadishu to Dollow. Qatar to finance rehabilitation of 30 km of the corridor close to Mogadishu to Afgooye	S2B Feasibility	600	Donor funds	Somalia Roads Authority	Feasibility study and detailed designs
TRDMo10	Construction of Aware – Warder - Ferfer /Somalia border highway (Horn of Africa Initiative)	Road	Mogadish u	Total road length is 711 km of which 80% of the entire road requires total construction which	S1 Project Definition	764	Donor funds	Ethiopia Roads Authority (ERA)	Feasibility study and detailed designs

				20% of the highway needs rehabilitation					
TRDMo11	Construction of Kebridahar – Warder – Turdibi /Galdogobi highway (Horn of Africa Initiative)	Road	Mogadishu	Construction of Kebridahar – Warder – Turdibi/Galdogobi highway with total road length is 335 km	S1 Project Definition	148	Donor funds	Ethiopia Roads Authority (ERA)	Feasibility study and detailed designs
TRDMo12	Construction of Mogadishu – Beled weyne - Galkayo highway (Horn of Africa Initiative)	Road	Mogadishu	85% of the road is in poor condition requiring upgrading. Galkacyo/Bossaso paved but in 80% poor condition; Galdogob - Galkacyo gravel road funded by local and diaspora community. Bosaso - Gaalkacyo 537 km; Gaalkacyo - Galdogobi 160 km. Feasibility studies done for Galkayo to Bossaso only	S1 Project Definition	796	Donor Funds	Somalia Roads Authority	Feasibility study and detailed designs for the other sections of the road
TRDMo13	Construction of Mogadishu - Jowhar - Beled weyne - Ferfer highway (Horn of Africa Initiative)	Road	Mogadishu	74% of the road is in poor condition requiring upgrade. Mogadishu - Jowhar rehabilitation part of Qatar $200 milion road project. Mogadishu - Jowhar - Beledweyne is 299 km; road connection between Beledweyne and Ferfer is estimated at 41 km. Feasibility study done for	S1 Project Definition	338	Donor funds	Somalia Roads Authority	Feasibility study and detailed designs for the other sections of the road

				Mogadishu – Jowhar section only					
TRDMo14	Galkayo – Bossaso	Road	Mogadishu	Construction of Bossasso - Gaalkacyo Road	S1 Project Definition	700	Concessional Finance	Somalia Roads Authority	Feasibility study and detailed designs for the road
TRDMo15	Mogadishu-Baidoa-Mandera Road	Road	Mogadishu	Construction of the segment connecting Dollow to Mandera from Baidoa	S1 Project Definition	270	Concessional Finance	Somalia Roads Authority	Feasibility study and detailed designs for the road segment
TRDK04	Construction of Kismayo – Elwak road	Road	Kismayo	The total distance of the road is 507 km which has neither been paved or tarmacked. The project will entail construction of a new road linking Kismayo to Elwak on Somali side. Existing thoroughfare consists of paths and earth road in very poor condition.	S1 Project Definition	681	CONCESSIONAL FINANCE	Somalia Roads Authority	Design Review and Procurement for construction
TRDK05	Construction of Kismayo-Bilis Qooqani – Liboi highway	Road	Kismayo	The road project is a new road linking Somalia to Kenya through Liboi. Existing thoroughfare consists of paths and earth road in very poor condition. Total road length is 244 km.	S1 Project Definition	327	CONCESSIONAL FINANCE	Somalia Roads Authority	Feasibility study and Detailed Engineering Design

Development of physical infrastructure in the IGAD Region, 2025-2030

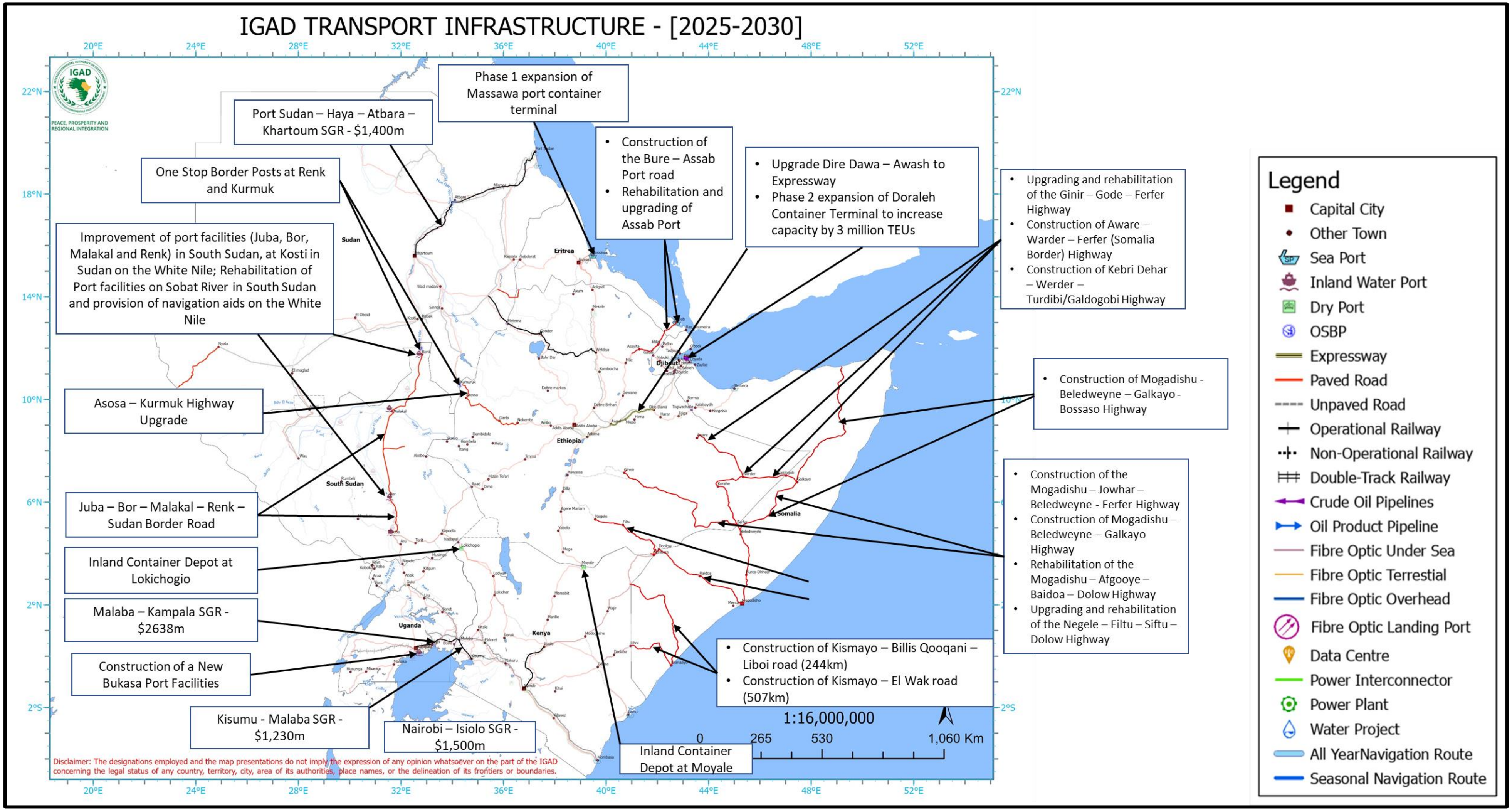


Table A2.3: Transport Infrastructure Projects to be Implemented 2031-2050

Project ID	Name	Sub-sector type	Corridor	Description	Stage	Cost ($m)	Financing	Implementing agency	Next steps
TRAN26	Tororo – Gulu SGR	Railway	Northern	Standard gauge railway project. Also referred to as the Northern Line, would extend from Tororo, and go through Mbale and Lira to Gulu, a distance of approximately 375 km.	S2A Pre-Feasibility	1,900	Concessional finance – China Exim Bank	Uganda Railways Corporation	Full feasibility, await completion of other SGR lines
TRAN27	Gulu –Nimule – Juba – Wau SGR	Railway	Northern	Standard gauge railway project from Gulu, one spur will continue north to Elegu for 107 km in Uganda, and on to Nimule and Juba in South Sudan, 200km. A final stretch of 650 km will end the line in Wau.	S2A Pre-Feasibility	4700	Concessional finance – China Exim Bank	Ministry of Transport, South Sudan	Full feasibility, await completion of other SGR lines
TRDN28	Nairobi – Nakuru Expressway	Road	Northern	In the long-term horizon the road from Nairobi to Nakuru will need to be upgraded to dual carriageway.	S1 Project Definition	1256	Concessional Financing	KeNHA	Long-term vision project to be further developed in future IRIMP revision
TRDN29	Nakuru – Kisumu Expressway	Road	Northern	In the long-term horizon the road from Nakuru to Kisumu will need to be upgraded to dual carriageway.	S1 Project Definition	1464	Concessional Finance	KeNHA	Long-term vision project to be further developed in future IRIMP revision
TRDN30	Kisumu – Busia Expressway	Road	Northern	In the long-term horizon the road from Kisumu to Busia will need to be upgraded to dual carriageway.	S1 Project Definition	968	Concessional Finance	KeNHA	Long-term vision project to be further developed in future IRIMP revision
TRDN31	Nakuru – Eldoret – Malaba Expressway	Road	Northern	In the long-term horizon the road from Nakuru to Eldoret to Malaba will need to be upgraded to dual carriageway.	S1 Project Definition	2320	Concessional Finance	KeNHA	Long-term vision project to be further developed in future IRIMP revision
TRDN32	Malaba – Kampala Expressway	Road	Northern	In the long-term horizon the road from Malaba to Kampala will need to be upgraded to dual carriageway.	S1 Project Definition	1128	Concessional Finance	Uganda National Roads Authority (UNRA)	Long-term vision project to be further developed in future IRIMP revision
TRAN33	Conversion of Mombasa – Nairobi SGR to double track + electrification	Railway	Northern	In the long-term horizon the SGR from Mombasa to Nairobi will need to upgrade from single track to double track and should also be electrified.	S1 Project Definition	100	Concessional Finance	Kenya Railways Corporation	Long-term vision project to be further developed in future IRIMP revision

TSPN35	Expansion of Mombasa Port	Sea Port	Northern	Mombasa port will need to upgrade capacity to meet demand in the long-term.	S1 Project Definition	380	Concessional Finance	Kenya Ports Authority	Long-term vision project to be further developed in future IRIMP revision
TRAD29	Asayta - Tadjourah Port SGR	Railway	Djibouti	SGR line, part of Route 6 of the Ethiopian Railways Master Plan. Fully electrified single-track line of 215km (47km in Ethiopia and 168km in Djibouti) with the major stations at Asayta, Afambo, border, Yoboki, Dhikhil, Gaggade, Firale, Airlof and Tadjourah.	S2A Pre-Feasibility	1172	Concessional Finance	Ethiopia Railways Corporatio n	Undertake full feasibility study
TRAD30	Hara Gebeya - Asayta SGR	Railway	Djibouti	SGR line, part of Route 6 of the Ethiopian Railways Master Plan. Fully electrified single-track line of 218km with the major stations at Hara Gebeya, Semera, Onale, Dobi and Asayta.	S2A Pre-Feasibility	640	Concessional Finance	Ethiopia Railways Corporatio n	Undertake full feasibility study
TRAD31	Addis Ababa - Jimma - Dima - Raad SGR	Railway	Djibouti	SGR line, part of Route 3 of the Ethiopian Railways Master Plan. Fully electrified single-track line of 740km with the major stations at Sebeta, Ambo, Ijaji, Seka, Jimma, Bedele, Tepi and Dima.	S2B Feasibility	2800	Concessional Finance	Ethiopia Railways Corporatio n	Review feasibility and identify sources of funding
TRAD32	Raad-Boma-Kapoeta SGR	Railway	Djibouti	SGR line that will link South Sudan to Ethiopia via the border at Raad/Boma to Kapoeta where it will connect with the planned SGR line on the LAPSSET Corridor to Juba.	S1 Project Definition	1344	Concessional Finance	South Sudan Ministry of Transport	Implementation of the project depends on the construction of Addis Ababa - Jimma - Dima – Raad line
TRAD33	Upgrade Djibouti – Adama SGR to double track / double stack	Railway	Djibouti	In the long-term horizon the SGR from Mombasa to Nairobi will need to upgrade from single track to double track or double stack carriages.	S1 Project Definition	2640	Concessional Finance	Ethiopia Railways Corporatio n	Long-term vision project to be further developed in future IRIMP revision
TRAP26	Haya-Kassala-Gedarif – Metema SGR	Railway	Port Sudan	Construction of a standard gauge railway from Haya to Metema at the Ethiopian border.	S2B Feasibility	3736	Concessional finance - China Exim Bank	Sudan Railways Corporatio n	Undertake feasibility, wait for construction of Port Sudan to Khartoum line
TRAP27	Gedarif-Sennar-Kosti-Babanusa-Meram SGR	Railway	Port Sudan	Construction of a standard gauge railway from Al Quadarif to Meram at the border with South Sudan.	S2B Feasibility	1824	Concessional finance - China Exim Bank	Sudan Railways Corporatio n	Undertake feasibility, wait for construction of Port Sudan to Khartoum line

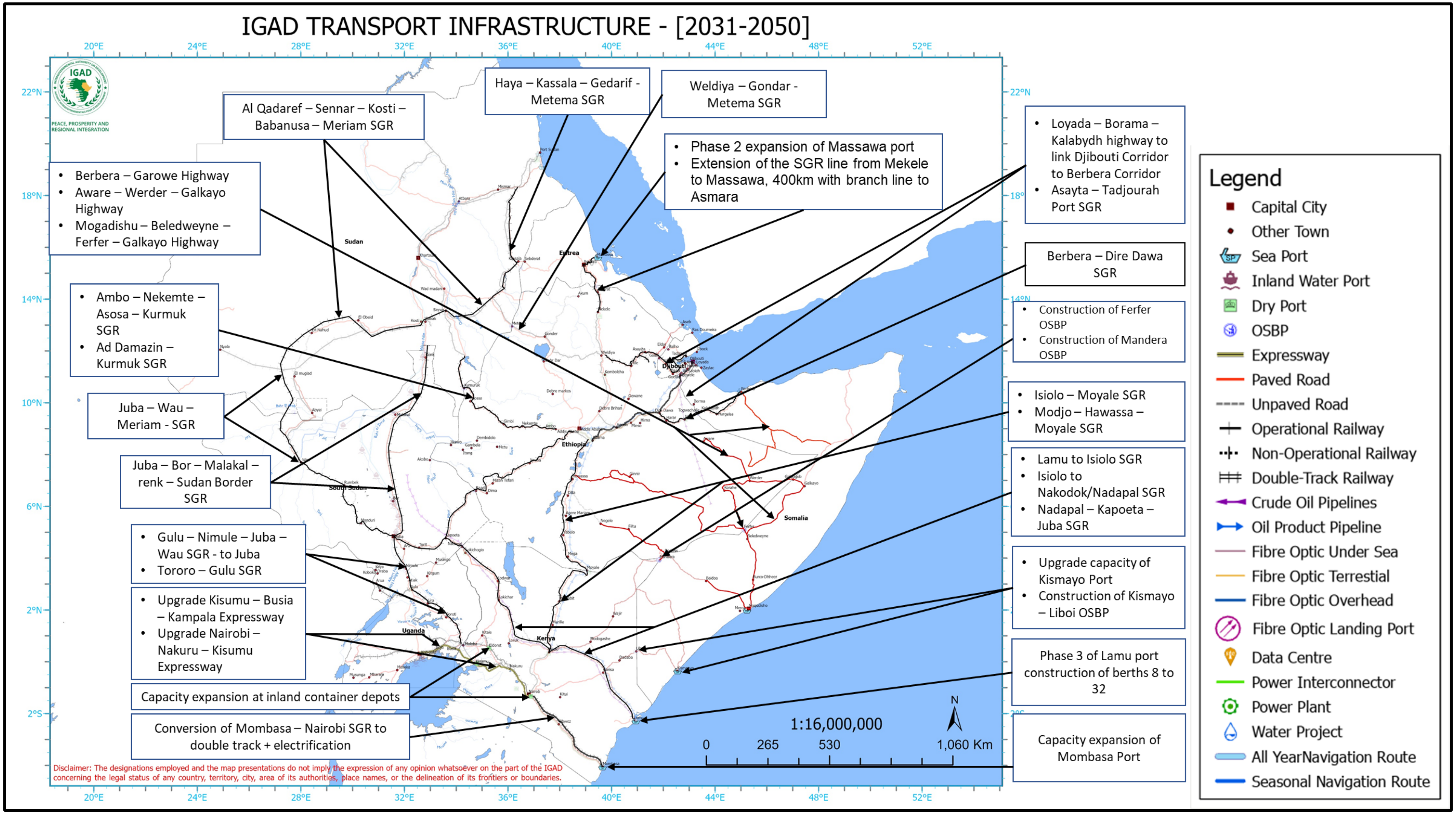
TRAP28	Ad-Damazin - Kurmuk Railway SGR	Railway	Port Sudan	Construction of a standard gauge railway from Al Damazin to Kurmuk at the border with Ethiopia.	S1 Project Definition	632	Concessional finance - China Exim Bank	Sudan Railways Corporation	Project was originally proposed, but later put on hold. Reassess project for viability
TRAP29	Juba-Bor-Malakal-Renk-Sudan Border Railway	Railway	Port Sudan	Construction of a standard gauge railway from Juba via Bor, Malakal and Renk to the border with Sudan.	S1 Project Definition	3096	Concessional Finance	Ministry of Transport, South Sudan	Define project details and undertake feasibility
TRAP30	Ambo – Nekemte–Asosa–Kurmuk SGR	Railway	Port Sudan	Construction of a standard gauge railway from Ambo (where it connects to Addis Ababa) to the border with Sudan at Kurmuk, via Nekemte and Asosa.	S2A Pre-Feasibility	2080	Concessional Finance	Ethiopia Railways Corporation	Undertake feasibility
TRAP31	Juba-Wau-Meram SGR	Railway	Port Sudan	Construction of a standard gauge railway from Juba to link with the Sudan SGR at the border in Meram.	S1 Project Definition	5200	Concessional Finance	Ministry of Transport, South Sudan	Long-term vision project to be further developed in future IRIMP revision
TSPL23	Lamu Port Phase 3: Remaining Berths	Sea Port	LAPSSET	Construction of berths additional berths depending on demand the additional berths will be constructed in phases and financed by the private sector. The project is part of the overall Lamu Port project to construct a second port at an estimated cost of $5billion, which forms the anchor project of the LAPSSET Corridor programme.	S2A Pre-Feasibility	4,000	PPP	LAPSSET Corridor Development Authority; Kenya Ports Authority	To be procured in phases subject to demand triggered by 80% occupancy of previous phases.
TRAL24	Lamu to Isiolo SGR	Railway	LAPSSET	533km SGR line for freight and passengers. Part of LAPSSET. The LAPSSET Standard Gauge Railway (SGR) lines will run from Nairobi to Isiolo (270 km), Lamu to Isiolo (533 Km), Isiolo to Nakodok (738 Km) Nakodok to Juba, South Sudan (368 km) and from Isiolo to Moyale (448 Km), Moyale to Addis Ababa, Ethiopia (905 km).	S2B Feasibility	2132	PPP	LAPSSET Corridor Development Authority	Full feasibility, environmental social impact assessment (resettlement RAP). The railway project preliminary designs are complete for the Kenyan and Ethiopian route and expected to proceed to the Detailed Engineering Design stage.
TRAL25	Isiolo to Moyale SGR	Railway	LAPSSET	448km SGR line for freight and passengers. Part of LAPSSET. The LAPSSET Standard Gauge Railway	S2B Feasibility	1792	PPP	LAPSSET Corridor	Full feasibility, environmental social impact

				(SGR) lines will run from Nairobi to Isiolo (270 km), Lamu to Isiolo (533 Km), Isiolo to Nakodok (738 Km) Nakodok to Juba, South Sudan (368 km) and from Isiolo to Moyale (448 Km), Moyale to Addis Ababa, Ethiopia (905 km).				Development Authority	assessment (resettlement RAP). The railway project preliminary designs are complete for the Kenyan and Ethiopian route and expected to proceed to the Detailed Engineering Design stage.
TRAL26	Modjo-Awassa-Moyale SGR	Railway	LAPSSET	905 km SGR Line for freight and passengers. Part of LAPSSET. The LAPSSET Standard Gauge Railway (SGR) lines will run from Nairobi to Isiolo (270 km), Lamu to Isiolo (533 Km), Isiolo to Nakodok (738 Km) Nakodok to Juba, South Sudan (368 km) and from Isiolo to Moyale (448 Km), Moyale to Addis Ababa, Ethiopia (905 km).	S2B Feasibility	3620	PPP	Ethiopian Railways Authority	Full feasibility, environmental social impact assessment (resettlement RAP). The railway project preliminary designs are complete for the Kenyan and Ethiopian route and expected to proceed to the Detailed Engineering Design stage.
TRAL27	Isiolo to Nakodok/Nadapal SGR	Railway	LAPSSET	738 km SGR Line for freight and passengers. Part of LAPSSET. The LAPSSET Standard Gauge Railway (SGR) lines will run from Nairobi to Isiolo (270 km), Lamu to Isiolo (533 Km), Isiolo to Nakodok (738 Km) Nakodok to Juba, South Sudan (368 km) and from Isiolo to Moyale (448 Km), Moyale to Addis Ababa, Ethiopia (905 km).	S2B Feasibility	2952	PPP	LAPSSET Corridor Development Authority	Full feasibility, environmental social impact assessment (resettlement RAP). The railway project preliminary designs are complete for the Kenyan and Ethiopian route and expected to proceed to the Detailed Engineering Design stage.
TRAL28	Nadapal-Kapoeta-Juba SGR	Railway	LAPSSET	368 km SGR Line for freight and passengers. Part of LAPSSET. The LAPSSET Standard Gauge Railway (SGR) lines will run from Nairobi to Isiolo (270 km), Lamu to Isiolo (533 Km), Isiolo to Nakodok (738 Km) Nakodok to Juba, South Sudan (368 km) and from Isiolo to Moyale (448 Km), Moyale to Addis Ababa, Ethiopia (905 km).	S2B Feasibility	1800	PPP	Ministry of Transport, South Sudan	Full feasibility, environmental social impact assessment (resettlement RAP). The railway project preliminary designs are complete for the Kenyan and Ethiopian route and expected to proceed to the

									Detailed Engineering Design stage.
TRAB08	Berbera – Dire Dawa SGR	Railways	Berbera	Single track SGR	S1 Project Definition	1,800	Concessional Finance	Ethiopia Railways Corporation	Long-term vision project to be further developed in future IRIMP revision
TRDB09	Berbera – Burao (Burco) – Lascanood – Garowe	Road	Berbera	Construction of 515.6 km road from Berbera to Garowe which joins to route to Bossaso port and to Mogadishu	S1 Project Definition	520	Concessional Finance	Ministry of Transport, Somalia	Undertake feasibility studies
TRDB10	Misrak Gashamo - Bohotle – Quyale – Burao - Berbera	Road	Berbera	Construction of road from Misrak Gashamo in Ethiopia to Burao in Somalia which joins to extend to Berbera Port	S1 Project Definition	568	Concessional Finance	Ethiopia Roads Authority, Ministry of Transport Somalia	Undertake feasibility studies
TSPM13	Massawa Port Expansion Phase 2	Sea Port	Massawa	Additional expansion of the port facilities at Massawa to accommodate the increase in trade from Ethiopia; construction of multi-modal rail facilities to connect to SGR	S1 Project Definition	100	Private	Massawa Port Authority	Long-term vision project to be further developed in future IRIMP revision
TRAM14	Mekele – Massawa SGR	Railway	Massawa	Extension of the SGR line from Mekele to Massawa, 400 km, with branch line to Asmara	S1 Project Definition	2,000	Concessional finance	Ethiopian Railways Corporation	Long-term vision project to be further developed in future IRIMP revision
TRDMo17	Upgrade Capacity of Mogadishu Port	Sea Port	Mogadishu	Subject to assessment of demand, an expansion of the Mogadishu port is likely to be required in the long-term	S1 Project Definition	100	Private sector	Somali Port Authority	Long-term vision project to be further developed in future IRIMP revision
TBPMo18	Mandera OSBP	Border Post	Mogadishu	Construction of an OSBP at the Somalia-Kenya border at Mandera	S1 Project Definition	20	Concessional Finance	Kenya Revenue Authority; Somalia Revenue Authority	Long-term vision project to be further developed in future IRIMP revision
TBPMo19	Ferfer OSBP	Border Post	Mogadishu	Construction of an OSBP at the Somalia-Ethiopia border at Ferfer	S1 Project Definition	20	Concessional Finance	Ethiopia Revenue and	Long-term vision project to be further developed in future IRIMP revision

								Customs Authority; Somalia Revenue Authority	
TSPK07	Upgrade Capacity of Kismayo Port	Sea Port	Kisnayu	Subject to assessment of demand, an expansion of the Mogadishu port is likely to be required in the long-term	S1 Project Definition	100	Private sector	Somali Port Authority	Long-term vision project to be further developed in future IRIMP revision

Development of physical infrastructure in the IGAD Region, 2031-2050



Energy Sector

Table A2.4: Energy Infrastructure Projects to be Implemented 2020-2024

Project ID	Name	Sub-sector type	Corridor	Description	Stage	Cost ($m)	Financing	Implementing agency	Next steps
EPPN04	Kenya-Uganda Petroleum Products Pipeline (Uganda Section)	Petroleum/Gas Pipeline	Northern	This project involves the extension of the petroleum pipeline from Eldoret to the border with Uganda and on to Kampala, approximately 340 km. In November 2014, the International Finance Corporation, an arm of the World Bank, pledged to lend US$600 million towards the construction of the Eldoret-Kampala section of the project.	S3A Project Structuring	600	Concessional finance – IFC loan	Kenya Pipeline Company; National Pipeline Company Uganda Limited	The project was to be developed jointly by GoK and GoU, with each responsible for the section under its geographical jurisdiction.
EPIN15	Uganda – South Sudan Interconnector (400kV)	Power Interconnector	Northern	Also known as the Karuma–Juba High Voltage Power Line, is a planned double circuit transmission line of 400kV, connecting the high voltage substation at Karuma, in Kiryandongo District, in the Western Region of Uganda, to another high voltage substation at Juba, South Sudan. The line is approximately 190 km in Uganda, running from Karuma to Olwiyo and on to the border at Elegu. In South Sudan it runs 190 km from Nimule to Juba.	S2A Pre-Feasibility	300	Concessional finance	Uganda Electricity Transmission Company; South Sudan Electricity Corporation	Full feasibility to be undertaken
EPPD02	Djibouti to Ethiopia Pipeline (Horn of Africa Initiative)	Petroleum/Gas Pipeline	Djibouti	The 550km long, 20in-diameter steel multi-product pipeline has the capacity to transport 240,000 barrels of fuel a day. It will transport diesel, gasoline and jet fuel from Damerjog in Djibouti to a storage facility at Awash in central Ethiopia. The project will include the construction of an import facility and 950,000 barrels of buffer storage tank farm, as well as pump and monitoring stations at Damerjog in Djibouti, which	S3B Transaction Support & Financial Close	1,550	Private sector	Black Rhino Group, Royal Bafokeng Holdings	Project is currently on hold

				will be connected to a storage terminal and truck loading facility in Awash in Ethiopia through the proposed pipeline.					
EPID12	Second Ethiopia – Djibouti 230kV Power Transmission Interconnector	Power Interconnector	Djibouti	The proposed second interconnector will consist of a new 292km (190km in Djibouti, 102km in Ethiopia) 230kV double circuit transmission line connecting the substations of Semera, Ethiopia and Nagad, Djibouti. The project also includes extension of the existing substations at Semera and Nagad. An MoU for the project between the two countries was signed in July 2013, and a feasibility study was completed in 2017, undertaken by Tractebel and funded by the Kuwait Fund.	S3A Project Structuring	100	Concessional finance – Kuwait Fund and India ExIm Bank have expressed interest	Ethiopian Electric Power (EEP) and Electricité de Djibouti (EDD)	Identify funder
EPIP06	Ethiopia-Sudan (500KV) Transmission Interconnector (Eastern Africa Green Power Transmission Network Project 6 – Guba (Ethiopia)- Khartoum (Sudan))	Power Interconnector	Port Sudan	Construction of a 500kV transmission line and the associated substations that connects the power networks of Ethiopia and Sudan to facilitate trading in electricity and promote power systems stability. The line will be 580 km, 564 km in Sudan, terminating in Khartoum, 16 km in Ethiopia, terminating at the Grand Ethiopian Renaissance Dam (GERD). 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).	S3A Project Structuring	514	Concessional finance	Sudanese Electricity Transmission Company Ltd. (SETCO); Ethiopian Electricity Power Cooperation (EEPCo)	Update financial model, including affordability assessment by the utilities; Market soundings with DFIs and institutional investors; RFQ/ RFP process to appoint EPC contractor; Negotiations with lenders and possible funding applications.

EPPL03	Crude Oil Pipeline: Lamu to South Sudan	Petroleum/ Gas Pipeline	LAPSSET	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. The Crude Oil Pipeline Front End Engineering Design (FEED) studies were completed in 2019 and a Joint Development Agreement (JDA) was signed between the Government of Kenya and Upstream Investors (Tullow Oil Company, Africa Oil and Maersk) in 2017.	S2B Feasibility	3,064	PPP, Tullow Oil	Tullow Oil; LAPSSET Corridor Development Authority	Progressing the Investment decision and first oil flows expected in 2022
EPIL08	Multiple 220kV Power Transmission Interconnectors to power the LAPSSET corridor	Power Interconnector	LAPSSET	Several 220kV power transmission lines are planned to provide power to the corridor, including: 120km Turkwel – Lokichar – Lodwar line(100MUSD) 92km Loosuk – PS2 – Baragoi line(76MUSD), 165km 220kV Isiolo – PS6 - (Loosuk line(121.8MUSD), 320km 220kV Isiolo – PS6 - Garba Tula – PS9 – PS10 - Garissa line(168.78MUSD), 18km 220kV Lamu (Hindi) – Marine Terminal Jetty line(15MUSD), 220kV Lodwar – Lokichogio line(120MUSD) will be part of the Kenya – Southern Sudan Interconnection	S2B Feasibility	232	Concessional finance	Kenya Electricity Transmission Company (KETRACO)	Undertake feasibility studies
EPIM07	Sudan - Eritrea 66kv power interconnector (Eritrea Section)	Power Interconnector	Massawa	Development of 66KV power interconnector in Eritrea – an extension of the 66kv power line from Kassala to Aligider	S1 Project Definition	8	Government funding	Eritrean Electricity Authority	Undertake feasibility studies
EPIMo03	Ethiopia – Somalia Interconnector (500KV) (Horn of Africa Initiative)	Power Interconnector	Mogadishu	Construction of 500KV power transmission line to connect Ethiopia	S1 Project	1188	Concessional finance	Ethiopia Electric Power	Feasibility study

				and Somalia. The exact routing to be determined	Definition			Corporation (EEPCO)	
EPPN04	Kenya-Uganda Petroleum Products Pipeline (Uganda Section)	Petroleum/Gas Pipeline	Northern	This project involves the extension of the petroleum pipeline from Eldoret to the border with Uganda and on to Kampala, approximately 340 km. In November 2014, the International Finance Corporation, an arm of the World Bank, pledged to lend US$600 million towards the construction of the Eldoret-Kampala section of the project.	S3A Project Structuring	600	Concessional finance – IFC loan	Kenya Pipeline Company; National Pipeline Company Uganda Limited	The project was to be developed jointly by GoK and GoU, with each responsible for the section under its geographical jurisdiction.

Development of physical infrastructure in the IGAD Region, 2020 - 2024

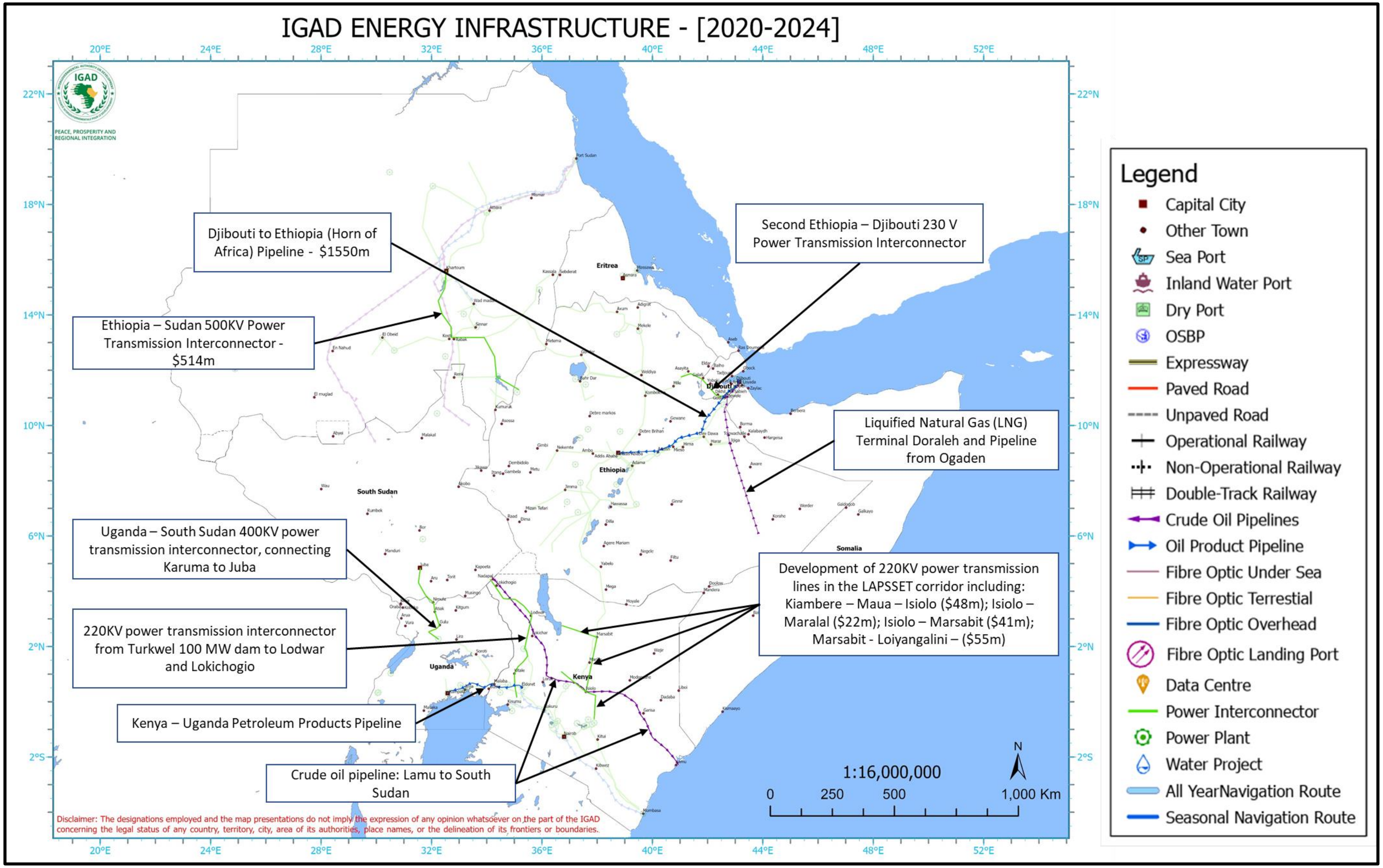


Table A2.5: Energy Infrastructure Projects to be Implemented 2025-2030

Project ID	Name	Sub-sector type	Corridor	Description	Stage	Cost ($m)	Financing	Implementing agency	Next steps
EPID23	Ethiopia – South Sudan Interconnector (400KV)	Power Interconnector	Djibouti	400kV, Ethiopia – South Sudan (Tepi-Bor) Interconnector (Ethiopia (Dedesa-Tepi) – South Sudan (Bor) Power TL -Juba, 500 kV of 700 km)	S2A Pre-Feasibility	235	Concessional finance	Ethiopian Electricity Power Cooperation (EEPCo); South Sudan Electricity Corporation (SSEC)	Feasibility study & detailed design (No Feasibility Study done but project profile prepared by EAPP)
EPID24	Ethiopia – South Sudan Interconnector (230KV)	Power Interconnector	Djibouti	230kV Ethiopia-South Sudan Interconnection (Gambella-Malakal (Phase 1), 230kV of 357 km)	S2A Pre-Feasibility	100	Concessional finance	Ethiopian Electricity Power Cooperation (EEPCo); South Sudan Electricity Corporation (SSEC)	Feasibility study & detailed design (No Feasibility Study done but project profile prepared by EAPP)
EPPD26	South Sudan – Djibouti port crude oil pipeline	Pipeline	Djibouti	The project will provide an alternative route for South Sudan crude oil to access the Djibouti Port for export to international market. Project will cover 3 countries traversing through Ethiopia	S0 Enabling Environment and Needs Assessment	5000	Donor Financing	Ministry of Petroleum and Mining, South Sudan; Ministry of Mines and Petroleum, Ethiopia; Ministry of Energy and Natural Resources, Djibouti;	Undertake concept design work needed before the pre-feasibility phase
EPPP10	Sudan-Ethiopia Petroleum Pipeline	Petroleum/Gas Pipeline	Port Sudan	Extending the 12-inch pipeline from the Haya region to Gedaref, Alglabat and then to Addis Ababa, Ethiopia, to supply Ethiopia with petroleum products. The total length of the pipeline is around 1,600km.	S2A Pre-Feasibility	300	Government funds	Sudanese Petroleum Pipeline Company	Undertake feasibility
EPPP11	Sudan-South Sudan Petroleum Pipeline	Petroleum/Gas Pipeline	Port Sudan	Extending the 12-inch pipeline from the Madani region to Algabalian through Rabak to Juba. Algabalain is located near to the border of South Sudan. The length of this pipeline is approximately 320 km.	S1 Project Definition	250	Government funds	Sudanese Petroleum Pipeline Company	Undertake feasibility

EPPL13	Product Oil Pipeline: Kenya to Ethiopia	Petroleum/ Gas Pipeline	LAPSSET	The project runs from Lamu – Isiolo – Moyale – Addis Ababa (Ethiopia), a distance of 1810 km. Considering that Kenya and Ethiopia are connected through road infrastructure, it might be strategic to fast track the construction of a product pipeline connecting to Ethiopia which to-date does not have a product pipeline. The Bilateral Agreement on the development and operation of the Lamu Port – Isiolo, Nakuru – Isiolo and Isiolo – Moyale – Hawassa – Addis Ababa Product Oil Pipeline was drafted and approved by the Attorney General on 17th June 2016. The Bilateral Agreement was then negotiated with Ethiopia during Bilateral negotiations held on 18th and 19th June 2016. The Agreement was then signed on 23rd June 2016 during the state visit to Kenya by Prime Minister of the Federal Democratic Republic of Ethiopia.	S2A Pre-Feasibility	885	PPP	LAPSSET Corridor Development Authority	Design of pipeline by Investors; Feasibility study on pipeline project by investors.
EPPL15	Crude Oil Pipeline: Jonglei to Nadapal	Petroleum/ Gas Pipeline	LAPSSET	Proposed South Sudan phase of the crude oil pipeline to link the oil producing regions from Jonglei to the Kenyan pipeline at the border in Nadapal / Nakodok.	S1 Project Definition	800	PPP	South Sudan Ministry of Petroleum and Mining	Undertake feasibility study
EPIL16	Kenya – South Sudan Interconnector (220KV)	Power Interconnector	LAPSSET	The implementation of the 220KV interconnector is linked to the Jonglei crude oil pipeline. It will connect the grid in Juba and South Sudan to the Kenyan grid.	S1 Project Definition	85	Blended finance	Kenya Electricity Transmission Company (KETRACO)	Undertake feasibility study

EPIB07	Ethiopia – Somalia Interconnector (230KV) (Horn of Africa Initiative)	Power Interconnector	Berbera	230 KV power interconnectors from Jijiga to the port in Berbera via Hargeisa	S1 Project Definition	40	Concessional finance	Ethiopian Electric Power	Undertake a full feasibility and identify potential funders and financing arrangements
EPIM09	Eritrea – Sudan Interconnector (230KV)	Power Interconnector	Massawa	Double circuit 230kV Sudan-Eritrea power transmission interconnector from Kassala in Sudan via-Tesene-Barentu-Akordat-Keren to Asmara, Eritrea	S2A Pre-Feasibility	140	Concessional finance	Eritrean Electricity Corporation (EEC); Sudanese Electricity Transmission Company Ltd. (SETCO)	Undertake full feasibility and identify potential funders
EPIM10	Eritrea – Ethiopia Interconnector (230KV) (Horn of Africa Initiative)	Power Interconnector	Massawa	Double circuit 230kV, Ethiopia-Eritrea (Enda Silasie-Asmara) power transmission interconnector	S2A Pre-Feasibility	75	Concessional finance	Eritrean Electricity Corporation (EEC); Ethiopian Electricity Power Cooperation (EEPCo)	Undertake full feasibility and identify potential funders

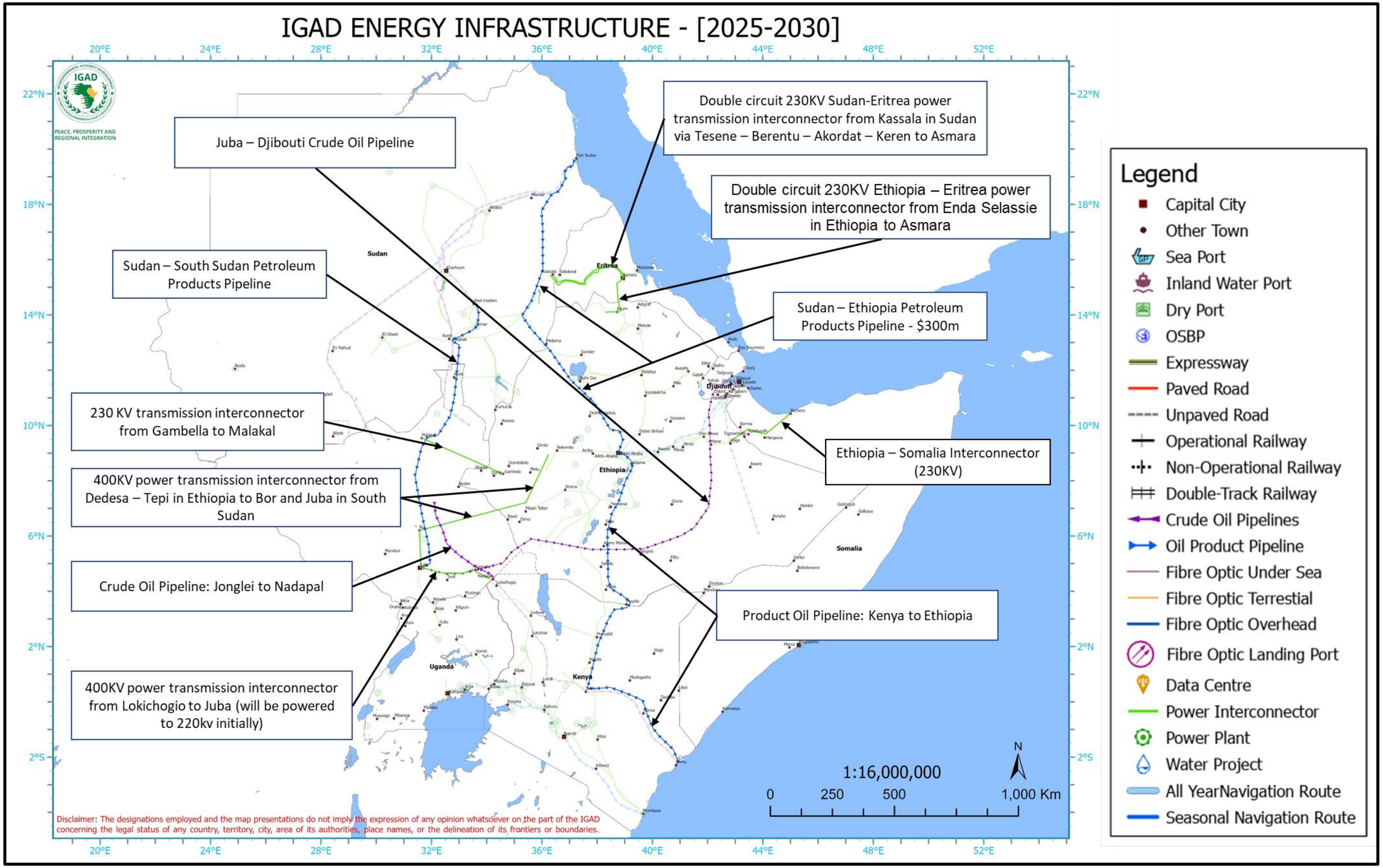
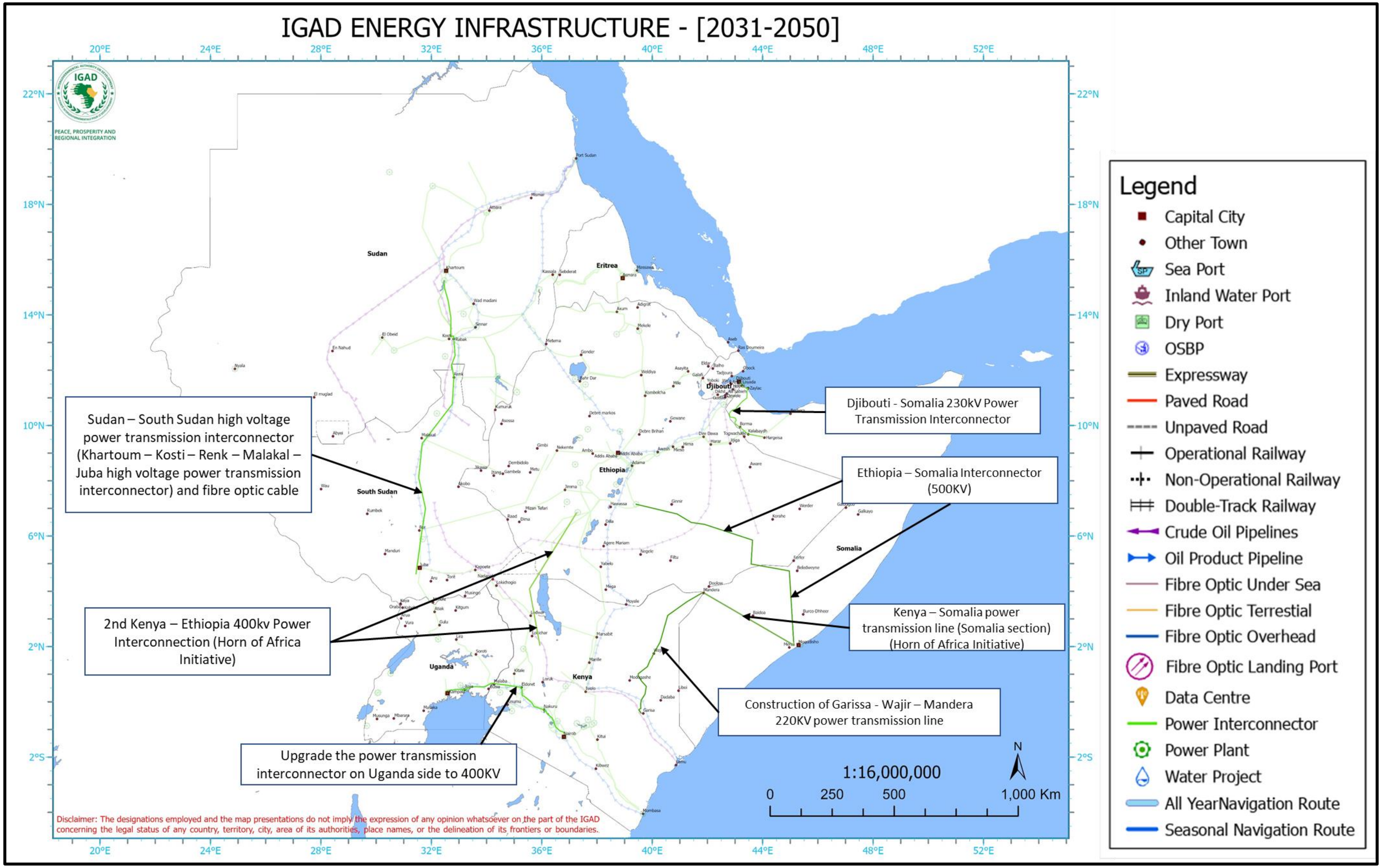

IGAD ENERGY INFRASTRUCTURE - [2025-2030]
PEACE, PROSPERITY AND REGIONAL INTEGRATION
Juba – Djibouti Crude Oil Pipeline
Double circuit 230KV Sudan-Eritrea power transmission interconnector from Kassala in Sudan via Tesene – Berentu – Akordat – Keren to Asmara
Double circuit 230KV Ethiopia – Eritrea power transmission interconnector from Enda Selassie in Ethiopia to Asmara
Sudan – South Sudan Petroleum Products Pipeline
Sudan – Ethiopia Petroleum Products Pipeline - $300m
230 KV transmission interconnector from Gambella to Malakal
Ethiopia – Somalia Interconnector (230KV)
400KV power transmission interconnector from Dedesa – Tepi in Ethiopia to Bor and Juba in South Sudan
Crude Oil Pipeline: Jonglei to Nadapal
Product Oil Pipeline: Kenya to Ethiopia
400KV power transmission interconnector from Lokichogio to Juba (will be powered to 220kv initially)
Sudan
Eritrea
Djibouti
Ethiopia
Somalia
Uganda
Kenya
1:16,000,000
0 250 500 1,000 Km
N
Legend
Capital City
Other Town
Sea Port
Inland Water Port
Dry Port
OSBP
Expressway
Paved Road
Unpaved Road
Operational Railway
Non-Operational Railway
Double-Track Railway
Crude Oil Pipelines
Oil Product Pipeline
Fibre Optic Under Sea
Fibre Optic Terrestial
Fibre Optic Overhead
Fibre Optic Landing Port
Data Centre
Power Interconnector
Power Plant
Water Project
All YearNavigation Route
Seasonal Navigation Route
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.

Table A2.6: Energy Infrastructure Projects to be Implemented 2031-2050

Project ID	Name	Sub-sector type	Corridor	Description	Stage	Cost ($m)	Financing	Implementing agency	Next steps
EPIN34	Kenya – Uganda upgrade on Uganda side to 400kV	Power Interconnector	Northern	When demand is sufficient, the power transmission interconnector should be upgraded to 400kV on the Uganda side; it is currently 220kV	S1 Project Definition	520	Concessional Finance	Uganda Electricity Transmission Company	Long-term vision project to be further developed in future IRIMP revision
EPID34	Djibouti - Somalia 230kV Power Transmission Interconnector	Power Interconnector	Djibouti	The proposed interconnector borrows much of the voltage from the Second Ethiopia – Djibouti 230kV Power Transmission Interconnector since Djibouti and Somalia are non-producers of power	S1 Project Definition	100	Concessional Finance	Electricité de Djibouti (EDD)	Feasibility studies
EPIL29	2nd Kenya – Ethiopia 400kv Power Interconnection (Horn of Africa Initiative)	Power Interconnector	LAPSSET	The construction of a 400KV power interconnector from Lodwar – Lokitung to Ethiopia 400KV proposed under the Horn of Africa Initiative. The project involves a 180km 400kV transmission line from Lodwar – Lokitung – Ethiopia Border on the Kenyan side. Its approximate cost is 111.6 million USD. Power to Lodwar will be supplied from: 1. Proposed 400kV Baringo – Lodwar Transmission line; 2. Proposed 400kV transmission line from Loiyangalani to Lodwar	S1 Project Definition	111.5	PPP	KETRACO, EEPCo	Undertake feasibility study
EPIP32	Khartoum – Kosti – Renk – Malakal – Juba high voltage power transmission interconnector	Power Interconnector	Port Sudan	Construction of a high voltage power transmission line linking Juba to Sudan.	S1 Project Definition	1152	Concessional Finance	Sudan Electricity Distribution Company (SEDC);South Sudan	Long-term vision project to be further developed in future IRIMP revision

								Electricity Corporation (SSEC)	
EPIMo21	Garissa – Wajir – Mandera 220KV power transmission line	Power Interconnector	Mogadishu	Construction of a 220 KV line from Garissa to Mandera through Wajir	S1 Project Definition	192	GOK	Kenya Electricity Transmission Company Ltd (KETRACO)	Undertake feasibility studies
EPIM020	Kenya – Somalia power transmission line (Somalia section) (Horn of Africa Initiative)	Power Interconnector	Mogadishu	Construction of a 220 KV line from Mandera to Mogadishu	S1 Project Definition	192	Concessional Finance	Ministry of Energy Somalia	Undertake feasibility studies

Development of physical infrastructure in the IGAD Region, 2031 - 2050



ICT Sector

Table A2.7: ICT Infrastructure Projects to be Implemented 2020-2024

Project ID	Name	Sub-sector type	Corridor	Description	Stage	Cost ($m)	Financing	Implementing agency	Next steps
IFON16	Juba-Kampala Fibre Optic Link (South Sudan Section)	Fibre Optic Cable	Northern	This proposed fibre optic cable linking Juba to Kampala, approximately 630km, was featured in PIDA PAP 2020.	S1 Project Definition	19	Donor grant	South Sudan Ministry of Telecommunications and Postal Service	Full feasibility to be undertaken
IFON20	Transborder Submarine Fibre Points of Presence (PoPs) and Regional Smart Hub Facility and Data centre	Fibre Optic Cable and Data Centre	Northern	The project will promote inter-connectivity infrastructure at the border points which will comprise of 400 Gbps PoPs and Smart Hub data centre in Mombasa are currently unavailable. The project interconnection will contribute to the Trans – African ICT highway Cape to Cairo, Northern Corridor and LAPSSET corridor.	S1 Project Definition	70	CONCESSIONAL FINANCE	IGAD Member States Ministries of ICT	Full Feasibility to be undertaken
IFON21	Konza National Data Centre and Smart City Facilities	ICT Data Centre	Northern	The Konza Technopolis will be a sustainable, World Class technology hub and a major economic driver in IGAD region	S4B Construction	173	Konza Technopolis Authority; Ministry of ICT	IGAD Member States Ministry of ICT	Commissioning and operationalisation
IFON22	Adoption of One Area Network	Voice Traffic Exchange	Northern	Adoption of One Area Network for reduced call charges across the region	S1 Project Definition	0.5	Government funding	Djibouti, Eritrea, Ethiopia, Kenya, Sudan, South Sudan, Somalia, Uganda Ministry of ICT	Feasibility studies
IFOD13	Djibouti Africa Regional Express (DARE)	Fibre Optic Cable	Djibouti	Submarine cable of 60 Tbit/s, total length of 4,763km. Kenya consider it as redundancy for TEAMs. Private sector considers Djibouti as redundancy for Mombasa landing points. DARE will commence in Djibouti and have landing points in Berbera, Bossaso, Mogadishu,	S3A Project Structuring	100	Private sector	Consortium of: Djibouti Telecom; Africa Marine Express; TeleYemen; Telesom Company Hormuud Telecom Somalia Inc. Golis Telecom. Somtel Group	Finalise the consortium structure, allocate shares, finalise contract

				Mombasa, Dar es Salaam, and Yemen.					
IFOD14	Installation of 681 km Fibre Optic Cable	Fibre Optic Cable	Djibouti	Cable installation to boost traffic along road corridors: Djibouti-Ethiopia (Djibouti-Galafi, Djibouti-Galilee and Tadjourah-Balho); Djibouti-Somalia (Djibouti-Loyada)	S3A Project Structuring	32	Private sector	Djibouti Telecom	Finalise the financing
IFOD15	South Sudan Internet Exchange Point	Internet Exchange Point	Djibouti	Construction of an internet Exchange Point in South Sudan	S1 Project Definition	3	Government funding	South Sudan Ministry of ICT & Postal Services	Undertake feasibility study
IFOD16	Djibouti – Addis Ababa – Juba –Fibre Optic Link	Fibre Optic Link	Djibouti	Construction of a Fibre Optic Line from Djibouti to Juba to compliment and transform the Djibouti – Kampala highway into a smart corridor	S1 Project Definition	30	Private Sector	Djibouti, Ethiopia, South Sudan ministries of ICT	Undertake feasibility study
IFOD17	Juba - Kampala Fibre Optic Link	Fibre Optic Link	Djibouti	Construction of a Fibre Optic Line from Juba to Kampala to compliment and transform the Djibouti – Kampala highway into a smart corridor	S1 Project Definition	19	Private Sector	South Sudan and Uganda ministries of ICT	Undertake feasibility study
IFOD18	Adoption of One Area Network	Voice Traffic Exchange	Djibouti	Adoption of One Area Network for reduced call charges across the region	S1 Project Definition	0.5	Government funding	Djibouti, Eritrea, Ethiopia, Kenya, Sudan, South Sudan, Somalia, Uganda Ministry of ICT	Feasibility studies
IFOL09	Nadapal – Juba Fibre Optic Cable	Fibre Optic Cable	LAPSSET	The project will link South Sudan to Kenya to exchange traffic and voice data with the world via submarine landing points in Mombasa. Should have been implemented concurrently with construction in Kenya, but security issues prevented this.	S2A Pre-Feasibility	62	Donor grant – World Bank	South Sudan Ministry of Telecommunications and Postal Service	Fibre optic cable on the Kenya side connecting Nandapal to Eldoret is complete. Need to secure financing for South Sudan side.
IFOL10	Adoption of One Area Network	Voice Traffic Exchange	LAPSSET	Adoption of One Area Network for reduced call charges across the region	S1 Project Definition	0.5	Government funding	Djibouti, Eritrea, Ethiopia, Kenya, Sudan,	Feasibility studies

								South Sudan, Somalia, Uganda Ministry of ICT	
IFOB05	Berbera – Togochaale Fibre Optic Cable	Fibre Optic Cable	Berbera	The Berbera – Togochaale terrestrial optical fibre cable is an ICT project that will link Somalia and Ethiopia telecommunication networks. The estimated length of the cable will be 260 km and twenty-four pair with estimated capacity of 100G. The link will be designed according to the ITU standards which is globally accepted. In addition, the project will run along the Berbera – Togachale road.	S3A Project Structuring	10	Private sector	Telesom	Transaction advisory support
IFOB06	Adoption of One Area Network	Voice Traffic Exchange	Berbera	Adoption of One Area Network for reduced call charges across the region	S1 Project Definition	0.5	Government funding	Djibouti, Eritrea, Ethiopia, Kenya, Sudan, South Sudan, Somalia, Uganda Ministry of ICT	Feasibility studies
IFOMo04	Nairobi – Mogadishu Fibre Optic Link (Kenya Section) and Point of Presence (PoP)	Fibre Optic Cable	Mogadishu	Construction of a fibre optic cable connecting Nairobi to Mogadishu through Isiolo and Mandera (also known as the Isiolo - Mandera fibre optic link)	S1 Project Definition	34	Concessional finance	Kenya ICT Authority and Liquid Telecom	Long-term vision project to be further developed in future IRIMP revision
IFOMo05	Somalia Internet Exchange Point	Internet Exchange Point	Mogadishu	Construction of Somalia Internet Exchange Point in Mogadishu	S1 Project Definition	4	Concessional finance	Somalia Ministry of ICT	Feasibility study
IFOMo06	Adoption of One Area Network	Voice Traffic Exchange	Mogadishu	Adoption of One Area Network for reduced call charges across the region	S1 Project Definition	0.5	Government funding	Djibouti, Eritrea, Ethiopia, Kenya, Sudan, South Sudan, Somalia, Uganda Ministry of ICT	Feasibility studies
IFOK02	Garissa - Kismayo Fibre Optic Link (Kenya Section)	Fibre Optic Cable	Kismayo	Construction of a fibre optic cable connecting Garissa in Kenya to Kismayo Port in Somalia through Liboi. The fibre optic connection at Liboi will support the operations of the planned Liboi One Stop Border Post	S1 Project Definition	20	Concessional Finance	Ministry of ICT Kenya	Feasibility study and Detailed Engineering Design

Development of physical infrastructure in the IGAD Region, 2020 - 2024

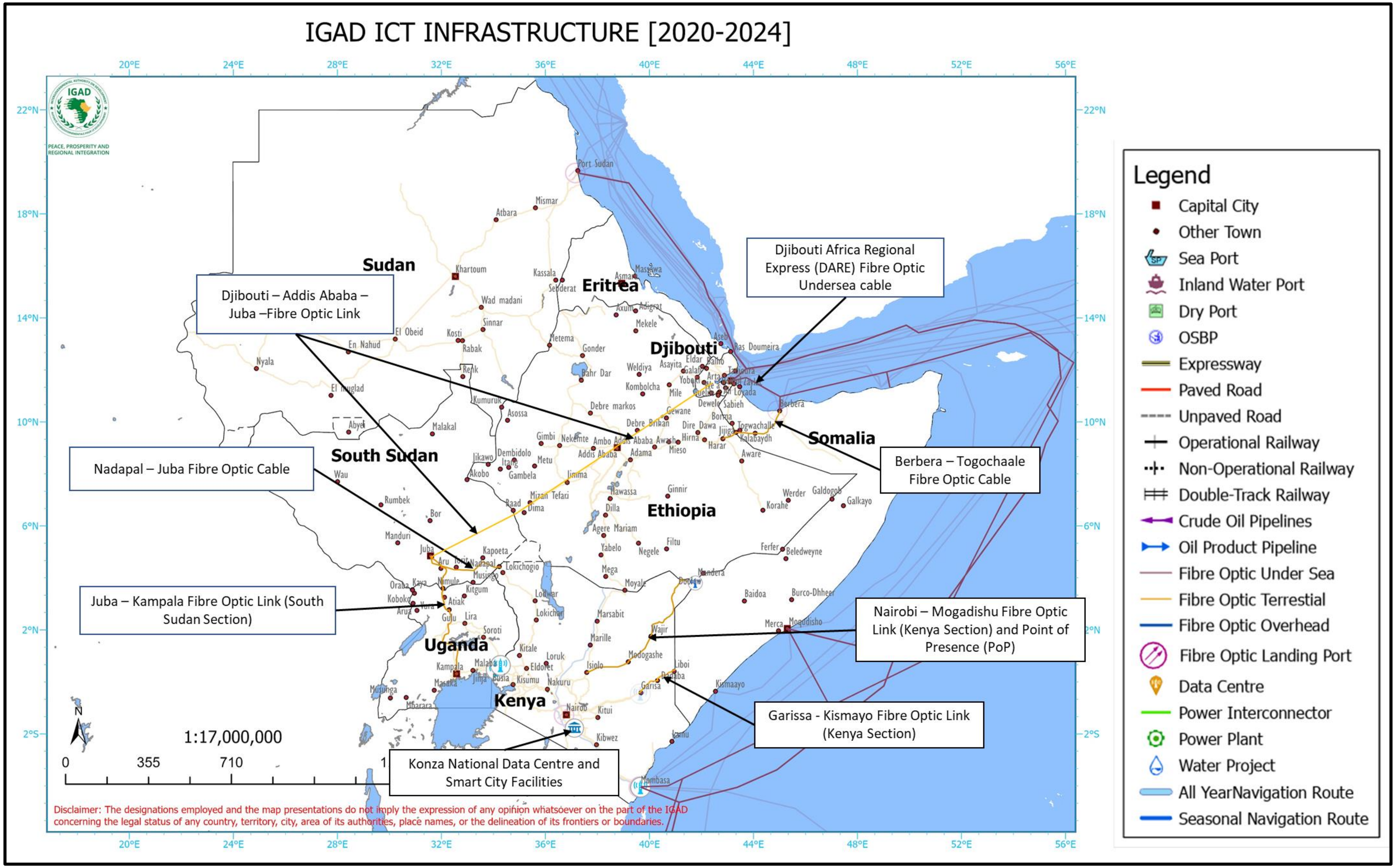
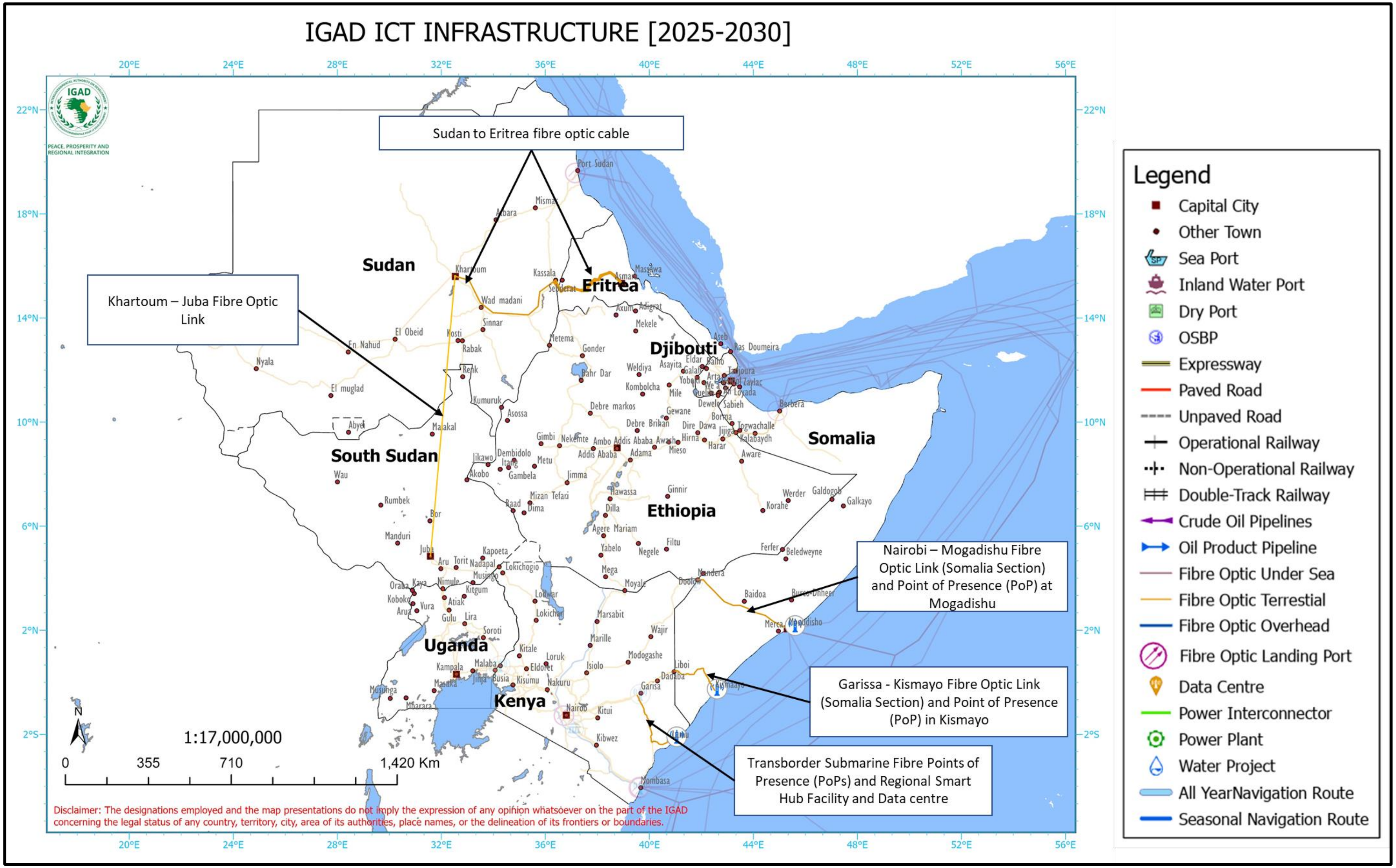


Table A2.8: ICT Infrastructure Projects to be Implemented 2025-2030

Project ID	Name	Sub-sector type	Corridor	Description	Stage	Cost ($m)	Financing	Implementing agency	Next steps
IFOP23	Khartoum – Juba fibre optic cable	Fibre Optic Cable	Port Sudan	Fibre optic cable linking Khartoum to Juba.	S1 Project Definition	25	Concessional Finance	South Sudan Ministry of Telecommunications and Postal Service	Long-term vision project to be further developed in future IRIMP revision
IFOP24	Adoption of One Area Network	Voice Traffic Exchange	Regional	Adoption of One Area Network for reduced call charges across the region	S1 Project Definition	0.5	Government funding	Djibouti, Eritrea, Ethiopia, Kenya, Sudan, South Sudan, Somalia, Uganda Ministry of ICT	Feasibility studies
IFOL21	Transborder Submarine Fibre Points of Presence (PoPs) and Regional Smart Hub Facility and Data centre	Fibre Optic Cable and Data Centre	LAPSSET	The project will promote inter-connectivity infrastructure at the border points which will comprise of 400 Gbps PoPs and Smart Hub data centre in Mombasa are currently unavailable. The project interconnection contributes to the Trans – African ICT highway Cape to Cairo, Northern Corridor and LAPSSET corridor (Lamu port, Moyale and Nadapal).	S1 Project Definition	70	Concessional Finance	LAPSSET Partner Member States Ministries of ICT	Full Feasibility to be undertaken
IFOM11	Sudan-Eritrea Fibre-optic Link	Fibre Optic Cable	Massawa	Construction of a fibre optic link between Khartoum (Sudan) and Asmara (Eritrea)	S1 Project Definition	10	Private sector	CONCESSIONAL FINANCE	Detailed project definition and pre-feasibility study
IFOM12	Adoption of One Area Network	Voice Traffic Exchange	Regional	Adoption of One Area Network for reduced call charges across the region	S1 Project Definition	0.5	Government funding	Djibouti, Eritrea, Ethiopia, Kenya, Sudan, South Sudan, Somalia, Uganda Ministry of ICT	Feasibility studies

IFOMo16	Nairobi – Mogadishu Fibre Optic Link (Somalia Section) and Point of Presence (PoP) at Mogadishu	Fibre Optic Cable	Mogadishu	Construction of a fibre optic cable connecting Nairobi to Mogadishu	S1 Project Definition	134	Concessional Finance	Somalia Ministry of ICT	Long-term vision project to be further developed in future IRIMP revision
IFOK06	Garissa - Kismayo Fibre Optic Link (Somalia Section) and Point of Presence (PoP) in Kismayo	Fibre Optic Cable	Kismayo	Construction of a fibre optic cable connecting Garissa in Kenya from Liboi border to Kismayo Port in Somalia and construction of a Point of Presence (PoP) in Kismayo	S1 Project Definition	25	Concessional Finance	Ministry of ICT, Somalia	Feasibility study and Detailed Engineering Design

Development of physical infrastructure in the IGAD Region, 2025 - 2030



Water Sector

Table A2.10: Water Infrastructure Projects to be Implemented 2020-2024

Project ID	Name	Sub-sector type	Corridor	Description	Stage	Cost ($m)	Financing	Implementing agency	Next steps
WMRN17	Kocholia Trans-boundary Multipurpose Water Storage	Multi-purpose Reservoir	Northern	This project is to develop a multi-purpose dam and reservoir primarily for irrigation at Kocholia.	S2A Pre-Feasibility	55	Concessional finance – AfDB and Korea Keim Bank	Kenya State Department for Irrigation; Nile Basin Initiative	Full feasibility to be undertaken
WMRN18	Nyimur Multipurpose Water Resources Project Studies	Multi-purpose Reservoir	Djibouti	The core scheme of the project consists of a 26 m head dam and reservoir on Nyimur River and five (5) modules of irrigated lowland rice of approximately 5,105 ha. A mini hydropower plant with a capacity of 350 kW is included in the dam component	S2B Feasibility	2	Donor funds	Nile Basin Initiative (NBI)/NELSAP Coordination Unit, Governments of Uganda, and South Sudan (Ministries of Water and Natural Resources)	Project structuring (financial structuring plan)
WMRN19	Angololo Multipurpose Water Resources Development Project	Multi-purpose Reservoir	Mogadishu	The project consists of a proposed 30-metre-high dam with a reservoir capacity of 43.0 million cubic metres that will supply potable water to 20,000 people and irrigate 3,300 hectares (1,180 Ha in Kenya and 2,120 Ha in Uganda). The dam will generate 1.75MW hydropower.	S2B Feasibility	1.65	Donor Grant - African Development Bank/ African Water Facility NEPAD-IPPF and Financing from Governments of Kenya and Uganda	Ministries of Water and Natural Resources – Kenya and Uganda	Project structuring (financial structuring plan)
WWAP07	Assessment and Management of Bagara Transboundary Groundwater Aquifer	Water Aquifer Management	Port Sudan	The Bagara is a shared groundwater resource that, if developed, has huge potential in promoting cooperation among the shared water resource users. This project will assess the potential of the aquifer for irrigation.	S3A Project Structuring	2.7	Donor grant – World Bank	Ministry of Irrigation and Water Resources, Sudan; Ministry of Irrigation and Water Resources, South Sudan	Design TOR and contract the consultants

WMRMo02	Dawa River Multi-purpose Dam	Multi-purpose Reservoir	Mogadishu	The proposed Dawa dam will be located approximately 20 km upstream of Rhamu Dimtu town in Mandera County and 2km upstream of Boni centre in Ethiopia. The estimated dam height is about 90m with a capacity of approximately 4.5 Billion m3 and can be utilised to generate 8.2MW of hydropower.	S2B Feasibility	604	Concessional finance	Ministry of Water and Sanitation, Kenya; Ministry of Water, Irrigation and Electricity, Ethiopia; Ministry of Energy and Water Resources, Somalia	Finalise feasibility study, identify finance

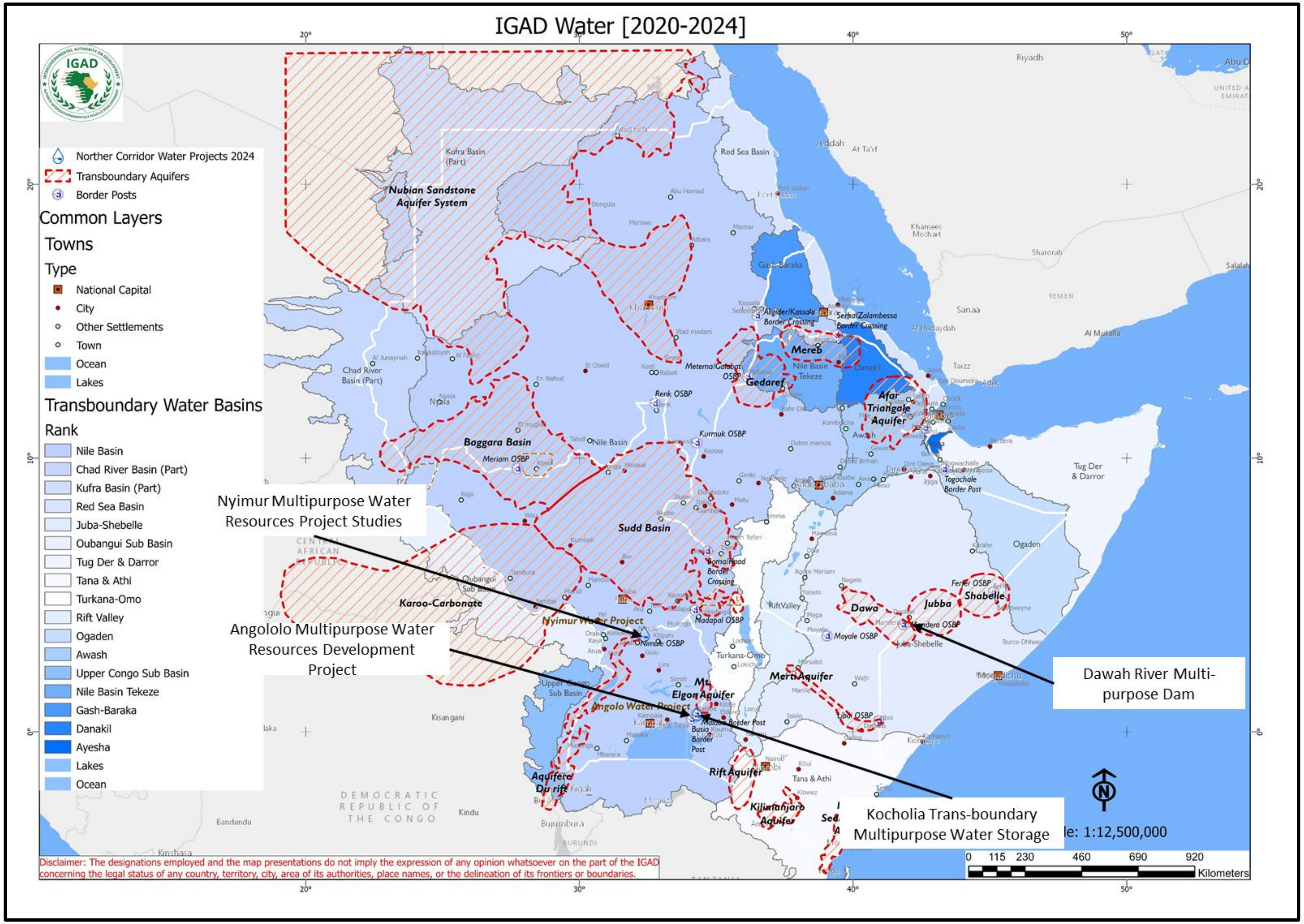
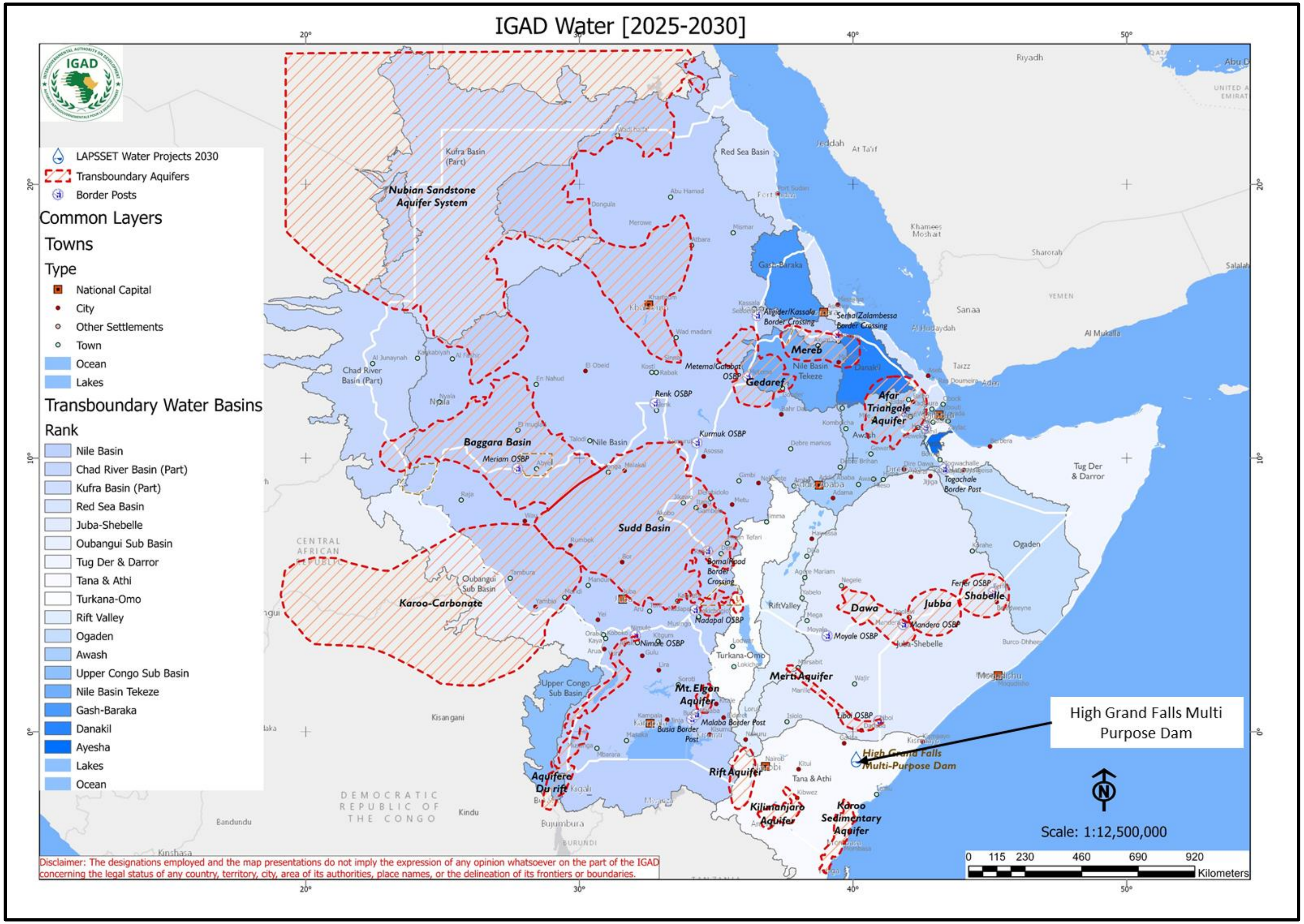

IGAD Water [2020-2024]
Norther Corridor Water Projects 2024
Transboundary Aquifers
Border Posts
Common Layers
Towns
Type
National Capital
City
Other Settlements
Town
Ocean
Lakes
Transboundary Water Basins
Rank
Nile Basin
Chad River Basin (Part)
Kufra Basin (Part)
Red Sea Basin
Juba-Shebelle
Oubangui Sub Basin
Tug Der & Darror
Tana & Athi
Turkana-Omo
Rift Valley
Ogaden
Awash
Upper Congo Sub Basin
Nile Basin Tekeze
Gash-Baraka
Danakil
Ayesha
Lakes
Ocean
Nyimur Multipurpose Water Resources Project Studies
Angololo Multipurpose Water Resources Development Project
Dawah River Multi-purpose Dam
Kocholia Trans-boundary Multipurpose Water Storage
Nubian Sandstone Aquifer System
Baggara Basin
Sudd Basin
Karoo-Carbonate
Nyimur Water Project
Angolo Water Project
Elgon Aquifer
Rift Aquifer
Kilimanjaro Aquifer
Merti Aquifer
Afar Triangale Aquifer
Gedaref
Mereb
Dawa
Jubba
Shabelle
1:12,500,000
0 115 230 460 690 920 Kilometers
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.

Table A2.11: Water Infrastructure Projects to be Implemented 2025-2030

Project ID	Name	Sub-sector type	Corridor	Description	Stage	Cost ($m)	Financing	Implementing agency	Next steps
WMRL17	High Grand Falls Multi-Purpose Dam	Multi-purpose Reservoir	LAPSSET	The High Grand Falls Multi-Purpose Dam is a project to be located 50 km downstream of the Kiambere Hydro Power Station along the River Tana at Kitui, Embu and Tharaka-Nithi County's junction. The project scope is 165 km2 to hold over 5.6 billion m3 of water. The project incorporates three user principles of 700 MW hydro power generation; the downstream area irrigation schemes of 250,000 Ha and supply of domestic and industrial water for Lamu Metropolis and LAPSSET downstream counties. The dam is a strategic reservoir that to tame perennial flash floods that occur in Tana Delta region.	S2B Feasibility	2,000	PPP through Build Operate Transfer (BOT) backed by a Power Purchase Agreement (PPA) by Kenya Power Limited (KPL)	Kenya Power Limited	Undertake feasibility study


IGAD Water [2025-2030]
LAPSSET Water Projects 2030
Transboundary Aquifers
Border Posts
Common Layers
Towns
Type
National Capital
City
Other Settlements
Town
Ocean
Lakes
Transboundary Water Basins
Rank
Nile Basin
Chad River Basin (Part)
Kufra Basin (Part)
Red Sea Basin
Juba-Shebelle
Oubangui Sub Basin
Tug Der & Darror
Tana & Athi
Turkana-Omo
Rift Valley
Ogaden
Awash
Upper Congo Sub Basin
Nile Basin Tekeze
Gash-Baraka
Danakil
Ayesha
Lakes
Ocean
Nubian Sandstone Aquifer System
Baggara Basin
Sudd Basin
Karoo-Carbonate
Gedaref
Mereb
Afar Triangale Aquifer
Dawa
Jubba
Shabelle
Merti Aquifer
Mt. Elgon Aquifer
Rift Aquifer
Aquifere Du rift
Kilimanjaro Aquifer
Karoo Sedimentary Aquifer
High Grand Falls Multi Purpose Dam
Scale: 1:12,500,000
0 115 230 460 690 920
Kilometers
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.

Annex Three:
Case Studies

Annex Three IGAD Infrastructure Sector Case Studies

Introduction

The case studies are a compilation of infrastructure projects that offer crucial lessons that can be adopted and replicated for successful projects show cased and offer insights on failure of failed projects and what IGAD member states can adopt. The projects in the case studies have been extensively discussed in the main report and this section serves to give the insights on the challenges and lessons learnt for each of the projects.

Summary of the Case Studies

The case studies have offered important insights on the implementation of key projects in the various countries which can serve as key vital lessons for the IGAD secretariat to advocate for infrastructure development. This is detailed in the table below:

Case Study Critical Success Factors and Challenges	Potential Lessons for IGAD
• ***Joint participation in project packaging*** – **some of the successful cross border projects have been as a result of joint participation in project packaging between the participating countries.** • ***Joint Infrastructure fundraising*** – **joint lobbying for infrastructure funding has been a crucial element in securing funds on favourable terms for the implementation of cross border infrastructure projects which has in turn ensured completion of cross border projects in both participating countries. The Ethiopia Djibouti Railway line was funded by the Exim Bank of China after joint lobbying by Ethiopia and Djibouti for its construction to the Exim Bank of China which also guaranteed favourable loan terms for the project** • ***Project alignment to the National Development Plan (NDP)*** – **The alignment of the infrastructure project with or inclusion into the NDP greatly helps in prioritizing the infrastructure project for development The NDP provides estimates of economic growth as a result of the infrastructure development.** • ***Vetting of Private Sector actors in infrastructure management*** – **Lessons from the Kenya-Uganda Railways Concession portends that successful management of critical infrastructure is pegged on vetting the private sector actors to ensure that the**	• ***Coordination of projects*** - IGAD Secretariat should to emphasise to the member states on 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 Secretariat should advocate for capacity building*** - Capacity building for local personnel

public private partnership yields positive returns on investment. On energy, the Turkana Wind Power project details a flop in the structuring of private sector agreements in terms of private sector responsibilities leading to government incurring losses.

- ***Systematic 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 participation and efficient coordination of stakeholder. Stakeholder participation is further facilitated by clear frameworks with a road map up to the end of project implementation**
- ***Favourable diplomatic relations*** **– 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*** **- 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**

Policies

Favourable Polices **– investments in the infrastructure projects require favourable and conducive policies that will attract investors to develop infrastructures. Favourable policies**

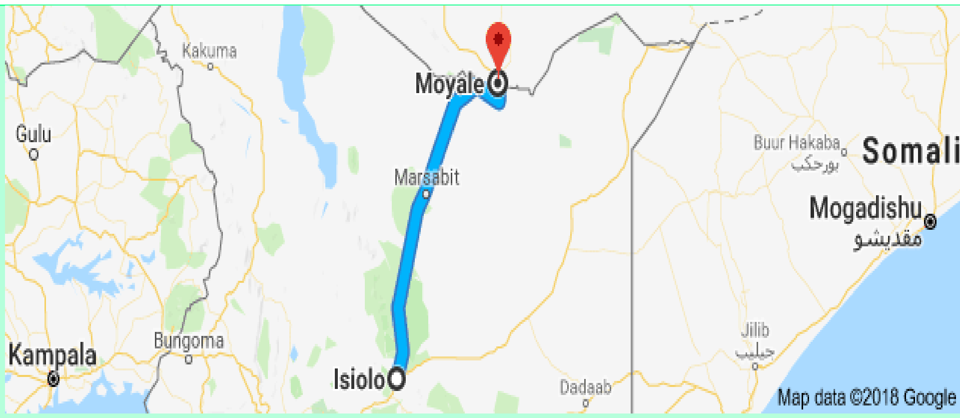
in the IGAD member states should be made a priority so that such personnel will be available before or soon after project completion in order to avoid dependence on hired external managements. Knowledge transfer and skills development of IGAD member state workers should be written into the terms of the contract with the developer, and regional agencies should work with national universities to develop training and certification staff

- Arising from the experience of the concession, ***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 Secretariat should spearhead the establishment of integrated technical standards and system for the region and comprehensive guidelines for infrastructure sector policies
- The secretariat should advocate for strengthening of linkages 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 sceptical of the project and the impact that it will have on their community.

provide for sustainable development of infrastructures and exploitation of resources ***Political will and support by governments to develop cross border infrastructure projects*** **- Political clout 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**	

Transport Sector Case Studies

Case Study 1: Isiolo – Moyale Highway

<table>
<tr><th>Project title</th><th>Upgrading of the Isiolo/Moyale Road to Bitumen Standard</th></tr>
<tr><td>Location</td><td>Kenya</td></tr>
<tr><td>Cost Estimate</td><td>US$420 Million</td></tr>
<tr><td>Countries Linked</td><td>Kenya and Ethiopia</td></tr>
<tr><td>Contracting Authority</td><td>Kenya National Highways Authority (KeNHA)</td></tr>
<tr><td>Map</td><td>
</td></tr>
<tr><td>Description</td><td>This project involved the upgrading to bitumen standards of the Trans African Highway from Isiolo to Moyale. It was divided into three segments namely; (Merile River/ Marsabit, Marsabit/Turbi and Turbi/Moyale. As the completion of the entire road link was necessary in order to realise it full benefit, the designs, funding and procurement of contractors were synchronised among the three segments and the Moyale/Agremariam segment in Ethiopia.
The road project details are as follows:
<table>
<tr><th>Road Segment</th><th>Length (Km)</th><th>Cost (Million US$)</th><th>Completion Date</th></tr>
<tr><td>Isiolo – Merile</td><td>136</td><td>62.0</td><td>2011</td></tr>
<tr><td>Merille – River Marsabit</td><td>123</td><td>137.0</td><td>2017</td></tr>
<tr><td>Marsabit – Turbi)</td><td>121</td><td>130.0</td><td>2017</td></tr>
<tr><td>Turbi – Moyale</td><td>128</td><td>12.0</td><td>2016</td></tr>
</table></td></tr>
<tr><td>Outcome and Impact (what did the case study in question achieve? Or what does it set out to achieve?)</td><td>The construction of this road has had the following main outcomes:

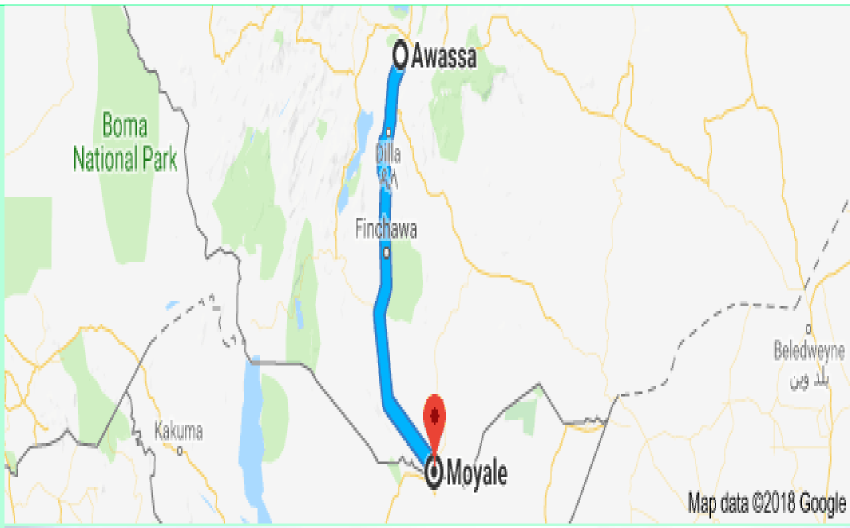
Seamless surface transport between Nairobi and Addis Ababa;
Travel time between Nairobi and Moyale (Kenya/Ethiopia border town) reduced from about 3 (three) days about 8 (eight) hours;
Security stabilised among local communities resulting in the reduction of inter-community conflicts;
Increased trade between Kenya and Ethiopia and rest of the IGAD region;
Improved market access for agricultural and livestock products in the domestic and cross-border markets; and
Improved government services including security
</td></tr>
<tr><td>Critical Success Factors</td><td>The success of the construction of the road was enhanced by the following favourable factors:</td></tr>
</table>

(what accounted for the success of the project?)	• Packaging of the project jointly with those in neighbouring Ethiopia where design, resource mobilisation, tendering and construction were synchronised to have the entire road network completed between Isiolo in Kenya and Awasa in Ethiopia. • Funding was provided by the African Development Bank for Marsabit/Moyale segment in Kenya and the Ethiopian segment (Moyale/Agremariam) while the remaining segment (Merille River/Marsabit link) was funded by the European Union. • This road also forms an important segment of the LAPSSET Corridor which has been accorded high priority for Kenya, Ethiopia and South Sudan
Challenges (what difficulties were encountered implementing or operationalising the project?)	This road comprised four segments all implemented by different contractors.The following were the main challenges: • Delays in the works on the Merile River to Marsabit and the Marsabit to Turbi segments caused by insecurity hostilities between the nomadic communities; and • Long distances for the procurement of building materials for the Merile River/Marsabit and the Marsabit/Turbi segments.
What lessons can be learnt from the case study for the design and implementation of IGAD trans-border projects?	• The main lessons learnt on the construction of this road segment was the willingness of lending institutions and development partners appreciation of coordinated interstate projects where transport infrastructure is planned for seamless interconnection. • The AfDB funded all the three Ethiopian segments and another two segments in Kenya (Moyale/Turbi and Turbi/Marsabit) while the European Union funded the remaining segment in Kenya (Marsabit/Merile River) to complete the interstate link from Isiolo to Awassa. • The needs to have coordination of 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.
Other comments	This road is part of the Trans-African Highways network and will link the Northern, LAPPSET and Kismayu corridors

Case Study 2: Moyale – Agremariam Road

Project Name	**Moyale - Agremariam Road**
Location	Ethiopia
Countries Linked	Ethiopia and Kenya
Contracting Authority	Ethiopian Roads Authority
Financiers	AfDB and Government of Ethiopia

Map



Description

The Moyale - Agremarian road was constructed in the 1970's but needed rehabilitation and capacity expansion to attain the TAH recommended standards. In addition, a provision was made for the construction of an OSBP.

The rehabilitation of the road facilitated the reduction of vehicle operating costs and the cost of freight and passengers transport. The new road was also to improve the land transport connectivity between Kenya and Ethiopia.

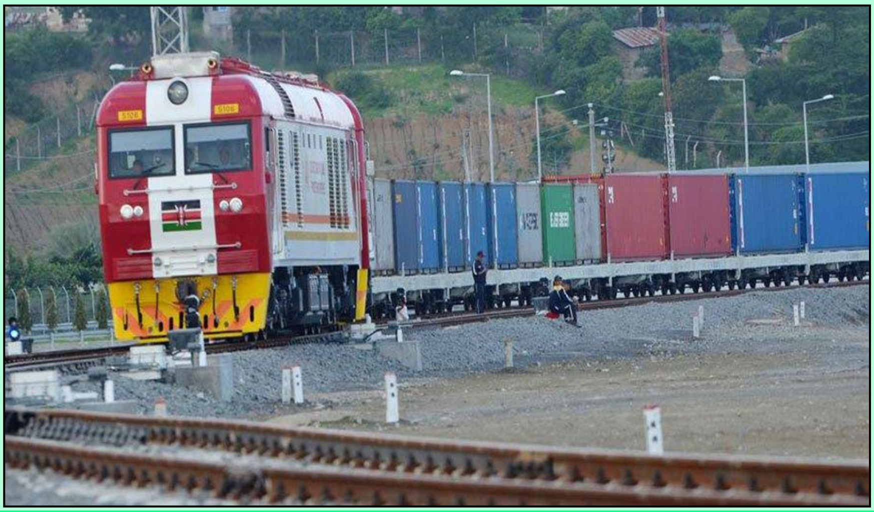
The road was constructed under the three contracts as follows:

Segment	Length (Km)	Cost (US$)	Completion Date
Moyale-Mega	109	70.0	2017
Mega – Yabelo	98	62.0	2014
Yabelo – Agremariam	94	58.0	2014

Outcomes and Impact	• The road links the southern part of Ethiopia, an important coffee growing part of the country with the regional capital of Awassa and national capital Addis Ababa. • The rehabilitation of the road is a continuation of Ethiopian government's efforts to improve the standard of Trans African Highways and its import-export corridors to minimise the transport costs for domestic transit traffic. • At the regional and continental levels, the rehabilitation of this road together with the construction of the One Stop Bordet Post (OSBP) in Moyale completed the Cape to Cairo link which had been outstanding for over forty years. • At the national and local levels, the road opens up business opportunities within the Oromia sate and access to Addis Ababa and other regions in Ethiopia. It also provides connectivity with the rail served part of Ethiopia through the city of Modjo which is on the Djibouti/Addis Ababa SGR line. It also provides opportunities for tourism into the southern parts of Ethiopia. • During construction, business was provided to local subcontractors, suppliers and employment opportunities were provided to both skilled and other unskilled workers along the road routing. The road also facilitates better business environment for the agricultural and livestock farmers to receive inputs and access markets for their products.
Critical Success Factors	The success of the construction of the road was enhanced by the following favourable factors: • There was already an existing paved road built in the 1960's but not to the standards of the regional trunk road networks; • Packaging of the project jointly with those in neighbouring Kenya where design, resource mobilisation, tendering and construction were synchronised to have the entire road network completed between Isiolo in Kenya and Awasa in Ethiopia; and • Funding was provided by the African Development Bank for the Ethiopian segment together with Marsabit-Moyale segment in Kenya while the remaining segment of the Isiolo-Marsabit link was funded by the European Union. • This road also forms an important segment of the LAPSSET Corridor which has been accorded high priority for Kenya, Ethiopia and South Sudan.
Challenges *(what difficulties were encountered implementing or operationalising the project?)*	While the Awassa-Moyale road had already been constructed to bitumen standard in the 1970's, the specifications were not to the standards of the regional highways and it had already been dilapidated hence requiring rehabilitation. The following were the major challenges faced during the rehabilitation of the road: • Compensation for property owners delayed the final segment at the Moyale OSBP; • The property owners put injunctions for completion and the contractor left the site prior to the completion of one link to the OSBP; and • Road construction work was interrupted by a number of insecurity incidents along the route especially towards the border
What lessons can be learnt from the case study for the design and implementation	• The main lessons learnt on the construction of this road segment was the willingness of lending institutions and development partners appreciation for coordinated interstate projects where transport infrastructure is planned for seamless interconnection. • The AfDB funded this road in Ethiopia, the OSBP in Moyale and two segments of the road Isiolo/Moyale road in Kenya. The European Union funded the Merile

of IGAD trans-border projects?	River-Marsabit segment completing all the missing links for TAH4 • It would be advisable for the IGAD countries to emphasise on the coordination of 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.
Other comments	The rehabilitated segment completes the remaining segments of the Cape to Cairo TAH in Ethiopia and provides southern Ethiopia with access for LAPPSET Corridor and for trade with Kenya.

Case Study 3: Nairobi – Mombasa Standard Gauge Railway

Project	**Construction of the Mombasa/Nairobi Standard Gauge Rail (SGR)**
Location	Kenya
Cost Estimate	US$ 3.4 Billion
Countries to be served	Kenya, Uganda, and South Sudan
Funding	Exim Bank of China and Government of Kenya
Contracting Authority	Kenya Railways Corporation
Map	
	
Description	The Mombasa-Nairobi Standard Gauge Railway (SGR) project was the first SGR line implemented under the East African Railway Masterplan. It is a 485-kilometre-long single-track rail with a gauge 1.435 meters. The railway runs from the port of Mombasa to Nairobi with primary stations in Mombasa, Mariakani, Miasenyi, Voi, Mtito-Andei, Kibwezi, Emali, Athi River and Nairobi and with minor passing stations. Following the signing of a Memorandum of Understanding (MOU) between the Kenya Government and the China Road and Bridge Corporation (CRBC) in 2011,

	Kenya negotiated financing with the China Exim Bank. Negotiations were finalised in May, 2014. The project cost US$3.6 billion and the Exim Bank of China extended a loan for 90 percent of the project cost while the remaining 10 percent coming from the Kenyan government part of which was raised through a levy on goods passing through Mombasa port. Traction is by diesel electric locomotives. The laying of the track commenced in 2014 and was completed in December 2016. After initial trial runs, passenger services were inaugurated on 31 May 2017. Commercial freight services commenced on 1 January 2018.
Outcome and Impact ***(what did the case study in question achieve? Or what does it set out to achieve?)***	The construction of the SGR has had the following main outcomes: • Resumption of regular and reliable freight and passenger services between Mombasa and Nairobi that had experienced considerable decline in the previous two decades; • Passenger travel time between Nairobi and Mombasa reduced from over 15 hours to 5 hours; • Freight transit time on the Mombasa/Nairobi sector reduced from over 24 hours to 8 hours; • Congestion in the Mombasa port container Terminal reduced • Improved safety in public transport
Critical Success Factors	The success of the construction of the railway was enhanced by the following favourable factors: • Loan facilities extended on favourable terms by the Exim Bank of China and counterpart domestic funding obtained from the rail levy; • Rapid mobilisation by the contractor with required equipment and skilled expatriate and local personnel; • This rail also forms an important segment of the LAPSSET Corridor which has been accorded high priority for Kenya, Ethiopia and South Sudan
Challenges	• The project upon commencement was faced with intense public critique with debates that were heavily based more on political inclinations than on the rigorous assessments of SGR economic and social benefits; • The issue of rights of way became a challenge as landowners some of whom were speculators demanded heavy compensation; • While the track network was completed in a record time actually ahead of schedule, other ancillary facilities such as intermodal links with road to evacuate freight and passengers for the last mile were not in place; • There was lack of sufficient skilled personnel in terms of rail sector engineers, technicians, operators, planners and managers as the such personnel from the old railways had retired or retrenched many years earlier and capacity building even at the railway training school had almost ceased • Although there training has commenced especially for technical staff who are taken to China, a lot of additional training for technical, operational and management personnel will need to be undertaken in order to provide sufficient local staff to run the expanding rail network in the country.
Lessons Relevant for the Design and Implementation	The Mombasa/Nairobi SGR projects provides many lessons for the design and implementation of similar projects in the IGAD and other regions in the continent and the following are pertinent: • The design of rail projects where routing avoids existing cargo terminals or

of IGAD Interstate Projects	passenger stations should consider issues such as intermodal links for delivery of cargo from the new terminals and the flow of passengers; • The designs should also consider in depth the current and potential sources of traction and incorporate electric traction to avoid additional costs of installing such traction in the near future after realising the omissions made; • 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; • Capacity building for local personnel 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. • The development of new rail networks should be structured in sync with counterpart intermodal projects such as roads and commuter trains so that they are ready on or immediately after commissioning of the project to avoid congestion in new terminal or passenger stations; and • Capacity building to provide for skills and knowledge transfer for national labour force should be a high priority and should include the identification and resourcing of centres of excellence that can provide training and certification of experts for groups of countries.
Other Comments	Further extensions are planned for Nairobi – Naivasha - Kisumu to Malaba to link and connect to the planned Ugandan and South Sudan networks

Case Study 4: Ethiopia – Djibouti Standard Gauge Railway

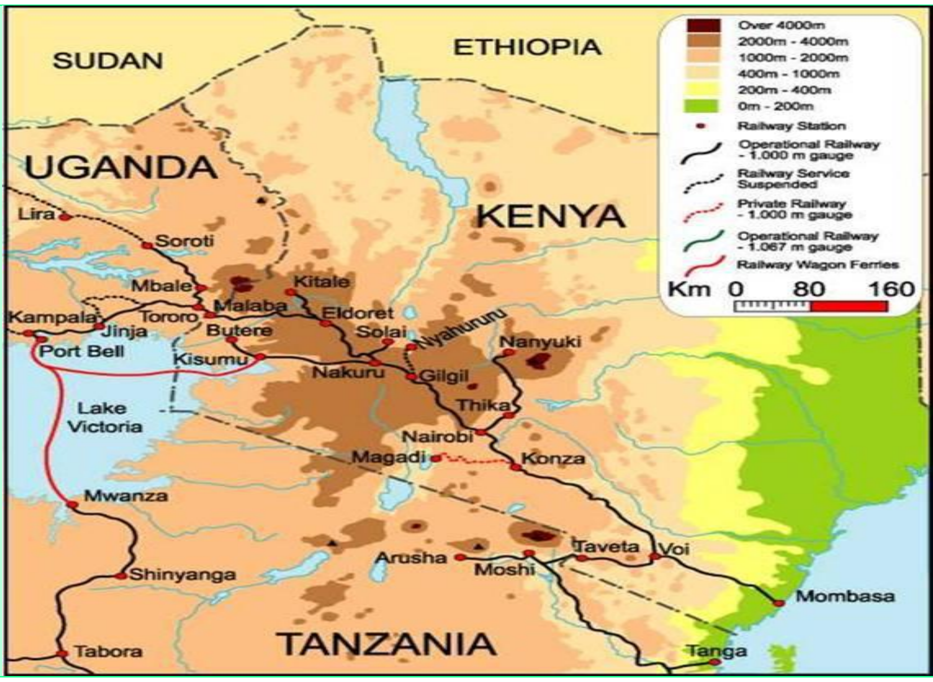
Project	**Construction of the Ethiopia-Djibouti Standard Gauge Rail (SGR)**
Location	Djibouti, Ethiopia
Cost Estimate	US$3.0 Billion
Countries to be served	Djibouti, Ethiopia, South Sudan, Sudan and Uganda
Funding	Exim Bank of China, China Development Bank, Industrial and Commercial Bank of China and Government of Djibouti and Government of Ethiopia
Contracting Authority	Ethiopian Railways Corporation
Map	 
Description	The Ethiopia/Djibouti Standard Gauge Railway (SGR) project was the first standard gauge network to be constructed in the Eastern and Horn of Africa region. The line commences from the port of Djibouti to Addis Ababa the Ethiopian capital. It is 759 kilometers long with a gauge 1.435 meters. While the line is mainly single track, the Addis Ababa-Adama section has double track. The railway alignment is principally parallel to the old meter gauge rail. The principal stations in Djibouti are Doraleh, Nagad and Al Sabieh while in Ethiopia

	they include Dewele, Dire Dawa, Awash, Adama, Moijo and Sebeta (Addis Ababa). The design capacity is about 25.0 million tonnes of freight annually, with a volume of 6 million tonnes expected by 2023. The railway was constructed under three contracts with two segments in Ethiopia and one in Djibouti contracted to different Chinese companies. The project cost US$3.0 billion where US$2.4 billion expended on the Ethiopian side and US$0.6 billion to the Djibouti side. Financing was provided by Exim Bank of China with additional funding from China Development Bank and the Industrial and Commercial Bank of China. Traction is by electrified locomotives. The laying of the track commenced in 2011 and the line was commissioned in October 2016. After trials, commercial full rail services commenced on 1 January 2018.
Outcome and Impact	The construction of the SGR has had the following main outcomes: • Resumption of regular and reliable freight and passenger services between Djibouti and Addis Ababa that had ceased after the failure of large segments of the original narrow-gauge railway; • Passenger travel time along the entire network were reduced with total time between Djibouti and Addis Ababa reduced from over 36 hours to about 11 hours; • Freight transit time on the Djibouti and Addis Ababa was reduced from over 72 hours to 12 hours; • Delays for Ethiopian cargo at Djibouti port and were reduced significantly; and • There was improved safety in public transport in both countries
Critical Success Factors	The success of the construction of the railway was enhanced by the following favourable factors: • Construction of the railway was backed by the Growth and Transformation Plan (GTP) a national five-year plan which set high targets for economic growth and hence made infrastructure development a high priority; • Loan facilities extended on favourable terms by the Exim Bank of China and counterpart domestic funding obtained from the rail levy; • Rapid mobilisation by the contractor with required equipment and skilled expatriate and local personnel; and • The property owners were largely satisfied with the compensation granted and hence the rights of way for the rail infrastructure were not extensively contested.
Challenges	While the railway was built as a turnkey project, key accompanying infrastructure was not adequately provided for and during handover the railway was not ready especially for commercial freight operations. The following were the major challenges faced: • The line did not include adequate access roads, spur lines, branch lines, storage facilities, goods handling facilities or dry ports; • The beneficiary states decided to build the mainline first and provide the other required integration infrastructure later on a gradual basis; • Many of the railway stations were built far outside the city centers and even outside the towns they were intended to serve; • Spur lines were not provided to the primary terminals such as in Dire Dawa and Addis Ababa and the infrastructure for handling bulk goods and fuels was

	omitted; and • The budget allocated for construction of the railway was not sufficient to complete the necessary ancillary infrastructure to enable it launch full operations on commissioning
Lessons Relevant for the Design and Implementation of IGAD Interstate Projects	The Ethio/Djibouti SGR projects provides many lessons for the design and implementation of similar projects in the IGAD and other regions in the continent and the following are pertinent: • The design of rail projects where routing avoids existing cargo terminals or passenger stations should consider issues such as intermodal links for delivery of cargo from the new terminals and the flow of passengers; • 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; • Capacity building for local personnel 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. • The development of new rail networks should be structured in sync with counterpart intermodal projects such as roads and commuter trains so that they are ready on or immediately after commissioning of the project to avoid congestion in new terminal or passenger stations; and • Capacity building to provide for skills and knowledge transfer for national labour force should be a high priority and should include the identification and resourcing of centres of excellence that can provide training and certification of experts for groups of countries.
Other Comments	The railway is to be operated by the Ethio-Djibouti Standard Gauge Rail Transport S.C., a company jointly owned by Djibouti and Ethiopia with headquarters in Addis Ababa. The company ownership by share capital is 75% by Ethiopia and 25% by Djibouti.

Case Study 5: Kenya – Uganda Railways Concession

Project	**Concession of the Kenya -Uganda Narrow Gauge Transport**
Location	Kenya
Cost Estimate	NA
Countries Linked	Kenya and Uganda
Contracting Authority	Kenya Railways Corporation



Description	Concession Agreements (Kenya Concession Agreement Uganda Concession Agreement) took effect from April 7, 2006. Other agreements between the parties to which the Concession was subordinate were the Interface Agreement and Direct Agreements with lenders. In November 2006 both Kenya and Uganda concessioned their operational rail network to the Rift Valley Railways (RVR) on a 25- year freight concession and a 5 -year passenger concession for Kenya. The total length of running lines conceded was 1,920 kms consisting of Mainline: Nairobi-Mombasa - Malaba 1,083 km as the operating line to Uganda. The principal branch lines in Kenya: Nairobi - Nanyuki line 235km, Nakuru - Kisumu line 217km. The concession commenced, the inventory of locomotives and rolling stock handed over to concessionaire consisted of 139 mainline, 49 light, 43 shunters. The fleet of serviceable wagons fleet included 3,212 wagons. The Passenger coaches were 175 in number. There was also the one serviceable rail wagon ferry. The history of performance of the concession was as below; From November 2006 to June 2010 the railways share of the transport market dropped from 10% to 8%; RVR made insignificant investments and maintenance suffered serious neglect over the period;

	RVR defaulted on most provisions of the Concession Agreement and concession was headed for termination; As a way out, Kenya and Uganda agreed to a restructuring of the concession to address the poor performance. Shetland the main shareholder offloaded its shares to the Egyptian firm Qalaa Holdings. Qalaa on entry controlled 80% of RVR. The concession was restructured and supported as below: • Lenders provided USD 164 million for investment into the conceded assets, and a shareholder's equity injection of USD 82 mn was made. The Loan Agreements were signed in August 2, 2011.; • Management of the concession was strengthened by engaging America Latino Logistica (ALL) as a technical partner; • The Concession debt was restructured to be paid over 12 months; and • Performance targets adjusted.
Outcome and Impact	• The railways network in Kenya and Uganda had a share of nearly 20% of the transport market share within the country before concession. However, this shrunk to as low as 2% by the time the concession of the railway network failed. • The full operating capacity of the Kenya and Uganda railways network was undermined by poor state of the infrastructure and rolling stock together with poor oversight on the running of the concession.
Critical Success Factors *(what accounted for the success of the project?)*	The success of the concession agreement was based on the following factors: • The two governments had been shouldering heavy financial burden to support money losing railway services. There was little opposition from the railway industry as most of its labour force had already been retrenched • The critical failures of the concession were the following: • Failure to maintain assets to the required standards; and • Failure to meet freight volume targets. • The concessionaire could not provide efficient and reliable services • Low revenues could not achieve financial sustenance. • Unsound board decisions with regard to investment and manpower services (human capital)
Challenges	• The main challenges of the concession were: • Inability by concession grantors and transaction advisers to effectively evaluate the capacity of the concessionaire to operate the railway services sustainably; • Concession terms did not provide for clear verifiable services performance indicators; • Poor transaction advisory services; and • Lack of capacity by the Concession Grantors to negotiate with concessionaires;
What lessons can be learnt from the case study for the design and implementation of	• The concession was essentially a net-cost contract with investment that failed to deliver on its goals. The concession structure was flawed from the start specifically on the legal and regulatory fronts and to monitor the performance of the concession.

IGAD trans-border projects?	• Arising from the experience of the concession, it is necessary in future to adopt guidelines for the railway sub-sector to cover safety, infrastructure financing, regional level certification requirements for freight and passenger services and provision of common rail statistics. • There is need to set up integrated technical standards for national and regional rail systems and comprehensive guidelines for common transport policy covering all transport modes. • As far as integration of the railway sub-sector is concerned, for RVR concession, there was serious overlapping in the two countries legal frameworks and therefore harmonisation to common legal framework for commercial operations as related to transit and trade facilitation would be required.
Other comments	• As the railway networks are being upgraded to standard gauge in both Kenya and Uganda the issues of operations will emerge and where open access by operators will require proper concession agreements that will need to be negotiated and supervised for the required levels of performance • Legal and regulatory issues will need to be in place; • Capacity to monitor and regulate the concessions will need to be developed

Case Study 6: Lamu Port

Project title	**Lamu Port**
Location	Lamu County, Kenya
Cost Estimates	US $480 Million
Funding Source	Government of Kenya
Countries to be served	Kenya, Ethiopia and South Sudan

Map

Description	The deep-sea port of Lamu at Manda Bay, Lamu County was first proposed in 1975 under the East African Harbours Corporation. Initial feasibility study was undertaken under the East African Ports Development Study but the development of port facilities was not pursued until it was revived and incorporated in the NEPAD Priority Projects in 2003. It was then adopted as a key project in Kenya's Vision 2030, launched in 2008. Following a feasibility study conducted for the LAPSSET Corridor, the port potential

	was estimated to have a capacity of 32 berths consisting of 6 container berths, 21 general cargo berths, 4 dry bulk berths and 1 liquid bulk berth, and will have the capacity to handle 23 million TEUs annually by 2030 – making it the second largest container port in Sub-Saharan Africa and largest in East Africa. The port is one of the anchor projects for the LAPSSET (Lamu Port-South Sudan-Ethiopia Transport) Corridor Programme, which comprises the following components: Lamu port; roads; SGR railway; crude and product oil pipelines; international airports; resort cities in Lamu, Isiolo and Lake Turkana; multipurpose High Grand Falls Dam; and Special Economic Zone in Lamu. The LAPSSET Corridor Development Authority (LCDA) was established in March 2013 to plan, coordinate and manage the implementation of LAPSSET. The feasibility study and a Masterplan for the port was completed in 2010 and ground was broken in 2012, followed by the tendering and ESIA in 2013. Contract award to the China Communication Construction Company (CCCC) and mobilisation for the construction of the first three berths were undertaken in 2015 and work began at the site in October 2016. This phase of the project is being financed by the Government of Kenya through the national budget and is being managed by Kenya Ports Authority (KPA). The works were 55% complete as of October 2018 and completion is scheduled for September 2020. Subsequent phases are intended to be financed by private sector developers through competitive tendering. Negotiations are ongoing between KPA and the Lamu Port Consortium led by Transnet and Development Bank of Southern Africa (DBSA) to operate the first three berths and develop the next three berths. The cost of the first three berths is approximately $480m. Subsequent phases will be developed and financed by the private sector, with the trigger for development being 80% occupancy of existing berths.
Outcome and Impact (what did the case study in question achieve? Or what does it set out to achieve?)	Once complete, Lamu Port and the LAPSSET Corridor will provide access to an efficient transport network for over 100 million people, a key handling point for goods from South Sudan, Ethiopia and the Lamu SEZ, and will serve as a transhipment hub for the Eastern and Horn of Africa regions. It will also provide much needed increase in capacity in addition to the ports of Mombasa (for Kenya and South Sudan) and Djibouti (for Ethiopia). At present, Ethiopia relies on the Port of Djibouti for 95% of its imports and exports while South Sudan and Kenya are reliant on the Port of Mombasa and the Northern Corridor. The draft capacities of berths in both Djibouti and Mombasa ports are not sufficient to cater for the new generation of container vessels such as New Panamax and Ultra Large Container Vessel (ULCV). The maximum draft for berths in Mombasa and Djibouti are 14.5 meters and 12 meters respectively. The New Panamax vessels have draft of 15 meters. Lamu port will have container berths of 18 meters draft– large enough to serve the largest container vessels currently in operation. Thus, it is proposed that Lamu will serve as a trans-shipment hub for the region increasing the competitiveness of region. At the national level, it is envisaged that the port will serve as the anchor project for a new port city of up to 1 million people, as well as an economic corridor spanning 50km on either side of the infrastructure corridor. This economic corridor will comprise the three resort cities, plus special economic zones, industrial parks, agro-processing plants, irrigation schemes, mining and blue economy (fishing and

	maritime) activities. Thus, development of the port will act as a catalyst for economic development to the north of the Kenya, a region which is currently undeveloped but with significant untapped potential. During the construction phase, the port is providing employment to 800 Kenyan workers and create more employment opportunities once it is completed. It is estimated that a total of 425,000 new jobs will be created in the new Lamu Port City of which 60% will be in manufacturing. There will be further indirect impacts on employment and wages in the agricultural and mining value chains that will provide inputs into the manufacturing firms in the SEZ.
Critical Success Factors (what accounted for the success of the project?)	The port is still in its early stages of development and the success of the project will depend on several factors among which will be the following: • Securing suitable private sector investors for the next phase of development and management of port operations; • Timely completion of the other LAPSSET Corridor infrastructure projects – in particular the roads and railways; • Effective structuring, phasing and packaging of infrastructure investments to ensure that they are economically viable and attractive to investors; • LAPSSET Corridor Development Authority has a critical role to play in coordinating the actions of the various stakeholders involved in the project – including in Ethiopia and South Sudan – to ensure that each fulfils their roles and responsibilities and all work together to effectively develop and manage the corridor; • Ethiopia and South Sudan are expected provide much of the demand for the port, therefore it is critical that all barriers to trade between these countries and Kenya are also addressed to ensure that cargo can flow smoothly along the corridor and costs are minimised; and • The development of the port and other corridor projects can provide a boost to the economy of a region that is at present underdeveloped and suffering from chronic instability. To maximise its impact, it is critical that strong linkages are established to local economies and job opportunities created for local workers. This will require strategic planning, training and capacity development for local firms and workers to ensure that they are in a position to take advantage of emerging opportunities
Challenges (what difficulties were encountered implementing or operationalising the project?)	• The greenfield nature of the project site presented some difficulty in attracting investors to develop the initial phase of the project, due to the high levels of risk and uncertainty involved. As a consequence, the Government of Kenya has had to finance the construction of the first three berths through the national budget; • The project has faced protracted clamours from speculative landowners who have been demanding high compensation for their properties at the port area and along the proposed rail and road routes; • There has also been a strong lobby of environmentalist who have opposed the development of the port arguing on the basis of preserving Lamu as a touristic and natural heritage location; • Transporting equipment and construction materials has been a challenge due to the remote location of the port site. The new highway to link the port to the national road network is due to be completed in 2019; • Kenya does not, at present, have sufficient workers to fill the highly skilled roles on

	the project (engineers, planners, managers etc.) and the majority of these workers are currently engaged on the Mombasa port expansion; • Despite the apparent skills gaps, there is currently no formal programme in place to transfer skills and knowledge from the Chinese contractors to local Kenyan workers; • Given the long-term and nationally strategic nature of the project, it should be expected that over time the proportion of positions (including high-skill and technical positions) filled by Kenyan workers will increase, so that by, e.g., the construction of berth 10 the vast majority of workers on the project are Kenyan.
What lessons can be learnt from the case study for the design and implementation of IGAD trans-border projects?	• Due to the complex and ambitious nature of the project, and its development on a new greenfield site with no pre-existing infrastructure, the project has encountered several challenges to date, from which lessons can be learnt and applied to the future development of the port, as well as other infrastructure projects: • When developing infrastructure projects on greenfield sites, it can be difficult to attract investors to develop the first phase due to the high level of uncertainty and risk involved. The Lamu port project overcame this by the Government of Kenya financing the first phase of construction from the national budget, which has led to increased interest from private sector players. • For similar projects in the future, it may be more efficient to establish a public-private partnership (PPP) with the government providing guarantees or part-funding of the project to lower the uncertainty and risk involved for private investors. • It is advisable to structure the phasing of complementary projects so that they begin / end simultaneously hence tendering for the package of investments together could also have the same effect. • For future phases, it is recommended that knowledge transfer and skills development of Kenyan workers is written into the terms of the contract with the developer, and KPA works with national universities to develop training and certification staff. • More effort needs to be made to strengthen linkages and create opportunities for the local community. At present, the port and associated infrastructure is developing as an economic enclave with few linkages and employment opportunities being created for the local Lamu County economy. As such, the local population are sceptical of the project and the impact that it will have on their community. • It may have been beneficial to construct the paved highway prior to beginning construction of the port to make it easier and less costly to transport construction materials.
Other comments	Arising from the experience gained from the high costs of land compensation, it is important to develop a clear policy on the valuation of properties that will discourage those who purchase land purely for speculative purposes.

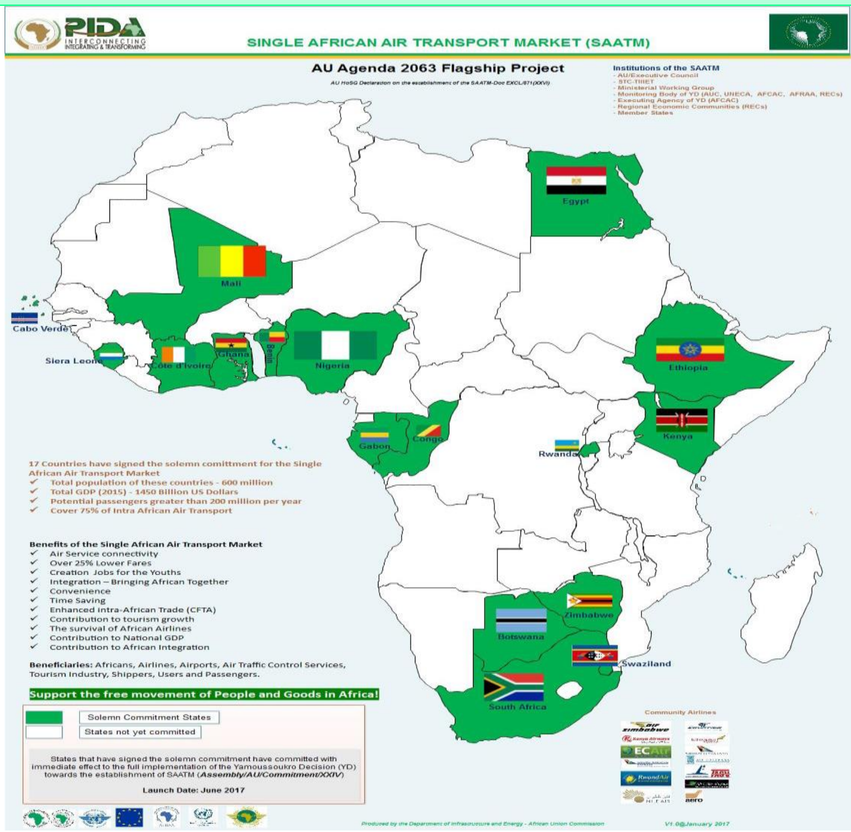
Case Study 7: Moyale One Stop Border Post (OSBP)

Project title	**Moyale OSBP Project Case Study**
Location	Ethiopia, 771 KM southeast of Ethiopia's capital, Addis Ababa
Map	
Description	The Moyale OSBP has recently been completed and is operational. It was conceived in 2011 when Ethiopia and Kenya signed a bilateral agreement to develop the joint border point and road in order to enhance bilateral trade relations. The OSBP is located on the Hawassa-Mombasa corridor that provides land-locked Ethiopia access to Mombasa port as an alternative to the port of Djibouti. The corridor and the Moyale OSBP serve the south part of Ethiopia, an area with unexploited trade potential. The implementing organisations are the Ethiopian Road Authority (ERA) and the Kenyan Revenue Authority (KRA). A regionally based consultancy, LASA Consult PLC, has been employed to ensure that target results are achieved. The Indian company, JMC, is the contractor of both the road from Hawassa to Moyale and the OSBP project implementation/construction. The OSBP project, the first of its kind in Ethiopia, has three components: • Construction of a road from Hawassa to Moyale (496 KM), • Construction of the OSBP facilities, and • Construction of the holding yard which is around 7 KM away from the OSBP building. Work commenced with construction of all the three components in 2014. The project has been financed by the African Development Bank. The road construction which links the Moyale OSBP and the main road network in Kenya was completed a year before the corresponding road on the Ethiopian side. The section from Hawassa to Dilla to Bule Hora road (196 Km) is mostly complete; a short section of the road is not complete and/or tarred besides, and the road from Yirgachefie to Dilla (38 KM) needs high attention. The road from Bule Hora to Moyale (300KM) is completed (tarred). As per the agreement between the two countries, the road construction will be finalised by the beginning of 2019. The supporting access roads for the border post have been completed. The construction of the OSBP building contains a secure server room, standby generator, and ASYCUDA World System. Border post security is enhanced by the installed CCTV, computers, printers and office equipment are distributed as well the holding yard are ready for commissioning albeit some constraints like quality issue of the building for example cracking of the floor and wall, leaking pipelines in the

	rest room and the housing for firefighting pumps are not finished (planned to be finished within 20 days in the month of November) and utilities are not equipped in yet at the holding yard. As part of border post management, the meeting of various stakeholders convened in the month of September 2018 from both countries at Mersa province and deliberated on the management of the border post.
Outcome and Impact ***(what did the case study in question achieve? Or what does it set out to achieve?)***	It is still too early to make a comprehensive assessment of the impact of the Moyale OSBP on transit time, border crossing time, costs, trade volume, and custom clearance documentation requirements. However, the substantial progress on construction of the OSBPs, together with the strong commitment from the respective stakeholders; border and government agencies to implement accompanying port transformations in border operations, advocate that the project outcome is likely to be achieved. For instance, the Hawassa-Moyale road will provide an important and efficient link between the Hawassa Industrial Park - the largest specialised Textile and Apparel Industrial Park in Africa - to the Moyale OSBP thereby facilitate export. This will in turn boost the economy of the local people along the road through employment, trading their own produces and so on.
Critical Success Factors ***(what accounted for the success of the project?)***	The factors crucial for the success of OSBP include: • The political commitment and support from the top would make everything is possible. • Learning from best practices and benchmark of similar projects. • Any development like OSBP should be implemented in a phased approach for consistence purposes and control. • Timely furnishing of the remaining facilities specifically scanner machine erection (Erection is expected to be complete after two months), availing utilities for holding yard and completion of roads in the components of the OSBP. • Effective management of border post is possible through the project's stakeholder's accomplishment of their responsibilities by both regional countries. • Develop the capacity of local community and enterprises to be able to capitalise on the opportunities emanating from the OSBP project.
Challenges ***(what difficulties were encountered implementing or operationalising the project?)***	• It is noted that the challenge of solving the issue, related to the demolition of the two hotel houses around the weighbridge where the loop road for the turning of loaded trucks and entering into the weighbridge, is not settled, hence the loop road is not constructed in yet even if the compensations were affected for the houses. Without such a loop road, there is likely to be a delay in materializing the full benefits of the OSBP. • Scanner machines erection has lagged behind though foundations for erection are under construction. • The area is prone to insecurity which is evidenced by one of the major reasons for the delay of the project is the conflict arose among Moyale dwellers due to various reasons. Thus, the contractor's staff went out of the town in search of security stopping the project and stayed till peace is instilled. • Lack of attention and monitoring on the progress of the project by the stakeholders particularly ERA, Ministry of Transport, and Custom Office.

	• Short of capacity building for custom staff as well as border agencies pertaining to the concept and practice of OSBP which is expected from the Indian contractors as part of skills and knowledge transfer. • The important staff to work with the operation of the OSBP both from Kenya & Ethiopia is not held their offices including Ministry of Agriculture, Quality Standard, and Bank whereas Immigration, Health Quarantine and Federal Police Investigation held their offices to equip them.
What lessons can be learnt from the case study for the design and implementation of IGAD trans-border projects?	The specific lessons from the OSBP project include: • Demonstrated support from government is a pre-requisite for the progress to be materialised which should be vivid through solving issues raised in the project such as decision making in the case of removing the hotel houses after providing appropriate compensations. • Considering the state of local insecurity, the government should provide guarantee for the risks involved through conflicts before the stoppage of project undertakings. • It is advisable to solve the project related issues before proceeding with construction of the port rather than resolving the issues after constructing some components of the port. • Capacity building endeavors including for local community should be the part of the project and agreement on this with the contractor must be binding. • All stakeholders should be able to receive real time information about their role and progress of the project and to that effect there must be an efficient communication mechanism between parties to convene their responsibilities. • Prudent monitoring system establishment to track the progress of the project must be done.

Case Study 8: Development of a Single African Transport Market (SAATM)

<table>
<tr><th>Project</th><th>Development of a Single African Transport Market -SAATM</th></tr>
<tr><td>Sector</td><td>Transport</td></tr>
<tr><td>Subsector</td><td>Civil Aviation</td></tr>
<tr><td>Location</td><td>African Union</td></tr>
<tr><td>Cost Estimate</td><td>NA</td></tr>
<tr><td>Countries to be served</td><td>African Union</td></tr>
<tr><td>Funding</td><td>AUC</td></tr>
<tr><td>Contracting Authority</td><td>AUC</td></tr>
<tr><td>Map</td><td>


</td></tr>
<tr><td>Description</td><td>The idea of establishing a Single African Air Transport Market - SAATM is part of the wider agenda of establishing the African Continental Free Trade Area -ACFTA and the African Customs Union within the framework of the African Regional Integration Programme that is based on the Abuja Treaty.

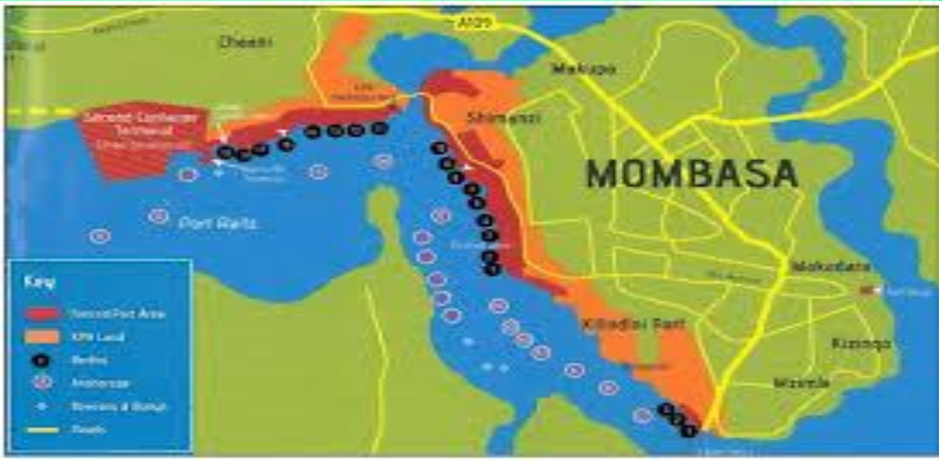
The idea of establishing an African Continental Free Trade Area was enunciated at the First All African People's Conference convened by Kwame Nkrumah in April 1958.

The African Union project is based on a similar motivation as the European Union project founded on the Treaty of Rome of 1956 had in reality the same objectives, to unite their respective continents</td></tr>
<tr><td>Outcome and Impact</td><td>The following were the outcomes in establishing the single African Air Market:</td></tr>
</table>

(what did the case study in question achieve? Or what does it set out to achieve?)	• Establishment of the African Airlines Association - AFRAA in 1968 • The adoption of the Yamoussoukro Declaration on air Transport of 1988 • The Yamoussoukro Decision of 1999 to implement the above declaration • The COMESA air transport services liberation Regulations, 1999 • The adoption of the AU Heads of State and Government Solemn Commitment of 2018 to implement the SAATM; and • The formulation and adoption of the Competition and Consumer Protection Laws of 2018 by the AU Heads of States and Governments in 2018.
Critical Success Factors	The Air Transport Liberalisation programme has not achieved the level of success that states expected following the adoption of the Yamoussoukro Decision. The following are the critical factors that would have ensured its successful implementation: • Willingness of states to grant the appropriate air traffic rights to each other; • Establishment and capacitation of a continental monitoring body as provided for in the YD. • Sustained growth in the regional air transport market has not grown at appropriate rates to justify investment and expansion in airlines; • State owned airlines have often been managed through patronage by governments and decisions taken on investment and management of airlines have not been favourable for competitive business in the industry; • Active inter-state business relations that create the demand for travel by businessmen and tourists; and • Removal of restrictions on ownership of airlines and air travel related undertakings by nationals of other countries
Challenges	The following are the challenges to the implementation of the Yamoussoukro Decision which may also encumber the SAATM programme; • The unwillingness of states with small airlines to grant extended traffic rights to regional airlines due to fear that their national airlines will be competed out of the market; • Travel restrictions among African countries imposed through visa requirements and other bottlenecks to travel; • Restrictions with respect of granting of equity in national airlines by larger regional or international airlines or by non-nationals hence denying African airlines the opportunity to benefit from access to capital, global business networks and experiences of expertise in the industry; • While the Yamoussoukro Decision provided for the setting up of a monitoring body to oversee its implementation, it took many years to designate AFCAC to carry out the mandate and once this was done, AFCAC has not been properly resourced to carry out the functions; and • It took a long time to develop the appropriate legal and regulatory instruments to enhance governance in implementing YD.
Lessons Relevant for the Design and Implementation	The African Air Transport Liberalisation provides many lessons for regional and continental initiatives.

of IGAD Interstate Projects	While the desire to cooperate is there, it takes commitment and allocation of resources to ensure such projects achieve their intended goals The following are the specific lessons that can be drawn from this important continental programme: • Need for the programme to be governed by shared principles and be well regulated. Liberalisation be based on a legal framework that incorporates the notions of frank partnerships and mutual assistance; • Establishment of the necessary intercountry institutions to oversight the liberalisation process; • Implementation needs to be gradual and flexible so that all nations can take part, on an equitable basis and preferably through in partnership; • Countries need to accept and appreciate some initial inequalities linked to the maturity of markets, the level of technological development, trade and technical capabilities as well as know-how; and • Need to provide adequately the necessary resources to fund the accompanying measures so as to ensure the complete success of the liberalisation process.
Other Comments	It will still require concerted effort AFCAC and the AUC to oversee the implementation of SAATM and the individual state parties, to implement the enabling legislation, rules and regulations, including the domestication of Competition and Consumer Protection Law already adopted by the AU Summit

Case Study 9: Phase I of the Mombasa Port Second Container Terminal

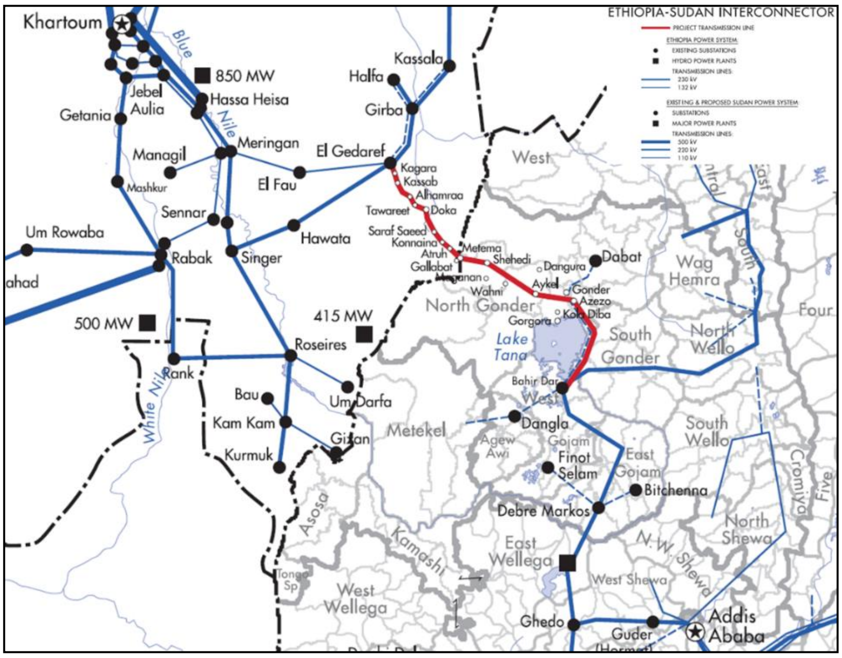
Project	**Phase I of the Mombasa Port Second Container Terminal**
Sector	Transport
Subsector	Ports
Location	Mombasa Port
Cost Estimate	US$ 280 Million
Countries to be served	Northern Corridor
Funding	Japanese Government Loan
Contracting Authority	Kenya Ports Authority
Map	
Description	The first phase of the Second Container Terminal at Mombasa port was built to relieve the port of vexing congestion that had encumbered its operations following the exhaustion of capacity from the older container terminal. The older terminal together with the Nairobi Inland Container Terminal (ICD) were built in the mid 1980's following increased global containerisation that also affected that the African continent. The design capacity of the old terminal was 250,000TEUs per annum but this capacity was surpassed in 2001 when throughput reached 290,500 TEUs. By 2011 when construction of Phase I commenced, annual container throughput at the port had reached 903,500 TEUs. The Phase I terminal design capacity is 550,000 TEUs increasing the total capacity to 800,000 TEUs per annum. The terminal berths have a draft of 11 meters which can handle Post Panamax vessels of 60,000 DWT The terminal was commissioned in September, 2016. Phase II of the Second Container Terminal which is currently under construction will provide an additional capacity of 450,000 TEUs.
Outcome and Impact ***(what did the case study in question***	The following were the outcomes in establishing the single African Air Market: • Capacity increase of 550,000 TEUs per annum bringing the total capacity to 800,000 TEUs per annum;

achieve? Or what does it set out to achieve?)	• Larger vessels including Post Panamax vessels can be handled at Mombasa port; • Connection to the higher capacity SGR rail network; • Additional two high capacity access road outlets through Miritini and Port Retz airport road; and • Reduction of ship delays and terminal congestion
Critical Success Factors	The development of the port facilities took advantage of the support provided to Africa by Japan under the Tokyo International Conference of African Development (TICAD) initiative; Kenya Ports Authority had prepared a comprehensive port development masterplan which had identified the critical port infrastructure facilities that were required to meet the growing traffic levels that were projected; The Japanese loan had favourable terms with under the Special Terms for Economic Partnership (STEP) with an interest rate of 0.2% and a repayment period of 40 years including a 10-year grace period; Procurement of contractors was undertaken transparently, and supervision of construction was effectively carried out by a consortium of Japanese and Kenyan consulting firms
Challenges	The project prior to commencement faced the following challenges: • Litigation on compensation and relocation of property owners to provide for a new access road and rail to serve the terminal; • Environmentalist lobbies opposing the harvesting of sand to provide infill material for the quay and terminal facilities; • Once all the terminal facilities had been completed, there were delays in completing the access roads due to court injunctions placed by property owners who were contesting the compensation provided; • While the official policy was to have the terminal concessioned to the private sector to operate it, the procurement of the operator was encumbered by litigation from bidders who claimed that they had been unfairly excluded from the tendering process. The ensuing litigation processes delayed the procurement process and the terminal was ready before the operator was identified; and • Concessioning of the terminal was viciously challenged by the port workers' union which averred that its workers would lose their jobs and benefits if a private operator was to run it adjacent to the existing terminal which was operated by the incumbent state-owned corporation.
Lessons Relevant for the Design and Implementation of IGAD Interstate Projects	The development of the Second Container Terminal provides lessons that need to inform future projects in terms of the following issues: • Projects funding, procurement of contractors and supervision of works; • Rights of way and compensation of property owners; • Legal and regulatory issues in structuring and procuring concessionaires under the national PPP Acts; and • Handling interested parties such as workers' unions and port users

Other Comments	Whereas the Second Container Terminal has greatly eased congestion at the port, this came after many years of not taking action even as decision makers were aware that the port traffic levels had long surpassed the capacity of existing port facilities. The delays in providing for the new facility had seriously compromised the efficiency of the port resulting by making it costly to the maritime trade through ship congestion at berths cargo congestion and delays at the terminal.

Energy Sector Case Studies

Case Study 1: Nile Basin Initiative: Cross Border Ethiopia-Sudan interconnector

<table>
<tr><th>Project title</th><th>Nile basin Initiative: cross border Ethiopia-Sudan interconnector</th></tr>
<tr><td>Location</td><td>Ethiopia, Sudan</td></tr>
<tr><td>Map</td><td>


</td></tr>
<tr><td>Description</td><td>The Nile Basin Initiative (NBI) seeks to interconnect the electrical grids of the Nile equaitorial lakes countries with 1,000 km long transmission lines. With power passing at either 220 kV or 400 kV. The priority interconnectors for these are :

Kenya -Uganda interconnector – 254 km

Uganda-Rwanda interconnector – 172 km

Rwanda-Burundin – 200 km

Burundi-DRC -Rwanda - 545 km

Ethiopia-Sudan interconnection - Commissioned in 2013, this project has erected 296 km of line with a transmission capacity rating of 1200 MW. Around 1.4 million households - 8 million people - are expected to benefit from access to cheaper power. The power trade has increased Ethiopia's foreign-exchange earnings by US$8.8 million per year. The consumers in Sudan benefit from lower tariffs (US$0.05 per kWh for imported power, compared to US$0.096 per kWh from power generated domestically).

Zambia-Tanzania-Kenya interconnection – This will link the EAPP to the SAPP

The Project's development objective is to promote Ethiopia's power export revenue generation capacity through the development of regional trade opportunities in the context of the Nile Basin Initiative regional effort. The Project has two components:
a) construction of a transmission interconnection from GERD hydro power plant to Khartoum, Sudan through Rabek, and</td></tr>
</table>

b) strengthening Ethiopian Electric Power Corporation (EEPCo)'s institutional capacity to promote and implement regional power integration.

The Ethiopia-Sudan transmission interconnector is prioritised as PIDA project and is part of the larger North-south power transmission corridor. This involves construction of a 580km, 500 kV double circuit interconnector. The interconnector will have a capacity of 4 GW. The project is estimated to costs USD 1.81 billion and is currently at project structuring phase. The construction of the transmission line and the substations are expected to be completed by 2021 [2]

Ethiopia - Sudan Transmission Interconnector (Ethiopia section)

The 16km, 500 kV interconnector in the Ethiopian side starts at the Grand Ethiopia Renaissance Dam (GERD). GERD is a 6GW, USD 4.7 billion hydroelectric power project constructed on the blue nile. Its construction has drawn critique over 3 main issues including:-

- Socio-environmental impact
- Resettlement of people

Concern by Egypt that the dam could reduce its of 55.5 billion cubic meters of the Nile water.

Two transmission lines each of 500 kV will be installed from GERD to the Sudanese town of Rabak, 350 km away. The Rabak substation is rated at 500 kV.

Ethiopia - Sudan Transmission Interconnector (Sudan section)

In the Sudan section two new 500 kV capacitated sub-stations at Rabak (220 kV) and Jebel Aulia (220 kV) and power line extensions connect to the 500kV line from GERD. Currently Ethiopia imports about 200 MW from Ethiopia. During summer season (later April to end of July) it has been importing 300 MW to deal with the frequent power cuts that last upto 8 hours a day [3] .

Existing cross-border transmission line:- Ethiopia begun selling electricity to Sudan in 2012 upon completion of the 296 km, 230 kV Ethio-Sudan transmission line project. The line was built at a cost of USD 41 million. It has 3 section at Bahir Dar-Gondar, Gondar-Shehedie and Shehedie-Metema that connect with a transmission line in the Sudanese border town of Gedaref The power purchase agreement of the two country has a clause of "take up or pay" wherein Sudan has to pay for electricity and Ethiopia has to generate and supply electricity to Sudan regardless of whether Sudan uses it. Further in developing the interconnect on the Ethiopian Side, the Government of Ethiopia has partnered with the State grid corporation of China (SGCC) in a PPP arrangement. SGCC will develop the infrastructure on the Ethiopian side and will share in the revenue generated from utilisation of the line .

A single line diagram showing the interconnector is shown in *Fig 1*

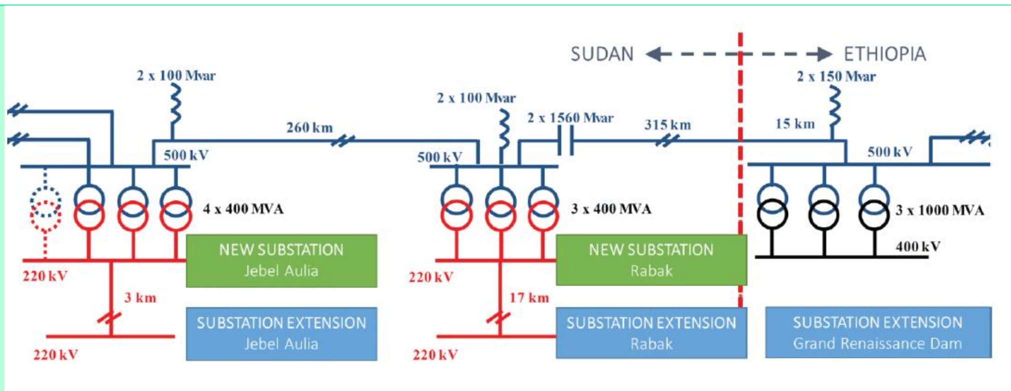


Fig 1:Single line diagram for the Ethio-Sudan interconnector

It will be noted that the Ethio-sudan interconnect is just one of the many interconnectors planned with neighbouring countries. Such interconnectors include (*Fig 2*):

Ethiopia-Sudan – currently connected using a 230-kV interconnector with power flow up to 250 MW. The second interconnector which is addressed in this case study will carry 3GW in a double circuit AC

Ethiopia-Djibouti – currently connected using a 230-kV interconnector. It has a power flow of 90 MW. A second interconnector from Dicheto, Ethiopia to northern Djibouti is undergoing a feasibility study.

New Ethiopia-Kenya interconnection – 2 GW, HVDC (construction to be completed in 2019). In the initial phase it will transfer 400 MW over ~1,200 km from Wolayta/Sodo to Longonot, Kenya.

New Ethiopia-Sudan interconnection - 3GW feasibility study completed

There are also plans for interconnections with the South Sudan and Somalia (northern and southern parts)

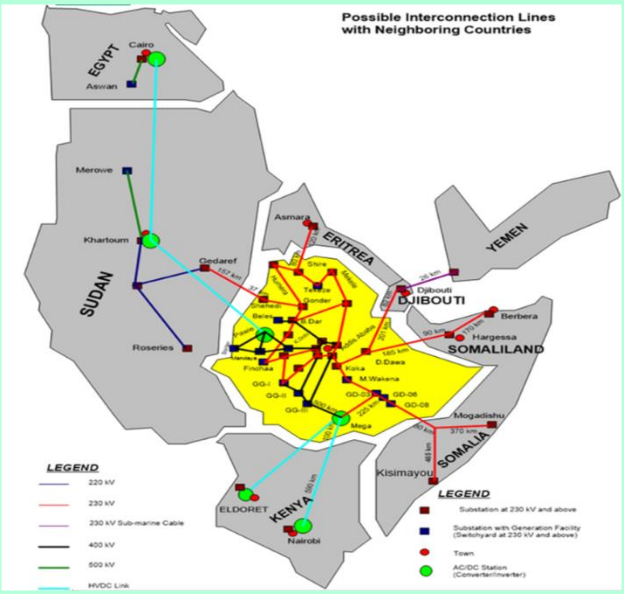


Fig 2:Potential cross-border electricity interconnectors

The most notable aspect of the Ethio-Sudan interconnect is the use of bilateral power

	trade agreement (BTPA) as a revenue model. The BPTA allows two things: - a) Power trading in a reciprocal manner, irrespective of the power plant that has generated the power i.e. something akin to net metering b) Both parties can act as buyers and purchasers according to price-differentials as well as market needs. The advantage of a BPTA is that it has fewer requirements than a PPA since it does not explicitly include clauses or conditions on specific power plants nor does it ensure bankability of specific assets. The Ethio-Sudan interconnect will have the following costing scheme for transmission lines only

Description	**Quantity**	**Unit cost, USD ('000)**	**Ethiopia USD$ ('000)**	**Sudan USD$ ('000)**	**Total USD$ ('000)**
500kV double circuit OHL GERD to Rabak	330 km	600	9,000	189,000	198,000
500 kV double circuit OHL, Rabak to Jebel Aulia	260 km	600	-	156,000	156,000
Substation series capacitors	2 set	31,000		62,000	62,000
500 kV line bay substation extenuation at GERD	2 set	2,500	5,000		5,000
500 kV line bay extension at Jebel Aulia substation	2 set	2,500		5,000	5,000
500 kV line bay substation extension at Rabak substation	4 set	2,500		10,000	10,000
Grand CAPEX costs			14,000	422,000	436,000

	Demand and supply projections Currently Ethiopia trads about 100 MW with Sudan, 65MW with Djiobuti using the 220-kV line. The country has also signed a 400 MW per
Outcome and Impact ***(what did the case study in question achieve? Or what does it set out to achieve?)***	The project will 6 elucidated impacts • To promote power system stability in the countries concerned; • To promote energy connectivity among the countries by assisting them to integrate their respective networks and thereby develop ability for building larger power projects to meet larger regional markets; • To develop ability to negotiate better terms for procurement of power equipment and technical assistance; • To reduce the cost of power in both countries; • In the long term, complete integration of the power systems in Egypt and Sudan;

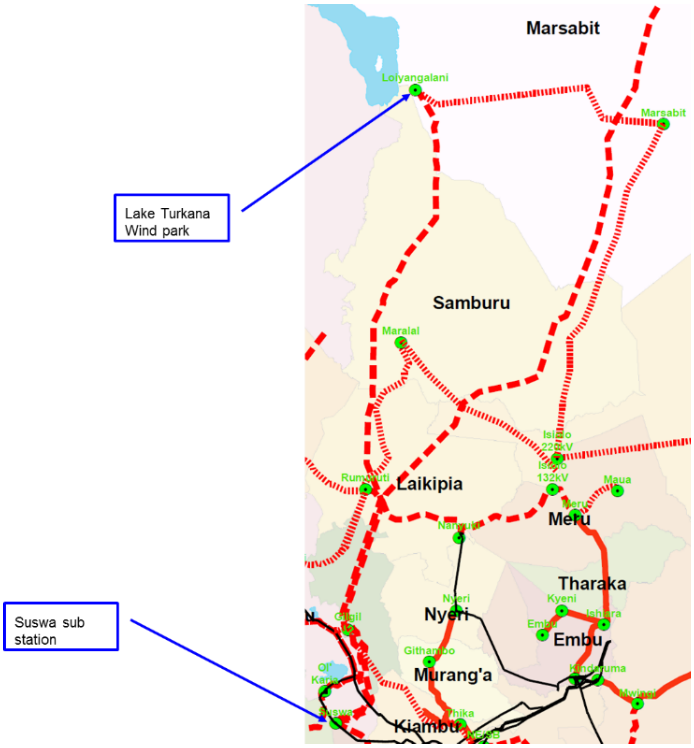
	and • To create productive employment and economic development across the borders. An outcome of the project includes the provision of transmission infrastructure to cater for future grid interconnections to other countries, promotion of regional cooperation through sharing of power generation resources and facilitation of rural electrification and improve the standard of living for the population in project areas. In addition, the integration of GERD into the Sudan electric power grid will increase system reliability and availability at a lesser cost in comparison with thermal generation.
Critical Success Factors *(what accounted for the success of the project?)*	The critical success factors for electricity transmission lines with respect to cross-border interconnectivity are ○ Increased short circuit currents: - ▪ Increase in installed generation capacity from GERD along with rising load levels tends to increase short circuit currents, hence threaten security of the power grid. Circuit breakers will need to be installed to effectively clear the faults [2] ○ Refineries development – The region can attain a lot by investing more on refineries – since the by-products of the refinery will add value to the industrial value chain ○ Emphasis on natural gas as a cooking fuel – it its endeavour to replace unsustainable biomass as a source of cooking fuel, the use of natural gas offers a cheaper better alternative. This may mean considering cross-border pipelines for natural gas as well as avoiding flaring the natural gas found in oil fields.
Challenges *(what difficulties were encountered implementing or operationalising the project?)*	• The biggest challenge for the region is acquisition of finance for infrastructural development and/or repair of the Infrastructure • Another is the assessment of potential energy generating capacities. • Lastly, is the lack of technical capacity for IGAD member countries to develop its human resources to build power infrastructure projects. It is noteworthy that in many cases the financing of the project is tied with the a constructing firm that related to the country that is providing finance.
What lessons can be learnt from the case study for the design and implementation of IGAD trans-border projects?	Various lessons are arising in terms of interconnectivity of pipeline. These challenges can be put in the following forms: • Funding for cross-border projects – the USD 4.7 billion USD GERD project is funded entirely from domestic funds no foreign investments. IGAD member states may consider that some projects may be funded from domestic funds. • Another approach towards funding of infrastructure projects is the use of partnership instead of loans. For instance, the Ethiopian section of the interconnect has been built under a PPP with the SGCC, which then shares in the revenue generated from utilisation of the line. Realizing that Ethiopia generated USD 73.4 million from exporting electricity to Djibouti, Sudan and Kenya – such a model then makes more sense.

	• In developing cross-border projects – simplified wheeling costs without taxes like transit tax, value added tax, corporate income tax, depreciation tax holiday, as well as free corridor where interconnect passes and purchasing of shares in the company managing the interconnect are but some of the key factors that make cross-border interconnection investor friendly. • In February 2018, Ethiopia has enacted a proclamation that will regulate public private partnership (PPP) arrangements, in an effort to attract investment and in recognition that the private sector is essential to supporting the country's economic growth and improving the quality of public services, particularly in infrastructure. IGAD member states can learn from this • Lastly the use of bilateral power trade agreement (BTPA) as a revenue model should be investigated further as addition to the East African power pool market system

Case Study 2: The Ethiopia-Kenya Interconnect with respect to the Lake Turkana Wind farm

Project title	The Ethiopia-Kenya Interconnect with respect to the Lake Turkana Wind farm
Location	Northern Kenya

Map



Description

The Lake Turkana project is located in Loyangalani district in Northern Kenya. It is the biggest wind farm in Sub-saharan Africa and comprises of 365 wind turbine generators with a maximum generating capacity of 850kW each for a total installed capacity of 310.25MW and a capacity factor of 62%. A 428 km, 400 kV double circuit transmission line from Loyangalani evacuates the power to Suswa substation. The same station is the one that is linked to the Ethiopia-Kenya interconnect (**Error! Reference source not found.**). The project costed 630 million euros (Kes 72 bilion) of which the deb component wa 475 millions (Kes 54.9 billion). The wind park is expected to supply 1,250 GWh per annum of green energy and offset 16 million tonnes of CO2 emissions.

The wind park (Table 0-1) will enhance the interconnect from 500 HV DC interconnector from Ethiopia while also providing additional energy for the planned Isinya-singida line that is part of the Zambia-Tanzania-Kenya (ZTK) interconnect. The ZTK interconnect links Kenya to the Southern African Power Pool (SAPP). The wind park is adding about 18% of Kenya's current installed capacity of 1,600 MW. By mid-2019 the Ethiopian-Kenya Interconnect will become operational and add about 400 MW. By 2020 the exiting capacity will have risen to 3.9 GW, thus wind will provide about 12.5% of of the total installed capacity.

Table 0-1: Lake Turkana wind park technical characteristics

Description	Lake Turkana wind park
Wind Park area (km^2)	162

Year of commissioning	September 2018
Annual mean run-off (m^3/sec)	38
Cut-in wind speed	4 m/s
Rated wind speed (m/s)	14
Cut-out wind speed (m/s)	25
Turbine type	Vestas V52 (variable speed Pitch-regulated upwind turbine)
Number of turbine	365
Rated output / turbine (kW)	850
Installed wind park capacity (MW)	310.25
Hub height (m)	44
Rotor diameter (m)	52
Generator	365 units of double fed Asynchronous generator 690 V, with a grid frequency of 50 Hz.
Transformer	0.6kV / 33kV step-up transformer.
Average farm capacity (MW)	303
Average expected load factor	55%
Annual energy produced at 55% load factor (GWh)	1,388
Feed in tariff at 55% load factors (Eur cts / kWh	7.22
Average annual revenue (Eur millions)	104.1

Outcome and Impact

(what did the case study in question achieve? Or what does it set out to achieve?)

The addition of 300 MW into the grid – enhances the capacity of Kenya to rely less on its neighbour and be a net exporter of electricity through the power interconnectors. It is projected that by 2020 the total installed capacity will be 3.9 GW, and average excess capacity of 583 MW, if demand grows modestly (Table 0-2).

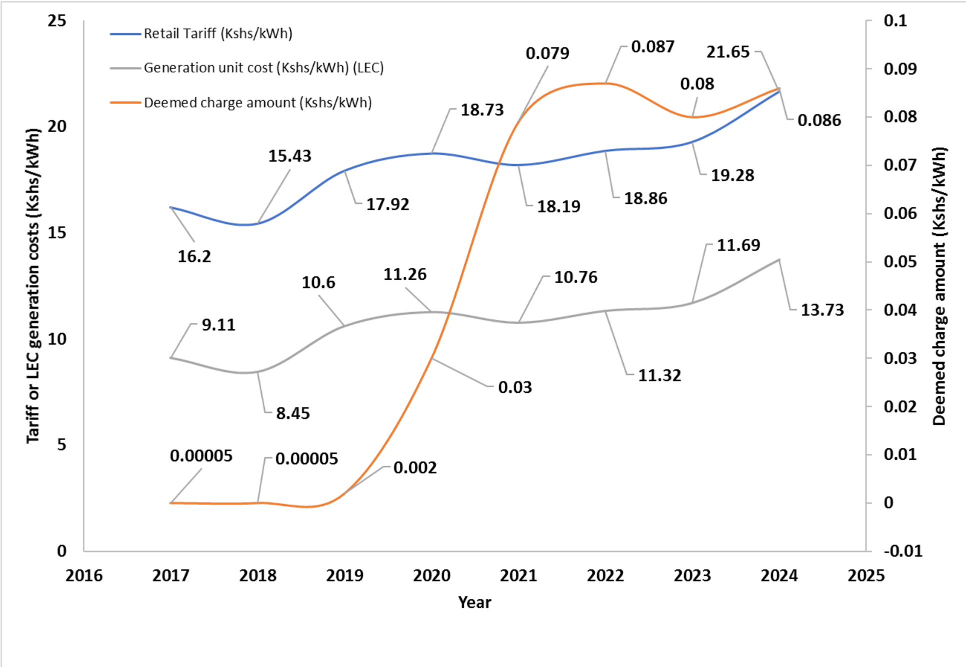
Table 0-2: Energy demand projects Kenya

	Ranges	2017	2037
Peak demand actual (MW)	1,586MW (2016)	1,656 MW (June 2017) 1,710 MW (Dec 2017)	
Low case scenario		1,754MW 10,465 GWh	4,763MW 27,945GWh
Reference case scenario		1,754MW 10,465 GWh	6,638MW 39,187 GWh
High case scenario		1,754MW 10,465 GWh	9,790MW 57,990 GWh

- However, the addition of 981.5 MW Lamu coal power plant in 2024 will results in surplus margin above 1.5 GW by 32%. This will impact the system Levelised electricity Cost (LEC) from Kshs 16.20/kWh in 2017 to Kshs 21.65 kWh by the year 2024 (a 24% increase).

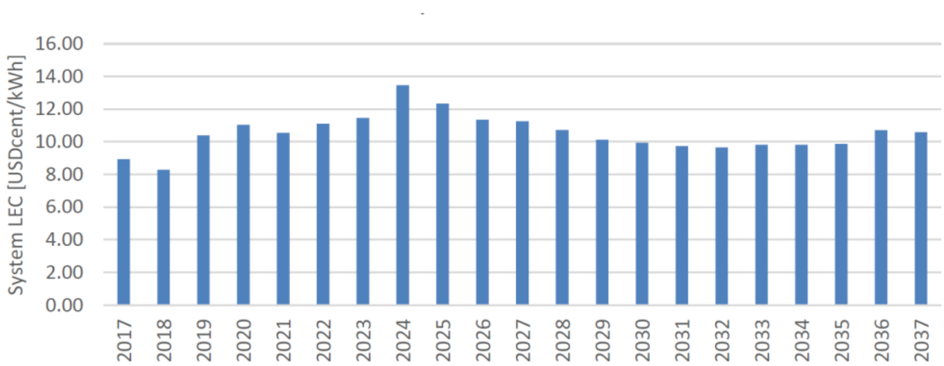
- On a year by year basis upto 2024, the LEC for generation, as well as retail tariffs will increase gradually reaching a peak in 2024 (). This is mainly attributed to (a) deemed charge amount ("take up or pay" clause in many IPP contracts) as well as in (b) the FiT tariff charges (Fig 3).

Fig 3: Energy costs projections upto 2024



Extrapolating Fig 3 to the medium term (upto 2037), the LEC of the system reduces slightly from Kshs 13.73 / kWh (13.73 USD cents/kWh) in 2024 to Kshs 10.5 / kWh in 2037 which is still higher than the 2017 costs (Fig 4).

Fig 4: LEC projections for the system under high demand scenario



- This will impact the quantity of energy imported particularly through the Ethiopian-Kenya interconnector (Table 0-3)

Table 0-3: Trend analysis of balance of imports and exports for energy into Kenya

	2012/13	2013/14	2014/15	2015/16	2016/17
Imports from EEPCO (GWh)		2.1	2.8	2.6	3.4
Imports from UETCL (GWh)	41	83	76	65	180

<table>
<tr>
<td></td>
<td>
<table>
<tr><td>Imports from Tanzania (GWh)</td><td>1.2</td><td>1.3</td><td>0.6</td><td>0</td><td>0</td></tr>
<tr><td>Exports to UETCL (GWh)</td><td>30</td><td>37</td><td>38</td><td>43</td><td>20</td></tr>
<tr><td>Exports to Tanzania (GWh)</td><td>1</td><td>2</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Effective net imports (GWh)</td><td>11.2</td><td>47.4</td><td>39.4</td><td>22.6</td><td>161.4</td></tr>
</table>
From Table 0-3 it is noted that over the years the effective net imports has been on a downward trend. The increased anomaly in 2016/17 could be attributed decreased hydrology / rainfall during this period, which resulted in purchase of more electricity from Uganda.
</td>
</tr>
<tr>
<td>Critical Success Factors

(what accounted for the success of the project?)</td>
<td>The critical success factors for grid tied renewable energy power plants with respect to interconnectivity are

Interconnectors development: -

The development of an evacuation line between sub-station and the renewable energy plant (Lolangalani-Suswa sub station) must be properly catered for and constructed in a timely fashion to avoid contractual penalties.
The need to upgrade the Uganda-Kenya interconnector, some of the components maybe pretty old by now

An attractive Feed in Tariff that attracts investors
A scheduled and rigorously implemented synching of construction of generation and transmission plants to now only avoid the cost associated with power plant not generation because of no demand in the system.
A systematic forecasted analysis of type and amount of generating plant to construct, retire or use as reserve to avoid significant changes on the least cost of energy.

</td>
</tr>
<tr>
<td>Challenges (what difficulties were encountered implementing or operationalising the project?)</td>
<td>One of the challenges in implementing the project was the so called “take-up or pay” clause – this essentially meant that once the wind park was ready, the up taker (KPLC) had to evacuate the power or pay for it not to be produced. This situation occurred mid 2017 – due to the Lolangalani-Suswa transmission not being ready. A total of Euro 46 million had to be paid by the government to Lake Turkana Wind farm

Changes in the least electricity cost due to bringing online of more expensive generating plants</td>
</tr>
<tr>
<td>What lessons can be learnt from the case study for the design and</td>
<td>Various lessons are arising in terms of interconnectivity of generating plants to interconnectors. These challenges can be put in three forms
The economics and impacts of Feed in tariffs: - it is instructive the updated
</td>
</tr>
</table>

<table>
<tr>
<td>implementation of IGAD trans-border projects?</td>
<td>
least cost power development plant for 2017 – 2022 recommends the phase-out of committed medium term solar and wind projects that are under FiT policy, while fast tracking the operationalisation of the energy auction market for new intermittent capacity plants. This in part has obviously arisen due to the cost's implications the project, though the electricity it generates is relatively inexpensive.

• Synchronised Cross-matching of generation-transmission projects: - One key lesson learnt from the Turkana Wind energy project is the need to closely match implementation of the transmission line construction with the generation line construction to avoid the nominally accepted "take-up or pay" clause in energy project. This will avoid incurring deemed generated energy costs arising from non-dispatch of some plants.

Currently the Government of Kenya has paid Euro 46 million to the Lake Turkana Wind power for failure to take up the energy generated with the balance of Euro 81 million to be paid over a period of 6 years with a minor tariff increase.

• Avoiding negative Citizen advocacy: -It noteworthy that despite legal provision on acquisition of land for development, the communities in Laisamis and Karan went to court regarding the illegal acquisition of their land, that the current wind park stands. The power development plan in view of this, suggest that Ministry of energy push for the enactment of the compulsory land acquisition legislation to facilitate easier implementation of strategic national projects such as power infrastructure. It is instructive that some countries like Ethiopia, Land is held by the state and cannot be private held as in Kenya. This makes it easier for it to develop power infrastructural projects.

Exemplary showcase: - the development of such a large complex project as the lake Turkana Wind energy demonstrates the ability of Kenya as a country to undertake such projects, in addition to its ability to honour its contractual obligations (including the "take up or pay clause") – which is quite attractive to investors who may be willing to invest in more cross-border projects.

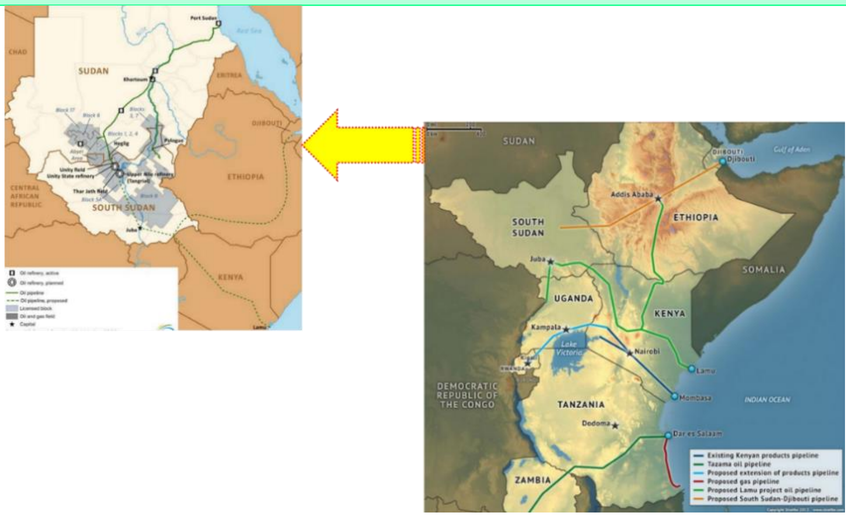
• Inclusion of private sector in transboundary energy generation projects – The wind power project special case that demonstrates the inclusion of private sector in transboundary energy projects. This helps ensure funding, construction and operationalisation of such projects.

Generally, the projection by [1] suggests a decrease in the amount of electricity imports from the three main interconnectors (Ethiopia-Kenya, Uganda-Kenya and Tanzania-Kenya) until 2023. Beyond this period, the coming online of the almost 1GW installed coal power plant will lead to an effective increase in the LEC to KES 16.87 / kWh. This has four lessons

○ Lesson 1: - Proper analysis need to be done to know when to bring the coal power plant online for generating to avoid a situation of having to vent of steam from the geothermal power plants or
</td>
</tr>
</table>

	resulting in increased electricity tariffs ○ **Lesson 2:** An revision / Introduction / expansion of the Time-of-Use tariffs to domestic consumers and other consumer groups, as well as interruptible tariffs for irrigation loads may encourage balancing of household consumption through shifting of peak load to earlier or later times. ○ **Lesson 3:** Generally, the addition of new renewable energy power systems (wind) and coal power plants into the current energy mix will results in a 13.14% increase in the LEC, which could increase retail tariff by > 20% [1]. Thus, approaches like changes in tariffs (Time-of-use, interruptible supply) may become attractive ○ **Lesson 4:** Some countries may make more trade benefits by charging wheeling charges for allowing electricity to pass through their countries to the neighbours as opposed to actually consuming the electricity. This may probably be the case for Kenya. A key lesson coming from the coupling of intermittent (renewable energy) supply systems into the interconnect is the need to have reserve (in Kenya's case of 35%) in case of reduced supply. This will mainly be covered by hydro, coal, oil thermal, natural gas and geothermal to some extent. In going for Coal, a lesson learnt from other developed countries like China, there is a need to incorporate some form of carbon capture and storage technologies to help mitigate environmental impacts. This if project is wholly an IPP can be achieved under some form of carbon trading mechanisms.

Case study 3: Petroleum Interconnectors within IGAD

Project title	**Petroleum Interconnector**
Location	IGAD member countries
Map	
Description	Probable and proven reserves[21] of oil and gas for IGAD REC are mainly in Kenya, Uganda, South Sudan and Tanzania. However, contingent and prospective fossil resources[22] are in Somalia, Ethiopia and Djibouti. **Existing cross-border pipelines** Currently within the IGAD member states only two major pipelines are operational. These are: Kenyan Fuel products pipeline from Mombasa to Nairobi from where it branches to Kisumu and Eldoret. Initially the pipeline would carry products from the refinery in Mombasa. The refinery which has since been shut down and turned into a storage bay for refined products, used to refine about 80,000 barrels/day of crude oil. The pipeline from South Sudan Abyei area to Sudan and onwards to port of Sudan. Sudan has two main export pipelines: a) The 1,368 km Petrodar pipeline takes crude from Palogue and Adar yale oil fields in the Melut basin to the Bashayer Marine terminal in port Sudan. With a capacity of 500,000 barrels per day, it has to be heated in order to transport the Dar blend (25° API gravity, 0.11% sulphur) of crude oil. b) The Muglad Basin to Khartoum pipeline transport the Fula blend of crude oil from the Muglad basin to the Khartoum refinery where it is processed for domestic and export use. c) The Greater Nile petroleum Operating Company pipeline transports the Nile blend (33.9° API gravity, 0.06% sulfur) crude oil from the Heglig oil fields (in Sudan), Thar jath and Mala oil fields in South Sudan to the Bashayer marine terminal in Port

[21] *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].

[22] *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.

Sudan for export and to two refineries in El-Obeid and Khartoum for refining and distribution to the domestic market

d) The South Sudan 160 km Thar jath-Heglig section has a 200,000 barrels per day capacity While the 1,497 km Heglig-Port Sudan has design capacity of 450,000 barrels per day.

e) It is noteworthy that China is the leading export destination for crude oil from Sudan and South Sudan. In 2016, China accounted for 94% and 100% of Sudan's and South Sudan's crude oil exports respectively. However India and Japan also import relatively small volumes of Sudan and South Sudan's crude oil.

f) Sudan is the only country in the region with the refining infrastructure capable of processing the Nile and Dar blend of crude. Currently all crude oil produced in South Sudan is exported via the Bab el-Mandeb straight to Asia

(Though not strictly within IGAD region) there exists a 1,700 km pipeline from Tanzania port city of Dar es salaam to Zambia. It carries crude oil into Zambia. Built in 1968, the pipeline has deteriorated severely moving only 12,000 barrels / day instead of the previous 22,000 barrels/day. Further, demand for the crude has also reduced in the Zambian market, since the country imports most of its refined products by truck from South Africa.

Planned cross border pipelines

However, the recent oil and gas exploration activities have seen planning of various cross-border pipeline projects and extension of existing ones.

- Extension of the Fuel products pipeline from Eldoret, Kenya to Kampala, Uganda. This is estimated to cost USD 300 million. Recent suggestions have it that Uganda would like to have the pipeline be converted to dual channel to also transport oil from Uganda to Mombasa
- Ongoing construction of the 532 km gas pipeline from Mnazi Bay concession in southern Tanzania to the economic hub of Dar es salaam. It will transport 22 million cubic meters of natural gas per day. Costing USD 1.2 billion, the project is funded by the Export-Import bank of China
- LAPPSET (Lamu Port and South Sudan Ethiopia Transport Project) that includes a crude oil pipeline beside a products pipeline.
    a) The crude oil pipeline provides an alternative route to South Sudan to export its oil. The 1,700 km, USD 3 billion pipeline would pass near Lake Turkana, Kenya where oil is currently being extracted. It is designed to carry about 500,000 barrels /day of crude oil.
    b) The USD 2.8 billion, 450 km products pipeline will move 100,000 barrels / day of refinery products from Isiolo, Kenya to Addis Ababa Ethiopia. A new refinery is to be built in Bargoni, near Lamu. The refinery will have a capacity of 120,000 barrels/day
- In Uganda, discovery of oil near Lake Albert has seen alliances formed with Tanzania to construct a USD 3.5 billion, 1,445 km East African crude oil pipeline (EACOP). 80% of the pipeline costs will be spent for the 1,147 km long Tanzania section, while the 296 km Ugandan section of EACOP from Hoima, Uganda to Masaka-Bukoba, Tanzanian border is estimated to cost USD 700 million. Currently, Uganda is building a 30,000 barrels/day refinery The key technical characteristics of the pipeline are detailed below:.

	a. The pipeline is expected to transport about 216,000 barrels per day b. Operation-wise the crude oil will be partly refined in Uganda to supply the local market while the rest is exported to the international market. A special purpose vehicle (SPV) in form of a pipeline company will construct and operate the pipeline. The SPV will have a shareholding from Uganda National Oil company, the Tanzania Petroleum Development Corporation and three oil companies – CNOOC, TOTAL and Tullow c. Due to the viscous and waxy nature of Uganda's crude oil, the pipeline will need to be heated along the entire route - making it the longest electrically heated pipeline in the world. d. First oil is expected by the end of 2020 and the project is expected to create 10,000 jobs during construction e. The pipeline is 24 inches in diameter and will 1.2 meters underground, insulated and heat-traced. f. An integrated heating system will maintain the crude oil's temperature above 50°C so that the wax remains in-solution. It will comprise 6.6kV Electrical Heat Trace (EHT) cables, each providing 30W/m of heat powered by 33kV underground cables g. The Ugandan section of the pipeline will be installed with 230km of 33kV power cables and 296km of fibre-optic cables, while the Tanzania segment will include the installation of 3,465km of 6.6kV single phase EHT cabling, and 939km of 33kV power cabling. h. the pipeline will feature 27 heating stations, a loading pad in Kabaale and a facility to load crude oil into tankers at Chongoleani. The project will also include the construction of 96.5km of temporary and permanent access roads, ten construction camps, and 15 electrical heat trace substations in Tanzania • A memorandum of understanding (MoU) has been signed for construction of a USD 3 billion crude pipeline from South Sudan to Djibouti through Ethiopia. • Horn of Africa pipeline:- The USD 1.55 billion, 550 km Horn of Africa multi-fuel pipeline from Damerjog, Djibouti to Awash, Ethiopia is expected to be completed by 2018. It will transport diesel, gasoline, and jet fuel from port of Djibouti to Central Ethiopia to a buffer storage tank farm in Awash, Central Ethiopia. The pipe has a diameter of 20 inches and has a capacity to transport 240,000 barrels per day. The buffer storage tank farm in Awash can store 950,000 barrels • Uganda-Kenya products pipeline: - the 325 km pipeline will move from Eldoret through Malabe to Kampala, Uganda. It is a 14-inch pipeline. The pipeline construction also includes development of a user depot and pipeline terminal in Kampala as well as spur line to Jinja. The terminal will include construction of two tanks with a capacity of 32,500m^3 for MPS products, two tanks with a capacity of 5,654m^3 for BIK products, two tanks with a capacity of 10,544m^3 for JET products, and two more tanks with 22,570m^3 capacity for AGO products. It will also include construction of four interface tanks with a capacity of 904m^3 • Melut basine , Palouge to port sudan pipeline [7] :- a 32 inch people that transports 500,000 barrels per day over a distance of 1,380km.

Current oil and gas resources and reserves within IGAD member states

The current resources and reserves within the IGAD region are as follows:

Table 0-4: Fossil based resources and reserves within IGAD states

Country	Proven Oil or gas reserves	Prospective resources	Potential revenue from reserves
Uganda – Lake albert Basin	~1.7 billion barrels of oil	2 billion barrels of oil (other sources put it at 6.5 billion barrels [3])	Over USD 2 billion per year for over 20 years
Tanzania	~0.21 billion cubic meters of natural gas	1.43 trillion cubic meters of natural gas not tied to oil fields	~ USD 3 billion per year
South Sudan (operational)	3.5 billion barrels of oil		
Kenya	~600 million barrels of oil	~4 billion barrels	
Sudan [23](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	

With the existing resources and pipeline, the need for value addition within the petroleum sector has fuelled the existence and/or development of a number of refineries and topping plants in Sudan, while South Sudan, Kenya and Uganda are planning to construct (Table 0-5)

Table 0-5: Refineries within the IGAD region

Country	Capacity ('000 barrels per day)	Status
Khartoum (al-Jaili), sudan	100 (it is proposed to increase capacity to 100)	Full refinery, operational
Port Sudan, Sudan	21.7 (it is proposed to increase capacity to 100)	Full refinery, Not 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

[23] 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 stabilise 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 7. Technology, H. *Melut Basin Oil Project*. 2018..

Upper Nile (Thiangria)	10	Full refinery, suspended
Hoima, Uganda	30	Full refinery, under construction
Lamu, Kenya	120	Full refinery, planned

Outcome and Impact ***(what did the case study in question achieve? Or what does it set out to achieve?)***

Sudan, South Sudan, Kenya and Uganda are the only East African nations with proved oil reserves. 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 reserves in the world (Table 0-2).

Table 0-6: Crude oil production

	Reserves (billion barrels)	Production ('000 barrels per day)	Lifespan (years)
Kenya	0.754	80	25.8
Uganda	6.5	60	296.8
South Sudan	3.5	118	27.4
Sudan	1.5	500	3000
Total east Africa	10.74	490	60.13
% East Africa	8.39%	6.21%	

Current 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 (27 years) and South Sudan (296.8 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.
- This if further augmented by the fact that the range of future production rates is determined by the size of the reserve, which in itself will drive the scale of investment in a given reserve.
- Thus, it may be possible that IGAD member states like Kenya, with smaller reserves, may find it much more profitable to use their reserves for domestic consumption and thus save on foreign exchange rates than on export. This will however be based on the rates at which the reserves are extracted. (Table 0-3).

Table 0-7: Crude oil consumption within the IGAD region

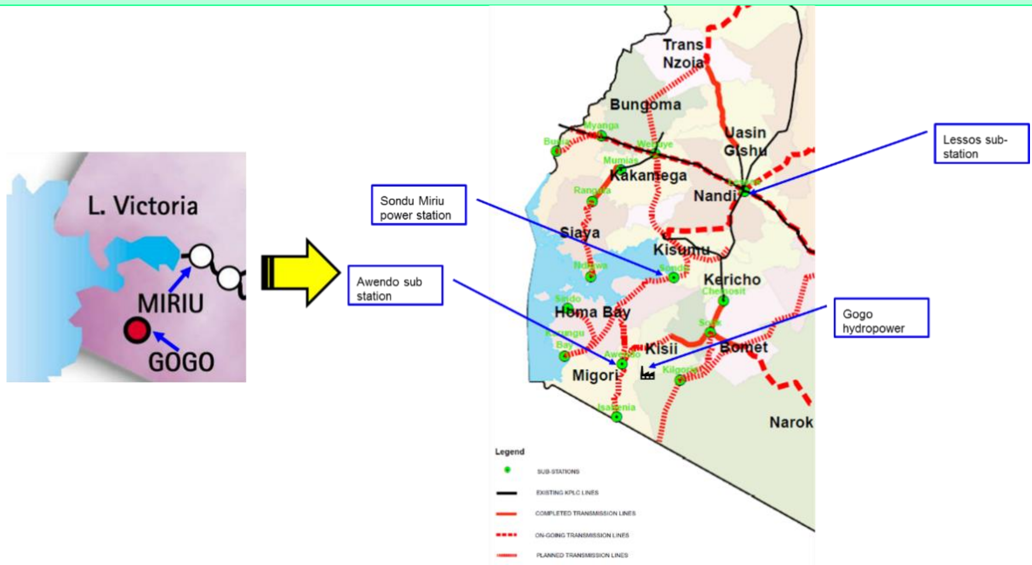
Country	Demand ('000 barrels per day)
Kenya	93
Ethiopia	65
Uganda	27
South Sudan	11
Sudan	1
Total IGAD Demand	197

- The secession of South Sudan in 1999 significantly affected Sudan Economy, since it lost almost 75% of its oil production fields to South Sudan. This was not only due to the transit and processing fees South Sudan was paying to Sudan, but also access to cheaper oil. It resulted in Sudan negotiating with Saudi Arabia to supply it with oil for the next 5 years under loan from the Saudi Development Bank. Under the

	agreement Saudi Arabia will supply Sudan with 1.8 million tonnes of oil in the first year, with a 7% increase in the quantity each successive year. • The security situation and attendant insufficient increases in foreign investments to address the lowered production levels as well as repairing of infrastructure has seen combined production levels for South Sudan and Sudan fall to 257,000 barrels per day in 2016, lower than the peak of 486,000 barrels per day in 2010. In 2017 the production was 102,000 and 150, 000 barrels per day respectively for Sudan and South Sudan.
Critical Success Factors ***(what accounted for the success of the project?)***	The critical success factors for gas and oil pipelines with respect to interconnectivity are Pipeline Interconnectors development: - • Proven reserves availability:- Higher quantity of oil and goal reserves will attract relative higher investments. This is why the Lamu-south Sudan pipeline is still looking for funding while the Hoima-Tangu (Uganda-Tanzania) pipeline has financial investment decision and construction work should begin soon • Regional politics:- The best option for realisation of the Kenyan pipeline is to connect it to oil fields in South Sudan. But this will face tremendous competition from Sudan. • Cost of heating the pipeline – The oil reserves in Uganda, Kenya and some of those in south Sudan are require heating in order to be transported. Uganda in this regard is mulling over tapping into Tanzania's natural gas potential for heating the EACOP pipeline [9]. The South-Sudan-Kenya pipeline will need to consider this option, since heating with electricity will be costlier. However, with the coal deposits coming in 2024, that could also be a possibility. • Economics of oil export market – While the reserves in Kenya are not comparatively huge as those of South Sudan or Uganda. The key success factor is to assess the potential of using the extracted oil to meet domestic demand, since the intricacies of supplying to the international market, so small a quantity may not provide as much foreign currency as compared to savings made in foreign currency by not importing oil. • Refineries development – The region can attain a lot by investing more on refineries – since the by-products of the refinery will add value to the industrial value chain • Emphasis on natural gas as a cooking fuel – it its endeavour to replace unsustainable biomass as a source of cooking fuel, the use of natural gas offers a cheaper better alternative. This may mean considering cross-border pipelines for natural gas as well as avoiding flaring the natural gas found in oil fields.
Challenges ***(what difficulties were encountered implementing or operationalising the project?)***	• The biggest challenge for the region is acquisition of finance for infrastructural development and/or repair of the pipeline • The pipelines are mainly being developed on a bilateral national level – Uganda-Tanzania, South Sudan – Kenya, Kenya-Ethiopia and Ethiopia-Djibouti. This makes the acquisition of finance and provisioning for redundant alternative routes difficult. If something like a ring pipeline that interconnects all the IGAD countries could be set up, this would provide a better infrastructural system
What lessons can be learnt from the case	Various lessons are arising in terms of interconnectivity of pipeline. These challenges can be put in the following forms • Lifetime of the oil fields - Depending on the production rate, the oil fields in Kenya

study for the design and implementation of IGAD trans-border projects?	have a lifetime of 25 years, South Sudan (25 years), and Uganda (300 years) . Consequently, IGAD member states will need to: ○ decide on how to manage / limit their production to allow a longer time frame over which oil is available. ○ Constraints in finance is inversely related to the amount of reserves an IGAD country has and to the security situation of the country. Secure country with bigger reserves attract more finance – residual quantity of reserve is also dependent on product rates • Role of China in pipeline sector and refinery development- . ○ It is noted that over 98% of the existing export of oil in IGAD region (which is mainly located in Sudan & South Sudan) goes to China. Thus, under the one belt one road movement, China is willing to fund infrastructure that allows it to bring more crude oil to its shores. ○ The downside of it being that efforts to create a refinery for processing crude for domestic consumption may not be easily funded. Thus it may be necessary that the IGAD member countries consider development of regional refinery for domestic production. • Connecting of the Pipeline into a ring – a key lesson arising from the case study is that the IGAD countries face challenges in transportation of oil especially Kenya and South Sudan due to security and civil unrest. The setting up of a ring connector could not only attract more investors but increase the reliability of the system. • A key lesson coming from the cost of building EACOP pipeline is that it generally to build a heated pipeline costs USD 2.5 – 3 million / km. However if not properly managed operational costs for a heated pipeline may significantly reduce the profits. This applies to both Kenya and Uganda. • In developing cross-border pipeline projects – simplified wheeling costs without taxes like transit tax, value added tax, corporate income tax, depreciation tax holiday, as well as free corridor where pipeline passes and purchasing of shares in the company managing the pipeline are but some of the key factors that made Uganda agree to the pipe passing through Tanzania instead of Kenya. The wheeling cost offered by Tanzania was USD 12.2 per barrel much lower than what Kenya was offering – hence making it profitable for Uganda even when international oil prices are at USD 50 per barrel [10] .

Case Study 4: Uganda-Kenya Interconnect with respect to the Mini Hydro power plants located within the Lake Victoria lake basin

Project title	Uganda-Kenya Interconnect
Location	Western Kenya, Lake Victoria basin in Kenya
Map	

Description

The Uganda-Kenya double switch interconnect has historically been used to import power from Uganda to Kenya. However, in recent years Kenya has also been using the same line to export power to Uganda. Thus, there are times Kenya imports and at other times it exports. A study of the electricity imports from Tanzania, Uganda and Ethiopia shows a decrease in imports and increase exports

	2012/13	2013/14	2014/15	2015/16	2016/17
Imports from UETCL (GWh)	41	83	76	65	180
Exports to UETCL (GWh)	30	37	38	43	20
Net imports (GWh)	11	46	38	22	160

Due to decreased hydrology (rainfall) in 2016/17 period, there was increased generation from fossil fuels as well as imports. It is projected that an excess capacity of 583 MW will exist as from 2019 – 2023 [1].

Within the Lake Victoria basin, a number of hydro power plants exists (**Error! Reference source not found.**) which could significantly impact the Kenya-Uganda interconnector for cross-border electricity trade. These include the run of the river 60 MW Sondu Miriu Power plant and the currently 2 MW Gogo hydro power.

Gogo hydro power:

- The Gogo hydropower plant (latitude 0°54'32.40"S and longitude 34°20'52.80"E) was commissioned in 1958. It is located about 35km from Migori Town and about 25km from the new Awendo substation (latitude 0°53'29.73"S and longitude 34°31'26.31"E) in Migori County. The current station rating is 2MW comprising of two Kaplan turbine type units of 1 MW per unit. The plant draws water from Kuja River in a catchment area of 2980km^2.

The water abstraction for the existing plant is through a small dam that is currently silted.

- The Gogo hydropower plant is of such an age and condition that the entire plant is in need of redevelopment to modernise the plant and increase the installed capacity into the Kenyan electricity generation mix. Furthermore, studies [2, 3] had been carried out in the past that indicated that upgrading the plant from the current 2MW to higher capacity of between 12MW and 60MW may be feasible.

The Sondu Miriu power plant

- The Power plant lies 350 km west of Nairobi, the capital of Kenya, and 55 kilometers southeast of Kisumu. Its geographical coordinates are Latitude:0°20'33.0"S; Longitude:34°51'08.0"E.
- Unlike the Gogo hydropower plant, Sondu Miriu is a run-of-river hydropower plant with a 6.2 km intake tunnel. After power is generated, the discharged runs along a channel into a second hydropower stations (Sangoro hydroelectric power station) (**Error! Reference source not found.**) before returning into the r iver Sondu.
- Sondu Miriu was built with a loan of Kes 19 billion (USD 2.49 million) from the Japan Bank for International Cooperation. From 1999 until 2007.
- The cost went up due to the citizen demonstration that lasted almost 5 years as well as addition of Sangora hydro power plant. Total project cost came to about Kes 22 billion (USD 33 million) .by project close
- The Sondu plant generates from 2 Vertical Francis turbine each with an installed capacity of 30 M (**Error! Reference source not found.**), while the Sangoro h ydroelectric power station has an installed capacity of 20.2 MW
- Sangoro is estimated to have costs KES 3 billion

Power plant	Gogo Hydro power	Sondu Miriu power plant	Sangoro hydro power plant
Catchment area (km^2)	2980	3,345	Utilises discharge water from Sondu Miriu
Year of commissioning	1957	2007	2011
Annual mean run-off (m^3/sec)	38	41	41
Gross head (m)		196.9	
Net head (m)	19.8	178.6	
Rated output (MW)	2 MW (1 MW * 2 units)	60 MW (30MW *2 units)	
5 year Average energy production (GWh / year)	8.1	364.2	114.8

	Turbine type	2 vertical Kaplan turbine units each of 1 MW	2 units of 31.2 MW vertical shaft Francis turbine	2 units of 10.9 MW vertical shaft Francis turbine
	Generator	2 units of 1.15 kVA AC generators	2 units of 33.7 MVA AC generators	2 units of 12.5 MVA AC generators
	Transformer	Step down transformer	2 33.7 MVA capacity, 3 phase, forced air-cooled. Transforms 11 kV to 132 kV Voltage	2 transformer units of 2.5MVA each.
	Switchgear		132 kV outdoor and 11 kV indoor	132 kV, 33 kV and 11 kV and low voltage switchgear.
	Transmission line	None – only distribution lines	132 kV single circuit, 49km long to Kisumu substation at Mamboleo	132 kV single circuit 5 km transmission line to Sondu Miriu step up station.
	Funding		2 loans from the JICA (formerly Japan bank for international cooperation)	
Outcome and Impact ***(what did the case study in question achieve? Or what does it set out to achieve?)***	▪ Due to its strategic nature, Gogo power plant has been ear marked for upgrading. The European union has currently tendered out a call for proposals to undertake a prefeasibility study of the power plant for upgrading. The upgrade may take the form of development of completely new dam (with the attendant environmental and social challenges) or upgrading of generators, dam desilting, and increasing the height of existing dam wall. ▪ If upgraded the Gogo hydropower plant will be able to evacuate more than 10MW. It has been indicated that a number of stakeholders (KENGEN and/or KPLC would be willing to consider the potential of constructing an evacuation line from Gogo hydropower to Awendo transmission sub-station, which is about 20 km away from Gogo hydropower station. This sub-station will then link up with the Uganda-Kenya (Bujangali-Lessos) interconnect at lessos -thus providing an alternative route for the interconnect to the Kenyan grid as well as stabilising the grid (**Error! Reference source not found.**) ▪ A further impact will be the potential of Kenya to further increase its export of electricity to Uganda by addition of more power into the grid from Gogo power plant. ▪ The accumulated silt at the Gogo hydropower plant is a nutrient rich resource which the power plant can in liaison with the Sony Sugar company and local organisations sell / distribute to the locals farms and hence improve soil fertility, agribusiness and livelihoods of surrounding communities.			
Critical Success Factors	• The critical success factors for potentially upgraded Gogo hydropower plant and Sondu Miriu power plant with respect to interconnectivity are			

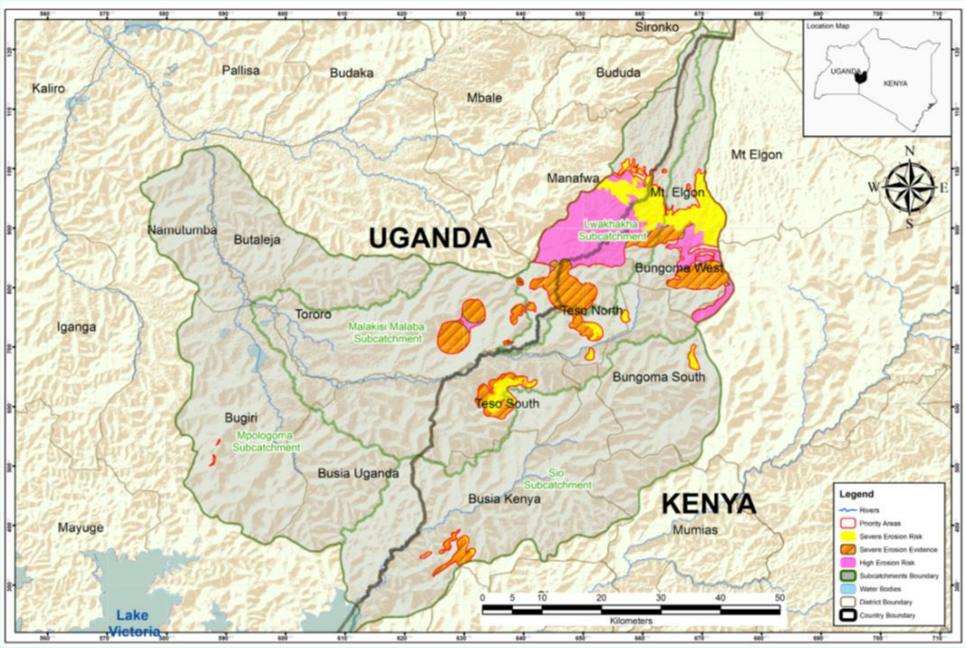
(what accounted for the success of the project?)	○ Interconnectors development:- ▪ The development of an evacuation line between Awendo sub-station and Gogo hydro power plant. ▪ The need to upgrade the Uganda-Kenya interconnector, some of the components maybe pretty old by now ○ Rigorous O&M plan:- Once upgraded, there will be need of establishing a rigorous maintenance and operational plan, to prevent desilting of dam – this refers particularly to Gogo hydropower plant (**Error! Reference source not found.**) ○ System upgrades:- the Gogo case also demonstrates the need for systematic improvement of both generation, transmission and distribution systems. ○ Rigorous prediction of the rainfall and drought seasons: ▪ Gogo sometimes runs only one generator due to low water levels ▪ Sondu Miriu also runs only 1 generator due to low water levels ○ Finalisation of the ring interconnection ▪ Currently the Kisii-Awendo is operational, thus the line from Tororo-Webuye-lessos-Kericho-Bomet-Kisii-Awendo is operational – forming one side of the ring ▪ Another operational part of the ring connects Sondu to Kisumu then onwards to lessors and Chemosit ▪ The line from Awendo-sondu is currently under construction, which when finished will form a complete ring that strengthens the Uganda-Kenya Interconnect. ▪ From Awendo also a connection to Isebania, at the Tanzania - Kenya border is possible, but no construction work has not begun on it.
Challenges *(what difficulties were encountered implementing or operationalising the project?)*	Gogo Hydropower plant • Reduced performance: - Over the years, the dam of the hydro power plant has become silted to the extent that vegetation has grown in the dam, total reducing the amount of water discharge • Human resource capacity: - In addition the current 13 staff members who operate the plant are fast approaching their retirement age, with no replacement in sight • Technical challenges: - As the plant is aged, obtaining spare parts has become quite a challenge, with many parts having to be fabricated locally when they break, leading to high operational costs
What lessons can be learnt from the case study for the design and implementation	Various lessons are arising in terms of interconnectivity of generating plants to interconnectors. These challenges can be put in two forms • Avoiding negative Citizen advocacy: -In Considering the serious citizens demonstrations during the construction of Sondu Miriu, it may be necessary to assess the risk of people within Gogo and greater Migori county demonstrating against the power plant and thus halting its further construction. Sondu Miriu

of IGAD trans-border projects?	construction was halted for over 5 years – increasing costs and delaying grid interconnectivity due to such demonstrations. • Proper operational and maintenance plan: - Assessing Gogo hydropower plant, one is struck by the fact that the plant is past it lifetime of ~40 years, and has not been well maintained as demonstrated by the dam that is almost 60% completely silted with vegetation. Sondu Miriu is already showing certain signs of ineffectual maintenance with the fence (consisting of barbed wire and mesh wire) surrounding discharge canal having been vandalised and the barbed wire is missing, whilst also local villages are putting pipes[24] into the canals to abstract water. • Inclusion of private sector in transboundary energy generation projects – The Gogo hydropower is a classic case of hydropower whose source of power, the dam, was literally being chocked by silt and vegetation and for which no efforts were being implemented to address it. The interest of private sector in form of the European Union may revitalise the power plant. The implication being that national governments may ignore or prioritise other energy projects leading to systematic / structural failure of others. Inclusion of private sector may help in ensure that project continues to operate at its best efficiency.

[24] While this may not affect flow at the moment, if more villagers do so. They may not only destroy the fence protecting the canal but also affect the flow rate to the Sangoro hydroelectric power station

Trans-Boundary Water Resources Sector Case Studies

Case Study 1: Sio-Malaba-Malakisi (SMM)

<table>
<tr><th>Name of case study</th><th>Sio Malaba Malakisi Basin Transboundary</th></tr>
<tr><td>Sector</td><td>Water and Sanitatiom</td></tr>
<tr><td>Country and location</td><td>Uganda/Kenya</td></tr>
<tr><td>Location in Country</td><td>
</td></tr>
<tr><td>Brief Description</td><td>This is a framework that is being undertaken under a project titled “strengthening transboundary water governance and cooperation in the IGAD region.” This project was launched in December, 2016 and was aimed at strengthening framework for cooperation on cross border water resources at regional and basin level. It is also intended to strengthen negotiation, conflict mitigation and foster dialogue among stakeholders. It will also build capacity in diplomacy in water, international water law and negotiation skills. The project will ultimately lead to improved cross border water governance and cooperation.

The Sio-Malaba Basin was selected as a demonstration basin of the project. This basin is shared by Kenya and Uganda. This is the first basin where the transboundary cooperation will be assessed, evaluation of development scenarious carried out through a participatory process and the necessary framework and plan developed.</td></tr>
</table>

Outcome and Impact

(what did the case study in question achieve? Or what does it set out to achieve?)

A memorandum of understanding was signed in 2015 by Kenya and Uganda with NELSAP on the integrated management and development of the transboundary water resources of the Sio-Malaba-Malakisi (SMM) river basin. The two parties developed an investment framework and a road map for development of a fully fledged SMM investment plan. The road map includes (1) Launch of masterplan, (2) Development of portfolio of projects, (3) development of resource mobilisation strategy, (4) Approval of basin investment plan, and (5) Regular update of project portforlio. A project portfolio of 12 projects have so far been identified. See below:

No.	Project	Budget	Country	Rating
1.	Malaba Irrigation	USD 2.2 million	Both	5.0
2.	Eastern SMM Water Security and Development (combining six SCMPs)	USD 5.2million	Kenya	4.6
3.	Sio-Sango Irrigation	USD 37 million	Kenya	4.4
4.	Toloso SCMP	USD 9 million	Kenya	4.4
5.	Lwakhakha Hotspots	USD 0.8 million	Both	4.2
6.	Community-based Wetlands Management NELSAP	USD 6.7 million	Both	4.0
7.	Food Security	USD 22.7 million	Kenya	4.0
8.	Angolola Dam NELSAP	USD 67.1million	Both	4.0
9.	Solid Waste NELSAP	USD 9.2 million	Both	3.8
10.	Nyabanja Irrigation NELSAP	USD 23.3 million	Uganda	3.6
11.	Stormwater Drainage Master Plans NELSAP	USD 3.2 million	Both	3.4
12.	Bulusambu Small Multi-purpose Reservoir	USD 10 million	Uganda	3.4

Critical Success factors,CSFs

(what acounted for the success of the project?)

- The programmes has been co-funded by SDC through IUCN, OES US State Department, UNECE and coordinated by the IGAD Secretariat with the two riparian States providing the necessary political will.
- There is a strong stakeholder participation in the decision making and steering of the project.
- There is a clear framework developed with a road map to follow to the end of the implemention. This has also been agreed.
- There has been a fair distribution of the portfolio of project so far identified.
- Major decision are arrived at during workshops convened for that purpose. So far three manegerial workshops have been held.
- Cooperation on our shared water resources is key in all aspects of Water Resources Management and Development, conflict resolution, etc.
- There is need to sustain and strengthen gains made so far in relation to cooperation among riparian states.
- The benefits from SMM projects, demonstrate the shared fruits of our cooperation on the transboundary waters.

Challenges	• There are difficulties in balancing portfolio of projects in terms of geographical representation. • Political decisions sometimes overule technical consideration in terms of prioritisation of projects. • Mobilisation of resources for implementation of the projects is limited. • There has been some resistance from activists to some projects because of the persived negative impacts to downstream ecosystem. • There is need for resttlement of persons affected by the project implementation .
What lessons can be learnt from the case study for the deisgn and implementation of IGAD trans-border projects?	• Cooperation on cross border water resources enhances the effective, efficient and equitable use of the water resources. • Cooperation also mitigates water use conflicts and fosters dialogue and stakeholder engagement • Capacity building is an importart ingredient of the sustainable water resouces management and development. This is more so interms of knowledge of water law negotiation skill and deplomacy.
Other comments	This project will consider other basins in future.

Case Study 2: Merti Aquifer

<table>
<tr><th>Name of case study</th><th>Merti Aquifer</th></tr>
<tr><td>Sector</td><td>Water</td></tr>
<tr><td>Country and location</td><td>Kenya/Somalia

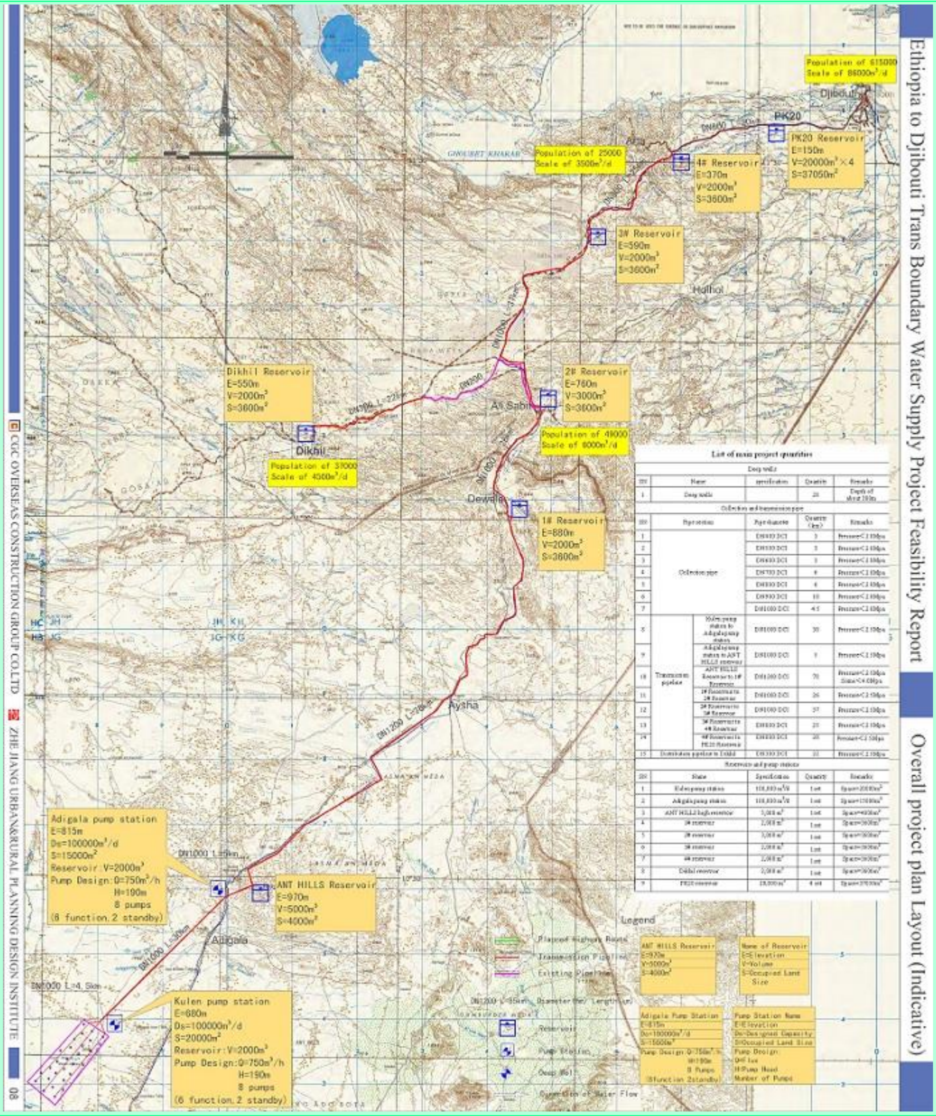
Merti Aquifer</td></tr>
<tr><td></td><td>al Location

- Merti Aquifer is located in North Eastern part of Kenya, generally east of Mount Kenya.
- The Aquifer extends East of Diff-Liboi-Jarajilla into the south of Somalia.
- It is a transboundary aquifer that is largely in Kenya and covers 130,000 Km3 on the Kenyan side.
- The Merti Aquifer is an important regional and national resource that continues to be exploited in an area where surface water resources are lacking. The refugees influx has increased the pressure on the local scarce water resources.
- The Ewaso Nyiro River, has continued to recede upstream due to increased irrigation development in the upper regions.
- The recurring drought due to climate change accelerates the existing web of economic, social and security problems in the region.

The development of groundwater resources is important in combating the negative effects of the drought and stabilisation of the local economy and security of the area, but lack of effective and sustainable</td></tr>
</table>

	management as well as over exploitation of this resource is likely to result in water use conflicts. On the other hand, lack of data on Aquifer characteristic, pollution monitoring, abstraction levels, governance and cooperation due to the fact that somalia has had no government for over two decades, compounds this situation further
Outcome and Impact ***(what did the case study in question achieve? Or what does it set out to achieve?)***	From the case study it is evident that there has been increased use of the aquifer over the years particularly by the refugee population in the area. For example, the abstraction level of 2.7million cubic meters/ year experienced is high for a confined aquifer with millennial recharge. Most of the data on knowledge base available are more than 8 years old and given that there is dynamism in the use of the water in the area there is need to carry out assessment to establish current data on aquifer dependent ecosystem, recharge, abstraction, pollution vulnerability, transmissivity, hydraulic conductivity, storage coefficient and governance.
Critical Success factors,CSFs ***(what acounted for the success of the project?)***	• There has been efforts made by governments to delineate the aquifer boundaries in the past. • Government of Kenya has developed a transboundary waters policy that provides for sustainable exploitation of ground waters as well as surface water resources. • Development of a legal framework for the implementation of this policy is under way • There is established Transboundary Waters Department in Kenya whose mandate is to conserve, protect and sustainably manage and develop transboundary surface and ground waters in collaboration with its neighbouring states. • Water Resources Authority is charged with the responsibility of water use regulation including water abstraction permitting.
Challenges *(what difficulties were encountered implementing or operationalising the case study?)*	• Monitoring of the GW exploitation is not undertaken periodically hence most aquifer parameters on record may have changed overtime. • Institutional arrangements to govern the aquifer and its exploitation interms of abstraction, pollution control, water depletion, water quantity and quality are adhoc. • Somalia has had no government for over 2 decades and there has been no attention given to goverance issues of aquifer.
What lessons can be learnt from the case study for the design and implementation of IGAD trans-border projects?	• Need to negotiate establishment of a framework to guide the sustainable exploitation of this aquifer • There is need to have adequate knowledge base of the aquifer so that the quality and quantity, and hydraulic conductivity of the aquifer can be established in order to provide for equitable sharing of the resources across borders. • For successful exploitation of the resources there is need to have good governance in place at regional and local level. This includes policy, regulatory framework and institutional arrangement at regional and local level.

Case Study 3: Ethiopia-Djibouti Cross Border Water Project

Name of case study	Ethiopia-Djibouti Cross-Border Water Project
Sector	Water
Country and location	Ethiopia-Djibouti
Location in Country	
Brief Description	This is a transboundary water project intended to supply portable water to over 700,000 inhabitants of Djibouti. It consists of construction of water wells and reservoirs, and provision of 102 kilometer distribution network within Djibouti. The water is sourced from groundwater at Hadagalla wells in Ethiopia to Djibouti's city and key towns of Djibouti city, Ali Sabieh, Dikhil and Arta through a pipeline length of 374Km. The project implementation was launched in 2015 at a cost of US Dollars 340 million through a concessionary loan from Exim Bank of China. The capacity of the project is 104,000 cubic meters of water per day.
Outcome and Impact	• Supply of portable water to the over 700,000 inhabitants in city and key towns of djibouti.

(what did the case study in question achieve? Or what does it set out to achieve?)	• Successful implementation having been tested and approved as successful in June, 2018. • Deepening of relations between Ethiopia and Djibouti. • Alleviating the cronic water security and stress of Djibouti which has an average annual rainfall of 200mm. • Creating positive environmental impact in Djibouti.
Critical Success factors,CSFs ***(what acounted for the success of the project?)***	• Ethiopia is providing the sourcing of the water free to Djibouti as a good neighbour. • Good diplomatic and trade relations between Ethiopia and Djibouti with ongoing efforts to economically intergrate the two countries. • Full government support/ political will. The council of ministers in Djibouti approved the project in 2014 and have fully supported it during implementation. • The existence of the stratey for economic revitalisation of Djibouti enhanced the implementation of the project. • The interdependence between the two countries with Ethiopia being land locked strengthened the relations between the two countries and enhanced the implementation of the project. Ethiopia utilises Djibouti port for 95% of its imports/exports. Ethiopia is also constructing a 342mile long pipeline to move 240,000 barrels of petroleum per day from Djibouti port to Awash in Ethiopia. There is also a planned LPG pipeline on the same route.
Challenges *(what difficulties were encouuntered implementing or operationalising the case study?)*	• Harsh desert conditions of the project area with dust storms and wind during construction. • Hard rock was encountered during construction (about 60 Km length). • This was a chinese built project and skill gap was filled by chinese and Ethiopian labour
What lessons can be learnt from the case study for the deisgn and implementation of IGAD trans-border projects?	• Where there is political will and government support project implemetation is smoother. • Where participating countries in transboundary projects have good relations (political, economic, trade) there is a high chance of delivering the projects successfully. • Interdependence between countries (economic/trade) helps cement relations and enhance project implementation. • Building trust across national borders strengthens partnerships that prosper and endure. • The existence of a strategy enhances the implementation of transboundary projects
Other comments	• Djibouti has a high level of power – 41% poor and 23% etremely poor and unemployment is 39% . The project contributed significantly in employment during construction.

	• The economic revitalisation programme of Djibouti enhanced the implemenation of the project. • Total Population of Djibouti (2015) is 887,900 with an urban population of 695,800(78%) and a rural population of 192,100(22%).

Information Communication and Technology (ICT) Sector Case Studies

Case Study 1: The East Africa One Network Area (ONA) Roaming Initiative

Name of case study	**East Africa One Network Area (ONA) Roaming Initiative**
Sector	ICT
Country and location	Kenya, Uganda, Rwanda and Tanzania
Location in Country	
Brief Description	Roaming is a service provided by mobile radiotelephone networks enabling their customers to communicate through the networks of operators in visited areas. But to make that happen the customer home network needs inter-operator agreements to support call forwarding, account verification and cost/revenue sharing. The wholesale prices that network operators charge each other for such services are usually treated as confidential. The Zain One Network was based on the principle that roaming customers should only have to pay to use any Zain network what they would pay to use their home network. This is now known as roam like at home (RLAH). Another approach based on domestic tariffs is for visitors to pay what locals pay – roam like a local (RLAL). The ONA framework was originally based on RLAL. Many people avoid or minimise their use of international roaming services due to the high cost which is not affordable. A common alternative is to buy a local SIM card with time credits in the visited country, to take advantage of domestic

calling rates. Another alternative is to use a Voice-over-IP application through a Wi-Fi access point. The mobile roaming traffic will grow will very high If cost reduced making it affordable.

Regional Mobile Roaming Challenges and Benefits

There are studies carried out to harmonise the International Mobile Roaming (IMR) charges. The IMR charges are very high and from an affordability barrier. The challenges face the regional mobile charges are:

- High IMR price is an obstacle to the regional integration efforts
- Growth in regional (EAC) travel due to opening of economies
- Significant tariff differentials while roaming on different networks within the host country in EAC
- Roaming Cross Border Services – Absence of Regulatory oversight single country or NRA cannot tackle this issue alone
- Weak/Limited Competitive Forces in the Roaming Market Segment
- International roaming services involve multiple stakeholders (operators, regulators, taxation authorities) and a regional policy framework is paramount

The benefits of One Network Area in addition of the traffic high growth and increase in revenue are:

- Enhance Regional Socio-Economic Integration
- Fast-Tracks the Regional Common Market
- Reduced cost of doing business for all Member
- Spurs other Economic Activities such as Trade and Services ; and
- Increased Government Revenues from increased usage of ICT services

Roaming charges Principles

A Committee of National Regulatory Authorities was established to analyze the tariffs based on current operator tariffs, A set of principles were proposed to determine harmonised EAC roaming charge. These principles are as follows:

a. Roaming charges should be cost oriented – that is, reflective of real costs but not mechanically derived from them.

b. The harmonised EAC roaming framework only applies to traffic originating and terminating within EAC Partner countries.

c. Traffic originating and terminating within the EAC should be exempt from international traffic surcharges.

d. Mobile telecommunication taxes (excise, VAT, etc.) should be regionally harmonised.

e. Partner states should establish systems to prevent traffic re-filing, tariff fraud, and illegal call termination.

The member states negotiated *wholesale* price for roaming services: USD 7.63 cents per minute including surcharges. The surcharges are small fraction of the total price to keep roaming charges affordable. Examples of tariffs are shown in tables below.

Voice roaming tariffs (EAC averages in USD/minute)	Average Minimum	Average Maximum
Wholesale with surcharge	0.0763	0.9775
Wholesale without surcharge	0.0588	0.4042
Retail – voice call within visited country	0.0870	0.9944
Retail – voice call back home	0.1435	2.1982
Retail – voice call to other countries within EAC	1.0455	3.6238

Table: Rwanda: Incoming and outgoing voice roaming traffic per operator

Minutes per quarter as of September 2015				
	MTN	Tigo	Airtel	TOTAL
Incoming	4 882 015	1 694 937	4 753 708	11 330 660
Outgoing	1 250 362	4 216 951	10 395 879	15 863 192
Minutes per quarter as of September 2014				
Incoming	482 879	229 548	3 315 228	4 027 655
Outgoing	567 378	53 940	1 106 271	1 727 589

CALL TARIFFS FOR CUSTOMERS ROAMING IN UGANDA

	MTN		UTL		AIRTEL		orange	
	OLD RATES	NEW RATES	OLD RATES	NEW RATES	OLD RATES	NEW RATES	OLD RATES	N
Calls to networks in Uganda	17.50	10.00	17.20	10.00	50.00	10.00	25.00	
Calls from Uganda to Kenya	25.00	10.00	22.00	10.00	85.00	10.00	30.00	
Calls to Rwanda	25.00	10.00	36.50	10.00	215.00	10.00	150.00	
Calls to Other Countries	25.00	25.00	36.50	16.00	215.00	180.00	150.00	
Receiving calls while roaming in Uganda	25.00	0.00	25.00	0.00	25.00	0.00	25.00	

CALL TARIFFS FOR CUSTOMERS CALLING UGANDA FROM KENYA [redacted]

	OLD RATES	NEW RATES
International Direct Dialing	25.00	10.00

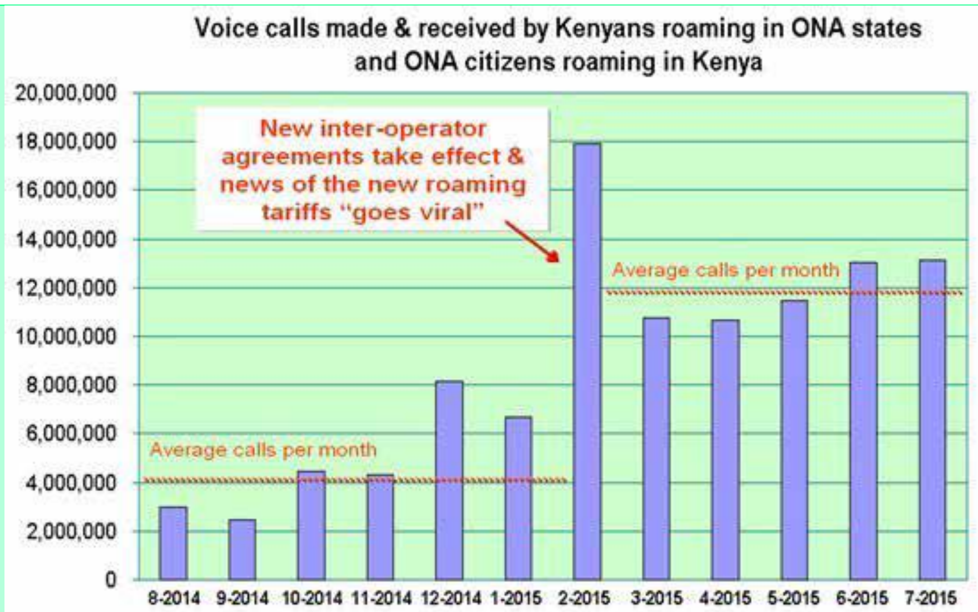
[redacted]

Outcome and Impact

(what did the case study in question achieve? Or what does it set out to achieve?)

The ONA implementation has positive effects on the mobile voice traffic between the countries. In Kenya the traffic growth by 951%. The figure below shows the traffic volume growth.

Figure 1: ONA tariff impact on voice roaming traffic: Kenya

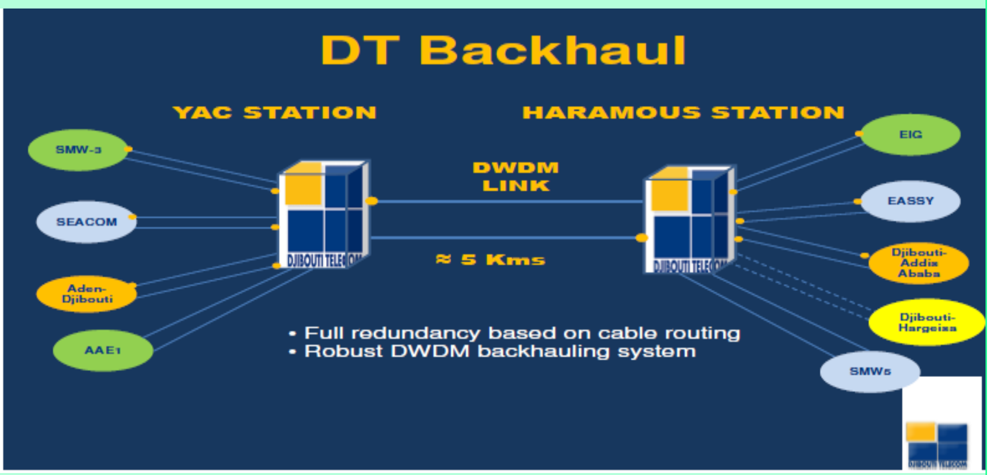
	 The traffic high growth was also noticed in other countries. Most of the countries have optical fibre connectivity which made it easier for the operators to implement due to the direct and high capacity of network. South Sudan depends on satellite connectivity but still joined the initiative which means the arrangement is also possible using satellite communications. In East Africa, the latest statistics from Kenya Communications Authority show 41.2 million minutes of voice traffic originated by mobile network customers roaming abroad in the July to September 2015 time frame; 31.7 million minutes of that was due to roaming in the other EAC Member States. On the other hand, the Kenya total mobile-originated local voice minutes in that same period came to nearly 10 877 million. So, Kenyans roaming abroad generated less than 0.4 per cent of the Kenya mobile voice traffic, less than 0.3 per cent of that due to roaming in the EAC countries. The data from Rwanda shows that only about 10 per cent of citizens use international mobile roaming (IMR) and generate 11.3 million minutes of voice traffic versus 2 834 million mobile-originated domestic voice minutes. So, roaming by subscribers from the smallest ONA country (Rwanda) was proportionally the same as in the largest (Kenya): roaming traffic amounts to less than 0.4 per cent of domestic traffic.
Critical Success factors,CSFs ***(what acounted for the success of the project?)***	Heads of State directed the implementation of **"**One-Network- Area" by 31st December 2014. The Head of States decisions was taken and implemented based on the East Africa Community Treaty. The EAC Treaty article 99 on telecommunications made the implementation of ONA easier. The ministers in the countries implemented the ONA on the principles developed the NRAs. Rwanda and Kenya launched the ONA on 8th October 2014, Uganda 7th January, 2015, and Tanzania and Burundi 15th July,2015 The ONA started with implementation on voice services then later principles developed for data roaming. The principles recommended for data roaming are:

	• Prices for data roaming services should be transparent, fair and non-discriminatory. • Consumers must be provided with adequate information regarding retail prices and billing cycles related to the provision of roaming services, especially to near-border areas where inadvertent data roaming occurs. • Prices for regional roaming services should be cost based and not be excessive in comparison with prices charged for the same services at national level. • Any roaming network connection shall be only established with user consent. • Quality of service parameters for roaming services should at least be equivalent to those approved by the NRA of each Member State. • Competitive conditions among MNOs in the EAC region should be maintained. Prices charged, and other obligations imposed on, MNOs should not distort that competition. • Glide-paths for the progressive capping of data roaming service prices based on cost models applying to both retail and wholesale tariffs, the latter requiring inter-MNO agreements.
Challenges *(what difficulties were encouuntered implementing or operationalising the case study?)*	The ONA has is facing the following challenges which are a threat to the collapse of the initiative: • Discordant tax policies in the region – the regional heads of state summit had recommended the development of a framework for harmonisation of EAC roaming charges including removal of surcharges for international telecoms traffic originating and terminating within the EAC. However, this seemed only to work on paper as the actual implementation of the framework has proved difficult • The finance ministers from the four countries have not harmonised their laws in ine with the ONA requirements • Telcos not fully adherinng to the enforcement mechanisms of ONA • Partner states not being comfortable with the modalities of determining the harmonised termmination tariffs through SIM card boxing proess
What lessons can be learnt from the case study for the deisgn and implementation of IGAD trans-border projects?	• Empower National Regulatory Authorities (NRA) to implement the regional regulatory tools on data roaming services, as for voice at the national level, pursuant to the EAC NRA Roaming Charter.21 East Africa One Network Area roaming initiative Enable and encourage NRAs to adopt harmonised EAC costing and pricing models for data roaming services. • Enable and encourage NRAs to co-operate through treaties and agreements with other NRAs in the region. • Empower NRAs to obtain relevant information from network operators and relevant roaming exchange enterprises for the purpose of implementing this policy. • Authorise NRAs to share information collected from operators with other NRAs in the region. • Installation of fraud detection systems to monitor routing of international calls (not ONA members) which are charged at ONA rates

Other comments	The ONA impact of lower tariffs on individual roamers is significant. Cross border voice traffic has grown rapidly since the ONA implementation. The regional mobile roaming prices affordability will contribute positively to regional economic integration as well as social integration. There are three countries in ONA which are member States of IGAD which will make it easier to expand the network to cover the rest of the IGAD member States. These countries are Kenya, South Sudan and Uganda. IGAD Secretariat has to develop a document on the ONA and sell it to the remaining countries as well as facilitate the implementation at national level by forming a Committee for the National Regulatory Authority.

Case Study 2: Djibouti Submarine Cables Landing Points

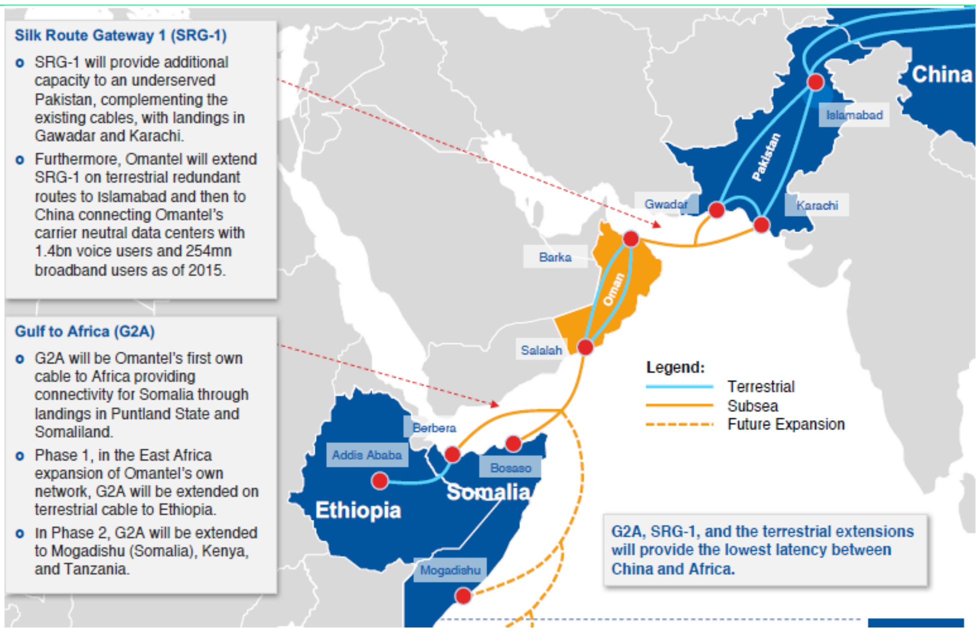
Name of case study	Djibouti Submarine Cables Landing Points
Sector	ICT
Country and location	Djibouti, Ethiopia
Location in Country	
Brief Description	 A submarine cable system is a cable laid on the sea bed between landing stations to carry voice traffic and Internet data across the ocean and sea. The first submarine communications cables laid beginning in the 1850s carried telegraphy traffic, establishing the first instant telecommunications links between continents, such as the first transatlantic telegraph cable which became operational on 16 August 1858. The new generations of submarine cables use optical fiber technology to carry telephone traffic, Internet and private data traffic. Africa especially east Africa coast has submarine cable laid in 2009 which gave more capacity for voice and data traffic volumes. It has positive impact on the affordability barrier by reducing the prices of the ICT services. Because, submarine cables are cheap and carry huge traffic compared to satellites services. Most of the Internet data traffic crossing oceans and seas is carried by undersea cables. The reliability of submarine cables is high, especially when multiple paths are available in the event of a cable cut. Also, the total carrying capacity of submarine cables is in the terabits per second, while satellites typically offer only 1000 megabits per second and display higher delay.

	The world now has many submarine cable systems around providing global connectivity. Djibouti has strategic locations, hence Djibouti attracted many submarine cables system it which reached nine cables.
Outcome and Impact ***(what did the case study in question achieve? Or what does it set out to achieve?)***	-They will provide more submarine cables capacities with many geographical locations globally -Provide alternative routing to voice traffic and internet data bandwidth - Provide redundancy to other landing points in the region 
Critical Success factors,CSFs ***(what acounted for the success of the project?)***	The two landing points which are five kilometer apart have been established and operated.
Challenges *(what difficulties were encouuntered implementing or operationalising the case study?)*	• The main chalenges are the inland connectivity capacity, policies, legislations and regulations in the IGAD Member States.
What lessons can be learnt from the case study for the deisgn and implementation of	• Enhance the affordability, and availability of regional and international connectivity. • Encourage Internet Services providers to utilise the data base centre established in Djibouti.

IGAD trans-border projects?	• Provide alternatives submarine cable connectivity to the other coastal cities such as Berbara, Mogadishu, Mombasa and Port Sudan • Improve competition at national level by providing lower prices
Other comments	The submarine cables systems impact of lower tariffs on international voice traffic and Intenet bandwidth. They will contribute positively to the affordability and reliability as well as expansion of broadband connectivity and regional economic and social integration.

Case Study 3: Gulf to Africa Submarine Cable System

Name of case study	Gulf to Africa Submarine Cable System
Sector	ICT
Country and location	Somalia, Ethiopia
Location in Country	
Brief Description	G2A will be a new low-latency cable system with the purpose of bringing content closer to end-users in Africa and providing Somalia and Ethiopia with much needed Internet capacity and access to global cloud services and applications. The subsea part will run from Salalah, Oman, to both Bosaso in Somalia and Berbera in Somaliland. From Salalah, a terrestrial route through Oman will interconnect with all of Omantel's nine submarine cable systems, soon to be twelve, with some of them the largest in the world connecting the Middle East with the Far East, Europe and North America. Omantel also hosts a wide range of content and cloud providers in Oman serving the Middle East region from their central hubs in Oman, all which will be available to the G2A system.

	
Outcome and Impact ***(what did the case study in question achieve? Or what does it set out to achieve?)***	-G2A provide terrestrial connectivity to China (silk road) -It also provides terrestrial alternative optical fibre to Frankfourt - It will be expanded to other coastal cities in East Africa
Critical Success factors,CSFs ***(what acounted for the success of the project?)***	The cables and terrestrial route to China have been constructed.
Challenges *(what difficulties were encouuntered implementing or operationalising the case study?)*	• The main chalenges are the policies, legislations and regulations for the landing points in IGAD Member States.
What lessons can be learnt from the case study for the deisgn and	• Enhance the affordability, and availability of regional and international connectivity. • Utilisation of the terrestrial optical fibre to China (Silk Road).

implementation of IGAD trans-border projects?	• Improve competition at national level by providing lower prices
Other comments	The submarine cables systems impact of lower tariffs on international voice traffic and Intenet bandwidth. They will contribute positively to the affordability and reliability as well as expansion of broadband connectivity and regional economic and social integration.