



GRID DEVELOPMENT AND MAINTENANCE PLAN 2016-17 – 2020-21



GRID DEVELOPMENT

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LIST OF ACRONYMS AND ABBREVIATIONS

ADSS Fib	All Dielectric Self Supporting Fibre Optic Cable	GDC	Geothermal Development Company Ltd
AFD	French Agency for Development	GDP	Gross Domestic Product
AfDB	African Development Bank	GOK	Government of Kenya
AMR	Automatic Meter Reading	GPOBA	Global Partnership for Output Based Aid
CAIDI	Customer Average Interruption Duration Index	GPS	Global Positioning System
Capex	Capital Expenditure	GWh	Gigawatt hour
CFL	Compact Fluorescent Light Bulb	H2	Horizon 2
CSR	Corporate Social Responsibility	HV	High Voltage
DA	Distribution Automation	HVDC	High Voltage Direct Current
DCS	Design and Construction System	IAD	Internal Audit Department
DMS	Distribution Management System	ICT	Information and Communication Technology
DSM	Demand Side Management	IDA	International Development Agency
E/hse	Electricity House	IMS	Incidences Management System
EAC	East African Community	IOs	Internal Orders
EAT	Earnings After Tax	IPPs	Independent Power Producer
EIB	European Investment Bank	IT & T	Information Technology and Telecommunications
ERC	Energy Regulatory Commission	KEEP	Kenya Electricity Expansion Project
ERM	Enterprise Risk Management	KEMP	Kenya Electricity Modernisation Project
ESIA	Environment and Social Impact Assessment	KenGen	Kenya Electricity Generation Company Ltd.
FDB	Facilities Database		
FIT	Feed In Tariff		
FTTH	Fibre to the Home		



LIST OF ACRONYMS AND ABBREVIATIONS

KENINVEST	Kenya Investment Authority	PBT	Profit Before Tax
KETRACO	Kenya Electricity Transmission Company Ltd.	PPA	Power Purchase Agreement
Kms	Kilometers	RAP	Resettlement Action Plan
KPIs	Key Performance Indicator	RE	Rural Electrification
KPLC	The Kenya Power and Lighting Company	REA	Rural Electrification Authority
Limited		RMU	Ring Main Units
KShs	Kenya Shillings	S,I	Supply Install
Kv	Kilovolt	s/s	Sub Station
kWh	Kilowatt hour	SAIDI	System Average Interruption Duration Index
LCPDP	Least Cost Power Development Plan	SAIFI	System Average Interruption Frequency Index
L&T	Labour and Transport	SCADA	Supervisory Control and Data Acquisition
LNG	Liquid Natural Gas	SCOT	Strengths Challenges Opportunities and Threats
LRA	Local Reading Application	SMEs	Small and Medium Enterprises
LV	Low Voltage	T&D	Transmission and Distribution
MSD	Medium Speed Diesel	TMR	Transport Mileage Returns
MV	Medium Voltage	TMS	Transport Management System
MVA	Megavolt Amperes	TXs	Transformers
MVAR	Megavolt Amperes Reactive	UNFCCC	United Nations Framework Convention on
MW	Megawatt		Climate Change
MWh	Megawatt hours	UPS	Unlimited Power Supply
NEMA	National Environment Management Authority	USD	United States Dollar
NERA	National Electrification and Renewable Energy	WFM	Work Flow Management
	Authority		

Load forecasting

Network Management Plan

Distribution Infrastructure

5000+ mw Generation Plan

Transmission Network Development

OVERVIEW

GRID DEVELOPMENT AND MAINTAINANCE PLAN

OVERVIEW OF THE PLAN

The grid network development and maintenance plan forms part of the Kenya Power 5-Year Corporate Plan by operationalizing the strategic initiatives and providing details of the specific projects or programs to be implemented yearly to ensure adequate power supply. It provides a detailed power supply value chain with activities that centre on the committed, planned, and future electricity generation, transmission, and distribution projects. In summary, the document is arranged as follows:

i. Load Forecasting

This encompasses the review of load forecast assumptions, pertinent variables, historical data set and methodology, taking cognizance of the future macro-economy.

ii. 5000+MW Generation Plan

Discusses the medium-term planned generation projects under the 5000+ MW programme, the time frame and the long-term requirements necessary to meet the growing national load at least cost. It also includes a review of the expected energy mix that would be applicable with the introduction of the different generation sources.

iii. Transmission Network Development Plan

Provides a detailed summary of both the committed and future transmission projects including the regional grid interconnection requirements. The projects are mainly developed by KETRACO as identified and planned under the least cost power development plan.

iv. Distribution Infrastructure Development Plan

The plan indicates the need for the company to invest in the distribution and transmission infrastructures (66kV Network) for the short-term period of 2016-2021. The plan proposes the required system reinforcement, upgrades and network expansion programme that ensures that the network is robust and reliable to transmit and carry the load demands as and when it grows and more so with the injection of the new 5,000MW generation.

v. Network Management Plan

In a bid to ensure 100% network asset maintenance and automation, the Network Management strategic plan has put in place plans to reinforce, upgrade, underground (based on economic viability and prudent resource use) and refurbish the network. This is aimed at reducing the interruptions per 1,000 index, increased customer satisfaction and a well maintained network.

Other plans that are linked to this strategic plan although not part of the plan include the Least Cost Power Development Plan, 5,000+MW Power Development Plan, Ministry of Energy and Petroleum Strategic Plan and the Vision 2030 Medium Term Plan.

1. DEMAND FORECASTING

1.1 Introduction

Demand for electricity energy has been increasing steadily since the year 2004 due to accelerated economic growth leading to improved industrial and commercial activity. Kenya's peak demand increased from 899MW in 2004/05 to 1,585MW in 2015/16, while the number of electricity consumers increased fivefold from 735,144 in 2004/05 to 4,890,373 in June 2016. The effective installed capacity is 2,341 MW where hydro accounts for about 35 percent of the total generation. The network has undergone tremendous expansion and improvement and the LV reticulation has greatly expanded to reach more households. In its quest for the socio-economic transformation of the country, the Government has set the goal of electrifying 70 percent of households in 2017 and universal access to electricity by 2020.

The load forecast is used to shape the power sector expansion program. It will determine future requirements for both the capacity (in MW) and energy (in GWh) for planning a supply system capable of matching demand and the future generation and transmission investments.

1.2 General approach

The Model for Analysis of Energy Demand (MAED) developed by the International Atomic Energy Agency (IAEA) was used for energy demand forecasting in this update.

The forecast considers population evolution in terms of urbanization. Several assumptions have been made in the estimation of the demand forecast as follows:

- Commercial industrial consumption has used ratios significant to the counties commercial consumption in the past year.
- Future economic expansion and its impact on electricity consumption has been incorporated in the demand forecast through the linear correlation of electricity consumption and the GDP growth rate. A factor of 1.5 percent is used to impact on the commercial and industrial consumption.
- A GDP growth rate of 5.7 per cent was assumed since this is the current target of Vision 2030 medium term plan for year 2016.
- The number of households as well as the electrification rate has been factored in the load forecast i.e. Government intention to connect 70 per cent of household by 2017 and universal access in 2020
- Street lighting growth in the counties has also been considered in terms of increased electricity consumption.

Three demand scenarios were developed based on assumptions which were defined to reflect both current and future economic and social outlook in the vision 2030. The low GDP forecast reflected a pessimistic case while the high scenario gives an optimistic case based on the vision 2030 aspiration while the reference scenario was the middle ground between the two scenarios.

1.3 Energy Demand Forecast

The energy demand forecast and the peak load forecast are displayed in Table 1.1 Below:

Table 1.1 Energy forecast in GWh

Year	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

Source: Power Sector Medium Term Plan 2016-2021

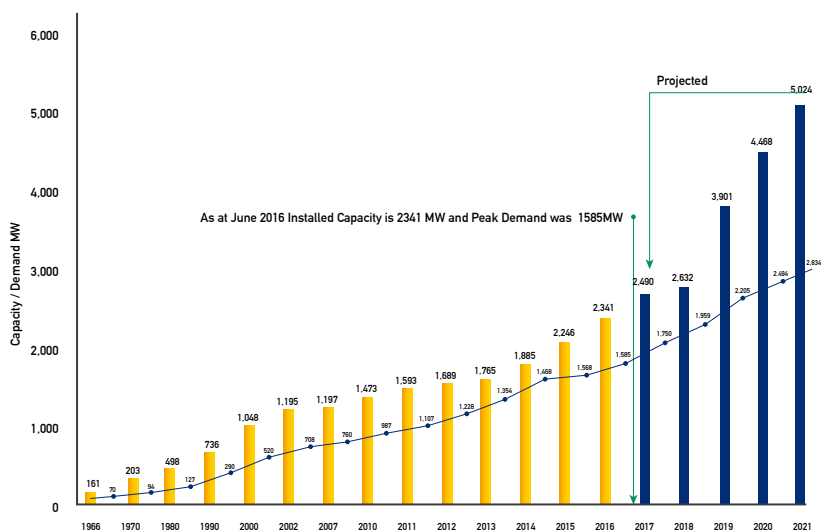
1.4 Current Energy Demand Status

Peak demand had reached 1,586MW by June 2016 and is expected to rise to 2,864MW in 2021 under normal growth scenario, including 30MW export to Rwanda. Peak demand in 2021 would be equivalent to 42.6% of the projected installed capacity. Total system generation capacity is targeted to reach 6,670 MW in 2021 if there are no slippages in completion of dates of committed projects. However, under the deferred growth scenario that takes account of the likely project delays, total installed capacity would be expected to reach 5,024MW. The peak demand is expected to grow as a result from the following:

- Normal demand growth linked to growth in the national economy and to major new industrial and commercial investments
- Vision 2030 flagship projects: namely the ICT Park, light rail, standard gauge railway, Port of Lamu, new pipeline pumping stations, resort cities and iron smelting industry

The trend in Generation Capacity and Peak Demand from the past, present and projected future up to year 2021 is shown in Figure 1.1 below.

Figure 1.1 Installed Capacity and Peak Demand MW



2. GENERATION PLAN

The Government formulated a 40-month target to expand the power generation capacity by 5,000+ MW. The additional capacity was deemed necessary for various reasons which include:

- diversification of the generation mix
- reduce power tariffs through addition of least cost generation projects
- avoid overreliance on hydropower
- availing adequate capacity and reserve margin

In the Government formulated generation expansion plan a total of 5,098MW of new generation capacity was planned to be built in the period July 2013 to December 2016. However, after review of the implementation progress by late 2015, this plan is now envisaged in the Medium Term Power Development Plan to be completed by 2020/21. Total system generation capacity is targeted to reach 6,670 MW in 2021 if there are no slippages in completion of dates of committed projects.

The MTPD also provides for a deferred growth scenario that takes account of the likely further project delays. Under the deferred growth scenario total installed capacity would be expected to reach 5,024MW. The capacity factor of the system would range between 38% and 51%, and average 43% over the period. This ambitious growth as compared to the past is based on a development model that is transformative as opposed to incremental. The model relies on the assumption that new large scale investments in the economy will occur if suitably supported by available infrastructure. Despite higher risk of idle capacity in the short term, the transformative generation development approach will allow single projects to cater for incremental demand growth over a longer span of time and will allow for larger size generation plants to be developed that would be more economic and cost efficient in the long term.

The new additional generation capacity reflects an annual average capacity growth of 17% in the deferred growth scenario, as compared to 8.9% annual average growth in the past 5 years. Kenya Power, as the generation off-taker will be engaged in procuring power from 34 new power stations as well as supporting the government's effort to stimulate power market peak demand growth to absorb the new capacity.

As a result of the 5,000+MW plan the average generation tariff was targeted to fall from US cts/kWh 12.5 in 2014/15 to US cts /kWh 7.4. However, based on revenue requirements for the committed new power plants, in 2021, the attained generation tariff is estimated to be 11.44USc/kWh. Additional power plants are not sufficiently reducing the overall cost of power, as the overplanting and underutilized capacity is not covered by adequate revenue growth. The tariff will reduce only when generation is closely matched by demand growth.

The company's generation procurement that is completed to date under the 5000+MW plan is shown Table 2.1 below. The Generation Expansion Medium Term Plan list of committed projects likely to be realized in the period 2015 to 2020 is shown in Table 2.3. A summary of the ongoing generation procurement including PPA negotiations currently in progress is shown in Table 2.4. Table 2.5 shows a summary of the status of the proposed and ongoing Feed in Tariff projects, while Table 2.6 gives the KPIs expectations that would be associated with implementation of the generation procurement plan.

Table 2.1 5000+MW Commissioned Projects

Project	Type	MW	Term	Expiry Date
1	Thika Power	87	20	Mar-34
2	OrPower4 plant III	16	25	Feb-39
3	Olkaria IV	140	25	Aug-39
4	Olkaria I additional units	140	25	Jan-40
5	Gikira Small Hydro	0.5	20	May-24
6	Gulf Power	80	20	Nov-34
7	Ngong 1 Phase II	20.4	20	Jan-35
8	Kengen Wellheads	50.6	20	Apr-33
9	Kindaruma optimization	4	20	Jun-33
10	Triumph Power	77	20	Feb-35
11	OrPower4 plant IV	24	25	Jul-39
12	Orpower4 plant IV	29	25	Jul-39
13	Biojoule Kenya Limited	2	-	-
Total		657.5		

Table 2.2 Generation Capacity Mix 2016/17 to 2020/21

Year	Generation Capacity Mix MW			Generation Energy Mix GWh		
	2015/16	% of total	2020/21	2015/16	% of total	2020/21
Hydro	821	35.1%	871	3,787	38.58%	2,664
Geothermal	632	27.0%	1,321	4,608	46.95%	4,134
Thermal	833	35.6%	792	1,296	13.20%	1,140
Cogeneration	28	1.2%	51	0.31	0.003%	52
Solar	1	0.0%	52	0.79	0.01%	4
Wind	26	1.1%	556	56.7	0.58%	335
Coal	0	0.0%	981	0	0.00%	2,593
Imports	-	0.0%	400	67	0.69%	1,818
Total	2,341	100.0%	5,024	9,817	100.00%	12,740
						100.00%

Figure 2.1 Generation Capacity 2014/2015 and Projected Generation Capacity 2020/2021

Energy Purchased 2015/16

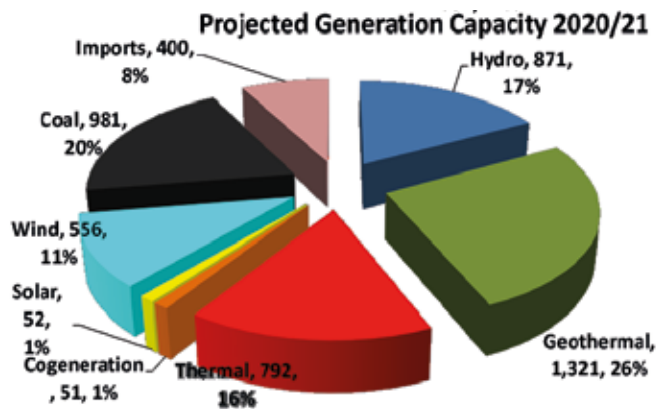
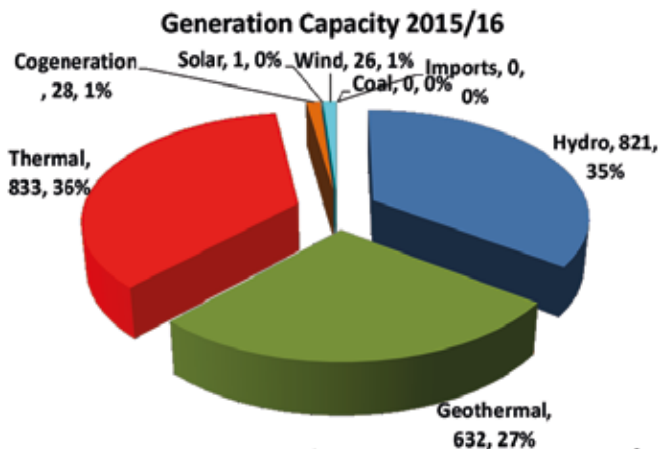


Table 2.3 Committed Projects likely to be realized 2015-2020

Year	Plant	Type	Added Capacity MW	Total Capacity MW
2016	Strathmore	Solar	0.6	2,448.2
	Kwale Sugar	Cogen	510	
	Cummings	Biomass	10	
	KTDA Chania	Hydro	1	
	MEN1 Sosian	Geothermal	35	
	MEN1 Orpower 22	Geothermal	32	
	MEN1 Quantum	Geothermal	35	
	KIWP	Wind	60	
	OWH4	Geothermal	35	
	AGRK	Diesel	(30)	
	Orpower 4	Geothermal	50	
	OLK 1	Geothermal	(45)	
	Genpro	Hydro	5	
	NGW 3	Wind	10	
2017	MEN2	Geothermal	60	2,540
	MERW	Wind	50	
	Klean Energy	Hydro	6	
	Tindinyo	Hydro	1.5	
	KTDA Gurra	Hydro	5.8	
	Oldanyat	Wind	10	
	Mt. Kenya CBO	Hydro	0.6	
	KTDA Itare	Hydro	1.3	
	Marco Boroero	Solar	1.5	
	KGT1	Kerosene	(27)	
KGT2	Kerosene	(27)		

Year	Plant	Type	Added Capacity MW	Total Capacity MW
2018	AGIL	Geothermal	70	3,808
	OLK5	Geothermal	140	
	OLK 1	Geothermal	51	
	LTWP	Wind	300	
	EIMP	Import	400	
	OLK 1B	Geothermal	70	
	OLK Topping	Geothermal	60	
	KIPW	Wind	100	
	AKIG	Geothermal	70	
	KTDA Metumi	Hydro	5.6	
2019	KTDA Lower Nyaminde	Hydro	1.8	4,376
	Amu Power	Coal	490.75	
	AGIL	Geothermal	70	
	KTDA Iraru	Hydro	1.5	
	KTDA Maara	Hydro	2.0	
	KTDA Kipsanoi	Hydro	3.6	
	Amu Power	Coal	490.75	
	Alten	Solar	40	
	Solarjoule	Solar	10.0	
	KTDA Gucha	Hydro	4	
2020	Global	Hydro	11	5,024

Table 2.4 Summary of ongoing generation procurement

Project/PPA Status	No.	Capacity (MW)
Commissioned & operational Plants	55*	2,325
PPAs commissioned since March 2013	10	642
PPAs negotiated and approved by ERC	23	690
PPAs negotiated awaiting ERC approval	4	1,134
PPAs under negotiations	16	509.7
RFP approved awaiting PPAs negotiations	57	1,032.6
FIT Policy awaiting RFP approval	90	1,924
5000+MW Projects yet to start PPA negotiations.	4	1,830
TOTAL (Ongoing only)		7,120.6

*Includes 21 off-grid power plants

Table 2.5 Summary Feed in Tariffs Projects

	Wind	Biomass	Biogas	Small Hydro	Solar PV	Geothermal	Total	Total Capacity (MW)
Plants in Operation	0	0	0	2	0	0	2	1
Projects With Signed PPAs	2	1	0	10	0	0	13	106
Projects with Initialled PPAs	2	0	1	1	0	0	4	158
Projects with Finalized PPA Negotiations	0	1	0	0	2	0	3	19
Projects with PPAs under Negotiations	2	1	0	2	7	0	12	323
Approved Projects with PPA Negotiations Yet to Start	1	1	1	14	3	0	20	305
Projects in Feasibility Study Stage	8	10	4	30	37	1	90	1,924
Total no. of Approved Projects	15	14	6	59	49	1	144	2,836

Table 2.6 Generation Procurement Performance Measures

Strategic Performance Measures		2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Generation Capacity MW (Deferred case)		2,341	2,490	2,632	3,901	4,468	5,024
New generation capacity procured MW		460	192	142	1,269	567	556
Energy Purchase GWh		9811	11,689	13,149	14,871	16,901	17,945
Peak Demand MW		1,585	1,750	1,959	2,205	2,494	2,864
Reserve Margin*		31.0%	28.5%	24.4%	42.7%	43.5%	43.0%
System Capacity Factor %		46%	48%	51%	38%	38%	38%
Average Bulk Supply Cost US cts per kWh		12.89	12.46	12.3	12.14	11.71	11.44
Note: * Reserve margin reflects projected excess capacity of the new plant being commissioned ahead of demand growth							

2.1 Challenges and Mitigation of New Generation Procurement

The major challenges faced in the generation procurement plan and mitigation measures are as follows:

Challenge	Mitigation
Investors awarded generation projects are sometimes unable to reach financial closure and implement development within agreed time frames	<ul style="list-style-type: none"> Improved access of IPPs to IDA Partial Risk Guarantees Selection of IPPs with stronger Limited Recourse Financing Government support to dispute resolution Developers to address factors leading to implementation delays such as project financial closure, tendering delays and construction delays
Completion of transmission network reinforcements to evacuate power from the new power stations within required time frames is important to avoid a rise in transmission losses due to overloading of the existing network	<ul style="list-style-type: none"> Improve coordination of transmission project development to ensure timing coincides with associated generation development Strengthen legal means to accelerate resolution of community related disruptions to project implementation
A high reserve margin may entail higher unit energy costs due to idle capacity attracting capacity charges	<ul style="list-style-type: none"> Improve transmission and distribution extensions to high economic potential areas Increase redundancy to large power customers to eliminate downtime due to outages Development of demand growth strategies that match the supply strategies

3. TRANSMISSION NETWORK PLAN

3.1 Introduction

The transmission expansion plan aims to provide an additional 3,178MVA of transmission substation capacity and 3,325kms of new transmission power lines over the next five years that will serve the increasing demand and customer growth. The new lines will provide the vital link for the evacuation of power from the additional generation sources under the 5000+MW plan and improve the power quality and stability across the network. Some of the transmission development strategies being implemented to maximize expected benefits from the projects include:

- i. Develop the power system to operate under N-1 criteria
- ii. Extend scope of SCADA system to monitor and control more sub-stations and equipment.
- iii. Fast track ongoing projects
- iv. Comply with transmission system maintenance schedules
- v. Increase line carrying capacities as necessary
- vi. Convert single circuits to double circuits where applicable
- vii. Dedicated supply for heavy Industrial loads

KPLC and KETRACO are working closely in implementation of transmission projects for evacuating power from ongoing generation projects and others for transmission capacity enhancement. Some of the recently completed transmission lines include 30km 132kV Thika-Gatundu, 77 km 132kV Kilimambogo - Thika - Githambo and 328km 220kV Rabai-Malindi -Garsen -Lamu. Kenya Power will lease and maintain the new transmission lines developed by Ketraco. Table 3.1 provides a summary of the projects under implementation while Tables 3.2 and 3.3 show the transmission projects at contract award/procurement stage and Projects at Preparation/Financing Stage, respectively. Table 3.4 shows the status of the transmission lines associated with the flagship 5000MW additional generations project and the status of other high priority projects for the Government.

3.2 Regional Power Trade Projects

The Ethiopian Electric Power Company and Kenya Power have a PPA for export of 400 MW to Kenya through a 500kV HVDC line spanning over 1,100 km. The line is currently being developed by KETRACO on the Kenyan side and it is expected to be commissioned by 2018. Kenya Power has signed a Power Purchase Agreement (PPA) with the Rwanda power utility Rwanda Energy Group Limited (REG) for export of 30-50MW through the Ugandan transmission line although at the initial stage, only 10-15MW will be exported due to transmission constraints along the Uganda line. The sale take effect through the three entities' already interconnected transmission grid, following the signing of a wheeling agreement between Kenya Power, Uganda Electricity Transmission Company Ltd (UETCL) and REG. A new line being built between Kenya and Uganda will increase capacity transfer capability, while additional capacity enhancements are required in the power transmission system of Uganda for delivery of the power to Rwanda.

Table 3.1 Transmission Line Recently Complete and Ready for Official Commissioning

No	Projects	Comments	Energization date
1	Rabai - Malindi - Garsen - Lamu Line	Shunt Reactor installed and Lamu substation energized	November 2015
2	Olkaria 1AU - Suswa Line	Completed and awaiting energization of Suswa substation	To be determined
3	Olkaria IV - Suswa Line	Completed and awaiting energization of Suswa substation	To be determined
4	Isiolo - Meru line section	Meru substation, Isiolo substation and Isiolo - Meru section energized	April 2015
5	Kindaruma - Mwingi line section	Kindaruma substation and Kindaruma - Mwingi line section energized	December 2015

Table 3.2 Transmission Projects at Construction Stage to be completed in 2016

No	Projects	Status	Projected Completion date
1	Eldoret - Kitale Line	Commissioning tests ongoing	Feb-16
2	Kindaruma - Mwingi - Garissa Line	Only 15% of transmission line pending	Mar-16
3	Kisii - Awendo Line	39% transmission line and 52% of substation completed	Jun-16
4	Menengai - Soito	35% transmission line and 40% of substation completed	Jun-16
5	Nanyuki - Isiolo - Meru	Only 8% of transmission line pending	Jun-16
6	Mombasa - Nairobi Line	Only 7% of Lot 2 works pending	Aug-16
7	Suswa - Isinya Line	65% of works complete	Aug-16
8	Turkwel - Ortum - Kitale	58% of tower erection complete	Aug-16
9	Athi River and Isinya substation	Procuring new contractor	Oct-16
10	Loiyangalani - Suswa Line	Tower erection commence	Oct-16
11	Lessos - Tororo Line	39% transmission line and 52% of substation completed	Nov-16
12	Machakos - Konza & Isinya-Namanga*	Only 18% of tower erection in Machakos Konza pending and Isinya - Namanga virtually stopped	June 2016 and December 2016*
13	Bomet - Sotik Line	Substations 100% complete; foundations 52% complete; and tower erection 24% complete	Apr-16
14	Ishara - Kieni Line		Apr-16
15	Lessos - Kabarnet Line		Dec-16
16	Mwingi - Kitui - Wote - Sultan Hamud Line		Dec-16
17	Nanyuki - Rumuruti Line		Sep-16
18	Olkaria - Narok Line		Dec-16

Table 3.3 Transmission Projects to be completed in 2017

No	Projects	Status	Projected Completion Date
1	Mariakani Substation	Contract signature in January 2016	Oct-17
2	Kimuka and Koma Rock Substation	Procuring new contractor	Jun-17
3	Olkaria - Lessos - Kisumu Line	Procurement of contractors complete and engineering design ongoing	Dec-17
4	Isinya 400kV substation Reinforcement Component A4	Earthworks complete	Feb-17

Table 3.4 Transmission Projects to be completed in 2018

No	Projects	Status	Projected Completion Date
1	Voi - Taveta	Loan Agreement at National Treasury	Jun-18
2	Rabai - Bamburi - Kilifi	Loan Agreement at National Treasury	Jun-18
3	Kenya - Tanzania (ZTK) interconnector	Evaluation of bidder completed	Mar-16
4	Eastern Electricity Highway (Ethiopia - Kenya Interconnection)	Procurement of contractors complete and engineering design ongoing	Dec-18
5	Lamu - Nairobi East	Evaluation of bidder completed	December 2018*
6	Menengai - Rongai	Seeking for finance	December 2018*
7	Silali/Baringo - Rongai	Seeking for finance	December 2018*
8	Isinya - Nairobi East	Seeking for finance	December 2018*

Table 3.5 Ongoing Transmission Projects at Preparation & Financing Stage

No	Projects	Scope	Estimated Construction Cost (MUSD)
1	Menengai - Rongai	33km 400V double circuit line (evacuate 400MW)	34.71
2	Silali/Baringo - Rongai	180km 400kV double circuit line	65.06
3	Konza - Nairobi East	52km, 400kV double circuit line	51.18
4	Narok - Bomet	88km 132kV double circuit line	14.2
5	Karbanet - Nyahururu	111km 132kV double circuit line	20.24
6	Suswa - Ngong	40km, 220kV double circuit line	18.82
7	Meru - Maua	50km 132kV Line and 1 No. 23MVA Sub-station at Maua	12.12
8	Rumuruti - Maralal	148km 132kV Line and 1 No. 7.5MVA Sub-station at Maralal	20.59
9	Garsen -Bura - Hola - Garissa	240km 220kV or 132kV single circuit line and 1 No. 23MVA Sub-station at Hola and Bura	53.18
10	Garissa - Wajir	330km 132kV single circuit line and 1 No. 23MVA Substation at Wajir and Habaswein	87.76
11	Awendo - Isabenia	50km 132kV single circuit line and 23MVA Sub-stations at Isabenia	11.65
12	Galu - Lunga Lunga	60km 132kV single circuit line and 23MVA Substations at Lunga Lunga	12.71
13	Ishara - Chogoria	40km 132kV single circuit line and 1 No. 15MVA Substation at Chogoria	10.82
14	Sultan Hamud - Loitoktok	120km 132kV single circuit line and 2 No. 15MVA Sub-station at Loitoktok and Merueshi	22.35
15	Kamburu - Thika	196km 220kV Line, with substations in Embu and Thika	67.06
16	Isinya - Konza	45km 400kV double circuit line, with substation in Konza	46.76
17	Gilgil- Thika - Nairobi East	205km 400kV double circuit line, with substation in Longonot, Thika, Kagundo and Konza	102.35
18	Kitui - Mutomo - Kibwezi	144km 1320kV double circuit line, with substation in Mutomo and Kibwezi	29.41
19	Ngong - Magadi	84km, 132KV double circuit transmission line, with substation at Magadi.	22.35
20	Uplands - Limuru	132/33kV Substation	7.65
21	Kisumu - Kakamega - Musega	72km 220kV double circuit line with substations in Kakamega	35.29
22	Webuye - Kimilili - Kitale	73km 132kV double circuit line with substation in Webuye and Kimilili	20
23	Sotik - Kilgoris	48km 132kV double circuit line with substation in Kilgoris	12.35
24	Rongai - Kilgoris (Lake Victoria Ring)	235km 220kV line with substation in Rongai and Kilgoris	63.53
25	Myanga - Busia	34km 132kV double circuit line with substation in Myanga and Busia	14.12
26	Rangala - Bondo - Ndigwa	72km 132kV single circuit line with substations in Bondo and Ndigwa	20

No	Projects	Scope	Estimated Construction Cost (MU\$D)
27	Homa Bay - Sindo	72km 132kV single circuit line with substation in Sindo	18.24
28	Ndhiwa - Karungo Bay	60km 132kV single circuit line and substations at Ndhiwa and Karungo Bay	17.65
29	Kiambere - Maua - Isiolo	288km 220kV double circuit line with substations in Maua and Isiolo	81.18
30	Isiolo - Maralal	150km 220kV double circuit line with substation in isiolo and Maralal	57.65
31	Isiolo - Marsabit	306km 220kV double circuit line with substation in isiolo and Maralal	81.18
32	Turkwel - Lodwar - Lokichogio	228km 220kV double circuit line with substation in Lodwar and Lokichogio	69.41
33	Loiyangalani - Marsabit	180km 400kV double circuit line with substation in Marsabit	64.71
34	Galu T-off - Likoni	15km 132kV double circuit line with substation in Likoni	8.24
35	Menengai - Nyandarua - Rumuruti	70km 132kV double circuit line with substation in Nyandarua and extension works in Menengai and Rumuruti	20.59
36	Electrification of Standard Gauge Railway	Construction and extension of 9 substations	92.8
37	Transmission line along LAPSET corridor	400/220kV double circuit lines and associated substation in Lamu, Garissa, Isiolo, Baringo, Lokichar and Lodwar	470.92
38	Wajir - Marsabit - Loiyangalani	400km 220kV double circuit lines and associated substation in Wajir, Marsabit and Loiyangali	138
		TOTAL	1,996.80

3.3 Extension of Transmission lines to connect current Off Grid Stations

The Distribution Master Plan indicates an economic case for extension of the grid to Lodwar, Marsabit, Wajir, Habaswein and Hola. These sites will be interconnected to the grid through extension of the transmission network. Transmission projects that will bring currently off-grid stations into the interconnected network in the plan period are shown in Table 3.4 below

Table 3.6 Transmission Projects connecting Off Grid Power Stations

Transmission project	Voltage (kV)	Status	Expected completion	Affected off-grid power plant
Rabai-Malindi-Garsen-Lamu	220	RabaiMalindi commissioned Malindi Garsen Lamu commissioned	2015	Lamu
Kindaruma-Mwingi-Garissa	132	Under construction	2016	Garissa
Garsen-Hola-Garissa	220	Feasibility stage	2019	Hola
Garissa-Wajir	132	Feasibility stage	2019	Wajir Habaswein

3.4 Major Power Hub at Suswa

The upcoming Substation at Suswa is designed and located strategically to be a major hub within the GRID networks of the Eastern African region and beyond. The substation is meant to play a critical role in enhancing power reliability, quality and security for a conducive business environment and better lives for the people in the Region. There will be high inflows of power from diverse generation centres including Gibe in Ethiopia, Olkaria geothermal, Loiyangalani wind, among others. Outflows of power from Suswa will feed Nairobi City County, onward export to Tanzania and beyond through a southern corridor. There will also be interconnectivity with East African countries towards the western flank. Already the implementation of a high capacity HVDC line from Ethiopia to Suswa is ongoing and will deliver power from huge generation capacity in Ethiopia to Kenya and beyond, through this important hub. Also the implementation of the Olkaria - Lessos - Tororo line is ongoing, providing supply corridor towards the western flank of East Africa. The Suswa - Isinya - Arusha line will link Kenya's national Grid to the Southern Africa.

Suswa Substation is not only strategically located near Kenya's biggest load centres around Nairobi City County, but also a key pillar in the greater Nairobi high voltage ring circuit. The HV ring circuit around Nairobi will provide flexibility in supply sources, enhanced system redundancies for stability and security of power supply to industry, businesses, important facilities and residences. The interconnectivity of the region through Suswa will enhance supply stability and security for a more competitive Eastern Africa region. The substation will therefore serve as an entry and exchange point for geothermal, wind and hydro-generated power into the Kenya's National Grid and Regional GRID networks.

Infrastructure development involving the construction and upgrade of distribution substations across the country for increased capacity, loss reduction and quality supply



4. DISTRIBUTION INFRASTRUCTURE DEVELOPMENT PLAN

4.1 Distribution Development Plan

Distribution master plan is based on a projected maximum demand of 2,864 MW by 2021 consistent with the analysis in the Power Sector Medium Term Least Cost Power Development Plan, 2015-2020. The plan takes account of the additional demand expected to arise from the Vision 2030 Flagship Projects that would have been completed.

4.2 Objectives

Infrastructure development in the planning period aims to address three major strategic objectives

i. Improve quality of supply.

This is to enhance customer satisfaction and to maximize productivity in the country by minimizing power supply interruptions experienced by customers.

ii. Reduce technical losses.

By enabling a greater percentage of energy purchased from generators to be converted into sales, the gross profit margin will increase by an amount equivalent to one percent of total revenue for every percentage point reduction in losses.

iii. Expand the network.

Expansion and upgrade of the distribution substation capacity and power lines is necessary to absorb and distribute the 5,000+ MW of new generation that will come in to the system in the medium term planning horizon. This expansion is also necessary to meet the goal of universal access to electricity by 2020.

4.3 Strategies

The company will use the following strategies to achieve these objectives:

i. Automate existing and new networks by integration of new and existing substations to the SCADA (Supervisory Control and Data Acquisition) system and installation of automatic load switches to reduce operational costs.

ii. Increasing electricity connections country-wide both rural and urban areas. This is through the Kenya Power and Lighting Company under the Kenya Electricity Expansion Project (KEEP), The Last Mile Project and GPOBA (Global Partnership for Output Based Aid) project.

iii. Modernise Power generation to incorporate renewable energy to reduce cost of producing electrical energy under the Kenya Electricity Modernization Programme (KEMP).

iv. Reduce technical losses by upgrade and expansion of the existing system.

The distribution plan entails construction of 116 new distribution substations totalling 2,809 MVA with 1,244 kms of associated 66 and 33KV lines, 20 new bulk supply substations and installation of a total of 336.5MVAR reactive power compensation equipment in 15 transmission substations. The plan further recommends upgrade on several parts of the network as enumerated below:

a) Existing Distribution & Bulk Supply substations were identified for upgrade between Financial Year 2016 - 2021 with a project increase in capacity of 2,473 MVA.

b) 38 Existing distribution substations were identified for Reactive Power Compensation between FY 2014/2015 and 2017/2018.

- c) The load growth in these substations will be closely monitored so that upgrades and reactive power compensation are implemented on timely basis.
- d) These strategies and initiatives are expected to ensure that the grid network system is stable reliable and efficient. In particular the following key outputs are expected over the planning period.

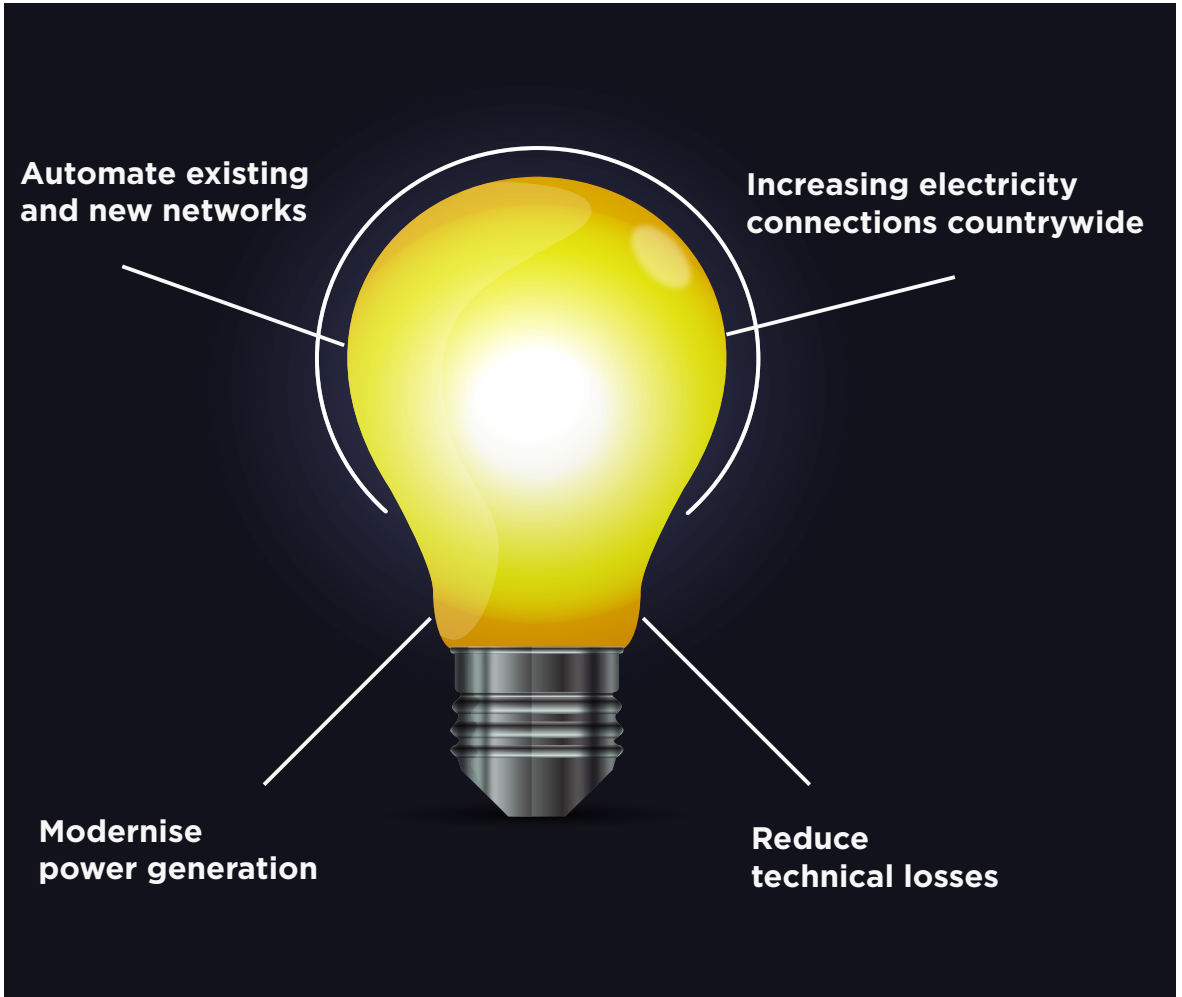


Table 4.1 Key Outputs of Infrastructural Development Initiatives

	Key Outputs	2016/17	2017/18	2018/19	2019/20	2020/21
1	No. of Distribution substations added	0	250	630	120	0
2	New LV lines constructed IDA	0Km	3,000Km	8,000Km	1,500Km	0
3	No. of new primary substations	28	35	37	4	12
4	Capacity of new primary substations (MVA)	717MVA	795.5MVA	937MVA	716MVA	276MVA
5	No. of primary substations upgraded	6	13	0	1	4
6.	Capacity of primary substations upgraded (MVA)	145MVA	276MVA	0MVA	180MVA	92MVA
7	No. of primary substations under N-1 criterion	13	15	9	4	0
8	New lines MV constructed	145Km	295Km	630Km	120Km	0Km
9	No of lines MV constructed under N-1 criterion	3	0	0	2	0
10	Reactive power compensators installed	6	9	0	0	0
11	Capacity of reactive power compensators installed (MVar)	145MVar	191.5MVar	0MVar	0MVar	0MVar
12	No. of automatic load break switches installed	0	400	400	200	0
13	No. of substations added to the SCADA system	28	35	37	4	12

4.4 Investment required over the planning period

The distribution plan indicates the need for the following investment in the distribution and transmission infrastructures for the short term period of 2016-2021. Table 4.2 shows the proposed investments. The study identifies and proposes the need for approximately (88) 66kV and 33kV distribution projects beyond those that are already committed or under construction. The estimated investment required for the 66kV and 33kV projects over 2015-2020 period is USD 120,437,233 as indicated in Table 4.3 below:

Table 4.2 Number of Proposed 66kV and 33kV Primary substations Investment in short to medium Term (USD)

Region	2017	2018	2019	2020	2021	Total Investment USD
Nairobi (66kV)	12	1	6	4	1	95,682,502
Coast	0	0	0	0	1	2,676,340
West Region	8	7	7	2	4	19,351,120
Mt. Kenya	0	0	1	0	3	2,727,271
Total	20	8	14	6	9	120,437,233

Source: Grid Distribution Plan 2016-2021

The plan also established the need for various scope on 17Nos bulk supply points at total estimated cost of USD 89,026,425 over the 2016-2021 period.

Table 4.3 Proposed Bulk Supply Points investment in short/Medium term (USD)

Region	2016	2017	2018	2019	2020	2021	Total Investment USD
Nairobi	0	0	0	0	0	0	0
Coast	1	1	2	1	0	1	20,379,282
West Region	1	0	1	1	4	1	65,224,188
Mt. Kenya	0	1	0	2	0	0	3,422,955
Total	2	2	3	4	4	2	89,026,425

The table 4.4 below shows a summary of the details of the projects currently under implementation and those to be developed during the plan period.

Table 4.4 Status of the Projects Currently Under Implementation

Objective	Initiatives/ Projects/ Strategies	Total Cost Kshs.	Current Status%	2015/16%	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %
1	Supply Quality Improvement & Capacity Enhancement	14.2Billion	90%	75%	100%	0%	0%	0%	0%
2	Supply Quality Improvement & Capacity Enhancement	10.4Billion	5%	0%	50%	100%	0%	0%	0%
3	Access – Connectivity	193Million	80%	0%	100%	0%	0%	0%	0%
4	Voltage Improvement (Supply Quality improve.)	2.29Billion	70%	10%	100%	0%	0%	0%	0%
5	Supply Quality Improvement & Capacity Enhancement	1.62Billion	60%	0%	90%	100%	0%	0%	0%
6	Supply Quality Improvement & Flexibility	778Million	5%	0%	40%	100%	0%	0%	0%
7	Supply Quality Improvement & Flexibility	1.26Billion	10%	5%	75%	100%	0%	0%	0%
8	Supply Quality Improvement & Flexibility	2.6Billion	2%	0%	65%	100%	0%	0%	0%
9	Load Management	720Million	5%	0%	80%	100%	0%	0%	0%
10	Supply Quality Improvement & Flexibility	18.6Billion	5%	0%	45%	70%	100%	0%	0%
11	Supply Quality Improvement & Flexibility	5.3Billion	1%	0%	30%	60%	100%	0%	0%
12	Training & Capacity Building	100Million	0%	0%	0%	100%	0%	0%	0%

Objective	Initiatives/ Projects/ Strategies	Total Cost Kshs.	Current Status%	2015/16%	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %
13	Supply Quality Improvement & System Operational flexibility	1Billion	0%	0%	35%	70%	100%	0%	0%
14	Building								
15	Supply Quality Improvement & system operational flexibility	2Billion	0%	0%	35%	70%	100%	0%	0%
16	Supply Quality Improvement & system operational flexibility	2Billion	0%	0%	30%	100%	0%	0%	0%
17	Revenue Protection	4Billion	0%	0%	20%	75%	100%	0%	0%
18	Access to Electricity - Connectivity	16.5Billion	0%	0%	0%	60%	100%	0%	0%
19	Access to Electricity - Connectivity	11Billion	0%	0%	15%	85%	100%	0%	0%
20	Supply Improvement & Capacity Enhancement	1.4 Billion	90%	40%	100%	0%	0%	0%	0%
21	Supply Improvement & Capacity enhancement	0.5 Billion	100%	0%	0%	0%	0%	0%	0%
22	Retrofitting of Renewable energy to Existing 23 Mini-grids	33 Million Euros	0%	1%	25%	50%	75%	100%	0%
23	Retro-fit of Renewable Energy Component at Lodwar & Hola	3 Million Euros	0%	5%	50%	100%	0%	0%	0%
24	Supply Quality Improvement & Capacity Enhancement	Kshs 12 million	0%	100%	0%	0%	0%	0%	0%
25	Supply Quality Improvement & Capacity enhancement	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 4.5 Expected Key Outcomes of Externally Funded Initiatives

	Initiatives/ Projects/ Strategies	Key Outcome	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
1.	KEEP - KEEP/MoEP/IFC /Rights Issue - Distribution & Transmission SS's and associated lines	Increase in capacity to absorb 5000MW New Generation	10MVA	580MVA	OMVA	OMVA	OMVA	OMVA
2	KEMP - RMB Financed 36 Substations and associated lines	Increase in capacity to absorb 5000MW New Generation	OMVA	OMVA	OMVA	537MVA	OMVA	OMVA
3	EIB Interest Subsidy	No of New Customers	0	1,440	0	0	0	0
4	Last Mile AfDB - Phase 1	No. of New Customers	0	47,000	315,000	0	0	0
5	Last Mile AfDB - Phase 2	No. of New Customers	0	0	0	125,000	0	0
6	Reactive Power Compensation	Voltage Improvement - Supply Quality Improvement	OMVAR	145MVAR	191.5MVAR	OMVAR	OMVAR	OMVAR
7	MoEP/IFC - Distribution & Transmission SS's and associated lines	Increase in capacity to absorb 5000MW New Generation	10MVA	564.5MVA	305.5MVA	156MVA	137MVA	80MVA
8	Kipevu GIS Substation	System Flexibility	0	0	1	0	0	0
9	KEEP Feed outs from Transmission SSs	System Flexibility & Supply Quality Improvement	OKm	OKm	389Km	51Km	OKm	OKm
10	KPLC Distribution Substation Upgrade Projects (13No)	System N-1 Capacity in Upgraded Substations	0	0	13	0	0	0
11	AFD funded - Supply of compact fluorescent bulbs	Energy Conservation	0	0	3 Million units distributed to customers	0	0	0
12	KPLC/NORDEA/ CHINA Exim Bank Transmission Substation Projects	Increase in capacity to absorb 5000MW New Generation	0	0	0	566MVA	400MVA	0
14	AFD - KEMP - DMP	Increase in capacity to absorb 5000MW New Generation	N/A	N/A	N/A	N/A	N/A	N/A

	Initiatives/ Projects/ Strategies	Key Outcome	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
15	AFD - KEMP - DMP- Training & Capacity building	Capacity Building and Training for KPLC Staff	0	0	No of KPLC staff trained	0	0	0
16	World Bank - KEMP	Expansion of SCADA system to existing substations - No added	N/A	N/A	N/A	N/A	N/A	N/A
17	World Bank - KEMP	Expansion of automation on Nairobi 11kV network - No added	N/A	N/A	N/A	N/A	N/A	N/A
18	World Bank - KEMP	Purchase of tools and equipment, Training for Live Line Maintenance - Qty purchased	N/A	N/A	N/A	N/A	N/A	N/A
19	World Bank - KEMP	Establishment of Meter Management system and purchase of AMI meters for Large Power and Premium customers	N/A	N/A	N/A	N/A	N/A	N/A
20	World Bank - KEMP	Capacity Building and Training for KPLC Staff	0	0	0	No of KPLC staff trained	0	0
21	Connectivity - Last Mile Ph 1 AfDB,	Access to Electricity - Connectivity	0%	15%	80%	100%	0	0
22	Last Mile Ph 2 AfDB,	Access to Electricity - Connectivity	0%	0%	20%	60%	90%	100%
23	Peri- Urban Electrification -WB - KEMP	Access to Electricity - Connectivity	0%	0%	10%	50%	80%	100%
24.	Supply Improvement & Capacity enhancement	To meet the increasing customer demand.	N/A	N/A	N/A	N/A	N/A	N/A
25	Retrofitting of renewable energy to existing mini-grids	To reduce cost of power generated	N/A	N/A	N/A	N/A	N/A	N/A
26	Supply Quality Improvement & Capacity enhancement	To have reliable power supply	0	1	2	0	0	0
27	New Off-grid Power Stations	To electrify areas not covered by the national grid	368KW	736KW	736KW	736KW	736KW	736KW

	Initiatives/ Projects/ Strategies	Key Outcome	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
28.	Lines Projects – New	Network Expansion Reliability Improvement	373.23MVA	400MVA	MVA	MVA	MVA	MVA
29	Lines Projects – Upgrade	Quality & reliability Improvement	192.04MVA	200MVA	MVA	MVA	MVA	MVA
30	Customer Scheme Large Power – New	No of New Customers	2	6	N/A	N/A	N/A	N/A
31	Customer Scheme Large Power – Upgrade	Quality & reliability Improvement	0	9	N/A	N/A	N/A	N/A
32.	Lines Projects – New	Network Expansion Reliability Improvement	135MVA	140MVA	360MVA	650MVA	MVA	MVA
33	Lines CC – Upgrade	Quality & reliability Improvement	N/A	N/A	N/A	N/A	N/A	N/A
34	Customer Scheme Large Power – New	No of New Customers	18	27	45	N/A	N/A	N/A
35	Customer Schemes Large Power – Upgrade	Quality & Reliability Improvement	35	58	93	N/A	N/A	N/A

The company targets at connecting over 1.5 million new customers yearly through the last mile connectivity project to increase access levels to over 70% by 2017 and 100% by 2021.



Table 4.6 Summary of Proposed Distribution Projects by Year of Implementation

Summary of Proposed Transmission & Distribution Projects for 2016										
No	Region	County	Project Type	Name/Location	Asset Type	Project Status	Equipment	Unit	Quantity	Total Cost(USD)
1	Central Rift	Nakuru	Upgrade	Njoro ex Soilo	Overhead Line 33kV	Proposed	33kV 150mm2 AAAC OHL	km	25	732,955.00
2	Central Rift	Nakuru	Upgrade	Narok 33/11	Primary ss	Proposed	33/11,X7.5MVA	Each	1	454,545.00
3	Central Rift	Nakuru	Upgrade	Mwariki33/11	Primary ss	Proposed	33/11,1X7.5MVA	Each	1	454,545.00
4	Central Rift	Nakuru	Upgrade	Rongai 33/11	Primary ss	Proposed	33/11,1X7.5MVA	Each	1	454,545.00
5	Central Rift	Nakuru	Upgrade	Njoro 33/11	Primary ss	Proposed	33/11,1X7.5MVA	Each	1	454,545.00
6	Central Rift	Nakuru	Upgrade	Gilgil 33/11	Primary ss	Proposed	33/11,1X7.5MVA	Each	1	454,545.00
7	Central Rift	Nakuru	New	Nakuru Depot II (Soilo)	Primary ss	Proposed	33/11,2x7.5VA	Each	1	900,000.00
8	Central Rift	Nakuru	New	Rongai Ex Makutano	Overhead Line 33kV	Proposed	33kV 150mm2 AAAC OHL	Each	25	732,955.00
9	Coast	Kilifi	Upgrade	Kakuyuni	Bulk Supply Point	Proposed	220/33,1X23MVA	Each	1	1,679,282.00
10	Coast	Mombasa	New	Makande II	Primary ss TX	Proposed	33/11kV,2x7.5MVA TX	Each	1	800,000.00
11	Coast	Kwale	Upgrade	Diani ex Galu	OverHead Line	Proposed	33kV 150MM 2 ACSR	KM	20	387,209.00
12	Coast	Kilifi	Upgrade	Ribe	Primary ss TX	Proposed	33/11kV,7.5MVA TX	Each	1	663,043.50
13	Coast	Taita Taveta	Upgrade	Loitkotok	Primary ss TX	Proposed	33/11kV,7.5MVA TX	Each	1	663,043.50
14	Nairobi	Kajiado	New	Magadi Substation	Switch Shunt	Proposed	10MVAR capacitor	Each	1	410,000.00
15	Nairobi	Nairobi	New	Mtito Andei	Primary ss TX	Proposed	33/11kV, 2x7.5MVA TX	Each	2	7,600,000.00
16	North Rift	Uashin Gishu	Upgrade	Moi Barracks	Overhead Line 33kV	Proposed	33kV 150mm2 ACSR OHL	km	100	1,704,545.00
17	North Rift	Uashin Gishu	Upgrade	Eldoret 1 ex Eldoret 132	Overhead Line 33kV	Proposed	33kV 150mm2 ACSR OHL	km	10	1,704,545.00

Summary of Proposed Transmission & Distribution Projects for 2016

No	Region	County	Project Type	Name/Location	Asset Type	Project Status	Equipment	Unit	Quantity	Total Cost(USD)
18	North Rift	Uashin Gishu	Upgrade	Eldoret2 ex Eldoret 132	Overhead Line 33kv	Proposed	33kv 150mm2 ACSR OHL	km	15	255,682.00
19	North Rift	Uashin Gishu	Upgrade	Industrial ex Eldoret 132	Overhead Line 33kv	Proposed	33kv 150mm2 ACSR OHL	km	43	732,682.00
20	North Rift	Uashin Gishu	Upgrade	Moi Barracks	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
21	West Kenya	Kisii	New	Kisii High School 33/11kv s/s	Primary s/s tx	Proposed	33/11kv, 2x7.5MVA TX	Each	2	7,600,000.00
22	West Kenya	Elgeyo	Upgrade	Iten	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
23	West Kenya	Siaya	New	Bondo	Primary s/s	Proposed	33/11V, 7.5MVA, tx	Each	1	454,545.00
24	West Kenya	Bungoma	Upgrade	Simbembe*check capacity	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	2	454,545.00
25	West Kenya	Bungoma	Upgrade	Malakisi	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
26	West Kenya	Busia	Upgrade	Bumala	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
27	West Kenya	Kakamega	Upgrade	Ingotsi	Primary ss TX	Proposed	33/11kv,2.5MVA TX	Each	1	454,545.00
28	West Kenya	Bomet	Upgrade	Bomet	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
29	West Kenya	Busia	Upgrade	Ruambwa	Primary ss TX	Proposed	33/11kv,2.5MVA TX	Each	1	454,545.00
30	West Kenya	Transnzoia	Upgrade	Kaplamai	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
31	West Kenya	Kericho	Upgrade	Changoi	Primary ss TX	Proposed	33/11kv,2.5MVA TX	Each	1	227,272.00
32	West Kenya	Kisumu	Upgrade	Sondu	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00

Summary of Proposed Transmission & Distribution Projects for 2016										
No	Region	County	Project Type	Name/Location	Asset Type	Project Status	Equipment	Unit	Quantity	Total Cost(USD)
33	West Kenya	Vihiga	Upgrade	Cheptulu	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
34	West Kenya	Busia	Upgrade	Busia	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
35	West Kenya	Kakamega	New	Kakamega Town	Primary ss TX	Proposed	33/11kv,2x7.5MVA TX	Each	2	454,545.00
35	West Kenya	Bomet	Upgrade	Chemosit 132	BSP	Proposed	132/33,2X45MVA	Each	2	3,255,814.00
37	Nairobi	Machakos	New	Machakos II	Primary ss TX	Proposed	33/11kv,2x7.5MVA TX	Each	2	454,454.00
38	Nairobi	Machakos	New	Various 11kV lines to link Machakos 11kV network to Tala 66/11kV s/s	OHL 11kV in 150mm2 ACSR	Proposed	11kV 150mm2 ACSR OHL	km	20	3000,000.00
GRAND TOTAL IN (USD)										31,085,383

Summary of Proposed Transmission & Distribution Projects for 2017										
NO	REGION	COUNTY	PROJECT TYPE	NAME/LOCATION	ASSET TYPE	PROJECT STATUS	EQUIPMENT	UNIT	QUANTITY	TOTAL COST(USD)
1	Coast	Kilifi	New	Shanzu	Bulk Supply Point	Proposed	132/33,2X23MVA	Each	2	16,000,000.00
2	Mt Kenya	Meru	New	Kiajai ex Meru	Meru-Kiajai 33kV line	Proposed	33kV 150mm2 AAAC OHL	km	25	722,955.00
3	Nairobi	Nairobi	New	NRB West ex CBD	UG 66kV cable	Proposed	66kV 300mm2 UG cable	km	4.5	1,620,000.00
4	Nairobi	Nairobi	New	Westlands ex CBD	UG 66kV cable	Proposed	66kV 300mm2 UG cable	km	8.5	3,060,000.00
5	Nairobi	Nairobi	New	Parklands West ex CBD	UG 66kV cable	Proposed	66kV 300mm2 UG cable	km	5	1,800,000.00

Summary of Proposed Transmission & Distribution Projects for 2017										
NO	REGION	COUNTY	PROJECT TYPE	NAME/LOCATION	ASSET TYPE	PROJECT STATUS	EQUIPMENT	UNIT	QUANTITY	TOTAL COST(USD)
6	Nairobi	Nairobi	New	Cathedral ex CBD	UG 66kV cable	Proposed	66kV 300mm2 UG cable	km	1.5	540,000.00
7	Nairobi	Nairobi	New	JeeVanjee ex CBD	UG 66kV cable	Proposed	66kV 300mm2 UG cable	km	3.5	1,260,000.00
8	Nairobi	Nairobi	New	Mamlaka ex CBD	UG 66kV cable	Proposed	66kV 300mm2 UG cable	km	2.5	900,000.00
9	Nairobi	Nairobi	New	Ragati ex CBD	UG 66kV cable	Proposed	66kV 300mm2 UG cable	km	3	1,080,000.00
10	Nairobi	Nairobi	New	Muthurwa ex CBD	UG 66kV cable	Proposed	66kV 300mm2 UG cable	km	5	1,800,000.00
11	Nairobi	Nairobi	New	Ngong Road ex CBD	UG 66kV cable	Proposed	66kV 300mm2 UG cable	km	5	1,800,000.00
12	Nairobi	Nairobi	New	Southern Bypass	Primary ss TX	Proposed	66/11kv,2x23MVA TX	Each	2	7,600,000.00
13	Nairobi	Nairobi	New	Enterprise Road-Dohn ss-GIS	Primary ss TX	Proposed	66/11kv,2x23MVA TX	Each	2	8,000,000.00
14	Nairobi	Nairobi	New	Commercial Street-DT Dobie-GIS	Primary ss TX	Proposed	66/11kv,2x23MVA TX	Each	2	8,000,000.00
15	North Rift	West Pokot	upgrade	Kapenguria	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
16	North Rift	Uashin Gishu	upgrade	Elgon View	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
17	West Kenya	Kericho	upgrade	Kericho	Overhead Line 33kV	Proposed	33kV 150mm2 ACSR OHL	km	12	204,545.00
18	West Kenya	Kisumu	upgrade	Muhoroni	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
19	West Kenya	Migori	Upgrade	Migori	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
20	West Kenya	Kisumu	upgrade	Siaya	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
GRAND TOTAL IN (USD)										56,660,225

Summary of Proposed Transmission & Distribution Projects for 2018											
No	Region	County	Project Type	Name/Location	Asset Type	Project Status	Equipment	Unit	Quantity	Total Cost(USD)	
1	Central Rift	Nakuru	Upgrade	Subukia 33/11	Primary ss	Proposed	33/11,1X2.5MVA	Each	1	227,272.00	
2	Central Rift	Nakuru	Upgrade & Modernize	Lanet 33/11kV	Primary ss	Proposed	33/11kv, 3x7.5MVA	Each	1	900,000.00	
3	Coast	Kilifi	Upgrade	Kilifi	Bulk Supply Point	Proposed	132/33,1X45MVA	Each	1	900,000.00	
4	Coast	Taita Taveta	New	Wundanyi ex Voi	Overhead Line 33kV	Proposed	33kV 150mm2 ACSR OHL	Each	40		
5	Nairobi	Nairobi	upgrade	Embakasi-Langata	Overhead Line 66kV	Proposed	66kV 300mm2 AAAC OHL	km	18	920,455.00	
6	North Rift	Uashin Gishu	New	Eldoret Industrial II	Primary ss TX	Proposed	33/11kv,2x7.5TX	Each	2	454,545.00	
7	West Kenya	Bungoma	upgrade	Webuye	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00	
8	West Kenya	Kakamega	upgrade	Mumias	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00	
9	West Kenya	Transzoia	upgrade	Cherengani	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00	
10	West Kenya	Bomet	upgrade	Litein	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00	
11	West Kenya	Vihiga	upgrade	Chavakale	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00	
12	West Kenya	Transzoia	uprate	Kitale 132	BSP	Proposed	132/33,1X23MVA	Each	1	4,628,907.00	
	GRAND TOTAL IN (USD)									10,303,904	

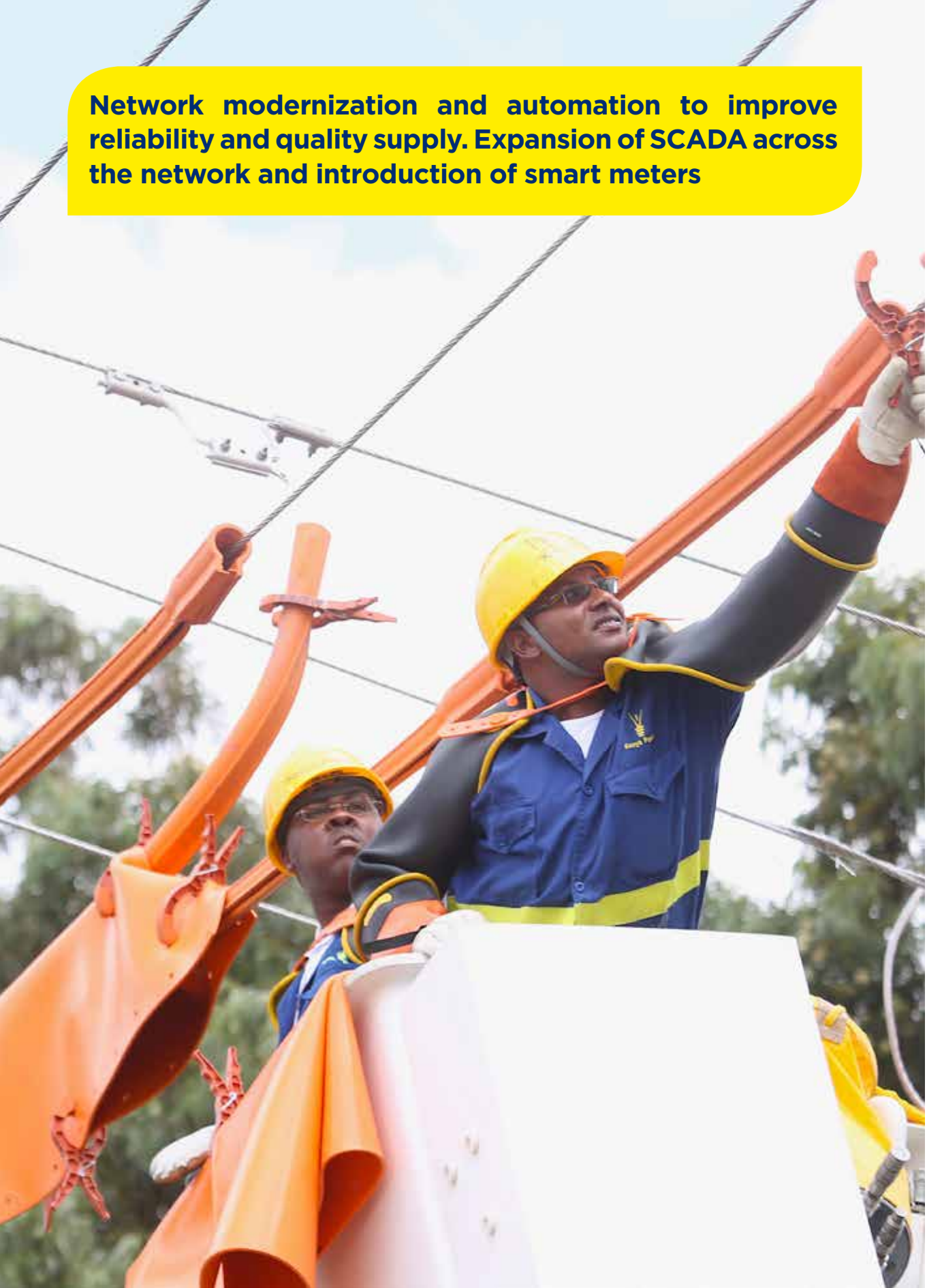
Summary of Proposed Transmission & Distribution Projects for 2019													
No	Region	County	Project Type	Name/Location	Asset Type	Project Status	Equipment	Unit	Quantity	Total Cost(USD)			
1	Coast	Taita/Taveta	Upgrade	Voi	Bulk Supply Point	Proposed	132/33,1X23MVA	Each	1	900,000.00			
2	Mt. Kenya	Muranga	Upgrade	Muranga 33/11	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00			
3	Mt. Kenya	Nyeri	Upgrade	Kiganjo	Bulk Supply Point	Proposed	132/33,1X45MVA+1x23MVA	Each	2	1,350,000.00			
4	Mt. Kenya	Meru	Upgrade	Meru	Bulk Supply Point	Proposed	132/33,2X45MVA	Each	2	1,350,000.00			
5	Nairobi	Nairobi	upgrade	JujaRd-Nrb South	Overhead Line 66kV	Proposed	66kV 300mm2 AAAC OHL	km	5	255,682.00			
6	Nairobi	Kajiado	upgrade	Langata-Matasia	Overhead Line 66kV	Proposed	66kV 300mm2 AAAC OHL	km	18	920,455.00			
7	Nairobi	Nairobi	New	Kenya Science/Jamhuri	Primary ss TX	Proposed	66/11kv,2x23MVA TX	Each	2	7,600,000.00			
8	Nairobi	Nairobi	New	Highridge - KPLC staff quarters	Primary ss TX	Proposed	66/11kv,2x23MVA TX	Each	2	7,600,000.00			
9	Nairobi	Kajiado	New	Ngong-Kiserian 66kV link	Overhead Line 66kV	Proposed	66kV 300mm2 AAAC OHL	km	18	920,455.00			
10	Nairobi	Kajiado	New	Kajiado II,	Primary ss TX	Proposed	33/11kv, 2x2.5MVA TX	Each	2	7,600,000.00			
11	North Rift	Nandi	upgrade	Lessos 33/11	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00			
12	North Rift	Nandi	upgrade	Kapsumbweiwa	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00			
13	North Rift	Uashin Gishu	New	Chepkollele	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00			
14	North Rift	Uashin Gishu	New	Eldoret North 132	BSP	Proposed	132/33,2X23MVA	Each	2	16,306,047.00			

Summary of Proposed Transmission & Distribution Projects for 2019										
No	Region	County	Project Type	Name/Location	Asset Type	Project Status	Equipment	Unit	Quantity	Total Cost(USD)
15	West Kenya	Kericho	Upgrade	KITCO	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
16	West Kenya	Homabay	Upgrade	Homabay	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
17	West Kenya	Kisumu	Upgrade	Kibos	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
18	West Kenya	Kisii	Upgrade	Kiamokama	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
	GRAND TOTAL IN (USD)									48,438,999

Summary of Proposed Transmission & Distribution Projects for 2020										
No	Region	County	Project Type	Name/Location	Asset Type	Project Status	Equipment	Unit	Quantity	Total Cost(USD)
1	Central Rift	Nyandarua	New	Ndaragwa 33/11	Primary ss	Proposed	33/11,1X7.5MVA	Each	1	4,000,000.00
2	Nairobi	Nairobi	upgrade	MSA RD Substation	Primary ss TX	Proposed	66/11kv,1X45MVA TX	Each	1	675,000.00
3	Nairobi	Kajiado	New	Ongata Rongai substation	Primary ss TX	Proposed	66/11kv,2X23MVA TX	Each	2	7,600,000.00
4	Nairobi	Nairobi	New	Quarray's II-Sykimau	Primary ss TX	Proposed	66/11kv,2X23MVA TX	Each	2	7,600,000.00
5	Nairobi	Nairobi	New	Ruai-NSSF 66kV link	Overhead Line 66kV	Proposed	66kV 300mm2 AAAC OHL	km	18	920,455.00
6	North Rift	Nandi	Upgrade	Kapsabet ex Lessos	Overhead Line 33kV	Proposed	33kV 150mm2 ACSR OHL	km	42	732,955.00
7	West Kenya	Kisumu	Upgrade	Chemelil ex Lessos	Overhead Line 33kV	Proposed	33kV 150mm2 ACSR OHL	km	70	1,193,182.00
8	West Kenya	Siaya	Uprate	Rangala	BSP	Proposed	132/33,1X23MVA	Each	2	3,255,814.00
9	West Kenya	Kakamega	New	Kakamega	BSP	Proposed	132/33,2X23MVA	Each	2	16,306,047.00
10	West Kenya	Siaya	New	Bondo	BSP	Proposed	132/33,2X23MVA	Each	2	16,306,047.00
11	West Kenya	Homabay	New	Homabay	BSP	Proposed	132/33,2X23MVA	Each	2	16,306,047.00
	GRAND TOTAL IN (USD)									74,895,547

Summary of Proposed Transmission & Distribution Projects for 2021										
No	Region	County	Project Type	Name/Location	Asset Type	Project Status	Equipment	Unit	Quantity	Total Cost(USD)
1	Coast	Kwale	Upgrade	HoroHoro	Primary ss TX	Proposed	33/11kv,2.5MVA TX	Each	1	163,043.50
2	Coast	Kilifi	Upgrade	Kakuyuni	Bulk Supply Point	Proposed	220/33,1X23MVA	Each	1	900,000.00
3	Mt. Kenya	Meru	Upgrade	Kianjai 33/11	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
4	Mt. Kenya	Meru	Upgrade	Kianjai 33/11	Primary ss TX	Proposed	33/11kv,23MVA TX	Each	1	1,363,636.00
5	Mt. Kenya	Muranga	Upgrade	MukaMukuu 33/11	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
6	Nairobi	Nairobi	New	South B Substation	Primary ss TX	Proposed	66/11kv,2X23MVA TX	Each	2	7,600,000.00
7	North Rift	Uashin Gishu	Upgrade	Moi Barracks 33/11	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
8	North Rift	Baringo	Upgrade	Mariggat	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
9	West Kenya	Bomet	Upgrade	Sotik	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
10	West Kenya	Nyamira	Upgrade	Matutu	Primary ss TX	Proposed	33/11kv,7.5MVA TX	Each	1	454,545.00
11	West Kenya	Migori	Uprate	Awendo	BSP	Proposed	132/33,1X23MVA	Each	1	16,306,047.00
GRAND TOTAL IN (USD)										29,059,997

Network modernization and automation to improve reliability and quality supply. Expansion of SCADA across the network and introduction of smart meters



5. NETWORK MANAGEMENT

5.1 Background and Objectives

The Network Management Strategic Plan has identified distribution automation, improved load management, undergrounding* and network reinforcement and refurbishment as the key factors likely to impact positively on the power market and on operations of the company during the planned period.

The objectives are:

- i. Supply Quality Improvement by way of
 - Implement Distribution Network Refurbishment projects in the Short Term
 - (Trace clearance, S/Stns, sags repairs, LV works repairs, Re-alignments, etc.)
 - Implement Distribution Network Refurbishment projects in the Medium
 - Term (HT poles replacements, re-conductoring, feeder switchgears, redundancy and interconnector projects, etc.)
- ii. Improve reliability by
 - Reducing interruption/1000 customers from 9.22 to 6.9 in 2021
 - Implement Distribution Live Line work
 - Implement Distribution Automation

5.2 Supply Quality Improvement

This will be achieved through the implementation of Distribution Automation on the distribution grid, live line maintenance work and the undergrounding of MV + LV feeders. The benefits of these initiatives will include:

- Improved load management and power quality.
- Decreased technical losses in the distribution systems.
- Improved Customer Services and reliability indices (SAIDI, SAIFI, CAIDI).

Enhanced and optimized asset utilization by reducing maintenance and related repair costs.

Distribution Automation

Table 5.1 Projected Cost of Automation on the distribution network

Financial year	Project	Projected cost (kshs. Millions)
2015 / 2016	Nairobi	600
2016 / 2017	Kisumu	500
2017 / 2018	Nakuru	400
2018 / 2019	Thika	400
2019/2020	-	-
2020/2021	-	-
Total cost		1,900

Distribution automation will be achieved through:

- Installation of a modern robust and integrated Distribution Management System (DMS).
- Installation of different types of sensors on feeders, transformers and distribution substations.
- Installation of metering on transformers and feeders.

The progressive percentage of the equipment on the network to be automated is shown in Table 5.2 below

Table 5.2 Planned Progression of Automation

Installations to Automate	2016/17	2017/18	2018/19	2019/20	2020/21
Air Break Switches (11kv 33kv)	50%	70%	80%	100%	100%
RMUs	40%	70%	80%	100%	100%

5.3 Integrated Grid Modernization Project

The project is expected to automate the existing distribution power grid in select areas within Nairobi in a bid to provide reliable, quality, affordable and sustainable energy services to Kenya Power customers. The project will take an integrated approach in the implementation of the various distribution, metering and telecommunications technology initiatives that are currently approved and independently taking place within the divisions of Network Management, Customer Service and ICT to make the Kenya Power distribution grid strong and smart. The integrated approach will address:

- The requirements of the approved CBD undergrounding* projects.
- Improve services to large power customers.
- Smart metering of transformers and feeders to enable energy balancing.
- Smart metering of SMEs and large domestic customers.
- The requirement for an enterprise mission critical data center by ICT to meet the ever growing data storage and management needs for the company.
- The business requirements of the telecommunications business unit of extending fibre optics to the home through FTTH.

Automation of the grid to improve transmission and sub transmission substations and feeder management will involve the following:

- Replacement of ordinary (air break) switches with high capacity (load break) switches
- Automation of equipment at primary substations for faster supply restoration

To avoid extra implementation costs this project will be implemented alongside the Undergrounding* of 11kV Feeders project. Major benefits will include energy loss reduction, operational cost reduction and new revenues from telecommunications services. The total project investment cost is estimated at USD 235 million, which will be associated with a benefit to cost ratio of 4:1 over a 20 year period.

***Undergrounding will be limited to an economic assessment (cost- benefit analysis and alternative resource use) and where way leaves prove to be difficult and restrictive.**

5.4. Undergrounding of overhead HV, MV + LV network to eliminate 3rd party interference with the lines.

As the CBD moves into areas such as Upper Hill and Westlands, it is necessary that the distribution network in these areas be undergrounded so as to improve supply quality and reliability in these areas. This initiative will be achieved through;

- Undergrounding of key priority feeders within urban areas.
- Installation of Ring Main Units (RMU) with automated switch gear.
- Installation of Compact Substations (CSS) with transformers and telecommunications.

The projected plans and costs are as given in Table 5.3 below;

Table 5.3 Projected Undergrounding plans/costs near CBDs

Financial year	Undergrounding Project	Projected cost * (kshs. millions)
2015 / 2016	Upper Hill	1,000
2016 / 2017	Upper Hill	1,000
2017 / 2018	Westlands	1,000
2018 / 2019	Westlands	1,000
2019/2020	-	-
20120/2021	-	-
Total cost		4,000

*Project cost for undergrounding is not yet funded.

Distribution Network reinforcement

As the distribution network expands, the network requires reinforcement involving:

Upgrading conductors

- Upgrading overloaded / faulty transformers
- Upgrading low voltage network to create more capacity
- Re-siting transformers and creating new ones to improve supply quality

This activity shall be enhanced in the coming years as more customers are connected to the network, according to the projected plans.

Table 5.4 below gives the projected cost of reinforcement plans.

Table 5.4 Projected Reinforcement plans / budget

Financial year	Scope	Projected cost (kshs. millions)
2015 / 2016	Distribution network reinforcement	2,800
2016 / 2017	Distribution network reinforcement	3,200
2017 / 2018	Distribution network reinforcement	4,000
2018 / 2019	Distribution network reinforcement	4,000
2019 /2020	Distribution network reinforcement	4,000
2020 /2021	-	-
Total cost		18,000

5.5 Boresha Umeme Program

The Boresha Umeme program was rolled out in early 2014 with the aim of ensuring the network serving major customers as well as areas with repeated poor supply quality issues are given priority in a focused and thorough maintenance effort that pools resources to one locality.

To date the Boresha Umeme campaign has been implemented in over 40 areas spread across the country covering major cities and towns, economic zones, high load growth areas and major residential areas. The program has led to significant improvement in sales in the areas served as a result of reduced power supply interruption incidences. This program will continue to be implemented in the plan period.

5.6 Mechanization + MV Live line work

Table 5.5 Projected Mechanization / Live line work plans/costs

Financial year	Scope	Projected cost (kshs. millions)
2016 / 2017	Procure mechanized vehicles + start live line work training	800
2017 / 2018	Procure mechanized vehicles + continue live line work training	1,000
2018 / 2019	Procure mechanized vehicles + continue live line work training	1,000
2019/2020	Procure mechanized vehicles + continue live line work training	1,000
2020/2021	Procure mechanized vehicles + continue live line work training	1,000
Total cost		4,800

5.7 Achieve N-1 criteria on primary substations and primary feeders.

This entails development of redundancy in the network in order for alternative supply routes to be available to reach customers in the event of faults and supply interruptions. The envisaged progress is as shown in Table 5.6 below.

Table 5.6 Percentage of Feeders and Substations under N-1

Installation	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021
Primary Feeder	50%	55%	60%	65%	70%	75%
Primary Substation	30%	35%	40%	70%	75%	80%

5.8 Distribution Network Refurbishment in the short term includes:

- i. System audit carried out to identify weak points in the network
- ii. Trace Clearance both on MV and LV Lines to cover a total of 45,700km
- iii. Refurbishment works in progress on distribution substations including earth improvements, fuse grading in 9,150 problematic S/S
- iv. Realignment of poles and installations of mid-spans poles on LV Network
- v. Major workings to re-do jumpers and correct poor sags on 240 MV lines
- vi. LV lines refurbishment, correcting poor sags, load balancing in 6,415 S/S

5.9 Distribution Network Refurbishment Medium term to do the following:

- i. Replacement of 74,000 wooden poles with concrete in Main Lines.
- ii. Introduction of 970 sectionalisers on MV spurs.
- iii. Introduction of feeder breakers on MV lines in place of auto-reclosers in small substations (82 No.)
- iv. Linking of Substations by MV interconnectors to improve flexibility. Total of 1770 km of Lines to be done.
- v. Provision of alternative supplies to major customers to create redundancy and thus reduce interruptions and increase sales. Table 5.7 gives the projected cost of system refurbishment.

Table 5.7 Projected System Refurbishment plan /costs

Financial year	Scope	Projected cost (kshs. millions)
2016 / 2017	Network refurbishment to create redundancy, capacity & flexibility	5,500
2017 / 2018	Network refurbishment to create redundancy, capacity & flexibility	5,500
2018 / 2019	Network refurbishment to create redundancy, capacity & flexibility	5,500
2019 / 2020	Network refurbishment to create redundancy, capacity & flexibility	5,500
2020/2021	Network refurbishment to create redundancy, capacity & flexibility	-
Total cost		22,000

5.10 Supply quality improvement metrics

The scheduled progress of the supply quality improvement initiatives to be implemented in the plan period is shown in table 5.8 below.

Table 5.8 Supply Quality Improvement Initiatives Scheduled Progress

Objective	Initiatives/ Projects/ Strategies	Benefit	Total Cost US \$ Mill	Current Status %	2016/17 %	2017/18 %	2018/19 %	2019/20 %	2020/21 %
1. Reliability- Reduction of interruptions/1000 customers.	Short Term projects M&E tool effected for fast-tracking performance	Reduction in LV Breakdowns per 1000 customers	25.81	31%	60%	100%	-	-	-
2. 5000+MW readiness refurbishment projects (major refurbishment projects)	Medium Term Projects - M&E tool effected for fast-tracking performance	Redundancy, Flexibility and 5000+ MW capabilities	259.6	1%	10%	30%	60%	90%	100%
4. Implement the Distribution Live Line work	Purchase Equipment, Hire a Trainer and build capacity in KPLC Training School	Reduce outage time	Ksh3 Billion	5 %	30%	50%	80%	100%	-
5 Implement the Distribution Automation	Introduce LBS and Automate RMUs	Improve response time	Ksh 3 billion	20 %	50%	70%	80%	100%	-

The Key Outcomes and Outputs of the strategic initiatives and expected progression indicating success over the next five years is shown in Table 5.9 below.

Table 5.9 Network Management key outputs and Performance Indicator Improvements

Key Outcomes and Outputs	2016/17	2017/18	2018/19	2019/20	2020/21
1 Reliability- Reduction of interruptions/1000 customers	7.50	7.3	7.1	6.9	6.7
2 Avg. response time(CAIDI)	2.0	1.8	1.5	1	1
3 5000+MW readiness refurbishment projects (major refurbishment projects)	10%	30%	60%	90%	100%
4 Reduce outages - No of teams carrying out Live Line work	2	14	28	40	52
5 Improve response time - Switches Automated	237	377	950	1,200	1,600
6 Asset Management	20 %	50%	100%	100%	100%
7 Accident Frequency Per 100,000 Man-hours	0.10	0.08	0.07	0.06	0.05
8 Environmental Sustainability	100%	100%	100%	100%	100%

Undergrounding of electricity network in Nairobi and Mombasa to reduce losses and improve reliability



5.11 Network Loss Reduction initiatives

Loss reduction is a key strategy as this will result into improvements in revenues. The objective is to reduce losses from 19.4% in 2015/16 to below 10% by 2020/21. The following initiatives are planned over the next 5 years:

- i. Reactive power compensation through installation of capacitor banks
- ii. Reconfigure heavily loaded MV feeders and add HV / MV substations near load centres
- iii. Reconductoring medium voltage as well as low voltage networks
- iv. Attend to MV / LV housekeeping activities to include durable joints / cable terminals, etc.

Table 5.10 captures the planned budget for these activities.

Table 5.10 Projected Loss reduction plan /costs

Financial year		Scope	Projected cost (kshs. millions)
2016/17	1	GIS Data Gathering	-
	2	Large Power Outdoor Metering	-
	3	Meter Data Management Control Center & Smart metering Rollout	4,000.0
	4	Feeder Metering	25.0
	5	Border Point Metering/ Regions	110.0
2016/18	6	Smart Metering Pilot Project	-
	7	Energy Balance Module Project	275.0
	8	Reactive Power Compensation Schemes	1,000.0
2017/18	9	IBorder Point Metering/ Counties	500.0
2016/19	10	Distribution Transformer Metering	5,000.0
		TOTAL	10,910.0

1. **GIS Data gathering** & re-design of meter reading itineraries to align with Feeders and DTs - To capture and correctly link the entire network and customers' accounts into the GIS system. This provides a data bank for other systems that include EBM. Current meter reading routes are based on geographical boundaries; hence not easily usable in energy balancing.
2. **Large Power Outdoor Metering** - This project objective is to relocate all the large consumer metering points to outside customer premises for exclusive management by KPLC.
3. **Meter Data Control Centre (MDCC) & Smart Metering rollout** - The MDCC will be managing meters just like the National Control Center. Smart meters will send alarms to the MDCC from where teams will be promptly directed to attend to the alarms. The MDCC also will aid fault location under O&M activities

- 4. Feeder Metering** - We intend to complete the metering of all the approx. 1000 distribution feeders that originate from our primary substations country.
- 5. Border Point Metering (Regions)** - Due to restructuring of the regions and counties to follow administrative borders, it has become necessary to border at points where feeder cross over to get the exact energy delivered to a given Region.
- 6. Smart Metering Pilot Project** - Project to install smart meters for domestic and small commercial customers consuming above 500kWh/Month. Pilot project targets 9,900 accounts.
- 7. Energy Balance Module** - EBM does both Horizontal and Vertical Balances. The scope of project also involves developing GIS-EBM interface to enhance a graphical presentation and capacity to flag areas with losses beyond threshold.
- 8. Reactive Power Compensation Schemes** - Following studies from EIU, Capacitors are to be placed on approx.100 No. 11 KV feeders for reactive compensation.
- 9. Border Point Metering (Counties)** - After metering regional border points, it will be of interest for each region to know the losses contribution by each specific county.
- 10. Distribution Transformers (DTs) Metering** - We Project to meter all 50,000+ DTs and link connected customers' meters correctly. This will enhance through measurement the identification and prioritization of loss reduction activities.

The above alongside other initiatives under Customer Service and Network Management divisions will enable the company reduce both technical and non-technical (commercial) losses top below 10%.

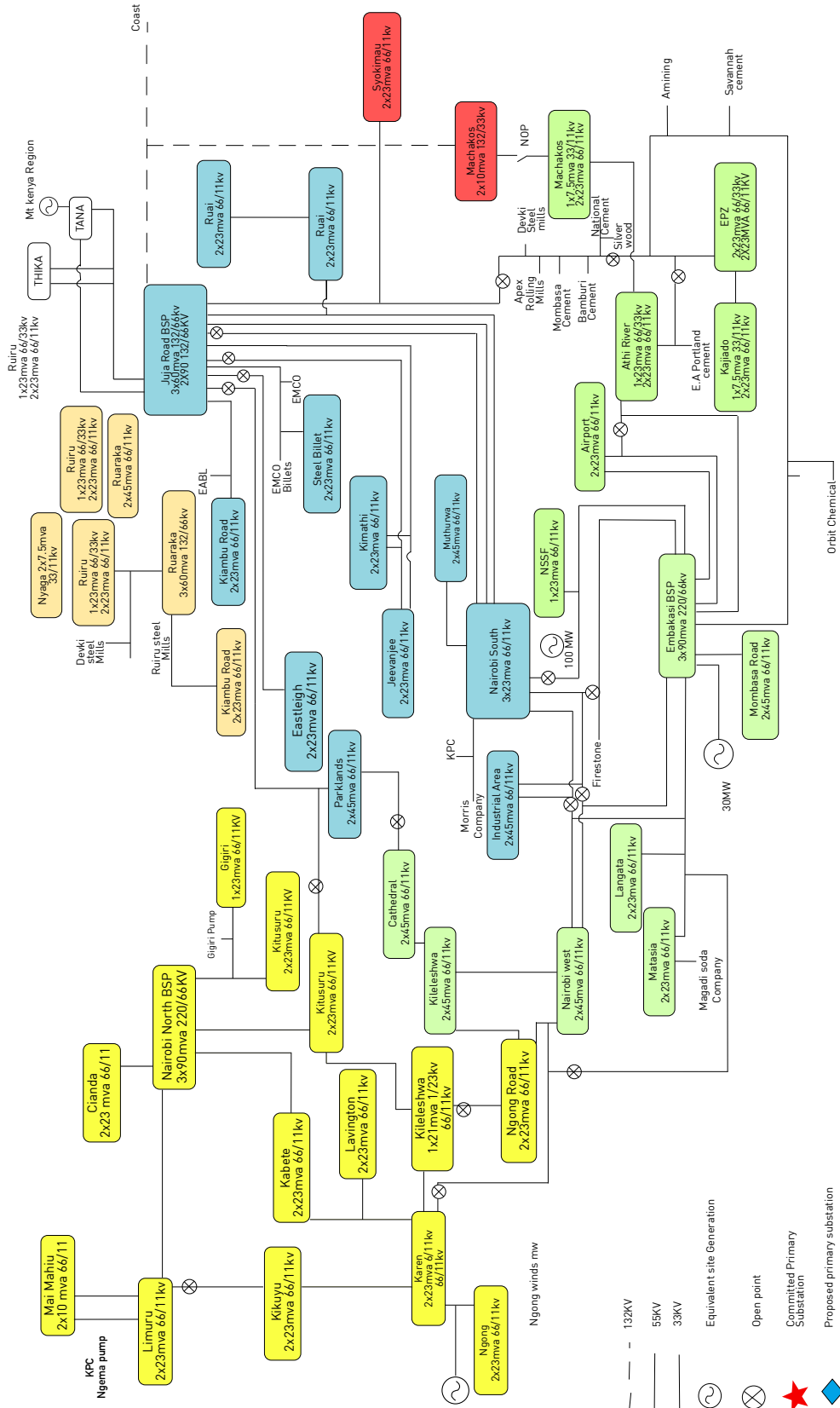
6. CONCLUSION

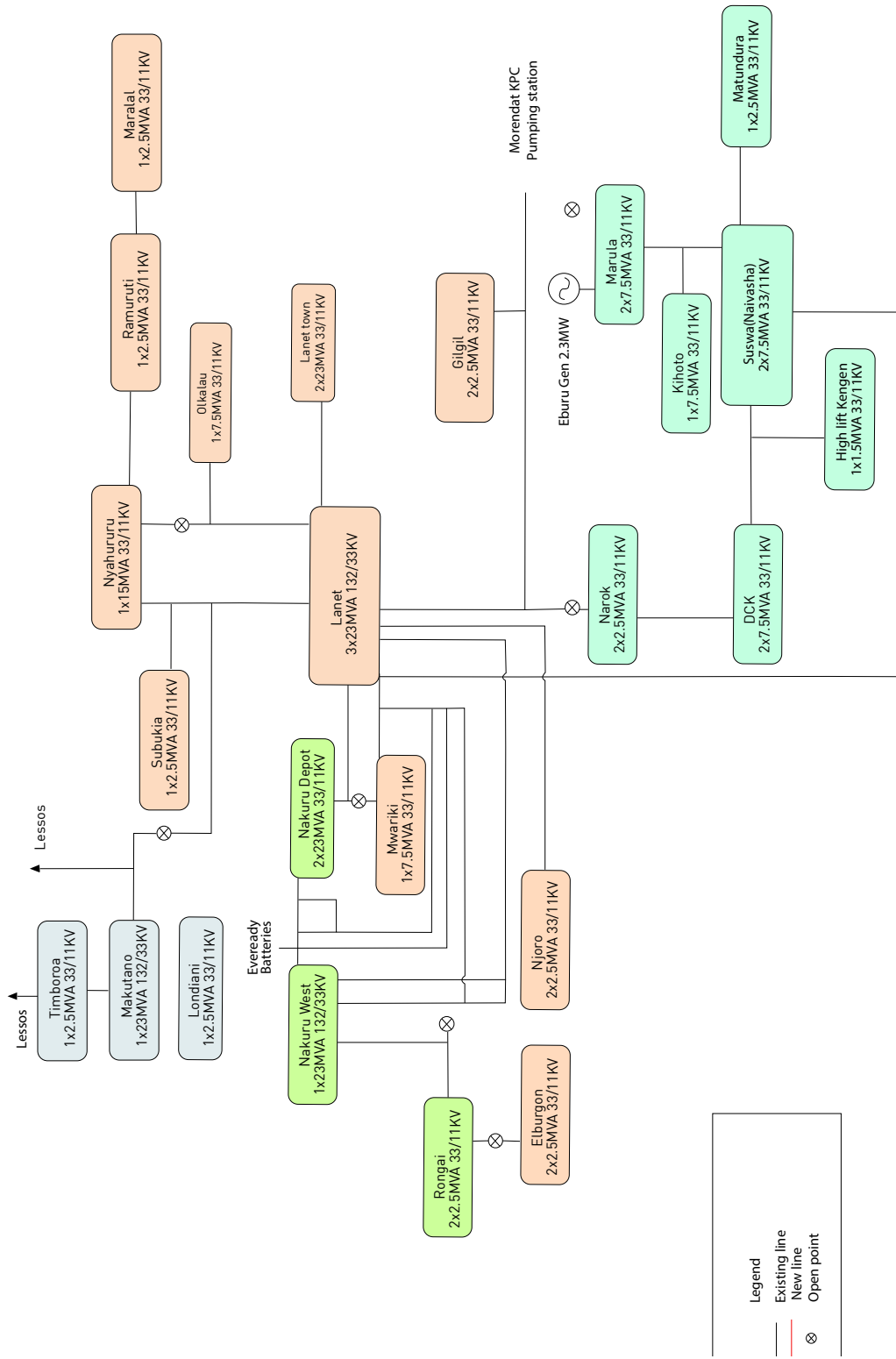
The national power generation capacity expansion programme for the period 2016-2021 should be implemented to ensure the projected demand is supplied adequately. The capacity added should be sequenced to closely match system demand requirements for least cost power supply to consumers. Electricity demand creation should be stepped up to avoid underutilization of capacity, stranded investments and high electricity tariffs as the 5,000+MW plan is added. The deferred scenario provides a comparatively low cost system expansion strategy compared to the Base Case. It is therefore recommended that a total of 1,795 MW of the committed capacity addition projects be added after 2020. Thorough analysis and review of load growth factors and possibilities should be undertaken so as to inform decisions on sizing and sequencing of generation capacity expansion, for improved generation capacity factors and to avoid high overall unit cost of electricity. There is need to plan demand creation beyond the borders for export of power.

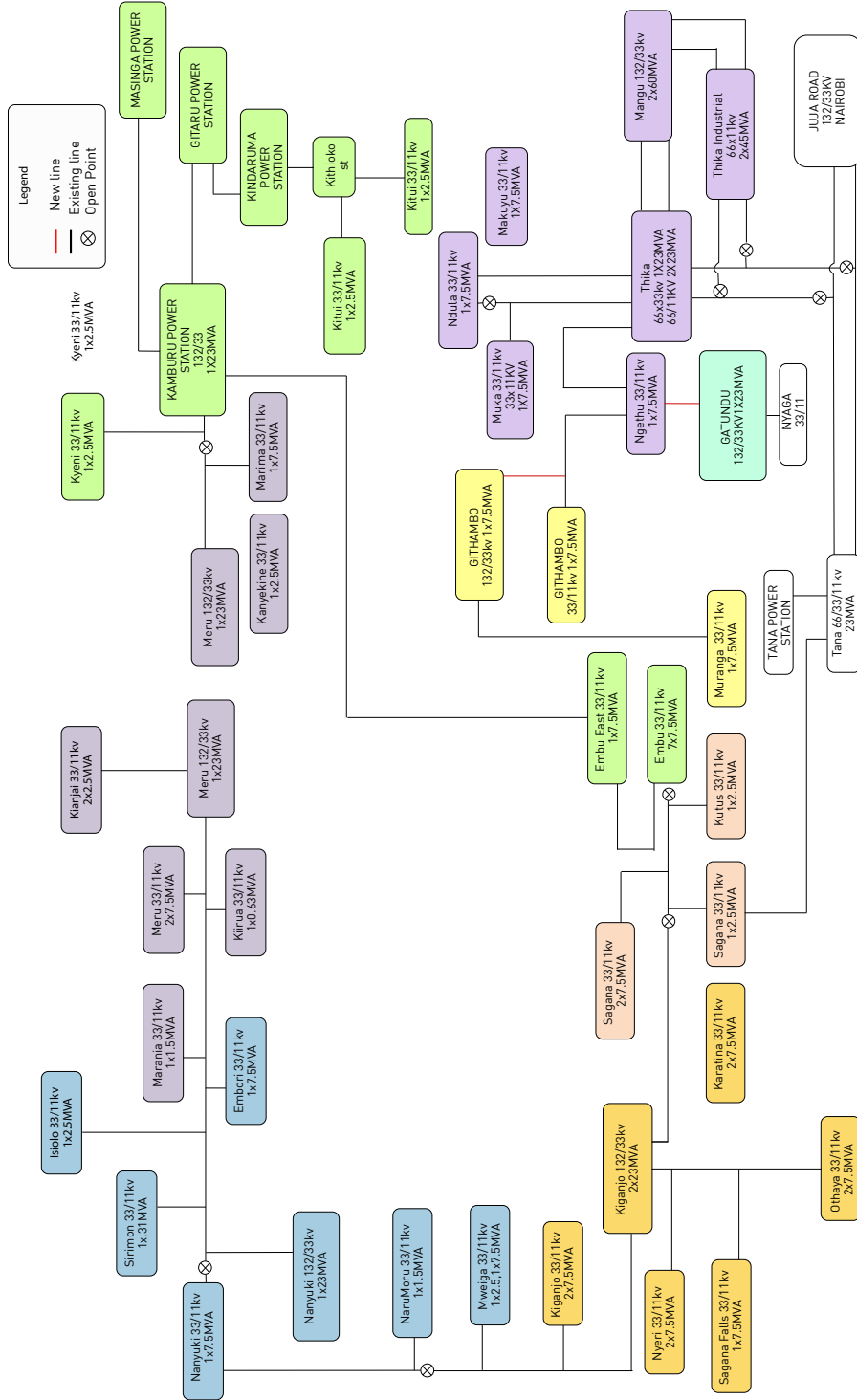
This Grid Development Plan has explained the short term (2016-2021) 66kV and 33kV distribution network reinforcement and expansion plan that was developed for each of the KPLC's regions. The plan has identified the proposed 66kV and 33kV projects that are required beyond the committed and proposed as per Distribution Master Plan 2012-2017 projects. The need for additional BSPs and reinforcement of existing substations in order to support the distribution network has also been identified. Across the network, a total of 105 projects are proposed for completion by 2020. These include 66/33kV lines, new Primary substations, new BSPs and capacitor compensation. An estimated grand total investment cost of these projects is **USD 209,463,658**.

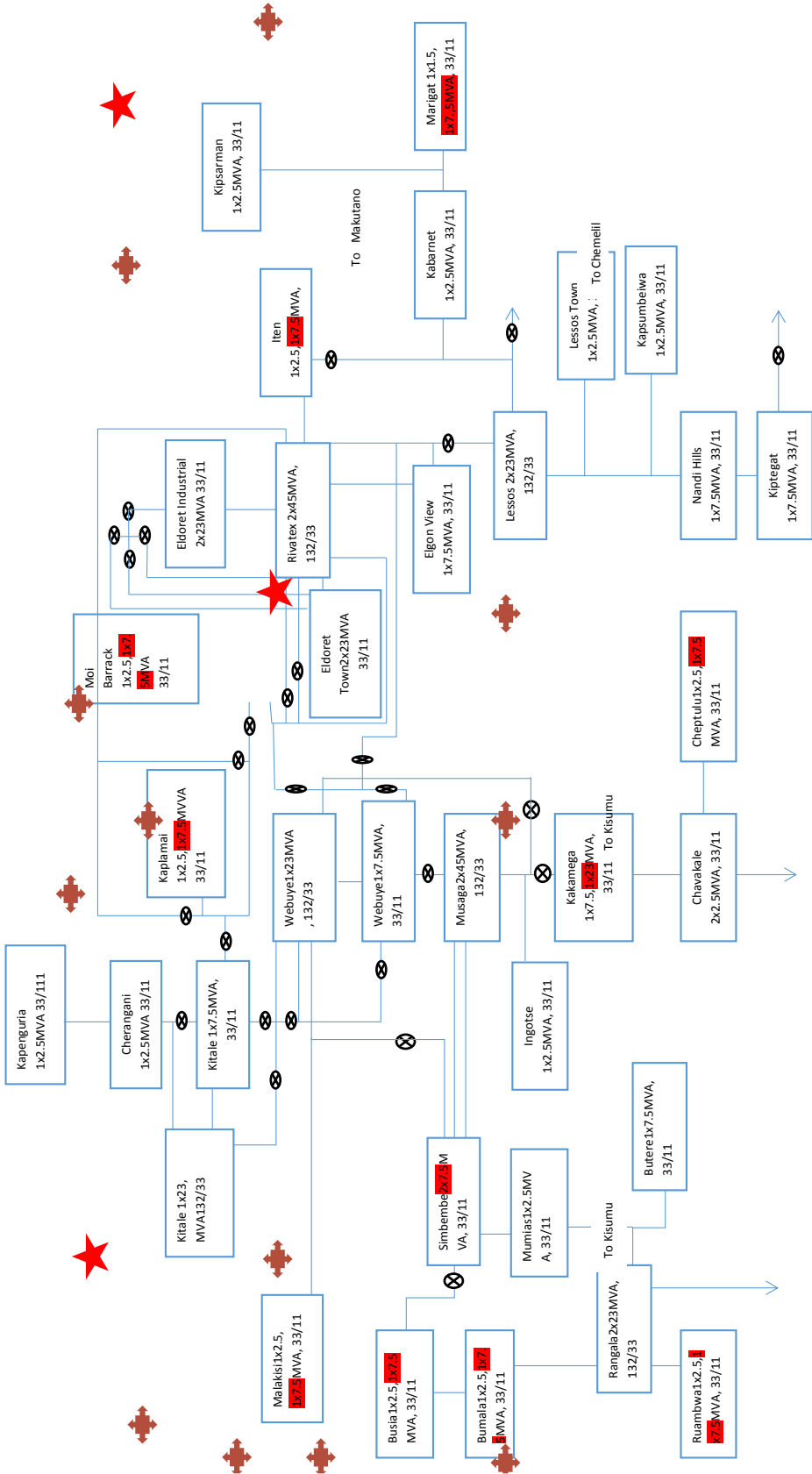
Public lighting program towards a 24 hour economy and to boost security; the program will cover 52 towns across the 47 counties.

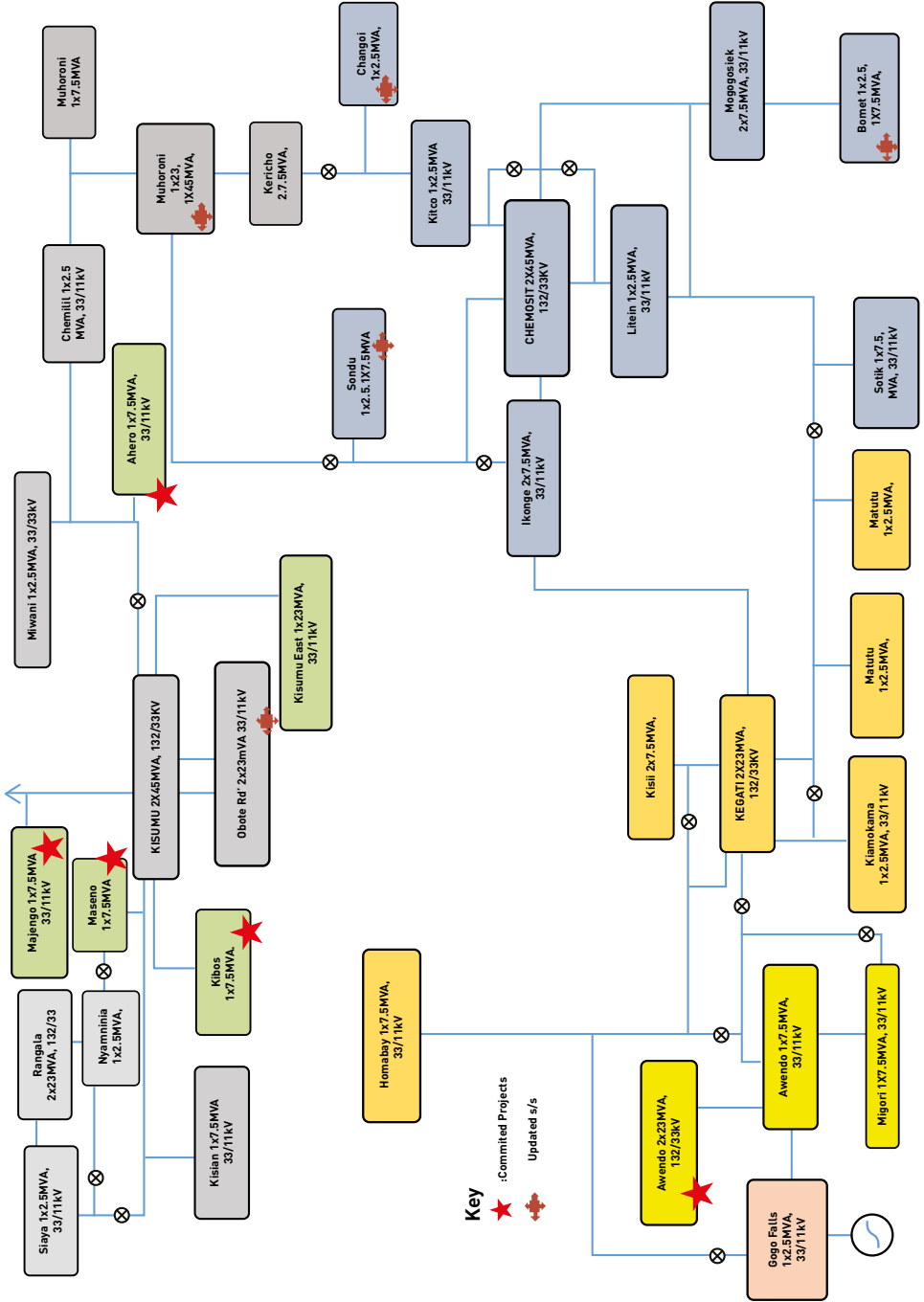


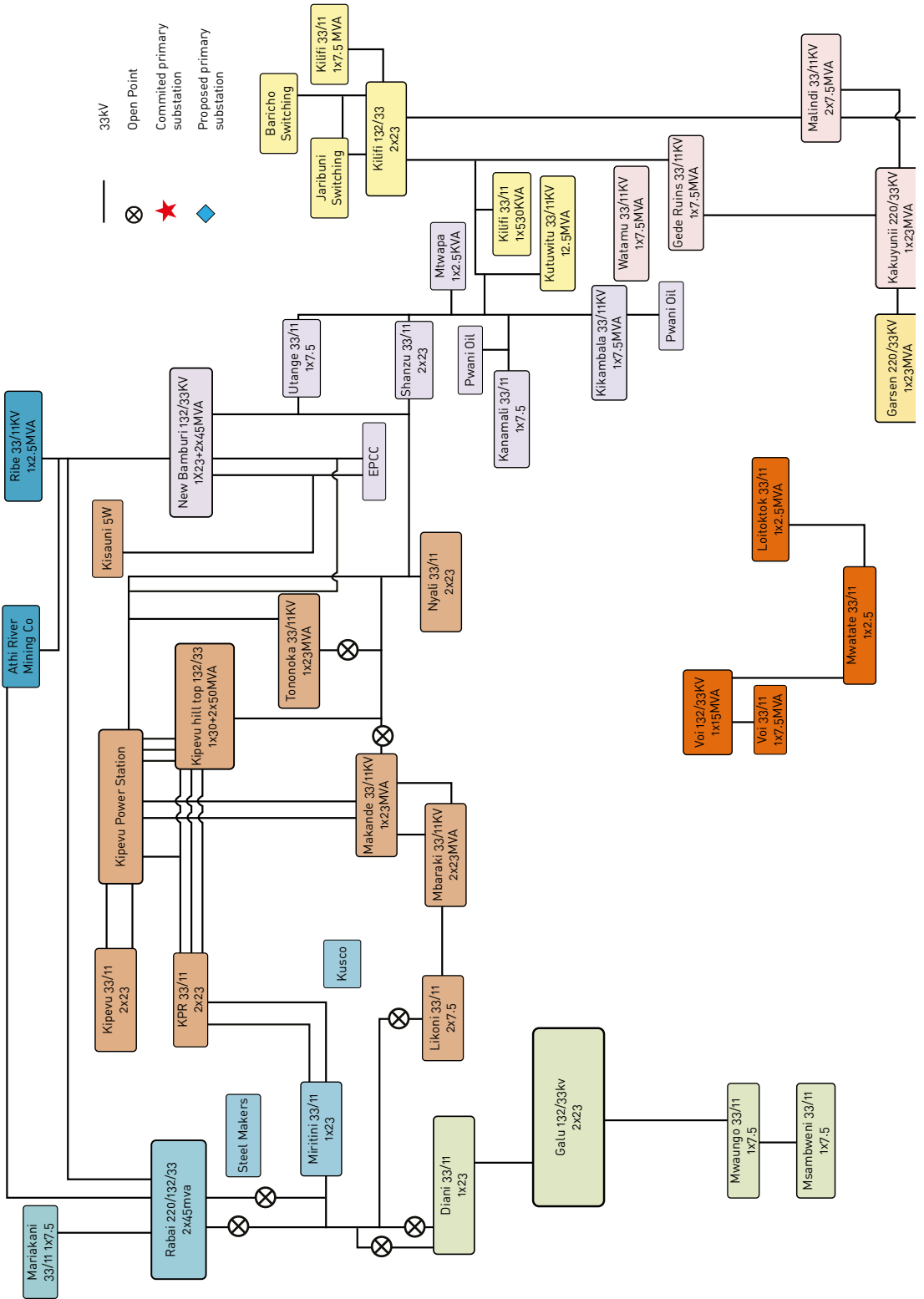




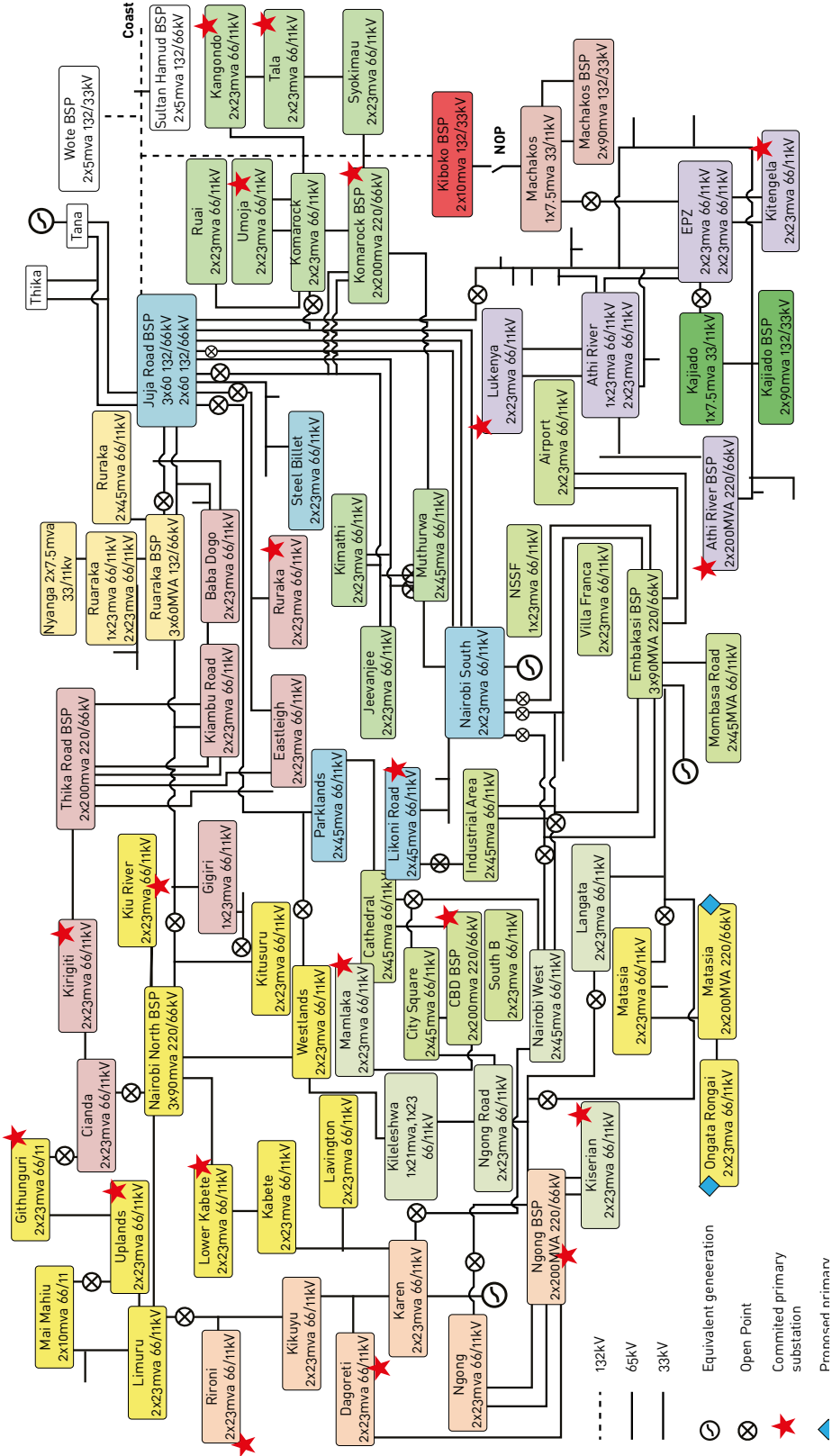


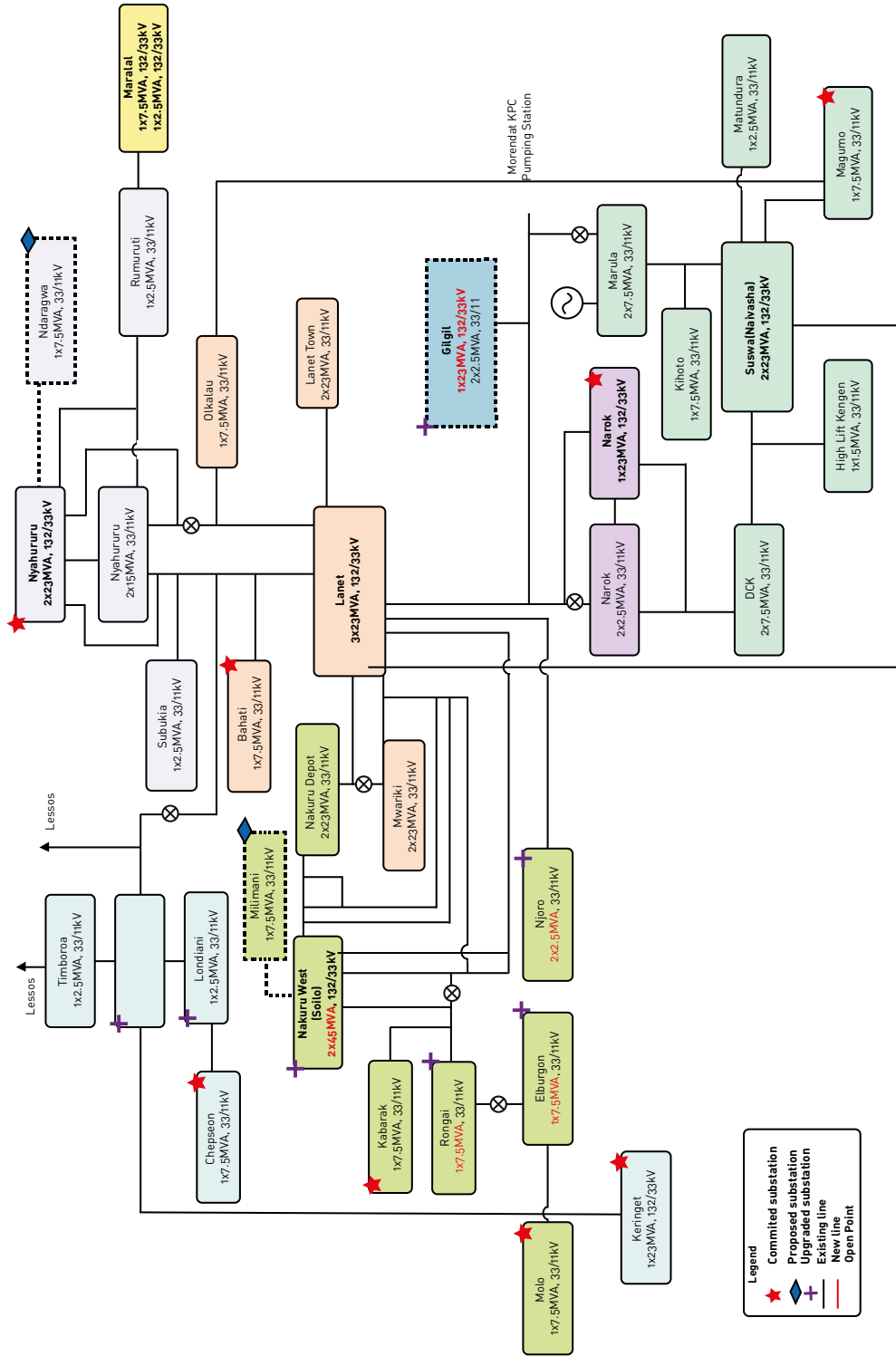






APPENDIX B: BULK SUPPLY POINTS PER REGION 2021

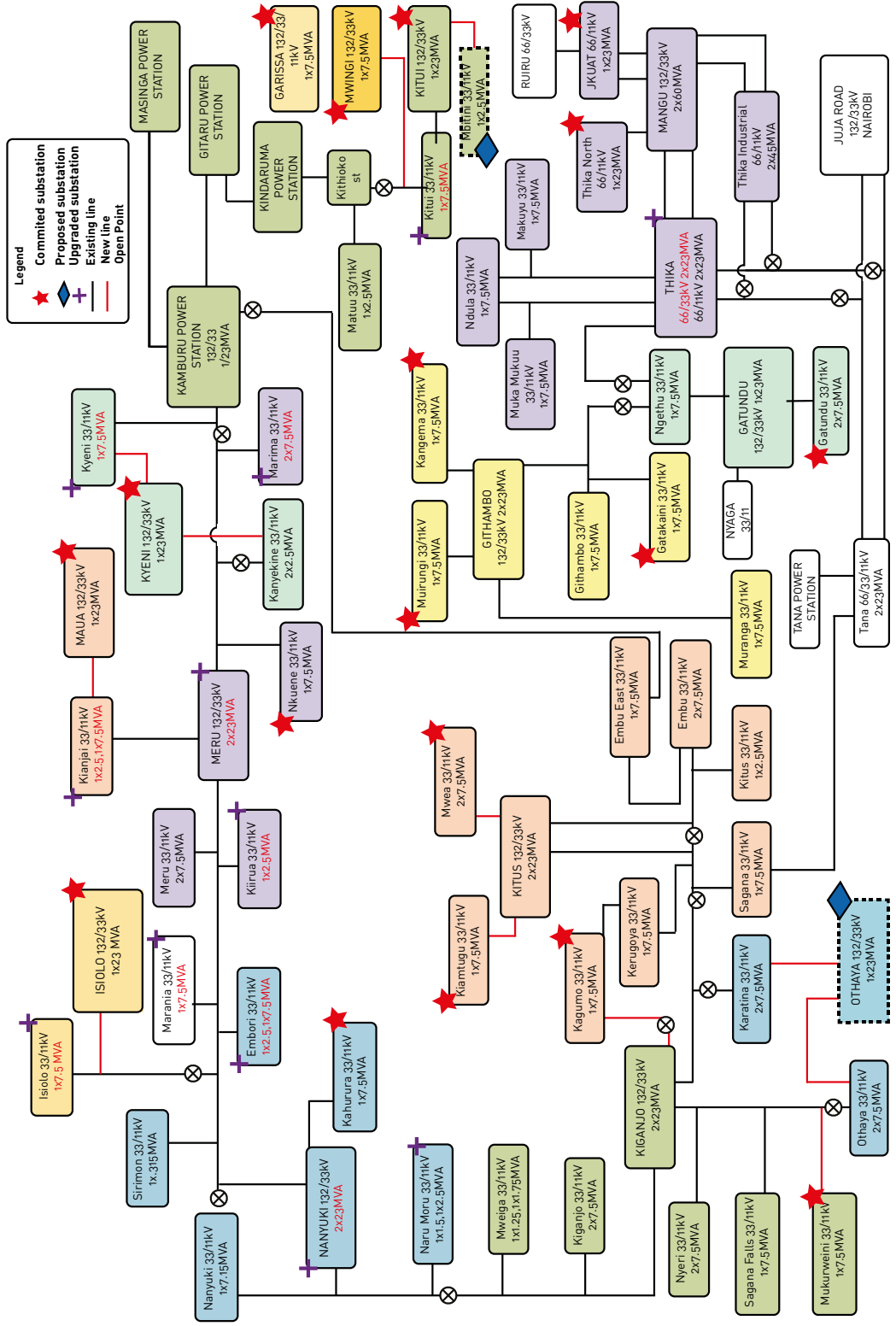


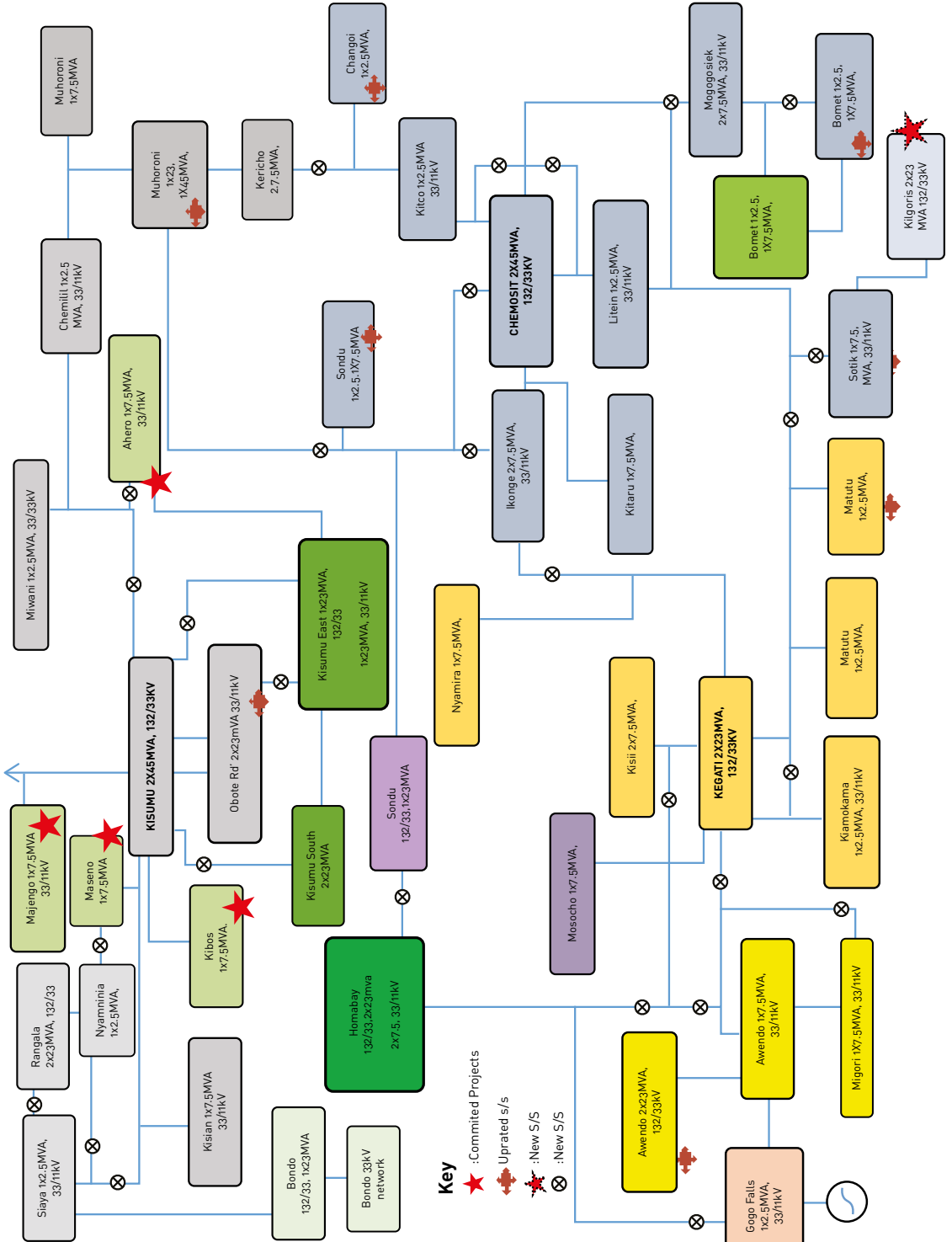


Morendat KFC Pumping Station

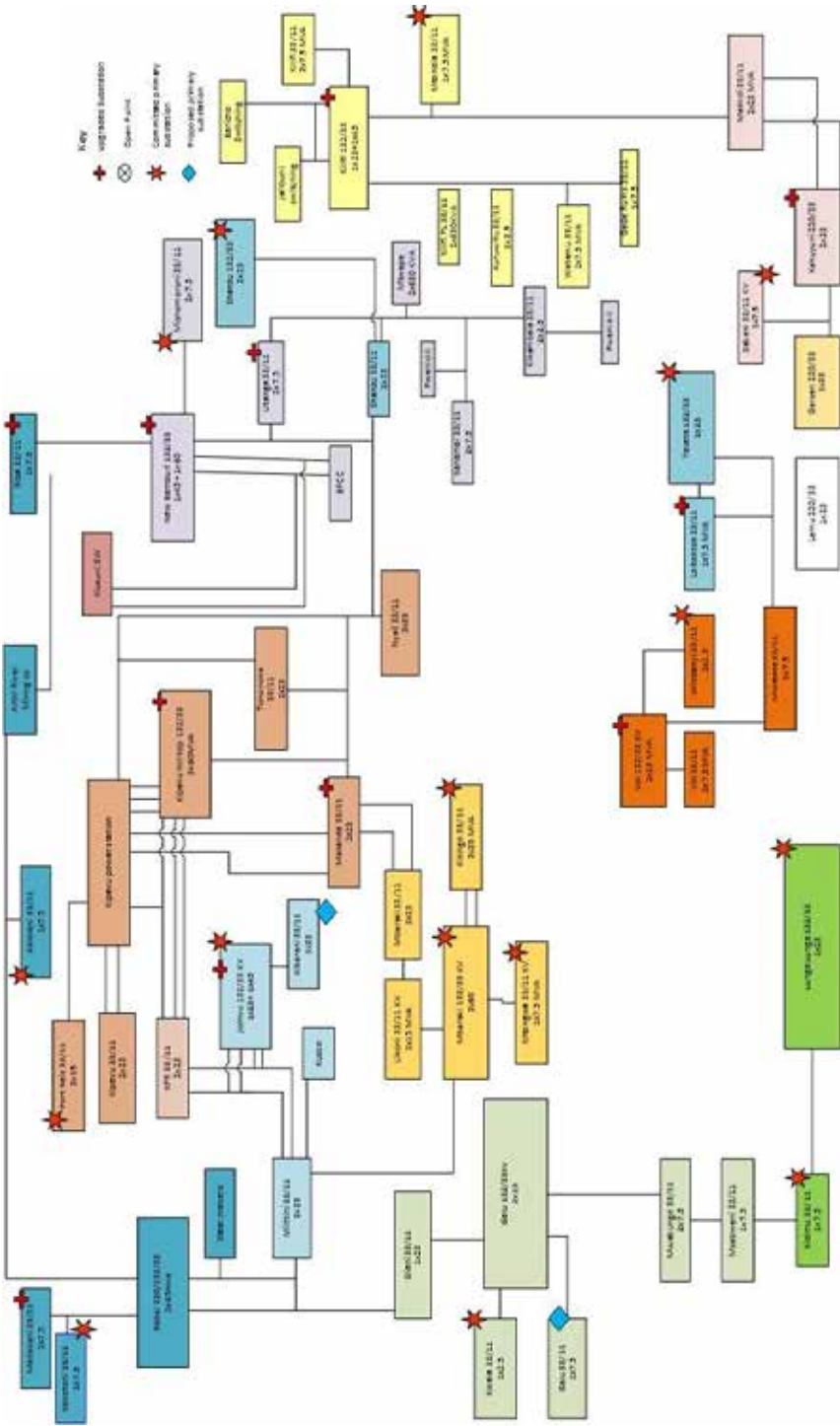
- Legend**
- ★ Committed substation
 - ◆ Proposed substation
 - ⊕ Upgraded substation
 - Existing line
 - - - New line
 - Open Point

Mount Kenya Region -2021





Key
 ★ : Committed Projects
 ⚡ : Upgraded s/s
 ⚡/ : New S/S
 ⚡/ : New S/S







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