



**CLEAN POWER**  
EAST AFRICA   

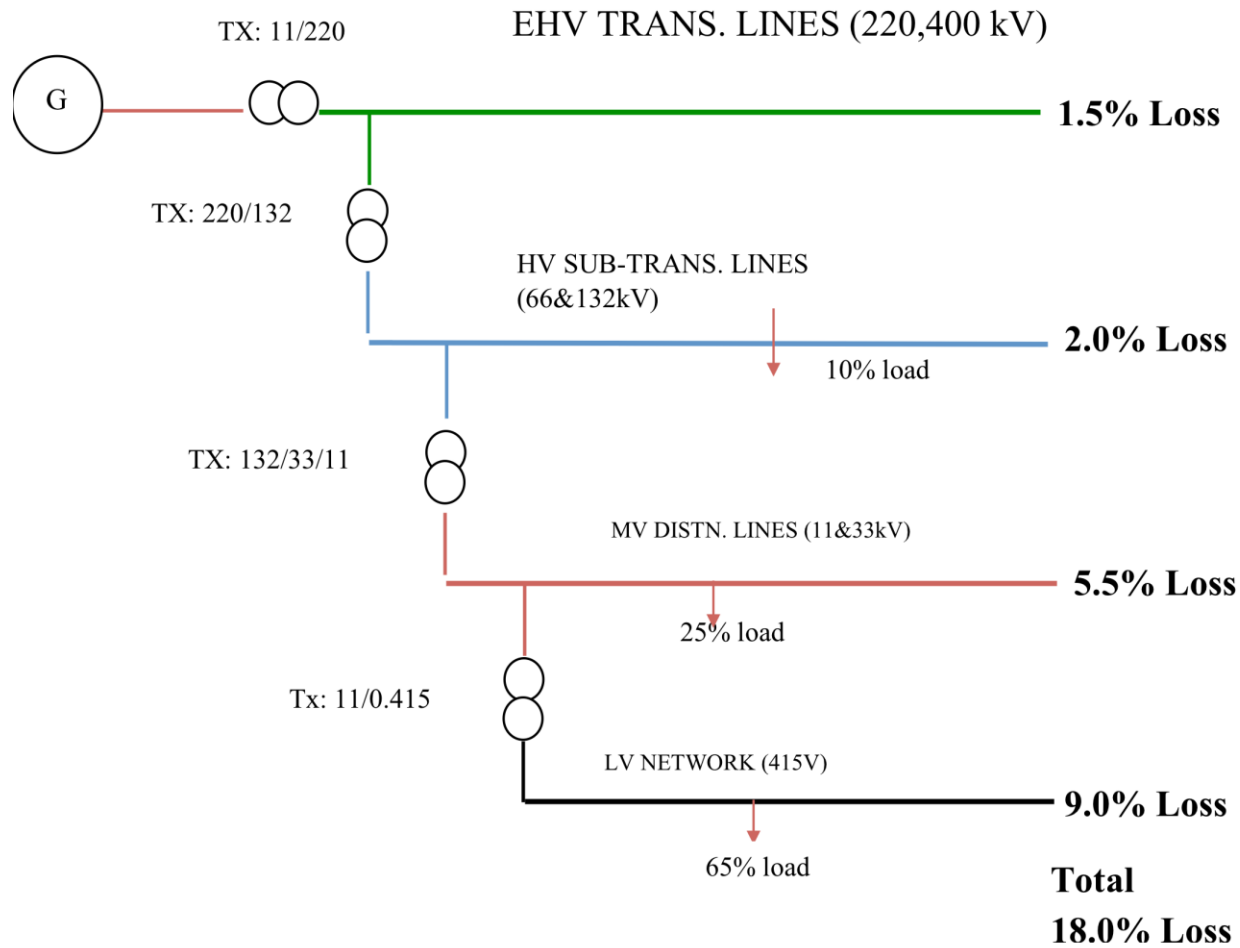
# Brief Overview of Kenya Power Sector & Regional Interconnection

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# Simplified T&D System Diagram



# Technical & Non-technical Losses at Diff. Voltage Levels (FY 2013/14)

Voltage Levels	Losses %	Av. No. of Faults Per Month	Av. Outage Time (hrs)
TRANSMISSION $\geq 220$ kV	1.5	< 5	1 – 2
SUB-TRANS.      66,132 kV	2.0	< 20	2 – 4
MV DISTN.        11,33 kV	5.5	450	4 – 8
DISTN. TXs.    11/33/0.415 kV	1.0	300*	24 – 72
LV LINES 415V    Tech. Losses	6.0	12,000	4 – 8
Non-Tech. Losses	2.0		
<b>TOTAL Losses</b>	<b>18.0%</b>		

*\* About 100 distn. transformers are vandalized every month*

## Basic Rules that govern Least Cost Planning

- Load forecasting must be realistically prepared based on historical trends and future economic growth.
- Peak demand (in MW) must be met with effective installed capacity and about 20% reserve margin..
- Annual Energy demand (in GWh) must be met with minimum hydro energy available in a critical drought year.
- Imports should not exceed 20% of Peak Demand.
- Generation mix and siting of plant must be based on least cost criteria, and projects must be completed on a timely basis

# Load Forecasting

## Projected Peak and Energy Demand FYE 2014-2030

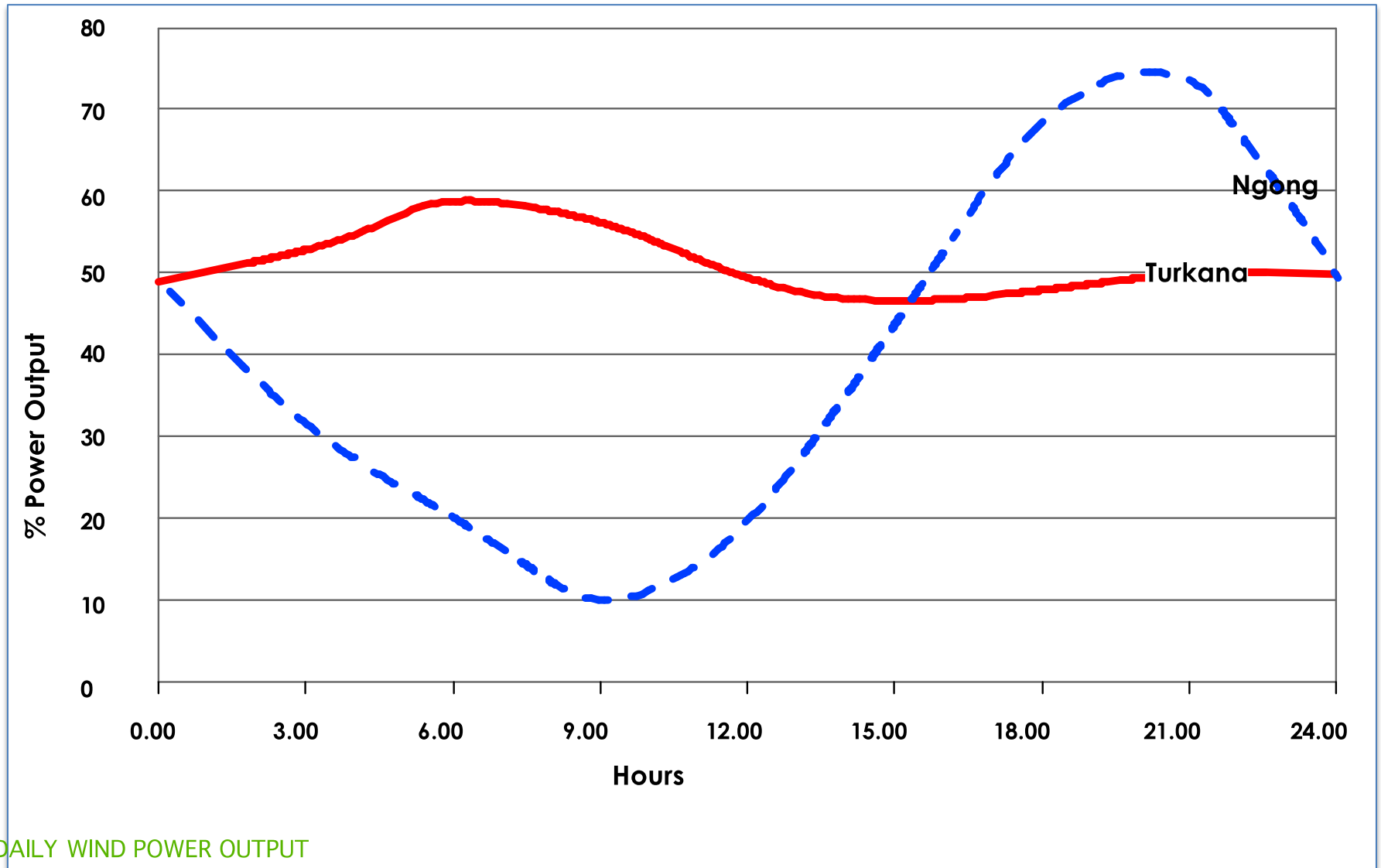
	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30
Basic Demand(MW) 7.00% Gr	1,600	1,700	1,810	1,930	2,060	2,190	2,330	2,480	2,640	2,820	3,000	3,400	3,600	3,900	4,150	4,500
VISION "2030" FL/ Sh Projects																
ICT Cities	10	20	20	30	30	40	50	60	60	80	90	110	140	160	180	200
Lamu Port/Lapset	10	10	20	30	40	50	50	60	60	80	100	120	150	200	250	300
Railways		10	10	10	40	40	40	40	60	70	80	90	110	160	180	200
Mining Industries		10	20	20	40	70	100	120	140	160	200	240	300	340	370	400
Other Industry	20	30	30	30	40	70	100	120	140	160	200	240	300	340	370	400
Total FL/SH Projects	40	80	100	120	190	270	340	400	460	550	670	800	1000	1200	1350	1500
Total Demand (MW)	1,640	1,780	1,910	2,050	2,250	2,460	2,670	2,880	3,100	3,370	3,670	4,200	4,600	5,100	5,500	6,000
Ann. Energy @0.69LF (GWh)	9,913	10,759	11,545	12,391	13,600	14,869	16,139	17,408	18,738	20,370	22,183	25,386	27,804	30,826	33,244	36,266

**Av. Annual Load Growth = 9.0%**

# Summarized Cost of Gen. in UScts/kWh at 10% DCF

Gen. Source	Capacity MW	Available Plant LF	Range of Costs Uscts/kWh
HYDRO      Gibe IV (Eth)	1,470	0.44	7.0 – 8.0
Karuma (Uganda)	700	0.75	8.0 --9.0
Gr. Falls (Kenya)	400	0.55	11.0—12.0
GEOHERMAL (Convnl)	70	0.80	8.0 – 9.0
(Well-Hd)	10	0.80	7.5– 8.5
WIND           (Turkana)	300	0.50	9.0 – 10.0
(Others)	60	0.35	11.0 – 13.0
BIOMASS (Juliflora)	20	0.80	10.0 – 11.0
SOLAR, PV	20	0.20 – 0.25	12.0 – 16.0
BIO–SOLAR HYBRID	20	0.80	11.0 – 12.0
COAL (Imported)	400	0.80	11.0 – 12.0
NATURAL GAS (Tz)	240	0.80	9.0 – 10.0
MSD, (HFO)	100	0.80	14.0 – 16.0
NUCLEAR	1,000	0.80	11.0 – 12.0

# Daily Wind Power Output



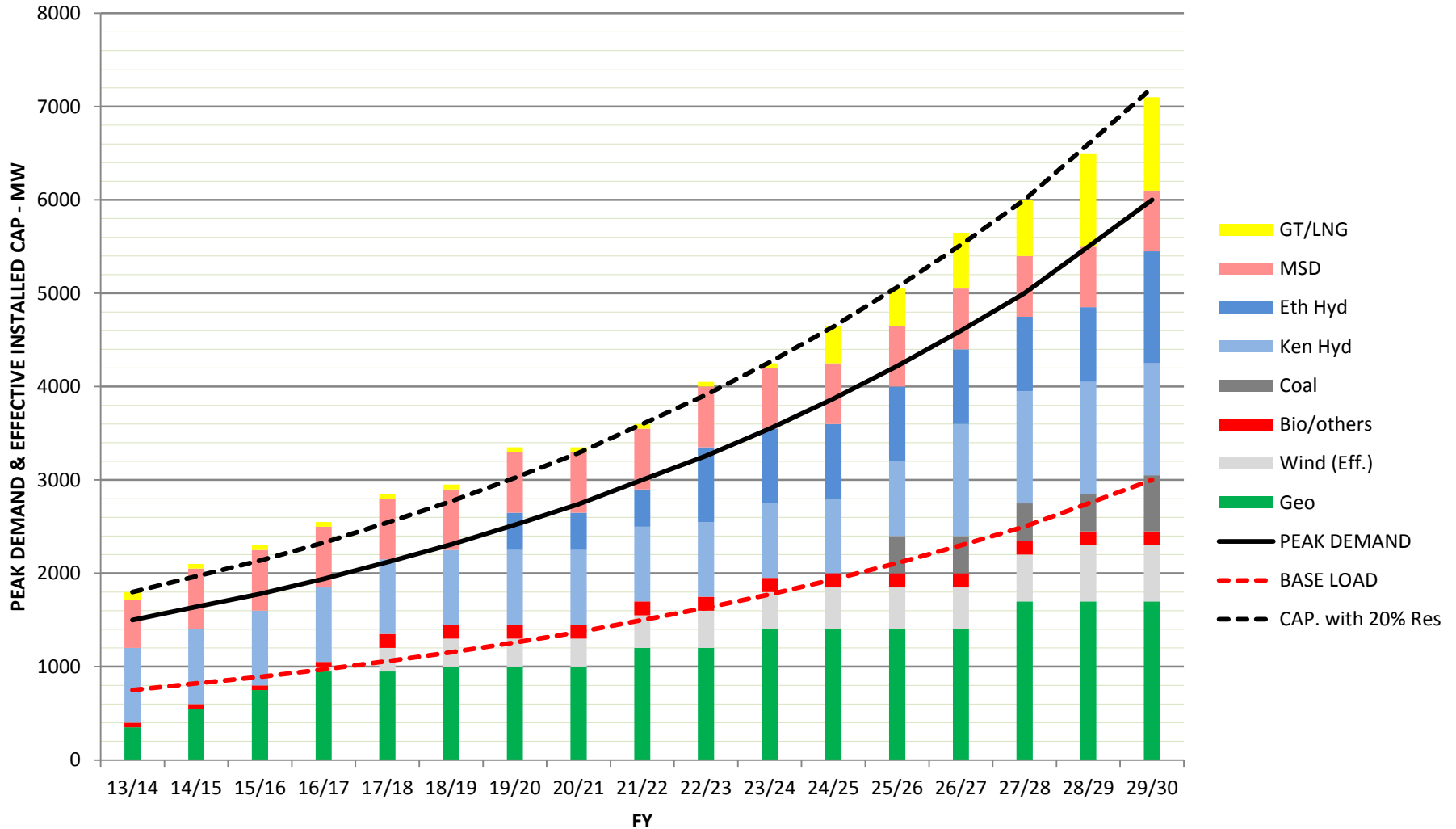
DAILY WIND POWER OUTPUT



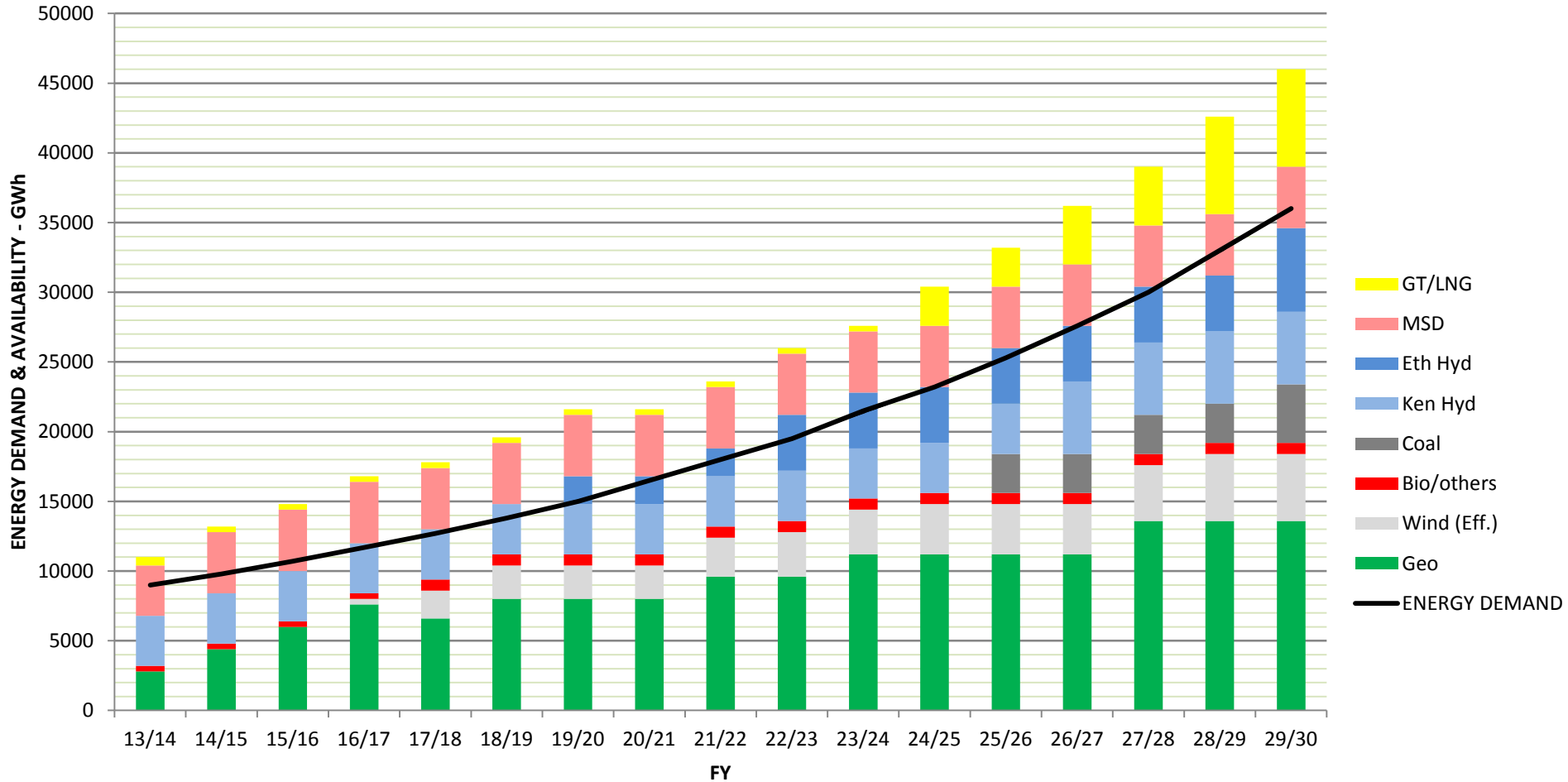
# INDICATIVE LEAST COST PLAN (FYE 2014-2030)

FY	PLANT	EFF. ADDL CAP. MW	EFF. INSTAL CAP MW	PEAK DEMAND MW	FY	PLANT	EFF. ADDL CAP. MW	EFF. INSTAL CAP MW	PEAK DEMAND MW
13/14	GEO BIO/ OTHERS Ken. HYDRO HSD GT/EMP.	350	1800	1500	21/22	GEO WIND 100	200 50	3600	3000
		50			22/23	WIND 100 ETH. HYDRO	50 400		
14/15	GEO MSD Retire EMP	200	2100	1640	23/24	GEO	200	4250	3550
		130 (30)			24/25	WIND 100 GT/LNG Retire GTs	50 400 (50)		
15/16	GEO	200	2300	1780	25/26	COAL PLANT	400	5050	4220
16/17	GEO WIND 100	200 50	2550	1940	26/27	Ken. HYDRO GT/LNG	400 200	5650	4600
17/18	WIND 400 BIO/OTHERS	200 100	2850	2120	27/28	GEO WIND 100	300 50	6000	5000
18/19	GEO WIND 100	50 50	2950	2310	28/29	WIND 200 GT/LNG	100 400	6500	5500
19/20	ETH. HYDRO	400	3350	2520	29/30	COAL ETH. HYDRO	200 400	7100	6000
20/21	NIL	0	3350	2740					

# Projected Peak Demand & Installed Capacity in MW FYE (2014 - 2030)



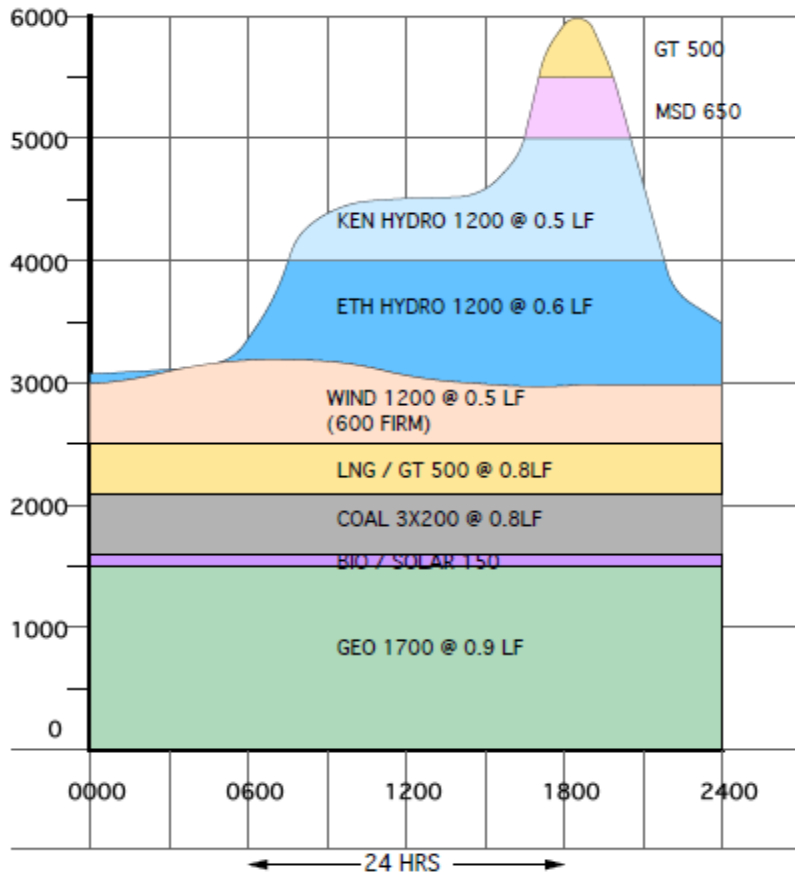
## Projected Energy Demand & Energy Available in GWh FYE (2014 - 2030)



# SIMPLIFIED DAILY LOAD & ANN. LOAD DURATION CURVES

**SIMPLIFIED DAILY LOAD CURVE  
(TYPICAL WEEKDAY 2029/30)**

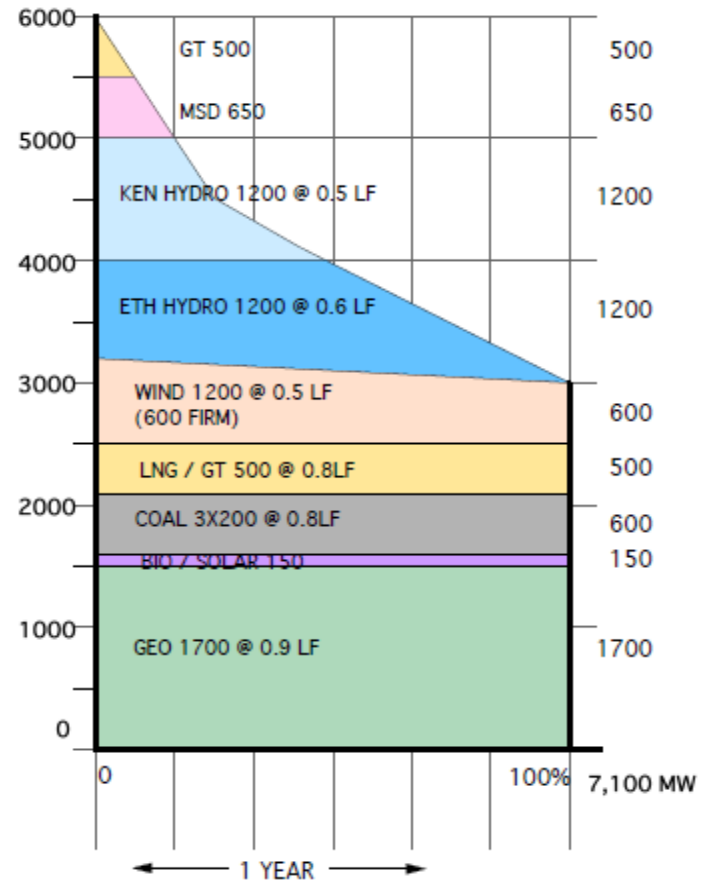
PEAK DEMAND  
in MW



**SIMPLIFIED ANN. LOAD DURATION CURVE  
FY 2029 / 30**

PEAK DEMAND  
in MW

EFF.  
INSTALLED  
CAP MW



# REGIONAL INTERCONNECTION

- In future base load in East African countries will be supplied by renewable resources like geothermal, wind, bio/solar, and LNG.
- The variable load will be supplied by hydro plant.
- The peak load will be met by standby thermal plant.
- Once all the East African countries are interconnected, they should then exchange power appropriately, at the most economic costs.