

Zambia's Nuclear Programme



Presentation Made to the 21st INPRO Dialogue Forum of SMR in Saint-Petersburg

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Presentation Outline

General Introduction

Electricity Supply

What is the Projected Energy Demand based on 2030 and 2060 population?

Where does the NPP fit in the overall Long Term Energy Plan for Zambia?

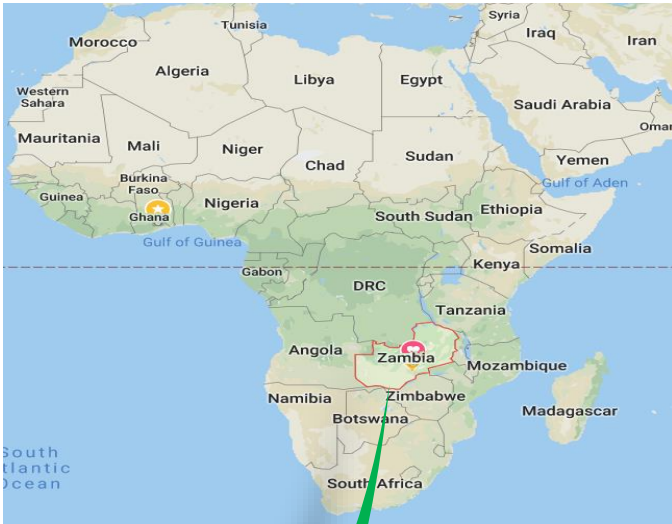
Planned Generation Projects versus Projected Demand

General Introduction

Capital City : Lusaka

Population : 18 million

Area : 752,614 km²



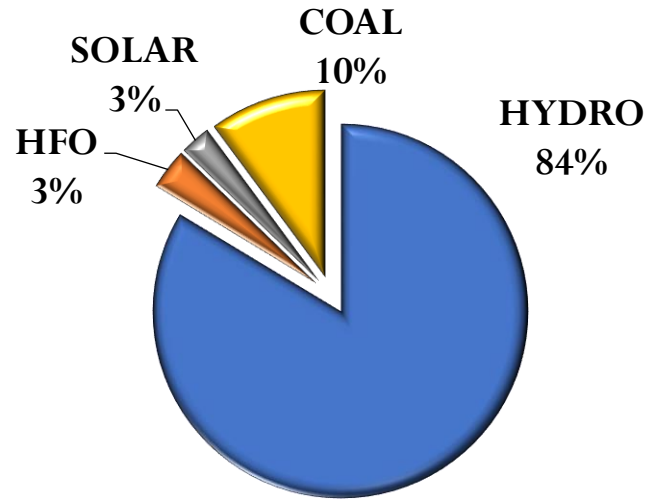
Hydro Potential

6,000 MW



Energy_Mix

Installed Capacity: 2, 928 MW @ 2019



Projected Demand – 2030
(Population: 23.6 million)

27,427.56 MW

Projected Demand – 2060
(Population: 56.8 million)

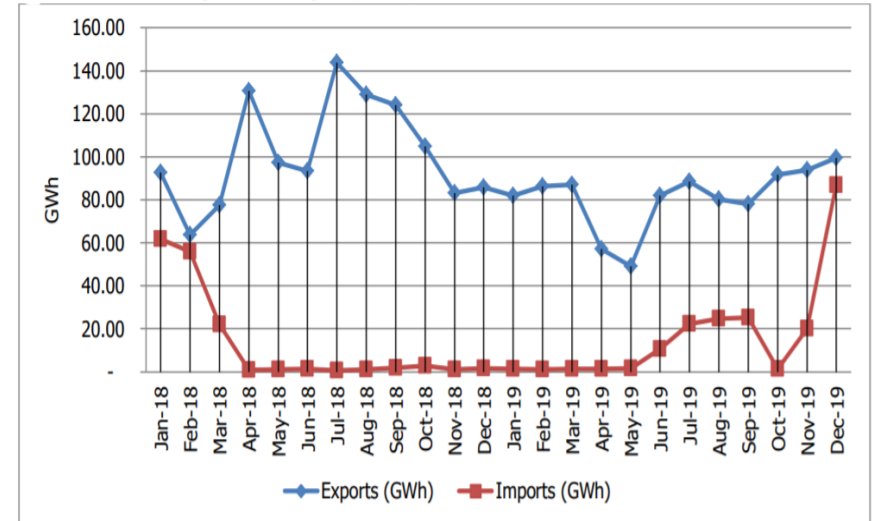
54,855.12 MW

2015/16

Power Deficit due to poor rainfall: 1, 000 MW

Unbudgeted electricity import:
≈ \$ 440,000,000.00

ZESCO's Imports and Exports, 2017, 2018 and 2019



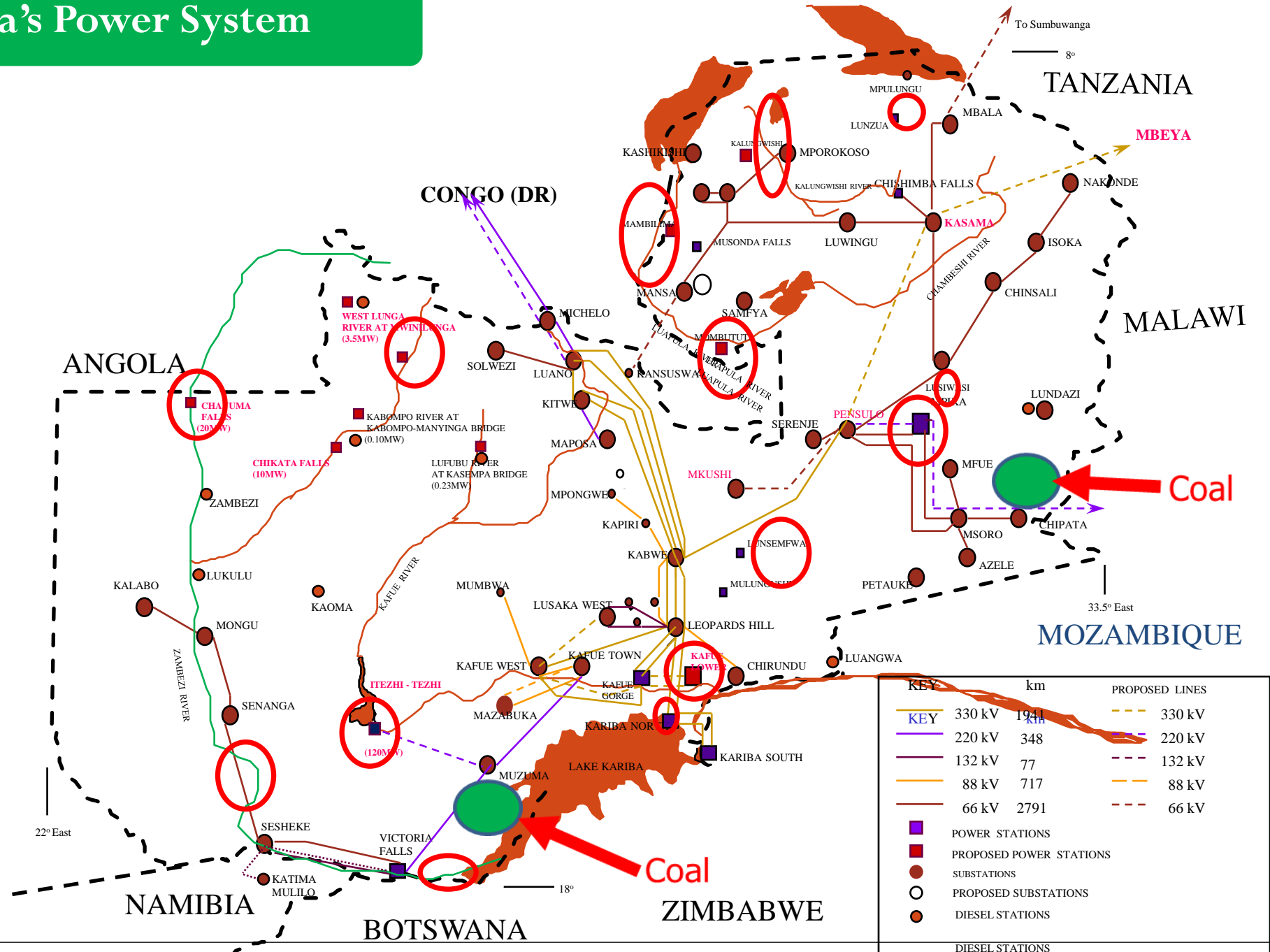
2018/19

Power Deficit due to poor rainfall : 872 MW

Unbudgeted electricity import :
≈ \$ 41,000,000.00

Electricity Supply

Zambia's Power System



Electricity Consumption by Economic Sector, 2017, 2018, and 2019

Sector/Month	2017 (GWh)	2017 (%)	2018 (GWh)	2018 (%)	2019 (GWh)	2019 (%)
Mines	6,202.00	50.87	6,681.88	51.08	6,360.29	50.77
Services (Households)	4,146.85	34.01	4,336.92	33.16	4,022.54	32.11
Finance & Property	640.04	5.25	713.87	5.46	721.53	5.76
Manufacturing	503.39	4.13	442.15	3.38	463.71	3.70
Agriculture	261.49	2.14	297.03	2.27	312.56	2.50
Quarries	118.15	0.97	147.61	1.13	227.25	1.81
Others	87.29	0.72	235.08	1.80	193.25	1.54
Trade	110.21	0.90	113.85	0.87	103.36	0.83
Energy and Water	80.88	0.66	68.54	0.52	82.94	0.66
Transport	31.95	0.26	32.47	0.25	31.23	0.25
Construction	9.62	0.08	10.83	0.08	8.35	0.07
Grand Total	12,191.87	100.00	13,080.23	100.00	12,527.02	100.00

**What is the Projected Energy Demand
based on Estimated Population for 2030
and 2060?**

Modeling of Demand for Electricity

- Assumption 1:
 - Estimated Population for 2030 and 2060 as the basis for Projections
- Assumption 2:
 - Two Scenarios
 - Zesco Projections of Supply and Demand
 - World Average Per Capita Use of Electricity
- Assumption 3:
 - Uptake of renewables without a Smart Grid at 15%
 - Uptake of renewables with a Smart Grid at 36%
- Assumption 4:
 - Zambia to Contribute to the reduction of the GHG emissions by having 25% of overall electricity generation nuclear

Projected Energy Demand

Scenarios		2030 Estimated population at 23.6 million			2060 Estimated population at 56.8 million		
Without Smart Grid	Smart	Projected Overall installed capacity	25% Nuclear contribution of total capacity	Projected Overall installed capacity	25% Nuclear contribution of total capacity		
Zesco Scenario		4,563 MW		9, 126MW	2, 281.5MW		
World averages per capita Scenario		27,427.56 MW	6,856.89 MW	54,855.12 MW	13,713.78 MW		

Base Load ~ Variable Renewable Energy Scenarios under the Current Grid

Base Load ~ Variable Renewable Energy Scenarios

Scenarios		2030 Estimated population at 23.6 million		2060 Estimated population at 56.8 million	
Without Grid	Smart	RE contribution at 15%	RE contribution at 15% based on 25% Nuclear	RE contribution at 15%	RE contribution at 15% based on 25% Nuclear
Zesco Scenario		684 MW at 15 %		1, 368.9MW	342.2MW
World averages per capita Scenario		4, 114.13MW	1,029 MW	8, 228.27MW	2, 057.07MW

Base Load ~ Variable Renewable Energy Scenarios under A Smart Grid

Base Load ~ Variable Renewable Energy Scenarios

Scenarios	2030 Estimated population at 23.6 million		2060 Estimated population at 56.8 million	
With Smart Grid	RE contribution at 36%	RE contribution at 36% based on 25% Nuclear	RE contribution at 36%	RE contribution at 36% based on 25% Nuclear
Zesco Scenario	1,642 MW		3,285MW	821MW
World averages per capita Scenario	9, 874 MW	2,468MW	19,748MW	4,937MW

Where does the NPP fit in the overall Long Term Energy Plan for Zambia?

Long Term Energy Plan

Short Term

0 – 5 years (2020 – 2025)

- *Demand and Supply Side Management*
- *Micro Grids*
- *Renewables (Hydro, Solar, Wind, Geothermal)*
- *Human Resource Development for NPP*
- *Smart Grid Development (Phase I)*
- *Finalized Business Model for NPP*
- *CO2 sequestrated Coal (Feasibility)*
- *Waste to Energy (Feasibility)*

Medium Term

6 – 11 years (2026 – 2030)

- *Smart Grid Development (Phase II)*
- *Increased Renewables uptake because of expanded Grid and Baseload capacity*
- *CO2 sequestrated Coal*
- *Waste to Energy*

Long Term

12 – 100 years (2031 – 2131)

- *Construction & Commissioning of first Two (2) Units of NPP*
- *Expansion and Replacement of NPPs (2040 and beyond)*
- *Increased uptake of Variable Renewables due to increased Baseload Capacity*



Smart Grid



Nuclear Power Plant



Renewables

Integration of SMRs and Large NPP

Long Term Scheme for Nuclear Power Plant Expansion and Replacement

EXPANSION OF NUCLEAR POWER PLANTS

REPLACEMENT OF NUCLEAR POWER PLANTS

NPP1
2040-2120



Replacement
of NPP1
2110-2190



NPP2
2045-2125



Replacement
of NPP2
2115-2199



NPP3
2050-2130



Replacement
of NPP3
2120-2200



SMR1



Replacement
of SMR1



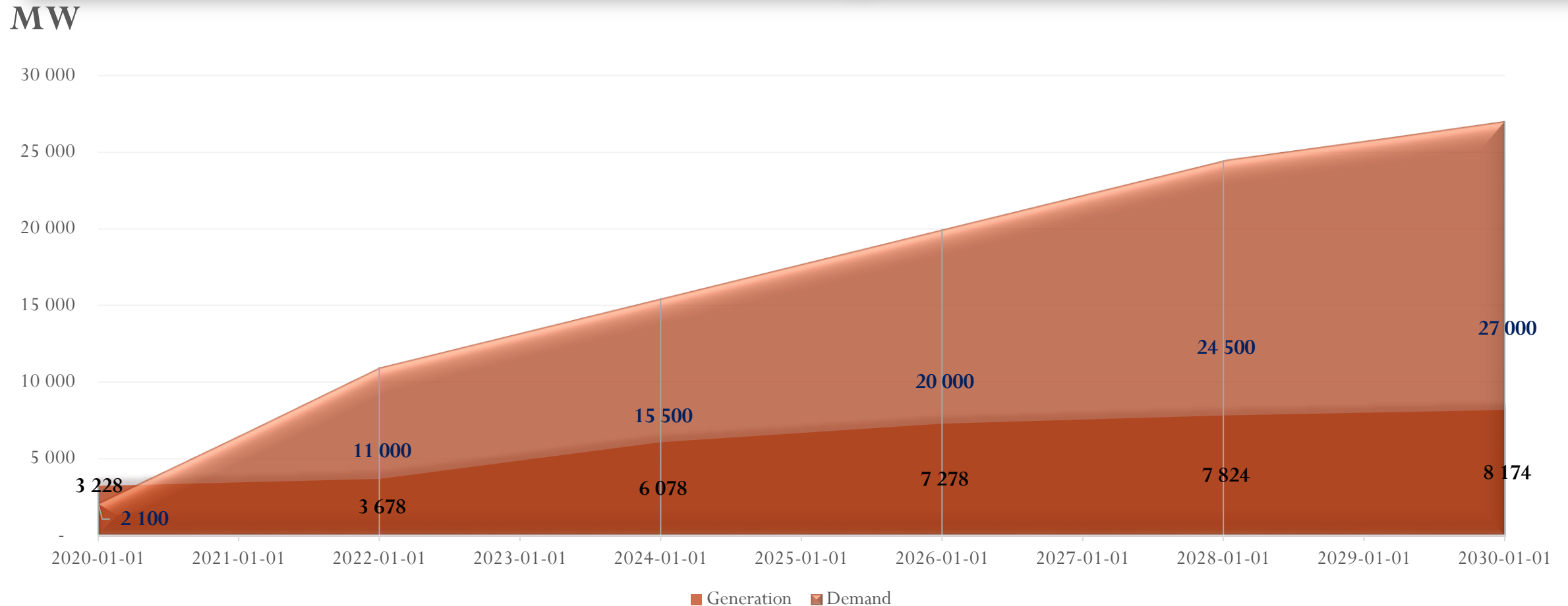
Planned Generation Projects Vs. Demand

Planned Generation Projects Versus Demand

Project	Capacity	Resource	Year	Company
Kabompo Power Project	40MW	Hydro	TBA	CEC plc
Ngonye Falls Power Project	80MW	Hydro	TBA	Western Power Company
EMCO Coal Fired Power Plant	340MW	Coal	TBA	EMCO Limited
Lusiwasi	12MW to 86MW	Hydro	2020	Zesco Limited
Kafue Gorge Lower Hydro Power Project	750MW	Hydro	2021	Zesco Limited
Batoka Power Project	2,400MW	Hydro	2024	Zambia & Zimbabwe
Luapula hydro scheme	850-1200MW	Hydro	2026	Zambia & DRC
Maamba Coal Power Plant Extension	350MW	Coal	TBA	Maamba Collieries Ltd
Nuclear Power Plants	300 – 2, 400MW	Nuclear	2027 – 2040	TBA

- Projected Demand by 2030 ~ 27, 000MW,
- Planned Generation Projects Capacity ~ 5,246 MW (with Nuclear ~ 7, 646 MW)
- Deficit by 2030 will be approximately *16, 354 MW*

Planned Generation Projects Versus Demand



- Projected Demand by 2030 ~ 27,000MW,
- Planned Generation Projects ~ 4,896 MW (with Nuclear ~ 7,296 MW)
- Deficit by 2030 will be approximately *16,704 MW*

