

2020 – 2040 Baseline and Reference Case Planning Scenario Results

The Continental Power System Masterplan (CMP) was initiated in 2019, following a decision of the African Energy Ministers to serve as a blueprint for the African Single Electricity Market (AfSEM).

The integrated planning scenarios, developed with support from the European Union - Global Technical Assistance Facility (EU-GTAF), provide an outline of credible pathways of how the electricity sector in Africa will evolve in the next 20 years, considering the unique challenges and aspirations of each of Africa's five regions and guided by the continental aspirations espoused in the AU Agenda 2063 Goals.

The synergy and complementarity of the AfSEM and CMP assignments will ensure that efficient generation facilities and resilient electricity interconnections will support adequate and efficient market-based mechanisms for trading.



OBJECTIVE

This deliverable aims to provide:

- Summaries of the installed, committed and candidate generation options to supply the future reference energy demand that was entered into the SPLAT Africa optimisation model;
- Summaries of the technical, economic and financial assumptions used in the SPLAT Africa model;
- Description of how the baseline and reference scenarios for the five regional power pools and the continental level were developed; and
- Results and key outcomes of the SPLAT Africa optimisation runs conducted on the baseline and reference scenarios.



METHODOLOGY

In order to disseminate knowledge to all Power Pools and to ensure the comprehensive discussion, review and agreement on model inputs and outputs, capacity building workshops and consultation sessions on the SPLAT Africa modelling approach played a crucial role throughout the development of the baseline and reference scenario models.

Summary of the analysis

DESCRIPTION OF THE SCENARIOS

The baseline scenario mimics the key priority projects that have been specified in the Power Pool master plans and other approved documents at both the country and Power Pool levels, while the Reference scenario is a least cost optimisation for the reference demand with low regional integration considering the committed and planned transmission interconnectors.

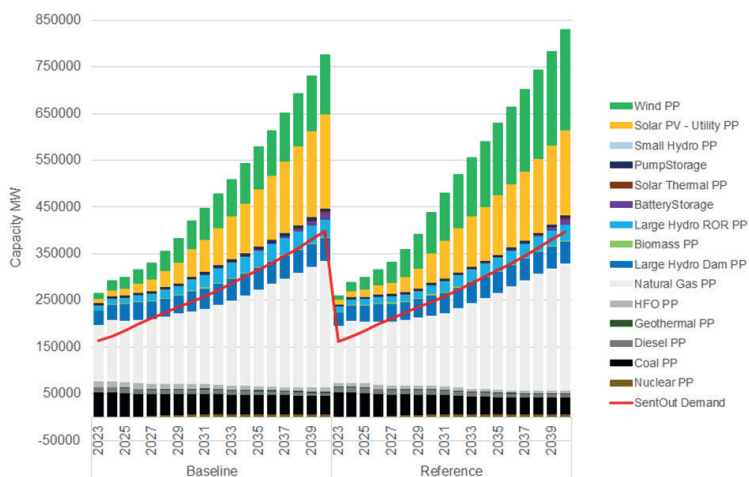
OVERVIEW OF THE RESULTS

The projected growth of the installed capacity in Africa's interconnected power system for the duration of the study until 2040 shows a significant rise from its current level, reaching 775 GW in the baseline scenario and 830 GW in the reference scenario. This corresponds to a three-fold increase compared to the existing capacity of 266 GW in 2023.

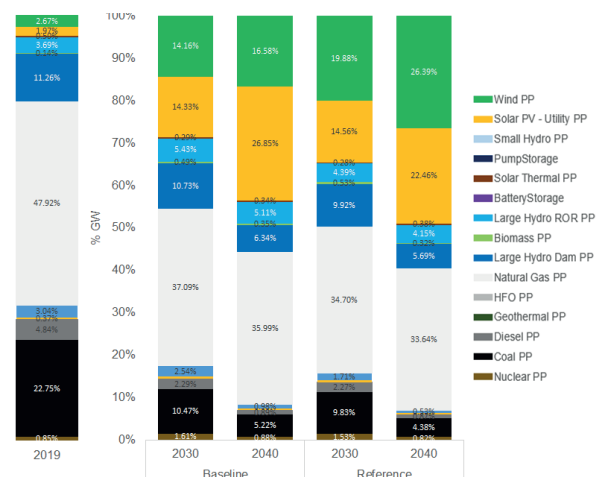
The difference in installed capacity between these two scenarios, despite having identical demand projections, can be attributed to the higher proportion of fossil fuel plants selected as firm capacity in the baseline scenario.

A common trend observed across most results from the optimisation runs is that renewable energy sources (RES) have a higher presence under the reference scenario, due to more conservative preferences towards RES penetration represented by power pools within the baseline scenario.

Total installed generation capacity development in Africa's interconnected power system



Evolution of installed capacity mix in Africa's interconnected power system



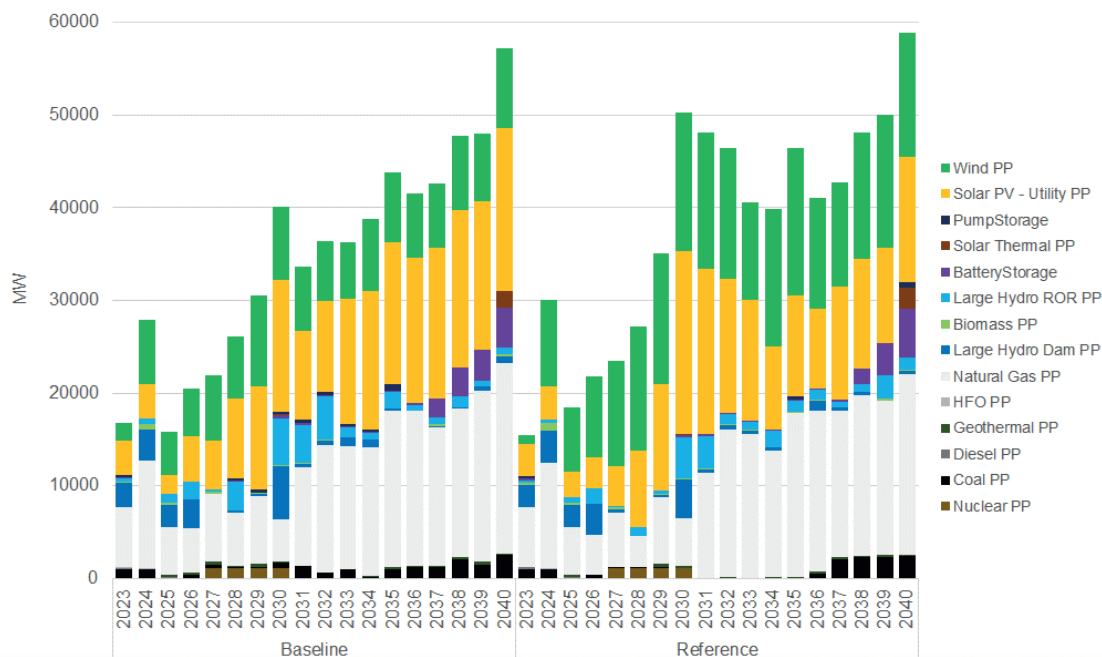
The total variable renewable energy capacity share for the baseline scenario is projected to increase from 4.6% in 2019 to 28.5% by 2030 and 43.5% by 2040. The corresponding shares in the reference scenario are 34.4% in 2030 and 48.8% by 2040. The total RE capacity share is projected to increase to 44.6% by 2030 and 55% by 2040 in the baseline scenario, compared to 49% and 58.6% correspondingly in the reference scenario.

The contribution of coal, HFO and diesel fired plants is projected to diminish towards 2040. Although the level of gas fired capacity (GW) is increasing, its share is steadily decreasing to cover about one third of the capacity mix by 2040.

NEW CAPACITY ADDITIONS

The projected annual capacity increases in the two scenarios within the interconnected African system reveal a significant need for additional energy sources to meet the growing demand, particularly after 2030. Both scenarios include solar and wind capacities exceeding 20 GW per year after 2030 to achieve the projected renewable energy generation level by 2040. This emphasizes the importance of variable renewable energy in meeting Africa's future energy needs.

New capacity additions in the Baseline and Reference scenarios for Africa



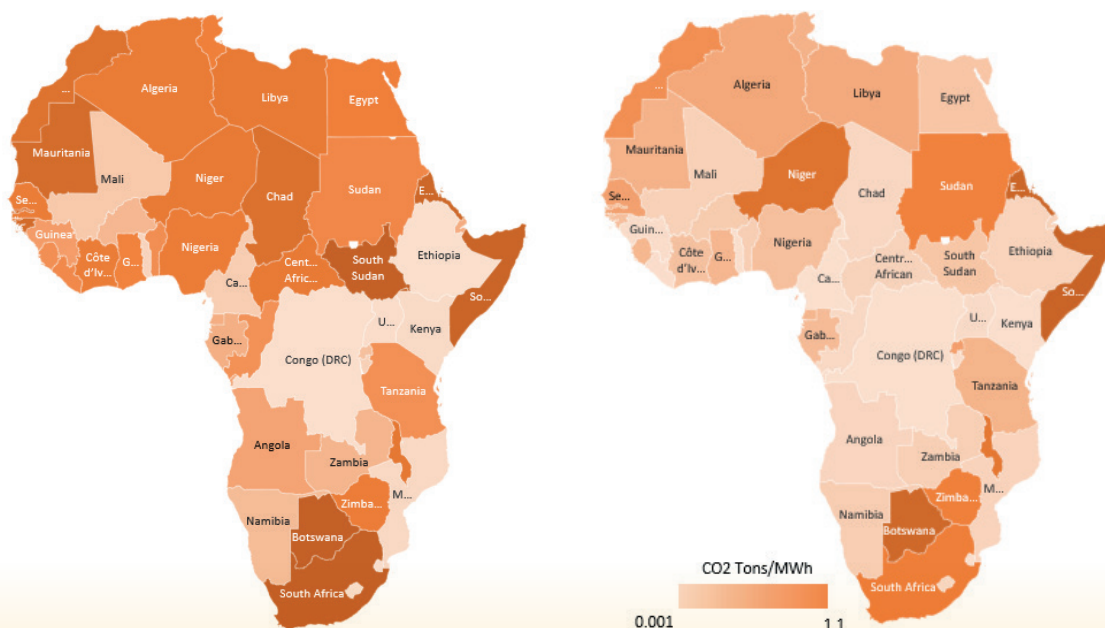
WHAT ARE THE KEY CROSS-BORDER TRANSMISSION INVESTMENTS REQUIRED TO LINK AFRICA'S FIVE REGIONS, AND CONNECT THE CONTINENT WITH EUROPE AND ASIA?

Interconnector Name	Status	Countries involved	Regions / Power Pools Interconnected	Investment Date Baseline / Reference
Angola – Namibia (ANNA)	Committed	Angola, Namibia	CAPP, SAPP	2025
Zambia - Tanzania (part of ZTK)	Committed	Tanzania, Zambia	EAPP, SAPP	2024
DRC (Inga) – Angola (Cabinda) – Congo (Pont Noire)	Committed	Angola, DRC	CAPP, SAPP	2027
Mozambique – Tanzania	Candidate	Mozambique, Tanzania	CAPP, SAPP	2027
Kolwezi (DRC)- Solwezi (Zambia)	Candidate	DRC, Zambia	CAPP, SAPP	2038 / 2037
Cameroun - Nigeria	Candidate	Cameroun, Nigeria	CAPP, WAPP	2033
DRC (Inga) - South Africa (Merensky) Grand Inga HVDC Phase 1 600HVDC	Candidate	DRC, South Africa	CAPP, SAPP	2030
DRC - Uganda	Candidate	DRC, Uganda	CAPP, EAPP	2030
Burundi - DRC	Candidate	Burundi, DRC	CAPP, EAPP	2023
Morocco - Mauritania	Candidate	Morocco, Mauritania	COMELEC	2037
Mlaaba - Sicilia	Committed	Italy, Tunisia	COMELEC, Europe	2025
Morocco - Spain	Committed	Morocco, Spain	COMELEC, Europe	2026
Morocco - Portugal	Candidate	Morocco, Portugal	COMELEC, Europe	2027
Egypt – Saudi Arabia	Committed	Egypt, Saudi Arabia	COMELEC, Asia	2025

WHAT HAS BEEN THE DECLINE IN CO₂ EMISSIONS INTENSITY OVER THE STUDY PERIOD?

The figure below shows the reduction of the CO₂ emissions intensity between 2019 and 2040 for the Reference scenario.

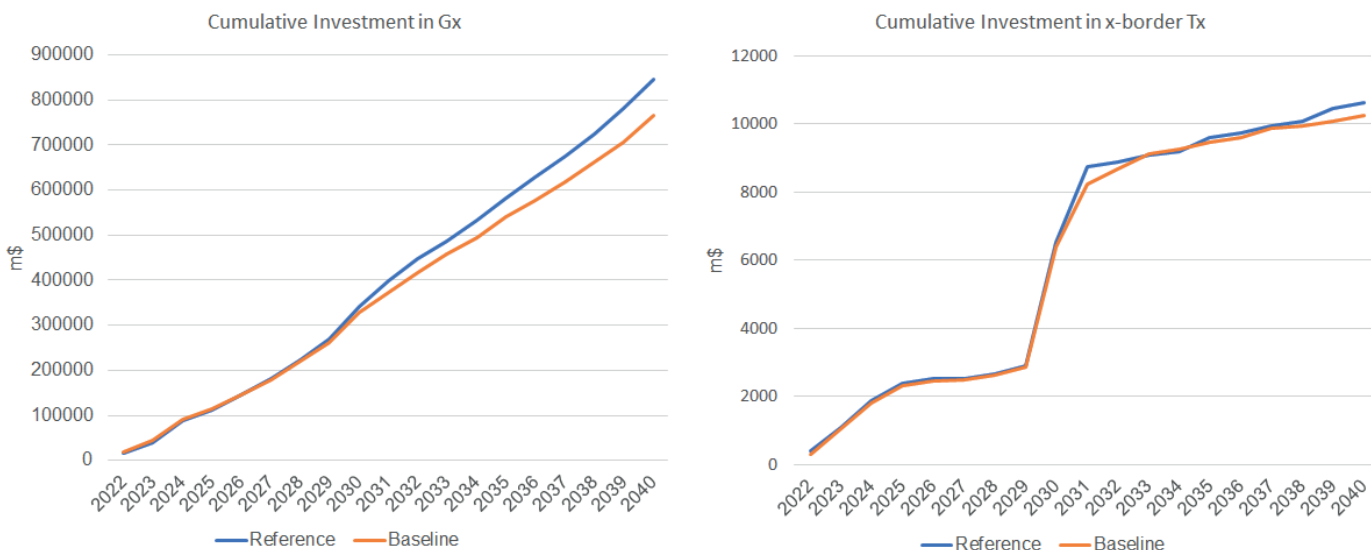
Reduction in CO₂ emissions in Africa from 2019 to 2040 in Reference scenario



WHAT INVESTMENTS IN GENERATION AND CROSS-BORDER TRANSMISSION INFRASTRUCTURE ARE NECESSARY TO BUILD THE CONTINENTAL POWER SYSTEM?

By 2040, the cumulative investment costs for the reference scenario are projected to grow to about USD 836 billion and to USD 756 billion for the baseline scenario. The cross-border transmission interconnectors contribute about 13.6% (USD 10.3 billion) and 12.6% (USD 10.6 billion) to the total cumulative costs in the baseline and reference scenarios, respectively.

Cumulative generation and transmission investment costs for Africa's interconnected power system



Key insights

- SAPP, WAPP and EAPP are projected to be the net importers in both scenarios, while CAPP and COMELEC will be net exporters. CAPP is projected to export to SAPP, EAPP and WAPP, highlighting the importance of the CAPP region as the hub for power exports in the continent. However, CAPP has the lowest intra- power pool trade volumes.
- In absolute value, the largest intra- power pool trade volumes are projected within the SAPP, WAPP and EAPP power pools, with SAPP being the dominant. In both scenarios, intra- power pool trade within SAPP is projected to double from 2030.
- Transmission interconnectors enable a higher share of variable renewable energy and lower CO2 emissions in the continent.

Even more cross-border transmission interconnectors will be required for the CMP to effectively serve as the blueprint for the realisation of the AfSEM and to meet the aspirations of the AU's Agenda 2063 for electrification and economic growth.

