

# Synthesis of Africa's Continental Power System Masterplan 2020 - 2040

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

The CMP seeks to:

- Address some of the challenges in Africa's electricity sector and meet the aspirations of the countries in the five African regions in a way that optimises the economical use of the available vast and diverse electricity generation resources across the continent regardless of their location;
- Align the development of the African electricity sector with the electricity sustainability goals set by international organisations such as the United Nations Sustainable Development Goals (SDGs) and 2015 Paris COP21, which also have the support of African institutions and governments; and
- Identify key generation and cross-border transmission projects required to realise the AfSEM and meet the continent's developmental needs and goals.

This final CMP deliverable consolidates the results and recommendations, highlighting the key messages drawn from demand forecasting, scenarios development, generation resources assessment, generation and transmission capacity expansion and trade optimisation analysis. The report focusses on the three key CMP planning scenarios:

- baseline scenario,
- regional integration scenario, and
- continental integration scenario.



## METHODOLOGY

The primary focus of the CMP revolves around the development of an interconnected continental grid that facilitates electricity trade amongst the five regions of Africa and externally to Europe and the Middle East. To conduct the necessary analysis, different CMP models were created by gathering, confirming, and validating data from the five regional Power Pools. The African Union Development Agency (AUDA-NEPAD) and the Power Pools adopted the use of common modelling tools for the three main modelling pillars of the CMP:

- demand forecasting (EViews),
- generation capacity expansion optimisation (SPLAT-MESSAGE), and
- transmission network studies (PSS®E).

The CMP study was conducted with the aim to build the planning capacity in the relevant African institutions and establish a planning process that can be repeated even after the study duration so that the CMP and regional masterplans can be regularly updated and kept as live documents. In this regard, the CMP was developed with ownership by AUDA-NEPAD and the Power Pools, predicated upon three complimentary activities:

- capacity building through training,
- development of CMP models, and
- extensive stakeholder consultations and validation of deliverables.

## Resources assessment

The resources assessment was conducted to characterise the existing and committed power generation plants and assess Africa's electricity generation resource potential. Today, natural gas fired power plants account for almost half (46.5%) of the total installed capacity and coal fired plants capacity for almost 23% of the installed capacity in Africa. Overall, fossil fuel fired plants account for 77% of the installed capacity on the continent.

The evaluation of the potential for generating energy from existing and new resources in Africa resulted in estimating the capacity for renewable and non-renewable energy. The continent possesses abundant resources of fossil fuels and renewable energy sources that can be utilized for generating electricity. In particular, the extensive renewable energy resources in Africa hold significant potential for further expansion and growth.

## Demand projections

The CMP Reference Demand Forecast is closely aligned to the baseline demand forecasts contained in country documents and Power Pool masterplans. It projects that Africa needs to meet a total of 2,368 TWh in electricity demand by 2040 (corresponding to an increase of 1,490 TWh from today). This represents an average annual growth rate of 5.4% until 2040.

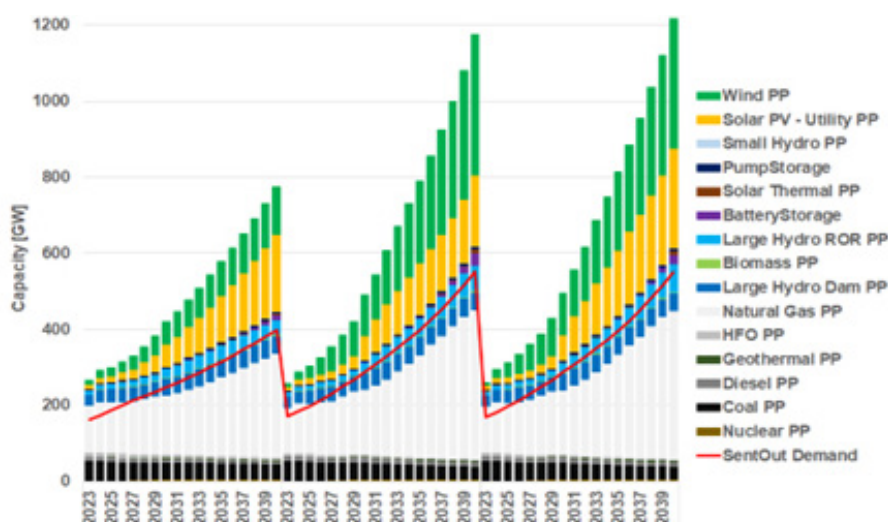
Additional demand scenarios were developed to assess the pathway towards universal electricity access and economic development, with the ultimate goal of transitioning African countries from their current income levels to higher income categories. In the CMP Medium Growth Rate Demand Forecast scenario the electricity demand in Africa is expected to grow at an average annual growth rate of 8.3%, reaching 3,976 TWh in 2040.

## Generation and transmission capacity expansion and trade

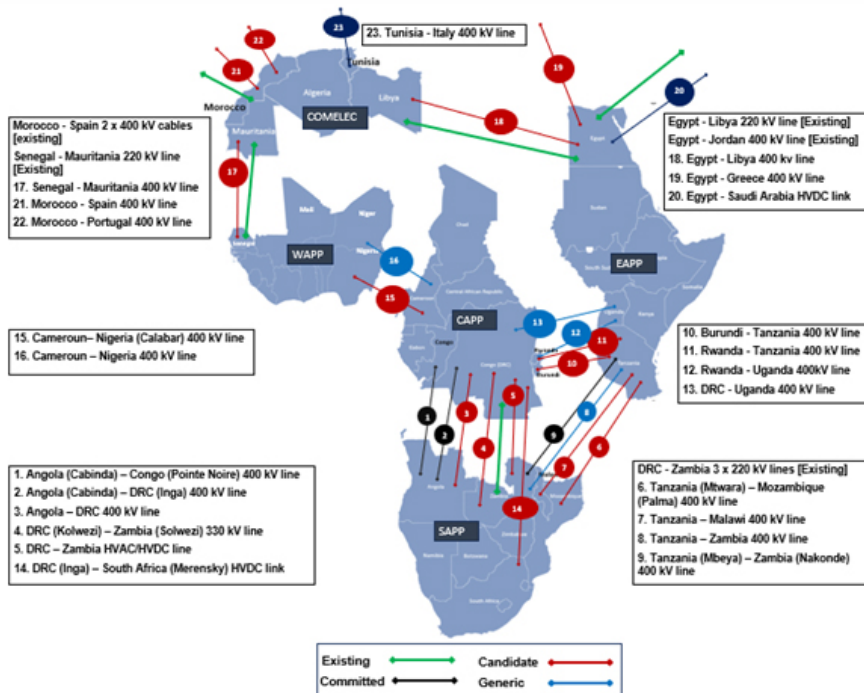
Results from the SPLAT-Africa model developed for generation and transmission expansion optimisation indicate that, at the continental level, the total installed capacity is projected to increase from 266 GW in 2023 to 775 GW, 1,176 GW and 1,218 GW in 2040 for the Baseline, Regional and Continental scenarios, respectively.

By 2040, the generation mix in the continent is expected to be more diversified with the commissioning of more renewables, mainly wind and solar PV plants. However, natural gas is still expected to remain the dominant technology given its strategic role as a transition technology in the future greening of the continental power sector.

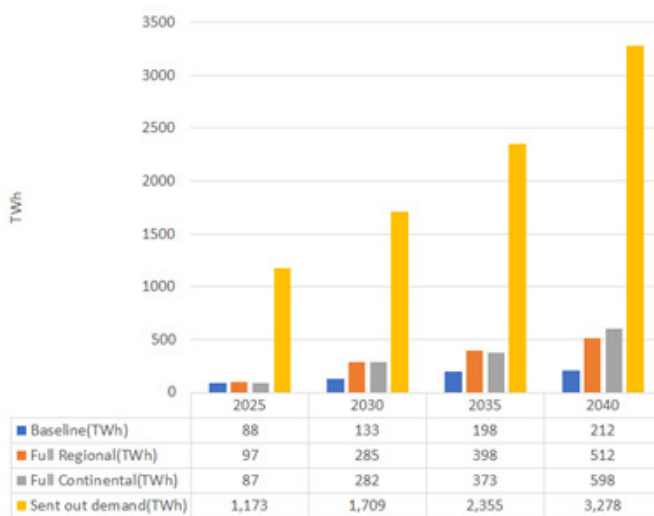
*Continental total installed generation capacity*



Selected inter-regional existing, committed, candidate and generic interconnectors



Continental Annual trade volumes



Substantial investment is necessary, estimated cumulatively at USD 1.29 trillion, which could result in the creation of a strong continental electricity market valued at around USD 136 billion annually by 2040. The total CO2 emissions intensity from electricity generation in Africa is expected reduce to around 26% of its current level by 2040.

## Transmission network analysis

Transmission network analysis formed a crucial part of the CMP development process by assessing the adequacy of the country backbone transmission networks to transport power from the identified generation sources to the demand centres. By 2030, it is expected that the COMELEC, EAPP, SAPP and CAPP regional electricity grids will be interconnected. By 2040, all five regional power pools are expected to be interconnected, with CAPP interconnecting to SAPP, EAPP and WAPP. In addition, EAPP will interconnect to SAPP and COMELEC, and COMELEC will interconnect to WAPP.



The transmission development plan comprises both intra- and inter- regional interconnectors recommended from the SPLAT-Africa optimisation model and findings from the network analysis. It was concluded that the interconnector capacity utilisation selected in the SPLAT-Africa model is technically feasible and that additional backbone strengthening is required for few countries under system healthy conditions.

## Key recommendations

- The integrated approach applied is more beneficial compared to isolated national approaches
- Developing forward-thinking, cost-effective and climate-friendly expansion plans for energy systems is a high priority on the national agendas of most African countries
- Africa has immense potential for generating renewable energy, which presents a compelling economic argument for transitioning to renewable sources. This transition not only offers the opportunity to create new jobs but also contributes to a greener future.
- The development and deployment of renewable energy must be prioritised and emphasized, particularly in rural and remote areas where grid extension may pose challenges and incur high costs.
- It is crucial to identify the most beneficial of the CMP generation and transmission projects and expedite the necessary preparatory studies to enhance their feasibility and attract financial investment.

## Implementation of the CMP and connection with AfSEM

The CMP integrates the vision of the AU as expressed in various Ministerial meetings, including the AfSEM, the AfDB New Deal for Energy in Africa and the concept of Clean Energy Corridors. The CMP will be the blueprint of the AfSEM and will act as the central pillar to solve Africa's energy challenge. The CMP will enable the realization of the AfSEM, allowing electricity to be sourced from the most competitive suppliers within Africa, making a significant step towards achieving a more integrated and prosperous Africa.

The synergy and complementarity of the AfSEM and the CMP are evident, as the former will ensure adequate and efficient market-based mechanisms for trading, and the latter will identify the key priority generation and transmission interconnector projects (physical or "hard" infrastructure) that will enable the cross-border trading. The AfSEM and CMP implementation would enable the continent to optimize the use of its abundant renewable energy resources to achieve universal access to electricity for the African people in line with the AU's Agenda 2063 and the United Nations' Sustainable Development Goal (SDG 7).

In September 2023, the Ministerial decision-making organ of the AU for the energy sector officially adopted this CMP synthesis deliverable and CMP and AfSEM were recognized as AU Agenda 2063 Flagship Projects. Africa's first CMP will be submitted to the AU Heads of State Summit for endorsement in 2024.

