

Integrated Continental Demand Forecasts-Scenario Analysis

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

Due to the uncertainty inherent in electricity demand forecasts, the main objective of the current study (Part 2 of demand forecast) was to develop a number of scenarios in addition to the base case (Part 1) over a range of potential outcomes that have implications for the socio-economic development of African countries, so that the power pools and their member utilities can effectively plan for the different future possibilities.



METHODOLOGY

To establish a common continental methodology for demand forecasting, the power pools decided to use the econometric approach, which will enable power pools and their member utilities to understand the relationship between demand drivers and future demand projections. The study used scenario and sensitivity analysis to explore the potential outcomes. The high case scenario reflects an ambitious outlook for accelerated economic growth, universal access by 2030, and improved living standards in African countries. Correspondingly, universal access is aimed to be reached by 2035 in the medium case scenario and 2040 in the low case scenario. It is important to note that forecasting electric load is a complex task and achieving 100% accuracy is rare. Scenario and sensitivity analysis help mitigate uncertainty and guide investment decisions.

Impact of scenario analysis on key demand drivers

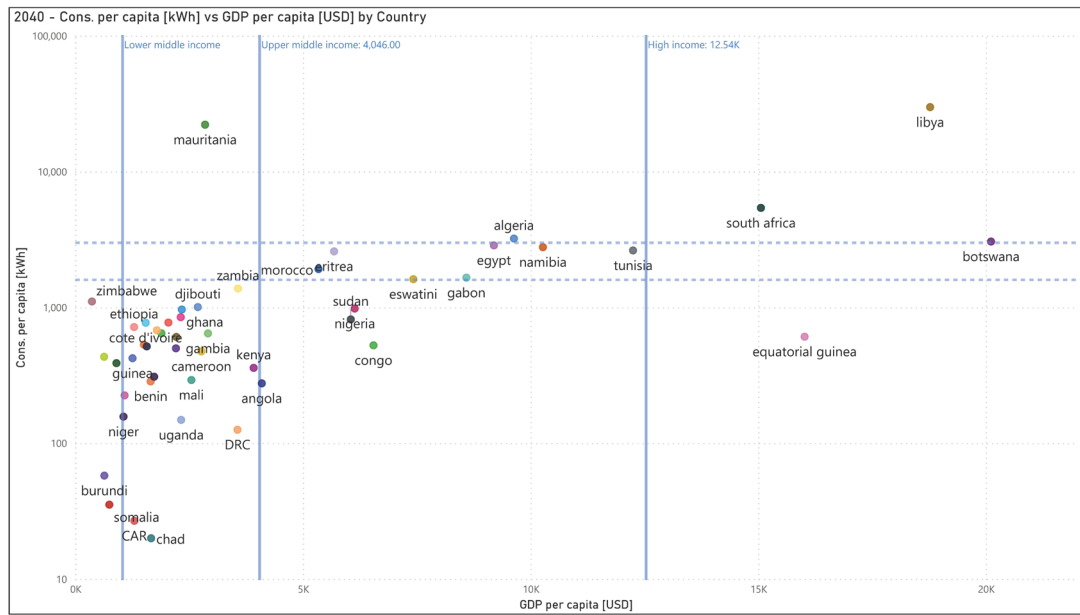
GDP PER CAPITA AND ELECTRICITY CONSUMPTION PER CAPITA

The power pool reference data for 2019 reveals that most African economies have low GDP per capita and low electricity consumption, which reflects their low-income status. This is mainly due to limited economic activities and an overdependence on commodities like oil and diamonds. Additionally, only a few upper middle-income countries have an annual per capita electricity consumption rate between 1,000-3,000 kWh.

Looking ahead to 2040, the forecast results of the power pool reference and CMP base cases show that most African countries are expected to remain in the lower middle-income category with low electricity consumption per capita. The average GDP per capita and electricity consumption per capita are projected to stay low at 5,200 USD and 1,091 kWh per person per year, respectively.

By the year 2040, Africa is projected to have significantly lower GDP per capita and electricity consumption per capita than the global average of USD 12,263 and about 3,000 kWh, respectively. The additional scenarios highlight the level of effort required for African economies to transition from lower to higher income levels. Based on the high scenario results depicted in Figure 1, most African countries are expected to move up to the next income level by 2040, with many reaching upper middle-income status. The average electricity consumption per capita is also predicted to increase to 3,506 kWh, which is in line with the global average.

Figure 1: GDP per capita vs Consumption per capita (2040)

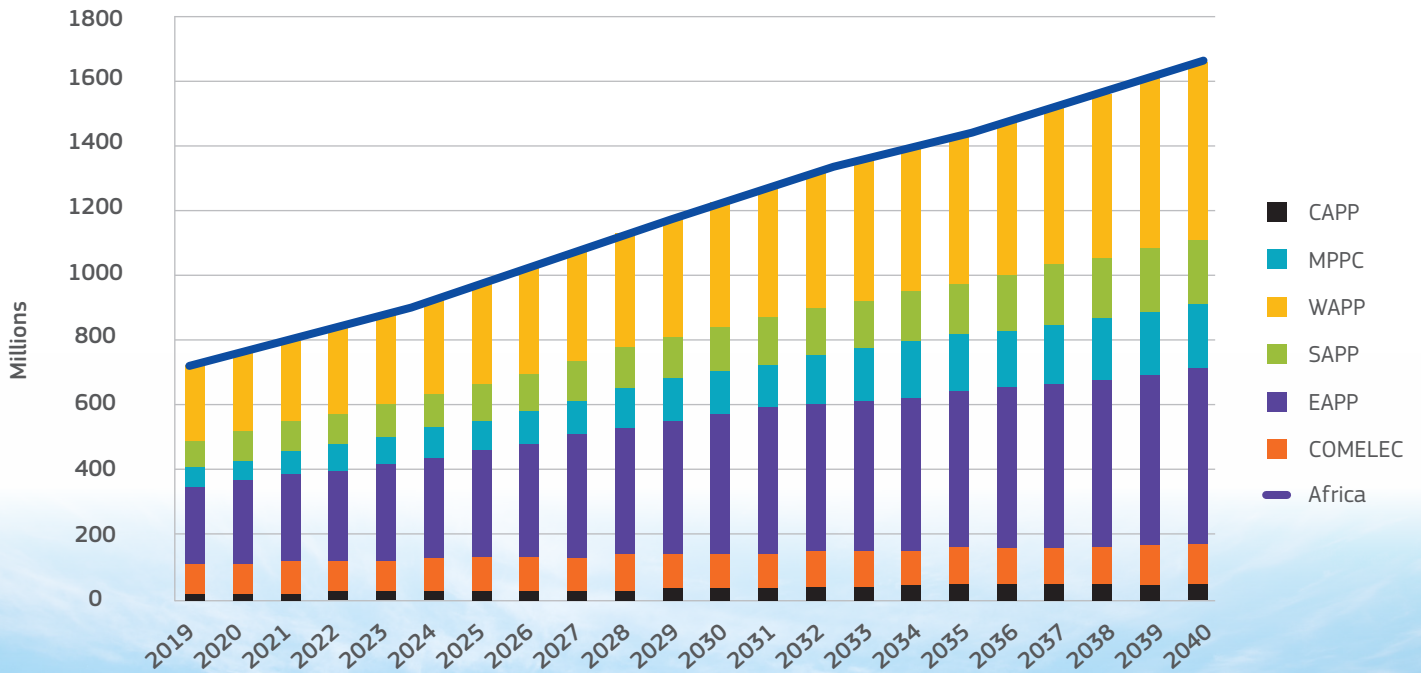


ELECTRICITY ACCESS

In 2019, Africa’s total population stood at 1.277 billion based on UN population data. Of these, only 56.1% had access to electricity. This means half of Africa’s population have no access to electricity and thus cannot develop effectively. Based on the UN 2019 data, Africa’s population is projected to reach 2.026 billion by the year 2040, with results from the CMP base case showing that 82% of this population will have access to electricity.

According to the reference and CMP base case scenarios, it is improbable for Africa to achieve universal access to electricity and uplift its economy from low-income levels to higher income levels by 2040. However, based on the scenario analysis to meet SDG 7 and AU’s Agenda 2063 targets, universal electricity access is projected to be attained by 2030 under the high scenario, 2035 under the medium scenario, and 2040 under the low scenario.

Figure 2: Electricity Access in Africa (2019-2040)



SCENARIO ANALYSIS

1.1.1 Electricity demand scenarios (TWh)

- High Case: It is projected that the demand for Africa will grow from 873 TWh in 2021 to 4,445 TWh in 2040 at an average growth rate of 8.9%. The growth in all cases is mainly driven by EAPP, SAPP and WAPP regions.
- Medium Case: It is projected that the demand for Africa will grow from 873 TWh in 2021 to 3,976 TWh in 2040 at an average growth rate of 8.3%.
- Low Case: It is projected that the demand for Africa will grow from 873 TWh in 2021 to 3,518 TWh in 2040 at an average growth rate of 7.6%.

1.1.2 Peak Demand Scenarios (GW)

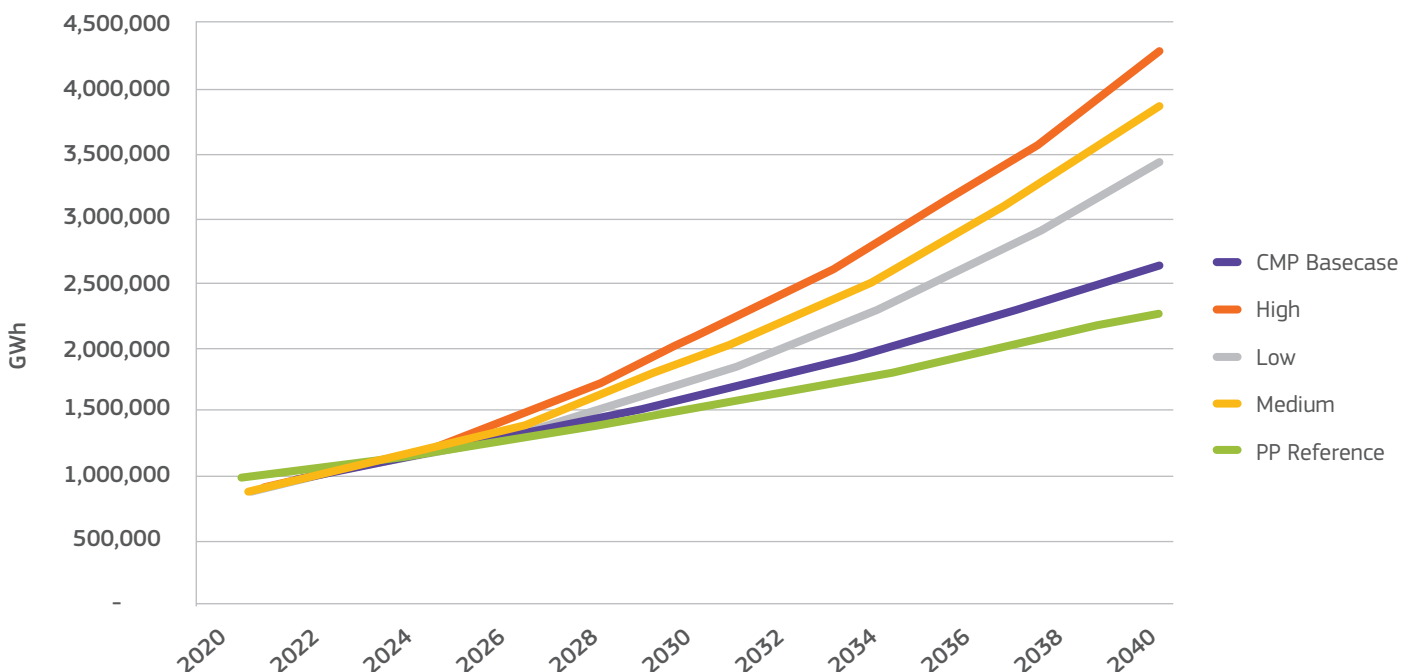
- High Case: For the entire African continent, it is projected that peak demand will grow from 160 GW in 2021 to 716 GW in 2040 representing an average growth rate of 8.2%. EAPP, SAPP and WAPP are the largest contributors to this growth with an average growth rate of 8.8%, 7.1% and 11.5% respectively.
- Medium Case: For the entire African continent, it is projected that peak demand will grow from 160 GW in 2021 to 634 GW in 2040 representing an average growth rate of 7.5%. EAPP, SAPP and WAPP are the largest contributors to this growth with an average growth rate of 8.3%, 6.1% and 10.7% respectively.
- Low Case: For the entire African continent, it is projected that peak demand will grow from 160 GW in 2021 to 555 GW in 2040 representing an average growth rate of 6.7%. EAPP, SAPP and WAPP are the largest contributors to this growth with an average growth rate of 7.6%, 5.0% and 9.9% respectively.

The results of the scenario analysis indicate that merely using the econometric approach alone is not sufficient for countries with low economic and electricity consumption levels to achieve the electricity consumption and access goals of Agenda 2063.

ELECTRICITY DEMAND (TWh) GAP ANALYSIS – SUMMARY OF BASE CASE, HIGH, MEDIUM AND LOW CASE SCENARIOS

How is electricity demand projected to grow at the continental level?

- **High Case:** from 878 TWh in 2021 to 4,283 TWh in 2040 (additional 2,050 TWh and 1,638 TWh vs Reference and Base case in 2040 respectively) representing an average annual growth rate of 8.7% compared to 6.0% and 4.5% in the Reference and Base case scenarios respectively over the CMP planning period.
- **Medium Case:** from 878 TWh in 2021 to 3,842 TWh in 2040 (additional 1,609 TWh and 1,197 TWh vs Reference and Base case in 2040 respectively) representing an average annual growth rate of 8.1%.
- **Low Case:** from 878 TWh in 2021 to 3,421 TWh in 2040 (additional 1,189 TWh and 776 TWh vs Reference and Base case in 2040 respectively) representing an average annual growth rate of 7.4%.



The energy demand in Africa is expected to witness substantial growth in the coming years. The WAPP and EAPP regions are estimated to grow at an average of 12.6% and 9.9%, respectively, under the high scenario. While the WAPP region has the highest growth rate, the EAPP region is anticipated to contribute the most to the continent's energy demand. Ethiopia and Egypt are the main drivers behind the EAPP region's energy demand, which is expected to reach 1,968 TWh by 2040. The SAPP region's energy demand also plays a crucial role in Africa's growth, increasing to 1,061 TWh by 2040. Meanwhile, the WAPP region is projected to reach 931 TWh by 2040.



PEAK DEMAND (GW) GAP ANALYSIS – SUMMARY OF BASE CASE, HIGH, MEDIUM AND LOW CASE SCENARIOS

How is peak demand projected to grow at the continental level?

- **High Case:** from 160 GW in 2021 to 715 GW in 2040 (additional 344 GW and 280 GW vs Reference and Base case in 2040 respectively).
- **Medium Case:** from 160 GW in 2021 to 633 GW in 2040 (additional 262 GW and 198 GW vs Reference and Base case in 2040 respectively).
- **Low Case:** from 160 GW in 2021 to 554 GW in 2040 (additional 183 GW and 119 GW vs Reference and Base case in 2040 respectively).

This growth will mainly be driven by countries in WAPP, EAPP and SAPP regions whose peak demand is projected to grow at an average of 11.5%, 8.8% and 7.2% respectively under the high scenario. EAPP region is expected to have the highest contribution to the continent's peak demand requirements with demand under the high scenario forecasted to reach 289 GW by 2040 largely driven by Ethiopia and Egypt. SAPP and WAPP regions are forecasted to reach 202 GW and 164 GW by 2040 in the high scenario mainly driven by South Africa and Nigeria respectively.

