EU Global Technical Assistance Facility (TAF)
for the Sustainable Energy

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Resource Assessment and Techno-economic Data and Assumptions

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)**.

This report, developed with support from the European Union - Global Technical Assistance Facility (EU-GTAF), provides reasonable estimates of existing, priority and potential generation resources as well as the techno-economic data and assumptions. These are inputs into the System Planning Test (SPLAT-Africa) capacity expansion model as well as the Power System Simulator for Engineering (PSS®E) model to allow energy planners to determine the least cost supply scenarios and sustainable investments for a reliable and secure interconnected power system.

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.

Resource assessment

OBJECTIVE

To carry out an assessment of the electricity generation resource potential in Africa and ascertain its ability to supply the growing demand.

METHODOLOGY

Consolidation of results from previous studies done by power pools and other key institutions active in the Africa energy sector. Consultation and bilateral verification process. Selection of the SPLAT-Africa model developed by the International Renewable Energy Agency (IRENA) based on the MESSAGE software of the International Atomic Energy Agency (IAEA), as the preferred tool for generation expansion planning. The techno-economic assumptions and data addressed the modelling needs for the existing, committed and candidate power plants.

Key findings

1. The share of non-renewable technologies (coal, gas, fuel oils, nuclear) to the overall installed (as of December 2020) continental generation capacity of 230.4 GW is about 78%, while the contribution from renewable energy resources is about **22%**.

2. The compounded annual growth rate (CAGR) for the 2000-2020 period in generation capacity expansion in Africa was about **5.2%**. There was a steady increase in investments in generation capacity expansion in Africa since the late 1980s, becoming sharper since 2010. However, these investments have not been evenly distributed across the regions of the continent and most of the countries still have supply deficits, which become even more acute when the availability of capacity from the installed power plants is also taken into consideration.

3. The committed and candidate generation projects (in regional Power Pool masterplans for the next 10 to 20 years) will support the transition towards clean energy solutions. Based on the capacity of all specifically identified candidate generation plants, the contribution from non-renewable resources to the overall continental generation capacity could decrease **from about 78% in 2020 to about 52% in 2040**, while the contribution from renewable energy resources could increase **from about 22% in 2020 to about 48% by 2040** – The future generation mix is determined precisely in the scenarios of the optimization study.

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The continental baseline peak demand could grow by **about 100 GW by 2030**, from the demand of about 163 GW in 2020 and thereafter the demand could grow by an additional 150 GW to reach about 413 GW in 2040. In addition to the committed and candidate plants, new generation plants are needed to cover the gap that will be created by the decommissioning of ageing plants, which cannot be operated effectively and reliably.

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The expected CAGR (2021-2040) from committed and candidate projects is about **18%**. This increase of 13% for future capacity expansion is indicative of significant plans projected to ramp up generation capacity in Africa. This could however still be insufficient to meet the supply gap of 223GW projected by 2040, if the anticipated decommissioning of ageing plants is considered.

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The variable (solar PV and wind) renewable generation resource potential across the continent that has largely not been tapped presents opportunities for even more ambitious targets to promote the transition towards cleaner energy solutions. **Less than 2%** of the wind and solar generation potential had been exploited as of December 2020, and this points to vast opportunities for increasing renewable energy generation capacity in Africa. The identified solar and wind resources of about 7,470 GW are about **18 times** the continental baseline peak demand of 413 GW projected by 2040.

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The diversity of the generation resource potential (type, location and size) presents opportunities for regional and continental electricity trading with surplus generation from one country and region offsetting deficits in another and supporting network operation flexibility. This will mitigate the need for load shedding in some countries at the same time that other countries may have unutilized generation capacity.

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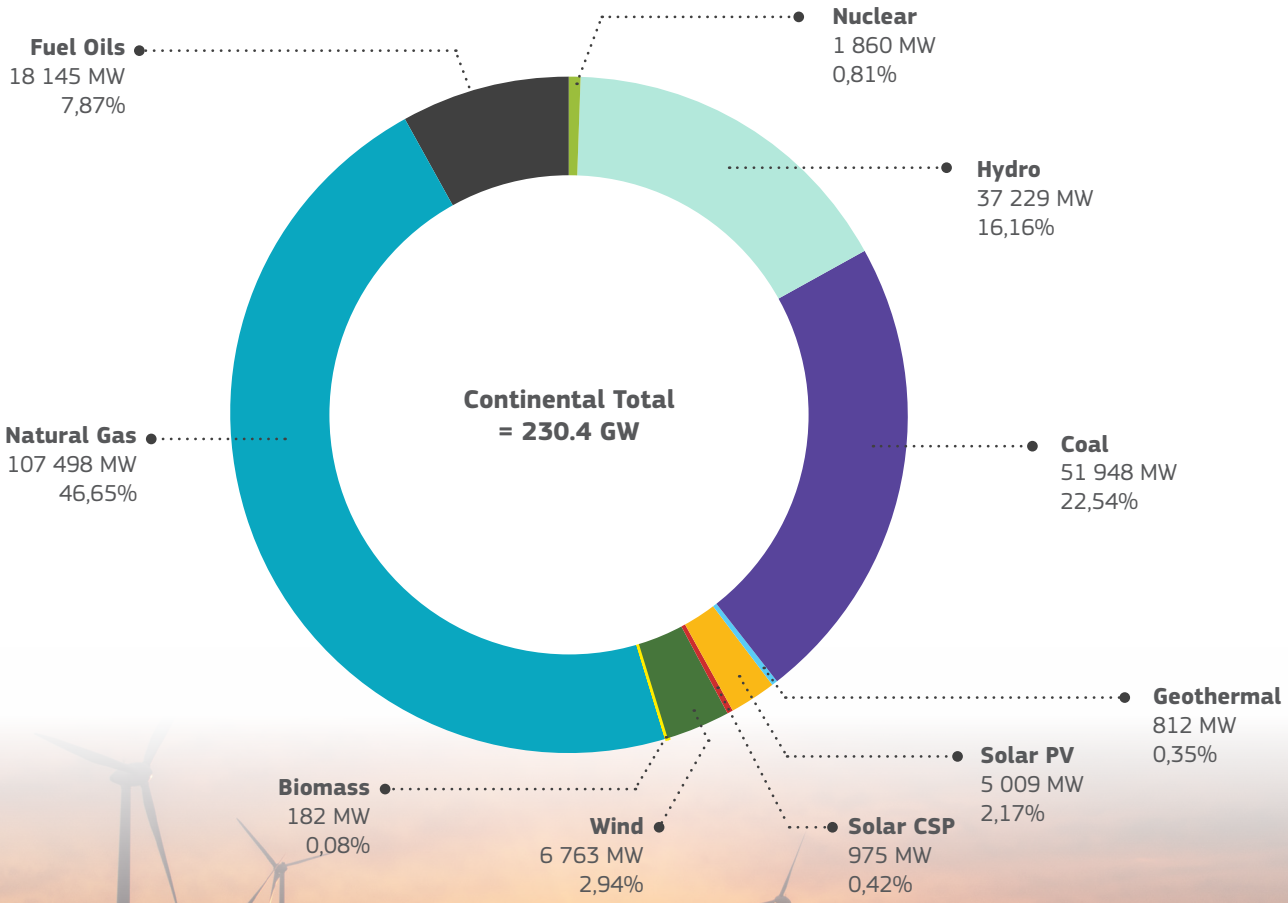
The optimised exploitation of the diverse resources on the continent in an integrated manner is aligned with the vision of the African Union that is articulated in the Agenda 2063 to create an integrated electricity infrastructure and promote trade within the framework of the Africa Continental Free Trade Area (AfCFTA) agreement.

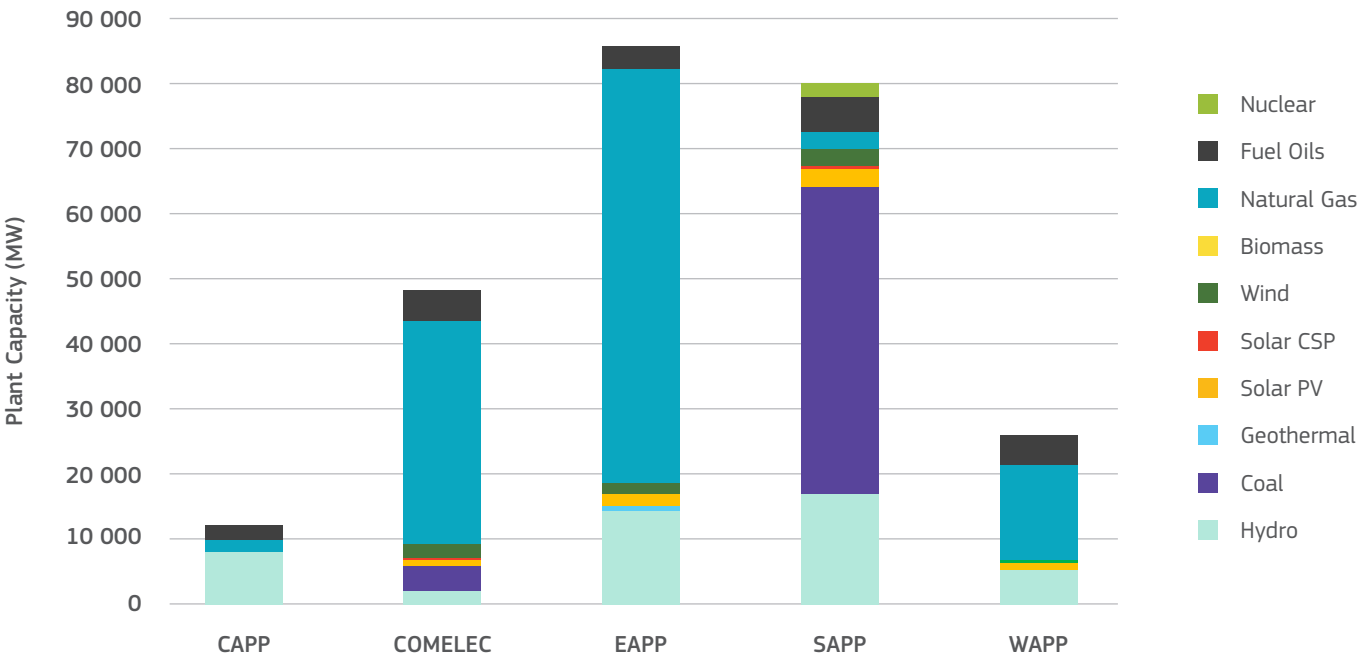
Installed generation capacity analysis

The installed generation capacity in Africa comprises a diverse set of technologies, which include both non-renewable and renewable energy resources. The total installed generation capacity on the continent was about 230.4 GW as of December 2020.

Continental generation capacity contribution per technology in 2020



Distribution of capacities per technology by each power pool at continental level in 2020

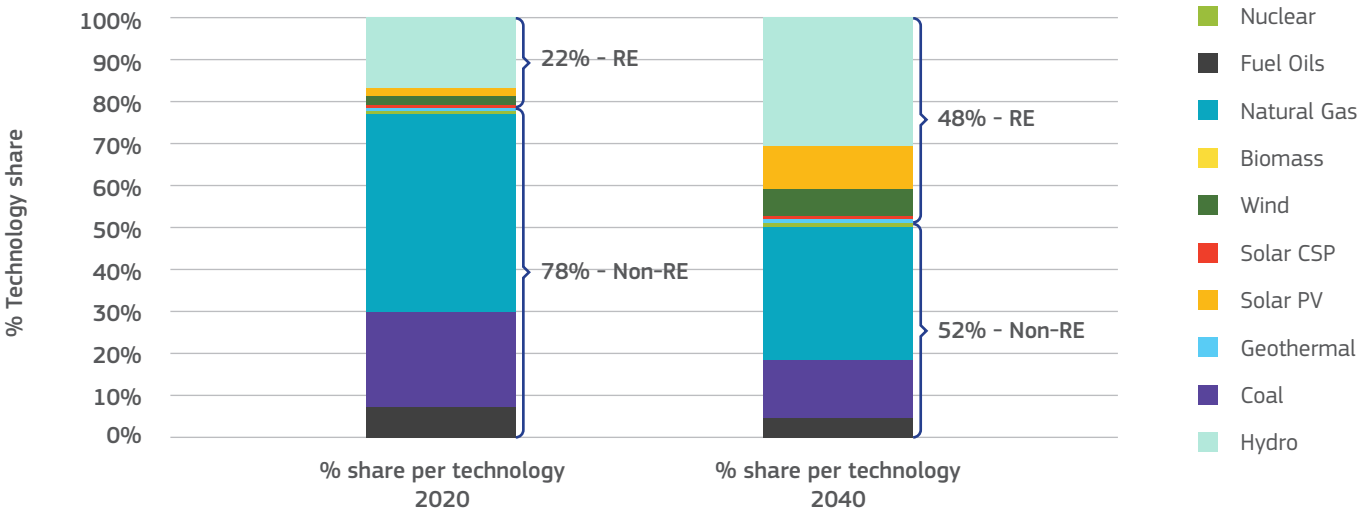


Despite a steady historical growth in investments, they have not been evenly distributed across the regions of the continent and most of the countries still have supply deficits.

Committed and candidate generation capacity analysis

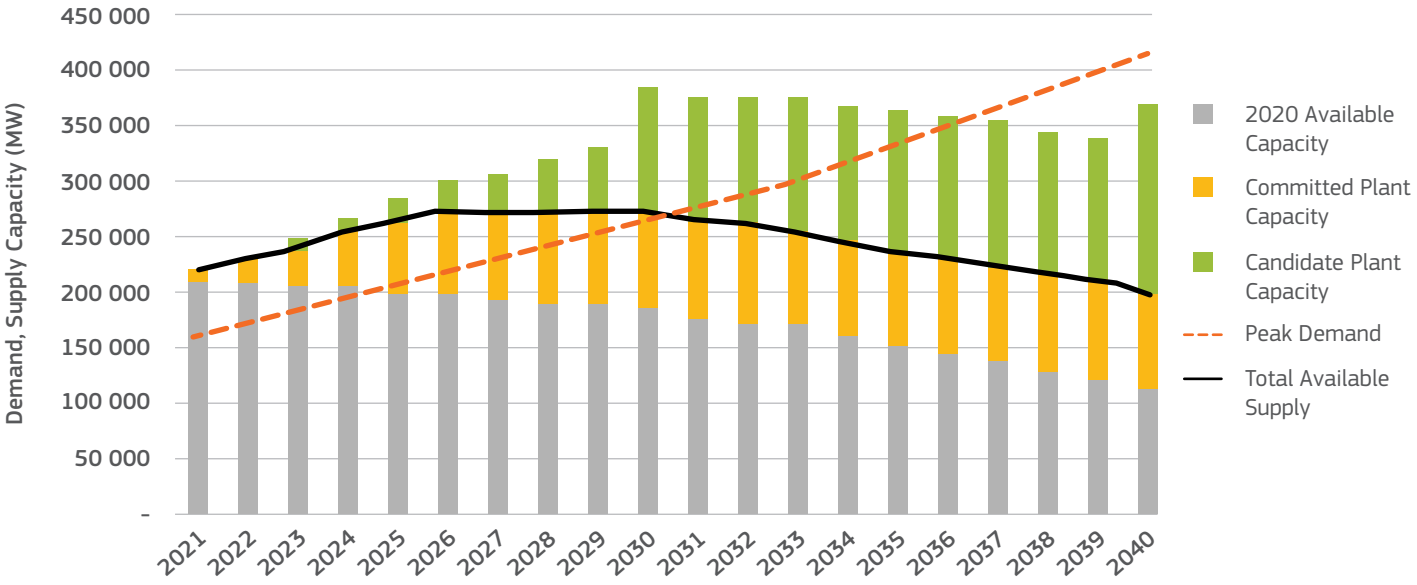
Capacity increase is expected from 2020 to 2040 due to committed and candidate projects.

Expected % change in technology shares in Africa from 2020 – 2040



Although there is generation excess between 2021 and 2031 (considering the installed and committed projects), many countries still have deficits and currently cannot benefit from the excess in their neighbors or excess in other regions due to the absence of interconnectors. The figure below also indicates that there could be a generation supply shortfall from 2031 to 2040 even if all the committed and candidate projects are commissioned.

Expected available future supply versus peak demand for Africa

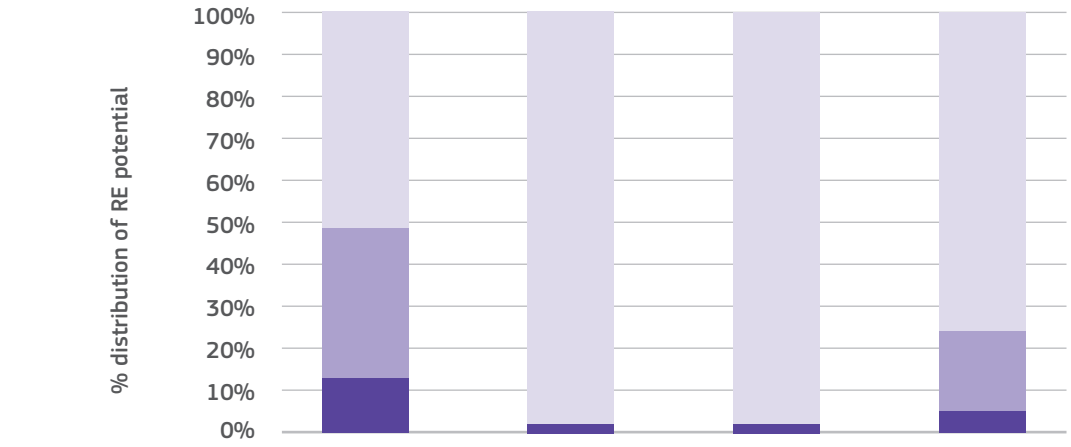


Projected supply excess/shortfall per power pools

Power Pool	Supply Shortfall/Excess (MW) - Year 2030	Supply Shortfall/Excess (MW) - Year 2040
CAPP	+ 458	- 15,500
COMELEC	+ 24,900	- 14,700
EAPP	+ 200	- 108,700
SAPP	- 5,880	- 66,550
WAPP	- 14,400	- 59,000
Continental Totals	**+ 5,278**	**- 264,450**

Generation resource potential analysis

Summary of installed, expected and unexploited RE resource potential in Africa



	Hydro	Solar PV	Wind	Geothermal
Unexploited Potential by 2040 (MW)	145 232	4723 365	2744 983	12 621
Expected Additional Capacity by 2040 (MW)	104 936	42 129	25 963	3 267
Installed Capacity (MW)	37 229	5 009	6 763	821
Potential Capacity (MW)	287 397	4770 503	2777 709	16 700