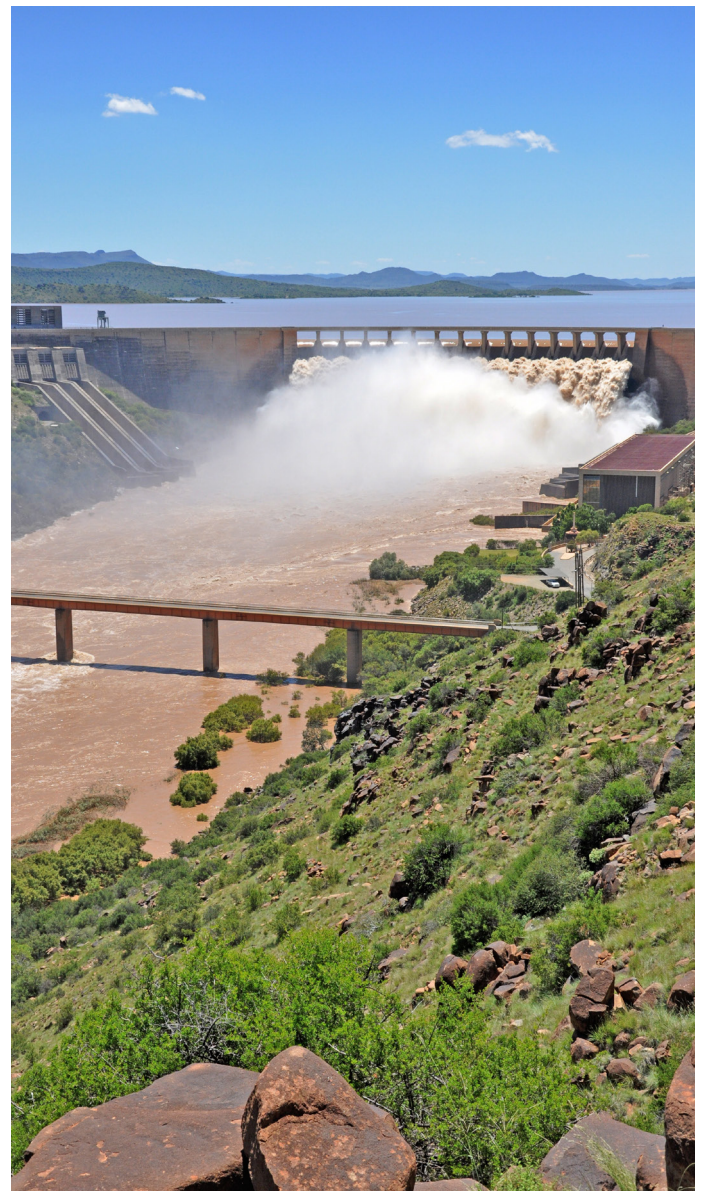


# A new spatial inventory of power plants shows Africa is stepping up in construction and planning up to 2030

## Africa power plant study forecasts increasing electricity production, water use and CO<sub>2</sub> emissions

### Key messages

- Africa is stepping up in planning and constructing additional power plants up to 2030, with renewables' share growing from 19% to 34%. However, the growth is not equal across the continent.
- IWMI researchers compiled a detailed spatial inventory of operational, under construction and planned African power plants from 2020 until 2030, covering 3,139 individual plants. They differentiate between three types of fossil fuels (coal, oil and gas), five renewables (hydropower, wind, solar, biomass and geothermal) and two other fuel types (nuclear and waste heat).
- They forecast a 57% increase in African electricity production, with related water use increasing 73% and CO<sub>2</sub> emissions increasing 19%. Especially the expansion in hydropower increases water use and puts additional pressure on scarce water resources in selected basins.
- Water intensity and carbon intensity of different fuel types need to be accounted for in planning additional power plants, to meet broader sustainability goals.
- Current and planned power plant construction falls slightly short of the commitments in the Nationally Determined Contributions (NDCs).
- The open access database and its detailed description is published in the high profile scientific journal *Nature Communications*<sup>1</sup>, freely available to all.
- Policies require nexus thinking to drive collaboration among sectors and institutions, accounting for different carbon and water intensities of energy sources.



Gariep Dam (South Africa) overflowing after abundant rain.  
(photo: Chris Jooste/Shutterstock)

# Summary

Africa needs to increase electricity production to improve electricity access. For informed decision making, there is a need for reliable, findable, high-quality, open access and spatially distributed power plant data with associated water use and CO<sub>2</sub> emissions amounts. IWMI presents a detailed spatial inventory of operational, under construction and planned African power plants from 2020 until 2030, covering 3,139 individual plants, the result of an intensive data mining effort. This inventory forecasts a 57% increase to 1,787,858 gigawatt-hours in electricity production from 2023 to 2030. Related water use and CO<sub>2</sub> emissions increase substantially. Africa is stepping up in planning and constructing additional power plants, with renewables' share growing from 19% to 34%. However, the increase in hydropower installations puts additional pressure on available water resources. Policies on the electricity system require nexus thinking to avoid unintended and costly consequences, by accounting for different carbon and water intensities of energy sources. This involves strengthening coordination and collaboration between different ministries and stakeholders, including at the transboundary level. It is essential that African countries secure investment and financing for their planned and under construction power plants.

## Africa needs to increase electricity generation, yet data for informed decision making are scarce

Many African countries have low electricity access rates<sup>2</sup>. Countries across Africa consequently need to increase electricity generation. Electricity generation requires water and emits CO<sub>2</sub>. Overall water demand across the continent is expected to rise substantially in the future<sup>3</sup>. So meeting rising water demands for electricity generation needs to occur in a sustainable way, considering the limited availability of water resources<sup>4,5</sup> as well as the demand of other sectors, including cities, agriculture<sup>6</sup>, industries and ecosystems<sup>3</sup>. Many African regions are already facing water scarcity<sup>4</sup> and meeting the future water needs of electricity generation will become more challenging. From a planning perspective, it is therefore important to understand countries' current and future water requirements for electricity generation to balance competing water uses.

There is, however, a persistent lack of reliable water data<sup>3</sup>, especially sectoral water demand data. For informed decision making, there is a need for reliable, findable, high-quality,

open access and spatially distributed power plant data with associated water use and CO<sub>2</sub> emissions amounts.

## IWMI's new African power plant inventory

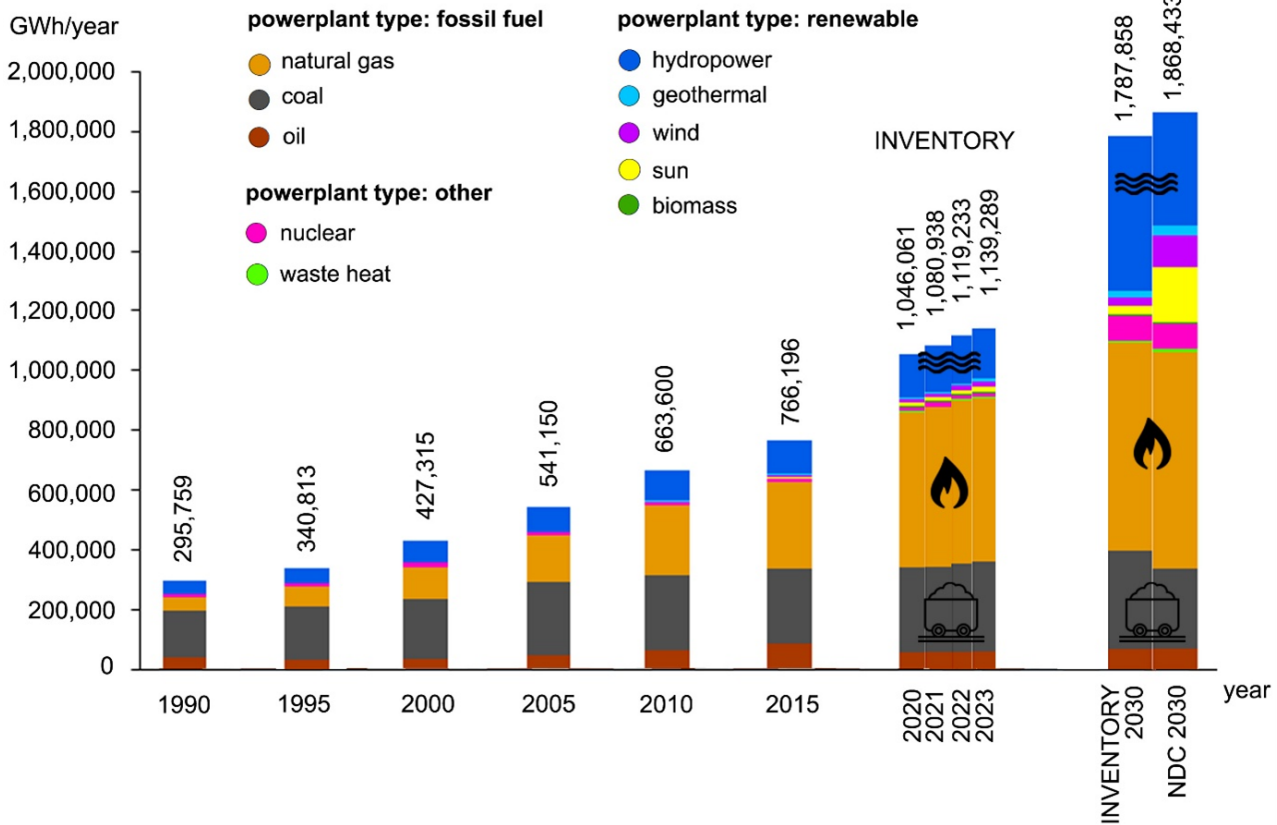
To address this gap, IWMI researchers collaborated with different partners to provide a spatial inventory of African power plants from 2020 until 2030, the result of an intensive data mining effort. The results and database are published and made available open access in the scientific journal *Nature Communications*.

### IWMI's new African power plant inventory

The inventory includes 3,139 operational, under construction and planned power plants from 2020 until 2030. Power plants are differentiated between fossil fuels (coal, oil and gas), renewables (hydropower, wind, solar, biomass and geothermal) and other fuel types (nuclear and waste heat). Each power plant has exact geographical coordinates and includes information on country, power plant name, year of operation, installed capacity (megawatt or MW), electricity generation (megawatt hour or MWh), water withdrawal, water consumption and CO<sub>2</sub> emissions.

## Africa is stepping up in planning and constructing additional power plants up to 2030

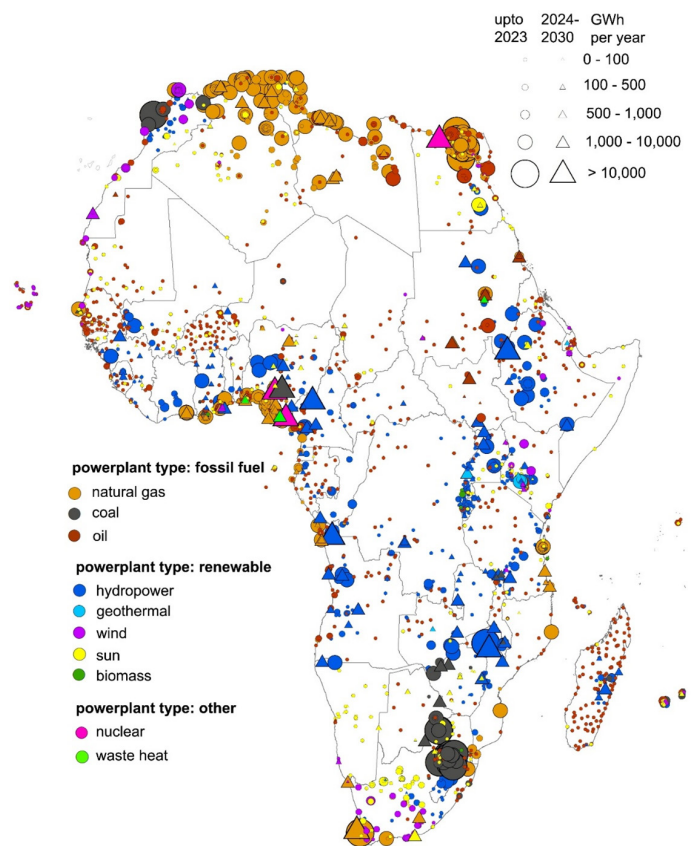
The researchers forecast an increase in electricity generation from 1,139,289 gigawatt-hours (GWh) in 2023 to 1,787,858 GWh in 2030 (+57%), with renewables' share growing from 19% (213,675 GWh) to 34% (599,220 GWh) of the total (Figure 1). Especially hydropower is projected to expand substantially (from 169,184 GWh to 517,501 GWh), whereas the other renewables combined grow from 44,491 GWh to 81,718 GWh. Fossil fuel power generation is also expected to increase, although at a slower pace compared to renewables. Gas-fired electricity generation is forecast to increase from 550,258 GWh to 693,476 GWh, oil-fired generation from 59,504 GWh to 73,051 GWh and coal-fired generation from 298,509 GWh to 331,593 GWh. Egypt and Nigeria plan the construction of nuclear power plants, which would grow nuclear power generation from 13,668 GWh (current South African Koeberg nuclear power plant north of Cape Town) to 84,213 GWh.



**Figure 1.** Electricity generation (in GWh per year) in Africa from 1990 to 2030 for the new inventory (INVENTORY) as well as for the Nationally Determined Contributions (NDCs) in 2030. Total amounts are shown as well as amounts per powerplant (fuel) type

The 2030 forecast is higher than what would be expected from past electricity generation growth from 1990 (295,759 GWh) to 2020 (1,046,061 GWh)(Figure 1). Africa is thus stepping up in planning and constructing additional power plants up to 2030. Not all countries are contributing equally; some drive this increase, while others lag behind. The Nationally Determined Contributions (NDCs)<sup>7</sup> of African countries amount to 1,868,433 GWh in 2030 (Text box 2). This means current power plant construction up to 2030 as determined by the new inventory (1,787,858 GWh) falls slightly short of meeting commitments in the NDCs. Additional power plants should be constructed up to 2030 to meet the NDC commitments, especially solar and wind power plants (Figure 1).

Countries that drive electricity generation increases in the inventory include Nigeria, Egypt, the DRC, Ethiopia, South Africa, Algeria and Mozambique, with large hydropower, nuclear or gas-fired power plant projects (Figure 2). Countries that invest substantially in wind and solar expansion include Morocco, South Africa, Egypt, Namibia, Ethiopia, Kenya and Ghana. The rift valley countries of Kenya, Ethiopia, Uganda and Tanzania invest in the expansion of geothermal energy. Countries where almost no additional power plants are planned or constructed include Somalia and Eritrea, although only small fractions of their population currently have electricity access. These countries are characterized by unstable governments and institutions or conflict.



**Figure 2.** Map of the new power plant inventory displaying plant specific annual electricity generation in GWh per fuel type for existing power plants (up to 2023, displayed as circles) and new power plants from 2024 to 2030 (displayed as triangles). The size of the symbols relates to the amount of electricity generation.

## BOX 2: Nationally Determined Contributions (NDCs) of African countries

Nationally Determined Contributions (NDCs) are national climate action plans under the Paris Agreement, where countries outline efforts to reduce emissions and adapt to climate impacts. Updated every five years, these pledges aim to limit global temperature rises to 1.5°C–2°C. IWMI researchers find that African countries pledged an increased electricity generation to 1,868,433 GWh in 2030, whereas actual construction and planning identified in the inventory amount to an increase up to 1,787,858 GWh. The electricity generation per power (fuel) type also differs between the inventory and the NDCs (Figure 1). In the inventory, 61% is produced by fossil fuels, 34% by renewable energy and 5% by other sources. For the NDCs, 57% is produced by fossil fuels, 38% by renewable energy and 5% by other sources. For the renewables, considerably more power is produced from hydropower in the inventory compared to the NDCs. For solar and wind it is the opposite. This means African countries need to scale up solar and wind expansion to meet the NDCs. As solar and wind projects require relatively short construction times (average 1 to 2 years), not all projects will be identified in inventory up to 2030.

### The water use and CO<sub>2</sub> emissions of power plants

Power plants need water while emitting CO<sub>2</sub> to generate electricity. Water scarcity can constrain electricity generation. For instance, thermal, including nuclear power plants, use water for cooling, hydropower needs water to move its turbines, and solar panels need water for cleaning<sup>8,9</sup>.

There is a large difference in water intensity (the amount of water required to produce a unit of energy) between different energy sources (Text box 3). On average, in Africa, reservoir hydropower has the highest water intensity, fossil fuels are in the mid-range and the renewables wind and solar have the lowest water intensities<sup>10</sup>. Freshwater is a limited resource and its use by different sectors, including the energy sector, leads to water scarcity in many places around the world<sup>4</sup>. It is therefore important to have insight into the current and future water requirements for electricity generation within a country.

Total African water withdrawal is forecasted in the inventory to increase from 38,255 Mm<sup>3</sup> in 2023 to 66,235 Mm<sup>3</sup> in 2030, especially due to hydropower expansion (Figure 3). This includes some large hydropower projects which take many years to construct, such as the Inga Power Stations on the downstream part of the Congo River or the Mambilla power

plant in Nigeria. In river basins such as the Volta and the Nile, this puts additional pressure on already stressed water resources. In other basins such as the Congo, hydropower expansion does not result in water scarcity as water resources are abundant for current water demands.

Hydropower, while a renewable electricity source, is one of the major causes of the decline in freshwater biodiversity<sup>11,12</sup>. Almost one in three freshwater species is threatened with extinction, which is consistently higher than for their terrestrial counterparts<sup>13</sup>. Freshwater biodiversity includes fish, important for local food security, but also amphibians and large animals such as crocodiles and hippos, important for income from wildlife tourism.

Hydropower is also vulnerable to droughts and floods, aggravated by climate change. The drought throughout 2024 in Southern Africa has plunged Zambia into daily blackouts, as the reservoir of the Kariba hydroelectric dam had not enough water<sup>14</sup>.

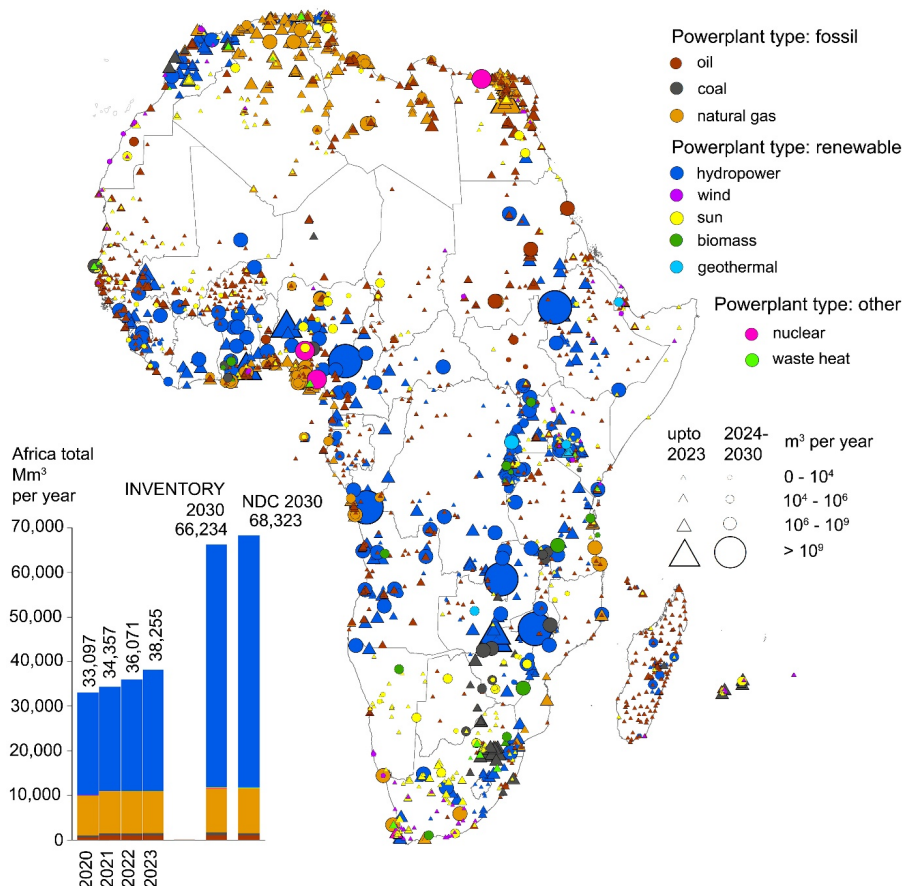
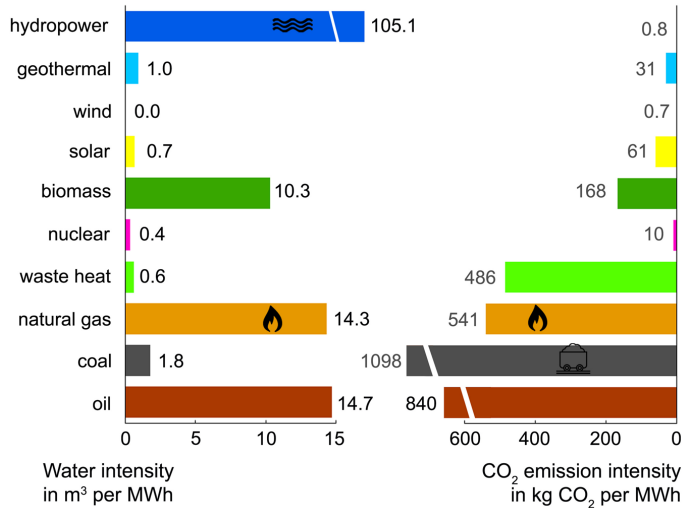
Gas-fired power plants account for a substantial portion of current and future water withdrawal, as their water intensity is rather high (14 m<sup>3</sup> per GWh, Figure 3). The inventory shows a low increase in water withdrawal for the renewables solar, wind and geothermal, as their water intensities are very low.



Wind turbines in the park of Boujdour in Morocco (photo: Castling Short/shutterstock)

### BOX 3: The average African water intensity and CO<sub>2</sub> emissions (or carbon) intensity of different fuel types

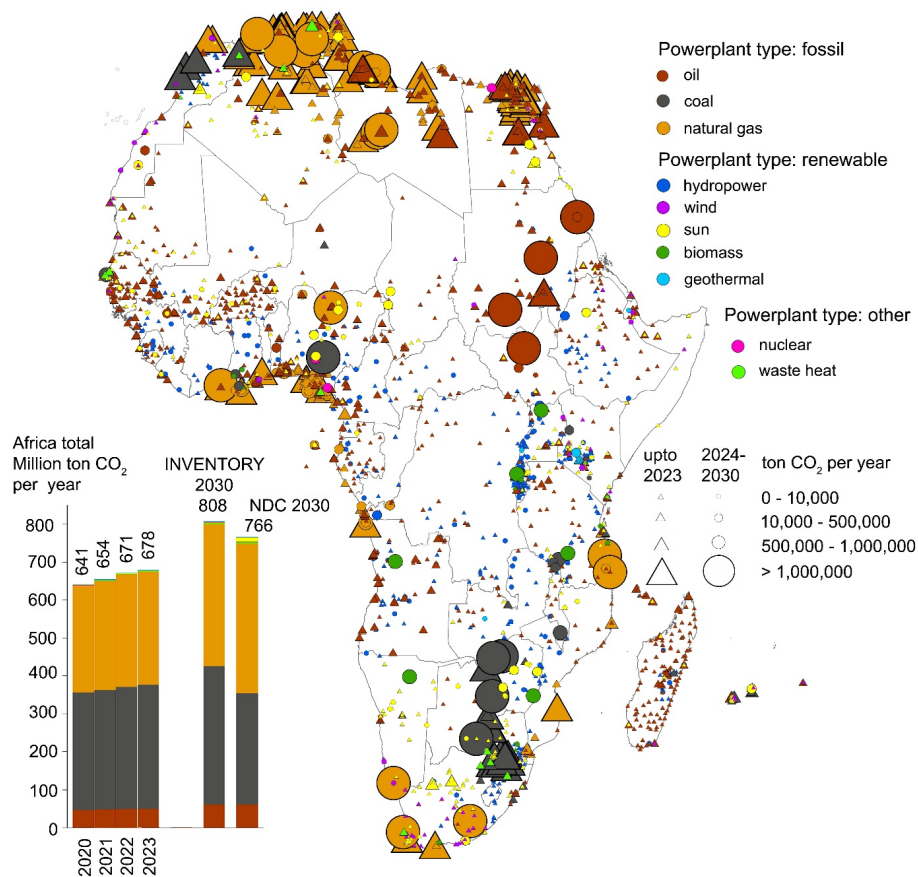
The water intensity is the amount of water required to produce a unit of energy. The CO<sub>2</sub> emissions or carbon intensity is the amount of CO<sub>2</sub> emitted to produce a unit of energy. For the expansion of electricity generation, both need to be accounted for. As fossil fuels have much larger CO<sub>2</sub> emissions intensities than renewables, they need to be phased out to be able to meet the Paris Agreement. Of the renewables, hydropower has a large water intensity of 105 m<sup>3</sup> per MWh electricity generated, resulting in large water use increases throughout Africa up to 2030, due to ongoing and planned hydropower expansion. The renewables wind, solar and geothermal have both low water and carbon intensities, making them good choices for electricity generation expansion. The potential for wind and solar is huge in Africa, the cost of both has decreased substantially and their average construction time of one to two years is relatively short. Nuclear has also low water and carbon intensities, but nuclear power is costly and requires long construction times.



**Figure 3.** Map of the new power plant inventory (INVENTORY) displaying plant specific annual water withdrawal in m<sup>3</sup> per fuel type for existing power plants (up to 2023, displayed as triangles) and new power plants from 2024 to 2030 (displayed as circles). The size of the symbols relates to the amount of water withdrawn. The bottom-left figure shows the increase in total water withdrawal amounts for Africa for the years 2020 to 2030 for the inventory as well as for the NDCs in 2030.

The generation of electricity also has an impact on climate change, due to related CO<sub>2</sub> emissions, especially when fossil fuels are used. The inventory forecasts an increase in CO<sub>2</sub> emissions from 678 million ton in 2023 to 808 million ton in 2030, mainly due to the expansion in coal-fired and gas-fired power plants throughout Africa (Figure 4). Large gas-fired power plants are being constructed and are planned in countries such as Algeria, Libya, Nigeria, Tanzania, and South Africa. Large coal-fired power plants are constructed and planned in Nigeria, Zimbabwe, and

Botswana, although their carbon intensity is the highest among all fuel types. The NDCs result in lower CO<sub>2</sub> emissions of 766 million ton in 2030, especially due to lower emissions from coal-fired power plants. In the inventory, emissions from coal-fired power plants increase from 326 million ton in 2023 to 364 million ton in 2030, whereas in the NDCs there is a decrease to 293 million ton in 2030. In the NDCs selected plants are decommissioned, such as the Grootvlei, Kelvin, Majumba and Tutuka plants in South Africa.



**Figure 4.** Map of the new power plant inventory (INVENTORY) displaying plant specific CO<sub>2</sub> emissions in ton CO<sub>2</sub> per fuel type for existing power plants (up to 2023, displayed as triangles) and new power plants from 2024 to 2030 (displayed as circles). The size of the symbols relates to the amount of CO<sub>2</sub> emitted. The bottom-left figure shows the increase in total CO<sub>2</sub> emissions for Africa for the years 2020 to 2030 for the inventory as well as for the NDCs in 2030.

## Recommendations for stakeholders including policy makers

Policies related to power systems need to embed nexus thinking. They need to account for water and carbon intensities of different energy sources, as well as local water availability and the water demand of other sectors. Hydropower, for example, is vulnerable to increased and intensified drought events due to climate change and can negatively affect freshwater biodiversity. To successfully implement the net-zero ambition in the energy sector, additional expansion in energy sources such as solar and wind is a win-win in many settings across the continent. Africa wide, wind and solar potential are far less exploited than hydropower<sup>15</sup>. Additional stepping up of these sources until 2030 and beyond may help reach the NDC goals.

Construction time and cost need to be accounted for. Nuclear power plants and larger hydropower dams have the longest mean construction times, i.e. seven and ten years, respectively<sup>16</sup>, and they are costly. Small run-of-river power plants take less time to construct. Fossil-fuelled thermal plants have mean construction times of almost 5 years. Solar projects and wind farms show the lowest average construction times of about two and one year, respectively. The cost of solar and wind projects has decreased substantially.

Coordination and collaboration between different ministries and stakeholders is required, thereby aligning policies on energy, water, agriculture, industry and the environment<sup>17</sup>. But policies also need to address cooperation and river management across borders<sup>18</sup>.

It is essential that African countries secure investment/financing for their planned and under construction power plants, so that

they are not delayed or cancelled. Financing can occur through a mix of public and private funding, from the private sector, multilateral institutions such as the World Bank or African Development Bank, bilateral development agencies or others. Many African NDCs include targets that are conditional on financial support from other countries<sup>7</sup>.

Integrated solutions are required, including the construction of a mix of different (renewable) energy

sources<sup>19</sup>, battery storage<sup>19</sup>, the establishment of a reliable national grid including transnational electricity sharing (international power pools)<sup>15</sup> as well as small scale localized solutions<sup>15</sup>.

Policies should be data and science based. This new inventory, an openly accessible and location specific dataset for the years 2020 to 2030 is fundamental for the development of an integrated sustainable renewable energy mix.

## References

1. Vaca-Jiménez, S. D., Gerbens-Leenes, P. W., Holmatov, B., Vanham, R. & Vanham, D. Forecast on Africa's power production up to 2030 with related water use and CO<sub>2</sub> emissions. *Nat. Commun.* (2026).
2. Center For International Earth Science Information Network-CIESIN-Columbia University. SDG Indicator 7.1.1: Access to Electricity, 2023 Release. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC) <https://doi.org/10.7927/GXNR-SX57> (2023).
3. IWMI & CGIAR System Organization. *CGIAR Water Systems Integration Roadmap 2024–2030: Science to Transform Water Systems – Creating Impact from Genes to Basins*. <https://hdl.handle.net/10568/155336> (2024) doi:10.5337/2024.234.
4. Vanham, D. et al. The number of people exposed to water stress in relation to how much water is reserved for the environment: a global modelling study. *Lancet Planet. Health* **5**, e766–e774 (2021).
5. Vanham, D. et al. Physical water scarcity metrics for monitoring progress towards SDG target 6.4: An evaluation of indicator 6.4.2 “Level of water stress”. *Sci. Total Environ.* **613**, 218–232 (2018).
6. Chukalla, A. D. et al. Global spatially explicit crop water consumption shows an overall increase of 9% for 46 agricultural crops from 2010 to 2020. *Nat. Food* **6**, (2025).
7. UNFCCC. Nationally determined contributions strategy. <https://unfccc.int/NDCREG>. (2026).
8. Gleick, P. H. Water and Energy. *Annu. Rev. Energy Environ.* **19**, 267–299 (1994).
9. Meldrum, J., Nettles-Anderson, S., Heath, G. & Macknick, J. Life cycle water use for electricity generation: a review and harmonization of literature estimates. *Environ. Res. Lett.* **8**, 015031 (2013).
10. Gerbens-Leenes, P. W., Vaca-Jiménez, S. D., Holmatov, B. & Vanham, D. Spatially distributed freshwater demand for electricity in Africa. *Environ. Sci. Water Res. Technol.* **10**, 1795–1808 (2024).
11. Grill, G. et al. An index-based framework for assessing patterns and trends in river fragmentation and flow regulation by global dams at multiple scales. *Environ. Res. Lett.* **10**, 015001 (2015).
12. Lynch, A. J. et al. Future-proofing the emergency recovery plan for freshwater biodiversity. *Environ. Rev.* **32**, 350–365 (2024).
13. Tickner, D. et al. Bending the Curve of Global Freshwater Biodiversity Loss: An Emergency Recovery Plan. *BioScience* **70**, 330–342 (2020).
14. Ghosh, S., Kour, S., Taron, A., Kaywala, K. & Rajakaruna, P. Assessing El Niño-induced drought in Zambia and its effects using earth observation data. *Nat. Hazards* (2024).
15. Peters, R. et al. Sustainable pathways towards universal renewable electricity access in Africa. *Nat. Rev. Earth Environ.* **5**, 137–151 (2024).
16. Sovacool, B. K., Schmid, P., Stirling, A., Walter, G. & MacKerron, G. Differences in carbon emissions reduction between countries pursuing renewable electricity versus nuclear power. *Nat. Energy* **5**, 928–935 (2020).
17. Pardoe, J. et al. Climate change and the water–energy–food nexus: insights from policy and practice in Tanzania. *Clim. Policy* **18**, 863–877 (2018).
18. Basheer, M. et al. Cooperative adaptive management of the Nile River with climate and socio-economic uncertainties. *Nat. Clim. Change* **13**, 48–57 (2023).
19. Abuzayed, A., Chitandula, A., Nyoni, K. J. & Solá Vilalta, A. Power system expansion and renewable integration for drought-resilient electrification in Zambia. *Energy Policy* **206**, 114786 (2025).



Coal Power station in Africa with wildlife in the area (photo: Chris Kruger/Shutterstock)

## Authors

Davy Vanham, Senior Researcher - Integrated Modeling and Assessment, International Water Management Institute (IWMI), Colombo, Sri Lanka ([d.vanham@cgiar.org](mailto:d.vanham@cgiar.org))

Bunyod Holmatov, Research Group Leader - Water, Food, Energy Nexus (WFEN), IWMI, Colombo, Sri Lanka ([b.holmatov@cgiar.org](mailto:b.holmatov@cgiar.org))

## Citation

Vanham, Davy, and Bunyod Holmatov. 2026. *A New Spatial Inventory of Power Plants Shows Africa Is Stepping up in Construction and Planning up to 2030*. International Water Management Institute.

## Acknowledgements

This research, led by IWMI, was carried out under the CGIAR Policy Innovations Program ([www.cgiar.org/cgiar-research-portfolio-2025-2030/policy-innovations](http://www.cgiar.org/cgiar-research-portfolio-2025-2030/policy-innovations)) and the DIWASA (Digital Innovations for Water Secure Africa) project ([www.iwmi.org/projects/diwasa/](http://www.iwmi.org/projects/diwasa/)). The authors would like to thank all funders who supported this research through their contributions to the CGIAR Trust Fund ([www.cgiar.org/funders](http://www.cgiar.org/funders)) as well as the Helmsley Charitable Trust.

Copyright © 2026 International Water Management Institute. Some rights reserved. This work is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0)

## Disclaimer

This publication has not been independently peer-reviewed. Responsibility for editing, proofreading, and layout, opinions expressed, and any possible errors lies with the authors and not the institutions involved. The boundaries, colors, denominations and any other information shown on maps do not imply any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, on the part of IWMI, its funders, or its partners.

### Headquarters

127 Sunil Mawatha, Pelawatte,  
Battaramulla, Sri Lanka

Mailing address:

P. O. Box 2075, Colombo, Sri Lanka

Tel: +94 11 2880000

Fax: +94 11 2786854

Email: [iwmi@cgiar.org](mailto:iwmi@cgiar.org)

[www.iwmi.org](http://www.iwmi.org)