Aloe Energy

RESEARCH NOTE

From power plant to battery site: Africa's thermal fleet and the reuse of its grid connections

About 32 GW of coal, gas and oil plant connections free up in Africa by 2030 and 105 GW by 2050. On South Africa's closing coal sites, solar plus a full-size battery saves 13 to 19 Mt of CO2 a year, whatever pace the rest of the grid's wind and solar is built at.

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Key findings

1. **Coal goes first, mostly in South Africa.** Africa runs 52 GW of coal plants (median start year 1986) and 122 GW of gas (median 2013). In our central timing 32 GW of plant connections free up by 2030 (6.5 to 45 GW across timings), 13 GW of it South African coal, and 105 GW by 2050. Most gas sites open only after 2045.
2. **A battery alone helps only once there is surplus to store.** An hourly model of South Africa's grid shows a battery on an old coal site saves 2 Mt of CO2 a year in 2030 and 9 to 10 Mt in 2035 and 2040, once the planned wind and solar arrive. If they arrive at half the pace, it saves almost nothing.
3. **Solar alone runs into a full grid at midday.** Solar with a smaller battery saves 12 Mt a year in 2030 but only 8 Mt in 2040, as curtailment grows.
4. **Build both.** Solar plus a battery at half the station's size (B+) saves 13 to 14 Mt a year on the national plan and 15 to 19 Mt if wind and solar lag. It is the best option in every year we tested.
5. **The carbon is worth more than the build at coal sites.** At the US EPA's 2023 social cost of carbon, the CO2 saved by solar and batteries on coal sites is worth about 2.5 times their cost; at gas sites about the same as the cost; B+ in South Africa 2.9 times.

The idea

A retiring thermal plant leaves behind a high-voltage connection, a substation, land, water and permits. A new solar plant or battery can often wait years for a connection; a closed plant offers one at once. Australia is building its largest batteries on coal sites for this reason, among them the 500 MW Liddell battery and the Waratah Super Battery on the old Munmorah site. South Africa's Eskom has a 5 GW

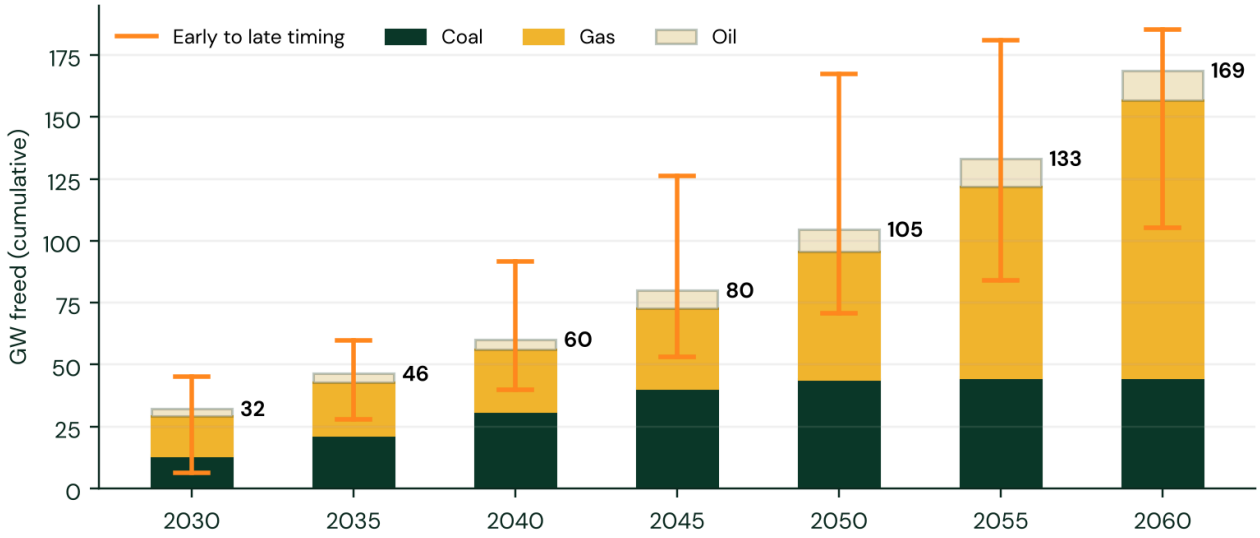
pipeline of solar, battery, wind and gas projects on six coal sites, starting with 122 MW of solar and 150 MW of batteries at Komati, which closed in 2022.

Africa differs from the US, Europe and Australia in one way that matters. Plants there close because cheap renewables push them out. In most African grids demand grows 3 to 7% a year and supply is short, so plants close for age and are often extended. The questions are when each site really frees up, and what reuse does for emissions in a grid that may not yet have spare clean power to store.

When the connections free up

We took every coal, gas and oil unit in Global Energy Monitor's Global Integrated Power Tracker (September 2026) that is operating, under construction, mothballed or closed since 2015, left out industry-only captive plants, grouped units by site and kept the 313 sites with at least 50 MW. Retirement uses announced dates where they exist (Eskom and NTCSA for South Africa, Morocco's coal pledge, planned years in the tracker) and plant age otherwise, in three timings.

Figure 1. Grid connection freed by thermal plants of 50 MW and above, Africa (GW, cumulative)



Central timing by fuel; the orange line runs from early timing (coal 40, gas and oil 30 years) to late timing (South African dates five years later, coal 60, gas 50 years). Central: Eskom's official dates (Camden, Grootvlei, Hendrina, Arnot and Kriel in 2030; Duvha and Matla in 2034), Morocco's coal exit by 2045, otherwise coal 50, gas 40 and oil 35 years. Source: Aloe Energy, from GEM GIPT September 2026.

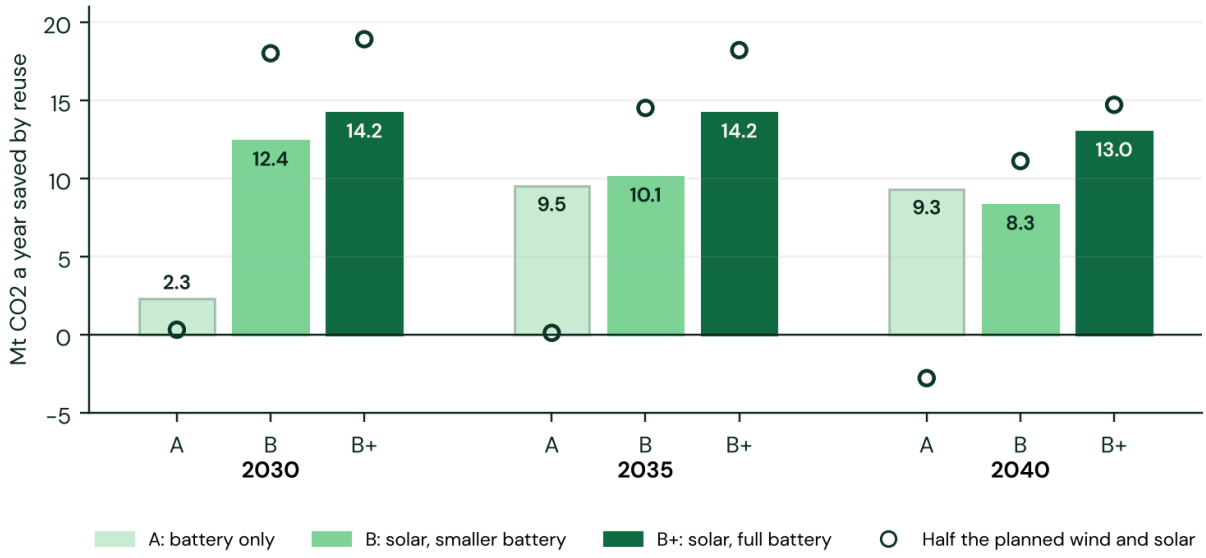
Of the 32 GW freed by 2030, about 14 GW has an announced date (9 GW of it South African coal), 6.5 GW is already mothballed or closed, and 11.5 GW is plant at or past its usual age limit, mostly gas and oil in Nigeria, Libya, Egypt and Algeria, that could just as easily keep running. South Africa frees 13 GW by 2030 and 30 GW by 2040; Egypt 5 GW by 2030 and most of its 53 GW after 2050. Another 56 GW of gas and 11 GW of coal is being built or planned.

South Africa, hour by hour

A battery stores energy; it does not make any. It cuts emissions only when it charges from wind and solar that would otherwise be curtailed, and displaces coal or diesel later. To test when that happens we ran a least-cost dispatch of South Africa's grid for every hour of 2030, 2035 and 2040: 2019 hourly demand and wind and solar profiles from the Eskom Data Portal, demand growing 1.5% a year less rooftop solar, the IRP 2025 build (gas four years late, no new nuclear), coal stations at 66% availability and at least 40% load,

Koeberg, diesel turbines and pumped storage. Three ways to reuse the freed connections: A, a 4-hour battery at half the station's size; B, solar up to the station's size (at most 1,500 MW per site for land) with a battery cut back in proportion; and B+, the same solar with the full battery of A.

Figure 2. South Africa: CO2 saved per year by reusing closed coal connections, compared with closing them without reuse



Bars: IRP 2025 build. Rings: the same case if wind, solar and grid batteries arrive at half the plan's pace. Source: Aloe Energy South Africa hourly dispatch, November 2026.

With the plan's 34 GW of wind, 25 GW of utility solar and 16 GW on rooftops, 22 TWh of wind and solar is already curtailed in 2035 and 41 TWh in 2040 before any site is converted, so extra solar mostly adds to the curtailment. Batteries on the old sites cycle 270 to 300 times a year and displace 0.6 to 0.8 t of CO2 per MWh delivered in 2035 and 2040 (0.4 t in 2030). When wind and solar lag, the battery mostly stores coal power; it still removes the 18 GWh of unserved demand that closing the stations without replacement would cause in 2040. Closing the stations saves about 5 Mt in 2030, when the remaining coal fleet takes up their output, rising to 20 Mt in 2035 and 42 Mt in 2040. If coal could run down to 25% load, B+ would still lead in every year (15 to 18 Mt). A run for 2025 gives 175 TWh of coal against 166 TWh in 2023 and 10.8 TWh of wind against 11.1 TWh in 2024 (CSIR), so the model runs coal slightly hard.

Carbon and its cost across Africa

For the continent we count, for each unit after it closes, the emissions of keeping it running, of closing it while the rest of the grid covers its output (at the grid's emission factor), and of each reuse case. South African units are scaled year by year to the hourly results. Elsewhere, closure and case A are unchanged, and case B runs from South African-style curtailment (low) to none (high), since no hourly model exists for those grids yet.

Central timing, 2026-2050	CO2 avoided, Mt	Value at US$51/t, US$ bn	Value at US$190/t, US$ bn	Build cost, US$ bn
Closing the plants (vs keeping them running)	1,480			
Added by case A: battery only	290-430	25-38	113-172	46
Added by case B: solar and battery	420-620	32-52	139-229	135
Added by B+, South Africa only	310	21	90	31

Value: present value in 2026 dollars of 20 years of savings per site, using the IWG 2021 interim social cost of carbon (US$51 a tonne for 2020 emissions, 3% discount rate) and the US EPA 2023 estimate (US$190, 2%), both in 2020 dollars rising with the year of emission, converted to 2026 dollars (x1.26). The EPA's 1.5% value (US$340) roughly doubles the middle column. Build costs: batteries US$190 per kWh in 2026 falling 3% a year to 2035; solar US$900 per kW. Running costs, battery replacement, site clean-up and the value of the electricity sold are not counted, so this is not a full cost-benefit test.

The social cost of carbon is the damage one more tonne of CO2 does worldwide, so a tonne avoided in Africa is worth the same as anywhere. The US government stopped using it in 2025; the 2023 numbers remain the most recent peer-reviewed set. Local prices are far lower: South Africa's carbon tax is R308 a tonne in 2026 (about US$17), and allowances bring the rate paid on power to about R46 (US$2.60).

What helps and what blocks

Helps

- The site comes ready-made: substation, lines, land, water and permits. Reuse saves about US$75 per kW of new connection and often years of waiting.
- Money is there for coal sites: the World Bank's US$497 million Komati loan and the Climate Investment Funds' US$2.6 billion coal transition plan for South Africa (2025).
- Batteries are cheaper every year: a complete system averaged US$117 per kWh worldwide in 2025, 31% less than in 2024.
- Grid space is scarce elsewhere: South Africa's Eastern and Western Cape have no connection capacity left.

Blocks

- Shortage keeps old plants running: Eskom kept five stations past their dates to 2030; Egypt is extending 1,250 MW of gas turbines by 13 to 15 years; Zimbabwe has applied to license Hwange's first six units for 25 more years. South Africa's first gas tender produced no preferred bidders in October 2026.
- A 4-hour battery covers the evening peak, not a plant's output day and night; that energy must come from new plants somewhere.
- Solar needs about 2 ha per MW, and coal sites lose the spinning machines that steady the grid (Komati's plan includes a synchronous condenser). City gas plants have room for batteries only.
- Long contracts (Morocco extended Jorf Lasfar's to 2044) and jobs: Komati closed before its replacement was ready. Eskom now plans repowering ahead of each closure.

What we did not model

Transmission limits inside each grid, more than one weather year, unit start-up and reserve rules, hourly dispatch outside South Africa, and the cost of running the new assets. The site list is a screening, not a

plan: dates slip, and many values are estimates. Not for engineering, investment, legal or regulatory decisions.

Sources

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Data: the 313-site table is free to download under CC BY 4.0 at aloeenergy.org/research/thermal-to-storage. Credit Aloe Energy and Global Energy Monitor.