Aloe Energy

RESEARCH NOTE

Power from waste: cogeneration potential across Africa

Africa's sugar mills, landfills, sewage works, cement kilns, crop residues and city waste could add about 5.4 GW of power that is not built yet (3.2 to 8.8 GW), about 35 TWh a year, and avoid about 23 Mt of CO2e a year. Sugar mills come first: 1.1 GW at about US$47 per MWh, with the fuel already on site.

Research note, version 1.0, November 2026. Aloe Energy. All 54 African countries, 1,321 sites plus country residue totals. Data and page: aloeenergy.org/research/waste-to-energy. Text and data: CC BY 4.0.

Key numbers (central case, power not yet built)

- **Sugar mills:** 1,135 MW (810 to 1,790) at 100 mills in 30 countries, about US$47/MWh, 5.5 TWh a year.
- **Crop and sawmill residues:** 2,080 MW (900 to 3,860) as country totals; rice husk and oil palm residue lead; Nigeria has 490 MW.
- **Cement and steel waste heat:** 610 MW at 179 kilns and 75 MW at 27 steel plants, about US$50/MWh.
- **Sewage sludge digestion:** 470 MW at 500 works serving 100,000 people or more, about US$97/MWh.
- **Landfill gas:** 160 MW at 308 sites but 7.2 Mt CO2e a year (31% of the total); credits worth about US$68/MWh at US$12/t.
- **City waste:** incineration passes in 19 of 168 cities over 300,000 people (15 in North Africa), 685 MW at about US$190/MWh before gate fees; organics digestion 165 MW.
- **Carbon:** about 23 Mt CO2e a year; South Africa 4.9 Mt, Egypt 4.0 Mt, Nigeria 2.2 Mt, Algeria 2.2 Mt, Morocco 1.6 Mt.

What we found

Mills first. Every sugar mill already burns its bagasse, but most run low-pressure boilers that make just enough steam and power for the mill. Upgrading to 65 to 110 bar boilers and condensing-extraction

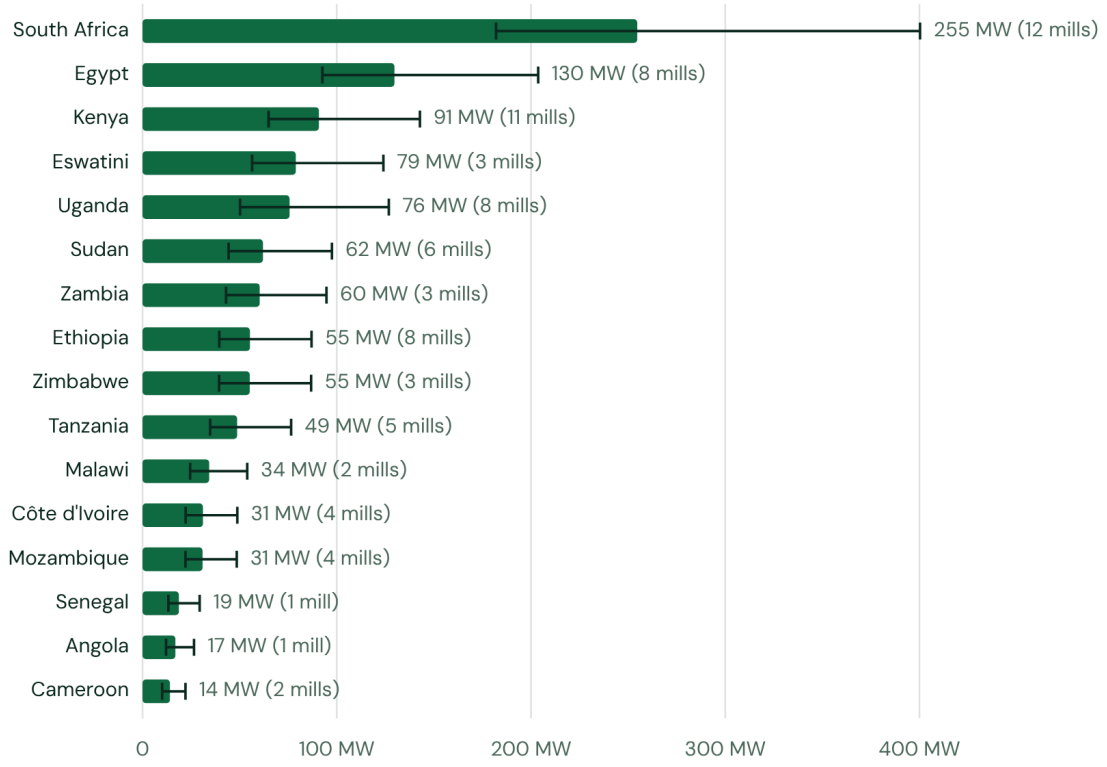
turbines lifts export from about 10 to 60 to 120 kWh per tonne of cane. With free fuel and an existing boiler house, staff and often a grid line, this is the cheapest power in the screening.

Methane second. Landfill gas adds little power but most of the carbon: captured methane counts 27 times its weight in CO2. Carbon finance, not power sales, carries these projects, and most African dumpsites need capping and gas wells first.

Burning last. Household waste south of the Sahara is mostly wet food scraps, with heating values of 5 to 7 MJ/kg, below the 7 MJ/kg usually needed. Only drier, plastic-rich waste in North African cities passes, and even there power costs about US$190/MWh before a gate fee. Digesting separated food waste suits most cities better.

Carbon follows the grid. Power displaced on coal and gas grids (South Africa, Egypt, North Africa, Nigeria) carries most of the carbon value. On hydro grids (Ethiopia, DR Congo, Zambia, Uganda) only methane capture earns carbon money.

Figure 1. Extra export power from sugar-mill cogeneration upgrades, by country

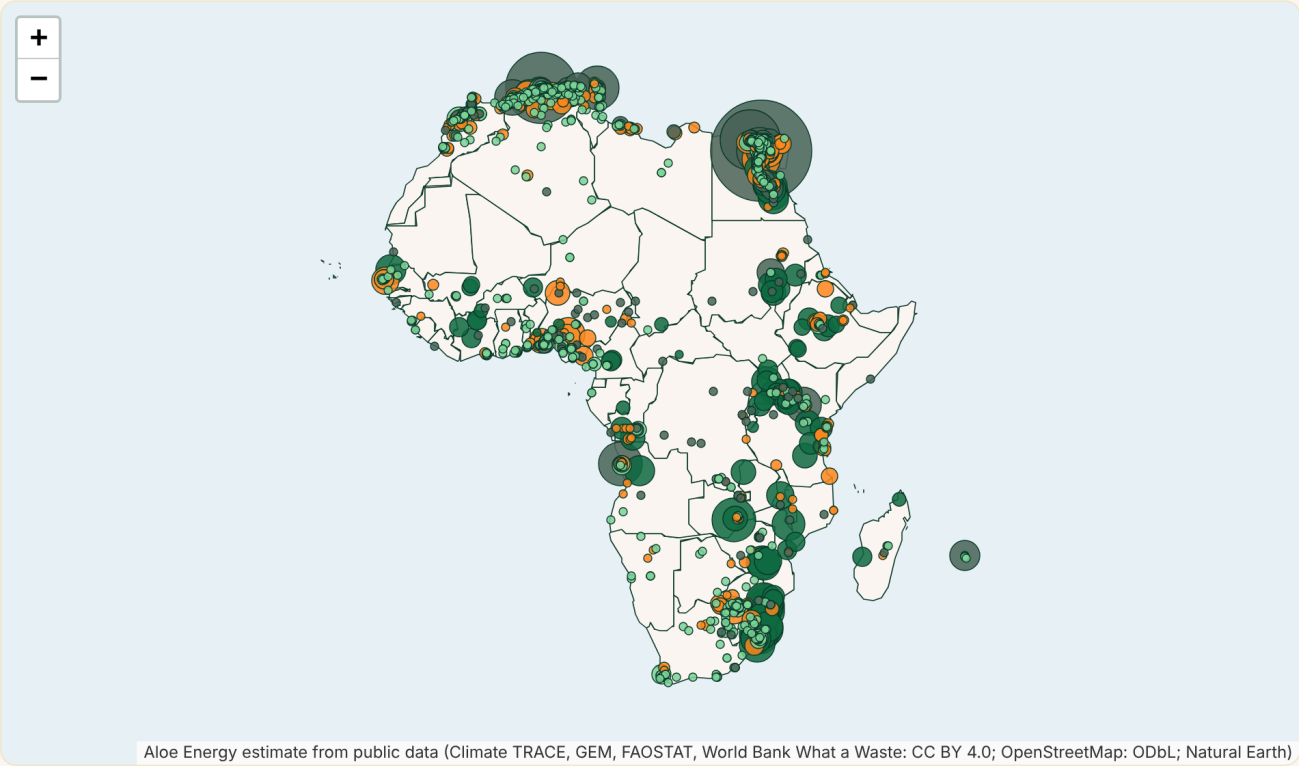


Bars: central case (80 kWh per tonne of cane, 55% capacity factor). Lines: 60 to 120 kWh per tonne. Mauritius left out (mills already export about 100 kWh/t).

Sugar mills in context

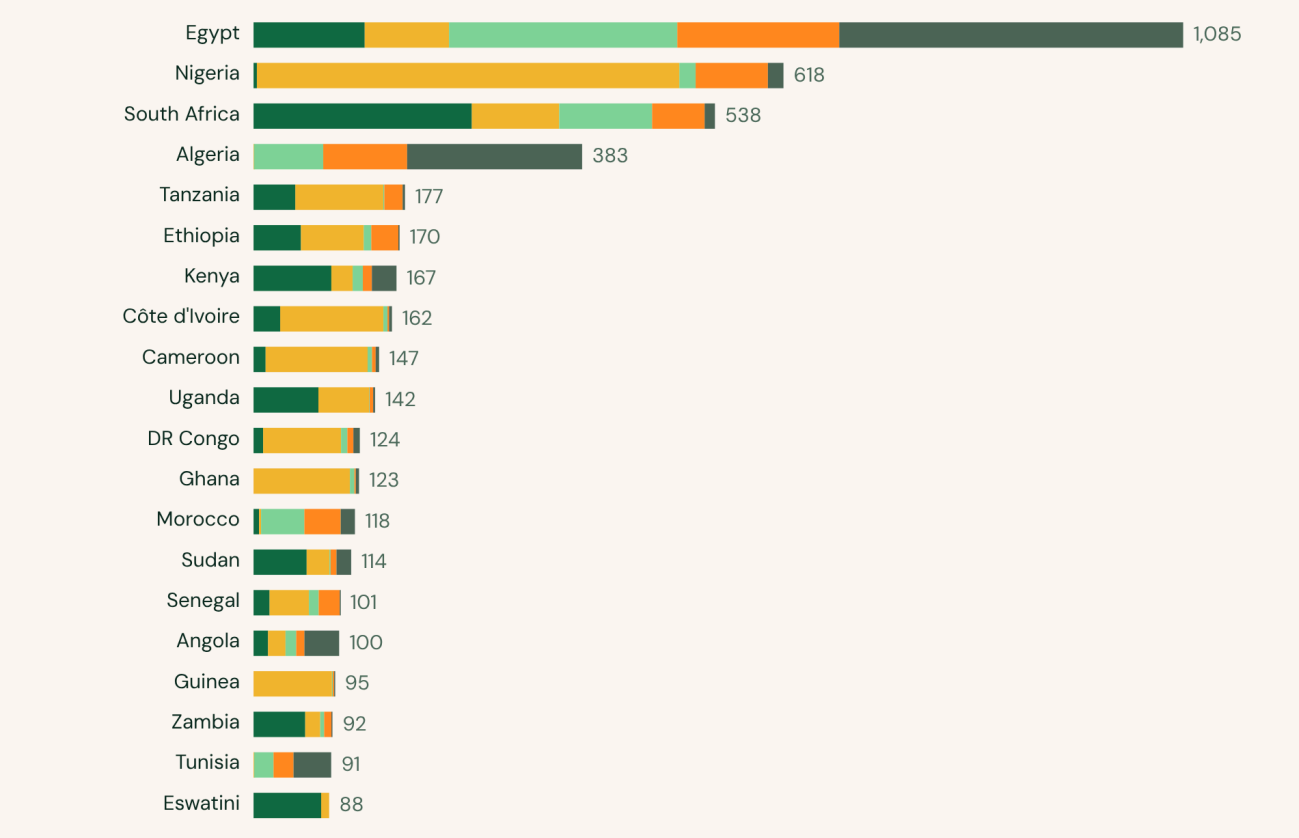
Our central case for South Africa's 12 mills is 255 MW (180 to 400 MW). The South African Sugar Association puts the industry's potential at about 700 MW, which assumes more cane trash, 14 mills and running beyond the crushing season (Engineering News, September 2026). Eswatini's Ubombo and Simunye mills already sell power to the grid, and bagasse made about 9% of Mauritius's electricity (SACREEE). The main barrier is a buyer: a power purchase agreement, a feed-in tariff or wheeling rules.

Figure 2. Sites by stream (dot size: MW not yet built, central case)



Green: sugar mills; light green: landfill gas and biogas; orange: industrial waste heat; grey: city waste. Crop residues are country totals and not mapped.

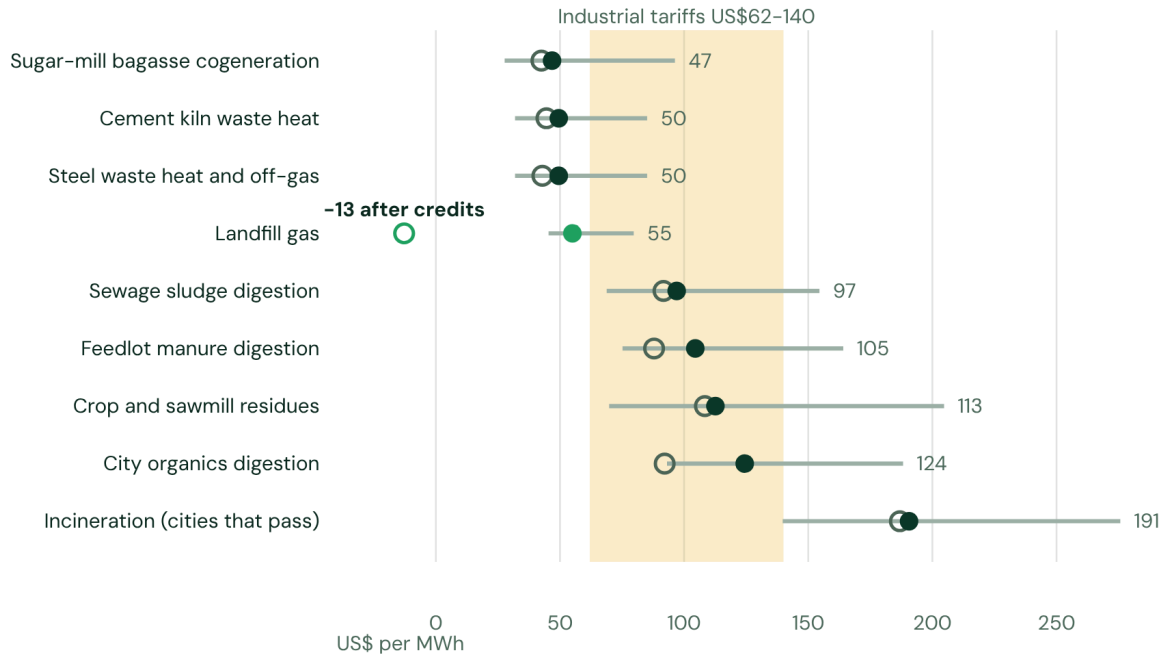
Figure 3. The 20 countries with the most potential, MW not yet built



Dark green: sugar mills; yellow: crop and sawmill residues; light green: landfill gas and biogas; orange: industrial waste heat; grey: city waste.

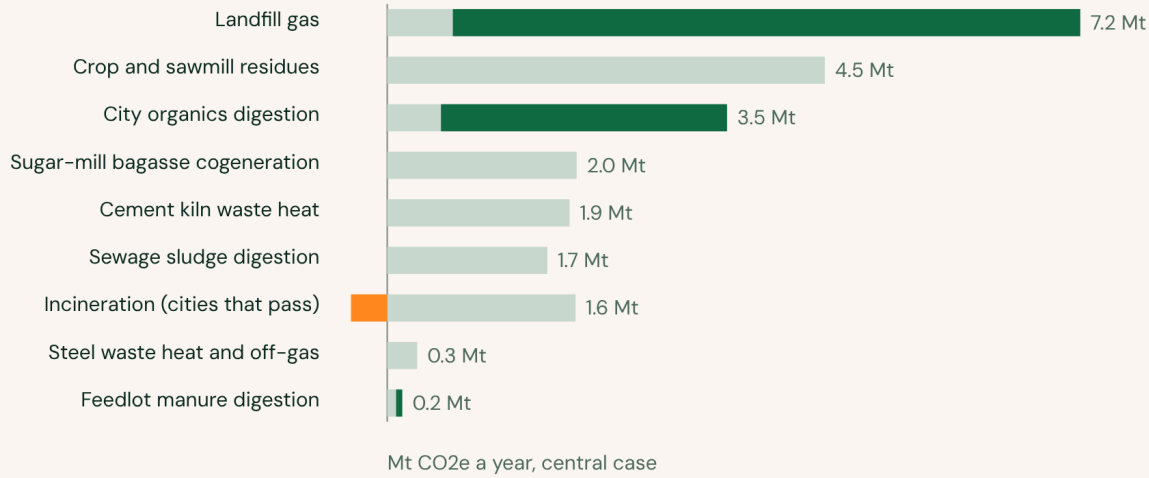
Cost and carbon

Figure 4. Levelized cost of power by technology, US$/MWh, against industrial tariffs



Dot: central case; line: best to worst case; ring: central cost after carbon credits at US$12/t. Band: middle half of industrial tariffs in the 26 African countries in Aloe's tariff tracker (US$62 to 140/MWh).

Figure 5. Carbon avoided a year by technology, central case



Grey: grid power displaced (Aloe combined-margin factors, 2024; North Africa: fleet emissions over generation). Green: methane avoided. Orange: fossil CO2 from burning plastic, net.

Cogeneration: who takes the heat

Engines and boilers at our sites could supply about 2.3 GW of heat. Mills and kilns use their own. We found an industrial heat user within 5 km at 89 sites, together about 180 MW of heat: mostly sewage works and landfills next to refineries, paper and cement plants in Cairo, Algiers, Tunis, Durban and Cape Town. Cold stores, breweries, abattoirs, dairies and hospitals are not yet in the heat-user list.

Method

Sites. Landfills and dumpsites, sewage works serving at least 100,000 people, feedlots with at least 10,000 head, cement kilns and steel plants: Climate TRACE asset data (2024). 103 sugar mills: Global Energy Monitor's Global Integrated Power Tracker (September 2026), company sources and OpenStreetMap. Cities over 300,000 people: Natural Earth and Aloe's atlases.

Quantities. Cane per country = FAOSTAT raw sugar (2021-23) times the cane share (Egypt 35%, Morocco 15%) divided by a 10.5% recovery, capped at FAOSTAT cane; split across mills by size class (large 3, medium 2, small 1). Landfill methane = Climate TRACE emissions / 0.9 (oxidation). Sewage: 25 kWh of power per person a year (18 to 35). Feedlots: 0.15 m3 methane per head a day (0.08 to 0.25). City waste: What a Waste per-person generation, a 1.5 urban uplift, collection rates by country group, and composition to heating value. Clinker = 75% of cement. Residues: FAOSTAT 2022-24 times residue ratios and a collectable share.

Conversion. Mill export 80 kWh/t cane (60 to 120) less 10 today (100 in Mauritius, 60 at Kakira). Landfill gas 50% collected (30 to 70%), engines 38%. Incineration only at 7 MJ/kg or more and 150,000 t a year or more, 22% net efficiency. Cement waste heat 30 kWh/t clinker (20 to 40); steel 60 kWh/t for blast furnace plants, 20 for electric arc. Residue plants 20% efficient (15 to 25%).

Cost. Levelized cost with a 10% real cost of capital (8 to 14%), lives of 15 to 25 years and capital costs from US$1,500/kW (mill upgrade) to US$8,000/kW (incineration); residue fuel US$20/t delivered; 2025 US dollars; grid connection and land not included.

Carbon. Power times the country grid factor; captured methane times 27 (IPCC AR6, non-fossil); organic waste diverted 0.6 tCO2e/t (0.3 to 0.9); plastic burned 2.7 tCO2/t. Known landfill gas plants (Durban, Johannesburg) are netted off; other existing projects only partly.

Limits

Mill-level cane is estimated; Climate TRACE landfill coverage is uneven (many sites in Algeria and Nigeria, few in Egypt); smelters and ferroalloy off-gas are not yet in the data; existing sewage digesters, cement waste heat units and mill export contracts are only partly netted off; residues have no site or season; North African grid distances use World Bank 2017 lines. Screening only, not for investment decisions.

Sources

- Climate TRACE, asset-level emissions data, v6 API, 2024 (CC BY 4.0). climatetrace.org
- Global Energy Monitor, Global Integrated Power Tracker, September 2026 (CC BY 4.0).
- FAO, FAOSTAT crops and livestock products, and forestry production (CC BY 4.0).
- World Bank, What a Waste global database, country and city data (CC BY 4.0).
- Natural Earth, populated places and admin 0 countries; OpenStreetMap contributors (ODbL), via Nominatim.
- Ember, yearly electricity data (CC BY 4.0); Aloe Energy, grid emission factors and utilities and tariffs tracker (aloeenergy.org).
- World Bank, Africa electricity transmission and distribution grid map, 2017.
- IPCC AR6 WG1, chapter 7 (methane GWP100, non-fossil, 27.0); IRENA, Renewable Power Generation Costs in 2024.
- Engineering News / Bloomberg, "South African sugar mills battle for survival over State indecision", 9 September 2026.
- GAIA report on the Reppie waste-to-energy plant, as reported by Packaging Insights; SACREEE, Mauritius country profile.

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https://aloeenergy.org/research/waste-to-energy