Aloe Energy

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When the river runs low: hydro dependence and drought exposure in the Southern and Eastern African power pools

Hydropower is the backbone of most grids between the Zambezi and the Nile. In 2024 the Zambezi basin had its driest year in decades and Zambia lost more than a third of its electricity. We measured how much of each of 17 grids is hydro, what a dry year takes away in megawatts, and whether the interconnectors can carry the difference.

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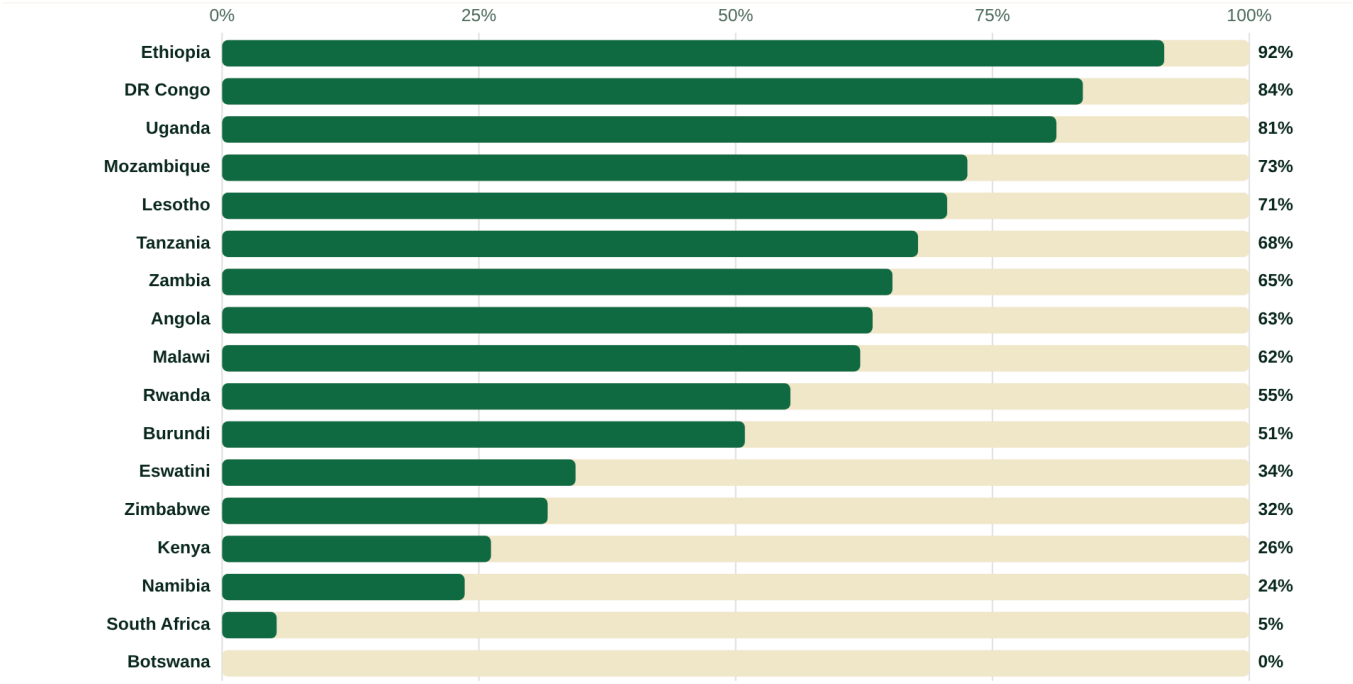
Key findings

- **Most grids in the region are hydro grids.** Outside South Africa, 62% of the operating capacity in the Southern African Power Pool (SAPP) is hydro; in the five Eastern Africa Power Pool (EAPP) core countries it is 77%. Ethiopia, DR Congo, Uganda, Tanzania, Mozambique, Zambia and Angola are all above 60%.
- **A severe dry year costs hundreds of megawatts.** Hydro output 40% below a normal year, which is what Zambia (2024) and Kenya (2022/23) lived through, is worth about 760 MW of average supply in Zambia, 740 MW each in Ethiopia and Mozambique, and 600 MW in DR Congo.
- **The wires did not save Zambia, and could not have.** The lines that normally bring power into Zambia had about 430 MW of room once contracted imports are taken off, against a 2024 loss that averaged about 730 MW and reached 1,300 MW at the evening peak. Imports peaked near 400 MW. Zimbabwe, drawing on the same lake, lost two thirds of Kariba South's output; Cahora Bassa kept its 2024 output only by running its reservoir down to 21%.
- **The global datasets missed the drought.** Ember and the US EIA still carry Zambia's 2024 hydro at 17 TWh, the 2023 figure, and Zimbabwe's at 5.7 TWh. The regulators report 10.7 TWh and about 2.0 TWh. We use regulator figures wherever the global data is wrong or missing.
- **The pipeline adds more of the same river, late.** About 15 GW of hydro in these countries has a stated commissioning year and another 10 GW has none. Most of it is in the same Zambezi and Nile basins, and the region's completed projects arrived a median of five years behind their first promise.

How much is hydro

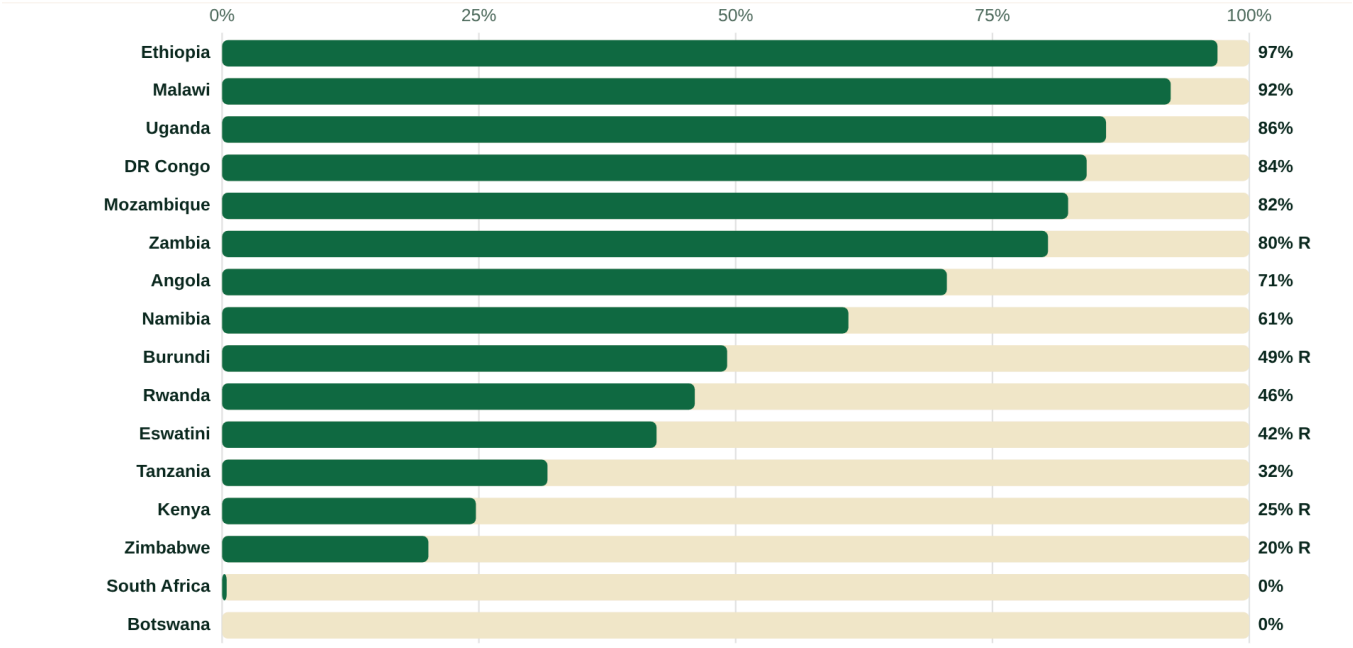
Figure 1 shows the hydro share of each country's operating power plants (10 MW and above) from our SAPP and EAPP grid atlases, and the hydro share of the electricity actually generated in 2024. Capacity shares include Julius Nyerere in Tanzania and GERD in Ethiopia, which only reached full output after 2024, so for those two the generation share lags the capacity share. Shared plants (Kariba, Ruacana, Ruzizi, Rusumo) are split equally between their countries.

Figure 1a. Hydro share of operating capacity, 17 countries



Operating plants of 10 MW and above. Source: Aloe Energy SAPP and EAPP grid atlases (Global Energy Monitor CC BY 4.0, WRI, AICD, OpenStreetMap ODbL and curated project records), November 2026.

Figure 1b. Hydro share of 2024 generation



Ember yearly electricity data (CC BY 4.0, based on US EIA statistics). R marks a regulator figure used instead: Zambia (ERB), Zimbabwe (ZimStat), Eswatini (EEC), Kenya (EPRA, fiscal year), Burundi (AREEN). Lesotho and Botswana have no usable 2024 total.

What a dry year costs

We take each country's normal hydro output, the 2021 to 2023 average, and remove a share of it, then express the loss as an average megawatt over the year. Two modeled cases bracket what the record shows. The low case removes 20% of hydro output: Eswatini's 2024/25 (-13%) and Tanzania's 2023 sit near it. The high case removes 40%: Zambia 2024 (-37%), Kenya 2022/23 (-38%) and Cahora Bassa 2025 (-30%). Observed 2024 changes are shown where a regulator published one.

Against the loss we set the room on the interconnectors: the usable transfer limit of the lines that normally carry power into the country, less the firm imports it already buys. Direction follows the SAPP monthly and utility reports; Ethiopia is counted as an exporter with no import path, and Kenya's 2,000 MW line from Ethiopia at the 500 MW its own grid can take.

Figure 2. Dry-year hydro loss against import room, hydro-reliant countries



Average MW over a year. Yellow: hydro output 20% below normal; orange: 40% below; dark green: usable import capacity less firm imports (SAPP transfer limits 2026, SAPP monthly report August 2026, EAPP atlas); dot: observed 2024 loss. Angola and Malawi had no operating interconnector in 2024; Lesotho's listed limit is below what it already imports.

On paper, most countries have several times more line than loss. Zambia does not: about 430 MW of room against a loss that averaged 730 MW in 2024. DR Congo and Uganda come within a factor of two in the high case. Angola, Malawi and Lesotho have no room at all.

A loss spread over the year understates the evening. Zambia's deficit at peak reached 1,300 MW in 2024 and households went without power for 12 hours or more a day. And a line is only as good as the energy at its far end. Zambia's imports grew from 64 MW in January 2024 to about 409 MW in July and then stalled: the central corridor from South Africa moves about 500 MW northbound in total and is shared with Botswana and Zimbabwe, Zimbabwe had lost two thirds of Kariba South's output, and Cahora Bassa was drawing down storage. Imports also cost about double: ZESCO's import bill rose from K689 million in 2023 to K9.7 billion in 2024, at about US$0.15 per kWh against 0.07 before. Zambia's own exports fell from 7.3 TWh to 2.6 TWh, so the pool lost a seller as it gained a buyer.

The east: different basin, same pattern

- **Ethiopia** is 92% hydro by capacity and 97% by output. GERD lifted output 43% in 2024/25, and Ethiopia's export lines are the region's biggest buffer, but the 2,000 MW HVDC to Kenya carries under 500 MW because of limits inside Kenya's grid; 400 MW is contracted from December 2026.
- **Kenya** lost 38% of its hydro in the 2022/23 drought and covered it with geothermal and imports, which rose from 197 GWh to 1,534 GWh a year. It is the one country in this set that has already lived through the high case and come out with a more diverse mix.
- **Uganda, Rwanda and Burundi** have small import paths (27 to 60 MW each). Burundi's own hydro fell 5% in 2024 while imports from Rusumo and Ruzizi covered 40% of supply. Uganda's 2025 problems came from waterweeds at its intakes, not rain.

Which corridors bind

The SAPP publishes a thermal rating and an applicable (usable) limit for each tie line; the gap between them is set by voltage and stability, not by the conductor. Actual flows are rarely published, so Table 2 shows the few public figures we found. Lines the SAPP or the utilities have named as bottlenecks are marked.

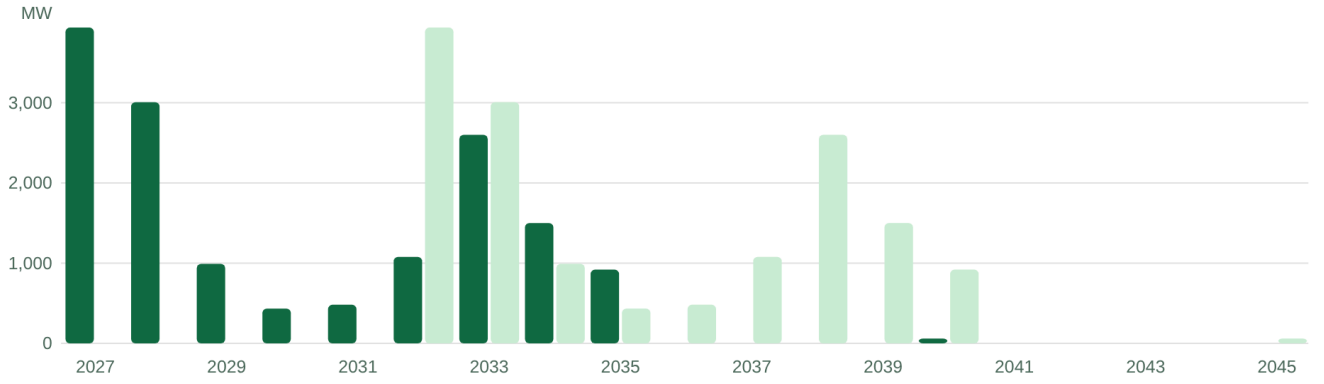
Corridor	Pool	kV	Thermal MW	Usable MW	Observed flow MW	Status
Ethiopia - Kenya HVDC	EAPP	500	2,000	2,000	200	Bottleneck: Kenya's own grid caps flows below 500 MW of the 2,000 MW rating
Ethiopia - Djibouti	EAPP	230	150	150	150	Bottleneck: Fully used; second line under construction
Kariba North - Kariba South	SAPP	330	700	428	-	Bottleneck: Central corridor: about 500 MW northbound in total; SAPP Jan 2026 names it the primary bottleneck
Karavia - Luano (CEC)	SAPP	220	310	247	-	Bottleneck: Zambia - DRC lines stretched by Copperbelt and Katanga mining load; tripped in Feb 2026
Karavia - Luano (ZESCO)	SAPP	220	310	247	-	Bottleneck: Zambia - DRC lines stretched by Copperbelt and Katanga mining load; tripped in Feb 2026
Insukamini - Phokoje	SAPP	400	700	220	-	Bottleneck: Central corridor: about 500 MW northbound in total
Bulawayo - Francistown	SAPP	220	200	200	-	Bottleneck: Thermal limit reached (200 MW); central corridor
Phokoje - Matimba	SAPP	400	650	190	-	Bottleneck: Central corridor: about 500 MW northbound in total
Zambezi - Gerus (Caprivi)	SAPP	220	200	180	122	Bottleneck: Namibia's only northern tie, single HVDC link
Kenya - Tanzania	EAPP	400	1,300	1,300	100	
Kenya - Uganda	EAPP	132	350	350	30	
Ethiopia - Sudan	EAPP	230	100	100	15	
Uganda - Rwanda	EAPP	220	-	27	27	
Rusumo - Rwanda	EAPP	220	-	27	27	
Rusumo - Burundi	EAPP	220	-	27	27	
Rusumo - Tanzania	EAPP	220	-	27	27	
Ruzizi I and II - Burundi	EAPP	110	-	10	10	
Rwanda - DR Congo	EAPP	110	-	-	-	
Arnot - Maputo (MOTRACO)	SAPP	400	1,300	1,100	-	
Camden - Edwaleni (MOTRACO)	SAPP	400	1,300	1,100	-	
Edwaleni II - Maputo (MOTRACO)	SAPP	400	1,300	1,000	-	
Songo - Apollo HVDC	SAPP	533	750	700	950	
Aries - Kokerboom	SAPP	400	630	380	-	
Kolwezi - Solwezi	SAPP	330	500	333	-	
Spitskop - Gaborone South	SAPP	132	300	245	-	
Songo - Bindura	SAPP	330	700	220	57	
Aggeneis - Kokerboom	SAPP	220	500	195	-	
Livingstone - Sesheke - Zambezi	SAPP	220	200	180	122	
Komatipoort - Infulene	SAPP	275	165	133	-	
Gaborone - Spitskop	SAPP	132	115	110	-	
Tweespruit - Maseru	SAPP	132	140	90	-	
Normandie - Nhlangano	SAPP	132	100	76	-	
Derdepoort - Dwaalboom	SAPP	132	115	70	-	
Komatipoort - Corumana	SAPP	110	75	67	-	
Mutare - Chicamba	SAPP	110	70	38	-	
Beitbridge - Messina	SAPP	132	70	15	-	

Table 2. Sources: SAPP transfer limits (2026), SAPP monthly and quarterly reports 2025-2026, HCB Relatorio e Contas 2024, NamPower via The Namibian (February 2026), KETRACO, EPRA. Observed flows are yearly or monthly averages; HCB's 950 MW to Eskom in 2024 used both the Songo - Apollo HVDC and the MOTRACO path. Mozambique - Malawi (energized August 2026, 50 MW initially) and Zambia - Tanzania (Tanzanian section due December 2026) were not yet trading.

Hydro in the pipeline, and when it really arrives

About 15 GW of hydro in these 17 countries has a stated commissioning year; another 10 GW (Inga III, Batoka Gorge and others) has none. Our Promised vs Built study found that the 15 regional projects completed so far arrived a median of five years late and none on time. Figure 3 shifts every stated year by that median.

Figure 3. Hydro MW by stated commissioning year, and the same MW five years later



Dark: hydro MW with this stated year (under construction and planned, SAPP and EAPP atlases). Light: the same MW if every project slips the median five years. Source: Aloe Energy; Promised vs Built (2026).

The recent record: GERD about 8 years late, Karuma 6, Rusumo 4, Julius Nyerere 3; Batoka Gorge was due to start construction in 2020 and now targets first power in 2028 at the earliest; Mphanda Nkuwa has moved from 2031 to 2034. Most of the dated pipeline sits in the same Zambezi and Nile basins as today's plants, so it adds capacity without adding much diversity.

All 17 countries

Country	Pool	Operating MW	Hydro share	Pipeline hydro	Hydro in 2024 gen.	Normal hydro TWh	Low case MW	High case MW	Observed 2024	Import room MW
Ethiopia	EAPP	10,855	92%	63%	97%	16.3	371	743	-	0
DR Congo	SAPP	3,851	84%	30%	84%	13.2	302	605	-	777
Uganda	EAPP	1,960	81%	8%	86%	4.9	111	222	-	350
Mozambique	SAPP	2,992	73%	18%	82%	16.0	366	732	-2%	2,300
Lesotho	SAPP	102	71%	27%	– R	0.5	11	23	-	0
Tanzania	SAPP	3,932	68%	14%	32%	2.9	66	131	-	1,327
Zambia	SAPP	4,928	65%	18%	80% R	16.8	382	765	-37%	433
Angola	SAPP	6,163	63%	54%	71%	12.2	278	556	-	0
Malawi	SAPP	565	62%	51%	92%	1.7	39	77	-	0
Rwanda	EAPP	338	55%	37%	46%	0.5	12	25	-	54
Burundi	EAPP	224	51%	-	49% R	0.3	7	14	-	37
Eswatini	SAPP	186	35%	21%	42% R	0.3	7	15	-	972
Zimbabwe	SAPP	3,408	32%	14%	20% R	5.8	131	263	-66%	971
Kenya	EAPP	3,068	26%	10%	25% R	3.1	71	143	-	2,150
Namibia	SAPP	703	24%	2%	61%	1.0	23	47	-	405
South Africa	SAPP	67,019	5%	3%	0%	2.4	54	108	-	1,800
Botswana	SAPP	1,012	0%	0%	-	-	-	-	-	985

Table 1. Average MW over a year. R marks a 2024 figure from the national regulator. Pipeline includes everything from under construction to early studies. Import room: usable limit of the lines that normally carry power into the country, less firm imports (SAPP monthly report, August 2026).

Method

Hydro shares. From the plant lists in our SAPP and EAPP grid atlases: Global Energy Monitor, WRI, AICD and OpenStreetMap plants of 10 MW and above plus curated project records. Operating, under construction and planned are the atlas statuses; duplicates between sources are removed and plants shared by two countries are split in half. Tanzania is taken from the EAPP list, which carries its gas plants.

Normal year and cases. Normal hydro output is the 2021 to 2023 average from Ember (US EIA based), replaced by regulator figures for Zambia, Zimbabwe, Lesotho, Eswatini, Kenya and Burundi where Ember is missing or wrong. The low and high cases remove 20% and 40% of that output; dividing by 8,760 hours gives the average MW. Observed 2024 changes are regulator numbers against the same normal year. The cases are brackets, not forecasts; no composite score or ranking is made.

Import room. SAPP applicable transfer limits summed over the lines that normally carry power into the country, less firm imports from the SAPP monthly report: Zambia through Kariba North - Kariba South and the Caprivi link (the DRC lines flow north); Zimbabwe from Zambia, Mozambique, Botswana and South Africa; southern Mozambique and Eswatini through the MOTRACO and Komatipoort lines; South Africa from Cahora Bassa; Namibia from South Africa and Zambia; Botswana from South Africa and Zimbabwe; DR Congo through the three Zambian lines; Tanzania from Kenya and Rusumo. For the EAPP we use the rated capacity in our atlas.

Limits. Capacity shares depend on the atlas plant lists, which are public and imperfect. Corridor flows are mostly unpublished. The 2021 to 2023 normal year understates the hydro that Julius Nyerere and GERD now add. Indicative only; not for system planning or investment decisions.

Sources

Energy Regulation Board of Zambia, Annual Statistical Bulletins 2024 and 2025 and Energy Sector Report 2024; ZESCO Integrated Reports 2024 and 2025; Zambezi River Authority water allocation and hydrological statements 2024 to 2026; ZimStat Index of Electricity Generation 2024 to 2026; HCB Relatorio e Contas 2024 and 2025 results; EEC Integrated Annual Report 2025; LHDA, electricity billed to LEC; EWURA Electricity Sub-Sector Performance Report 2023/24; EPRA Energy and Petroleum Statistics 2023/24 and June 2025; AREEN Rapport Annuel 2024; RURA and MININFRA Rwanda; Ethiopian Electric Power via press; CSIR Utility Statistics January 2025; Eskom Integrated Report 2025; SAPP transfer limits and monthly and quarterly reports 2025 to 2026; KETRACO; Ember yearly electricity data (CC BY 4.0); Global Energy Monitor (CC BY 4.0); OpenStreetMap contributors (ODbL); Aloe Energy SAPP and EAPP grid atlases and Promised vs Built (2026); Ansar, Flyvbjerg, Budzier and Lunn (2014), Should we build more large dams?, Energy Policy 69. The full list with links is in the data pack, available on request from brandon@aloeenergy.org.

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