



FROM EXPOSURE TO PROTECTION

The Case for Parametric Insurance
Revenue Cover for Hydro-Dependent
Utilities in Eastern and Southern Africa

A BRIEF FOR ACTION

September 2026

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EXECUTIVE SUMMARY

Hydropower accounts for over 17% of electricity generation across Africa, and above 80% in countries such as the Democratic Republic of the Congo (DRC), Ethiopia, Malawi, Mozambique, Uganda and Zambia.

This dependence makes electricity supply, public finances and sovereign creditworthiness directly vulnerable to hydrological variability, a risk that climate change is making more frequent, more severe and increasingly unpredictable.

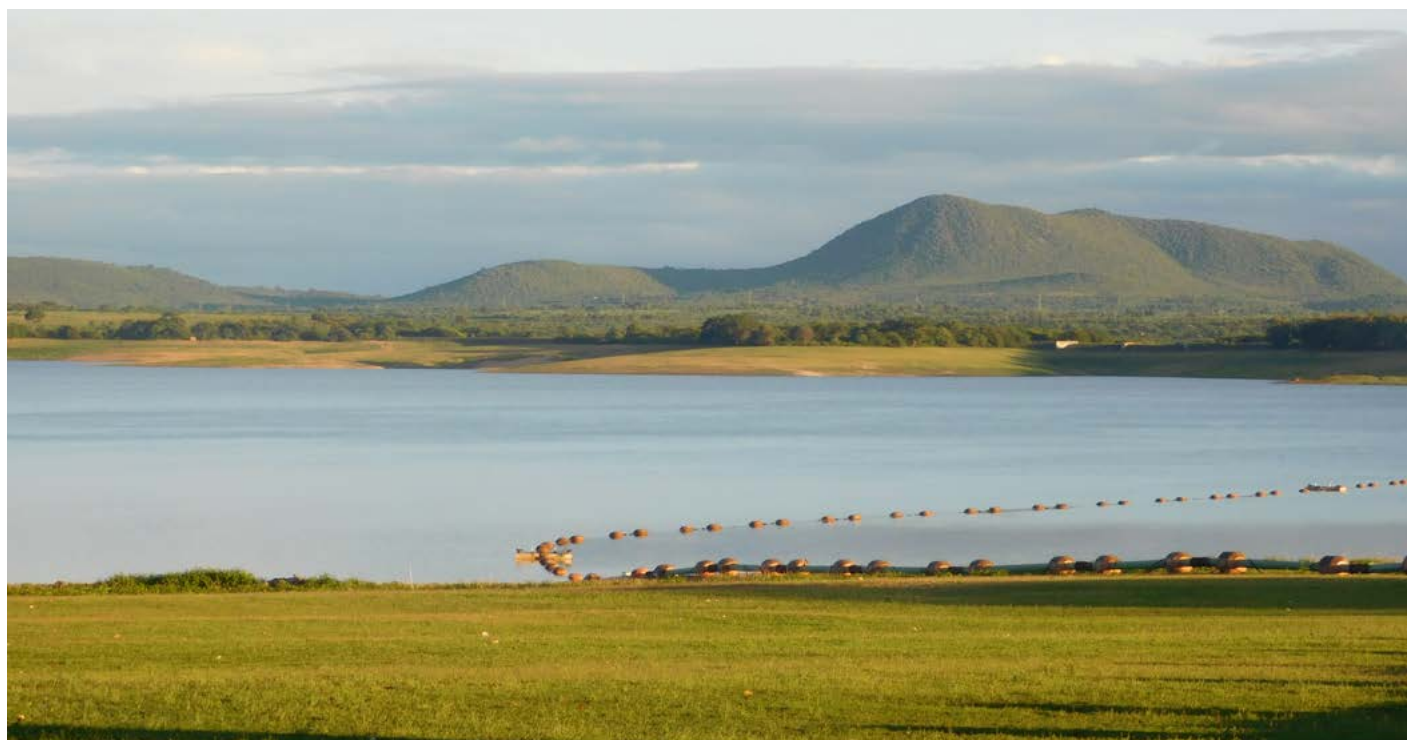
The cost of that exposure is already being paid, and it is paid in ways that never appear as an insurance claim. When drought struck Zambia in 2024, usable storage at the Kariba Dam fell below 3%, load shedding reached twenty-one hours a day, and the growth projection for the year was revised down from 4.7% to 2.3%. When Uganda's hydropower output halved in 2005–06, the production gap reached nearly half of national demand; consumers ended up paying the highest tariffs in the region, while the state-owned transmission company was still subsidising supply. In each case the shock arrived unbudgeted and was absorbed by tariffs, by budget, or both.

Despite this exposure to hydrological variability, **the vast majority of African hydropower utilities carry no structured financial protection against drought-driven revenue shortfalls or excess-rainfall disruptions**. When shocks occur, as they already do and will do more often, the losses cascade from the asset, to the system

operator, to the ministry of finance, and ultimately to countries' credit ratings and borrowing costs. The alternative is not to eliminate the shock but to convert it into a known annual cost, arranged in advance, that delivers liquidity in the year it is needed without adding to the debt stock.

IDRIMA (Integrated Disaster Risk Management Alliance), a joint initiative of the AFD Group (Agence Française de Développement) and the Insurance Development Forum, offers a structured response. Through three sequential phases: risk assessment, solution design, and placement, IDRIMA works with governments, state-owned utilities and development banks to move from exposure to protection.

Conceived as a follow-up to the *IDF Practical Guide to Insuring Public Assets*, **this Brief for Action makes the case for accelerating deployment of climate risk transfer solutions, explains the mechanisms and their limits, and sets out concrete actions for each category of public institution**. It follows the Zanzibar Declaration, in which twelve national insurance regulators from Eastern and Southern Africa committed, among other things, to promoting the insurance of critical and strategic infrastructure. **It is addressed to ministries, utilities, energy regulators, insurance regulators and all stakeholders concerned with protecting strategic public assets and revenues, with a particular focus on Eastern and Southern Africa.**



1.

CONTEXT AND RATIONALE

1.1. THE ELECTRICITY SYSTEM IS AT THE CROSSROADS OF DEVELOPMENT TRENDS AND CLIMATE PRESSURES

The energy sector has the particularity to be at the basis of every economic process: every economic activity needs energy as an input. Rising energy access is then both a condition and a consequence of social and economic development. This paper chooses to focus on the African continent as AFD and IDF, through the IDRIMA facility, are working closely with the COMESA¹ regional reinsurer – Zep Re – on mainstreaming climate insurance in Eastern and Southern Africa. However, the main insurance schemes outlined and conclusions shared remain useful and usable by Emerging Markets and Developing Economies (EMDEs) wherever climate change puts energy systems at risk.

Africa's development is embodied in a surging industrialization as the continent's demand for industrial products is projected to rise by a third between 2020 and 2030² and as a broader middle class is increasingly contributing to energy demand. The demographic side of the equation cannot be forgotten as Africa's population is expected to increase by 350 million between 2020–2030. Furthermore, urbanization is surging – the urban population is expected to increase by 235 million between 2020 and 2030 –, increasing energy demand even further. To guarantee a sustainable provision of energy, the electrification process is underway, trying to fulfil as much energy needs as possible with electricity. The International Energy Agency (IEA), in its Sustainable Africa Scenario, projected that the African electricity demand would surge to 1,180 TWh by 2030³ compared to 916 TWh in 2023⁴; i.e. an approximately 30% increase.

African electricity systems are already structurally fragile: Today, 80% of firms and close to 60% of households in sub-Saharan Africa face regular unplanned outages⁵ – and climate change is set to intensify this stress through a compounding mechanism operating simultaneously on the demand and supply sides. As temperatures rise further, so does the pressure on electricity systems. During heatwaves, cooling demand spikes sharply, boosting not only total electricity consumption but peak load in particular, while simultaneously degrading the performance of key generation assets. Solar panels and gas turbines lose efficiency at very high ambient temperatures, and power lines are impaired by the combination of heat and overload⁶. This supply-demand scissor effect is likely to worsen as AC ownership, currently averaging only 0.08 units per household across Africa compared to 0.7 globally, rises rapidly with income growth and electrification. The latter is projected to reach 0.25 units per household by 2050 in the Sustainable Africa Scenario⁷.

No energy asset is immune: From hydropower dams exposed to drought and floods, to solar panels vulnerable to hailstorms, to transmission lines that sag and fail under extreme heat. Understanding which assets are exposed, and to which hazards, is the first step toward building systems that can withstand what is coming.

1 Common Market for Eastern and Southern Africa

2 IEA (2022), *Africa Energy Outlook 2022*, International Energy Agency, Paris, p16.

3 IEA (2022), *Africa Energy Outlook 2022*, International Energy Agency, Paris, p60.

4 *Africa – Countries & Regions* – IEA

5 IEA (2022), *Africa Energy Outlook 2022*, International Energy Agency, Paris, p130.

6 IEA (2018), *The Future of Cooling: Opportunities for Energy-Efficient Air Conditioning*, International Energy Agency, Paris, p. 26

7 IEA (2022), *Africa Energy Outlook 2022*, International Energy Agency, Paris, p. 74.

1. CONTEXT AND RATIONALE

1.2. HYDROPOWER IS BOTH CENTRAL TO ELECTRICITY SYSTEMS AND VULNERABLE TO CLIMATE CHANGE

Hydropower is the single most important source of electricity across much of Africa. It accounts for 17% of electricity generation on average across the continent, but this average conceals extreme dependence in individual countries: in the DRC, Ethiopia, Malawi, Mozambique, Uganda, and Zambia, hydropower's share of electricity generation exceeds 80%⁸. The economic stakes are equally significant – in several countries, hydropower revenues represent a material share of GDP, as illustrated by the map below.

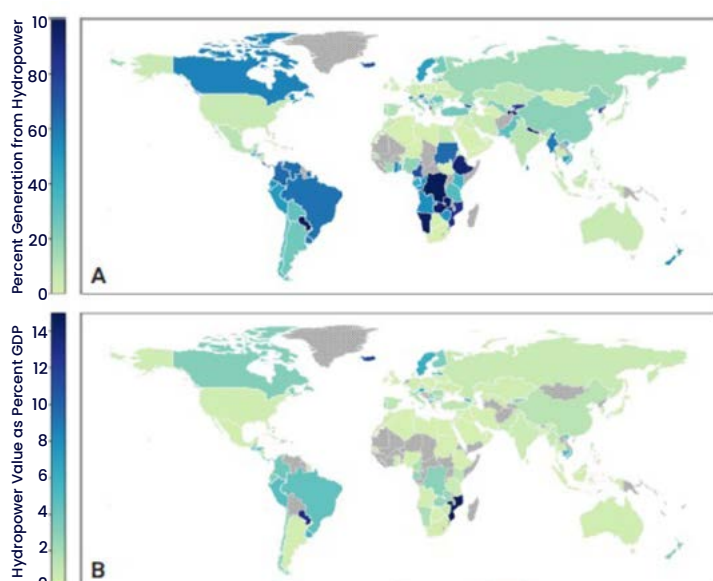


Figure 1: National level of dependence to hydropower in a) % of the generation mix of 2015 and b) in % of the GDP in 2022. Source: Cuppari et al, 2026.

For a hydro utility, the threat is not the falling average: it is the drought years in the tail. The IEA's assessment of 64 plants across 13 African countries projects a continental mean decline of only about 3% for 2060–99 against the 2010–19 baseline⁹; a figure that, on its own, sounds manageable. What breaks a balance sheet is the distribution around that mean: the drought years, whose frequency and depth are projected to rise even

in basins where average output increases. The average also hides severe country-level divergences – capacity-factor drops of 9–10% under a 3°C warming scenario across the Congo and Zambezi basins (Zambia, Zimbabwe, Mozambique, Malawi, DRC), and up to 35% in extreme cases such as Morocco, driven by declining peak monthly flows and worsening dry-season scarcity¹⁰ – although in systems where hydropower is a marginal contributor the financial consequence is correspondingly smaller. It is this widening of the distribution – more frequent, deeper shortfalls – that insurance is built to absorb.

The consequences are already visible: During the 2023–24 drought in Zambia, usable live water storage fell to 2.89% by 11 December, a reduction of 75% over the year¹¹. The national power utility ZESCO generated 215 MW against 1,080 MW of installed capacity at Kariba North Bank from the first quarter of 2024, and announced on 14 September the first ever outright suspension of generation at Kariba in the plant's history¹². Load shedding rose up to twenty-one hours a day affecting 80% of the population as well as businesses¹³. As a result, Zambia's 2024 economic growth projection was revised down from 4.7% to 2.3%¹⁴. The IMF attributed part of the severity to simultaneous drought in neighbouring countries, which curtailed the import buffer at the moment it was most needed and transferred the financial pressure back onto the utility¹⁵. The Kariba record shows a tightening cycle rather than isolated events: in December 2019, drought reduced the Kariba Dam to just 10% of its capacity; in 2016, it had already dropped to 12%, forcing power rationing and economic slowdowns¹⁶.

Kenya has also 4 documented droughts and their adverse effect on the grid can be highlighted. Meanwhile, Tropical Cyclone Idai in 2019 reduced Malawi's hydropower capacity from 320 MW to just 50 MW for six weeks¹⁷.

⁸ IEA (2020), *Climate Impacts on African Hydropower*, International Energy Agency, Paris, Executive Summary, p. 6.

⁹ IEA (2020), *Climate Impacts on African Hydropower*, International Energy Agency, Paris, p. 32.

¹⁰ Ibid

¹¹ ACAPS, Thematic Report – Zambia: Update on the impact of drought, 16th January 2025

¹² bne IntelliNews, « Historic drought compels Zambia to take unprecedented step of shuttering its largest hydropower plant », 13 September 2024

¹³ ACAPS, Thematic Report – Zambia: Update on the impact of drought, 16 January 2025

¹⁴ <https://www.imf.org/en/countries/zmb/zambia-qandas>

¹⁵ Spahia, Linda (2025), Zambia: Building Resilience to Climate Shocks, IMF Selected Issues Paper SIP/2025/127, Washington D.C.

¹⁶ IEA (2020), *Climate Impacts on African Hydropower*, International Energy Agency, Paris, p. 32.

¹⁷ IEA (2020), *Climate Impacts on African Hydropower*, International Energy Agency, Paris, p. 18.

1. CONTEXT AND RATIONALE

1.3. A REGIONAL RATIONALE IN EASTERN AND SOUTHERN AFRICA

Eastern and Southern African countries depend heavily on hydropower – in particular Ethiopia, Kenya, Uganda, Tanzania, Zambia, Mozambique –, which dominates their electricity mix and contributes materially to GDP in the most exposed cases.

Climate projections show Nile basin countries will see their average hydropower capacity factor increase as heavier precipitation raises streamflow. However, this conceals the more dangerous dynamic: inter-annual variability is simultaneously growing. The IEA finds that 85% of analysed plants will experience stronger year-to-year fluctuations under a 3°C warming scenario, and that a wetter Eastern African climate is itself projected to *increase uncertainty* in hydropower generation¹⁸.

A rising mean does not eliminate the left tail. Drought years remain, and their unpredictability grows, as Tanzania's Mtera Dam (80 MW) and Kihansi plant (180 MW), demonstrate¹⁹, as they already frequently operate well below capacity during dry spells. This is a crucial point for Tanzania, as the Julius Nyerere Hydropower Plant has been phased into service in 2024 adding 2,115 MW of hydropower to the energy mix, roughly quadrupling Tanzania's hydro capacity, doubling its electricity supply²⁰ and structurally deepening dependence on hydropower on a single basin.

East African countries are members of the Eastern African Power Pool (EAPP), and Southern African countries likewise with the Southern African Power Pool (SAPP), which enable cross-border electricity trade and allow countries to draw on neighbours when domestic generation falls short. Regarding the EAPP, for example, Kenya Power imports from Ethiopian Electric Power since November 2022 via the 500 kV Ethiopia–Kenya HVDC interconnector, under a 25-year PPA starting around 200 MW and scaling toward 400 MW; Ethiopia also exports to Djibouti and Sudan, with Tanzania interconnection following. This regional interconnection is a genuine adaptation mechanism: spatial diversification against imperfectly correlated weather shocks. But it is also a dependency: countries that rely on imports as a drought buffer lose resilience the moment their supplier faces the same shock – as witnessed in the 2024 Zambia drought.

Hence, The EAPP and the SAPP could simultaneously be shock absorbers and transmission channels for systemic risk.

This dual nature makes the case for approaching resilience at the regional rather than national level.

Coordinated investment in shared capacity costs less than each country independently sizing reserves against its own worst-case scenario. This is a logic the IEA already validates for West Africa Power Pool (WAPP), where interconnections have reduced the total installed capacity needed across member countries²¹. The logic extends to other energy pools and even continent-wide for an approach to resilience planning that could pool both physical and financial risk across uncorrelated hydrological basins.

These risks are not hypothetical. In April 2020, flooding blocked two of Uganda's major hydropower turbines, instantly knocking 20% of national grid capacity offline²². Tanzania's hydropower plants already experience repeated shortfalls during dry seasons driven by ENSO (El Niño–Southern Oscillation) and Indian Ocean Dipole variability, forcing costly thermal backup and reducing system reliability²³. The baseline is already under stress; climate change shifts the distribution further, against a backdrop of surging demand and systems not designed to absorb this level of hydrological uncertainty.

The question is therefore no longer whether African energy systems face a structural climate–financial risk: the evidence is unambiguous. It is whether governments, utilities, and their development finance partners choose to absorb that risk passively, or to manage it proactively. The following sections make the case for the latter: they lay out the financial mechanics through which hydrological shocks translate into sovereign stress, explain why parametric insurance is the most operationally suited instrument to close this protection gap, and describe how IDRIMA's three-phase methodology translates that logic into deployable solutions for East African utilities and their sovereigns.

18 IEA (2020), *Climate Impacts on African Hydropower*, International Energy Agency, Paris, pp. 12, 18, 35

19 Mwakapoma, S., Lyimo, R. & Kichonge, B. (2025). Sustainable hydropower planning and climate resilience in Tanzania for East African Power Pool (EAPP) energy security. *Discover Energy*, 5, 43. <https://doi.org/10.1007/s43937-025-00105-4>

20 <https://www.tanesco.co.tz/generation>

21 IEA (2022), *Africa Energy Outlook 2022*, International Energy Agency, Paris, Box 3.4, p. 134

22 IEA (2022), *Africa Energy Outlook 2022*, International Energy Agency, Paris, Table 4.1, p. 185.

23 Mwakapoma, S., Lyimo, R. & Kichonge, B. (2025), *op. cit.*, pp. 13, Table 4.

2.

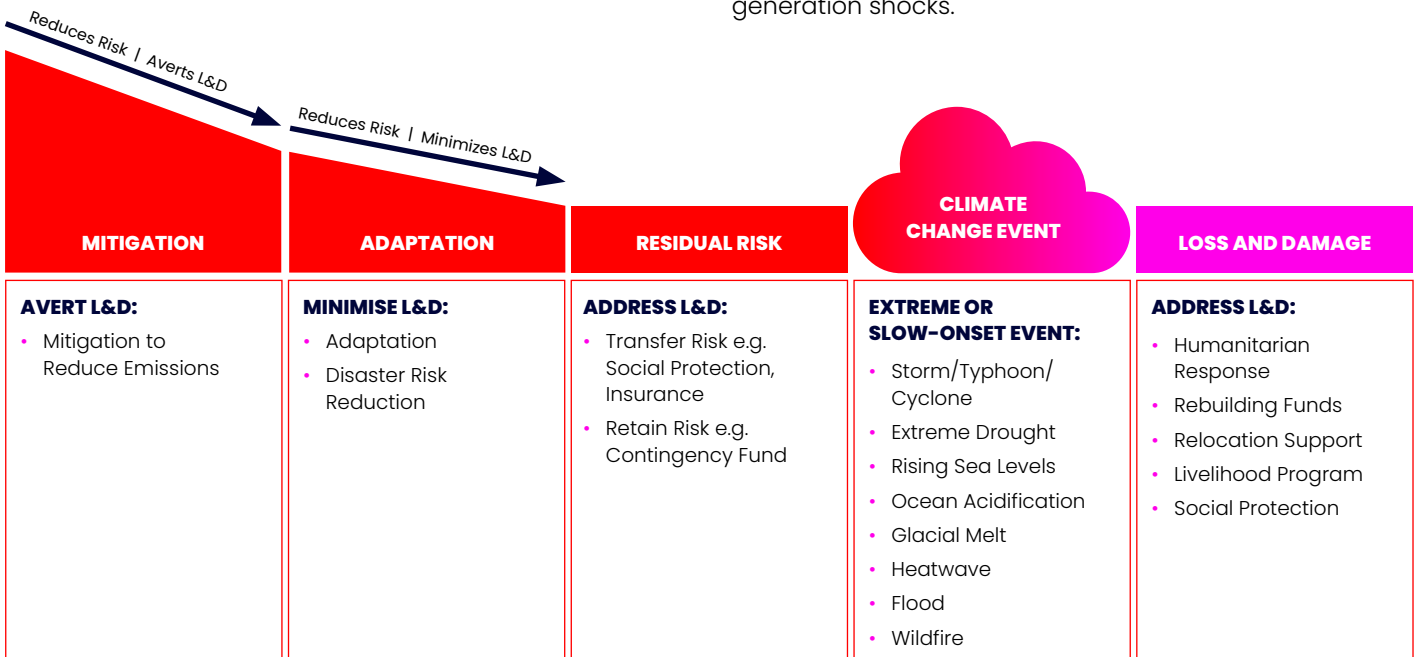
PARAMETRIC INSURANCE IS A TESTED AND YET TO BE SCALED SOLUTION

2.1. WHAT IS PARAMETRIC INSURANCE AND HOW CAN IT WORK FOR A POWER UTILITY?

Faced with growing climate exposure, a power utility or public asset owner has several levers of action, which operate in sequence rather than in isolation.

Risk reduction – through adaptation measures, infrastructure engineering, and diversification of generation assets – is the first line of defence; it shrinks the total exposure but always leaves a residual risk that no engineering solution can fully eliminate. That residual risk must then be managed through risk retention (reserves and budget reallocations, and contingency loans to absorb expected losses), risk transfer (paying a third party to bear the cost of more severe events), or a combination of both. What lies beyond these mechanisms, unmanaged losses from events that exceed retention and transfer capacity, falls into the category of loss and damage: emergency funding, reconstruction aid, social protection, etc. The question then, is not whether to build a risk management strategy, but how to design one that is comprehensive, cost-efficient, and matched to the actual distribution of risks, in terms of both frequency and severity^{24 25}. **Figure 2** shows AFD's sequential approach to risk management.

Figure 2: "After the last climate disaster, is before the next climate disaster." Diagram by Julie-Anne Richards, 2022.



24 Cuppari, Rosa Isabella, Tamlin M. Pavelisky, and Gregory W. Characklis. "Global Risk Pooling Mitigates Financial Risk from Drought in Hydropower-Dependent Countries." *Nature Communications* 17, no. 723 (2026). <https://doi.org/10.1038/s41467-025-67082-z>

25 IDF (2022), *Practical Guide to Insuring Public Assets*, Insurance Development Forum.

2. PARAMETRIC INSURANCE IS A TESTED AND YET TO BE SCALED SOLUTION

A related innovation lies in the level of coverage.

Conventional indemnity asset insurance asks: what is the damage to this specific plant? Revenue protection with parametric insurance, can be designed and priced at the *energy system level* – capturing the aggregate exposure of a utility's entire generation portfolio, or even of an interconnected national grid. This system-level approach allows for more accurate operational risk quantification, more efficient cover structuring, and a tighter alignment between the insurance product and the financial reality of the insured entity.

In a well-designed risk layering approach for an energy utility, retention covers the frequent attritional layer, revenue insurance covers both the moderate recurring and the severe insurable tail, and the catastrophic residual beyond insurance capacity is backstopped by sovereign instruments²⁶. The art of the strategy lies in calibrating the thresholds between layers – the deductible, the limit, the retention – to match the utility's risk appetite, budget, and the actual shape of its loss curve.

Three products, often conflated: Market usage distinguishes covers by what drives the payout, not by where they attach in the loss distribution:

- **Generation shortfall (volume) cover:** The index tracks hydrology – rainfall, inflow, reservoir level, streamflow. The payout converts a measured volume deficit into cash at a fixed contractual rate. Price is not a variable. Most placed hydropower covers sit here.
- **Revenue cover:** The payout reflects both the volume deficit and the price at which that volume would have been sold or replaced. This is the sense in which “revenue insurance” is used in agriculture and in energy markets.
- **Replacement cost / margin cover:** The index tracks the incremental cost of substitute generation – fuel, imports, spot purchases. The UTE Uruguay transaction (*Table 1*) combines a rainfall index with an oil price index and belongs here.

Parametric insurance – also known as index-based insurance – pays out when a pre-agreed objective indicator crosses a defined threshold, regardless of what losses actually occurred on the ground.

The index can be hydrological (reservoir inflow,

streamflow), meteorological (wind speed, rainfall, temperature), or geophysical (seismic intensity). Once the threshold is breached, the payout is automatic and rapid; within days or at most weeks, compared to months for traditional indemnity insurance, which requires loss assessment and claim adjudication²⁷. This speed of settlement is parametric insurance's most powerful feature in a post-disaster context: funds arrive when they are needed, not when the bureaucracy is ready.

Three further advantages reinforce parametric insurance' appeal for infrastructure owners. It is fully transparent: both parties know the trigger, the payout formula, and the data source in advance, reducing the scope for dispute over loss quantification. It reduces moral hazard: since the payout does not depend on actual damage, there is no incentive to exaggerate losses. And it is less informationally demanding than indemnity: structuring the contract does not require detailed asset inventories, condition surveys, or replacement cost data – a significant advantage where such data is limited²⁸.

The three benefits above are operational. A fourth is financial, and it is usually the one that carries a ministry of finance. Pre-arranged risk transfer functions as contingent capital: it converts an unpredictable and unbudgeted call on public resources into a known annual premium, and it delivers liquidity at the moment of the shock, without adding to the public debt stock.

The principal limitation is basis risk: the mismatch between the index and actual losses on the ground. Basis risk can be negative (the index does not trigger despite real damage, leaving the insured without a payout), or positive (the index triggers without real damage, generating a windfall). Negative basis risk is the more politically and operationally damaging scenario. A government that communicated coverage to citizens faces a credibility crisis when no payout arrives after a disaster. Basis risk **can and has to be mitigated** by careful index design, granular data, and rigorous calibration of the trigger to the insured's actual loss function; it is a crucial point when historical data is sparse, which is precisely the situation across much of Africa^{29 30}.

26 IDF (2022), *Practical Guide to Insuring Public Assets*, Insurance Development Forum.

27 Ibid

28 Ibid

29 Jensen, N.D., Barrett, C.B. and Mude, A.G. (2016), Index Insurance Quality and Basis Risk: Evidence from Northern Kenya. *American Journal of Agricultural Economics*, 98: 1450–1469. <https://doi.org/10.1093/ajae/aaw046>

30 Cuppari, R.I., Pavelsky, T.M. & Characklis, G.W. (2026), *Nature Communications*, 17, 723.

2. PARAMETRIC INSURANCE IS A TESTED AND YET TO BE SCALED SOLUTION

For a public buyer, basis risk is as much a contractual and governance question as a technical one. Careful index design reduces it; it does not remove it, and what remains has to be explicitly allocated and openly disclosed. The mitigations that have made parametric cover acceptable to sovereign and public-sector buyers are largely institutional: dual or secondary triggers so that a single dataset cannot alone determine the outcome; scheduled model review and recalibration between policy periods; defined second-look procedures where the index and observed conditions diverge materially; buffer or drop-down layers that absorb near-miss events; and, critically, disclosure of the modelled probability of a non-triggering loss to the finance ministry before the cover is bought rather than after it fails to pay. A public buyer that has been told in advance what the cover will not do is far better protected, politically, than one that has not.

What parametric cover does not do. It does not indemnify physical damage; a hydropower operator still needs conventional property and machinery breakdown cover, and index-based revenue protection is a complement to that, not a substitute. It does not eliminate basis risk. It does not remove the need for retention, and it is not a substitute for the reserve and contingent credit layers described above. And it is not a hedge against every driver of utility financial distress, such as tariff arrears, currency movement, and offtaker non-payment sit outside its scope. Its advantages include speed, transparency, low information requirements, and are purchased at the price of imperfect correlation with actual loss. Stated plainly, that trade is one most public buyers will accept.

Parametric insurance for energy infrastructure is an expanding but still uneven market. Products covering hydrological and wind revenue risk for generation assets are the most technically mature; physical damage covers for transmission infrastructure are less developed but attracting growing reinsurer interest as cat modelling capabilities improve.

2.2. PROTECTING HYDRO-DEPENDENT UTILITY REVENUES TO SHIELD PUBLIC FINANCES AND ENERGY TARIFFS

The link between hydrological variability and financial stress runs from the utility asset & revenue level to the sovereign level. At the asset level, hydropower plants carry a structural financial vulnerability: they are built with massive capital outlays, typically financed by debt whose repayment schedule is fixed, regardless of generation performance. A severe drought therefore creates a double bind, revenues collapse while debt obligations remain unchanged, threatening solvency. At the revenue level, the financial damage compounds through two simultaneous channels: utilities face reduced revenues from lower generation while being forced to procure backup electricity from costlier sources (thermal most of the time) to honour existing supply commitments. A scissors effect that squeezes utilities or public finances from both sides. The timing makes it worse: drought and extreme heat tend to co-occur in many regions, meaning that output shortfalls arrive precisely when cooling-driven electricity demand peaks. The sovereign consequences are documented. For example, Fitch rating agency explicitly cited

Zambia as vulnerable to a credit rating deterioration if drought forced large-scale electricity imports at a cost significant enough to unbalance the national budget³¹. The loop is self-reinforcing: weaker generation revenues erode fiscal positions, triggering rating downgrades that raise borrowing costs and further reduce the fiscal space available to invest in resilience.

Parametric revenue insurance is the instrument best suited to interrupt this cascade, for the following four reasons that are specific to how utilities operate.

First, it stabilises the cash flow that utilities need to keep operating. The parametric structure is decisive here: when a predefined hydrological index falls below a contractual threshold, a payout is triggered automatically, without loss assessment, without claim negotiation, and within days or weeks rather than months. For a utility facing simultaneously falling revenues and rising backup procurement costs, the speed of settlement is not a technical detail – it is the difference between absorbing a drought shock operationally and falling

31 Cuppari, R.I., Pavelsky, T.M. & Characklis, G.W. (2026), *Nature Communications*, 17, 723.

2. PARAMETRIC INSURANCE IS A TESTED AND YET TO BE SCALED SOLUTION

into a debt spiral. No contingency reserve achieves this: self-insurance requires liquid capital to be held idle at near-zero return, at a cost structurally prohibitive in economies where capital already carries a premium. Furthermore, **parametric insurance is often designed back-to-back with a contingency plan** describing the use of the emergency payouts, streamlining the utility's action in case of a climate shock and constraint of operation. The requirement is not new: sovereign risk pools have conditioned cover on the prior approval of a contingency plan for a decade. What the record shows is that the requirement is easily satisfied on paper. Operational reality can sometimes be different. **IDRIMA therefore treats the pre-arranged financial plan as a deliverable of the diagnostic phase**, produced alongside the index rather than after placement. For a public utility the questions are specific: whether the payout should be allocated to emergency thermal procurement and power imports; whether it can be used for adaptation measures; how it is treated for tax and for audit. Answering them at design stage is what converts a payout into a response.

Second, it protects energy tariffs and, through them, the broader economy. When a utility cannot absorb a drought shock on its own balance sheet, the pressure propagates in one of two directions: tariff increases passed on to households and industrial consumers, or losses absorbed by the public sector through emergency subsidies. Uganda's 2005–06 electricity crisis illustrates both dynamics simultaneously. The IMF characterized the episode as an acute crisis, threatening the country's macroeconomic performance. It attributed to the regional drought of 2005/06 a reduction in already inadequate hydropower capacity, that opened a production gap of nearly one-half of national demand³². Uganda's generating capacity fell from an estimated 300 MW of available capacity to just 135 MW, as Lake Victoria water levels dropped³³. The resulting financial burden did not disappear; it was displaced along both channels at once. By late 2006 Ugandan electricity was the most expensive in the region, with domestic consumers paying USD 0.24/kWh – and even that price did not reflect the underlying cost of supply, since UETCL, the state-owned transmission company, was subsidizing electricity to the tune of USD 126 million that year³⁴. Consumers absorbed a record tariff, and the public sector absorbed the remainder. Replacement

cost / margin cover insurance would have interrupted this transmission: the utility receives a payment covering the shortfall, tariffs remain decoupled from hydrological variability, and the political and economic disruption produced by emergency subsidies or abrupt tariff shocks is avoided.

Third, and perhaps most importantly, deploying revenue insurance opens a political dialogue that goes well beyond the insurance policy itself. Structuring a parametric revenue cover requires a utility to articulate, quantify, and communicate its hydrological risk exposure in financial terms to its regulator, its ministry of energy and/or finance, its lenders, and its development finance partners. This process forces conversations that are rarely held proactively: what is the utility's actual risk appetite? What share of hydrological risk should sit on the balance sheet, on the public budget, or on the insurance market? How should tariff structures account for the cost of protection? These are inherently political questions, and the insurance structuring process creates the occasion – and the data – to address them. The value of IDRIMA's approach, in this regard, is that it provides the methodology and the convening function to bring utilities, regulators, ministries of energy, finance, and development finance institutions into the same conversation about the financial architecture of resilience.

A fourth benefit accrues to those who finance the asset rather than operate it: parametric revenue cover strengthens bankability. Hydropower is highly capital-intensive and typically project-financed, with debt service fixed, regardless of how much the plant generates. Because output, and therefore revenue, swings with hydrology, lenders and investors face volatile debt-service coverage ratios (DSCR) and downside risk to project returns (NPV, IRR) – most acutely when a dry spell strikes early in the asset's life. A parametric layer that pays out when generation falls, stabilises the revenue line the financial model relies on, tightening the distribution of projected cash flows and, where the structure is robust enough for lenders to credit it, supporting better financing terms. The caveat is the one that governs the whole instrument – lenders only credit cover whose basis risk is demonstrably low, which brings bankability straight back to the quality of index design.

32 International Monetary Fund. "Uganda: 2006 Article IV Consultation and Staff Report for the 2006 Article IV Consultation, First Review of the Policy Support Instrument, Request for Waiver of Assessment Criteria, and Request for a Three-Year Policy Support Instrument: Staff Report; Public Information Notice and Press Release on the Executive Board Discussion; and Statement by the Executive Director for Uganda", IMF Staff Country Reports 2007, 029 (2007), accessed 28/07/2026, <https://doi.org/10.5089/9781451838824.002>

33 Christopher D. Gore, "Electricity and Privatisation in Uganda: The Origins of the Crisis and Problems with the Response," in *Electric Capitalism: Recolonising Africa on the Power Grid*, ed. David A. McDonald (Cape Town: HSRC Press, 2009).

34 Ibid

2. PARAMETRIC INSURANCE IS A TESTED AND YET TO BE SCALED SOLUTION

The technical prerequisites for these risk transfer instruments are now in place. Index design based on satellite-derived streamflow data, actuarial pricing of hydrological risk, and reinsurer appetite for hydropower

revenue exposure have all matured sufficiently to underpin commercial products – as evidenced by the policies already placed in Brazil, Uruguay, Nepal, and Southern Africa ([Table 1](#)).

Table 1: Selection of hydropower risk transfer mechanisms.

PRODUCT / PROJECT	COUNTRY	POLICY STATUS	PRODUCT TYPE	(RE)INSURER(S)	POLICY DURATION	PLACEMENT YEAR
UTE Weather & Oil Insurance	Uruguay	Expired	Hybrid parametric derivative (rainfall index + oil price)	Swiss Re, Allianz / Nephila Capital	18 months (Jan 2014 – Jun 2015)	2013
Upper Trishuli-1 Earthquake Cover	Nepal	Active	Parametric (seismic index)	Swiss Re Corporate Solutions (lead)	5 years (construction period, renewable annually)	2023
Brazilian Energy Parametric Policy	Brazil	Active	Parametric (hydrological index)	Swiss Re Corporate Solutions	Annual (renewable)	2016
Hydroelectric Yield Cover	Southern Africa (undisclosed)	Active	Parametric (river flow index)	Descartes Underwriting	Annual	2021
Swiss Re FLOW – Water Level Insurance	Europe (multi-country)	Active	Parametric (water level index)	Swiss Re Corporate Solutions	Up to 3 years	2022
EPM	Colombia	Active	Parametric (hydrological index)	Undisclosed	Up to 4 years	2024

2. PARAMETRIC INSURANCE IS A TESTED AND YET TO BE SCALED SOLUTION

2.3. TOWARD REGIONAL HYDROPOWER REVENUE RISK POOLS

The financial logic of risk pooling applies to hydropower revenue insurance just as it does to physical infrastructure:

when risks are uncorrelated across participants, combining them into a single instrument allows the aggregate reserves – or premiums – needed to achieve a given level of protection to fall well below what each party would need to maintain independently. This is the same mechanism that explains why diversified investment portfolios outperform concentrated ones, and it has been empirically demonstrated for hydrometeorological risk facilities: pools covering drought, storm, and rainfall risks could achieve cost reductions of 27–65% relative to individually purchased cover, depending on the correlation structure among members^{35 36 37}. For EAPP and SAPP countries looking to manage hydropower revenue risk collectively, the scale of this dividend depends critically on one empirical question: how correlated are their drought regimes? Available evidence suggests that hydrological conditions across eastern and southern Africa are not perfectly correlated. In particular, published studies indicate contrasting hydrological futures for the Nile Basin and the Zambezi Basin, with projected increases in hydropower capacity factors in parts of Eastern Africa, and declining capacity factors in parts of Southern Africa. While these findings extend beyond the current EAPP and SAPP membership, they demonstrate that neighbouring African power systems may exhibit sufficient hydrological diversity to support regional risk pooling. For the current EAPP and SAPP member countries, however, the degree of drought correlation remains an empirical question that should be assessed using historical rainfall, streamflow, reservoir and hydropower generation data, before the diversification benefits of an EAPP/SAPP-wide hydropower revenue insurance pool can be quantified.

Deploying a regional parametric insurance pool requires not just hydrological data and actuarial models, but an enabling regulatory environment at both the national and cross-border level. The picture across East and Southern Africa is uneven, but moving in the right direction.

Kenya remains the most developed insurance market of Eastern Africa, with penetration at 2.39%³⁸, alongside a mature ecosystem of index-based agricultural products.

Tanzania's insurance market is expanding rapidly; the government has progressively widened the scope of compulsory insurance through the revised Insurance Act (Cap. 394 R.E. 2023), although energy assets remain outside that perimeter. What Tanzania does have is a dedicated institutional vehicle for the sector: the Tanzania Energy Coinsurance Consortium (TECC). Launched in November 2022 under MUA Insurance Tanzania with TAN-RE as operational manager, by end-2024 it had underwritten twelve energy risks for TZS 4.5 billion (around USD 1.7 M) in gross premiums, retaining only 17.8%³⁹. Energy risk in Tanzania is thus already underwritten through a sector-specific consortium and already ceded overwhelmingly to international reinsurance capacity. Both the domestic counterparty and the reinsurance channel that a structured revenue product would need, are in place; what is absent is the product itself and the regulatory recognition of parametric triggers. At regional level, the 2025 Zanzibar Declaration – adopted by insurance supervisors from twelve East and Southern African states, including Kenya, Uganda and Tanzania – commits signatories to developing enabling frameworks for critical infrastructure insurance, with an ambition to establish regional risk pooling mechanisms. The gap that remains is therefore not the absence of regulation, nor the absence of counterparties, but the absence of explicit parametric product guidelines and of cross-border supervisory coordination frameworks specific to structured energy risk. This is a gap that international financial institutions and regulators will need to address collaboratively in the wake of the Zanzibar Declaration.

Looking beyond the immediate EAPP and SAPP case, two structural pathways could extend the pooling logic further.

The first path is pooling across energy asset types within the same geography. Solar irradiation deficits, wind speed shortfalls, and hydrological droughts are driven by different meteorological mechanisms and are not perfectly correlated – a year with low rainfall is not necessarily a year with low solar irradiance, and vice versa. Combining revenue risk from multiple generation assets into a single pool could therefore capture cross-asset diversification benefits alongside geographic ones. The critical constraint is risk homogeneity: for

35 World Bank. Sovereign Climate and Disaster Risk Pooling: World Bank Technical Contribution to the G20

36 ARC. How arc works. <https://www.arc.int/how-arc-works> (2025).

37 CCRIF. The Evolution of CCRIF's Parametric Insurance Models. <https://www.ccrif.org/sites/default/files/DRF-Course-2023/CCRIFModel-Evolution-February2023.pdf> (2025).

38 Deloitte, Insurance Outlook Report 2025, 10

39 TIRA, Annual Insurance Market Performance Report 2024

2. PARAMETRIC INSURANCE IS A TESTED AND YET TO BE SCALED SOLUTION

pooling to work actuarially, the underlying risks must share a sufficiently similar structure — same peril type, comparable trigger mechanisms, compatible product terms — so that the law of large numbers applies, and adverse selection does not undermine the pool's pricing. Combining hydrological revenue risk (driven by slow-moving, seasonal water dynamics) with wind speed risk (driven by short-duration meteorological events) in a single product raises complex basis risk and pricing challenges that would need to be resolved before this path is viable at scale.

The second path is geographic expansion toward a continental hydropower insurance pool. This would need to happen in stages, starting with a regional arrangement before expanding to additional countries and power pools. As a regional reinsurer operating across multiple African markets, ZEP-RE can support this process by bringing together governments, utilities, insurers, reinsurers and development partners, while contributing its experience in disaster risk financing and regional risk transfer.

A regional structure raises a question that national supervisors are entitled to ask first. Several markets in the region operate statutory cessions to a national reinsurer, on the stated ground of building domestic capacity and mobilising national savings. A regional energy pool

appears, on its face, to move premium in the opposite direction. The tension is real, but it is narrower than it looks, because hydropower drought risk behaves unlike the classes for which statutory cession was designed. Fire, motor and marine losses are largely independent of one another, so retaining them domestically builds capital without concentrating exposure. A national drought is correlated with almost everything else on a domestic reinsurer's balance sheet, from agricultural index portfolios to credit and currency exposure. The year the pool pays on a utility is the year that reinsurer's other lines deteriorate. On this class, retention adds concentration rather than diversification, which is a prudential argument as much as a commercial one. The proposition is therefore not that premium should leave the market, but that supervisors should set the terms on which it does: local fronting with a defined commission; a retention ladder that rises with demonstrated domestic capacity; technical transfer attached to cession approvals, and participation of local underwriters in index design. On those terms, an anchored regional pool builds the domestic market, rather than bypassing it. It is also worth noting that the foreign exchange flow reverses in the year it matters: premium leaves in normal years, and settlement arrives in the year reserves are under pressure.

HOW THIS CHALLENGE IS APPROACHED BY IDRIMA

3.1. IDRIMA: TURNING CLIMATE RISK INTO RESILIENCE

A joint initiative of the Agence Française de Développement (AFD Group) and the Insurance Development Forum (IDF), IDRIMA brings together the financial reach of development banking and the technical expertise of the world's leading reinsurers, insurers, and brokers, to help climate-vulnerable

countries move from exposure to protection. Its mandate is specific: to work with governments, state-owned utilities, municipalities, and development banks that manage critical infrastructure, serve vulnerable populations, and need to build long-term financial resilience – not next decade, but now.

3.2. WHAT WE DO

IDRIMA is not primarily an insurance product design programme. The technical instruments exist: parametric policies covering hydropower drought risk have been placed in Brazil, Uruguay, Nepal, Colombia and Southern Africa. Reinsurer appetite is growing. What has been missing is the institutional pathway that allows a state-owned utility – operating under political constraints, with limited insurance expertise, and in a regulatory environment that has never processed a parametric product – to move from awareness of the risk to a signed policy. Lack of local expertise to structure such insurance products and the need to find a long term economic model to finance the premium may also have been some constraints.

IDRIMA fills that gap through three sequential contributions.

- **The first is diagnostic:** a rigorous, data-driven assessment of the utility's hydrological exposure, quantifying how rainfall variability translates into generation losses and establishing the statistical relationship between climate indices and financial outcomes. Without this foundation, no insurer can price the risk and no regulator can approve the product.

- **The second is solution design,** calibrated to how the utility actually operates, not to what the market happens to offer, and structured to give decision-makers a transparent comparison of coverage options against their operational risk tolerance and liquidity needs.
- **The third contribution is the most distinctive: what happens around the insurance product, not within it.** Structuring a parametric revenue cover forces a utility into conversations with its energy regulator, its ministry of finance, and its lenders that are rarely held proactively: on tariff structures, on risk appetite, on the financial architecture of resilience. IDRIMA's value lies in creating the occasion and the data for that dialogue. Designing a policy is the outcome; opening that conversation is the purpose.

This is also what makes IDRIMA structurally different from a standard insurance intermediation. AFD maintains active lending relationships with finance ministries, utilities, and public banks across more than 115 countries. IDRIMA does not prospect for clients: it accompanies institutions with which AFD already has a trusted relationship, providing access to top management, operational engagement with non-sovereign entities, and a direct link to the public policy dialogue that any tariff-relevant insurance decision ultimately requires.

3. HOW THIS CHALLENGE IS APPROACHED BY IDRIMA

Figure 3: The Instituto Costarricense de Electricidad – ICE case study

CASE STUDY

PARAMETRIC DROUGHT INSURANCE FOR COSTA RICA’S NATIONAL ELECTRICITY UTILITY (ICE)

IDRIMA | ZURICH RESILIENCE SOLUTIONS | HOWDEN



Costa Rica



Hydropower



Drought Risk



Parametric

Project near completion –
presented at IDF Summit 2026, London

CONTEXT

Costa Rica generates 98.6% of its electricity from renewables – 65% from hydropower. ICE, the national utility, operates 15 hydroelectric sites totalling 2,342 MW of installed capacity.

The 2023–24 El Niño crisis exposed the system’s vulnerability: reservoirs at historic lows, a rationing plan activated, emergency thermal capacity leased (146 MW for 30 months), and regional imports absorbed by neighbouring countries.

No existing instrument covered the revenue shortfall – the gap IDRIMA set out to fill.

IDRIMA’S APPROACH

- Zurich Resilience Solutions: Climate & asset risk modelling (2025–2050–2080) and Probabilistic Hydro-Drought Impact Model (vulnerability curve)
- Howden: Co-design of parametric insurance product

KEY MODELLING FINDINGS

- Monthly portfolio rainfall is the dominant driver of power loss across all 15 sites
- Droughts hit all basins simultaneously – no in-country diversification buffer

PARAMETRIC PRODUCT DESIGN

Using 30 years of CHIRPS V3 data (1996–2025), the product will use monthly aggregated rainfall across the ICE polygon as its trigger.

Structure options provided to ICE:

Trigger	Payout Shape	Rate on Line
5th / 10th / 15th / 20th rainfall percentile	Linear or Exponential	4% / 7% / 10%

All structures will be modelled at 100% limit, to give ICE full flexibility to scale cover by month or season.

HEARD AT IDF SUMMIT 2026

Taking an approach at system level rather than asset level was essential for ICE. This work opened our eyes and innovation capacity.



– Luis Ricardo Ureña Ureña,
Insurance & Risk Coordinator, ICE

WHAT’S NEXT

- Final product selection and policy placement methodology with ICE
- Building block for a regional hydro risk pool

3. HOW THIS CHALLENGE IS APPROACHED BY IDRIMA

Figure 4: The Kenyan KENGEN case study

CASE STUDY

PARAMETRIC DROUGHT INSURANCE FOR KENYA’S NATIONAL UTILITY (KENGEN)

IDRIMA | ZEP RE | SWISS RE | BRITAM GENERAL INSURANCE

 Kenya	 Hydropower	 Drought Risk	 Parametric	Project at early stage — presented at IDF Summit 2026, London
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CONTEXT

KenGen operates 80% of Kenya’s grid and owns ~850 MW of installed hydropower capacity — 40% of national output — anchored on the Seven Forks cascade on the Tana River.

Hydropower is Kenya’s cheapest electricity source. When rains fail, generation drops, PPA penalties reduce hydro capacity-payment revenues, costly thermal backup is activated, and debt-service obligations remain unchanged — squeezing revenues precisely when margins are thinnest.

4 significant droughts hit the Tana basin since 1999. The 2023–24 La Niña brought inflows to critically low levels. PPA structures expose KenGen to penalties during these exact periods. No existing instrument covers hydro revenue shortfall.

WHY KENGEN ENGAGED IDRIMA

- Revenue certainty when water is scarce — the gap no traditional product addresses
- Parametric cover triggers fast, without loss adjustment delay
- Forward looking climate modelling outputs to inform PPA negotiations

PARTNER ROLES

IDRIMA / AFD	Project coordination, advisory, client interface with KenGen
Swiss Re	Full climate & nature risk assessment — water stress, drought, precipitation as primary hazards; risk scores 2030–2100 across 3 scenarios
Britam	Rainfall-triggered parametric product, dry-season calibrated — development
Zep Re	Institutional and Stakeholder engagement.

HEARD AT IDF SUMMIT 2026

When the rain fails, it is not just a dam that empties. It is a national energy system under stress. Having reliable data helps us engaging with reinsurance sector to challenge their pricing, but also to convince my Board to invest into insurance solutions.

— Austin Ouko, Insurance Director, KenGen

BROADER SIGNIFICANCE

- Kenya is the first country-level building block for a regional hydro risk pool in East and Southern Africa.
- ZEP-RE willing to structure pool as a segregated portfolio — Zanzibar Declaration (2025) provides political mandate
- Low cross-country drought correlation across Eastern Africa makes pooling viable
- Concessional funding (AFD, MDBs) seeds technical work; pool becomes self-sustaining as countries join

3. HOW THIS CHALLENGE IS APPROACHED BY IDRIMA

3.3. STRATEGIC DEVELOPMENT: WHERE IDRIMA IS GOING IN THE ENERGY SECTOR

On the geographic front, IDRIMA's clearest near-term priorities are countries where hydropower dependence is highest and fiscal buffers thinnest: within Africa, eastern and Southern African countries stand out. The EAPP and SAPP present compelling regional pooling opportunities given their institutional frameworks. Across Latin America and the Caribbean, as in South and Southeast Asia, many countries present similar profiles combining high hydro dependence with limited sovereign capacity to absorb drought shocks.

On the asset extension front, IDRIMA's methodology is applicable beyond hydropower to any asset whose revenue or operational performance is directly indexed to a measurable climate variable. Solar PV irradiation revenue products, and wind speed deficit covers are the most technically mature adjacent opportunities, with growing reinsurer appetite and commercially available index templates. Transmission and distribution infrastructure represents a longer-term frontier, where parametric physical damage products are beginning to develop and that IDRIMA aims at catalysing.

3.4. ACT NOW: ENSO IS HERE AND UTILITIES ARE NOT COVERED

El Niño–Southern Oscillation (ENSO) events are a driver for hydropower revenue losses across Eastern Africa and Latin America. ENSO's influence on Eastern African rainfall is well-documented – El Niño phases tend to suppress rainfall in the Zambezi basin, driving the droughts that have repeatedly crippled Southern African utilities, while La Niña phases reduce rainfall in parts of Eastern Africa; both modes create asymmetric shocks across the two sub-regions simultaneously. For utilities that are not yet insurance-ready when the next event strikes, the consequences follow the same pattern documented throughout this paper: forced electricity imports at peak prices, debt service strain, budget deficits, and potential sovereign credit deterioration, all in the middle of an operational crisis.

The Zanzibar Declaration, signed on 24th July 2025, committed twelve insurance supervisors from Eastern and Southern Africa to developing enabling frameworks for critical infrastructure insurance and to establishing regional risk pooling mechanisms.

Translating that commitment into placeable products requires decisions that no single actor holds. Hence we invite the following actors to consider the proposals below.

Power utilities and state-owned enterprises are invited to initiate a climate risk and insurance readiness assessment before the next hydrological shock arrives. Analysis at system level, rather than asset level, is what makes revenue protection possible, and it requires generation, hydrological and contractual data that only the utility holds.

Ministries of Finance are invited to integrate parametric energy risk transfer into national disaster risk financing strategies, and to consider pre-arranged cover for critical infrastructure alongside reserves and contingent credit. The IMF has recommended precisely this for Zambia, advising that climate risks be more fully reflected in the Fiscal Risk Statement, and that insurance schemes be promoted in vulnerable sectors. What such cover protects is its stressed coverage ratio, and by extension the sovereign guarantee standing behind it.

Energy regulators are invited to clarify whether, and on what terms, a climate risk transfer premium qualifies as an eligible cost within a regulated utility's revenue requirement. This is the single determination that decides whether protection outlives the funding that seeded it. Without it, a placed policy is a pilot; with it, tariff volatility for households and industry becomes something a regulator can actively manage rather than absorb after the fact.

Insurance regulators are invited to address four questions that recur in every engagement of this kind.

- The first is legal characterization: whether a parametric revenue contract constitutes insurance, a derivative, or a distinct regulated class, and on what conditions insurable interest and the indemnity principle are satisfied where no loss is adjusted. Settling this in advance, rather than product by product at approval stage, is the change that would most accelerate deployment.

3. HOW THIS CHALLENGE IS APPROACHED BY IDRIMA

- The second is a disclosure standard for basis risk: that any parametric product covering a public asset or public revenue be accompanied by a published back-test of the index against historical generation, stating the years in which it would and would not have triggered. IDRIMA applies this standard in its own engagements and would support its adoption as a market requirement.
- The third is index governance: the independence of the calculation agent, the treatment of revisions or discontinuation of the reference dataset, the fallback source, and the dispute resolution route. These are the terms on which parametric contracts fail in practice, as the regional record shows.
- The fourth is the relationship between regional pooling and domestic market development. These are frequently presented as competing objectives and need not be. Supervisors can set the terms on which

cross-border placement is permitted, including local fronting, a retention ladder that grows with domestic capacity, and technical transfer attached to cession approvals. An anchored insurance pool built on those terms strengthens local markets rather than bypassing them.

International financial institutions and development

banks are invited to incorporate insurance readiness as a standard component of energy sector financing, and to fund scoping missions within technical assistance programmes.

Private finance institutions are invited to treat insurance readiness as a credit quality signal, and to examine how parametric cover can improve financing terms for energy infrastructure in climate-exposed markets.

Designing a policy is the outcome. Opening these conversations is the purpose, and it is what IDRIMA is aiming for.



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ABOUT OUR ORGANISATIONS

ABOUT IDRIMA

IDRIMA (Integrated Disaster Risk Management Alliance) is a Facility under AFD Group designed to better integrate insurance and climate risk transfer solutions into development finance. Building in particular on IDF members expertise, it supports public actors in understanding, managing and transferring climate risks, complementing adaptation efforts and helping build long-term financial resilience.

ABOUT THE AFD

AFD Group finances and drives the transition to a fairer, safer and more resilient world, working with its partners to support communities all over the world. Drawing on the complementary strengths of its entities – Agence Française de Développement for public financing, Proparco for responsible private investment, and Expertise France for technical expertise – the Group is ideally positioned to meet all sustainable development challenges.

Working in over 160 countries, including France's Overseas Territories and Departments, the Group adapts its operations to the realities on the ground, actively supporting local initiatives. With over 4,000 projects, whose objectives are aligned with the Sustainable Development Goals (SDGs), AFD Group works on behalf of the French people, together with all stakeholders committed to economic development and the preservation of common goods: climate, biodiversity, peace, gender equality and global health. Working by your side, toward a world in common.

For more information, visit: www.afd.fr

ABOUT THE IDF

A unique public-private partnership, the IDF helps close protection gaps so that people, businesses and nations can recover faster from disaster, attract investment and thrive.

Led by industry and co-chaired by the United Nations Development Programme (UNDP) and the World Bank Group, the IDF aligns insurance expertise with public policy and development priorities to drive resilience. It brings together change agents from across sectors to help build future-ready nations.

For more information, visit: www.insdevforum.org