ENERGY FOR GROWTH HUB

Who is Driving Africa's Energy Future?

How to Fix Africa's Broken Energy Transition Planning Ecosystems

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Summary

African energy transitions will be critical to the world's climate and economic future — and will shape opportunities, livelihoods, health, and educational outcomes across the continent. Planning those transitions is a monumental task, requiring countries to build energy systems that consider social, economic, and environmental goals — as well as locally-specific political windows, trade-offs, and liabilities. Yet, all too often, the analysis and energy systems modeling that drives energy planning across the continent and in global fora is not being led by African institutions or researchers, or even commissioned by African governments. This results in energy plans and targets that lack local relevance, credibility, and impact — impeding the actual work from getting done.

To address these issues, this report presents a new framework for understanding the key elements of healthy energy transition planning ecosystems and identifies the critical gaps and leverage points in the African context. Through extensive landscape research into the structure and evolution of energy planning ecosystems within and outside Africa, we sought to understand the core conditions entrenching the problem and identify solutions capable of establishing sustainable African-led energy systems modeling, analysis, and decision-making.

There is no silver bullet. But we identify three key strategies for lasting impact:

1. **Provide flexible, long-term, and adaptive funding:** Creating room for creative solutions to flourish from the bottom up, in contrast to the norm of tightly-scoped project funding.
2. **Improve energy data sources:** Encompassing top-down support for national energy statistics capacity and bottom-up investment in research and innovation to fill data gaps.
3. **Anchor independent local expertise:** Ensuring intellectual independence and stable institutional homes for credible local experts who can respond to evolving needs.

Based on these findings, we lay the groundwork for a new initiative designed to empower African experts, and also provide actionable insights that others can incorporate into their own efforts, so that all countries have the capacities, resources, and tools to shape their own energy transitions and ultimately achieve sustainable development and global climate goals.

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Introduction

The Problem

Every country on earth is at some stage of an 'energy transition' — whether they are currently focused on replacing coal plants with renewables, electrifying transportation, expanding electricity services to all people, or deploying alternatives to cooking with wood and charcoal. What is commonly referred to as 'the energy transition' is not one thing: it is a wide spectrum of possible pathways aiming toward a future in which energy is abundant, affordable, and safe for all people.

Energy systems modeling and analysis shapes our climate and economic future by helping decision-makers explore these potential pathways; assess their risks, opportunities, and trade-offs; and develop plans that prioritize and sequence investments and policy choices. Communities with different energy resources and different energy challenges will prioritize different things: therefore, energy transition plans, and the technical analyses that inform them, must reflect the diversity and specificity of local needs and realities. Logically, this suggests that African institutions and experts should be playing a leading role in the planning process.

But Africa's energy transition planning is not being driven by African-led analysis. African governments and their development partners currently rely heavily on foreign consultants to produce one-off plans or deliverables for major global fora like Conference of the Parties (COP) summits, often with limited involvement by local experts.[1] This trend is mirrored in academic research about the continent's energy transition: A recent report by the Clean Air Task Force found that 63% of published energy transition studies on Africa do not include a single Africa-based author.[2]

Why it Matters

Without local input and leadership, African energy transition plans often lack relevance, credibility, and impact.

First, the lack of African involvement in African energy planning has resulted in plans that are often disconnected from the local context. Energy transitions in Africa — where many countries are working to address critical economic challenges and provide basic services — will be closely intertwined with countries' development outlooks. Yet only 10% of African-focused energy transition studies in the academic literature consider economic growth and poverty as metrics of interest.[2] Second, African energy planning too often suffers from insufficient analytical rigor because tools and concepts are applied without being adapted

[1] Recent examples include: Energy Transition Plans for Nigeria, Ghana and Kenya were developed by international consulting firm McKinsey in collaboration with Sustainable Energy for All and its funding partners. Foreign technical advisors also play a big role in preparing and updating the Nationally Determined Contributions (NDCs) of most African countries, including through initiatives like the NDC partnership which is managed by the World Resources Institute and supported by global network of implementing partners. IRENA and IAEA are also leading the development of African Union's Continental Master Plan process.

[2] Blimpo, M., Dato, P., Mukhaya, B., Odarno, L. (2023). Climate Change and Economic Development in Africa: A Systematic Review of Energy Transition Research. Clean Air Taskforce.

for the local context — and because the planning process remains static, without incorporating the latest locally-relevant data and research.[3] Finally, the fact that so many energy plans are driven by non-African actors weakens their local ownership and credibility.[4] This results in deficient energy transition narratives and investments that hinder development, resilience, and climate objectives.[3,5,6]

With African analysts sidelined, global energy policy and investment largely marginalizes Africa.

African expertise is markedly underrepresented in both the academic research and global political fora around energy transition planning. The majority of African countries have not a single published energy transition study focused on their economy.[6,7] Three-quarters of energy transition studies on Africa cited in reports by the Intergovernmental Panel on Climate Change (IPCC) are published by only non-Africa-based researchers,[7] and only 9% of IPCC authors are from Africa, despite Africans making up 18% of the global population.[8] This underrepresentation helps skew international policy and investment focus away from Africa and towards the perspectives and priorities of wealthy economies, further entrenching African marginalization.

Yet Africa's energy transitions are critical to the world's climate and economic future.

To achieve an equitable global net zero future, lower-income and under-electrified countries must play a much bigger role in deciding how we get there. Africa will be home to roughly a quarter of the world's total population by 2050 and is a vital source of resources critical to achieving global energy and climate goals. Mapping viable pathways to a net zero emissions global energy system cannot happen without African leadership, analysis, and data.[9] A deeper pool of African energy researchers and experts would foster new thinking, knowledge sharing, and technology transfer that benefit all — and stronger African policies, positions, and interlocutors on energy and climate issues would open new channels for global partnership, trade, and investment.

Goals of this Report

This report complements and builds upon the Energy for Growth Hub's Net Zero Equity working group report, "Who Decides Africa's Net Zero Pathways?" published one year ago.[10] That working group — comprised of economists, energy modelers, and climate experts drawn largely from Africa — focused on the central role of energy systems modeling in shaping global and local energy transition strategies; identified the significant problems

[3] Dioha, M., and Mutiso, R. M. 2023. Generating Meaningful Energy Systems Models for Africa. Issues in Science and Technology.
[4] Youba S., 2022. Building capacity for 'energy for development' in Africa. Climate Policy.
[5] Sterl, S., Shirley, R. Dortch, R. Guan, M., Turner, A. 2023. A path across the Rift: Informing African energy transitions by unearthing critical questions and data needs. World Resources Institute.
[6] Mulugetta et al. 2022. Africa needs context-relevant evidence to shape its clean energy future. Nature Energy, 7: 1015–1022.
[7] Blimpo, M., Dato, P., Mukhaya, B., Odarno, L. 2023. Climate Change and Economic Development in Africa: A Systematic Review of Energy Transition Research. Clean Air Taskforce.
[8] Carnegie Endowment for International Peace. 2023. The IPCC's Lack of Geographically Diverse Expertise May Be Stymieing Climate Efforts.
[9] Mutiso R. M. 2022. "Net-Zero plans exclude Africa". Nature.
[10] Energy for Growth Hub. 2022. Who Decides Africa's Net Zero Pathways? Five ways to fix how we model African energy transitions and why it matters for climate and development.

associated with the underrepresentation of African expertise and analysis; and explored how African countries might play a bigger role in shaping an equitable net zero future that centers their needs and priorities. The working group's core recommendations were to: (i) expand access to critical Africa-specific data, (ii) center sustainable development when modeling Africa's energy transition, and (iii) build and strengthen African institutions and analysts doing this work.

This follow-up report seeks to understand how best to realize these recommendations. The key audiences for this analysis include African experts and institutions involved in analyzing, setting and implementing energy development pathways and policies; and development and climate funders interested in strengthening local energy planning capacities and ensuring that African experts and leaders play a much greater role in driving research and policy agendas.

Approach and Methods

The findings in this report were informed by an extensive scoping of the energy systems modeling and analysis landscape both within and outside Africa.

The following key components constituted the methodology:

1. **Semi-structured interviews:** We engaged a total of 59 stakeholders representing 40 diverse organizations active in the fields of energy data and energy systems modeling and analysis in semi-structured interviews. This provided valuable insights into the current landscape, emerging trends, challenges, and opportunities. The interviewees' perspectives contributed significantly to the foundation of the report's findings. All names and references to specific input have been removed to protect respondents' identities.
2. **Desk landscape review:** We conducted a detailed desk review encompassing over 100 relevant organizations and initiatives active in the landscape of African and global energy systems modeling. This provided a robust overview of many of the organizations and initiatives that have played a role in shaping the energy systems modeling and analysis space in Africa, as well as their relative strengths and limitations.
3. **Country case studies:** We commissioned seven deep-dive case studies giving a snapshot of the energy data, modeling and decision-making landscape in illustrative countries within and outside Africa: Kenya, Senegal, Nigeria, Zambia, South Africa, China, and India. These seven case studies provided critical insights into the unique challenges, solutions, and best practices in diverse contexts.
4. **Thematic case studies:** We commissioned nine case studies focused on specific planning processes and topical deep dives to provide additional insights into real-world practice and application of energy modeling and analysis. Topics included Kenya's long running Least Cost Power Development Planning (LCPDP) and recently established Integrated National Energy Planning (INEP) processes; Chile's Energía 2050 and the Deep Decarbonization Pathways initiative's Latin America planning

exercises; African energy data ecosystems; the use of energy modeling in legal practice; the role of academic research groups; and energy planning systems at the regional and sub-national level, including one deep dive on urban energy governance in South Africa and another on regional planning by the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE).

5. **Additional consultations:** Upon completion of our initial scoping exercise, we convened a stakeholder workshop in July 2023, co-hosted by The Rockefeller Foundation, which brought together 20 leading experts to ground-truth our findings, provide additional inputs, and design follow-on work. We continued to host informational events — including a side-event at the African Climate Summit and a Kenya-focused roundtable discussion in September 2023 — and conducted one-on-one consultations with additional experts up to the publication of this report.

The Energy Transition Planning Ecosystem

The Role of Knowledge Ecosystems in Complex Problem Solving

In writing this report, we adopted an ecosystem approach to understand the core conditions entrenching the problem of weak African participation in energy system analysis and planning. Bolstered by a comprehensive landscape analysis, an ecosystem framework provides a structured way to diagnose complex problems and pinpoint the most effective strategies to address underlying issues at their source.

A knowledge ecosystem represents a dynamic network of individuals, organizations, and resources that collaborate to create, share, and apply knowledge.[11] Originally rooted in biology, researchers have widely applied the concept in business, entrepreneurship, and innovation spheres.[12,13,14] Large-scale scientific and societal problems are inherently complex with no one-size-fits-all solution. Järvi et al. state, "As the required expertise to address such complex problems is both specialized and scattered, the search for solutions and related knowledge creation increasingly occurs in ecosystems of individual and organizational actors, involving diverse inputs, resource commitments, and motives."[15] An ecosystem approach takes into account the broader context, relationships, and feedback loops, rather than focusing on an isolated aspect of the problem, to encourage systemic thinking and transformative change.

A knowledge ecosystem framework is well-suited for assessing energy transition planning. Energy system modeling and analysis involves multiple producers and users of knowledge, including technical analysts, specialized institutions, policy and decision-makers, and various

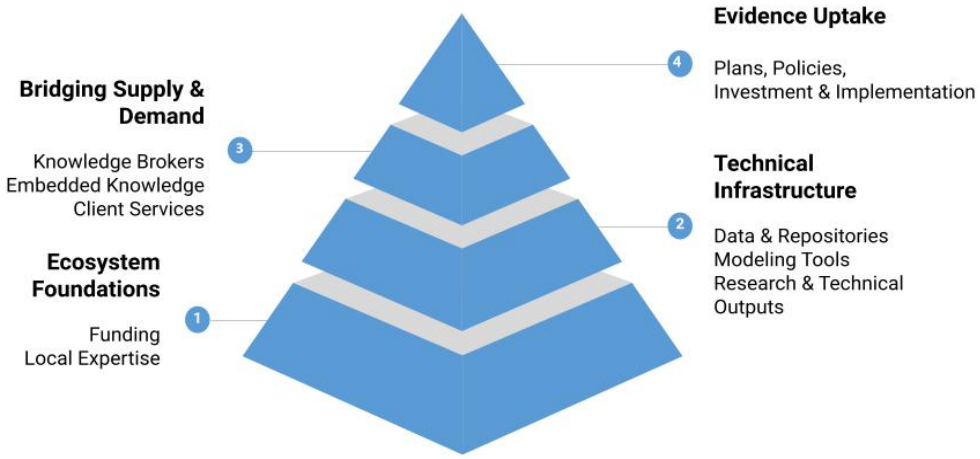
[11] Voda, A.I., Bortos, S., Şoitu, D.T. 2023. Knowledge Ecosystem: A Sustainable Theoretical Approach. European Journal of Sustainable Development. 12:2:47-66.
[12] Cobben, D., Ooms, W., Roijakkers, N., Radziwon, A. 2022. Ecosystem types: A systematic review on boundaries and goals. Journal of Business Research, Volume 142.
[13] Jacobides, M., Cennamo, C., Gawer, A. 2018. Towards a theory of ecosystems. Strat Mgmt J. 39:2255–2276.
[14] de Vasconcelos Gomes, L. A., Figueiredo Facin, A.L., Salerno, M.S., Ikenami, R.K. 2018. Unpacking the innovation ecosystem construct: Evolution, gaps and trends. Technological Forecasting and Social Change. 136: 30-48.
[15] Järvi, K., Almpanopoulou, A., Ritala, P. 2018. Organization of knowledge ecosystems: Prefigurative and partial forms. Research Policy. 47:8:1523-1537.

data sources, technical tools, and approaches. Understanding the structure and dynamics of this ecosystem is key to formulating strategies that can build the deep human, technical and institutional capacities necessary to underpin credible, actionable, and equitable energy transition plans.

The Energy Transition Planning Ecosystem Framework

Based on our scoping research and analysis and review of ecosystems in other fields, we created a framework for understanding the key elements of healthy energy transition planning ecosystems, illustrated in Figure 1.

FIGURE 1: The Energy Transition Planning Ecosystem



1. Ecosystem Foundations: Dedicated **funding** for ecosystem activities — typically provided by governments, development donors, intergovernmental organizations, and philanthropies — is critical. A lack of sustainable resources is often the overarching barrier to success. In strong ecosystems, world-class **local expertise** exists across an array of relevant disciplines (e.g., energy modeling, economics, climate science, etc.) and is housed within diverse local institutions such as universities, think tanks, technical government agencies, and consultancies. Local experts are contextually grounded and well-positioned to respond to evolving priorities and realities.

2. Technical Infrastructure: Robust, accessible and timely energy **data** are a fundamental input when designing, implementing, and maintaining energy models and plans. Critically important are statistical **repositories** that allow for collecting, processing, updating, publishing and curating energy data. In a healthy ecosystem, a variety of actors produce relevant data including government statisticians, industry players, and researchers who are a rich source of bottom-up data via innovative methods such as satellite imagery, remote sensing, artificial intelligence, and machine learning. **Modeling tools** are software programs used to create stylized representations of complex energy systems, providing a structured framework to assess costs, interdependencies, opportunities, risks, and trade-offs, enabling relevant actors to explore and weigh the impacts of different energy development trajectories and investments. Leveraging these data and tools, technical experts conduct

analyses and produce **technical outputs** such as research papers, reports and outlooks, which are validated through peer review and other channels, and feed into a research ecosystem where efforts build on each other and move the state of knowledge forward. Rigorous technical work forms the basis for insights that feed into downstream policies and decision-making. The underlying knowledge base must thus be both scientifically sound and context-specific, and lines of inquiry should have resonance with decision making priorities.

3. Bridging Supply and Demand: This critical knowledge translation layer bridges the evidence supply with end-users such as decision-makers in government and industry. These translators include both **knowledge brokers** and advisors (such as consultants, policy practitioners, and think tankers), as well as centers of **embedded expertise** within demand-side actors (e.g., technical divisions within government agencies). These actors synthesize technical insights into advice and analysis tailored to evolving needs, including by providing on-demand **client services** via commissions from decision-makers.

4. Evidence Uptake: These are the multiple forms in which knowledge and evidence produced upstream in the ecosystem are taken up and utilized — from informing energy and climate **plans** and **policies** to guiding **investment** and **implementation**. Demand-side actors sit across government, industry, civil society, multi-lateral organizations, global fora, media, and other diverse domains.

It is important to stress that relationships and feedback loops between the pillars and across the entire ecosystem are dynamic and iterative. Energy transition planning is not a static or one-off process. The path between ideas and evidence to policy and implementation is often meandering and unpredictable. A robust ecosystem is one in which diverse actors across research, advocacy, policy and implementation can produce iterative advice and analysis that reflects evolving leading edge research, is adapted to local context, and both informs and responds to shifting policy and civic discourse. The Problem Driven Iterative Adaptation (PDIA) approach developed by Matt Andrews, Lant Pritchett, and colleagues at Harvard University also speaks to the tight feedback loops that allow organizations to build their own solutions that fit their local context.[16]

Understanding African Energy Planning Ecosystems

The framework described above provides a benchmark to compare energy planning ecosystems across geographies and contexts. Based on our analysis, we found the four pillars are consistent across a variety of political, economic, and institutional structures and configurations. Understanding the key actors within each pillar and their proximity to locally embedded capacities and institutions is key to a supporting a healthy ecosystem. We focus our insights on the most common trends across the continent, drawing on both country-specific case studies and broader landscaping research.

[16] Andrews, Matthew, Lant Pritchett, and Michael Woolcock. 2017. Building State Capability: Evidence, Analysis, Action. Oxford University Press.

Comparative Analysis of Global and African Energy Planning Ecosystems

Through our extensive landscape research, we sought to understand the structure and evolution of energy planning systems around the world, encompassing both mature energy markets (e.g., the United States and Europe) and a broad spectrum of emerging economies (e.g., India, China, and Chile). Table 1 summarizes a comparison of the key findings from global geographies to those on the African continent.

TABLE 1: Key Findings from Global vs. African Energy Planning Ecosystems

Pillar	Highlights from the Global Landscape	Highlights from the African Landscape
Funding *Ecosystem Foundations*	· Diverse funding sources are critical, ranging from government funding for basic research to analysis funded by industry and interest groups.	· Short-term, one-off, tightly prescribed project funding is the norm.[17] · European and UK donor funding dominates.[18] · Philanthropic funders play a small but growing role.[19] · MDBs and DFIs provide targeted support,[20] and the African Development Bank plays a bigger regional role.[21] · Domestic government funding is limited, though South Africa is a notable exception.[22]

[17] Over half of our interviewees (51%) explicitly called out challenges related to securing long-term funding and flexible funding.
[18] EU funding channels include EU-AU Energy Partnership, European Union - Global Technical Assistance Facility (EU-GTAF), and direct bilateral funding from European countries or into initiatives such as the NDC Partnership. UK is also a major partner in this space through support for initiatives like the Climate Compatible Growth programme, the International 2050 Calculator programme, and UK-PACT.
[19] Major philanthropic activity is currently focused on supporting Just Energy Transition processes in South Africa, with plans to expand to other geographies. Rockefeller Foundation and Bloomberg Foundation, through collaborations with Sustainable Energy for All, are playing a big role in supporting development of Energy Transition Plans in Nigeria, Ghana, Kenya, and more to come. Philanthropy has historically played a bigger role in initiatives focused on planning in the off-grid and energy access space, e.g. supporting WRI's Energy Access Explorer and others.
[20] For example World Bank's country climate and development reports (CCDRs) based on internal modeling and analysis that guide country programs and investments, as well as technical assistance tied to specific projects.
[21] AfDB supports a number of regional planning and capacity building activities, including through its new Africa Energy Transition Catalyst Program.
[22] The South African government has historically allocated some funding for local analysis and research e.g., providing dedicated funding for energy systems modeling researchers at local universities. It also has a long history of funding local players to conduct analysis related to climate and energy planning, such as the 2004 National Climate Change Response Strategy and 2007 Long-term Mitigation Scenario (LTMS) processes that have served as important anchors for the country's energy and climate planning ecosystem.

Local Expertise *Ecosystem Foundations*	• Universities play a major role in training and retaining talent.[23] • Energy modeling forums have been particularly successful in grounding skills and collaboration.[24] • Returning foreign-trained experts have been a major driver in anchoring local capacities in emerging ecosystems.[25]	• 86% of our interviewees cited local technical capacity as one of the biggest gaps. • The majority of energy systems modeling capacity, funding, and expertise sits in non-African institutions.[26] • One-off training workshops dominate capacity building interventions.[27] • Few dedicated training courses exist at the undergraduate or postgraduate level.[28] • Systemic underfunding in higher education and local research institutions perpetuates expertise gaps.[29] • African experts in the diaspora are also making significant contributions to advancing energy systems research.[30]
Data *Technical Infrastructure*	• Strong institutionalized infrastructure for energy data management at the country level is	• 78% of our interviewees cited data as one of the biggest gaps. • Few countries can produce robust

[23] Energy modeling and analysis is typically embedded in broader energy-related degree programs (e.g. KTH, DTU, Carnegie Mellon), and university-based energy research groups serve as major anchors for the entire ecosystem by training and housing experts.

[24] For example, the US Energy Modeling Forum (EMF) is a decades-long platform that brings together experts to improve modeling tools across a range of energy and environmental themes. The community of practice built through the EMF is often more additive than the technical outputs themselves, including training numerous graduate students involved in the projects. US EMF has inspired similar initiatives in Europe and India. The Deep Decarbonization Pathways project (DPP) has been successful in cultivating and maintaining expert networks through in-country modeling exercises in both mature and emerging ecosystems.

[25] In India, for example, local energy modeling and planning activities were heavily shaped by leading experts such Prof. Rajendra Pachauri, Dr. Kirit S. Parikh, and Prof Ramprasad Sengputa who received advanced training or other professional experiences abroad.

[26] National and regional offices of international NGOs and consultancies (e.g. SEI, WRI, McKinsey, Dalberg) hold significant expertise base. Overreliance on these and other external consultants perpetuates low investment in building local capacities. South Africa is an outlier with stronger local capacities, though trained experts are often recruited into more remunerative sectors where skills in data science and related fields are in high demand.

[27] A notable example for high quality training is CCG's Energy Modeling for Platform-Africa summer school and online courses, though long-term impact is constrained by lack of on-going support for further professional development and collaboration - a promising area of future work for this initiative.

[28] The University of Cape Town's now defunct Masters of Energy studies included dedicated courses in energy modeling, and this training is now limited to a small group of research-based masters & PhD students.

[29] See Dr. Sokona's powerful reflection on why decades of "capacity building" efforts in the African energy sector hasn't delivered lasting impact due to failure to address core issues.

[30] For example, Nigerian researchers spread around the globe are actively involved in adapting modeling tools for the Nigerian context. This includes work by Michael Dioha, who developed a TIMES-Nigeria energy system model which was later adopted for modeling Nigeria's Renewable Energy Roadmap, and Nnaemeka Emodi, who developed a LEAP model for Nigeria's energy system.

	critical.[31] • International organizations like the International Energy Agency are important data sources, but rely on a strong base of reported national statistics from member countries. • New tech is revolutionizing data collection & analytics.[32]	and timely energy balances,[33] and limited funding for national statistics capacity.[34] • Uneven sectoral data coverage, particularly outside power sector. • Increasing use of innovative data collection tools to fill data gaps.[35]
Technical Tools *Technical Infrastructure*	• A healthy ecosystem requires a wide range of modeling tools and approaches to probe different aspects of complex energy systems.[36] • Increasing availability of open source tools is a growing trend,[37] but sustainable funding to expand capabilities and maintain tools is a challenge.[38] • A related push towards open source input databases is underway,[39] but more challenging.[40]	• Models and tools are poorly adapted to the local context,[41] and limited funding is available to support development and maintenance. • Proprietary tools are cost prohibitive for many local users; open source alternatives are gaining traction. • Lack of comprehensive context-specific input databases is a major constraint to the applicability of modeling tools,[42] and is an area of increasing focus.[43]

[31] Energy data repositories typically managed by a government agency or department, but structure varies from a dedicated agency (e.g. US Energy Information Agency) or division with a national statistics body (e.g. Statistics Netherlands).
[32] Diverse actors (e.g., research groups, industry players) are advancing data innovations e.g., satellite technology, artificial intelligence and machine learning, remote sensing, forecasting.
[33] This is reflected in the major gaps in the African Union's Energy Agency's (AFREC) energy database.
[34] Leading efforts by AFREC and IEA are modest scope and resources, and are heavily reliant on external experts & consultants.
[35] For example, researchers at E-GUIDE and Atlas AI are leveraging satellite data and machine learning technologies to fill energy and climate data gaps in the East African context.
[36] See Luca Petrarulo's synthesis piece for a simple classification of different modeling tools, ranging from optimization models specify the conditions needed to meet a specific target, simulation models used to generate forecasts and predictions, mixed models that incorporate optimization and predictive elements, as well as energy-economy models that probe interactions between energy systems and economic activities.
[37] According to the Open Energy Modeling Initiative (openmod), for a model to be open source its source code should be accessible to anyone and can be freely used, studied, and modified. Examples of such tools are listed on the Openmod site.
[38] In contrast, private and commercial tools have an assured revenue stream via licensing fees. The widely used LEAP tool has a unique revenue model in which licensing fees for private users support free access for government, academic, non-profit, and users from low-income countries.
[39] Data input requirements for each modeling tool will vary depending on its purpose, scope, complexity, resolution, and other features. These are represented as structured databases and are a critical component of energy models, and include information such as energy sources, end-use demand, technology characteristics (efficiency, capacity factors, emissions profiles), economic parameters, relevant policies and regulations, etc. The Open Energy Outlook is an example of an initiative that couples an open source model of the US energy system with a fully open input database that documents all data types and sources used with the model.
[40] Sensitivities such as ethical and privacy considerations, security, intellectual property, and others constrain data sharing. The wide variety of data specifications for different modeling tools and contexts is a further complication.
[41] See Dioha and Mutiso (2023) and Jaramillo (2022).
[42] Particularly pressing gaps include poor country-specific data on technology costs and learning curves, as well as limited end-use demand data and forecasting (especially outside the power sector).
[43] Examples of projects aimed at improving input databases for African energy modeling include CCG's Data Starter Kits and IRENA's recent work on solar and wind supply regions. In many cases, lack of upstream sources of granular data limit efforts.

Research & Outputs *Technical Infrastructure*	· Rich landscape of published research in academic journals and grey literature advances the state of knowledge. · Regional and global technical work is anchored on strong localized capacities.[44]	· Limited published energy research across the continent,[45] and black box methodologies used by external consultants cannot be scrutinized or built upon.[46] · Broad regional studies dominate, and country-level analysis is limited.[47]
Bridging Supply & Demand	· Poor tailoring of technical work for uptake by policy and other non-technical audiences is a universal issue.[48] · Embedding technical capacities within government (particularly in technical agencies) is an important strategy,[49] but approaches and outcomes vary widely.[50] · Independent think tanks play a major role in influencing policy,[51]	· Relevance of technical work to policy is also an issue, though researcher-practitioners with policy experience and entry points are common.[54] · Many initiatives target technical capacity building of government actors,[55] but sustainable skills transfer and deep embedding of capacities is limited with a few exceptions.[56,57]

[44] For example, the IPCC incorporates the work of thousands of scientists, leveraging existing and decentralized capacities around the world. Notably, Africans are poorly represented: 75% of energy transition studies on Africa cited in IPCC reports are published by only non-Africa-based researchers and only 9% of IPCC authors are from Africa.
[45] Blimpo, M., Dato, P., Mukhaya, B., Odarno, L. (2023). Climate Change and Economic Development in Africa: A Systematic Review of Energy Transition Research. Clean Air Taskforce.
[46] See Pfenninger et al.(2017) for more details on why transparency in modeling tools and related analyses are necessary to improve scientific quality, efficiency, and knowledge translation into policy.
[47] See Mulugetta et al. (2022), Clean Air Task Force (2023), and World Resources Institute (2023).
[48] A successful strategy to overcome this barrier is to engage policy actors from the outset of technical work and continuously throughout the process. For example, The Mitigation Action Plans and Scenarios (MAPS) initiative in Latin America provided an effective platform for government and other stakeholders to actively shape modeling exercises from the initial scenario building stage.
[49] Institutionalized technical capacities that are deeply embedded within and directly responsive to policy and decision-making ensure tight feedback loops between evidence supply and demand.
[50] Positive examples include: Netherlands Environmental Assessment Agency (PBL), a dedicated technical agency whose remit includes conducting energy, climate and environmental analysis on request from other government departments; Brazil's EPE, a state-owned research institution that is fully integrated into energy planning; The China Renewable Energy Center (CNREC), a unit within the China's Energy Research Institute (ERI) which was created to facilitate international technical collaboration on renewables integration and has since been fully absorbed into ERI thereby institutionalizing its influence. As decision-making on energy and climate issues occurs at different levels within governments, embedding capacity within the right spheres is critical and will be highly context specific. See this working paper from Jose Maria Valenzuela (2023) for an insightful discussion of embedded knowledge networks within power sector regulation in different geographies.
[51] For example, the EU Parliament's Member Research Service tracks analysis from leading think tanks in their "What Think Tanks Are Thinking" series, including positions on energy transition and climate issues.
[54] A consequence of the chronic underinvestment in basic research on the continent is that many African academics dabble in consulting, often for development donors working on policy-facing projects. This is a major source of dysfunction, but also has the unique side-effect of creating a culture of researcher-practitioners who have stronger orientation towards policy than traditional academics.
[55] Initiatives targeting government actors on the continent include: NDC Partnership that provides support to developing countries on developing and updating their NDCs, IRENA and IAEA's collaboration with the African Union on a Continental Master Plan, and SE4All's work supporting governments to create Energy Transition and Investment Plans.
[56] Continued dependence on external partners is a manifestation of these failures. Limited staff and high turnover rates within government agencies also compound the challenge of embedding capacities.
[57] Kenya's Least Cost Power Development Planning (LCPDP) process is a notable success story. The plan is updated every two years by a multi-agency power sector technical team under the supervision of a Ministry of Energy oversight committee. This process evolved from being fully led by external consultants (before 1986), to being developed in collaboration with external experts (1987-2000), to being fully led by in-country experts (since 2001).

	but facing existential crises in an evolving political climate.[52] • Private consulting firms, international NGOs, and other global brands play a role in providing advice to policymakers, but engage alongside academics, think tanks, and other local players in more mature ecosystems.[53]	• The region has few think tanks,[58] and are highly dependent on short-term project funding from donors.[59] • International consulting firms and NGOs (including through their local & regional offices) dominate in securing commissions from government and development partners.
Evidence Uptake	• Path between evidence, policy, and implementation is dynamic and iterative, and strongly reliant on long-running relationships between credible experts and decisionmakers rather than specific outputs.[60] • Diverse actors outside of government, including private sector and advocacy groups, are involved in all stages of energy planning in mature ecosystems.	• A lot of activity is concentrated on producing static plans and reports that have limited impact on policy and implementation.[61] • Limited involvement of private sector and other decisionmakers outside government in planning processes, though demand for analysis is increasing in many domains such as the legal sector.[62]

Africa's Ecosystem is Lopsided

Overall, African institutions across the ecosystem are underfunded, understaffed, or entirely absent. Our landscape research identified a variety of initiatives — mainly led by foreign or international organizations — concentrated on bolstering individual components of the African ecosystem. However, the vast majority of efforts primarily focus on building government capacity to apply particular technical tools or produce one-off plans, with little attention paid to addressing the essential need for skilled independent expertise capable of

[52] These two essays are a helpful guide to exploring the state of the 21st century western think tank: Niblett (2018) and Pautz (2020).
[53] The influence of global consulting firms in government policy and processes is a growing concern in wealthy countries as well.
[58] According to the 2020 Think Tank Index Report, sub-Saharan Africa accounts for 6% of the global share of think tanks, versus 47% in Europe and North America.
[59] Lah, J. 2017. Think Tank Funders in Developing Countries: Status and Outlook.
[60] Since the path from evidence to policy is non-linear, policy impact relies on existence of trusted experts who are positioned to provide input and advice in response to changing political and policy needs. The recent passage of the Inflation Reduction Act (IRA), which is the first major climate legislation in the United States, illustrates this well. Years of debate, compromise, shifting strategies, political headwinds and chance alignments preceded this legislative landmark. Implementing the provisions of the IRA is currently the subject of heated debate, showing that the work of energy analysis and planning doesn't end at the promulgation of a policy or publication of a report.
[61] External consultants dominate in producing these outputs, channeling resources away from local experts and institutions that are better suited to providing adaptive and long-term policy advice.
[62] Legal professionals are increasingly called upon to navigate complex regulatory frameworks and related litigation that require a technical understanding of energy system. For example, claimants utilized independent energy modeling analysis to challenge the projections from the Kenyan government in the recent Lamu coal plant litigation, and was instrumental in winning the case.

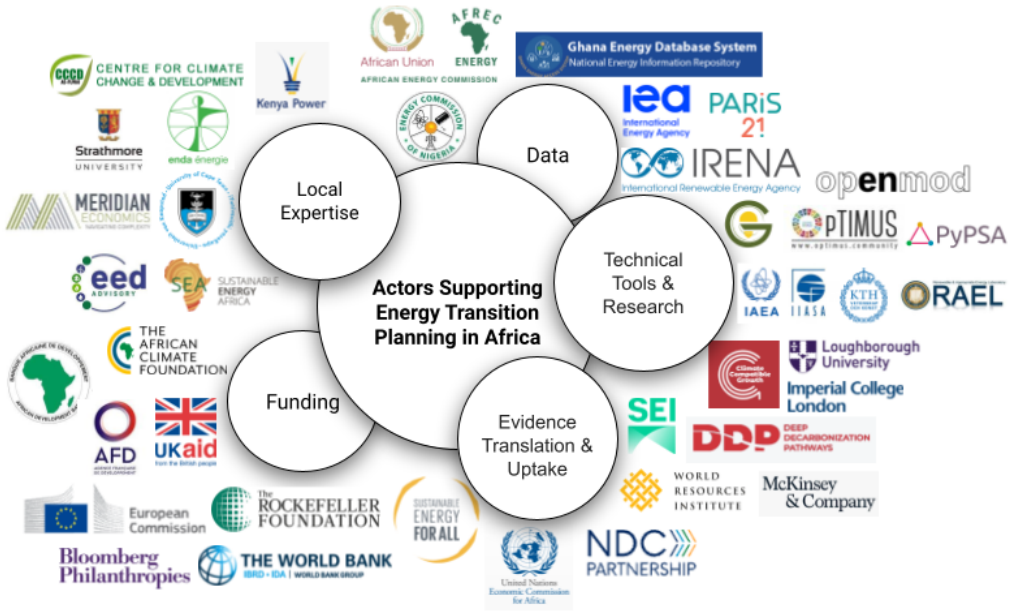
strengthening the local evidence base and informing decision-making. Alternatively, many initiatives offer short-term training programs that are disconnected from knowledge generation and decision-making and often lose effectiveness due to high turnover rates. Despite these gaps, we identified a number of leverage points that can be built on to strengthen the overall ecosystem function in many African countries.

TABLE 2: Top Challenges and Leverage Points in the African Energy Transition Planning Ecosystem

Challenges	Leverage Points
• Dysfunctional donor/outsider involvement (e.g., limited local ownership of agendas, preference for external implementers, lack of coherence and duplication).[63] • Limited long-term and flexible funding. • Projects and deliverables are short-term and tightly prescribed by external funders, and funding levels have not reached the adequate scale to make the aggregate of these projects sufficient. • Unsustainable initiatives (interest dries up when donor money dries up and consultants move on). • Lack of granular data & centralized data clearing houses. • Over-reliance on external consultants perpetuates low investment in building local capacities. • Conflicting and duplicative responsibilities for energy planning across different parts of government.[64] • Constrained data and technical capacities at national and sub-national levels.[65] • Weak transference of technical results into policy and decision-making.	• Foundation of existing actors & initiatives in need of longer-term funding and coordinated support. • Growing pool of African experts locally and in the diaspora. • Significant data already exists but needs to be aggregated and made available. • New technology and innovative approaches to build data sets; and increasing availability of robust and affordable open-source modeling tools. • Opportunities to build on existing capacities in power sector analysis and planning. • Increasing interest and engagement in energy systems modeling by governments, industry, and funders.

[63] UK-funded Energy and Economic Growth (EEG) programme launched 5 principles at COP26 which are intended to serve as a "code of conduct" for development partners to support more coherent strategic energy planning, which is an important first step though uptake has been slow.
[64] For example, Nigeria has over 15 different policy frameworks related to sustainable energy planning, often with conflicting targets and managed by several uncoordinated government institutions.
[65] While the critiques against "whole of Africa" analysis and push for more country-level narratives is gaining traction, the role of sub-national planning and capacities is particularly poorly understood. Yet, sub-national entities such as cities and municipalities are under increasing pressures to weigh complex energy and climate decisions. For example, the electricity crisis and rise of distributed generation are pushing increasing decision-making responsibilities to municipalities in South Africa. In Kenya, devolution of some energy functions under the new constitution requires counties to develop complex County Energy Plans (CEP), but lacking the technical and financial resources only 6 of 47 counties have completed a CEP to date. The City of Cape Town is one of the few on the continent with a well-staffed energy and climate directorate that has internal capacity to drive detailed energy modeling exercises and related analyses in-house.

FIGURE 2: Sample of Actors Active in Supporting Energy Modeling and Transition Planning Activities in Africa[66]



Strategies to Strengthen Local Energy Planning Ecosystems in Africa

Creating a robust and comprehensive ecosystem from the ground up is a tall order. Energy planning ecosystems in wealthy countries — like the intricate network in the United States involving overlapping efforts by national labs, government entities, universities, lobbyists, think tanks, consultancies, and grassroots advocacy groups — have evolved and adapted over time. As Järvi et al. (2018) point out, knowledge ecosystems involve diverse inputs, resource commitments, and motives.[67] Through our scoping analysis, we identified **three major strategies** with the highest potential to seed strong nucleation points within the ecosystem, providing an anchor for its sustainable growth and development:

1. Provide flexible, long-term, and adaptive funding. Wealthy economies, development funders, and philanthropic institutions will continue to play a role within African energy transition planning ecosystems. However, in contrast to the typical use of tightly scoped requests for proposals in which bidders compete to produce specific deliverables, they should earmark resources to provide flexible long-term funding to African institutions and experts. This adaptive funding will allow local actors to set and pursue research and policy agendas most relevant to their own countries, creating room for creative solutions to flourish from the bottom-up. This new funding approach will provide true agency to recipients yet also requires high levels of trust and patient investment. As Dr. Youba Sokona notes,

[66] This sampling of initiatives and institutions reflects a subset of actors we interviewed or reviewed during our landscape research and does not represent the full scope of actors active in this space.
[67] Järvi, K., Almpanopoulou, A., Ritala, P. 2018. Organization of knowledge ecosystems: Prefigurative and partial forms. Research Policy. 47:8:1523-1537.

"intellectual, institutional, and political resources under control of southern leadership, with northern solidarity" is the goal.[68] African governments must also play a part in this shift by providing more funding for local research, particularly in strategic areas like energy and climate.[69]

2. Improve energy data sources. Model outputs and related analyses are only as good as their data inputs. Both top-down and bottom-up strategies will be needed to make energy data sources robust and timely. For the former, particular focus should be placed on strengthening national energy statistics capacity, as comprehensive, timely, and quality energy statistics are the foundation of all energy planning. Deep and long-term support to national statistics agencies should be tailored to their baseline capacities, needs and ambitions. This will range from aggregating existing data sources to improve foundational statistical reports to expanding publicly accessible energy data repositories.[70] Across the board, significant focus should be placed on institutionalizing processes and capacities. The bottom-up strategy should involve funding independent research that leverages innovative (e.g., satellite technology, AI & machine learning, remote sensing, advanced forecasting techniques) and targeted field-based (e.g., community consultations, crowdsourcing) to fill critical data gaps rapidly, efficiently and cost-effectively.

3. Anchor independent local expertise. Local networks of researchers and technical experts housed at universities, research institutions, and think tanks have a force-multiplying effect across the ecosystem. These independent experts create new context-specific knowledge and tools, often act as entry points to inform policy debates and civic discourse, and can provide on-demand advice and client services to decision-makers to displace foreign consultants. They also train the next generation of analysts and experts, including the revolving pool of students and junior researchers trained at local universities and research institutions, and are well positioned to form productive collaborations with peers in regional and global scholarly and practitioner communities. Too often, promising young African researchers emigrate solely due to noncompetitive academic opportunities and job markets. They need dedicated resources and stable institutional homes to earn good salaries, pursue self-defined research interests, cultivate relationships with decisionmakers, and build their professional reputations and visibility.

Of these three strategies, we believe anchoring independent local expertise has the highest potential for transformative change across the continent as it cuts across all ecosystem pillars and intersects with diverse actors. It also incorporates the other two strategies: the intellectual independence and institutional stability of local experts will require long-term and adaptive funding; and independent experts will also be instrumental to furthering bottom-up research and innovation to help fill local data gaps.[71]

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[68] Youba S., 2022. Building capacity for 'energy for development' in Africa. Climate Policy.
[69] As a starting point, governments should work towards meeting the 2006 African Union target to invest 1% of GDP in research and development, building from the current average of 0.51% of GDP for sub-Saharan Africa.
[70] Two notable examples include Malawi, which published its first energy statistics digest earlier this year and Ghana, who is ahead of the curve in the region with their Ghana Energy Database System.
[71] Note however that top-down support for national statistics capacity is not well covered under the banner of anchoring independent expertise, and will require tailored investments to support relevant government institutions.

Independent local expertise has been instrumental in shaping India's national energy planning process

Globally, independent expertise housed within stable institutional homes has been instrumental in shaping national energy planning processes. For example, local academics and non-governmental research institutions have played a key role in India's energy planning for decades. In the 1980s, the Indian Planning Commission[72] created a first of its kind steering group for integrated energy modeling exercises comprised of leading Indian academics.[73] Over time, the Government of India has increasingly placed trust and credibility in experts from local research institutions, leading to extensive use of modeling in Indian energy and climate planning.[74] Local experts are also regularly called upon to serve various government working groups and committees. The Indian ecosystem is still maturing, but showcases the cross-cutting impact of early investments in independent expertise.

The importance of deep independent expertise in South Africa

Within Africa, the South African experience illustrates the importance of deep independent expertise clearly. The current Just Energy Transition Partnership (JET-P) process,[75] is drawing on technical expertise that has deep roots beyond the current moment, dating back to capacities built over a decade and a half ago during the now obsolete Long-Term Mitigation Scenario (LTMS) process,[76] which itself drew from a solid foundation of energy research at local institutions such as the University of Cape Town's Energy Research Centre.[77] This experience underscores that no single report, plan, or policy matters as much as the existence of world-class, trusted experts in the ecosystem who can respond to evolving needs.

Conclusion and Next Steps

International funders are showing increasing interest in supporting African energy transitions that achieve both development and climate goals. However, without a deep understanding of how healthy energy planning ecosystems are structured and nurtured, this unique window of opportunity will miss the mark in fostering true long-lasting and locally relevant impact.

[72] Note that the Planning Commission was replaced by a new agency known as NITI Ayog in 2015.
[73] Sengupta, R. 1993. Energy Modelling for India: Towards a Policy for Commercial Energy. Planning Commission, Government of India.
[74] A strong network of Indian think tanks are involved in energy modeling and analysis, including The Energy and Resources Institute (TERI), Council on Energy, Environment and Water (CEEW); Prayas (Energy Group), National Council of Applied Economic Research (NCAER); Integrated Research for Action Development (IRADe), and the Center for Study of Science, Technology and Policy (CSTEP). Academic institutions with strong involvement in this space include Jawaharlal Nehru University, IIT Delhi, IIT Bombay, and others.
[75] Fakir, S. 2023. South Africa's Just Energy Transition Partnership: A novel approach transforming the international landscape on delivering NDC financial goals at scale. South African Journal of International Affairs, 30:2, 297-312.
[76] Tyler, E. 2018. Long-term Planning Efforts: The South African Long-term Mitigation Scenario Planning Process. Case Study. University of Cape Town.
[77] Winkler, H. 2007. Long Term Mitigation Scenarios: Technical Report. Prepared by the Energy Research Centre for Department of Environment Affairs and Tourism, Pretoria.

The vast majority of current efforts to strengthen African capacity in energy systems planning and analysis provide project-based support for very narrowly scoped efforts, such as instructing analysts in the use of new modeling tools, delivering short-term training programs, or producing outputs that are often disconnected from iterative knowledge generation and decision-making. Without deep pools of local expertise and stable African-based institutions, these efforts may successfully produce one-off outputs or plans -- but ultimately will not elevate African energy planning ecosystems to the level needed for countries to navigate complex energy and climate decisions effectively.

This report identifies key strategies that development and climate funders, international finance institutions, and African governments should prioritize: (i) provide flexible, long-term, and adaptive funding, (ii) improve energy data sources, and (iii) anchor independent local expertise. Given that each country has vastly different needs, institutional structures, and existing leverages points, implementation of these strategies will vary depending on the specific context. However, a common theme that emerged from our analysis was the crucial and versatile role that independent experts play in a healthy energy planning ecosystem in any country. As a result, investments targeted at supporting the intellectual independence and institutional stability of local experts deliver a strong multiplier effect and high bang for buck in the short to long term.

Moving forward, the findings presented in this report will feed into the design of a new initiative that aims to puts into practice the leading strategy around anchoring independent expertise. The proposed initiative will provide competitive multi-year grant funding to interdisciplinary networks of experts housed in existing African institutions to pursue self-defined energy systems research and translation activities, while supporting broader ecosystem goals including training young analysts, collaborating with regional and global peers, and informing policy and civic discourse. Depending on the local context, their research may include assessing viable national or subnational pathways to accomplish goals including achieving universal energy access, scaling up renewable energy, accelerating the transition from coal, and powering economic growth without locking in dependence on carbon-intensive technologies. As a proof of concept, the effort aims to validate the impact of this approach to nucleating vibrant energy planning ecosystems in diverse African geographies, and crowd-in follow-on investments to address the huge unmet need for locally grounded and globally connected African experts on the energy transition. The initiative is still under development with input from a wide range of stakeholders and will be launched in 2024 under full African leadership. More broadly, we hope that the findings in this report inspire and help bolster a wide range of other initiatives and efforts across the continent.

Ensuring an equitable and prosperous energy future for over 1 billion Africans — a quarter of humanity by 2050 – requires an end to the status quo of static planning that is detached from local knowledge and political priorities. Over the course of our research, we've had the honor of engaging with so many talented African experts, including academics, civil servants, and policy practitioners. Supporting these people and expanding the pool of credible experts who are deeply embedded in specific national contexts and available to respond to evolving needs is a critical first step in the right direction.