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POWERING AFRICA: CHINA'S EXPANDING ROLE IN THE CONTINENT'S ENERGY FUTURE

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China 中南项目
Global South Project

China-Africa Energy

The China-Global South Project

Cover photo caption:
Mali's President of the Transition, Assimi Goïta with China's Ambassador to Mali, Chen Zhihong during the solar project's inauguration. Photo / Chinese Embassy in Mali.

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Executive Summary

China has emerged as a pivotal partner in addressing Africa's critical energy infrastructure gap, with over 600 million people on the continent—primarily in sub-Saharan Africa—lacking electricity access. This report examines Chinese-backed energy projects in Africa from 2020 to 2024, highlighting the scale, strategies, and implications of this partnership for Africa's sustainable development goals.

Key Insights:

- **Strategic Engagement:** From 2020 to 2024, Chinese investments totaling over USD 33 billion have delivered over 32 gigawatts (GW) of power generation capacity across 30 African countries. This engagement underscores China's role as a key driver of Africa's energy transition and its ability to adapt to local contexts while addressing infrastructure needs.

- **Renewable Energy and Regional Focus:** Analysis of 84 identified projects reveals a concentration in Southern Africa (35 projects), followed by West Africa (22), East Africa (16), Central Africa (6), and North Africa (5). Renewable energy dominates the portfolio, with hydropower and solar leading the mix, complemented by gas, wind, coal, geothermal, biomass, and wave energy. This distribution highlights China's strategic emphasis on sustainability and local needs.

- **Investment Models and Implementation:** Chinese involvement increasingly demonstrates sophistication through flexible financing structures, including hybrid models combining Chinese and international capital. This evolution extends to projects where Chinese entities serve solely as builders or equipment suppliers, with non-Chinese financing sources, indicating growing global confidence in Chinese technical expertise. Resource-rich countries have attracted substantial investments, as evidenced by Zimbabwe and Angola, suggesting a strong resource-infrastructure connection in investment decisions.

- **Challenges and Opportunities:** Despite significant progress, several projects face delays or dormancy due to technical, financial, or political challenges. These hurdles underscore the complexities of large-scale infrastructure development in Africa. The success of these investments will depend on careful consideration of project viability, effective risk management strategies, and continued adaptation to local contexts and needs.

These insights provide valuable guidance for policymakers, researchers, and stakeholders involved in Africa's energy sector development, particularly as the continent works towards achieving universal electricity access and sustainable development goals.

PART I: CONTEXT

Introduction

Access to reliable electricity stands as a fundamental pillar of modern society, serving as a crucial catalyst for economic growth, social development, and improved quality of life.[1] Despite global progress in electrification, Africa continues to face significant challenges in providing consistent and affordable electricity to its growing population.[2] According to the International Energy Agency's African Energy Outlook, over 600 million people in Africa, majority of them in sub-Saharan Africa, still lack access to electricity—nearly half of the region's population. This persistent energy poverty has profound implications for healthcare delivery[3], educational opportunities,[4] business development,[5] and overall economic development.[6]

1. IEA (2022), Africa Energy Outlook 2022, IEA, Paris https://www.iea.org/reports/africa-energy-outlook-2022, Licence: CC BY 4.0
2. IEA (2024), World Energy Investment 2024, IEA, Paris https://www.iea.org/reports/world-energy-investment-2024, Licence: CC BY 4.0
3. Khogali, A. et al. (2022). Building powerful health systems: the impacts of electrification on health outcomes in LMICs. Psychology, Health & Medicine, 27(sup1), 124–137. https://doi.org/10.1080/13548506.2022.2109049; Lammers, K. et al. (2024). Increasing electricity access for health facilities in Ghana through solar powered mini-grids—a GIS-based energy system modelling approach. Environmental Research: Infrastructure and Sustainability 4:2, pages 025004.
4. Banerjee, R. et al. (2021). Energy poverty, health and education outcomes: Evidence from the developing world, Energy Economics,101 (2021), https://doi.org/10.1016/j.eneco.2021.105447.
5. Avordeh, T.K. et al. (2024). Impact of power outages: Unveiling their influence on micro, small, and medium-sized enterprises and poverty in Sub-Saharan Africa - An in-depth literature review, Heliyon, 10 (13), https://doi.org/10.1016/j.heliyon.2024.e33782.
6. Andersen T.B and Dalgaard, C.J. (2013). Power outages and economic growth in Africa. Energy Economics, 38(2013), pp. 19-23

In recent years, China has emerged as a pivotal player in addressing Africa's energy infrastructure gap, particularly as traditional Western involvement in the sector has shown signs of decline.[7] This shift in development partnerships comes at a critical time when many African nations are actively seeking to expand their power generation capacity to meet growing domestic demand and support industrialization efforts. This report, a companion piece to the China-Global South Project (CGSP) China-Africa Energy Tracker, aims to provide a comprehensive analysis of Chinese-backed energy projects across Africa from 2020 to 2024, offering insights into their scale, distribution, and impact on the continent's energy sector development.

The CGSP China-Africa Energy Tracker is an interactive map showing Chinese energy projects across Africa. The map aims to track all projects that include Chinese financing, implementation, or stakeholder involvement. Based on our tracked projects, Chinese entities are currently involved in the development of energy infrastructure with a combined capacity of over 32 gigawatts (GW) across Africa. This capacity is equivalent to powering approximately 135.3 million urban households, assuming an average annual consumption of 2,072 kilowatt-hours (kWh) per household in Africa. In rural areas, where average household electricity consumption is estimated at 480 kWh per year, this capacity could supply power to around 584 million households annually.

Our Finding

Chinese energy projects are currently set to provide 32 gigawatts of power across Africa. That could power 135.3 million urban households.

The CGSP China-Africa Energy Tracker portfolio includes a mix of renewable and conventional power sources, from large-scale hydropower projects to solar installations, wind farms, and thermal power plants. The diversity of these projects reflects China's ability to adapt to different local contexts and energy requirements whilst supporting Africa's transition toward a more sustainable energy future.

The significance of these investments extends beyond mere numbers. Chinese-backed projects are often accompanied by financing packages, technical expertise, and implementation support, making them particularly attractive to African nations facing constraints in accessing traditional international funding sources. Through various mechanisms, including policy bank loans, equity investments, and engineering, procurement, and construction (EPC) contracts, Chinese entities

A cook heads back to the kitchen of a small restaurant in Alexandra, Johannesburg, on January 19, 2023 as a City Power technician checks for electricity consumption during an operation by City Power aimed at improving revenue collection levels on outstanding debts on electricity bills in the area. (Photo by MARCO LONGARI / AFP)

7. Chiyemura, F. et al. (2023). A dynamic institutional analysis of China's engagement with Africa's renewable energy market. Environmental Politics, 32(7), 1140–1162. https://doi.org/10.1080/09644016.2023.2194773

have demonstrated their commitment to long-term engagement in Africa's energy sector.

Through our analysis of Chinese energy investments in Africa, several notable patterns emerge that are of particular interest to stakeholders across the energy sector. Chinese involvement predominantly manifests through EPC contracts, supported by substantial funding from key Chinese financial institutions such as the Export-Import Bank of China (CHEXIM). There is an emerging strong emphasis on renewable energy projects, particularly in hydropower and solar, demonstrating an alignment with Africa's energy resources endowment and commitment towards sustainable energy futures. In addition, projects have a broad geographical distribution, spanning from Morocco to South Africa, reflecting China's continent-wide engagement strategy.

Our analysis reveals sophisticated project structuring. Many initiatives involve partnerships between Chinese entities, local utilities, and African governments, with financing models that include EPC contracts, Build-Own-Operate (BOO), Build-Own-Operate-Transfer (BOOT), Build-Operate-Transfer (BOT), and hybrid financing structures combining Chinese and international capital that help distribute risk and enhance project viability.

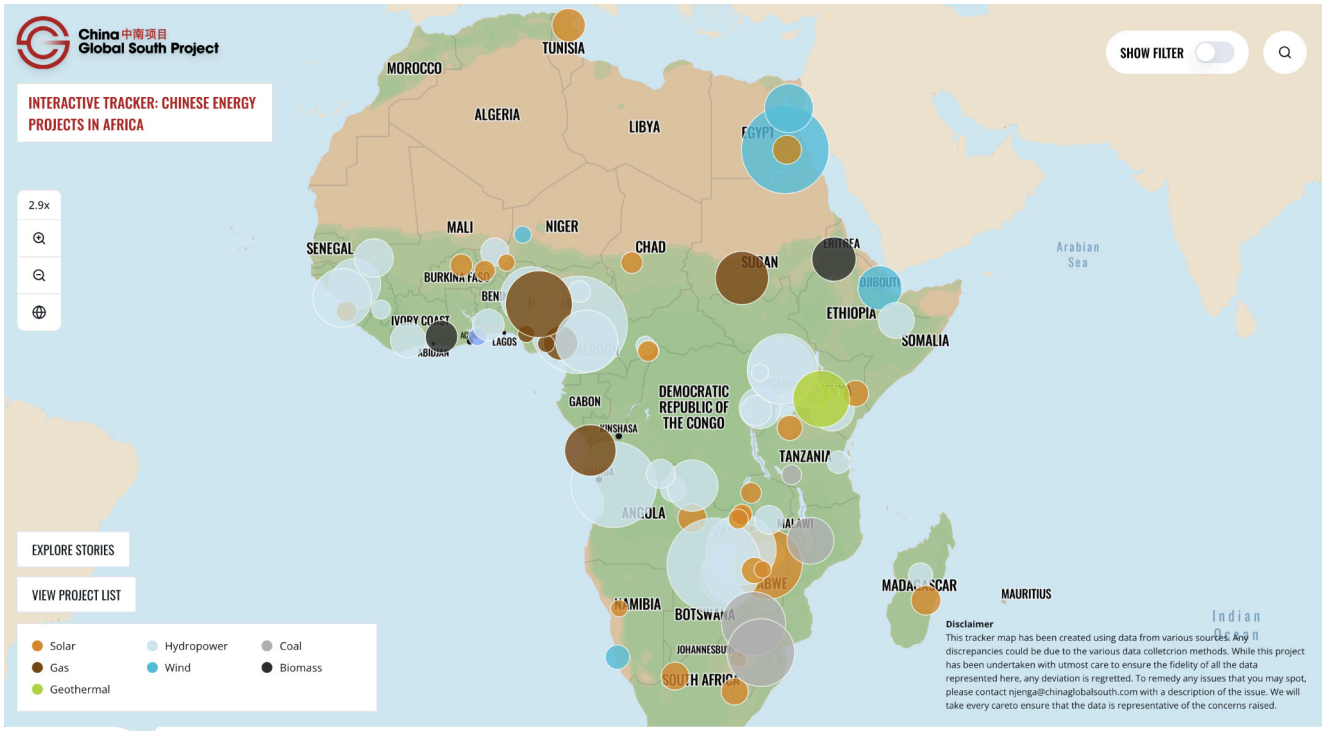
Table 1: Project delivery models

Model	Ownership	Operation	Transfer	Risk
Build-Own-Operate (BOO)	Private entity retains ownership indefinitely.	Private entity operates indefinitely.	No transfer of ownership.	Higher risk for the private entity due to indefinite ownership.
Build-Own-Operate-Transfer (BOOT)	Private entity owns during the concession period, then transfers to the public sector.	Private entity operates during the concession period.	Ownership is transferred after the concession period.	Risk is shared; private entity recovers costs during the concession period.
Build-Operate-Transfer (BOT)	Private entity does not own; transfers ownership after the concession period.	Private entity operates during the concession period.	Ownership is transferred after the concession period.	Lower risk for the private entity as ownership is not retained.

However, several projects in our database face significant delays or have become dormant due to various technical, financial, or political obstacles. In some cases, growing concerns about debt sustainability have influenced the pace and scale of new investments. These challenges underscore the complexity of large-scale infrastructure development and highlight the need for careful consideration of project viability and risk management strategies.

China-Africa Energy Tracker

To better understand and visualize the scale and distribution of Chinese energy investments across Africa, CGSP has developed a China-Africa Energy Tracker map that tracks these projects in unprecedented detail.



CGSP's China-Africa Energy Tracker.

What is it?

This mapping tool serves multiple crucial purposes. First, it provides policymakers, researchers, and stakeholders with a broader context of Chinese energy sector engagement in Africa, enabling better-informed decision-making and policy planning. Second, the map identifies patterns in project distribution, energy technology choices, and investment strategies, offering insights into China's approach to energy infrastructure development in different African contexts.

The interactive nature of the China-Africa Energy Tracker allows users to explore projects based on various parameters, including project type, location, capacity, investment pattern and value, and implementation status. This granular level of detail helps illuminate the complex web of relationships between Chinese companies, African governments, and other stakeholders involved in these energy projects. Furthermore, it enables the identification of successful project models that could be replicated in other regions facing similar energy access challenges.

As Africa continues its journey toward universal electricity access and sustainable development, understanding the role of Chinese investments in the energy sector becomes increasingly important. This tracking tool not only documents current developments but also provides a foundation for analyzing future trends and opportunities in Africa's evolving energy landscape. By making this information readily accessible and interactive, we aim to contribute to more informed discussions about energy development strategies and international cooperation in addressing Africa's power needs.

"This tracking tool not only documents current developments but also provides a foundation for analyzing future trends and opportunities in Africa's evolving energy landscape."

Through this mapping effort, we seek to enhance transparency, facilitate knowledge sharing, and support evidence-based dialogue about the crucial role of international partnerships in advancing Africa's energy sector development. As the continent works toward achieving its energy access goals, tools like this tracker will become increasingly valuable for understanding and optimizing the impact of international investments in Africa's energy infrastructure.

Where we got the data from

The data underpinning this report and tracker draws from multiple sources and rigorous verification processes. We collected information from publicly available sources and cross-referenced it with researchers at a partner organization. At the organization's request, it is not named in this report. Additional verification came through WeChat Professional communities and direct telephone conversations with project developers. We also conducted stakeholder interviews to triangulate our findings, focusing particularly on projects from 2020 onwards – a critical threshold following COVID-19 that marked increased renewable energy development. This timeframe coincides with significant industry shifts, including declining costs for wind and solar projects, improved delivery capabilities, and China's central government policy shift away from overseas coal projects.

Our classification system categorized projects into several distinct stages, including 'Permitting' (securing necessary approvals), 'Ongoing' (construction commenced), 'Completed' (construction finished but not operational), 'Active' (feeding power to the grid), and 'Suspended' (projects on hold due to funding, contract breaches, or political obstacles). This granular classification, supported by field investigations in China, including project developers, state-owned enterprises, and equipment manufacturers, provides a holistic picture of project progression and challenges.

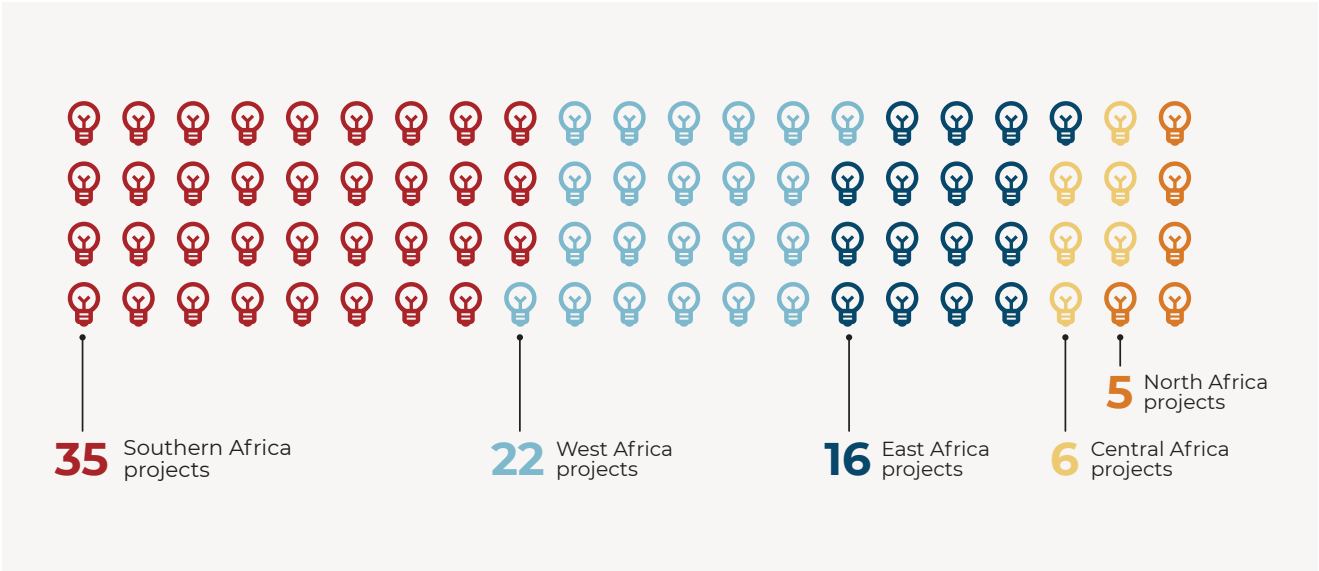
This interactive map reflects our best efforts to collect and present comprehensive data on China-Africa energy sector engagements. However, we acknowledge that this is an ongoing project, and there may be gaps or inaccuracies in the data. We are committed to continuously improving and updating the map to provide a more complete and accurate resource over time.

A picture taken on August 7, 2012 shows a partial view of the Chinese-owned Collum Coal mine in Sinazongwe, 325 kilometers (200 miles) south of Lusaka.

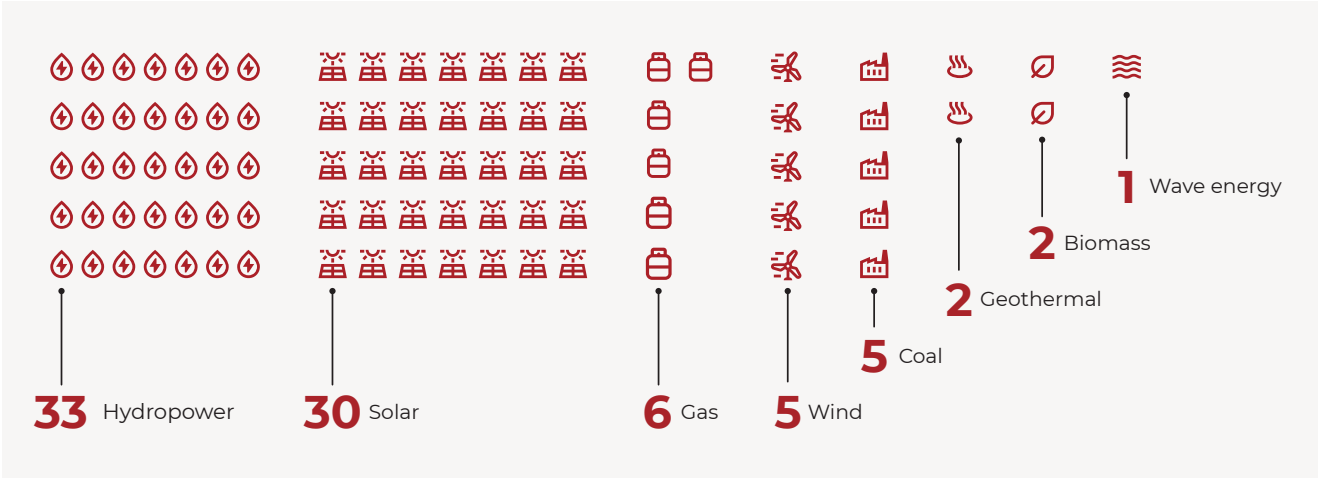
What we found

Between January 2020 and December 2024, Chinese entities were involved in 84 energy projects across Africa through different capacities, from financing to project construction and supply and manufacturing of energy equipment. Our focus was on all projects that were either actively underway—such as those in the construction phase or being launched—or those that had been commissioned and were already supplying power to the grid starting from 2020.

Geographically, Southern Africa led with 35 projects, followed by West Africa (22 projects), East Africa (16 projects), Central Africa (6 projects), and North Africa (5 projects).

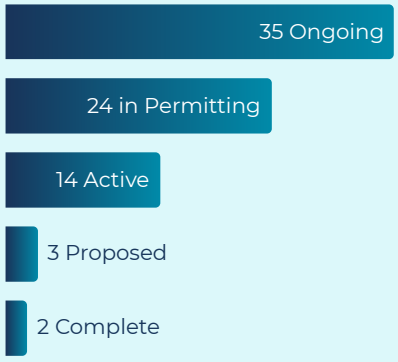


The project portfolio was dominated by hydropower with 33 projects, followed by solar (30 projects), gas (6 projects), wind and coal (5 projects each), geothermal and biomass (2 projects each), and wave energy (1 project). Total investment reached over 33 billion USD, with a combined capacity of over 32GW.



Regarding project delivery methods, 37 projects utilized EPC contracts, while 24 were developed using EPC and financing arrangements. The remaining projects were executed through various models, including BOO, BOOT, BOT, or with Chinese entities serving as builders, financiers, or investors.

Project status breakdown showed



Individual projects in various other stages (Announced, Dormant, Pending, Planning, Retendering, and Suspended). Chinese companies served as project builders in 79 of the 84 projects, with Chinese policy banks (including CBD, CHEXIM, and others) providing financing for 31 projects.

The geographical distribution of these projects reflects both China's strategic interests and local energy demands, particularly concentrated in regions and countries with strong bilateral relationships and established economic partnerships. The pattern of investment suggests a resource-infrastructure connection, as more projects appear to be clustered in resource-rich countries. For instance, the two largest recipients of Chinese finance in the sector, Angola and Zimbabwe, are resource-rich countries with longstanding ties to China. Zimbabwe hosts nine projects with a combined investment of US$5.5 billion, delivering nearly 2GW of capacity, comprising four hydropower facilities, four solar installations, and one coal plant. Angola's portfolio features four projects totaling US$5.8 billion, adding approximately 3GW to the national grid through three hydropower developments and one gas-fired facility.

Chinese entities are increasingly adapting to hybrid project financing and delivery mechanisms where they could be just a builder or equipment supplier, with financing coming from non-Chinese sources. This shift is evidenced by a growing number of projects funded through traditional capital markets but executed by Chinese firms, highlighting the global market's confidence in Chinese construction expertise and equipment quality.

China's Role in Africa's Energy Sector

"The cooperation between the People's Republic of China and the African Continent is a historical, strategic and constant one. It was founded on the principles of friendship, equality, solidarity and mutually beneficial development."

Moussa Faki Mahamat, during the 8th Ministerial Conference of the China-Africa Cooperation Forum, 2021).

Since the early 2000s, China has emerged as a significant development partner to Africa, becoming its largest trade partner in 2009 and largest bilateral infrastructure financier in 2017. [8] After the launch of the BRI in 2013, infrastructure development, especially in energy, has become central to China-Africa relations. The Global China Initiative at Boston University's Global Development Policy Centre reports that of the $182.28 billion committed to Africa between 2000 and 2023, $62.72 billion was allocated to the energy sector. [9] While large hydropower projects received the majority of this funding, other renewable energy sources such as wind, solar, and geothermal have also received attention. Following the COVID-19-related lending slowdown, recent investments show a shift toward renewable energy, with half a billion dollars committed to three African countries. This shift aligns with Xi Jinping's 2021 pledge to end coal project financing, marking a significant change in China's energy investment strategy in Africa.

These financial flows have fostered new institutional and governance arrangements, creating distinct development patterns that are unique in how the projects are structured and delivered compared to traditional, mainly Western approaches. This has sparked numerous commentaries that often present a simplified binary of "competition versus cooperation" between the West and China, failing to capture the nuanced dynamics at play on the ground.

8. Chiyemura, F. (2024). China-Africa relations in a changing world, in Dauncey, E., Desai, V., & Potter, R.B. (eds). The Companion to Development Studies (4th ed.). Routledge. https://doi.org/10.4324/9780429282348

9. Boston University Global Development Policy Center. "Relative Risk and the Rate of Return: Chinese Loans to Africa Database, 2000-2023." August 21, 2024. https://www.bu.edu/gdp/2024/08/21/relative-risk-and-the-rate-of-return-chinese-loans-to-africa-database-2000-2023/.

A Chinese worker rests in a coal coking factory in Huaibei city, east China's Anhui province, 28 April 2011.

The reality of China-Africa relations, particularly in the energy sector, reveals a complex web of interactions involving multiple stakeholders. These include African actors, Chinese state and private enterprises, and various external institutions, all engaging in processes of cooperation, negotiation, and occasional conflict. [10] The outcomes of these relationships are shaped by local political, social, and governance factors rather than following predetermined patterns—a complexity often overlooked in conventional analyses. In the next section, we focus on the key trends around Chinese involvement in Africa's energy sector.

10. Chiyemura, F., Shen, W. and Chen, Y. (2021). Scaling China's green energy investment in Sub-Saharan Africa: Challenges and Prospects. African Climate Foundation. https://www.africanclimatefoundation.org/wp-content/uploads/2021/11/800539-ACF-NRDC-Report.pdf

PART II: DATA

Key Trends Around Chinese Involvement in Africa's Energy Sector

Recent analyses reveal a significant shift in China's approach to African energy investments. Since late 2016, China has notably reduced its overall loan commitments to Africa, marking a strategic transformation in its engagement approach. [11] This change reflects China's adoption of the '小而美' or 'small is beautiful' approach, where the focus has moved away from large-scale financing towards more targeted and strategic lending practices. [12] Under this new paradigm, Chinese investors prioritize the potential impact and quality of projects rather than simply pursuing large volumes of investment or ambitious project scales. [13] This refined approach suggests a more mature and sophisticated engagement with Africa's energy development needs.

11. Dreher, Axel et al. 2021. "Aid, China, and Growth: Evidence from a New Global Development Finance Dataset." American Economic Journal: Economic Policy, 13 (2): 135–74.

12. Nyabiage, Jevans. 2022. "China Finds Small is Beautiful for African Projects Under Belt and Road." South China Morning Post 1 August. https://www.scmp.com/news/china/diplomacy/article/3187214/china-finds-small-beautiful-african-projects-under-belt-and

13. Ray, Rebecca. 2023. '"Small is Beautiful" A New Era in China's Overseas Development Finance?' Boston University Global Development Policy Centre. https://www.bu.edu/gdp/files/2023/01/GCI_PB_017_CODF_EN_FIN.pdf.

Below we provide some key statistics around the project types, status, capacity distribution, financing patterns and the geographic distribution.

Project type by energy source

Africa stands at the crossroads of multiple energy technology options given the energy resources endowment. At the same time, China's involvement in Africa's energy sector is by and large shaped by its own energy sector development. First, China's involvement in Africa's energy sector is dominated by hydropower projects (see Figure 1), and there are logical reasons for this. On the one hand, African nations have cultivated extensive expertise in damming rivers and managing hydropower projects, which continues to influence African and Chinese decision-makers to opt for this technology when expanding energy generation. This preference is further reinforced by hydropower's lower costs and operational lifespans that exceed the typical 15-20-year duration of wind or solar installations. However, the centralized nature of hydropower infrastructure creates vulnerabilities to political influence, rent-seeking, and corruption—challenges commonly associated with large-scale energy projects. [14]

On the other hand, Chinese companies' emphasis on African hydropower projects reflects their domestic experience, particularly with projects like the Three Gorges Dam. [15] This expertise, developed through major domestic projects, positioned Chinese state-owned enterprises (SOEs) to successfully implement hydropower projects overseas when the country launched its 'going out' strategy.

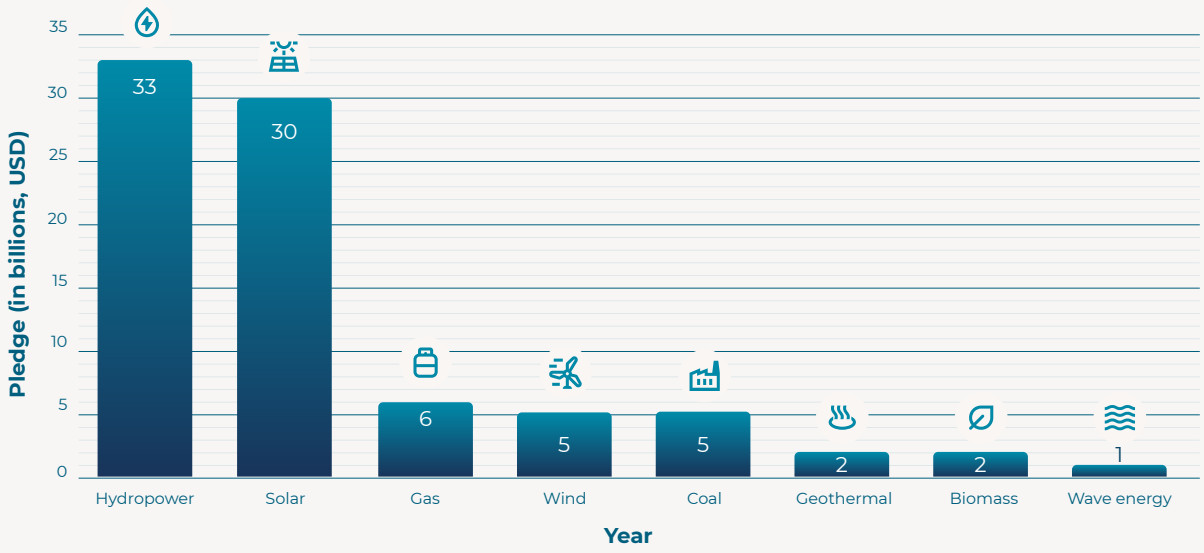
Ugandan President Yoweri Museveni and Chinese Ambassador to Uganda Zhang Lizhong plant a tree together at the Karuma dam site in Kiryandongo, Uganda, Sept. 26, 2024. Ugandan President Yoweri Museveni has commissioned the Chinese-built 600-megawatt Karuma Hydropower Station and the Karuma Interconnection Project in the midwestern Ugandan district of Kiryandongo. (Photo by Hajarah Nalwadda/Xinhua)

Apart from the dominance of hydropower, other renewables such as solar and wind are emerging as the energy technology of choice for both Chinese and African developers [16]. Our analysis reveals a significant shift in Africa's renewable energy landscape, with both solar and wind power experiencing substantial cost reductions compared to 2019 levels. Recent data from International Renewable Energy Agency shows that in 2023, renewable energy costs varied across technologies, with

14. Rimšaitė, L. (2019). Corruption risk mitigation in energy sector: issues and challenges, Energy Policy., 125 (2019), pp. 260-266
15. Brautigam, Deborah and Jyhjong Hwang, 2019. "Great walls over African rivers: Chinese engagement in African hydropower projects," Development Policy Review, Overseas Development Institute, vol. 37(3), pages 313-330.
16. RES4Africa, 2023

onshore wind being the most cost-effective at $0.033/kWh, followed by utility-scale solar PV at $0.044/kWh, while hydropower decreased to $0.057/kWh, geothermal rose to $0.071/kWh, offshore wind reached $0.075/kWh, bioenergy increased to $0.084/kWh, and CSP was highest at $0.117/kWh[17]. This cost decline coincides advantageously with Africa's abundant renewable resources: the continent receives more solar radiation than Europe on average, and numerous regions across Africa possess wind speeds exceeding 6 meters per second, making them ideal for wind power generation.[18]

Figure 1: Number of projects by energy source



Project status classification

Our database shows that 73 out of the 84 projects are classified as either 'Ongoing, 'Permitting,' or 'Active' (see Figure 2).

- **Proposed**: The project has been mentioned in some form, such as through an announcement, memorandum of understanding (MOU), press release, news article, or other means, but has not yet entered the planning stage.
- **Planning**: Relevant stakeholders are developing the project plan but have not yet begun securing permits.

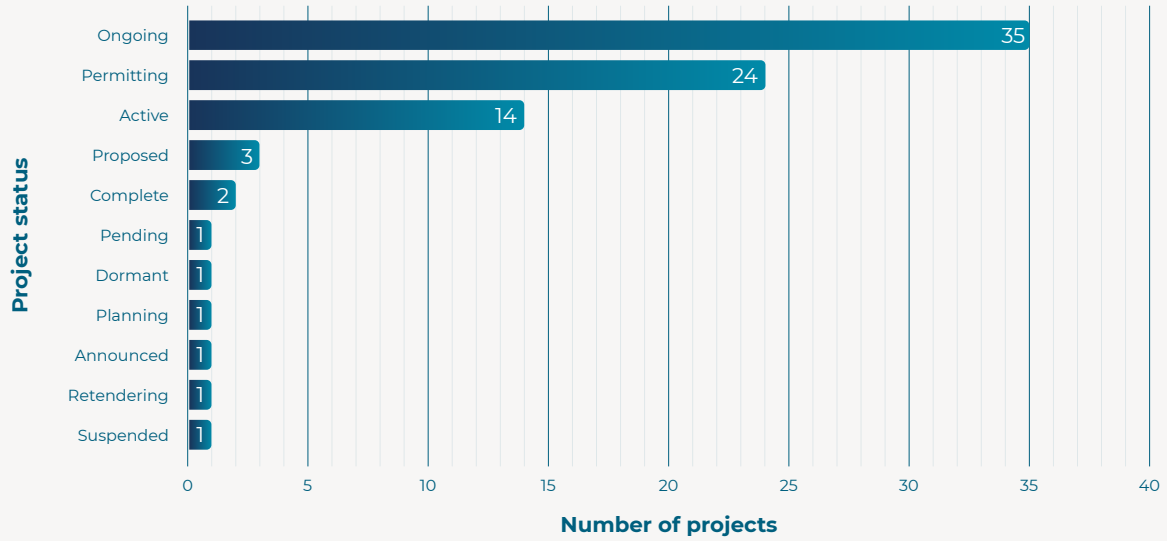
17. IRENA, (2024)

18. Kassem, Y., Camur, H., Adamu, M.T., Chikowero, T. and Apreala, T. 2023. Prediction of Solar Irradiation in Africa using Linear-Nonlinear Hybrid Models. Engineering, Technology & Applied Science Research. 13, 4 (Aug. 2023), 11472–11483. DOI:https://doi.org/10.48084/etasr.6131; Whittaker, Sean. (2020). Exploring Africa's untapped wind potential. IFC, https://www.ifc.org/content/dam/ifc/doclink/2020/africa-wind-technical-potential-oct-2020-ifc.pdf

- **Permitting**: The project is in the process of securing necessary permits and zoning approvals.
- **Announced**: The project has been publicly disclosed through government announcements, news articles, company press releases, or other official channels.
- **Pending**: The project is awaiting formal approval to proceed.
- **Ongoing**: The project has been approved, and construction is underway.
- **Complete**: Construction work has been finished, but the project is not yet operational.
- **Active**: The project is operational and supplying power to the grid.
- **Suspended**: The project was approved, and construction began but has been put on hold. This may be due to funding issues, contract breaches, political instability, or other factors.
- **Dormant**: The project is not currently operational but has the potential to resume operations in the future.
- **Retendering**: The project is undergoing changes in stakeholders or financing arrangements.

More granular analysis shows that 35 of the 84 projects are in the 'Ongoing' stage. However, 18 of the 35 projects are hydropower. 24 projects are at the 'Permitting' stage, and 14 projects are at the 'Active' stage. What this tells us is that the majority of Chinese-backed projects are currently and still not yet feeding power to the grid. Our analysis shows that for projects classified as Ongoing, Permitting, or Active, hydropower still dominates energy technology.

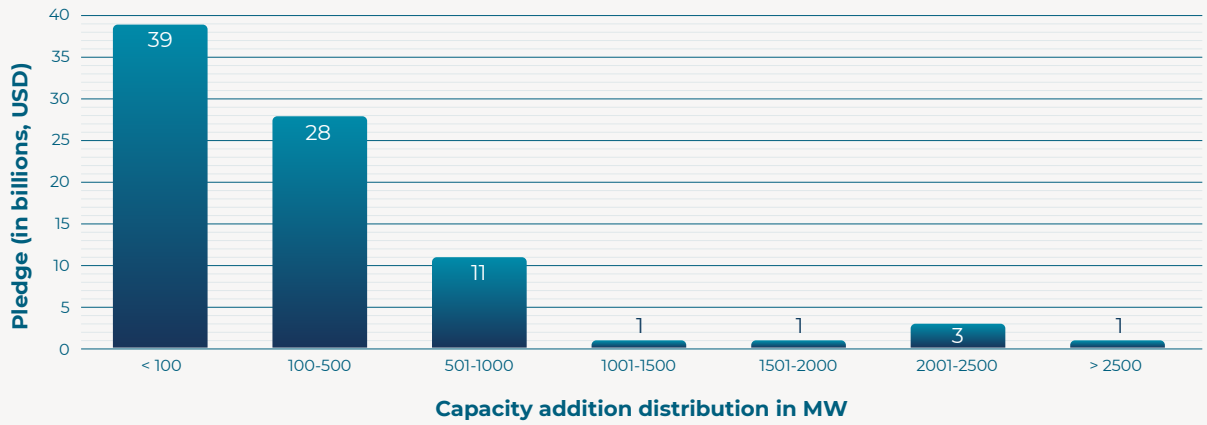
Figure 2: Project status



Capacity addition distribution

We found that the majority of the projects are under 100 MW (39 projects), followed by 28 projects between 100-500 MW and 11 projects between 501-1000 MW. 3 projects are between 2000-2500 MW (2 hydropower and 1 coal power), and there is 1 project each in the 1001-1500 MW and 1501-2000 MW ranges. Only 1 project is classified for over 2500 MW capacity — the Khusile coal plant in South Africa (see Figure 3).

Figure 3: Capacity distribution range



When summing the total MW capacity within each energy category, hydropower dominates at 13,054.32 MW, followed by coal at 7600 MW (see Figure 4). However, comparing the number of projects to their total capacity reveals an interesting trend: just five coal projects account for 7,600 MW, while six gas projects contribute 4,470 MW (see Table 2). This means coal and gas projects tend to be large compared to solar projects, clocking in at 3200 MW in capacity across 30 projects. Nonetheless, we anticipate the rise of more small-scale projects emerging as part of the 'small is beautiful' mantra, which has already manifest in some of the solar energy projects.

Figure 4: Capacity by energy source

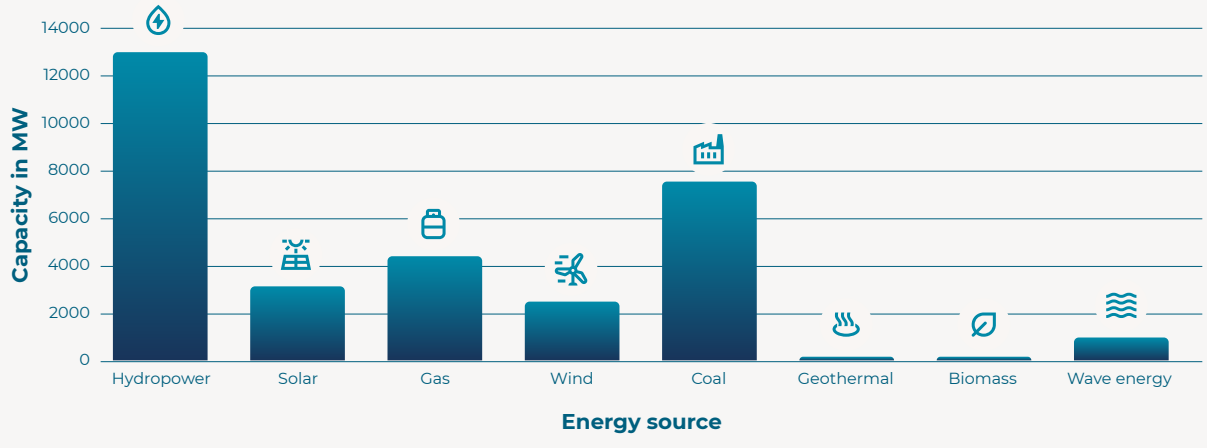


Table 2: Number of projects compared to sum capacity

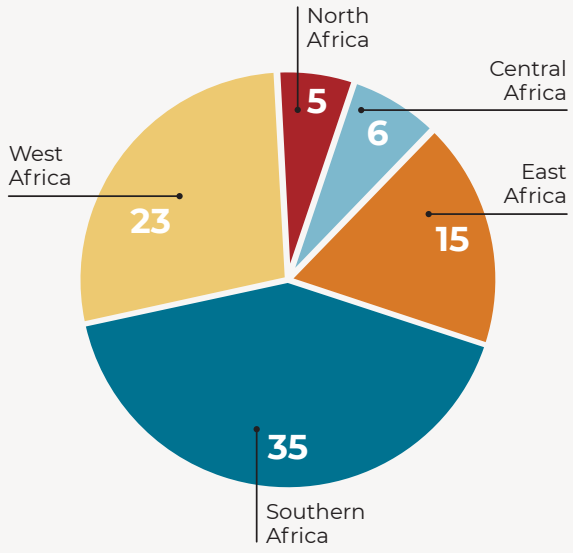
Energy source	Sum capacity (MW)	Total number of projects
Hydropower	13,054	33
Solar	3,170	30
Gas	4,470	6
Wind	2,720	5
Coal	7,600	5
Geothermal	98	2
Biomass	106	2
Wave energy	1,000	1
Total	**32,219.1**	**84**

Geographic distribution of projects

Our database reveals varying regional priorities and resource utilization strategies across Africa, with a clear trend towards renewable energy adoption alongside traditional power sources to meet growing energy demands. Below we describe the geographical distribution of energy projects, their sum capacities, and associated investments across the continent's five major regions (see Figure 6, 7 and 8).

Southern Africa emerges as the leader in both project count and capacity, hosting 35 projects with a remarkable total capacity of 16,146 MW and an investment of USD 23,205.44 million (see Figure 5). The region's portfolio is notably diverse, with South Africa spearheading large-scale developments through two coal projects totaling 6,400 MW and two solar installations, which together produce 238 MW. Zambia demonstrates a strong commitment to renewable energy with 11 projects, including three hydropower installations (3,251 MW) and eight solar projects (787 MW). Angola focuses on hydropower development with three projects, totaling 2,220 MW, complemented by a 750 MW gas installation. Zimbabwe's nine projects reflect a mixed energy approach,

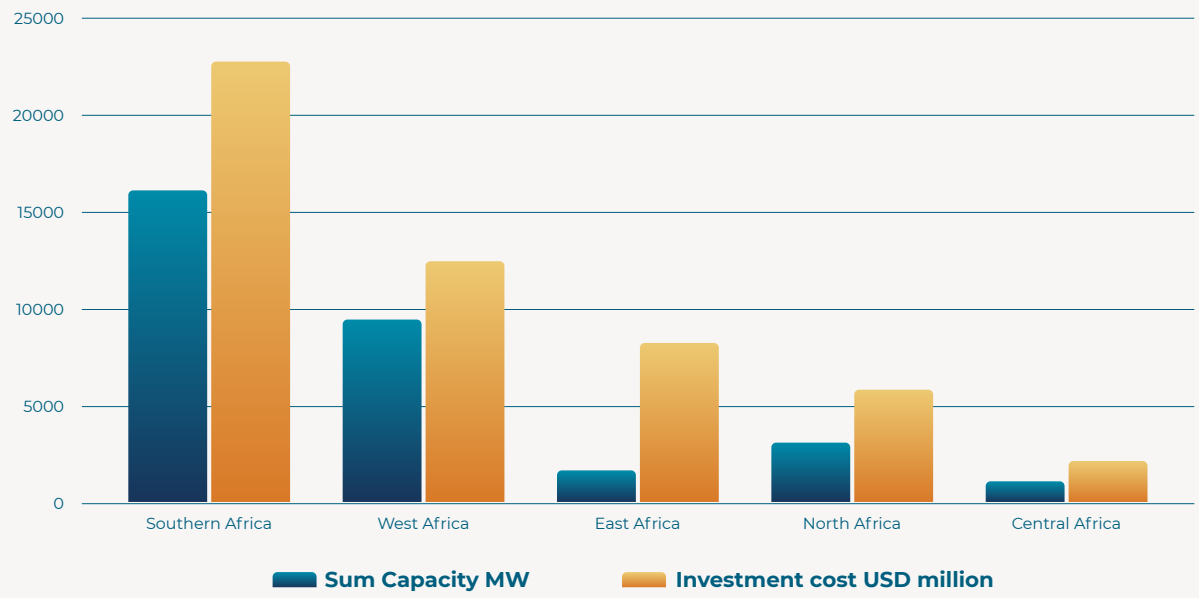
Figure 5: Number of projects per region



combining coal (600 MW), hydropower (17 MW), and solar (1,225 MW) installations. Smaller but significant contributions come from Namibia's wind and solar projects (168 MW combined), Madagascar's hybrid approach of hydropower and solar (120 MW total), Lesotho's solar installation (70 MW), and Malawi's coal project (300 MW) (see Table 3 and Figure 8).

West Africa represents the second-largest concentration of projects, with 23 installations generating 9,515 MW and attracting USD 12,509.52 million in investments (see Figure 5). The region shows impressive diversity in its energy mix, with hydropower dominating at 5,066 MW across ten projects. Nigeria leads the region's gas development with three projects totaling 2,900 MW, alongside three hydropower installations. The region also embraces innovative technologies, including Ghana's 1,000 MW wave energy project and Niger's 250 MW wind installation. Solar energy features prominently with seven projects contributing 253 MW, whilst Côte d'Ivoire adds to the mix with a 46 MW biomass project (see Table 3 and Figure 8).

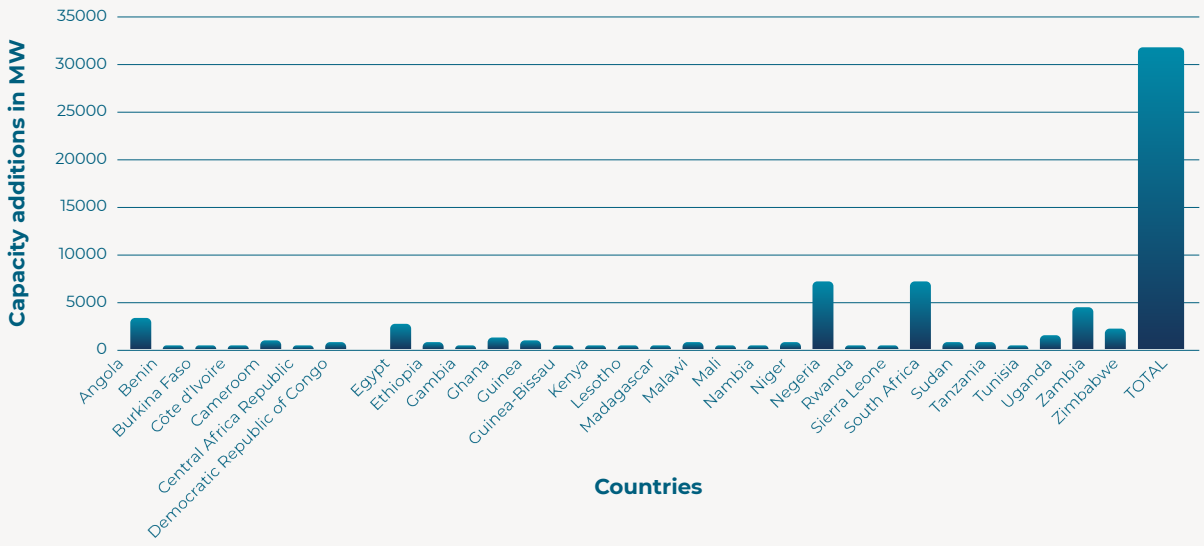
Figure 6: Sum capacity and total investment cost by region



East Africa hosts 15 projects with a combined investment of USD 8,137.85 million (see Figure 5). Hydropower dominates the region with eight projects totaling 1,701 MW. Kenya demonstrates leadership in geothermal energy with two projects totaling 98 MW in addition to a 50 MW solar installation. Tanzania matches this solar capacity, with an additional 300 MW coal project. Ethiopia diversifies East Africa's portfolio with a 60 MW biomass project and a 120 MW wind installation (see Table 2 and Figure 8).

Unlike Western aid models, China emphasizes transactional partnerships, prioritizing access to Africa's vast natural resources—oil, minerals, and rare earths—through carefully tailored investments. By aligning energy projects with each country's resource profile and risk factors, China positions itself as an indispensable partner.

Figure 7: Sum capacity by country

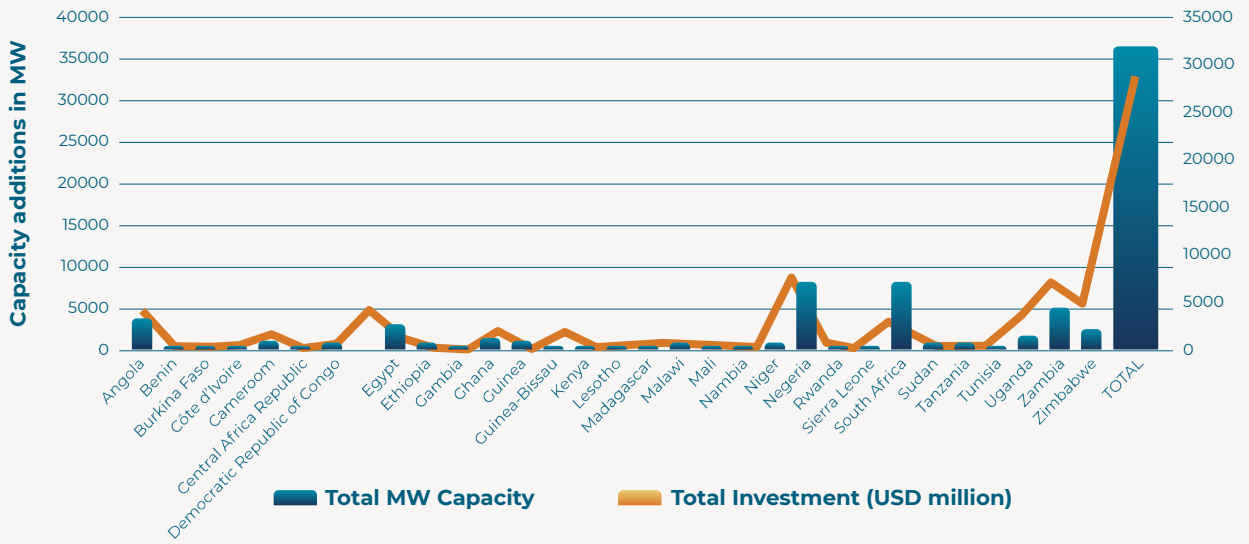


Central Africa, though only host to 6 projects, still achieves substantial sum MW capacity of 1,109 MW with USD 2,533 million in investments (see Figure 5). The Democratic Republic of Congo focuses on hydropower with two projects, totaling 314 MW, whilst Cameroon combines a 350 MW gas project with a 420 MW hydropower installation. The Central African Republic contributes through a 15 MW solar project and a 10 MW hydropower installation (see Table 3 and Figure 8).

Unlike Western aid models, China emphasizes transactional partnerships, prioritizing access to Africa's vast natural resources—oil, minerals, and rare earths—through carefully tailored investments. By aligning energy projects with each country's resource profile and risk factors, China positions itself as an indispensable partner. These initiatives strengthen bilateral ties, offering mutual but uneven benefits: African nations gain critical infrastructure, while China secures strategic resources, diplomatic leverage, and geopolitical influence.[19]

19. Sylvaire, D. , Fatoumata, T. and Aimée, U. (2020) Infrastructure Development: China's Investment Aid and Subsidy Projects in Africa: Case of the Central African Republic. American Journal of Industrial and Business Management, 10, 1870-1885. doi: 10.4236/ajibm.2020.1012117.

Figure 8: Capacity additions and investment cost by country



North Africa's five projects represent a significant capacity addition of 3,070 MW, requiring USD 6,074 million in investment (see Figure 5). Egypt leads the region's renewable energy push, with two wind projects totaling 2,300 MW in addition to a 500 MW solar installation. Tunisia hosts a 100 MW solar project, whilst Sudan adds diversity with a 470 MW gas project (see Table 3 and Figure 8).

Our database also reveals North Africa prioritizes solar and wind projects, while Southern Africa utilizes a combination of solar, hydro, and coal resources. East Africa leverages its hydropower and geothermal potential, with West Africa developing a diverse energy mix of gas, solar, and hydro. Finally, Central Africa focuses primarily on hydropower projects (see Table 4).

Table 4: Energy source by region

Region	Energy source								Total projects
	Hydropower	Solar	Gas	Wind	Coal	Geothermal	Biomass	Wave	
Southern Africa	11	18	1	1	4				35
West Africa	10	7	3	1			1	1	23
East Africa	8	2		1	1	2	1		15
North Africa		2	1	2					5
Central Africa	4	1	1						6
TOTAL	**33**	**30**	**6**	**5**	**5**	**2**	**2**	**1**	**84**

Table 3: Country-level analysis by energy source, capacity, and investment cost

	Country	Hydropower	Solar	Gas	Wind	Coal	Geothermal	Biomass	Wave	Total capacity (MW)	Total investment (usd $ millions)
1.	Angola	3		1						2,970	4,830
2.	Benin	1								147	229
3.	Burkina Faso		2							50	123
4.	Côte d'Ivoire	1						1		159	552
5.	Cameroon	1		1						770	1,660
6.	CAR	1	1							25	48
7.	DRC	2								314	825
8.	Egypt		1		2					2,500	4,891
9.	Ethiopia	1			1					4,34.1	1,449
10.	Gambia		1							23	64
11.	Ghana								1	1000	10
12.	Guinea	3								746	2,014
13.	Guinea-Bissau		1							20	43
14.	Kenya	2	1				2			173	2,082.6
15.	Lesotho		1							**70**	147
16.	Madagascar	1	1							120	295
17.	Malawi					1				300	667
18.	Mali	1								140	390
19.	Namibia		2		1					168	174.33 (1 project missing $ value)v
20.	Niger	1	1		1					390	167 (2 projects missing $ value)
21.	Nigeria	3		3						6,690	8,865.52 (2 projects missing $ value)
22.	Rwanda	2								124	638
23.	Sierra Leone		2							150	52 (1 project missing $ value)
24.	South Africa		2			2				6,683	3,464.91 (1 project missing $ value)
25.	Sudan			1						470	920
26.	Tanzania	1	1			1				370	223.25
27.	Tunisia		1							100	263
28.	Uganda	2								1,278	3,700
29.	Zambia	3	8							4,038	8,111.2
30.	Zimbabwe	4	4			1				1,842	5,516 (1 project missing $ value)
	TOTAL	**33**	**30**	**6**	**5**	**5**	**2**	**2**	**1**	**32,264.1**	**33,395.05**

PART III: ANALYSIS

What the Data Means

In terms of country-level analysis, Zambia led with 11 projects, followed by Zimbabwe with 9 projects, Nigeria with 6 projects, while Angola and South Africa each had 4 projects, and both Egypt and Namibia had 3 projects each, with the remaining projects distributed amongst 30 other countries in our database (see Table 3).

The distribution of projects across African countries reveals interesting patterns that reflect several key factors in international development and investment. The concentration of projects in Zambia (11) and Zimbabwe (9) can be attributed to these countries' rich mineral resources, particularly copper in Zambia and various precious metals in Zimbabwe. These countries have historically attracted significant mining investment and related infrastructure development projects. Their relatively stable political environments in recent years have also made them attractive destinations for international investors and development partners.

Nigeria's position with 6 projects aligns with its status as Africa's largest economy. The somewhat lower number of projects compared to Zambia and Zimbabwe might reflect the country's focus on oil and gas sectors, as well as its more developed internal capacity to manage projects independently.

The middle tier consisting of Angola and South Africa with 4 projects each tells different stories. Angola's projects likely relate to post-conflict reconstruction and oil sector development. South Africa, despite being one of Africa's most advanced economies, shows moderate numbers because it often self-funds projects or attracts private sector investment rather than requiring external development support.

Egypt and Namibia's 3 projects each reflect their distinct circumstances. Egypt, despite its large economy, might show lower numbers because many of its projects are funded through different channels or bilateral arrangements. Namibia's small population and relatively stable economy mean it requires fewer but more targeted interventions.

A truck drives towards a coal power-generating plant on August 03, 2023, in Hwange, Zimbabwe. The newly commissioned expansion generates 600 MW easing power outages in the country. Zimbabwe's President Emmerson Mnangagwa on Thursday inaugurated a Chinese-funded power station that he said would go a long way in easing power shortages ahead of national elections.

The distribution of remaining projects amongst 30 countries demonstrates the broad reach of development efforts across the continent. This spread suggests a strategy of maintaining presence and support across multiple nations whilst concentrating resources in countries where specific opportunities or needs arise.

This pattern ultimately reflects a complex interplay of factors: natural resource endowments, political stability, existing infrastructure, economic development levels, and strategic priorities of both funding organizations and recipient countries.

Project financing and modalities of Chinese involvement

In total, we analyzed the financing structure of 84 projects. Of these, 38 projects' financing status was identified, with 34 being loan-financed and 4 not loan-financed. This means that for 46 projects, the financing modality remains unclear based on available information. This pattern suggests a lack of transparency in project financing documentation.

When we look at Chinese financial institution involvement, CHEXIM emerges as the primary Chinese financier, backing 23 projects. This far outweighs the China Development Bank's involvement in just 2 projects. An additional 10 projects received funding from other Chinese financial institutions. Importantly, whilst 53 projects did not involve Chinese policy banks directly, Chinese companies still maintained a strong presence in construction and equipment supply.

The financing landscape extends beyond Chinese institutions, revealing a complex web of international cooperation. The African Development Bank has funded 6 hydropower projects spread across North, Central, and East Africa. One particularly notable example of multi-institutional financing is a hydropower project in Mali, which brings together CHEXIM, the EU-Africa Infrastructure Trust Fund, European Investment Bank, and the International Development Association.

There are several project funders involved in Africa's energy sector, including:

- World Bank
- KfW Development Bank
- West African Development Bank
- European Investment Bank
- French Development Agency
- Industrial and Commercial Bank of China Limited
- Bank of China
- China Construction Bank
- China Minsheng Bank
- Ping An Bank Co., Ltd
- International Finance Corporation
- Sustainable Energy Fund for Africa
- Islamic Development Bank
- EU-Africa Infrastructure Trust Fund
- International Development Association
- Dutch Entrepreneurial Development Bank
- International Finance Corporation
- Japan Bank for International Cooperation
- Sumitomo Mitsui Banking Corporation
- Sumitomo Mitsui Trust Bank
- Standard Chartered Bank
- Commercial International Bank Egypt
- and the China International Development Cooperation Agency.

Ivorian President Alassane Ouattara speaks during the celebration of the 60th anniversary of the African Development Bank (AfDB) at the Sofitel Ivoire hotel in Abidjan on September 10, 2024. (Photo by Sia KAMBOU / AFP)

Our database shows that the project implementation models vary. There is a clear preference for EPC (Engineering, Procurement, and Construction) approaches. The breakdown reveals that EPC and EPC+financing models account for 61 projects combined (37 EPC and 24 EPC+financing), representing the dominant implementation strategy. Other models like BOO (7 projects), BOOT (5 projects), and BOT (4 projects) play smaller but still significant roles.

The construction data is particularly striking - Chinese companies built 79 out of 84 projects, demonstrating China's dominant role in project execution. Only three projects stand out as exceptions: two coal projects in South Africa (which, interestingly, involved the Chinese Development Bank but not Chinese construction companies) and one gas project in Sudan (funded by CHEXIM but lacking clear information about Chinese construction involvement).

The temporal distribution of projects shows recent acceleration, particularly in solar energy. Whilst the overall timeline spans from 1986 to 2025, recent years have seen increased activity: 9 solar-dominated projects in 2024, 7 in 2023, and 6 in 2021. However, 12 projects lack commencement dates, indicating some gaps in project documentation.

This data paints a picture of China's substantial influence in African energy infrastructure, particularly through construction capabilities and financing, whilst also highlighting the diverse ecosystem of international financial institutions supporting African energy development. The predominance of solar projects in recent years suggests a shift towards renewable energy in the project pipeline.

The Development Implications of China-Backed Energy Projects in Africa

Since the 2010s, China has emerged as a significant partner in addressing Africa's energy infrastructure needs—as financiers providing capital for major projects, as developers managing complex infrastructure construction, and as suppliers delivering essential energy equipment. The scale of Chinese involvement has grown substantially, with investments spanning from small, rural electrification projects to massive hydroelectric dams and solar farms.

However, like any large-scale development program, Chinese-backed energy projects in Africa present a complex mix of opportunities and challenges. These projects have demonstrated the potential to accelerate electrification rates, transfer technical knowledge, and create local employment.[20] At the same time, they raise important considerations about project sustainability, environmental impact, and the long-term implications of infrastructure financing arrangements.[21] Understanding these varied outcomes requires careful analysis of specific projects within their local contexts.

Deepening dependency

China's expanding role in developing Africa's energy infrastructure is particularly evident in Zambia, where Chinese entities are currently involved in eleven power projects that will add over 4GW to the country's electricity generation capacity (see Table 5). The scale of this involvement becomes especially noteworthy when compared to Zambia's existing generation capacity of 3.7 GW, as

20. Lema et al. (2021). China's investments in renewable energy in Africa: Creating co-benefits or just cashing-in?, World Development, 141 (2021) 105365

21. Zakari et al. (2022). Are abundant energy resources and Chinese business a solution to environmental prosperity in Africa? Energy Policy, 163 (April 2022), 112829

reported by the Minister of Energy, Hon. Makoze Chikote, in August 2024.[22] These projects are at various stages of development: five are securing permits, two are actively under construction, one is being retendered, one has reached completion, and another is ongoing. This extensive Chinese participation demonstrates their increasingly crucial role in shaping Zambia's energy sector.

Table 5: China's involvement in Zambia's energy sector

Energy source	Number of projects	Total capacity addition	Investment cost (USD millions)
Hydropower	3	3,251	7,383.2
Solar	8	787	728
Total	**11**	**4,038**	**811.2**

Nonetheless, this growing Chinese presence in Zambia's energy infrastructure development raises important strategic considerations. While infrastructure development addresses critical power needs, scholars like Ian Taylor argue that such concentrated involvement from a single development partner in a strategic sector like energy creates potential vulnerabilities.[23] This situation could limit Zambia's policy autonomy and expose the country to economic and political pressures, particularly if disagreements arise over project terms or broader bilateral relations. The challenge lies in balancing the urgent need for energy infrastructure development with the strategic imperative of maintaining diverse international partnerships.

Skills, capacity building and tech transfer

Chinese projects have been praised for their approach to transferring technical skills and building capacity for Africans in the sector. The Adama wind farms in Ethiopia serve as a notable example. Ethiopian engineers and project stakeholders involved in these developments have commended the Chinese approach to capacity building, though they acknowledge room for improvement.[24] They note that Chinese partners demonstrate flexibility in working with African governments' realities.[25] Whilst some critics have raised concerns about inadequate technical training and

22. Presidential Delivery Unit. (2024). Zambia's Energy Minister Addresses Ongoing Energy Crisis. https://www.pdu.gov.zm/blog/zambias-energy-minister-addresses-ongoing-energy-crisis#:~:text=Minister%20Chikote%20outlined%20the%20current,capacity%20remains%20at%203%2C777%20Megawatts.

23. Taylor, I. (2015). Dependency redux: why Africa is not rising. Review of African Political Economy, 43(147), 8–25. https://doi.org/10.1080/03056244.2015.1084911; Taylor, I. (2014). Africa Rising? BRICS – Diversifying Dependency. Woodbridge, UK, and Rochester, NY: James Currey.

24. Chiyemura, F. (2020) Contextualizing African agency in Ethiopia–China engagement in wind energy infrastructure financing and development. The Open University Innovation Knowledge and Development working paper 88. Available at: https://oro.open.ac.uk/73326/1/Contextualizing%20African%20Agency%20IKD%2088.pdf.

25. Fei, D. (2024). China–Africa skills transfer through overseas economic and trade cooperation zones. Journal of International Development, 36, pp:172–191

capacity building,[26] our investigation sought to understand the validity of these claims. Our research reveals that two key factors shape how skills and capacity development materialize in Chinese infrastructure projects. First, national-level governance structures determine how contracts can be designed and enforced within each country. Second, sector-specific characteristics influence how projects are implemented on the ground. The interplay between these national and sectoral factors creates distinct patterns in project execution across different contexts. For example, South Africa, with its robust contract enforcement mechanisms and strong governance frameworks, has demonstrated particularly effective outcomes in infrastructure projects involving Chinese partners.

Employment creation

Research has challenged the common perception that Chinese companies consistently underemploy African workers in their African projects.[27] Our findings reveal a more nuanced reality: Chinese firms typically maintain high localization rates, employing African workers at levels between 80 and 90 percent, particularly in unskilled labor positions. However, a distinct pattern emerges in the distribution of roles: management and technical positions remain predominantly filled by Chinese nationals.[28]

This staffing structure can be attributed to several interconnected factors. Contractual requirements often specify certain positions must be filled by Chinese personnel, whilst differences in technical training and certification systems between China and African nations create additional complexities. Furthermore, divergent workplace cultures and management practices influence hiring decisions.

Construction workers work on a highway construction site near Abidjan on September 4, 2024. (Photo by Issouf SANOGO / AFP)

26. Lema et al. (2021). China's investments in renewable energy in Africa: Creating co-benefits or just cashing-in?, World Development, 141 (2021) 105365

27. Liu et al. (2024). Effect of Chinese outward FDI on youth unemployment in sub-Saharan Africa. PLOS ONE, 19(7), e0305482. https://doi.org/10.1371/journal.pone.0305482; Oya, C and Schaefer, F (2020) 'Chinese Firms and Employment Dynamics in Africa: A Comparative Analysis', ' China Journal of Political Economy, 18. pp. 63-134.

28. Chiyemura et al. Scaling China's green energy investment in Sub-Saharan Africa: Challenges and Prospects. African Climate Foundation. https://www.africanclimatefoundation.org/wp-content/uploads/2021/11/800539-ACF-NRDC-Report.pdf

Importantly, when examined in a broader context, this employment pattern is not unique to Chinese companies. [29] Existing research demonstrates that similar staffing distributions are common across multinational firms operating in Africa, regardless of their country of origin [30]. This suggests that these hiring practices reflect broader industry trends rather than specifically Chinese business practices. [31]

Environmental and social impacts

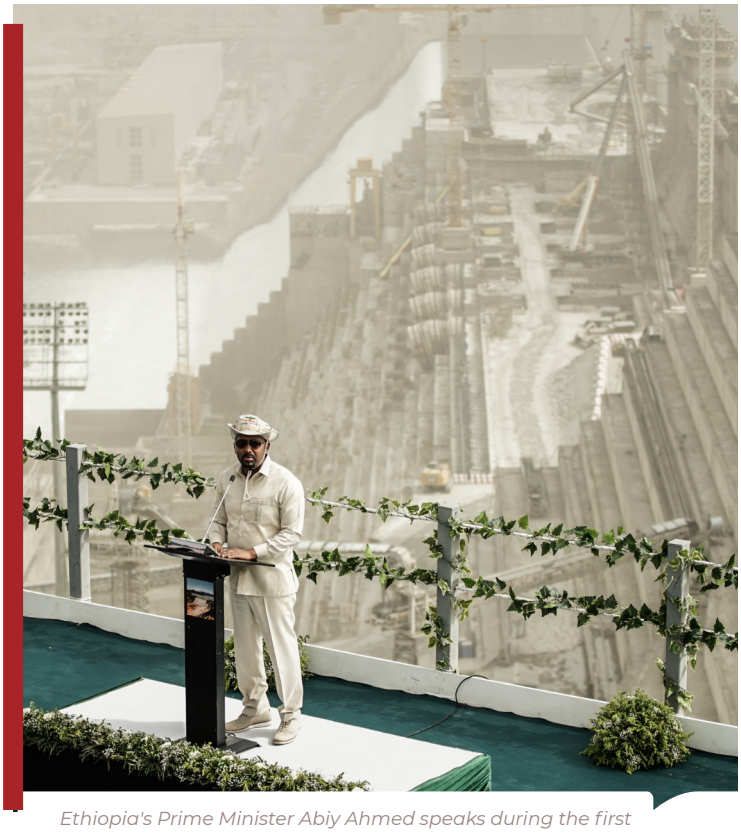
Our database indicates that hydropower projects constitute the majority of Chinese energy investments. While hydropower represents a renewable energy source, it raises significant social and environmental concerns. The primary issues include habitat disruption and changes in land use patterns, with some projects leading to population displacement and the complex challenge of resettlement. [32] Nevertheless, like other renewable energy sources such as wind and solar power, hydropower plays a crucial role in reducing greenhouse gas emissions, thereby contributing to global efforts to mitigate climate change. [33]

Conclusion

Africa's energy sector stands at a pivotal moment, reflecting both the promises and complexities of rapid industrial development in today's interconnected global economy. Over the past two decades, various African nations' strategic approaches to their energy resources, particularly in renewable and fossil fuel sectors, have become central to their economic aspirations and development goals. However, this transformation carries significant implications.

The substantial involvement of Chinese enterprises, particularly through the Belt and Road Initiative, has deeply integrated Chinese influence within Africa's energy landscape. Whilst these investments have catalyzed unprecedented development in power generation and distribution across the continent, they have also introduced complex dependencies and geopolitical considerations. Chinese state-owned enterprises have become major players in hydroelectric projects, such as Ethiopia's Grand Renaissance Dam, and in fossil fuel infrastructure across countries like Angola and Nigeria.

29. Oya et al. (2020) 'Contributions of Chinese Firms to Employment Dynamics in Africa: A Comparative Analysis Based on a Large-scale Survey' China Review of Political Economy, 11 (6). pp. 184-224.
30. Ibid.
31. Oya, C and Schaefer, F. (2023). Do Chinese firms in Africa pay lower wages? A comparative analysis of manufacturing and construction firms in Angola and Ethiopia, World Development, 168 (August 2023), 106266.
32. Yang et al. 2021. Risks to global biodiversity and Indigenous lands from China's overseas development finance. Nature Ecology & Evolution, 5(11), pp.1520-1529.
33. Springer et al. 2023. Elevating ESG: Empirical Lessons on Environmental, Social and Governance Implementation of Chinese Projects in Africa. Available at https://www.bu.edu/gdp/files/2023/08/GCI_GIZ-Report_2023_FIN.pdf



Ethiopia's Prime Minister Abiy Ahmed speaks during the first power generation ceremony at the site of the Grand Ethiopian Renaissance Dam (GERD) in Guba, Ethiopia, on February 20, 2022.

Although Chinese involvement has accelerated energy infrastructure development across Africa, it's crucial to understand that the challenges facing Africa's energy sector stem from multiple sources, and we can't really expect China to address them all. Many issues originate from domestic governance challenges, regulatory inconsistencies, and historical infrastructure deficits. Nevertheless, given China's extensive involvement, its practices warrant careful examination to ensure that energy sector development aligns with local interests and environmental sustainability.

A persistent challenge in Africa's energy sector is the widespread lack of transparency in project implementation and financing arrangements. This opacity makes it difficult to accurately assess the true impact of various energy initiatives and their long-term implications for host nations. The limited access to detailed project information and financing terms complicates efforts to ensure accountability and evaluate the environmental and social consequences of major energy developments.

Without enhanced transparency and stronger accountability mechanisms, the long-term implications could be significant for African nations. There's an urgent need for better monitoring and evaluation systems to track energy sector developments, assess their impacts, and ensure they contribute positively to sustainable development goals. Improved oversight could help foster more equitable partnerships and ensure that energy sector growth genuinely benefits local communities whilst supporting environmental sustainability.

The complexities of China-Africa energy cooperation highlight the need for African nations to strengthen their negotiating positions and regulatory frameworks. This would help ensure that foreign investments in the energy sector align with national development objectives whilst protecting local interests and environmental standards. The future of Africa's energy sector will largely depend on how effectively nations can balance the benefits of Chinese investment with the need for sustainable and equitable development practices.

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