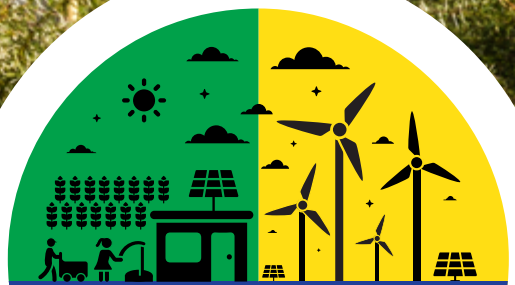
KENYA SOLAR AND WIND MANUFACTURING IN THE RENEWABLE ENERGY TRANSITION:

Global Production Networks and Local Realities

By
Joan Andega, Gillian Achieng, Joel Onyango, Eric Magale



Just Energy Transition:
Localisations, Decent Work, SMMEs, and Sustainable Livelihoods

INSTITUTE FOR ECONOMIC JUSTICE
COSATU
ACTS
ACEP Africa Centre for Energy Policy
IDRC · CRDI
International Development Research Centre
Centre de recherches pour le développement international

KENYA SOLAR AND WIND MANUFACTURING IN THE RENEWABLE ENERGY TRANSITION:

Global Production Networks and Local Realities

By
Joan Andega, Gillian Achieng, Joel Onyango, Eric Magale

SUMMARY

Kenya's solar and wind sectors have expanded rapidly over the past decade, driven by policy reforms, investment in clean energy, and strong resource potential. Solar capacity has grown more than tenfold since 2015, and wind generation – anchored by flagship projects such as Lake Turkana and Kipeto – now plays a stabilising role in the national grid. Using the Global Production Networks (GPN) framework, the paper examines how value is created, captured, and distributed across Kenya's Renewable Energy (RE) production systems.

Production remains highly import-dependent, with high-value manufacturing – such as solar cell and turbine component production – concentrated in China, Europe, and the United States. Kenyan firms operate mainly in low-value segments such as distribution, Engineering, Procurement, Construction (EPC) contracting, assembly, and civil works. This positioning limits technological upgrading and value capture. Workers generate significant value in installation and construction, yet employment is often temporary, low-skilled, and precarious, with limited access to formal contracts, social protections, or skills upgrading – especially for women, who remain underrepresented in technical roles.

Corporate and institutional power strongly shape sectoral outcomes. International Original Equipment Manufacturers (OEMs) and financiers dominate technology choices, procurement frameworks, and long-term revenue flows through Power Purchase Agreements (PPAs), while Kenyan regulators focus on compliance rather than industrial development. Local content and gender equity policies exist but lack enforcement capacity. Collective power from unions and communities is limited, except in isolated cases such as the Lake Turkana Wind Power (LTWP) Project land rights dispute.

Kenya's renewable energy transition will only deliver deeper economic and social benefits if the country moves beyond downstream assembly and installation into higher-value manufacturing segments, through coordinated industrial policy, R&D support, and patient capital. Strengthening enforceable localisation mechanisms, including clear local content requirements linked to technology transfer and joint ventures, is essential to reduce structural import dependence and improve domestic value capture. Kenya should scale up green skills development through targeted TVET investments and employer-linked training pathways, while ensuring that decent work standards, formal contracts, and social protections are embedded across project-based employment. Gender-responsive interventions, including childcare support, safe workplace policies, and proactive recruitment into technical roles, are necessary to address the persistent exclusion of women from higher-quality jobs. Finally, institutional reforms should enhance regulatory capacity and multi-stakeholder coordination so that workers, communities, and local firms gain stronger bargaining power and equitable benefit-sharing within global production networks.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

AfDB	African Development Bank
CAGR	Compounded Annual Growth Rate
COTU	Central Organisation of Trade Unions
DRE	Decentralised Renewable Energy
EIB	European Investment Bank
EPC	Engineering, Procurement and Construction
EPRA	Energy and Petroleum Regulatory Authority
GPN	Global Production Networks
GVC	Global Value Chain
IEA	International Energy Agency
IEC	International Electrotechnical Commission
ILO	International Labour Organization
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
KEBS	Kenya Bureau of Standards
KEPSA	Kenya Private Sector Alliance
KEREA	Kenya Renewable Energy Association
KETAWU	Kenya Electrical Trades and Allied Workers Union
KOSAP	Kenya Off-Grid Solar Access Project
LCPDP	Least Cost Power Development Plan
LTWP	Lake Turkana Wind Power
MASEN	Moroccan Agency for Sustainable Energy
NDC	Nationally Determined Contribution
O&M	Operations and Management
OEM	Original Equipment Manufacturer
OPIC	Overseas Private Investment Corporation
PPA	Power Purchase Agreement

PPP	Public-Private Partnership
PV	Photovoltaic
PVoC	Pre-Export Verification of Conformity to Standard
R&D	Research and Development
RE	Renewable Energy
REIPPP	Renewable Energy Independent Power Producer Procurement Programme
SERC	Strathmore Energy Research Centre
SEZ	Special Economic Zone
SIPLF	Sarima Indigenous Peoples' Land Forum
TVET	Technical and Vocational Education and Training
VAT	Value Added Tax
WHO	World Health Organization
WISEe	Women in Sustainable Energy and Entrepreneurship

1. INTRODUCTION AND OVERVIEW

Over the past decade, Kenya's Renewable Energy (RE) landscape has experienced significant growth, particularly in solar and wind power. As of 2024, renewable sources contributed over 80% of the national electricity mix, with wind and solar collectively accounting for approximately 18% of total generation capacity, and geothermal accounting for the remainder (Rotich et al., 2024). This growth has been driven by deliberate policy reforms, infrastructure investments, and public-private partnerships (PPPs), under frameworks such as Kenya's Vision 2030 and the Least Cost Power Development Plan (LCPDP).

Wind energy potential in Kenya is estimated at over 3,000 MW, with commercially viable wind speeds (above 6 m/s) prevalent in regions such as Marsabit, Turkana, and Kajiado (EPRA, 2024). Between 2015 and 2023, wind power capacity grew from under 30 MW to over 330 MW, reflecting a compounded annual growth rate (CAGR) of more than 35%. Wind energy now plays a stabilising role in the national grid, particularly during dry seasons when hydropower output declines. National planning documents project that wind power could contribute over 15% of total installed capacity by 2030, under current development trajectories (Ministry of Energy and Petroleum, 2023a).

Solar energy has similarly witnessed rapid expansion, both in centralised and decentralised systems. By 2024, Kenya had installed more than 250 MW of grid-connected solar capacity, up from just 20 MW in 2015, marking more than a 1,150% increase in less than a decade. In addition to grid-scale development, Kenya has become a continental leader in off-grid solar, with over 1.7 million households using solar home systems, and more than 140 solar mini-grids operating in underserved regions (Ministry of Energy, 2023). Solar irradiance levels across the country average between 4 and 6.5 kWh/m^2/day, making it highly favourable for photovoltaic deployment. The declining cost of solar technology (dropping by nearly 85% since 2010), combined with fiscal incentives and access to climate financing, has accelerated uptake in both urban and rural settings. Solar now contributes significantly to Kenya's goal of achieving universal electricity access by 2030, while also supporting its Nationally Determined Contributions (NDCs) under the Paris Agreement.

As Kenya moves toward its universal electrification targets and emissions reduction goals, wind and solar energy remain integral to a more sustainable and resilient power sector.

This background paper analyses Kenya's solar and wind technology manufacturing using the Global Production Networks (GPN) framework. A global lens is relevant because local outcomes in the RE sector in Kenya do not arise in isolation. Prices, technologies, quality standards, and access to markets are set or influenced by multinational agencies, international lead firms and Original Equipment Manufacturers (OEMs). We use a GPN lens to explain local outcomes and apply GPN concepts to Kenya's national solar and wind component production network, by tracing how cross-border inputs, quality standards, financing, and lead firms or OEMs shape what local firms do, what value they capture, and the working conditions of workers in this sector. We apply the global lens by mapping local activities such as assembly, Engineering, Procurement and Construction (EPC), distribution, operations, and maintenance, and then tracing their ties to foreign firms and standards. This helps highlight, at a local level, which inputs from abroad set the terms of participation for local firms. In short, we use the global linkages to explain the pattern of value creation, capture, power, and embeddedness we observe in Kenya.

Scope and limitations

Our paper draws on literature and trade data to map key components, examine how value is created and captured across households, firms, and the state, and explore power dynamics within the sector. The paper also assesses how local actors are embedded in global production systems, and concludes with key insights, gaps, and questions to guide future research.

While the paper leans towards solar, wind remains integral to Kenya's power mix and industrial policy trajectory, and is therefore retained in our analysis. While there are data gaps, recent official statistics place installed wind capacity at 435 MW as of December 2024, underscoring the role of wind energy (EPRA, 2025a). The Kenya National Energy Compact 2025–2030 also targets further scale-up of wind energy, alongside solar and hydrothermal, as part of the push to increase clean energy sources from 82% to 100% by 2030, with a 530 MW increase in wind capacity by 2030 to 965 MW (Ministry of Energy and Petroleum, 2025). Since it started operations in 2018, the Lake Turkana Wind Power (LTWP) project has delivered 9.5 billion kWh of clean energy to the national grid, equivalent to roughly 12% of Kenya's total supply, demonstrating the significance of large-scale wind projects (LTWP, 2025). Ongoing developments illustrate continued momentum and need for research. For example, Kenya's second largest wind energy producer (Kipeto Energy) plans to add 18 turbines (Mwita, 2025). Furthermore, in November 2025, Kenya lifted the multi-year moratorium on new Power Purchase Agreements (PPAs) with Independent Power Producers (IPPs) that had been in effect since 2018 (Anyango, 2025), signalling a potential jumpstart in the wind energy sector. Thus, although our data on the wind energy remains limited, recent developments indicate it is a key area for future research.

How the paper is structured

Section 2 of this paper outlines the methodology, including the approach to component selection and the production network mapping for solar panels and wind turbine towers. Section 3 shows Kenya's production network mapping for solar panels and wind-turbine towers. Section 4 analyses value creation and enhancement, including workforce roles, skills pathways, firm strategies, and links to social reproduction. Section 5 examines value capture for workers/households and firms, tracing how wages, procurement, finance, standards, and control of core technologies shape retention of benefits. Section 6 maps power dynamics (corporate, institutional, and collective). Section 7 assesses embeddedness (network, territorial, societal) of firms and institutions, and finally, Section 8 summarises key findings, highlights data and literature gaps, and outlines questions for future fieldwork.

2. METHODOLOGY

The Global Production Network (GPN) is the nexus of interconnected functions, operations and transactions through which a specific product or service is produced, distributed and consumed (Coe et al., 2008). A GPN involves "interconnected nodes and links extending spatially across national boundaries and, in so doing, integrating parts of disparate national and subnational territories" (IRENA and ILO, 2024). This analytical lens helps uncover how power, value, and embeddedness manifest in RE technology supply chains, especially in the Kenyan context where industrial capacities vary significantly. Our choice of a GPN framework builds on and extends the Global Value Chains (GVC) tradition that first standardised key concepts such as value creation, upgrading, and governance across production. GVC approaches (Gereffi, Humphrey and Sturgeon, 2005) emphasise how lead firms coordinate activities and how firms upgrade or move to higher value activities. The GPN framework retains those strengths but is better aligned with this study's aims because it highlights power, institutions, and different forms of embeddedness (Coe and Yeung, 2015). In Kenya's solar and wind component production, where financing architectures, standards regimes, and social reproduction conditions shape value capture, the GPN framework offers a more precise analysis.

This background paper employed a desktop-based literature review and secondary data analysis to map Kenya's position in the GPNs of solar panels and wind turbine towers. Methodologically, it relies on a comprehensive literature review to examine Kenya's solar and wind component manufacturing landscape. Key sources included academic publications; policy reports; industry analyses to contextualise the sector; trade data to trace import and export flows of key renewable energy components and materials; and datasets from institutions such as IRENA, EPRA, ILO, and the World Bank. The review critically examined patterns of value creation, enhancement, and capture across firms, households, and the state. Gaps in existing literature were identified and linked to questions that the accompanying fieldwork would further investigate, particularly around social reproduction, skills development, and local firm competitiveness.

2.1 Approach to component selection and mapping

Solar panels and wind turbine towers as components of RE PVs represent critical hardware for Kenya's transition to a low-carbon energy system. Solar photovoltaic (PV) systems are among the most widely deployed renewable technologies in Kenya, especially in off-grid rural areas. Similarly, wind energy has gained prominence through utility-scale projects such as the LTWP Project and Ngong Hills Wind Farm, where wind turbine towers are indispensable components. Mapping these components provides insights into the structural dependencies and opportunities in two of Kenya's fastest-growing RE sub-sectors.

The production network mapping process adopts a dual approach that combines:

- **Activities Approach:** Tracking value-adding processes from R&D and design to manufacturing, distribution, and end-of-life.
- **Inputs-Manufacturing-End- of -Life Approach:** Highlighting flows of raw materials, subcomponents, and assembled systems to understand dependencies and opportunities for localisation.

This allows a granular view of how upstream, core, and downstream stages in solar and wind value chains are distributed globally and nationally. The mapping also critically considers four mapping approaches:

1. Firm-level mapping (tracing individual lead firms and suppliers);
2. Commodity chain analysis (focusing on flows of goods and materials);
3. Institutional mapping (exploring governance structures and policy frameworks); and
4. Socio-technical systems mapping (considering broader socio-economic contexts).

For this background paper, a hybrid of firm-level and commodity-chain analysis was chosen to foreground material flows and governance while acknowledging local institutional environments.

3. KENYAN PRODUCTION NETWORK FOR SOLAR PANELS AND WIND TURBINE TOWERS

3.1 Purpose and component selection (brief)

The GPN process mapped two components where Kenyan actors are most likely to be active today and where localisation policies could plausibly target industrial development: solar PV modules (final module assembly from cells, encapsulants, glass, frames, and junction boxes) and wind turbine towers (foundations and lower tower fabrication). These components were selected because (a) they represent the primary points of Kenya's current industrial engagement (assembly, civil works, steel/concrete fabrication), and (b) they offer contrasting prospects for localisation: solar module assembly is already occurring on a small scale (for example, Solinc), while tower foundations build on established local civil engineering capabilities and local material supply (cement, steel). The GPN maps therefore deliberately centre the GVC (upstream, core, and downstream) for each component and then overlay the key actors (OEMs, EPCs, financiers, regulators, local suppliers, and civil society).

3.2 Production network map for solar panels and wind turbine towers in Kenya

Kenya's solar PV and wind turbine tower sectors are characterised by a clear division between high-value activities such as R&D, manufacturing, and component design, which are concentrated abroad, mainly in China, Europe, and the US, and labour-intensive, lower-value, downstream activities within Kenya. Local firms like Solinc focus on assembly, distribution, installation, and Operations and Management (O&M) for solar PV using imported components, while wind projects rely on domestic contractors for foundation works and supply of raw materials, but import most key turbine parts. Institutional players, including the Ministry of Energy, the Energy and Petroleum Regulatory Authority (EPRA), and the Kenya Bureau of Standards (KEBS), govern quality compliance and licensing but have yet to cultivate upstream industrial capabilities. Development partners provide capacity building, yet Kenya lacks robust mechanisms for technology transfer, R&D financing, and industrial clustering, limiting value capture locally. This structure results in Kenya's peripheral position in GPNs, performing essential but low-value tasks without significant technological spill- overs or long-term strategic partnerships (see Figures 1 and 2 below).

Figure 1: Production Networks for Solar Panels (Source: created by author)

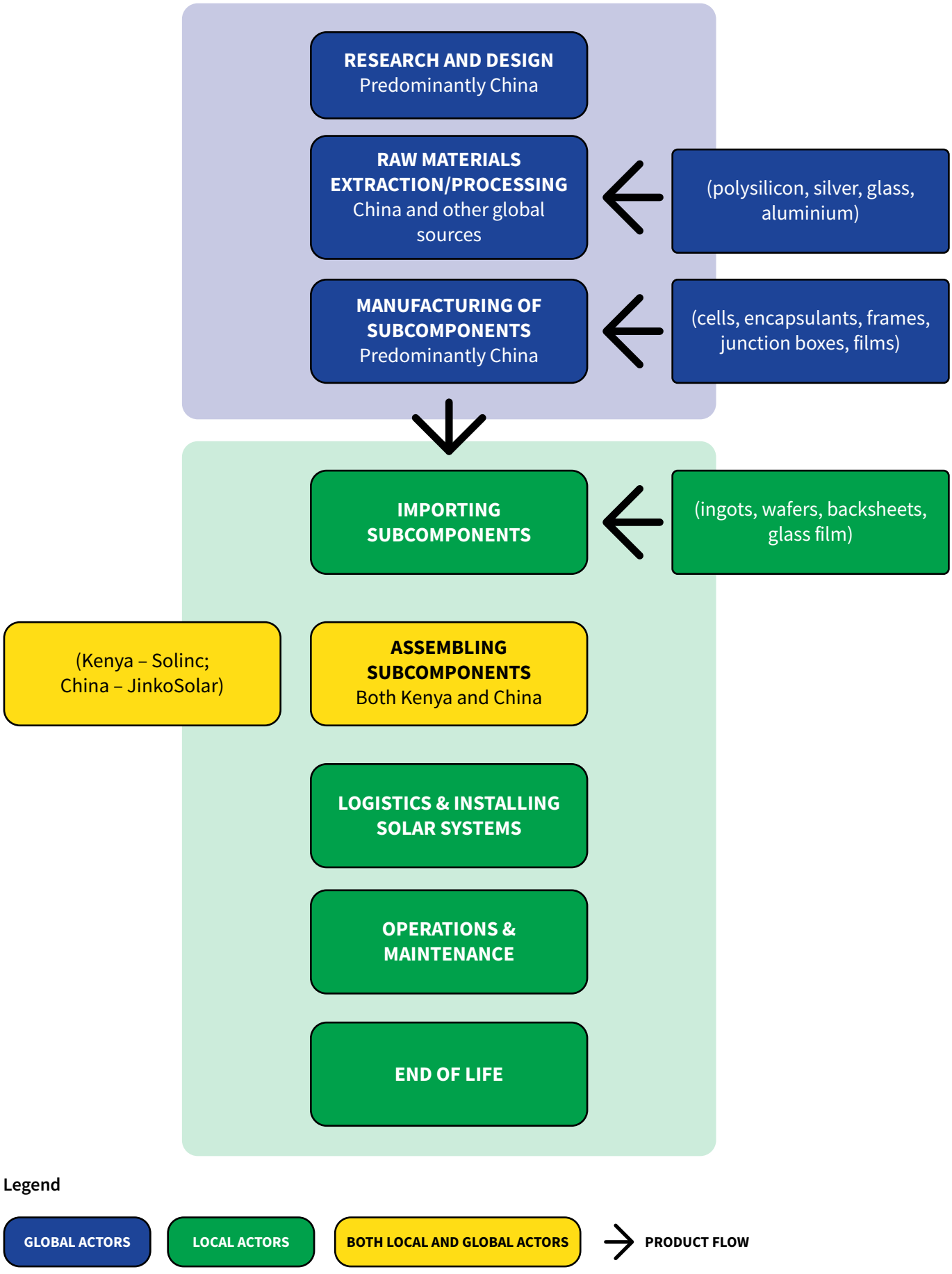
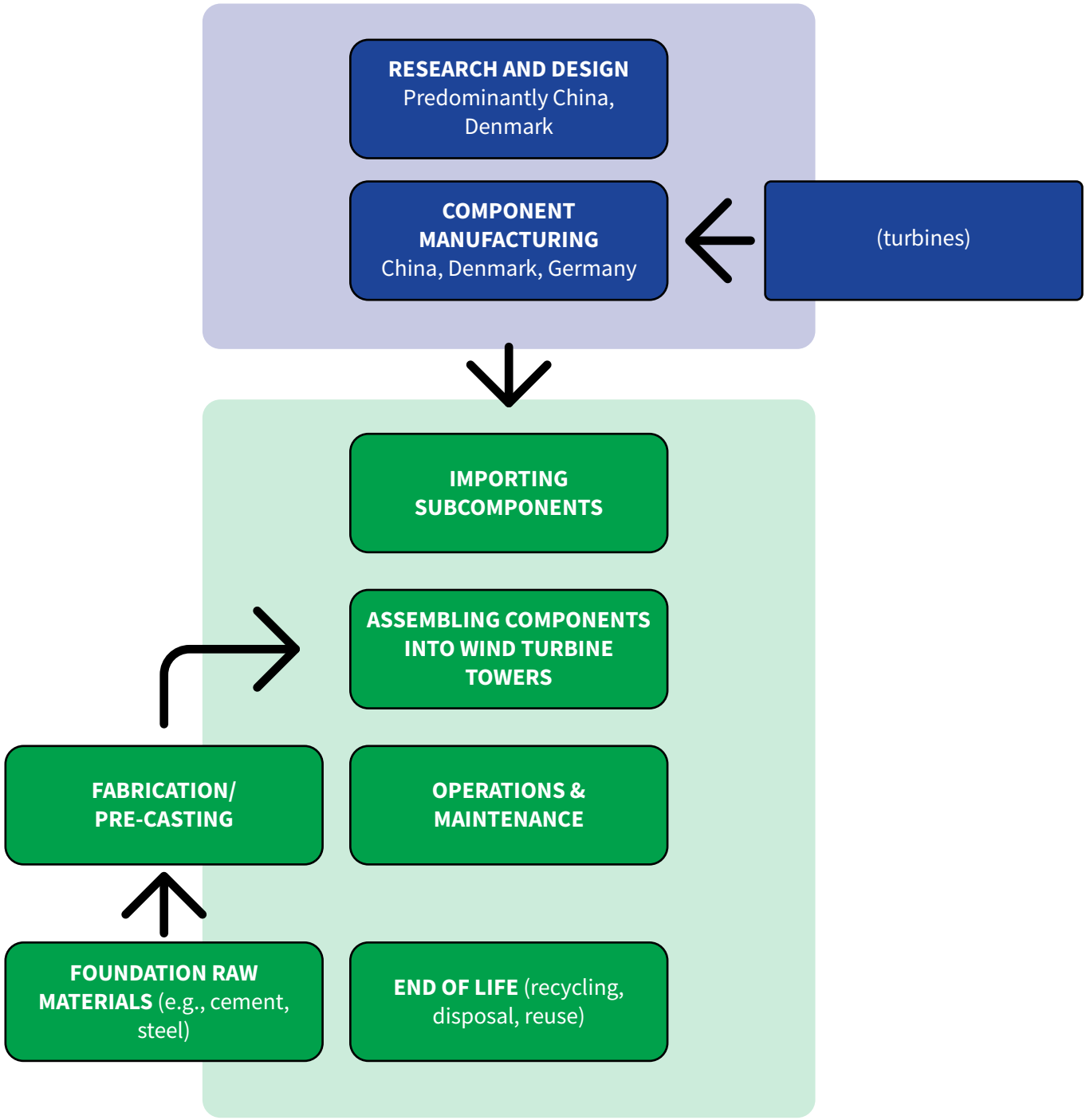


Figure 2: Production Network Map for Wind towers in Kenya (Source: created by author)



Legend

GLOBAL ACTORS LOCAL ACTORS PRODUCT FLOW

4. VALUE CREATION AND ENHANCEMENT

Value within GPNs is conceptualised as a multidimensional dynamic encompassing creation, enhancement, and capture (Coe et al., 2015). These categories allow for an interrogation of how economic, technological, and social gains are distributed across different actors and geographies. Value creation refers to the generation of economic output and employment within the production process; value enhancement involves upgrading activities to achieve greater sophistication or productivity; while value capture denotes the ability of firms, states, and households to retain the benefits from participation in GPNs (IRENA and ILO, 2024).

Existing literature indicates that Kenya faces significant green skills gaps, particularly in basic electrical and mechanical competencies, with only a small proportion of workers qualified for PV and wind energy installation roles (Pickles and Godfrey, 2013). National TVET investments have improved enrolment in science and technology disciplines, yet tertiary enrolments remain low (about 12%) and only 10.6% of graduates attain science or engineering qualifications (Pickles and Godfrey, 2013). RE projects offer short-term technical training, yet structured pathways to advanced qualifications such as technician-level certification are still limited. The ILO-backed National Green Skills Strategy is expected to improve this gap in the coming years.

Education and skills training are expanding but insufficiently meet industry needs. The Kenya Off-grid Solar Access Project (KOSAP) and several TVET centres have incorporated RE modules into their curricula, demonstrating a growing policy intent to address skills shortages. However, most RE roles, especially in installation, demand only basic technical competencies, limiting access to upskilling pathways such as technician certifications or advanced engineering qualifications. National capacity-building initiatives receive support but remain modest in scale relative to sectoral growth. Initiatives like WISEe (Women in Sustainable Energy and Entrepreneurship) and programmes linked to the Global Energy Alliance for People and Planet (GEAPP) have begun to improve access, especially for women, with hands-on basic PV skills training. However, this training remains limited in scale.

Technical and vocational training centres are expanding green curricula, but most RE jobs still require only low-skill labour, restricting pathways to higher-paying roles. This persistent mismatch between training initiatives and labour market needs highlights the structural barriers preventing Kenya from developing a highly skilled RE workforce capable of moving beyond low-value, labour-intensive roles in GPNs. Moreover, existing literature on Kenya's RE skills landscape is sparse, highlighting a critical gap that requires further empirical research.

4.1 Role of workers in value creation and enhancement

Workers constitute the foundation of value creation in Kenya's solar and wind sectors. Value is created through labour- intensive processes such as assembly, installation, and foundation construction, that turn imported technology into operational systems. However, the conditions under which workers contribute to this value reveal the limits of value enhancement and social upgrading.

Statistics show that women hold approximately 41% of jobs in Kenya's decentralised solar PV sector, slightly above the continental average (~38%) (IRENA and ILO, 2024). However, they remain underrepresented in technical and installation roles, where men dominate due to cultural norms and mobility constraints. This gender disparity shapes how value is produced, concentrating women in low-skill, low-paid positions, while men occupy the higher-paying technical roles. Youth under 30 make up the majority of the workforce, reflecting Kenya's median age of 19 and rising youth unemployment (~31%). However, most work opportunities are short-term, reflecting how value creation in the RE sector banks on the rising youth unemployment rate and relies on temporary low-cost labour rather than stable long-term employment.

Stable housing remains out of reach for most workers in Kenya's utility-scale wind and solar sectors. According to the Environmental and Social Impact Assessment for the LTWP project, over 2,500 construction workers were housed in temporary "camp" accommodation, which has been associated with overcrowding, sanitation issues, and lack of privacy factors that negatively affect worker well-being and community relations. Similarly, studies on rural and urban informal settlements suggest that semi-skilled workers involved in panel assembly and installation often live in slum areas, with insecure tenure and substandard services, reflecting their low and unstable incomes. These precarious living arrangements lower operational costs for firms, but they also externalise social costs to workers and communities, demonstrating how value creation often depends on the under-provision of social infrastructure to the workers.

Nearly 72% of Kenya's population lives in rural zones where healthcare is sparse, compounded by a ratio of 1 doctor per 5,725 people, well below WHO standards (Haller Foundation, 2025).

Access to healthcare is uneven and often inadequate. While some international firms involved in large-scale projects have implemented contractor-supplied medical provisions, most local contractors offer only the bare minimum mandated by Kenya's Occupational Health and Safety Act. This leaves many workers to rely on under-resourced public health facilities or pay out-of-pocket, which is especially burdensome in rural areas. This lack of provision of health insurance/healthcare support for workers keeps labour costs low for firms, which reinforces the competitive advantage of the firms, at the expense of their workers' well-being. This reveals how value creation in the sector can occur through the undermining of social welfare, rather than its enhancement . The reproduction of labour occurs under precarious, unconducive conditions that shift social costs onto households, which subsidises the RE sector.

4.2 Role of private firms in value creation in nationally selected renewable component production networks

Kenyan RE firms have primarily capitalised on downstream activities such as EPC, assembly, and distribution, with limited involvement in high-value upstream stages like component manufacturing or R&D. While firms like Serengeti Energy Ltd and Kipeto Energy thrive amid supportive policies like the Energy Act 2019 and the Kenya National Energy Strategy (KNES), they mainly participate in low-technology segments, constrained by the dominance of global OEMs (for example, General Electric (GE) and the China Machinery Engineering Corporation) who control critical technologies, patents, and turbine design. Kenyan firms (for example, M-KOPA and Bboxx) generate organisational rents, particularly in the PAYGo solar sector, through superior customer data management, credit modelling, and effective last-mile distribution, showing some brand power in consumer markets. However, these rents are limited to downstream service differentiation rather than upstream technological or proprietary innovation. There is no clear evidence of Kenyan firms holding technological rents via patents or proprietary processes in turbine or module manufacturing, nor organisational rents relating to core technology governance, which remain controlled by international OEMs and financiers. Regulatory frameworks and financing constraints further inhibit domestic upgrading, keeping Kenyan firms largely in competitive, low-differentiation markets within the global production networks of wind and solar energy.

To unlock greater value capture, Kenya would need to develop targeted R&D financing, foster industrial clusters for component manufacturing, and expand green finance tools, enabling firms to move beyond purely competitive downstream roles and capture technological, organisational, and brand rents more effectively.

5. VALUE CAPTURE

Value capture in Kenya is the ability of Kenyan firms, workers, and the broader economy to secure economic benefits, such as profits, technological capabilities, skilled employment, and social gains, from their participation in RE production and value chains.

5.1 Workers

Acknowledging the limited existing evidence on how employment in Kenya's RE sector translates into tangible improvements in household income, welfare, and decision-making power, this section critically examines value capture at the household level. In Kenya's RE sector, wages remain low and unevenly distributed, notably reinforcing existing gender disparities. According to Power for All's *Powering Jobs Census 2022*, women in Kenya's decentralised renewable energy (DRE) sector earn on average 78% less than men in comparable roles, a disparity suggesting deep-seated wage gaps based on gender, skill level, and job hierarchy (Power for All, 2022). Jobs are frequently short-term, informal, and project-based, with little access to contracts, benefits, or social protections. As a result, working conditions are unfavourable, with limited occupational safety measures outside the scope of statutory minimums.

Income generated from RE jobs does spill over into households and communities, but mainly into covering basic needs rather than transformative investment. KOSAP-backed solar mini-grids and off-grid schemes allow some low-income households to reduce spending on kerosene and mobile charging, yet expenditures on health, education, and seasonal care demands remain high (Energy 4 Impact, 2024). Gendered household patterns also persist, where female wage-earners often channel more of their income into childcare and eldercare needs, due to the lack of institutional support. However, quantifiable data remains sparse on how much is transferred or spent within households, a clear gap in the literature.

In terms of energy access, Kenya has made significant strides: off-grid solar adoption, KOSAP mini-grid installations, and tariff reforms have expanded electricity coverage to one in five households outside the main grid (IEA, 2024a; IEA, 2025). Electricity access has, in turn, improved household productivity. Studies show median incomes quadrupled in rural areas following mini-grid connection, supporting educational outcomes and business activities (Carabajal et al., 2024; Kiprop et al., 2019). Despite this, the link between RE sector employment and improved household energy usage (for example, electrification of cooking or care-related tasks) remains underexplored and underreported.

5.2 Firms

Control over high-value segments of Kenya's RE production network, such as solar cells, turbines, and technological design, resides largely with global lead firms and financiers from the Global North, including Independent Power Producers like GE (Kipeto Wind Power) and financiers such as the Overseas Private Investment Corporation, the African Development Bank, and the European Investment Bank, which capture most economic surplus through long-term PPAs and equity stakes (UNEP CCC, 2024). These lead firms extract value primarily through technological rents, retaining control over turbine technology, solar cell production, and intellectual property, and further consolidate dominance via tied procurement in public tenders under the Energy Act 2019 and PPP frameworks, a structure that perpetuates underdevelopment of local manufacturers and limits their ability to upgrade.

Value capture systems are reinforced through vertical integration and preferential procurement, locking local firms into low-margin EPC and subcontracting roles that rarely lead to progression along the value chain without foreign partnerships or concessional finance. While a few Kenyan innovators, such as off-grid solar and clean cook stove

firms like BURN, demonstrate the potential to contest these extractive structures by leveraging local innovation and impact finance, such cases remain rare and dependent on supportive policies (EIB, 2024). Meanwhile, financiers capture additional gains through interest on loans and by bundling high-return hydro and solar assets into green investment portfolios, whereas local firms mainly benefit from short-term access to relatively low-cost electricity under PPAs, but remain vulnerable to unstable supply and cost-reflective tariffs (IEA, 2024b).

6. POWER IN THE GPN

6.1 Corporate power

Corporate power refers to the extent to which lead firms in a particular GPN can exercise influence over other firms within the GPN, and strategically control production, trade, employment, investment and even state policy, allowing them to shape markets and labour relations in pursuit of higher profits (Cowling and Tomlinson, 2005). Corporate power in wind and solar energy in Kenya is deeply asymmetric, with global lead firms and financiers controlling core high-value segments. These firms, such as GE (supplying turbines for Kipeto Wind Power), Chinese-origin OEMs for solar modules, and financiers like the Overseas Private Investment Corporation (OPIC), the African Development Bank (AfDB), and the European Investment Bank (EIB), capture the bulk of economic surplus through long-term PPAs and equity stakes in major projects like LTWP and Kipeto Wind Power Station (Simberg-Koulumies, 2023). Local firms, ranging from PV assemblers like Solinc East Africa Ltd to EPC contractors, are relegated to low-margin subcontracting roles, bearing operational risks while retaining minimal profit share. Lead firms leverage their dominance through technological control, maintaining proprietary access to wind turbine blades and nacelles (the covers that house the generating components) and solar cells, which reinforces dependency and limits domestic production.

This dominance is further consolidated through active participation in industry associations, such as the Kenya Private Sector Alliance (KEPSA) and the Kenya Renewable Energy Association (KEREA), enabling these firms to exert significant influence over public policy, regulatory standards, and procurement frameworks via lobbying and formal dialogue mechanisms. This enhances their corporate power beyond market dominance, embedding control within technical standards, licensing, and preferential procurement systems. In Kenya, RE components must meet challenging compliance requirements ("Kenya Bureau of Standards [KEBS] certification"), which are costly and time-consuming for local firms, favouring multinational suppliers who have the technical and financial capacity to navigate these processes. Consequently, local firms are locked into lower-value EPC roles without pathways for upgrading, unless supported by substantial foreign capital or technology transfer.

This ecosystem reflects a broader pattern where finance, standards, and policy act as corporate power levers, maintaining lead firm dominance while limiting local firm agency. Similar hierarchical governance structures characterise global solar and wind production networks, although some countries such as Germany and Denmark have historically adopted more coordinated and collaborative approaches, supported by strong industrial policy, public research institutions, and deliberate efforts to strengthen domestic industries.

Overall, these patterns show that corporate power in Kenya's RE value chains could possibly extend far beyond ownership concentration. Lead firms influence participation and value distribution through control of standards, finance, and contracts within the GPN, yet, despite evidence from other regions, there is barely any publicly available literature in Kenya documenting how these mechanisms actually operate in practice. This remains a critical knowledge gap.

6.2 Institutional power

Institutional power is the influence that states (both foreign and national), and multinational agencies such as the EU, exert on corporate investment strategies and capabilities, and the operations of firms within the GPN. Institutional power in Kenya's RE component production network is exercised through a multi-layered governance structure that includes national regulators, international financiers, and regional standard-setting bodies, each shaping the trajectory of local industrial development. At the national level, the Energy and Petroleum Regulatory Authority (EPRA), under the Ministry of Energy and Petroleum, is the primary regulator responsible for licensing,

quality assurance, and technical standards in RE projects. EPRA enforces the Energy Act 2019 and oversees grid integration, net metering, and off-grid licensing, while also approving tariffs and monitoring PPAs (EPRA, 2025). EPRA's framework raises compliance requirements that screen market entrants and influence business models. KEBS supplements EPRA's role by enforcing product quality standards for imported solar modules and wind components. EPRA and KEBS raise minimum capabilities, deter low-quality entrants, and push product and service upgrading, thus demonstrating that the state does have instruments that influence firms. However, the ability of these institutions to drive domestic manufacturing and local content enforcement is limited, as most regulation prioritises project delivery and energy security.

Kenya has developed several policy instruments aimed at localisation, gender equity, and decent work in the RE sector, yet their implementation remains constrained by weak enforcement mechanisms and institutional capacity gaps (Newell and Phillips, 2016). The Energy Act 2019 includes provisions for local content requirements in RE projects, mandating that developers submit local content plans during licensing (EPRA, 2025). However, enforcement remains inconsistent due to limited monitoring capacity within EPRA and the absence of clear penalties for non-compliance (Tsui et al., 2014). The Ministry of Energy and Petroleum *Strategic Plan 2023-2027* outlines aspirations for increasing domestic manufacturing participation in RE, but lacks specific roadmaps, financing mechanisms, or industrial support programmes to achieve these targets (Ministry of Energy and Petroleum, 2024). This gap between policy aspiration and implementation reflects broader challenges identified in studies of local content policies across developing countries, where regulatory frameworks often fail to translate into meaningful industrial development, without accompanying institutional capacity and financial support (Hansen et al., 2015).

Kenya's 2019 *National Energy Policy* includes commitments to gender mainstreaming and women's participation in energy sector employment (Ministry of Energy and Petroleum, 2024). The policy mandates that at least 30% of technical training positions in RE projects be reserved for women. However, implementation data from EPRA shows that female participation in technical roles remains below 15% as of 2024, indicating a significant implementation gap (EPRA, 2025). Contributing factors include the absence of workplace policies addressing childcare, sexual harassment, and discriminatory hiring practices, as documented in gender audits of energy sector firms. Research on gender mainstreaming in the energy sector across developing countries demonstrates that policy commitments alone are insufficient without targeted interventions addressing structural barriers, such as lack of access to technical training, discriminatory recruitment practices, and workplace environments that fail to accommodate women's care responsibilities (Pearl-Martinez and Stephens, 2016; Clancy et al., 2017).

The Employment Act 2007 and Occupational Safety and Health Act 2007 establish baseline labour protections, including provisions for fair wages, safe working conditions, and social security (Muthini, 2025). However, RE projects frequently rely on temporary and casual labour arrangements that circumvent these protections. A 2023 ILO assessment found that over 65% of workers in Kenya's RE construction projects lack formal employment contracts, limiting their access to statutory benefits and dispute resolution mechanisms (Ndi, 2024). This reliance on precarious employment undermines decent work standards and reflects broader patterns in infrastructure sectors across sub-Saharan Africa, where project-based employment models prioritise cost reduction over worker welfare (Baah-Boateng, 2015; Mitullah et al., 2017).

The state's ability to enforce localisation, gender equity, and decent work standards is constrained by institutional fragmentation, with overlapping mandates across EPRA, the Ministry of Labour, KEBS, and county governments creating coordination challenges (Newell and Phillips, 2016). Additionally, the state faces pressure from international financiers and foreign investors, who prioritise project completion timelines and cost minimisation over compliance with local content and labour standards. This asymmetric power dynamic limits Kenya's policy space to impose stringent requirements on foreign-led projects (Hansen et al., 2015; Morris et al., 2012).

International development banks and foreign states exert outsized influence over Kenya's RE sector by financing and structuring major utility-scale projects. Countries where foreign lead firms originate, such as the United States, China, and members of the European Union, shape Kenya's RE policies and market dynamics through diplomatic engagement, development aid, and investment conditions aligned with their geopolitical and economic interests. For example, the European Union supports Kenya's renewable transition through substantial funding for flagship

projects like the LTWF, and regulatory capacity-building aligned with the European Green Deal. The US, through development finance institutions like OPIC, promotes financing structures that emphasise bankability and tech standards favouring US-based firms like GE. China leverages its Belt and Road Initiative to finance infrastructure and energy projects, influencing Kenya's energy mix and procurement preferences. These countries also participate in shaping international standards and preferred technologies embedded within Kenya's regulatory frameworks.

Collectively, this geopolitical and institutional embeddedness of corporate and financial power ensures that lead firms from these countries maintain their dominance by influencing local policies, procurement rules, and financing conditions, thereby limiting Kenya's ability to develop independent manufacturing capacity or negotiate more favourable terms (SEETAO Energy, 2025).

The World Bank, AfDB , and EIB have provided concessional loans, equity financing, and political risk guarantees for landmark projects such as LTWF and Kipeto Wind Power, effectively shaping market orientation towards large-scale, foreign-led investment. While these flows have accelerated project deployment, they have reinforced dependency on foreign OEMs for turbines and solar modules, and project contracts often favour foreign EPCs and suppliers, leaving local firms in low-value subcontracting roles. Foreign dependency in Kenya's RE sector is reinforced through long-term PPAs favouring foreign OEMs and EPCs, which perpetuate reliance on imported turbines and solar modules. These contracts embed foreign firms in central roles for technology supply, operation, and maintenance, limiting local firms mainly to lower-margin, labour-intensive, subcontracting tasks. The procurement frameworks often require international certifications and prior experience with large projects, which local firms find difficult to meet without foreign partnerships or concessional finance (IRENA, 2025). Moreover, foreign financiers such as AfDB and EIB promote standardised project models emphasising bankability and reduced financial risk, which advantage established multinational suppliers over local firms, thereby locking Kenya into dependent supplier relationships and constraining domestic manufacturing growth (UNEP CCC, 2024).

In the Kenyan context, the implications for localisation are twofold. First, while external financiers and partner governments rarely mandate a specific brand or model, their risk frameworks, tendering rules, and certification requirements function as de facto technology filters. Bankability thresholds, conformity with KEBS standards, warranty provisions, and prior experience criteria effectively narrow the technological set from which developers can choose, favouring incumbent multinational OEMs with long track records (Ockwell and Byrne, 2017). This reduces delivery risk but raises entry barriers for emergent Kenyan assemblers and component suppliers that lack accredited testing histories or extended performance guarantees. Second, procurement architectures, especially turnkey EPC contracts bundled with long-term operations and maintenance, stabilise execution yet externalise high-value manufacturing and specialised services, confining local participation to civil works, logistics, mounting structures, and routine site services (Hansen et al., 2015; Morris et al., 2012). Where enforceable local-content, training, and technology-transfer clauses are embedded and supported, projects may create demand and stronger incentives for Kenyan firms to invest and upgrade. However, the absence of such provisions, together with foreign funding, tight delivery milestones, and import-friendly cost structures, tilt outcomes towards rapid importation of ready-to-install systems, with limited deepening of domestic capacity (Altenburg and Lütkenhorst, 2015). In short, external finance does not typically name the technology, but its standards and contracting templates determine the feasible technological options and, by extension, the attainable depth and trajectory of localisation.

Tax incentives such as zero-rated VAT, import duty exemptions for solar equipment, and investment allowances are essential features of Kenya's renewables policy. However, while these incentives attract investment, they also reduce potential revenue streams, causing government to forfeit modest but meaningful income, as estimated in sectoral policy analyses (GOGLA, 2024). Beyond incentives, the state's role in value capture includes project-level contributions to infrastructure, licensing fees, and land negotiations. However, there is limited evidence of systematic mechanisms such as royalty streams, profit-sharing agreements, or national equity stakes that capture value beyond immediate project taxation. Corporate Social Responsibility programmes, like those connected to LTWP, offer localised benefits but lack state-wide frameworks for redistributing gains (Babijes and Endo, 2025).

At the policy level, Kenya possesses legal allowances for localisation but lacks a coherent, sector-specific industrial strategy for RE component manufacturing. The Energy Act 2019 provides for local-content plans and oversight, and

general pro-investment instruments such as Special Economic Zones and tax incentives. However, these provisions remain broad and are only rarely turned into enforceable targets for RE components (Kingiri and Nderitu, 2014; Newell and Phillips, 2016). Procurement in externally financed projects usually follows donor rulebooks that put bankability and proven technology first. This tends to lock in turnkey EPC contracts with long operations and maintenance deals, which in practice favour established foreign suppliers (Hansen et al., 2015). Together with funding in foreign currency, tight delivery deadlines and cost structures that make importing cheaper, this setup encourages purchases of component imports and leaves less room for domestic supplier upgrading. When projects include clear, enforceable provisions on local content, training, technology transfer and access to accredited testing and certification, they create predictable demand and stronger incentives for Kenyan firms to invest and build capability (Altenburg and Lütkenhorst, 2015; Morris et al., 2012). Without such provisions, interactions between firms, the state and financiers remain mostly transactional, making it harder to move beyond assembly into manufacturing and design.

In addition to this, EPRA and KEBS enforce licensing and quality standards that raise production thresholds but emphasise project deployment and safety rather than industrial upgrading or local content enforcement, thereby limiting firms' ability to capture higher value. Local labour markets and educational systems, such as partnerships between the Strathmore Energy Research Centre (SERC) and Machakos University, or the Strathmore-Fortescue MoU, offer valuable skills training but lack integration into sustained innovation or R&D ecosystems, which is crucial for technological advancement. Industrial policies remain underdeveloped, providing limited incentives or support for joint ventures or in-depth local content development. Firms operate through transactional interactions with state bodies and finance institutions, with limited leveraging of social networks beyond operational necessities, which constrains progress from assembly roles to manufacturing or design (AfDB, 2015; EPRA, 2023; KEBS, 2023).

6.3 Collective power

Collective power refers to the influence of collective agents over companies at particular nodes in the GPN, as well as over their respective governments and international bodies. These can include trade unions, employee associations, NGOs and civil society organisations. These collective agents exercise countervailing power against corporate and institutional power, targeting companies, governments or international bodies either directly or indirectly.

Collective power among trade unions, civil society groups, and community organisations in Kenya's RE sector remains limited and unevenly organised, largely due to the project-based and short-term nature of RE development, and the sector's dependence on informal labour. This mirrors broader trends in Kenya's labour market, where trade unions have struggled to adapt to liberalisation, privatisation, and the growth of non-standard employment relations. A survey of Kenyan unions showed that workforce restructuring, outsourcing, casualisation and subcontracting have eroded traditional union strongholds and fragmented the workforce, making it harder to build solidaristic organisation across sectors (Gitari, 2010). Trade unions, including the Kenya Electrical Trades and Allied Workers Union (KETAWU), under the umbrella of the Central Organisation of Trade Unions (COTU), have a strong historical base in established utilities such as Kenya Electricity Generating Company (KenGen) and Kenya Power and Lighting Company (KPLC). At KPLC , for example, KETAWU is the recognised bargaining agent for more than half of the unionised employees, and management–union relations are governed by established grievance, disciplinary and collective bargaining procedures that are renegotiated biennially. Evidence indicates relatively high levels of satisfaction with internal grievance handling, disciplinary procedures and the collective bargaining process, suggesting that trade unions retain meaningful influence over wages, working conditions, and dispute resolution in this node of the electricity system (Wachira, 2010). On the other hand, there is a minimal presence of unions within the decentralised solar and wind installation segments. Most employees in these areas are casual, temporary labourers without union representation, and female installers, who often face job precarity, are particularly excluded from unionised structures (LTWP, 2017).

Community organisations have played roles in asserting collective agency, especially around issues of land and social justice. For instance, communities near the LTWP project, mobilised through the Sarima Indigenous Peoples' Land

Forum (SIPLF), eventually took legal action against the project's land acquisition. As the High Court confirmed in late 2021, title deeds had been irregularly obtained, leading to grassroots pushback and demands for benefit-sharing (Achiba, 2019). While the litigation forced renegotiations on benefit-sharing, its impact on upstream governance, where foreign OEMs and financiers dominate, remained limited.

NGOs and advocacy networks such as KEREA, Practical Action, and WISEe have offered limited channels for collective mobilisation, providing skills training, policy engagement, and gender equity support. However, they typically operate within donor-funded project parameters and lack formal mechanisms for labour inclusion or coordinated bargaining (Remote Energy, 2015). WISEe, for instance, has successfully empowered a small cohort of women PV technicians, but remains peripheral to the broader sector in terms of labour.

Comparative experiences elsewhere in Africa underscore both the potential and limits of collective power. In South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), community trusts and mandatory socioeconomic development and enterprise development contributions have institutionalised local equity participation and community benefit schemes around wind and solar projects. However, research suggests that these mechanisms often produce forms of participation that do not fundamentally alter ownership structures, elite control over finance, or technology choices (Baker, 2015). In the case of Kenya, collective power remains largely project-based and reactive, lacking similar statutory instruments to guarantee long-term community benefits or to redistribute decision-making power within the GPN. The constraints identified in the functioning of Kenyan unions — casualised workforces, limited organisational capacity, and restrictive legal frameworks — suggest that the weakness of labour power in RE is not an anomaly but an indicator of a wider crisis in union representation.

Overall, collective actors have limited capacity to influence wages, social reproduction conditions, or firm-level agreements, leaving value distribution and governance largely shaped by dominant corporate and institutional players. They may exert reactive and localised influence, but none have meaningfully shifted the core asymmetries of technological dependency, financial control, or market access that define Kenya's position in the RE GPN. However, literature on collective power within Kenya's RE sector remains sparse, signalling a gap that calls for more research.

7. EMBEDDEDNESS

Embeddedness refers to the anchoring of local actors in their network ties to lead firms, financiers, regulatory bodies and EPCs; their territorial footing in specific regions; and their social relations shaped by labour markets, gendered care burdens, skills systems and community consent Baker et al., 2022. At its core, the GPN framework argues that production networks are embedded in specific territorial, institutional, and social contexts, and do not operate in a vacuum. While GPN analysis traces the cross-border flows of capital, technology, standards, and organisational practices, the concept of embeddedness explains how these global flows are shaped locally through place-specific geographical, institutional, and social relations.

7.1 Network embeddedness

This refers to the degree of connectivity within a GPN, the stability of its agent relationships, and the importance of the network for the participants. Key elements include the architecture, the durability and stability of relationships, and the trust between network agents. It specifically concerns the strength, stability, and trust within business relationships in the network, as distinct from territorial embeddedness, which refers to how firms are rooted and constrained by their geographical and social contexts

Kenyan firms occupy low-value, downstream positions within global RE production networks, primarily being involved in solar panel assembly, distribution, EPC contracting, and wind foundation work. High-value stages — such as polysilicon refining, wafer and solar cell manufacturing, turbine design, and global supply chain control — are dominated by multinational OEMs, like JinkoSolar based in China. This hierarchical configuration leaves Kenyan firms structurally dependent, with limited scope for technological upgrading or value capture. The nature of relationships between Kenyan firms and GPN actors reinforces this subordinate role. Most local firms engage in short-term, project-based contracts, with little to no long-term partnerships or equity participation in upstream supply chains. Co-ownership or shared investment with global OEMs is uncommon. Even when supplying inputs like steel and concrete, Kenyan firms rely on episodic purchasing contracts, lacking formal, long-term supply linkages with OEMs or tier-1 global suppliers, underscoring their peripheral positioning in the network structure (SEforALL, 2025).

Specific cases in Kenya show the durability and form of these ties. At LTWP, the developer contracted Vestas (a Danish manufacturer, seller, installer, and servicer of wind turbines), on supply-and-installation plus a 15-year service agreement, anchoring repeated interactions around O&M and warranties. By contrast, the transmission-line EPC was a project-specific award to a foreign contractor, indicating short-lived, transactional ties (AfDB,2014). At Kipeto wind project, GE supplied 60 turbines and provides O&M, while China Machinery Engineering Corporation (CMEC), a construction and engineering company, held a turnkey EPC, explicitly split into offshore (equipment/design) and onshore (site works), again showing durable OEM–operator relationships with time-limited EPC/local subcontractor arrangements (GE Renewable Energy, 2018; Renewables Now, 2016). Local firms face entrenched barriers to embedding, because global OEMs maintain technological control, require stringent OEM-certified quality standards, and enforce procurement chains that limit access to local suppliers. Despite Kenya's Green Manufacturing Strategy, local firms remain unable to meet these technical thresholds without substantial foreign support. SMEs occasionally participate in assembly roles in off-grid solar (for example, Solinc East Africa) or civil works for wind foundations, but these engagements are fragmented, low-margin, and rarely lead to higher-value opportunities such as solar cell or inverter production.

Standards and warranty rules also shape who works with whom. The use of the KEBS Pre-Export Verification of Conformity (PVoC) checks and internationally recognised quality tests for off-grid solar steers firms toward proven, certified products and partners with reliable after-sales support. This encourages lead firms to choose familiar, pre-approved suppliers (KEBS, 2023). By contrast, the PAYGo off-grid model builds frequent, ongoing relationships

between companies, their distributor and agent networks, and customers' formal contracts, and performance targets work alongside day-to-day trust around installation, payments, warranties, and repairs, creating denser and more durable ties than one-off sales. On the global stage, China dominates solar PV production, with over 75% of global capacity driven by state-backed investment across the supply chain (Chadly et al., 2024). Emerging hubs like Vietnam and Malaysia leverage export-friendly policies and proximity to Chinese OEMs. Firms such as Canadian Solar, AE Solar, Maxeon Solar Technologies (Singapore), and Trina Solar operate across continents, integrating R&D, manufacturing, and shaping price/technology trajectories and finance networks, strengthening Western and Asian control over the RE value chain. With production concentrated overseas, local firms mostly purchase and warranty imported gear, rather than co-developing or licensing it; so relationships don't deepen (IEA, 2022).

Regarding standards and regulatory frameworks, Kenya aligns with International Electrotechnical Commission (IEC) technical standards and Paris Agreement targets. However, there are no enforceable international agreements mandating technology transfer or local content participation. This governance gap means Kenyan firms have little leverage to access higher-value production stages. Relationally, the absence of binding technology-transfer obligations lowers the probability of long-term, capability-oriented partnerships and sustains transactional ties. Global growth trajectories in solar PV point to sustained expansion anticipated to exceed 500 GW annually by 2025, with concentrated manufacturing power firmly rooted in China (WhatCost, 2025; Ember Energy, 2025; NREL, 2025). Southeast Asian assembly hubs are escalating production capacity, but Kenya's growth narrative remains tied to downstream deployment, not upstream manufacturing or component production.

Without effective enforcement of local content policies, industrial R&D investment, or incentives for joint ventures, local firms are likely to stay structurally marginalised within GPNs. This implies few durable, trust-building inter-firm relationships beyond OEM O&M contracts and PAYGo distribution networks; even where utility-scale supply chains exist, the dominant pattern remains short EPC subcontracts rather than multi-year supplier frameworks with learning and technology transfer commitments.

There is little to no Kenya-specific research that tracks how long contracts last, how often they are renewed, or how much trust builds up between developers, OEMs, EPCs, and local suppliers in utility-scale wind or grid-connected solar. Many contract terms are confidential, so public evidence is thin. To fill this gap, we refer to South Africa's REIPPPP, where studies show that local-content rules increased assembly and services; however, deeper manufacturing stalled without finance, accredited testing capacity, and predictable multi-year demand. In other words, without those supports, ties stayed short and transactional (Eberhard et al., 2014). In the local context, ties tend to be longer where there is ongoing operations and maintenance with an OEM, shorter where work is a one-off EPC subcontract, and high-frequency in PAYGo distribution, where companies interact constantly with agents and customers. This theoretical framing lets us make sense of Kenya's pattern even while noting the gap in literature and the need for Kenya-specific research.

7.2 Territorial embeddedness

Territorial embeddedness refers to the anchoring of firms in specific places, from national down to local, and how they become absorbed by or leverage local socio-political contexts such as institutions, labour markets, social networks, and regulatory frameworks, which shape their strategies, capabilities, and development trajectories (Henderson et al., 2002). Literature emphasises that territorial embeddedness is shaped not only by where firms are located, but also by the reason for their location, whether it's due to local demand, industrial policy, infrastructure, agglomeration economies, or special economic zones. For instance, in major solar manufacturing countries, production tends to cluster near ports, logistics hubs, or regions with preferential incentives, demonstrating how state policy and spatial infrastructure shape industrial geography. As emphasised in the literature, localisation is rarely accidental: firms respond to global market-formation policy and policy incentives that shape where value-chain segments take root (Zhang and Gallagher, 2016). For example, solar PV manufacturers in China anchor their activities in regions able to exploit mass-manufacturing capabilities and local capacity for large-scale production (Binz and Anadon, 2018), thus highlighting the role of regional industrial capabilities. Studies further show that

agglomeration dynamics matter: the spatial concentration of industrial production generates productivity advantages that attract firms into clusters (Ke, 2009).

Closer to home, on the African continent, we have examples such as South Africa's Atlantis Special Economic Zone north of Cape Town. This was designated as a greentech SEZ to attract wind tower and RE manufacturers, leveraging industrially- zoned land, bulk infrastructure, proximity to Cape Town and the Saldanha port, and targeted tax and investment incentives (Grant et al., 2020). In Morocco, the Noor Ouarzazate Solar Complex, located on desert land near the city of Ouarzazate in the Drâa-Tafilalet region, is a multi-phase 580 MW, concentrated solar power and PV complex, developed by the Moroccan Agency for Sustainable Energy (MASEN) as part of a national solar plan. Sited in an area with very high solar irradiance, existing road and grid connections, and access to the El Mansour Eddahbi reservoir for cooling, it is used as a platform to develop local construction, engineering and O&M capabilities and related service and supply chains around Ouarzazate (Laaroussi et al., 2021). In Egypt, the Benban Solar Park near Aswan has catalysed a cluster of more than 30 project companies and associated service providers under a feed-in tariff framework. Its site is justified by high solar irradiation, available desert land, and the ability to share grid connection and permitting infrastructure (Adel, 2020; Mohamed and Maghrabie, 2022).

Kenya's RE production network is geographically concentrated but globally fragmented. It reflects a sector where local firms have primarily anchored operations domestically, while the higher-value manufacturing and design remain externalised. Most firms are headquartered in Nairobi, which serves as the hub for solar distribution, EPC management, and project finance, but the physical production of high-value components like solar cells, wafers, and turbine nacelles occurs abroad. This means anchoring is strongest in sales, warehousing, light assembly, and services, while upstream component production is located outside Kenya. Firms such as Davis and Shirtliff, a dominant regional distributor, extend their market reach into Uganda, Tanzania, Rwanda, Ethiopia, and Zambia, but their activities remain focused on distribution and installation rather than component production, highlighting a pattern of geographic reach without upstream industrial anchoring.

The social and environmental dimensions of Kenya's territorial embeddedness are complex. At the global level, reliance on imported components links Kenya with upstream industrial practices associated with sustainability concerns and human rights issues. Locally, projects like LTWP have generated land disputes and raised questions of benefit sharing, highlighting the difficulties firms face in gaining social legitimacy and building trust with communities, which are vital for deepening territorial embeddedness (Krishnan, 2023).

7.3 Societal embeddedness

Societal embeddedness refers to the ways in which production networks are shaped by the wider social relations, cultural norms, and everyday conditions of life in the places where they operate. In the GPN framework, societal embeddedness highlights that economic activities are not only organised through firms and markets, but are also conditioned by labour regimes, gender relations, household structures, and systems of social reproduction (Coe and Yeung, 2015). Renewable sector jobs rarely accommodate care duties. Women workers, who shoulder the majority of child and elder care in Kenya, often rely on informal networks such as grandparents or community support, since workplace support remains virtually non-existent. According to a study by the Partnership for Economic Policy (PEP), the main constraints preventing Kenyan women from accessing decent work are having young children, the limited enforcement of anti-discrimination laws, and a large informal sector (Energypedia, 2020; PEP, 2024). This aligns with broader research on women's double burden, which highlights how women in sub-Saharan Africa spend significantly more time on unpaid domestic and care work than men, limiting their ability to enter and remain in formal employment (Shrestha 2015; Robino et al., 2023). Further, studies in Kenya's informal urban settlements demonstrate the impact of childcare constraints, highlighting that limited access to affordable early childcare inhibits poor urban women's participation in paid work (Clark et al., 2019; Okelo et al., 2022). This has direct implications for RE roles like PV installers or wind farm technicians, which often require travel or irregular hours. Without childcare support, many women are pushed into informal, part-time, or seasonal roles, reinforcing occupational segregation. A gender-focused energy-sector analysis also observed that, without adequate leave

policies, flexible work schedules, lactation rooms, and on-site or nearby childcare services, women are less likely to enter and remain in the clean energy sector (WEL, 2024; EEP Africa, 2017).

The lack of employer-provided childcare and family-friendly working conditions in Kenya's RE sector creates significant barriers for female workers, particularly in technical roles that demand mobility and time flexibility. This is both a structural constraint on gender equality and a threat to unlocking the sector's full employment potential.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

This background paper has critically examined Kenya's RE production networks for solar panels and wind turbine towers through the lens of the GPN framework. It has traced the structure of the value chains, identified the key local and international actors, and analysed the distribution of value creation, enhancement, and capture among households, firms, and the state. The paper explored social reproduction dimensions, highlighting the precarious conditions and limited social upgrading for workers, particularly women and casual labourers. It also assessed the role of public institutions, international financiers, EPC firms, local suppliers, and social actors, including trade unions, NGOs, and community organisations, in shaping Kenya's position in global RE production networks. Further, the paper critically mapped network and geographic embeddedness, revealing that Kenya's participation is heavily downstream and import-dependent, with domestic firms confined to low-margin assembly, civil works, and distribution, while high-value innovation, manufacturing, and governance remain concentrated with Chinese, European, and American firms.

8.2 Recommendations

The study also exposes significant research and policy gaps. Kenya lacks the R&D capacity, patient capital, and coordinated industrial policies needed to move beyond low-value roles and integrate into higher-value segments of global RE production. Empirical evidence on how RE employment translates into household welfare, gender equity, and intergenerational social reproduction is limited, while the impacts of emerging green skills programmes and community engagement initiatives remain under-documented. Fieldwork should therefore explore:

(i) The lived experiences and social upgrading outcomes for RE workers and their households.

(ii) The conditions under which local firms can scale production or develop joint ventures for technology transfer and upstream participation.

(iii) The institutional reforms needed to embed local firms more deeply in global networks while ensuring equitable benefit sharing. Without deliberate investment in industrial capability, social infrastructure, and policy alignment, Kenya's RE transition risks remaining project-led and externally governed, offering temporary economic gains but limited transformative potential for domestic industry and society.

(iv) The conditions of social reproduction, including unpaid care, commuting and shift patterns, and access to social infrastructure, that shape labour supply, worker retention, and household incomes, and what targeted policy interventions are required to address these constraints.

(v) The configurations of power across the GPN and how they determine value creation and capture, entry barriers, and upgrading prospects for Kenyan manufacturers, as well as the policy, regulatory, and financial instruments needed to shift bargaining power in favour of local firms and workers.

REFERENCES

Achiba, G. 2019. "Navigating contested winds: Development visions and anti-politics of wind energy in northern Kenya." Land, 8(1): 7. DOI: 10.3390/land8010007.

African Development Bank. 2014/2015. *Review of AfDB's procurement policy, procedures and processes: Policy framework paper*. Abidjan, Côte d'Ivoire.

African Development Bank. 2015. *Lake Turkana Wind Power Project report*. Abidjan, Côte d'Ivoire.

African Development Bank. 2015. *Renewable energy in Africa: Kenya country profile*. Abidjan, Côte d'Ivoire.

Baah-Boateng, W. 2015. "Unemployment in Africa: How appropriate is the global definition and measurement for policy purpose." *International Journal of Manpower*, 36(5): 650–667. DOI: 10.1108/IJM-02-2014-0047.

Babijes, R. M., and Endo, K. 2025. *Kenya – Nairobi Metropolitan Services Improvement Project: Environmental and social impact assessment (ESIA) report for the construction of Ngong Market*. Vol. 31 of 41. World Bank. Washington DC, USA.

Baker, L. 2015. "Renewable energy in South Africa's minerals–energy complex: A "low carbon" transition?" *Review of African Political Economy*, 42(144): 245–261. DOI: 10.1080/03056244.2014.953471.

Baker, L., Sesan, T., Bhattacharyya, S., Pueyo, A., Bukari, D., Meena, S., Onsongo, E., Oyinlola, M., Sawe, E., Otu-Eleri, E., Uduka, U., Handem, Y., Onjala, B., and Katyega, M. 2022. "Of monopolies and mini grids: Case studies from Kenya, Tanzania, Nigeria and Senegal." *Sustainability, Inclusiveness and Governance of Mini-Grids in Africa (SIGMA) project report*.

Carabajal, A. T., Orsot, A., Moudio, M. P. E., Haggai, T., Okonkwo, C. J., Jarrard III, G. T., and Selby, N. S. 2024. "Social and economic impact analysis of solar mini-grids in rural Africa: A cohort study from Kenya and Nigeria." *Environmental Research: Infrastructure and Sustainability*, 4(2): 025005. DOI: 10.1088/2634-4505/ad4ffb.

Chadly, A., Moawad, K., Salah, K., Omar, M., and Mayyas, A. 2024. "State of global solar energy market: Overview, China's role, challenges and opportunities." *Sustainable Horizons*, 11: 100108. DOI: 10.1016/j.horiz.2024.100108.

Clark, S., Kabiru, C. W., Laszlo, S., and Muthuri, S. 2019. "The impact of childcare on poor urban women's economic empowerment in Africa." *Demography*, 56(4): 1247–1272. DOI: 10.1007/s13524-019-00793-3.

Coe, N. M., Dicken, P., and Hess, M. 2008. "Global production networks: Realizing the potential." *Journal of Economic Geography*, 8(3): 271–296. DOI: 10.1093/jeg/lbn002.

Coe, N. M., and Yeung, H. W-C. 2015. *Global production networks: Theorizing economic development in an interconnected world*. Oxford: Oxford University Press.

Cowling, K., and Tomlinson, P. R. 2005. "Globalisation and corporate power." *Contributions to Political Economy*, 24: 33–54.

Eberhard, A., Kolker, J., and Leigland, J. 2014. *South Africa's Renewable Energy IPP Procurement Program: Success Factors and Lessons*. Washington DC: PPIAF/World Bank. DOI: 10.1596/20039.

EEP Africa (Energy and Environment Partnership). 2017. *Understanding the Role of Women and Girls in Renewable and Energy-Efficiency Projects in Southern and East Africa – Phase II.* Helsinki: EEP Africa.

Ember Energy. 2025. *China's Solar and Climate Energy Opportunity.* London: Ember.

Energy 4 Impact. 2024. *About Energy for Impact.* London: Energy 4 Impact. [Accessed on: 28 November 2025].

Energy and Petroleum Regulatory Authority. 2023. *Annual Report 2022/2023.* Nairobi: Energy and Petroleum Regulatory Authority.

Energy and Petroleum Regulatory Authority. 2024. *Energy and Petroleum Statistics Report FY 2023–2024.* Nairobi: Energy and Petroleum Regulatory Authority.

Energy and Petroleum Regulatory Authority. 2025. *Renewable Energy Overview*. Nairobi: Energy and Petroleum Regulatory Authority.

Energypedia. 2020. *Gender and Energy Country Brief: Kenya*. Bonn: Energypedia. [Accessed on: 28 November 2025].

European Investment Bank. 2024. *Kenya's Green Energy Leadership*. Luxembourg: European Investment Bank.

General Electric (GE Renewable Energy). 2018. *GE connects financing and turbine technology to its flagship onshore wind project in Sub-Sahara Africa*.

Gereffi, G., Humphrey, J., and Sturgeon, T. 2005. "The governance of global value chains." *Review of International Political Economy*, 12(1): 78–104. DOI: 10.1080/09692290500049805.

Gitari, D. K. 2010. *Strategies Adopted by Trade Unions in the Changing Nature of Workforce in Kenya.* MBA research project. Nairobi: University of Nairobi.

Government of Kenya. 2008. *Kenya Vision 2030*. Nairobi, Kenya.

Government of Kenya. 2023. *Kenya's Updated Nationally Determined Contributions (NDCs).* Nairobi: Ministry of Environment, Climate Change and Forestry.

Haller Foundation. 2025. "Improving Access to Healthcare in Rural Kenya." *The Haller Foundation News*, 24 January. [Accessed on: 28 November 2025].

Hansen, U. E., Nygaard, I., Romijn, H., Wieczorek, A., Kamp, L. M., and Klerkx, L. 2015. "Sustainability transitions in developing countries: Stocktaking, new contributions and a research agenda." *Environmental Science & Policy*, 84: 198–203. DOI: 10.1016/j.envsci.2017.11.009.

Henderson, J., Dicken, P., Hess, M., Coe, N. M., and Yeung, H. W-C. 2002. "Global production networks and the analysis of economic development." *Review of International Political Economy*, 9(3): 436–464. DOI: 10.1080/09692290210150842.

International Energy Agency. 2022. *Solar PV Global Supply Chains.* Paris, France.

International Energy Agency. 2024a. *Kenya 2024 – Energy Policy and Market Analysis*. Paris, France.

International Energy Agency. 2024b. *Kenya Energy Policy Review 2024.* Paris, France.

International Energy Agency. 2025. "Kenya's Energy Sector is Making Strides Toward Universal Electricity Access, Clean Cooking Solutions and Renewable Energy Development." *News Release*, 14 April. [Accessed on: 28 November 2025].

International Renewable Energy Agency. 2025. *Renewable Energy Investment Factsheet: Kenya*. Abu Dhabi: United Arab Emirates. (Accessed on: 30 January 2026) .

International Renewable Energy Agency and International Labour Organization. 2024. *Renewable Energy and Jobs: Annual Review 2024*. Abu Dhabi, United Arab Emirates.

Kenya Bureau of Standards (KEBS). 2023. PVOC Program Operations Manual (Version 13). Nairobi, Kenya.

Kenya Electricity Transmission Company. 2025a. *Project Portfolio – Loiyangalani–Suswa 400 kV Transmission Line*. Nairobi: Kenya Electricity Transmission Company.

KEREA and GOGLA (Global Off-Grid Lighting Association). 2021. *Impact of VAT and Import Duty on the Stand-Alone Solar Sector in Kenya*.

Kiprop, E., Matsui, K., and Maundu, N. 2019. "The role of household consumers in adopting renewable energy technologies in Kenya." *Environments*, 6(8): 95. DOI: 10.3390/environments6080095.

Krishnan, A. 2023. "Embeddedness beyond the lead firm in global production networks: Insights from Kenyan horticulture." *Environment and Planning A: Economy and Space*, 55(8): 1859–1883. DOI: 10.1177/0308518x231170194.

Lake Turkana Wind Power. 2017. *Construction Labour Summary Report*. Nairobi, Kenya. Lake Turkana Wind Power.

Lake Turkana Wind Power. 2025. Lake Turkana Wind Power Hosts CS Opiyo Wandayi as it Marks Six Years of Full Production. [Accessed on: 28 November 2025].

Ministry of Energy. 2021. *Least Cost Power Development Plan (LCPDP) 2021–2030*. Nairobi, Kenya.

Ministry of Energy and Petroleum. 2023a. *Climate Investment Funds Renewable Energy Integration Program investment plan for Kenya.* Nairobi, Kenya.

Ministry of Energy. 2023b. *Kenya Energy Transition and Investment Plan (ETIP 2050)*. Nairobi, Kenya.

Ministry of Energy and Petroleum. 2024. *Ministry of Energy and Petroleum Strategic Plan 2023–2027*. Nairobi, Kenya.

Ministry of Energy and Petroleum. 2025. *Kenya National Energy Compact 2025–2030* (Draft 2). Nairobi, Kenya.

Muthini, M. 2025. *Assessment of the Occupational Safety and Health Act (2007) in Kenya's Manufacturing Sector: A Case Study of Compliance and Worker Safety in the Athi River Export Processing Zone*. DOI: 10.13140/RG.2.2.35321.53608.

National Renewable Energy Laboratory. 2025. Winter 2025 Solar Industry Update.

Ndi, F. A. 2024. "Justice concerns in large-scale renewable energy projects: a case study echoing the importance of procedural justice in wind energy development in Kenya." *Energy, Sustainability and Society*. DOI: 10.1186/s13705-024-00482-z.

Newell, P., and Phillips, J. 2016. "Neoliberal energy transitions in the South: Kenyan experiences." *Geoforum*, 74: 39–48. DOI: 10.1016/j.geoforum.2016.05.009.

Nunoo, I. K., Klug, T., Plutshack, V., Mawunyo Agradi, Appiah, S., and Rajah Saparapa. 2025. "Who has power over policy? The political economy of Kenya's 2019 gender policy in energy access." *Energy Research and Social Science*, 127: 104201. DOI: 10.1016/j.erss.2025.104201.

Okelo, K., Nampijja, M., Ilboudo, P., Muendo, R., Oloo, L., Muyingo, S., Mwaniki, E., Langat, N., Onyango, S., Sipalla, F., and Kitsao-Wekulo, P. 2022. "Evaluating the effectiveness of the Kidogo model in empowering women and strengthening their capacities to engage in paid labour opportunities through the provision of quality childcare: A study protocol for an exploratory study in Nakuru County, Kenya." *Humanities and Social Sciences Communications*, 9(1). DOI: 10.1057/s41599-022-01260-y.

Partnership for Economic Policy. 2024. *Education, childcare and formal sector opportunities are key to promoting decent work for women in Kenya*. Nairobi, Kenya.

Pickles, J., and Godfrey, S. 2013. "Economic and social upgrading in global apparel production networks." *SSRN Electronic Journal*. DOI: 10.2139/ssrn.2265831.

Power for All. 2022. *Study shows jobs in Kenya's decentralized renewable energy sector to reach pre-pandemic levels by end of 2022.* Mombasa, Kenya.

Remote Energy. 2015. WISEe – Women in Sustainable Energy and Entrepreneurship Programme. Seattle, USA.

Renewables Now. 2016. "Kipeto Wind Farm Inks Power Purchase Contract with Kenya Power; CMEC Signs Turnkey EPC Contract."

Robino, C., Mbiekop, F., and Grantham, K. 2023. "The link between clean energy and women's labour."

Rotich, I. K., Chepkirui, H., and Musyimi, P. K. 2024. "Renewable energy status and uptake in Kenya." *Energy Strategy Reviews*, 54(1): 101453. DOI: 10.1016/j.esr.2024.101453.

SEETAO Energy. 2025. "China Energy Engineering Group and Kenya Cooperation."

Shrestha, A. 2025. "Building evidence on the role of women in the clean energy transition: ANDE and IDRC announce support for six research teams." *Aspen Network of Development Entrepreneurs*.

Simberg-Koulumies, N. 2023. "Just sustainabilities: Lessons from the Lake Turkana Wind Power project in Kenya." Local Environment, 29(1): 1–17. DOI: 10.1080/13549839.2023.2249497.

Sustainable Energy for All. 2025. *Kenya Green Manufacturing Policy and Investment Guide*. Vienna, Austria.

The Star. 2025. "Kipeto Wind Farm to Double Capacity to 200 MW Pending New PPA." [Accessed on: 28 November 2025].

Tsui, J., Hearn, S., and Young, J. 2014. *Monitoring and evaluation of policy influence and advocacy*. DOI. http://www.jstor.org/stable/resrep50410.

UN Women. 2025. *Sectoral Brief: Gender and the Energy Sector in Kenya*. Nairobi: Kenya.

United Nations Environment Programme Copenhagen Climate Centre. 2024. *Insights from the Solar PV Industry in Kenya*. Copenhagen, Denmark.

Wachira, L. N. 2010. *Factors Affecting Industrial Relations in Kenya Power and Lighting Company Limited*. MBA research project. University of Nairobi, Kenya.

WhatCost. 2025. *Solar Panel Statistics for 2025*. London, England.

Women in Energy Leadership. 2024. *Women Leading Kenya's Renewable Energy Revolution*. Nairobi, Kenya.

World Bank. 2024. *Kenya Energy Sector Overview*. Washington DC, USA.

Yeung, H. W-C., and Coe, N. M. 2015. "Toward a dynamic theory of global production networks." *Economic Geography*, 91(1): 29–58. DOI 10.1111/ecge.12063.