USING POLICY TO BUILD SOUTH AFRICA'S RENEWABLE ENERGY INDUSTRY AND CREATE DECENT, EQUITABLE JOBS

By
Rachel Alexander



JUST ENERGY TRANSITION:
Localisation, Decent Work, SMMEs,and Sustainable Livelihoods

INSTITUTE for ECONOMIC JUSTICE
COSATU
ACEP Africa Centre for Energy Policy
WORLD ENERGY COUNCIL | FUTURE ENERGY LEADERS GHANA
A ROCHA GHANA
ACTS
IDRC · CRDI
International Development Research Centre
Centre de recherches pour le développement international

USING POLICY TO BUILD SOUTH AFRICA'S RENEWABLE ENERGY INDUSTRY AND CREATE DECENT, EQUITABLE JOBS

By
Rachel Alexander

October 2026

Published by the Institute for Economic Justice
Johannesburg, South Africa

ACKNOWLEDGMENTS

This report was co-created alongside a dedicated research team including James Musonda, Jezri Krinsky, Basani Baloyi, Tengo Tengela, Boitumelo Molete, Nonhlanhla Ndlovu, Lupumlo Ngcukana, Thobani Khumalo, Freeman Mateko, Thembela Sofisa, and Melikaya Blani. Access to industry stakeholders was facilitated through the support of the Department of Electricity and Energy, with field-level access to workers and community members further aided by Thina Mnini and the Kouga Community Development Forum team.

Seutame Maimele, Basani Baloyi, Gilad Isaacs, Sumayya Goga, Bipasha Baruah, Odile Mackett, Lorenza Monaco, and Lucy Baker reviewed background papers and earlier drafts of this report providing insightful comments and suggestions. In addition, attendees of the 15-16 July IEJ-COSATU workshop and the 22 July 2026 Just Energy Transition Localisation Stakeholder Engagement also provided invaluable feedback on earlier versions of this report.

Editing, layout, and design services were provided by Richard Pithouse, Roger Etkind, Dalli Weyers, and Mzikayise Sithole, alongside other members of the Growco team. Administrative and logistics support was provided by Morongwa Kekana and Michelle van Roy.

Finally, all of the people who volunteered their time to support this project through participating in interviews made this study possible.

EXECUTIVE SUMMARY

South Africa's renewable energy transition creates significant opportunities to expand domestic production of solar, wind and battery energy storage systems. Yet, much of the technology needed for renewable energy systems is being imported. Increasing local manufacturing in renewable energy production networks has the potential to trigger widespread benefits, such as local business development and job creation. However, the analysis shows that increased localisation does not automatically generate greater domestic value capture, decent work or gender-equitable outcomes. Realising the socio-economic potential of the transition requires coordinated action to strengthen markets and domestic productive capabilities, improve institutional and policy coordination, and ensure that industrial development supports decent work and more equitable participation. To address these objectives, this report identifies a series of policy recommendations:

a. Shaping Demand

I. Establish Continual Public Tenders to Build a Sustainable Manufacturing Sector.
II. Expand the Role of Eskom Green.
III. Strengthen the Design, Implementation, and Enforcement of Local Content Requirements.
IV. Enable Shared Orders and Capacity Pooling for Smaller Firms.
V. Mandate Regional and Municipal Geographic Sourcing Minimums.

b. Trade, Investment and Regional Market Development

I. Refine Tariff System to Provide Targeted Support to Renewable Energy Manufacturers.
II. Implement Port-of-Entry Customs Audits to Combat Trade Corruption.
III. Attract Global Cell Plants and Mineral Refiners.
IV. Create Regional Mineral Refining Hubs to Secure Supply Autonomy.
V. Position South Africa as a Regional Renewable Energy Manufacturing and Export Hub.

c. Supporting Business Upgrading and Increasing Local Manufacturers' Competitiveness

I. Reduce Utility Costs for Domestic Manufacturers.
II.Simplify Administrative Processes.
III. Support Upgrading for Renewable Energy Manufacturers.
IV. Expand Service Provision and Service-Led Business Models.
V. Establish Recycling Loops and Reverse Logistics Channels.
VI. Launch Shared Quality Testing Labs to De-Risk Local Innovation.
VII. Foster Industry Interactions and Networking.

d. Driving Decent Work and Inclusivity

I. Run Technical and Vocational Education and Training Programmes with Ring-Fenced Gender Quotas.
II. Enhance Social Impact of Public Procurement.
III. Make Continued Industrial Policy Support Conditional on Providing Decent Work.
IV. Refine Methods of Measuring Development Outcomes.
V. Address Gender Stereotypes and the Burden of Reproductive Work on Women.
VI. Reskill Workers for Sustainable Transition Pathways.
VII. Update Existing Curricula to Expand Knowledge and Skills Related to Renewable Energy.

e. Strengthening Cross-Government Coordination and Implementation of Policies to Support the Renewable Energy Industry

I. Coordinate Inter-Departmental Industrial Policies.
II. Be More Active in Seeking Industry Perspectives.

TABLE OF CONTENTS

Acknowledgements 3
Executive Summary 4
Table of contents 6
Acronyms 8

1. Introduction 10
2. South Africa's role in renewable energy production networks 13
2.1 South Africa's energy provision systems and market structures 14
2.2 South Africa's role in producing component parts of renewable energy systems 21
2.3 South Africa's role in producing raw materials for renewable energy systems 32
2.4 Utility-scale project deployment and smaller-scale system installation 33
2.5 Operations and maintenance 34
2.6 Decommissioning renewable energy systems in South Africa 35
2.7 Localisation and industrial development 36
3. South African value capture in renewable energy production networks 38
3.1 Workers 39
3.2 The state 39
3.3 Foreign companies 39
3.4 Communities 40
3.5 Financiers 42
3.6 Local companies 42
3.7 Dynamics of local value capture 44
4. Decent work 46
4.1 Work in the renewable energy industry 46
4.2 Trajectories of work in the renewable energy sector 51
4.3 How localisation pathways can shape future employment 52
5. Gender 54
5.1 Gender at work 54

5.2 Gender and societal expectations 56
5.3 Gender and localisation 58
6. Key factors supporting or preventing localisation, decent work and gender equity 60
6.1 Socio-economic conditions 61
6.2 Infrastructure 62
6.3 Availability of inputs 63
6.4 Demand 67
6.5 Competition 70
6.6 Impact of local context 71
7. Key actors supporting or preventing localisation, decent work and gender equity 73
7.1 Public sector 73
7.2 Firms at the core of the value chain 82
7.3 Global geopolitical actors 88
7.4 Financial actors 91
7.5 Skill building institutes, universities, and other research institutes 93
7.6 Trade unions and professional networks 95
7.7 Communities 98
7.8 Multi-actor dynamics: power asymmetries and the state 98
8. Conclusion: increasing localisation that enables decent work and gender equity 100
8.1 Key challenges and opportunities 100
8.2 Recommendations 108
8.3 Final reflection: moving forward with the localisation agenda 113

References 114
Appendix A: domestic component part capabilities 121
Appendix B: South African policies supporting renewable energy industry development 125
Appendix C: bilateral relationships and multilateral organisations supporting technology transfer 139
Appendix D: connecting recommendations to challenges and opportunities 140

ACRONYMS

AfCFTA	African Continental Free Trade Area
B-BBEE	Broad-based Black economic empowerment
BaaS	Battery-as-a-Service
BESIPPPP	Battery Energy Storage Independent Power Producer Procurement Programme
BESS	Battery energy storage system
BMS	Battery management system
BoP	Balance of plant
BTM	Behind-the-meter
Cosatu	Congress of South African Trade Unions
CSIR	Council for Scientific and Industrial Research
DEE	Department of Electricity and Energy
DEL	Department of Employment and Labour
DFFE	Department of Forestry, Fisheries and the Environment
DHET	Department of Higher Education and Training
DIRCO	Department of International Relations and Cooperation
DMPR	Department of Mineral and Petroleum Resources
DoT	Department of Transport
DSBD	Department of Small Business Development
DSTI	Department of Science, Technology and Innovation
dtic	Department of Trade, Industry and Competition
DWYPD	Department of Women, Youth and Persons with Disabilities
ED	Enterprise development
EMS	Energy management system
EPC	Engineering, procurement and construction
EPR	Extended producer responsibility
ERA	Electricity Regulation Act
Ewseta	Energy and Water Sector Education and Training Authority
FDI	Foreign direct investment
FTM	Front-of-the-meter
GDP	Gross domestic product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GPN	Global production network
IDC	Industrial Development Corporation
IEC	International Electrotechnical Commission
IEJ	Institute for Economic Justice
ILO	International Labour Organization
IP	Intellectual property
IPG	International Partners Group
IPP	Independent power producer
IPPPP	Independent Power Producers Procurement Programme
IRP	Integrated Resource Plan
Itac	International Trade Administration Commission

JETP	Just Energy Transition Partnership
JV	Joint venture
LCR	Local content requirement
LIB	Lithium-ion battery
LRA	Labour Relations Act
MFMA	Municipal Finance Management Act
NBI	National Business Initiative
NECOM	National Energy Crisis Committee
Nedlac	National Economic Development and Labour Council
NEMA	National Environmental Management Act
Nersa	National Energy Regulator of South Africa
NMU	Nelson Mandela University
NTCSA	National Transmission Company of South Africa
Numsa	National Union of Metalworkers of South Africa
O&M	Operations and maintenance
OEM	Original equipment manufacturer
PCC	Presidential Climate Commission
PFMA	Public Finance Management Act
PPA	Power purchase agreement
PV	Photovoltaic
R&D	Research and development
RE	Renewable energy
REI4P	Renewable Energy Independent Power Producer Procurement Programme
RMIPPPP	Risk Mitigation Independent Power Producer Procurement Programme
SABS	South African Bureau of Standards
SAFEE	Southern African Females in Energy Efficiency
SANAS	South African National Accreditation System
SANS	South African National Standard
Sapvia	South African Photovoltaic Industry Association
Sarebi	South African Renewable Energy Business Incubator
SAREM	South African Renewable Energy Masterplan
Sars	South African Revenue Service
Sawea	South African Wind Energy Association
SED	Socio-economic development
Seta	Sector education and training authority
SEZ	Special economic zone
SME	Small and medium enterprise
SOE	State-owned enterprise
SSEG	Small-scale embedded generation
TVET	Technical and vocational education and training
UIF	Unemployment Insurance Fund
UNDP	United Nations Development Programme
VRFB	Vanadium redox flow battery
WEGE	Women Empowerment and Gender Equality
WTO	World Trade Organization

1. INTRODUCTION

South Africa is rapidly expanding its renewable energy (RE) sector. Installed RE generation capacity is expected to grow from 17 GW in 2025 to more than 45 GW by 2030, with new wind and solar projects, together with battery energy storage systems (BESS), contributing a large share (Department of Electricity and Energy [DEE] 2025). Solar, wind, and battery systems are already running across the country (see Box 1), generating electricity at globally competitive prices (DEE et al. 2025), while supporting a widening array of economic activities. Increasing RE generation will require constructing new systems, which should create opportunities for local businesses to grow and spur new jobs and livelihoods for the marginalised. These opportunities can serve as a vital catalyst within a broader suite of economic reforms designed to revitalise industrial sectors and ultimately expand total national employment as fossil fuel use decreases. Realising these opportunities as part of a just transition, however, will require purposeful localisation that seeks to create decent work and support gender equity, ensuring that these objectives are achieved alongside the goals of decarbonisation and improved energy security.

Box 1: South African use of solar and wind energy generation and BESS

South Africa is well endowed with solar and wind energy with high levels of solar radiation along the northwestern regions and strong and consistent wind in the Cape areas. By 2025, this potential had translated to 2.3 GW of solar photovoltaic (PV) and 3.3 GW of wind capacity installed in utility-scale (greater than 1 MW) plants and an estimated 6 GW of rooftop solar PV systems across the country (DEE 2025). As reliance on RE grows, BESS are playing an increasingly important role in supporting grid stability and facilitating the integration of wind and solar power. By 2025, more than 0.2 GW of BESS had been installed to support South Africa's national electricity grid (DEE 2025; Labuschagne 2025).

The quality and tenure of the jobs created by the deployment of RE systems will vary and be strongly influenced by public policy. While many construction jobs are short-term, opportunities for longer-term jobs exist in manufacturing, as well as operations and maintenance (O&M).[1] Manufacturing jobs, in particular, can act as growth engines with features such as increasing returns to scale, enabling learning-by-doing and capability development, tradability, developing backward and forward linkages, stimulating local technological development, and creating jobs in other sectors (Andreoni et al. 2021; Lavopa and Riccio 2025).

[1] Based on the current project pipeline and shifting demand, the RE sector is projected to sustain between 120,000 and 200,000 new jobs by 2030 (NBI 2024).

While a large portion of RE components are currently imported, South Africa has the potential to increase its role in production for solar, wind, and battery systems. However, achieving greater localisation of production will require concerted policy efforts, and the way the process unfolds has important implications for the quality of employment created and for gender equity. The key question is therefore not simply whether more RE technology can be produced domestically, but whether localisation can develop productive capabilities that generate sustained domestic value, decent employment, and more equitable participation.

This paper therefore seeks to identify how policy can promote RE production network localisation that advances decent work and greater gender equity. To understand the key factors shaping dynamics in this sector, this paper draws on insights from the global production network (GPN) framework (Henderson et al. 2002; Hess 2004; Coe et al. 2008). This approach focuses on exploring global and local connections which shape firms' experiences. Specifically, it involves considering the networks of relationships and power dynamics that connect firms and other actors. Firms in these networks are also considered as being embedded within territorial and societal contexts which shape their behaviour and opportunities. This framing is used to explore how economic and social value are created and enhanced and how value is captured across the production network.

The findings presented here are drawn from a larger body of research conducted by researchers at the Institute for Economic Justice (IEJ). Specifically, this report draws on four pieces of work by the IEJ, three published and one unpublished: *South Africa Renewable Energy Policy Scan: Critical Insights and Questions for Localisation and Decent Employment* (Hermanus and Kamanzi 2026); *Solar Panels and Inverters: Potential and Obstacles in South Africa, Value, Power* (Krinsky 2026); *Embeddedness in the South African Wind Turbine Towers Manufacturing Sector: Implications for Industrial Policy* (Musonda 2026); and *Value, Power, and Embeddedness in South Africa's Battery Energy Storage Systems Manufacturing and Assembly: Implications for Industrial Policy* (Musonda *Unpublished*). The research team reviewed published literature and other documentary sources, conducted interviews,[2] made observations in communities connected to RE projects, and conducted a firm survey.[3] This evidence was used to identify opportunities and challenges facing South African firms' contributions to RE system production. In addition to examining domestic dynamics, experiences in other countries were reviewed to draw lessons and explore how global actions impact South Africa. All data was analysed with the purpose of identifying how national policies can improve outcomes within South Africa. Finally, preliminary findings were shared in two validation workshops, one with trade union representatives and the other with RE businesses, and the feedback was used to refine the final report.[4]

The paper identifies interrelated challenges and opportunities shaping the developmental effects of localisation across four areas: market dynamics, institutions and governance, productive capabilities, and inclusion and decent work. Market constraints include uncertain and inconsistent demand, intense price competition, and existing relationships that limit opportunities for new entrants. Also, systemic

[2] A total of 59 interviews were conducted, including 16 interviews with firm-level managers, 21 interviews with workers (including 2 group interviews), 6 interviews with experts, 6 interviews with government representatives, 3 interviews with trade union representatives, 5 interviews with community members (including 2 group interviews), and 2 interviews with NGO representatives.
[3] The firm survey received responses from nine manufacturers.
[4] Methodological details are provided in *Using Policy to Build South Africa's Renewable Energy Industry and Create Decent, Equitable Jobs: Methodological Annex* (Alexander 2026).

gaps in policy design and coordination intersect with weaknesses in technical infrastructure supporting policy implementation, alongside unequal policy engagement that disadvantages smaller enterprises, regulatory evasion, and subsidised global competition. In addition, shortfalls in labour force skills and firm capacity were found. Finally, unequal transition benefits reflect a failure to expand manufacturing as an anchor for decent work and a reliance on low-quality, precarious contracts, persistent gender inequalities rooted in occupational segregation and household care burdens, and limited worker representation across an unstable workforce. Together, these factors influence not only the extent of domestic production, but also the quality of employment and the opportunities for more equitable participation. Conversely, the report uncovers significant avenues for industrial advancement, demonstrating how South Africa can capitalise on private and regional market expansion, bridge capabilities through midstream technology transfers, and cultivate subcomponent and service niches. Crucially, it maps ways to expand decent work, dismantle persistent gender divides, and rebalance the sector through localised circular economies and social ownership models.

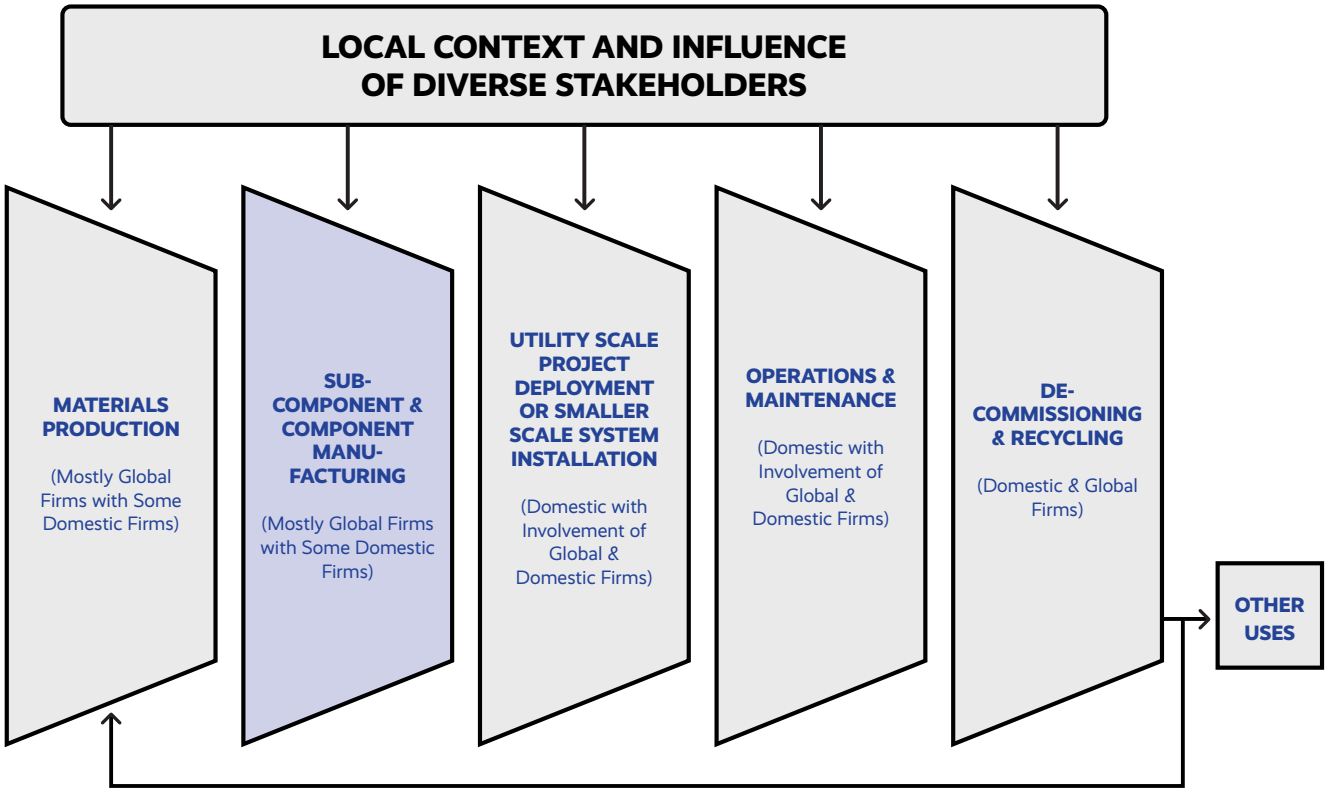
The findings therefore show that RE expansion does not necessarily involve local production systems and that localisation does not automatically translate into decent work or greater gender equity. Achieving more inclusive and sustainable localisation requires coordinated interventions that strengthen markets and domestic productive capabilities while embedding decent work standards and gender equity within industrial and localisation strategies. Localisation should therefore be understood not simply as increasing the share of production undertaken domestically, but as a multi-faceted process of building productive systems capable of generating sustained domestic value, decent employment, and more equitable participation.

The rest of this paper proceeds as follows. Section 2 identifies existing levels of localised production for South Africa's solar, wind, and BESS systems. Section 3 assesses how value is currently captured in South Africa and explores strategies to increase it. Section 4 explores the conditions of work associated with these production processes. Section 5 considers the gender dynamics underpinning production in RE systems. Section 6 seeks to explain current levels of localisation, provision of decent work, and gender outcomes by considering how contextual factors shape RE production systems in South Africa. Section 7 examines how different actors shape or influence localisation, decent work, and gender outcomes. Section 8 concludes by synthesising the challenges and opportunities identified across the analysis and presenting policy recommendations for expanding localisation in ways that support decent work and gender equity. Across the paper, specific characteristics of the solar, wind, and battery production networks are identified.

2. SOUTH AFRICA'S ROLE IN RENEWABLE ENERGY PRODUCTION NETWORKS

While South African firms participate across solar, wind, and battery production networks, the domestic market still relies heavily on global production. The production of RE systems involves five main stages: material production, subcomponent and component manufacturing, deployment/installation, O&M, and decommissioning and recycling. Although each stage has localisation potential, the focus of the paper is on opportunities related to manufacturing (indicated in the shaded region in Figure 1). To properly contextualise these production networks, this section audits current domestic capabilities while assessing localisation levels across all five core stages of the value chain, as their interconnected structures directly shape and bound the domestic manufacturing environment.

Figure 1: Stylised depiction of solar, wind, or battery energy storage system production network



Source: Author's creation

Production network structures vary according to the markets being served and the ways in which electricity is generated, supplied, procured, and consumed. These structural variations matter for localisation because they shape the types of firms involved, the activities that can be undertaken domestically, and the opportunities for domestic value creation, enhancement, and capture. Crucially, the range of commercial actors involved across these production networks varies significantly, meaning that the distribution of value remains highly uneven. Although many deployment and installation activities are inherently domestic in term of physical location — such as construction and installation — even these are frequently undertaken by foreign firms. For example, engineering, procurement, and construction (EPC) contractors involved in utility-scale installations have included German, Spanish, and Chinese firms (I27 Solar Industry Manager).[5] This distinction is critical for assessing localisation. An activity can take place within South Africa without necessarily resulting in substantial participation by South African firms or domestic value capture (as discussed further in Section 3).

To evaluate these dynamics systematically, the discussion therefore begins by distinguishing the main markets within utility-scale project deployment and smaller-scale system installation, the structure of which directly dictates the commercial market volume available to domestic component manufacturers. It then examines how components and systems are produced for these markets, considering the manufacturing stage followed by the raw material production stage, before covering deployment and installation, the use phase, and the post-use phase. Finally, the section evaluates how these combined value chain dynamics interact to support industrial development, illustrating how fragmented market pathways concentrate South Africa's manufacturing footprint within basic components and downstream assembly. It concurrently highlights the missed opportunities arising from a failure to leverage public procurement to guarantee sufficient market volumes required to sustain expanded local manufacturing, a lack of local critical mineral processing, and underdeveloped circular economy systems.

2.1 South Africa's energy provision systems and market structures

RE systems at all scales are expected to expand in South Africa, driven by investment in utility-scale RE as well as private-sector and household installations, including systems that feed back into the grid (Montmasson-Clair 2024). These different markets create a range of opportunities for domestic firms to participate in RE production networks. Box 2 outlines trends in South African solar, wind, and stationary battery markets. Beyond these internal markets, domestic manufacturers increasingly have access to cross-border regional export markets (see Section 2.2.4), which expand the total scale of demand available to local production lines (GreenCape 2024).

[5] This report cites original interview data, with each interview (I) assigned a number.

Box 2: South African RE market

The South African Renewable Energy Masterplan (SAREM) sets an ambition for a minimum annual rollout of 3 GW of RE, increasing to 5 GW per annum by 2030. It identifies this sustained expansion of demand as an important condition for developing domestic manufacturing capabilities, particularly where procurement supports local value addition (DEE et al. 2025).

Solar Energy Systems: While public procurement through the Renewable Energy Independent Power Producer Procurement Programme (REI4P)[6] drove growth from 2011 to 2021, regulatory reforms since 2019 have enabled rapid growth in private generation, reinforced by load-shedding and tax incentives. By 2023, private procurement accounted for approximately 60% of installed solar photovoltaic capacity, compared with approximately 40% from public procurement (Sapvia 2024). Across this total capacity, large-scale projects accounted for approximately 67% of installed capacity, while small-scale embedded generation accounted for the remaining 33% (Sapvia 2024). However, residential figures are uncertain due to unregistered systems (Hermanus and Kamanzi 2026). Overall, the solar value chain is projected to capture roughly 50% of all clean-energy employment, anchoring between 59,000 and 99,000 new jobs by 2030 (NBI, 2024). Within this segment, utility-scale solar is expected to create 55,600 to 93,400 new jobs by 2030, largely concentrated in construction, while rooftop solar installations are projected to sustain 2,400 to 5,600 jobs (NBI, 2024).

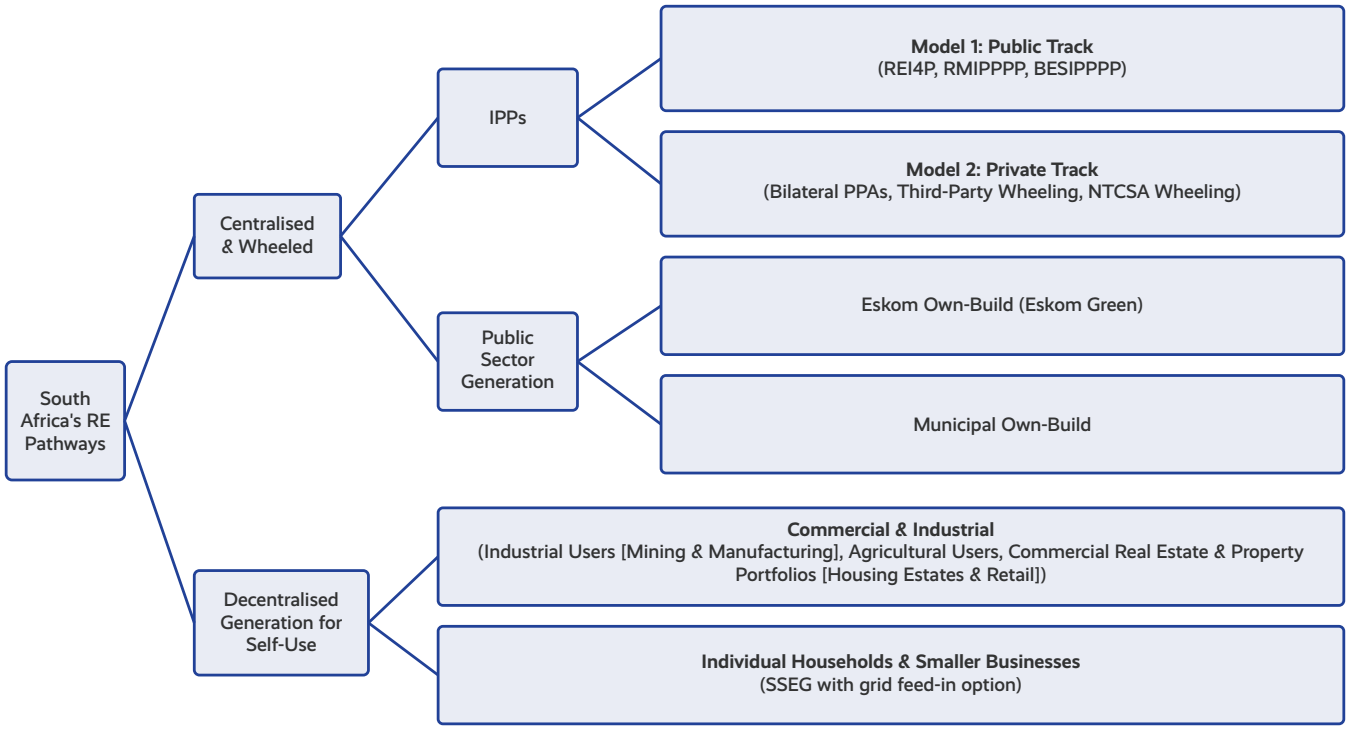
Wind Energy Systems: After a pilot project in the early 2000s, public procurement under the REI4P and Risk Mitigation Independent Power Producer Procurement Programme (RMIPPPP) drove wind sector growth in South Africa. Subsequent reforms to the Electricity Regulation Act 4 of 2006 (ERA), including the raising and eventual removal of licensing requirements for embedded generation, enabled substantial growth in private generation, accelerated by chronic load-shedding and the demand for cost-competitive energy security. Nevertheless, public procurement remains a key part of the wind market. By Q3 2025, 62 operational and under-construction wind projects represented almost 7 GW of capacity procured, comprising 42 projects through REI4P and RMIPPPP and 20 projects through private offtake arrangements (Sawea 2025).[7] The market is therefore increasingly characterised by multiple procurement and offtake arrangements. The sector has a substantial development pipeline, with national planning frameworks anticipating further expansion of wind generation over the coming decade (DEE 2025; Sawea 2025). This structural scale-up is projected to create 22,300 to 35,700 new wind sector jobs by 2030, predominantly in site construction (NBI 2024).

[6] Some of which are private and some of which feed into the public system.
[7] These figures exclude Sere Wind Farm, which is state-run and adds 100 MW to the overall wind capacity.

BESS Markets: The stationary storage market evolved from a 2020 baseline of approximately 270 MWh, with early applications concentrated largely in behind-the-meter (BTM) systems (CES 2022). While capital constraints limited these traditional applications, advanced chemistries are now expanding across both BTM and front-of-the-meter (FTM) segments (CES 2022). Technologies like lithium-ion batteries (LIB) and vanadium redox flow batteries (VRFB) are gaining traction, including a notable 1 MW/4 MWh VRFB hybrid mini-grid (DEE et al. 2025). On the public FTM side, utility-scale procurement frameworks have scaled demand significantly. REI4P and RMIPPPP have procured 415 MW of battery storage capacity, while national power utility Eskom initiated a 500 MW procurement programme and the Battery Energy Storage Independent Power Producer Procurement Programme allocated 513 MW for procurement (DEE et al. 2025). Despite public sector bottlenecks like slow rollouts and grid constraints, deregulation has contributed to rapid growth in private RE generation and associated storage applications. SAREM identifies both utility-scale and decentralised storage as important components of the future market (DEE et al. 2025). South Africa's battery-storage market, which includes BESS and emerging EV demand, is projected to expand to between 9,700 MWh and 15,000 MWh by 2030 (CES 2022). The scale and structure of this demand will determine whether South Africa can develop domestic capabilities in battery-system assembly, components, and related services, with the BESS value chain projected to generate 800 to 1,600 new jobs by 2030, featuring a high concentration of specialised technical roles (NBI 2024).

The extent of domestic participation varies across market structures. For instance, for smaller installations, domestic companies that sell batteries and solar panels may provide installation services, while independent contractors may also be hired. However, even within these localised deployment loops, the underlying value chain relies heavily on foreign multinational involvement, as local installers act primarily as distribution conduits for hardware manufactured by dominant global original equipment manufacturers (OEMs). The discussion below first examines centralised and wheeled electricity pathways, distinguishing between public and private procurement and generation, before addressing decentralised generation for self-use. Figure 2 illustrates these different pathways.

Figure 2: Commercial Pathways and Institutional Structures for South African Renewable Electricity



Source: Author's creation

However, the electricity market structure is evolving, including the planned introduction of the South African Wholesale Electricity Market. Such changes may alter existing relationships between public utilities, municipalities, IPPs, and private offtakers (NTCSA Media Desk 2026). These changes are therefore likely to influence the future organisation of RE production networks and the opportunities available to domestic firms.

2.1.1 Centralised and wheeled

The structure of centralised and wheeled electricity pathways in South Africa plays a decisive role in shaping domestic value creation by dictating the applicability of local content requirements (LCRs). The rollout of RE systems across the country has been driven by Eskom, the national electricity public utility, procuring generation (and more recently storage) from independent power producers (IPPs) under a state-led framework and expanded through a rapidly growing private utility market that enables developers to wheel power directly to corporate buyers. In addition, there have been some cases of cities and Eskom developing their own RE systems. These different arrangements matter for localisation because procurement structures determine order requirements and who participates in projects.

Independent power producers

The South African IPP sector is dominated by a mix of large international developers, prominent domestic firms and OEMs, whose control over the market creates barriers for smaller, localised

players. Because large-scale project development demands extensive balance sheets, highly structured project finance networks, and rigorous track records, smaller domestic firms are frequently excluded from lead-developer roles. Instead, these emerging local firms are often constrained to sub-contracting positions, limiting their upward mobility within the broader value chain. Furthermore, global ownership in these companies may create a national security risk.

Project deployment and procurement across the sector are organised through two primary institutional pathways: the public utility track model (Model 1) and the private utility track model (Model 2).

- Model 1, 'the public utility track', involves selling to the government through the Independent Power Producers Procurement Programme (IPPPP) Office. Through this office, the government runs competitive auctions for RE generation through which private companies, operating as IPPs, can win contracts to own and operate power generation and storage facilities. The key tendering pipelines are: the Renewable Energy Independent Power Producer Procurement Programme (REI4P), which covers solar and wind generation; the Risk Mitigation Independent Power Producer Procurement Programme (RMIPPPP), which is a fast-tracked procurement programme for hybrid systems that can combine solar, wind, storage, and gas to address electricity-supply constraints; and the Battery Energy Storage Independent Power Producer Procurement Programme (BESIPPPP), which contracts standalone front-of-the-meter battery installations to provide capacity and grid-balancing services. Municipalities can also run their own tenders for RE generation. The structure of this procurement track has important implications for localisation because LCRs and broader economic and social development requirements can shape supplier selection. However, while these public tenders legally mandate elements of local production, the historical record shows persistent friction between formal LCR targets and results. This divergence stems from both structurally flawed policy designs that have been systematically diluted over time (Borchardt 2025) and developers bypassing domestic sourcing by exploiting regulatory loopholes and porous post-bid exemptions, effectively undercutting domestic producers in favour of cheaper foreign imports (Hermanus and Kamanzi 2026; IEJ 2026). Crucially, while this public framework successfully mandates local equity shareholding and community investments on paper, sector dominance shifts toward foreign actors when measuring actual technology imports and hardware market share, allowing a small number of global developers and OEMs to capture large shares of industrial value. This topic is discussed in more depth in Section 3.

- Model 2, 'the private utility track', involves selling to private buyers through power purchase agreements (PPAs). This track enables private developers to establish generation projects without relying on the centralised public procurement process, contributing to the emergence of more decentralised, private-private production networks. Under this framework, private developers contract directly with commercial, industrial, or mining buyers through bilateral PPAs. Instead of relying on the state as a centralised single buyer, these IPPs register with the National Energy Regulator of South Africa (Nersa) and use wheeling frameworks. Through this wheeling mechanism, developers pay regulated transmission fees to the National Transmission Company of South Africa (NTCSA) or local municipalities to transport electricity across the public grid directly to the private buyers' facilities. While this model initially faced stringent licensing restrictions, an amendment to Schedule 2 of the Electricity Regulation Act (ERA), gazetted in 2021, raised the licensing exemption threshold to 100 MW, driving a surge in project registrations with Nersa. By 2022,

solar photovoltaic (PV) accounted for approximately 86% of the total reported generation capacity registered under the licensing exemption (Rivett-Carnac 2022a). Subsequently, the Energy Action Plan, announced by President Cyril Ramaphosa on 25 July 2022, included the removal of the licensing threshold for embedded generation, further accelerating private project development (Parliamentary Monitoring Group 2023). This structure places greater commercial risk on private developers, financiers, and corporate offtakers, while reducing reliance on public procurement pipelines. At the same time, these private arrangements introduce socio-economic imbalances. While corporate actors bypass state bottlenecks, communities with low energy demand face the risk of being excluded from coverage. Furthermore, because these private networks rely on wheeling across state-maintained infrastructure, they utilise public grid capacity without contributing to broader social cross-subsidies, leaving the long-term structural and distributional burdens on the public system.

The defining industrial divergence between these two tracks lies in the regulatory enforcement of local procurement. Model 1 with public LCR mandates and Model 2 with private procurement freedom each result in different production network structures. In Model 1, government procurement explicitly leverages binding, scorecard-enforced LCRs and community development objectives as a condition for market entry. Conversely, local sourcing in Model 2 remains voluntary -- sometimes driven by companies' internal motivation, or resulting in compromises when market incentives discourage it. For example, one local subsidiary of a foreign company described the tension between its preference for local sourcing and the cost and availability of domestic inputs:

> *"Unfortunately, for us to be competitive, we had to get [some] steel outside of South Africa and then [some] steel to manufacture locally because we didn't want to, for such a big project, to import everything from China."* (I39 Wind Industry Manager)

This illustrates the critical point that localisation is shaped not only by formal procurement mandates, but also by the competitiveness and availability of domestic inputs.

Public-sector generation

State-led infrastructure development offers a direct institutional mechanism to establish and enforce LCRs and support domestic industries through public procurement. As the national utility, Eskom invests in battery energy storage to enhance grid stability, accommodate RE, provide ancillary services (for example, frequency regulation, voltage support, and reactive power control), and address network constraints (Eskom 2023). Eskom also operates the 100 MW Sere Wind Farm in the Western Cape, which became operational in 2015. In addition, the establishment of Eskom Green in 2026 as a dedicated RE unit introduced a public-sector vehicle for developing utility-scale RE projects for large power users. Eskom Green's long-term impact on localisation will depend on how its procurement and public-private financing models incorporate domestic suppliers.

At the municipal level, own-build programmes similarly allow local authorities to deliberately use their purchasing power to stimulate localised supply chains. This capability is demonstrated by the City of Cape Town's development of the Atlantis solar PV plant, a 7 MW grid-connected, ground-mounted solar PV installation paired with a strategic tender for an integrated BESS (City of Cape Town 2024). Localisation can also be prioritised by other municipalities such as those that are setting up solar arrays on the roofs of public buildings.

2.1.2 Decentralised generation for self-use

Decentralised self-use networks operate on an open, commercial sourcing model that accelerates rapid technology deployment but fundamentally limits the state's ability to enforce domestic industrial value creation through tender-based LCR mandates. Because project developers in this pathway — including individual households and businesses — escape LCRs mandated in public tracks, they possess the commercial freedom to source systems globally based on price, quality, and logistics. Consequently, Chinese systems are widespread, accounting for most imported panels and storage components entering the private market (Ritchie 2026; BloombergNEF 2026). This absence of regulatory sourcing constraints leaves domestic manufacturers facing direct, unmitigated price competition from highly competitive export hubs. Nevertheless, this regulatory freedom does not entirely strip the state of industrial leverage. While direct LCRs are absent, the government heavily shapes the commercial feasibility of sourcing imported products through trade and fiscal mechanisms — such as customs tariffs on imported hardware and structured tax incentives —which can be strategically deployed to shield or incentivise local business participation. The range of South African government policies shaping localisation is discussed in Section 7.1.1.

As detailed in Box 2, South Africa's deregulated private RE market has expanded rapidly following post-2019 policy reforms, driven by falling global technology costs alongside acute domestic grid constraints (DNV 2025). This massive demand surge means that private distributed generation now functions as an essential, standalone engine of market demand that matches or exceeds centralised public procurement volumes for solar PV and battery storage (Sapvia 2024; Moshikaro-Amani 2026). Conversely, this private procurement pathway remains comparatively limited within the wind sector, where project development continues to rely heavily on utility-scale frameworks (Sawea 2025).

The specific composition of private demand for RE systems determines the types of equipment, services, and capabilities that can realistically be supplied domestically. Because the requirements of end-users vary considerably, they create highly fragmented supply needs across two distinct categories:

- the commercial and industrial sector, which encompasses heavy industrial operations (such as mining and manufacturing), agricultural users, and commercial real estate or property portfolios (including housing estates and retail facilities); and
- individual households and smaller businesses, which typically use small-scale embedded generation (SSEG) configurations often paired with grid feed-in options.

These energy users combine self-generation and storage with electricity purchased from public utilities or through private PPAs.

2.2 South Africa's role in producing component parts of renewable energy systems

This section focuses on RE system manufacturing, the key stage of production considered in this report, providing an industrial audit of the sector by exploring production capabilities, firm characteristics, upgrading strategies, and buyer-seller links. The analysis diagnoses where local enterprises possess established competitive advantages. It also highlights dependencies on global imports.

2.2.1 Domestic production capabilities

Across solar, wind, and battery technologies, South Africa's localised manufacturing strengths are heavily concentrated in heavy industrial engineering, structural fabrication, heavy electrical balance-of-plant (BoP) production, and downstream system integration, coexisting with a near-total reliance on foreign imports for high-value components and primary cells (Montmasson-Clair 2024; DEE et al. 2025; Krinsky 2026; Musonda 2026; Musonda *Unpublished*).[8] These domestic strengths draw on a shared cross-cutting industrial base that produces power cables, distribution transformers, fasteners, fabricated steel profiles, protective coatings, and industrial software. Nevertheless, industrial capability gaps fundamentally restrict the extent to which South African firms can produce complex RE components. Local firms' abilities to participate in these networks depend heavily on their technological and organisational readiness to meet the demands of highly competitive markets. Because these domestic capabilities vary, the production of many of the technologically complex RE components is concentrated within GPNs, creating acute dependencies on imported technologies and inputs.

In the solar PV segment, domestic manufacturing combines localised downstream assembly and testing with a reliance on foreign imports for high-value midstream electronic nodes (Sapvia 2024; DEE et al. 2025; Krinsky 2026). Outside of the panels themselves, local firms successfully contribute heavy industrial, structural, and electrical BoP equipment — including combiner boxes, switchgear, and mounting structures — to the construction of solar energy systems. However, this BoP footprint is bounded. Local electronic firms function primarily as subcomponent assemblers rather than hardware manufacturers because domestic components are not built to International Electrotechnical Commission (IEC) standards, creating a total reliance on imported circuit boards and electronics (Rivett-Carnac 2022a). In addition, a critical lack of local production exists across primary components running from raw silica processing into polysilicon, ingots, wafers, or solar cells (Crozier et al. 2025; Sapvia 2024). This upstream gap stems from global asset specificity and the intensive capital expenditure required to establish midstream ingot and wafer slicing facilities, which effectively locks domestic firms into downstream, lower-margin structural fabrication (Krinsky 2026). Parallel to these structural constraints, the electrical BoP segment represents a more established domestic capability tier, where local producers successfully supply high-volume alternating current (AC) cables and grid transformers, despite facing severe low-voltage component import competition (Barnes et al. 2023a).

[8] See Appendix A for an overview of key components in solar, wind, and BESS production, while additional details on wind and solar sector-specific capabilities are provided in previously published IEJ papers. For further details see Krinsky (2026) on solar and Musonda (2026) on wind.

South Africa's wind sector leverages the country's robust heavy engineering and civil construction capabilities to produce towers along with several key components, while remaining dependent on imports for many wind turbine elements (Musonda *Unpublished*). As wind towers represent a large share of the total project capital expenditure in wind turbine projects, these capabilities present a key area where local firms can create value (Rivett-Carnac 2022b; Sawea 2025; Musonda 2026). Because tower sections are exceptionally heavy and logistically restrictive to transport, the physical dimensions of wind infrastructure create a natural geographic protection that favours domestic steel and concrete tower fabrication over direct importing. However, this local manufacturing footprint is limited, as many tower 'internals'—including specialised aluminium platforms, ladders, and internal electrical cabling—are imported due to a lack of specialised technical specifications or localised precision extrusion capabilities (Rivett-Carnac 2022b). Despite these material limits, domestic firms possess active engineering and CNC machining capacity to process, assemble, and cast localised structural internals directly into the tower panels, mitigating total reliance on fully imported internal components (Rivett-Carnac 2022b; Musonda 2026). Furthermore, within this specialised segment, domestic precast concrete towers maintain a distinct logistical and labour-intensive advantage over steel towers because they utilise localised cement networks and lower cross-provincial transport costs (Rivett-Carnac 2022b; Musonda 2026). Crucially, while high-value, IP-intensive internal subcomponents — such as rotors, main bearings, generators, and specialised nacelle gearboxes — remain reliant on imports due to the lack of precision domestic forging infrastructure, an industrial audit highlights dormant, unutilised local capacity to manufacture fibreglass housing covers and machine steel turbine mainframes, though active production remains trapped by strict OEM specification boundaries (Barnes et al. 2023 b; Musonda 2026). The electrical BoP segment represents a final area of established national capability, with local suppliers successfully manufacturing large grid-scale transformers and heavy alternating current power cables (Rivett-Carnac 2022b; Barnes et al. 2023b).

In the battery storage sector, the domestic industry circumvents its lack of primary cell manufacturing by capturing a competitive, high-value niche in downstream assembly of modules, battery-system integration, and selected raw material processing for lithium-ion batteries (LIBs) and vanadium redox flow batteries (VRFBs). While historically dominated by automotive lead-acid technologies, the local landscape is undergoing a shift led by new entrants whose advanced chemistry frameworks cannot easily utilise legacy infrastructure (Moshikaro-Amani 2026). Instead, domestic BESS enterprises function primarily as pack assemblers and custom system integrators, manually or semi-automatically wiring imported lithium-ion cells into protective casings and programming proprietary localised battery management systems (BMSs) to handle South Africa's specific environmental and grid conditions, a downstream profile that remains highly dependent on foreign cell imports (DEE et al. 2025; Moshikaro-Amani 2026; Musonda *Unpublished*). Reflecting this downstream strength, the local integration ecosystem has scaled its collective manufacturing capacity to an estimated 2 GWh per annum to absorb surging behind-the-meter demand (Barnes et al. 2023c). This downstream baseline reflects a unique, 'storage-first' strategic trajectory, leveraging immediate stationary utility grid requirements to anchor local engineering capacities with the long-term ambition of eventually entering mature electric vehicle supply chains (Moshikaro-Amani 2026). In advanced chemistries, the country maintains a nascent VRFB ecosystem encompassing vanadium mining, refining, electrolyte production, and selected downstream battery activities (DEE et al. 2025). This vertical VRFB integration offers a distinct advantage over the lithium-ion supply chain, allowing South Africa to hedge against global cell import shocks by leveraging its massive primary vanadium reserves and exploiting the circular

economy advantages of local electrolyte processing, which yields an asset that never degrades and can be infinitely reused or leased (Moshikaro-Amani 2026; Musonda *Unpublished*).

A wide range of existing manufacturing capabilities and connections to RE production networks demonstrate that South Africa's position in RE production networks is not limited to installation and construction. However, domestic participation in manufacturing remains concentrated in selected activities, while many technologically complex or high-value components continue to be imported. Crucially, the long-term scale and volume of domestic production are fundamentally contingent upon and bounded by whether firms can successfully upgrade their technological capabilities and deepen their participation in production networks. Importantly, however, merely possessing technical capability does not guarantee successful localisation. A diverse array of factors, including market structures and government priorities, shapes these industrial opportunities (see Sections 6 *&* 7), while the specific operational landscape is defined by the varying organisational structures of the domestic manufacturing firms as discussed below.

2.2.2 Businesses and organisations involved in manufacturing and manufacturing support services

The domestic RE technology manufacturing base features highly fragmented business profiles that vary significantly across solar, wind, and battery storage markets based on their level of vertical integration and market focus. This industrial landscape is driven by a mix of independent domestic brands alongside prominent international OEMs. In practice, these foreign entities typically engage with the local economy either by directly importing complete systems or by deploying localised licensing joint venture (JV) frameworks.

The South African landscape for solar PV spans highly diverse enterprise types, including a localised assembly plant, global electronic importers, and a range of domestic BoP component manufacturers (Barnes et al. 2023a; Krinsky 2026). While the country lacks upstream commercial-scale cell fabrication, a key player is ARTsolar, which carries out the laminating, testing, and framing of PV modules (Krinsky 2026). ARTsolar has upgraded its facilities to a cutting-edge 340 MW capacity assembly plant (Labuschagne 2026). Demonstrating the industry's shift towards global technology integration, this facility operates under an OEM licensing framework to produce high-efficiency, large-format PV modules for tier one global brands such as JA Solar (Krinsky 2026; Labuschagne 2026). Beyond module assembly, the broader solar value chain relies on an established ecosystem of domestic firms supplying critical BoP infrastructure. In the structural and mechanical segment, localised manufacturing is supported by tracking and mounting suppliers like Caracal Engineering, K2 Systems, PVH, and Barnes Tubing (Barnes et al. 2023a). Simultaneously, the heavy electrical infrastructure segment features local transformers manufactured by ACTOM, while inverter assembly is driven by Rubicon (under the acquired MLT brand), and emerging player Ario (Barnes et al. 2023a). These electrical systems are paired with robust cable production capacities from industry mainstays like Aberdare Cables, CBI African Cables, and SOEW (Barnes et al. 2023a). Finally, foundational subcomponent supply networks are integrated by high-volume domestic hardware specialists, including CBC Fasteners and Impala Bolts *&* Nuts (Barnes et al. 2023a).

Firms operating within the domestic wind supply chain function almost exclusively as project-dependent, tier-one engineering sub-contractors tied to heavy metalworking and civil infrastructure frameworks (Barnes et al. 2023b; Musonda 2026). This structural reality creates a sharp divide between international turbine OEMs — such as Vestas, Nordex, Siemens Gamesa, and Goldwind, which operate as foreign suppliers within the country — and localised manufacturing entities. Local manufacturers specialise in the heavy fabrication of concrete and steel tower sections, anchor blocks, and associated structural internals (Barnes et al. 2023b; Musonda 2026). For instance, heavy steel towers are fabricated by companies like Gestamp Renewable Industries (GRI) Towers, though their Atlantis facility has historically operated significantly below its full capacity due to severe operational disruptions caused by 'stop-start' public procurement pipelines (Rivett-Carnac 2022b). Consequently, concrete tower alternatives have gained substantial traction within the local market, produced by localised ventures like Concrete Units and Copperton Concrete (Barnes et al. 2023b). These local fabricators draw on primary inputs from domestic steel giants like ArcelorMittal and Columbus Stainless, though specialised thick plate alloys for steel towers must still be imported due to local specification parameters (Rivett-Carnac 2022b; Barnes et al. 2023b). Concurrently, secondary steel and tower internals are supplied by local engineering entities like Modetech Services and Naledi Engineering, but the project-by-project procurement model continues to place significant working capital strains on local enterprises (Rivett-Carnac 2022b; Barnes et al. 2023b). Similarly, the electrical BoP segment relies on established domestic firms, including ACTOM, SGB-SMIT Power Matla, and Matelec for transformers, alongside localised cable suppliers like CBI African Cables, M-Tech, and Aberdare Cables (Barnes et al. 2023b).

The corporate profile of the BESS sector is defined by a dense, competitive cluster of specialised domestic system integrators that capitalise on downstream value addition (Barnes et al. 2023c; Musonda *Unpublished*). This market is driven by new greenfield entrants and pioneering domestically based operations — including Balancell, BlueNova, Freedom Won, Hubble Lithium, Maxwell & Spark, Polarium, Rubicon, and Solar MD — which focus on designing, repurposing, and assembling usable battery packs for residential, commercial, and industrial markets (Barnes et al. 2023c; Moshikaro-Amani 2026; Musonda *Unpublished*). These firms maintain average individual production volumes of 200–300 MWh per year, combining imported lithium-ion cells with proprietary intellectual property, advanced BMSs, and localised software frameworks. Operating as highly agile local market entrants, these companies strategically focus their business models on capturing attractive downstream segments that face lower barriers to entry and scaling than capital-intensive mineral refining, rather than attempting to compete directly against large foreign cell foundries (Barnes et al. 2023c; Moshikaro-Amani 2026). Value creation within this sector is split by chemistry, with firms maintaining strong downstream assembly presence for LIB packs, alongside a nascent, vertically integrated ecosystem for VRFBs spearheaded by Bushveld Minerals and Bushveld Energy, where processing local vanadium into high-purity electrolyte offers high domestic industrial potential (Moshikaro-Amani 2026).

Beyond physical production, the ecosystem relies on a network of specialised institutional and manufacturing support services that enable domestic quality compliance. For example, the sector utilises localised regulatory verification frameworks, such as established domestic testing capabilities for large power transformers, which ensure that both locally built BoP components and complex imported technologies safely meet national grid integration standards (Sapvia 2024). However, this support architecture is severely uneven across RE segments. While heavy electrical transformers

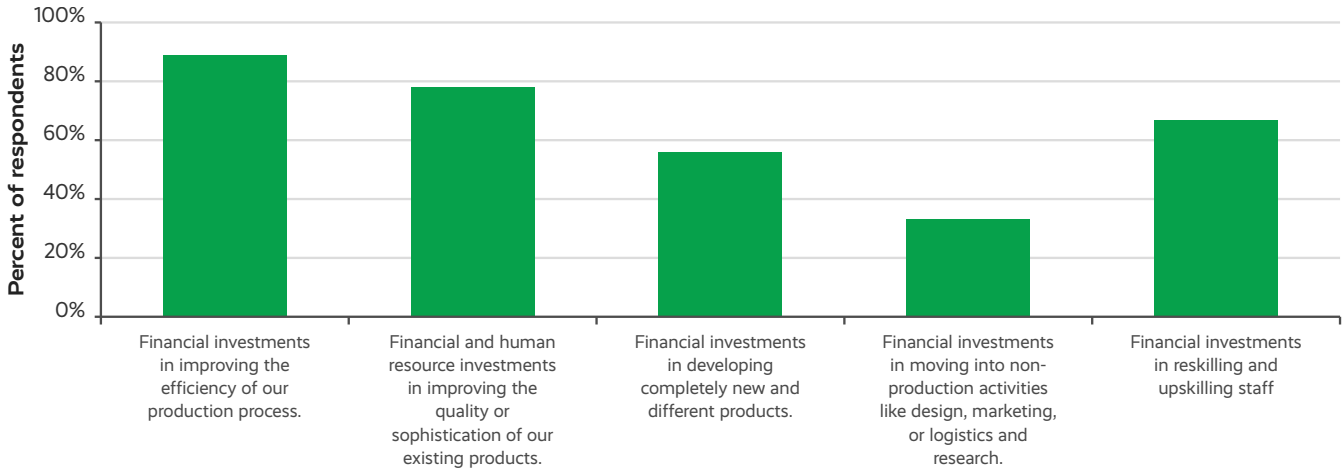
benefit from advanced domestic laboratory testing, South Africa lacks local laboratories capable of certifying advanced inverters to required electromagnetic compatibility and safety standards (Rivett-Carnac 2022a). Consequently, domestic electronics firms and battery assemblers must export their components offshore for international quality testing at great expense, which severely erodes their cost-competitiveness against foreign imports (Rivett-Carnac 2022a; Moshikaro-Amani 2026).

2.2.3 Firm upgrading and capacity development

This subsection evaluates the strategic pathways through which South African manufacturers improve their positioning within the RE production network via product, process, and functional upgrading, as well as how they adopt innovative business models and diversify target markets. The discussion illustrates how domestic enterprises deploy capital and absorb technology. Ultimately, these insights deepen understanding of the mechanisms firms use to scale up domestic production.

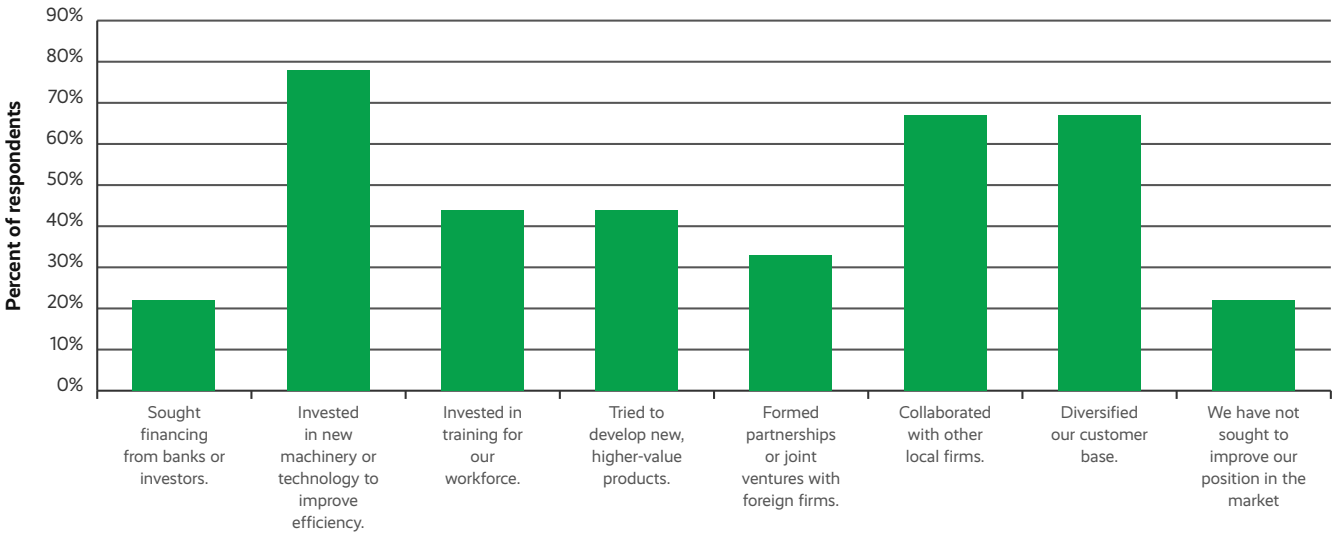
Empirical data from the firm survey and stakeholder interviews demonstrate that domestic manufacturers actively pursue multidimensional upgrading strategies to enhance their competitiveness and deepen localisation within RE production networks. Every firm surveyed invested in upgrading over the last three years, most commonly to improve production process efficiency (see Figure 3). This was backed by seven firms purchasing new machinery or technology (see Figure 4).

Figure 3: In the last three years, in which of the following areas has your firm made investments? (Check all that apply)



Source: Firm Survey

Figure 4: Which of the following strategies has your firm used to improve its position in the market? (Select all that apply)



Source: Firm Survey

Firm-level capacity development relies on an interlocking matrix of formal research and development (R&D), hands-on production experience, and context-specific engineering to adapt RE technologies to local operating conditions. This evolutionary learning occurs across both structured product development and informal shop-floor experience, heavily enriched by close customer relationships. Highlighting this focus on context-specific design, one respondent noted:

> *"South African technology is technology that is developed in Africa for Africa — African conditions. It is not just a copy of technology."* (I21 Battery Industry Manager)

However, the speed and success of domestic industrial upgrading are heavily mediated—and frequently constrained—by the shallow depth of local innovation systems. The innovation system involves beneficial connections between firms and South African universities but this appears to be limited. For example, an interview respondent mentioned that South African universities have sent a small number of students on international exchange programmes to learn about battery technologies with support from the Department of Science, Technology and Innovation (DSTI) (I25 Cross-Sectoral Expert). In addition, another respondent mentioned that students from universities visit their solar plant (I10 Solar Industry Worker).

Because domestic institutional linkages remain limited and other countries have already developed advanced RE systems, South African firms rely heavily on globally generated knowledge. For instance, an industry player noted that the design of a particular wind turbine project he was working on was done by a Spanish team (I19 Wind Industry Manager). Situations such as this can indicate that local capacity is not being used but can also be a powerful way for global knowledge to enter and be absorbed by South African firms. Crucially, this operational dependence extends past component designs to encompass the complete import of the manufacturing machinery and capital equipment

itself. Unlike leading export hubs like China—which successfully scaled up from importing technology to building the actual machinery that manufactures the components (Bradsher, 2024)—South African factories remain dependent on foreign capital equipment that arrives with rigid, pre-determined technical specifications. Consequently, the domestic manufacturing footprint is frequently restricted to executing strict processing instructions, such as mixing and pouring concrete for predefined wind tower sections, or using imported automated machinery to arrange and connect foreign battery cells. This reliance on imported assembly lines limits independent technological upgrading by forcing local firms to adjust their workforces to external specifications rather than cultivating sovereign equipment engineering capabilities.

Nevertheless, interactions with foreign technology can foster local learning and capability accumulation. A major source of knowledge transfer mentioned in the interviews is relationships with foreign firms, a dynamic that is documented in academic studies (see Humphrey and Schmitz 2002; Morrison et al. 2008; Pietrobelli and Rabellotti 2011; Lema et al. 2018). As one respondent indicated:

> *"[We don't want] inferior quality products. The Chinese partner will not allow that either. So, a tried and tested supply chain in the short term, importation of prefabricated electrodes, and then concurrently working with them to build up the value chain…learnings from other countries that have walked before us are very important, the likes of China, the likes of India, the likes of Thailand. These are countries where they have put in place mechanisms to sort of catalyse the domestic industry."* (I20 Battery Industry Manager)

These experiences show that it is necessary to balance measures to grow local industry with the need to remain open to foreign know-how and ensure technology transfer.

The practical execution of these firm-level capability accumulation processes defines how firms navigate the tensions between global cost pressures and domestic localisation mandates. As detailed below, product upgrading profiles reveal how domestic firms utilise branding, software services, and global licensing to capture value, even when physical manufacturing is decoupled from local factories. Simultaneously, process upgrading patterns show that expanding organisational capacity requires capital investments in advanced line machinery to remain globally competitive, while functional upgrades and market diversification serve as vital defensive survival mechanisms to hedge against erratic public tendering pipelines. Finally, the long-term adaptation of the network is shown through innovative business models, where firms use JVs and circular economy frameworks to enter emerging frontiers like component recycling.

Product upgrading

To increase value creation, domestic enterprises pursue product upgrading by advancing technical specifications and establishing distinct local brand identities. Local battery firms achieve this differentiation by engineering higher-quality products with longer lifespans (I17 Battery Industry Manager). Cultivating a distinct "South African-made" identity further helps local innovators capture domestic market share. For example, one interview respondent outlined an explicit strategy to expand

her company's global footprint, stating a desire to become an important international player to show the world what South African firms can do (I41 Battery Industry Manager). Another battery firm also highlighted a focus on innovation and expressed a desire to be "able to innovate and change, develop design, and be first to market (I17 Battery Industry Manager)."

Paradoxically, some domestic firms engage in international white-labelling — outsourcing physical manufacturing overseas while maintaining domestic brand ownership, quality control, and local warranties. This practice operates as a critical defensive strategy, allowing South African companies to offer products with advanced technologies at lower prices than would be possible with domestic manufacturing, thereby bypassing uncompetitive local raw material input costs (Barnes et al. 2023a; Barnes et al. 2023c). However, this runs counter to efforts to localise manufacturing. Nevertheless, it illustrates that domestic value creation can extend beyond manufacturing itself, through activities such as product specification, quality assurance, branding, and warranties, even where physical production takes place elsewhere.

Conversely, local manufacturing is directly supported when domestic factories upgrade to manufacture components under licence for established global brands. This involves developing the ability to meet international standards. For example, a solar industry firm described becoming licensed to make products for global brands (I11 Solar Industry Manager).

Integrating proprietary digital and software services directly into physical components represents an increasingly important form of product upgrading that embeds long-term value creation within the hardware itself. For example, local manufacturers enhance product differentiation by developing customised battery monitoring services, diagnostic customer support platforms, and tailored BMS software configurations (I26 Battery Industry Manager; Musonda *Unpublished*).

Process upgrading

Process upgrading within the sector focuses heavily on modernising manufacturing infrastructure and achieving international technical certifications to survive strong global price competition. Firms actively pursue these technical credentials and deploy online customer diagnostic platforms to meet higher quality standards, expand field-service responsiveness, and comply with updated domestic wiring and grid regulations (Barnes et al. 2023a). For example, one firm described developing an online platform to improve their ability to provide good customer service (I26 Battery Industry Manager). Government regulations have also pushed firms to upgrade their processes. Another respondent described how updates to wiring codes forced companies to change how they operate (I40 Substation Industry Manager).

RE firms in South Africa have also been expanding their organisational capabilities. This includes expanding their production capacities. Sectoral registries showing that collective domestic battery assembly capacity has rapidly scaled to approximately 2 GWh per annum to absorb local demand (Barnes et al. 2023c). Similarly, within the solar segment, firms have deployed capital directly into upgrading physical line equipment. For example, a leading domestic module assembler invested in advanced, large-format line machinery to transition its factory floor towards modern n-type technology

configurations, demonstrating that capacity expansion is intimately tied to upgrading process machinery to maintain global cost-competitiveness (Krinsky 2026; Labuschagne 2026).

Functional upgrading

In the South African context, functional upgrading can also help to embed local production, as evidence indicates that local manufacturers utilise this strategy to increase their competitiveness by internalising adjacent supply chain activities. This includes adding installation services (I11 Solar Industry Manager), building structures instead of buying them (I27 Solar Industry Manager), and doing metal fabrication in-house (I41 Battery Industry Manager). One firm also shared plans for functional upgrading by adding recycling to their activities (I26 Battery Industry Manager). Beyond initial project deployment, manufacturers can also extend their corporate architectures into the long-term operational use-phase. For example, this can include battery monitoring services or customer support (I26 Battery Industry Manager; Musonda *Unpublished*).

However, the practical extent of functional upgrading is bounded by firm-level risk tolerances, as some domestic manufacturers deliberately choose not to internalise capital-intensive upstream nodes. For example, this research reveals a distinct capability ceiling within the domestic battery segment. While local enterprises are highly successful at adding adjacent downstream functions like custom software integration and mechanical casing fabrication, existing battery pack builders frequently lack the commercial ambition or risk tolerance to functionally upgrade into primary cell manufacturing. This strategic hesitation is driven by the massive upfront capital requirements, intense global price competition, and acute environmental sensitivities inherent in adding a raw chemical cell production function to their businesses (I26 Battery Industry Manager), with local businesses remaining dependent on establishing external JVs to fill South Africa's cell manufacturing gaps.

Adopting innovative business models

In the South African context, the emergence of innovative business models was found across two distinct frontiers: commercial technology-sharing partnerships and circular economy frameworks. To accelerate technology transfer and create higher-value components, some domestic producers are establishing JVs with international market leaders. Concurrently, a separate high-growth frontier is emerging around dedicated component repurposing, remanufacturing, reuse, and recycling enterprises (Moshikaro-Amani 2026). Solar PV reuse and recycling activities are emerging in South Africa, although current volumes remain limited and questions remain regarding the commercial viability and future development of these activities (Crozier et al. 2025). In advanced chemistries, battery companies are leveraging circularity to pioneer innovative business models. While the non-degrading properties of vanadium electrolyte enable leasing schemes like "Battery-as-a-Service" (BaaS), to reduce users' upfront costs, local enterprises concurrently capture value in the stationary storage sector by repurposing imported electric vehicle cells into second-life assets (Moshikaro-Amani 2026).

Market diversification

Market diversification functions as a vital defensive mechanism for local firms navigating highly erratic domestic public procurement timelines. In some cases, this operates as a commercial imperative

to survive when business in existing public tendering channels slows or stops. A solar industry company described initially focusing on government tenders before expanding into commercial and residential markets when public tenders were unavailable (I11 Solar Industry Manager).

Market expansion has also attracted new entrants into RE-related activities. However, weak regulatory oversight and a lack of formalised installation standards can enable entrants without sufficient technical capabilities to enter the market. Respondents raised concerns that businesses with unqualified staff had entered the rooftop solar installation market, posing a severe operational safety risk to the wider SSEG market (I27 and I42 Solar Industry Managers; Barnes *et al*. 2023a).

2.2.4 Manufacturers' Customers and Suppliers

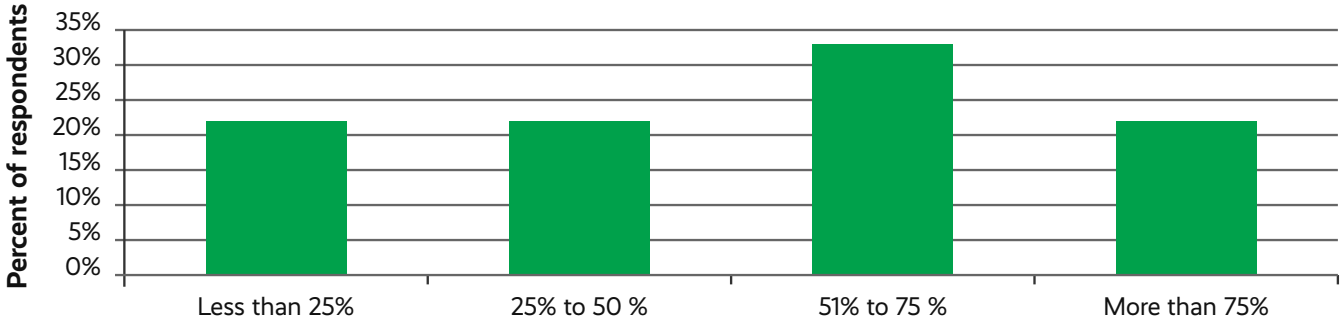
Domestic manufacturing operations are structurally anchored by backward supply chains and forward customer linkages, which determine their capacity to generate value within RE production networks. Manufacturers can sell into any of the markets described above, which include centralised and wheeled tracks, downstream distributed installers, and cross-border export markets. Simultaneously, these enterprises rely on an asymmetric mix of localised material streams and foreign technical hardware inputs to sustain their production lines. While this section outlines the broad structural composition of these commercial pipelines, the qualitative nature and relational power dynamics of these buyer-supplier relationships are discussed further in Section 7.2.1.

Accessing cross-border regional export markets functions as a vital commercial pathway that expands the total scale of sustainable demand available to South African RE manufacturers (GreenCape 2024). Within the broader African continent, Southern African Development Community (SADC) nations increasingly look to South Africa as a primary logistics, engineering, and component-sourcing hub to alleviate regional grid instability and fuel energy-access programs. This regional demand channel operates as an alternative for domestic enterprises when they struggle to access South African markets (Rivett-Carnac 2022b; Sapvia 2024; Moshikaro-Amani 2026). Local manufacturers can strategically route their hardware through smaller-scale regional installations and distributed export networks, where customer demand is heavily prioritised around immediate component availability, short shipping lead times, and rapid replacement under local warranties (Barnes et al. 2023a; Barnes et al. 2023c). Because cross-border regional developers and downstream installers operate on exceptionally thin project construction margins, South African manufacturers must maintain high input competitiveness and logistical reliability to supply these markets, ultimately allowing local factories to maintain stable capacity utilsation and achieve the economies of scale required to remain globally competitive (Barnes et al. 2023a; GreenCape 2024).

The extensive variation in localised input sourcing of components, raw materials, and services among domestic manufacturers underscores an unevenly integrated supply chain network. In IEJ's survey, firms reported procuring inputs from both domestic and global suppliers. Two firms indicated that they source under 25% of their inputs from domestic sources, while two firms indicated that over 75% of their inputs are from local sources (see Figure 5). The remaining five firms were divided between the 25–50% and 51–75% categories. Two firms indicated that large or foreign firms are their suppliers. Additionally, one firm described high costs or scarcity of raw materials as one of their three biggest challenges. These findings indicate substantial variation in the extent to which domestic

manufacturers are embedded in local supplier networks, a fragmentation reinforced because low and erratic market demand cycles make it difficult for factories to coordinate predictable local sourcing channels or secure stable, long-term supply agreements with domestic subcomponent vendors.

Figure 5: What proportion of your key inputs (raw materials, components, services) do you source from suppliers within your country?



Source: Firm Survey

This uneven localised embedding coexists with a high level of domestic reliance on fully assembled foreign imports, driven by technical gaps in midstream cell fabrication and intense global price competition. In some cases, these are complex products, such as solar cells and LIB cells, that are not produced domestically (Krinsky 2026; Musonda *Unpublished*). In many cases, imported products compete directly with, and in many cases outcompete, domestically produced alternatives.[9] South Africa's existing manufacturing capabilities therefore coexist with continued dependence on imported components and finished systems.

Crucially, the scale of localised input sourcing is severely restricted by procurement pipeline gaps and a lack of predictable domestic demand, which directly prevents local component vendors from expanding operations. When state utility procurement slows or halts entirely, local manufacturers lose the market volume necessary to sustain local supplier contracts, making them dependent on cheaper, readily available foreign material streams (Krinsky 2026; Musonda 2026). Consequently, expanding domestic value creation and advancing productive upgrading require not only addressing technical capacity, but also establishing stable, policy-backed demand pipelines that allow local firms to confidently de-risk investments in localised supply chains (Krinsky 2026; Musonda 2026; Musonda *Unpublished*).

South Africa has also seen a rise of specialised trading firms that rely entirely on fully assembled foreign imports, creating a direct conflict with long-term industrial capacity-building. While this pure wholesaling activity generates short-term commercial value, local manufacturers argue that it actively undermines the development of deeper domestic productive capabilities. This structural tension is underscored by industry insiders who question whether unmitigated import arbitrage suppresses localised factory investments (I17 Battery Industry Manager).

[9] See Rivett-Carnac (2022b), Krinsky (2026), Musonda (2026) and Moshikaro-Amani (2026) for discussion of patterns of import and export of RE system component parts.

2.3 South Africa's role in producing raw materials for renewable energy systems

> *"We have the right mining, but we send those things outside of the country."*
> (I31 Trade Union Representative)

The structural disconnect between South Africa's extensive primary mineral production and its downstream RE manufacturing industries highlights a domestic gap in participation in high-value midstream processing links. While the country actively produces the core raw materials undergirding global energy transitions, a widespread reliance on mineral exports means these resources are routinely shipped abroad for high-purity refinement. This export pathway is heavily reinforced because domestic extraction operations secure long-term capital financing by locking their raw output into multi-year off-take supply agreements with major global refining hubs, primarily based in China, which maintain the world's lowest processing costs (Musonda 2026; Moshikaro-Amani 2026). Consequently, local value creation remains stifled as processed materials must be re-imported in the form of finished components.

This processing deficit historically created a dual failure at opposite ends of the industrial network, simultaneously driving raw material outflows while forcing local component builders to import finished inputs. For instance, while South Africa is expanding rare earth mining to leverage its known reserves of 860,000 metric tonnes (U.S. Geological Survey 2025), early extraction tracks routinely shipped raw output abroad for processing. However, domestic beneficiation is emerging through partnerships between national research councils like Mintek and private mines to produce high-purity mixed rare earth products locally (Jardim 2026), alongside substantial U.S.-backed investments to fund localised processing factories directly on domestic soil (Gumede 2026). Yet, despite these emerging midstream steps, manufacturers often remain entirely dependent on foreign inputs, a systemic isolation highly visible in the solar PV segment. Here, despite possessing massive primary silica deposits, South Africa still lacks the precision processing infrastructure required to convert raw quartz into the electronics-grade polysilicon cells needed for solar modules and semiconductors (Sapvia 2024; Krinsky 2026). Resolving this structural trap requires strategic coordination to simultaneously protect the primary mining sector—which anchors critical shares of national GDP, export earnings, and employment—and cultivate local midstream processing alternatives (Moshikaro-Amani 2026).

The broader mineral reality mirrors the rare earths trajectory. The country's well-established advantages in primary mineral extraction and upstream refinement coexist with severe midstream capacity gaps that prevent these resources from being directly channelled into domestic component manufacturing (Sapvia 2024). Upstream, South Africa holds the world's largest reserves of manganese ore and an established vanadium mining industry, which is supported by a regional transport advantage for importing Class 1 nickel, lithium, cobalt, and graphite (Barnes et al. 2023c). Within this upstream footprint, entities such as Manganese Metal Company (MMC) produce electrolytic manganese metal, while companies such as Thakadu are developing or producing battery precursor materials for downstream battery value chains. South Africa's VRFB industry possesses one of the most integrated

value chains globally, extending from mining and refining through to electrolyte production (CES 2022; DEE et al. 2025; Musonda *Unpublished*). Yet, these primary material capabilities are severely bottlenecked down the line. In the LIB sector, South Africa lacks the chemical processing infrastructure required to transform refined metals into active precursors like nickel manganese cobalt oxide (NMC) powder, requiring downstream manufacturers to import processed battery precursor materials despite South Africa possessing many of the underlying minerals (CES 2022; DEE et al. 2025; Musonda *Unpublished*). Furthermore, South Africa's primary copper processing capacity is limited, with recycled copper derived from volatile scrap recovery networks playing an increasingly important role in domestic supply (CES 2022).

Beyond primary minerals, the domestic localisation of foundational structural and industrial construction materials is severely constrained by uncompetitive domestic pricing mechanics and strict international engineering standards. While components like utility-scale steel and concrete tower bases are frequently produced within South Africa, the economic benefit of local sourcing is routinely eroded. For example, solar systems need steel, with ground-mounted solar needing higher steel volumes than rooftop installations (Rivett-Carnac 2022a). Although South Africa processes raw materials into industrial metals and polymers, monopolistic import-parity pricing structures wipe out any inherent raw-material cost advantage, leaving local fabricators highly vulnerable to cheap, completed metal structures imported from Europe and Asia (Rivett-Carnac 2022a; Sapvia 2024). Similarly, although South Africa has substantial steel production capacity, locally available products do not always satisfy the technical specifications required by wind turbine OEMs (Rivett-Carnac 2022b; Musonda 2026). Interviewees reported importing steel because of price (I39 Wind Industry Manager) and lack of availability of needed types of steel (I40 Substation Industry Manager), while others reported relying on local steel (I41 Battery Industry Manager). Finally, South Africa does have strength in cement production, although the industry has struggled to compete with low-priced imports (Rivett-Carnac 2022b; Musonda 2026).

In conclusion, South Africa's position in global RE production networks features a structural gap: the country maintains world-class primary resource extraction alongside a sophisticated downstream system assembly niche, yet lacks capabilities in the high-value midstream manufacturing core. This structural fragmentation means that expanding the volume of local deployment does not automatically result in localised industrial value creation. Moving forward, a successful localisation policy cannot rely solely on imposing local content mandates. Rather, addressing critical midstream capability gaps is crucial for expanding localisation across the entire supply chain. Ultimately, resolving these gaps hinges on how the state coordinates its wider industrial and energy planning, a political economy dynamic that is evaluated alongside the role of public policy and state-owned enterprises (SOEs) in Section 7.1.

2.4 Utility-scale project deployment and smaller-scale system installation

The project deployment and system installation phase represents the physical realisation of RE infrastructure on the ground, acting as a high-volume, highly visible driver of domestic productive activities. While this value chain stage is inherently localised by its geographic nature, the corporate organisation behind its execution is fractured between foreign-dominated utility consortia and highly

localised retail installer networks. In practice, while several established domestic engineering and civil construction firms successfully execute utility-scale BoP projects, the highest-value technical tiers remain heavily dominated by multinational consortia. Ultimately, this operational divide shapes an uneven market where short-term civil construction opportunities on utility-scale projects stand in sharp contrast to the burgeoning, yet under-regulated, local networks managing decentralised retail installations (Krinsky 2026; Musonda 2026).

The asymmetric structure of utility-scale procurement restricts domestic engineering firms to lower-margin subcontracting roles, creating highly volatile 'boom-and-bust' labour cycles. Driven by international pricing asymmetries that favour global OEMs over local producers, domestic participation is primarily cornered into these tier-two and tier-three positions. While local communities absorb a brief, high-intensity influx of low- to semi-skilled jobs during the peak building phase, this labour footprint collapses immediately upon commissioning. As a result, local value creation often remains restricted to site preparation, basic grid connection infrastructure, and civil logistics, reinforcing the reality that physical installation inside South Africa does not automatically translate into deep or lasting domestic economic opportunities (Krinsky 2026; Musonda 2026).

The deregulated, small-scale distributed generation market operates domestically, though its rapid growth has severely outpaced formal quality-assurance and regulatory verification systems. Bypassing international EPC frameworks completely, local firms and independent artisans have established businesses that directly target the demand generated by the rapid rollout of rooftop solar and modular battery storage systems. Field evidence reveals deep anxieties among established industry actors that a proliferation of uncertified operators and unqualified staff has flooded the rooftop solar installation market, allowing entities to take technical shortcuts that compromise engineering certifications, bypass national safety legislation, and directly undermine the credibility of localised productive capabilities (I27 and I42 Solar Industry Managers).

Ultimately, the deployment phase represents the primary engine for raw job numbers during the initial phase of South Africa's energy transition. However, the fundamentally short-term nature of this construction work caps its long-term industrial impact. Building sustainable, resilient industrial capabilities requires shifting the focus of national policy from short-term field-level construction to securing stable, multi-year component manufacturing and midstream processing pipelines (Krinsky 2026; Musonda 2026; Musonda *Unpublished*).

2.5 Operations and maintenance

The O&M phase functions as a critical long-term anchor for localised productive activities, offering far more predictable and sustained commercial horizons than the volatile construction phase. While civil installation works yield short-term employment spikes, the multi-decade lifespans of centralised and wheeled facilities establish a steady baseload of industrial demand that South African engineering and service firms are increasingly equipped to capture. One respondent mentioned that companies are fulfilling local sourcing requirements for tenders by using local providers for these services (I41 Battery Industry Manager).

However, the total labour- intensity of this phase remains constrained by the highly automated and low-maintenance nature of modern RE and battery technologies. In the solar PV segment, local O&M opportunities are predominantly limited to low-complexity physical services, such as site security and module cleaning (Sapvia 2024). Similarly, utility- scale wind farms require specialised technical engineers for complex drivetrain and blade maintenance, but a persistent local deficit in advanced electro- mechanical skills forces asset owners to rely on foreign OEM service contracts for critical interventions (Musonda 2026). In the BESS sector, local firms successfully capture technical servicing niches through localised BMS software monitoring and modular pack cell replacements, though overall stationary LIB and VRFB installations run largely unmanned (Musonda *Unpublished*).

Decentralised small- scale system servicing represents a highly localised O&M tier that relies extensively on regional installer networks for post-installation troubleshooting, inverter recalibrations , and battery warranty management. However, overall job levels in this phase remain low across RE segments compared to the manufacturing and deployment tiers. Consequently, this structural capacity ceiling demontrates that O&M cannot serve as a lone driver for wide- scale industrial job creation unless it is paired with deep domestic component production networks.

2.6 Decommissioning renewable energy systems in South Africa

The decommissioning, reuse, and recycling phase represents a major frontier for domestic industrial development, yet South Africa's RE circular economy currently suffers from a significant execution gap between ambitious environmental policies and localised physical infrastructure. While progressive legislative mandates — including a total landfill ban and extended producer responsibility (EPR) frameworks — legally mandate post-consumer management, actual recycling networks remain limited and narrow (Sapvia 2024; Crozier et al. 2025). Consequently, the sector presents a missed opportunity for value creation and productive activity, coexisting alongside a domestic reliance on exporting waste.

A primary structural barrier to building localised commercial recycling operations is the insufficient volume of end-of-life RE technology generated domestically, which leaves commercial processing facilities economically unviable. Because utility installations are relatively young and private rooftop systems are highly decentralised, the baseline volume lacks the scale required to attract large-scale capital investments. For instance, despite inbound panel imports surging to R17.5 billion during recent residential expansions — threatening up to one million tonnes of solar e-waste by 2050 — local solar recycling remains isolated due to prohibitive collection and transport logistics (Sapvia 2024; Crozier et al. 2025). As one battery executive noted:

"There isn't the volume of recycling of end-of-life batteries at the moment to really get anyone's attention to invest heavily in a recycling operation ...everybody's crushing solar panels, crushing batteries into black mass and exporting that supposedly to be responsibly recycled. Who knows if it ends up in the landfill somewhere else." (I17 Battery Industry Manager)

A second critical hurdle stems from domestic deficits in processing complex, technologically intensive component materials, which restricts recycling activities to low-value scrap separation. While established domestic metallurgy networks easily reprocess basic structural materials like steel towers and copper BoP cabling, specialised technical capabilities remain limited for highly complex subcomponents (Sapvia 2024; Crozier et al. 2025). This capability gap is particularly acute in the wind energy segment, where composite turbine blades remain technically challenging to recycle and are routinely diverted away from local reclamation processes due to a lack of advanced chemical or thermal separation infrastructure (Sapvia 2024; Crozier et al. 2025).

The limited development of domestic midstream manufacturing directly starves emerging recycling enterprises of local end-markets for recovered secondary raw materials, leaving them with highly restricted domestic sales loops. This market constraint is illustrated by a highly bifurcated battery ecosystem, where South Africa maintains a well-developed, closed-loop network that reprocesses over 75% of traditional lead-acid batteries directly back into local automotive manufacturing lines (CES 2022; DEE et al. 2025). Conversely, a severe implementation deficit exists for advanced LIB chemistries because the country lacks local commercial chemical refining plants to turn recycled inputs into fresh components, so local end-of-life management is restricted to basic crushing, dismantling, and pre-processing into 'black mass' for direct export to overseas manufacturing hubs (CES 2022; DEE et al. 2025). Furthermore, institutional support remains hollowed out across this post-use segment, where localised testing infrastructure for verifying a battery's state of health or tracking components via digital battery passports' remains limited, leaving a vital regulatory gap in the domestic circular economy (Moshikaro-Amani 2026).

2.7 Localisation and industrial development

An evaluation of South Africa's position within RE production networks reveals that while localised industrial capabilities exist across all five value chain stages, several industrial challenges prevent the country from translating rising aggregate market demand into sustainable domestic value creation. The domestic energy transition is characterised by highly fragmented market pathways — including state-led auctions under Model 1, deregulated corporate wheeling channels under Model 2, state managed generation, and distributed self-use networks — each creating different levels of opportunity for local firms. Crucially, a comprehensive audit shows that localisation is fundamentally undermined by an uneven industrial profile, where established competitive capabilities in civil infrastructure and structural BoP fabrication contrast sharply with dependence on foreign imports for advanced midstream components. Downstream, South African firms successfully manufacture utility-scale wind steel and

concrete tower sections, heavy AC grid cabling, industrial fasteners, power distribution transformers, and local battery module enclosures, which are supported by strong domestic participation across onsite civil deployment, installation, and field O&M networks. Conversely, the high-value technical core remains limited. Primary solar materials (including electronics- grade polysilicon cells, ingots, and wafers), core precision wind machinery (such as generators, gearboxes, bearings, and specialised pitching systems), and advanced LIB cells are not produced domestically due to technical and capital gaps, as well as missed opportunities.

Overall, South Africa's role in RE system production is focused on downstream assembly, integration, and service provision rather than deep upstream component manufacturing. This section has identified three challenges that contribute to this imbalance:

- Erratic Public Demand and Fragmented Market Sourcing: Local manufacturers are unable to achieve sustainable operational scaling because the public utility track (Model 1), which has LCRs and is looked to by many buyers as a potential sales channel, fails to provide a consistent, predictable pipeline of market demand. While the private utility track (Model 2) and decentralised self-use networks signal immense aggregate demand, their deregulated, open sourcing architectures enable project developers and small-scale users to completely bypass local components in favour of imports. Without being able to maintain high capacity utilisation, which could be facilitated by a stable, guaranteed baseline of public offtake, domestic component builders struggle to enhance competitiveness against what is available in global sourcing networks.

- Absence of Intersectoral Mineral Linkages: A gap persists between South Africa's material extraction and its downstream manufacturing industries due to limited midstream processing integration. This represents a major missed opportunity to exploit the country's profound comparative advantage between its raw critical mineral endowment and downstream RE industry. Because South Africa lacks the needed chemical refining infrastructure, primary raw minerals are exported for processing abroad, forcing domestic manufacturers to re-import processed components at a premium.

- Underdeveloped Circular Economy Infrastructure: Failing to harness circular economy opportunities stifles domestic value creation by driving the direct export of valuable scrap material rather than reusing or recycling used RE equipment on domestic soil. The domestic infrastructure for advanced recycling is underdeveloped and commercially unviable due to low domestic volumes, preventing local circular enterprises from extracting high-value secondary minerals from spent hardware.

Despite these challenges, high-potential pivot points exist across the local manufacturing footprint. Firms are actively investing in process and functional upgrading — expanding to gigawatt-capacity factories, insourcing metal fabrication, writing customised software code, and establishing JVs. Moving forward, the developmental effects of localisation will depend not only on expanding the sheer quantity of local installations but also on whether firms can upgrade their capabilities, public and private offtake channels can be secured, and midstream refining linkages can be developed.

Understanding the nature of productive activities carried out in South Africa provides the necessary baseline to analyse how value is captured across these stages, the conditions of work created, and the gender dynamics underpinning the industry. Each of these dimensions is discussed in the following three sections of this report.

3. SOUTH AFRICAN VALUE CAPTURE IN RENEWABLE ENERGY PRODUCTION NETWORKS

The distribution of value across South Africa's RE production networks reflects differences in firms' capabilities, ownership, access to technology, market power, and positions within domestic production networks and GPNs. In this report, domestic value capture refers to the portion of value generated through production networks that is retained by actors within South Africa, including firms, workers, or government agencies. Crucially, this analysis defines value as a multidimensional concept comprising both direct economic returns and social outcomes. Activities associated with technology development, intellectual property, and the production of technologically complex components with high economic value are frequently controlled by firms outside South Africa, while domestic benefits are more concentrated in areas such as fabrication, assembly, construction, installation, and services (Krinsky 2026; Musonda 2026; Musonda *Unpublished*). As discussed above, South African firms nevertheless participate across a range of activities and, in some cases, have developed capabilities that allow them to undertake more complex manufacturing and service functions. Consequently, to navigate these technological barriers as well as gain access to investment capital, South African firms frequently partner with international companies, particularly Chinese and European firms, which in turn capture some of the value. Furthermore, in some cases, global companies have set up manufacturing operations within South Africa, which involve domestic production but can also support systems of global value capture with proceeds going back to parent companies.

Where projects are procured through the public utility track under Model 1, tender requirements can influence how economic benefits are distributed among different groups of firms and communities (DEE et al. 2025). Public procurement frameworks include requirements relating to ownership, preferential procurement, and providing support for enterprise development (ED) and socio-economic development (SED). However, the extent to which these mechanisms result in sustained participation and value capture by different groups of South African firms and communities varies.

To evaluate these distributional patterns, this section sequentially maps how economic and social value are captured by workers, the state, foreign companies, local communities, financiers, and domestic enterprises across public and private tracks. It then synthesises the overarching dynamics of local value capture across these groups. Ultimately, this analysis illustrates that a divide persists between South Africa's high participation on paper and its low level of ownership over core, high-value RE technologies. Furthermore, value that is captured domestically is unevenly distributed with select actors gaining more benefits than others.

3.1 Workers

While workers capture value through employment, the immediate socio-economic benefits are heavily restricted by low wages and structural precarity, leaving technical training as a key mechanism for durable value retention. In terms of job creation, some South African RE businesses are deliberately optimised to maximise raw job numbers over automated capital infrastructure. As one executive explained: "This plant is designed such that it is labour intensive, not capital" (I42 Solar Industry Manager). Nevertheless, field interviews with factory staff reveal severe anxieties regarding low pay scales and highly vulnerable contract terms. As one worker said: "We bring in most of the income for the company, but our pay is very low" (I08 Solar Industry Worker). Compensating for these immediate wage constraints, empirical data shows that local enterprises actively invest in formal and informal training, allowing workers to build portable technical capabilities that outlast individual project construction timelines. The specific qualitative conditions of employment, labour relations, and job quality metrics across the sector are evaluated in deeper detail within Section 4.

3.2 The state

The South African state captures industrial value by generating tax revenues and using public procurement frameworks to shape domestic ownership, procurement, and community participation. Domestic manufacturing and related economic activity can generate public revenue through corporate taxes, payroll-related taxes, and other taxes associated with production, employment, and economic activity. Beyond these direct revenues, localised production expands the fiscal tax base by generating indirect employment and multiplying taxable income streams across upstream and downstream linkages (DEE et al. 2025). Furthermore, the state leverages public procurement frameworks like the REI4P to establish requirements for local and community participation in grid-scale projects, including equity ownership mechanisms for community trusts that can direct a share of project revenues towards community development, which can alleviate demands on public budgets (DEE et al. 2025; Sawea 2025).

3.3 Foreign companies

Transnational corporations capture a significant share of value generated in South African RE production networks by controlling technologically complex components, intellectual property, and global sourcing networks, even when local equity and shareholding mandates are formally satisfied (Krinsky 2026; Musonda 2026). A key pathway for foreign value capture is through projects sourcing from foreign suppliers or sourcing foreign-made components and equipment from South Africa-based importers. Additionally, when domestic production is undertaken by foreign- or partially foreign-owned firms, a portion of profits may accrue to actors outside South Africa. This commercial interface frequently manifests through JVs. While international partners typically retain high-margin design rights, these arrangements simultaneously offer vital pathways for South African firms to absorb advanced technology, capture operational knowledge, and build long-term domestic engineering capacity. Profit sharing within these arrangements can take many forms, as one executive explained: "[The foreign partners] do the design. We do the casting. And then we split the profits" (I19 Wind Industry Manager). Furthermore, foreign firms often support global production at lower tiers through vertical integration

or through sourcing inputs via established global sourcing networks. These dynamics allow foreign networks to extract profits from higher value elements while local operators are often restricted to basic assembly activities.

3.4 Communities

While local communities capture economic value through diverse pathways in RE networks, the extent to which these mechanisms translate into sustained and transformative local development remains contested. Key channels for community value capture include scorecard-mandated equity ownership structures and SED spending under public procurement tracks, localised job creation across all tracks, and regional environmental outcomes. Ultimately, the long-term developmental impact of RE localisation depends on how effectively local networks overcome structural barriers, top-down corporate gatekeeping, and uneven spatial distributions of work and resource benefits.

While IPPs bidding on REI4P projects are legally required to allocate mandatory equity ownership stakes to targeted demographic groups, specifically Black South Africans and community trusts, the impact of these programmes has been questioned (Khan 2021; Hermanus and Kamanzi 2026). The breakdown of ownership stakes of IPPs in 2026 is outlined in Table 1. This ownership is typically facilitated through highly leveraged debt arrangements, forcing community trusts to divert early-stage dividend revenues almost entirely toward servicing upfront equity vendor loans rather than financing local community assets (Khan 2021). Consequently, while official portfolios boast a substantial 54% local equity shareholding on paper (IPP Office 2026), a severe operational gap persists on the ground, as strict debt-repayment structures frequently delay direct cash distributions to host neighbourhoods (Khan 2021).

Table 1: Ownership of IPPs in 2026

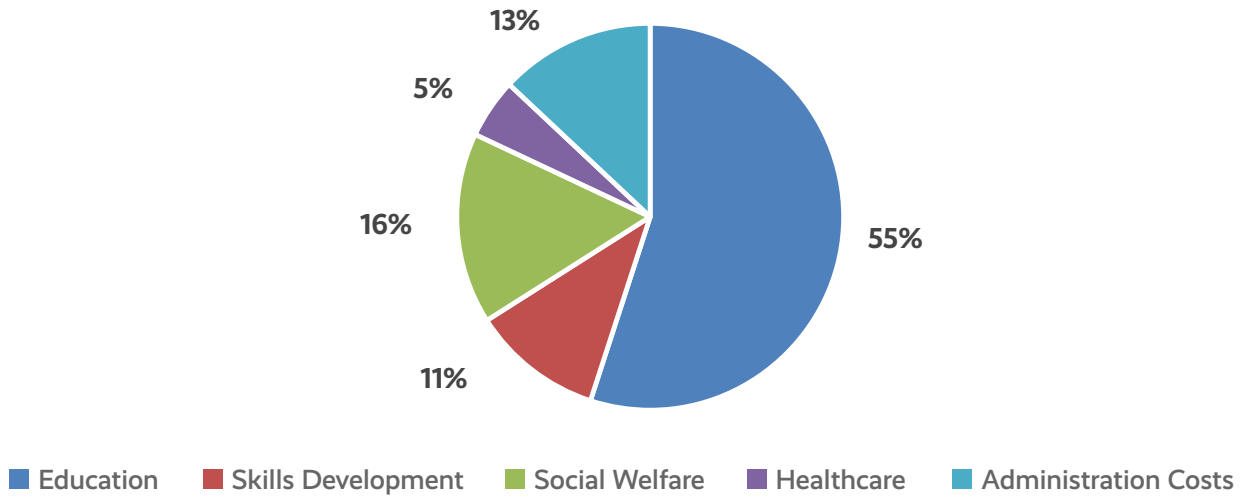
Ownership	Obligation	Achieved (March 2026)
Shareholding by Black people in the Project Company	32%	39%
Shareholding by Black people in the EPC Contractor	23%	23%
Shareholding by Local Communities in the Project Company	5%	8% (8.9% Total Portfolio)
Shareholding by Black People in the Operating Company	23%	32%

Source: IPP Office 2026

Similarly, the execution of scorecard-mandated SED spending is frequently undermined by uncoordinated project implementation and a reliance on self-reported developer data. Figure 6 presents the reported allocation of SED expenditure, showing that these companies claim to support education, skills development, social welfare, and healthcare. However, because these metrics rely almost entirely on self-reported developer data, they do not, by themselves, establish the extent, quality, or sustainability

of the benefits received by community members. Without independent regulatory verification, this spending often flows into fragmented, short-term initiatives managed by corporate gatekeepers, bypassing local municipal integrated development plans and failing to generate long-term structural economic changes (Wlokas et al. 2017; Khan 2021; Mabele et al. 2024). Detailed field evaluations confirm that SED investments are routinely introduced in a piecemeal, top-down fashion that falls short of holistic planning, frequently becoming mired in local patronage politics and sparking intense friction between neighbouring towns within the same municipality as residents jostle for an equitable geographic allocation of corporate spending (Malope 2022). By reducing local development to an inflexible needs analysis signed at the national level, this highly centralised framework bypasses local accountability structures and fails to require the ongoing local consent or collaborative planning necessary to mitigate adverse socio-economic impacts (Mabele et al. 2024).

Figure 6: Self-reported IPP spending on SED in 2025



Source: Gxasheka *et al*. 2026

Communities also benefit when businesses develop to provide inputs and services to RE companies, which can support the local economy and job expansion, although the distribution of these opportunities across firms and communities remains uneven. Field research for this study showed that people in communities felt that they were not getting access to jobs in local RE projects. These frustrations manifested in localised protests and demonstrations to demand direct economic participation, demonstrating how top-down compliance mandates can fuel local social disruption and community alienation rather than local goodwill (Malope 2022; Mabele et al. 2024). This alienation is compounded by the fact that the majority of locally created jobs are strictly short-term positions concentrated in the construction phase, leaving host communities with a severe operational bust once commercial operations begin and very few local workers are absorbed into permanent roles (Malope 2022).

Beyond direct financial and employment channels, RE localisation alters value capture through localised environmental upgrading, which may reduce some of the environmental pressures associated with conventional electricity generation. For example, solar PV energy uses 15–17% of the water that is required by nuclear and coal electricity generators (Rivett-Carnac 2022a). Nevertheless, these environmental benefits are distributed unevenly across locations and communities. Conversely,

large-scale infrastructural build-outs can simultaneously introduce localised habitat stress or environmental concerns which are frequently worsened through a lack of long-term decommissioning guidelines at the local level (Mabele et al. 2024).

3.5 Financiers

Financial actors capture economic returns by deploying investment capital across private offtake agreements, localised manufacturing platforms, and specialised asset-restructuring networks. This financial value extraction operates through multiple channels, as described below. Ultimately, the scale and geographic distribution of these financial returns are shaped by how these actors integrate into South Africa's RE production networks.

A key way that financiers capture value is through investing in project development. Through these investments, they can secure multi-year cash flows. Financiers capture predictable, high-yield revenue streams over 5-to-20-year contract lifespans by backing private PPAs with creditworthy mining and industrial buyers (Sawea 2025).

Financiers also obtain returns from investment in domestic production platforms. Capital injections into localised, foreign-owned assembly platforms or domestic RE component producers can generate returns through domestic production, regional market access, and the expansion of RE demand (CES 2022; Sawea 2025; DEE et al. 2025).

Separately, another way that financial actors capture value is by investing in circular production models. Emerging venture capital investments in solar and electronic asset refurbishment may create new opportunities for financial returns from refurbishment and resale activities (Crozier et al. 2025).

Across these investment channels, particularly within large-scale utility and industrial project tracks, financiers use strategies to grow their investments beyond direct project returns. They extract high financial returns by refinancing their projects to capture future returns when market conditions improve. Moreover, they also capture higher financial returns by converting these long-term project assets into securities that are sold onto secondary markets (Baloyi and Krinsky 2022).

3.6 Local companies

South African companies capture industrial value across both public and private tracks, but their capacity to scale is constrained by challenges including limited access to public procurement opportunities, weaknesses in the implementation of LCRs, under-spending on ED, and competition from lower-cost imported products. Domestic actors have significant participation in project investment and corporate shareholding while having more limited participation in the supply of technologically complex equipment.

3.6.1 The Public Utility Track and Value Capture Dynamics

Within the public utility track, public procurement and economic-development requirements can create opportunities for domestic firms, including small and medium enterprises (SMEs) and historically disadvantaged businesses. IPPs are legally required to route a portion of their project revenues into local ED and preferential procurement channels, enabling domestic SMEs, Black-owned firms, and women-owned vendors to secure direct manufacturing contracts (Gxasheka et al. 2026). The large scale of this public utility track is reflected in the fact that by early 2026, the programme had successfully mobilised R239 billion in total private sector investment, with 82% originating as domestic capital against 18% foreign direct investment (FDI) (IPP Office 2026). This capital mobilisation directly reshaped the corporate landscape. Total domestic shareholding across participating REI4P entities reached 54% ownership by South Africans, with 39% held by Black South Africans under B-BBEE frameworks, 23% Black ownership achieved within EPC contracting tiers, and an average of 32% Black ownership embedded across the 101 operating IPP companies spanning Bid Windows 1 through 5 (IPP Office 2026). However, IPPs spent a cumulative R1.1 billion on ED since inception, a figure which represents just 0.39% of generated revenue, falling short of the targeted 0.6% threshold (IPP Office 2026). Mechanisms behind gaps in realising the potential for local manufacturers to benefit from public procurement processes are discussed further in Section 7.1.1.

By early 2026, cumulative B-BBEE-compliant procurement spend under the public track reached R115.9 billion, representing 84% of total programme procurement, while actual local content expenditure during the construction phase accounted for R76.2 billion, or roughly 50% of total project value (IPP Office 2026). This local content footprint is structurally skewed because competitive tender scorecards evaluate compliance by overall financial value rather than component-specific origin, allowing developers to easily fulfil their mandates through downstream expenditures. Consequently, localised spending is heavily concentrated within civil construction, onsite physical assembly, and O&M rather than upstream factory manufacturing.

The uneven distribution of these industrial benefits across the value chain is mirrored by an intense spatial polarisation of RE investments across South Africa. As illustrated by IPP Office tracking data, this local content footprint is heavily concentrated in the coastal and arid regions of the country, with the largest construction and operational expenditures localised within the Northern Cape (R48.3 billion), followed by the Eastern Cape (R11.3 billion) and Western Cape (R9.8 billion) (IPP Office 2026). Conversely, older inland industrial centres that house the traditional manufacturing base have captured comparatively limited shares of this localised demand, highlighting a deep regional divergence in how transition-driven value is retained.

Moreover, maximising the public utility value stream remains a challenge, particularly within newer procurement pipelines like the BESIPPPP, where domestic equipment producers report limited opportunities to supply directly. This dynamic exposes a critical structural paradox: while South African actors dominate project equity and corporate shareholding, they supply the least amount of advanced hardware. Taking advantage of the value-based design of these tender metrics, non-manufacturing local intermediaries and commercial import traders routinely insert themselves into the supply network to satisfy demographic supplier-development scorecards. Consequently, these non-

manufacturing shell entities secure lucrative procurement opportunities while importing finished hardware from foreign OEMs, effectively excluding genuine domestic manufacturers from infant-industry protection and baseline market demand. This regulatory circumvention is mirrored on a financial level by compliance deficits in non-hardware spending tracks. Even where mechanisms exist, compliance relative to target averages is weak.

This public procurement footprint varies significantly by technology segment. In the wind energy sector, public auctions have successfully directed R47 billion of a total R53 billion procurement spend to B-BBEE vendors, allocating R16 billion directly to Exempt Micro Enterprises (EMEs) and Qualifying Small Enterprises (QSEs) while directing R5 billion to women-owned vendors (Sawea 2025). Yet, despite these large wind allocations, macro-level industry data reveals that women-owned manufacturing assets still capture a negligible 5% to 6% of total RE supply chain expenditure, confirming that procurement targets are overwhelmingly met via non-manufacturing service intermediaries rather than local manufacturing assets (Sapvia 2024; Sawea 2025). In contrast to these private developer compliance frameworks, further empirical research is urgently required to evaluate how state-led RE infrastructure programs —such as public Eskom Green initiatives —interact with local manufacturing firms and alter domestic value capture.

3.6.2 The Private Wheeling and Embedded Generation Tracks

Conversely, the marketised corporate wheeling and SSEG tracks operate on open, deregulated architectures that largely bypass public localisation mandates and requirements for project developers to support ED. In the private utility track, local manufacturers supply components, equipment, and services into projects serving commercial, industrial, and mining buyers. This is further augmented by the private market for small to large installations, which creates additional sources of demand for installation, assembly, electrical equipment, software, and related services. However, high levels of global competition in the private utility track and smaller-scale private installations can limit the extent to which expanding deployment translates into increased domestic manufacturing.

Nevertheless, local firms do have opportunities to access this decentralised, private market-driven track to capture value. One firm, which sells components of RE systems, described how it creates demand for other local subcomponent fabricators:

> *"I can now create demand and then they can now say, 'Hey, hang on, there's demand here. Let me go expand or invest in a bigger machine, a bigger lathe, a bigger whatever.'"*
> (I42 Solar Industry Manager)

3.7 Dynamics of local value capture

South Africa's RE sector demonstrates substantial domestic value capture through local ownership, procurement, local-content expenditure, community equity, and domestic investment. However, the distribution of this value remains uneven. Domestic actors have gained significant participation in

project ownership, construction, procurement and service activities, while technologically complex production, intellectual property and some higher-value components remain more strongly held by global actors. The result is an important distinction between the extent of domestic participation in the RE sector and the extent to which South African firms capture value from its technologically and commercially strategic segments. Moreover, aggregate measures of value capture do not necessarily translate into evenly distributed benefits for workers, communities or local manufacturers. Similarly, while the state successfully captures value through broader fiscal revenue streams and indirect supply chain tax multipliers, these systemic gains do not automatically resolve localised socio-economic disparities.

The distribution of value across South Africa' s integration into RE GPNs reveals a persistent geographic pattern. Higher-value, intellectual property-intensive segments — such as advanced technology design, core software development, and complex subcomponent production — are often controlled by foreign firms and their international partners. Conversely, domestic value capture is more concentrated in activities such as structural steel fabrication, basic component assembly, physical installation, and localised support services. This asymmetric commercial interface frequently manifests through JVs with international market leaders controlling high-margin design rights. Simultaneously, these arrangements serve as a channel to absorb advanced technology, capture operational knowledge, and build long-term engineering capacity.

The benefits of localisation remain highly uneven across the industrial landscape, as high-volume procurement expenditure is heavily absorbed by downstream services rather than local manufacturing assets. Domestic expenditure on RE projects is concentrated within downstream civil construction, physical installation, and O&M. While the broader RE sector boasts high localised value on paper, the high-margin core technical hardware remains outsourced to foreign OEMs—leaving domestic component factories isolated from baseline tender demand while allowing financial actors to secure stable, long-term returns through low-risk service channels.

Simultaneously, the distribution of these procurement opportunities remains highly uneven among targeted Black- and women-owned businesses, as well as SMEs. For example, while domestic SMEs and Black-owned vendors have successfully secured substantial contract volumes within the wind ecosystem (Sawea 2025), their total share remains low within the sector's wider value distribution. This access deficit is further compounded by IPPs under-spending on ED, falling short of targeted funding thresholds (IPP Office 2026). Furthermore, women-owned manufacturing businesses remain marginalised, capturing a small fraction of total supply chain expenditure in REI4P projects (Sapvia 2024).

Current structures also limit the socio-economic value captured by communities and workers. Communities benefit from mandatory equity stakes in IPPs and SED spending, yet these gains are often limited, uneven, and highly contested (Hermanus and Kamanzi 2026). While workers have received some levels of training, they have faced challenges with gaining localised employment, while also facing systemic concerns regarding low wages. The operational details of decent work and gender dimensions are considered in greater detail in the following two sections.

4. DECENT WORK

Evaluating work in South Africa's RE sector requires moving past simple descriptive counts of job numbers to ask a fundamental analytical question: is the country localising elements of RE production networks in a manner that secures decent work? A critical argument of this report is that the quality and depth of the localisation model deployed directly dictates how employment is created. If localisation remains concentrated in construction and installation, the resulting labour market will inherently be trapped in temporary, precarious, and low-wage configurations. Conversely, establishing a stronger foothold in manufacturing and developing advanced raw material processing can help to secure high-wage, permanent, and technically sophisticated career paths. To evaluate industrial labour dynamics, this section first assesses the nature and baseline conditions of current work within South African RE production networks, before tracking the skills development and career trajectories associated with the sector. Finally, it concludes by analysing how alternative localisation pathways can shape future employment quality. While gender dimensions cross-cut these labour assessments, gender dynamics are considered in greater detail in Section 5.

4.1 Work in the renewable energy industry

The capacity of South Africa's energy transition to deliver on the ILO's decent work criteria — predicated on productive work with a fair income, secure employment, social protection, opportunities for personal development and social integration, along with freedom of expression and organisation to be able to participate in decision making (ILO 2007) — is directly determined by the structural configuration of RE GPNs. Across the domestic landscape, labour outcomes split into highly polarised trajectories where long-term, upgrading opportunities are bound to localised component manufacturing, while the majority of employment remains locked in transient, low-margin installation pipelines. Consequently, evaluating these labour dynamics requires a critical assessment of how precarity, import dependency, and regulatory enforcement deficits interact to shape the duration, quality, and inclusivity of RE jobs.

4.1.1 Job creation

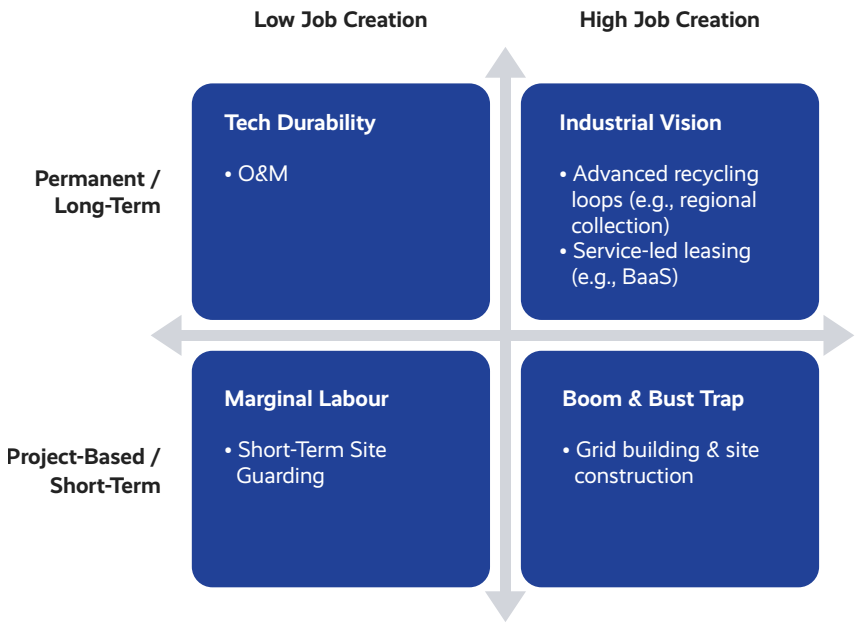
While RE production has been creating a wide variety of jobs in South Africa, current job levels remain lower than existing potential. Job creation can be considered across several factors, which include the number of jobs, the length of jobs, and who gets jobs. Employment intensity within the RE sector varies with activities, such as construction generating high levels of short-term jobs, O&M generating low levels of longer-term jobs, and manufacturing creating high levels of longer-term jobs.

A key factor in South Africa's RE industry is that intermittent demand has created a volatile 'boom-and-bust' cycle that results in severe labour instability, with new projects triggering labour surges for short-term jobs while operational lifetime staff requirements are much lower (I33 Cross-Sectoral Expert). This is because evidence suggests that employment associated with RE deployment

is often concentrated in construction and installation, where jobs may be temporary and linked to individual projects. In a case study of the development of two linked wind farms outside Loeriesfontein, a small town in the Northern Cape, Malope (2022) showed that the construction of the wind farms created jobs that provided wages that were generally higher than other employers. However, the projects neglected local training and generated misleading job claims, ultimately leaving very few permanent positions for residents once operations began.[10] By contrast, longer-term employment opportunities may be found in O&M, manufacturing, project development, and associated services. Furthermore, the relative scale of these different forms of employment also differs. Where domestic manufacturing firms receive stable orders and are able to sustain production, they can provide longer-term employment and opportunities for learning and upgrading. Where demand is intermittent, however, firms may rely more heavily on temporary employment or be unable to maintain production capacity. A key challenge with evaluating these volatile dynamics is that the process used to track job creation in South Africa's RE production networks is methodologically limited, counting jobs without distinguishing part-time or short-term positions (Musonda 2026).

Job characteristics are shaped by network structures with different business activities across construction, manufacturing, O&M, and circular service flows occupying highly distinct positions in relation to employment duration and labour intensity. As mapped in Figure 7, considering the two dimensions of permanent versus project based work and low versus high job creation activities, four quadrants emerge to illustrate employment structures that vary fundamentally in their capacity to generate high quality jobs. While advanced technology maintenance segments build durable employment trajectories, low-complexity deployment and collection niches frequently trap local communities in a short-term, project-based 'boom-and-bust' loop.

Figure 7: Jobs in construction, service, and circular flows

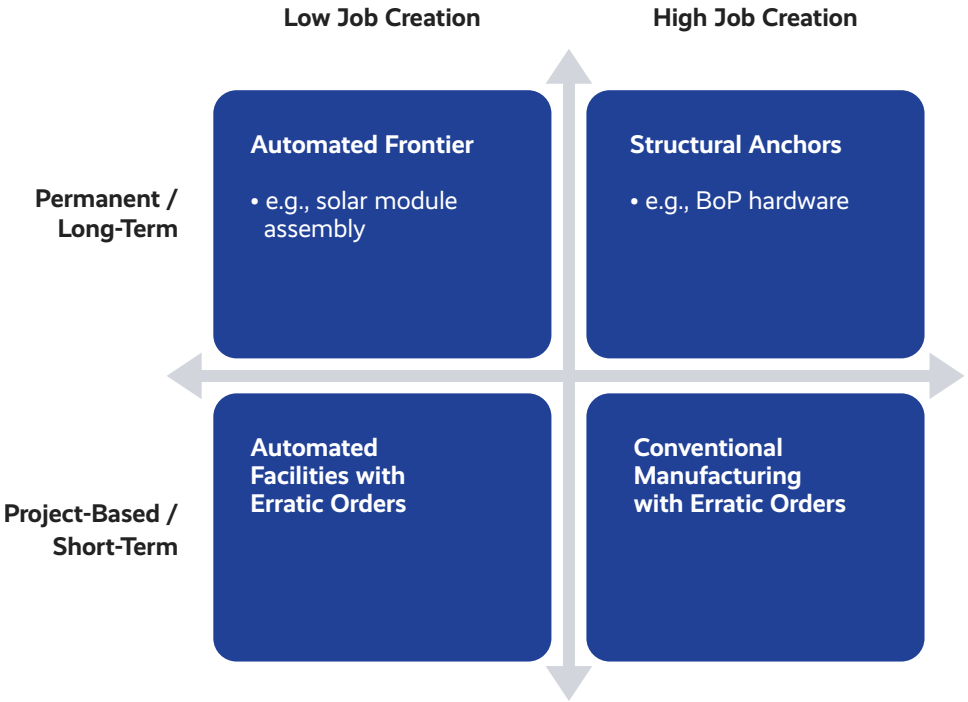


Source: Author's creation

[10] Furthermore, the mandated community development projects were implemented in a top-down, fragmented manner influenced by local patronage politics, failing to achieve holistic sustainable development for the municipality.

Considering the manufacturing industry, job quality can also vary along the same dimensions with consistent demand and technology choices being critical factors in providing long-term jobs (see Figure 8). For example, manufacturing processes that are highly automated may employ relatively few workers, while the production of some structural components and BoP equipment can be more labour intensive (Sapvia 2024). When local manufacturers receive consistent orders and adopt labour-intensive component practices, they possess the commercial security to transition from temporary, project-based contracts to highly stable, permanent manufacturing roles. Conversely, when exposed to 'stop-start' ordering cycles or highly automated frontiers, firms are pushed towards low-volume or short-term hiring patterns to absorb global market shocks. In the wind sector, for instance, the domestic fabrication of concrete towers represents a labour-intensive structural anchor capable of generating significant permanent employment (Rivett-Carnac 2022b). Conversely, the domestic assembly of technologically complex solar PV modules and LIB packs remains highly constrained by these market interruptions, frequently forcing local factories into project-based, short-term hiring cycles to survive procurement gaps (Hermanus and Kamanzi 2026 ; Krinsky 2026; Musonda *Unpublished*).

Figure 8: Jobs in manufacturing



Source: Author's creation

However, the expanding scale of aggregate employment numbers does not guarantee inclusive or equitable distribution. Job access is connected to demographic characteristics, location, and skill sets. Construction and other entry-level activities can provide employment opportunities for workers living near project sites, while more specialised technical and managerial positions require higher levels of technical knowledge and experience (Hill et al. 2025; Tamasiga 2025; NBI 2024; Davidson et al. 2025).

Compliance data from the centralised public procurement track frequently camouflages widespread precarity underneath aggregate demographic figures. As can be seen in Table 2, IPPs involved in

public tenders reported exceeding their employment targets across a range of categories, covering citizens, Black citizens, skilled Black citizens, and citizens from local communities. However, many of these are likely to be short-term jobs. The duration and quality of this employment should therefore be considered alongside the reported number of jobs, as headcounts fail to reflect secure, long-term employment status. Sectoral employment of women is discussed further in Section 5.

Table 2: Employment in REI4P power plants based on information submitted by IPPs

Criteria	Obligation	Achieved	As a % of Employees who are Citizens
Employees who are Citizens	1,639	1,869	--
Employees who are Black Citizens	1,175	1,757	94%
Employees who are Skilled Black Citizens	523	996	53%
Employees that are Citizens from Local Communities	757	1,402	75%

Source: Gxasheka et al. 2026

While jobs exist at multiple skill levels in RE production networks, the supply and demand of labour remain misaligned across different skill categories, with many lower-skilled workers seeking access to a limited number of jobs and too few higher-skilled workers being available to meet demand. Reflecting this operational disparity, firms in the IEJ survey reported employing a wide spectrum of educational profiles — ranging from workers without a secondary school certificate to professionals with post-graduate degrees. Davidson et al. (2025) found that there are overlapping skill needs across battery storage and RE component recycling; solar installation; repair and maintenance; and battery assembly. Because many RE firms operate across multiple industrial sectors, building broad, adaptable capabilities may be more beneficial than narrow, specialised tracks, enabling workers to navigate an inherently fragmented RE labour market.

The persistent domestic deficit in specialised engineering and technical talent creates a bottleneck that restricts local factory expansions, drives recruitment competition, and compromises technology transfer. Reflecting this constraint, some firms and industry participants report difficulties in accessing workers with specialised technical skills and experience. These challenges can constrain firms' ability to expand production and undertake more technologically sophisticated activities while interacting with other productive-capability constraints, including access to testing and certification facilities and the ability to retain specialised technical staff (I28 Battery Industry Manager; Sapvia 2024). Firms in the IEJ survey reported struggling to find workers with adequate skills and experience for junior/production roles as well as for senior/management positions. Four firms also indicated that skills were a challenge hindering the development and growth of local solar and wind component and battery manufacturing, with one indicating that a shortage of workers was one of their top challenges and three indicating that the lack of relevant human skills and capacities was one of their main fears

and risks of participating in the sector. However, two firms reported not facing struggles to find employees. This scarcity of technical talent means that properly trained individuals encounter local demand. Further, Davidson et al. (2025) report that people trained with needed skills are getting jobs immediately, sometimes receiving job offers before completing their qualifications. This finding should be interpreted as evidence of strong demand for some skills rather than as evidence that all RE graduates face immediate employment.

To address these human-resource shortages and protect their operational capacity, local manufacturers implement in-house upskilling models and actively push Technical and Vocational Education and Training (TVET) colleges for coordinated green-curriculum expansion. Eight of the manufacturing firms in IEJ's survey reported providing training to workers, with four having official training programmes and three providing training as needed. Six firms indicated that they have engaged in financial investments related to reskilling and upskilling their workers in the last three years and four companies said they have invested in training their workforce to improve their market position. TVETs have also reported being asked by employers to provide RE-related training (Davidson et al. 2025).

4.1.2 Job quality

RE manufacturing employers are subject to intense cost-cutting pressures and sporatic demand often with short timelines that manifest as precarious, short-term casual contracts paired with extreme operational work intensities. One worker on a short-term contract described:

> *"It's a three-month contract ... They want this job to be done now. Don't even let us rest."*
> (I09 Solar Industry Worker)

Furthermore, many of these jobs do not have benefits, while workers lack access to protections such as medical aid and health care (I23 Cross-Sectoral Expert).

The compensation metrics of the domestic RE sector generate a severe disconnect between initial worker satisfaction and the actual baseline costs of independent living. Field observations reveal a paradox: when asked directly, entry-level workers state that they are happy with or satisfied with their salaries. However, a diagnostic audit of these workers' monthly budgets reveals that their remuneration is fundamentally inadequate to cover basic independent living requirements. This superficial satisfaction is explicitly conditioned by the background of severe, prolonged unemployment endured by these individuals prior to securing their jobs, causing them to accept sub-living wages out of economic survival. This wage deficit also limits workers' social mobility because their earnings cannot cover independent subsistence, leaving adult workers frequently forced to remain within multi-generational, female-headed households as discussed in Section 5.

The domestic RE sector faces a severe regulatory enforcement deficit that manifests as direct non-compliance with national labour standards, acute physical hazards, and the systemic concealment of statutory employment records. While the expansion of these smaller-scale and decentralised RE markets creates rapid employment opportunities, these alternative pathways frequently undermine

traditional worker protection and access to social benefits (Tamasiga 2025; Tarazona et al. 2026). Reflecting these challenges, workers described enduring long hours and strenuous work. Workers and a trade union representative also noted that workers sometimes do not receive benefits or contributions that they believed should have been provided, such as Unemployment Insurance Fund (UIF) and retirement allocations. Compounding this legal vulnerability, companies routinely fail to provide workers with physical copies of their employment contracts or basic formal records, leaving them with no transparent proof of their employment terms. These challenges are faced in a context with minimal involvement of trade unions or active shop-floor representation, stripping transient workers of any collective bargaining power to contest these conditions. In addition, in cases where workers face risks of accidents, they feel they do not have adequate training or equipment. This is a particular issue in the rooftop solar industry, where workers must absorb acute occupational safety risks without baseline legal protections.

The precarity of these RE roles is worsened by commuting requirements that drain workers' limited disposable income. Because RE installations are frequently located far from working-class residential hubs, labourers must absorb exorbitant daily transport costs just to travel to and from work sites, often having to travel on dangerous routes. This transit burden is compounded by an unappealing alternative of high costs of living and poor infrastructure characterising temporary worker housing or surrounding settlements.

4.2 Trajectories of work in the renewable energy sector

Sustained, higher-skilled employment trajectories within South Africa's RE sector are fundamentally contingent upon firms developing deep productive capabilities, accelerating localised supply chain sourcing, and synchronising training frameworks with emerging RE production needs. However, the benefits of these developments are not automatic. Employment outcomes ultimately depend on whether firms can scale up operations, whether procurement demand is sufficiently stable to support longer-term job retention, and whether workers can access opportunities to develop relevant skills.

The expansion of industry-academic interfaces and cross-border commercial alliances serves as a primary vector for localised workforce capability building and technology transfer (Davidson et al. 2025). Firms are partnering with public TVET colleges and other training institutions, while some are also developing relationships with universities and research organisations. These connections contribute to the development of future sources of skilled workers and to knowledge exchange between firms and training institutions (Davidson et al. 2025). As one respondent in the battery industry explained, his company has sought to build an ecosystem bringing together universities in South Africa and China and other businesses. This initiative involved conducting a pilot trial of new technology and creating a pipeline for South African students to get jobs (I20 Battery Industry Manager). Additionally, firms are engaging in foreign partnerships that foster workforce skill development, with workers noting that Chinese collaborators provide essential training on how to use machines (I06 Solar Industry Worker).

At the same time, employment trajectories remain vulnerable to changes in industrial and procurement policy. Where domestic manufacturing is weakened by inconsistent demand, changes in localisation

requirements, or competition from imported products, employment and opportunities for workforce upgrading may also be affected (Hermanus and Kamanzi 2026). For instance, one firm expressed challenges with implementing desired improvements to contract conditions because of an inconsistent flow of work:

> *"We want to go into the renewable transition, employ people, give them longevity in terms of secure — instead of giving them six-month contracts, we want to give them three-year contracts or five-year contracts and say, 'hey, our capacity is booked for the next five years. Your job security for the next five years.'"* (I11 Solar Industry Manager)

This procurement volatility directly reinforces entrenched low-wage traps, creating a secondary challenge where the jobs being created are of highly uneven quality. Because local factories cannot risk escalating permanent, fixed labour overheads in the face of 'stop-start' public tendering rounds, the developmental promise of high-quality manufacturing employment remains unrealised.

Ultimately, these combined labour blockages reinforce the broader argument of this paper that RE deployment does not automatically produce sustained domestic employment. Lasting employment outcomes and the stabilisation of decent work remain heavily dependent on the structural organisation of markets, the depth of localised production networks, and the capacity of industrial policy to secure continuous demand for domestic firms.

4.3 How localisation pathways can shape future employment

The evidence presented throughout this section demonstrates that the specific strategic pathway through which localisation is executed directly dictates the structural viability of providing decent work in South Africa's RE production industry. It highlights that industrial success must be assessed not merely by aggregate, short-term job counts, but by the depth of activities anchored domestically, the stability of demand pipelines needed to sustain permanent contracts, and the equitability of access to training and upward technical mobility. Crucially, these pathway dynamics heavily influence long-term job quality across the workforce. Localisation based on expanding manufacturing can help to ensure that firms can offer durable, long-term employment trajectories. However, the ultimate quality of jobs depends on paired regulatory measures and establishing a strong union presence to protect workers against contract precarity, suppressed base wages, unmitigated physical hazards, and the evasion of mandatory social benefits.

Manufacturing, O&M, construction, installation, and related services can generate different forms of employment, with different levels of stability, skill requirements, and opportunities for progression. Policies that promote localisation need to be explicitly connected to measures that support stable markets and productive upgrading while also strengthening worker protection, skills development, and equitable access to employment. Without this targeted alignment, decentralised market expansions

will continue to degrade job quality by trapping workers in highly fragmented, unregulated employment relationships that force households to absorb long-term occupational risks without basic legal or financial security.

The following sections examine these issues further. Section 5 considers gender dynamics within RE production networks. Sections 6 and 7 then examine how contextual factors and different actors shape localisation, decent work, and gender outcomes, providing the basis for Section 8's identification of the challenges, opportunities, and policy interventions required to achieve more inclusive and sustainable localisation.

5. GENDER

Gender equity operates as a core structural axis of the localisation process, dictating whether RE manufacturing systems dismantle or actively reproduce historical socio-economic inequalities. Consequently, gender is central to assessing the developmental effects of localisation. Expanding domestic participation in RE production networks does not automatically produce more equitable outcomes. The distribution of employment, skills, ownership, income, and decision-making power, alongside patriarchal social norms, shape who benefits from localisation and whether new production systems reproduce or transform existing inequalities. Crucially, as this section demonstrates, these structural disparities are reinforced on the shop floor by entrenched occupational stereotypes and gendered beliefs regarding technical capability. These cultural norms and internal expectations create powerful, invisible barriers that actively shape recruitment practices, training access, and job allocation within local factories.

The physical execution of industrial localisation is deeply bounded by spatial constraints and unpaid household labour systems that shape women's entry into the workforce. Crucially, their disproportionate caregiving burdens impose mobility restrictions making local, community-based employment far more practically accessible than positions requiring long-distance commutes. Moreover, as this section demonstrates, the financial viability of localised assembly often relies directly on an uncompensated care infrastructure within household units, where unpaid social reproduction work subsidises the formal labour market. Crucially, these gender relations within households and factories interact dynamically. While entrenched societal expectations frequently carry occupational stereotypes onto the production floor, entry into formal RE value chains simultaneously introduces a powerful institutional mechanism to challenge traditional generational norms regarding women's work. Securing equitable recruitment practices that are accessible to women can help support incremental shifts towards domestic equality.

To unpack these dynamics, this section first examines gender within RE workplaces. The following sub-section assesses wider social and household structures that shape workers' ability to participate in, and benefit from, the sector. Finally, the concluding sub-section analyses how localised industrial development pathways can generate contradictory gender effects by expanding formal employment while simultaneously locking households into deep generational dependencies.

5.1 Gender at work

Gender employment statistics across South Africa's RE landscape reveal that women remain underrepresented and are unevenly represented across occupations, technical roles, and senior positions (DEE et al. 2025; Sapvia 2024; Krinsky 2026; Musonda 2026). Empirical data indicates that while women comprise 33% of the overall wind and solar workforce in South Africa, they occupy only 19% of director positions, leaving senior executive positions predominantly occupied by men (Sawea and Sapvia 2025a). This disparity is even more acute in some parts of the sector. Under public

procurement (REI4P) frameworks, the mandatory hiring target for women in IPP projects is set at 5% (Sapvia 2024). Furthermore, out of a cumulative public procurement spend of R99 billion, only R4 billion has been channelled to women-owned enterprises (Sapvia 2024). Furthermore, only 7% of vendor spend has gone to women-owned enterprises (IPP Office 2026). In addition, women are found in higher concentrations in lower-skilled positions with limited decision-making autonomy and in temporary roles, while also experiencing a gender pay gap (GIZ 2023; Sawea and Sapvia 2025a).

Interviewees and industry assessments highlight persistent barriers to women's entry, participation, and career progression in technical, factory, and operational environments (DEE et al. 2025; Sapvia 2024). On the factory floor of large component manufacturers, women occupy few positions. For example, a South African tower manufacturer reported that, out of 156 permanent positions, only 11 were filled by women (Rivett-Carnac 2022b). In IEJ's firm survey, all nine surveyed companies reported having women employees but with overall employment again weighted towards men. Three companies indicated that more than half of their workforce was made up of women workers, while four companies indicated that less than half of their workforce was made up of women workers.[11] Five companies reported having a gender policy, while one indicated that they were in the process of developing a gender policy and one indicated that they do not have a gender policy.

These findings indicate substantial variation across firms. They also suggest that aggregate industry statistics may conceal important differences between manufacturing activities, firms, and occupational categories.

Interviewees shared a variety of perspectives on the employment of women. Some offered a positive take, for instance:

> *"Maybe not necessarily 50-50, but I would say that in every job that we have [here], there are women employed as well. So, we have women that are employed in the factory, that are assembling the batteries. There are women engineers. There are women in our support teams."* (I26 Battery Industry Manager)

However, many elements of the industry were described as having gendered roles, which can lead to a lack of equitable opportunities. On the production floor, the allocation of tasks is sometimes reported in gendered terms, with physical strength associated with men and precision or care associated with women (I01 Solar Industry Worker). This division of labour separates everyday factory tasks along gender lines, with female workers noting that certain engineering nodes, such as high-voltage terminator welding, are treated as too complicated or physically taxing for women to survive long-term (I07 Solar Industry Worker). These patterns are connected to gender stereotypes, which were expressed by both men and women. For example, when a woman was asked about her ability to do a job that a man was currently doing, she said, "I can't weld the type of work he does" (I07 Solar Industry Worker). When asked why, she responded:

[11] While these three outlying firms exceed the 33% national sector baseline (Sawea and Sapvia 2025a), these survey responses reflect a localised sample and are not directly representative of the broader South African renewable energy industry.

"It is very complicated. It's so difficult that I don't think there is a woman who can work in that department. She may try, but I don't think she would last long there." (I07 Solar Industry Worker)

These accounts suggest that gender inequality is shaped not only by formal barriers to employment, but also by occupational norms and beliefs about which types of work are appropriate for women and men. Such norms can influence recruitment, training, job allocation, and workers' own expectations about their opportunities. Addressing gender inequality in localisation therefore requires attention to both formal employment practices and the social processes through which occupational roles become gendered.

5.2 Gender and societal expectations

Gender inequalities within RE production networks are also connected to wider systems of social reproduction[12] and household organisation. The economic viability of South Africa's downstream factory labour relies heavily on a hidden domestic subsidy provided by female relatives who absorb the uncompensated burden of social reproduction. Workers' ability to participate in employment is shaped by access to housing, care, food, social grants, and other forms of household support, which are often organised through gendered divisions of labour (DEE et al. 2025; Hermanus and Kamanzi 2026; Krinsky 2026). Where wages and employment are insufficient to support household needs, workers often rely on family networks, shared household resources, and social grants.

Anthropological field evidence reveals that this household survival mechanism is explicitly generational and gendered, particularly for young factory workers who remain dependent on extended family structures. Inside these domestic spaces, the daily reproduction of labour — ensuring that a worker is fed, clothed, rested, and physically prepared to return to the assembly line each morning — is systematically sustained by mothers, aunts, and grandmothers who do not participate in the formal workforce. This arrangement creates a structural challenge where the low wages paid by component assemblers are indirectly cushioned by the unpaid care work provided by women, directly shaping how the economic benefits of localisation are fragmented at the household level.

This relationship between employment and household survival is reflected in the following account from a worker receiving a low wage:

"I'm happy with it. Yeah. Whatever you're going to give me, I'm happy with it ... they've hired ... all these [people] who wasn't working. So, they're all happy they've got something to do and they're earning something at the end of the month." (I09 Solar Industry Worker)

[12] Social reproduction "includes care of children, the elderly, and the infirm as well as all the activities of housework, and it is integral to the functioning of the monetized economy" (Posel 2025, 1593).

However, multiple workers expressed living with family members who provided support, which meant that they did not have to rely on their salary to cover all living expenses. This dynamic and its reliance on extended family care structures are illustrated by the following interchange:

> Q: Okay, do you contribute to the household now?
> R: Yes.
> Q: Before you were employed, how were you managing?
> R: Obviously, I wasn't contributing.
> [...]
> R: I live with my aunt and my siblings. . . We are seven. . . Some are children though — two are still small. We're actually five.
> Q: Who is the breadwinner?
> R: It's my younger aunt.
> Q: Okay, okay. She's the one who provides most things?
> R: Yes. (I01 Solar Industry Worker)

This dialogue underscores how low-wage entry-level positions fail to provide individual financial independence, forcing young workers to cohabit within large, multi-generational households where the primary survival and care burdens fall on female relatives. By relying on an aunt to absorb the multi-layered financial and care responsibilities for a seven-person household, the worker's presence on the factory floor is made possible only through an unequal domestic distribution of labour that stabilises the household unit from the top down.

Beyond the immediate financial cushion provided by these kinship networks, the structural instability of the manufacturing market locks workers within these multi-generational spaces, preventing upward social mobility or household independence. The same worker also explicitly details how contract precarity directly halts long-term life planning:

> Q: Do you have aspirations — just asking — to move out and live somewhere else, away from home?
> R: Yes.
> [. . .]
> Q: What has stopped you from moving out?
> R: Like I explained earlier, brother, this job — I'm not permanent here. So, I can't take those steps because anything can happen at any time. At least if I become permanent, then I'd be able to do that. (I01 Solar Industry Worker)

This exchange highlights that the lack of employment permanence acts as an invisible barrier to personal autonomy. In a context defined by transient contracts, workers cannot de-link their livelihoods from extended household structures, illustrating how macro-level industry volatility directly deepens dependency on household support, with women often bearing these support roles.

A further issue is that women's self-perceptions and household responsibilities can create challenges with accessing RE jobs. One barrier is that they may be reluctant to pursue training in technical fields (Hill et al. 2025). Additionally, they may not take jobs that require long commutes and long hours. Furthermore, they may not take advantage of family-friendly policies that are available for fear it might impact their career trajectories (GIZ 2023).

At the same time, employment in RE production can create opportunities to challenge established expectations regarding women's work (DEE et al. 2025; Hermanus and Kamanzi 2026). Working-class families increasingly look to RE value chains as a legitimate vehicle for equal opportunity, encouraging their daughters to break out of traditional, low-paying municipal sweeping or domestic services and enter the formal industrial economy. Some interview respondents highlight such changing gender expectations, for instance:

> *"These days, there's no job that a woman can't do. You'll even see them out on the road working with shovels and pickaxes. That old belief that women can't do certain jobs doesn't exist anymore."* (I05 Solar Facility Community Member)

However, the extent to which employment translates into greater economic autonomy or changes in household decision-making will depend on the quality, stability, and remuneration of the jobs created.

5.3 Gender and localisation

Taken together, these findings suggest that localisation can have contradictory gender effects. It may expand women's access to formal employment and new technical occupations, while simultaneously reproducing gendered occupational divisions and relying on wider systems of unpaid and underpaid social reproduction. Crucially, the interview data demonstrates that the viability of localised assembly relies directly on the uncompensated care infrastructure of household units, where female relatives—such as mothers, aunts, and grandmothers—absorb the daily burdens of social reproduction. This hidden domestic subsidy means that while entry-level industrial roles provide formal wages to individual workers, they do not deliver complete economic autonomy, instead locking transient labourers into extended generational dependencies sustained by women who are themselves often excluded from formal employment.

This reinforces the report's broader argument that increasing domestic production does not automatically produce inclusive developmental outcomes. Localisation may create new employment and business opportunities, but the distribution of these opportunities is shaped by institutional arrangements, workplace practices, skills systems, procurement structures, and wider social norms. Gender equity must therefore be considered as part of the structure of localisation rather than as a separate social outcome. Policies that seek to expand domestic participation in RE production networks therefore need to incorporate gender equity, including through skills development, procurement, workplace standards, support for women-owned firms, and measures that address gendered barriers to

participation. The following two sections examine the factors and actors that shape localisation outcomes, after which Section 8 identifies key challenges and opportunities and considers how public sector interventions could support forms of localisation that generate greater domestic value, decent work, and more equitable participation.

6. KEY FACTORS SUPPORTING OR PREVENTING LOCALISATION, DECENT WORK AND GENDER EQUITY

This section pulls together the critical factors that support or constrain the localisation of manufacturing in solar, wind, and battery production networks to evaluate how this external ecosystem directly influences opportunities for productive upgrading, decent work, and gender equity. The central argument is that localisation outcomes cannot be understood only by examining individual firms and their relationships. Firms operate within wider market, institutional, technological, and social conditions that shape their ability to enter production networks, upgrade, create employment, and distribute the benefits of industrial development.[13]

To systematically unpack these external conditions, the discussion evaluates current socio-economic baseline conditions, before providing an assessment of how domestic infrastructure facilitates the expansion of a local RE production industry. This is followed by a consideration of the availability of domestic inputs, including finance, skills, materials, technology, and support services. The section then details how demand shapes opportunities for local firms and goes on to consider how the competitive environment, particularly the existence of low-cost global competition, plays a key role in shaping firms' options. Finally, the section concludes by evaluating the overarching impact of local context, mapping how these combined environmental factors set the qualitative limits for local value creation and capture, decent work, and gender transformation.

Box 3: Location decisions

Respondents in IEJ's survey expressed a variety of motivations for selecting where to locate their businesses. Among the factors identified were proximity to suppliers (two firms), customers (three firms), an available workforce (two firms), transportation and logistics (three firms), and lower operating costs (one firm), with one firm referring specifically to being "close to mills". Firms also expressed relatively high levels of commitment to their locations over the next five years. Six indicated that they were very or fairly committed, with one saying they were not very committed and expressing uncertainty. These findings suggest that location decisions are influenced by a combination of market proximity, access to inputs, infrastructure, and labour, rather than by a single factor.

[13] Box 3 provides insights into how firms see their location decisions.

6.1 Socio-economic conditions

Entrenched socio-economic crises involving widespread poverty and systemic unemployment shape the landscape where South African RE firms operate, acting as a double-edged sword that inflates community dependency while weakening workers' long-term bargaining power. Firms are embedded in a context characterised by high levels of inequality, unemployment, and uneven access to economic opportunities. Notably, in some rural areas where large-scale solar and wind projects are located, households face high levels of economic vulnerability and dependence on social grants (Hermanus and Kamanzi 2026; Krinsky 2026; Musonda 2026; Musonda *Unpublished*).

Severe domestic unemployment creates an acute oversupply of unabsorbed labour that fundamentally increases workers' vulnerability to precarious, low-paid employment. Businesses operate in an environment with high levels of demand for employment opportunities, which compresses local wage expectations. Reflecting this structural squeeze, one interviewee openly stated that he is willing to accept any wage because he is simply grateful for an income (I09 Solar Industry Worker). The extreme scale of this labour surplus is visible during recruitment phases. One firm noted that during a basic screening day intended to assess potential workers' eligibility:

> *"there were 6,000 people sitting outside our facility looking for work, which was really, really sad ... and we could only employ about two to three hundred people at the time ... which was only a short-term contract as well."* (I11 Solar Industry Manager)

This large pool of unabsorbed local labour creates profound operational tension for RE firms, which simultaneously face heavy policy and social pressures—including formal public procurement scorecards—to actively incorporate marginalised demographic groups (Sapvia 2024). To manage this pressure, some businesses choose to maintain labour-intensive production processes where employment creation forms an explicit part of their developmental objectives. The same local manager explained that the company purposefully did not pursue advanced automation in order to preserve local jobs.

Socio-economic conditions can therefore influence both the availability of labour and the developmental expectations placed on firms. This creates an important connection between localisation and decent work. Expanding domestic production may generate employment, but the quality, stability, and distribution of that employment remain shaped by the wider labour market and social context.

Beyond these macroeconomic labour dynamics, this challenging environment is further strained by a secondary crisis of infrastructure vulnerability and localised resource theft. Widespread property crime, theft of copper from infrastructure[14], and other economic sabotage function as a regressive operational tax on domestic manufacturers, inflating baseline logistics overheads and disrupting factory-floor continuity. Illustrating this extreme occupational hazard, one manufacturer recounted

[14] In the context of such challenges, the government has considered strict raw material export bans to protect localised component production (Rivett-Carnac 2022b; Sapvia 2024)

that his “copper guy” was attacked and stabbed and ended up in the hospital for a few months (I40 Substation Industry Manager).

Furthermore, pervasive spatial insecurity and the threat of personal violence severely restrict basic worker mobility, particularly for shift-based personnel. Reflecting these systemic hazards, one worker noted that: "Once the sun sets, I can’t walk anymore because there are thugs everywhere around here” (I08 Solar Industry Worker). This problem is exacerbated by long commutes, which are often dangerous.

As shown above, deep-seated gender stereotypes and institutionalised sexism funnel women into low-paying auxiliary roles (GIZ 2023; DEE et al. 2025; Sawea and Sapvia 2025a; Hermanus and Kamanzi 2026). Furthermore, on the production floor, target firms frequently structure assembly tasks around traditional gender biases, assuming that men possess the ‘rough hands’ suited for heavy warehouse lifting, while women possess the ‘careful, delicate hands’ required to handle precise subcomponents like solar cells (I01 Solar Industry Worker).

Women persistently face barriers to entering technical occupations and advancing into higher-paid or managerial roles (DEE et al. 2025; Sapvia 2024; Hermanus and Kamanzi 2026). South Africa's historically racialised and gendered socio-economic inequalities also shape who can access employment, business opportunities, and the benefits associated with RE localisation (Hermanus and Kamanzi 2026). Key challenges include that women have higher unemployment rates than men and women provide on average more than twice the time of men in carrying out household and family care work, notably making up 97% of the caregivers qualifying for the Child Support Grant (Sapvia 2024). These household dynamics may also help to sustain workers whose wages are insufficient to meet the full costs of social reproduction, with unpaid and underpaid care work often absorbing some of these costs. Moreover, these socio-economic disparities are also racialised with 57% of Black women experiencing poverty (Sapvia 2024).

These socio-economic conditions therefore influence localisation outcomes in several ways. They shape firms' access to labour and workers' bargaining power, while creating an environment for RE businesses that involves acute community pressures and spatial security risks. Because these deeply entrenched social dynamics define the baseline environment for local producers, they directly dictate how domestic manufacturers respond to regulatory rules, procurement constraints, and market demand conditions.

6.2 Infrastructure

Infrastructure shapes the costs, reliability, and feasibility of RE manufacturing and related production activities, with South Africa’s uneven and unreliable infrastructure serving as a crucial bottleneck. At the foundational level, the expansion of the RE value chain is constrained by electricity and grid constraints that affect both RE deployment and industrial development (Sawea 2025; Hermanus and Kamanzi 2026). A respondent said that South Africa’s electricity supply needs to be expanded before it can transition (I23 Cross-Sectoral Expert). This illustrates a broader infrastructure challenge where the expansion of RE production networks depends not only on manufacturing capacity but also on

the transmission, distribution, and electricity infrastructure required to connect new generation and support industrial activity.

One area where this has been a challenge is the port system, where severe inefficiencies and maritime bottlenecks across the country's port terminals function as a major regressive barrier, inflating shipping overheads and disrupting component production schedules (Sapvia 2024). Exposing these maritime logjams, one wind industry executive noted that the Cape Town Harbour ranks as the most inefficient port facility in the world, sitting at the very bottom of global operational lists (I19 Wind Industry Manager). These persistent shipping delays force local companies to hold expensive backup inventory, which directly undercuts their financial ability to compete with cheap foreign imports.

Infrastructure thus affects localisation in two interconnected ways. First, electricity and grid infrastructure shapes the growth of RE demand and the ability to connect new projects. Second, transport and logistics infrastructure shapes the cost and reliability of moving inputs and finished products through production networks. These conditions can influence whether domestic manufacturing provides a competitive alternative to imported components.

6.3 Availability of inputs

The capacity of South African manufacturers to scale up RE technology production is heavily constrained by an uneven domestic resource ecosystem, where acute deficits in finance, specialised skills, processed materials, and testing infrastructure form interlocking barriers to industrial upgrading. While the country possesses robust primary mineral reserves and basic engineering foundations, the missing midstream links within this supply framework leave local firms highly vulnerable to global trade shocks and predatory import competition. Consequently, assessing localisation requires analysing how the domestic availability — or scarcity — of these critical operational inputs shapes the day-to-day competitiveness and survival of local RE enterprises.

6.3.1 Finance

Access to capital shapes the operational survival and scale of domestic RE manufacturers, with prohibitive funding barriers and high interest rates advancing as primary obstacles to local industrial expansion. Interviewees highlighted that South Africa has financial institutions and potential sources of capital which are available to provide funding (I31 Trade Union Representative; I36 Government; I27 Solar Industry Manager). However, manufacturers face difficulties accessing such finance financial opportunities because of perceived sectoral risks, uncertain demand, and the financial requirements associated with manufacturing investment. Noting that a recent stabilisation of the electricity grid has softened solar demand, an interviewee pointed out that:

> *"If the drive was sufficient, you will see everybody taking advantage of [investments in solar energy]. But that's not the case because even though there are those who are willing to finance, it's still questionable."* (I30 Cross-Sectoral Expert)

These stringent capital constraints create barriers for SMEs and new entrants, frequently leaving firms with "limited funds to finance their business" (I30 Cross-Sectoral Expert). Financial challenges were also highlighted in IEJ's firm survey (see Box 4). Commercial banks routinely view localised RE manufacturing as a high-risk venture, enforcing prohibitive balance-sheet and collateral requirements that systematically starve localised component assemblers of the upfront funding needed to clear mandatory performance bonds (Krinsky 2026; Musonda *Unpublished*).

Box 4: Financial challenges expressed in firm survey

- Finance and firm growth: 3 respondents reported that finance hinders the development and growth of local manufacturing; 2 identified difficulty accessing finance is one of their three biggest challenges to growing their firms.
- Finance as a sector risk: 1 respondent identified lack of finance as a main fear or risk of participating in the sector, compared with 6 respondents who identified lack of government subsidies.
- SME participation: 3 respondents identified lack of finance and access to loans as a factor hindering SME participation, while 2 identified lack of subsidies and cheap loans.

6.3.2 Skills

A severe deficit of specialised technical skills and the absence of coordinated industrial training frameworks fundamentally constrain the long-term growth and capabilities of South African RE manufacturing (CES 2022; DEE et al. 2025). While initial enrolments in technical qualifications are high, completion rates are low, standing at only 19% for universities and 29% for TVET colleges (DEE et al. 2025). This misalignment yields a low-volume graduate pool that fails to meet industry standards, leaving firms facing severe shortages in sought-after roles like high-voltage electricians, advanced welders, and specialised inverter technicians (DEE et al. 2025). This deficit becomes especially acute when project developers attempt to fulfil localised procurement mandates within isolated, host-community jurisdictions. As one industry executive detailed:

> *"There's a lot of challenges within these communities to get skilled people. Even now, in one of the areas where we are building a wind farm, it's a requirement that we should employ, I think, around two people, two technicians from the area of which you'll find that it's next to impossible to get those people."* (I39 Wind Industry Manager)

This acute geographical mismatch demonstrates that formal localised employment targets frequently collide with the reality of an under-resourced local talent pool. In advanced niches, this talent deficit

is compounded by brain drain (Litheko and Pelser 2024; Lechman 2026). Reflecting this phenomenon, one respondent described how industry instability is driving experienced people out of the country (I27 Solar Industry Manager).

6.3.3 Materials

The commercial viability of South African manufacturing is severely eroded by the uncompetitive domestic pricing of foundational raw materials and limited midstream processing capabilities (CES 2022; Sapvia 2024). In IEJ's firm survey, one firm selected raw material high cost or scarcity as a top challenge. Crucially, because local steel and aluminium mills apply global import-parity pricing, the domestic abundance of base metals fails to translate into cost advantages for local wind and solar manufacturers, completely erasing their geographical proximity advantage (Rivett-Carnac 2022b; Sapvia 2024). This pricing disadvantage is particularly damaging for local wind tower fabricators who require immense volumes of heavy-gauge industrial steel but are forced to buy local inputs at premium global import prices (Musonda 2026). Furthermore, a domestic capacity gap for advanced subcomponents — like solar cells and circuit boards — tethers firms to expensive, long-lead import supply chains (CES 2022; DEE et al. 2025). In advanced energy storage, limited domestic beneficiation and processing capabilities constrain the development of integrated battery production networks (CES 2022). Consequently, LIB developers must import critical component parts and primary cells from dominant East Asian logistics hubs, eroding the domestic value-capture potential of local assembly operations (Musonda *Unpublished*).

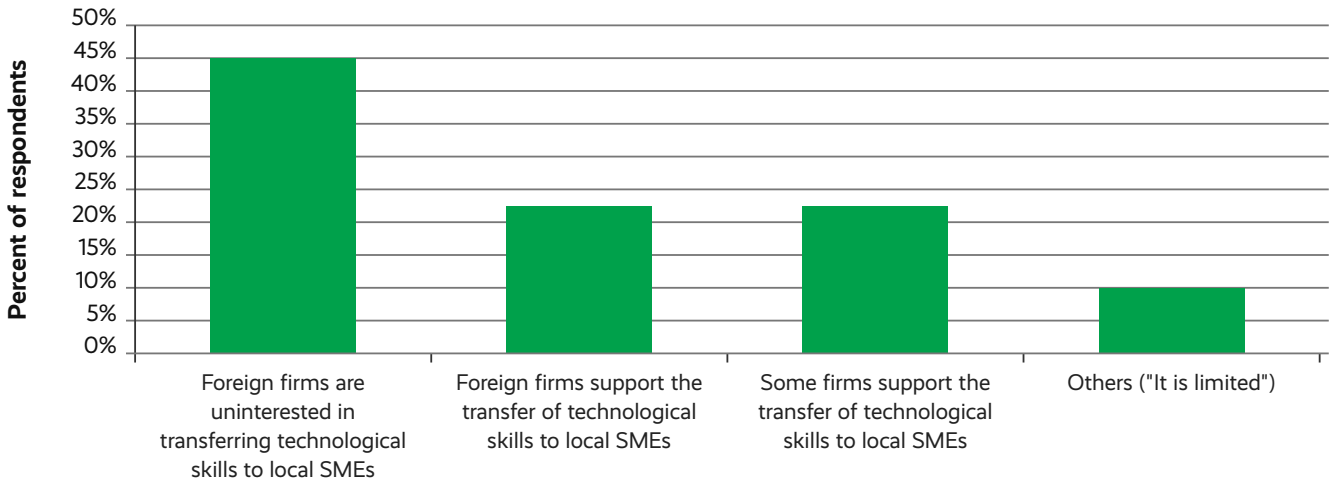
6.3.4 Technology and technological capabilities

The hyper-concentration of core intellectual property and technology within dominant global firms often results in South African firms finding opportunities in downstream assembly, limiting deep entry into high-value manufacturing nodes (CES 2022; DEE et al. 2025). The absence of domestic production capabilities in some technologically complex segments also limits opportunities for firms to participate in higher-value stages of RE production networks (CES 2022; DEE et al. 2025). Across RE industries, South Africa lacks commercial manufacturing capacity in some important upstream and technologically complex components, including solar cells and advanced LIB cells (CES 2022; Crozier et al. 2025; DEE et al. 2025). This systemic capability gap is directly reinforced by a low level of technology transfer from dominant multinational corporations, leaving domestic enterprises locked out of intellectual property and proprietary engineering designs.

For example, in the solar sector, domestic assemblers are completely dependent on imported crystalline silicon cells because the local market lacks the capital-intensive midstream wafer slicing facilities necessary for vertical integration (Krinsky 2026). Similarly, the domestic wind industry remains concentrated in basic tower fabrication, as local engineering firms lack the advanced precision metallurgy and specialised forging capabilities required to manufacture internal turbine components like gearboxes, main bearings, and rotors (Musonda 2026). In the battery storage sector, local firms are restricted to downstream pack assembly and custom enclosure wiring, because a lack of local commercial cell manufacturing forces reliance on importing foreign lithium-ion cells (Moshikaro-Amani 2026; Musonda *Unpublished*). Crucially, even within localised assembly lines and operational plants,

technology transfer is severely bottlenecked by language barriers embedded within specialised hardware architectures. Because complex machine operating systems and technical software manuals are frequently written in foreign languages, local technical staff face severe operational constraints when attempting to master machinery, troubleshoot system errors independently, or transition into expert users. Technology was also described as a challenge hindering development and growth by four firms in the survey. Furthermore, technology transfer from large and foreign firms was described as happening at low levels (see Figure 9). Importantly, interview responses reveal that this technology gap is not merely a passive deficit but also reflects deliberate business strategies. Several domestic firms explicitly stated they have no interest in upgrading to more complex upstream stages, such as cell manufacturing, due to the prohibitive capital requirements, intense global price competition, and restrictive international intellectual property regimes associated with these advanced tiers.

Figure 9: To what extent do large/foreign firms support technological transfer to local SMEs in the manufacturing of solar panels, inverters, towers and batteries



Source: Firm Survey

Compounding these restrictive IP regimes, the translation of domestic academic prototypes into market-ready RE systems faces a commercialisation 'valley of death' driven by a national funding bottleneck that undermines technology absorption and stalls industrial scaling (DEE et al. 2025). This challenge persists because South Africa's total R&D expenditure sits at a restricted 1% of GDP, with less than 3% of that capital dedicated to energy supply (DEE et al. 2025). To bypass this blockage, public policy under SAREM is fast-tracking a new Solar Research Facility alongside the reopened Manufacturing Technology Centre at SAREBI to anchor university prototypes directly into active factory assembly lines before critical engineering talent is lost to global poaching networks (DEE et al. 2025).

However, this technology gap should not be viewed as an insurmountable industrial barrier, as South African manufacturers have successfully built competitive downstream engineering capabilities where local demand pipelines are stable. While firms have thus far been unable to sever their dependence on pre-made components imported from dominant Chinese and European markets, South African firms have developed capabilities in activities such as fabricating heavy steel wind towers, assembling

tracking frames, and coding custom battery management firmware (CES 2022; Sapvia 2024; DEE et al. 2025). Crucially, these localised downstream successes serve as an important incubator for broader industrial entrepreneurship. The advanced engineering competencies and digital capabilities developed within these niches create viable pathways for local firms to execute lateral upgrades, allowing entrepreneurs to leverage their accumulated technical expertise to enter entirely new sectors.

6.3.5 Standards, testing, and support services

The severe underdevelopment of domestic testing, certification, and verification facilities artificially penalises South African RE firms, drastically inflating product development costs and blocking entry into utility-scale deployment queues. While a national framework exists under the Standards Act 8 of 2008, the domestic testing ecosystem cannot match international baselines, forcing local firms to rely on expensive overseas laboratories that severely prolong product development lifecycles (CES 2022; Rivett-Carnac 2022a; Sapvia 2024). This infrastructure gap also hampers BESS firms, blocking exports and letting uncertified foreign imports flood the market (CES 2022). Sapvia (2024) highlights that South African solar and inverter manufacturers struggle to secure projects because local factories use older equipment and lack the testing facilities needed to match the strict international safety, quality, and grid connection standards major buyers demand. This deficit challenges local firms, as commercial banks and offtakers mandate 'Tier 1 certification' to guarantee multi-year component performance warranties before unlocking finance (Sapvia 2024).

These strict international validation mandates ultimately dictate local market access, upgrade velocity, and regional export opportunities. Ultimately, this barrier illustrates that a successful localisation strategy cannot rely solely on imposing local content quotas. Rather, it demands government intervention to build public certification assets, protect infant industries, and de-risk the testing infrastructure needed to anchor sovereign technological upgrading.

6.4 Demand

The rapid expansion of RE across South Africa's centralised and decentralised segments has generated substantial aggregate market demand, yet domestic component and subcomponent manufacturers frequently struggle to convert this growth into localised production opportunities (CES 2022; Sapvia 2024; Sawea 2025). For example, rapid growth in the solar industry was driven by chronic load-shedding and market liberalisation (Krinsky 2026). Sapvia (2024) identifies substantial potential for additional solar PV deployment across market segments through to 2030.

Domestic industrial investment is fundamentally contingent on the scale, predictability, and institutional structure of this demand pipeline, as local firms require sustained production volumes to justify capital commitments. Sapvia (2024), for instance, identifies the importance of achieving sufficient annual demand to support economies of scale in locally produced solar BoP components, mounting structures, trackers, and related products. Crucially, a stable market provides the baseline commercial security necessary for these manufacturing investments, whereas large but highly erratic project pipelines exacerbate factory underutilisation and fail to support long-term localisation. This commercial risk is further stratified by the institutional mix between public procurement, private centralised projects,

and decentralised installations, which creates highly uneven opportunities for local firms based on varying applications and enforcement of LCRs.

The commercial environment through which local component makers experience this expanding demand is heavily mediated by deep-seated institutional hurdles, running from compressed procurement lead times to predatory developer purchasing practices. First, short lead times constrain investment in local manufacturing by forcing compressed project deployment cycles that domestic suppliers cannot realistically meet. Public energy contracts may require projects to be completed within relatively short implementation periods which leaves local factories with insufficient time to secure long-lead raw materials, retool specialised machinery, or scale up assembly capability (CES 2022). This structural compression incentivises developers to rely on established imported supply chains, while simultaneously encouraging the hiring of temporary workers on short-term project contracts rather than stable, permanent positions. Similarly, as shown in Krinsky (2026), IPPs in South Africa have deliberately sought to procure from local suppliers at the last minute, knowing they would be unable to meet these timeframes, and thereby circumvent LCRs.

Second, weak enforcement and structural loopholes in the design of LCRs severely restrict deep domestic participation, capping local engagement at low-value, technologically simple assembly nodes (CES 2022; DEE et al. 2025). This access barrier is directly worsened by a systemic regulatory deficit, as state auditing bodies lack the institutional capacity to physically verify component-level origins or penalise developers who use creative accounting to bypass local factories (IEJ 2026). Because competitive tender scorecards have evaluated compliance by overall financial spend rather than component-specific origin, developers have routinely satisfied their local content mandates through downstream service costs rather than domestic hardware manufacturing.

Third, erratic, 'stop-start', and delayed public procurement pipelines directly erode business confidence and prevent local factories from maintaining stable production lines or justifying long-term capital investments (Montmasson-Clair 2024; DEE et al. 2025; Krinsky 2026; Musonda 2026). Without a predictable, consistent annual public demand schedule, local factories cannot engage in long term planning or sustain continuous operations. Consequently, these extended procurement gaps force manufacturers to downsize, laying off staff and dismantling productive capabilities before receiving new orders.

Fourth, the domestic application of global import-parity pricing by South African steel and aluminium mills artificially inflates industrial input costs, severely undermining the cost competitiveness of local manufacturers against cheap foreign components (Rivett-Carnac 2022b; Sapvia 2024). Where domestic input prices do not provide a cost advantage, local manufacturers struggle to compete with imported components and systems (Krinsky 2026; Musonda 2026).

Fifth, highly prescriptive and rigid tender specifications frequently choke technological innovation, preventing local firms from introducing alternative production approaches or cost-effective local technologies that fall outside established procurement templates (CES 2022). This creates challenges for domestic firms with products that can fulfil a project's needs but do not conform to technical specifications (Eberhard and Naude 2017; Moshikaro-Amani 2026).

Sixth, prohibitive upfront capital expenditure requirements and a lack of specialised, affordable end-user financing compress commercial demand among smaller businesses, commercial users, and agricultural producers (DEE et al. 2025). Access to affordable finance is therefore critical for expanding decentralised solar and battery markets that could generate additional demand for domestic products and services (DEE et al. 2025; Musonda *Unpublished*).

Seventh, low market entry barriers paired with systemic gaps in product-quality assurance have flooded the decentralised rooftop solar sector with uncertified operators using cheap, non-compliant equipment (Rivett-Carnac 2022a; Krinsky 2026). In decentralised residential and commercial segments, this lack of verification allows technical shortcuts that bypass safety regulations. This dynamic directly undercuts established domestic manufacturers attempting to compete on certified, high-specification production standards (Krinsky 2026).

Eighth, widespread consumer scepticism regarding quality and warranty risks severely limits the commercial expansion of localised component refurbishment and second-life supply models. Homeowners and small buyers view second-hand or alternative local hardware as lower quality (Crozier et al. 2025). Installers may therefore prefer products with established brands, with warranties and after-sales support, potentially limiting the development of circular and alternative supply models in the solar and battery sectors (Crozier et al. 2025; Musonda *Unpublished*).

Ninth, stringent financial requirements associated with large-scale projects, including performance guarantees and delayed payment cycles, create severe cash-flow pressures that act as absolute participation barriers for smaller domestic firms (Rivett-Carnac 2022a; Krinsky 2026; Musonda *Unpublished*). This balance-sheet constraint is particularly restrictive for localised solar component assemblers and battery integration SMEs, who are regularly excluded from major contract queues because they lack the deep financial reserves required to clear upfront performance bonds or absorb extended payment lag times (Krinsky 2026; Musonda *Unpublished*). Furthermore, the stringent bankability and risk-mitigation criteria imposed by commercial lenders directly influence technology selection, systematically favouring mature, globally standardised technologies over domestic alternatives and undermining localised technological capabilities (Baker and Sovacool 2017).

The long-term capacity of South Africa's green transition to deliver decent work and equitable development is ultimately dictated by whether demand translates into feasible opportunities for domestic firms.[15] The key issue is not simply whether demand is growing, but whether that demand is leveraged to create opportunities for domestic firms, fostering deep supply chain integration and supporting localised technology upgrading. Ultimately, stabilising the domestic production network requires an industrial strategy that actively eliminates these short-term procurement lead times, tightens local content definitions, and de-risks the financial constraints that block local firm participation.

[15] Buyer-supplier relationships are discussed in more detail in Section 7.2.1

6.5 Competition

The capacity of South African firms to capture emerging market opportunities is heavily dictated by asymmetric competitive conditions, forcing local manufacturers to compete directly with foreign producers who are well established in GPNs. Local solar, wind, and battery manufacturers are exposed to strong global price pressures, as large-scale foreign producers routinely flood the domestic market with cheap RE imports (Sapvia 2024; Sawea 2025). China's position in several RE manufacturing segments, combined with economies of scale and periods of global overcapacity, has contributed to low international prices for some RE technologies and components (Sapvia 2024; Sawea 2025). In the solar sector, an unmitigated influx of low-cost Chinese PV modules directly undercuts localised assembly lines, confining domestic firms to thin-margin, downstream structural fabrication like trackers and brackets (Krinsky 2026). Similarly, the domestic wind turbine market is heavily bottlenecked by a near-total reliance on foreign OEM import pipelines for high-value internal subcomponents like nacelles and rotors, due to deep-seated domestic deficits in high-complexity precision metallurgy (Musonda 2026). Meanwhile, South African battery system integrators manage to circumvent intense global cell-manufacturing cost curves by capturing a specialised local niche in downstream pack customisation, proprietary BMS coding, and regional raw material value chains like VRFB (Musonda *Unpublished*).

South African manufacturers face a severe structural disadvantage due to insufficient industrial and policy support, standing in stark contrast to global competitors and regional peers that actively deploy public funding, tax credits, and grant systems to counter China's dominance (Sapvia 2024). Unlike competitor nations (or blocs) like the United States, European Union, India, and Türkiye, South Africa has a policy vacuum that exposes local firms to direct import threats. Even within the African continent, peers like Morocco are outcompeting South Africa by deploying comprehensive state backing — including 10-year customs waivers on manufacturing machinery, capital grants, and subsidised industrial land — to deliberately secure localised RE and green hydrogen supply chains (Energy Solutions Intelligence 2026; Parema 2026). Firms across the interviews spoke about competing with Chinese companies. For instance, one respondent reflected on economies of scale, saying:

> *"The Chinese make things on a scale that I don't think we can fully wrap our head around ... They can mass manufacture modules, cables, mounting structures, inverters. The whole value chain they make at the scale that dwarfs everybody else."*
> (I27 Solar Industry Manager)

Weaknesses in regulatory standards, testing, and quality assurance frameworks actively distort domestic competition by allowing low-cost, uncertified components to enter the market and penalise local manufacturers trying to compete on safety and reliability (CES 2022). This market structure severely threatens market credibility, causing a battery industry executive to emphasise that protecting quality and brand reputation has become crucial to survive this underregulated competition (I20 Battery Industry Manager).

The absence of widespread and enforced LCRs forces a sharp friction between some developers' intent to source domestically and the commercial imperative to import cheaper inputs to remain competitive. Price competition was described as being a strong factor in the solar industry, where unmitigated global pricing pressures frequently override local procurement goals. Some respondents spoke about being patriotic and wanting to support South African development. For instance, in the wind sector, one respondent described bidding on projects without LCRs and having competitors outbid his company because they were importing everything (I39 Wind Industry Manager). He went on to say that his company is now looking for ways to optimise, which may include reducing local sourcing to remain competitive.

Domestic manufacturers face an equally acute dimension of competition in the labour market, where a persistent deficit of specialised technical skills triggers cross-sectoral and international poaching. As described above, domestic manufacturers are constrained by competition for specialised technical skills, including the movement of skilled workers between domestic and international firms and sectors. This human-capital flight is driven by international developers and large EPC firms who utilise deeper balance sheets to offer premium salaries, effectively starving local factories of the engineering and technological talent required to scale up operations.

This multi-layered asymmetric competitive landscape demonstrates that firm-level commitments to domestic sourcing are routinely neutralised by the superior cost and scale advantages of unmitigated global imports. The persistent undercutting of local producers across all technology tracks confirms that raw market expansion cannot foster infant-industry protection without rigorous, long-term state policy anchors. Ultimately, altering this restrictive competitive landscape requires coordinated public interventions.

6.6 Impact of local context

The trajectory of RE production localisation in South Africa is ultimately determined by the interaction of deeply embedded market, institutional, and socio-economic realities. Rather than acting as isolated operational inputs, the interlock between infrastructure bottlenecks, prohibitive commercial financing criteria, and raw import cost pressures collectively dictates the scope of domestic industrial capability. A local factory's capacity to scale up technology production is bound by this localised resource landscape, where domestic input shortages and weak local testing frameworks systematically complicate entry into high-value manufacturing segments. Consequently, aggregate market expansion cannot translate into sustainable domestic upgrading unless industrial policy directly insulates local factory floors from these combined environmental constraints.

These localised factors operate as an interdependent matrix, where strengths in one node catalyse upgrading across the value chain, while gaps in another can trigger a systemic bottleneck that traps firms in lower-margin activities. For example, predictable public and private demand supports investment in domestic skills and technology, while improved testing infrastructure allows local firms to meet the standards required to access new markets and de-risk commercial financing. Conversely, weak and 'stop-start' demand, expensive inputs, and limited access to finance reinforce an unmitigated dependence on imported technologies and constrain domestic upgrading.

The local context therefore directly dictates the qualitative boundaries of the transition, determining not only whether physical production takes place within South Africa, but also whether these localised supply chains reproduce historical patterns of precarity or build systems of decent work and gender equity. These conditions have implications for domestic value capture, the stability and quality of employment, and opportunities for more equitable participation by women and other historically excluded groups. Crucially, when limited demand forces local factories into volatile, project-based hiring cycles, the resulting low-wage trap shifts the financial burden of labour reproduction onto unpaid household networks, reinforcing gendered socio-economic inequalities. The following section examines how different actors shape the organisation and developmental outcomes of South Africa's RE production networks. This will be followed by Section 8, which concludes by identifying key challenges and opportunities, as well as policy recommendations to promote localisation that provides decent work and supports gender equity.

7. KEY ACTORS SUPPORTING OR PREVENTING LOCALISATION, DECENT WORK, AND GENDER EQUITY

The evolution and developmental impact of South Africa's RE sector are actively contested and organised by a diverse array of actors whose competing motivations dictate whether the transition advances localisation, decent work, and gender equity. The industrial landscape is shaped by a fractured policy environment where state agencies, foreign OEMs, large EPC contractors, and commercial financiers frequently prioritise low-risk global sourcing over long-term domestic capacity building. Conversely, organised labour, some government initiatives, public research consortiums, TVET networks, and host communities act as vital defensive nodes fighting to create opportunities for local jobs, protect workers, and demand an equitable redistribution of RE value. To systematically analyse these institutional dynamics, this section evaluates the actions of the public sector, private firms, global geopolitical actors, financial institutions, skill building and research institutes, trade unions and professional networks, and local communities. Finally, the section concludes by assessing the state's position within this contested system.

7.1 Public sector

South Africa has a complex tapestry of policies that shape the experiences of domestic manufacturers, incentivising RE localisation, decent work, and gender equity, while deploying parallel tracks that undermine these objectives through encouraging imports. This section first analyses the primary public policy directions shaping the RE industry and its societal impacts before sharing firms' perspectives on state execution.

7.1.1 Policy objectives

The state's strategic RE objectives are deeply fragmented across conflicting regulatory tracks, alternating between priorities such as crisis-driven market liberalisation and supporting local content in RE value chains. These public objectives can be categorised by their impacts: those that create localisation barriers, those that mitigate market volatility, and those that directly support domestic productive capabilities. They also sit[16] alongside policies targeted at supporting increased inclusion and equitable outcomes.

[16] Hermanus and Kamanzi (2026) outline key policies in the areas of energy policy, climate and transition policy, and industrial policy. A list of relevant policies is provided in Appendix B.

Creating challenges for localisation

One major challenge is that electricity market liberalisation has expanded private commercial demand for RE technologies, but it has simultaneously shifted demand away from centralised public procurement (Model 1), where socio-economic development and localisation requirements are embedded (CES 2022; Sapvia 2024; Hermanus and Kamanzi 2026). Dismantling Eskom's monopoly and removing the Nersa licensing ceiling drove a massive surge in business-to-business transactions and energy wheeling, drawing the procurement of subcomponent manufacturers into an unregulated market. While this deregulated pathway creates rapid deployment opportunities, its open sourcing model relies almost entirely on low-cost foreign RE imports, effectively isolating domestic factories from the protective localisation requirements built into public utility pipelines.

Furthermore, the state's rapid expansion of RE demand without parallel trade protections, functions as another barrier to localisation, pulling in an unmitigated flood of low-cost foreign imports (CES 2022; DEE et al. 2025). One aspect of liberalising the electricity market is enabling the growth of private sector RE production, anchored by strategic frameworks like the South African Renewable Energy Masterplan (SAREM) that outline an ambition to increase RE capacity (DEE et al. 2025). However, because this deployment strategy prioritises immediate grid absorption over local supply chain integration, the resulting procurement rush creates severe bottlenecks for local fabricators who cannot match the immediate volume curves or pricing of international suppliers (Krinsky 2026; Musonda 2026). Consequently, this state-driven demand surge primarily benefits established global producers, reinforcing a structural reliance on imported inputs while suppressing local technological capability development.

While the commercial market is constrained by intense global competition, domestic technology adoption within public tracks is restricted by rigid public accounting laws under the Public Finance Management Act (PFMA) and Municipal Finance Management Act (MFMA), which actively penalise state entities for procuring unproven local innovations (DEE et al. 2025). Because these restrictive auditing frameworks discourage risk- taking, public procurement remains biased against local commercial prototypes. To bypass this bottleneck, SAREM advocates for establishing ' Technology Trial Reservoirs' to create de- risked environments for testing locally produced technology (DEE et al. 2025).

To open standard manufacturing operations, domestic firms must navigate an exhaustive, slow-moving bureaucratic pipeline containing up to 58 separate regulatory approval layers across multiple government spheres (DEE et al. 2025). A government official (I37) acknowledged that because these overlapping licensing demands are fragmented across national, provincial, and local municipal authorities, firms must survive an administrative bottleneck where applications are reviewed in slow sequences rather than simultaneously. To cut through this red tape and improve the ease of doing business, the state is under pressure to deploy centralised InvestSA One-Stop Shops so all governing agencies can review regulatory applications at the exact same time (I37 Government; DEE et al. 2025). However, a risk in 'cutting red tape' is undermining regulations that are intended to achieve beneficial objectives, such as creating social protections.

At the operational level, this regulatory fragmentation manifests differently across the value chain. In the downstream installation market, a lack of coordinated quality enforcement has allowed unaccredited operators to compromise system safety, directly undercutting certified service providers during peak demand cycles. This policy imbalance highlights an uneven regulatory landscape where localised deployment channels experience limited verification while advanced product segments face increasingly rigid oversight. Similarly, while strict EPR regulations impose near-term regulatory compliance barriers for RE firms, they simultaneously generate vital market opportunities for developing circular production systems (Sapvia 2024).

A third challenge is created by trade policy and customs tariffs which exert a powerful, yet misaligned, structural influence on South Africa's RE manufacturers, failing to balance consumer import costs with long-term infant industry protection (CES 2022). Domestic firms face strong competition from lower-cost imports, particularly from China, undercutting local factory utilisation (Sapvia 2024; I32 Trade Union). While global competitors like India and the United States enforce import tariffs on the comprehensive bill of materials, South African firms must fight exhausting, multi-year bureaucratic battles at the International Trade Administration Commission (Itac) just to secure minimal trade support. A solar industry manager (I42) noted that local solar module assemblers had to wait seven years between submitting their formal trade protection application in 2017 and receiving final approval for a modest 10% tariff in mid-2024. This administrative delay caused local manufacturers to miss the historic private solar installation boom of 2023 (Krinsky 2026). Even when finally enacted, this protective measure was neutralised by extensive state rebate loopholes and legal pushback from large-scale IPPs and wholesalers (I23 Cross-Sectoral Expert; I42 Solar Industry Manager). Conversely, where the state enforces strict protectionist mandates — such as the National Treasury designating local cement sourcing for public infrastructure — domestic supply networks experience immediate stabilisation and localised jobs are protected (Rivett-Carnac 2022b; dtic 2025).

A primary operational barrier to trade protection is the lack of granular distinction in national import codes, which fails to separate raw subcomponent inputs from complete, fully assembled foreign systems (CES 2022; DEE et al. 2025).[17] For example, local electronic developers face counterproductive import tariffs on vital inputs like printed circuit boards, raising their production overheads compared to international competitors (CES 2022). In the energy storage sector, this coding deficit allows importers to bring in fully assembled, containerised battery packs under the exact same tariff classifications as raw battery cells, stripping local pack fabricators of potential commercial advantage (CES 2022; I26 Battery Industry Manager). Alongside demanding traditional tariff protections, battery manufacturers emphasise that an effective parallel remedy is the introduction of strict local quality standards and mandatory offtake quotas for government tenders to guarantee local demand (I26 Battery Industry Manager).

These import challenges are worsened by reported customs fraud and tariff misclassifications, allowing foreign suppliers to deliberately dodge duties and evade state measurement. Industry stakeholders report extensive misclassification of imported equipment, such as registering high-value power transformers as generic fasteners or wind turbine parts (I22 Components Manufacturer; I30 Cross-Sectoral Expert). This situation makes it difficult for the South African Revenue Service

[17] See IEJ (2026).

(Sars) to track the actual volume of hardware crossing the borders, meaning that even when Itac approves protective tariffs, the reviews remain functionally useless (I22 Components Manufacturer). Furthermore, large project developers, OEMs, and EPCs use loopholes related to staged consignments to reduce tariff liabilities (I22 Components Manufacturer).[18] This regulatory breakdown represents a severe policy misalignment between the dtic, DEE, and National Treasury, which serves the interests of international supply chains while depriving domestic manufacturers of the vital state resources and predictable order volumes needed to justify localised factory investments (I22 Components Manufacturer; I30 Cross-Sectoral Expert; Krinsky 2026; Musonda 2026).

Mitigating and balancing challenges for localisation

The centralised public procurement framework — executed via the IPP Office across the REI4P, RMIPPPP, and BESIPPPP windows — serves as the state's cornerstone tool used to promote domestic sourcing through developmental scorecards. Through this Model 1 public utility track the state utilises public procurement to anchor domestic demand, forcing IPPs to operate under scorecards assigning a portion of bidding points to developmental objectives like local ownership and local content, with bidding consortia expected to fulfil localisation thresholds (Morris et al. 2022; Sawea 2025; Hermanus and Kamanzi 2026). However, this developmental leverage has been diluted over time with as shifting national regulations altered the bidding scorecards to expand the weighting of short-term project price competition at the direct expense of socio-economic development criteria (Borchardt 2025). Driven by the National Energy Crisis Committee's (NECOM's) crisis-framed push to resolve load-shedding, this structural dilution saw state officials actively water down enforcement mechanisms between 2022 and 2024, offering weak local content allocations in utility battery auctions while failing to include any meaningful localisation objectives in Bid Window 6 and the initial rounds of the BESIPPPP (Hermanus and Kamanzi 2026).

Compounding this dilution, the public tender system has been designed to allow developers to easily bypass local component manufacturing. Historically, scorecards evaluated overall project value spend rather than component-specific ratings, prompting IPPs to concentrate expenditure on civil works and basic BoP infrastructure (Morris et al. 2022). This blunt policy design has kept high-tech precision component margins out of reach, limiting opportunities for local firms (CES 2022; Morris et al. 2022). This vulnerability is heavily exacerbated by a persistent backlog of porous post-bid exemptions that insulates developers from actually sourcing local hardware —a political backtracking that has penalised local component builders by triggering a massive crash in localised solar product exports from US$500 million to US$300 million alongside R1.69 billion in factory closures (Sapvia 2024; Hermanus and Kamanzi 2026). Although recent procurement windows have introduced component- specific minimum thresholds to curb this imbalance, the legacy of early project-level spending rules and porous exemptions leaves local factories struggling to maintain and grow their businesses (Borchardt 2025).

The long-term effectiveness of these LCR mandates has also been severely undermined by the state's erratic, 'stop-start' procurement cycles, which trap local factories in volatile boom-and-bust trajectories

[18] Staged consignment allows a large piece of capital equipment, machinery, or an entire industrial plant to be imported in multiple separate shipments, while being cleared under a single tariff classification code.

(CES 2022; Sawea 2025). Reflecting these temporal imbalances, an expert observer (I33 Cross-Sectoral Expert) noted that host communities initially experience a construction boom characterised by high short-term employment surges and heightened local economic expectations. However, this localised labour footprint quickly collapses into an operational bust after two years, requiring minimal permanent staff members to maintain an entire utility-scale wind farm.

Poor compliance enforcement of LCRs remains a widespread operational challenge, allowing IPPs to routinely bypass domestic supply chains via regulatory loopholes (Krinsky 2026; Musonda 2026; Musonda *Unpublished*). This evasion was highlighted during high-profile proceedings involving ArtSolar, which exposed disputes regarding compliance with local content procurement requirements (Krinsky 2026). Furthermore, verification of compliance is lacking (Ettmayr and Lloyd 2017).

Driving localisation

To directly lower investment barriers and foster clustered industrial manufacturing, the state utilises the SEZ Act 16 of 2014 alongside accelerated tax allowances and targeted supply-side funding programmes to insulate RE firms from national grid constraints and global price pressures (CES 2022; DEE et al. 2025). These fiscal measures include the Section 12B tax allowance for accelerated corporate tax allowances for qualifying RE assets. Furthermore, the state deploys dedicated industrial financing schemes to build domestic capabilities. The dtic's Black Industrialist Programme provides black-owned firms with capital grants alongside product design and patent support, while the Manufacturing Competitiveness Enhancement Programme (MCEP) offers working capital loans and business support. These programmes are reinforced by the Industrial Development Corporation (IDC), which provides development finance, including debt and equity, to qualifying industrial and RE projects. Moreover, the dtic's Industrial Development Strategy 2026 outlines the proposed reinstatement of the legacy Section 12I Tax Allowance programme to support capital-intensive, large-scale greenfield manufacturing investments (dtic 2026).

Industrial zones such as the Atlantis SEZ (ASEZ) and Coega SEZ lower investment barriers by providing serviced industrial sites, shared infrastructure, investment incentives, and competitive lease arrangements that anchor localised hardware manufacturing (CES 2022; DEE et al. 2025). Operating within these areas enables qualifying firms to access reduced corporate income tax rates, building allowances, and specialised tax and customs incentives. In addition to supporting domestic business development, the state leverages this dedicated infrastructure to attract foreign investment. For example, efforts have been made to engage global RE leaders to use these specialised zones as a strategic manufacturing base to serve South Africa and the broader African continent (I12 Government; CES 2022; DEE et al. 2025). Such efforts have seen some success with representatives of RE startups reporting that economic motivations contributed to the decision to set up in SEZs (Larsen and Hansen 2022).

Public capability-building policies utilise shared institutional assets, vocational partnerships, and diagnostic incubation platforms to increase the technical competencies of localised factory workforces (DEE et al. 2025). Industrial execution is supported on the ground by data frameworks like the PowerUp capability database and the Yes4Youth placement system to build specialised labour pipelines. To enhance factory-floor capabilities, public interventions facilitate direct access to specialised incubation

networks and reopened technical testing infrastructure at the South African Renewable Energy Business Incubator (Sarebi), directly elevating firm competencies in localised hardware certification, equipment repair, and complex component diagnostics (I12 Government; DEE et al. 2025).

To foster cross-sectoral knowledge transfer, the state backs collaborative vocational programmes, such as Northlink TVET College partnering with university PhD researchers to physically build LIB storage 'energy carts' (Davidson et al. 2025). This institutional approach ensures that local technicians gain practical experience working alongside advanced academic teams, building specialised engineering capabilities required to upgrade local RE system production. For more on skill building institutes, universities, and research institutes, see Section 7.5.

The Political Economy of Privatisation and State Capacity

This regulatory fracturing emerges from a strategic shift by the state to prioritise rapid market privatisation and cost minimisation over sovereign industrial capability development. Confronted with chronic power deficits, the state has allowed short-term pricing optimisation to override long-term midstream localisation mandates by shifting the responsibility of generation expansion onto private financiers (Borchardt 2025). This market- led strategy exposes a profound political economy paradox within South Africa's developmental state ambitions. Proposing an increased, interventionist role for the state to enforce local content and build manufacturing capabilities faces scepticism due to persistent operational deficits and continuous fiscal bailouts across major SOEs like Eskom (Hermanus and Kamanzi 2026). Consequently, critics argue that expanding state mandates risks deepening fiscal dependencies and administrative gridlocks rather than driving productive efficiency. However, field data indicates that leaving localisation entirely to the open architecture of private procurement encourages project developers to bypass local factory lines, leaving domestic manufacturers highly vulnerable to global market developments.

Governing inclusion, labour, and equity

Uncoordinated labour and employment regulations have undermined decent work and manufacturing stability by prioritising headcount metrics over long-term career tracking. While the state's framework under SAREM aims to 'sustain decent jobs', it lacks an evidence-based qualitative definition or enforcement mechanism, focusing instead on blunt headcount projections (DEE et al. 2025; Hermanus and Kamanzi 2026; Musonda 2026).

Worker protection is limited by the statutory lag between South Africa's high-level climate commitments and active labour market regulations. While the overarching Climate Change Act 22 of 2024 establishes the authority of the Presidential Climate Commission (PCC) to oversee a long-term transition, South African labour legislation lacks a parallel, enforceable code of good practice on the just transition under the Labour Relations Act (LRA) to mandate workplace-level compliance standards for emerging technology manufacturing. Although baseline mechanisms like the LRA regulate standard retrenchments, they fail to address transition-specific shocks. Existing labour statutes contain no mandatory provisions to compel industries to fund long-term worker reskilling, smooth over state procurement gaps, or govern advanced technology transfer.

Consequently, the integration of green energy skills remains loosely fragmented between a coordination challenge across SAREM's targets and the broader National Skills Development Plan, alongside sector-level skills initiatives involving the Energy and Water Sector Education and Training Authority (Ewseta). This raises questions about the extent to which existing arrangements provide coordinated workforce reskilling and pathways into sustainable employment. Initiatives such as Ewseta's PowerUp platform may help connect training institutions with industry needs, but their contribution to longer-term workforce development requires assessment. See Section 7.5.1 for more on skill building.

Ultimately, this fragmented policy environment manifests as severe operational instability on the ground, directly eroding job security for local manufacturing workers. By allowing developers to bypass domestic assembly in favour of low-cost imports during emergency procurement regimes, this regulatory backtracking may have contributed to reductions in local labour demand. Unmanaged local expectations and the sudden loss of short-term livelihoods cause localised friction to rapidly escalate, generating systemic "grudges within communities, that either sabotage programmes [or] divert programmes" (I33 Cross-Sectoral Expert).

State initiatives to advance gender transformation remain inconsistent and disconnected from broader energy frameworks (Hermanus and Kamanzi 2026). For example, the proposed Women Empowerment and Gender Equality Bill mandates 50% female representation in decision-making roles, while the Department of Mineral Resources and Energy's energy sector Women Empowerment and Gender Equality (WEGE) Strategy (2021–2025) frames gender diversity as central to sector innovation and resilience (Sawea 2025; Hermanus and Kamanzi 2026). Under the public tender procurement framework, REI4P includes gender-related economic development criteria through its scorecards (Sawea 2025). However, the transformative potential of these targeted gender strategies is severely blunted because macro-level energy roadmaps fail to include structural gender considerations, while rapid market liberalisation continuously weakens the state's direct procurement mechanisms to enforce transformation targets (Hermanus and Kamanzi 2026). Attempting to counter these divides, SAREM is designing a comprehensive gender inclusivity action plan that integrates equal-pay audits, punitive workplace harassment measures, and ring-fenced training allocations to pull women into high-value engineering careers, though actual execution is bottlenecked by a critical data monitoring gap (DEE et al. 2025). This operational gap persists because state agencies lack the resources to collect sex-disaggregated data to verify if decentralised private utility expansions are actually delivering safe, sustainable livelihoods for rural women (DEE et al. 2025; Hermanus and Kamanzi 2026).

The public procurement framework of the REI4P serves as an explicit mechanism to enforce wealth redistribution and secure equity stakes for host communities. Under the programme's competitive bidding scorecards, IPPs are legally mandated to allocate a portion of their total scoring points to economic development criteria, requiring project consortia to establish localised community trusts that hold mandatory equity ownership stakes — averaging 8% across active projects — while committing a specified percentage of project revenues to localised SED and ED channels. While this redistributive mechanism has channelled billions of rands into rural infrastructure, education, and small-scale business financing, the real-world disbursement of these funds remains heavily contested and restricted at the household level. Local communities and labour organisations frequently critique the policy's implementation, noting that complex financing structures, slow-moving loan repayments,

and inadequate monitoring systems mean that these asset yields rarely deliver sustainable economic autonomy or immediate structural transformation at the household level. Furthermore, such initiatives do not cover activities in private tracks (e.g., Model 2 or decentralised pathways).

7.1.2 Perspectives on government's role

Empirical evidence from IEJ's firm survey (see Box 5 for a summary of relevant survey results) and industrial stakeholder interviews demonstrates that domestic RE manufacturers maintain a deeply critical perspective on the state's regulatory performance, characterising existing policies as drivers of import dependency rather than localisation. This widespread dissatisfaction is defined by an interlocking matrix of policy misalignment, inconsistent compliance enforcement, acute market uncertainty, erratic application of LCRs, and deficiencies in collaborative institutional dialogue across the RE sector.

Box 5: Firm perspectives on government policies

IEJ firm survey results reveal a deep dissatisfaction with existing industrial policy execution, paired with strong support for strategic planning frameworks.

Macro Policy Impressions: Six firms state that existing industrial policies actively encourage finished technology imports at the direct expense of domestic manufacturing, while seven label SME support mechanisms as entirely ineffective. (One firm reports positive impacts for both categories).

Strategic Value: Five enterprises view South Africa's national strategic plans as a highly useful tool for green industrialisation, while one deems them ineffective.

Core Institutional Bottlenecks: Firms identify three primary structural barriers hindering these RE strategies:

- State Capacity Deficits: Poor inter-departmental coordination (6 firms); weak monitoring and evaluation systems (5 firms); limited institutional skills (2 firms).
- Policy Design Flaws: The absence or sudden withdrawal of LCRs (5 firms); a total lack of clear implementation guidelines (4 firms); unfavourable tax barriers (2 firms).
- State Behaviour Hurdles: A distinct lack of political commitment (5 firms); poor LCR implementation (5 firms); insufficient funding allocations (2 firms); corruption (1 firm).

One systemic friction point identified by local producers is the profound institutional misalignment between policy-drafting ministries and the downstream bodies tasked with practical bid evaluation.

A government official (I37) acknowledged that while their department retains a direct mandate over policy creation, they are excluded from active bid evaluation committees, leaving public planners to discover baseline implementation and enforcement failures after the fact. Reflecting this fragmentation, a domestic components manufacturer (I22) noted that this institutional disconnect directly enables lower-cost imports to flood the market and undercut local factories.

A second challenge is that inconsistent technical enforcement systematically forces domestic manufacturers onto an unlevel playing field against foreign competitors. Interviewees reported that local producers often face stricter compliance requirements than importers. For instance, a substation infrastructure executive (I40) detailed that while domestic factories are legally forced to comply with gruelling state electronics baselines to survive, the government routinely relaxes compliance rules for fully assembled hardware imported from international trade partners, making it impossible for local quality builders to compete on price.

This uneven playing field is worsened by gaps in consumer-facing standard enforcement that allow uncertified operators to distribute non-certified hardware across the private rooftop solar market (Krinsky 2026). Representatives from the solar industry report that a proliferation of uncertified technicians are bypassing national safety standards. By constructing non- certified electrical enclosures rather than type-tested hardware backed by international guarantees, these unqualified operators trigger mechanical failures and electrical fires that compromise safety and damage the broader market credibility of locally integrated systems (I13 Component Manufacturer Manager; I24 Government; I42 Solar Industry Manager).

A third challenge is that policy uncertainty and erratic energy roadmap execution destroy long-term market predictability, destabilising production schedules and eroding investment confidence for RE component manufacturers (Morris et al. 2022; Sawea 2025). This risk was highlighted as a core growth barrier by all nine RE firms surveyed. The commercial survival of local manufacturing relies on a stable environment where instruments like the IRP and ERA provide a transparent investment climate, enabling efficient licensing, predictable procurement, and stable factory lines (Sawea 2025).

Although the recent promulgation of the IRP 2025 has established a long-term R2.23 trillion electricity roadmap, South Africa's legacy of 'stop-start' procurement cycles continues to trap local manufacturers in a devastating 'boom-and-bust' environment (DEE 2025; Hermanus and Kamanzi 2026). Without long-term policy reliability and strictly enforced domestic offtake mandates, global OEMs and developers refuse to make multi-million-rand localisation investments, forcing the sector to default to foreign imports to meet short-term deadlines (Morris et al. 2022; Hermanus and Kamanzi 2026). Consequently, firms stress that stabilising and enforcing these procurement pipelines are mandatory preconditions to unblock manufacturing investments and protect domestic supply lines from collapse (Sawea 2025; Hermanus and Kamanzi 2026).

Reflecting this instability, a solar industry executive (I11) emphasised that local factories require a non-negotiable, legally binding pipeline of public and private projects to justify scaling up operations, yet the sudden halting of state procurement rounds creates immense financial instability that scares off private investors. Short tender implementation timelines further prevent domestic manufacturers from accessing long-term credit or expanding assembly lines (I15 Trade Union Representative). In the

wind energy sector, a factory manager (I19) noted that sudden mid-stream alterations to public local content rules forced his company to immediately close its local fabrication facility and retrench its entire workforce, illustrating that localisation cannot survive without policy continuity.

Fourth, erratic, poorly designed, or laxly enforced local sourcing requirements undermine sector stability, rendering localisation conditional and easily reversed. Because higher domestic production costs often tie supply chain survival directly to state protections, the sporadic implementation of local content targets leaves manufacturing investments highly exposed.

Tender structures frequently feature structural design flaws that favour transnational corporations over locally owned enterprises. Industry participants note that public auctions routinely mandate large-scale historical project track records that automatically exclude domestic SMEs. A battery industry manager (I20) explained that the lion's share of public procurement windows has historically been captured by foreign-owned corporate entities that utilise complex legal vehicles and local trusts to satisfy basic scorecard criteria without internalising actual industrial ownership or engineering capabilities within South Africa. This structural loophole allows global corporations to set up superficial local businesses that win tenders while keeping the scope of local geographic activities restricted to basic assembly. A factory executive (I42) summarised this implementation gap by stating that while South Africa maintains some of the most progressive localisation policies globally, the framework is compromised by a lack of compliance enforcement.

Fifth, a lack of inclusive social dialogue and state responsiveness to public perspectives prevents consensus building. A trade union representative (I32) sharply critiqued the state's consultative frameworks, arguing that bodies like the Presidential Climate Commission fail to facilitate genuine social dialogue between labour and business, functioning instead as mere "feeling ventilation platforms" where communities voice concerns but no concrete consensus building or consensus- driven transition planning occurs. This systemic lack of institutional responsiveness leaves small manufacturing SMEs isolated, without access to infant industry tariff protections, state-backed manufacturing subsidies, or specialised low-interest credit facilities necessary to compete against dominant global production systems.

Sixth, compounding this isolation, surveyed SMEs cite a severe deficit in supply-side financial backing. Multiple firms indicated that a lack of subsidies, protective import tariffs, and affordable loans acts as an absolute barrier to sustainable market participation. Because private commercial banks view local green component manufacturing as highly risky, these startups are often locked out of traditional private sector credit channels. This funding vacuum systematically prevents local startups from upgrading their factory floors and limits their ability to compete with large multinational corporations.

7.2 Firms at the core of the value chain

The relationships between firms, including buyers, suppliers, and competitors, shapes the commercial trajectory of South African RE manufacturers, contributing to whether firms achieve local capability upgrading or remain trapped in positions with few opportunities. Interfirm connections provide vital pathways for market access, technology transfer, and collaborative knowledge exchange, but they concurrently expose domestic SMEs to extreme price pressures and severe power asymmetries.

Furthermore, firms' internal corporate behaviours and private policies act as primary determinants in operationalising localised decent work standards and advancing gender-equitable employment benchmarks. By evaluating these factors, this section uncovers how buyer power and corporate gatekeeping shape the long-term viability of domestic RE manufacturing and how firms shape processes of upgrading and socio-economic inclusion.

7.2.1 Buyer-seller relationships

The downstream market structure into which South African RE firms sell is heavily fragmented across public and private utility-scale, smaller-scale, and global buyer networks, each generating highly distinct buyer-seller dependencies. These buyer-seller links dictate the level of commercial autonomy local manufacturers retain and shape opportunities for sellers.

Selling in public tender projects

When domestic manufacturers sell into projects on public tenders, they engage with powerful buyers whose procurement decisions are influenced by project specification and prescribed localisation and socio-economic criteria, yet these buyers rarely prioritise local sourcing, often finding ways around these requirements. Consequently, this Model 1 procurement track frequently fails to generate direct orders for local factories (CES 2022; Morris et al. 2022). In this context, competitive pressure within the tendering process places downward pressure on project costs and supplier margins, making local producers less competitive. Furthermore, because the state delays bid windows or project implementation, anticipated orders fail to materialise on schedule, leaving manufacturers with uncertainty and underutilised capacity (Morris et al. 2022; Sapvia 2024; Sawea 2025).

These relationships cede considerable power to EPCs, IPPs, and other lead firms who minimise domestic involvement by dictating project parameters, leaving local suppliers with limited influence over supplier selection, project timelines, and procurement specifications. For example, buyers can revise project expectations and delay order placements until the last minute, creating severely compressed timelines to which local manufacturers cannot realistically adapt. This operational manipulation creates an artificial urgency that lead firms use to justify bypassing local sourcing requirements in favour of fast-tracked imports. As a respondent in the solar industry noted:

> *"[IPPs] take you to a point and then they constrict you and they restrict you and then they say, 'Oh, we're so sorry, you actually just have three months left because we need to hand this over. So, we have to import.' But all this time, we tell them, 'Guys, 24 months, 23 months.' And up front."* (I42 Solar Industry Manager)

This asymmetric power dynamic fosters restrictive commercial gatekeeping. Foreign-owned EPC contractors and developers frequently delay payments or structure disadvantageous agreements that local subcontractors perceive as geared to failure (I27 Solar Industry Manager). Furthermore, lead firms frequently use arbitrary decisions based on personal relationships to influence who is included in project pipelines (I42 Solar Industry Manager). Furthermore, these dominant actors create

contractual and qualification requirements that smaller suppliers lack the resources to fulfil (I42 Solar Industry Manager). Ultimately, these financial, contractual, and timeline barriers demonstrate that domestic firms may possess established physical capabilities across solar, wind, and battery value chains, yet they still struggle to participate because they cannot clear the resource benchmarks established by more powerful lead firms (Krinsky 2026; Musonda 2026; Musonda *Unpublished*).

Nevertheless, some buyer-supplier interactions in the public track involve buyers supporting their suppliers. In select instances, large project developers provide direct financial support to local vendors to de-risk component manufacturing and protect localised energy infrastructure from operational delays (I39, Wind Industry Manager). Where local manufacturers successfully secure entry into these public sector project pipelines, they can also receive support through mandatory ED allocations.

Selling to IPPs serving the open market

In contrast, when domestic manufacturers interface with utility-scale buyers, EPC contractors, or large industrial operators selling to private buyers, relationships form through commercially driven connections without public tender scorecards. These private utility buyers place greater emphasis on price, quality, technical performance, reliability, and the ability of suppliers to integrate with existing project systems (Morris et al. 2022). To protect private investments, EPCs and developers enforce rigid compliance with international quality certifications and multi-year equipment performance warranties (Sapvia 2024; Morris et al. 2022). This strict commercial focus creates a bifurcated impact on potential localisation, as it places barriers on smaller, under-resourced local firms while simultaneously driving advanced domestic manufacturers to upgrade their capabilities to compete globally.

Private EPC contractors often prefer vertically integrated production or familiar global suppliers over domestic alternatives. In some cases, global OEMs bypass independent local newcomers entirely by utilising a 'follower sourcing' strategy. This approach requires preferred global suppliers to establish factories in South Africa (Morris et al. 2022).

However, domestic manufacturers that successfully establish trusted relationships with large private buyers gain predictable demand and opportunities to plan production and investment over longer periods. Thus, for firms that can secure these contracts, long-term, high-trust relationships may develop. Crucially, this developmental path remains stratified, as the absolute duration of these high-trust arrangements varies across individual private agreements.

General dynamics of manufacturers selling to large buyers

The long-term commercial relationships between local manufacturers and large utility buyers remain structurally fragile, as private developer commitments are routinely abandoned the moment global price pressures emerge. Despite citing strong buyer-supplier relationships, one respondent (I39 Wind Industry Manager) described breaking ties with local suppliers due to mounting cost constraints. This situation highlights the vulnerability of domestic RE technology assembly in the absence of continuous local content mandates (Musonda 2026).

Extremely protracted contract negotiations and rigorous qualification frameworks impose heavy administrative transaction costs that create deep barriers to entry for smaller domestic RE firms. Firms shared experiences of qualification processes that included site audits, non-disclosure agreements, supplier certification standards, and requirements for financial bonds (I19 and I39 Wind Industry Managers; I11 and I42 Solar Industry Managers; Krinsky 2026). While these complex requirements improve quality assurance and reduce buyer risk for lead developers, they simultaneously lock out under-resourced domestic manufacturers who lack the specialised financial and administrative assets required to complete them.

Selling to smaller-scale buyers

The decentralised commercial market for small-scale buyers operates on highly transactional retail relationships where the near-absence of formal localisation rules exposes domestic RE technology assemblers to unmitigated global price competition (Rivett-Carnac 2022b; Sapvia 2024; Crozier et al. 2025). Small-scale buyers often prioritise established international brand identities over localised assembly, creating barriers to entry for South African target firms seeking space on retail shelves (Sapvia 2024; Crozier et al. 2025). Furthermore, a reputation that local hardware is high-risk or lower-quality leads small installers and retailers to avoid local components to preempt expensive callbacks lacking extended warranty backing (Crozier et al. 2025). Intermediaries default to cheap, mass-produced Chinese imports instead (Rivett-Carnac 2022b; Crozier et al. 2025), leaving local firms struggling to build market share on highly demanding domestic standards (Krinsky 2026; Musonda *Unpublished*). Interview data reveals that local manufacturers struggle to compete against these mass-produced inflows, prompting industry stakeholders to demand protective tariffs against fully assembled solar panels and battery imports.

Faced with intensive domestic price pressures, some South African firms report being forced to supply a higher volume of components to export markets outside the country's borders than within them. This domestic bottleneck may be overcome through interventions such as tariffs, subsidies, and public education to boost consumer uptake, alongside strategic efforts by local firms to leverage their geographic proximity with a service-level pivot via rapid diagnostics and localised after-sales support.

Selling to global buyers

Cross-border export networks into neighbouring African states offer a critical alternative demand channel, allowing South African manufacturers to achieve vital economies of scale through regional trade arrangements. These sales can be to utility-scale projects run by IPPs or public-private partnerships or to off-grid projects funded by governments and development agencies (GreenCape 2024). This regional channel is highly lucrative for advanced domestic battery companies supplying localised storage packs and lithium-ion systems across SADC (Moshikaro-Amani 2026). South Africa benefits from preferential trade agreements with countries in the region, though differences in tariff structures and trade policies across export markets affect South African manufacturers' competitiveness.

7.2.2 Other interfirm relationships

Interfirm linkages extending beyond direct transactional buyer-seller lines encompass a complex matrix of JVs, global brand licensing, and competitor collaborations that directly condition localised capacity development and market access. While these multi-dimensional connections can facilitate technology transfer and skills absorption, they frequently function to reproduce a deeper structural dependence on foreign core technologies and reinforce unequal bargaining power across GPNs.

Developing partnerships with global firms

Collaborative JVs and international licensing agreements allow selected South African manufacturers to bridge local funding deficits, capture major contracts, and de-risk high upfront capital expenditures. IEJ survey data provides information on these relationships, with firms reporting global partnerships using fixed-fee and profit-sharing JV models. ARTsolar is an example of a company that has harnessed global relationships to expand its role in the domestic solar energy sector (see Krinsky 2026). A representative from the wind industry noted that their company's early contracts were obtained because their international partner negotiated the deals and lent the projects crucial reputational credibility (I19 Wind Industry Manager).

The presence of multinational manufacturing subsidiaries within South Africa operates as a major channel for technical skills transfer and technological capability absorption, though domestic support for foreign firms remains highly qualified. Firms in IEJ's survey indicated that having foreign firms manufacturing RE components in South Africa is important for skills transfer and learning, while supporting the country's component manufacturing deficits. Nevertheless, some local producers expressed tepid support, arguing that foreign firms should only be welcome in the short term while local firms develop capacities. Ultimately, the primary benefits of foreign involvement reside in plugging near-term technical gaps by importing advanced hardware and training local operators (S06; S07).[19]

However, technology absorption is fundamentally bottlenecked by severe operational asymmetries, as foreign partners control technical knowledge and intellectual property blueprints. Partnerships may provide access to technology without transferring the knowledge required to independently reproduce, repair, or develop it. A worker in the solar sector described that when he faced problems he could not solve on his own, he would simply call in a Chinese technician, without developing the underlying diagnostic capability (I01 Solar Industry Worker).

Furthermore, global technology leaders maintain a highly asymmetrical risk distribution, treating South African JVs as minor, disposable components of their multi-national balance sheets. Illustrating this vulnerability, a wind sector executive detailed a gruelling eight-month contract deliberation that was abruptly cancelled when the foreign parent corporation demanded a complete renegotiation of terms (I19 Wind Industry Manager). Consequently, while global partnerships offer a vital route to industrial upgrading, their real-world developmental effects depend on whether they enforce

[19] These numbers represent individual manufacturers who responded to the survey.

genuine technology transfer rather than permanently confining South African firms to low-value assembly nodes.

Relationships with competitors

Building relationships with competitors is a challenge because of the intense competitive pressure from dominant multinational RE conglomerates, which represents a primary threat to the survival and market participation of domestic manufacturing SMEs. IEJ survey data reveals that this competitive friction varies significantly by sector. While the findings show that domestic manufacturers perceive competition from foreign firms as a sectoral growth challenge, their specific strategic needs depend on their position within RE value chains. This value chain positioning exposes domestic firms to asymmetrical power dynamics, particularly regarding the control of core technologies.

Global firms' corporate pricing advantage is heavily guarded through global R&D monopolies, where transnational firms lock up advanced technical patents to freeze out localised midstream industrial upgrading. Because advanced R&D is heavily concentrated abroad, global leaders use proprietary processing patents to restrict domestic entry into lucrative upstream nodes like battery-grade mineral processing (Musonda *Unpublished*). A respondent questioned whether these companies would ever willingly cede this competitive edge, stating that global incumbents actively guard their market primacy (I20 Battery Industry Manager).

This defensive corporate behaviour limits local industrial collaboration, as RE manufacturers operate in a low-trust environment marked by severe fears of industrial espionage and idea theft. When one of the major wind companies was asked about collaborating with competitors, the interviewee said this was highly unlikely as the company does not want to share its proprietary technology (I39). Another smaller firm also expressed similar fears, describing having previously applied for patents but ceasing engagement with the process due to risk of larger firms stealing ideas (I17 Battery Industry Manager).

Nevertheless, compensating for these low-trust individual dynamics, domestic manufacturers are increasingly engaging in strategic collective action, establishing specialised business associations to transition from fragmented individual actions into powerful institutional lobbying networks (CES 2022; Morris et al. 2022). Firms utilise these local networks to improve their market position, establish SME support systems, and drive sector-specific advocacy. Relevant industry associations include Sawea, Sapvia, the South African Battery Manufacturing Association (SABMA), and the South African Energy Storage Association (SAESA) (CES 2022; Morris et al. 2022; Sawea 2025).

The formation of business associations illustrates relationships of both cooperation and divergence in the sector, as domestic manufacturers frequently clash with corporate association blocks that prioritise the commercial interests of foreign hardware importers. Some individual producers have actively boycotted legacy associations that they feel exclusively represent unvetted foreign equipment importers over true local producers, and have opted to form new organisations (Hermanus and Kamanzi 2026; I41 Battery Industry Manager; I42 Solar Industry Manager).

When aligned with local production, these industry bodies serve critical functional roles designed to transform the regulatory landscape and reach policymakers. First, by providing a collective voice on issues such as tariffs, national price determination, wheeling, and energy taxes, associations actively influence national policy (I16 RE Industry Association; I41 Battery Industry Manager). Second, they act as a vital information conduit between state bodies and private firms, while coordinating collaborative partner matching to help local factories secure large-scale contracts. Third, they also play a marketing role by publicising national capabilities and informing international developers that South Africa possesses active, high-specification manufacturing facilities (I26 Battery Industry Manager; Musonda *Unpublished*). Finally, these bodies advance gender equity by establishing progressive operational benchmarks. For example, working in direct alignment with national WEGE objectives, Sawea and Sapvia jointly published the *Gender Diversity Guideline for the Renewable Energy Industry* (Sawea and Sapvia 2025b), which provides practical institutional tools for investors and developers, and its companion, the *Study on Gender Diversity in the Wind and Solar Energy Industries in South Africa* (Sawea and Sapvia 2025a), which establishes data-driven transformation benchmarks for women's involvement in the RE industry.

7.2.3 Companies' private policies

Internal corporate policies deployed by localised RE companies serve as critical determinants in transforming workplace standards and moving beyond passive compliance to operationalise decent work and gender equity as a core business practice (Sawea 2025; Hermanus and Kamanzi 2026). Private local manufacturers and utility developers actively de-risk value chains and build an inclusive talent pipeline by adopting gender-responsive employment practices, utilising unbiased recruitment metrics, and offering structured operational flexibility for female caregivers (Sapvia 2024; Hermanus and Kamanzi 2026). However, corporate execution varies widely across firms, as the mere formal presence of internal policies fails to guarantee genuine transformation due to deep-seated patterns on the factory floor (Krinsky 2026; Musonda 2026).

Extending beyond internal hiring metrics, these private corporate frameworks also shape external impacts by guiding how lead developers engage with suppliers and communities. This can be seen in leading power producers actively routing contractually mandated ED expenditure directly into targeted Black, woman-owned RE small businesses to build sustainable capability upgrading (Hermanus and Kamanzi 2026). For example, Matla A Bokone Solar successfully implemented a targeted Enterprise Development Accelerator Programme that funded vital technical equipment, material resources, and operational assets for local women-led enterprises (Hermanus and Kamanzi 2026). This targeted delivery demonstrates that corporate strategies—whether driven by strict regulatory scorecards or broader social investment goals—govern how firms impact suppliers and host communities. However, evaluating the long-term impact of these private community disbursements remains constrained by an acute monitoring gap that obscures whether targeted capital support generates beneficial outcomes for target communities and enterprises.

7.3 Global geopolitical actors

Global actors directly influence the domestic commercial environment, market regulations, and investment strategies of South Africa's RE manufacturers by controlling the availability of finance,

technology, skills, standards, and market opportunities. However, their effects are mediated by South African policy choices and domestic institutional capacities. While this section maps the multi-layered ways these actors shape domestic production networks through technological dependencies and regulatory leverage, climate finance mechanisms and investment frameworks are evaluated separately under Section 7.4.

Policies regulating global trade shape domestic priorities with strict international standards and external environmental trade frameworks imposing a 'carbon barrier' that is forcing a market-driven transition towards low-carbon electricity (Sawea 2025; DEE et al. 2025). The implementation of the European Union's Carbon Border Adjustment Mechanism (CBAM) renders the carbon intensity of South Africa's grid a critical competitiveness issue for local steel, mining, and agricultural exporters (Sawea 2025). To preserve access to high-value global trade networks, these domestic exporters must rapidly bypass localised supply blockages to procure low carbon energy, directly driving private market demand for wind, solar, and battery installations.

Multilateral development organisations and international partners generate a highly diverse and often contradictory set of impacts across South Africa's regulatory and industrial landscape. Strategic entities channel resources into supporting domestic institutional capacity building, technical training, and gender-focused initiatives to mitigate local capability constraints (Sapvia 2024; Sawea 2025). For example, the deployment of the UNDP's Gender Equity Seal for Public Institutions supports public institutions in strengthening gender-responsive practice (Sapvia 2024). Conversely, powerful transnational coalitions push for market deregulation and short-term project price optimisation, systematically undermining defensive LCRs and leaving emerging domestic manufacturers directly exposed to global competition.

International technical partnerships and bilateral cooperation frameworks, such as those outlined in Appendix C, facilitate technical knowledge diffusion and industrial upgrading, though their long-term developmental effects depend on building sustained domestic capabilities rather than localised dependence on foreign expertise (Hermanus and Kamanzi 2026). These initiatives support the diffusion of workforce skills, manufacturing capabilities, and innovation in RE technologies while strengthening the capacity of domestic firms to participate in higher-value segments of global value chains (Hermanus and Kamanzi 2026). However, the transfer of international technological know-how is fundamentally conditional, relying heavily on the absorptive capacity of domestic firms and the strength of paired industrial policies. Access to global knowledge and transition finance does not automatically secure localised manufacturing upgrading. Realising the developmental potential of these technical links depends on the specific commercial terms of partnerships and whether the state enforces complementary regulatory safeguards that support local production, internalise learning, and protect long-term domestic capability development.

The baseline competitiveness of South Africa's RE market is heavily shaped by the industrial policies and export strategies deployed by foreign governments to back their own multinational firms (see Box 6). Leading global manufacturers benefited from decades of public investment, R&D support, export finance, and large protected domestic markets that enabled them to achieve economies of scale and offer highly competitive prices internationally. These historical and contemporary forms of support create highly challenging competitive conditions for South African manufacturers (as described in Section 6.5).

The sovereign capacity of developing states to enforce vital local content mandates is heavily restricted by international trade regimes. As analysed by Celli Junior (2019), LCRs face systematic legal challenges from the World Trade Organization (WTO) under agreements like the General Agreement on Tariffs and Trade (GATT 1994), the Agreement on Subsidies and Countervailing Measures (SCM), and the Agreement on Trade-Related Investment Measures (TRIMs). Historical precedents show that the WTO routinely dismantles defensive industrial policies, having previously struck down automotive sector LCRs and domestic value-add exemptions in Indonesia, Canada, India, and China. For South Africa, this restrictive legal environment means that using procurement scorecards to shield domestic factories remains structurally vulnerable to international trade litigation, capping how aggressively the state can legally insulate its infant RE industries. However, the post-2019 paralysis of the WTO Appellate Body has severely weakened immediate multilateral enforcement mechanisms, granting the state temporary policy space to enact strategic interventions (Bello 2022; Havertz 2026).

Despite these international legal constraints, comparative global experiences demonstrate that RE localisation succeeds only when policies combine predictable market demand with targeted capability-building support and strict compliance mechanisms. While past experiences cannot be replicated, a synthesis of international cases offers five critical lessons for South Africa:

- Target Realistic Segments First: Localisation is more likely to succeed when policies identify realistic priority segments rather than attempting to localise entire value chains immediately.

- Deploy a Cohesive Policy Mix: LCRs work best as part of a broader policy mix that combines predictable demand, financial support, infrastructure, skills development, research and development, standards, and compliance mechanisms.

- Eliminate Inter-Ministerial Conflict: Policy coordination is critical. Industrial, energy, trade, procurement, and investment policies can undermine one another when they pursue conflicting objectives. In particular, the objective of minimising short-term electricity or project costs can conflict with the development of domestic manufacturing capabilities.

- Monitor and Adapt Policies as Necessary: Policies need to evolve as domestic capabilities develop. Initial protection or demand support may need to be followed by measures that promote quality, technological upgrading, productivity, and international competitiveness.

- Draw Benefits from Global Connections: International partnerships and finance can support domestic upgrading, but only if they support sustained local capabilities, technology transfer, and domestic value creation.

Box 6: Renewable energy production network development in global contexts

In a global comparison, Eicke (2025) found that LCRs can foster domestic RE industries if prescribed production thresholds match existing industrial capabilities or if the country has related industries. The effectiveness of LCRs depends heavily

on policy design, with supportive policy mixes able to mitigate challenges across diverse national contexts. A comparative analysis of Australia, India, and China highlights distinct configurations of demand coordination, state subsidy, and upgrading.

Australia: Western Australia's battery industry strategy links upstream mineral resources with selected downstream activities rather than attempting full value chain localisation (CES 2022). Targeting value-adding opportunities associated with the state's mineral base, this approach channels investment through coordinated government action, industrial infrastructure, research support, and project development.

India: India drives RE localisation by combining LCRs with industrial incentives, technical certification mechanisms, and trade protections. Early phases of the National Solar Mission included LCRs, although efforts to promote domestic manufacturing were often in tension with the objective of achieving low-cost electricity generation (Hansen et al. 2020). This tension suggests that minimising short-term project costs while seeking industrial development creates a counterproductive policy gridlock unless buffered by supply-side state funding (Eicke 2025). India subsequently introduced approved supplier lists and targeted financial subsidies to verify compliance and help local factories lower costs (Hansen et al. 2020).

China: China's RE support involved a changing combination of market protection, domestic demand, industrial policy, public investment, and technological upgrading. In the wind sector, early policies included LCRs and measures that encouraged foreign firms to establish production and partnerships in China (Hansen et al. 2020; Li et al. 2023). As domestic capabilities expanded, the state phased out LCRs to pivot toward cost, quality, technological upgrading, and international competitiveness. China's solar PV expansion similarly targeted large domestic and international markets with extensive public support for manufacturing, research and development, and deployment (Guo and Li 2024; Wang and Liu 2024). This experience highlights the cumulative power of long-term public capital deployment and evolving policy instruments that adapt to industry maturation.

7.4 Financial actors

Financial actors active in South Africa's RE sector exert a decisive, top-down influence over the commercial experiences and strategic parameters of domestic component manufacturers by controlling capital access. Funders span international and domestic development finance institutions like the World Bank and the IDC, alongside major commercial lenders like Nedbank and HSBC. By enforcing conservative risk scorecards and rigid, short project delivery timelines, these financial actors systematically control which technologies enter the grid pipeline (CES 2022). International project

finance norms support the use of proven foreign technologies and global contractors, establishing a relationship dynamic that excludes local manufacturers from high-value tenders because smaller domestic firms lack the asset backing, international certifications, and multi- year product warranties required to satisfy investor risk profiles (CES 2022; Morris et al. 2022; Hermanus and Kamanzi 2026). A solar industry executive (I42) highlighted this institutional rigidity, noting that navigating development agency due diligence remains an exhaustive barrier to securing essential manufacturing credit.

International climate-finance initiatives, including the Just Energy Transition Partnership (JETP), introduce vital funding resources while simultaneously creating potential constraints to the sovereign policy space within which domestic industrial development takes place. This tension arises because the deployment of foreign capital often carries external conditionalities that run counter to domestic industrial priorities. As a trade union representative (I31) observed, well- funded foreign entities within these transition partnerships hold the leverage to dictate domestic policy architectures, potentially locking South African firms into anti-competitive traps that favour international supply chains over localised manufacturing setups. Whether these external frameworks strengthen or weaken localisation depends on how these resources and associated policy frameworks are aligned with domestic industrial, employment, and equity objectives.

Faced with the rigid restrictions of traditional banks and development agencies, domestic manufacturers increasingly pursue international JVs, structured corporate partnerships, and private investors to fund large-scale factory expansions. Driven by state scorecards, equity investors frequently capture structured ownership stakes — such as a share in EPC firms — to lock in long-term asset yields and steer project procurement decisions (DEE et al. 2025). As one industry participant noted, securing deep-pocketed private corporate relationships is vital to override local banking resistance when scaling up production lines:

> *"They [a battery company] are in a joint venture agreement with one of the big 5 Chinese manufacturers ... it's going to take billions of dollars of investment, of which their partners have already committed to half."* (I17 Battery Industry Manager)

High domestic interest rates and unyielding bank debt structures force local RE startups to turn to private shareholders for basic early-stage survival. This market-driven dependence forces factories to operate under a commercial framework that prioritises high-yield, short-term asset returns over long-term national industrial development (Ashley et al., 2020). Reflecting these constraints, a battery manufacturer detailed that his firm turned to private shareholders and angel investors after conventional commercial banks rejected their funding applications as high-risk ventures (I28 Battery Industry Manager). Independent factories must often cycle through multiple private equity rounds to fund basic factory expansions and maintain commercial viability.

7.5 Skill building institutes, universities, and other research institutes

A diverse network of training and research institutions directly conditions South Africa's localisation potential by shaping the technical skills base and R&D pipelines required for RE manufacturing. While these institutions are backed by supportive state policies, their real-world impact is heavily moderated by low graduation rates and misalignment between educational supply and RE factory needs. Undermining core developmental goals, this disconnect traps under-trained local workers in temporary, low-wage installation roles. Furthermore, the related lack of targeted training stalls the entry of women into high-value engineering tracks, reinforcing historic gender inequities across the production network. Beyond these frontline artisan and workforce training challenges, the sector's long-term upgrading concurrently relies on state-backed scientific networks and university laboratories to drive innovation and help local firms clear international technical certification barriers.

7.5.1 Skill building institutions and universities

The institutional capacity of sector education and training authorities (Setas) directly shapes whether local firms can secure high-value technical capabilities, functioning as top-down governance and funding bodies that allocate specialised skills levies across the industrial sector (Tamasiga 2025). Operating at the sectoral planning level, Setas — most notably the Ewseta — condition manufacturing capacity by funding workplace training initiatives, certifying work-based learning pathways, and underwriting the administrative costs of graduate internships. However, their funding mechanisms are frequently compromised by slow disbursement pipelines and a lack of direct coordination with factory-floor technology changes.

A severe misalignment persists between educational supply and industry expectations, particularly visible on the ground at TVET colleges — the institutions responsible for face-to-face classroom and workshop instructional delivery. This systemic friction is highlighted by public TVET electrical infrastructure programmes suffering from a dismal 29% throughput rate that leaves many graduates excluded from formal RE value chains (Tamasiga 2025). To bridge this learning-to-earning gap, South African TVET colleges offer specialised occupational certificates and short skills courses primarily focused on solar PV installation, repair, and maintenance (Davidson et al. 2025). While colleges like Northlink and False Bay report high business demand and strong work-placement rates, systemic capacity remains bottlenecked by a severe lack of trained educators, low staff retention, and an absence of ministerial approval required to unlock government grant funding (Davidson et al. 2025).

To navigate these barriers and protect long-term graduate employment stability, vocational institutions pivot towards a coordinated national framework that integrates specialised RE modules into broader, existing qualifications rather than treating renewables as standalone fields (Davidson et al. 2025). This nationwide industrial effort scales up ground-level capacity by pairing regional colleges with coordinated multi-actor frameworks (Sapvia 2024; Davidson et al. 2025). Under Ewseta's flagship initiatives and partnerships with the Chinese Culture and International Education Exchange Centre (CCIEEC), major institutions in Gauteng—such as South West Gauteng College, Central Johannesburg College (CJC), and Westcol—enable lecturers and establish dedicated solar PV manufacturing training

labs (Ewseta 2022; Bulbulia 2024). This national 'hub-and-spokes' model anchored by SARETEC and co-implemented through Ewseta frameworks has expanded state-of-the-art Renewable Energy Training Centres and operational microgrids out to Vhembe TVET in Limpopo, Elangeni TVET in KwaZulu-Natal, and specialised coal-transition hubs across Mpumalanga (Paker 2022; Burger 2026; Infrastructure News 2026).

Centralising workplace placement is vital to build local manufacturing capabilities. This commercial integration manifests in the Wind Industry Internship Programme (WIIP), launched by the Sawea and the Ewseta framework, which embeds graduates directly into factory environments over 12 months to successfully transition participants into permanent roles and de-risk human capital overheads (Sawea 2025). Reflecting this need for macro coordination, national development frameworks warn that the government must forge a unified initiative between universities and the Department of Higher Education and Training (DHET) to accelerate technology transfers and protect local talent from global poaching (Hill et al. 2025).

While state policy frameworks formally champion gender transformation, actual institutional and financial support for women's specialised education remains severely restricted, leaving gender equity initiatives confined to isolated, small-scale pilot tracks (Davidson et al. 2025; Sawea 2025). At the entry-level artisan tier, public TVET institutions train female students in practical solar PV mounting and electrical cabling qualifications to counter historic workforce segregation (Davidson et al. 2025). To concurrently dismantle the leadership bottleneck at senior levels, premier academic institutions — such as the Wits Business School — partner directly with industry bodies and the Ewseta funding framework to deliver the Management Development Programme (MDP) for Women in Renewable Energy (Sawea 2025). This executive pipeline equips mid- to senior-level female professionals with strategic business capabilities, preparing them for senior and board-level placement across the expanding RE grid (Sawea 2025). However, because the framework mandates candidate nominations from established corporate employers, the cohort size remains restricted, often benefiting better-resourced corporate professionals rather than grassroots entrants (Hill et al. 2025). This highlights an ongoing need for the DHET to expand fully funded, foundational scholarships and technical training courses to exponentially increase overall female participation across broader STEM fields (Hill et al. 2025).

7.5.2 Research institutions

State-supported research networks act as a critical mechanism for domestic manufacturers to overcome technical barriers and clear international quality thresholds. South Africa's DSTI links the Energy Storage RDI Consortium directly to RE component and subcomponent manufacturers to anchor localised technical innovation within active manufacturing networks (CES 2022; DEE et al. 2025). This network unites state entities like the Council for Scientific and Industrial Research (CSIR) and Mintek with premier universities — including the University of Limpopo, Wits, University of the Western Cape, and Nelson Mandela University (NMU) — to execute materials synthesis, electrode engineering, and manganese precursor development (CES 2022). For target manufacturers, academic links offer a mechanism to clear international 'certification walls' via pathways such as specialised CSIR stress testing and NMU laboratories operating under global IEC 62446-1 baselines, while Mintek's

battery recycling research helps assemblers satisfy mandatory EPR compliance rules (CES 2022; Sapvia 2024; DEE et al. 2025).

7.6 Trade unions and professional networks

Organised labour and workers' professional networks actively condition the RE sector by contesting precarious employment arrangements and establishing institutional benchmarks for decent work and gender equity. Although union membership in many RE businesses remains limited, factory-floor fabricators, automated battery assemblers, and steel and aluminium component workers fall under the jurisdiction of the National Union of Metalworkers of South Africa (Numsa), while heavy civil engineering labourers, raw mineral refinery operators, and grid infrastructure construction workers are represented by the National Union of Mineworkers (NUM). This industrial presence remains constrained, however, by a highly transient RE construction workforce that limits union expansion across newly established private assembly facilities (Box 7).

Box 7: Firm perspectives of trade unions

Firms in IEJ's survey expressed a variety of opinions related to trade unions. Four firms were less positive, with three indicating that companies can do without trade unions and one saying that they do not deal with them. Conversely, four firms were more positive, with three indicating that companies need trade unions and one saying that "trade unions can be strategically important partners for any company when engaged constructively" (S06).

7.6.1 Shaping policy agendas

Organised trade unions, spearheaded by Cosatu, function as primary defensive actors fighting to institutionalise the Decent Work Agenda directly into South Africa's RE industrial frameworks (Hermanus and Kamanzi 2026). Labour negotiators criticise global OEMs and IPP developers for exploiting non-standard, precarious labour arrangements in remote areas characterised by weak collective bargaining structures (Hermanus and Kamanzi 2026). To counter this industrial downgrading and prevent businesses from using deceptive measures to import tariff-free items, trade unions actively execute policy interventions, submitting formal frameworks to Itac to demand that local firms or multinational importer benefiting from protective state tariffs must reciprocate by upgrading employment levels and adhering to the national decent work agenda (I32 Trade Union). Furthermore, to protect workers from the project-driven construction cliff, unions utilise the National Economic Development and Labour Council (Nedlac) to lobby for inclusive labour market protections, automated income stabilisers for seasonal contract employees, and the establishment of municipality-owned recycling depots to secure permanent, safe RE jobs within nascent circular economy value chains (IEJ and Cosatu 2021; Hermanus and Kamanzi 2026). The IEJ has partnered with trade unions in some of these policy engagements.

The policy-shaping role of organised labour is highly concentrated on securing a just transition framework that safeguards workers vulnerable to fossil-fuel job losses and the creation of new jobs that provide decent work. As one union representative put it: "Labour, it's involved in almost every policy and strategy of government as far as the sector is concerned" (I31 Trade Union Representative). Another trade union respondent highlighted the movement's success in getting formal just transition terminology legally accepted within national frameworks (I15 Trade Union Representative). Worker organisations have also played an important role in advocating for broader statutory protections to insulate individuals engaged in non-standard forms of employment.

Labour organisations actively contest the increasing privatisation of energy production, advocating instead for a strong, centralised role for SOEs as a protective labour shield. In actively questioning the hollowing out of public infrastructure, a trade union representative noted an explicit desire for "big state companies employing people" (I15 Trade Union Representative), alongside concerted industrial policies that prioritise the creation of physical manufacturing jobs in RE supply chains. They have sought to protect local industry from international market pressures and directly link such protective measures to increased employment (I32 Trade Union). This anti-privatisation stance has also driven unions to contest the growth of private-sector driven RE expansion to protect existing fossil-fuel jobs, leading to disruptions like Numsa's 2018 court injunction against the government to halt independent renewable procurement contracts (McNamara 2024). In parallel, federations like the NUM have advocated for a moratorium on the REIPPPP pipeline while growing increasingly obstructive toward the debt-driven architecture of JETP (McNamara 2024).

7.6.2 Strengthening enforcement of labour laws

Beyond macro-level policy debates, trade unions play an active operational role in ensuring compliance with statutory labour laws on the factory floor. A trade union representative noted that improved enforcement is something they have been pushing very strongly for (I15 Trade Union Representative). This respondent highlighted the challenge of businesses giving workers repeated short-term contracts instead of permanent positions, which may violate South African labour laws.

7.6.3 Organising workers

Increasing trade union membership across the expanding RE production network remains an urgent necessity that is fundamentally constrained by the structural fragmentation of the value chain. The distribution of RE employment across different value chain segments directly dictates the ease and efficacy of trade union organising. While component manufacturing and assembly plants provide stable, geographically fixed work environments, downstream utility-scale project installation is defined by temporary, highly transient field deployment. This operational divergence fragments the labour force, forcing worker networks to split their strategic focus between conventional factory-floor collective bargaining and highly volatile construction site mobilisation.

While operating within fix locations, midstream manufacturing operations pose severe challenges for unionisation due to a high prevalence of short-term contracts. To counter this vulnerability, pragmatic organising strategies target emerging private energy entities to scale up collective bargaining

structures. A trade union representative described the challenge of small private businesses not meeting the compliance standards of large established enterprises, highlighting the urgent need to engage in collective bargaining to improve wages and working conditions for workers at these smaller firms (I15 Trade Union Representative).

Downstream, the structural characteristics of utility-scale construction create severe operational barriers for trade unions accustomed to organising within geographically fixed locations. These challenges were highlighted by an industry expert:

> *"Historically, [trade unions] have been trained to organise in factories, in mines, at a single point of workplace but during construction, these companies move around with their coworkers across different spaces. South African unions in the main have struggled to organise these workers, who are moving around, the journeymen."* (I33 Cross-Sectoral Expert)

Overcoming this low level of unionisation among mobile and temporary RE workers across the value chain remains a key challenge that labour networks must resolve to support the long-term growth of decent work and gender equity.

7.6.4 Collective bargaining

The active formalisation of centralised sectoral bargaining structures serves as labour's primary tool to establish mandatory minimum wages and condition employment terms across private plants. A trade union representative (I32) detailed that they had successfully secured formal labour recognition rights across six separate manufacturing plants within a two-month window. Such factory-floor organising is geared towards establishing a bargaining council for the RE sector, allowing labour to bargain directly with international OEMs for improved base prices of labour.

7.6.5 Promoting gender equity

Defending gender equity functions as a core component of labour's green transition planning, manifesting through data-driven operational tools and specialised professional mentorship networks. This includes developing the Just Transition Blueprint for Workers: Gender Toolkit, which provides concrete policy tools, bargaining materials, and organising strategies to ensure that the transition to a low-carbon economy actively dismantles gender inequalities rather than replicating them in a new form (Cosatu 2024). In addition, professional networks, such as Southern African Females in Energy Efficiency (SAFEE), provide peer mentoring, technical skills development, and formal networking circles. This collective platform helps women systematically dismantle the institutionalised sexism, limited technical support structures, and deep-seated workplace biases that traditionally characterise male-dominated industrial engineering sectors.

7.7 Communities

Local communities and civil society actors heavily impact localisation prospects, not as passive recipients of social spending but as active forces that can condition a project's ability to operate (Sawea 2025; DEE et al. 2025). Illustrating friction, recent factory protests in the Eastern Cape saw residents march against investors who imported workers rather than hiring locally. Tensions have escalated through communication failures regarding realistic employment expectations, creating historical grudges that independent manufacturers must manage (I12 Government; I33 Cross-Sectoral Expert; Morris et al. 2022).

Establishing genuine community ownership stakes safeguards local infrastructure by transforming host populations into defensive allies who actively safeguard localised RE assets. Historical cross-sectoral evidence shows that when local communities legitimately own and extract value from RE assets, residents actively protect the hardware from destruction even during moments of intense social conflict (Mabele et al. 2024; I29 Cross-Sectoral Expert). Consequently, embedding local equity structures changes the socio-economic dynamic, converting passive community gridlock into long-term operational stability across the production network.

7.8 Multi-actor dynamics: power asymmetries and the state

The state plays a multi-faceted role in South Africa's RE sector, executing public policies driven by regulatory motivations that vary widely in their support for localisation. As established in Section 6, acute local contextual pressures — including chronic power deficits and intense socio-economic crises — directly condition these policy motivations. Rapid electricity market liberalisation and deregulation prioritise fast capital deployment to resolve immediate energy crises, acting as a passive or unsupportive force for localisation that mirrors international financiers and global actors who favour cheap, fully assembled imports. Conversely, the state attempts to drive local development through SAREM, SEZs, and public procurement scorecards that encourage project developers to meet local sourcing, ED, decent work, and gender equity benchmarks. However, because the state lacks cohesive internal alignment, these competing objectives clash. For example, under crisis-framed political pressures, government branches have backtracked on their mandates, reducing the impact of LCRs and granting porous post-bid exemptions that undermine domestic factories. Furthermore, the state's capacity to enforce supportive policies is heavily constrained by technical blind spots like widespread customs fraud and poor distinction in national import codes that render Itac's protective tariffs toothless, allowing global suppliers to undercut local producers. This regulatory friction directly limits the state's capability to insulate local infant industries from predatory international pricing cycles.

The resulting regulatory breakdown leaves a structural vacuum where foreign OEMs, lead EPC contractors, and conservative commercial lenders often exercise gatekeeping power over local RE pipelines. These globally connected actors restrict opportunities for local SMEs, particularly in high-value manufacturing segments. This power disparity is worsened by the state's 'stop-start' procurement cycles, triggering volatile 'boom-and-bust' cycles that lead to factory closures and worker retrenchments.

Volatility in this sector triggers localised protests and site sabotage from disappointed communities facing unmanaged employment expectations, though genuine community asset ownership may mitigate this friction.

Simultaneously, public research entities and TVET networks attempt to mitigate these structural deficits, though their interventions remain severely resource-constrained and bottlenecked by low throughput rates. Rather than functioning as frictionless pipelines, these institutional networks struggle to align educational supply with factory-floor realities, with limited implementation of targeted industrial training, technological research support, and specialised gender equity frameworks.

Concurrently, organised trade unions spearheaded by Cosatu, Numsa, and NUM leverage structures like Nedlac and Itac to institutionalise the Decent Work Agenda and demand labour reciprocity from tariff-protected importers. Trade unions also actively contest infrastructure privatisation, advocating instead for a centralised state-owned shield to secure permanent manufacturing jobs. To overcome low unionisation rates among transient RE construction workforces, trade unions also seek to establish a sectoral bargaining council, while utilising targeted toolkits to ensure the transition dismantles institutionalised gender divides.

Ultimately, the state's failure to coordinate its policy mix means that despite progressive legislative ambitions, existing interventions inadvertently cede control of how localisation happens, enabling the expansion of global producers over opportunities for domestic industrial upgrading. Integrating structural blockages, unequal power levels, and multi-actor frictions across the entire production network provides the foundational baseline for the final section of this report, which outlines actionable policy recommendations to expand South African localisation equitably.

8. CONCLUSION: INCREASING LOCALISATION THAT ENABLES DECENT WORK AND GENDER EQUITY

Synthesising the empirical insights on RE localisation involving domestic value creation and capture, decent work, and gender dynamics with a structural analysis of the factors and actors shaping the sector allows this report to distil specific industrial challenges, identify opportunities, and develop targeted policy recommendations. This section begins by isolating these key challenges and opportunities. It subsequently presents actionable policy recommendations before concluding with an analytical reflection on the future of South Africa's RE landscape.

8.1 Key challenges and opportunities

The interaction of shifting market dynamics, institutional blockages, and unequal power disbursement across actors creates a highly demanding commercial landscape that defines the primary hurdles and opportunities facing South Africa's green industrial transition. These forces operate across four interconnected thematic axes: market dynamics, institutions and governance, domestic productive capabilities, and inclusion and decent work.

8.1.1 Market dynamics

Market challenges

A. Price Competition. Domestic manufacturers face immense pressure from high production costs with domestic component and subcomponent fabricators remaining significantly more expensive than international suppliers. This disparity is driven by multiple factors including a historical deficit in state-directed industrial supports, low production volumes, and an imbalanced regulatory landscape where locally made products face more stringent compliance standards than imported alternatives. While publicly managed RE projects have built in demand for local content, increased liberalisation in the sector has made global price competition a stronger factor.

B. 'Stop-Start' Demand Cycles from Public Procurement. Demand levels fluctuate severely due to erratic tender windows, creating a volatile market environment that disrupts local production lines. This commercial instability prevents manufacturers from negotiating long-term component pricing with upstream suppliers, stabilising production schedules, or justifying physical facility investments.

C. Global Project Implementers Rely on Existing Suppliers Leaving Limited Opportunities for South African Manufacturers. IPPs and EPCs maintain existing relationships with preferred suppliers that often shut out new relationships with South African suppliers. Moreover, in some cases, global businesses are vertically integrated and source inputs within self-owned supply chains.

Market opportunities

A. Attracting Global Technology Transfers and FDI. The shifting global landscape offers an industrial catch-up opportunity to leverage (South-South) cooperation by attracting established multinational firms—most notably Chinese manufacturers—seeking to diversify their production footprints (I32 Trade Union). South Africa and the broader African Union can strategically negotiate tangible technology-sharing frameworks and JVs that accelerate knowledge flows and build domestic manufacturing capacity. A key aspect of this opportunity is filling South Africa's gap in cell manufacturing. This research showed that existing battery pack builders are not interested in updgrading into this tier (I26 Battery Industry Manager). Therefore, a significant opportunity exists to attract foreign companies with established expertise to set up environmentally responsible battery cell manufacturing facilities (I22 Components Manufacturer).

B. Leveraging the Surging Private Track and Decentralised Markets. The dismantling of Eskom's monopoly, the elimination of Nersa licensing caps, and the expansion of decentralised SSEG frameworks across local government structures have unlocked a massive private, business-to-business value chain (DEE et al. 2025). By supplying hardware directly to commercial, industrial, mining, and agricultural buyers —alongside private IPPs and EPC contractors managing private grid connections—local component manufacturers can secure stable, long-term revenue streams that bypass public procurement bottlenecks (Sawea 2025; Hermanus and Kamanzi 2026). However, capitalising on this decentralised market is not straightforward, as private buyers regularly default to established international procurement channels (see Market Challenge C: Global Project Implementers Rely on Existing Suppliers Leaving Limited Opportunities for South African Manufacturers).

C. Expanding State-Led Renewable Energy Generation with Local Content Requirements. To ensure predictable demand for local producers, the government can ensure that RE projects continue to be developed by the public sector with strict LCRs. A key player in this process could be Eskom Green. Additionally, municipally managed projects can also establish LCRs.

8.1.2 Institutions and governance

Institutions and governance challenges

Policy design, inconsistency, and institutional alignment gaps

A. Watering Down of Local Content Policies. State-directed industrial policy metrics prioritising LCRs degraded in the face of NECOM's crisis response priorities that overrode long-term development criteria (Hermanus and Kamanzi 2026). Although subsequent tender frameworks attempted to rectify early design defects by migrating to component-targeted minimum thresholds, the continuous

approval of porous post-bid exemptions has insulated commercial project developers from using domestic factories (Borchardt 2025; Sapvia 2024). This regulatory backtracking has directly penalised local component builders, squeezing factory utilisation rates and rendering local entrepreneurs deeply sceptical of expanding physical plant capacity based on expected demand from public sector tender pipelines (CES 2022; Morris et al. 2022; Sawea 2025).

B. Erratic Policy Implementation. South Africa's inconsistent regulatory execution and frequent delays in finalising national energy roadmaps destroy long-term investor confidence. This bureaucratic gridlock forces local factories to operate below capacity or face permanent closure, as prolonged state delays push project developers to default to cheap foreign imports to meet compressed grid-connection deadlines (Sapvia 2024; Morris et al. 2022; Hermanus and Kamanzi 2026).

C. Lack of Government Policy Coordination and Regulatory Clarity. Conflicting mandates across different government departments actively fracture the RE industrial landscape, leaving policy-making and implementation branches pulling in opposite directions and rendering local value capture initiatives toothless. This friction reflects a deep structural misalignment between industrial departments like the dtic, which push for local sourcing, and financial bodies like the National Treasury, which prioritise lowest-cost project tariffs. This inter-ministerial conflict creates severe regulatory uncertainty that prevents domestic manufacturers from securing stable public procurement commitments.

D. Trade and Tariff Misalignment. Current trade and tariff arrangements do not consistently support the development of competitive domestic RE manufacturing. This deficit is driven by an unrefined customs architecture where raw subcomponents and completed hardware are lumped into the same code categories, preventing Sars from executing targeted protection. Consequently, this classification blur leaves local assemblers competing with cheap, finished foreign imports while simultaneously inflating the customs duties on the imported raw inputs required for domestic manufacturing.

Technical infrastructure, capabilities, and data systems

E. Weak Standards, Testing, and Certification Systems. South Africa's RE industry lacks sufficiently developed product testing, certification, and quality assurance systems to consistently distinguish high-quality domestic products from poor-quality imports. This deficit weakens confidence among installers and buyers, reduces opportunities for local manufacturers to compete on quality rather than price, and allows substandard imported products to undermine reputations. Domestic firms also struggle with a lack of enforcement that leads to unfair competition as unpoliced and cheap knock-offs enter the market, causing structural failures or electrical fires that damage broader sector credibility (I13 Component Manufacturer Manager). Crucially, the absence of accessible testing infrastructure restricts domestic innovation opportunities by forcing local firms to absorb prohibitive international laboratory fees to validate new component designs.

F. Data Quality Challenges. Current methods of measuring employment-related outcomes in the RE sector use narrow metrics that can obscure the actual net impacts of RE interventions (Hermanus 2022; Musonda 2026). This measurement gap directly distorts both job creation and community outcomes, preventing accurate evaluations of policies influencing RE value chains.

Asymmetric policy influence

G. Concentration of LCR Benefits. A restricted set of firms benefiting from LCRs monopolises public contracts, consolidating resources within established corporate networks. These firms get multiple orders related to public tenders, while other eligible firms report struggling to access these contracts.

H. Liberalisation of Energy Markets. Accelerated liberalisation of energy markets decreases the impact of LCRs in public tenders, as publicly tendered projects drop as a proportion of total energy provision. Crucially, private tracks operate outside the influence of state-enforced developmental scorecards, directly undermining their objectives which promote localisation, decent work, and gender equity. Driven by short-term cost-minimisation mandates, deregulated private buyers actively default to low cost, pre-assembled foreign hardware. Because private business-to-business transactions escape the statutory procurement rules attached to public utility tenders, these private track projects routinely bypass B-BBEE frameworks, ring-fenced training and executive pipelines previously established to support women, and collective bargaining structures. Market liberalisation thus traps workers in temporary, non-unionised installation roles.

I. Corporate Capture and Exclusion of Small and Medium Enterprises. The formulation of national industrial strategies or trade protections is heavily compromised by focusing on the voices of large firms. This creates an asymmetric lobbying landscape where multinational project developers, EPC contractors, and large-scale equipment importers possess the institutional resources to heavily influence policy outcomes. Smaller domestic manufacturers and local SMEs face systemic exclusion from these policy dialogues. This imbalance has fractured industry representation, leading some domestic producers to explicitly boycott legacy trade associations and opt to form new, fragmented sector advocacy networks to get their voices heard by the state. This corporate capture is exemplified by the heavy presence of IPPs and multinational developers during the creation of SAREM, which led to significant policy compromises that weakened manufacturing LCRs in favour of import flexibility.

Regulatory evasion and systemic abuse

J. Corruption. Corruption manifests through distinct channels which include customs fraud, corporate fronting, and active extortion. Specifically, industry stakeholders report that unverified international suppliers and local distributors deliberately misclassify high-value imported equipment to dodge national customs duties and evade state measurement. For instance, high-value power transformers are routinely registered under shipping manifests as generic fasteners or basic wind turbine components (I22 Components Manufacturer; I30 Cross-Sectoral Expert). This technical blindness prevents Sars from accurately tracking the true volume of RE hardware crossing national borders, rendering approved protective tariffs functionally ineffective because the state cannot measure what it cannot see. Furthermore, corrupt tenderers exploit procurement gaps through B-BBEE fronting, using shell entities to falsify local ownership metrics and artificially inflate development scorecards while routing actual value away from domestic communities. Broader, more pervasive corruption also hinders business viability and the quality of production. One respondent described how corruption leads to lower quality manufacturing:

> *"[I have to] keep on underneath the table feeding this guy here and this guy … I can't use that amount of money … So, now I have to start skimping here and putting in as low as quality possible that I can get, that will still work when I switch it on the first time."* (I13 Component Manufacturer Manager)

K. Evasion of Local Content Policies. Commercial project developers frequently exploit weak regulatory enforcement to circumvent national localisation scorecards, often with the tacit approval of state entities prioritising rapid capacity deployment (Hermanus and Kamanzi 2026). This circumvention stems from a legacy tender design that evaluated aggregate capital expenditure instead of isolated component metrics, enabling bidders to fulfil their statutory obligations through non-manufacturing categories like basic civil works and BoP infrastructure (Morris et al. 2022). By exploiting these structural flaws and securing post-bid modifications, transnational consortia claim full regulatory compliance while flooding the domestic market with cheap, fully assembled foreign hardware (CES 2022; DEE et al. 2025).

Geopolitical and foreign state interventions

L. Foreign State Subsidisation of Homegrown Enterprises. Foreign states deploy broad ranging support to back their own domestic firms and stimulate strong national innovation systems. This creates a challenge for South African firms who struggle to compete with foreign conglomerates that can, for example, offer high-quality products at a low cost.

Institutional and governance opportunities

A. Building Regional Connections. South Africa can position itself as a regional manufacturing and export hub for RE components by leveraging the African Continental Free Trade Area (AfCFTA), its relatively advanced logistics infrastructure, and rapidly growing RE demand across Southern and broader African markets. Strengthening regional value chains would allow domestic firms to source inputs from neighbouring countries while exporting higher-value manufactured components, helping to achieve economies of scale and improve the competitiveness of South African producers (I37 Government).

B. Establishing Collaborative Production Alliances and Small-Firm Joint Bidding. Smaller domestic manufacturers are traditionally locked out of public utility tenders due to a technical capacity and volume mismatch. An opportunity exists for small-capacity manufacturers to collaborate through outsourcing or collaborative models to jointly fulfil large utility contracts. For example, an energy storage manufacturer (I21 Battery Industry Manager) affirmed that allocating a stable base of multi-gigawatt-hour public contracts across local firms would allow the sector to scale up rapidly without direct state financial inputs.

C. Improving Government's Responsiveness to Market Conditions. Updating national procurement policies more frequently would allow the state to dynamically adapt to shifting market conditions.

8.1.3 Productive capabilities

Productive capabilities challenges

A. Skill Shortages. Acute domestic RE expertise shortages operate across two distinct educational tiers, disrupting both localised shop-floor operations and advanced industrial engineering tracks. At the vocational tier, uncoordinated TVET initiatives suffer from weak industry alignment, producing certified graduates who struggle to secure formal placement within active production lines (I18 Government). Concurrently, the advanced academic tier faces a severe retention deficit. Postgraduates and senior engineering professionals migrate abroad due to prolonged domestic market instability, stripping local manufacturers of the specialised R&D capacity needed for high-value innovation (I27 Solar Industry Manager; I31 Trade Union Representative).

B. Limited Capacities of Firms. Small domestic enterprises face severe capital access barriers that restrict their entry into RE production networks, often leaving them locked out of high-value supply tracks (I30 Cross-Sectoral Expert). Furthermore, localised capital deficits limit production volumes across the entire sector, forcing even established South African manufacturers to absorb higher unit costs than global competitors who benefit from massive economies of scale. Beyond these firm-level constraints, South Africa has deficits in key upstream value-chain nodes, including commercial solar cell manufacturing, LIB cell manufacturing, and advanced mineral processing capabilities. These industrial gaps are partially driven by a historical lack of large-scale capital investment and long-term funding commitments. This upstream void forces an unmitigated reliance on imported core technologies, trapping domestic firms in downstream assembly roles where they cannot achieve global competitiveness.

Productive capability opportunities

A. Capitalising on Low-Risk SME Subcomponent Spin-offs. While entering top-tier core manufacturing is capital-intensive, local assemblers require an expanding array of secondary inputs, creating a powerful entry point for SMEs to capture localised production value. This demand provides small local firms with clear commercial pathways to manufacture items such as frames, junction boxes, and specialised chemical adhesives without absorbing prohibitive upfront machinery overheads (I11 Solar Industry Manager).

B. Establishing Core Midstream Manufacturing Capabilities. Expanding domestic demand for highly complex midstream components such as solar PV and battery cells creates a significant opportunity to establish local production lines. While traditionally restricted by steep capital barriers and intense global cost competition, establishing domestic cell production facilities bridges a vital value-chain gap, reducing the country's import dependency and unlocking high-value component manufacturing nodes. As local firms generally do not have the resources needed to invest in this stage of production, capitalising on this tier requires state-led development or targeted frameworks to attract foreign investors (see Market opportunities A: Attracting Global Technology Transfers and FDI).

C. Upgrading Domestic Mineral Beneficiation Capabilities. South Africa' s mineral resources create a large opportunity. Building domestic processing capabilities can feed into multiple parts of RE value chains. A particular opportunity is providing inputs for cell manufacturing.

D. Scaling up Services. Firms can build competitive advantages by adding specialised aftercare services to their existing manufacturing structures or establishing independent O&M business models. Rather than attempting to compete head- on with dominant global monopolies on bulk hardware pricing, South Africa can secure low- cost imported equipment to drive a cheap green transition while scaling up a domestic, high- value servicing sector (Sapvia 2024). In addition, the expansion of RE offers substantial openings for South African enterprises to move away from rigid, transactional sales and capture value through the development of innovative business models. One opportunity is that firms can expand business models that focus on BaaS.

E. Expanding Recycling Capabilities. Deploying circular economy business models to harness upcoming RE technology decommissioning waves presents high-growth commercial opportunities. By setting up specialised recycling enterprises to handle end- of- life solar panels, battery components, and wind assets, South African firms could capture secondary materials, prevent heavy -metal leaching and other potential forms of pollution, and unlock circular economy job segments (Pandarum et al. 2023; DEE et al. 2025; Moshikaro- Amani 2026). A government representative emphasised the role of the state in informing the private sector about these emerging circular opportunities, a role that could be supported by setting up municipality- owned, state-subsidised e- waste hubs (I36 Government; IEJ and Cosatu 2021). Furthermore, domestic fabricators can increase the quality of their products by ensuring their hardware designs are fully serviceable and recyclable from the onset (I17 Battery Industry Manager).

8.1.4 Inclusion and decent work

Inclusion and decent work challenges

A. Unequal Benefits of Transition. A key risk of RE expansion is that private companies end up owning all RE infrastructure and that electricity will not be available for all (I31 Trade Union Representative). Furthermore, without concerted policy efforts, local businesses may not have adequate participation in production processes, which restricts the growth of manufacturing as an anchor for decent work, concentrating domestic value capture away from workers and job outcomes. Another risk is long- term unemployment following the loss of coal jobs, as regional variations shape how RE benefits are distributed and enjoyed. Moreover, current economic activities are not creating sufficient jobs, with employment heavily skewed toward volatile, short- term roles rather than sustained manufacturing or O&M positions. This deficit in job quality is particularly felt by workers in casual contracts that feature high work intensity, a lack of health benefits, and non- compliance with national labour standards like UIF contributions.

B. Gender Stereotypes and Occupational Segregation. Persistent gender stereotypes continue to shape recruitment, training, and career progression across the RE sector, contributing to the underrepresentation of women in technical, leadership, and higher- paid occupations. Women are often concentrated in lower- paid administrative and support roles despite having the skills and capacity to perform technical work.

C. Unequal Social Reproduction Burdens. Women continue to shoulder a disproportionate share of unpaid care work and household responsibilities, limiting their access to training, employment, and career advancement in the RE industry.

D. Limited Trade Union Representation. While organised labour has successfully elevated the Just Transition and Decent Work Agendas into national green industrial frameworks, actual union density on the ground remains limited and fragmented across South Africa's emerging RE value chains. This representation gap is fundamentally driven by dual structural barriers spanning both manufacturing plants and construction sites. Union density within geographically fixed factories is heavily suppressed by a widespread reliance on short-term contracts that create chronic precarity and disrupt stable workplace organising. Downstream, the highly mobile and transient nature of utility-scale construction deployment creates severe operational hurdles for traditional unions accustomed to fixed geographical hubs. Operating across scattered locations defined by transient contract cycles, local union structures struggle to effectively recruit, represent, and organise these atomised workforces. This structural exclusion leaves casualised workers highly vulnerable to precarious contract conditions, unpaid statutory benefits, and weak collective bargaining power.

Inclusion and decent work opportunities

A. Generating Increased Numbers of Good Jobs in Renewable Energy Production Systems. The high labour intensity of specific manufacturing segments — such as solar tracker systems and BoP hardware — provides an economic entry point for deep domestic job creation and broader socio-economic upgrading (Sapvia 2024). Coordinated technical upskilling through updated TVET courses and dedicated work placements could allow new people, including women, to develop manufacturing or service careers (DEE et al. 2025; Sawea 2025).

B. Expanding Worker, Social, and True Community Ownership Models. To dismantle high levels of economic concentration where wealth is held by a few companies and insulated from the majority of South Africans, the green transition offers a powerful opening to change ownership relations and power dynamics by institutionalising worker-led equity and genuine social ownership (I15 Trade Union Representative). Moving beyond the passive, compliance-driven shareholding structures currently used in public tenders, establishing new social models can transform communities from passive recipients of social spend into asset stakeholders with a direct financial and employment interest in RE infrastructure. Community ownership can also create more positive relationships between communities and companies, particularly where state policies enable and enforce meaningful community participation in ownership (I29 Cross-Sectoral Expert).

C. Expanding Rural Mini-Grids for Localised Community Livelihoods. Some rural areas of South Africa remain distant from central transmission lines, making decentralised RE mini-grid infrastructure a viable electrification path. Deploying these systems creates sustainable, long-term technical and service livelihoods for marginalised youth within isolated spaces, avoiding the prohibitive capital expenditures required to expand central grid infrastructure. A government representative highlighted that this decentralised approach aligns perfectly with regional geographical realities, providing an efficient electrification mechanism that anchors permanent local maintenance and operational jobs directly within rural host communities (I36 Government).

8.2 Recommendations

Coordinated public policy and strategic state interventions can be key drivers to dismantle systemic challenges, unlock local manufacturing capabilities, and secure equitable development tracks. To achieve these objectives, the interventions described below operate across five core programmatic areas: shaping demand, regulating and promoting trade and FDI, supporting business upgrading, driving inclusivity, and increasing government effectiveness. Table 3 shows the key ministries, institutions and supporting bodies associated with each recommendation area and Appendix D shows how these recommendations are connected to the challenges and opportunities described above.

Table 3: Key actors associated with each recommendation area

Recommendation area	Main lead ministries / institutions	Key supporting bodies
8.2.1 Shaping Demand	DEE, IPP Office, dtic, National Treasury	Eskom Green, SABS, Sars, provincial and municipal government
8.2.2 Trade, Investment & Regional Development	dtic, Itac, Sars, InvestSA	DEE, DIRCO, mineral resources functions, DoT, Transnet, National Treasury
8.2.3 Supporting Business Upgrading & Increasing Local Manufacturers' Competitiveness	dtic, DSTI, DSBD, DFFE	IDC, CSIR, Mintek, SANAS, universities, municipalities
8.2.4 Decent Work & Inclusivity	DHET, Ewseta, DEL, National Treasury	Nedlac, Stats SA, DEE, dtic, DWYPD
8.2.5 Government Coordination & Implementation	Presidency/Cabinet coordination, dtic, DEE	National Treasury, DSTI, DSBD, DEL, Nedlac

Source: Author's creation

8.2.1 Shaping demand

Creating predictable demand allows the local industry to grow and upgrade.

I. Establish Continual Public Tenders to Build a Sustainable Manufacturing Sector. Move from irregular 'stop-start' procurement rounds to predictable, multi-year procurement supported by regular IRP updates. Greater demand certainty improves factory utilisation and supports long-term manufacturing investment.

II. Expand the Role of Eskom Green. Capitalise on Eskom Green as a primary state-backed anchor customer to secure consistent, long-term procurement pipelines for domestic RE manufacturers. Providing predictable, multi-year funding to Eskom Green allows the utility to issue large-scale hardware offtake guarantees, insulating local factories from private market volatility and anchoring sustainable production volumes.

III. Strengthen the Design, Implementation, and Enforcement of Local Content Requirements. The state must firmly institutionalise and standardise the component-specific minimum thresholds introduced in recent bidding rounds to eliminate developer circumvention (Borchardt 2025). Crucially, the state must design these tender rules to prevent cost-minimisation criteria from eroding domestic advantages, ensuring that procurement evaluation metrics actively prioritise long-term developmental categories over short-term price competition. Implementation and enforcement must be strengthened through a standardised pre-qualification framework. The South African Bureau of Standards (SABS) should administer upfront verifications and issue official local content certificates at the bidders' expense to prevent developers from evading localisation policies via minor civil works spend instead of high-value component sourcing. Enforcement must link to punitive legal tools, compelling non-compliant bidders to deploy locally manufactured equipment at their own cost alongside facing public tender debarment. To ensure complete transparency, the dtic must formally gazette all waivers, while actual levels of realised local content must be publicly reported to ensure full accountability, and procurement committees must be equipped with skilled technical personnel to reject falsified compliance claims.

IV. Enable Shared Orders and Capacity Pooling for Smaller Firms. The public IPP Office should issue single, multi-gigawatt, bankable anchor contracts specifically structured to allow networks of smaller local component manufacturers to pool production capacity, enabling domestic industry collaboration.

V. Mandate Regional and Municipal Geographic Sourcing Minimums. Allow municipalities and provincial governments to incorporate local geographic sourcing requirements into RE procurement where appropriate. This guarantees baseline demand for RE component factories operating within regions.

8.2.2 Trade, investment and regional market development

Strategic cross-border trade interventions allow South Africa to shift its position within GPNs by exploiting changing international geopolitical dynamics.

I. Refine Tariff System to Provide Targeted Support to RE Manufacturers. Updating the national tariff architecture insulates infant RE industries from predatory foreign pricing structures. Revising customs classifications to distinguish between cells (to be duty-free) and completed battery packs (to have tariffs) would benefit local producers. Tariffs can also be applied to steel and cement imports (where cement imports are not banned), as well as to steel towers and internals, directly increasing the competitiveness of local products.

II. Implement Port-of-Entry Customs Audits to Combat Trade Corruption. Deploying targeted Sars and Itac inspectors to ports of entry combats the 'staged consignment' loopholes used to circumvent local content scorecards and other irregularities. This operational enforcement verifies tariff codes, combats customs fraud, and protects compliant local producers from unfair import undercutting.

III**. Attract Global Cell Plants and Mineral Refiners.** InvestSA could offer specialised industrial zone incentives to attract major global cell manufacturers and mineral refiners, expanding local production and accelerating local knowledge flows.

IV. Create Regional Mineral Refining Hubs to Secure Supply Autonomy. Use AfCFTA frameworks to sign bilateral trade pacts with mineral-rich neighbours, importing raw resources for processing inside vertically integrated refineries to secure the raw inputs required for RE component manufacturing. This action can be tied with capacity building (see Section 8.2.3).

V. Position South Africa as a Regional Renewable Energy Manufacturing and Export Hub. Exploit AfCFTA frameworks to align trade and investment policies to attract export-oriented investment, strengthen regional value chains, reduce non-tariff barriers, and improve cross-border logistics to enable domestic firms to compete in African markets. This recommendation should be implemented alongside capacity building measures (see Section 8.2.3).

8.2.3 Supporting business upgrading and increasing local manufacturers' competitiveness

Providing support directly to South African RE manufacturers can also create impact.

I. Reduce Utility Costs for Domestic Manufacturers. Implementing targeted electricity and water tariff relief frameworks for registered RE component manufacturers can protect infant green technology industries from uncompetitive local input costs. The state could coordinate with NERSA and local municipalities to provide such supply-side cost relief, allowing local component builders to lower their per-unit production costs and more effectively compete against international hardware imports.

II. Simplify Administrative Processes. Establishing one-stop regulatory approval systems under the dtic streamlines licensing pipelines and reduces costly operational delays for local manufacturers.

III. Support Upgrading for RE Manufacturers. Implementing a comprehensive business upgrading framework that builds domestic firm capabilities across all tiers of the RE value chain can help to fill in gaps where value chain nodes are absent or current offerings are not competitive. Deploying targeted production subsidies and grants can support new entrants and existing domestic factories to become active RE suppliers. Capital grants and concessional green loans could directly support firms in covering prohibitive capital-switching expenditures. This process could involve reinstating Section 12I Tax Allowances and providing strategic subsidies to local companies, such as steel producers and other raw input suppliers to expand capacity in domestic RE supply chains. Crucially, the state must increase public funding for innovation to support R&D and technological advancement, expanding domestic mineral beneficiation capabilities, de-risking localised prototype testing, and

encouraging foreign knowledge transfer. To embed these capabilities, public tenders can mandate technology transfer from global OEMs to lower-tier producers, expanding the dtic's Strategic Partnership Programme so that lead contractors share technical blueprints and tooling configurations with existing local factories, to lower entry barriers for midstream subcomponents like aluminium module frames, junction boxes, and cabling tools.

IV. Expand Service Provision and Service-Led Business Models. Deploying service-led business models—which include BaaS, specialised diagnostics, and localised maintenance—creates long-term sources of revenue. The frameworks reduce upfront capital costs for buyers while capturing high-value domestic aftercare yield. Crucially, transitioning to ongoing contracts like BaaS (e.g., VRFB liquid electrolyte leasing) insulates domestic enterprises from the volatility of public procurement windows. Furthermore, this service-oriented pivot establishes permanent local maintenance channels and supports asset-retention frameworks, ensuring that valuable core hardware and secondary minerals are kept within the country to anchor circular recycling loops.

V. Establish Recycling Loops and Reverse Logistics Channels. Developing circular business models for recycling, remanufacturing, and refurbishment creates opportunities to capitalise on upcoming RE technology decommissioning waves. The state can guide domestic firms on global extraction technologies to build commercial loops for upcycling materials from solar PV, battery packs, and wind turbine blades. At the same time, the state could introduce regulatory mandates that encourage design for repair, reuse, and recycling and subsidise localised reverse logistics hubs to overcome the prohibitive transport freight costs that make remote rural recycling unviable. Municipal-run facilities could also play a role in processing post-use RE products.

VI. Launch Shared Quality Testing Labs to De-Risk Local Innovation. Establishing state-subsidised, accredited testing laboratories via CSIR, Mintek, and university networks would enable local manufacturers to clear restrictive international 'certification walls' without incurring prohibitive overseas shipping costs. These shared facilities could embed dedicated solar, wind and battery e-waste upcycling research hubs to internalise advanced turbine blade, spent battery packaging, and PV cell repurposing methodologies within active local manufacturing operations.

VII. Foster Industry Interactions and Networking. Institutionalising comprehensive multi-stakeholder network platforms is essential to bridge deep communicative divides across South Africa's RE landscape. Establishing formal business-to-business networking platforms connects local manufacturing SMEs directly with established multinational OEMs. Launching regional RE development hubs can link academic researchers and private manufacturers, accelerating the commercialisation of localised innovations. Furthermore, knowledge about existing government support systems and programmes should be shared through expanded network connections to ensure that smaller enterprises can navigate infant-industry tariff protections and accessible credit frameworks. Crucially, these strengthened network bridges must be leveraged to feed the operational perspectives of these smaller firms back into government policy-making processes.

8.2.4 Driving decent work and inclusivity

Driving broad-based social transformation across the green transition requires a comprehensive shift away from precarious employment models toward structured equity and inclusivity. To achieve this, the state must anchor targeted technical upskilling initiatives within ownership reforms, active gender de-segregation, and enforceable labour accountability frameworks.

I. Run TVET Programmes with Ring-Fenced Gender Quotas. Reallocating the Ewseta funding framework away from centralised utility monopolies toward decentralised, demand-led technical courses at local TVET facilities could address acute talent shortages and pull women into advanced manufacturing tracks. This intervention should prioritise training in regions targeted for RE investment, while tender requirements should be expanded to compel project developers to fund graduate work-placements, directly linking state-subsidised training to permanent employment guarantees.

II. Enhance Social Impact of Public Procurement. Establishing an improved system for mandating local equity stakes for workers and local communities could help to dismantle extreme wealth concentration. To ensure that B-BBEE requirements lead to broad-based impact and prevent over-reliance on a narrow supplier group, measures need to be taken to discourage fronting and corruption by implementing robust monitoring safeguards across project consortia. Additionally, the state should provide targeted capacity-building support to workers and communities holding these equity stakes to facilitate more sustainable developmental outcomes.

III. Make Continued Industrial Policy Support Conditional on Providing Decent Work. Linking all state-directed industrial support, including protective tariffs and local manufacturing designations, directly to strict labour law compliance, training allocations, and decent work standards ensures that public protections actively drive workplace transformation. Such a system could be facilitated through having trade union representatives integrated into state monitoring committees.

IV. Refine Methods of Measuring Development Outcomes. Standardising the transparent collection and reporting of employment and socio-economic metrics within the RE sector is vital to effectively coordinate labour and industrial policies. This updated framework must replace abstractly calculated 'job-years' with verifiable individual headcounts covering job characteristics (e.g., part-time versus full-time), while expanding tracking protocols to measure localised community outcomes, including direct asset ownership yields and the long-term impact of community trust investments.

V. Address Gender Stereotypes and the Burden of Reproductive Work on Women. Launching a targeted national awareness campaign that highlights women working in the RE industry in roles such as operating heavy machinery and leading engineering teams could help to dismantle persistent gender stereotypes and support career progression. To co-equally alleviate the structural burden of unpaid reproductive and domestic labour, the state can couple these media interventions with investments in subsidised, high-quality public care services and mandatory employer provisions for flexible working arrangements.

VI. Reskill Workers for Sustainable Transition Pathways. Deploying targeted retraining and skills-matching programmes for workers exiting legacy fossil-fuel industries is vital to build an adaptable

RE workforce. To ensure these opportunities align with the Decent Work Agenda, reskilling initiatives must explicitly transition workers into permanent, secure manufacturing and operational roles, rather than temporary, precarious construction contracts, while actively addressing the needs of older workers.

VII. Update Existing Curricula to Expand Knowledge and Skills Related to Renewable Energy. Integrating specialised RE modules directly into existing public vocational and tertiary engineering curricula will enhance the skill base of the domestic workforce. This intervention is necessary to support local industry standards and facilitate technology transfer.

8.2.5 Strengthening cross-government coordination and implementation of policies to support the renewable energy industry

Establishing mechanisms for inter-departmental policy coordination, information sharing, and joint implementation can support all other recommendations.

I. Coordinate Inter-Departmental Industrial Policies. Enforcing centralised, inter-departmental policy alignment between relevant bodies eliminates conflicting mandates, reduces administrative duplication, and secures long-term investor certainty by stabilising market rules. Simultaneously, this institutional alignment ensures that the state's industrial and socio-economic objectives are pursued in a complementary manner.

II. Be More Active in Seeking Industry Perspectives. Establishing structural feedback loops allows government departments to actively capture the operational experiences and commercial requirements of domestic manufacturing startups and SMEs. This information collection could be facilitated through the strengthened networks described in Section 8.2.3.

8.3 Final reflection: moving forward with the localisation agenda

Shifting ingrained production network structures and altering the balance of power across South Africa's RE sector requires the active, synchronised mobilisation of diverse national stakeholders. While the state provides the essential legislative scaffolding and enforcement mechanisms, domestic actors such as local manufacturing firms, commercial lenders, organised labour, and vocational institutions must actively align their strategic operations. Crucially, driving this agenda forward requires a collective commitment to industrial innovation, where public laboratories, universities, and private enterprises dynamically partner to bridge the commercialisation 'valley of death'. Expanding domestic capabilities allows these networks to decrease dependencies on foreign imports and transform South Africa's RE landscape. It requires lead contractors to allocate strategic commercial opportunities to local firms, financial actors to back early-stage RE initiatives, and trade unions to continuously promote the Decent Work Agenda. Ultimately, moving forward with this agenda requires aligning such efforts across diverse stakeholders.

9. REFERENCES

Alexander, R. (2026). *Using Policy to Build South Africa's Renewable Energy Industry and Create Decent, Equitable Jobs: Methodological Annex.* IEJ

Andreoni, A., Mondliwa, P., Roberts, S., & Tregenna, F. (2021). *Framing structural transformation in South Africa and beyond*. Oxford University Press.

Ashley, B., Chavez, D., Forslund, D., Sweeney, S., & Van Niekerk, S. (2020). E*skom Transformed: Achieving a Just Energy Transition for South Africa*. Alternative Information & Development Centre, Transnational Institute, and Trade Unions for Energy Democracy.

Baker, L., & Sovacool, B. K. (2017). The political economy of technological capabilities and global production networks in South Africa's wind and solar photovoltaic (PV) industries. *Political Geography*, *60*, 1–12.

Baloyi, B., & Krinsky, J. (2022). *Towards a just energy transition: A framework for understanding the just energy transition partnership on South Africa's just transition*. Climate Finance Series Policy Brief 1. IEJ.

Barnes, J., King, M., Ndlovu, M., Carstens, K., Marais, O., Ellis, S., & Kirsten, D. (2023a). *Manufacturing Localisation Potential in Renewable Energy Value Chains: Solar Photovoltaic Localisation Potential*. LSF.

Barnes, J., King, M., Ndlovu, M., Carstens, K., Marais, O., Ellis, S., & Kirsten, D. (2023b). *Manufacturing Localisation Potential in Renewable Energy Value Chains: Wind Energy Localisation Potential*. LSF.

Barnes, J., King, M., Ndlovu, M., Carstens, K., Marais, O., Ellis, S., & Kirsten, D. (2023c). *Manufacturing Localisation Potential in Renewable Energy Value Chains: Battery Energy Storage Localisation Potential.* LSF.

Bello, W. (2022). The Global South in the WTO: Time to go on the offensive. *Foreign Policy in Focus.*

BloombergNEF. (2026). *BloombergNEF's South Africa Transition Factbook: Power-Market Reform and Private Investments Drive Energy Transition*.

Borchardt, S. P. (2025). Dust in the wind: Renewable energy and the limits of South Africa's developmental state. *New Agenda: South African Journal of Social and Economic Policy*, 2025(99), 38-62.

Bradsher, K. (2024). How China Came to Dominate the World in Solar Energy. March 7, *New York Times*.

Bulbulia, T. (2024). EWSETA undertakes programme to boost renewables skills development, at TVET colleges. *Engineering News*.

Burger, S. (2026). Renewable energy training centre at Vhembe TVET College the first of national programme. *Engineering News*.

Celli Junior, U. (2019). The Impact of WTO Case Law on the Use of Local Content Requirements. In A. d. Amaral Júnior, L. M. d. O. Sá Pires, & L. Carneiro (eds.) *The WTO Dispute Settlement Mechanism: A Developing Country Perspective*. Cham: Springer International Publishing, p. 83-97.

CES. (2022). *South Africa & Southern Africa Battery Market & Value Chain Assessment Report*. Flagship Report. World Bank Group.

City of Cape Town. (2024). *City News: Area North Edition*. December 2024. Issue 70.

Coe, N. M., Dicken, P., & Hess, M. (2008). Global production networks: Realizing the potential. *Journal of Economic Geography*, *8*(3), 271–295.

Cosatu. (2024). *Just Transition Blueprint for Workers: Gender Toolkit*.

Crozier, M. N., Ntsala, P. G., Schenck, C., Crozier McCleland, J., van Dyk, E. E., & Petersen, J. (2025). Drivers, barriers and enablers of a South African circular solar PV module supply chain: A focus on reuse. *Waste Management & Research*, *43*(12), 2116–2132.

Davidson, K., Grotte, J., & De Lannoy, A. (2025). *Renewable energy skills mapping and labour market analysis in the Western Cape.* SALDRU Working Paper Number 313. Cape Town: Southern Africa Labour and Development Research Unit, University of Cape Town.

DEE. (2025). *Integrated Resource Plan: October 2025*.

DEE, dtic, and Department of Science, Technology and Innovation. (2025). *South African Renewable Energy Masterplan (SAREM): An inclusive industrial development plan for the renewable energy and storage value chains by 2030*.

DNV. (2025). *Energy Transition Outlook 2025: A global and regional forecast to 2060*.

dtic. (2025). *The dtic Annual Report 2024/25*.

dtic. (2026). *South Africa's Industrial Development Strategy*.

Eberhard, A., & Naude, R. (2017). *The South African Renewable Energy IPP Procurement Programme: Review, Lessons Learned & Proposals to Reduce Transaction Costs*. Graduate School of Business, University of Cape Town.

Eicke, L. (2025). Does policy design matter for the effectiveness of local content requirements? A qualitative comparative analysis of renewable energy value chains. *Policy Studies Journal*, *53*(3), 604–617.

Energy Solutions Intelligence. (2026). *Morocco Solar Industrial Park*.

Eskom. (2023). *Battery Energy Storage System*. Eskom Distribution.

Ettmayr, C., & Lloyd, H. (2017). Local content requirements and the impact on the South African renewable energy sector: A survey-based analysis. *South African journal of economic and management sciences*, *20*(1), 1–11.

Ewseta. (2022). *EWSETA, CJC and USAf join hands for meaningful TVET College participation in Renewable Energy*. Ewseta.

GIZ. (2023). *Study on Gender Diversity in the Wind and Solar Energy Industries in South Africa*.

GreenCape. (2024). *Industry Brief: Viable African export markets for South African renewable energy component manufacturers*. GreenCape.

Gumede, M. (2026). U.S. backs a South Africa project to extract rare earths despite a diplomatic clash. *Los Angeles Times*.

Guo, Q., & Li, J. (2024). Technological innovation structure and driving factors of China's photovoltaic industry: based on patent innovation network. *International Journal of Low-Carbon Technologies*, *19*, 1596–1609.

Gxasheka, A., Ndlovu, N., Mokoena, R., Moroeng, M., Makeke, I., Mantshintshi, S., & Maseko, P. (2026). *Nersa Report on Monitoring Performance of Renewable Energy Power Plants: Progress and Performance During 2025*. Issue 27 — March 2026. Nersa.

Hansen, U. E., Nygaard, I., Morris, M., & Robbins, G. (2020). The effects of local content requirements in auction schemes for renewable energy in developing countries: A literature review. *Renewable and Sustainable Energy Reviews*, *127*, 109843.

Havertz, R. (2026). The crisis of the WTO appellate body and the current trajectory of neoliberalism. *Frontiers in Political Science*, 8, 1779375.

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

Hermanus, L. (2022). *Employment metrics in South Africa's electricity value chains: Creating a basis for coherent discourse and decision-making*. Policy Brief: 4/2022. TIPS.

Hermanus, L., & Kamanzi, B. (2026). *South Africa Renewable Energy Policy Scan: Critical insights and questions for localisation and decent employment*. IEJ.

Hess, M. (2004). 'Spatial' relationships? Towards a reconceptualization of embeddedness. *Progress in Human Geography*, *28*(2), 165–186.

Hill, R., Malomalo, M., Manenji, S., Maphosa, S., Masondo, A., Matebese, K., Mlatsheni, C., Mpuongose, Z., Muntumuni, M., Neethling, L., Oosthuizen, M., & Sikhakhane, S. (2025). Restless Development and Development Policy Research Unit. *Green jobs and young people. South Africa country report*. Working paper. University of Cambridge

Humphrey, J., & Schmitz, H. (2002). How does insertion in global value chains affect upgrading in industrial clusters?. *Regional studies*, *36*(9), 1017–1027.

IEJ and Cosatu. (2021). *SAREM: Challenging Privatisation, Centring Public Ownership and Decent Work*. https://www.iej.org.za/sarem-challenging-privatisation-centring-public-ownership-and-decent-work/

IEJ and Cosatu. (2023). *Joint Submission on the draft South African Renewable Energy Masterplan*. 18 August 2023.

IEJ. (2026). Comment on the General Public Procurement Regulations of 2026. 15 July 2026.

ILO. (2007). *The ILO at a glance*. International Labour Office.

Infrastructure News. (2026). EWSETA Launches Renewable Energy Training Centre And Microgrid To Advance South Africa's Just Energy Transition.

IPP Office. (2026). *Independent Power Producers Procurement Programme (IPPPP) : An Overview as at 31 March 2026*. DEE.

Jardim, S. (2026). Steenkampskraal, Mintek achieve breakthrough in rare earth beneficiation. *Mining Weekly*.

Khan, Z. (2021). *Communities in Transition: The Role of Community Ownership in South Africa's REIPPP Programme.* Intellidex.

Krinsky, J. (2026). *Solar Panels and Inverters: Potential and Obstacles in South Africa.* IEJ.

Labuschagne, H. (2025). Massive batteries coming to South Africa. *Mybroadband*.

Labuschagne, H. (2026). South African solar panel company scores big win against government. *Mybroadband*.

Larsen, T. H., *&* Hansen, U. E., (2022). Sustainable industrialization in Africa: the localization of wind-turbine component production in South Africa. *Innovation and Development*, 12(2), 189-208.

Lavopa, A., *&* Riccio, F. (2025). *The multiplier effect of industrial jobs*. UNIDO Policy Brief Series: Insights on Industrial Development, Issue 18. UNIDO.

Lechman, A. (2026). Africa's renewable energy growth stifled by engineering skills crisis. *IOL*.

Lema, R., Rabellotti, R., *&* Gehl Sampath, P. (2018). Innovation trajectories in developing countries: Co-evolution of global value chains and innovation systems. *The European Journal of Development Research*, *30*(3), 345–363.

Li, A., Sun, Y., *&* Song, X. (2023). Gradual improvement and reactive intervention: China's policy pathway for developing the wind power industry. *Renewable Energy*, *216*, 119068.

Litheko, A., *&* Pelser, F. (2024). Strategic Implication Of Globalization On 'Brain Drain' In Emerging Economies: South Africa. *Management and Economics Research Journal*, 10(4): 9900099.

Mabele, B., Marais, L., Balta-Ozkan, N., Mirzania, P., Mbobo, B., van der Watt, P., Cloet, J., *&* Venter, A. (2024). Renewable energy, social disruption and formalising the social licence to operate in South Africa. *Corporate Social Responsibility and Environmental Management*, 31(1), 331-343.

Malope, B. J. (2022). *Power struggles: An exploration of the contribution of renewable energy to sustainable development, decent work and the "just transition" through a case study of wind farm development outside Loeriesfontein, Northern Cape Province (2011–2020)*. Doctoral Dissertation. Stellenbosch University.

Monaisa, L., *&* Montmasson-Clair, G. (2022). *South Africa's Aluminium Value Chain and Climate Change Compatibility*. TIPS.

Montmasson-Clair, G. (2024). *Bridging the gap between aspiration and reality: What would it take to localise the renewable energy value chain in South Africa*. Policy Brief: 3/2024. Trade and Industrial Policy Strategies.

Morris, M., Robbins, G., Hansen, U., *&* Nygaard, I. (2022). The wind energy global value chain localisation and industrial policy failure in South Africa. *Journal of International Business Policy*. *5*, 490–511.

Morrison, A., Pietrobelli, C., *&* Rabellotti, R. (2008). Global Value Chains and Technological Capabilities: A Framework to Study Learning and Innovation in Developing Countries. *Oxford Development Studies*, *36*(1), 39–58.

Moshikaro-Amani, L. (2026). *A Green Industrial Policy Framework for South Africa's Battery Value Chain*. TIPS.

Musonda, J. (2026). *Value, power, and embeddedness in the South African wind turbine towers manufacturing sector: implications for industrial policy*. IEJ.

Musonda, J. (*Unpublished*). *Value, Power, and Embeddedness in South Africa's Battery Energy Storage Systems Manufacturing and Assembly: Implications for Industrial Policy.* IEJ.

NBI. (2024). *Powering Futures: The Green Skilling Opportunity*. NBI and BCG.

NTCSA Media Desk. (2026). *The NTCSA provides an update on the establishment of the Wholesale Electricity Market in South Africa (SAWEM).*

Pandarum, A., Rakaibe, T., & Mbam, V. (2023). Battery Energy Storage Systems Value Chain Analysis for the Identification of Opportunities for Enterprise Development. *11TH CIGRE Southern Africa Regional Conference*. Council for Scientific and Industrial Research South Africa.

Parema. (2026). *Morocco's Private Energy Sector: A Market Opening to Private Investors*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Parker, D. (2022). Eskom, Saretec collaborate to train renewable energy artisans. *Engineering News*.
Parliamentary Monitoring Group. (2023). *Question NW3284 to the Minister in the Presidency for Electricity*.

Pietrobelli, C., & Rabellotti, R. (2011). Global value chains meet innovation systems: are there learning opportunities for developing countries?. *World development*, *39*(7), 1261–1269.

Posel, D. (2025). Who Cares? Gender Differences in Social Reproduction and Well-Being in South Africa. *Gender, Work & Organization*, *32*(4), 1593–1603.

Ritchie, G. (2026). Outlier #141: Solar imports, mobile money and online retail. *The Outlier*.

Rivett-Carnac, K. (2022a). *Insights into the Solar Photovoltaic Manufacturing Value Chain in South Africa*. TIPS & WWF South Africa.

Rivett-Carnac, K. (2022b). *Insights into the Wind Energy Value Chain in South Africa*. TIPS.

Sapvia. (2024). *State of South African Manufacturing, its Potential and Resources Required for Further Development of PV Value Chains: Final Report*. GIZ.

Sawea. (2025). *Wind Energy Market Intelligence Report South Africa 2025*.

Sawea and Sapvia. (2025a). *Study on Gender Diversity in the Wind and Solar Energy Industries in South Africa. DEE*.

Sawea and Sapvia. (2025b). *Gender Diversity Guideline for the Renewable Energy Industry*.

Tamasiga, P. (2025). *Workforce transition in South Africa's just energy transition: An analysis of needs, policy gaps, and socioeconomic implications* Megatrends Afrika Policy Brief 39. German Institute of Development and Sustainability.

Tarazona, M., Ghosh, D., Larraquy, U., Nyawacha, S., & Chasi, V. (2026). *Unlocking Africa's green transition: Jobs, value-chain positioning, and clean energy potential*. FSD Africa.

U.S. Geological Survey. (2025). *Mineral commodity summaries 2025* (ver. 1.2, March 2025), Reston, Virginia. https://doi.org/10.3133/mcs2025.

Wang, F., & Liu, W. (2024). The current status, challenges, and future of China's photovoltaic industry: A literature review and outlook. *Energies*, *17*(22), 5694.

Wlokas, H. L., Westoby, P., & Soal, S. (2017). Learning from the literature on community development for the implementation of community renewables in South Africa. *Journal of Energy in Southern Africa*, 28(1), 35-44.

APPENDIX A: DOMESTIC COMPONENT PART CAPABILITIES

Table A1: Producing solar energy systems for South Africa

Component	Subcomponents	Level of production in South Africa
Photovoltaic module/panel	Aluminium frame, superstrate glass, crystalline silicon cell, copper ribbon wiring, backing sheet, ethylene vinyl acetate, laminate, junction box	Low
Mounting and tracker	Clamps and rails, steel/ aluminium profiles, servo motor and arm, nuts and bolts	Medium
Electrical balance of plant	Conductors, armour, insulation, DC cables, AC cables, direct current cable connectors	Some local production (strength in AC cable production), with high import competition and under-utilised capacity in low-voltage categories
Civil balance of plant	Earthworks, foundations, road construction, drainage	Local provision
Inverter	Enclosures, magnetics, transformers, electronics, circuit boards	Large centralised inverters: mostly imported, some local assembly Small inverters: assembled or produced locally (high competition from imports)

Sources: Rivett-Carnac 2022a; Barnes et al. 2023a; Sapvia 2024; Krinsky 2026

Table A2: Main components and subcomponents of wind turbines

Component	Subcomponents	Level of production in South Africa
Blades and rotor	Blades, rotor hub, pitch system	Blades and pitching systems not manufactured locally;[20] physical mechanical assembly of the rotor hub can be executed domestically using imported parts
Tower and base	Tower sections, anchor cage (bolts, fasteners), tower internals (staircase, platforms)	High local manufacturing capacity for utility-scale steel and concrete tower sections; structural anchor cages are locally produced; specialised aluminium internals (ladders, platforms) face localised spec limits and are mostly imported but supported by domestic CNC machining and panel-casting fabrication capacity
Cables and electrical balance of plant	Conductors, insulation, armour, DC/AC cable connectors	Highly competitive domestic production for heavy AC grid cables, collectors, conductors and structural armour; specialised medium-voltage (MV) collector cables and flexible PVC internal insulation polymers are imported
Nacelle	Generator, gearbox, main shaft, yaw gear, bearings, cooling system/fan, brakes, housing cover	Core precision machinery (generators, gearboxes, main shafts, yaw drives, brakes, bearings) entirely imported; dormant, unutilised local capacity exists to manufacture fibreglass housing covers and machine internal steel mainframes under OEM licensing structures.
Other	Pumps, controls, backup batteries, step-up transformer, converter/inverter	Power distribution transformers are manufactured locally; converters/inverters, automated micro-control software hubs, and specialised hydraulic pumps are completely imported; see Table A3 for details on battery production

Sources: Rivett-Carnac 2022b; Barnes et al. 2023b; Sawea 2025; Morris et al. 2022; Montmasson-Clair 2024; Musonda 2026

[20] However, commercial-scale blade manufacturing has previously taken place within South Africa via the Isivunguvungu Wind Energy Converter (I-WEC) plant in 2011-2012, which successfully produced localised 50-meter rotor prototypes using imported technology licenses before being closed due to subsequent pipeline market volatility and a lack of predictable domestic procurement orders.

Table A3: Lithium-ion battery production in South Africa

Component	Subcomponents	Level of production in South Africa
Electrochemical cells	Cathode, anode, separator, electrode	Cells are not produced domestically (upstream mineral extraction and raw beneficiation capabilities are detailed separately in Section 2.3)
Modules and battery packs	Internal wiring harnesses, cell brackets, compression plates, thermal barriers	Competitive domestic production
Battery management systems	Custom PCBs, firmware, digital safety relays	Local firms strong in designing custom battery management system (BMS) hardware and coding proprietary firmware; raw electronic subcomponents (PCBs, shunts, capacitors) not produced domestically
Enclosures and casings	Aluminium base plates, high-tensile steel bodies, protective covers, rack housings	Produced domestically
Balance of system and software	Cloud-based energy management system (EMS) software, containerised frames, HVAC chillers, heavy wiring	High software capabilities exist in creating remote-monitoring EMS which increases product lifespan; local production of heavy structural container steel and cooling layouts

Sources: CES 2022; DEE et al. 2025; Pandarum et al. 2023; Musonda *Unpublished*

Table A4: Vanadium redox flow battery production in South Africa

Component	Subcomponent	Level of production in South Africa
Liquid electrolyte	Vanadium pentoxide processing, high-purity sulphuric acid, chemical stabilising agents	Domestic production
Storage tanks and fluidics	Heavy carbon-fibre or polymer chemical tanks, specialised piping, structural frames	Domestic capabilities
Power stack	Ion-exchange membranes, current collectors (copper), bipolar plates, carbon electrodes	No domestic production
BoP electricals	High-volume fluid pumps, flow controllers, industrial automated monitoring systems	Limited local capacity

Sources: CES 2022; DEE et al. 2025; Musonda *Unpublished*

APPENDIX B: SOUTH AFRICAN POLICIES SUPPORTING RENEWABLE ENERGY INDUSTRY DEVELOPMENT

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
Just transition policy	JETP Investment Plan and Implementation Plan	The JETP is a multilateral finance package to facilitate South Africa's just transition, initially pledged at US$8.5 billion by donor countries in the IPG (the United Kingdom, United States, Germany, France, and the EU); the United States withdrew in 2025. It aims to cover a much broader set of actions and investments but maintains a focus on the power system, with a lesser focus on new energy vehicles and green hydrogen.	yes	yes	yes	The plan has been critiqued for its power system focus and limited mobilisation of grant funding and funding for social security.

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
	Framework for a Just Transition	Primarily articulated through the Just Transition Framework established by the PCC. Aims to coordinate and guide the country's transition to a low-carbon economy while ensuring that the process is equitable and inclusive.	yes	yes	yes	
Energy policy	Integrated Resource Plan	A strategic framework developed by the South African government to guide the country's electricity supply and demand management. It considers the implications of different technologies on the overall energy mix, emphasising the need for a least-cost, diversified approach to ensure energy security and sustainability. It does consider economic impacts of different energy mixes, including employment impacts.	n/a	n/a	n/a	
	Integrated Energy Plan Implementation Plan	Provides a holistic view of the energy landscape, addressing not just electricity generation but also the overall energy supply and demand.	n/a	n/a	n/a	

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
Electricity legislation	National Energy Act 34 of 2008 (NEA)	Refers to the need for a diversity of energy and its sources, which should be available, sustainable, and affordable. It promotes energy efficiency, which is described as "economical and efficient production and utilisation of an energy carrier or resource".	n/a	n/a	n/a	
	Electricity Regulation Act 4 of 2006 (ERA)	Amendments (2021, 2022, 2023) to the ERA have enabled holistic changes to the structure of the power system, including liberalisation of the generation industry, transitioning the country to a competitive market with an independent transmission system operator.	n/a	n/a	n/a	
	National Energy Regulator Act 40 of 2004 (NERA)	Gives Nersa its powers.	n/a	n/a	n/a	

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
Electricity regulations	Electricity Pricing Policy (GG31741 19 December 2008) (EPP)	Prescribes the pricing regulations for the access and use of electrical networks. Currently a municipality may only lawfully charge an approved tariff or an approved surcharge.	n/a	n/a	n/a	
	Grid code for Renewable Power Plants (RPPs) connected to the transmission or distribution network in South Africa	Prescribes the acceptable Quality of Supply (QoS) for distinct categories of generators connected to the grid network.	n/a	n/a	n/a	
	Regulatory Rules on Network Charges for Third Party Transportation of Electricity ("Rules")	Allows load customers to enter bilateral arrangements with third-party generators. Municipalities may need to acquire ministerial approval to sign third-party PPAs.	n/a	n/a	n/a	

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
	South African National Standard (SANS) 474	The Code of practice for electricity metering.	n/a	n/a	n/a	
	SANS 10142	The "specific requirements for embedded generation installations connected to the low-voltage distribution network in South Africa".	n/a	n/a	n/a	
	NRS 097 Series and NRS 057	The NRS 097 series focuses on the interface between the small-scale embedded generator and the utility. NRS 057 prescribes the appropriate guidelines for deployed electrical meters.	n/a	n/a	n/a	
	Wheeling Framework(s)	Eskom draft and local policies	n/a	n/a	n/a	There is no national wheeling framework .

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
	Cost of Supply Framework for Licensed Electricity distributors in SA	Used to design electricity rates to be implemented to provide the service required by customers and recover the cost incurred by the licensees. Provides a guideline for how these studies should be conducted.	n/a	n/a	n/a	
Institutional / finance	PFMA	Governs the financial management and fiscal responsibilities of national and provincial government departments, public entities, and other institutions in South Africa. Creates a framework that allows government entities to incorporate B-BBEE criteria into their procurement processes.	yes	yes	no	
	MFMA	Establishes the financial and procurement process obligations to which municipalities must adhere. Creates a framework that allows government entities to incorporate B-BBEE criteria into their procurement processes.	yes	yes	no	Does not allow municipalities to transact in line with ERA amendments.

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
	Municipal Fiscal Powers and Functions Act 12 of 2007 (MFPFA)	Governs various other aspects related to the financial powers and functions of municipalities.	n/a	n/a	n/a	
	Municipal Systems Act 32 of 2000 (Systems Act)	Provides a legal framework for the functioning and governance of municipalities, including decision-making processes, planning and development, service delivery, performance management, and public participation.	n/a	n/a	n/a	
	By-laws for municipal functions such as electricity supply (vary per authority)	Cover land use and zoning, building codes, water use, and electricity reticulation.	yes	yes	no	

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
	The Broad-based Black Economic Empowerment (B-BBEE) Act 53 of 2003	Defines B-BBEE as the viable economic empowerment of all Black people, specifically mentioning women, workers, youth, people with disabilities, and those living in rural areas. Enables the use of preferential procurement and employment to achieve these aims and applies to public and private entities.	yes	yes	partial	
	The Public Procurement Act (Act 28 of 2024)	Signed into law in July 2024 to consolidate South Africa's fragmented public procurement system by introducing enabling frameworks for local production thresholds, set-asides, and preferential supplier criteria. However, the Constitutional Court struck down the Act in its entirety on 17 September 2026 because Parliament failed to facilitate meaningful public participation, particularly regarding amendments to Chapter 4 on preferential procurement. Consequently, the previous, fragmented regulatory regime remains the active law governing state spending.	yes	yes	yes	

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
Spatial develop-ment	Spatial Planning and Land Use Management Act 16 of 2013 (SPLUMA)	Provides a framework for spatial planning and land use management, and for municipal development planning.	na	na	na	
Climate change	Climate Change Act 22 of 2024	Addresses various aspects of climate change mitigation, adaptation, and resilience. Aims to enhance institutional capacity and accountability for climate change, and enable cross-sector collaboration. Signed into law in July 2024.	yes	yes	yes	
	South Africa Updated Nationally Determined Contribution (2021)	South Africa published its latest updated NDC in September 2021. Enhanced the country's commitment to reducing greenhouse gas emissions and outlined specific targets for the years 2025 and 2030. Includes a commitment to a target range for greenhouse gas emissions of 398–510 MtCO2e by 2025 and 350–420 MtCO2e by 2030.	yes	partial	no	

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
	Low Emission Development Strategy 2050 (LEDS)	Outlines a sequenced path to realising a low-carbon economy in South Africa, inclusive of structural changes that need to be implemented across economic sectors. Does consider employment impacts of decarbonisation (including job creation) within a just transition approach, broadly articulated.	no	no	partial	
	National Climate Change Adaptation Strategy (2019)	Outlines a framework for addressing the impacts of climate change through adaptation measures.	no	no	no	
Environ-mental manage-ment	National Environmental Management Act 107 of 1998 (NEMA)	Serves as the legal framework for cooperative environmental governance. Covers cooperative governance, sustainable development, public participation, integrated management, and regulatory enforcement. Aims to protect the environment while promoting social equity and economic development.	yes	yes	yes	

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
	Environmental Impact Assessment (EIA) Regulations and Listed Activities Notices	EIAs are a critical tool for assessing the potential environmental impacts of proposed projects. However, EIAs under NEMA do not explicitly address gender, youth, and decent work in a comprehensive manner. EIAs require public consultation with parties affected by planned activities. Must also include climate change impact assessments.	no	no	no	
Industrial policy	SAREM (2025)	A strategic framework to guide the development of the RE sector. Explicitly addresses localisation by setting targets for local content, aligning industrial policies, supporting emerging suppliers, and promoting skills development. Includes commitments to decent work principles that encompass working conditions, union access, and gender considerations. Acknowledges the need for gender responsive and youth-targeted approaches in developing the RE sector.	yes	yes	yes	Several critiques have been made, notably by labour.

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
	SMME Support Plan	A strategic initiative aimed at enhancing the growth and sustainability of SMMEs and cooperatives in South Africa. Explicitly considers gender, youth, and decent work as part of its objectives and interventions.	yes	yes	yes	
	Industrial Development Strategy	A comprehensive strategic blueprint aimed at reversing deindustrialisation and reindustrialising the South African economy. Built upon three core pathways—decarbonisation, diversification, and digitalisation—it explicitly prioritises the development of green industries, including RE component manufacturing and recycling infrastructure. It reinforces SAREM by formalising state commitments to localised procurement, structural capability building, and inclusive economic growth.	yes	yes	yes	Lacks a dedicated standalone funding mechanism

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
End-of-life manage-ment	Norms and standards for the "Management of Waste Electrical and Electronic Equipment for South Africa" [draft, 2024]	Aimed at promoting a waste electrical and electronic equipment management chain to reduce waste through reuse by restoring functionality and ensuring safe and accessible Electrical and Electronic Equipment (EEE).	no	no	no	
	Extended Producer Responsibility (2021)	Prescribes requirements for a defined group of producers/manufacturers to manage the end-of-life of specific types of component, in alignment with environmental regulations. Producer responsibility organisations are required to collect fees from registered producers to invest in, amongst others, collection, aggregation and end-of-life management solutions.	yes	yes	yes	
	E-Waste landfill ban (2021)	Prohibits the disposal of all electrical and electronic waste (e-waste) in landfills, requiring producers and consumers to find alternative means of managing this type of waste.	n/a	n/a	n/a	

Issue	Applicable national legislation, regulations, and policy	Notes	Explicit reference to gender and women	Explicit reference to youth	Explicit reference to decent work	Notable policy gaps
Labour Regulation	The Employment Equity Amendment Act (Act 4 of 2022)	Amends the foundational Employment Equity Act (1998) by eliminating compliance and reporting burdens for smaller businesses, while empowering the Minister of Employment and Labour to set binding sectoral transformation targets. Under this framework, firms with 50 or more employees must align with these Employment Equity plans, making measurable progress toward these benchmarks a prerequisite for securing a Compliance Certificate, which is legally required to tender for contracts or transact with any organ of state.	yes	yes	yes	

Source: Adapted and updated from Hermanus and Kamanzi 2026

APPENDIX C: BILATERAL RELATIONSHIPS AND MULTILATERAL ORGANISATIONS SUPPORTING TECHNOLOGY TRANSFER

Countries	Selected initiatives
Germany	South Africa-Germany Energy Partnership (2013–ongoing) GIZ South Africa Energy Programme (2008–ongoing)
China	Forum on China-Africa Cooperation (2000–ongoing) China-South Africa Comprehensive Strategic Partnership (2010–ongoing) Belt and Road Initiative (2015–ongoing)
Denmark	South Africa-Denmark Energy Partnership (2012–ongoing)
United Kingdom	UK PACT (Partnering for Accelerated Climate Transition) (2018–ongoing)
United States	Power Africa (2013–2025) USAID South Africa Energy Programme (until 2025)
European Union	Just Energy Transition Partnership (2021–ongoing) EU-South Africa Strategic Partnership (2007–ongoing)
Japan	JICA Energy Cooperation (1997–ongoing)
Korea	Korea-South Africa Green Industry Cooperation (2012–ongoing)
Norway	NORAD Climate and Energy Programmes (1994–ongoing)
Netherlands	Netherlands Enterprise Agency (2014–ongoing)
Multilateral	International Solar Alliance (2015–ongoing) IRENA Collaborative Framework AfCFTA Green Rules (2021–ongoing)

Source: Author's creation

APPENDIX D: CONNECTING RECOMMENDATIONS TO CHALLENGES AND OPPORTUNITIES

Recommendation area	Recommendation	Challenges addressed	Opportunities unlocked
8.2.1 Shaping demand	I. Establish Continual Public Tenders to Build a Sustainable Manufacturing Sector	Market B: 'Stop-start' demand cycles from public procurement; Institutions and governance B: Erratic policy implementation; Institutions and governance K: Evasion of local content policies	Market C: Expanding state-led RE generation with LCRs
	II. Expand the Role of Eskom Green	Market B: 'Stop-start' demand cycles from public procurement; Institutions and governance H: Liberalisation of energy markets	Market C: Expanding state-led RE generation with LCRs
	III. Strengthen the Design, Implementation, and Enforcement of Local Content Requirements	Market C: Global project implementers rely on existing suppliers; Institutions and governance A: Watering down of local content policies; Institutions and governance K: Evasion of local content policies	Productive capabilities A: Capitalising on low-risk SME subcomponent spin-offs
	IV. Enable Shared Orders and Capacity Pooling for Smaller Firms	Market A: Price competition; Productive capabilities B: Limited capacities of firms; Institutions and governance G: Concentration of LCR benefits; Institutions and governance I: Corporate capture; Institutions and governance K: Evasion of local content policies	Institutions and governance B: Establishing collaborative production alliances and small-firm joint bidding

Recommendation area	Recommendation	Challenges addressed	Opportunities unlocked
	V. Mandate Regional and Municipal Geographic Sourcing Minimums	Market B: 'Stop-start' demand cycles from public procurement; Market C: Global project implementers rely on existing suppliers	Market C: Expanding state-led RE generation with LCRs
8.2.2 Trade, investment and regional market development	I. Refine Tariff System to Provide Targeted Support to RE Manufacturers	Market A: Price competition; Productive capabilities B: Limited capacities of firms; Institutions and governance D: Trade and tariff misalignment	Market B: Leveraging the surging private track and decentralised markets; Productive capabilities A: Capitalising on low-risk SME subcomponent spin-offs
	II. Implement Port-of-Entry Customs Audits to Combat Trade Corruption	Institutions and governance J: Corruption	Market B: Leveraging the surging private track and decentralised markets; Productive capabilities A: Capitalising on low-risk SME subcomponent spin-offs
	III. Attract Global Cell Plants and Mineral Refiners	Productive capabilities B: Limited capacities of firms	Market A: Attracting global technology transfers and FDI; Productive capabilities B: Establishing core midstream manufacturing capabilities; Productive capabilities C: Upgrading domestic mineral beneficiation capabilities
	IV. Create Regional Mineral Refining Hubs to Secure Supply Autonomy	Market A: Price competition	Productive capabilities A: Capitalising on low-risk SME subcomponent spin-offs; Institutions and governance A: Building regional connections
	V. Position South Africa as a Regional Renewable Energy Manufacturing and Export Hub	Market A: Price competition	Productive capabilities E: Expanding recycling capabilities; Institutions and governance A: Building regional connections

Recommendation area	Recommendation	Challenges addressed	Opportunities unlocked
8.2.3 Supporting business upgrading and increasing local manufacturers' competitiveness	I. Reduce Utility Costs for Domestic Manufacturers.	Market A: Price competition; Institutions and governance O: Global governments providing support to national firms	Market B: Leveraging the surging private track and decentralised markets
	II. Simplify Administrative Processes	Market A: Price competition; Productive capabilities B: Limited capacities of firms; Institutions and governance C: Lack of government policy coordination and regulatory clarity	Market B: Leveraging the surging private track and decentralised markets; Inclusion and decent work C: Expanding rural mini-grids
	III. Support Upgrading for RE Manufacturers	Productive capabilities B: Limited capacities of firms; Market A: Price competition; Institutions and governance O: Global governments providing support to national firms	Productive capabilities A: Capitalising on low-risk SME subcomponent spin-offs; Market A: Attracting global technology transfers and FDI; Productive capabilities B: Establishing core midstream manufacturing capabilities; Productive capabilities C: Upgrading domestic mineral beneficiation capabilities; Productive capabilities D: Scaling up services; Productive capabilities E: Expanding recycling capabilities
	IV. Expand Service Provision and Service-Led Business Models	Productive capabilities B: Limited capacities of firms	Market B: Leveraging the surging private track and decentralised markets; Productive capabilities D: Scaling up services

Recommendation area	Recommendation	Challenges addressed	Opportunities unlocked
	V. Establish Recycling Loops and Reverse Logistics Channels	Market A: Price competition; Inclusion and decent work A: Unequal benefits of transition; Productive capabilities B: Limited capacities of firms	Productive capabilities E: Expanding recycling capabilities
	VI. Launch Shared Quality Testing Labs to De-Risk Local Innovation	Productive capabilities B: Limited capacities of firms; Market A: Price competition; Institutions and governance E: Weak standards, testing, and certification systems	Productive capabilities A: Capitalising on low-risk SME subcomponent spin-offs; Productive capabilities E: Expanding recycling capabilities
	VII. Foster Industry Interactions and Networking	Productive capabilities B: Limited capacities of firms	Productive capabilities A: Capitalising on low-risk SME subcomponent spin-offs; Market A: Attracting global technology transfers and FDI; Institutions and governance B: Establishing collaborative production alliances and small-firm joint bidding
8.2.4 Driving decent work and inclusivity	I. Run TVET Programmes with Ring-Fenced Gender Quotas	Productive capabilities A: Skill shortages; Inclusion and decent work B: Gender stereotypes and occupational segregation	Inclusion and decent work A: Generating increased numbers of good jobs
	II. Enhance Social Impact of Public Procurement	Inclusion and decent work A: Unequal benefits of transition; Institutions and governance J: Corruption	Inclusion and decent work B: Expanding worker, social, and true community ownership models

Recommendation area	Recommendation	Challenges addressed	Opportunities unlocked
	III. Make Continued Industrial Policy Support Conditional on Providing Decent Work	Market A: Price competition; Inclusion and decent work A: Unequal benefits of transition	Market B: Leveraging the surging private track and decentralised markets
	IV. Refine Methods of Measuring Development Outcomes	Institutions and governance F: Data quality challenges	Institutions and governance C: Improving government's responsiveness to market conditions
	V. Address Gender Stereotypes and the Burden of Reproductive Work on Women	Inclusion and decent work B: Gender stereotypes and occupational segregation; Inclusion and decent work C: Unequal social reproduction burdens	Inclusion and decent work A: Generating increased numbers of good jobs
	VI. Reskill Workers for Sustainable Transition Pathways	Productive capabilities A: Skill shortages; Inclusion and decent work A: Unequal benefits of transition	Inclusion and decent work A: Generating increased numbers of good jobs
	VII. Update Existing Curricula to Expand Knowledge and Skills Related to Renewable Energy	Productive capabilities A: Skill shortages	Inclusion and decent work A: Generating increased numbers of good jobs

Recommendation area	Recommendation	Challenges addressed	Opportunities unlocked
8.2.5 Strengthening cross-government coordination and implementation	I. Coordinate Inter-Departmental Industrial Policies	Institutions and governance C: Lack of government policy coordination and regulatory clarity	Institutions and governance C: Improving government's responsiveness to market conditions
	II. Be More Active in Seeking Industry Perspectives	Institutions and governance I: Asymmetric policy influence and exclusion of SMEs	Institutions and governance C: Improving government's responsiveness to market conditions

Source: Author's creation