THE STATE OF RESEARCH ON RENEWABLE ENERGY VALUE CHAINS IN SOUTH AFRICA: FIRMS AND EMPLOYMENT CHARACTERISTICS

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ABBREVIATIONS AND ACRONYMS

BOP	Balance of Plant
BOS	Balance of System
CSIR	Council for Scientific and Industrial Research
C&I	Commercial and Industrial
EPC	Engineering, Procurement and Construction
FTE	Full-time equivalent
IPP	Independent Power Producer
IRP	Integrated Resource Plan
MW	Megawatt
NBI	National Business Initiative
NERSA	National Energy Regulator of South Africa
OEM	Original Equipment Manufacturer
PV	Photovoltaic
RE	Renewable Energy
REI4P	Renewable Energy Independent Power Producers Procurement Programme
SALGA	South African Local Government Association
SAPVIA	South Africa Photovoltaic Industry Association
SAREM	South African Renewable Energy Masterplan
SAWEA	South African Wind Energy Association
SSEG	Small-scale Embedded Generation
Stats SA	Statistics South Africa
SUT	Supply-Use Tables
VC	Value chain

1. INTRODUCTION AND BACKGROUND

The Presidential electricity plan announced in July 2022, which is set to relax regulations for private generators and double the size of Bid Window 6 of the Renewable Energy Independent Power Producers Procurement Programme (REI4P), is intended to drive more renewable energy (RE) uptake (Ramaphosa, 2022). This should in turn lead to an increase in the demand for value chain manufactured components and services to RE generators.

Such a demand could create opportunities for South African suppliers and lead to employment creation. This is, however, contingent on local firms being able to respond to the opportunity with appropriate industrial development support from government. To do this, in the case of the manufacturing value chain in particular, an improved understanding is needed of local manufacturing and the firms producing materials, and their employment characteristics. This is not in place: there is significant research on South African RE industries, but few studies provide details on the value chains (VCs) supplying the different RE industries. They also do not detail the local firms within these VCs or their employment characteristics. Only a few studies provide information on the materials used to manufacture these inputs (and the jobs associated with the materials used in RE manufacturing VCs).

It is crucially important to develop a granular understanding of the VCs, firms and employment in these firms including the processing of materials used to produce manufactured components for RE industries. The reasons for this include:

1. To identify where in the value chain local manufacturing takes place, or could take place, in order to direct industrial development support to those areas;
2. Linked to point 1, to develop a detailed understanding of employment characteristics of local RE VC manufacturing firms in order to align appropriate employment and skills development programmes to build the base of manufacturing skills and capabilities in the country; and
3. To account for the full employment impacts from RE industries across the value chains and inputs. This is required to compare the RE industries' employment impacts on a like-for-like basis with employment in non-RE energy generation (and their supply chains).

This report describes and discusses the major sources of data that exist on RE VC firms and employment in these VCs. It concludes with some ideas on how and where to build this knowledge base.

2. RESEARCH QUESTIONS ON FIRMS AND EMPLOYMENT IN RE VALUE CHAINS

Data is required on firms and their employment characteristics in the manufacturing and service industries supplying the RE industries including:

1. Across the project phases – from project planning, to materials, manufacturing, construction, installation, operations and maintenance and project closure/end-of-life phases (which might include reuse, recycling or disposal).
2. At all generator scales – including those within the RE14P and across all distributed energy generators. (This includes those greater than 1MW and those less than 1MW. The latter market is known as Small-Scale Energy Generation, or SSEG).
3. For both wind and solar photovoltaic (PV), specified at a technology specific level.
4. Materials' industries which provide materials used in manufacturing of RE components. This would include steel and cement, among others. The share of jobs in these material producers would need to be attributed to RE manufacturing demand.
5. In addition to the numbers of people employed in the RE VCs, more information is required on the nature of the employment – full time, part time, casual – as well the gender characteristics' characteristics and skills levels.

This report focuses on the manufacturing VCs in particular.

3. EXISTING SOURCES OF DATA

3.1 Plans and databases detailing the RE VCs and firms within them

A number of databases and recent plans provide some detail on the manufacturing value chains for solar PV and wind energy and the firms operating in these VCs.

The draft South African Renewable Energy Masterplan (SAREM), the first (public) document that attempts to provide details on manufacturing inputs in RE value chains in South Africa, assesses the extent of current localisation as well as its potential. The masterplan process and document is an industrial development plan for the renewable energy value chain to 2030. It indicates opportunities, challenges and priority actions to be taken. The masterplan was developed through collaboration between representatives of industry, government, labour and community. It estimates that, if 70% of components and 90% of Balance of Plant (BOP) are localised, 36 500 new direct jobs could be created by 2030 (DMRE, the dtic and DSI, 2022).

Alongside this national master planning process, in 2021, the South African Wind Energy Association (SAWEA) and the South African Photovoltaics Industry Association (SAPVIA), the industry associations representing the wind energy and solar PV industries respectively, held a number of digital webinars which explored localisation opportunities – in manufacturing, project development, construction, operations and maintenance, logistics and transport, among others. Industry players presented their experiences and shared insights on the opportunities for and barriers to greater local participation.

SAWEA and SAPVIA also provide details of their members on their websites. As these are voluntary industry associations, they do not comprehensively cover the two industries and their suppliers. In the case of both associations, membership is dominated by project developers with few manufacturers of solar PV or wind energy components listed as members. The industry association membership lists are provided in Annexure A and Annexure B.

GreenCape's database of local firms operating in industries that produce goods with designated local content is a further resource (GreenCape, 2021). It includes a list of Solar PV firms across the main components. There are also lists of firms that produce and wholesale more general products also used with renewable energy generation, like fasteners, for example. The Solar PV specified firms in the GreenCape database are listed in Annexure C of this report. This is not necessarily comprehensive but includes many of the main players.

A recent Manufacturing Circle study into materials' requirements for the RE industries uses European Union data to estimate structural materials required per MW generated and extrapolates this for South Africa's Integrated Resource Plan (IRP2019) to arrive at total material requirements. This report provides insights into the kilogrammes and tonnes (material dependent) of materials required for Solar PV and Wind energy rollout. Structural materials are the main focus of the report (not technology specific materials, such rare earth elements). The report also contains some analysis of the capacity and capability gaps in South Africa in the production of these materials at the specifications required by Solar PV and Wind energy Original Equipment Manufacturers (OEMs). Different forms of steel, cement, glass and carbon composites, aluminium, copper and nickel are the main materials required at high volumes (Manufacturing Circle, 2022).

Municipalities across the country have to accommodate a number of SSEG installations by firms and households. A 2020 South African Local Government Association (SALGA) report, *Status of small scale embedded generation (SSEG) In South African municipalities*, estimated total official registered SSEG installation numbers of at least 3 280 in November 2020 with an estimated capacity of 282MW (SALGA, 2020). These records are also a source of data but the information needs significant improvement. While

certain of the larger metros have processes in place to register SSEG users, many others do not. In an effort to support a standardised approach, in 2021 a guide was developed for municipalities on SSEG to help streamline their processes and cover important policy and other elements (Sustainable Energy Africa, 2021). It includes guidelines on a record-keeping system. This could in time yield more accurate and detailed data on SSEG adoption, and contain details of installers, to serve as a database for possible surveys. Other sources of installers' details already exist, for example, the PV GreenCard, a SAPVIA initiative, provides details for over 300 installers across the country. This is an additional source of data on firms.

The National Energy Regulator of South Africa (NERSA) has until recently approved licences of private generators of over 1MW, and will continue to register these private generators even though the licensing requirements have fallen away (Ramaphosa, 2022). This data held at NERSA is a further potential source of information on other, larger, private generators in the country.

3.2 Routine surveys of the RE industries

There is currently no routine survey of all renewable energy generators in the country or of their supplying industries.

The most significant current data source is the Independent Power Producers (IPP) Office reports. Data from "under development" and "in operation" REI4P projects is provided in an aggregated format each quarter for solar PV and wind separately and together. This is provided at a national level and also broken down by province.

The stated intent of these reports is to provide a "high level – 'at a glance' – overview of the Renewable Energy Independent Power Producers Procurement Programme (REI4P)". The reports cover data on energy generation, investment amounts, South African shareholding, employment creation and local content, among other measures. Total aggregate jobs' figures are provided per quarter, for construction and operations, and are measured in job years. A job year is defined as the equivalent of a full-time employment opportunity for one person for one year (IPP Office, 2021).

- By the end of December 2021, for all projects that had entered (or completed) construction and/or were operational, a total of 63 291 job years had been delivered for South African citizens, of which 48 110 job years had been created up to that point in construction.
- While local content is measured, jobs in the manufacturing of the local content are not. Jobs are also not provided per MW generated. This is a measure generally regarded as useful, as linking jobs to energy units allows for comparison across technologies and project sizes (CSIR, 2021).

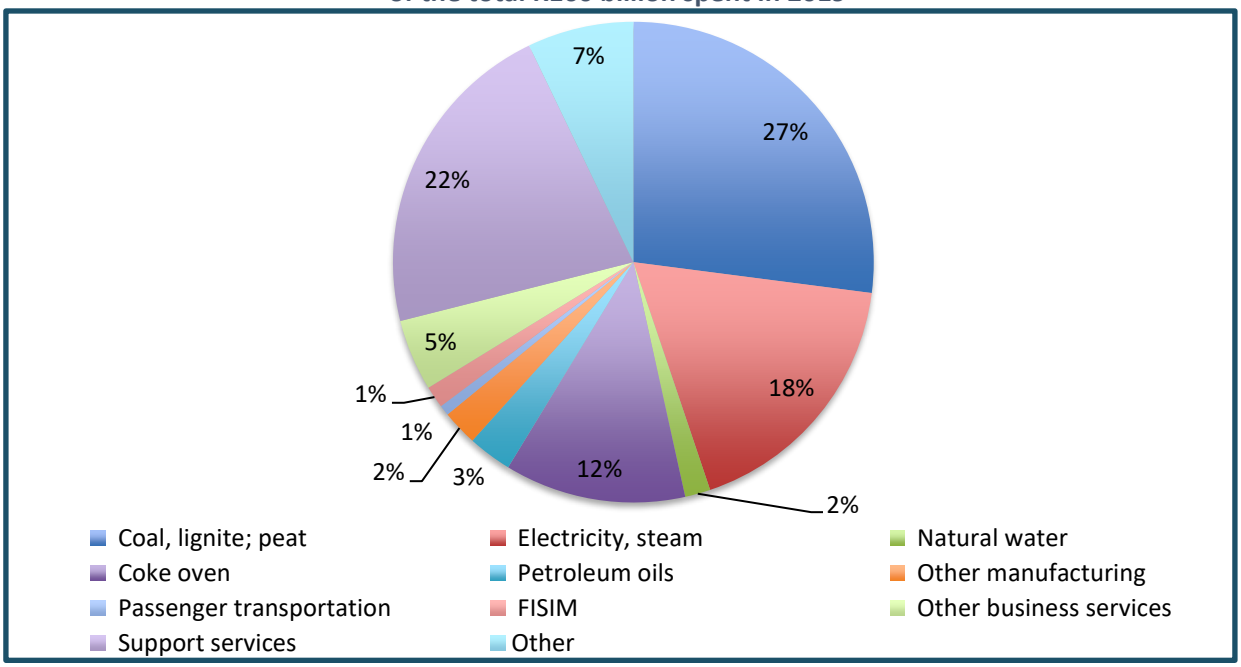
The IPP Office data indicates that more jobs are created during the construction phase, which typically lasts around two years per plant, than in the operational phase. In terms of local content, half of the total procurement spend of the IPPs is in the construction phase and half is anticipated to take place over the remaining 20 years of operations. (In reality, this is still to be determined). The total projected procurement spend as reported for Bid Window 1 to Bid Window 4 during the construction phase is R73.1 billion, while the projected operations procurement spend over the 20 years' operational life is estimated at R76.8 billion (IPP Office, 2022).

Statistics South Africa (Stats SA) undertakes a number of surveys which provide some insight into the electricity generation industry. They have limitations in terms of the full picture for RE versus other generators:

- The Stats SA Supply-Use Tables quantify in value terms the goods and services procured by the electricity industry each year by category of use (Stats SA, 2022). This is not yet provided at a level that distinguishes between the different generation technologies. The data in Figure 1 shows the

categories and value of procurement spend by the Electricity industry in total in 2019, as contained in (the latest) SUT for the country. "Coal, lignite, peat' was the largest spend category for the industry overall in 2019, followed by 'support services', 'electricity', and 'coke oven' in that order.

Figure 1: Goods and services used by the electricity industry, by percentage share of cost, of the total R160 billion spent in 2019



Source: Adapted from Stats SA 2022.

- The Stats SA survey of the Electricity, gas and water supply industry, released in September 2021 (Stats SA, 2021), provides employment data for the "generation, transmission and distribution of electricity" in 2010, 2013, 2016 and 2019. This data is not disaggregated by technology of generation, or between generation, distribution and transmission. The total number of employees in the generation, transmission and distribution of electricity was 39 756 in 2010, 46 060 in 2013, 46 286 in 2016 and 43 219 in 2019. These are likely only operational jobs. This survey is conducted every three years.

3.3 Research studies on manufacturing jobs in RE industries in South Africa

A number of research studies have been conducted on RE industries, some of which estimate jobs, including in the value chain. While each may provide a true reflection of a particular study subject at a point in time, the different approaches taken in the studies make an overall view and a comparison very difficult. Of the studies, two, in particular, include manufacturing job estimates.

A SAPVIA study, published in 2021, and undertaken by CSIR, measured jobs in Solar PV in SA based on an industry survey of 936 firms, with an 11.4% response rate, focussing on the actual jobs in respondent firms in 2018 and 2019. (CSIR, 2021).

- Of the 936 firms, 91 were manufacturers, of which 16 responded.
- The methodology required the calculation of the job intensity at full time job equivalent per MW of Solar PV installed in South Africa.
- Utility scale REI4P and distributed generators were both included. The survey responses were classified into categories according to the different roles the companies perform in the value chain, to include: IPPs, Services, Manufacturers and Equipment Providers, Engineering, Procurement and Construction (EPC) Utility, EPC Commercial and Industry (C&I) and SSEGs. The MW of installed capacity was linked to these firms' activities in 2018 and 2019. Survey results are shown Table 1.

Table 1: Actual installed capacity and jobs in 2018 and 2019, per value chain segment, for survey respondents

	2018			2019		
VALUE CHAIN SEGMENTS	INSTALLED CAPACITY	PERMANENT JOBS	CONTRACT JOBS	INSTALLED CAPACITY	PERMANENT JOBS	CONTRACT JOBS
IPP						
IPP project companies	546	341	33	546	373	31
IPP companies	365	96	70	365	108	37
Developers	419	39	40	313	38	37
Services						
Legal	52	10	10	52	10	10
Funders	52	23	50	52	46	9
Logistics	52	6	-	52	8	-
Consultants	52	23	50	52	46	9
Miscellaneous	52	61	21	52	64	24
Manufacturers						
Inverter	-	-	-	160	14	4
Panel	284	225	162	359	239	147
Tracker	70	53	-	70	53	-
Balance of system	395	203	58	1029	271	160
EPC Utility scale						
EPC Company	75	64	53	75	43	695
EPC Commercial and Industrial scale						
EPC Company	49	190	391	93	268	664
Small-scale embedded generation						
SSEG Company	6	69	71	16	107	114

Source: CSIR, 2021.

- Based on these figures, a base case was developed on job creation in solar PV between 2011 and 2018 in full-time jobs equivalents. In 2018, only 4 121 full-time job equivalents were estimated in total for solar PV.
- Jobs were extrapolated to cover three scenarios to 2030. The first is linked to the IRP2019 and the additional two are further "accelerated" scenarios. Across the scenarios, between 34 726 and 39 817 employment opportunities are forecast to be created each year for Solar PV in 2028, 2029 and 2030.
- While the IPP project companies contributed the largest proportion to Solar PV employment, SSEG has the highest jobs per installed MW (CSIR, 2021).

The COBENEFITS study of 2019*, Future skills and job creation through renewable energy in South Africa: Assessing the co-benefits of decarbonising the power sector* (COBENEFITS, 2019) employed a qualitative analysis of interviews, a review of the existing literature and a quantitative analysis to arrive at jobs' estimates for four scenarios. The models used for the quantitative analysis were to establish both gross and net employment impacts. The International Jobs and Economic Development Impacts tool adapted for South Africa was used to assess the gross employment impacts. The South African SATIMGE model was used to assess the net employment impacts.[1]

[1] SATIMGE is a linked energy-economy modeling framework for analysing energy and climate policy in South Africa.

Industry surveys and interviews estimated jobs created for a typical 86 MW solar PV power plant and are shown in Table 2:

- 386 job years were created during the development and manufacturing phases of the project.
- 66% of headcount jobs and 48 % of job years required skilled workers to achieve the required task; 76 jobs (8% of total jobs) and 470 jobs years (13% of total jobs years) were created for unskilled labour over the lifetime of the projects assessed.
- Of the jobs created, only 5% were in manufacturing, or 186 job years of the total of 3 670. The project activity category for manufacturing only indicates "module assembly" so it appears that inverter manufacture, mounting frames and other Balance of System (BOS) were not included in the survey and findings of a "typical" 86MW solar PV plant. The module assembly jobs were identified as skilled jobs requiring vocational training (COBENEFITS, 2019).

Table 2: Jobs created and skills needed in an 86MW solar PV plant

PROJECT PHASE	PROJECT ACTIVITY	NUMBER EMPLOYED	SKILL LEVEL	PERIOD	JOB YEARS
Manufacturing	Module Assembly	186	Skilled (vocational)	1	186
Development	Developer employees	10	High-skilled (university)	1.5 - 2	20
	Permitting phase (consultants)	15	High-skilled (university)	1.5 - 2	30
	Ancillary services	5	High-skilled (university)	1.5 - 2	10
	EIA process	3	High-skilled (university)	1.5 - 2	6
	From development to sale	25	High-skilled (university)	1.5 - 2	50
	EPC	15	High-skilled (university)	1.5 - 2	30
	Banking	18	High-skilled (university)	1.5 - 2	36
	Construction management firm	9	High-skilled (university)	1.5 - 2	18
	TOTAL	**286**			**386**
Construction and Installation	Civils (site clearing, foundation, basic construction, etc.)	211	Semi-skilled	1.5 - 3	633
	Construction team from various contractors and EPC	65	Skilled or high-skilled	1.5 – 3	195
	Electrical	6	Skilled or high-skilled	1.5 – 2	2
	Structure erection, excluding civils	202	Semi-skilled or skilled	1.5 – 3	606
	Grid work	52	Skilled	1.5	78
	Transportation of equipment	65	Unskilled	1.5 – 3	195

	TOTAL	**601**			**1709**
Operations and Maintenance	Control centre (projects in process)	20	High-skilled (university)	25	500
	Grass-cutting	11	unskilled	25	275
	Operations and maintenance	32	Semi-skilled or skilled	25	800
	TOTAL	63			**1575**
SUM TOTAL		**950**			**3670**

Source: COBENEFITS, 2019.

The *Assessment of local skills for South Africa Renewable Energy Value Chain*, published by GreenCape considered occupational skills required at the various parts of the renewable energy value chain, as well as the current status of skills importation (Rassool, et al.). Secondary research was complemented by 37 interviews of private sector companies operating in the renewable energy value chain and nine higher education institutions interviews. Skills were mapped for each stage of the project delivery value chain.

Key findings include:

- Development stage (wind and solar utility scale): Business Development Managers and Contract Managers are the most employed white collar occupational skills, while Power System Engineers are the most commonly employed highly skilled occupational roles for this part of the value chain.
- Engineering, Procurement and Construction stage: Plant and turbine (wind and solar utility scale): Procurement Manager is the most employed white collar role, while Electrical Engineers and Project Engineers are most commonly employed highly skilled roles.
- Engineering, Procurement and Construction stage: Civils and Logistics (wind and solar utility scale): Logistics Coordinators (white collar) and Civil and Electrical Engineers (highly skilled) were found to be most commonly employed.
- Operations and Maintenance stage (wind and solar utility scale): High Voltage Electricians or Electrical Technicians were commonly employed blue collar skilled roles, while Plant Supervisors/Managers and Health and Safety Advisors/Supervisors were identified as the most common white collar roles.
- Engineering, Procurement and Construction and Installation (domestic/commercial scale solar PV): Solar PV Engineers, Solar PV Installers and Solar PV Designers are the highly skilled roles most employed in this part of the value chain.
- Transmission and Distribution: Electrical Engineers (networks, integration and automation), Grid Engineers and Power System Engineers are all common highly skilled occupations employed in this stage of the value chain for utility, commercial and domestic scale renewable energy projects.
- Battery Energy Storage Systems: Occupational skills such as Storage Engineer and Battery Design Product Engineer are the highly skilled roles most commonly employed, while an Electrical Assembler is a typical blue collar semi-skilled role commonly employed in this part of the value chain. White collar would be senior managerial and supervisory roles, while highly skilled would be senior technical roles such as engineering graduates or technical specialists.
- Manufacturing (wind and solar PV): For those components that are manufactured or assembled locally, Quality Control Technicians/Supervisors (blue collar skilled/white collar), Electricians (blue collar) and Warehouse Supervisor/Worker (white collar/blue collar unskilled) are the most common roles filled (Rassool, et al, 2022).

The study also considers challenges relating to skills that are highly in demand and the retention of skills, and considers trends in the importation of skills. Findings identify future skills needs and make recommendations on training and accreditation as well as institutional alignment and support.

Current studies

A number of studies are being undertaken in the second-half of 2022 on employment in the renewable energy industries to better understand VC impacts. These are described in the box below.

Current (2022) research initiatives

- *The University of Cape Town's* energy and economy (SATIGME) model with updates underway during the second half of 2022 to improve the investment vector for electricity in terms of value chain impacts (that is, multipliers in the economy). This will include improved data for indirect and induced jobs. The updated Supply-Use Tables of Statistics South Africa and the SAREM and (select) firm interviews will be used to refine the data and assumptions in that important local model.
- *SAPVIA* has commissioned a study (being undertaken by Urban-Econ) into the solar PV manufacturing value chain to identify localisation potential and generate data based on interviews with firms.
- *Stellenbosch's Centre for Sustainability Transitions* is undertaking a study on the value chain in RE technologies.
- The *Just Transition Hub* managed by the National Business Initiative (NBI) houses work undertaken by NBI with Business Unity South Africa and the Boston Consulting Group in consultation with main South African corporations. The work assesses what it will take for South Africa to reach net-zero by 2050 and to ensure a just transition. Research work is ongoing on decarbonising main sectors of the economy. A recent integrated energy report (released on 21 July 2022) calls for a coordinated approach to green industrialisation, skills development, economic diversification and job creation. The work within the Climate Pathways study will continue to deliver additional analytical and model-based sector-level reports (National Business Initiative, n.d).

4. CHALLENGES WITH EMPLOYMENT MEASURES AND METHODS

Over and above the lack of routine studies or comprehensive data sources to measure the firms and employment in industries supplying RE generators, there are also a number of challenges with the way employment is measured. In particular, different methods and measures are used across many studies.

The main challenges with measures of jobs in electricity include (Hermanus, 2022):

- Metrics (unit of employment). Here job years, jobs and full-time equivalents[2] are some of the definitions employed differently across various studies.
- Methodologies, assumptions and boundaries.
    - There is no shared application of the same definition for direct, indirect and induced employment.
    - Jobs data also varies – some looks just at a project in isolation, other by technology, some include (certain) value chain jobs. Other data looks at the economy-wide impacts that would include net jobs after jobs lost in non-RE electricity are included.
    - Certain research reports link jobs to an energy unit, that is, per MW, which allows comparison across technologies and project stages (manufacturing, construction, operations).
    - Furthermore, many of the jobs are modelled to understand the total impact across new generation. This requires assumptions about investments and their impacts in the economy. The assumptions are not always clear.
- Data sources vary from company data, to statistical releases and occasional surveys undertaken by industry associations.

[2] The SAPVIA report of 2021 (CSIR, 2021) indicates that the terms "job-years'' or full-time equivalent (FTE) are often used loosely and misinterpreted as meaning the number of persons employed (pg 9). The SAPVIA report also notes that there is no reputable referenced document to understand the concept of 'job years'. The SAPVIA report further states 'the concept of FTEs is critical. Substantial differences will arise when reporting on the number of people employed versus FTEs. A lack of clarity on these specifics is likely to result in large differences in reported numbers and will render comparison of numbers largely invalid'.

5. CONCLUDING COMMENTS AND RESEARCH IDEAS

This report has indicated the research gaps that must be addressed to better identify firms and establish employment numbers and characteristics (including the quality of jobs) in the VCs supplying the RE industries in South Africa. It also notes some of the existing databases of firms, the routine surveys that take place of the electricity industry, and certain of the econometric models that estimate job multipliers. Furthermore, challenges have been highlighted about inconsistent employment measures and methods, including differing uses and applications of job metrics.

Developing better data on firms and employment in the RE value chains will require a number of strategic partnerships, budget allocations, and industry (and intermediary organisations') willingness to provide information on employment in a consistent format.

Opportunities for deepening RE firms and employment research exist in the following areas:

- Stats SA could be a partner to disaggregate the industry survey of electricity generation, which is conducted every three years. This could be done by technology and by installed capacity. It would then be possible to provide a sense of jobs in operation across the technologies and per installed MW. As more generators come online, this could be useful data source for operational jobs.
- Stats SA could also provide disaggregated data in its Supply-Use Tables for electricity industry procurement by technology. This would provide an excellent source of data, produced annually, on the goods and services used by the different electricity generation technologies, including the value of this procurement as part of a wider system of national accounts. These tables already feed into the SATIMGE model and could further enhance its multipliers.
- A joint project with the IPP Office and the main investors, developers, EPCs and OEMs could be established to better measure and report on REI4P projects' employment impacts. OEMs and EPC firms could be required to specify where they procure their inputs, particularly the main components. Making the IPP Office datasets open-source would also assist greatly with generating insights.
- Given the growth in the SSEG market, and the more than 300 installation companies listed on the PV GreenCard website alone, a routine survey could assess these installers' employment levels, skills requirements, and where they source componentry (i.e. their supplying firms). This could draw on the PV GreenCard database as well as records from local government.
- As indicated, NERSA has a licensing and registration database of large private projects. Access to data on these project developers could allow for a survey that similarly establishes patterns of sourcing of goods and services into the distributed energy market, outside of the SSEG.
- To better understand and measure subcomponent manufacturers and material suppliers and their employment, existing industry surveys and data could be expanded with additional questions to establish where supply takes place to RE industries. This would allow for a better understanding of the share of demand from RE for products and how this does (or does not) stimulate employment creation or job retention in materials and manufacturing firms. This would include questions to materials suppliers of inputs like steel and cement, for example, as well as to those manufacturing more generic inputs into RE projects (such as fasteners).

More generally, as new routine data sources for RE industries are developed and improved, the measures for employment data generation must be standardised.

The SAREM will be finalised and implemented over the upcoming months. As this happens, there will be opportunities to discuss these data and insights requirements. Better data is needed to ensure that industrial development support is appropriately aligned to industry conditions and potential, and, with that, supports decent work creation.

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Annexure A: SAWEA membership list, May 2022

CONSTRUCTION, INSTALLATION AND GRID CONNECTIONS	
Element Consulting Engineers	Noupoort Wind Farm (RF) (Pty) Ltd
Kangnas Wind Farm (RF) (Pty) Ltd.	South Africa Mainstream Renewable Power Perdekraal East (Pty) Ltd
Khobab Wind Farm (RF) (Pty) Ltd	Umoja Rope Access (Pty) Ltd
Loeriesfontein 2 Wind Farm (RF) (PTY) Ltd	Worley
CONSULTANCY, PROFESSIONAL SERVICES/RESEARCH	
3E	Fasken
3Energy Renewables (Pty) Ltd	GEO-NET South Africa (Pty) Ltd
Alon Meyerov	GeoWIND
American Clean Power Association	Harmattan Renewables (Pty) Ltd
Arcus Consultancy Services Ltd	Inlexso (Pty) Ltd
ArcVera Renewables	Obelisk Group
Arup (Pty) Ltd	Raymond Takuba
Bophelo Impilo Development Centre	SAICA Enterprise Development (Pty) Ltd
CDQ Group	South African Renewable Energy Technology Centre (SARETEC) (CPUT)
Council for Scientific and Industrial Research (CSIR)	SP-Wind (Pty) Ltd
DNV	UL
ED Platform	VoltaConsult
ENSafrica	Zutari
DEVELOPERS	
ABO Wind renewable energies (Pty) Ltd.	Longyuan South Africa Renewables (Pty) Ltd
African Clean Energy Developments	Marubeni Middle-East & Africa Power Ltd
Atlantic Renewable Energy Partners (Pty) Ltd	Mulilo Renewable Project Developments
BTE Renewables	REDCap
EIMS Africa	Rosatom Central and Southern Africa
EnergyTEAM (SA) member of FEAG	South Africa Mainstream Renewable Power Developments (Pty) Ltd
G7 Renewable Energies (Pty) Ltd	Voltalia
Infinity Power Holding	Windlab Developments South Africa (Pty) Ltd
WKN-Windcurrent SA (Pty) Ltd	
FINANCIAL SERVICES	
Actis	Rand Merchant Bank
AIIM	
IPP	
Aurora Wind Power	Noblesfontein Wind Farm
Dorper Wind Farm	Red Rocket
ENGIE Southern Africa (Pty) Ltd	Rubicept (RF) (Pty) Ltd
Iberdrola Renewables South Africa (Pty) Ltd	Scatec
Kouga Wind Farm (RF) (Pty) Ltd	
MANUFACTURER	
Goldwind Africa (Pty) Ltd	GRI Wind Steel South Africa (Pty) Ltd
Nordex Energy South Africa (Pty) Ltd	Resolux Africa (Pty) Ltd
BFG Africa (Pty) Ltd	Ver-Chem (Pty) Ltd
OPERATIONS AND MAINTENANCE	
AID Renewables	Globeleq South Africa

Bureau Veritas South Africa	juwi Renewable Energies
Cennergi (Pty) Ltd	Tritec Sintered Products (Pty) Ltd
EDF Renewables	TUV Rheinland Inspection Services (Pty) Ltd
Enel Green Power RSA (Pty) Ltd	
OTHER	
Life College Trust	Savannah Environmental
ArcellorMittal	Sika South Africa (Pty) Ltd
Eskom	Valentino Adams
Adcorp BLU	GreenCape
Johnson Cranes	South African Independent Power Producers Association (SAIPPA)
TRANSPORT/ LOGISTICS	
GAC Laser International Logistics	Grant Cromhout
OEM	
General Electric South Africa (Pty) Ltd	Wind-Energy ENERCON South Africa (Pty) Ltd
Siemens Gamesa Renewable Energy (Pty) Ltd	ZEST WEG Group
Vestas Southern Africa (Pty) Ltd	

Annexure B: SAPVIA membership list, May 2022

CONSULTING	
Energy Infrastructure Management Services (Pty) Ltd	Zutari (Pty)Ltd
Eskom	UL VS South Africa
DNV South Africa (Pty) Ltd	ED Systems
Element Consulting Engineers	IBC Solar
Estudios Energeticos Consultores	PVinsight, Nelson Mandela University
GREEN Solar Academy Pty Ltd	Resolution Circle (Pty) Ltd
Hamsa Consulting Engineers	Council for Scientific and Industrial Research (CSIR)
Jager (Pty) Ltd	
CUSTOMER	
CPV Power Plant No. 1 (RF) (Pty) Ltd	
DEVELOPER	
Cennergi Pty Ltd	Leano Construction Solutions
Genesis Eco-Energy (Pty) Ltd	Mabe-Tinyi Business Enterprise
Globeleq South African Management Services (Pty) Ltd	Mulilo Renewable Project Developments
juwi Renewable Energies	Solar Saver
Mainstream Renewable Power, SA (Pty) Ltd	SolarAfrica Energy (Pty) Ltd
Biotherm	Solek
Bright Light Solar	SOLINK
Firefly Investments 253 (Rf) (Pty) Ltd	Total Solar Southern Africa
Iberdrola Renewables South Africa	WKN Windcurrent
Kabi Solar (Pty) Ltd	

EPC	
ACDC Dynamics	New Southern Energy
Distributed Power Africa (Pty) Ltd	oneSolar
Ellies Electronics (Pty) Ltd	Romano Solar (Pty) Ltd
Enel Green Power RSA (Pty) Ltd	Shared Energy Management
MBHE Group (Pty) Ltd	Sinetech Energy (Pty) Ltd
Scatec Solar	Solar MD (Pty) Ltd
Barloworld Power	Sosimple Energy
Eco Trades Solar Pty Ltd	Soventix
EDF Renewables	Sustainable Power Solutions
Emergent Energy	Synergy Energy Solutions Pty (Ltd)
Emesco Holdings (Pty) Ltd	Tagex Energy (Pty) Ltd
ENERTRAG South Africa	Terra Firma Solutions
EP Solar	Wetility
GC Solar	IMPOWER Solar Energy & Storage
Gransolar (Pty) Ltd	LTM Energy (Pty) Ltd
Granville Energy	Motla Consulting Engineers (Pty) Ltd
IB Vogt SA (Pty) Ltd	Nesa Power (Pty) Ltd
FINANCE	
African Infrastructure Investment Managers (AIIM)	candi solar
Nedbank	Reatile Group (Pty) Ltd
Broadreach Capital	
INSTALLER	
Bafenyi Energy	Ohmega Renewable Energy (Pty) Ltd
Cedar Solar	One Energy Group (Pty) Ltd
Earth Care Solar	Oryx Renewables (Pty) Ltd
Elite Energy Solutions	Premium Solar
EnergyOn South Africa Pty Ltd	Renen Energy Solutions
Genergy	Sensible Solar
Mike's Electrical and Solar	Sinetech (Pty) Ltd
Solardelight (Pty) Ltd	
MANUFACTURER/SUPPLIER	
Canadian Solar Inc	Hulamin Extrusions
Hellermann Tyton (Pty) Ltd	Ingeteam Pty Ltd
Huawei Technologies Africa (Pty) Ltd	Qinisa Steel Solutions (Pty) Ltd
JinkoSolar (Pty) Ltd	Renewsys South Africa (Pty) Ltd
SMA Solar Technology South Africa	Rubicon Renewables & Automation
SOLA	SARETEC - South African Renewable Energy Technology Centre

DEHN Africa (Pty) Ltd	SegenSolar (Pty) Ltd
Fibon Energy	Specialised Battery Systems
GoodWe Europe GmbH	STI Norland
OTHER BOS	
DevRani Consult	GAC Laser International Logistics
Solarvest	

Annexure C: Locally designated sectors, components or products: Solar PV specific products

DESIGNATED SECTOR, COMPONENT OR PRODUCT	SUPPLIER NAME	MANUFACTURER/ WHOLESALER
DC Combiner Boxes	Valsa	Wholesaler
DC Combiner Boxes	Sinetech	Wholesaler
DC Combiner Boxes	SegenSolar	Wholesaler
DC Combiner Boxes	IBC Solar	Wholesaler
Inverter	SMA Solar Technology	Wholesaler
Inverter	Allsolar	Wholesaler
Inverter	ACDC Dynamics	Wholesaler
Inverter	3W Power/AEG Power Solutions	Manufacturer
Inverter	GoodWe	Wholesaler
Inverter	ZRW Mechanika	Wholesaler
Inverter	SMA Solar Technology	Wholesaler
Inverter	Microcare	Manufacturer
Inverter	MLT inverters	Manufacturer
Inverter	Valsa	Wholesaler
Inverter	Huawei Technologies Africa	Wholesaler
Inverter	IBC Solar	Wholesaler
Inverter	Sinetech	Wholesaler
Inverter	Enertronica Santerno South Africa	Manufacturer
Laminated PV Modules	SegenSolar	Wholesaler
Laminated PV Modules	ARTSolar	Manufacturer
Laminated PV Modules	Seraphim Solar	Manufacturer
Laminated PV Modules	Canadian Solar	Wholesaler
Laminated PV Modules	JinkoSolar	Wholesaler
Laminated PV Modules	IBC Solar	Wholesaler
Laminated PV Modules	Valsa	Wholesaler
Laminated PV Modules	Renewsys South Africa	Wholesaler
Laminated PV Modules	Rubicon Renewables & Automation	Wholesaler
Laminated PV Modules	SegenSolar	Wholesaler
Laminated PV Modules	SetSolar	Wholesaler

Laminated PV Modules	Sinetech	Wholesaler
Laminated PV Modules	Suntech	Wholesaler
Laminated PV Modules	IBC Solar	Wholesaler
Module Frame	DEHN	Wholesaler
Mounting Structure	Caracal Engineering	Manufacturer
Mounting Structure	PiA Solar	Wholesaler
Mounting Structure	Valsa	Wholesaler
Mounting Structure	KD Solar	Manufacturer
Mounting Structure	K2 Systems	Wholesaler
Mounting Structure	Sinetech	Wholesaler
Mounting Structure	Solarframe	Manufacturer
Mounting Structure	STI Norland	Wholesaler
Mounting Structure	Lumax Energy	Wholesaler

Source: GreenCape, 2021.