TRADE & INDUSTRIAL POLICY STRATEGIES

ELECTRICAL EQUIPMENT REGIONAL VALUE CHAIN BETWEEN SOUTH AFRICA, ZAMBIA AND ZIMBABWE

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CONTENTS

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ABBREVIATIONS

AfCFTA	African Continental Free Trade Area
DMRE	Department of Mineral Resources and Energy
DRC	Democratic Republic of the Congo
IEA	International Energy Agency
IPPs	Independent Power Producers
LPI	Logistics Performance Index
NDC	Nationally Determined Contribution
NRCS	National Regulator for Compulsory Specifications
R&D	Research and Development
REIPPP	Renewable Independent Power Producer Programme
RIDMP	Regional Infrastructure Development Master Plan
SADC	Southern African Development Community
SAPP	Southern African Power Pool
SARS	South African Revenue Services
SAS	Sustainable Africa Scenario
UAE	United Arab Emirates
US	United States
ZAMEFA	Metal Fabricators of Zambia Plc
ZESCO	Zambia Electricity Supply Corporation
ZESA	Zimbabwe Electricity Supply Authority

INTRODUCTION

The demand for electricity in the Southern African Development Community (SADC) region is anticipated to double from 280 terawatt hours (TWh) in 2010 to 570 TWh by 2030 (Bowa et al., 2021). By extension, the region will require significant amounts of electrical equipment, which includes items that are used for generation, conversion, transmission, supply, control, and utilisation of electric energy (Makarov, 2023). The SADC region is a net importer of electrical equipment, although South Africa supplies some of the equipment, including cables and structural steel products to the region, and Zambia produces copper wire on a large scale. If more local requirements for electrical equipment were produced in the region, it would stimulate investment, innovation, manufacturing, and job creation both directly and indirectly.

This regional value chain report examines whether SADC countries can move up the value chain and produce more inputs. It considers opportunities for further value addition in three Southern African countries – South Africa, Zambia, and Zimbabwe. South Africa is the largest producer of electrical equipment (cables, steel products). Zimbabwe has an electrical equipment manufacturing sector where advanced and sophisticated manufacturing can be developed further. Zambia is a major producer of copper, a critical input in electrical equipment. It scopes the electrical equipment regional value chain in South Africa, Zambia, and Zimbabwe. It explores the potential for regional production of electrical equipment to meet regional demands, exporting to the continent, and eventually to the rest of the world. To this end, it outlines the current state of electricity demand, electrical equipment production, trade, and employment within the region. The report further highlights strengths, weaknesses, opportunities, and threats for the sector within the region.

Findings from the study reveal that the region has planned electrification projects that will increase the demand for electrical equipment. Most of these are green energy projects, which generally require a significant expansion in transmission lines as well as generation equipment. While South Africa plans to continue reliance on coal-fired energy, most of the new capacity planned is renewable or based on gas. Logistical constraints point to the issues that the value chain still faces, with Zambia and Zimbabwe struggling with infrastructure and delays in transit, especially at border crossings.

The SADC region has the potential to enhance value addition in the electrical equipment value chain, especially with the emergence of industries such as batteries. This presents an opportunity for the SADC region and the African continent to participate in global value chains while increasing the value addition in regional value chains.

1. SCOPE OF THE ELECTRICAL EQUIPMENT VALUE CHAIN

This section outlines the regional value chain for electrical equipment. The electrical equipment value chain is composed of research and development (R&D), raw materials and inputs to electrical equipment components, final product assembly for a range of end market groups, and the final consumers of finished products. In addition, the paper also discusses the manufacturing capabilities and gaps along the value chain for each of the three countries in this study – South Africa, Zambia, and Zimbabwe. Understanding the regional value chain should point to improvements in the regional division of labour and opportunities to develop new industries.

1.1. Scope

Electrical equipment uses key components to convert a variety of energy into electricity and supply power. The industry is part of the electrotechnical industry. It provides a broad range of products

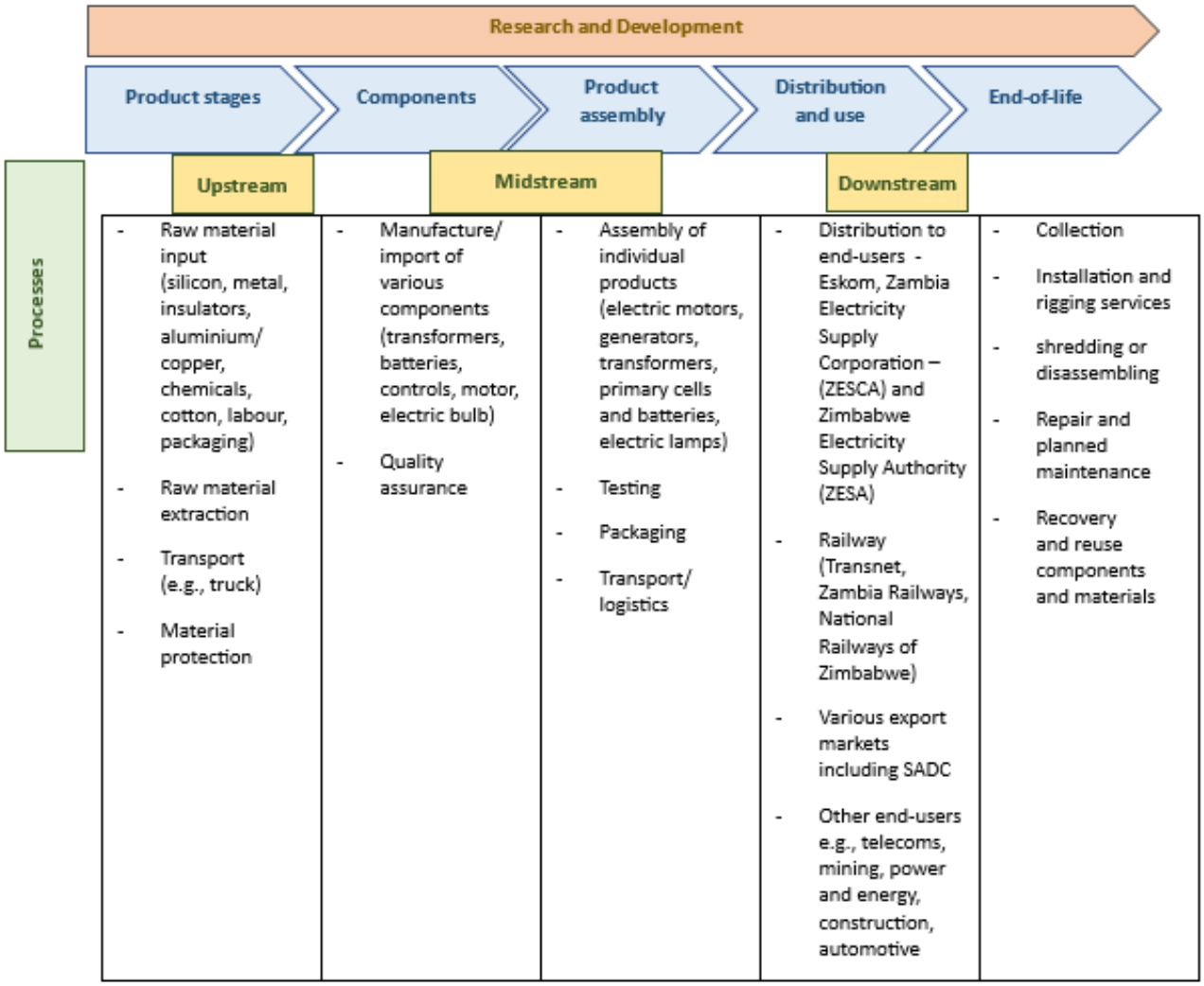
such as electric cables and insulated wires, electric motors, transformers, generators, electric lamps, and lighting equipment. The global market for power generation, transmission, and control equipment grew by annual growth of 6.8% to US$551.95 billion in 2023 from US$516.88 billion, and by 2027, the growth is anticipated to reach US$691.37 billion (BRC, 2023).

There is a potential for innovation for electrical equipment required in the future with the introduction of green technologies, electric motors, and electrification. The new machinery and equipment components will be used in infrastructure, electricity, railways, electric vehicles and building projects. It is anticipated to see increased demand throughout the world most especially in less developed countries (Makgetla et al., 2019).

1.2. Structure of the value chain

The electrical equipment regional value chain map, from components production to assembly, use and disposal (see Figure 1), is pictured below. This is an illustration of the various components and procedures from research and development, component manufacturing, and assembly that make up the value chain. Analysing the value chain of the power sector, as the main source of demand, would help identify particular elements of the sector that present opportunities for value-adding activities.

Figure 1: Electrical equipment value chain



Source: Authors' compilation

The Research and Development (R&D) of electric equipment marks the beginning of the value chain. This is a challenging and yet important stage of the sector. It involves a small number of specialised, often multinational, companies that are engaged in the research and design phases.

The research is conducted by either outsourcing research, or in-house, as some components do not require significant R&D. Proper R&D is important and it allows efficiency for high-volume manufacturing, competitiveness, and reliability in system planning and grid operations. After the product sample has been developed and undergone testing, it will be submitted to various stakeholders for regulatory approval. The testing process may take several months or even years. The approved concept is sent for actual product manufacturing once the samples have been authorised.

1.2.1. Component manufacturing and assembling

The manufacturing process of electrical equipment has become more complicated due to technological changes over the years, making it impossible for one country to produce every part on its own.

The main activities involved in the manufacturing process of these instruments are cutting or punching, staking, winding and second insulation and mechanical. The production and assembling of electrical transformers and semiconductors takes place mainly in Asia, Europe, and North America, where a range of companies can produce different components on a large scale.

Once the manufacturing components are done, the equipment is then assembled into different components. After the final assembly, the product goes through testing, quality control, and packaging before distribution.

1.2.2. Distribution and use

Distribution channels involve manufacturers, importers, intermediaries (wholesalers, retailers, agents), and final users for industrial applications (Guan, 2010).

These final users may include public/private power providers, railways, telecoms, mining, and the automotive sector. Distribution channels depend on the type and value of the products. Low-value products like insulated wire cables and light bulbs go through wholesale distributors, while higher-value products like transformers and generators are sold directly to government and private agencies.

1.3. Country analysis

1.3.1. Zambia

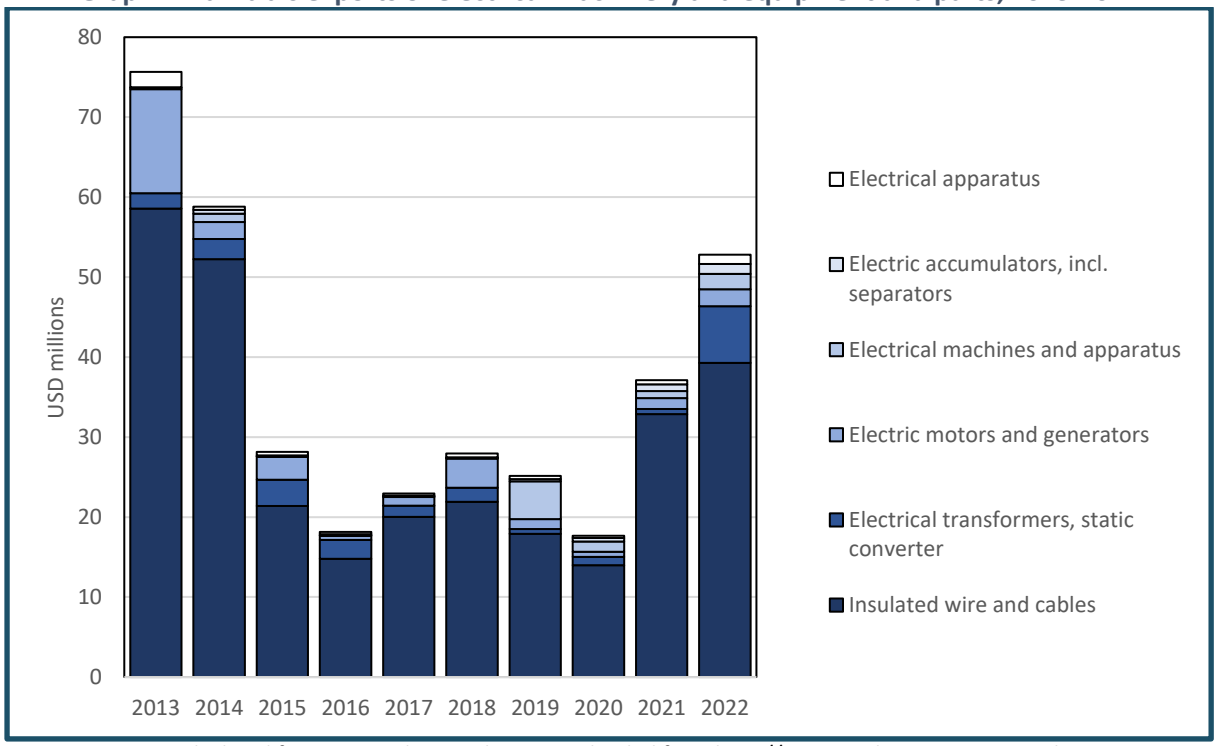
Zambia is the biggest producer of copper in Africa. producing about 880 000 tonnes of copper in 2021 (Sasu, 2023). Copper is the most commonly used conductor material in the manufacture of electrical equipment (electrical wire and cables) due to its efficiency in conducting electricity. The vast majority of downstream companies, such as Metal Fabricators of Zambia Plc (ZAMEFA), rely on the copper they source from local mines to convert products into copper wires, low-voltage cables, and wire rods (World Bank, 2011).

Zambian firms, including ZAMEFA, Non-Ferrous Metal Works Zambia Limited, and Morganite Zambia Limited, have some manufacturing capabilities along the electrical equipment value chain as they can produce low- and medium-voltage power cables, bare copper products, general wire insulated,

electrical switchgear, motors, starters, and switchgear (Sutton and Langmead, 2013). These local firms even go so far as to produce other crucial parts, such as metal fabrication, rod, and aluminium, which are used as materials in making the electrical components. Copper cables and wire produced by ZAMEFA dominate the export market because of its sales. Main exporting countries include the Democratic Republic of the Congo (DRC), South Africa and Equatorial Guinea. In 2023, total export sales of copper products generated from ZAMEFA's two largest customers amounted to ZK1 585 831 million, of which ZK1 147 762 million was for copper rods and ZK438 069 thousand was for wires and cables (ZAMEFA, 2023).

Graph 1 presents Zambia's exports of electrical machinery and equipment from 2013-2022. It illustrates Zambia's top six exported products for electrical machinery and equipment: insulated wires and cables, electrical transformers, and electric motors and generators.

Graph 1: Zambia's exports of electrical machinery and equipment and parts, 2013-2022



Source: Calculated from ITC Trade Map data. Downloaded from https://www.trademap.org in March 2024.

In terms of trade, ZAMEFA imports other important inputs such as plastic compounds from Mauritius, Malaysia, the US, South Africa, and Europe for wire insulation (Sutton and Langmead, 2013). Another imported input is enamel wire. Enamel wire is a crucial part of manufacturing transformers, inductors, motors, and other electrical appliances, that copper wire. This wire is not produced by two of Zambia's largest electrical cable companies (AfDB, 2019). Besides manufacturing, there is practically a wide range of services offered by various agents situated in Copperbelt, including inventory management and repair and maintenance services (Fessehaie, 2014).

1.3.2. South Africa

For over a decade, South African manufacturing firms operating in the electrical equipment sector have been well-developed companies offering a complete electronics value chain from R&D and manufacturing to packaging (Mtanga et al., 2019). Who Owns Whom recorded more than 100 local and multinational firm manufacturers operating in the electrical equipment market with capabilities

along the whole value chain. Some, however, distribute and service imports, as opposed to producing locally.

South Africa buys copper from the United Arab Emirates, Zambia, and the Democratic Republic of Congo, turning it into copper wire. It exports more advanced equipment primarily to SADC countries including Namibia, Botswana, Zimbabwe, and Zambia (Trade Map, 2024). The main components produced in South Africa for generation, transmission line, and distribution are a broad range of conductors, insulators, generators, transformers, switchgear, copper cables, and wires products (LSF, 2023). South Africa also has good cable production capability from high voltage (HV), medium-voltage (MV), and low voltage (LV) cables used in distribution lines. M-TEC, Aberdare Cables, and Alvern Cables are South Africa's three largest electrical cable producers (WOW, 2019).

Apart from other inputs into electrical equipment, insulators like tempered glass, composite, and porcelain are utilised heavily in the manufacturing of high-voltage transmission powerlines and substations. Both glass and porcelain are not made locally. Composite insulators are 100% designated for local procurement by government agencies. Only one manufacturer, Vexila, produces insulators for up to 765kV (LSF, 2023). Locally, there is a limited capability for high-standard power transformers classified as Class 3 and 4 manufacturing. SGB-Smit Power Matla is the only technically accepted manufacturer that has a permit to manufacture these power transformers of up to 400/132kV, 500MVA (LSF, 2023). Also, most medium-voltage to extra-high-voltage lines used in transmission networks are not manufactured in the country, and circuit breakers for transmission and distribution are imported as their design and production are highly specialised processes.

Local transformer manufacturers have an in-house 100% assembling line that assembles a whole transformer. The case study done by TIPS on the electrotechnical industry regional value chain revealed that the country has also created a large production facility for inverters and rectifiers, power metering, and mini substations (Mtanga et al., 2019). Product testing is one of the most vital processes carried out at the end of the manufacturing electrical equipment value chain. Transformers producers in the country have some modelling, simulation, and designing capabilities in-house for small to medium transformers (LSF, 2023). For short circuits, high voltage, and materials and installations, the National Electrical Test Facility NETFA has a high-power test facility to do all the external tests.

1.3.3. Zimbabwe

No manufacturing capabilities were recorded in Zimbabwe for electrical equipment. The country can produce cables, but they have not recorded any export transactions (Levin and Makgetla, 2021). During 2020, the country imported approximately US$230 million of electrical machinery and equipment, and South Africa dominated the imports with a share of 51.2% (Kamer, 2022).

2. TRENDS IN DEMAND

Population and economic growth shape electricity demand. Increasing population growth within the African continent will certainly accelerate demand for energy services, with the continent being occupied by 1.3 billion people and projected to increase by 350 million to 1.7 billion by 2030 (IEA, 2023). This section of the paper presents projected electricity demand within the African continent and the SADC region. This is followed by the production of electrical equipment in the region, trade of electrical equipment, and last, employment within the sector in the region.

2.1. Trends in electricity demand and generation

2.1.1. Continental electricity demand

Access to electricity in Africa has stagnated and has not kept up with population growth (Mtanga et al., 2019; IEA, 2023). This trend was accelerated by the COVID-19 pandemic, with more than 970 million people lacking access to clean cooking fuels and technologies (IEA, 2023).

All 54 African countries, including South Africa, Zambia, and Zimbabwe, committed to reducing greenhouse gas emissions by submitting a Nationally Determined Contribution (NDC) (AfDB, n.d.). This climate action pledge is a plan towards climate change adaptation and a transition towards clean energy. The Sustainable Africa Scenario (SAS) (based on climate goals in NDCs), modelled by the International Energy Agency IEA, projects modern primary energy supply to increase at an average annual rate of 3% between 2020 and 2030, and the total primary energy supply (including the use of traditional solid biomass) to fall 13% by 2030 (IEA, 2023). Projections by the IEA forecast declining traditional use of biomass and a rapid increase in the use of renewable energy, followed by oil and natural gas (IEA, 2023).

The predicted trends suggest that demand for electrical equipment utilised to generate, transmit, and distribute especially renewable will increase within the continent.

2.1.2. The SADC region

The Southern African Power Pool (SAPP) indicated that a total of 10 040 Megawatts (MW) (table 1) was planned to be commissioned from 2021 to 2023 while a total of 5 059 MW was planned to be decommissioned during the same period in the region (SAPP, 2021). The SADC Regional Infrastructure Development Master Plan (RIDMP) identified 73 power generation projects to increase generation from the current 56 000 MW and surpass the projected demand of 96 000 MW by 2027 (SADC, 2012). A total of 2 781 new generation capacity was commissioned in 2020. The projects were commissioned by both national utilities and Independent Power Producers (IPPs) (SAPP, 2021).

Table 1: Committed new generation capacity (MW) by SADC country (2021 – 2023)

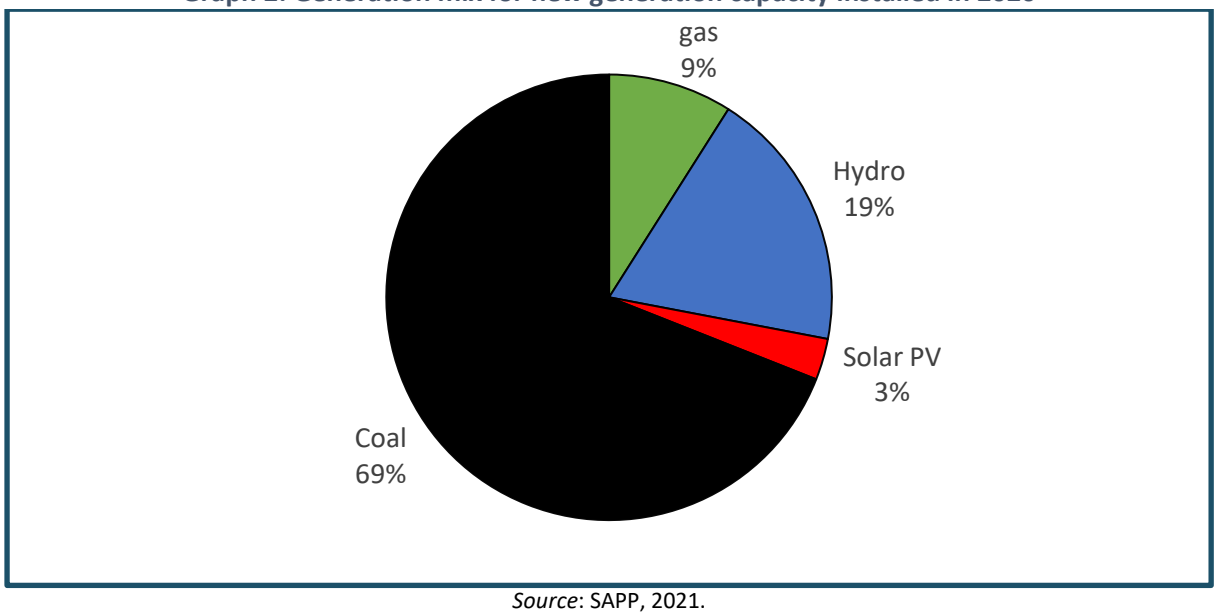
NO	COUNTRY	2021	2022	2023	TOTAL	% SHARE
1	Angola	190	303	83	577	5.7%
2	Botswana	0	100	100	200	2.0%
3	DRC	0	0	0	0	0.0%
4	Eswatini	10	0	59	69	0.7%
5	Lesotho	0	20	0	20	0.2%
6	Malawi	20	110	145	275	2.7%
7	Mozambique	0	45	50	95	0.9%
8	Namibia	45	134	50	229	2.3%
9	South Africa	1247	822	720	2 789	27.8%
10	Tanzania	0	2 650	1 012	3 662	36.5%
11	Zambia	300	750	400	1 450	14.4%
12	Zimbabwe	55	320	300	675	6.7%
Total		1867	5 254	2 919	10 040	100%
Plants planned to be commissioned		1867	2 280	909	5 059	

Source: SAPP, 2021.

Coal-fired energy generation still dominates new generation capacity, as shown in Graph 2, despite increasing efforts by SAPP to reduce the carbon footprint by investing in renewable energy (SAPP, 2021). The demand for electrical equipment and machinery will be driven by these new energy generation projects in the region over the medium to long term (Mtanga et al., 2019).

The IEA's SAS projects that renewable energy will be dominant by 2030 in the Sub-Saharan region (excluding South Africa), replacing the traditional use of biomass and coal-generated energy (IEA, 2023). Renewable energy is projected to be supplemented by oil-fired supply and natural gas.

Graph 2: Generation mix for new generation capacity installed in 2020



Source: SAPP, 2021.

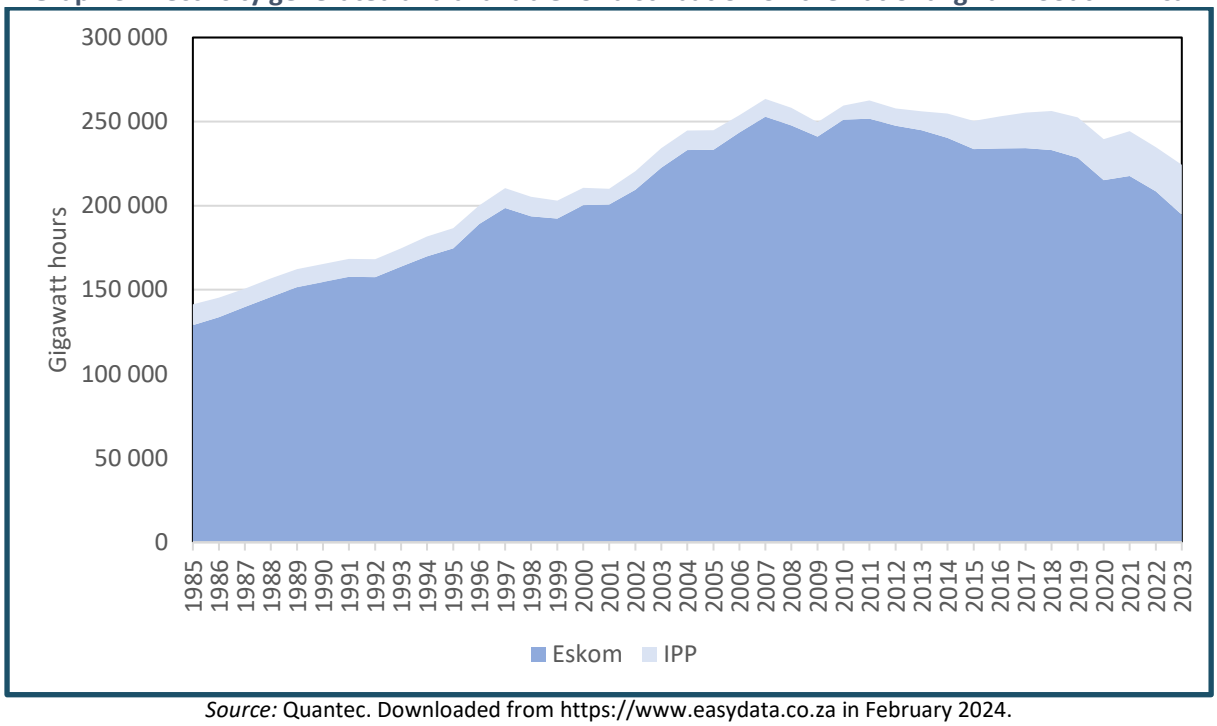
2.1.3. Electricity generation and demand in South Africa

Eskom is a state-owned energy enterprise responsible for generating, transmitting, and distributing electricity within South Africa. In August 2022, the national utility produced about 88% of South Africa's electricity, while IPPs produced 12% (WOW, 2022b). Electricity generation in South Africa peaked in 2007 at over 263 000 gigawatt hours (GWh), as shown in Graph 3.

The subsequent decline in 2008/09 correlated with the global financial crisis, with the following years showing a steady recovery until 2011. Electricity production by Eskom has been decreasing since 2011, while IPP generation has been steadily increasing. The increase in IPP power generation correlates with legislative changes including the Integrated Energy Plan in 2015 which allowed the private sector to generate power from 1MW to 100MW without a licence. The emergence of IPPs indicates the demand for electrical equipment that is utilised in the generation of electricity.

South Africa's energy generation sector is troubled, with the national utility facing financial instability, mismanagement and corruption, which led to insecure energy supply (WOW, 2022b). Eskom faces a high debt burden, ageing and failing coal generation plants (WOW, 2022b). These issues have led to scheduled power outages, commonly known as loadshedding, to avoid complete blackouts because of insufficient electricity supply.

Graph 3: Electricity generated and available for distribution on the national grid in South Africa



Source: Quantec. Downloaded from https://www.easydata.co.za in February 2024.

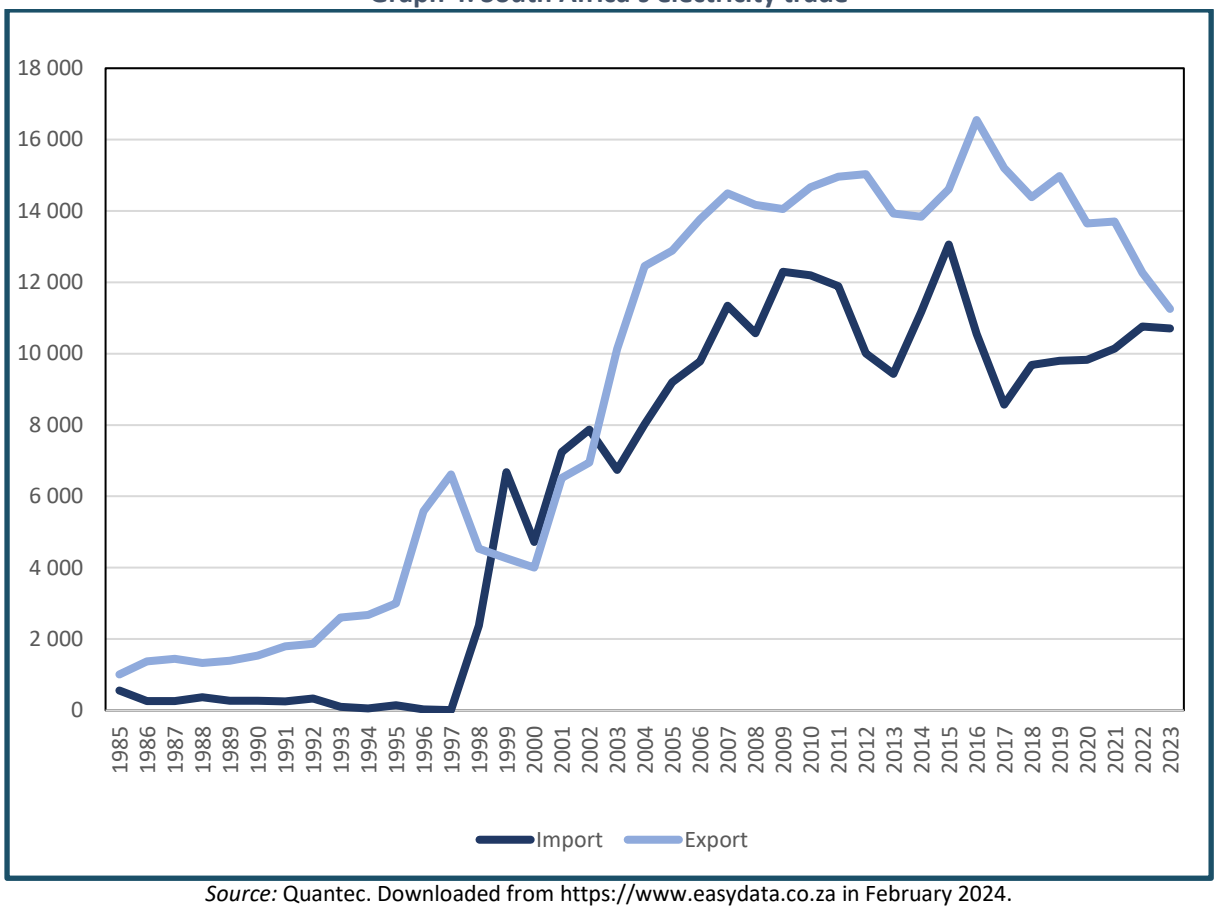
South Africa's national power utility has hegemony in the energy sector within the country. The utility also has a substantial demand for electrical equipment and machinery to generate, transmit, and distribute electricity. This is true for other national utilities including ZESCO and ZESA. South Africa's forecast electricity demand detailed in the Integrated Resource Plan of 2019 shows that with projected 1.33% and 3.18% annual GDP growth, electricity demand will surge by 1.21% and 2.0% by 2030 and by 1.24% and 1.66% by 2050 (DMRE, 2019). The IEA's SAS projects that a majority of South Africa's coal-fired energy supply will be replaced by renewable energy as coal supply is planned to be phased out by 2030 (IEA, 2023). Deliberations in South Africa, however, point out that shutting down of coal-fired power stations will be delayed post 2035 by 10 years (DMRE, 2024).

South Africa imports electricity from Lesotho, Mozambique, and Zambia, and exports electricity to Botswana, Eswatini, Lesotho, Mozambique, Namibia, Zambia, and Zimbabwe through the Southern African Power Pool (WOW, 2022b).

Most of South Africa's electricity exports are sent to Mozambique under a long-term Special Pricing Agreement for the Mozal Aluminium Smelter, with Eskom providing about 47% of Mozal's electricity (Monaisa and Montmasson-Clair, 2022). South Africa's declining electricity generation has resulted in a decline in electricity exports (almost all of which goes to power the Mozal aluminium plant in Mozambique) and a surge in imports, as shown in Graph 4.

Over the past 10 years, exports of electricity declined by 2% on average in comparison to a 2% increase in imports. Exports also decreased by 4% over the past five years while imports surged by 5% over the same period. When looking at year-on-year, exports declined by 10% from 13 705 GWh in 2021 to 12 270 GWh in 2022, while imports surged by 6%, from 10 137 gigawatt hours to 10 761 gigawatt-hours over the same period.

Graph 4: South Africa's electricity trade



Source: Quantec. Downloaded from https://www.easydata.co.za in February 2024.

2.2. Sales and trade

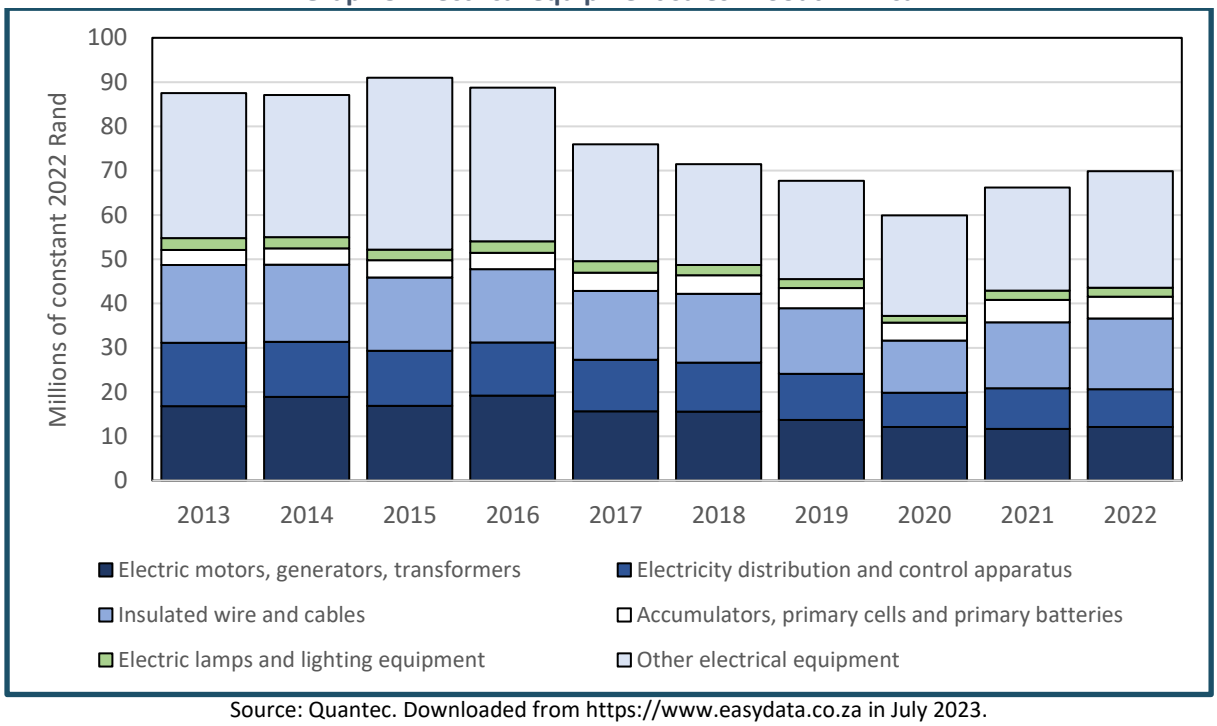
2.2.1. Sales of electrical equipment in South Africa

Graph 5 presents South Africa's sales of electrical equipment from 2013 to 2022 in constant 2022 Rand. The graph shows that:

- Sales of electrical equipment declined from 2016 to 2020 but recovered in 2021 after a sharp pandemic-related drop the previous year. As loadshedding picked up in 2021, sales of electrical equipment surged by 11% in 2021 and by 5% in 2022 from previous years.
- During the 10-year period, "Other electrical equipment" accounted for the largest share of total sales. Following behind in 2022 were insulated wires and cables; electric motors, generators, and transformers; electricity distribution and control apparatus; accumulators, primary cells and primary batteries; and finally, electric lamps and lighting equipment.
- From 2016 to 2020, sales of electrical machinery decreased by 8%. Only accumulators, primary batteries, and primary cells saw an average growth of 1% during the same period.
- Looking at year-on-year growth in 2022, sales of other electrical equipment grew by 13%, followed by insulated wires and cables at 7%; and electric motors, generators, and transformers at 3%. Other products saw a decline from the previous year in 2022.

The main source of demand for transformers in South Africa is Eskom, with renewable energy projects also demanding such equipment (WOW, 2022a). Generators are in high demand due to loadshedding as they serve as an alternative source of energy generation.

Graph 5: Electrical equipment sales in South Africa



Source: Quantec. Downloaded from https://www.easydata.co.za in July 2023.

2.2.2. Trade in electrical equipment

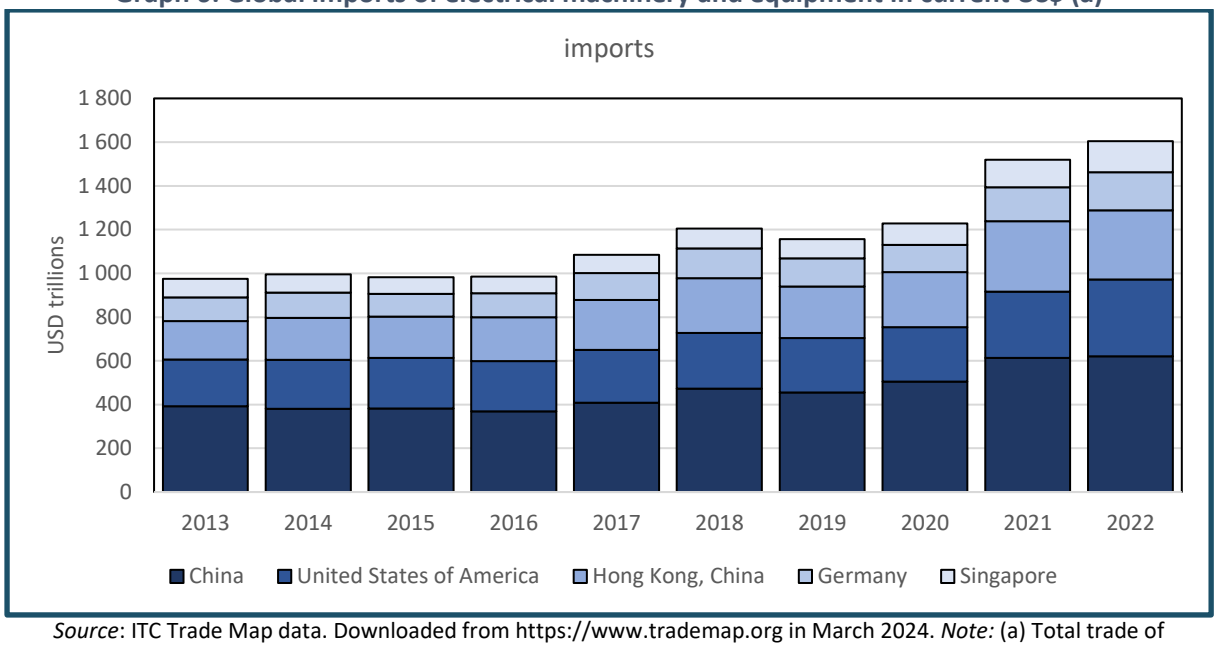
Global trade

Global imports of electrical machinery and equipment, presented in Graph 6, amounted to US$3.2 trillion in 2022, a 7% increase from the previous year.

The top 10 importers were China; the US; Hong Kong, China; Germany; Singapore; the Republic of Korea; Taipei, Chinese; Japan; Mexico; and Vietnam. In 2022, China accounted for 20% of global imports, the US 11%, Hong Kong, China 10%, Germany 6% and Singapore 4%. Among the top five importers, the US's imports increased by 15% from the previous year, Singapore and Germany's surged by 13%, China by 1%, with only Hong Kong, China decreasing by 2%.

The top imported products globally are presented in Table 2, including electronic integrated circuits; semiconductor devices; insulated wires and cables; electrical transformers and static converters; electrical apparatus for switching or protecting electrical circuits; electric accumulators; monitors and projectors; flat panel display modules; boards, panels, consoles etc; electric generating sets and rotary converters; and electric motors and generators.

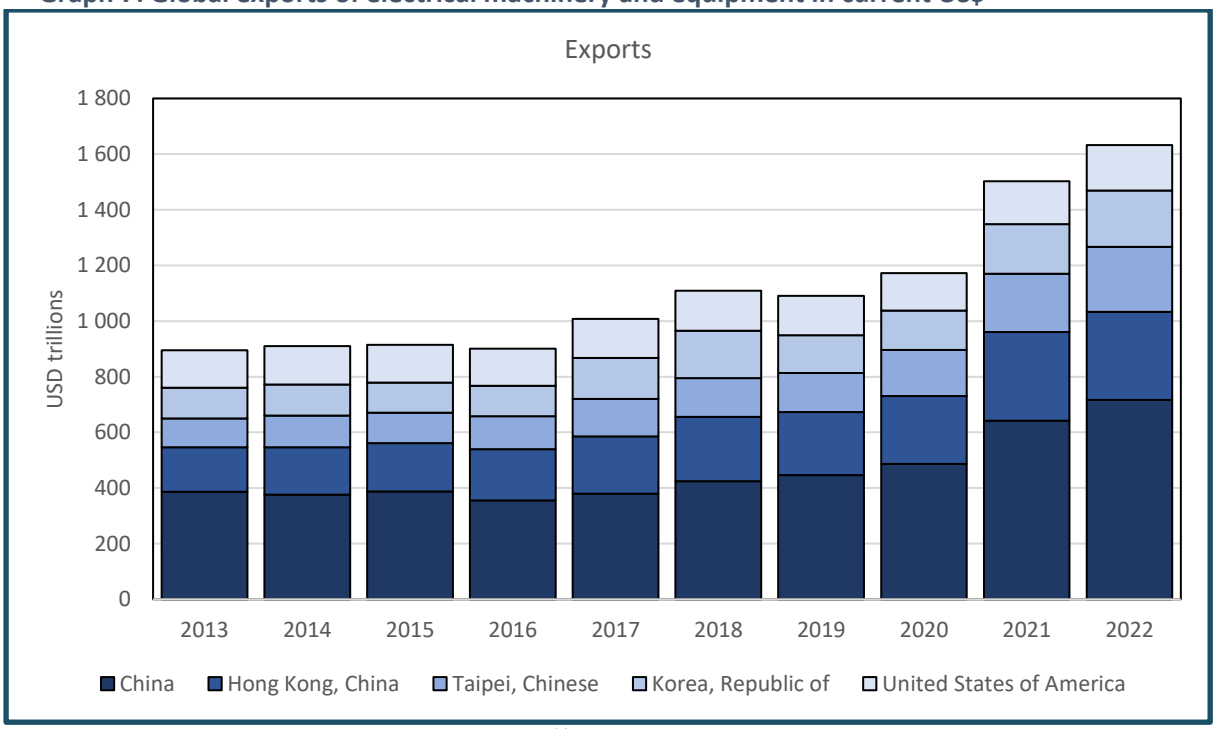
Graph 6: Global imports of electrical machinery and equipment in current US$ (a)



Source: ITC Trade Map data. Downloaded from https://www.trademap.org in March 2024. *Note:* (a) Total trade of electrical machinery and equipment excluded telephone sets, including smartphones and other telephones for cellular networks (HS8517) because they are not part of electrical equipment.

Global exports (Graph 7) of electrical machinery and equipment amounted to over US$3 trillion in 2022, a 9% increase from the previous year. The top 10 exporters were China; Hong Kong, China; Taipei; the Republic of Korea; the US; Vietnam; Singapore; Germany; Malaysia; and Japan. In 2022, China accounted for 32% of global exports; Hong Kong, China 12%, Taipei 8%; the Republic of Korea 7%, US; Vietnam; Singapore; Germany 6%; Malaysia and Japan 4%. Among the top 10 exporters, Vietnam saw a 46% increase in 2022 from 2021, while Malaysia saw a 25% increase. The top exported products were similar to the top exported products.

Graph 7: Global exports of electrical machinery and equipment in current US$



Source: ITC Trade Map data. Downloaded from https://www.trademap.org in March 2024. Note: Total global trade excludes the trade of telephone sets, incl. smartphones and other telephones for cellular networks.

Table 2: Global Trade in electrical machinery and equipment by product (current US$ thousand)

IMPORTS	HS CODE	PRODUCT LABEL	2013	2022
1	'8542	Electronic integrated circuits; parts thereof	605 986 997	1 257 761 694
2	'8541	Semiconductor devices “e.g. diodes, transistors, semiconductor-based transducers”; photosensitive ...	107 625 984	175 068 344
3	'8544	Insulated “including enamelled or anodised” wire, cable "incl. coaxial cable" and other insulated ...	111 685 793	160 127 052
4	'8504	Electrical transformers, static converters, e.g. rectifiers, and inductors; parts thereof	98 351 391	143 813 670
5	'8536	Electrical apparatus for switching or protecting electrical circuits, or for making connections ...	100 194 390	129 577 873
6	'8507	Electric accumulators, including separators therefor, whether or not square or rectangular; parts ...	34 025 665	127 334 142
7	'8528	Monitors and projectors, not incorporating television reception apparatus; reception apparatus ...	95 769 567	98 445 538
8	'8537	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus ...	53 303 636	81 186 629
9	'8501	Electric motors and generators (excluding generating sets)	50 713 712	72 426 062
10	'8523	Discs, tapes, solid-state non-volatile storage devices, “smart cards”” and other media for the ...	57 167 730	72 160 632
EXPORTS	**HS CODE**	**PRODUCT LABEL**	**2013**	**2022**
1	'8542	Electronic integrated circuits; parts thereof	502 985 103	1 077 650 619
2	'8541	Semiconductor devices “e.g. diodes, transistors, semiconductor-based transducers”; photosensitive ...	102 963 348	165 951 374
3	'8544	Insulated “including enamelled or anodised" wire, cable "incl. coaxial cable" and other insulated ...	113 406 991	162 111 085
4	'8504	Electrical transformers, static converters, e.g. rectifiers, and inductors; parts thereof	98 047 215	145 056 543
5	'8507	Electric accumulators, including separators therefor, whether or not square or rectangular; parts ...	35 932 523	131 971 840
6	'8536	Electrical apparatus for switching or protecting electrical circuits, or for making connections ...	95 175 720	124 432 245
7	'8528	Monitors and projectors, not incorporating television reception apparatus; reception apparatus ...	95 861 209	101 422 295
8	'8537	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus ...	52 196 076	81 429 331
9	'8523	Discs, tapes, solid-state non-volatile storage devices, “smart cars” and other media for the ...	50 039 665	72 924 000
10	'8524	Flat panel display modules, whether or not incorporating touch-sensitive screens	4 296	72 537 942

Source: ITC Trade Map data. Downloaded from https://www.trademap.org in March 2024.

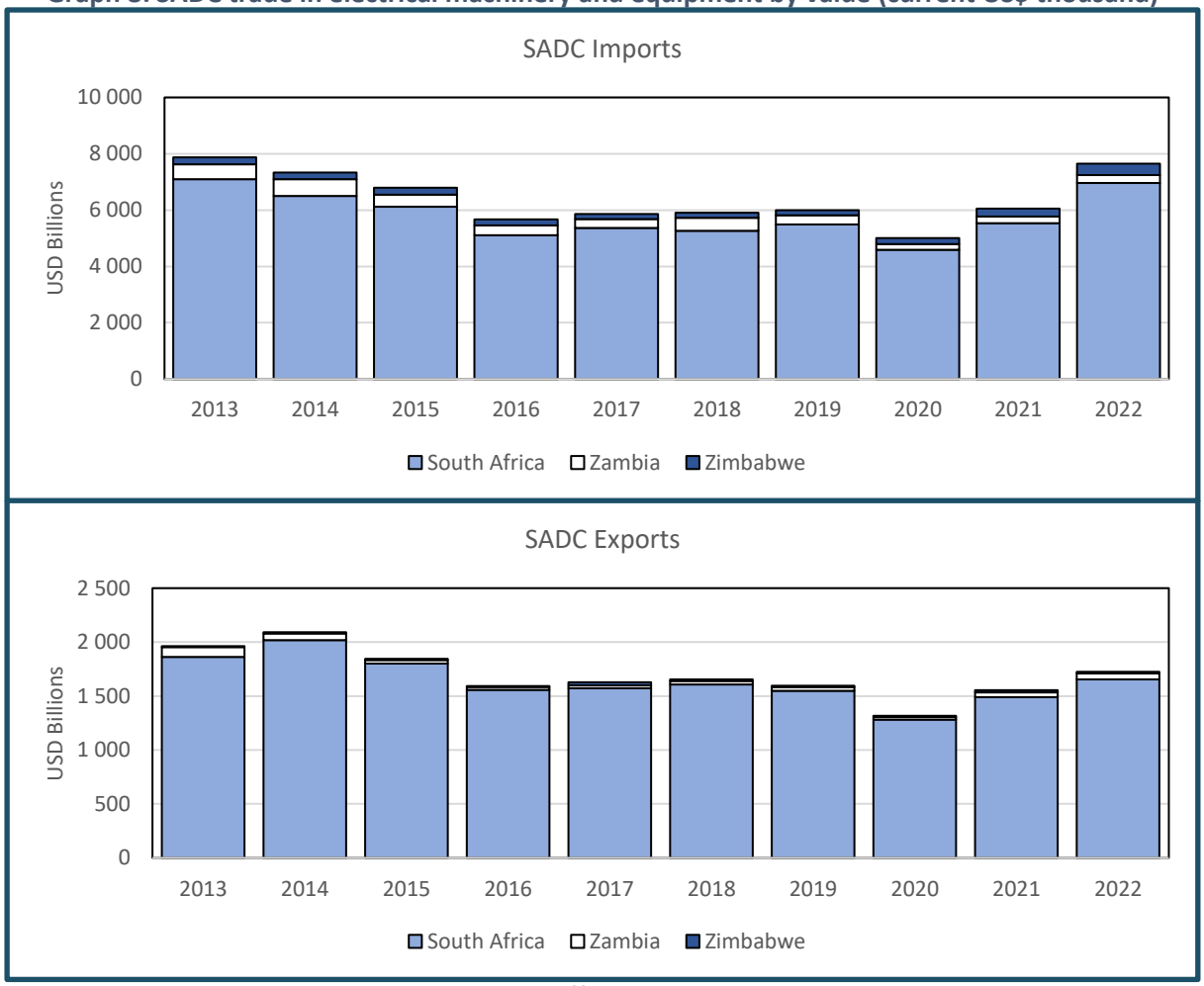
The SADC region

Graph 8 shows that in 2022, the SADC region imported electrical machinery and equipment in current US dollars’ worth US$12 billion, excluding telephone sets. South Africa accounted for 58% of

SADC's imports in 2022, Zimbabwe 3%, and Zambia 2%. The top imported products by SADC in 2022 included electric transformers and static converters; electric accumulators; insulated wires and cables; electrical apparatus; semiconductor devices; boards, panels, consoles; electric generating sets and rotary converters; electric motors and generators; electric instantaneous or storage water heaters and immersion heaters; and monitors and projectors.

SADC's exports of electrical machinery and equipment accounted for over US$2 billion in 2022. South Africa accounted for the highest share of exports at 80%, Zambia 3%, and Zimbabwe 1%. SADC exports increased by 15% in 2022 from the previous year, South Africa by 11% and Zambia by 31%, while Zimbabwe saw a 38% decline. The top exported products from SADC were insulated wires and cable; electrical apparatus; electrical transformers and static converters; electric accumulators; boards, panels, consoles; monitors and projectors; electric instantaneous or storage water heaters; parts for flat panel display modules; and electric motors and generators.

Graph 8: SADC trade in electrical machinery and equipment by value (current US$ thousand)



Source: ITC Trade Map data. Downloaded from https://www.trademap.org in March 2024. Note: Total SADC trade excludes the trade of telephone sets, incl. smartphones and other telephones for cellular networks.

South Africa is a net importer of electrical machinery and equipment. In 2022, China was in first place with a 58% share of total exports to South Africa followed by Vietnam; India; US; Germany; Taipei, Chinese; Japan; Italy; Malaysia; and Botswana. On a 10-year average, South Africa's imports from Botswana (owed to ignition wiring sets for vehicles and electric conductors) grew by 16%; with 14% from India; 12% from Vietnam; and 10% from China. South Africa's top imported products included electric accumulators; insulated wires and cables; diodes, transistors; electrical apparatus for switching or protecting circuits; electric instantaneous or storage water heaters; electric motors

and generators; electric generating sets and rotary converters; and boards, panels, consoles; and discs, tapes, solid-state non-volatile storage devices.

South Africa's export market of electrical machinery and equipment was mainly to SADC countries in 2022: 12% to Namibia; Botswana 11%, Zimbabwe; Zambia and DRC 7%; with other exports going to Lesotho; Mozambique and Eswatini; and the United Arab Emirates (UAE). South Africa's top exported products included insulated wires and cables; electrical transformers and static converters; electrical apparatus for switching; electric accumulators; boards, panels, consoles; monitors and projectors; parts for transmission or reception apparatus; electric instantaneous or storage water heaters; and electric motors and generators.

Table 3: SADC trade in electrical machinery and equipment by product (current US$ thousand)

IMPORTS	HS CODE	PRODUCT LABEL	2013	2022
1	'8504	Electrical transformers, static converters, e.g. rectifiers, and inductors; parts thereof	955 201	1 341 741
2	'8507	Electric accumulators, including. separators therefor, whether or not square or rectangular; parts ...	332 289	1 284 199
3	'8544	Insulated "incl. enamelled or anodised" wire, cable "including coaxial cable"" and other insulated ...	877 412	1 279 276
4	'8536	Electrical apparatus for switching or protecting electrical circuits, or for making connections ...	721 056	693 169
5	'8541	Semiconductor devices "e.g. diodes, transistors, semiconductor-based transducers"; photosensitive ...	606 927	691 181
6	'8537	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus ...	472 582	601 894
7	'8502	Electric generating sets and rotary converters	1 144 043	563 437
8	'8501	Electric motors and generators (excl. generating sets)	464 061	506 413
9	'8516	Electric instantaneous or storage water heaters and immersion heaters; electric space-heating ...	448 911	468 006
10	'8528	Monitors and projectors, not incorporating television reception apparatus; reception apparatus ...	543 641	454 184
IMPORTS	**HS CODE**	**PRODUCT LABEL**	**2013**	**2022**
1	'8544	Insulated "including enamelled or anodised" wire, cable "incl. coaxial cable" and other insulated ...	318 886	451 156
2	'8536	Electrical apparatus for switching or protecting electrical circuits, or for making connections ...	174 160	172 447
3	'8504	Electrical transformers, static converters, e.g. rectifiers, and inductors; parts thereof	143 136	159 475
4	'8507	Electric accumulators, incl. separators therefor, whether or not square or rectangular; parts ...	62 738	126 652
5	'8537	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus ...	122 700	112 988
6	'8528	Monitors and projectors, not incorporating television reception apparatus; reception apparatus ...	181 384	92 496
7	'8516	Electric instantaneous or storage water heaters and immersion heaters; electric space-heating ...	98 502	76 159
8	'8529	Parts suitable for use solely or principally with flat panel display modules, transmission ...	76 938	74 156
9	'8501	Electric motors and generators (excluding generating sets)	119 663	73 035
10	'8538	Parts suitable for use solely or principally with the apparatus of heading 8535, 8536 or 8537, ...	76 264	65 414

Source: ITC Trade Map data. Downloaded from https://www.trademap.org in August 2023.

Table 4: South Africa's electrical machinery and equipment trade by product (current US$ thousand)

	HS CODE	SOUTH AFRICA'S TOP 10 IMPORTS OF ELECTRICAL MACHINERY AND EQUIPMENT	2013	2022
1	'8507	Electric accumulators, including separators therefor, whether or not square or rectangular; parts ...	178 995	1 003 579
2	'8504	Electrical transformers, static converters, e.g. rectifiers, and inductors; parts thereof	581 400	734 588
3	'8544	Insulated "incl. enamelled or anodised" wire, cable "incl. coaxial cable" and other insulated ...	359 041	503 140
4	'8541	Semiconductor devices "e.g. diodes, transistors, semiconductor-based transducers"; photosensitive ...	544 069	430 863
5	'8536	Electrical apparatus for switching or protecting electrical circuits, or for making connections ...	406 326	392 255
6	'8516	Electric instantaneous or storage water heaters and immersion heaters; electric space-heating ...	297 584	315 809
7	'8501	Electric motors and generators (excluding generating sets)	280 147	314 654
8	'8502	Electric generating sets and rotary converters	677 527	248 133
9	'8537	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus ...	201 589	223 602
10	'8523	Discs, tapes, solid-state non-volatile storage devices, "smart cards" and other media for the ...	389 784	221 962
	HS CODE	SOUTH AFRICA'S TOP 10 EXPORTS OF ELECTRICAL MACHINERY AND EQUIPMENT	2013	2022
1	'8544	Insulated "including enamelled or anodised" wire, cable "including coaxial cable" and other insulated ...	215 953	241 289
2	'8504	Electrical transformers, static converters, e.g. rectifiers, and inductors; parts thereof	133 083	139 237
3	'8536	Electrical apparatus for switching or protecting electrical circuits, or for making connections ...	154 456	125 930
4	'8507	Electric accumulators, incl. separators therefor, whether or not square or rectangular; parts ...	50 637	111 225
5	'8537	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus ...	120 232	110 049
6	'8528	Monitors and projectors, not incorporating television reception apparatus; reception apparatus ...	162 659	78 985
7	'8529	Parts suitable for use solely or principally with flat panel display modules, transmission ...	74 245	73 132
8	'8516	Electric instantaneous or storage water heaters and immersion heaters; electric space-heating ...	94 769	71 985
9	'8501	Electric motors and generators (excluding generating sets)	95 139	65 834
10	'8538	Parts suitable for use solely or principally with the apparatus of heading 8535, 8536 or 8537, ...	53 468	61 936

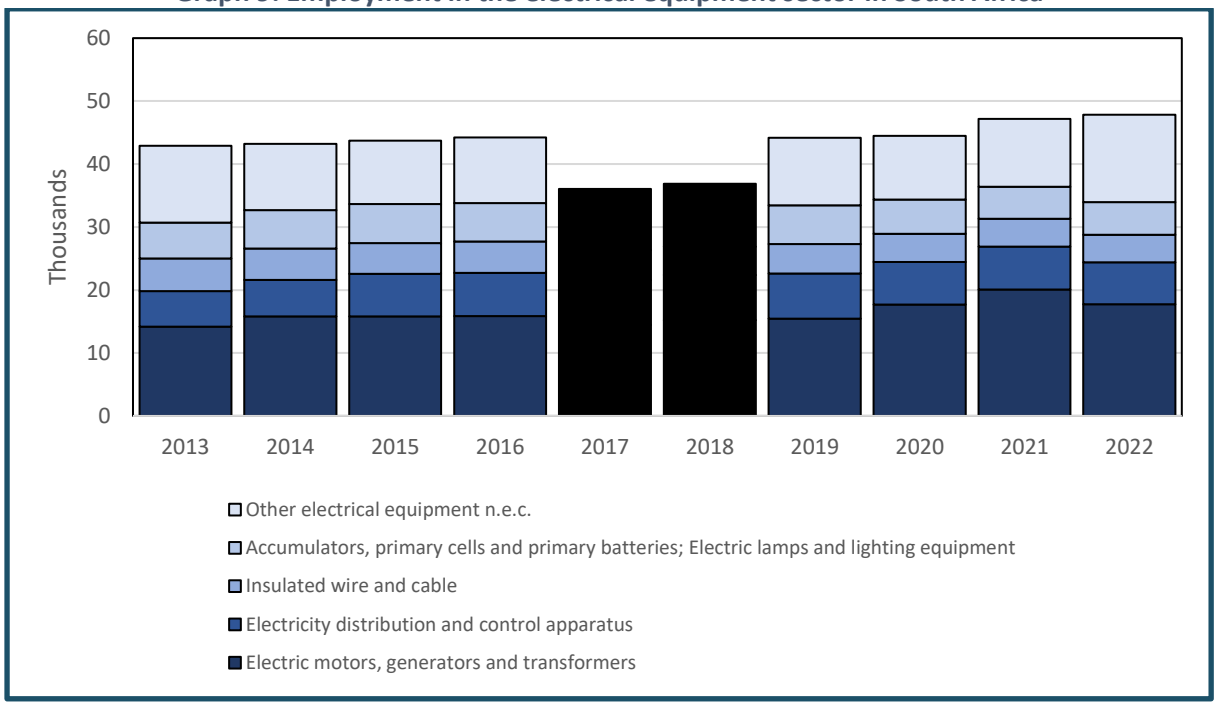
Source: ITC Trade Map data. Downloaded from https://www.trademap.org in February 2024.

2.3. Employment in the region

Manufacturing is the third largest employer in Zambia, accounting for a 10.5% share of the employed population, that is 330 000 of 3.2 million employed people (ZSA, 2021). Manufacturing is also the third largest employer in Zimbabwe, accounting for 9.7% of the share of the employed population, about 303 000 of over 3.1 million employed people (ZimStat, 2023). Manufacturing is the fourth largest employer in South Africa, accounting for about 9.5% share of the employed population, that is over 1.5 million of 16.3 million employed people (Stats SA, 2023).

Employment in South Africa's electrical machinery and equipment was over 47 800 in 2022. As shown in Graph 9, electrical motors, generators and transformers had over 17 700 employees; other electrical equipment employed about 13 900; electricity distribution and control apparatus employed about 6 700; and last, insulated wires and cables employed over 4 300. Between 2013 and 2022, the annual growth rate of employment in the industry was only 1% on average. Employment in electric motors, generators, and transformers rose by an average of 4% per year while employment in the insulated wires and cables industry decreased by an average of 2% per year. It is important to note that data for accumulators, primary cells, and primary batteries, and electric lamps and lighting equipment for 2017 and 2018, was not published – hence the decrease in total employment for those years.

Graph 9: Employment in the electrical equipment sector in South Africa



Source: Quantec. Downloaded from https://www.easydata.co.za in July 2023. *Note:* Employment statistics for accumulators, primary cells, and primary batteries; and electric lamps and lighting equipment was not reported in 2017 and 2018.

Employment in the generator and transformer industry in South Africa is centralised in urban areas, particularly in Gauteng. The industry has been experiencing a shift towards skilled and highly skilled workers (WOW, 2022a). At the same time, the energy sector in South Africa has a skills shortage within manufacturing, while Eskom has been losing workers in its generation department (WOW, 2022b).

The insulated wires and cables industry in South Africa also faces a general shortage of skills, particularly technical skills (WOW, 2019). Reduction in expenditure at large state-owned enterprises has resulted in losses of technically skilled professionals to the international market, while skilled labour that remains in the industry nears retirement, with most being 15 years away from retirement. This indicates a prospective skills shortage within the industry (WOW, 2019).

According to the World Economic Forum, "the battery industry in South Africa faces a human capital cost as raw materials for batteries are extracted at a high human and environmental toll, this includes child labour, health, and safety hazards in informal work as well as poverty and pollution" (WOW, 2021:11). This industry is characterised by multiple challenges including a general lack of good sales and marketing skills, a shortage of technical skills and experienced staff. In the electronic

vehicle manufacturing industry, there is a demand to upskill technicians to ease the transition to electronic vehicles (WOW, 2021).

Within the electric lamps and lighting equipment industry, ACTOM instituted a technical training centre for artisans which provides apprenticeship training in electrical and mechanical trade to applicants that have N2 (ACTOM, 2023). The Illumination Engineering Society of South Africa developed training courses for continual professional development with the Engineering Council of South Africa, with courses ranging from basic light fitting to more specialised courses such as outdoor lighting design (WOW, 2020). The Department of Mineral Resources and Energy (DMRE) in collaboration with training professionals created a programme to upskill retail consultants who sell household appliances, teaching them how to display, communicate, and use the South Africa Energy Efficiency Label (WOW, 2020). The programme started nationwide in 2018 as all retailers and retail consultants that sell household appliances were then required by DMRE to explain to customers the significance of buying energy-efficient appliances (WOW, 2020).

3. SUPPLY-SIDE CONSTRAINTS

The electrical equipment industry faces many industry-specific constraints. Key issues adversely affecting the industry include high tariffs in South Africa, logistics as a result of poor infrastructure, access to investment, and access to technology and skills. New opportunities for new projects and opportunities market for electrical equipment will only emerge if these constraints can be addressed.

3.1. Tariffs in regional markets

There is no customs duty for the South African trade of electrical machinery and equipment within the SADC region according to the South African Revenue Services (SARS) Customs & Excise Tariff book. Table 5 presents the tariffs for final bound duties for electrical machinery in South Africa, Zambia, and Zimbabwe. With regards to imports of electric lamps and lighting equipment, some reports suggest that South Africa confronts imports of substandard and inferior products because of ineffective enforcement of regulations set by the National Regulator for Compulsory Specifications (NRCS) and inadequate sampling and testing of imported products (WOW, 2020).

Table 5: Tariffs for final bound duties

COUNTRY	SOUTH AFRICA	ZAMBIA	ZIMBABWE
Average	17.2	-	3.0
Duty-free in %	6.6	-	78.8
Maximum	30	-	25
Binding in %	99.6	0	13.1

Source: World Trade Organization, 2023

There are no customs duties levied for trading under the African Continental Free Trade Area (AfCFTA) agreement for about half of electrical machinery and equipment products in South Africa, while levied products rate of duty ranges from 4%-20% (SARS, 2023). In Zimbabwe, the customs and excise tariff book ranges the rate of customs duty from 0%-40% for both general and Most Favoured Nations (ZIMRA, 2022). In Zambia, the rate of customs duty ranges from 0%-40% (ZRA, 2023). However, the transportation of copper and cobalt, crucial components of batteries, is often delayed for weeks due to poor customs services at Zambia's borders. (Short, 2023).

3.2. Logistics in the region

Table 6 presents the World Bank's Logistics Performance Index (LPI), which standardises trade performance of countries across the world. A high score indicates capacity to transport electrical equipment, particularly in large quantities with limited logistical constraints. According to the 2023 LPI, South Africa is the best African performer in trade and logistics. In the same LPI, Zimbabwe ranked 97th. Zambia ranked 111th when the country was last surveyed in 2018. Customs, infrastructure, logistics competence and timeliness stand out as clear issues for adequate trade and logistics performance for Zambia, and Zimbabwe.

The LPI's low scores on infrastructure underscore poor infrastructure development in transport logistics within the SADC region, except in South Africa (Ramos, 2023). All the countries tend to fare well with international shipments as well as tracking and tracing except for Zimbabwe. Still, Zambia and Zimbabwe rank near the bottom of the scored countries included in the index, while South Africa is in the top 20.

Table 6: Logistics Performance Index

Country	LPI Rank	LPI Score	Customs	Infrastructure	International shipments	Logistics competence and equality	Timeliness	Tracking and tracing
South Africa (2023)	19	3.7	3.3	3.6	3.6	3.8	3.8	3.8
Zambia (2018)	111	2.53	2.18	2.30	3.05	2.48	1.98	3.05
Zimbabwe (2023)	97	2.5	2.2	2.4	2.5	2.3	2.8	2.7

Source: World Bank Logistics Performance Index, 2018; 2023

In the South African context, rising fuel costs increase the cost of transport logistics as well as input costs. In addition, delays at ports, which have doubled the lead time to import parts and gensets, are considered to have influenced companies to reduce imports of such generators (WOW, 2022a). Addressing logistical constraints is important to facilitate trade for the regional value chain. Reduced lead times are likely to lead to improved imports, higher productivity, and revenues for the electrical equipment sector.

3.3. Access to investment finance

When exploring new market potential, one of the most important things to keep in mind is the availability of financing. The way electricity is generated is evolving around the world. To accommodate the decarbonization of the power sector on a large scale, a substantial new investment will be needed in the installation of renewable energy infrastructure and storage capacity.

Financing for new projects in clean energy technologies has been a key challenge that manufacturers encounter, especially those operating in the energy-intensive sector. An estimated US$2.8 trillion is expected to be invested in the energy sector by 2023, according to the IEA (IEA, 2023).

Major projects in SADC have been restricted from getting funding by a large number of private multinational banks as a result of a lack of legal/regulatory frameworks; lack of creditworthiness; and negative balance sheets making it hard for them to be competitive (SADC, 2012).

Zambia has been battling financially over the past three years to pay back the US$6.3 billion in foreign debt it obtained from its creditors, China and the Paris Club (Reuters, 2023). An agreement between its creditors and the government is still underway to solve this debt crisis.

Over the years, Zimbabwe's primary source of funding has been China. China intends to invest US$$2.8 billion in the power and lithium industries in Zimbabwe (Bloomberg News, 2023). In 2022, Sinomine Resource Group bought Bikita Minerals and invested US$300 million to expand production of lithium aluminum phyllosilicate minerals. Sinomine makes use of lithium, which is a crucial component in the production of batteries for electric cars.

In addition, the African Export-Import Bank (Afreximbank) pledged to invest US$188.6 million in four Zimbabwean companies in 2021. ZB Bank is one of the four companies that reached an agreement for a US$10 million term sheet that will allow it to take part in a loan for Zimbabwe's energy sector as one of the syndicated lenders (Afreximbank, 2021). It will be able to assist businesses operating in the mining, manufacturing, and industrial sectors to expand their capacities by providing adequate financing for power generation and transmission infrastructure.

In South Africa, the Renewable Independent Power Producer Programme (REIPPP) raised R209.7 billion in investment (equity and debt) in seven bid rounds for the development of renewable energy, of which R41.8 billion came from foreign investors and financiers by March 2021 (DMRE, 2021).

There is a need for regional funding for generation and to set up local manufacturing for manufacturing renewable energy products e.g., electrical equipment and building testing facilities, and R&D for renewable energy when the projects take off.

Addressing the matter of conflicting policy is also need. For example, there is a clash between the dtic's Export Credit Insurance Corporation local content and strict localisation standards imposed by the Zambian government

3.4. Access to technologies and skills

3.4.1. Technology

According to the Who Owns Whom (2022a) report, rapid modifications in technology are changing the way electricity is generated, for example components of power grid infrastructure, such as transformers, being digitalised. The shift to renewable energy also seems likely to transform major electrical equipment needs, for instance moving away from liquid-fuel-based generators and coal-fired burners to batteries, solar cells, and wind turbines.

The electrotechnical sector has long been recognised for technological innovation with products that involve complex production processes (Lemay, 2022). The focus is on a wide range of products comprising advanced high technologies, including complex electrical engineering, electronics, and telecommunication products (Eltgen, et al., 2020). Developed countries (such as the US and European countries) have been successful at innovation with the use of medium-to-high technology. These extremely advanced technologies allow them to be more competitive. In most cases, multinational corporations control local production and sales through their control of technologies, and consequently high-end components, through a combination of branding and patents that allow them to benefit disproportionally from regional value content.

There is a huge gap in technology defusion and innovation in most developing countries as they are dependent on imported technology, and are frequently located far from technological frontiers. SADC is still reliant on medium- and high-technology production. South Africa's electrotechnical sector is highly innovative but the industry struggles to reach its full potential due to the use of

medium-to-high technology in the market. The country has undertaken several initiatives that may facilitate technology. The Industrial Policy Action Plan of 2018/19-2020/21 noted that in 2004 South Africa introduced the National Advanced Manufacturing Technology Strategy to reduce South Africa's reliance on imported technologies which will foster local innovation.

In additional, most entrepreneurs in Zambia do have not enough access to technology and knowledge to tap into most projects. The existing plant facilities are outdated, and modern technology and new equipment are needed to compete with international products (AfDB, 2019). There is a need to consistently promote regional innovations, and the ability to employ technologies to encourage growth. Both Zambia and South Africa have existing technology in the manufacturing of medium- and high-voltage cables and uprating would not require significant upgrades to existing manufacturing technology.

3.4.2. Skills

Finding workers who are suitably qualified and possess the essential skills to work with the newest technology will require new training interventions to reskill the current workforce (Foli, 2020). Having workers who are qualified and trained is important for the growth of the electrical equipment industry. Electrical equipment such as power generators are complicated machines that require certain qualifications and skillsets including electrical, mechanical, automation and technical skills for designing, manufacturing, assembling and installing.

Electrical engineers will play a crucial role in developing new off-grid technologies. They can be responsible for research and development, the creation of renewable energy products like solar panels and wind turbines, as well as the design of new power storage systems (Utilities One, 2023).

There is a poor education system in the region and there are serious skills gaps (SADC, 2022). In engineering-related fields, South Africa has a shortage of engineers, technicians, and artisans. The Engineering Council of South Africa reported that in South Africa, there is one engineer for every 3100 people, compared to 1:310 in the US and Japan. Additionally, skilled and qualified engineers relocate abroad and there is a lack of technical skills in the region especially in the manufacturing of electrical conductors (LFS, 2023). To tackle this issue, South Africa managed to develop local knowledge through a variety of initiatives, such as the Energy and Water Sector Education and Training Authority in collaboration with Chinese companies to transfer their knowledge in renewable manufacturing to South African technical colleges (Arnoldi, 2023). It will be required for the local workforce to have the skills and ability to contribute to the development of renewable energy.

There is a need to restructure the education system with a strong focus on technical and vocational skills, especially those required in medium- and high-technology sectors and occupations within the region and enable students to find work in the emerging energy industry.

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3.5. Regulations

Multiple public and private governing bodies regulate the power sector in the region. SADC countries, however, lack a definite regulatory body that governs electrical equipment. In South Africa, the National Regulator for Compulsory Specifications Act No. 5 of 2008 established the NRCS to regulate the electrical equipment industry. The body grants permits and licensing to South African-based companies that manufacture and import electrotechnical goods, these companies are not permitted to carry out their operations without a current licence. There is also a need to create a clear policy targeted at finances to fund project development and implementation, and joint investment arrangements.

4. SWOT ANALYSIS

This section of the paper focuses on the SWOT analysis of the regional value chain between South Africa, Zambia, and Zimbabwe, in the electrical equipment industry. The analysis highlights the strengths of the value chain's capacity, opportunities for industry growth, weaknesses that identify deficiencies, and threats that reveal limitations to regional and global competitiveness.

The SWOT analysis in Table 7 shows that these countries have manufacturing capacity. Zambia is the largest copper producer in the region, which is a key input into insulated wire and cables. Increasing demand for electrical equipment is evident in existing, transforming, and emerging industries such as mining, construction, automotive, and energy. Emerging new energy vehicles seeking to replace internal combustion engine vehicles require battery inputs. Electric equipment is used by power utilities and IPPs to carry out electrification projects. Localisation policies, particularly in South Africa, stimulate demand for products manufactured in the country.

Countries in the region export raw materials due to limited technical capacity and skills, which limits value addition. The dominant players in the global value chain are large-scale foreign competitors with established supply chains, giving them significant influence compared to regional and domestic players. Global competitors often receive subsidies that give them an advantage in the global value chain. Meanwhile, regional manufacturers produce lower value-added products while global competitors produce higher value-added products. South Africa's exports see limited global demand for electrical machinery and equipment, with the US and the UAE being the only exceptions among the country's top 10 export markets in 2022; all the others are SADC countries. The region faces logistical constraints, as discussed in the supply-side constraints section. While South Africa has adequate logistical performance, this is not the case for Zambia and Zimbabwe. Logistical constraints including border delays make it harder to trade within the region. Countries within the region lack aligned localisation policies. The capital-intensive nature of the electrical equipment industry limits job creation. There is a pressing need for increased investment to finance the establishment of the manufacturing of electrical equipment inputs and products.

The projected demand for electrical equipment is increasing due to the shift towards renewable energy and electrification projects in the region, as discussed in the trends in demand section. Structural transformation within the regional and global context sees the demand for electrical equipment for green industrialisation including electrical vehicles, batteries, and new transmission lines that are planned to be constructed by national power utilities and IPPs within the region. This presents an opportunity to produce electrical equipment to supply both regional and global markets. AfCFTA presents an opportunity for regional governments to align their demand. This agreement would enable countries to establish a division of labour within the region, leading to economies of scale. The AfCFTA will also help facilitate free trade within the region. The region can increase value addition by improving the downstream part of the value chain, creating employment opportunities, and greening electricity generation across the region. The region has an opportunity to increase export finance and insurance, particularly for regional trade.

The trends in the demand section showed that the region relies on low-cost imports, particularly from China, presenting a threat to the regional market. Regional integration is limited because the region cannot align localisation policies and procurement strategies, which is needed to achieve economies of scale to compete with imports. The lack of technological capacity and skills limits the expansion of electrical equipment manufacturing. The lack of financing for electrification projects hinders the growth of demand for new power generation.

Table 7: SWOT analysis

STRENGTHS	WEAKNESSES
- Manufacturing capacity. - Copper (mostly in Zambia). - Demand from mining; construction; automotive; electricity utilities. - Localisation policies in South Africa.	- Technical capacity and skills are limited . - Large-scale foreign competitors with established supply chains. - Demand is limited compared to global demand. - Logistics and electricity are short across the region, especially in Zimbabwe and Zambia. - Localisation policies unaligned in the region. - Capital intensive (not creating a lot of jobs). - Lack of financing for investment in generation limits demand. - Lack of financing for new manufacturing investment limits growth in the industry.
OPPORTUNITIES	**THREATS**
- Demand from electrification projects and shift to renewables and electric vehicles (copper products and batteries) - Demand for electrical equipment products and inputs - AfCFTA and regional alignment of government demand (e.g., align localisation programmes). (requires division of labour within the region to get to economies of scale/competitiveness plus buy-in for lower barriers to trade within the region) - Maximise the employment impacts by growing downstream (equipment) and by improving and greening electricity across the region - Increase export finance/insurance, especially for regional trade	- Lower cost imports - Cannot align localisation policies/national procurement strategies so cannot achieve economies of scale to compete with imports - Lack of technological capacity and skills to expand the manufacture of electrical equipment - Inadequate export finance and insurance - Unable to get financing for the new generation, so demand does not materialise

Source: Authors' compilation

5. CONCLUSION

The demand for electrical equipment heavily relies on electricity generation, transmission, and distribution across the world. There is a huge growth potential in the power sector in Africa with many opportunities to attract new investments across the whole value chain. The new electrification of renewable energy systems such as wind and solar and the planned power generation projects have the potential to transform the energy sector, thus requiring electrical equipment to realise powering of the SADC region and the African continent.

South Africa is one of SADC's largest producers of electrical equipment and Zambia has the necessary inputs needed in the manufacturing of electrical equipment. Both countries are in an strong position to take advantage of the rising demand for electrical equipment within the continent, particularly for electrification projects. There are opportunities within the global value chain to take advantage of the green energy transition, which forecasts global demand for electrical equipment for renewable energy projects and batteries.

The findings of the paper show that the power industry has experienced a challenging period over the past few years. The value chain between South Africa, Zambia and Zimbabwe has shown some gaps within it and, without intervention, the industry will remain stagnant. With no planned interventions, there is no strong opportunity for growth within the regional value chain.

Since all three countries have the capacity within the value chain to manufacture electrical equipment, it will be advantageous for them to work together on industrial development projects that are aimed at boosting trade and investment between the three nations. Improving the value chain gaps within the region will not only benefit the industry itself but enhance economic growth, investment in high-tech technology, skills development transfer, and lastly the development of new varied products for consumers to choose from.

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