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# Manufacturing Localisation Potential in

# Renewable Energy Value Chains

## **Wind Energy Localisation Potential**

Prepared by BMA

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## 1 Tables, figures, and annexures

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## 2 Acronyms

| | |
|---|---|
| BoP | Balance of Plant |
| IRP | Integrated Resource Plan |
| IEA | International Energy Association |
| kW | Kilowatt |
| LCOE | Levelized Cost of Energy |
| MW | Megawatt |
| OEM | Original equipment manufacturers |
| RE | Renewable energy |
| REI4P | Renewable Energy Independent Power Producer Programme |
| SAWEA | South African Wind Energy Association |
| SEZ | Special Economic Zone |
| EIA | Environmental Impact Assessment |
| WTO | World Trade Organisation |
| EPC | Engineering, Procurement, and Construction |

# 3 Executive Summary

## 3.1 Value chain and technology overview

The wind energy value chain in South Africa exists because of the Renewable Energy Independent Power Producer Procurement Programme (REI4P), that requires local manufactured content.

While South Africa has some of the best wind energy resources in the world, with leading to a significant local market for utility scale wind power, the manufacturing base has not emerged on the basis of competition and market forces, but out of policy and procurement rules.

The local market is one dimensional technologically; with all wind installations horizontal axis, gear driven, onshore, utility scale wind farms. This technology is maturing, as reflected in the increased size of wind turbines and their increasing reliability.

Alongside solar power, technology advances have made wind power one of the cheapest options for energy generation. Wind power should therefore be a key part of South Africa's future energy mix and South Africa can and should capitalise on the manufacturing potential of this.

## 3.2 Local capacity and capabilities

Figure 1 provides and overview of current capacities and capabilities in the wind energy value chain. The intention is to demonstrate the current key role players in an industry ramp up programme. The figure does not aim to provide an end-to-end list of current and possible manufacturers (as this is already available through REI4P).

Figure 1: Current local value chain capacity, capability, and supply

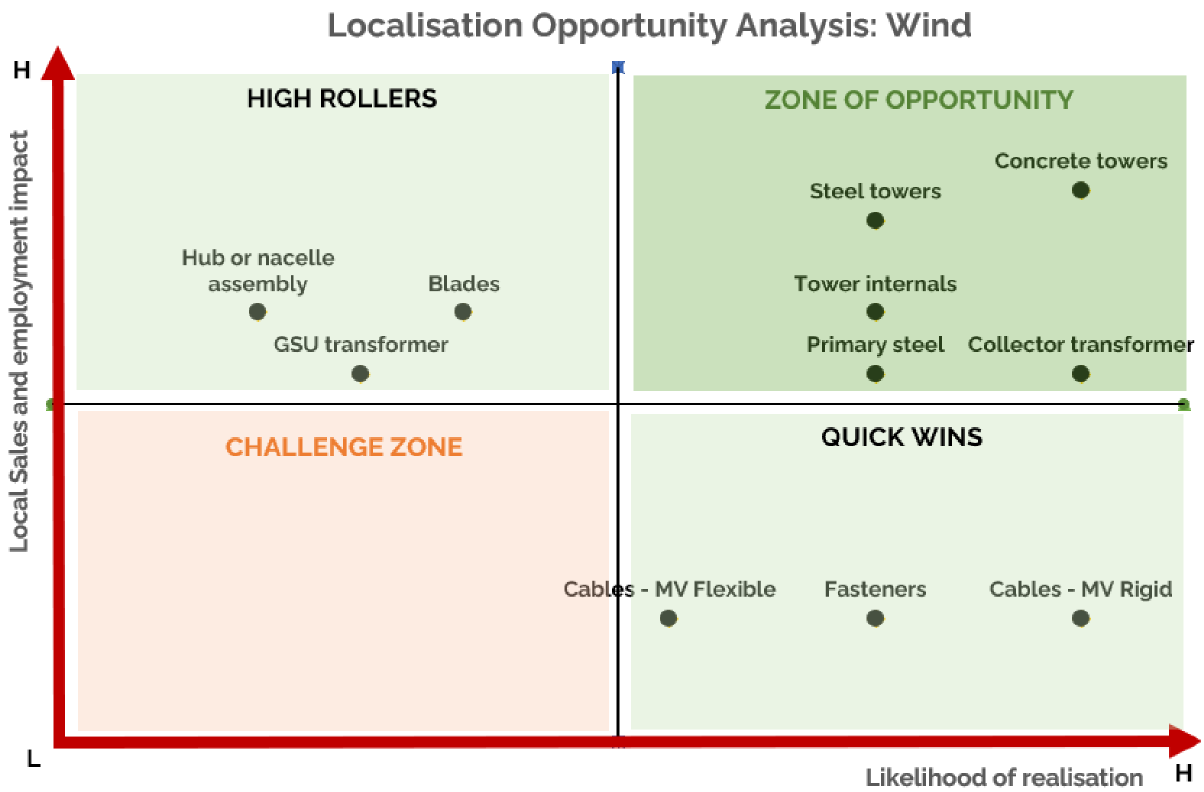
| Turbines | Steel towers | Concrete towers | Primary steel | Tower internals | Secondary steel for towers | GSU transformer | Collector transformer | Fasteners | Rigid medium voltage cables | Flexible medium voltage cables |
|---|---|---|---|---|---|---|---|---|---|---|
| Vestas Δ | GRI Towers β Ω Δ | Concrete Units β Ω Δ | ArcelorMittal β Ω Δ | Modetech β Ω Δ | Modetech β Ω Δ | Actom β Ω Δ | Actom β Ω Δ | SA Bolts β Ω | CBI African Cables β Ω Δ | Aberdare β |
| Nordex Δ | | Copperton Concrete β Ω Δ | Columbus Steel X | | Naledi Engineering X | | Powertech β Ω Δ | | M-tech β Ω Δ | CBI African Cables β |
| Siemens Gamesa Δ | | Colossus β Ω | | | K5 Engineering X | | Matlakse β | | Aberdare β Ω Δ | |
| Gold Wind Δ | | | | | | | | | | |

| | |
|---|---|
| X | In development to enter value chain |
| β | Local capacity |
| Ω | Local capability |
| Δ | Currently supplying |

### 3.3 Prioritisation of localisation potential

The wind energy value chain localisation potential matrix, as presented in Figure 2, does not contain many surprises. The industry is recovering from hugely inconsistent demand in the domestic market and consequently there is little optimism in the industry, or appetite for localisation.

Figure 2: Localisation opportunity analysis for components in the wind supply chain.




*Hub and nacelle assembly*

This key component is unlikely to be localised. The technology is highly complex and covered by restrictive intellectual property laws. It sits close to the wind Original Equipment Manufacturers (OEMs) and therefore assembly is usually centralised in regions of manufacturing excellence. These components also require a large, mature, and stable market. Potentially the assembly could be localised through preferential procurement levers, but it is unlikely that it will occur from market forces.

*Blades*

Blades represent the more likely key component to be localised, alongside existing local towers. Key is a consistent market with annual demand of 1 GW, as well as sufficient incentives for local production and protection from lower priced imports. It could be possible that blades are localised by 2030, but this will only happen if there is follow through on a range of interventions.

*Generation Step Up (GSU) transformers*

Because of the design of turbines (a medium voltage transformer is preferred in the nacelle), local supply opportunities are limited. GSU transformers will become relevant only if nacelle assembly is localised.

*Concrete towers*

There is currently excess capacity in South Africa, with three concrete tower plants in operation. Concrete towers if located near a nucleus of wind energy demand are competitive even against imported steel towers. Concrete tower components are highly localised (>99%) and present the highest likelihood and largest potential impact component for localisation within the value chain.

*Steel towers*

Currently there is only one steel tower manufacturer in South Africa, GRI Towers. Interviews suggest that domestic steel towers cost up to 60% more than imported steel towers. This renders local steel towers uncompetitive in the private domestic market. It remains a high priority component, but attention is needed to ensure greater levels of price parity with imports. Key interventions include stable demand, implementation and control of import duties, and local access to competitively priced steel.

*Tower Internals*

Tower internals represent a high priority group of components, especially in the secondary steel. This includes anchor cages, tower extenders, flanges, door frames, platform brackets the highest impact components. Smaller components relate to the internal platforms, lifting gear, ladders, cable cages, etc. There is already capability and capacity in this space for some components.

*Primary steel*

Primary steel presents a high impact opportunity. In REI4P steel is designated, leading to the localisation of steel for towers and other tower components. However, local steel is comparatively expensive and in an open market private demand would likely favour imported steel.

*Collector transformer*

The collector transformer (one or two per wind farm) has a strong local footprint (>90% of collector transformers currently installed on wind farms are sourced from local manufacturers). This component is competitive and of a high quality with several manufacturers locally. Stable demand will ensure that this remains a key part of the local value chain.

*Flexible medium voltage cables*

There is no local supply of flexible rubber cables that go inside of wind towers. There is one supplier who could potentially be capacitated to produce these cables (Aberdare). This could be a quick win opportunity, but will require some capacitation from the global companies who own the local companies. These global companies that own local cable manufacturers for the most part have established manufacturing capabilities in flexible medium voltage rubber cables for the wind industry.

*Fasteners*

Fasteners are a quick win opportunity with at least one local manufacturer (SA Bolts) already manufacturing to a required wind energy standard. There is excess capacity and capability that needs to be aligned with OEM needs, and then tested.

*Rigid medium voltage cables*

Most medium voltage rigid cables in wind farms are local cables due to designation and local content requirements for REI4P. Even in the private market the local manufacturing base is robust with three large manufacturers already supplying. This component will continue to be supplied locally provided there is sufficient demand.

### 3.4 Ramp up analysis

The wind energy localisation ramp up to 2030 is summarised in a single view in

Figure 3.

Although the demand over the next two years will be low considering the time that it takes to develop, reach financial closure, build, and commission new wind capacity. The demand from the value chain will be a lot sooner even when new capacity will only likely be connected to the grid from 2025.

Short term interventions to secure consistent local demand are key. This will lead to the further localisation of components like towers, tower internals, cables, fasteners, transformers, and steel.

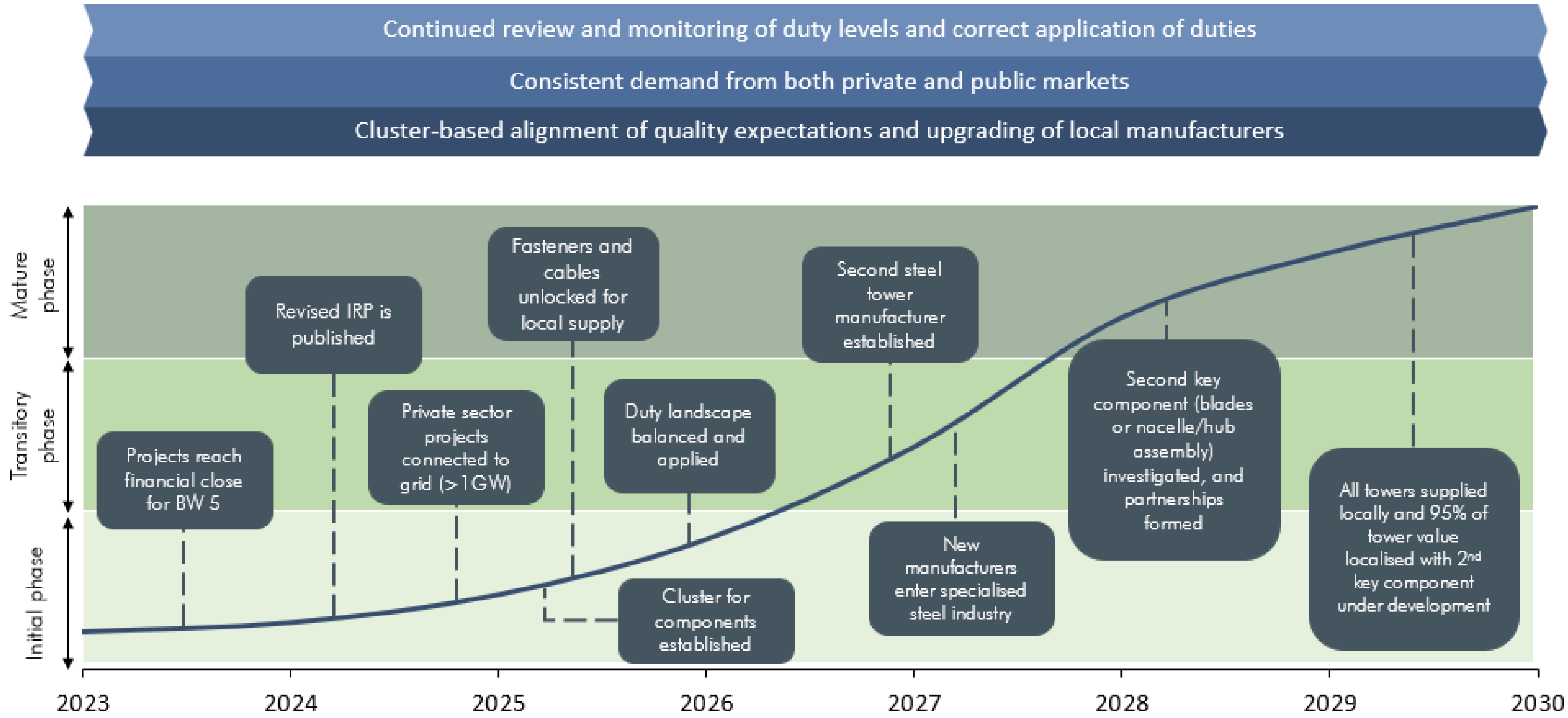
If import duties are revised and a cluster platform established, the value chain should move into a transitory phase with significant further localisation occurring.

At this point it is likely that additional manufacturers will enter the industry. This is most likely in the steel towers and specialised steel for tower internals sectors. This could push the local industry into a more mature phase: one where a well-established and sustainable local industry supplies a local market with consistent demand.

The keystone achievement that will signal the mature phase is the localisation of the second key component, most likely blades, but also potentially hub or nacelle assembly.

A potential vision for 2030 (assuming that the recommended interventions are implemented) is the localisation of 95% of steel and concrete towers.

Figure 3: Key milestones to realising increased localisation of the wind value chain



### 3.5 Conclusion

There is potential to increase the localisation of components for the wind energy value chain based on existing capacities and capabilities are within the manufacturing sector.

However, fundamental challenges need to be addressed or local content could decrease with the opening of private sector generation projects. Implementing the interventions highlighted in this report is therefore critical. Local content exists because of public procurement policy. Industry interviews indicate that this policy does not apply to the private sector, and unless competitiveness improves, imports will dominate. Conversely, if interventions are successfully implemented through an organised and effective vehicle (SAREM for instance), then the wind energy industry could grow rapidly. What this success would look like is a strong local market for wind towers and all affiliated components; steel plates, secondary steel components (anchor cages, flanges, door frames, etc), tower internals (platforms, cables, lifts, ladders, etc.), fasteners. For the balance of plant, further opportunities include the local supply of the collector transformers and the medium voltage cables.

The second marker for success would be the successful localisation of a second key component. Most likely this will be blades, especially when considering the localisation success of other regions (blades and towers). There is some possibility for local assembly operations for the nacelle or the hub, but the value addition from local components will be small initially.

# 4 Introduction

## 4.1 Value chain localisation opportunity overview

South Africa's energy crisis is at a critical point. The South African Reserve Bank (SARB), indicates that each day of load shedding currently costing South Africa $51 million[i]. With a forecast of 250 days of loadshedding for 2023, the projected cost to the country this year alone is $13 billion[ii]. It is therefore critical to ensure the successful and rapid roll out of renewable energy (RE) in the country.

South Africa's present electricity generation capacity struggles to meet current demand and is only expected to increase at an annualised rate of 1%. South Africa is moreover largely reliant on coal for its supply of electricity (87% of total supply). South Africa's dependence on coal is forecast to decrease to 64% by 2030 as plants reach maturity and are decommissioned[iii]. The largest growth is forecast is in the wind and solar energy sectors, although this is subject to transmission and distribution (grid) capacity being available.

Despite abundant natural advantages, South Africa has experienced several challenges with its roll out of wind and solar energy projects. This is evident from the limited successes of the various Renewable Energy Independent Power Producer Procurement Programme (REI4P) bid windows. These challenges have generated important lessons that will hopefully result in a more pragmatic and focussed roll out of RE generation in future.

## 4.2 Study objectives

Despite the challenges presented by South Africa's energy crisis, there are a range of RE generation opportunities, and as importantly, related opportunities to develop local manufacturing capability and capacity. The purpose of this study is to unpack the supply chain and existing technologies to evaluate what opportunities may exist to localise the manufacturing of wind energy components in South Africa and determine the ramp-up curve for those components.

## 4.3 Report structure and methodology overview

This project has been delivered in two phases. Phase one encompassed both desktop and primary research and culminated in a value chain review, anchor demand analysis, and an industry engagement summary. Phase two then involved a localisation ramp up analysis focusing on the development of a localisation roadmap for various components in the wind energy value chain, as well as the identification of cross cutting opportunities to support localisation.

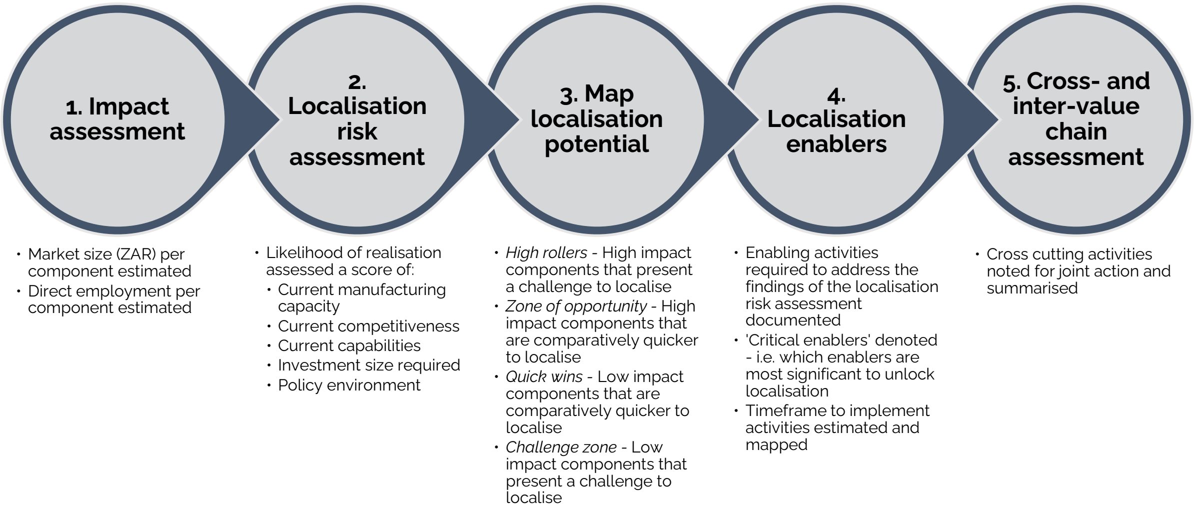
Details of the methodology deployed across both phases is presented below. The process followed for phase 1 is presented in Table 1. As highlighted, the focus of this phase was on understanding each of the three value chains being focused on (wind, solar, batteries), calculating anchor demand parameters, and engaging with industry on key value chain dynamics.

Table 1: Phase 1 research methodology

| | |
|---|---|
| **Value chain review** | » Review current literature available for wind, solar, and battery storage value chains to establish the current technology available and upcoming technological disruptions<br>» Map value chains to understand flow of components from the end product side |
| **Anchor demand analysis** | » Estimate and forecast anchor demand (end of value chain demand) to be able to reverse project demand through the value chain<br>» Include demand and future investments from both public and private sector<br>» Estimate grid capacity and expansion plans as a boundary condition for market growth |
| **Industry engagement** | » Engage with industry experts and manufacturers to confirm breakdown of value chains<br>» Visit current manufacturers of components within the value chain and evaluate the capacity and capability of servicing the demand for the sector (starting with the high priority components)<br>» Engage with manufacturers that can alter their current operation to deliver components into the value chain or who are able to import and distribute components |

The schematic diagram presented in Figure *4* provides and overview of the methodology process for Phase 2 of the project. As highlighted the ramp up analysis required the completion of five activities.

Figure 4: Phase two methodology overview



# 5 Literature and technology review

## 5.1 Overview

South Africa's current wind energy manufacturing capacity and capability is derived from the local content requirements of the REI4P programme.

While South Africa has some of the best wind energy resources in the world, and a clear market case for utility scale wind power, the manufacturing base was not born out of local competitiveness and market forces, but out of policy and procurement rules.

In terms of technology the local market is one dimensional; all wind installations are horizontal axis, gear driven, onshore, utility scale wind farms.

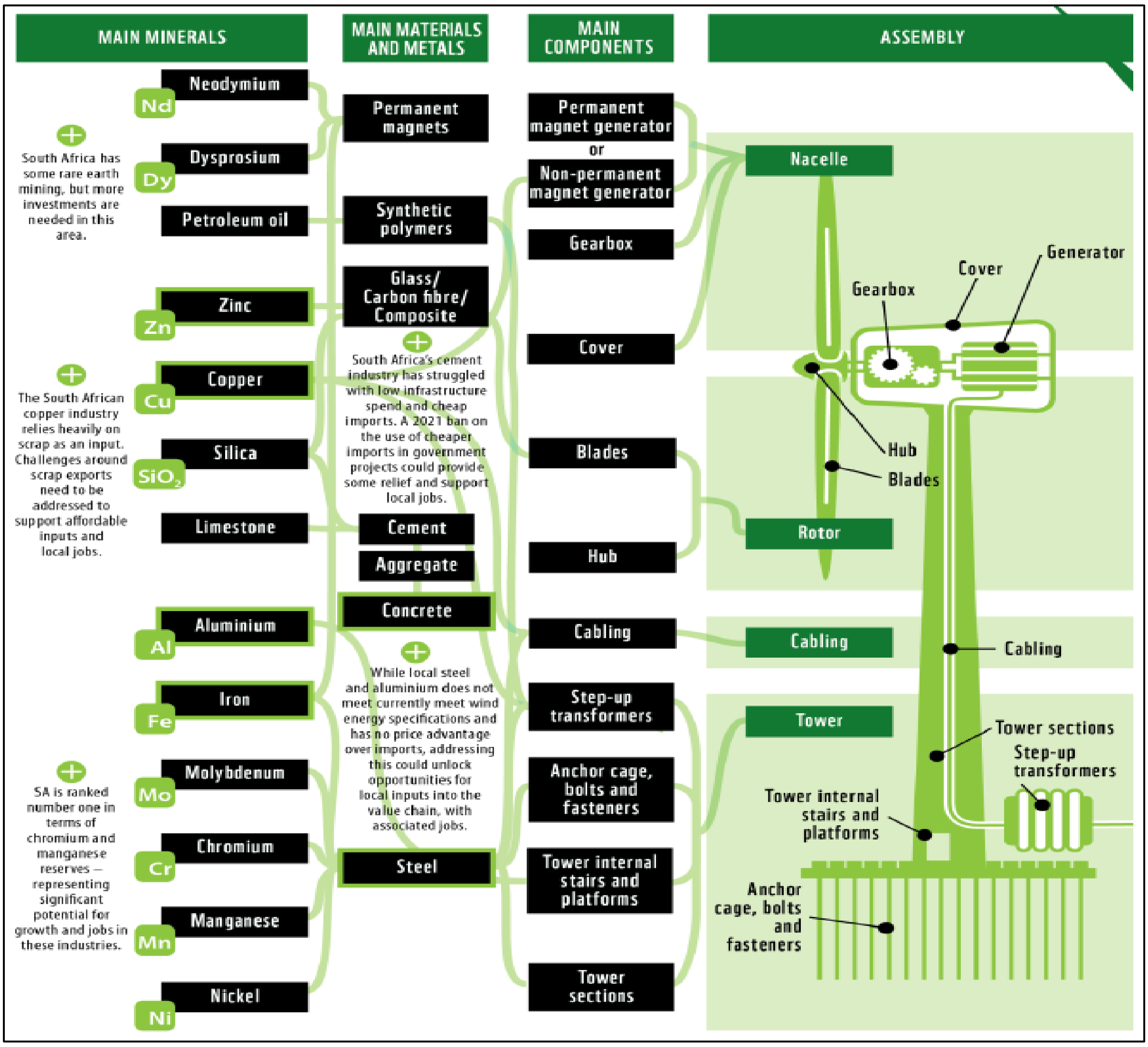
The technology is maturing, and this is reflected in the increased size of wind turbines and the increased reliability of the turbines.

Technology advances have made wind power, alongside solar power, one of the cheapest options for generation. The history of wind power in South Africa has demonstrated that wind farms are a competitive commercial option for utility scale power generation and should be a key part of South Africa's future energy mix.

## 5.2 Wind energy value chain governance

Global OEMs (see Figure 5), like Vestas, Nordex, Acciona, and Siemens Gamesa, control the wind energy value chain. These OEMs own the proprietary technology used in the wind energy value chain, and therefore largely decide what technology is ideally deployed in specific locations. Their decisions frame what components are sourced, with this then strongly influencing whether the components are sourced locally or internationally.

Figure 5: Wind turbine high level value chain diagram




Source: TIPS, Insights into the wind energy value chain in South Africa (2022)

Figure 5 indicates the key upstream components in the wind energy value chain.

The construction of REI4P bids is set up so that one single OEM is responsible for executing on the procurement, manufacturing, assembly, installation, and maintenance and operation of the wind farm for the full operating life.

Procurement through the REI4P is scored on a 90% price and 10% economic development basis. Local content is supported through this procurement channel via the 40% threshold for points allocation under the 10% economic development weighing. To a large degree this regulation drives localisation. On a pure cost competitive calculation, the localisation of wind turbine components at this point is not favoured by the OEMs.

The designation of standard materials (steel being the latest) and other componentry also drives localisation of the wind energy value chain.

There is no industrial policy that forces or encourages localisation of the wind energy value chain in the private sector. Considering that the demand for private wind energy in the first five months of 2023 was 1.3 GW[iv], this constitutes a notable change in the landscape for localisation. Potentially, for most private sector demand the motivation for localisation will be on a purely cost competitive basis.

### 5.3 Wind energy technology review

*Vertical versus horizontal wind turbines*

There are two types of wind turbines that are widely available and present in the industry. These are vertical and horizontal turbines.

Horizontal turbines are by far the most common type[v]. Horizontal turbines are defined by their rotational axis being parallel to the ground or horizontal (see Figure 6). In large scale wind applications, all the installed turbines are of the horizontal type. The significant advantage of HAWTs (Horizontal Axis Wind Turbines) is that they generate more energy because of their ability to harness energy from wind at high speed.

However, for that reason HAWTs are typically exceptionally large and require substantial space to operate. Commercial HAWTs are typically more than 80 metres high with blade diameters of 40-60 metres, or larger. HAWTs also require laminar fluid dynamics to operate effectively and do not do well with turbulent wind flows often found at a lower height[vi]. Another disadvantage is that HAWTs are expensive to build, install and maintain compared to VAWTs (Vertical Axis Wind Turbines).

Figure 6 Horizontal Axis Wind Turbine

Source: Engineering.com (2019)

The energy efficiency of HAWTs is the dominating factor and the reason commercial scale wind farms almost exclusively feature these types of turbines.

Vertical turbines edge out horizontal turbines in the residential and light industrial markets because of their efficiency at lower wind speeds, flexibility towards turbulent wind conditions and lower space and cost requirements.

VAWTs rotate perpendicular to the ground (see Figure 6) and can harness wind energy over a 360˚ range. This feature makes VAWTs efficient even in turbulent wind conditions.

Figure 7: Vertical Axis Wind Turbine

Source: Engineering.com (2019)

*Offshore versus onshore*

Selecting the environment to position turbines is critical. There are two broad categories for wind turbine geographical placement, either onshore or offshore. Both have advantages and disadvantages. Presently, 93% of wind energy is generated from onshore locations[vii] with 7% from offshore generation.

The biggest advantage in favour of onshore generation is cost. The onshore Levelized Cost of Energy (LCOE) is 34$/MWh, while the offshore LCOE is 78$/MWH for fixed bottom construction and 133$/MWH for floating bottom construction. This is for the US market (at 2021 prices)[viii].

Onshore generation also benefits from quicker installation, easier maintenance, and a reduced environmental impact compared to offshore generation. The reduced environmental impact is only from the construction phase. Offshore generation has a lower environmental impact during operation given its lower interference with the air and ground environment.

Offshore generation is also more efficient. Offshore wind conditions are more consistent and wind speeds are higher. This means that fewer wind turbines are needed to produce the same amount of electricity compared to onshore generation[ix].

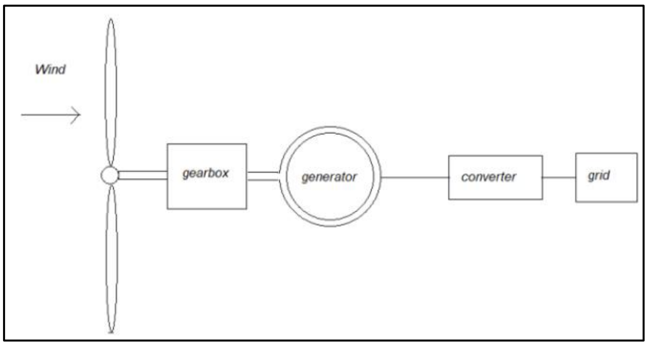
Offshore generation also benefits from reduced regulation around blade tip height compared to onshore generation, meaning that turbines can be built closer to the ground. This increases the capacity factor due to improved operating conditions for those turbines.

*Direct drive versus gearbox driven turbines*

There are two types of wind turbine drive technologies that are the focus of development currently: the gearbox driven turbine and the direct drive turbine.

The gearbox driven turbine (see Figure 8) is identified based on the gearbox that forms a key component of the assembled turbine. The rotor drive shaft or low speed drive shaft is a slow turning shaft that comes from the turbine rotor which is in turn rotated by the wind force acting on the blades. The purpose of the gearbox is to increase the rotational speed of the drive shaft. Typically, the rotor turns at around 15-20 rotations per minute. The gearbox increases that to about 1800 RPM through a series of gears[x]. The high-speed drive shaft that is located on the other side of the gearbox is fed into the higher speed electrical generator (usually a double-fed induction generator).

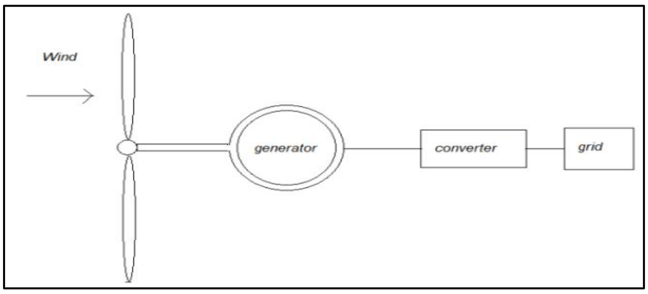
Figure 8: Gearbox driven wind turbine.




Although this design increases the speed of rotation, it also increases design complexity. Gearbox driven turbines require regular maintenance of the gearbox and advanced control systems to ensure that they operate safely and that the excess wind power does not destabilize the system.

To eliminate the shortcomings of gearbox driven turbines, direct drive turbines were developed (see Figure 9). This design eliminates gearbox issues and associated transmission losses. For a direct drive turbine, the rotational speed of the rotor is directly fed into the generator at the low speed of 15-20 revolutions per minute.

Figure 9: Direct drive turbine




Higher torque requirements mean that direct drive turbines require much larger generators and a specific specification of generator. Permanent magnet synchronous generators provide a good fit for direct drive turbines. These types of generators work more effectively at lower loads, which is often the real-world conditions, making them more effective compared to gearbox driven turbines. There are several benefits added into the advanced control functionality of direct drive turbines which provides a higher yield, quiet operation, long-term availability, and reliability.[xi]

Direct drive is the better, more efficient technology that is ideally suited for offshore generation. However, geared turbine technology will continue to be the main technology because of its lower costs. Potentially, there is a place in the market for both technologies at market maturity.

*Trend towards larger wind turbines as technology matures*

There has been a trend toward larger wind turbines. Since 2009, the swept area of wind turbine blades has doubled thanks to 20% longer blades[xii]. Blades most used in onshore commercial wind farm applications range between 50-65m in diameter. The blades used in offshore generation are typically longer with the longest production blade produced by LM Wind Power a staggering 107m long.[xiii]

A similar trend is present for turbine towers. The hub height for utility-scale land-based wind turbines has increased 66% since 1998/9, to about 94 meters in 2021. However, this trend is flattening out due to the added complexity operating a turbine at increased heights outweighing the additional wind shear efficiency at greater heights. An analysis of optimal hub heights from the National Renewable Energy Laboratory (NREL) found that the optimum height at current technological and economic conditions is between 80-110m[xiv]. This is dependent on wind conditions.

This trend is important to keep in mind when looking at ramping up the manufacturing capability of the value chain. Potential manufacturers should not just be able to produce the components currently being deployed but should also consider what the future demands from the market will be.

*New materials for turbine manufacturing*

There are a few key material evolutions to take note of that are potentially significant in the component landscape.

The first material is the steel that is used for tower manufacturing. The general trend is towards more sustainable materials, including the use of green steel. Siemens Gemesa, in their 1 GW Thor offshore wind project, introduced 36 GreenTowers. The GreenTowers are made of lower carbon emission steel, primarily produced with renewable energy[xv]. This trend is expected to continue as green steel becomes more readily available. Any localisation strategy for steel turbine materials needs to take this trend into account and include future demand for green steel as a strategic focus.

Renewable and recyclable materials are increasingly being used in blade and nacelle construction. Thermoplastics resins that are recyclable provide a promising solution to the recycling problem of the widely used thermal setting materials (polyester and epoxy resins, polyvinyl resins, etc.)[xvi]. Core materials like the fast-growing Balsa wood and recyclable PET foam appear to be gaining an edge on other core materials (styrene acrylonitrile and PVC foam). Although all four offer unique properties, the sustainability of Balsa wood and PET foam is a crucial factor contributing to their growing popularity[xvii].

## 5.4 South African wind energy market

South Africa's wind energy market is in its infancy compared to the other energy generation sectors. The defining factor in terms of the technology deployed for wind energy is its cost efficiency.

For South Africa, the lowest RE energy and most reliable project completion probability is of primary consideration. This has led to the 3.4 GW of wind energy installed to be geared, horizontal, onshore turbines at commercial scale[xviii].

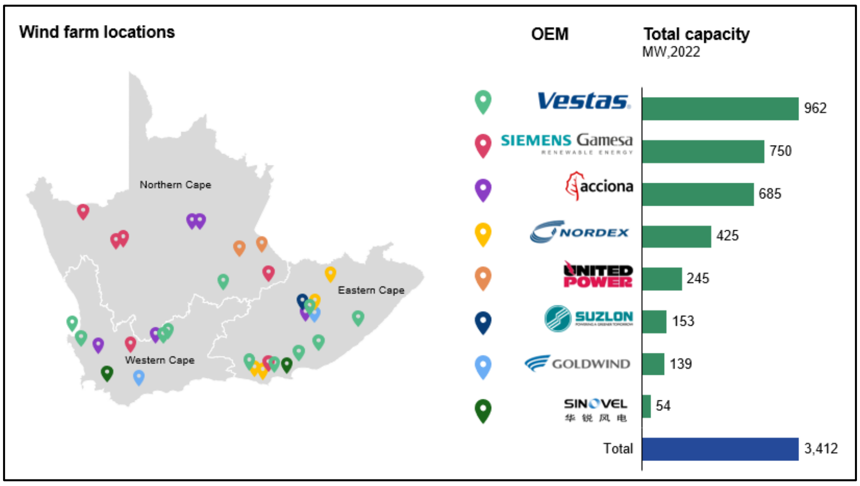
There is no offshore wind energy in South Africa. High quality, readily available and cost-effective land meant that there was no business case for offshore wind energy. The possibility of offshore wind energy is currently being explored by South African Wind Energy Association (SAWEA), but research suggests offshore is about 10 years away from being competitive with onshore wind turbines.

The average size of a wind farm in South Africa is 101 MW with a mean turbine size of 2.6 MW. Of the wind farms that are currently under construction the average turbine size is 3 MW with an average size of 116 MW. This corresponds with the international trend of increasing turbine size.

There is no discernible residential wind sector. There are a few sellers of residential size horizontal and vertical turbines (Tesup and others), but not at a level that is significant.

The current wind sector is dominated by global OEMs. The established OEMs with the dominant market share are Vestas, Siemens Gamesa, Acciona, and Nordex. There is no local turbine manufacturing or assembly apart from what is installed on site during construction.

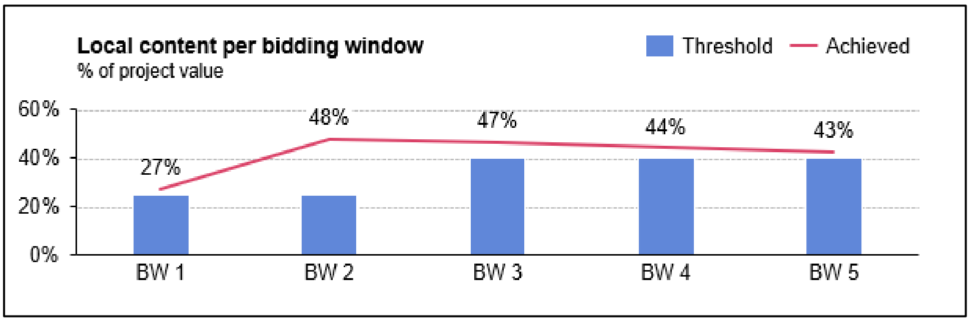
Figure 10: Installed wind farms in South Africa




Source: SAWEA (2023)

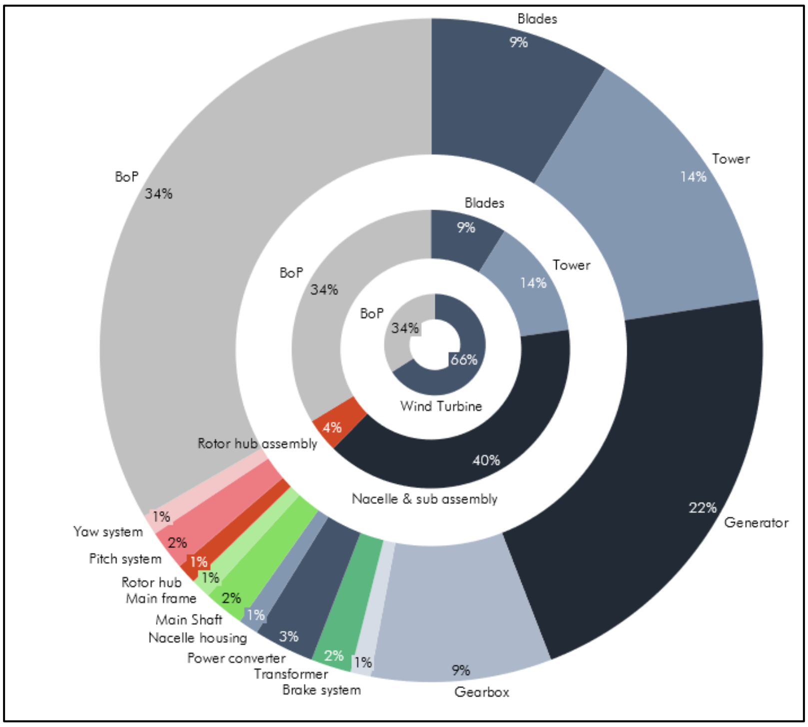
All the installed wind energy was procured through the REI4P. The average achieved localisation percent (%) has stayed in the mid 40% for the last three bidding windows (Figure 11).

Figure 11: Percentage of value localised through the REIPPP




Most of this localisation is from the balance of plant operations. The balance of plant accounts for approximately 34% of the project value (see Figure 12). The rest of the localised project value comes from the localisation of the turbine towers, which can add up to 14% additional localisation value.

Figure 12: Wind farm value chain breakdown




Source: SAREM (2022)

Turbine manufacturing is the only component of the turbine that is currently localised. There are two turbine manufacturers in operation, GRI towers that produce steel towers and Concrete Units that produce concrete towers in partnership with Acciona and Nordex.

There are two small scale, small capacity turbine blade manufacturers that produce for the home and light industrial market, Kestrel, and Adventure Power. Notably, these manufacturers are not in the same market as commercial wind farming.

Due to the stop-start demand of wind energy from 2014 there have been unfortunate closures of promising component manufacturers. Most notably, this includes concrete tower manufacturer, DCD, which was based in Gqeberha. I-WEC was a homegrown blade manufacturer that produced blades for a 2.5MW farm in the Western Cape. They have since shut down operations.

The local wind industry can be described as an industry that has low trust in the public procurement market. This comes from the history of the REI4P rounds and the evidence is clearly demonstrated in the conservative and at times indifferent approach towards investing in local manufacturing capacity to support the wind energy value chain.

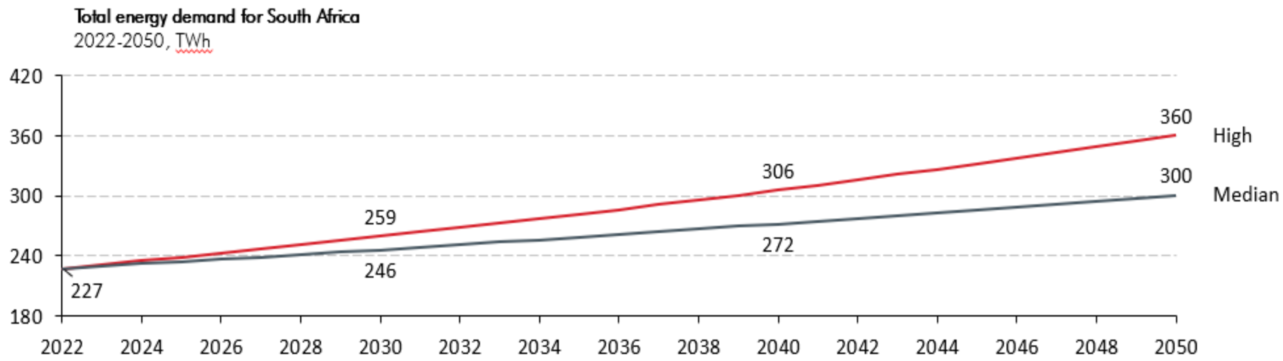
# 6 South African demand for wind energy

## 6.1 Wind energy demand

To put wind energy demand in perspective it is necessary to consider total future demand for electricity in South Africa, the combined installed grid capacity across technologies, and the outlook of these metrics. It is important to note that demand forecasts need to be realistic and motivated solely to give a manufacturing audience a guideline for the outlook of the industry. There are sufficient sources available that can provide an aspirational forecast with ambitious numbers. This forecast is not intended for that purpose.

Figure 13 shows the total forecast demand for electricity. The forecast considers the historical compound annual growth rate (CAGR) of -0.55% and the established publications from the Integrated Resource Plan (IRP), Eskom, CSIR, and the International Energy Agency (IEA). Demand is growing and is forecast to increase steadily at between 1% (median scenario) and 1.66% (high scenario) in future.

Figure 13: Total electricity demand forecast for South Africa




The most relevant assumptions that were used in the modelling of demand for wind energy is captured in Figure 15. These assumptions, combined with industry stakeholder engagements, were the basis for the forecasted number.

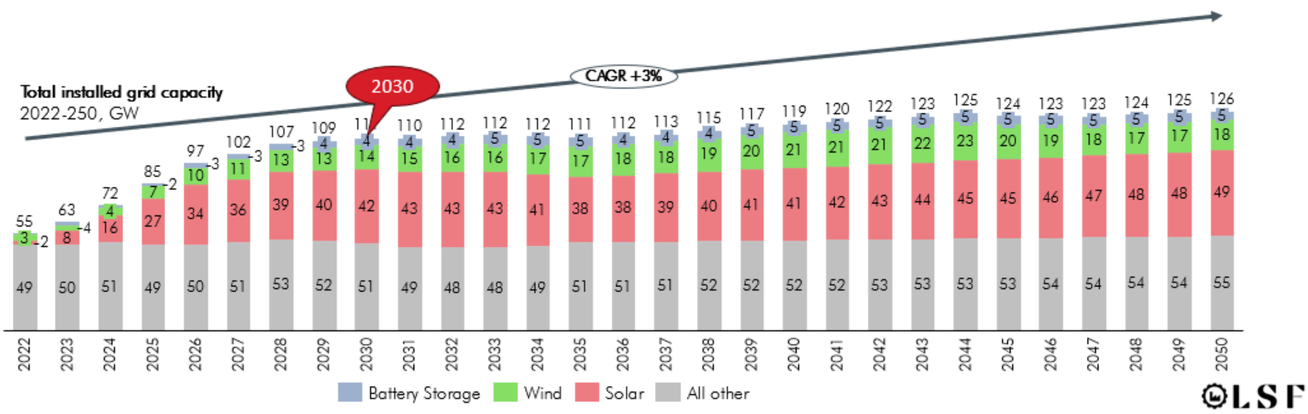
Figure 14: Assumptions for wind energy forecast modelling

| Assumption | Motivation |
|---|---|
| • 30% of the annual IRP 19 allocation for wind energy will be realised in alternating years (with gaps between years) by 2030 | • Historical allocations and irregularity between bid windows<br>• Speed of financial closures of projects from REI4P<br>• Lack of transparency from IRP office on future of REI4P |
| • From Eskom TDP 2022 and SAREGS 2023 only 30% of the near term (up to 2025) forecasted capacity will be realized<br>• 20% of the longer-term capacity (2025-2035) likely to be realised | • Wind energy position relative to solar is expensive (solar is the preferred technology)<br>• Wind resources are in with grid constraints that are likely to remain into 2030's<br>• Projects are taking a long time to close in the private market due to risk limitations, companies don't want to sign a long PPA<br>• Historically, wind projects are capital intensive and take a long time to develop and bring to market |
| • Public demand will stabilise at 420 MW per year after 2030 alternating with high and low (30%) years | • Irregularity of REI4P programme and no indication that it will change in future |
| • Steady state private demand (after 2035) is assumed to be 600 MW per year | • Considering the need for additional installed capacity and the competitive position with other generation types<br>• The steady state with repowering of old wind farms after their useful lifespan |
| • The lifespan of a wind farm is assumed to be 20 years | • Confirmed with industry that technology becomes outdated and repowering the likely outcome after 20 years |

Figure 15 shows the total installed grid capacity forecast with the relevant technology splits. This is the combined output of the modelling and gives an overall view. In the initial period to 2030 there is some catching up with demand based on existing shortages of generation capacity. The growth in installed grid capacity then slows down as balance is reached between growth in electricity demand and growth in installed grid capacity.

The important numbers are that wind generation is forecast to reach 14 GW by 2030 (from the current base of about 3.4 GW). Thereafter, growth will slow as plants reach their end of life and are decommissioned alongside new plant being added to the grid. The forecast is for wind to peak at 23 GW in the 2040-2045 period and to stabilise around the 15-20GW range.

Figure 15: Total installed grid capacity forecast



It can be seen in Figure 16 that there is little demand for wind energy forecast for the next two years. This is mainly due to bid window 6 of the REI4P not selecting any wind projects; as well as delays in financial closure for wind energy projects from bid window 5 of the REI4P. Private demand is picking up, but it will be a couple of years before the first private projects are connected to the grid. The big spike in wind farms connecting to the grid is forecast to be from 2025. It is important to keep in mind that the demand from the manufacturing base materialises 1-2 years prior to the wind farm being commissioned and connected to the grid.

Figure 16: Forecasted demand for wind power up to 2030

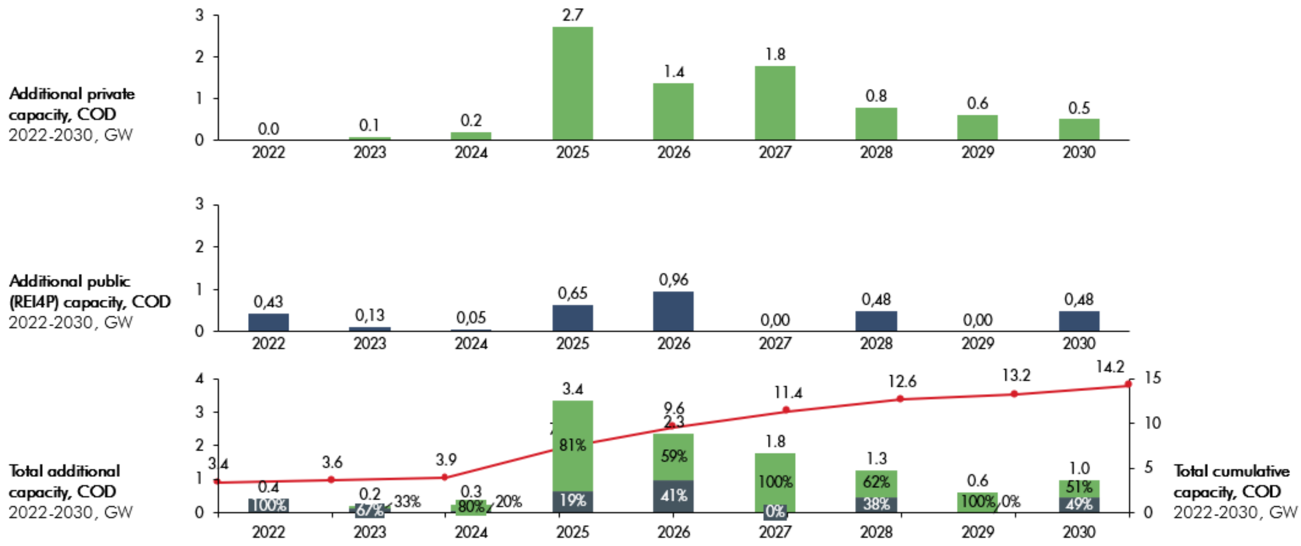
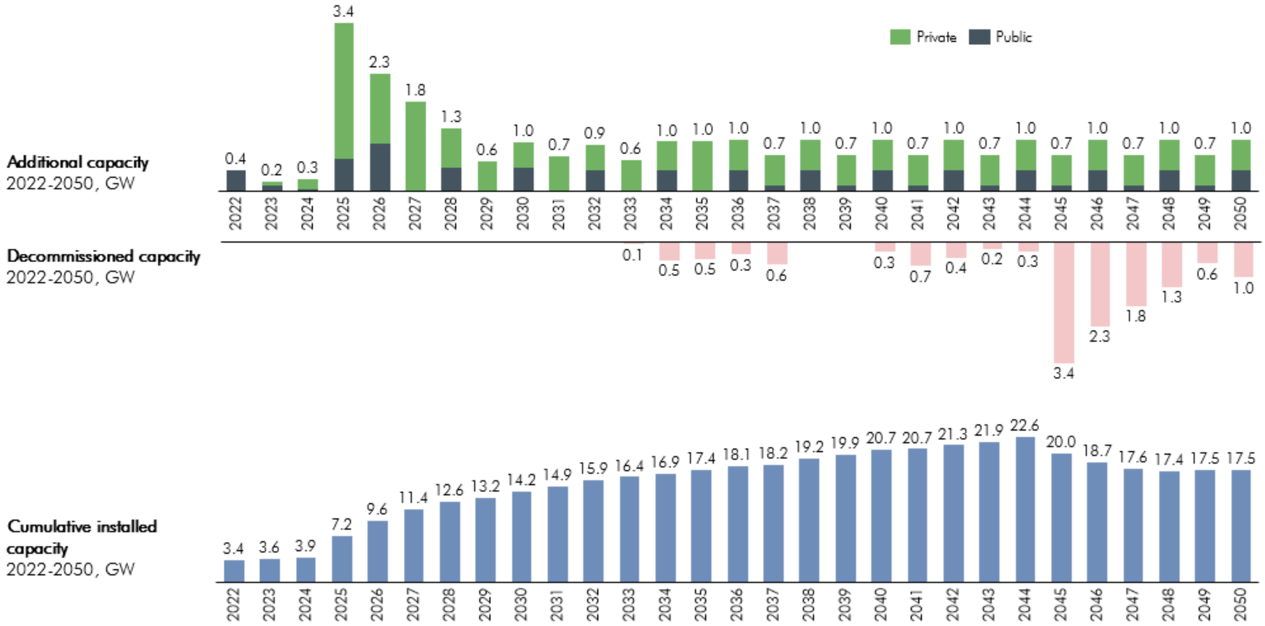



Figure 17 completes the picture with a forecast up to 2050. It includes the decommissioning of wind farms after their expected 20-year lifespan. Finally, it also looks likely that private demand will be greater than public demand. Even with an updated IRP, the trust in public procurement is low and is likely to remain that way in future.

Figure 17: Wind energy forecasted demand up to 2050



# 7 Localisation potential of wind energy components

## 7.1 Industry engagement

### 7.1.1 Existing wind energy component manufacturing capabilities in South Africa

Figure 18 provides an overview of current capacities and capabilities in the wind energy value chain. The list of companies presented in the figure is a current state view of the industry of the companies that are active in the value chain, ready to supply into the value chain, or in development to be ready to supply into the value chain.

There are companies in South Africa that given the adequate support and development time could supply components into the wind energy value chain. This list is long and difficult to establish. Instead, the below figure represents the list of manufacturing companies that would play a role in the ramp up of the local value chain and should be the focus of potential interventions.

The four wind turbine OEMs are the four major OEMs still active in South Africa. There have been other OEMs active in the past in South Africa and a few who are still active on a small scale. Important to note is that the OEMs are indicated to be supplying currently, this does not mean that they are supplying from local sources. It is intended to be understood that actively supplying without local capacity indicates that the supply is imported at least to some degree.


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Figure 18: Current local value chain capacity, capability, and supply

| Turbines | Steel towers | Concrete towers | Primary steel | Tower internals | Secondary steel for towers | GSU transformer | Collector transformer | Fasteners | Rigid medium voltage cables | Flexible medium voltage cables |
|---|---|---|---|---|---|---|---|---|---|---|
| Vestas Δ | GRI Towers β Ω Δ | Concrete Units β Ω Δ | ArcelorMittal β Ω Δ | Modetech β Ω Δ | Modetech β Ω Δ | Actom β Ω Δ | Actom β Ω Δ | SA Bolts β Ω | CBI African Cables β Ω Δ | Aberdare β |
| Nordex Δ | | Copperton Concrete β Ω Δ | Columbus Steel X | | Naledi Engineering X | | Powertech β Ω Δ | | M-tech β Ω Δ | CBI African Cables β |
| Siemens Gamesa Δ | | Colossus β Ω | | | K5 Engineering X | | Matlakse β | | Aberdare β Ω Δ | |
| Gold Wind Δ | | | | | | | | | | |

| | |
|---|---|
| X | In development to enter value chain |
| β | Local capacity |
| Ω | Local capability |
| Δ | Currently supplying |

### 7.1.2 Industry engagement summary

Through the industry engagements, five central themes emerged that sets the landscape for future interventions. These five themes are explained in Figure 19 below.

Figure 19: Localisation themes from industry engagements

**Inconsistent demand**

The single most significant recurring theme is the impact of inconsistent demand on the wind energy value chain

*"The history book of REI4P reads like a horror story for investors looking into the wind energy sector"*

**Changing public procurement policy**

Through the 6 REI4P bidding rounds the rules have changed in terms of local content requirements and allocated and contracted wind capacity

*"Bid Window 6 was a total disaster; everyone is now waiting for bid window 7 to know what to do"*

**No rules of engagement on private demand**

Currently private demand is the only demand that is available for wind energy. There is no designation, and local content requirements from PPA's are less stringent. Tariff prices are higher, and it is cheaper to import most of the turbine components.

**High quality levels and certifications are a barrier**

The quality levels required by the wind OEMs are high (like automotive), companies are deterred by the steep learning curve and process of getting their products and facilities certified (IATF, IEC, TUV, etc.)

*"It can easily take three years to get a part approved to supply an OEM and cost upward of R1M"*

**Import regulation is not good enough**

Tariff heading definitions are not sufficient, custom officials are not trained to differentiate correctly. Import duties are being dodged by bringing in components under equipment tariff codes.

*"We make quality components that have to compete with sub-par components coming in duty free"*

### 7.2 Localisation potential in South African wind energy value chain

The outcome of the wind energy value chain localisation potential matrix (Figure 20) does not contain many surprises. The industry is recovering from hugely inconsistent demand in the domestic market, and the supply chain is waiting for the market to stabilise and become more reliable and consistent before making any major investment decisions.

Local tower production is crucial to maintain as this is the only key component that has been successfully localised through the local content and designation procurement levers under the REI4P programme. The prioritisation matrix recognises this, with prioritised components all being components of the towers value chain.

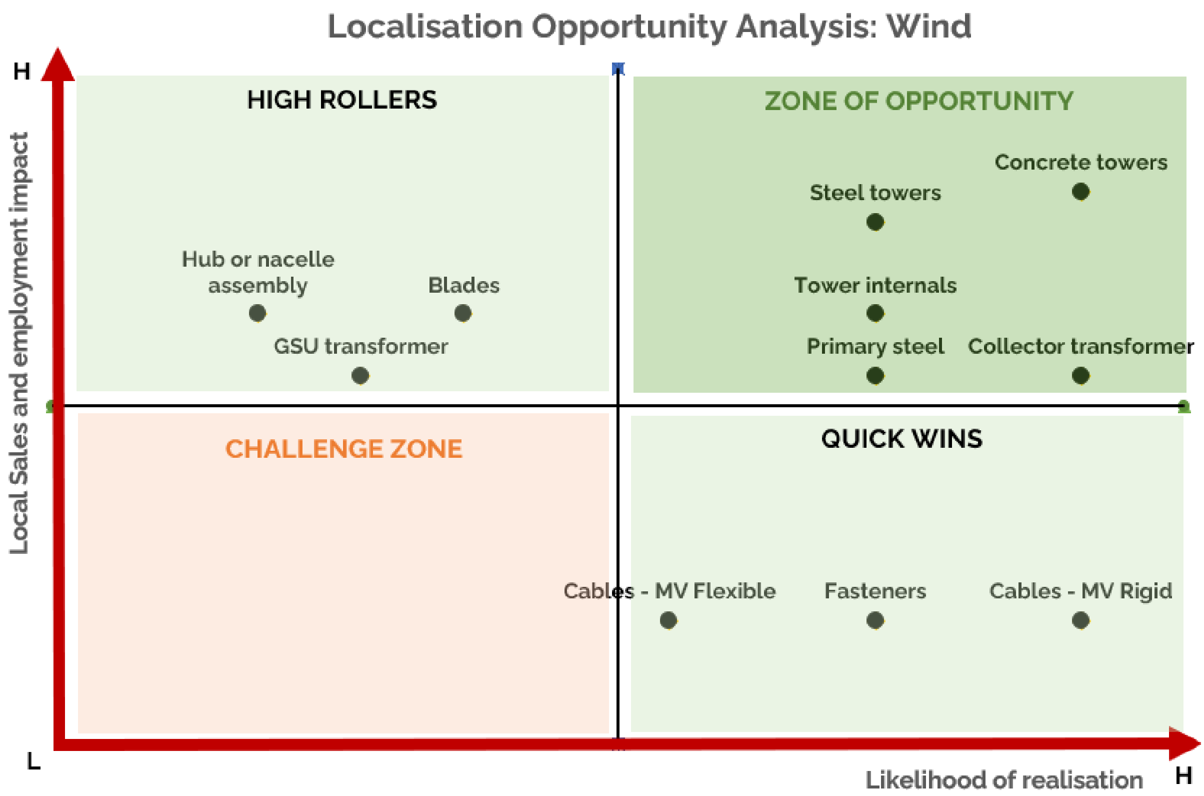
The only exception to this is the inclusion of blades and hub/nacelle assembly localisation opportunities. These key components fall in the 'high roller' quadrant, meaning that they are potentially high impact components but that are likely to be challenging to unlock. Blades are viewed as slightly more likely than hub/nacelle assembly because of the global strategy of OEMs to localise towers and blades, and the fact that blades were close to being localised in the earlier rounds of the Renewable Energy Independent Power Producers Procurement Programme (REI4P). This is before the interruption of the bid windows shattered investor confidence.

Components that are in the 'zone of opportunity' are towers, tower internals, primary steel, and transformers. For towers the likelihood of concrete towers is slightly higher than that of steel, primarily due to the higher cost of steel produced towers. For the transformers the collector transformers are deemed to be in the zone of opportunity and not the medium voltage transformers. These components represent the opportunities that have the highest impact and likelihood of realization. These components should sit at the core of the wind value chain localisation drive.

While cables and fasteners have a high likelihood of realisation and can be considered as potential 'quick wins' given their low barriers to localisation, they will have a relatively low impact on the value chain. The rigid medium voltage cables more so than the flexible cables that are used inside of the wind tower. Success can be achieved with the localisation of these components without excessive and intensive interventions being necessary.

The local wind value chain currently comprises only one steel and two concrete tower producers (a third plant, Colossus, is currently mothballed) who exclusively service public demand. Tower internals, such as anchor cages, tower extenders, lifting gear, and platform brackets are made locally by one company that supplies an estimated half of public demand. Primary steel was designated in round 5 of the REI4P and subsequently the steel was sourced locally for most of the tower mass.

Figure 20: Localisation opportunity analysis for components in the wind supply chain.

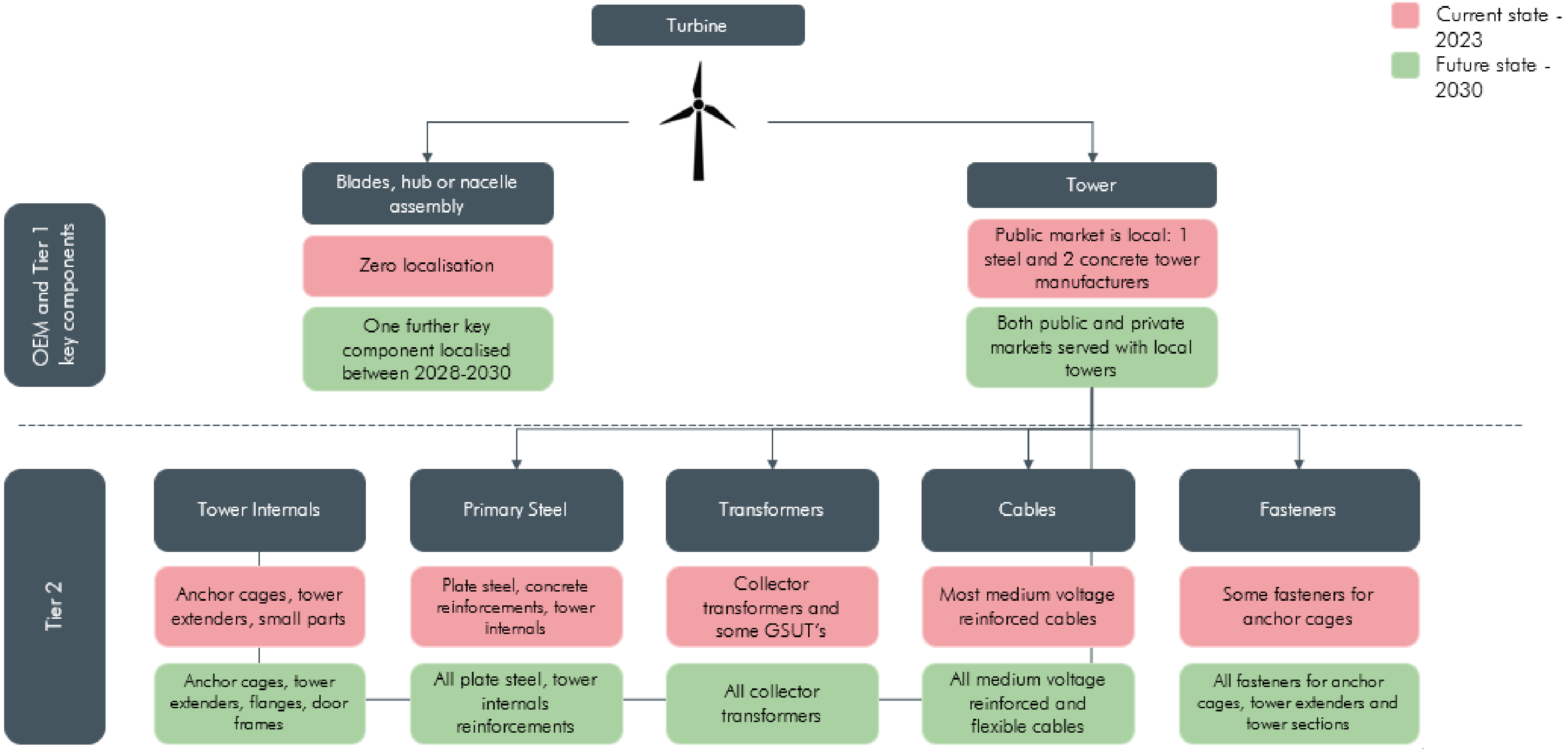



Local transformers dominate the market in the collector transformer space but are not supplied for medium voltage transformers. The medium voltage reinforced cables that run from the tower to the collector transformer enjoy a high local market share due to designation in REI4P, but no flexible rubber cables are provided locally. Fasteners are supplied in small volumes as second tier components into the anchor cages and tower extenders value chains but are not used for the tower sections.

The likely target state for the wind value chain by 2030 is to have both public and private demand serviced by local tower manufacturers. Additionally, the local industry could add the capability to produce the flanges and door frames on top of what is currently produced for the tower internals. Also, the primary steel for tower plates and steel tower internals can be made and supplied locally. All collector transformers are made locally. Both reinforced and flexible cables are supplied locally and all fasteners for anchor cages, tower extenders, and tower sections are manufactured locally.

A major achievement for the wind value chain would be to have one additional key component (blades, hub, or nacelle assembly) localised in the latter part of the decade (see Figure 21).

Figure 21: Current and future states of the 6 key components in the wind value chain



## 7.3 Turbines localisation realisation pathway

### 7.3.1 Turbines impact and implementation risks

The South African market, although the largest in Africa, is still very small compared to other regions (USA, South America, Europe, Asia). In the 12 years of utility scale wind energy being supplied in South Africa only 3.4 GW has been connected to the grid. This equates to an annual 280 MW. South Africa is not close to a larger export market (African demand is negligible), there are not any special assets like skills, cheap electricity, good infrastructure (ports, roads), nor are there advantages to be had from a well-established local supply of components and raw materials for turbine manufacturing. What this means is that the single reason why global OEMs came and stayed in South Africa was for the domestic market.

There are four OEMs who dominate the South African market. Vestas, Nordex, Siemens Gamesa, and Gold Wind.

Because the investment driver in South Africa is access to the market, imports of wind turbines was favoured. There was no business case for localisation outside of specific requirements set within bid windows.

The OEMs present in South Africa have excess capacity to manufacture and supply wind turbines. Their appetite to localise parts of that manufacturing has been reduced because of continued inconsistent domestic demand. The grid constraints in the Cape provinces, the changing rules for public procurement of wind energy, and the lack of an industrial policy framework for the private sector (where price is priority and importation is favoured) means that further localisation of key components is a conversation that does not generate any interest from OEMs.

OEMs have noted they desperately need:

- A level of consistent demand from both private and public markets,
- Clear and transparent rules for grid connection from Eskom, and
- An investable market (including faster and more efficient approval of sites; environmental impact assessments, environmental impact assessments (EIAs; water licences, etc.).

The OEMs argued that if they were provided with a stable market of 500-1,000 MW of installed capacity over a 5-year period, the localisation of key components (blades, hub assembly, nacelle assembly) would follow. A summary of the insights from engagements with the OEMs is captured in Table 2.

Table 2: Localisation potential for turbines

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| Low Potential | Demand | Capability | Capacity | Supply |
| Status quo | • SA market has been only public thus far (3.4 GW)<br>• Private now taking off but still unknown<br>• Demand has been fluctuating with years of zero demand | • Global OEMs are present in SA (Vestas, Gold Wind, Siemens, Nordex)<br>• Leading the industry in in technology for wind power<br>• Industry has high barriers of entry for newcomers | • Can procure and build wind turbines more than the highest demand forecast<br>• Between 4 OEMs could build 10 GW + annually | • Majority of components are imported<br>• Blades, nacelle, hubs are all imported<br>• Towers the only key component localised<br>• Due to local content requirements and not competition |
| Barriers | • Demand too small to support local capacity (REI4P started in 2011, in 2023 there is 3.4 GW on grid, 280 MW/year) | • Local capability in terms of intellectual property, skills and supporting industries not at the level to justify investment in local capacity | • Global OEMs have excess capacity worldwide and closing factories, consolidating production sites<br>• Global demand is lower than global supply, excess capacity and this is negatively | • Grid constrained environment (Cape Provinces)<br>• Only 3-4 GW capacity left<br>• Local components are more expensive than imported components |

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| Low Potential | Demand | Capability | Capacity | Supply |
| | • Demand is intermittent (2-3 years gap), investment not possible in unstable market | • No business case for investment into local assets for their capability | impacting global OEMs financially | |
| Enablers | • Absolutely crucial for growth in wind energy value chain is consistent demand from both public (REI4P) and private off-takers<br>• Clear rules for both markets<br>• Clear rules for grid connection | • GRI is the perfect example of what is needed<br>• Make the environment easy to invest in (site approvals, access to harbour and roads, EIAs)<br>• Reduce setup times from 2 years to 8 months | • Barriers are outside of the ability for SA to influence | • Clear timelines and plans to alleviate grid constraints from Eskom<br>• Less stringent local content requirements will enable local manufacturers to source more competitively<br>• Only if market is stable and standards and duties correctly applied to imports |

## 7.4 Towers localisation realisation pathway

### 7.4.1 Towers impact and implementation risks

Locally made towers are the only key component that is locally made.

Currently there is one steel tower manufacturer, GRI towers in Atlantis. They are producing towers for bid window 5 of the REI4P programme.

There are three concrete tower manufacturers in South Africa. Concrete Units have their primary factory in Western Cape. They have moved their equipment to Middelburg in the Eastern Cape to follow demand (three projects from BW 5 are being built near Middelburg). It is crucial for them to be close to the wind farm to be competitive (ideally less than 100km) because of the massive logistics costs to move the concrete segments.

The other two concrete manufactures are Copperton Concrete in Prieska, a jointly owned operation by Nordex, Acciona, and WBHO. The third factory is Colossal Concrete in De Aar. This factory has been mothballed until demand picks up sufficiently.

The combined capacity is over 2.8 GW annually. The story is nuanced because of where these factories are located and the demand for concrete versus steel towers. Logistics costs are significant for the towers and location could therefore easily decide a business case. For instance, a concrete tower that is close to an inland wind farm will be lower priced than an imported steel tower that must be transported inland. Furthermore, some OEMs use only one type of tower (Vestas with steel towers and Nordex with concrete towers) and this could cause demand bottlenecks.

Local towers are required for REI4P because of the 40% local content requirement (and steel designation). These requirements are absent from the private market, encouraging imports which are substantially cheaper than local steel or concrete towers (10-40%).

A primary enabler for tower localisation is consistent demand. This would lower the local cost of production. Alongside steady demand, adequate duties on imported towers that are consistently applied and monitored is also needed. Globally, the practice of negating duties by importing towers as equipment is an often-used mechanism that limits opportunities in the local value chain.

Concessions or incentives around local logistics costs would also assist local tower manufacturers that are often far from wind farms. As an example, steel towers from Western Cape serving the new demand materialising in Mpumalanga.

For the concrete tower manufacturers, it is necessary to assist with site approvals and especially EIAs, etc. Key is shortening setup times so that it is possible for firms to meet rapidly emerging demand. On new projects, firms ideally want to manufacture within eight months, produce the towers in one year, and have the project connected to the grid in six months.

Development of a second steel tower manufacturer will increase capacity, which will be needed, as well as introduce competition. IMAB is a likely candidate for this. Insights, barriers, and enablers to the localisation of wind tower are summarised in Table 3.

*Value and job creation description*

Given current capacities and capabilities, industry interviews suggest it is possible to localise 80% of cumulative tower demand from 2023 to 2030. This relates to an estimated R24.2b in local market sales. Even with the low labour intensity of steel and concrete tower manufacture, this can still sustain approximately 370 direct jobs.

*Key implementation risks*

There are fewer implementation risks for towers relative to other key components. There is excess local capacity especially in the concrete tower manufacturing space, while established steel and concrete manufacturers have advanced capabilities and have been supplying the industry for over five years.

Towers are de facto required local content for demand from the REI4P programme but not for private demand. Careful consideration of the levers available for competitiveness improvements in the private sector will be needed. The first and most obvious lever is that of consistent demand.

Investment into a second steel tower manufacturer might be needed as the demand for steel towers could outpace the supply coming from the only local steel tower manufacturer (GRI).

Table 3: Localisation potential for towers

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| High Potential | Demand | Capability | Capacity | Supply |
| Status quo | • REI4P designated local steel meaning steel towers had to be local<br>• Concrete towers too expensive to import<br>• Public market towers all local | • Local steel towers (GRI) produced to a high quality with local steel<br>• Concrete towers with 99% local materials competitive in market | • GRI producing steel towers = 250/year<br>• Concrete units = 120/year<br>• Copperton Concrete = 100/year<br>• Colossal Concrete = 100/year<br>• 250 steel towers and 320 concrete towers<br>• Over 2.8 GW per year | • Steel for steel towers all local steel (ArcelorMittal) except if steel plate more than 10 tons<br>• Flanges, door frames, cables, ladders, fasteners, internal lifts, platforms imported<br>• Anchor cages, tower extenders (concrete only), lifting gear and internal platform brackets locally supplied (Modetech)<br>• Paint is local (AkzoNovel, Jotun, Hempel) |

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| High Potential | Demand | Capability | Capacity | Supply |
| Barriers | • Private market now growing and local content rules less stringent<br>• No need to buy local towers<br>• For steel towers the price differential between imported and local a problem (local = 1m EUR, imported = 0.6m EUR)<br>• It is unlikely that this difference will be breached without import duty protection and local market scale | • Steel towers using local steel are expensive<br>• Concrete towers need to be close to wind farm (<100km) because of logistics cost<br>• To setup concrete tower plant is R130m, needs to be enough volume to justify setup | • Sufficient capacity for current demand forecast<br>• Some OEMs only use steel towers, could be a bottleneck for steel tower capacity | • Quality requirements are steep and local manufacturers require support to meet the standard<br>• ArcelorMittal production restriction on plates more than 10 tons, leads to imported steel |
| Enablers | • Absolutely key to keep local towers for private market<br>• If not, then there is no local value chain for wind turbines | • Logistics concessions for local tower transport to get to wind farms | • Invest in a second steel tower manufacturer that is of global standards in the emerging wind regions | • Setup cluster to align quality standards for key components (cables, fasteners, flanges, |

| Localisation Potential Matrix | Market | Asset | | Resource |
| --- | --- | --- | --- | --- |
| High Potential | Demand | Capability | Capacity | Supply |
| | • Duties for towers against low-cost regions (Asia, South America) critical | • Assistance in site approvals, EIA's, water licenses, etc. for concrete tower plants to be setup near wind demand node | (Eastern Cape/ Northern Cape border or Mpumalanga) – IMAB a potential candidate | platforms) between OEMs and manufacturers |

### 7.4.2 Towers interventions

Consistent demand remains the primary enabler of localisation for blades, hub and nacelle assembly.

For the sustained localisation of towers, the duty landscape needs to be analysed and the impact on the value chain investigated. South Africa's current tariffs do not specify wind towers, but rather only steel componentry. Towers are therefore either brought in under chapter 73 of the Customs and Excise Act for steel components with a general duty rate of 15% or as part of the assembled turbine. If it is brought in as part of an assembled turbine no duties are applied.

This duty differential is exploited, with industry engagements suggesting this happens regularly. Local tower manufacturers are consequently at a 15% disadvantage compared to imported towers purely from a tariff duty perspective. A developmental duty framework is something that should be tested, with downstream components securing a higher duty rate than upstream components, offering additional protection for the downstream key components.

From an initial investigation it seems that the World Trade Organisation bound rate on chapter 73 steel components is also 15%. This means that a new tariff chapter needs to be pursued that specifically identifies the steel wind towers outside of the 15% bound rate.

Additionally, once the duty framework is approved there is substantial work to be done to implement the duty changes and to monitor the correct application of duties by custom officials. The enablers and interventions for the localisation of towers are summarised in Table 4.

Table 4: Enablers and interventions for the localisation of towers into the wind value chain

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| Consistent demand of >1GW/year | 3 years | Updated IRP 19 | A | DoE | 1 year |
| | | Annual bid windows with consistent allocation volumes | A | REI4P | 3 years |
| | | Transparency in respect of grid availability, grid allocation rules and grid connection timelines | A | Eskom | 1 year |
| | | Private projects reaching financial close and commencing building at >500MW annually | B | Private sector | 3 years |
| Import duties revision | 2 years | Engage with current steel tower manufacturer to unpack mechanisms being used to negate import duties on towers (broad category applied at 15%, but often avoided) | A | LSF, GRI | 0.5 years |
| | | Investigate the maximum allowed import duty under WTO rules (15%) and test impact on value chain if current duty rates are raised | A | LSF, ITAC | 0.5 years |

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| | | Implement duty changes and train customs officials to correctly apply duty codes to towers | A | ITAC, Customs | 2 years |
| Establish second steel tower manufacturer | 2 years | Assist with the development of a second steel tower manufacturer in partnership with a global company | C | IMAB, IDC, global firm | 2 years |
| | | Approval of potential production sites in SEZs, EIAs, water licenses, and effluent licenses to be completed for sites | C | dtic | 2 years |

## 7.5 Tower internals localisation realisation pathway

### 7.5.1 Tower internals impact and implementation risks

The largest localisation value and highest potential for component localisation is in the internal and complimentary components for the turbine towers. These components are the anchor cages, tower extenders, flanges, door frames, lifting gear, internal platform brackets, internal platforms, ladders, internal lift assembly, cables, and fasteners.

Steel components that are presently being manufactured and supplied to the wind industry are the anchor cages, tower extenders, lifting gear, and the platform brackets. The anchor cages are a 15-20 ton steel milled and drilled kit. It is a specialised steel fabricated component that is design specific and requires large milling, drilling, and welding machines. The current capacity for the anchor cages is 350/year or about 1.8 GW annually. Currently it is only Modetech that manufactures and supply these components. Naledi Engineering and K5 Engineering are potential additions in the tower internal industry, especially to produce the flanges and door frames although Modetech could also diversify into these components. The barriers so far have been a shortcoming in capability and the availability of thick enough steel plates to produce the door frames and flanges.

The second largest component is the tower extender. This is a milled part that bolts into the top of a concrete tower. One tower extender weighs approximately 17 tons. The capacity for tower extenders is aligned with anchor cages at 350/year or 1.8 GW.

Smaller components are also manufactured locally. The lifting gear are small steel eyelets fixed to the inside of the tower and used to lift the tower section into place. Another local component is the internal platform bracket that is fixed to the inside of the tower and used as a mounting point for the platform. There are a couple other small parts supplied into the tower assembly value chain like specialised fasteners, etc.

All these components require substantial resources for design, development, and OEM approval, while the manufacturing process itself requires a very high level of precision and accuracy. The product development process is expensive (>R1m) and takes one to five years depending on the complexity of the part.

Firms appear to face two major barriers in respect of specialised steel fabrication. Firstly, inconsistent demand limits their ability to recoup their investment in additional capability and capacity, making it untenable to run a sustainable business. Companies either exit the industry, take on more debt, or divert their capability and capacity into other industries (mining, automotive, construction). Key then is consistent demand. This ensures companies are more competitive and encourages new companies to the industry.

The second barrier is the development process of the components. Companies are requiring support to upskill, develop, purchase equipment, secure access to protected technology, etc. The high level of development cost and high standard of manufacturing are a deterrent for companies. This was the case for the attempts to localise the tower flanges (used to bolt the tower sections together). Two companies were approached to develop the products (Naledi Engineering and K5 Engineering), but they indicated that they couldn't manufacture flanges with a diameter more than 3.6m and on the smaller sizes the low volume demand, combined with stringent product standards prohibited the localisation business case.

To remove this barrier, a cluster platform should be created that link parts of the value chain (OEMs, tier 1s, tier 2s) to ensure that volume opportunities are transparent. Further, the cluster would aid the manufacturers to access IP through licence agreements, secure skilled resources abroad or train internal resources abroad, improve manufacturing excellence, and assist with the approval of new parts. Table 5 contains a summary of localisation opportunities.

*Value and job creation description*

From the engagement with the current manufacturer of tower internals the opportunity to localise 80% of the market sales forecasted between 2023 and 2030 is possible. If this is achieved, it would equate to an estimated R6.8b in local market sales. The job creation potential of this opportunity, with 90 direct jobs to be created through tower internal localisation.

*Key implementation risks*

There are a few risks for the localisation of tower internals. One positive starting point is that there is excess capacity from the current manufacturers. However, there are stringent design and manufacturing requirements for supply into the wind OEMs and it takes several years to design and secure approval for the manufacture of a new component. Quality requirements are also onerous. As such, some level of investment may be needed to develop the capabilities of local manufacturers.

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Table 5: Localisation potential for anchor cages, tower extenders, lifting gear, platform brackets

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| High Potential | Demand | Capability | Capacity | Supply |
| Status quo | • Demand has been inconsistent<br>• Local designation of steel from REI4P main driver for these parts<br>• Local tower manufacturers open door to local components | • Modetech involved in wind for 10 years designing and approving 100+ parts with OEMs<br>• Only large machines in SA capable of fabricating (milling, drilling, welding) these components | • Capacity to service 350 towers annually for these internal parts<br>• More than 1.7 GW annually<br>• Space and ability to expand even more if demand is there and consistent | • Local steel from ArcelorMittal<br>• Steel quality is of a high standard although generally more expensive than imported steel |
| Barriers | • Competitiveness is poor because of inconsistent demand, can't invest and amortise over inconsistent demand<br>• Competing against lower quality imports | • Specifications from OEMs are stringent and often it takes a long time to get parts approved<br>• Manufacturing standards are high, local companies require support to meet requirements | • Historically demand has been low and couldn't fill capacity<br>• Depended on mining and construction industries to survive | • Working capital requirements from raw material expenditure a barrier<br>• Cash cycle more than 6 months, carrying steel |

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| High Potential | Demand | Capability | Capacity | Supply |
| | | | | cost that long makes business model tough |
| Enablers | • Consistent demand<br>• Duties correctly defined and applied against imported parts | • Support firm in developing capability by linking with international partners that supply steel parts into tower industry<br>• Assist with skills transfer, equipment upgrading, standards upgrading | • Capacity not an issue at current demand levels<br>• If consistent high demand expansion could best be supported through joint venture or acquisition by global company | • Need volume to improve negotiated steel price with ArcelorMittal and favourable credit terms<br>• In short term support with working capital for upcoming wind projects (BW5) important |

### 7.5.2 Tower internals interventions

The establishment of consistent demand is the single most important enabler of this opportunity. The revision of duties and the associated implementation of a developmental duty framework is also as important to the localisation of the tower internals as it is to the localisation of the towers. The same 15% duty rate for steel is applied for these components (and the towers), which provides limited protection for the industry.

Another enabler for the localisation of tower internal components is the upgrading of capabilities through a cluster-based programme. The cluster would need to be OEM-led and supported by public stakeholders. The primary objective would be to provide local manufacturers with access to global IP, and manufacturing best practice. This will ensure quality requirements are met.

The final enabler is access to competitively priced steel . This enabler ties in with the duty framework revision but can also be achieved with other interventions specified in the primary steel interventions section. The specific enablers and interventions for the localization of tower internals are summarised in Table 6.

Table 6: Enablers and interventions for the localisation of tower internals into the wind value chain

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| Consistent demand of >1GW/year | 3 years | Updated IRP 19 | A | DoE | 1 year |
| | | Annual bid windows with consistent allocation volumes | A | REI4P | 3 years |
| | | Transparency in respect of grid availability, grid allocation rules and grid connection timelines | A | ESKOM | 1 year |
| | | Private projects reaching financial close and commencing building at >500MW annually | B | Private sector | 3 years |
| Import duties revision | 2 years | Work with current steel internals manufacturer to unpack mechanisms being used to avoid import duties on imported steel components | A | LSF, Modetech | 0.5 years |
| | | Investigate the maximum allowed import duty under WTO rules and test impact on value chain if current duty rates are raised | A | LSF, ITAC | 0.5 years |


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| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| | | Implement duty changes and train customs officials to correctly apply duty codes to tower internals | A | Customs | 2 years |
| Cluster for increasing capabilities | 2 years | Firm participation in an OEM-led cluster to communicate specifications and expectations, provide access to experts and skills, and provide access to IP partnerships with established global companies | B | OEMs, tier 1s/2s | 2 years |
| | | Initiation, funding, and setting strategy of the cluster | B | SAREM | 1 years |
| | | Cluster management and facilitation to ensure goals are achieved | B | SAREM | 2 years |
| Development of manufactures | 3 years | Identification of complimentary specialised metal manufacturers and development to overcome specification and quality barriers | B | K5, Naledi, Wispeco | 2 years |
| Access to globally priced steel | 2 years | Interventions listed under primary steel opportunity and intervention tables | C | ArcelorMittal | 2 years |

## 7.6 Primary steel localisation realisation pathway

### 7.6.1 Primary steel impact and implementation risks

Primary steel is a large part of the local value chain for wind energy due to the nature of the components supplied into the tower manufacturing value chain. Many key components are tied into the local steel value chain and are negatively impacted by its relative lack of competitiveness against imported steel.

Steel was designated in round 5 of REI4P. This equated to a demand of approximately 77,600 tons of steel (48.5 tons/MW) for the 1.6 GW of wind projects procured. The total tonnage includes towers, anchor cages, tower extenders, lifting gear, internal platform brackets and fasteners. This translated to roughly R1b of steel demand.

There is excess capacity for primary steel in South Africa. ArcelorMittal has a sellable annual capacity of 4.5m tons and is currently only operating 2.5m tons annually. The total demand from wind energy is therefore only about 3% of its current operation. Even at the highest demand peak forecast for wind energy (3.5 GW/year), the total would be less than 7% of ArcelorMittal's primary steel capacity.

There also appear to be no capability barriers. ArcelorMittal is a global company producing high-quality steel products. They have invested resources into understanding the profiles and steel chemistries required by the wind energy industry and developed new products specifically for them. They have also increased their capability to manufacture larger and heavier plate steel (R50m investment) to be able to manufacture plate steel up to 10 tons.

The barrier for the local primary steel industry is price. Local steel is generally more expensive than imported steel (up to 40%). The strongest competition is from China, which produces about 100m tons per month. China also secures South African iron ore cheaper than the South African mills, as they have access to cheaper electricity, transport concessions, and export rebates. Local mills cannot compete against these advantages.

Increased duties against imported steel would increase the ability for local supply of primary steel but would also have a negative impact on the downstream value chain, making it less competitive. The problem of local steel premiums goes beyond the localisation of the wind energy value chain. A holistic approach to determining the future role of local steel manufacturing and its impact on the entire downstream manufacturing landscape is needed.

There are however other areas to focus on for further localisation of steel components. The development of a foundry operation to cast the hub nose (3-4-ton steel cast part) is an opportunity. ArcelorMittal has a foundry to dedicate to this operation and need about 1,000-1,500 tons of volume annually to be viable (1,3GW).

Lastly, the development of an alternative coil steel producer will add much needed competition into the local market. Columbus Steel can produce carbon coil steel products but need to develop the capability to produce higher quality steel (steel with a lower silicon content).

*Value and job creation description*

Most of the steel for towers under bid window 5 of REI4P is local. Considering that local steel is required for REI4P and that there are advantages for steel supply into the private market as well, 80% localisation could be achieved for cumulative demand from 2023 to2030. If this is realised, approximately R7.1b of local market sales would be achieved, creating about 190 direct jobs.

*Key implementation risks*

Excess domestic capacity exists due to the low level of demand coming from the construction and heavy infrastructure markets. The local steel industry has capacity to supply for over 3 million tons annually. The total forecast for wind energy demand is only 420,000 tons, which is small in comparison to this annual capacity. Additionally, local steel from ArcelorMittal is of high quality and meets the quality requirements of the wind industry.

A barrier for localisation is the negative cost position that local steel has compared to imported Chinese steel. This is a challenge for the industry, especially in respect of private sector supply. The expansion of capabilities to increase plate manufacturing and foundry capability and capacity will require substantial levels of investment; investment that industry appears to have limited appetite to make.

Table 7: Localisation potential for primary steel

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| High Potential | Demand | Capability | Capacity | Supply |
| Status quo | • Steel was designated for BW 5 of REI4P<br>• Local steel a large part of the tower value<br>• Local steel more expensive than steel from China<br>• When plates, anchor cages, tower extenders, fasteners, internal platform brackets, and lifting gear are procured locally that is approx. 48.3 tons of steel per MW of installed wind (assuming 50/50 concrete vs. steel tower split) | • High quality local steel to global standards<br>• Columbia Steel also do carbon steel plate and coil but have quality constraints on their silicon content<br>• SCAW metals and Cape Gate make also make long profile steel (rod and wire applicable to wind sector) | • ArcelorMittal have a sellable capacity of 4.5m ton/year, more than entire SA market<br>• Currently running only 2.5m ton/year because of low demand | • South African iron ore from Sishen is more expensive for ArcelorMittal than it is for Chinese mills in China because of volume disparity<br>• Three is no metallurgical grade coal in SA, they import it from Australia and now a small supply from Zimbabwe |

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| High Potential | Demand | Capability | Capacity | Supply |
| Barriers | • Inconsistent demand made it difficult to procure locally because of short timelines and large demand spikes<br>• Private demand not tied to designation status and are free to import | • A lot of the specifications come from overseas specifications and are not always available in South Africa<br>• ArcelorMittal can't produce a plate with a weight larger than 10 tons meaning they miss out on some of the steel (15%) for steel towers | • Have excess capacity but are more expensive than imported Chinese steel<br>• 1.2m tons of steel was imported last year into SA (total local market is 4m ton per year) | • Can't compete on price with China<br>• China get cheaper ore from SA, they have concessions on electricity and transport, and get an export rebate |
| Enablers | • Consistent demand from both private and public markets<br>• Duties that are correctly applied to imported primary steel and steel components | • Dedicated resources at the steel mills that engage with OEMs to develop new profiles and steel types for wind energy industry<br>• Focussed investment on capability to produce larger | • Opportunity on casting the nacelle nose (3-4 ton cast piece)<br>• Can dedicate a foundry for this purpose if demand was >1000 | • Consistent supply of iron ore and electricity<br>• Had to switch off their big blast furnace last year because of iron ore |

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| High Potential | Demand | Capability | Capacity | Supply |
| | • Duties that are high enough to even the market for competition from China | plate sizes and thicker plates | tons/year or approx. 1.5 GW/year | shortage, cost was R1 billion. |

### 7.6.2 Primary steel interventions

Local steel is not able to compete directly with imported steel. The most important enabler for the localisation of steel is to revise duty levels, particularly in respect of how these duties impact downstream value adding activity.

The current applied duty rate of 15% is equal to the World Trade Organisation's (WTO) bound rate of 15%. This limits the ability to increase the general duty rate. There are other import protection levers that can be explored, but the possibility of reducing duties on imported steel should be explored to improve the downstream competitiveness of the wind value chain. This will be at the cost of local steel supply, but it could unlock major downstream benefits.

A specific localisation opportunity is to increase the capability of ArcelorMittal to increase its maximum plate size to above 10 tons per plate. This will enable domestic supply of the very thick bottom section of the steel tower.

Another enabler of further localisation is investment into a dedicated foundry for the casting of the 4-ton hub nose piece. Demand of more than 300 MW annually is required for this investment, as it requires an estimated investment of R30m.

Finally, despite excess capacity at the current steel manufacturer (ArcelorMittal), an enabler of localisation could be the development of a second flat steel producer. The enablers and interventions for the localisation of primary steel is summarised in Table 8.

Table 8: Enablers and interventions for the localisation of primary steel into the wind value chain

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| Import duties revision | 2 years | Engage with current primary steel manufacturer to establish price differential between imported and local steel and unpack factors underpinning the difference | A | LSF, ArcelorMittal | 0.5 years |
| | | Review current duty levels and evaluate appropriateness of increasing import duties on primary steel or to remove them to assist downstream activity | A | LSF, ITAC | 1 year |
| Investment in increased capability for larger plate steel and casting foundry | 2 years | Invest in capability to produce steel plates in excess of 10 tons for steel tower manufacturing (estimated R50m investment) | B | ArcelorMittal | 2 years |
| | | Invest in a dedicated foundry to cast hub nose. Key is casting quality and accuracy (estimated R30m investment, also dependent on >1ktons/year demand or +- 300MW/year) | B | ArcelorMittal | 2 years |

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| Develop second flat steel manufacturer | 3 years | To increase competition in local market, assist with the development of a second steel plate manufacturer | C | Columbus Steel | 3 years |

## 7.7 Transformers localisation realisation pathway

### 7.7.1 Transformers impact and implementation risks

The localisation of transformers can be best understood by categorising the two types of transformers usually supplied to a wind farm.

The first type is the collector transformer that increases the voltage from 33 kV to 132 kV. Usually there are one or two of these collector transformers per wind farm ranging in size from 80 kVA to 180 kVA. This type of transformer is part of the balance of plant. It is procured by the Engineering, Procurement, and Construction (EPC) company is already largely localised. There are two local manufacturers of collector transformers, Actom Power Transformers and SGB-Smit Power Matla. These two manufacturers have a combined capacity of more than 8 GW per year. Actom are the dominant RE player with over 70% market share.

The second type of transformer is the medium voltage transformer or the generation step up transformer (GSUT) that increases the voltage from 0.6 kV to 33 kV. The design of this type of transformer depends on the design of the wind turbine. If the turbine is designed with the power conversion unit (converter, switchgear, transformer) inside of the nacelle, the transformer will be a dry-type transformer. If the turbine is designed with the transformer separately located at the base of the turbine, the transformer can be a normal oil-filled transformer.

The dry-type transformer is not produced in South Africa currently, an investment in equipment of between R50-60m is required to develop this capability. Even with capability localisation would be limited because of the design of turbines. The great majority (>90%) of turbines are designed with the power conversion units inside of the nacelle. In these cases the nacelle is procured as a complete assembled and tested kit and delivered to the wind farm for installation. Without local assembly and testing of nacelles, local supply of transformers into the nacelle is not possible.

This means that the localisation potential is low even though there is a capacity of more than 2.4 GW of GSUT's currently in South Africa. Actom, who manufacture these oil-filled GSUTs has done substantial work to develop their own designs that are performing well in the market, although only for a small part of the market (transformer at the base of the tower).

The biggest growth barrier for this component remains inconsistent demand. Both capability and capacity can be increased, but only if consistent demand exists. Importantly, local oil-filled GSUTs are competitive against imports when measured on a comparative quality basis. Competitive advantage is also secured from the support, installation, and maintenance services provided.

The trend in the market is for OEMs and EPCs to source the complete power conversion kit for both wind and solar. They are trying to move into this space of doing the assembly and testing and supplying the complete kit, but only on a small scale. A full facility would cost between R100-200m and employ over 100 people. This opportunity has greater potential for solar. For wind it is still dependant on the localisation of the nacelle assembly.

The barriers and enablers for the supply of transformers are summarised in Table 9.

*Value and job creation description*

Collector transformers range in value from R10m-R15m per unit. Engagements with leading transformer manufacturers made it clear that there are concrete advantages to sourcing collector transformers locally. Because of this a 95% localisation percentage should be targeted for the cumulative volume from 2023 to 2030.

Medium voltage transformers or generation step up transformers are generally not sourced locally because of the design of turbines (transformers inside of the nacelle). Only about 10% of turbines are designed with the medium voltage transformer positioned at the base of the tower. This is the maximum localisation potential for this part, unless nacelle assembly is localised.

Considering these two assumptions about R2.5b in local market sales can be captured. The direct manufacturing jobs associated with this level of localisation is calculated at 81.

*Key implementation risks*

There are small to no implementation risks for the localisation of the collector transformers as they already have over 90% of the local market with excess capacity still available to service future demand. The local collector transformers are competitive against imports, further boosting their localization potential.

Generation step up transformers are unlikely to be localised because of design restrictions, and the fact that there is currently no dry-type transformer capability in South Africa. This would require about R60m in investment.

Table 9: Localisation potential for transformers

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| Low Potential | Demand | Capability | Capacity | Supply |
| Status quo | • Collector transformers procured locally (1-2 per wind farm) as part of balance of plant<br>• Generator Step Up Transformer (GSUT) depends on the turbine design<br>• If transformer in nacelle, then imported with complete nacelle | • If medium voltage transformer (GSUT) at base of turbine, then there is capability in SA to make it<br>• If GSUT is in nacelle it is a dry-type transformer, and no one makes it currently in SA | • From the one main manufacturer in SA, they have capacity for collector transformers of 3 GW per year<br>• For GSUT they can do 480 per year, about 2.4 GW (of the oil-filled type) | • Raw materials are about 60% of the cost, 40% value addition<br>• Steel is sourced locally<br>• Copper and core steel is imported |
| Barriers | • 90% of turbines have the transformer in the nacelle and not at the base | • Most transformers for turbines (90%) are in the nacelle and of a type that is not made in SA | • Excess capacity in the industry for both collector and generator step up transformers | • Only a few mills globally that produce the core steel |

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| Low Potential | Demand | Capability | Capacity | Supply |
| | • Without local assembly of nacelle local transformers won't be procured | | | |
| Enablers | • Local assembly of nacelles<br>• Consistent demand | • Investment in manufacturing and testing of dry-type GSUT of abut R50-60m<br>• Local assembly of nacelle | • Local assembly of nacelles | • Opportunity to localise copper rod will also make them more competitive along with the cable manufacturers |

### 7.7.2 Transformers interventions

For generation step up transformers the key enabler is the localisation of nacelle assembly. Nacelle assembly is unlikely in the timeframe up to 2030 but can be achieved provided required enablers and interventions are implemented.

If nacelle assembly were localised, another enabler for the localisation of the medium voltage transformer is the investment in the dry-type transformer manufacturing capability. Additionally, an assembly operation and testing facility for the power conversion module will enable local supply of the medium voltage transformers. The power conversion module includes the converter, switchgear, and transformer. The trend in the industry is for this module to be procured as an assembled and tested kit. The supply of components into the module is dependent on the localized assembly and testing of the power conversion module.

As for the other components, consistent demand is the key enabler for continued local supply of collector transformers. A summary of the enablers and interventions are listed in Table 9.

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Table 10: Enablers and interventions for the localisation of transformers into the wind value chain

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| Localisation of nacelle assembly | 5 years | Interventions listed under blades, hub assembly and nacelle assembly opportunity/intervention tables | A | dtic, OEMs, IDC | 5 years |
| Consistent demand of >0.5 GW per year | 3 years | Updated IRP 19 | A | DoE | 1 year |
| | | Annual bid windows with consistent allocation volumes | A | REI4P | 3 years |
| | | Transparency in respect of grid availability, grid allocation rules and grid connection timelines | A | ESKOM | 1 year |
| | | Private projects reaching financial close and commencing building at >250MW annually | B | Private sector | 3 years |
| Invest in dry-type transformers | 2 years | Invest about R60m to develop and manufacture dry-type transformers for inside the nacelle type of turbine designs | A | Actom Power Transformers | 2 years |

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| Invest in power conversion module assembly, testing | 3 years | Invest about R150m to assemble and test power conversion modules for wind and solar energy | B | Actom Power Transformers | 3 years |

## 7.8 Cables localisation realisation pathway

### 7.8.1 Cables impact and implementation risks

The South African cable industry has international safety standards. The standard specifically relevant for wind turbines are the SANS 97 or 1339 standard. To supply a cable in South Africa manufacturers, must comply with this standard.

There is excess capacity in the industry due to low demand in the last decade and strong competition from imported Chinese cables. In the last four years, nine major cable manufacturing plants have closed.

The cables used for wind energy are primarily medium voltage cables. There are two broad categories. A more general reinforced insulated cable that is used between the turbine and the collector transformer, and a specialised flexible cable that is used inside of the turbine to run from the nacelle to the base of the tower.

Most of the cables used in a wind farm are part of the balance of plant. Approximately 120-180km of cabling is used in a standard 140 MW wind farm. Of this total, only 3.5 km is used inside the turbine tower.

There are three manufacturers in South Africa who can manufacture the regular reinforced medium voltage cables: CBI African Cables, Aberdare, and M-Tech. These manufacturers have a combined annual capacity for medium voltage cables of over 3,500 km. This is enough cable to service 4 GW renewable energy demand per year.

Only one of the three manufacturers, Aberdare Cables, has the capability to manufacture the flexible rubber cable that goes inside the wind tower. Other manufacturers are currently developing the capability to manufacture the flexible cable. The capacity to manufacture the flexible cable is unknown, but due to the low volume of demand (25m/MW), it is likely that there is excess capacity for this type of cable.

One of the barriers to localisation is the correct application of the compulsory safety standard on imported cables and the application of correct duties. Industry interviews suggest that sub-quality cables are imported on duty codes that are incorrect, thereby gaining access to the South African market at a price that local companies cannot compete with.

Another barrier to flexible cable manufacture is achieving OEM standards. No local cables are being supplied for the wind turbines as part of bid window 5 primarily due to quality specifications that could not be met.

To enable the local supply of cables consistent demand is key. Secondly, both the safety standard and correct duties need to be diligently applied to all imported cables.

For flexible rubber cables, a partnership with global IP holders is likely required. This will facilitate skills, IP, and machinery transfer to their local subsidiary, enabling the meeting of quality specifications (all three of the manufacturers are owned by global companies that manufacture flexible cables).

Lastly, a local independent testing facility for flexible cables would ensure compliance with OEM specifications and remove the need to have the cables tested internationally. This will shorten development lead time and provide easier market access for manufacturers. The barriers and enablers are summarised in Table 11.

Table 11: Localisation potential for cables

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| High Potential | Demand | Capability | Capacity | Supply |
| Status quo | • Balance of plant cables (medium voltage reinforced non-flexible cables and high voltage cables) sourced locally<br>• Tower medium voltage cables mostly imported | • Three companies (CBI, M-Tech, Aberdare) making medium voltage cables in SA<br>• Only one (Aberdare) making flexible medium voltage cables<br>• CBI installing a new line | • Excess capacity on normal medium voltage cables (>3,500 km from three companies)<br>• More than 4GW of annual cable capacity (0.85km/MW)<br>• Flexible cable specifically unknown but can easily switch available capacity | • All aluminium, XLPE, copper (except small supply from Palaborwa Mining Company) imported, +- 90% of raw materials<br>• Only getting PVC locally |
| Barriers | • If tower imported, then no local cable supply option (imported with internals)<br>• If tower is local, require a specialised flexible cable made from rubber | • High level of quality of medium voltage cables a barrier<br>• Testing of cables locally to ensure specifications are met a barrier | • No barrier in terms of capacity<br>• When capability is there excess capacity can easily be switched to flexible medium voltage cables | • Importing from the same sources globally for XLPE and Copper and Aluminium rod<br>• They can't improve cost base without competitive local suppliers |

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| High Potential | Demand | Capability | Capacity | Supply |
| Enablers | • Towers need to be sourced locally by OEMs for demand to be available for local cables<br>• Demand needs to be consistent for investment in capabilities<br>• Correct duties applied to imported cables<br>• Correct safety standard (SANS 1339 or 97) applied to imported cables | • Investment in new machines (R20-30m)<br>• Skills transfer from globally owned companies to build in quality<br>• Local testing facility for medium voltage flexible cables | • Excess capacity in industry | • Expand local supply of copper rod through PMC<br>• Support company setting up in Richards Bay to convert aluminium ingots to 8mm rod (name not disclosed) |

*Value and job creation description*

Reinforced medium voltage cables represent most cables used in wind farms (>100km). Only a small volume of flexible rubber cables (<4km) is used, with these going into the wind tower, Medium voltage reinforced ground cables have a high potential for localisation and are already being sourced locally for most of the market. A localisation potential of 97% is ascribed to this type of cable. The flexible rubber cable is a more specialised cable and the testing requirements and manufacturing skill level is high. This type of cable is likely to have a lower localisation level, which is assumed to be 50%.

This represents a combined localisation of market sales of 95% for cables which represents R0.9b of additional cumulative demand from 2023 to 2030. The direct jobs associated with this level of localization is 87 jobs.

*Key implementation risks*

There is excess capacity in this industry with more than 2.5GW of annual capacity and most reinforced cables already localised.

There is one company that has the capability to produce flexible rubber cables. They declined the request for quotation from a wind OEM to service volume for Bid Window 5 of the REI4P. The reason was not clearly specified but it is understood that quality specifications and testing requirements were a barrier for entry. A second manufacturer is installing the capability to manufacture flexible rubber cables.

Although there are duties for imported cables, the duties are often negated through creative duty declarations by importers. Local cable manufacturers import almost their raw materials, and this also limits the competitiveness of local firms relative to importers.

### 7.8.2 Cables interventions

Consistent demand is a key enabler of cable localisation, as it directly impacts the competitiveness of local manufacturers.

Although there are duties in place, it is not clear that the raw materials are at a lower duty level than the imported cables. If there is no duty differential through the value chain import-dependent downstream cable manufacturers have very limited actual duty protection. A value chain revision should be completed to map import duties through the value chain and align them with a developmental duty framework that remains aligned with South Africa's WTO bound rates.

Besides the correct level of duties, the correct application of duties is another key intervention to enable localisation. The focus should therefore be two-fold. First, it is necessary to engage with the manufacturers to understand what tariff codes are being used to avoid duty charges. Secondly, an exercise is required to capacitate custom officials to use the correct duty codes on products entering the country.

The cables industry would also benefit from a cluster platform to facilitate improved quality standards, the attainment of compulsory specifications, and the achievement of OEM requirements. The capability of local manufacturers requires upgrading. New machinery and the introduction of global IP is required to manufacture flexible cables. Lastly, establishing a local testing facility would be of major benefit to firms.

The full summary of the enablers and interventions of the localisation of the cables for wind energy is in Table 12.

Table 12: Enablers and interventions for the localisation of cables into the wind value chain

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| Consistent demand of >0.5GW/year | 3 years | Updated IRP 19 | A | DoE | 1 year |
| | | Annual bid windows with consistent allocation volumes | A | REI4P | 3 years |
| | | DTIC and IPPs to stop granting exemptions and commit IPPs and OEMs to plan projects with timelines that enable local manufacturing | A | dtic | 1 year |
| Revise import duties | 2 years | Engage with current cable manufacturer to unpack mechanisms being used to avoid import duties on imported cables | A | LSF, CBI, Aberdare | 0.5 years |
| | | Investigate what the maximum allowed import duty is under WTO rules and test impact on value chain | A | LSF, ITAC | 0.5 years |
| | | Implement duty changes and train customs to correctly apply duties | A | Customs | 2 years |
| | 2 years | Private sector participation in OEM-led cluster to communicate specifications/expectations, and enhance quality and technical capability | B | OEMs, CBI, Aberdare | 2 years |

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| Cluster for increasing capabilities | | Initiation, funding, and setting strategy of the cluster | B | SAREM | 1 years |
| | | Management and facilitation of cluster to ensure that goals are achieved | B | SAREM | 2 years |
| Develop flexible cable capability and capacity | 2 years | Investment in new machines (R20-30m) to increase capacity | C | Aberdare, CBI | 1 year |
| | | Transfer global skills and expertise to local entity producing flexible cables | C | Aberdare, CBI | 2 years |
| Local cables testing facility | 2 years | Development of local testing facility to certify both reinforced and flexible cables independently for local cable manufacturers | B | SAREM | 2 years |

## 7.9 Fasteners

### 7.9.1 Fasteners impact and implementation risks

Fasteners are a key structural component for wind turbines. OEMs consequently set stringent product and process requirements for suppliers. This has created a barrier to the localisation of fasteners.

Fasteners are designated under the REI4P programme for the most recent round 5 of bidding. Even though the designation is in place, OEMs have exemptions for fasteners because local manufacturers are currently not producing fasteners of the require standard.

At present there is only one manufacturer of fasteners that is capable of supplying to the wind energy industry. Impala Bolts & Nuts, through their subsidiary SA Bolts have the only local capability to hot forge the large fasteners required for wind towers. Wind towers use bolts in the size range of M36-M48. This excludes all cold forge manufacturers because they can only produce bolts up to size M30.

The local hot forge manufacturer has thus far only been a tier 2 supplier to the OEMs through the bolts that they supply for the anchor cages and the tower extenders. Recently they have been approved as a supplier to one OEM and are engaging with the other OEMs to become an approved supplier. If successful, they have the capacity to supply 4,800 tons annually. That is enough to service 2.2 GW of capacity every year. If the demand is consistent, they can also expand their capacity.

Another barrier to the supply of fasteners is the inconsistent demand that has plagued the industry. A key advantage for this industry is that they are competitive against imported bolts because of a 50% duty. However, the correct application of duties remains a problem and should be the focus for this component as well.

To overcome the barrier of high-quality standards and testing of fasteners, a local testing facility (mtlabs is a local testing facility) with the ability to perform specific tests required by wind OEMs would enable greater levels of local supply. From the industry engagements it was apparent that mtlabs are not currently capable of doing the tests that are needed but could add this capability without major barriers or risks.

Lastly, it was mentioned during industry engagements that the supply of raw materials (steel specifically) is sometimes a constraint on production of larger sizes of fasteners. More consistent demand and clearer communication between the OEM, fastener manufacturer, and raw material supply would smooth out the supply of raw material. A cluster platform where these firms can communicate expectations will help in this regard.

The findings from the industry engagements and the barriers and enablers for the local industry are summarised in Table 13.

*Value and job creation description*

A localisation potential of 70% is applied to fasteners resulting in an estimated R1.2b in local market sales for cumulative demand from 2023 to 2030. The direct job creation potential associated with this level of demand is about 131 manufacturing jobs.

*Key implementation risks*

There is only one local manufacturer (SA Bolts) of hot forged bolts used in wind tower construction. This firm has an annual capacity of >2.2 GW annually, which can be converted to other end markets if consistent demand does not materialize from the wind industry.

The manufacturer is a verified supplier for one of the locally operating OEMs and could have supplied the volume for bid window 5. However, an exemption was sought by the OEM for reasons that were not mentioned during the industry engagements.

There are high levels of duties for fasteners (up to 50%) so no duty policy review is necessary.

There is a risk with the supply of raw materials from ArcelorMittal. Because of inconsistent demand, local supply is sometimes highly constrained.

Table 13: Localisation potential for fasteners

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| High Potential | Demand | Capability | Capacity | Supply |
| Status quo | • Fasteners for wind not supplied locally<br>• Only one company (Impala Bolts & Nuts) have supplied small amount of fasteners | • Bolts used for wind turbines are large (M36-M48)<br>• Make them through hot forging<br>• Only one company in SA that can do hot forging of bolts (SA Bolts owned by Impala Bolts & Nuts) | • One manufacturer has capacity from hot forging factory for 4,800 tons annually<br>• Approx. 2.2GW annually (2.2 ton bolts/MW) | • Local steel used for fastener manufacturing<br>• Steel is of a high quality, but the rod steel availability is a constraint at times<br>• Local pricing higher than imported steel rod |
| Barriers | • OEMs source fasteners globally because they need to be of the highest quality<br>• Demand fluctuates and OEMs get exemptions from DTIC for REI4P in most cases | • High levels of quality and precision manufacturing a barrier<br>• OEMs asking for IEC accreditation and fatigue and yield testing to be done on bolts | • At current levels of demand there is excess capacity<br>• Potential barrier is hot forging capacity | • Availability of steel rod used for fasteners limited at times of high demand<br>• Pricing of local steel rod high |

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| High Potential | Demand | Capability | Capacity | Supply |
| | • Importing companies dodge import duties on fasteners | | | |
| Enablers | • Constant demand<br>• Correct application of duties on fasteners that are imported | • Manufacturer already IATF (high automotive standard) accredited and approved supplier to Vestas<br>• Local testing of fasteners (work with mtlabs) and assistance to be IEC accredited needed | • Assistance to invest in new equipment to do hot forging of larger bolts for wind towers | • Improved communication between primary steel, fastener manufacturer and OEM to ensure availability of raw material for project length<br>• Scale for improved local pricing |

### 7.9.2 Fastener interventions

As per the other components explored, consistent demand remains the key enabler of localisation and the potential for local competitiveness.

Additionally, the fasteners industry should be included in the cluster platform to remove the uncertainty of OEM quality requirements, and to facilitate capability improvements amongst local manufacturer keen to meet required quality levels. The local testing of fasteners would be another key enabler. Because of the critical nature of fasteners, robust testing is necessary to ensure that each batch of fasteners meet requirements. This needs to be done locally for competitive access to the local market.

IEC accreditation for local manufacturers will also enable local supply. This should not be a difficult barrier as a key local manufacturer is already IATF (International Automotive Task Force) certified, IATF is the automotive-specific standard that requires similar levels of conformance to the wind energy OEMs.

The enablers and interventions for the localisation of fasteners are summarized in Table 14.

Table 14: Enablers and interventions for the localisation of fasteners into the wind value chain

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| Consistent demand of >0.5GW/year | 3 years | Updated IRP 19 | A | DoE | 1 year |
| | | Annual bid windows with consistent allocation volumes | A | REI4P | 3 years |
| | | DTIC and IPPs to stop granting exemptions and commit IPPs and OEMs to plan projects with timelines supporting local manufacturing | A | dtic | 1 year |
| Local fastener testing facility | 2 years | Development of local testing facility to certify fasteners both at the manufacturer level and at the individual part level | B | SAREM, OEMs, mtlabs | 2 years |
| Cluster for increasing capabilities | 2 years | Private sector participation in OEM-led cluster to communicate specifications/expectations, and enhance quality and technical capability | B | OEMs, ArcelorMittal, Impala Bolts | 2 years |
| | | Initiation, funding, and setting strategy of the cluster | B | SAREM | 1 years |
| | | Cluster management and facilitation to ensure goals are achieved | B | SAREM | 2 years |

| | | | | | |
|---|---|---|---|---|---|
| IEC accreditation for manufacturers | 2 years | Assistance with IEC certification for wind tower bolts | C | SAREM and Impala Bolts | 2 years |

## 7.10 Blades, hub and nacelle assembly localisation realisation pathway

### 7.10.1 Blades, hub and nacelle assembly impact and implementation risks

Localisation of any of the other key components is of low potential for the timeframe up to 2030. The lack of demand, technical barriers to market entry, and the absence of other localisation drivers (assets or resources) leads to this negative conclusion.

The global wind energy model is for OEMs to localise towers first, followed by blades. In rare occasions the assembly of hubs and nacelles may then occur, but usually this is in markets with very strong demand, where it is legislated that they must be assembled locally or if most of the components are manufactured in the same region (gearbox, generator, pitch systems, etc.).

In South Africa none of these conditions for localisation exist.

What would enable further localisation of key components is consistent demand of 1-2GW annually for a 3–5-year period.

Alongside consistent demand there needs to be a robust trade and industrial policy that balances the import duties of the finished goods with the import duties on upstream component. One of the OEMs recently completed a business case on local hub assembly. The conclusion was that if they imported the entire piece there were no duties applied, but if they imported the components and then assembled them in South Africa, most of the components attracted an import duty. The business case did not work.

Similarly, conversations on local blade manufacturing have been ongoing since 2015 with a couple of companies, most seriously with LM Wind Power. The lack of consistent demand and the time to set up (approximately two years) were the main barriers to potential investment.

Another barrier to further localisation is the lack of capability of local skills to produce blades, assemble a hub or a nacelle. Significant focus and investment would need to occur to bridge this gap in capability. The dynamic in the wind industry is that of follower- procurement. Global OEMs invest first and as the local value chain matures, the preferred global component suppliers set up operation locally. These global component manufacturers should be the focus for partnerships, skills, and IP transfer into the local industry.

Although further localisation of key components is of low potential, enabling actions should not be ignored. These key components hold the key to deeper levels of manufacturing within the local value chain. Unfortunately, the market trend is for the turbine to be modularised. This means the tower, blades, nacelle, and hub arrive at the wind farm already assembled, tested, and ready to plug in. If the module is not local, it is highly likely that nothing inside of it will be local.

A summary of the barriers and enablers for the future localisation of key components are shown in Table 15.

*Value and job creation description*

A high-level estimate indicates that about R7.2b of local market sales could be generated from the localisation of other key components at a level of 5% of the cumulative market demand from now until 2030. This aligns with the demand model to be 50% of the demand for 2029 and 2030.

The most likely candidate is blades. If a facility were established locally it would contribute an estimated 250 direct jobs.

*Key implementation risks*

The implementation risks are significant, leading to the conclusion that investments in blades, hub, and nacelle assembly is unlikely to happen within the 2030 timeframe.

Table 15: Localisation potential for blades, hub assembly, nacelle assembly

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| Low Potential | Demand | Capability | Capacity | Supply |
| Status quo | • All blades, hubs, nacelles thus far have been imported<br>• The market is moving towards modular designs where the blades, hubs and nacelles are supplied as complete kits and bolted together on site | • No capability in SA to manufacture blades<br>• No capability to assemble hubs or nacelles<br>• There is a local industry for fibre glass boat building with capability that could be transferred but impact would still be small due to the wind specific technology barriers | • Zero capacity locally | • Local value chain for blade manufacturing components is somewhat available (resins, coatings, adhesives)<br>• Hub assembly no components are available but there is potential<br>• Nacelle assembly the switchgear, communications, other small electronics are available |

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| Low Potential | Demand | Capability | Capacity | Supply |
| Barriers | • Annual demand not enough for localisation of these components<br>• Blades require 1GW per year<br>• Hub assembly and nacelle assembly need between 1-2 GW per year<br>• Competition from China, South America, and India intense and local won't be able to compete | • Absence of large boat building, train building, large generator manufacturing or aerospace industries means that similar skills are not available locally<br>• | • Excess capacity globally for these key components | • If OEMs bring in the equipment, it doesn't attract any duties<br>• If they bring in the individual components, they attract duties<br>• Business case then doesn't make sense unless large portion of components sourced locally at competitive prices<br>• Transformer (GSUT) used in nacelle is a dry-type, that is not made in SA currently |
| Enablers | • Consistently high demand for 3-5 years and a steady pipeline of future demand<br>• Mechanisms to improve relative competitiveness of local blades, | • Critical skills would be imported and support for companies to do this<br>• Skills transfer by funding learnerships at | • Enabling actions for capacity not a focus | • Import duties on whole equipment to even business case<br>• Duty rebates on local content for OEMs assembling in SA on their imported components |

| Localisation Potential Matrix | Market | Asset | | Resource |
|---|---|---|---|---|
| Low Potential | Demand | Capability | Capacity | Supply |
| | hubs, and nacelles against imports from low-cost regions | international production facilities | | • Investment support in localising key components (Hub nose from primary steel and dry-type transformer for nacelles) |

### 7.10.2 Blades, hub, and nacelle assembly interventions

Even with the risks communicated above, it remains imperative that progress is made, with localisation of a second major component key to building a sustainable local value chain.

The central enabler is to have consistent demand that is greater than 1 GW/year for at least three, but ideally five years. To achieve this, an updated IRP is needed, leading to consistent annual REI4P rounds. In parallel Eskom needs to provide transparency into grid availability, expansion, and connection timelines. Additionally, private projects need to overcome legal and financial closure barriers to secure connections to the grid. Utility scale projects have a long payback period (longer than 10 years), and IPPs are wary of the risk of entering into a long Power Purchase Agreement (PPA) with a private company. Similarly, private companies are careful to enter long term agreements, as these constitute high risk, going concern, items on their balance sheet.

A key enabler is the establishment of an industrial policy that clearly covers localisation rules and incentives for both the REI4P programme and the private market. The precursors for foreign direct investment must also be established, with this entailing the approval and preparation of a potential site and the formalisation of a relationship with a global leading manufacturer. Lastly, if more substantial value is to be created locally, a skills pipeline needs to be developed to provide engineering and technical skills. One option is to develop an exchange-based programme with an international training facility and partnerships with leading OEMs to provide access to international learnership programmes. Another option would be to bring international experience, material, and standards to leading training facilities in South Africa and build a local centre of excellence for talent development in wind energy.

The enablers and interventions are summarised in Table 16.

Table 16: Enablers and interventions for the localisation of blades, hub and nacelle assembly into the wind value chain

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| Consistent demand of >1GW/year | 3 years | Updated IRP 19 | A | DoE | 1 year |
| | | Annual bid windows with consistent allocation volumes | A | REI4P | 3 years |
| | | Transparency in respect of grid availability, grid allocation rules and grid connection timelines | A | ESKOM | 1 year |
| | | Private projects reaching financial close and commencing building at >500MW annually | B | Private sector | 3 years |
| Local content policy established | 2 years | Local content rules for private projects | B | DoE | 2 years |
| | | REI4P local content requirements updated and if changed communicated early enough to alter bids | B | REI4P | 1 year |

| Localisation Enabler (Specific Outcome) | Outcome timeframe | Interventions (A = high priority, B = medium priority, C = low priority) | Intervention category | Key stakeholder | Implementation timeframe |
|---|---|---|---|---|---|
| Precursors for FDI established | 2 years | Approval of potential production sites in SEZs, EIAs approved, water licenses, effluent licenses completed for sites | C | dtic | 1 year |
| | | Formal relationship established with global manufacturer (partnership, joint venture, local entity) to invest in SA production facility | C | dtic/IDC/ local firm | 2 years |
| Pipeline of technical and engineering skills developed for new key components | 4 years | Establish partnerships with wind OEMs for graduate exchange programme at universities offering wind energy technical and engineering qualifications; support for internships/apprenticeships at OEMs | C | OEMs | 2 years |
| | | Partner with DHET to fund and manage exchange programme for wind energy technical and engineering skills | C | DHET | 2 years |

### 7.11 Wind energy cross component interventions

If we holistically consider all the components that are included in the ramp up analysis (see Table 17), a clear picture starts to form on the cross-cutting interventions necessary for deeper localisation within the South African wind industry. Crucially, interventions that enable consistent demand are the highest-level priority, with this not only evident for wind energy but for the entire renewable energy market. Substantial pressure should be applied to secure the publication of an updated IRP, establish consistent bid windows out of REI4P, secure transparency from Eskom on grid capacity and expansions, and ensure identified private projects close, commission, and connect to the grid.

Secondly, a value chain-wide investigation of the duty framework, duty levels, and tariff heading definitions should be completed. This impacts most of the component opportunities identified. A detailed investigation is required, and the potential re-design of import tariffs considered. Once the policy is drafted and approved, focus should shift to its implementation. Engaging with industry is especially critical to understand the mechanisms being used to bypass import duties; and to capacitate customs officials to correctly classify and apply tariff headings.

The last cross-cutting enabler is the establishment of a cluster platform to link OEMs and local manufacturers. Such an initiative will help remove the uncertainty in quality requirements and assist local manufacturers to reach OEM required levels of manufacturing excellence.

Table 17: Cross-cutting interventions to enable localisation in the wind value chain

| Intervention (A = high priority, B = medium priority, C = low priority) | Blades, hub and nacelle assembly | Towers | Tower internals | Primary steel | Transformer | Cables | Fasteners |
|---|---|---|---|---|---|---|---|
| Updated IRP 19 | A | A | A | | A | A | A |
| Annual REI4P bid windows | A | A | A | | A | A | A |
| Transparency for grid availability, grid allocation rules and grid connection timelines | A | A | A | | A | A | A |
| Private projects reaching financial close and commencing building at >500MW annually | A | A | A | | A | A | A |
| Local content requirements for both private and public sectors established | B | | | | | | |
| Import duty level revision | | A | A | A | | A | |
| Capacitation of custom officials to correctly apply duties | | A | A | A | | A | |

| Intervention (A = high priority, B = medium priority, C = low priority) | Blades, hub and nacelle assembly | Towers | Tower internals | Primary steel | Transformer | Cables | Fasteners |
|---|---|---|---|---|---|---|---|
| Cluster for aligning value chain quality expectations and increasing capability of manufacturers | | | B | | | B | B |
| Development of a local testing facility | | | | | | B | B |
| Development of a second manufacturer | | C | B | C | | | C |
| Access to competitively priced steel | | | B | | | | |
| Investment into additional capability | | | | B | B | B | |

# 8 Wind energy ramp up analysis

The wind energy ramp up to 2030 is summarised in a single view in Figure 22. If the interventions highlighted in the report are not implemented it is unlikely that current levels of local content will be maintained for private sector demand. Existing levels of local content have been derived from public procurement policy. Industry engagements suggest that if pure market competitiveness determined procurement, which will likely be the case in the private sector, local content will reduce. Therefore, the short term interventions to ensure consistent demand are the most important elements and will lead to the localisation of components like the towers, tower internals, cables, fasteners, transformers, and steel. If summarised into the top 3 interventions, these would be:

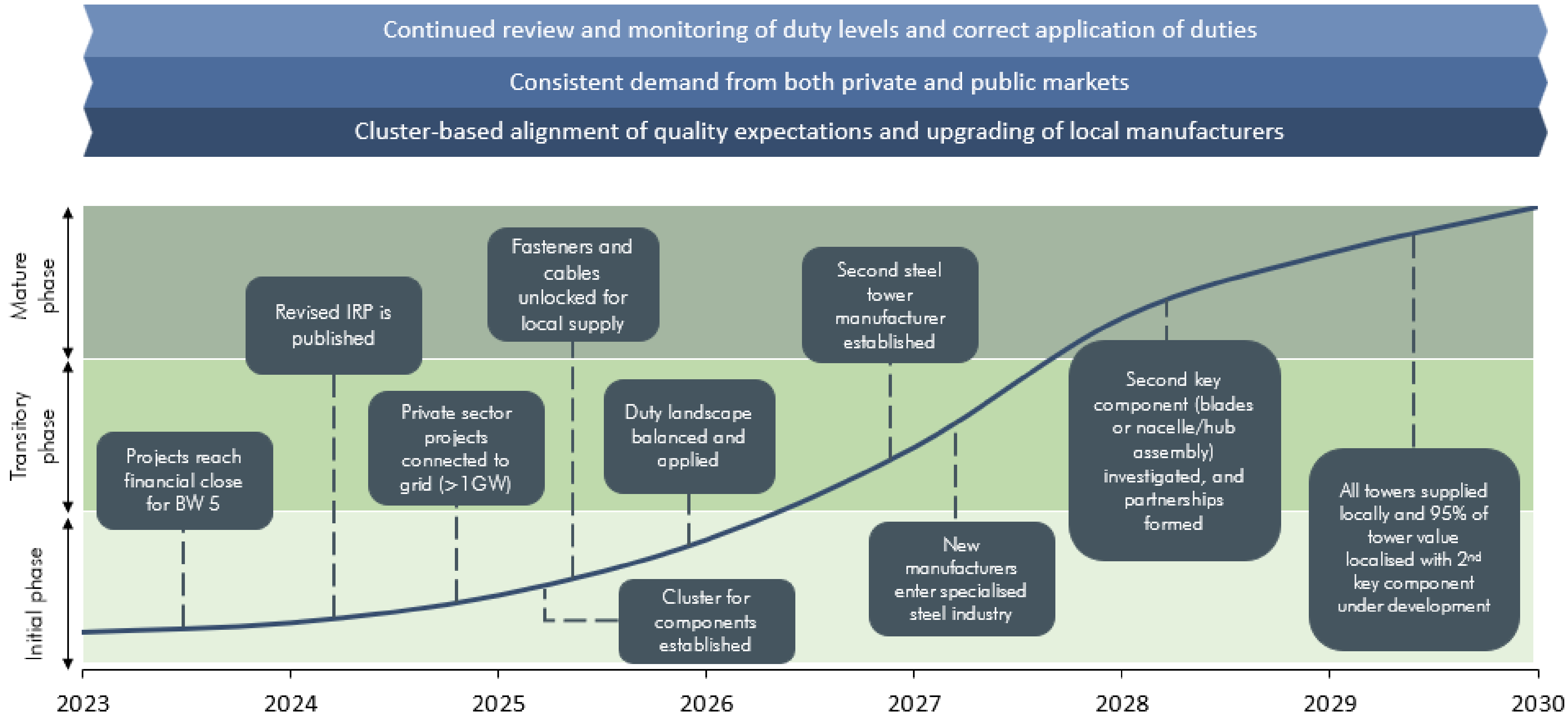
1. Consistent demand from both the private and the public sector
2. Revised duties on the towers, tower internals, cables, and primary steel
3. Establishment of a cluster to upgrade the capability of manufacturers in the component industry

If the duty landscape revision is implemented and the cluster platform established, the value chain will move into the transitory phase with significant further localisation occurring. At this point it is likely that additional manufacturers will enter the industry. The biggest opportunity appears to be in steel towers and specialised steel for tower internals. This could push the local industry into a more mature phase: one where a well-established and sustainable local industry supplies a local market with consistent demand.

The keystone achievement that will signal the mature phase is the localisation of the second key component, most likely blades but also potentially hub or nacelle assembly.

A potential vision for 2030 (assuming that the recommended interventions are implemented) is the localisation of 95% of steel and concrete towers.

Figure 22: Key milestones to realising increased localisation of the wind value chain



## 9 Conclusion

In conclusion, there is clear potential to increase the localisation of components for the wind energy value chain. This is based on existing capacities and capabilities within the domestic manufacturing sector.

However, there are also fundamental challenges that if not addressed could not just stagnate current local content but decrease it, especially with the opening of private sector generation projects.

The dynamics of the value chain suggest that specific components hold the key to any further localisation opportunities: blades, nacelle, hub, and towers. If the economics of importing towers are favoured over locally produced towers for the private sector it would remove most local opportunities for the value chain. It is not clear yet what the private market will do because it is too early to identify preferences. However, there is a fundamental difference between public and private markets, and the impact of this could well be the loss of more local components. What would be left is the balance of plant components; the collector transformer, medium voltage rigid cables, and some other small fabrications.

Conversely, if the interventions are successfully implemented through an organised and effective vehicle (such as the SAREM), the wind energy industry could become a major industrial success story in South Africa. This success would likely be a strong local market for towers and all affiliated components, such as steel plates, secondary steel components (anchor cages, flanges, door frames, etc), tower internals (platforms, cables, lifts, ladders, etc.), and fasteners. In the balance of plant, local supply would be secured for the collector transformers and the medium voltage cables.

The second marker of success would be the successful localisation of a second key component. Most likely this would be the blades, especially considering the local content roadmap followed in other regions (blades and towers). There is a small possibility for local assembly of the nacelle or the hub, but the value addition from local components will be small initially.

This study has hopefully provided a fresh perspective in a sea of well-intended but often overly optimistic and at times exaggerated voices on the opportunities for localisation in the South African wind energy sector.

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