Accelerating renewable energy industrialisation in South Africa: What's stopping us?

Final Report

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We acknowledge the role of a wide range of stakeholders and industry participants in the South African energy sector who granted us their time and input through interviews and engagements[1]. Without their insight and valuable contributions, this work could not have been undertaken.

[1] It was agreed upfront that participants would remain anonymous in the publication of this report.

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Executive Summary

A global transition to a clean energy future is underway. Many countries across the world have already achieved high levels of renewable energy integration, facilitated through technological investment and the creation of enabling policy and regulatory environments.

South Africa has seen past successes in stimulating growth in the renewable energy industry and facilitating additional capacity onto the national grid system, however, severe obstacles have stagnated this process in recent years. This has created an environment of uncertainty for the industry and resulted in missed opportunities to capitalise on cost-optimal wind and solar PV to address energy supply gaps and contribute to national climate change commitments.

In the current climate of pandemic and recession, South Africa will likely be looking to large, infrastructure-led programmes to stimulate economic recovery. Increasingly, 'green' stimulus packages which harness the opportunities presented by renewable energy technologies are being promoted by local and national institutions in the country.

This report presents the results of a study which unpacks some of the major political, institutional, regulatory and social barriers to renewable energy deployment in South Africa. It also provides some insight into proposed means of addressing these barriers to facilitate accelerated industrialisation in the renewable energy sector.

Because renewable energy development has largely been facilitated through private investment via the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) in South Africa, this report has focused on the constraints that have been faced by the private sector. Many of these constraints will also be relevant to public sector or community-driven renewables, however there are likely to be additional and specific constraints that these sectors may experience. It will be critically important to identify and address these, in addition to the constraints explored in this report, as participation in the renewable energy sector broadens in the ongoing pursuit of a just energy transition and inclusive transformation of the South African economy.

The analysis is based on a systematic literature review and in-depth interviews with 19 industry experts, project developers, academics, industry suppliers, a grid transmission expert, and an expert in community development, as well as numerous informal engagements with other industry players.

Key findings

Currently, the three most critical constraints on scaling up renewable energy are lack of political commitment to renewable energy, regulatory restrictions in the energy sector, and grid capacity issues:

- **Lack of political commitment** and policy certainty around an energy plan has obstructed industry growth in recent years. Delays in the publication of the country's Integrated Resource Plan (IRP) and the stop-start procurement of renewable energy have contributed to serious market uncertainty in South Africa. Developers and industry experts argue that this has resulted in the inability to establish a local manufacturing industry and skills base which may have knock-on effects on industry growth. It has also hampered the ability to resolve regulatory barriers to renewable energy project development and integration.
- **Regulatory restrictions** on generation licences and power purchase agreements (PPAs) with third parties make it difficult for businesses, municipalities, and other potential generators to produce their own electricity and/or trade outside of the current national procurement model. Experts argue that this has hampered opportunities in the small-scale embedded generation (SSEG) space and

constrained the number of large-scale projects developed, limiting the contribution of renewable energy to alleviate national generation capacity constraints.

- **Lack of grid capacity and connection issues** are reported as an immediate physical constraint on rollout. According to interviews, this is largely owed to a lack of strategic alignment between planning efforts around the timing and location of project development and transmission network upgrades. Both experts and developers argue that lack of coordination and slow processing of grid connection applications has resulted in the saturation of grid capacity in resource-rich areas and delays in projects coming online.

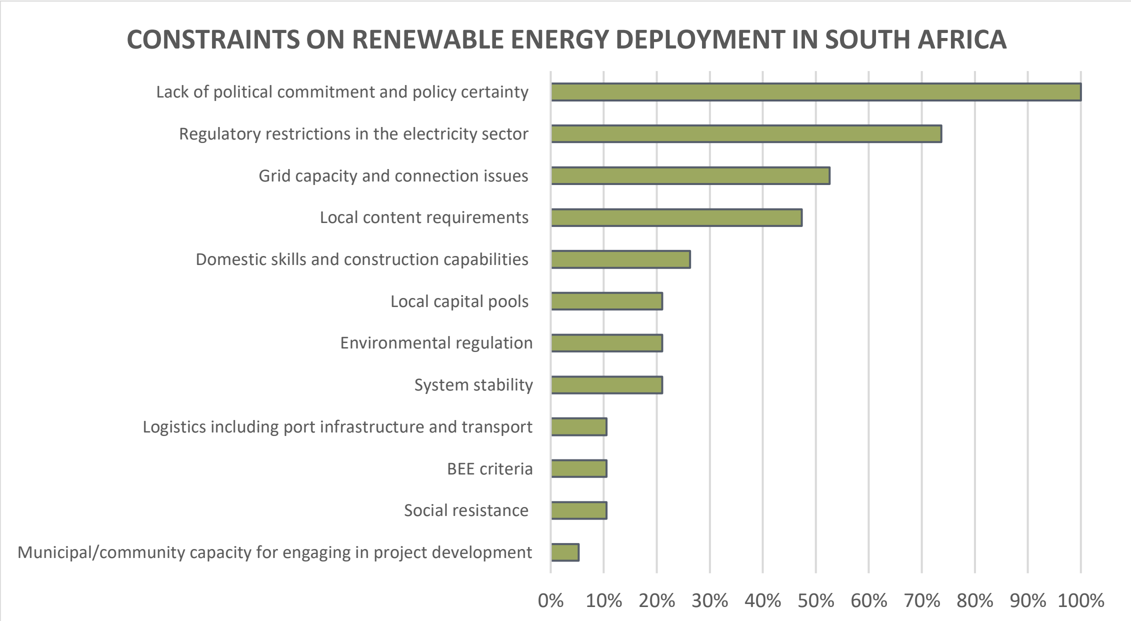

Figure 1. Constraints on renewable energy deployment in South Africa based on percentage of total interviewee sample that ranked them as a key barrier.

An important finding of this study is that, despite the top ranked constraint of policy uncertainty, industry players are reportedly still 'taking the risk' and have continued to develop projects during South Africa's procurement hiatus. There is reportedly a large portfolio of mature projects – in the order of 7-10 GW – that are 'shovel ready' and could come online over the next 12-24 months to alleviate existing generation capacity constraints at Eskom. However, delays in reaching concurrence on new determinations for procurement and slow regulatory processes are reportedly diminishing this potential and limiting the country's emergency response to the energy crisis, placing strain on smaller, local companies with limited capacity to absorb transaction costs and withstand market uncertainty.

Measures to address industry barriers

> ***"In general, it is a question of supply and demand. If you throw enough capacity to the market, and there were enough signals of consistency, the industry would make it happen."***
> *– wind project developer*

Based on the interviews, there is a general sense that the renewable energy industry is capable of meeting whatever demand is set in the country's energy plan, provided there is market certainty. Such market certainty would require a strong policy commitment to renewable energy, the lack of which is currently the major constraint on the industry.

That said, several other barriers were reported in this study which would need to be addressed through a combination of policy and other interventions to facilitate an accelerated industrialisation plan. These interventions include regulatory flexibility, strategic planning around transmission infrastructure, investment in storage solutions and strengthening social compact processes through transformation and benefit-sharing (Table 1). To address the second and third top-ranked constraints following on from the lack of policy certainty, experts and developers reported that:

- **Basic regulatory changes and clarifications** such as lifting the current generation licencing requirement for projects above 1 MW and allowing third party transactions would unlock a plethora of opportunities in the renewable energy space.
- **The strategic alignment of planning efforts** between project developers and the transmission entity could address grid capacity and connection issues. This alignment could be conducted through an Independent Market System Operator and include locational incentives for project development in areas with excess grid capacity in the short-term and expedited investment and implementation of transmission strengthening and expansion in the medium- to long-term.

Table 1. Interventions to address key constraints based on interview sample.

CONSTRAINT		INTERVENTION
Lack of political commitment and policy certainty	←	Unambiguous and tangible demonstration of political will
Regulatory restrictions	←	Regulatory reform
Grid capacity issues	←	Alignment of project development with transmission planning
Local content requirements	←	Consistent policy commitment to create industry certainty of programmatic rollout
Domestic skills and construction capabilities	←	
Local capital pools		Unspecified
Environmental regulation		Expediting processes in 'Power corridors' and 'REDZ'
Technical integration of renewable energy (grid stability)	←	Investment in storage solutions
BEE criteria	←	Transformation efforts
Logistics including port infrastructure and transport		Unspecified
Social resistance	←	Building social awareness through demonstration of benefits
Municipal/community capacity for project development	←	Capacity building and transaction funding

The IRP 2019 specifies new-build allocations of 1 GW for solar PV and 1.6 GW of wind energy in most years from 2022 till 2030. Several experts commented on a potential industrialisation rate (in GW per year) that was possible for the industry, provided a mixture of the above measures were in place to ensure market certainty and to tackle grid capacity and connection issues. All of them stated that the industry could realistically be rolling out *at least double* what the IRP 2019 specifies, with strong alignment that the industry could achieve a sustained rollout of 5-10 GW per year.

Contribution

Analyses of the South African power system have repeatedly demonstrated that scaling up renewable energy generation is the most cost-optimal energy pathway for the country (Mccall et al, 2018; Wright et al, 2018; Meridian Economics, forthcoming). Furthermore, the significant economic benefits and opportunities presented by scaling renewable energy in terms of job creation, reduction in air pollution and enhanced carbon mitigation are increasingly becoming recognised by a variety of stakeholders in South Africa (NPC, 2019; Hartley et al, 2019; TIPS, 2020).

South Africa needs to rebuild its economy and must do so in a manner that is sustainable for future generations. A 'green' industrialisation plan presents an enormous opportunity for economic recovery and setting South Africa on a sustainable growth path. Identifying and addressing the structural barriers that hold back the deep penetration of renewable energy into the South African grid is critical. A contribution of this report is to illuminate some of these barriers, and highlight opportunities to address them.

1 Introduction

South Africa has a large, ageing coal-fired power fleet generating the bulk of the country's electricity. This fleet is one of the main contributors to the country's carbon emissions, has expensive operation and maintenance costs, and has recently proven incapable of meeting electricity demand on a consistent basis.

Meanwhile, South Africa is endowed with world class wind and solar resources and the cost of clean energy technology is rapidly declining. Power system models have repeatedly demonstrated that scaling up renewable energy generation is the most cost-optimal energy pathway for the country (Mccall et al, 2018; Wright et al, 2018; Meridian Economics, forthcoming).

South Africa *has* seen past successes in stimulating growth and investment into the renewable energy industry and facilitating additional capacity onto the national electricity grid system through the implementation of the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP)[2]. The REIPPPP succeeded in the procurement of 2.3 GW solar PV and 3.4 GW wind energy since its inception in 2011 (IPP Office, 2020). Operational renewable energy capacity has increased substantially since 2013 (Figure 2), with further projects committed to reaching commercial operation in 2020. Over the course of 4 bid windows, average solar PV tariffs have decreased by 83% and wind by 59% (Wright et al, 2018). These dramatic declines in cost are in line with international experience.

However, South Africa's progress has stagnated in recent years. Significant obstacles have interrupted

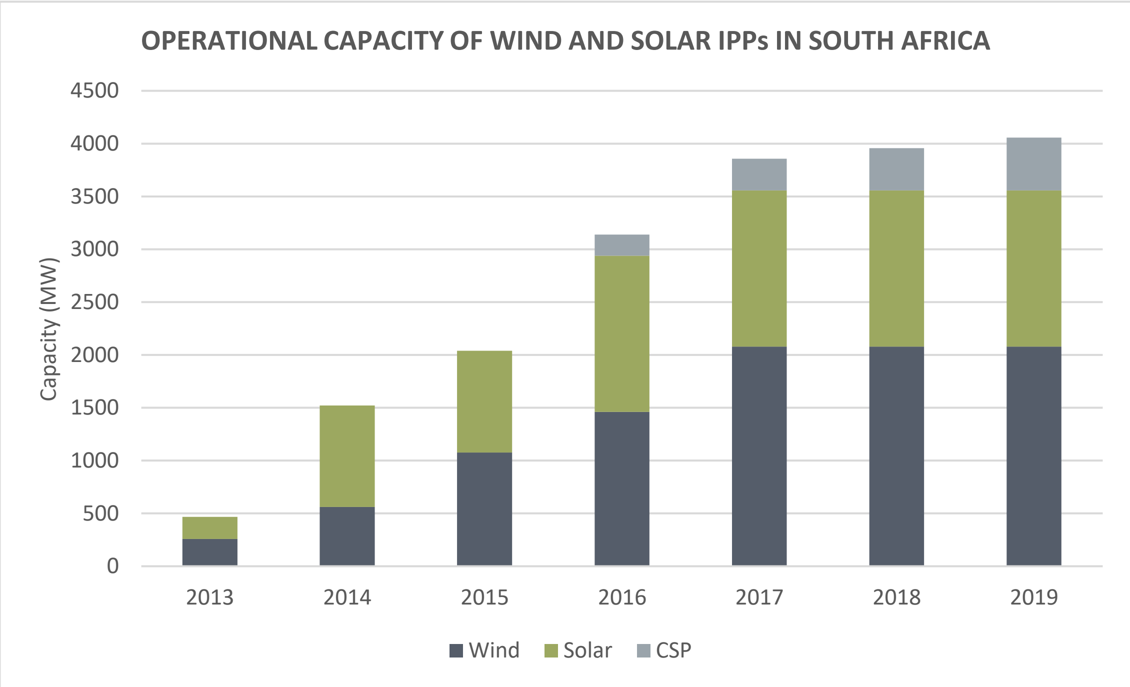

Figure 2. Operational wind and solar capacity contribution from IPPs, wind total includes Eskom's 100 MW Sere windfarm (CSIR, 2018; IPP Office, 2020; Eskom)

[2] The REIPPPP was launched in 2010 as part of a set of interventions to enhance South Africa's electrical power generation capacity. It is comprised of a competitive tender process, structured into rolling bid-windows and aimed at attracting sustained market interest and reduced prices for renewable energy projects (Eberhard and Naude, 2017).

procurement and development processes in the renewable energy sector since 2015 (TIPS, 2020), leaving the country reliant on an underperforming coal-fired power system. This has created an environment of uncertainty for the industry, undermined the ability of the country to achieve its climate mitigation commitments, and resulted in missed opportunities to capitalise on cost-optimal wind and solar PV to address what has spiralled into a national electricity crisis. In the meantime, significant milestones have been achieved in terms of renewable energy generation cost declines and increases in operational capacity in many countries across the world.

South Africa will be looking towards large, infrastructure-led programmes to stimulate economic recovery in the wake of the coronavirus pandemic. An accelerated renewable energy industrialisation plan provides an enormous opportunity as a 'green' economic stimulus package and the creation of thousands of jobs (TIPS, 2020; Meridian Economics, forthcoming). Identifying and addressing the structural barriers that are stagnating renewable energy industry growth is critical now, more than ever.

Study aim and motivation

Against this background, this study aims to unpack some of the major political, institutional, regulatory, technical, and social barriers faced by renewable energy developers in South Africa, assess how binding they are and what the renewable energy industry could achieve were these barriers addressed. A significant motivation for this work is to establish an understanding of what a realistic renewable energy industrialisation path could look like, considering the need to urgently address energy supply gaps, ramp up climate mitigation ambition and provide a much-needed economic stimulus for the country.

This study is guided by the following questions:

- What are the major barriers to renewable energy deployment in South Africa?
- Can these barriers be addressed?
- If so, what type of sustained build programme is feasible for the renewable energy industry?

This study can be used to inform policy on the specific interventions needed to address renewable energy industry barriers. It can also inform the assumptions in current energy optimisation modelling processes through an understanding of industry capabilities.

Importantly, because renewable energy development in South Africa has largely been driven by private investment in the REIPPPP, this report is guided by the constraints faced by private developers. Many of the constraints explored in this study will also be relevant to public sector and community driven renewables, but there are likely additional and specific constraints that these sectors may experience which make participation in the development and ownership of renewable energy difficult for entities like community organisations and second- and third tier municipalities. These include the current procurement model structure, access to capital and project finance, capacity for project development, restrictive regulations and lack of contracting models for community-owned renewable energy projects.

Each of these barriers warrant a study on their own – encouragingly, an important practical research agenda is emerging around how an accelerated energy transition can facilitate inclusive economic development and transformation, and the role of different institutional structures and financial mechanisms in this agenda.

2 International experience

The growing economic competitiveness of renewables coupled with enabling policy and regulatory environments has resulted in an accelerated integration of renewable energy into many regional power sectors. Significant milestones have been achieved both in terms of generation cost declines and growth in operational capacity.

2.1 What has been achieved globally?

In places such as Mexico, Brazil and India, energy auctions have seen bidding prices below 2 USD cents per kWh for renewable energy technologies over the past year. These cost declines have been attributed to rapid technological advancements and the development of economies of scale in the renewable energy industry value chain (IRENA, 2019).

Countries are witnessing notable operational capacity growth in renewable energy (Figure 3). Spain and Italy saw significant capacity increases in the early 2010s and Germany is currently witnessing a rapid rollout of solar PV and wind technologies in line with its commitment to phase-out coal by 2038. Many other countries like China, India and Ireland are seeing unprecedented increases in renewable energy capacity, while South Africa's progress has plateaued. Furthermore, with a renewables build programme as specified in the IRP (2019) of 1 GW solar PV and 1.6 GW per year in most years, by the late 2020s we would only just be catching up to the progress some other countries had already made by 2018.

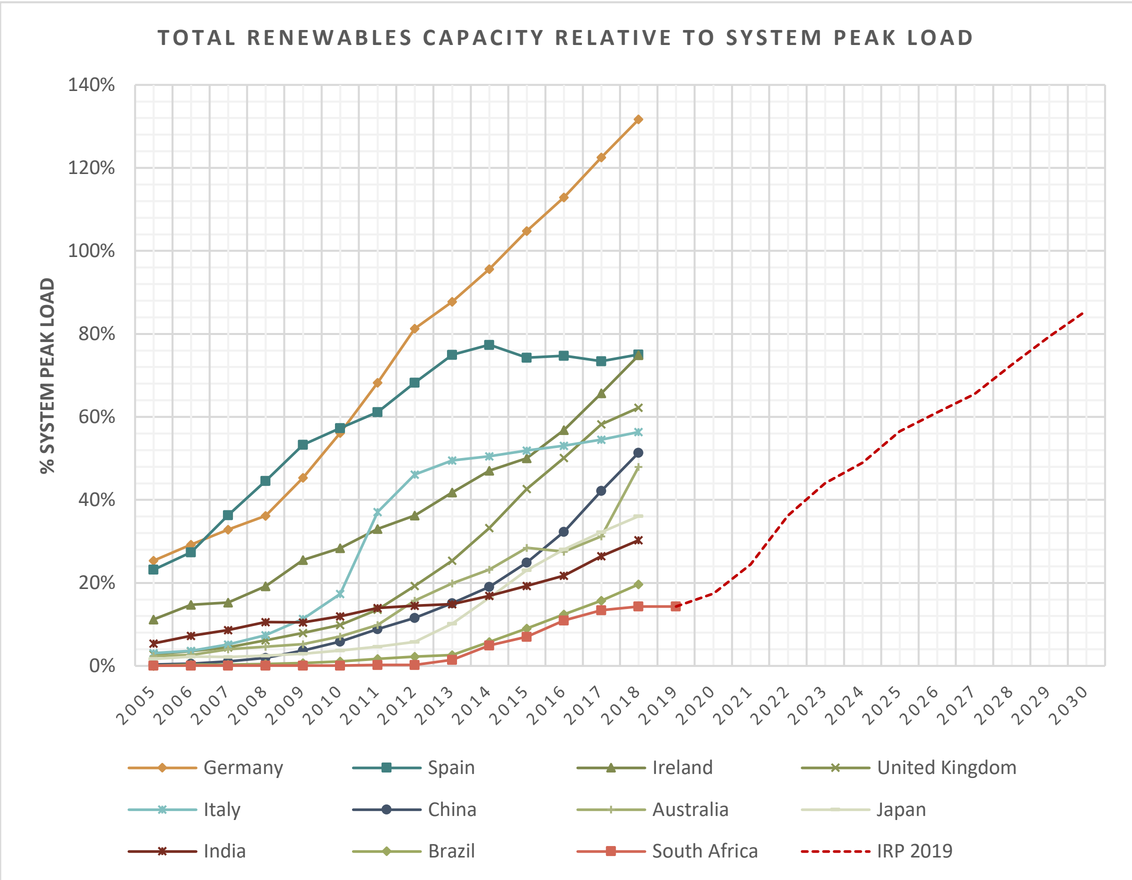

Figure 3. Total capacity of solar PV and wind energy in different countries relative to peak system load, and projected contribution of renewables to South Africa's peak load based on IRP 2019 build specifications (CSIR, 2018; www.ourworldindata.org; BP Energy Outlook, 2019, Meridian Economics, forthcoming)

2.2 Global lessons learnt

A critical element for enabling renewable energy integration in the global energy transition is the development and adaptation of transmission network infrastructure and ancillary services. This is to accommodate variable renewable energy generation into systems where electricity supply and consumption must always be balanced. Scholars and experts have argued for the need to establish mechanisms that can manage increased shares of flexible renewable energy supply including demand-side solutions, transmission network development and the expansion of storage technologies (Arndt et al, 2018; Lilliestam et al, 2019).

A wealth of technical best practice is emerging on how to balance systems that were originally designed for dispatchable energy solutions to accommodate non-dispatchable supplies, for example incorporating battery storage solutions.

Increasingly, lessons are also being learnt about the importance of transmission infrastructure expansion and strengthening. In some cases, renewable resources are geographically distant from existing transmission network infrastructure, which requires expansion of the transmission system to capture the resource. Germany, for example, has fantastic wind resources in the North of the country, however, the biggest load centres and strongest transmission lines are in the South. Upgrading and strengthening transmission infrastructure to be able to transport energy from resource rich areas has become a key technical and institutional planning consideration in Germany and other countries.

Furthermore, institutional alignment between project development and transmission infrastructure development has been raised as critical from international experience. Non-alignment between these variables has resulted in projects being operationally ready, but not able to come online due to lack of available transmission infrastructure for grid connection. For example, despite rapidly increasing project installation by the wind industry in Brazil, by 2014, a substantial number of wind farms were not delivering any power as they had not been connected to the grid on time (MEA, 2014). This set in motion discussions between wind industry associations and government to develop transmission infrastructure more closely linked to project development timelines (Spatuzza, 2013).

3 Study Design

3.1 Methodology

This report employs a qualitative approach to collecting and analysing data. During the months of January, February and March 2020, 19 in-depth interviews were conducted with targeted stakeholders in project development, industry, academia, supply contractors, transmission and community development spheres (Figure 4). These were supplemented by numerous informal engagements. The reason for selecting different types of stakeholders in the interview process was to gain insight into both broader level constraints on the industry and specific constraints at the project level.

Though utility-scale private renewable energy project developers and industry experts were the dominant stakeholder groups interviewed, we supplemented these perspectives with key insights around technical and social aspects of rolling out renewable energy by also interviewing key stakeholders in community development, transmission, and academia.

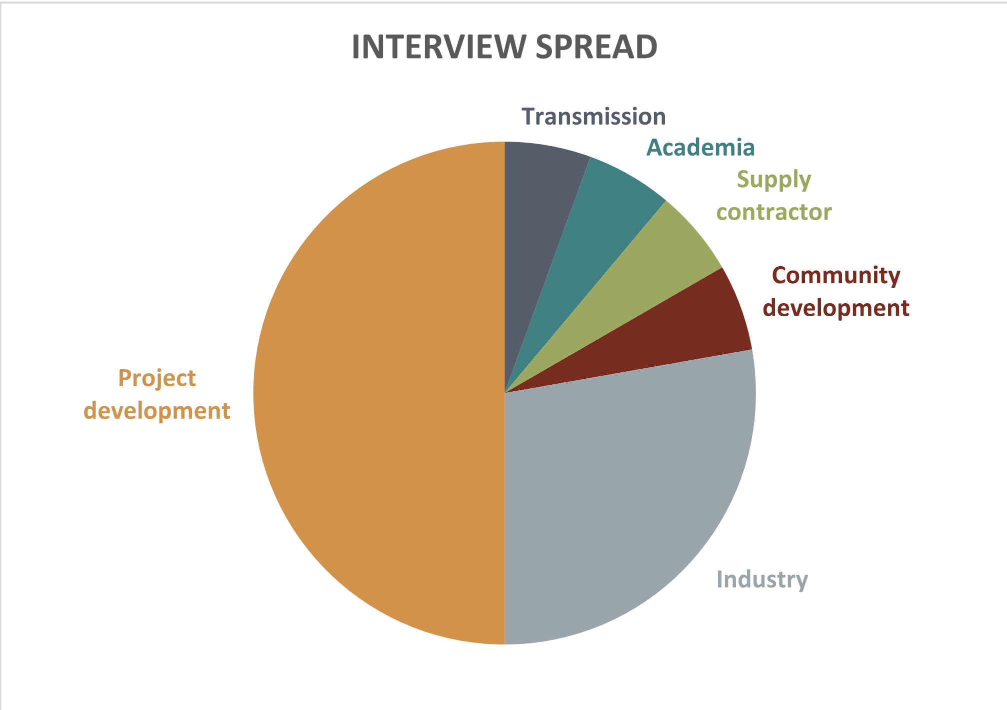

Figure 4. Spread of interviews across different stakeholder groups**.**

Interviews and engagements were guided by the following questions:

1. What are the most critical constraints on renewable energy rollout in South Africa? What are the 'hard ceilings'?
2. Which of these constraints could be alleviated, and through what interventions?
3. What is the industry capable of building if the above constraints were alleviated?

3.2 Considerations

3.2.1 Coronavirus Pandemic

This work was conducted before the height of the coronavirus pandemic in South Africa. However, the stark economic impacts of the pandemic make the findings of this study even more relevant.

The pandemic has triggered a deep, global recession which will likely impact pricing and supply chains across all sectors, including energy. Given South Africa's precarious economic state prior to the pandemic, the country will be particularly hard hit economically and national budgets will be strained for the foreseeable future. South Africa's heavy investment in and reliance on coal has positioned the country at high financial risk for years prior to the pandemic. The coal sector will likely become even more vulnerable as international financial institutions enforce divestment agendas in a post-coronavirus world.

South Africa will be looking for large economic recovery programmes to attract international investment and stimulate economic development. Cheaper, cleaner energy is increasingly recognised as one of the key potential stimulus packages at the international level (Bloomberg NEF, 2020; IEA, 2020; IRENA, 2020; Hepburn et al, 2020). A large renewable energy industrialisation plan in South Africa fits into this agenda. It is attractive by nature of it potentially being less susceptible to corruption (due to the greater competition in this market segment), for facilitating green industrialisation and job creation opportunities, and capitalising on South Africa's excellent renewable energy resources.

Identifying and addressing the structural barriers that hold back the deep penetration of renewable energy into the South African grid is critical. A contribution of this report is to illuminate some of these barriers, and some opportunities to address them.

3.2.2 'Just Energy Transition' objectives

An important consideration for this work is that of South Africa's 'Just Energy Transition'. Any thinking around the substantial transformation of the energy sector should be informed by a deep consideration of South Africa's 'Just Energy Transition' imperatives.

It is critical that the implementation of any accelerated renewable energy industrialisation process will need to be accompanied by a targeted programme that adequately addresses impacts on workers in the coal industry, targets broader developmental objectives in coal-dependent regions and ensures that the transition is inclusive and driven by most-affected parties.

A renewable energy industrialisation plan will play a major role in job creation and other regional economic contributions which, if managed in a strategic and consultative manner, could generate very large localised benefits for coal regions in South Africa. Initial investigations suggest that such benefits could easily outweigh the economic loss associated with closures of coal mines and coal-fired power stations.

4 Constraints to scaling up renewable energy in SA

This section presents key constraints on the development and integration of renewable energy projects into the South African electricity system through a literature and interview analysis.

4.1 Literature description

There is a diverse body of literature on barriers to renewable energy in South Africa which provides some key insight into financial, technical, political, regulatory and social hurdles to renewable energy deployment. Our approach to the literature was to gain a sense of the most dominant emergent barriers through a sample of South African studies. Of the 22 studies reviewed, all with a focus on South Africa, 14 focussed on specific individual barriers, 6 provided some form of overview perspective, and 2 technical studies referenced potential reasons for limits on new build renewable energy in IRP modelling.

The diversity of the literature and divergent analytical angles makes it difficult to quantifiably rank barriers relative to one another. That said, figure 5 is a rough representation of what emerges from the literature based on frequency of reference to each barrier in the literature sample.

Figure 5. Word cloud: barriers highlighted in 22 South African studies.

Studies with overview perspectives highlighted political barriers such as lack of political commitment and resulting policy uncertainty as a major barrier, and problematised the dominance of a centralised monopoly utility making it difficult for renewable energy producers to enter the field (Pegels, 2010; Nel, 2015, Baker, Newell and Phillips, 2014). A few overview studies mentioned the lack of social awareness and acceptance of renewable energy as a possible barrier to adoption (Murombo, 2016, Fouche and Brent, 2019, Le Merle, 2019).

Studies with a focus on specific barriers included the challenges posed by grid capacity and connection limitations (Carter-Brown, 2015; Smit, 2015), the operation of variable renewable energy supply (Arndt et al, 2018; Wright et al, 2018; Obert and Poeller, 2017), political constraints and vested interests in the coal sector (Baker, 2017), transaction costs in the national procurement model (Eberhard and Naude, 2017), local content requirements and available skills (Ettmayr and Lloyd, 2017), market uncertainty and deterrents to financial investment in renewable energy (De Jongh, 2014), legal and regulatory hurdles (Murombo, 2016; Fouche and Brent, 2019), transportation logistics (Takuba, 2014) and social resistance (Wlokas et al, 2017; Marais et al, 2017; Nkoana, 2018).

Though these studies illuminated some critical barriers, there still seems to be a gap in understanding the relative importance of constraints on project development in terms of their ranking. We conducted interviews with project developers and industry experts to understand how barriers were positioned relative to one another, gauge the extent to which constraints are binding and what could be possible for the industry if they were alleviated.

4.2 Interviews

This section provides nuance and relativity to the literature explored above based on a set of industry perspectives on barriers to renewable energy deployment. Interviewees were asked to provide their view on the top constraints on renewable energy rollout in South Africa, without prompting or providing a list of potential options. Figure 6 ranks constraints that were reported in the interview sample from most pressing to least pressing in the current South African climate, based on number of interviewees that listed this constraint. The three most pressing constraints reported by interview respondents are lack of policy certainty, regulatory restrictions in the electricity sector, and grid capacity issues.

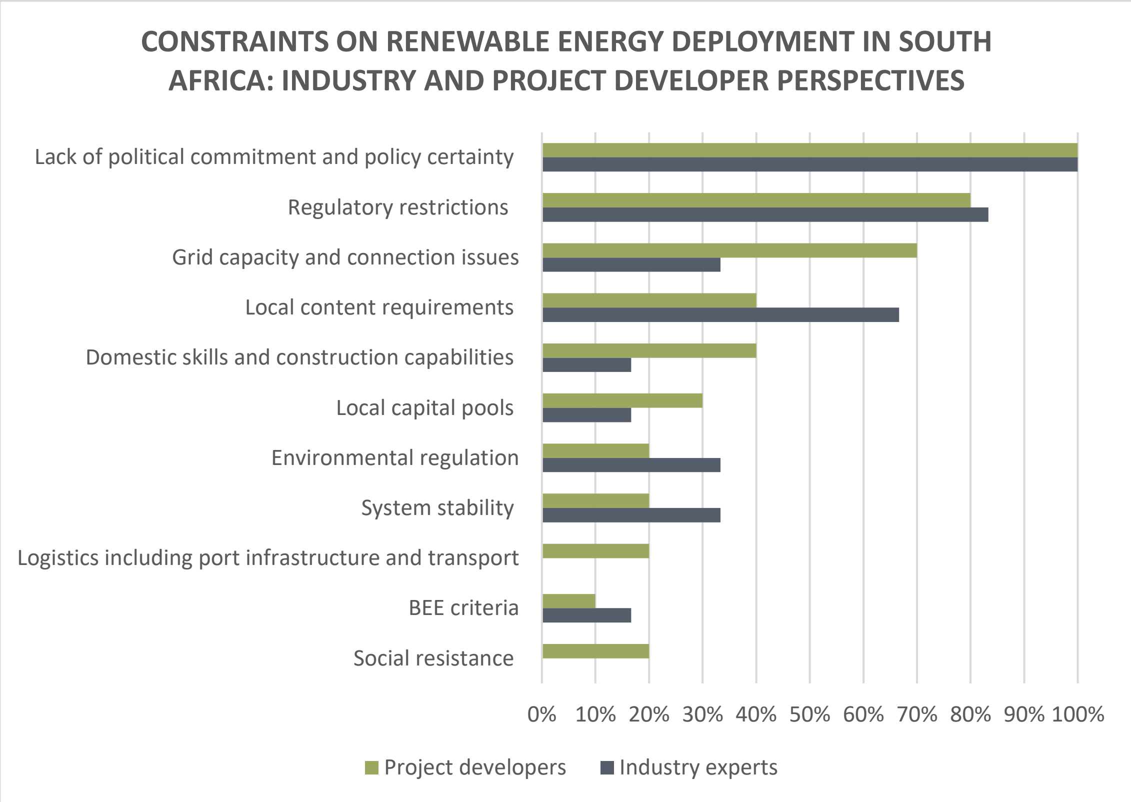

Figure 6. Constraints on renewable energy deployment in South Africa and percentage of industry experts and project developers that ranked each as a key barrier.

Several of the constraints in Figure 6, for example lack of policy certainty and difficulty in achieving local content requirements due to the limited establishment of a local industrialisation base, were found to be interlinked. Most were also found to be subject to change over time depending on various combinations of political, regulatory, institutional, and financing interventions which will be explored later in the report.

The constraints listed by interviewees are largely aligned with the literature, particularly the top ranked constraints such as the lack of policy certainty stemming from lack of political commitment, issues around regulation, and grid capacity issues. That said, there were a few areas of non-alignment. Lack of social awareness of the benefits of renewable energy was highlighted quite strongly as a constraint in the literature, but not as strongly in the interviews. On the other hand, the difficulty of gaining environmental permits was raised more frequently in the interviews, and not highlighted in the literature. This may owe to academic work having a potentially stronger focus on socio-political system dynamics and some technical/engineering aspects – and interviewees in the sample having a focus on project development realities such as practical licencing, contract agreements and permits and the ability to raise project finance. This suggests that in addition to the broader socio-political issues around the integration of renewable energy, there are some real and on-the-ground realities faced by developers that may cause the derailment of renewable energy ambitions. One of the critical contributions of this work is to illuminate some of these realities.

4.3 Lack of political commitment and policy certainty

"The political-industrial complex is our main limitation. The willingness to define and adhere to an energy plan." – project developer

Every single project developer and industry expert in our sample cited a lack of political commitment as the overarching barrier to renewable energy deployment in South Africa. South Africa's electricity sector has been bound up in a dependency on abundant coal resources for the generation of cheap electricity, giving rise to specific forms of wealth accumulation and vested interests in the coal sector (Baker, Newell and Phillips, 2017; Baker, 2017). This legacy has resulted in an institutional 'lock-in' to a coal-fired power system dominated by a monopoly state utility, which makes it challenging to introduce new energy technologies (Nel, 2015, Murombo, 2016). In the literature, the incumbent, centralised monopoly system is listed as a key constraint that ensures renewable energy producers maintain a peripheral or marginal role in the energy system.

Though the REIPPPP facilitated a significant upscaling of investment in renewables, literature and reports from interviewees demonstrate that numerous political obstacles have obstructed the programme over the past 5 years (TIPS, 2020). These include the halting of procurement in 2015 with Eskom refusing to enter into power purchase agreements with independent producers (only resolved in 2018), delays and indecision around the allocation of renewable energy generation capacity, contradictory statements by political Ministers around the country's energy pathway, and the critical absence of ministerial determinations for the procurement of renewable energy until February 2020 (Baker, 2017; Eberhard and Naude, 2017; Arndt et al, 2018).

Political uncertainty and the 'stop-start' nature of the REIPPPP has resulted in the inability to resolve many of the other barriers that have been highlighted in this study including the difficulty in achieving local content requirements, skills shortages and lack of coordinated planning around grid transmission infrastructure expansion and upgrades to accommodate new renewable energy projects.

4.4 Regulatory restrictions in the electricity sector

81% of project developers and 83% of industry experts listed South Africa's energy regulatory system as a critical constraint on the renewable energy industry.

South Africa has a highly regulated electricity sector, which makes it difficult for non-Eskom entities to generate their own power supply, or to sell it on to others, or to the grid. Based on the literature and interviews, the most critical regulatory constraints on the industry are generation licencing requirements, procurement processes and restrictions on third-party agreements.

4.4.1 Licence requirements

The Electricity Regulation Act (ERA) (2004) was the first piece of legislation allowing private participation in the power sector. The National Energy Regulator of South Africa (2005) was established in 2005, with primary responsibility for implementing the provisions of the ERA.

The ERA and its licencing stipulations have been argued to be an obstacle to renewable energy rather than an enabler (Murombo, 2016). Currently, all projects greater than 1 MW require a generation licence from NERSA (ERA, 2004). Interviewees reported the licencing procedure as lengthy due to extensive public participation processes and the "lack of sufficient capacity at NERSA", particularly when licencing numerous projects at a time. NERSA licensing has also been reported as unnecessary, given the number of other processes required for a project to be grid compliant. These issues have limited small-scale embedded generation (SSEG) opportunities at residential, community as well as commercial and industrial levels (TIPS, 2020).

"Projects must comply with grid codes, but there is no reason for this limit. 10MW at least gives commercial spaces the ability to install their own solar." – industry expert

Several interviewees specifically recommended removing, or at least lifting the 1 MW limit to unlock the opportunity for SSEG. This would allow commercial and public spaces such as shopping malls, government office blocks and private company buildings to generate their own electricity. This has also been supported in recent literature as an opportunity to unlock benefits in the renewable energy space (TIPS, 2020). In the recent SONA[3], it was announced that the generation licence requirement for projects above 1MW would remain in place, but that efforts would be made for projects to gain licenses within the stipulated 120-day time period (SONA, 2020). The ability to make this happen was met with scepticism amongst experts and developers, some of whom had experienced project licencing delays of up to 2 years.

4.4.2 Procurement regulations

Four industry experts reported the current centralised procurement structure and lengthy administrative processes as a constraint on industry growth, as well as the ability to manage an emergency response to the country's energy crisis.

In February 2020, the Minster of the Department of Mineral Resources and Energy (DMRE) finally reignited the procurement process after extensive delays and submitted to NERSA a ministerial determination for the procurement of renewable energy as per the IRP. NERSA will reportedly reach concurrence on this in the next 6 months, after which the bidding process may commence, and preferred bidders selected, who then will need to reach financial close. The time increments added by each element of this process were reported as key constraints on the industry's 'ability to ramp up with speed', limits the number of projects coming online and is also severely hampering the response to the country's energy crisis.

More than a third of interviewees consulted as part of this study reported that, despite procurement delays, project developers are 'still taking the risk' and have continued to develop projects during the procurement hiatus. There is reportedly a large portfolio of mature projects that are 'shovel ready' and could come online over the next 12-24 months to alleviate existing generation capacity constraints at Eskom – in the order of 7-10 GW (personal communications). However, delays in procurement and slow regulatory processes are reportedly diminishing this potential, placing strain on smaller, local companies with limited capacity to absorb transaction costs and withstand the uncertainty.

Several experts were critically concerned about the fact that there is vast amount of capacity in the utility-scale renewable energy space and the SSEG space could come online within the next year or two, but that there is a lack of sufficient managerial response at the political level to harness this and manage emergency deployment to mitigate adverse impacts of load-shedding on the South African economy.

[3] State of the Nation Address (SONA) by President Cyril Ramaphosa, February 2020

At a broader level, an industry expert highlighted that there are around 1000 projects at some stage of development in South Africa[4], "but only 15 projects will be procured in the next REIPPPP round… There is a vast gap in the number of projects and those that are procured which is not good for industry growth. This also means that only established players will get these projects, with not much room for small local players."

Experts recommended restructuring current procedures, including expediting emergency procurement and bidding rounds, having mixed models of procurement and regional auctions to reduce the delays associated with centralised procurement of renewable energy and tap into a larger pool of projects.

4.4.3 Restrictions on third-party transactions

Another regulatory constraint is the restriction on power purchase agreements (PPAs) outside of the national procurement model. Independent power producers (IPPs) are restricted to a single-buyer agreement, selling power directly to Eskom SOC Holdings (DoE, 2011). The Draft Second Electricity Regulation Amendment Bill makes provision for ministerial exemption from the single-buyer obligation, however, there is lack of clarity around this process (SEA, 2017; TIPS, 2020). IPPs, and other potential generators, have therefore in general been restricted from third party transactions with non-Eskom off-takers.

Several industry experts and recent literature suggest that allowing third party transactions would be a key step in leveraging South Africa's renewable resources. This would consist of allowing IPPs, municipalities, and any other generators to sell electricity to a third party, which could be businesses, households, consortiums of consumers, communities, municipalities or other customers, including Eskom (TIPS, 2020).

A community development expert argued that this could also unlock the opportunity for community-ownership of projects, provided there is sufficient capacity-building and transaction funding which may come through donor involvement.

The recent SONA (2020) announced that municipalities in good financial standing should be able to procure their own energy from generators, along with private businesses such as mines. However, there is still a considerable lack of regulatory and legislative clarity around these announcements.

Third party transactions will likely require 'wheeling' of electricity through the transmission grid system. Wheeling is defined as "third-party transportation of energy" (NERSA, 2012). Though NERSA published regulatory rules on wheeling in 2012, it remains an unclarified space and has thus far proven difficult to accomplish. Industry experts reported that there is no definite management framework and that gaining the necessary approvals is a complicated process. A number of experts argued that this could be simplified through the establishment of an independent system and market operator (ISMO) as stipulated in the Eskom Roadmap (DPE, 2019) which would manage and approve wheeling agreements, along with other functionalities which will be addressed later in the report.

In summary, South Africa's electricity sector remains highly regulated through licencing and restrictions on power purchase agreements through a centralised procurement model. A substantial number of industry experts and project developers have argued that increased regulatory flexibility is critical for stimulating industry growth through broader participation and competition.

[4] This estimate is based on the current Department of Environmental Affairs 'Renewable Energy EIA Application Database' for South Africa. https://egis.environment.gov.za/renewable_energy

4.5 Grid capacity and connection issues

A critical constraint reported by 70% of project developers and specifically highlighted in the literature (Smit, 2015; Carter-Brown, 2015, Baker, 2017) is the physical and institutional capacity to integrate renewable energy projects into the grid. Here, arguments largely focussed on the institutional components of connecting projects and transmission network development, rather than technicalities of system balancing. There is still a large amount of dispatchable power in the grid system, as such, grid stability was not reported as an immediate constraint.

The literature tends to focus on the limited available grid capacity in high resource areas and some around the institutional processes of grid connection. Interviews supplemented this with an understanding of the lack of broader strategic alignment of renewable energy procurement processes with transmission infrastructure planning, resulting in frustrating realities on the ground.

4.5.1 Lack of available grid capacity in resource rich areas

This issue is summarised by a transmission expert as: "not enough grid capacity in areas which are hot and windy". The sunny Northern Cape province received the bulk of solar projects in REIPPPP round 1-4 (51 out of 68) while windy coastal regions in the Western Cape and Eastern Cape received the bulk of wind projects (IPP Office, 2020). The concentration of projects in specific locations in these provinces has reportedly led to a saturation of available grid capacity in these areas. As such, transmission strengthening upgrades are urgently required to connect more projects and evacuate more power.

Discussions with a transmission expert, supplemented by industry views, revealed that a strategic move in the immediate term would be a focus on solar installations in areas with *excess grid capacity*, at least during the period that transmission infrastructure is being constructed and approved. This has directed some developers with a "keen eye for grid capacity openings" towards opportunities to build in Mpumalanga and the Northern Free State.

4.5.2 Grid connection processes

"Eskom does move, but it is difficult to get them to move" – project developer.

The South African electricity transmission system has legacy infrastructure geared both physically and institutionally to transmit power from coal-fired power plants in the North-East to the rest of the country. The institutional processes involved with connecting distributed forms of energy to the grid have been described by many interviewees as laborious and slow to adapt. This includes slow processing of grid connection applications, issuing cost estimate letters and ensuring the necessary transmission infrastructure is accessible on time to evacuate power.

As a result, some REIPPPP projects have not been integrated to the grid on schedule which has had direct impacts on profitability of projects (Eskom TDP, 2020; IPP Office, 2020). Delayed connection has been argued in the literature to actively discourage investment in the sector through increasing project risks (Ettmayr and Lloyd, 2017).

A wind project developer commented that "1GW solar and 1,6GW wind is doable, but it will be a challenge to do more with Eskom in charge of connection to the grid."

The Eskom transmission entity is reportedly well-aware of needing to expedite these processes and has put key parameters in place in order to do so including a dedicated Grid Access Unit to deal with applications (Smit, 2015) and provide developers with the option to 'self-build' the necessary transmission infrastructure. Developers reported some successes related to the 'self-build' option in reducing the risk associated with delayed connection, but there was also concern expressed around the "ad-hoc" nature of this process. Some developers reported negative outcomes of self-building transmission infrastructure such as uncoordinated and inefficient allocation of connection infrastructure in the distribution network (from generators to the transmission grid) and concern around self-build construction being "unhealthy" for the grid in the absence of an overall management framework.

4.5.3 Lack of coordinated grid planning

What became clear from some of the developers' and industry responses was that the lack of available grid capacity and sub-optimal connection processes were a result of a lack of coordinated grid planning.

"We need to urgently reform the renewable energy procurement model and align project development with grid transmission planning." – transmission expert

Strategic alignment of the location of renewable energy projects and transmission network development has been a critical lesson from overseas. A key issue is the mismatch of timelines: the strengthening and expansion of transmission infrastructure generally takes longer than project development. In South Africa, land acquisition and servitudes for substation and line construction projects are cited as key constraints for deep transmission upgrades conducted by Eskom (TDP, 2020). EIAs and land acquisition for connecting corridors can take up to 5 years for approval, with construction amounting to 2-3 years. Estimated timelines for deep transmission upgrades are hence 7-10 years. Project development to the point of commercial operation, on the other hand, can happen in 1-4 years.

Some developers mentioned Eskom's financial challenges as a potential constraint on performing necessary network upgrades. However, this was not a uniform view. The argument that Eskom has insufficient funds to engage with adequate and timely transmission planning did not hold much credibility amongst those with industry-wide and/or research perspectives, since 'deep' transmission upgrades do not constitute a significant portion of Eskom's budget.

Interviews with a transmission expert and research evidence (Bischof-Niemz, 2017) suggest that transmission network upgrades required for >70% penetration of renewables only constitute around 1% of overall system costs. Furthermore, both sources stated that the cost of upgrades for integrating high shares of renewables are not significantly different to other energy generation scenarios favouring gas, coal or nuclear. Basically, 'deep' transmission upgrades need to be performed and will have similar costs regardless of which energy pathway.

One key consideration, however, is the cost of 'shallow' connection upgrades. These costs are incurred by project developers, not Eskom, and are performed in the collector network – the grid infrastructure which connects renewable energy generators to the transmission grid – and to the transmission grid itself in order to evacuate more power. As more projects are connected, the collector network needs to be extended and transmission losses increase. There is uncertainty around how expensive this will become and/or if it will constrain the number of projects that can be connected in one area, further research is required on this issue.

In addition to the mismatch in timelines, there is a lack of "credible information transfer" between relevant parties on both project development and transmission planning. In all bid rounds, project developers have been able to select their own project sites, resulting in a reactive approach by the transmission entity to perform the necessary grid strengthening upgrades. This issue has been identified and is reportedly beginning to change, with concerted efforts from both the Eskom transmission entity team and the IPP Office to promote better collaboration and engagement over, for example, newly published grid capacity assessments by Eskom.

Project developers concurred that the transmission issue could be mitigated with strategic grid investment in the right places, and that self-build options do reduce the risk of delays associated with Eskom performing the distribution network upgrades.

4.6 System stability

Grid system stabilisation was not reported as an immediate constraint on a rollout of renewable energy due to the large amount of dispatchable supply that exists in the South African grid. However, it was reported as a key consideration by over a quarter of the industry experts and project developers for future high shares of renewable energy.

"This will require more gas, pumped storage and batteries in order to manage the system" – academic

A key challenge that has been experienced internationally is integrating relatively unpredictable variable renewable energy generation into a system where electricity supply and consumption must always be balanced. A wealth of best practice is emerging on how to adapt systems that were originally designed for dispatchable energy solutions to accommodate non-dispatchable supplies.

Research suggests that scaling up renewable energy is likely less challenging when demand is growing or when generation is being retired or replaced (Arndt et al, 2018). The planned decommissioning of coal positions South Africa in this category. South Africa's wind and solar resource profiles have also been determined as highly complementary, with the combination of typical daily outputs matching demand surprisingly well (Fraunhofer and CSIR, 2016; Arndt et al, 2018). A grid flexibility study commissioned by GIZ (Obert and Poeller, 2017) demonstrates that the South African grid can handle increased shares of renewable energy – based on a 'high PV installation scenario' of 27,5 GW by 2030 – without major system upgrades.

An academic and transmission expert in the interview sample reported that the share of wind to solar is one that needs to be considered, with wind likely having a balancing effect on the system which reduces the need for curtailment of power.

Batteries, pumped storage, gas and hydrogen generation are other mechanisms which provide system services through their dispatchability. Battery storage, for example, holds numerous benefits for system operation including frequency response, voltage control, capacity reserves and reduced curtailment of renewable energy power (IRENA, 2019). At the utility-scale, battery storage can be implemented at certain points in the transmission grid, in the distribution grid (transporting power from renewable generators to the main transmission grid) or at the generation site. The upfront costs of battery storage technologies to couple with renewable energy supply are still relatively high but are expected to fall over the next few years. Lithium-ion batteries are leading this trend and have seen major cost declines and uptake due to economies of scale in electric vehicle production (Cole and Frazier, 2019; IRENA, 2019).

"The grid is capable of accepting variable renewable energy with battery storage and there are enough companies that are able to provide services which will ensure grid stability in South Africa." – industry expert

An industry expert also reported that many of the REIPPPP round 5 bidders will be prepared to bid their projects with storage, depending on what the Request for Proposals (RFP) stipulates. This suggests there is a serious recognition of the technical issues by project developers who are willing to bid projects that are attentive to system balancing requirements.

Though grid stabilisation was not reported as an immediate constraint on rolling out renewables, a recent observation has raised concern around grid management solutions in the South African grid system. In the second week of the national lockdown imposed to mitigate the spread of the coronavirus, Eskom reported the need to curtail wind power during early morning hours due to an 'oversupply' of energy not being met by demand. The curtailment of renewable power is economically inefficient, and with batteries, this power could be stored and used to contribute to peak demand hours. The drop in demand witnessed was unprecedented, but raises important issues around the need for more flexible management solutions which need to accompany a rollout of renewables, none of which more important than addressing a legacy system with technical and institutional inertia in accommodating variable supply.

4.7 Local content and skills shortages

More than half of the total sample of industry experts and project developers reported achieving local content requirements as per specifications in the South African procurement model would be a constraint on the industry due to limitations on local equipment and services. There was also some concern expressed about the availability of high- and low-level skills and construction capabilities.

4.7.1 Local content requirements (LCRs)

LCRs are typically defined as a percentage of total project cost which must be sourced locally, including locally produced components, civil engineering work and consultancy fees (Hansen et al, 2019). LCRs are aimed at supporting the development of local industrial sectors during their infancy, by providing domestic industries with temporary protection from normal market conditions.

A few studies have investigated the effectiveness of LCRs in South Africa to date, with consensus that the market for renewable energy in South Africa has not signalled adequate growth and stability for local industries to establish themselves (Baker and Sovacool, 2017; Rennkamp and Boyd, 2015; Ettmayr and Lloyd, 2017). This argument was supported by over half of the industry experts and developers, who argued that despite signs of local industry growth through the establishment of some local component suppliers, "the supply chain has suffered under stop-start process of the REIPPPP". Some local component suppliers and service providers have been forced to cease operations, or dramatically scale down due to market uncertainty.

Most developers shared the view that the medium- to long-term goal of the industry is to develop a strong local industrial base which would supply the domestic market and be competitive at an international scale. However, they argued that the local industrial base is currently not extensive enough to scale renewable energy affordably suggesting that LCR thresholds, 'though honourable in their intent' will be seriously constraining in the next procurement round if set too high. One developer cited concern around the waning quality of parts due to a lack of investment in research and development.

A few industry experts suggested that this issue could potentially be addressed by less aggressive local content thresholds in an initial industry growth period, with a focus on developing an industry base for balance of system hardware like inverters, cables and transformers and continuing to import component parts panels and turbines. This would allow the industry to capitalise on technological advancements experienced internationally until there is enough local manufacturing capacity to contribute panels and turbines to the industry.

Most of the developers and industry experts that reported this as a barrier argued that, with certainty of rollout and a secure pipeline of projects, the industry would grow naturally and that LCRs would become easier and more affordable to achieve.

4.7.2 Skills shortages and construction capabilities

40% of project developers argued that skillsets and construction capabilities have dwindled in South Africa and that this could be an initial constraint on industry growth. A few developers reported that several highly skilled project managers and construction managers have emigrated to seek fruitful industries elsewhere. Some expressed concern around the migration of lower-skilled workers that are trained in the construction of renewable energy projects to other construction sectors, resulting in a loss of trained workers. Therefore, there may be a limited pool of skills to be distributed amongst projects under construction in different places around the country.

Once again, these developers argued that with certainty of rollout and a pipeline of projects, more training cycles would occur and construction capabilities would increase, ultimately stimulating a positive feedback loop of skills and development.

4.8 Environmental regulations

Many project developers reported that projects – particularly solar PV – can be built with all the necessary contractual agreements around land and environmental permits in a relatively short period of time. Hence, environmental regulations were not viewed as highly constraining on project development by all developers. However, three wind project developers and one industry expert spoke of the difficulties in gaining Environmental Impact Assessment (EIA) approvals which, "as they stand, make it difficult to scale wind" and reported that there is some uncertainty around how windfarm development will be impacted by EIA regulations going forward.

"In early rounds, no bird and bat monitoring was required before the project development process started, now a year of monitoring is required prior to project development." – said a wind project developer

Wind is geographically specific, sometimes in environmentally sensitive zones which may infringe on ecological populations including birds and bats. Conservation groups including Birdlife Africa are highly organised and mobilised in this area.

A transmission expert also stated that environmental authorisations and servitude negotiations add significant lead-time to the transmission development process. Power lines may cross many different pieces of land, increasing the risk of appeal and potentially triggering different environmental permitting requirements.

To assist in resolving some of these issues, the DEA commissioned a Strategic Environmental Assessment in January 2014 which aimed to achieve 'streamlined and integrated' environmental authorisation for transmission infrastructure projects in specific identified areas called 'Power Corridors' and renewable energy projects in 'Renewable Energy Development Zones (REDZ)' (Mabin, Lochner and Fischer, 2016). REDZ were established based on criteria of high resource potential, availability of transmission infrastructure and distance from ecologically sensitive areas.

Power corridors and REDZ have been established as a strategic guide to project and grid infrastructure development and should provide benefits in terms of expediting EIAs and land acquisition in these zones. However, these were gazetted after the last procurement round and it is yet to be seen how these will influence processes in future rollout.

4.9 Local capital pools

"Treasury backed PPAs cannot continue indefinitely, they are fine for now if projects are producing a good return, but the current off-take agreement structure needs to be revised if sovereign guarantee is not there." – project developer

As highlighted in Eberhard and Naude (2017), sufficiently strong signals around industry growth are critical to stimulate investor interest. With South Africa's fantastic wind and solar resources and a global movement towards renewable energy due to economic viability and withdrawing of funding to coal projects, the current uncertainty does not seem to have dramatically reduced the willingness of project financiers, particularly banks, to finance renewable energy projects in the country.

Three interviewees cited that though the limit has not yet been reached, the depth of the local finance pool could be a constraint on project rollout. There was also concern about how long treasury-backed PPAs would continue. These discussions highlighted the need to better understand whether and/or how many projects will continue to be backed by sovereign guarantees under the national procurement model, and the appetite for project finance in alternative power purchase agreements with private entities which are not backed by a sovereign guarantee.

"REIPPPP round 4 projects still closed even when the banks knew Eskom was bankrupt, because of the government guarantee. However, if this were to be removed, no one would reach financial close. If Round 5 was published now with preferred bidding, the question would be who would be signing from Eskom's side, the transmission entity?" – project developer

Though most of the project developers interviewed were from the utility-scale private development space, we also consulted an expert on community development who reported that project finance has proved a barrier in the public sector too. They argued that there is a serious need to address the lack of capacity for non-private entities to engage with project development. For example, the current norm is for IPP projects to be built on privately-owned land with relatively low transaction costs. Transaction costs for the development of projects on community-owned or municipal land are often higher as more people need to be consulted, and these projects are much less common. "We need to think about how we fund these transaction costs," said the expert, arguing that these would need dedicated transaction funding and partnerships for public sector renewable energy development. The expert argued that one mechanism to facilitate inclusive participation could be to pre-procure land and mobilise communities around project development opportunities through dedicated awareness-raising and capacity-building programmes. The role of Development Finance Institutions (DFIs) and donor grants could serve as financial mechanisms in this space.

4.10 Future logistical considerations

Logistical constraints around port infrastructure and transport of component parts have been cited as a potential reason for the current new build limits in the IRP (2019). However, a key finding of this study is that there is a scarcity of evidence provided for these considerations – either in the literature, or in interviews.

In the literature, one study (Takuba, 2014) mentioned challenges in the transportation of wind turbines as a potential obstruction to wind farm development. However, as the author highlighted, these challenges were inclined towards poor planning, non-coordination and inexperience due to the novelty of wind farm development, rather than the capacity of South Africa's transport sector which is described as being well-geared to support large industries.

Discussions with most industry experts and developers revealed that logistical issues around transport and port capacity are not currently a barrier to industry rollout. This is supported by Ettmayr and Lloyd (2017) who rank South African infrastructure as particularly good. No critical transport limitations or limitations on port capacity were described by interviewees. However, due to the lack of literature on this topic, there is uncertainty as to how this will play out in the future, for example if large volumes of parts were to suddenly need to be imported. What is clear from the interviews is that there is a lot of trust in current available logistical infrastructure to handle an accelerated rollout.

4.11 BEE Criteria

One industry expert and one project developer cited difficulties in raising black equity finance for projects in line with procurement model specifications for Black Economic Empowerment (BEE) criteria. It is imperative that the renewable energy sector enables democratic South Africa's objectives of transforming the racial profiling of the economy, but broad-based, inclusive ownership of IPP projects has been difficult to achieve. The industry and government needs to continue searching for mechanisms to do this whilst enabling and supporting an accelerated renewable energy build.

4.12 Social resistance

The literature suggests that a massive rollout of renewable energy is likely to cause some levels of social disruption (Wlokas et al, 2017; Marais et al, 2017; Nkoana, 2018). Though social resistance to installing renewable energy projects was only mentioned as a constraint on development by two project developers, it is uncertain as to how this will play out into the future, particularly if communities are not included in the benefits provided by renewable energy development, construction and ownership.

"At a micro-level, we need to look at this in terms of where we employ people from, if people do not get adequate service delivery but they see a big project being built in their backyard, they are rightly resistant." – project developer.

A community development expert in the interview sample argued that although South African communities are not yet strongly mobilised against renewable energy projects, for example compared to organised communities in the UK and Germany, there are not enough efforts to actively engage these communities and local municipalities for benefit-sharing and opportunities from renewable energy. Nkoana's (2018) study on solar farms in Limpopo concludes that the participation of surrounding communities in the governance of renewable energy projects might lead to community acceptance and avoidance of construction delays.

5 Measures to address constraints

Though the focus of this report was analysing and understanding barriers to renewable energy deployment, it also aimed to illuminate potential measures to address these. This section summarises some of the key political, regulatory, institutional, technical and social interventions that were reported by interviewees as having potential to unlock opportunities and address industry blockages highlighted in the previous section.

Table 1. Summary of constraints and potential interventions put forward by interviewees.

CONSTRAINT	INTERVENTION
Lack of political commitment and policy certainty	Unambiguous and tangible demonstration of political will
Regulatory restrictions	Regulatory reform
Grid capacity issues	Alignment of project development with transmission planning
Local content requirements	Consistent policy commitment to create industry certainty of programmatic rollout
Domestic skills and construction capabilities	Consistent policy commitment to create industry certainty of programmatic rollout
Local capital pools	Unspecified
Environmental regulation	Expediting processes in 'Power corridors' and 'REDZ'
Technical integration of renewable energy (grid stability)	Investment in storage solutions
BEE criteria	Transformation efforts
Logistics including port infrastructure and transport	Unspecified
Social resistance	Building social awareness through demonstration of benefits
Municipal/community capacity for project development	Capacity building and transaction funding

Interventions drawn from the interviews include strong political will and clear commitment to renewable energy, regulatory flexibility, strategic planning around transmission infrastructure, investment in storage solutions and strengthening social compact processes through transformation and benefit-sharing. In the list below, we outline the scope of these interventions and some of the detailed actions required for each. This list is a summary of key points made by interview participants and is not exhaustive.

5.1 Political will

Outline: A clear, credible commitment by government to a renewable energy plan, which would signal market growth and allow the establishment of local industries.

Detailed actions required:

- Expediting procurement and bidding processes, potentially including locational incentives for project development in areas with excess grid capacity in the near term.
- Rolling ministerial determinations to procure energy in terms of section 34 of the ERA to signal market consistency.
- Regularly updating the country's IRP (*at least* every 2 years).

5.2 Regulatory reform

Outline: Address generation licencing requirements and allow third party transactions to unlock opportunities for SSEG and utility scale renewable energy projects.

Detailed actions required:

- Increase the upper limit for exemption from the generation licence requirement to at least 10 MW, to enable the accelerated uptake of SSEG in residential and commercial spaces.
- The legal establishment of an **Independent System Market Operator (ISMO)** as per the ISMO Bill (2019) which would enable non-discriminatory access to the grid, facilitate third party transactions and wheeling agreements (e.g. between private generators and municipalities, consortiums of consumers, residential consumers, commercial and industrial players, Eskom and other off takers)

Independent System Market Operator (ISMO)

Several industry experts referenced the establishment of an ISMO as a critical step in enabling power purchase agreements conducive to a wider range of generators, coordinating project development and transmission planning and managing the stability of the system. The ISMO Bill (2019) seeks to break down the monopoly of Eskom who currently serves as the main generator and central purchaser and distributor of electricity. The ISMO will function independently from generation activities, allowing non-discriminatory access to the grid and will function as a public-private partnership. The entity will

1) **Purchase power from generators, including IPPS, sell power to distributors and customers,**
2) **Provide appropriate and guiding input for the planning of electricity supply and its transmission,**
3) **Ensure the efficient and effective dispatch of energy within the integrated electricity system.**

The establishment of the ISMO would lay the foundation for streamlining regulatory processes and institutional alignment necessary for accelerating the integration of renewables into the grid.

5.3 Strategic institutional alignment

Outline: Alignment of transmission planning efforts, project development and electricity procurement, in this way manage the strategic expansion of the grid to accommodate renewables (this could be driven by the ISMO).

Detailed actions required:

- Introduce locational bidding/locational incentives for areas with excess grid capacity in near term procurement rounds (for example Mpumalanga and the Free State)
- Provide appropriate and guiding input for the planning of electricity supply and its transmission, facilitate enhanced collaboration between transmission entity, the IPP Office and other potential project developer groups.
- Expedite transmission infrastructure upgrades for enabling medium- to long-term access to the grid for renewable energy projects across South Africa.

5.4 Investments in technical solutions

Outline: Investment and integration of storage technologies

Detailed actions required:

- Accelerate research and development into storage solutions.
- Initiate auctions for storage technologies and ancillary services to encourage a competitive market sector in this space.

5.5 Social benefit-sharing and transformative processes

Outline: Capacity building in municipalities and communities to engage with project development, efforts towards new ownership models and strengthening commitment to a 'just energy transition'.

Detailed actions required:

- Catalyse transaction funding and capacity building for municipal and community renewable energy project development.
- Dedicated efforts towards new ownership possibilities and benefit sharing through renewable energy projects.
- Strengthening focus on social compact process for a 'just energy transition', focussing the localisation of industrialisation benefits associated with renewable energy in Mpumalanga coal region.

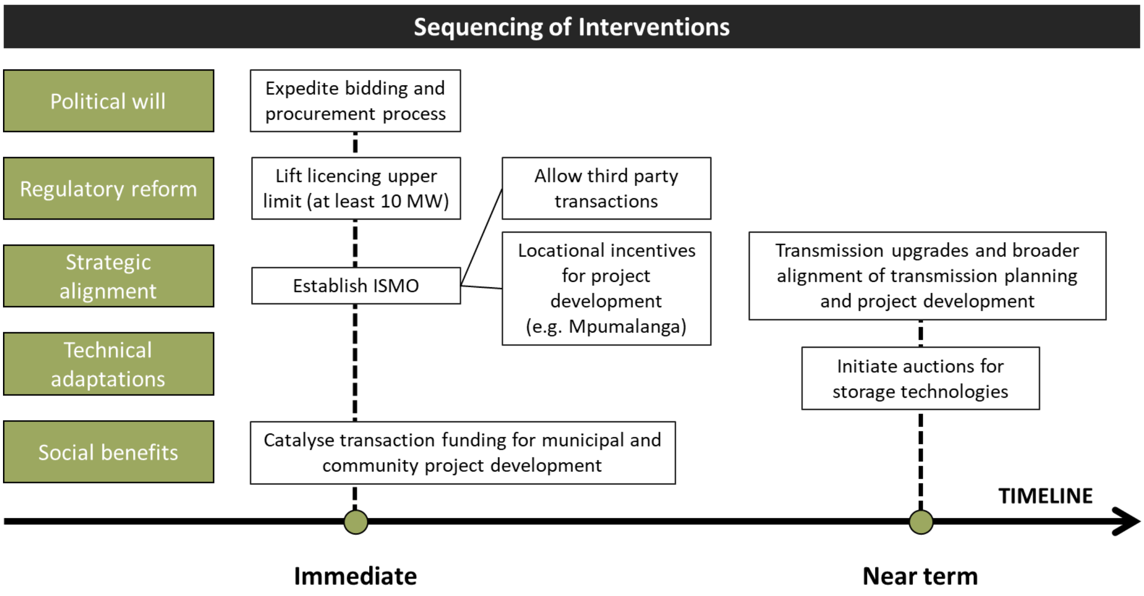

Figure 7. Theoretical example of a sequenced timeline of immediate and near-term interventions, deduced from interview responses.

6 Estimate of industry capabilities

South Africa's Integrated Resource Plan (IRP) 2019 specifies new-build limits for solar PV and wind energy of 1 GW and 1.6 GW in most years from 2022 till 2030. Based on interview discussions with key experts, these allocations are underestimating what the industry is capable of building.

6.1 Annual IRP new-build limits

The IRP includes annual new-build limits on solar PV and wind technologies in its modelling process, which limits the contribution of each technology to the country's energy mix trajectory. There are no concrete, industry-based justifications provided for these limits. Industry bodies including the South African Wind Energy Association (SAWEA) and the South African Photovoltaic Industry Association (SAPVIA) have consistently called for higher yearly capacity allocations than specified in draft versions of the IRP, arguing that this would in theory allow the establishment of a local manufacturing base (SAWEA, 2019; SAPVIA, 2017). Before the promulgation of the IRP 2019, public statements by SAWEA suggested that the IRP should allocate at least 2.5 GW of wind energy annually (SAWEA, 2019) and

SAPVIA has argued for the allocation of at least 1.5 GW utility scale solar and 1 GW SSEG, with continuous yearly allocations that grow into the future (SAPVIA, 2017; Creamer, 2019).

6.2 Potential industrialisation rate (GW/year)

In our sample, 9 interviewees commented on a potential build rate (in GW per year) that was possible for the renewable energy industry, provided a mixture of the aforementioned measures were in place to ensure market certainty and to tackle grid capacity and connection issues. All of them stated that the industry could realistically be rolling out *at least double* what the IRP 2019 specifies i.e. at least 5.2 GW per year, with strong alignment that the renewable energy industry could sustain a rollout rate of even more than this – in the range of 5-10 GW per year.

"This should be part of our emergency response for the energy crisis," argued an industry expert.

Some developers acknowledged that there might be some 'hiccups' in the initial 2-3-year ramp-up period as the industry gains momentum and establishes itself after a time of much uncertainty. However, to employ a phrase used by one of the developers, with rolling procurement and market certainty this would soon become a 'well-oiled machine'.

7 Conclusion and areas of further research

South Africa has fantastic wind and solar resources and scaling up renewable technologies in the energy mix would have significant benefits in terms of cost-optimality and addressing generation constraints at Eskom. Embarking on a renewable energy industrialisation plan presents an enormous opportunity for the country to capitalise on these opportunities and stimulate economic recovery and create sustainable employment in the wake of the Covid-19 pandemic.

This report outlined some of the critical barriers that need to be addressed to facilitate an accelerated rollout of renewable energy, including policy uncertainty, a hostile regulatory environment and misalignment of project and grid planning efforts. There is an existing portfolio of mature projects that could come online over the next 12-24 months in the SSEG space as well as at the utility-scale to alleviate existing capacity constraints. This presents a fantastic 'kick-start' opportunity for an industrialisation plan, provided the necessary regulatory shifts take place and procurement processes are expedited.

In the near term, a renewable energy rollout may require locational incentives to develop projects in areas with excess grid capacity, such as Mpumalanga and the Free State. These areas are better known for their solar resources, and this may result in a solar-heavy focus in the first few years. In the meanwhile, transmission upgrades with longer timelines should be performed under expedited conditions to create grid capacity openings and unlock project opportunities across the whole of South Africa. With the dedicated concentration of infrastructure development in coal regions such as Mpumalanga, accelerated renewable energy industrialisation could provide numerous socio-economic benefits to offset coal-sector job losses and stimulate economic activity.

Several experts argued that the IRP 2019 new-build limits of 1 GW solar PV and 1.6 GW wind energy are *underestimating* industry capabilities and missing an opportunity for the stimulation of a thriving local manufacturing industry. With certainty of rolling procurement, these experts estimated that the industry could be realistically rolling out *at least double* what is set in the IRP 2019 per year. Industry associations have argued that higher build allocations and rolling procurement have potential to stimulate significant local content growth, job creation, exports and present power cost saving to the economy.

This report highlights constraints that have been experienced by the renewable energy industry to date, which has largely been situated in the private sector. There are likely additional specific constraints that the public sector and community-driven projects may experience, which this study has only briefly touched upon. Each of these barriers warrant a study on their own – an important practical research agenda is emerging around how an accelerated energy transition can facilitate inclusive economic development and sustainable transformation, and the role of different institutional structures and financial mechanisms in this agenda.

This study points to areas of further research:

- The details of institutional and regulatory reforms required to build investor confidence by reducing the risk of project development and financing.
- The impact of 'power corridors' and 'REDZ' on streamlining environmental authorisations for transmission infrastructure and project development.
- The cost of upgrades in the collector network for connecting groups of renewable energy projects, and coordination of self-build grid connection infrastructure.
- Innovative financial mechanisms and institutional structures to facilitate capacity building in local municipalities and communities to unlock opportunities for community-driven renewable energy project development.
- The opportunities associated with investments in renewable energy value chain localisation.

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