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The Wind Energy Global Value Chain: Localisation and Industrial Policy Failure in South Africa

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ABSTRACT

The article utilises a GVC analytic framework to analyse the wind energy value chain in South Africa and its impact on localisation of goods and services. Its theoretical contribution highlights governance as dependent on system integration dynamics, with lead firms operating as system integrators. The empirical analysis focuses on the interplay between energy and industrial policy showing how policy failure, driven by coal based vested interests, disrupted system integration and undermined the renewable energy programme. The failure to ensure continuity and predictability of the auction bidding process within energy policy cascaded down the wind energy chain impacting negatively on industrial policy attempts to localise domestic and foreign enterprises. This also derived from the South African government failing to prioritise, develop, and embed renewable energy as a green economy strategy within its industrial policy framework. We conclude with the following lessons: a) GVC dynamics and lead firms cannot be ignored if localisation is to take root; b) green strategies should be mainstreamed within industrial policy; c) localisation starts with lead firms encouraging follower sourcing of first tier suppliers; d) localising domestic value-added services is just as important as developing manufacturing enterprises.

Keywords:
Wind renewable energy; global value chains; industrial policy; localisation; REIPPPP; green industrialisation

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Introduction

Industrialisation continues to be necessary in enabling developing countries to transition to better development outcomes. Whilst the globalization of production systems, and the rise of industrial output in the faster growing economies of Asia, has made industrialisation challenging, state facilitated industrial policies remain a key ingredient for many developing countries. For countries hoping to exploit economic opportunities, renewable energy (RE) can present manufacturing and service localisation opportunities by entering appropriate global value chains (GVCs) and linking to multinational (MNC) lead firms engaged in RE activities. This will deepen existing industrial and service capabilities, in fields often dominated by providers located in more advanced economies. However, this is not a straightforward path, since developing countries face a complex global economic environment where production and service hubs tend to select their territorial operational space based on multiple factors.

Globally, the emergence in the last two decades, of significant scale of RE demand and the parallel growth of supply of technologies for RE generation, particularly in wind and solar, has provided many countries with the opportunity of securing a lower carbon energy supply footprint. Alongside this, the growth of these technologies has also presented opportunities to bolster domestic economic sectors associated with the design, development and operation of such facilities and their integration into domestic, and in some cases, international energy supply systems. Between 2010 and 2018, global RE output for power in gigawatts has grown from 1,320 GW (312 GW excluding hydro) to 2,378 GW (1,246 GW excluding hydro) (REN21 2011 and 2019). The wind energy sector, both in terms of offshore and onshore wind energy generation, has seen its level of energy supply for power grow from 198 GW in 2010 to 591 GW installed capacity in 2018, or 5.5% of global electricity production (REN21 2011 and 2019). Significantly, this growing share of energy output has also been associated with substantial real declines in RE costs, as scale and technology innovation has grown. Beyond the 'greening' of domestic energy markets and associated economic opportunities, RE expansions have also provided opportunities to take advantage of reduced direct and indirect production costs (Harrison *et al*. 2017). This has stimulated policy interest in the potential of the RE sector and its associated activities in domestic economies. Increasingly well-developed global and domestic regulatory and finance associated with RE projects has further supported these developments in a context where many developing countries struggled to make advances even in conventional energy supply.

Thus, it is no surprise that many emerging economies have initiated plans to grow the RE share in their countries and to bolster their presence in economic activities associated with them. China, Vietnam, Turkey, Morocco, Brazil, Argentina and others have made very significant expansions in RE projects and, in solar energy, supply of RE technologies (REN21 2019). However, despite a much more globalised pattern of production, this has not necessarily improved the general ability of developing countries to localise elements of the GVC (Baker & Sovacool 2017; Harrison *et al*. 2017; Lema *et al*. 2018; Matsuo & Schmidt 2019). They either lack the scale of an energy market (and thus economies of scale for production), or are challenged by the capacity of producers in larger countries with more sophisticated markets to meet price and/or quality demands, or their governments have ineffectual policy interventions to influence the localisation process.

South Africa is widely noted as one of the pioneers for developing an internationally best practice regulatory auction bidding framework, having launched the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) in 2011 (Eberhard et. al. 2014; Baker and Wlokas 2015; Morris and Martin 2015). This auction bidding regulatory process has now been globally adopted and customised to different country contexts (Eberhard and Naude 2017; Hansen et. al 2020). Much of the literature on South Africa's experience has been concerned with the broader programme dynamics, challenges in terms of programme design, technical features of procurement and economic development criteria (Moldvay *et al*. 2013); Rennkamp and Westin 2013); Montmasson-Clair and

Ryan 2014; Baker and Wlokas 2015; Morris and Martin 2015; Baker 2016)). However, these did not explore the localisation dynamics in much detail. More recent contributions by Baker and Sovacool (2017), Eberhard and Naude (2017), Ettmayr and Lloyd (2017), and Larsen and Hansen (2020) have all looked more closely at the emergent localisation features of the first few rounds of the REIPPPP. However, their research was constrained in being undertaken when some of the negative impact features were still emerging. Notwithstanding the farsightedness of South Africa's initial policy, the implementation of the framework and its translation into both sustained RE projects and development of local industries linked to the wind energy GVC has been significantly less successful. Both the procurement of RE and some early moves to secure industrialisation gains got off to a roaring start that promised much, but by 2016, this process had stuttered and ground to a halt. These dynamics are considered in detail and the causal linkages analysed in the following pages.

In doing so this article attempts to throw light on some conceptual and practical issues. First, it asks what can generally be learnt from South Africa's failed attempt to build a local wind power industry? In answering this question, the article relies on an analysis of conflicts between coalitions of vested interest and power operating and impacting on the state (Morris and Martin 2015; Schmitz 2016), as well as the specificity of GVC informed industrial policy (Dalle et al 2013; Low and J. Tijaja 2013; Morris and Staritz 2019). It focuses on the relationship between the dynamics driving the wind energy GVC, the intersecting role of the government's energy and industrial policy, power relations between different vested interests in the state impacting on policy implementation, and the factors facilitating or constraining the localisation of goods and services in South Africa.

Second, it uses the South African example to ask whether the conventional GVC framework emphasising the power dynamics of governance between lead firms and suppliers to meet market requirements (Gereffi 1999; Kaplinsky and Morris 2003; Gereffi et al. 2005; Kaplinsky 2016; Davis et al 2018; Kano et al 2019) is sufficient to analyse the specific character of the renewable energy GVC dynamics. The conventional GVC framework is based on market dynamics driven primarily by private sector requirements and parameters, whereas the renewable energy GVC involves a specific combination of the public and private sector to operate systemically. Recent GVC analysis has however moved to giving greater role to the state in shaping value chain dynamics through public regulation, industrial policy, production, and procurement (Davis et al. 2017; Horner 2017; Morris and Staritz 2019; Horner and Aldford 2019). The renewable energy market is controlled by a state led enabling regulatory framework which sets the conditions of energy procurement which the private sector must meet to provide the requisite supply of saleable electricity units. However, while the public sector sets the enabling market conditions it does not actually intervene in the production of renewable energy nor the governance of the value chain relationships. Moreover, this requirement to satisfy complex market requirements means that huge demands are placed on the lead firms to ensure optimal integration of the multiplicity of firms and actors involved in order to ensure GVC systemic efficiency throughout the process. The discussion below analyses these dynamics using the concept of 'systemic integration' to capture the GVC dynamics, lead firm governance in both meeting state regulatory requirements and ensuring optimal operational efficiency in delivering saleable electricity units.

The article draws on a variety of sources and methods. The research process involved both a comprehensive desktop review of available published and grey material, as well as using a largely qualitative methodology involving semi-structured interviews with 44 respondents - domestic and international RE firms, government policy makers, regulators, associations, or known experts - in South Africa (24), Europe (9), and India (1). The interviews were focused on gaining insight into the varied features of local content in the South African REIPPPP and also the factors that influenced these local content elements. The respondents covered a broad range of actors in the wind energy sectors. They included many with direct responsibility for policy as well as those active in managing REIPPPP bids in the various auctions, those responsible for implementation of RE projects, and respondents from companies supplying goods and services to RE projects in the country. The interviews included

market-leading technology suppliers dominating the wind turbine market for grid-scale generation plants; companies involved in putting together and/or servicing the bids for the REIPPPP wind energy contracts (feasibilities, legal, finance); firms providing services to the Independent Power Producers (IPP) contracting parties; suppliers to the multinational OEM wind turbine providers and Engineering, Procurement and Construction (EPC) contractors; and government officials. The interviews covered the following: four lead firms, four lead firm subsidiaries, two blade suppliers, two tower suppliers, one fastener and steel supplier, two engineering suppliers, four consulting and advisory entities, two transport and logistics firms, one construction company, two project management firms, two training centres, two wind industry association, two operations and maintenance firms, three development agencies, eight government agencies, three specialist experts.

Conceptualising the Wind Energy GVC Dynamics and Drivers

Conventionally the wind energy value has been described as a "two-pronged value chain: a manufacturing chain concerned with producing the key equipment and a deployment services chain concerned with all aspects related to deployment and utilisation" (Lema et al 2011). These authors argued that the former produces the manufactured components whilst the latter encompasses the service chain, with lead firms – turbine assemblers and large European utilities or other types of project developers – respectively dominating each of these chains. Importantly Lema et al 2011 recognise that in practice the lead firms often have some form of cross involvement in other chain activities. Elola *et al*. (2013) follow a similar division between the manufacturing and deployment phases but refer to two different value chains in the wind energy industry – the manufacturing chain and the deployment chain. These authors set out the manufacturing chain as including turbines, blades, towers, bearings, gearboxes, controls, systems, power converters, and turbine generator assembly. The deployment chain consists of pre-deployment (e.g. site assessment, planning and finance), deployment (site construction, transport, grid connection), and post-deployment (operation, maintenance, sales). This bifurcation into two distinct value chains is also adopted by Larsen and Hansen (2017).

Whilst these studies have advanced our understanding of the wind energy industry we argue that their conceptualisation of the wind energy value chain is confusing. First, the two chains proposed – deployment and manufacturing – are in practice intertwined and mutually dependent making up an integrated GVC. Without the deployment process there is no substantial component manufacturing chain . In practical terms the former precedes and encompasses the latter, and the deployment decision-making process determines the shape and form of the manufacturing supply chain. Hence it makes little conceptual sense to speak of two separate value chains when analysing the wind energy global value chain. Second, although the manufacturing linkages are driven by different dynamics they exist as an embedded cluster nested within the overall wind energy value chain. These manufacturing chain dynamics do resemble that of a producer driven, vertically specialised, global value chain but this cannot be applied to the entire wind (or solar) energy global value chain. Third and similarly, it is mistaken to isolate services into the deployment chain. Services play a crucial role in both deployment and manufacturing. Finally, in terms of the appellation 'manufacturing chain' the term manufacturing does not capture its essential components. Service firms providing inputs are an essential part of this chain and integral for its successful functioning. In many respects the lead firm in this chain is akin to an auto assembler sourcing components or services, and assembling them into a final product.

The net result is that the wind renewable energy global value chain cannot be adequately captured by any of the existing theoretical GVCs frameworks. Neither the classic typology of buyer driven and producer driven GVCs (Gereffi 1999; Gereffi et al 2005; Kaplinsky and Morris 2001), nor the division into two families of vertically specialised and additive GVCs (Kaplinsky and Morris 2016), is adequate to encompass the specific characteristics of the dynamics driving the **totality** of this renewable energy GVC. This is because the nature of the energy market that the global wind energy value chains feeds into, and which drives its dynamics, displays very different characteristics from these conventional

GVC conceptualisations. The key dynamics driving the wind energy GVC are the fact that its market markedly differs from mass market consumer goods market dynamics, and that its lead firms are driven by overwhelming requirements to maintain **system integration** between companies from a variety of sectors in order to ensure systemic viability which then becomes a core competency driver.

The market driving the wind energy GVC is not a classic competitive market found in private sector commercial dealings where buyers and consumers compete to achieve differential price rates in order to buy, sell and purchase a product in a competitive terrain which can potentially shift at any given moment as the competitive struggle to buy and sell in that market proceeds. The wind renewable energy market differs substantially from this and hence produces different characteristics and drivers which impact on the manner in which its GVCs operate and need to be conceptualised.

First, in wind (and solar) markets, which procure IPPs on long term public contracts, which is our focus, the market is public sector determined and regulated. Second, in such public procurer markets the per megawatt (MW) unit price for energy procurement is fixed, after a complex bidding system, through a legally binding contractual agreement between the public energy procurer and the private sector provider of renewable energy. Third, in such contracts the MW procurement price agreement holds for a set period of time – e.g. 20 years. Once the contract is concluded there is hence limited competitive terrain that the producer is involved in for that period of time, although there are still incentives to maximise operational efficiencies so as to maximize revenues.

However, this does not mean that the discipline of a competitive market does not operate. But it does so between RE providers at the outset of the process (i.e. in the bidding and construction and installation process setting up the actual energy entity), rather than between entities in the delivery of renewable energy (i.e. once the entity is contractually procured, operationally set up, and connected to the grid). In other words the competitive edge lies in competing for access to the market, rather than operating in the actual market. Indeed, in any renewable energy auction bidding system, which has now become perceived as international best practice (Hansen et al 2020; Kruger et al 2021), the competition between the various bidding private sector entities over proposed price points (and meeting other official social and economic regularity requirements) is extremely fierce. Any auction window is open to a potentially large number of bids, but the government agency in charge of the process makes available only a limited number of successful places within that bid window. Hence there is fierce competition between the various consortia involved to create winning proposals and the bidders compete vigorously, offering increasingly lower unit price points and modalities of meeting the social and economic regulatory requirements (for example localising production) in order to secure places at the table. Competitive demands are also critical in the construction and installation process, once the contract has been awarded, in respect of procuring services and manufactured items necessary to in order to meet the conditionalities set out in the winning bid proposal, now contract.

All these conditions create highly specific dynamics driving the wind energy GVCs. There are two critical moments that determine the value chain dynamics and drive lead firm governance activities within the chain. The first phase involves the process of winning an auction bid, and if successful, the second phase encompasses a process of setting up the renewable energy (wind) plant to operationally meet the price point and other conditionalities set out in the procurement contract. Once the renewable energy plant is established it enters a third phase characterised by plant operations where maintenance activities predominate in order to meet contractual power generation obligations.

The critical competitiveness issue for the lead firms involved in each of the first two phases lies in being able to ensure **systemic integration** between the various value chain linkages. In both these initial phases the renewable energy GVC will either succeed or flounder depending on whether its systemic foundations are correctly put in place. Hence the crucial role that the lead firms play is that of being the **system integrators** that maintain value chain integrity between the various components, players, and linkages in these two discretely foundational phases.

Although this has not been recognised in the literature, in terms of complexity and interdependency, the wind energy GVC shows some similarities to the manner in which complex product systems (CoPS) operate (Hardstone 2004; Hobday 1998; Davies and Hobday 2005; Kiamehr et al 2015; Ranjbar et al. 2018). Historically the development of CoPS as an area of study derived from government procurement of large scale military and technical systems. Hobday (1998) theorised it, and defined it as any high cost, engineering-intensive product (system and network) of complexity. Essentially CoPS are high value, high technology, and knowledge intensive complex projects, utilising system integration management capabilities controlling multi-organisational networks, and where the underlying economic patterns are markedly different from those regulating mass market consumer goods. Government most often has a crucial role to play in such large complex projects – in terms of procurement, standards, and subsidisation of CoPS. The key capabilities and competencies required to maintain the integrity of CoPS - project management, network management, market capabilities, and system integration activities – are regarded as "critical and inevitable" (Ranjbar et al. 2018).

However, while the CoPS literature is useful in pointing to the importance of maintaining system integration of a complex network of actors and the role of government, it is limited in understanding the governance dynamics of the wind energy GVC. Even the CoPS theorists have themselves not found it useful to apply the GVC to the dynamics of such complex systems. Whilst there is a similarity in respect of government playing a regulatory role for renewable energy, state intervention in these GVC dynamics is limited to setting the conditions that the lead developer consortiums have to meet in the bidding process and the final buying of the electricity. Unlike military systems government does not procure any final products or components in the supply chain. Government does not even set the market price for procuring electricity. That is contained in the successful bid proposals in each window. Nor can the national electricity corporation refuse to buy electricity from an established IPP. All it can do is subvert connection to the national grid through what has been called "malicious compliance" (Morris and Martin 2015). So whilst the operations of the wind energy GVC is enmeshed in a complex public-private sector interplay, the roles of each are clearly defined and limited. The state has a critical role to play in setting up the need for system integration in the wind energy GVC but maintaining it is purely the responsibility of the lead firms.

In order to make clear the distinctive features of the phases of this value chain, and the actors playing a role in them (mapped graphically in Figure 1), the material that follows provides a more detailed description drawn from in-depth interviews of respondents from companies, regulatory bodies that have played a key role in these processes in South Africa and internationally, as well as key experts.

Phase 1 – the Auction bidding process: When a renewable energy auction window is announced by the responsible government agency (in South African the *IPP Unit*) puts out a Request for Proposals (RfP) to feed specified supply into the regulated grid energy market. In response private sector lead developers acting as sponsors start the process of putting together a bid. These large global firms and entities – energy utilities, or existing Independent Power Producers (IPPs), or large finance groups - establish a consortium under their clear control, drawing on a range of partners and external service provider organisations (both domestic and international). These range across financing mechanisms, legal services, feasibility analysis, environmental assessment, economic development, grid planning, wind mapping, and community engagement. The consortium will also include preferred international OEM (wind turbine generation firms) experienced in setting up the generation system and providing its specific technology and component supplier costings, as well Engineering, Procurement and Construction (EPC) contractors to set up the renewable energy plant.

The lead developer sets up a Special Purpose Vehicle (SPV), as the project's legal entity to secure project financing – usually 70% debt financing and 30% equity finance provided by the lead bidder and others. The financing is secured at risk on the assumption that a successful bid will generate future repayment revenue. If unsuccessful the expenditure is lost, although the project can be submitted in a

new form in subsequent bid windows. Once the necessary groundwork has been cleared, which will involve a certain amount of local spend, and the proposal is completed, then the lead developer (on behalf of the consortium) submits the bid to the responsible government agency.

Setting up and running a bidding consortium is a complex and expensive process requiring not only a high level of existing energy capability and organisational expertise but also managerial capacity, sufficient resources, and, given the risk involved, access to significant financial capital. The proposals are complex, marshalling huge resources, subject to major financial risk, and require systemic integration between the various consortium service providers. The complexity comes from a number of sources. First, the bid usually has to meet additional social, development and economic and regulatory requirements (for example supplier local content, or training skill demands and community involvement). Second, there isn't a specified price platform that has to be reached for the bid to be deemed successful – it is essentially a race without the bidders knowing beforehand what the qualifying price is. Third, in South Africa the target can also shift depending on how the other bidders organise their proposals, since in some cases the social or local content standardising criteria that set the stage are based on the average bid rather than being set at the minimum qualification thresholds as occurs in some other countries. Finally, at the heart of this is an attempt by each bidder to game the system, since the aim is always to find the best position amongst the spread of bids: to avoid the bottom few (highest prices) and be disqualified, but likewise not to be amongst the top bidders (lowest prices) because then the required price points puts extra competitive pressure in the next phase of constructing the plant and generating energy. Hence bidders are driven into a complex, mutually choreographed dance, with the dance steps determined by what each guesses the others are doing in their bids.

The bidding phase therefore requires great systemic skill in setting up a competitive bid, and organising a competitive consortium comprising all the required disciplines (financial, legal, engineering, environmental, etc) and the participating partners. This is the governance role of the lead developer and without it acting as the system integrator (SI) of the consortium, there is no hope of successfully competing for the limited number of places available in the window bid phase.

Phase 2 - Setting up the RE plant: Once a bid has been successful, the lead developer signs a power purchase agreement and moves into the second phase. Through the SPV it confirms contractual arrangements with its main consortium partners - its chosen financiers as well as the OEM and EPC providers. It reaffirms any contracts/agreements established in phase 1 with a land owner, and any local community structures in order to enable finalisation of plans and the commissioning of site-related works. A wide range of service providers are utilised and almost all of the manufactured input is sourced. At this point the bulk of pre-operational expenditure, including localised spending, occurs. Because they embody and distribute the financial risk and responsibility within the value chain these contracts drive, in a very strict fashion, this phase. The SPV has no other source of finance which is raised on the basis of expected return. Hence financial risk and responsibility drive the process, which is why the lead developer has to ensure system integration of the entire process.

Under the governance of the lead developer, the consortium then has to set up the plant to produce renewable energy and connect to the national grid – i.e. physically construct and project manage the complex assembly process. And the developer has to ensure it meets the bid's contractual requirements, and make the necessary profit throughout its operations. System integration of the consortium in this implementation phase is once again crucial and is the primary means of governing the value chain linkages involved. The lead developer with whom the contract has been signed has to ensure that it operationally maintains the required systemic integrity to meet the conditionalities imposed by the bid proposal and its auction contract. It therefore sets out the clear parameters and specifications which EPC and OEM partners must adhere to. Unless the discipline of the proposal requirements is adhered to the consortium lead firm places itself in huge financial risk.

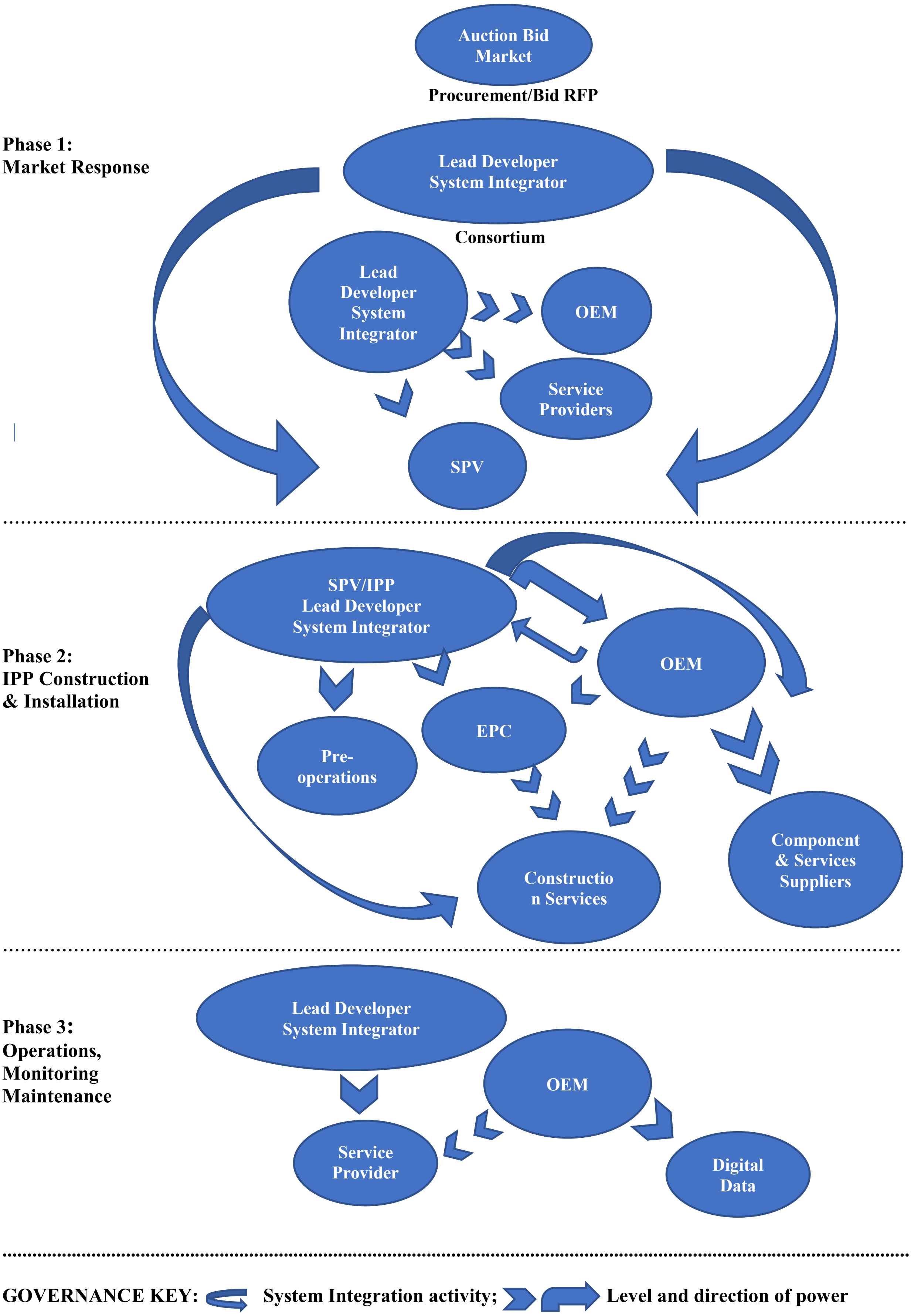
Mostly the lead developer/sponsor retains some form of critical control over system integration but it has to do so in conjunction with the OEM or the EPC contractor in order to align the project with the technology offerings of the selected OEM. The system integration governance role is hence subject to deliberative dynamics amongst the core players – the lead developer, the OEM and sometimes the EPC contractor. In this sense one can see the system integration role as iterative where contractual energy supply and other regulatory obligations (such as localisation), local site contextual factors (topography, weather patterns) and OEM technology offerings are explored and matched. Critically, it is not simply project managing the procurement of services and goods, a supply chain function. It is a lead firm governance role, exercising power over the entire value chain to ensure the pursuit of clearly defined protocols and parameters in order to maintain system integrity of the entire process. If government policy ignores the systemically integrated nature of the GVC and attempts to enforce ad hoc localisation this is likely to fail.

Nested within lies another embedded set of value chain activities which are more recognisable within the GVC literature as a producer value chain with a lead firm, as a result of its command over vital technologies and R&D, managing the supply chain of components and services (Gereffi 1999; Sturgeon 2008). In the wind energy GVC this lead firm role is the domain of a large global OEM (e.g. General Electric, Nordex Acciona, Vestas, Siemens-Gamesa, and Goldwind), often called the 'kit provider', handling the assembly of the full turbine and nacelle as the final stage before installation within the tower. It not only designs the requisite turbine equipment but also specifies any structural design matters for the EPC which is responsible for the civil engineering tasks and so-called balance of plant (BOP) related work. This can include a wide range of elements including equipment for grid connections such as transformers, road infrastructure, ancillary buildings, internal roads, drains, utility connections and the foundations for the towers.

Similarly, the OEM maintains control over its key turbine competence (R&D, and technology) and outsources services and the various turbine components (gears, switches, shafts, rotors, generators, wiring, electronic and digital controls), the turbine casing (nacelle), the towers, and the blades which are manufactured according to strict protocols and standards (Baker 2016; Baker & Sovacool 2017; Matsuo & Schmidt 2019). In similar manner to the auto industry (Barnes and Morris 2004), as companies seek to reduce transport costs and to access new sources of revenue, the OEM applies 'follower sourcing' principles encouraging or requiring their preferred first tier suppliers (e.g. tower, blade and nacelle turbine manufacturers) to locate plants close to the RE plant rather than importing such critical components (REN21 2019; Larsen and Hansen 2017; Larsen & Hansen 2020). Other local suppliers provide services and products , as a result of local industrial policy interacting with lead firm strategies or simply due to lower barriers to entry (Elola *et al*. 2013; Matsuo & Schmidt 2020).

Phase 3 - Operations, monitoring, and maintenance: In most cases the OEMs have at least a five-year renewable contract to operate the wind energy technology on behalf of the IPP. However, it is the IPP that ultimately takes control of operational decisions related to the project. Ongoing operations and maintenance (O&M) involves mostly services commissioned from local providers (crane operators, wind tower maintenance technicians) or through the OEM structures (locally or internationally), as well as IPP interactions with the range of project stakeholders (including grid operators, local communities, land owners, regulators). Some supply of manufactured inputs does take place for replacement parts (blades, gears etc), paint and lubrication. In other contexts the O&M spend has ultimately also turned into project recapitalisation work as outdated equipment reaches the end of its design life and gets replaced with updated equipment. Critical to this phase is the continued digital monitoring of operations and the collection of operational data throughout the operational life of the renewable energy plant. This is done by the OEM and its ability to muster a huge data base from various global operations plays a significant competitive part in its global core competence.

Figure 1: Wind Energy GVC Mapping of Governance, Linkages and Agency



In summary, the ability to maximise systemic integration is the key competitiveness driver underlying the wind energy GVC's dynamics. The greater the consortium's ability to achieve systemic integration in the auction bid process, the more chance there is of reaping success relative to other rival bids. This places enormous power in the hands of the lead developers maintaining the systemic integration of the bidding consortium. The same condition holds for the installation process where managing a high level of systemic integration within the IPP entity ensures its ability to meet the contract price and other conditional requirements, thus yielding the necessary profit levels to sustain the energy generation and distribution operations. Managing value chain systemic integration between linkages and nested supply chains, to achieve systemic efficiency therefore is the critical governance role that falls to the lead firm in this wind energy GVC. Even when management is devolved to other actors (e.g. OEMs or EPC contractors) it is the IPP lead developer/sponsor that plays the ultimate lead firm governance role. The OEMs are not without some kickback power though as the facilities have to be built and assembled largely around their own IP technology, and they hence also control the supply chain of goods and services. Finally, if such system integration is disrupted then this fractures the value chain dynamics with a negative rippling effect all the way down the chain. Hence, for most emerging market economies, localisation of the supply chain is dependent on the systemic integration of the wind energy GVC. Government policy aimed at creating a strategic green industrialisation path through localisation of suppliers therefore requires state policy makers to engage in a radical conceptual shift in how they conceptualise the local content problem, understand the constraints and formulate implementable policy solutions in a GVC driven world. This requires embracing a GVC policy perspective encapsulating the systemic totality of the value chain and the key role of the lead firms as maintain its systemic integrity rather than simply the ad hoc intention of localising this or that set of suppliers.

South Africa's renewable energy policy and industrial policy

The South Africa Department of Trade and Industry (DTI) has used various Industrial Policy Action Plans (IPAPs) to achieve broad industrial objectives across various priority sectors (Morris et. al. 2020). However, RE has never been a designated sector and has not featured high on any of its industrial policy priorities. The launch of REIPPPP in 2011, designed to procure the 3,725MW of new RE generation allocated in the 2010 Integrated Resource Plan (IRP), and the creation of the IPP Unit with the backing of the National Treasury but housed in the Department of Energy (DoE), heralded a major step forward for the nascent "green" energy industrial policy intentions (Eberhard & Naude 2017). The IPP Unit proceeded to build a coalition of support amongst critical government departments (Morris and Martin 2015). Allocating smaller amounts through five bid windows allowed renewable energy project developers the time to bring together complex consortia involving a variety of players, prepare their systemic bids, create a broader scope for participation, increased competition to drive down bid prices, and enhanced 'learning by doing', ensuring they managed a dynamic, continuously improving, systemically integrated process. The REIPPPP design built in programme features that might support the securing of significant local development impacts. Job creation and new industrial development were viewed as key aspect of the bidding programme in order to gain support across government, unions, and the various social partners. To facilitate localisation, the IPP Unit incorporated local content in auction requirements.

These programme design elements were also informed by DTI contracted technical work (Szewczuk et al. 2010), noting the importance of creating a supportive and appropriate policy environment for RE investors, considering the country's lack of technology and the institutional environment experience. It was stressed that industrial policy would need to underpin the RE programme and include local content requirements, fiscal and tax incentives, export credit, quality certification, and research. However, this did not filter through to subsequent industrial policy IPAPs.

The DoE and the DTI did agree on the procurement approach to adopt for using REIPPPP to achieve economic and developmental agendas. The IPP Unit was granted an exceptional procurement criteria

framework allocating 70 points to price and 30 points for a specific set of development-based criteria. The first auction round set minimum requirements (amended in later rounds) for economic development, including job creation, local content, ownership, management control, preferential procurement, enterprise development and socio-economic development. These broad economic criteria were used as the primary instrument to achieve a somewhat narrowly framed industrial policy outcome. As officials involved in the process interviewed noted, the country was entering a new field of energy investment, and government did not want to add significantly to already mounting issues of wider investment risk for potential investors. It was also cognisant of trying to avoid onerous requirements translating into higher energy prices when South Africa's energy costs were rising rapidly. Hence the support for green industrialization was somewhat muted.

Critically, departmental leadership of 'green' industrialisation was unclear. The small, marginalised Department of Economic Development (DED) was supposedly designated as the 'green economy' lead, whilst the DTI had the industrial policy mandate and paid lip service rather than championing a green industrialisation path (Interview with senior DTI officials). This lack of clear leadership opened the way for vested interests within government to pursue separate and often conflicting agendas and laid the foundations for numerous internal political struggles between various ministries.

Simultaneously there were ongoing discussions between the IPP office, various sympathetic government officials, and the South Africa Wind Energy Association (SAWEA) Manufacturers local content working group focused on the REIPPPP's economic development intentions. The IPP office raised local content expenditure targets in the second round and in the third round for both the qualifying threshold and the bidding criteria target. Wind and solar photovoltaic started the first round with local content thresholds of 25% and 35% with targets of 45% and 50% respectively. In round two the target jumped to 60% for both, whilst in round three the threshold rose to 40% and 45% respectively and both targets increased to 65% (IPP Office, 2016).

The rationale was to increase the spread of local spend but crucially without specifically focusing on what that spend should incorporate, as it did not specify actual local content items. The initial phase of REIPPPP had made allowance for project planning and EPC work to be done by South African-based teams or subsidiaries of international companies. The intention of shifting thresholds and targets was to raise local procurement spend beyond initial project services and construction-related consumables/inputs. Crucially though this approach to local content contained a major industrial policy flaw. By only focusing on the blunt policy instrument of local spend it was geared to various departments being able to meet the dispersed social targets of general employment and black economic empowerment, rather than a strategic industrial policy intent to build local services, local value added, manufacturing capacity. In the process it skewed local content away from focusing on increasing particular value-added activities (post project planning services, or critical manufactured items, or technology acquisition) in the supply chain to make the greatest domestic industrial impact. It also ignored the danger of local firms importing substantial inputs and passing this off as local spend rather than domestic value added.

There was some intent from a minority of DTI officials for a more focused and coherent institutional policy approach to industrialisation but this did not move much beyond these blunt localization and broadly dispersed social development aspects of the bidding programme.[1] The DTI commissioned a study intended to review the experience of the first phases of the RE programme and its industrialisation impacts, as well as to inform government industrial strategy choices and policy making on possible future reforms of the RE procurement efforts (Urban-Econ Development Economists & Escience Associates 2014). This set out an approach for a more substantial RE industrialization path than in the previous general statements of intent. However, as a senior DTI

[1] Interviews with present and former DTI officials

official noted, the study was commissioned simply as a guide for future strategy. It noted the progress at the time in the establishment of two steel wind tower producers - DCD and the Gestamp Renewable Industries (GRI) - and also the commissioning of concrete towers by Acciona (via Concrete Units). These were highlighted as important indicators of what could be achieved in domestic manufacturing terms, with a relatively modest local content policy, and without much in the way of additional policy support. However, this report also noted that the substantial deepening of manufacturing elements of the value chain depended on the government's energy policy allocating a greater market allocation to wind energy than those limited amounts contained in the 2011 and draft 2013 IRPs.

In other words, energy policy had to substantially shift if industrial policy was to be effective. Moreover, the development of local capacity beyond towers for blades and other components required clearly articulated and detailed industrial policy support measures to catalyse local manufacturing, as well as a revision of the manner in which local content thresholds were stipulated.

The government officials trying to press for a more substantial and aggressive commitment to RE in the review of the IRP in our interviews all suggested that this would have been critical for shifting the industrialisation gains from a few initial projects into a more viable green industry growth path. However, despite some initial encouragement, an aggressive commitment to green industrialisation was never mainstreamed into the DTI's industrial policy programmes and remained as marginal and peripheral statements dispersed throughout its narrative.

Energy and Industrial Policy - REIPPPP and Localisation

By 2015 four rounds of REIPPPP auctions had been initiated. Rounds 1 – 3 led to a number of RE projects being actually delivered after the conclusion of all the necessary regulatory procedures. By March 2019 there were 22 operational Wind IPP's with an installed capacity of 2,078 MW connected to the national grid with more than 900 Wind Turbines (SAWEA 2019a). The much delayed signing off of 27 additional REIPPPP bids in April 2018 (including projects from round 3.5 and 4) saw the total sum procured for all RE (although not yet all operational) stand at 6,328 MW (IPP Office 2018: 26). As of 2019 wind energy was supplying 52% of South Africa's RE power (SAWEA 2019a).

In terms of job creation in the first three round targets were generally exceeded (Lovins and Eberhard 2018). As Table 1 demonstrates, in terms of local content requirements, where the first three rounds initially had a threshold of 40% (later increased to 45%) and a target of 65% of the project value, achievement was reported at 50% or a total of R37bn.

Table 1: REIPPPP BW1-3 - Economic Development Criteria Thresholds, Targets and Achievements

Element	Description	Threshold	Target	Achieved
Job Creation	RSA based citizens	50%	80%	90% (Construction) 95% (Operators)
Local Content	Value of local content spending	40% - 45%*	65%	50% (R37 billion)

* 45% for solar PV, 40% for all other technologies
Adapted from Lovins and Eberhard (2018)

Across the bid windows the local content requirement was escalated (in terms of thresholds and targets) with more stringent obligations as policy makers sought to secure greater manufactured input. Across the solar and wind RE technologies the average bid levels for BW1 and BW2 did not change much, "suggesting that there were constraints to achieving higher local content expenditure" (Eberhard & Naude 2017: 4). This was confirmed by IPP Office officials and industry participants An energy project financing expert pointed out that the absence of local manufacturing of key turbine components made it difficult for local content to go much beyond the minimum specified bid levels. An EPC projects company director pointed out that establishment costs of wind farms generally involved 70% of costs contributed by the towers, turbines and blades.

Therefore, in order to raise the local content some higher cost items had to be sourced locally. This was initially achieved with locally produced concrete and steel towers. Towers and BOP not core to the turbine technology (i.e. excluding turbines and blades) were estimated to contribute to around 46.9% of costs in an average wind farm project (Urban-Econ Development Economists & Escience Associates 2014). The towers and tower foundations made up the bulk of these costs. On a per tower-turbine unit basis steel tower costs are generally estimated to be 25% of the total, excluding other ancillary costs for infrastructure at a wind farm such as general buildings[2].

Developing local tower capacity enabled the IPP Office to raise minimum local content required from 25% to 40% (Table 2). Bid projects had increased local spending through sourcing locally manufactured tower interiors (ladders, wiring, lighting), connecting into the grid, and specialised services (transportation and tower erecting, and turbine and blade installation)[3]. The head of a European OEM turbine subsidiary noted an industry-wide push to find ways over and above tower sourcing to win bids. However, there was insufficient market demand given the IRP limits imposed on wind energy generation, as well as the way the REIPPPP window bids were managed. Consequently, the impact was only deepening capabilities of a narrow set of firms rather than supporting a wide array of suppliers.

Table 2: Average Local Content as a percentage of Total Project Cost versus Thresholds* and Targets

	BW 1			BW 2			BW 3			BW 4		
	Min	Target	Average Bid	Min	Target	Average Bid	Min	Target	Average Bid	Min	Target	Average Bid
Wind	25%	45%	27.4%	25%	60%	48.1%	40%	65%	46.9%	40%	65%	44.4%
Solar PV	35%	50%	38.4%	35%	60%	53.4%	45%	65%	53.8%	45%	65%	62.3%

*Threshold = Minimum obligation
Adapted from Eberhard & Naude (2017)

However, as an OEM representative pointed out, the reason South Africa's local content regulations were highly ineffective was because they simply measured the value of the project and set a minimum percentage which OEMs have to be above to supply turbines. Hence there was no incentive to go beyond the minimum spend threshold level. Further, if the spend on the civils and balance of plants amount to X% of the total project value, then sourcing this locally was enough to meet the local content regulations. In some countries where the OEM operated, local content regulations were designed as a *scoring system* that could be used as a competitive parameter in the project bids. Hence, a relative higher price of electricity generated would not necessarily make the bid uncompetitive if the local content part of the bid is relatively high. This however required an industrial policy approach focusing on targeting critical value chain links for local content. The importance of more nuanced local content regulations was summed up by an OEM executive: *"It is not only a question about the levels of local content, ... equally important are the rules and regulations of local content - most local content systems are based on a point rating system (e.g. a locally produced generator is given a certain score, and firms can then add up the point scores to comply with the local content regulations)"*.

The overwhelming majority of private sector respondents were not surprised that local content regulations featured in South Africa's procurement model for wind energy. However, most respondents thought that the industrial policy intent for wind energy equipment required was less

[2] https://www.windpowerengineering.com/understanding-costs-for-large-wind-turbine-drivetrains/.
[3] The significance of the different categories of minimum, target and average (Table 2) requires elaboration in order to analyse the local content movement during these four bid windows. The weighting of local content (25%) in the total bid tender score meant that IPPs needed to go beyond the minimum threshold in order to up their score. Hence local content proposals within bids tended to collect around the target rather than the minimum. This is evident in the jump in average bids - from 27.4% in window 1 to 48% (window 2, 46.9% (window 3), and 44.4% (window 4) when the target was raised after window 1 – as the IPP office and DTI tried to use policy regulations to encourage an increase in local content.

substantial than many emerging economies they operated in. The head of a global turbine OEM claimed that it was a widely held view in the industry that South African policy makers had an inflated view of the attractiveness of the country as a market for investment. He noted that South Africa was not a particularly competitive location for manufacturing based on the following aspects: a small market at a great distance from other high growth markets; unpredictable labour relations and skills constraints; policy instability, including with impacts on economic stability and exchange rate volatility; and a lack of an existing wind energy value chain presence in a range of supply fields such as steel, metal casting and electronics assembly. For this respondent, echoed by others, these negative market features should have encouraged more substantial industrial policy support to meet local content objectives, citing South Africa's automotive sector programme as an example of what might have been considered for the window of opportunity the REIPPPP provided.

In line with its inflated view, government also sought to facilitate the market entry of a purely local tower producer (DCD) and local turbine and a local blade fabrication consortium (IWEC). As a DTI official noted, *"it was clear to us that we could not just sit back and wait for international suppliers to come, we wanted to encourage domestic firms to enter this business"*. However, respondents felt the DTI was ignorant about the GVC drivers, and failing to appreciate the obstacles facing local suppliers bypassing these dynamics. As one industry advisor to the sector noted: *"We see the IDC getting involved in these high-risk domestic projects and ask what might have this effort and these resources done if they had been directed to a stronger drive to secure more follower sourcing"*.

This initiative also demonstrated a deep-seated weakness in the governments understanding of the wind energy GVC, particularly the dynamics supporting a follower sourcing model. The OEMs typically start this follower sourcing process through localising production of *towers*, then *blades* (the most expensive component to localise other than production of key elements of the turbine itself), and then *nacelles,* including assembly of imported components (in some cases also locally sourced inputs). Follower sourcing ensures that critical technical standards are maintained, logistic import costs are cut, and delivery reliability is maintained. But OEMs only encourage follower sourcing if a combination of systemically integrated factors is in place – sufficient market demand, and continuity and predictability of window bids over time to ensure sustained market demand is guaranteed by the country's RE programme. Moreover, if the host country has an industrial policy specifying clear and key local content requirements that need to be met, coupled with appropriate incentives, then follower sourcing will be tailored to each country context.

Follower sourcing as a key GVC strategy was confirmed in interviews with company representatives from the European headquarters and South African offices of some major wind OEMs (e.g. Vestas, Siemens-Gamesa) as well as foreign multinational first tier suppliers (e.g. GRI, LM Wind, Resolux). As one leading OEM representatives put it, *"we encourage first tier suppliers of critical components to go together into a new market either by using sticks or carrots tactics"*. First tier suppliers depend greatly on established trust relationships with the OEMs, and they therefore follow direct requests and established commitments within an OEM's follower sourcing strategy. As a blade manufacturer said: "*We have no plans to localise. The OEMs have the plan and we simply react*".

In line with this the OEMs began engaging their trusted 1st tier suppliers to establish local production plants to meet expected increases in local content requirements. After window two the multinational wind tower company GRI established a large plant in Atlantis to ensure local wind tower supply, based in part on a promise of exclusivity of supply from one OEM. A number of industry respondents and government officials also confirmed that there were advanced discussions for a large international blade manufacturing company to establish a local plant. Two international OEM's also outlined that feasibility work had been undertaken on nacelle assembly and some additional component sourcing, based on projections of a possible longer-term horizon of wind energy projects in the country.

OEMs were thus not willing to risk procuring critical high-risk first tier components from an unknown new local producer. As one local OEM representative argued, *"we did share our specifications and certification requirements with the DCD team but they were trying to do in a year or two what other global suppliers had developed in almost two decades"*. Ultimately, despite IWEC/DCD acquiring equipment and producing a prototype, it did not secure any business in the four rounds. As a former senior DTI official reflected, *"there remains a very strong view amongst the political leaders that localisation must be about indigenous firms being grown into this supply chain, but this obsession might well have cost us opportunities to bring more follower suppliers in at an earlier stage"*.

The industrial policy weaknesses within REIPPPP were not only confined to a crude notion of local spend and a misunderstanding of follower sourcing. The DTI's localisation aim was also primarily focused on manufactured items and ignored the crucial role services played in the wind energy GVC. As the consortiums and OEMs became increasingly familiar with the capabilities of domestic firms they found there were many individuals and specialist service companies that could adjust to working in the RE space despite high barriers to entry. This was summarised by management of a European OEM subsidiary which encountered *"a surprisingly capable and innovative group of technical services companies"*. A major advantage for some of these local services suppliers was that they could also access global opportunities and were not limited to the emerging South African market

The underplaying of value chain services in the local content directives was given substantial attention by industry. Whilst REIPPPP allowed for many services provided in the establishment of wind farms to be counted in the contribution to local content, this was seen amongst the policy makers interviewed to be less desirable than manufacturing. There were two features that respondents emphasised that they felt should make policy makers take the high level of local services input more seriously:

First, the wind farm consortiums used suitable local personnel and specialised service inputs from suppliers ranging from environmental studies, legal services, structuring financial deals, engineering design, location assessments and many other specialisations. A number of respondents emphasised that policy should better acknowledge and seek to support the supply of these higher-level skills. Whilst REIPPPP had not been successful in creating a domestic wind energy *manufacturing* industry, it had been relatively effective in creating a *service* industry feeding into the RE sector. Second, industry respondents argued that the local content scheme focused almost exclusively on the establishment phase, ignoring the O&M stages in the value chain which accounts for 20–30% of a project's life-time value.

The technical skills development body for the sector, the South African Renewable Energy Technology Centre explained that, although the suspension of REIPPPP had resulted in a slowing down of training services demand, both the delayed projects that were starting to become operational and the growing maintenance needs of wind farms had seen a surge in demand for technicians to do tower-based maintenance work. A number of the international and local companies employing these technicians were deploying them to sites around the world (e.g. Denmark, Australia, Vietnam and Kenya). Various industry stakeholders emphasised that ongoing plant maintenance was an important element of local spending and this was also a manifestation of local content. One respondent noted that whilst it was not necessarily essential for the local content calculation to allocate points for local spending in ongoing maintenance, it should be picked up and supported in a broader RE industrial policy mechanism since developing world class exportable skills was core to helping build the country's status as a viable base for future RE industry developments.

However, government's strong emphasis that a key measure of localisation should be about black ownership as well as the focus on the simple quantum of employment generated, rather than the specific technological capabilities associated with firms and their related employment profiles, revealed the somewhat blunt character of the local content policy scoring system utilised by the IPP office. This is apparent in a presentation of the DTI's (Green Industries Directorate) which used three

very broad policy measures to measure the programme's contribution to broader development objectives: 30% percent "shareholding by black South Africans across the complete supply chain, with 11% by local communities"; 49% local content achieved in construction, with local content measured by percentage of total value spent; 111% total amount of employment achieved during construction, being 11% higher than the set target (DTI 2016).

An OEM executive pointedly argued that compared to South Africa's successful local content programme in the automotive industry, local content within the overall REIPPPP framework was less important compared to black empowerment. In his eyes it was apparent that the DTI had either not been involved in using its sector experience to design similar local content regulations for REIPPPP, or had not seen it as integral to its industrial policy priorities. By ignoring the crucial strategic task of building capabilities and skill levels in the RE value chain and instead using very unfocused policy instruments, government diverted state industrial policy away from a targeted process of enabling a new strategic industrialisation path, and sacrificed long term industrial possibilities for short term politically vested interests. As a foreign first tier MNC executive put it: *"It appears that the objective has been mainly to employ as many people as possible, preferably woman and black employees, rather than promoting a technology industrialisation strategy per se. This is the opposite in Russia, where local component production is key".*

A senior executive lamented the South African government's tendency to be *"caught in the headlights of indigenous production schemes"*. The OEMs reiterated the importance of having built key supplier relationships with enhanced trust, sharing of knowledge, and delivery and quality reliability. Another respondent concluded in relation to these ventures, noting about the IDC funding the DCD tower initiative, *"all that public money went into a project with stakeholders with no exposure to the industry and in the end the project failed – not just because of the policy mess in government's energy approach, but also because the plant really struggled to meet quality and delivery standards associated with the engineering specifications of the turbine OEMs."*

Many business leaders remarked that having such a broad mix of disconnected elements in the economic development scoring lessened the imperative to localise manufactured inputs around turbines and associated components. In other markets local content ensured that firm investments were able to be directed to delivering on a few focal areas rather than a handful. As one respondent pointed out, *"the signals we took from the way the REIPPPP scoring was set up was that the industrialising impacts were not necessarily the most important feature of economic development. In fact, one could say there was often more scrutiny around community impact features and ownership in terms of the questions we were asked by government officials or political leaders."*

In summary, industry respondents were concerned that the local content programme's design sent problematic signals about government priorities. Local content regulations could play an important role in driving localisation if properly implemented was the OEM consensus, pointing to newly established production facilities in Morocco, Russia, Turkey which were primarily driven by targeted local content regulations. However, a number of respondents observed that in South Africa the local content elements were but one of a number of economic development deliverables that IPPs were required to meet. Local content was not a central plank of a green industrial policy to weave into an industrialisation path through South Africa's RE program. This was not surprising since its original motivation from National Treasury had been triggered by an electricity crisis focused on insufficient supply and escalating prices rather than a direct response to climate change pressure (Morris and Martin 2015). Reducing carbon emissions through a RE path was an indirect result, not a direct motivation. Consequently, introducing economic and social development issues into the scoring system had more to do with creating a broad coalition of support backing alternatives to the energy utility's (Eskom) carbon-based energy generation than a substantial attempt to use local content regulations to drive a RE industrialisation path. Local content regulations therefore appeared as one

of many socio-economic add-ons to the REIPPPP framework, rather than a symbiotic way of systemically integrating the RE framework and industrial policy into a localised industrial drive.

The absence of a broad localisation vision in government was reinforced by the comments of two of the follower sourcing suppliers to the wind energy industry. Both pointed out that an industrial policy better attuned to the dynamics of the global value chain might have given serious consideration to how plants investing in the country could use South Africa as a base for exporting into other markets and ultimately serving the future demand of RE projects in Africa. As one said, *"We do hope that the future policy space will substantially increase the allowance for wind energy in South Africa but as it stands we are not yet convinced that we can make a sustainable business of this operation. The context is challenging from so many perspectives, including somewhat ironically in terms of the reliability of energy supply."*

Shifting energy policy disrupts and fractures the South African wind energy GVC.

Meanwhile the existing political fissures in government resulted in a dramatic shift against a RE based green industrialisation drive. Ironically just as the world was decisively shifting away from carbon-based energy generation, and the South African RE framework was being internationally hailed as pathbreaking, REIPPPP was stalled. The coal lobby and carbon emission coalition backing Eskom, supported by a predatory elite inside and outside the state intent on looting state coffers had consolidated their hold on government (Morris and Martin 2015). They pushed for a drastic reduction in RE allocations and the DoE backtracked on published and projected RE commitments. This predatory elite was actively engaged in securing massively corrupt coal tenders from Eskom at inflated prices, with no due diligence exerted, and no control over delivery performance. Since their economic success depended solely on diverting state funds, they viewed the private sector driven RE programme as a competitor to be undermined and stopped (Chipkin & Swilling 2018, Morris 2017). Rather than publish a new IRP the Cabinet instead effectively suspended the REIPPPP auction bidding process. Eskom refused to sign purchase power agreements for awarded projects. Ministers and the regulatory bodies under their supervision halted signing off on any of the planned future RE auction steps (SAREC 2017). The balance of forces within government had dramatically shifted against renewable energy growth and a green industrialisation growth path (Morris and Martin 2015).

The reliability of South Africa's RE bidding process was fundamentally undermined by starting and then capriciously stopping its well-designed policy regime. Global firms interested in South Africa as a viable RE environment would not make investment decisions without long term policy reliability. They could not consolidate consortium partners, nor prepare the bidding documentation if there was uncertainty in government's energy policy over the opening of bid windows. In short, they could not fulfil their governance role to maintain GVC systemic integrity. As one IPP developer argued: *"We need an IRP with clear yearly allocations to provide policy certainty for RE investment…. At the moment we are caught between REIPPPP commitments and policy uncertainty"*.

This refrain was repeated through a number of interviews with various private sector players. Respondents repeatedly emphasized that without the systemically integrated policy guarantee of long-term **continuity** of the REIPPPP programme, coupled with a scheduled and repetitive **predictability** of the window bidding process, South Africa could not continue to attract IPP developers and investors.

The breakdown in continuity and predictability of REIPPPP's auction framework not only put a halt to the bidding process. It also cascaded down the value chain, putting the brakes on foreign firms trying to localise subsidiaries, as well as blocking domestic suppliers from taking advantage of new opportunities provided by the energy policy. Hence, it fundamentally undermined the localisation process. This connection was pithily reiterated by an OEM executive: *"predictability is key to localise production"*, and *"the stop and go policy made sure that all industry localisation gains were killed"*. The impact of the breakdown in the continuity of the REIPPPP process on the limited industrial policy

measures was noted by a public sector official: "*It caused all the hard work in developing both local supplier and follower sourcing FDI projects to be put on the back burner*".

This breakdown of continuity and predictability systemically cascaded down the value chain. The first tier MNC tower supplier was eventually forced to stop production, and sought export markets elsewhere instead. An MNC blade manufacturer halted advanced negotiations to set up a plant in South Africa. Given the "*lack of predictability in the market demand"* it was not willing to invest in building up the entire local supply chain and developing efficiencies to meet international standards. The intermittency of auctions also rippled down to second and third tier local suppliers. A wholly South African owned services company engaged across different aspects of onsite plant installation, was saved from bankruptcy through its strong trust relations with its OEM partner (Vestas) which contracted it to follow its operations in foreign locations – e.g. France, Denmark, and Sweden. A small locally owned (black) transport company providing specialised rigs to transport towers which had managed to service nearly all of the successful IPP projects was hit badly by the policy breakdown. As the owner said: *"No industry can operate on a stop/start basis …. the banks tighten financing conditions, and shorten the repayment terms because of risk .... In order for business to be stable we need continuity …"*.

In summary the breakdown of continuity and predictability in the auction bidding process had a disastrous effect on the **system integrity** of the wind energy value chain. It disrupted plans of investors across different tiers, forced major adjustment costs on suppliers, resulted in company closures and blocked new supplier initiatives, caused a shedding of carefully developed skills capabilities, resulted in major job losses, and paused important local content policy reform efforts.

This was apparent to the wind energy industry association, albeit not to government: "In order to actively support local manufacturing … government needs to ensure that the energy policy is aligned to the industrial policy in order to create a supportive environment for localisation. Most critical is the continuity, certainty and transparency with regards to future plans for the REIPPPP. This will help maintain the country's existing manufacturing facilities while building confidence to attract more manufacturing investments" (SAWEA 2019b: 5). In arguing for policy certainty and bolder industrial policy, SAWEA noted that the 'low hanging fruit' of localisation were being met but not the crucial more skilled, complex and engineering intensive localisation targets (Table 3). Any additional manufacturing of higher-value items such as blades and manufacturing and assembly processes related to turbines or their components would necessitate sufficient scale and frequency of demand commitments and some additional industry support measures.

Table 3: Local manufacturing in South Africa for wind energy projects

Type of activity/product	Tech Level	Status
Civils inputs (aggregate, cement, steel, pre-cast elements, some yellow goods (plant and equipment)	Low/medium tech	Established
Ancillary structures – fencing, building materials for temporary/permanent buildings	Low tech	Established
Grid integration – cables, distribution and power transformers, medium voltage primary and secondary switchgear, mineral oil and bio-electra oil pole mount switchgear, pylons, indoor and outdoor ring main units	Low/medium tech	Established
Towers – steel towers	Low tech	Established
Towers – pre-cast concrete tower units	Low tech	Mostly disestablished
Tower internals – ladders, cabling, lighting	Low Tech	Established
Blades	Medium tech	None
Turbines – for the commercial grid wind energy sector	Medium tech	None
Nacelles panels	Low Tech	None
Assembly of nacelles & turbine elements	Medium tech	None

Authors adapted from SAWEA and Urban Econ data.

This cascading effect down the wind energy value chain demonstrates the failure to intertwine energy policy (i.e. the REIPPPP framework) with industrial policy and its disastrous impact on the ability to achieve the systemic integration that lead firms needed to maintain GVC dynamism. Continuity and predictability was not only critical for IPP bidders to systemically sustain the RE program, it was also necessary for integrating local suppliers into lead firm strategies and driving local content down the supply chain, as well as creating the potential for building horizontal linkages to firms operating in other supply chains (e.g. metal fabrication). Without state energy policy ensuring guaranteed continuity and repetitive predictability, the stable conditions for both IPP developer investment in the bid windows **and** localised industrial expansion was severely disrupted. The success of the former guaranteed the potential for the latter.

An OEM interviewee argued that the essential problem lay in the inability of government to build a strategic relationship with the GVC lead firms. He pointed to the experience in other markets where industry and government built a common strategy allowing lead firms to buy into an operationally feasible localisation agenda. Best practice involved a joint planning process focused on developing industrialisation gains rather than, as in South Africa, a compliance box ticking exercise driven by other agendas. He called the South Africa development approach an unproductive "back-and-forth" model where government proposes something and industry tries to find a way to meet these objectives, often in an unsatisfactory manner from the perspective of a localisation strategic agenda. As industry interviewees repeatedly said, with agreement from some members of the DTI Green industries team, interactions between government and industry were wholly focused on *compliance* matters rather than on *strategic* issues.

Finally, most private sector interviewees were outspoken about the fact that, when it came to industrial policy, the levels of support that were promised in broad policy statements were not forthcoming. As one remarked: *"it seems that energy policy [to meet short term electricity supply] was dictating to industrial policy and as a result the industrial policy input tended to be much less robust"*. Respondents highlighted the failure to come up with a more substantial suite of sector-specific industrial policy instruments that would help stakeholders work with the state actors to build up South Africa's capabilities as a supplier of some manufactured components for the wind energy sector. The overwhelming sense was that despite government's intention to drive local economic development, there was an insufficient understanding of the intertwined nature of energy and industrial policy in the RE sector, ignorance of the lead firm governance role in maintaining systemic integrity of the wind energy GVC, and a strategic neglect of the fact that building a more sustainable industry could not occur outside of the dynamics driving the wind energy GVC.

Conclusion

The analysis in the previous sections has dealt with a number of conceptual and policy issues, in the process of asking what can be learnt from the South African experience. This can be captured through providing some answers to the following questions: What are the dynamics driving the wind energy GVC and are these adequately captured by our existing conceptual frameworks? How do these GVC dynamics mesh with government policy and local industrialisation initiatives? How important is aligning energy and industrial policy for localisation of industrial (goods and services) linkages? How does a failure in such alignment of government policies impact on wind energy GVC dynamics and localisation of industry?

On a conceptual level, we have argued that the existing value chain analytic frameworks do not easily capture the complex dynamics driving the wind energy GVC. As we have shown these drivers and governance dynamics fundamentally hinge on the lead developer/sponsor's need to maintain the wind energy value chain's systemic integration throughout the various phases of its life cycle. The lead firms play a crucial governance role as system integrators a) to maintain the wind energy value chain's

coherence when setting up the bid consortium, b) ensure its systemic integrity and sustainability in project managing the set-up of the wind energy plant, and c) with the OEM managing the production process itself throughout all these major phases. These dynamics, although partially present, are not captured by solely depending on the existing concepts in the GVC literature – either as buyer/producer driven, or hierarchical/relational driven, or vertically specialised/additive GVCs.

Maintaining systemic integrity has implications for the relationship between state interventions and wind energy value chain dynamics. Government initiatives to facilitate the rapid take up of renewable wind energy require meshing state energy policy with the wind energy GVC dynamics. The most critical systemic condition is that energy policy maintains a process of continuity and predictability within the wind energy auction bidding, installation, and connection process, and that this is backed by regulatory guarantee and not left to the whims of individual ministers. If policy does not ensure repetitive continuity and predictability then lead developers cannot maintain the governance requirement of system integration and the dynamism of the sector will grind to a halt.

These conditions differentiate these types of renewable energy GVCs from other GVCs discussed in the literature. The dynamics of the wind energy GVC are in the hands of private sector lead firms, constructing and maintaining system integration and the continuity of the supply chain in setting up the facility, but these dynamics are at the mercy of the government in designing, implementing, and maintaining consistency in its energy policy. As we have showed government's inability maintain continuity and predictability in regard to energy policy impacts negatively on the role of lead developers in being able to maintain the systemic integrity of the wind energy GVC, but also ensuring integrating local suppliers into the chain. This is different from the operations of other types of GVCs which are mostly grounded and rooted in private sector dynamics and influenced at more of a distance by state policy.

The GVC dynamics in the wind energy sector also have implications for industrial policy. From a green economy perspective, the wind energy GVC dynamics mean that energy policy and industrial policy are intertwined. The success of the latter feeds off the dynamism of the former, and is dependent on the state's ability to maintain continuity and predictability of the RE investment dynamic. Industrial policy which attempts to operate in a separate silo from energy policy fractures the integrity of this intertwined relationship and is hence strategically suboptimum. As we have demonstrated such disruption cascades down the value chain with disastrous effects on foreign and local suppliers.

The practical policy making implication of the above is that energy and green industrial policy cannot be formulated in a state centred vacuum. Understanding how the lead firms operate as system integrators along the wind energy GVC is critical for fashioning a synchronised (energy and industrial) policy framework. Government has to work closely with the lead firms driving the wind energy GVC to produce a mutually aligned energy and industrial policy. In terms of the latter, this requires developing an agreed, nuanced localisation policy framework requiring the wind energy lead firms (developers/OEMs) to either specify clear sub-sectoral (e.g. towers, blades, nacelle components, generators etc) goals in some sequenced process or packaged together in a refined scoring system.

Therefore, attempting to leverage localisation off the back of a growing renewable energy sector requires strategically rethinking the role of the state in stimulating green growth and aligning green industrial policy with the dynamics driving the wind energy GVC. Given that the state does not play a role in procurement in the wind energy GVC this is about developing sharper and nuanced local content regulations. Such policy should be based on a negotiated partnership with the lead firms containing measures that global companies are willing to work with. They are essentially about finding targeted ways to entice first tier MNCs to set up local subsidiary suppliers through follower sourcing and incentivise OEMs to source more from local domestic suppliers. Government should also avoid using local spend as the index of local content which leads to very thin local value added, and instead explore a hierarchically weighted local content points system based on the thickness of value added

and complexity of inputs. In addition, local content policy needs to be embedded in a supportive industrial strategy based on building support institutions and programs to upgrade local suppliers so they can meet the necessary standards and become more competitive.

The South African example throws up three conclusions in this regard. First, government has to define its localisation policy goals, setting out clear targets to increase the rate of local manufacturing and services initiatives following in the train of an expanding RE programme. If the increased localisation of these green industrialisation activities is to have any serious traction in a new growth path then it has to become a central plank, a prioritised sector, of the state's industrial policy framework. Local industrial objectives (e.g. local content regulations) have to consider the dynamics of system integration driving the wind energy GVC and be developed symbiotically with the lead firms. They cannot be ad hoc and simply tacked onto the RE bidding processes to satisfy a broad range of other dispersed social development objectives. If these overwhelm local industrial objectives then the localisation impacts are likely to be dissipated. Second, policy has to recognise that follower sourcing in part and parcel of the dynamics driving system integration of these RE GVCs, and heavily impacts on the potential for stimulating localisation of goods and services in the domestic economy. These first-tier suppliers are global MNC firms with long standing relations of trust with the OEM based on their proven ability to meet its quality standards and protocols. Industrial localisation policies which attempt to operate outside of these GVC dynamics and instead attempt to replicate ab initio first tier suppliers are likely to result in a waste of state resources, as was the case with the South African state promoting local tower and blade manufacturers. Third, services can be important high value-added activities, and localisation of value chain suppliers should not be viewed only through a manufacturing lens. This is particularly important in a GVC such as wind energy dependant on maintaining system integration, since services play an important role in constructing and maintain a consortium, as well as in the setting up of the actual plant. If the wind energy GVC dynamic is viewed as governed by system integration then it is obvious that there is therefore significant scope for building a value-added local service industry feeding into this wind energy value chain. Indeed, the evidence from the South African case is that the lead firms welcome efficient service providers and moreover are willing to take them along as exporters into other locations. However if system integration dynamics of the GVC are not take into account then the crucial role of services is likely also to be ignored within government policy.

Finally, a conclusion that is of special relevance for South Africa. Vested economic interests matter politically, and just transitions to renewable energy futures cannot be reduced to issues of policy and technical solutions. Who wins and who loses, and which coalitions are formed to facilitate or constrain a transition to a lower carbon future are a critical part of the analytic and policy landscape. The political economy dynamics that bolstered a coalition of interests stalling a renewable energy growth path remain strong within the South African state. Entrenching continuity and predictability within the REIPPPP bidding process is still far from being realised, and the auction bidding process still stutters along rather than roaring forward. Furthermore, despite the warning from an increasing number of private and public sector quarters calling for a radical shift away from a carbon intensive industrialisation path dependent on coal fired power, the ministries comprising the 'economic cluster' within government have not placed 'green industrialisation' at the forefront of any economic recovery plan. This still remains a serious challenge which the society and state will have to face in the immediate future, and unfortunately it is not clear which way the balance of forces between the various coalitions struggling around this issue will play out.

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