AN ECONOMIC AND SOCIAL REVIEW OF THE PREFERRED BIDDERS UNDER THE SMALL PROJECTS IPP PROCUREMENT PROGRAMME: A CROSS-CASE SYNTHESIS

Timothy Mew

MWXTIM001

Thesis presented in partial fulfillment of the degree of Master of Philosophy in Energy and Development Studies

Under the supervision of Andrew Marquard and Wikus Kruger

Department of Mechanical Engineering: Energy Research Centre

University of Cape Town

9th October 2019

Plagiarism Declaration

I know the meaning of plagiarism and declare that all the work in the document, save for that which is properly acknowledged, is my own. This thesis/dissertation has been submitted to the Turnitin module (or equivalent similarity and originality checking software) and I confirm that my supervisor has seen my report and any concerns revealed by such have been resolved with my supervisor.

Signed: ____________________ Signed by candidate Date: 09/10/2019

Contents

“Electric power is everywhere present in unlimited quantities and can drive the world’s machinery without the need for coal, oil or gas”

-Nikola Tesla

Abstract

The literature on the economic and social impacts of infrastructure projects, such as renewable energy projects, largely point towards these projects having positive direct and indirect benefits for the local economy, especially if the ownership, components, construction, and operation are sourced from local enterprises. The recipients of project expenditure, the location of their employees and to whom the profits accrue are essentially the factors that determine how much local economic benefit these renewable energy projects have.

With this in mind, the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) was structured in such a way that gave additional weighting to socioeconomic criteria such as job creation, local content, local ownership, Socioeconomic Development (SED) funding, and Enterprise Development (ED) funding among others. The structuring of the REIPPPP in this way highlights the overarching policy objectives in the energy sector and how these renewable energy projects have been identified by the government as a means to achieve these socioeconomic objectives.

The REIPPPP formed the foundation upon which the Small Projects Independent Power Producers Procurement Programme (SP-IPPPP) was based. The SP-IPPPP was created by the government to further localise the renewable energy industry in South Africa and give local developers and suppliers better access into this emerging sector.

This research sought to compare Small Projects under the SP-IPPPP with projects of the same technology under the REIPPPP (in bid window 3 and 4) in a cross-case synthesis. Using an embedded, multiple-case study design the commitments made by Preferred Bidders in each programme were compiled and contrasted. Following this, the results for the Small Projects were scaled-up to identify how justified the additional costs associated with the Small Projects are, given their co-benefits to the South African economy.

The findings suggest that the impact of the Small Projects on the overall price of renewable energy from the chosen cases would be negligible; and therefore, the co-benefits from these projects could justify this price premium. Even when scaled-up to the 400 MW allocated to Small Projects, the impact on the overall cost of renewables from BW3 and BW4 could be argued to have been justified by the co-benefits afforded by these Small Projects. The impact on the electricity price from projects in the scenario and BW3 and BW4 was not substantial; however, the job creation, local (national) expenditure, and community (within 50km of the project site) benefit were substantial, which may

incentivise policy makers to go ahead with the procurement in order to meet these socioeconomic objectives.

In terms of the best technology option for the SP-IPPPP, the findings suggest that solar PV and biomass (in particular) are better suited to this capacity and offer improved socioeconomic benefits without a drastic price premium. Wind energy on the other hand, appeared to have a notable price premium over the Large Projects without proportionate socioeconomic benefits and would perhaps be better left to the REIPPPP.

Acknowledgements

The completion of this research would not have been possible without the guidance of my supervisors, Andrew Marquard and Wikus Kruger. I am sincerely grateful for their time, effort, and expertise which helped me shape and refine my writing. The NRF were instrumental in bringing this research to fruition through their financial support which allowed me to give my full attention to this writing. Appreciation is also given to the IPP Office and the UCT Graduate School of Business who provided the necessary data needed to conduct this research.

Lastly, acknowledgements must go to all of the people who motivated and supported me throughout this writing process. There were times when it seemed the finish line was too distant and the proverbial road too difficult to navigate, but words of motivation and encouragement from those around me gave me the strength to forge ahead.

1. INTRODUCTION

Private investment into renewable energy technologies has surged in the last decade for a variety of reasons. Climate change mitigation commitments and the increasing competitiveness in renewable energy prices have driven the proliferation of these technologies in recent years. South Africa saw significant investment into renewable energy technologies through a competitive bidding procurement programme launched in 2011; however, renewable energy in South Africa has been on the national agenda since 1998 as an industry that should be promoted to decarbonise and diversify the electricity sector, create employment, and stimulate the economy (Department of Mineral and Energy, 1998) (Aliyu, *et al*., 2017).

The role of renewable energy in the South African economy is therefore multi-faceted, and although still at a price premium to previously-built conventional energy sources such as coal and nuclear, has been labelled as 'inherently excellent for achieving positive socio-economic objectives' (DoE, 2013c) (pp8). Following the success of the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) in this regard, a Small Projects Independent Power Producers Procurement Programme (SP-IPPPP) was launched to further localise the industry and provide smaller project developers the opportunity to participate in this field. This chapter will introduce renewable energy and the SP-IPPPP in South Africa and provide the research problem statement that motivated this research inquiry into the social and economic commitments of the 'Preferred Bidders' under SP-IPPPP.

1.1. Background

Countries around the world are faced with a multitude of challenges in their social, environmental, and economic realms. Economic growth is necessary to drive employment, generate wealth and sustain livelihoods; however, it must be done in such a way that does not compromise the ability of future generations to sustain their livelihoods. Such is the aim of sustainable development (UN General Assembly, 2015).

Sustainable development recognises three pillars, or rather three interwoven threads - economic, social, and environmental - which are all inextricably linked. Historically, as economies progress from lower to middle income status, the use of electricity intensifies (Blanco, *et al*., 2014). Hence, in a country like South Africa where coal accounts for 90% of the primary energy mix for electricity generation (DoE, 2016), an increase in affluence (GDP/capita) shows strong positive correlation to increased carbon emissions per capita.

South Africa has committed to the global climate change response through numerous pledges and policies that have been made in the past two decades. South Africa is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol of 1997 (including the Doha Amendment to the Kyoto Protocol). The President, Jacob Zuma, ahead of the Copenhagen Accord in 2009 pledged a 34% reduction in emissions (relative to the business as usual case) by 2020 and a 42% reduction by 2025 (Ecofys, 2017). Furthermore, in 2016 South Africa ratified the Paris Agreement by translating its Intended Nationally Determined Contributions (INDCs) into Nationally Determined Contributions (NDCs) to limit greenhouse gas emissions to between 398 and 614 $MtCO_{2eq}$ between 2025 and 2030, which is concurrent with the Copenhagen Accord pledge made in 2009 (Ecofys, 2017).

South Africa has furthermore committed to the Sustainable Development Goals (SDGs) in the 2030 Agenda (United Nations, 2015). The 2030 Agenda identified poverty and rising inequalities, unemployment (particularly youth unemployment), natural resource depletion and environmental degradation, and climate change as key issues for sustainable development today. South Africa had already committed to tackling these challenges in the National Development Plan, which was promulgated in 2010 and in the African Union's Agenda 2063- signifying South Africa's strong political commitment to sustainable development (Reporter, 2015)These key issues are all pertinent to the South African context, particularly unemployment as the country is currently faced with a 27.7% unemployment rate; if one were to include discouraged workers (those who have given up searching for work as a result of failing to find work) the expanded unemployment rate sits at 36.4% (StatsSA, 2017). Due to this crisis, government has placed job creation at the heart of numerous development and economic policies (Department of Mineral and Energy, 1998) (National Planning Commission, 2012) (Republic of South Africa, 2003).

The energy sector is given considerable attention in the South African sustainable development setting, due to the disproportionately large contribution of this sector (79%) to the South African greenhouse gas inventory (Department of Environmental Affairs, 2014). This has made renewable energy an important sector on the climate change agenda in South Africa, as a means to reduce the electricity sector's high carbon emissions, diversify the primary energy mix, promote low-carbon manufacturing and create green jobs (Republic of South Africa, 2011).

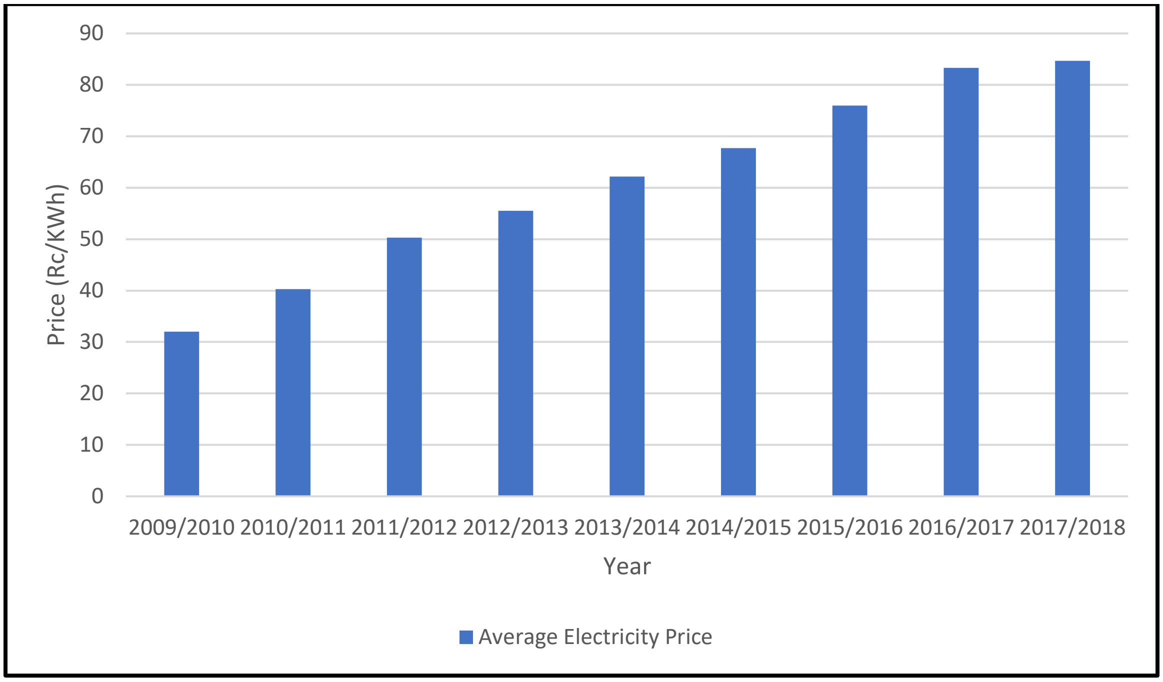
1.2. Renewable Energy in South Africa

Renewable energy has been on the South African energy agenda for many years now and has been mentioned in numerous governmental policies and plans dating back to 1998 (Department of Mineral and Energy, 1998) (National Planning Commission, 2012) (Republic of South Africa, 2003) (Department of Economic Development, 2011). Renewable energy procurement in South Africa did not get much traction until the launch of the REIPPPP as the country failed to meet the renewable energy target of 10,000 GWh (cumulatively) by 2013, as stipulated in the White Paper on Renewable Energy (2003). This was due, in part, to the economics associated with these technologies prior to the REIPPPP which were at a significant price premium to the abundant coal resources in the country (DoE, 2015). It was not until very recently (since 2013 or BW 3) that the price of electricity from renewable energy sources (with the exception of hydropower which was cost competitive) became competitive with electricity from more conventional technologies such as coal and natural gas. The first two bid windows (BWs) under the REIPPPP (running from 2011-2012) achieved weighted average electricity prices of R2.28/KWh and R1.43/KWh, respectively (Van Wyk, 2014); both of which were well above the cost of new coal power at the time (DoE, 2013a). Procurement of renewable energy was therefore not initially implemented based on its financial merits, but instead as a means to contribute positively to socioeconomic challenges and to fulfil climate change mitigation and development objectives that were, and still are, entrenched in South African documents such as the National Development Plan, The National Energy Act, The Green Economy Accord, and the Climate Change Response White Paper, among others. The socioeconomic and political rationale for the rollout of renewable energy in South Africa is explored below.

1.2.1. Economic Rationale for Renewable Energy

Eskom owns and operates 95% of the electricity generation capacity in South Africa. Most of this capacity comes from coal power plants. The old power plants, which are nearing the end of their lifespan and incurring only marginal costs, such as Hendrina and Grootvlei are currently producing the cheapest electricity at a cost of approximately R0.48/KWh and R0.58/KWh, respectively, using the levelised cost of energy (LCOE) formula (Steyn, *et al*., 2017). The cost of new-build coal is notably higher than this, with estimates for Medupi and Kusile reaching R1.70/KWh and R1.91/KWh, respectively (Steyn, *et al*., 2017). Eskom's average electricity selling price between 2009 and 2018 is depicted in Figure 1 below.

Figure 1: Eskom's historic and forecasted average nominal electricity price in 2014



Source: Adapted from DoE (2018).

The price of electricity can be seen to have increased by 120% between 2009 and 2014. When the first and second bidding rounds of the REIPPPP were conducted at the end of 2011, the average nominal price of electricity from Eskom would have been R0.50/KWh(DoE, 2018).The 2017 Eskom Integrated Report confirms the average electricity price for the 2016/2017 year as R0.84/KWh and listed the weighted average cost of renewable electricity at R2.09/KWh in that year (Eskom, 2017). The price caps for Bidding Window (BW) 1&2 of the REIPPPP were as follows:

Table 1: Price caps for renewable energy technologies in BW1 of the REIPPPP

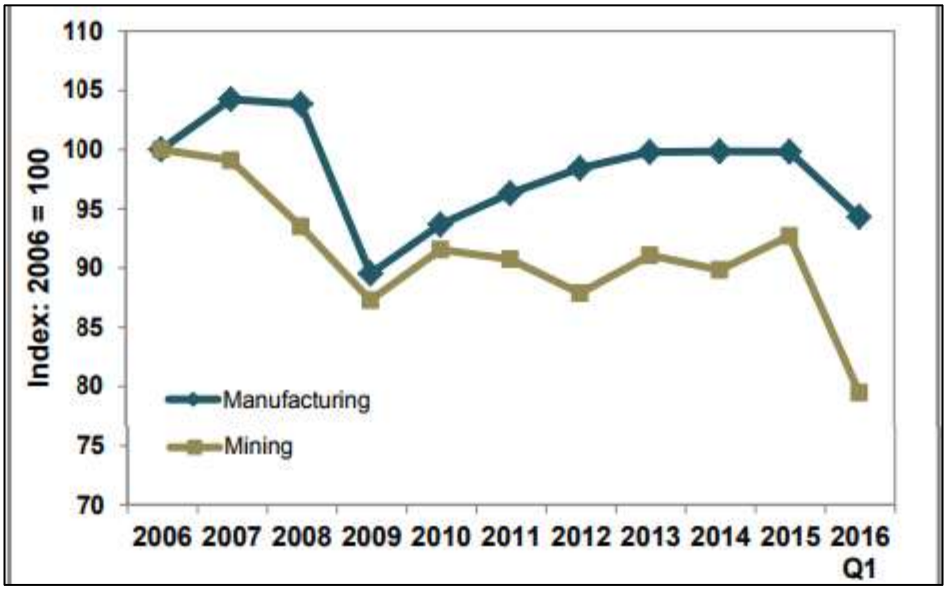
Technology	BW1 Price Caps (ZAR/KWh)	BW2 Price Caps (ZAR/KWh)
Onshore Wind	1.15	1.15
Solar PV	2.85	2.85
Concentrating Solar Power	2.85	2.85
Biomass	1.07	1.07
Biogas	0.8	0.8
Landfill Gas	0.6	0.84
Small Hydropower	1.03	1.03

Source: Adapted from Eberhard & Naude (2016).

Thus, it is evident that procuring electricity from renewable energy sources in BW1 and BW2 came at a price premium to Eskom's average electricity price at the same time, as seen in Figure 1. The only technology that was capped to prices similar to Eskom's average selling price was landfill gas, which was revised upwards in BW2 as there were no projects were awarded at that price, suggesting it was too low for bidding (Papapetrou, 2014). Instead the economic rationale for renewable energy procurement came on the merits of renewable energy in terms of achieving socio-economic objectives (boosting local manufacturing capacity and creating jobs) and reducing the carbon intensity of the sector (Papapetrou, 2014).

The South African manufacturing sector has shown a declining trend in both its total economic output and employment in the sector since 2008. Figure 2 illustrates the manufacturing output since 2006, highlighting how the sector has not since reached the same real output as in 2006. Furthermore, the number of jobs lost in the manufacturing sector between 2001 and 2014 was 82 728, which decreased the share of the manufacturing sector in total employment from 14.7% in 2001 to 11.3% in 2014 (Bhorat & Rooney, 2017). This was on the back of an existing and increasing unemployment problem in South Africa which increased from just under 22% in 2009 to around 25% when the REIPPPP was introduced at the end of 2011 (Trading Economics, 2017). The government was thus looking for a way to boost manufacturing output and employment and address the mounting unemployment problem in the country. These socioeconomic issues along with the climate change mitigation goals would have guided policy makers when setting their development goals in the three government documents mentioned below.

Figure 2: South African manufacturing and mining output trends



Source: IDC (2016).

1.2.2. Renewable Energy Political Motivation

There are three policy documents that were instrumental in enabling renewable energy development in South Africa, namely the White Paper on Energy Policy (1998), the White Paper on Renewable Energy (2003), and the National Climate Change Response Policy White Paper (2011) (DoE, 2015). The White Paper on Energy Policy pledged 'government support for the development, demonstration and implementation of renewable energy resources for both small and large-scale applications' (Department of Mineral and Energy, 1998). Importantly this document identified the potential of renewable energy to become the least-cost energy source in the future. The Energy Policy White Paper did not detail specific renewable objectives and timeframes; however, the five main policy objectives therein speak directly to the integration of sustainable energy sources in the South African energy system. As such, these objectives are worth mentioning and are as follows:

1) Increasing access to affordable energy services;
2) Improving energy governance;
3) Stimulating economic growth;

4) Managing energy-related environmental and health impacts;
5) Securing supply through diversity.

Objectives 2 through 5 clearly point towards the integration of low-carbon energy sources that are procured in a manner that maximises the benefit to the economy and its citizens through a transparent process. These goals are applicable to the entire energy sector, including electricity, liquid fuels and the gas sector.

The White Paper on Renewable Energy in 2003 saw the promulgation of the country's first renewable energy targets. The government (in this White Paper) set a target of 10,000 GWh of renewable energy as cumulative final energy consumption by 2013, which was to be in addition to the 115,278 GWh of annual energy from fuelwood and waste (Republic of South Africa, 2003). South Africa did not achieve this target by 2013, but has since surpassed this milestone as a result of the renewable energy procured by the REIPPPP (DoE, 2017). The Renewable Energy White Paper outlined the essential elements for renewable energy in South Africa to become mainstreamed, including creating an enabling environment and unbundling and commercialising the monopolistic institutional arrangement; the latter which is also echoed in the National Energy Act of 2008. Lastly, the White Paper on Renewable Energy (2003) mandated the government to adopt an Integrated Resource Planning approach which would see renewable energy resources being given an equitable share of investment to realise its potential.

The Climate Change White Paper, informed by the findings of the Long-Term Mitigation Scenarios (LTMS), identified how the country would achieve the Copenhagen Pledge made by Jacob Zuma in 2009. The climate change response was divided into sectors that were prioritised for adaptation efforts and mitigations efforts. The energy, transport, mining and industrial sectors were chosen as those prioritised for mitigation efforts. This necessitated the decarbonization of the electricity sector in particular, as it contributed significantly to the climate change impacts of the overall energy sector and paved the way for renewables to receive priority (DoE, 2015).

The National Development Plan (NDP) and the New Growth Path (NGP) are the overarching developmental plans that are applicable to many industries but that speak directly to the renewable energy industry in many instances. Table 2 provides an overview of the renewable energy objectives and target dates in each of the above-mentioned documents.

These objectives and target dates were primary drivers in the structuring and administration of the REIPPPP as the renewable energy procurement vehicle in South Africa. Lastly, the Industrial Policy Action Plan (IPAP) is an iterative document that identifies economic growth constraints and prospects and formulates an industrial plan for the country in the coming years. In the 2011/12 -2013/14 IPAP, the objectives of the IPAP included bolstering local manufacturing, skills development and employment through the green economy, and in particular emphasised the potential of localised manufacturing in the renewable energy industry (Department of Energy (DoE), 2013f). These political documents highlight how renewable energy in South Africa was positioned as a strategic industrial sector that could contribute to various developmental goals in its deployment. The cost of electricity from renewable sources at the time of procurement (2012) was notably higher than that of coal-fired power. Hence, it could be argued that renewable energy was procured on the premise that it had notable co-benefits to the country to justify its price premium over conventional electricity sources.

Table 2: Renewable Energy Plans and Policy Objectives and Deadlines.

Document	Renewable Energy Target	Date to Achieve
IRP 2011	• 17.8 GW of renewable energy capacity • 7 GW of renewable energy capacity	• 2030 • 2020
Renewable Energy White Paper	• 10,000 GWh of renewable energy from biomass, solar and wind	• 2013
National Development Plan	• 20,000 MW of renewable energy capacity • Reduce unemployment rate from 27% to 14%	• 2030 • 2020
New Growth Plan	• 35% localisation for the renewable industry • 300 000 green jobs (50 000 in the renewable energy sector) • 75% localisation in procurement for public and private sector	• 2016 • 2020 • N/A

Sources: Republic of South Africa (2011), Republic of South Africa (2003), National Planning Commission (2012), Department of Economic Development (2011).

The above policies and plans can be argued to be the most pertinent to renewable energy in South Africa, as they define the goals, governance and motivation for renewable energy in South Africa. In addition to these, there are plans that the government has promulgated which detail sector-specific outcomes and overarching social, environmental and economic objectives that are to be prioritised. The most important plan as it relates to the REIPPPP and the SP-IPPPP is the Integrated Resource Plan for Electricity (IRP) that details the future of the electricity sector in the country. The IRP was developed by the Department of Energy and acts as an implementation tool for the electricity sector. The IRP takes into account the national economic, environmental, and social objectives that are applicable to the electricity sector and formulates the future supply and demand scenarios that are most suitable for the country (Republic of South Africa, 2011).

There have been three IRP documents published to date, the first in 2011, the second (the IRP Update) in 2013, and the last iteration in 2018. At the time of writing the only IRP document to be gazetted is the 2011 IRP, making this the best to reference for electricity build plans. The Policy-Adjusted IRP devised a suitable energy mix for the South African power system which allocated 17.8 GW of renewable energy capacity, primarily onshore wind and solar photovoltaic (PV), to 2030 and a predicted installed renewable capacity of 3600 MW at the end of 2017. This capacity was to be distributed between wind, solar and concentrating solar power (CSP) as 1600 MW, 1800 MW and 200 MW, respectively (Republic of South Africa, 2011).

1.2.3. The REIPPPP

The South African government through the Department of Energy initially opted for a Renewable Energy Feed-in Tariff (REFIT) programme in 2009 as a procurement vehicle; however, it was concluded that this type of programme was inconsistent with the public procurement framework and that the tariffs offered to developers, even with revision in 2011, were considered to be too generous (Eberhard, 2013). Instead, a competitive auction programme was chosen and called the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). The REIPPPP is the vehicle through which renewable energy is developed and procured in South Africa and forms the centre piece of the RE landscape. This procurement programme makes use of a Power Purchase Agreement (PPA) in which a Single Buyer agrees to purchase all of the electricity generated by a given project at an agreed price (linked to inflation) over the lifetime of the project.

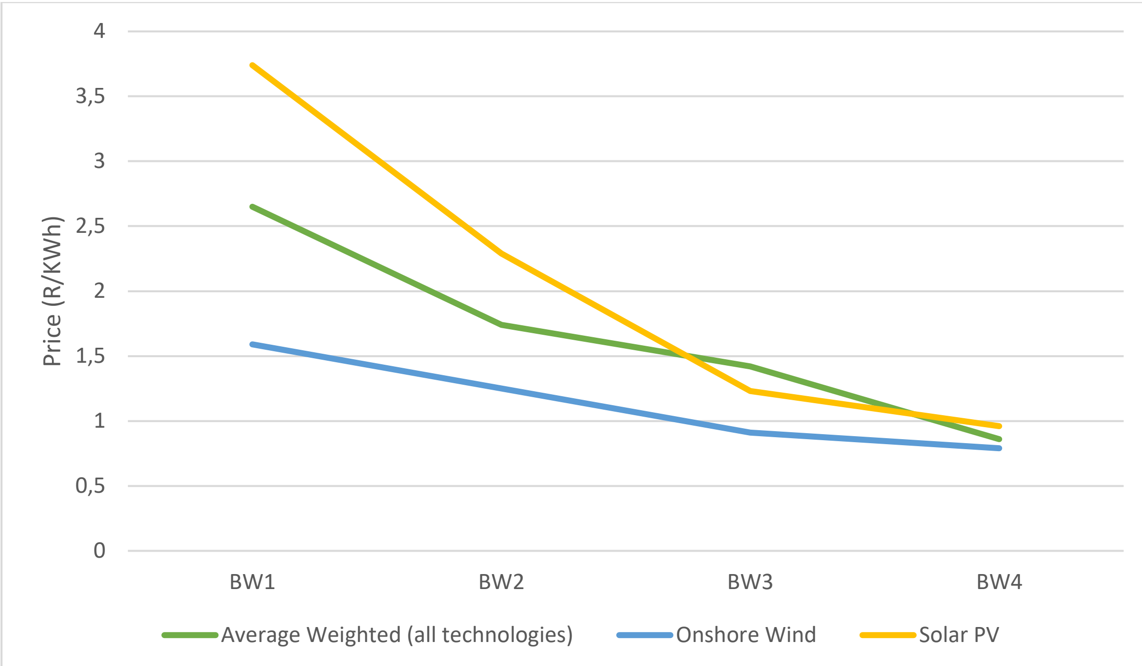
The renewable projects procured through the programme must be connected to the national grid and must therefore conform to all the grid codes and regulations of the transmission and distribution networks. The projects were to be larger than a 1 MW capacity, and were limited in maximum capacity depending on the technology; for example onshore wind was allowed 140 MW per project while biomass was restricted to 25 MW (Eberhard & Naude, 2016).

Due to the nature of the REIPPPP, being a private-public partnership (PPP), the procurement of electricity from these IPPs is subject to the jurisdiction of the Public Finance Management Act of 1999 which controls how public funds are used by the government to ensure it is used cost-effectively and in the best interest of the people. Furthermore, pursuant to the Preferential Procurement Policy Framework Act (PPPFA) of 2000, exemption was given to the REIPPPP allowing it to give the price (or electricity tariff) a weighting of 70% and the remaining 30% to 'Economic Development' obligations (Eberhard & Naude, 2016)- which is in contrast to the 90/10 weighting system mandated in the PPPFA for projects with a value greater than R50 million; meaning that 90% of the weighting when evaluating tenders is given to the price offered and 10% weighting to the achievement of specified goals such as the promotion of Small and Medium Enterprises (SMEs), job creation, and local content (National Treasury, 2017).

The decision to structure the REIPPPP in this way clearly shows that the government positioned renewable energy development in South Africa as a mechanism not only to decarbonise the electricity sector, but to contribute meaningfully to the achievement of socioeconomic goals such as job creation, skills development, local manufacturing, and rural community upliftment (DoE, 2011). In fact, Pahle, *et al*. (2016) identified the main underlying drivers of the REIPPPP to be energy security, job creation and industrial policy, which was reinforced by the then Minister of Energy, Tina Joemat-Pettersson's statement that the programme was designed to "contribute to economic growth and job creation, in addition to the contribution it makes to security of energy supply" (Pahle, *et al.*, 2016, pp 1333). The structuring of the REIPPPP in this manner is a reflection of the socioeconomic challenges being faced and the resulting plans and policies that have been promulgated to address these challenges.

The REIPPPP has been successful in procuring 6426 MW of electricity from 112 RE projects, inclusive of 99 MW from 20 Small Projects, and commissioning 3162 MW from 56 projects between 2012 and 2018. The technologies included in this programme are solar PV, onshore wind, CSP, biomass, landfill gas, hydropower, and biogas. This has attracted R200bn in total investment and nearly R50 billion in foreign direct investment, created 31 207 job years for South African citizens, and achieved more than R470 million in Socio-Economic Development and Enterprise Development contributions in the country up to 2017 (DoE, 2017). The REIPPPP has also contributed to reducing the price of electricity from renewable energy sources from an average of R2.65/KWh in 2011 to R0.86/KWh in 2015 (in 2016 Rands) as seen in Figure 3 (DoE, 2017). Solar PV has shown the most dramatic decrease in price since the start of the programme, falling by 75%. As such, the REIPPPP has been lauded as an excellent example of a PPP and as a renewable energy procurement mechanism (Yuen, 2014), and its social and economic contributions to the country are indeed commendable.

Figure 3: Decreasing cost of renewable energy in the REIPPPP (2016 inflation adjusted prices).



Source: Adapted from DoE (2017).

The REIPPPP has also succeeded in attracting considerable foreign investment; however, much of the installed capacity has been developed and majority-owned by large, multinational renewable energy companies (Baker, 2015). This trend of fewer companies dominating larger portions of each technology was becoming apparent with each Bidding Window, as the economies of scale favour fewer, larger projects that are more capable of absorbing the transaction costs of developing the project (Kolver, 2014). According to Kolver (2014), developing a Bid in any of the Bidding Windows costs between R2 million and R4 million, which when divided by a 140MW project has relatively low cost, compared to a project of only 5 MW. The cost per MW of the Small Projects is thus expected to be higher as the relative cost of bidding is greater and economies of scale reduced for these smaller projects.

1.3. Problem Statement

The development of a renewable energy industry in South Africa has been motivated by various factors internally and externally. External pressure to curb carbon emissions and strive for sustainable development resulted in the climate change mitigation commitments and the political drive towards a more sustainable energy system. This saw energy policy in the country calling for the diversification of the electricity sector away from coal and fossil fuels towards low-carbon alternatives, such as wind, solar PV, biomass etc. (Republic of South Africa, 2011). Internally, a declining manufacturing industry and high levels of unemployment have plagued South Africa for the last decade to 2018, requiring the government to devise a solution that will attract investment, boost local manufacturing and create significant jobs in the green economy. These factors combined were drivers of the renewable energy programme in South Africa and were instrumental in determining the structure of the procurement design, with the DoE (2013c) noting how the 'IPP Programme is inherently excellent for achieving socio-economic objectives' (pp8).

The REIPPPP has been reviewed and the social and economic commitments of these renewable energy projects researched in a few papers including Eberhard & Naude (2016), Stands (2015), Van Wyk (2014), Papapetrou (2014), Yuen (2014) as well as in the DoE IPP overviews that are published regularly. This has made the performance of these renewable projects in terms of price and Economic Development (ED) relatively well publicised. While this information is known, the costs and socioeconomic commitments of the Small Projects procured through the SP-IPPPP remains lesser known, having only been touched on by the DoE in presentations and briefly by Eberhard & Naude (2016), and is worth further investigation. A statement made by Stands (2015), based on Large Project estimates, that smaller projects would create more jobs per MW can also be substantiated using the information from the SP-IPPPP Preferred Bidders, which would either support or oppose this notion.

It needs to be seen how the projects under the SP-IPPPP will fare economically and socially and whether the trade-off between having smaller capacity projects that allow for more local developers and suppliers to participate in the programme can counteract the higher price due to the reduced economies of scale. It has been reported that the development cost per MW for the Small Projects is 'much higher' due to a reduction in economies of scale (Kolver, 2014). This would reflect in their overall cost per MW and result in a higher capital expenditure (Capex) and electricity tariffs per unit power than the Large Projects.

According to Kruyswijk (2012), small project developers are apparently unable to afford the development costs associated with the SP-IPPPP and struggle to fund their projects using their own equity, which therefore makes access to funding and the upfront costs unaffordable for these developers. Furthermore, it has been stated that commercial banks do not have an appetite for SP-IPPPP projects due to the small deal size, which forces the small developers to either fund the projects themselves (which is also an issue) or seek concessionary funding (Kruyswijk, 2012).

None of the Small Projects have been commissioned to date; however, these projects are in the pipeline and are waiting for the off-taker to sign the PPAs so that construction can commence (Creamer, 2017). As such, the data available for this research are in the form of legally binding project bid commitments and are not achieved values but rather proxies for future performance. The off-taker has, at the time of writing, not signed off on the PPAs for these Small projects and as it stands these bid commitments are the only usable data on the predicted performance of these Small projects socially and economically. This does, however, give an opportunity to conduct pro-active, pre-emptive research into this topic, which can be used by policy makers to make informed decisions regarding the future of the SP-IPPPP.

1.4. Research Questions and Objectives

This research seeks to review the SP-IPPPP and the Preferred Bidders that have been announced to date in terms of their social and economic commitments. The aim of this research is to ascertain for which technologies there are cost or price premiums for the Small Projects over those of the same technology in the REIPPPP; and to explore to what extent this premium can be argued to be justified by the socioeconomic co-benefits of the Small Projects. In this exploration, a recommendation for the most suitable technology options in the SP-IPPPP for meeting policy objectives will be provided. Lastly, the commitment data from the Small Projects will be scaled-up to ascertain the impact that these Small Projects would have on the overall social and economic contributions of Renewable energy projects in BW3 and BW4. The co-benefits to be explored include local content, job creation, socioeconomic and enterprise development funding. Local content will also include the amount of local finance or equity used in the projects.

This research seeks to answer this question using an exploratory case study approach. There is currently not much peer-reviewed research available on the SP-IPPPP and the socioeconomic benefits of the projects therein. This research will thus provide a foundation upon which further research can build to provide an holistic understanding of the social and economic role played by renewable energy projects in South Africa. This research is to be used for policy analysis, strictly as it pertains to decisions regarding the SP-IPPPP.

The data available for this research is limited to project bidding documents as the projects have not been constructed at the date of writing. The bid documents are legally binding contracts between the project developers and the Department of Energy and the commitments therein are regarded as legitimate proxies of future performance for each unit of analysis. There are six units of analysis in this research, namely: project cost, electricity price, project funding, local content, job creation, and community benefit. The values recorded for each unit of analysis have therefore not been realised to date but are estimates of future performance and assumed to be accurate in this research.

The co-benefits listed above are derived from the Economic Development (ED) commitments mandated in the SP-IPPPP and REIPPPP bidding documents. Bidders are required to outline their socioeconomic commitments, which must be in accordance with the minimum thresholds prescribed by the DoE in order to be selected as a Preferred Bidder (DoE, 2013c). Once selected as a Preferred Bidder, developers are obligated to fulfil these commitments or face penalties in the form of termination points, as stipulated in the Implementation Agreement (IA) between the project and the DoE (Papapetrou, 2014). If the project accumulates too many termination points for falling short on these commitments, the DoE can terminate the PPA with the project. Therefore, these commitments can be taken as a reliable indicator of the socioeconomic impacts that can be expected from these projects, once they have been commissioned.

Chapter 2 below shall review the relevant literature currently available on this topic and shall be used to identify the appropriate units of measurement for each of the parameters mentioned above. The Methodology will be discussed in Chapter 3. The findings of this research shall provide a case study on small-scale renewable energy projects in South Africa under the national procurement programme for onshore wind, solar PV and biomass technologies. These were the only technologies that have been awarded Preferred Bidder status at the date of writing and are thus the technologies in focus here (DoE, 2017). The results of the case study shall be presented in Chapter 4. A comparative analysis on the findings for the REIPPPP and the SP-IPPPP projects will then be conducted in Chapter 5 using these findings to determine which technology types proved to be best suited to the SP-IPPPP. The outcomes of the findings and the relevance to the South African renewable sector and policy makers therein shall be provided in Chapter 6, the Discussion chapter. Finally, the Conclusion and Further Research chapter (Chapter 7) shall conclude the key findings of this case study and identify the limitations, giving rise to topics of research that could build on to this and enhance the understanding of the South African renewable energy environment.

2. LITERATURE REVIEW

As a review of renewable energy policy in South Africa, particularly the SP-IPPPP and the REIPPPP, the relevance of the economic and social parameters of these projects to the overall objectives of the programmes needs to be identified. There are numerous impacts that utility-scale energy projects have on the local economy and society, and there are various measurements used to report these impacts. This chapter will identify and detail the economic and social impacts of renewable energy projects in South Africa. Additionally, the integration of these parameters into the REIPPPP and SP-IPPPP procurement procedure will be outlined to show the relevance of these parameters to the overall objectives of renewable energy policy in South Africa. From this, the justification for the procurement of Small projects under the SP-IPPPP can be argued through the analysis of the economic and social commitments made by Preferred Bidders in these programmes and their relevance to policy objectives.

In order to give relevance to the findings of this research, an understanding of the social and economic impacts of renewable energy projects must be developed. As such, this chapter seeks to identify and review these impacts in order to give context to the chosen case studies. In doing so, the overarching economic impacts of infrastructure projects in the form of employment and construction and operation expenditure will be analysed, including the value of local content in projects. Following this high-level overview, the focus will be narrowed to literature on renewable energy projects (in particular onshore wind, solar PV, and biomass) in South Africa and the empirical evidence of social and economic impacts within the economy, assessing the project value chains and the local value-added through procurement. Finally, literature on the Small Projects, including the departures in the bid structure under the SP-IPPPP from that of the REIPPPP, shall be analysed. This chapter will therefore position this research within the existing literature and will inform the research methodology in Chapter 4.

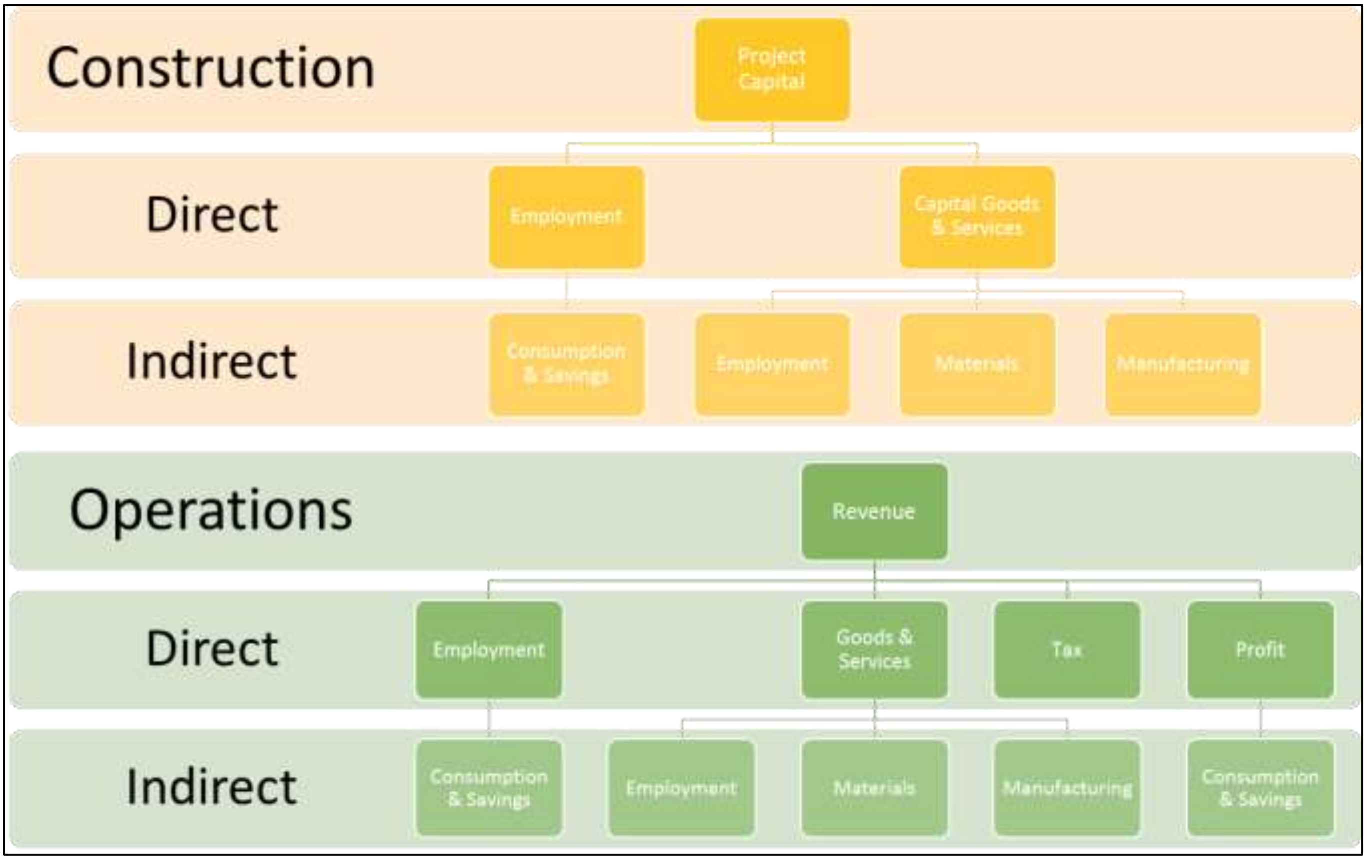
2.1. The Economics of Infrastructure Projects

Renewable energy projects, such as those proposed in the SP-IPPPP, can be classified as economic infrastructure, which require a considerable amount of up-front capital for construction. Economic infrastructure can be defined as assets or goods (physical and related services) that raise the productivity of other types of physical capital and include transport, communications, and power generation to name a few (Fedderke & Garlick, 2008). The role of electricity generation in the economy is notable as it is a necessary input into many production processes (manufacturing and mining especially) and services, and it thus pervades, either directly or indirectly, almost all sectors of a modern economy.

The impact that infrastructure projects has on the economy is dependent on numerous variables and factors, that either directly or indirectly influence growth. Infrastructure projects impact economic growth by creating a demand for goods and services in their construction and operation through expenditure; generating a public good that is used as an input in various other economic activities as a factor of production; and as an industrial policy tool that guides private investment into specific industries through PPPs (Ngandu, *et al*., 2010). All of which bolster economic growth, as long as there is sufficient demand for the product (electricity) and that the country can provide the inputs for construction and operation.

The inputs into infrastructure projects require a variety of goods and services, and mainly during construction of the project. The construction of large-scale infrastructure projects, such as power plants, requires considerable amounts of materials and minerals (steel and concrete), specialised equipment (turbines, generators, inverters), labour, and funding. The providers of these goods and services therefore directly benefit from the infrastructure investment as the projects increase aggregate demand for their products and services. Additionally, infrastructure projects create an output (for example, electricity) that is then sold to consumers and generates revenue. This revenue provides a return on investment (ROI) for the investors and covers the cost of capital and operation (including employee salaries and taxes). These are the fundamental principles of Keynesian economics wherein an increase in investment spending results in an increase in employment in businesses providing the capital goods during construction, as well as increased employment during the operation of the project. This increases the aggregate income in the economy which will in turn drive consumption expenditure in other sectors resulting in further employment in those sectors- thus creating cycles of expenditure which grow the economy (Keynes, 1936).

Figure 4: Illustration of the direct and indirect impacts that infrastructure project expenditure and revenue have on the economy.



Source: Authors adaptation of Vukeya (2015), Keynes (1936), Perkins (2011), Perkins, *et al*. (2005) and Fedderke & Garlick (2008).

Figure 4 illustrates the simplified flow of money throughout the life cycle of an infrastructure project. During the construction period there is the creation of direct employment to perform, oversee and coordinate the construction process as well as considerable expenditure on capital goods and services that creates a spike in demand. The demand created for these products and services indirectly increases job creation and demand along the supply chain for the finished goods to be used in the project. It is during the construction period of capital-intensive infrastructure projects where there is the greatest impact on the local economy (Ngandu, *et al*., 2010). This is due to the construction comprising and the fact that construction has been found to provide a large stimulus to overall household income, when compared to other activities (Ngandu, *et al*., 2010). Using structural path analysis, it has been found that the construction sector in South Africa spends 13% of its budget on labour, 5.6% of which is on low-skilled labour (Ngandu, *et al*., 2010). This makes the construction sector a valuable and politically important sector to stimulate, due to the magnitude of multipliers or the positive economic feedback effects associated with this sector. The construction industry is noted for increasing demand for manufactured/processed materials which, if localised, has significant economic impact (Tregenna, 2008).

During the operations phases, depending on the type of infrastructure, the major economic impacts include employment, goods and services (primarily in the form of fuel for conventional energy projects), taxes, and the profits arising from the sale of the product or services. Employment, as mentioned earlier, increases the income available for consumption and savings and if given to those previously unemployed has significant benefits for the surrounding economy in the form of increasing aggregate demand (Vukeya, 2015). The taxes paid, including municipal rates, income tax from employees and corporate tax, all boost the government revenues which (ideally) translates into more public expenditure on social and economic infrastructure. Lastly, the profits, net of tax, are accumulated from the sale of the goods or services of the project and are then used at the discretion of the shareholders to pay dividends, reinvest in further projects or to expand current projects, all of which indirectly increase aggregate demand in the economy. The benefit of localising the shareholders, to which these dividends accrue, is thus important to ensure that the profits are actually reinvested or spent in the country of the project and not withdrawn from the local economy and utilised abroad.

Manufacturing is viewed as an activity subject to increasing returns, wherein the unit cost of production decreases as volume of output increases; and is in opposition to activities exhibiting diminishing returns. Mathews & Reinert (2014) postulate that successful economies of the modern era were all based on manufacturing which attracts increasing returns through improved economies of scale (mass production) and specialisation; as opposed to economies dependent on activities of diminishing returns, such as mining and agriculture, where the cost of extracting raw materials increases as reserves are exhausted. Manufacturing employs scale and innovation to achieve increasing returns where for an additional input added, there is a greater than proportional increase in output, and when the manufacturing value chain is contained within an economy these increasing returns propagate throughout the chain creating a virtuous cycle, according to the economist Kaldor (Mathews & Reinert, 2014).

Kaldor describes manufacturing as an engine of sustainable growth that ‘pulls along’ the economy more so than other sectors, due to the innovation and inter-sectoral linkages between manufacturing and non-manufacturing sectors (Tregenna, 2008). Manufacturing is incredibly important for economic growth in South Africa and although in terms of employment potential per unit of final demand it ranks lower than the services sectors on average, it has been found (in terms of demand for inputs) that the manufacturing sector creates more demand for business services than the other way around (Tregenna, 2008).

The flow of money depicted in Figure 4 from the given project, in the form of personal income, expenditure, taxes and profit, gives economic benefit to the jurisdiction in which each of these elements falls; meaning that the country in which the income and expenditure occurs is the receiver of the economic benefit. Therefore, the economies in which the manufacturing, employment, and ownership occurs are the recipients of the positive 'chain reaction' and is the reason why many governments, including South Africa, impose local content requirements (LCR) for infrastructure projects in an attempt to stimulate the local economy and reap the benefits of these 'chain reactions'. Furthermore, the socioeconomic effects of renewable energy development have been found to be maximised when a sizeable portion of the manufacturing takes place in the country (Simas & Pacca, 2014). The theory and implementation of LCRs is detailed below.

2.1.1. Local Content Requirements

Many countries are using LCRs as a development strategy to encourage foreign investors to procure an increasing share of their goods and services from local suppliers. There are many different methods to enforce a LCR, such as legal requirements for foreign businesses to establish facilities in a given territory, minimum thresholds on the amount of locally-sourced expenditure for capital investment under PPPs, or quotas needed to qualify for government subsidies (UNCTAD, 2014). In low-income countries dependent on mining and agriculture, there is a need to diversify the economy away from traditional activities towards new sectors and technologies that will offset mineral depletion, diversify the economy and offer greater employment opportunities. Foreign direct investment from multinational businesses are needed to bring the required capital, knowledge and access to markets into these countries; however, LCRs are implemented to ensure that these companies do not outsource the capital and skills from their own countries, giving the target country little economic and social benefit (White, 2016).

There is considerable debate regarding the efficacy of LCRs in delivering their intended results. A report by Stone *et al*. (2015) found that LCRs cause a number of social and economic problems and fall short on delivering industrial and technological development and employment gains. They argue that LCRs artificially support uncompetitive industries, increase the domestic costs of goods and services, reduces trade and deters foreign investment. Moreover, LCRs have been found to be ineffective in some cases where the local suppliers did not have the capacity to be able to successfully participate in large-scale programmes, such as the REIPPPP (Macatangay, 2016).

Findings from other studies have found that LCRs do in fact offer economic advantages to the specific country. LCRs have been found to strengthen the local industrial base, improve a given country's balance of payments, increase employment in target industries, and to enforce the cession of power and market advantages from large multinational firms to domestic firms (Kuntze & Moerenhout, 2013).. Lastly, LCRs have allowed developing countries to 'leap frog' existing barriers to technology transfer in industries that are highly sophisticated, such as renewable energies, by implementing LCRs in investments in new industries (UNCTAD, 2014).

Johnson (2015) goes on to further state that successful LCRs should focus on technologies and industries for which sufficient technical expertise and manageable market entry barriers exist, otherwise the domestic industry will struggle to gain traction and meet the demand. A pre-condition for successful LCRs is therefore to have a market that is stable and sizeable so that there is sustained and sufficient demand for the product (Ettmayr & Lloyd, 2017). A product that is pervasive throughout many industries and sees increasing demand as economic growth occurs is therefore an optimal industry to target with LCRs, which makes the energy sector a particularly suitable industry in this regard.

2.2. The Value-Add of Renewable Energy Projects

Value-add or value creation refers to the processing, refining, and/or conversion of raw materials or existing resources into new, more valuable products (MWGSW, 2011). Renewable energy projects, like other infrastructure projects mentioned above, create value through investment (capital), expenditure, job creation (employee income), tax revenue, and profit generation. This value is created at the place of origin or where the materials are produced, meaning that if the project is owned by foreign shareholders, the profits are going to be channelled outside of the operating economy and the value-add will be realised in the shareholders' locale. Furthermore, if the goods and services (human capital) are imported for use in the renewable energy project, much of the value creation is being realised outside the local economy of the project.

The value chain of a renewable energy project therefore spans from cradle to grave and incorporates all the value creation with each step of the project, from conception through the design, manufacturing and installation, to operations and maintenance (O&M) and finally decommissioning (IRENA & CEM, 2014).

The upstream (before O&M phase) value chain for solar PV, onshore wind, and biomass have similar steps, although with varying value creation at each step. Biomass, however, in the O&M phase may have a stronger impact on the local economy. This is due to the demand for harvesting raw materials (bagasse, wood and other organic materials) needed to generate electricity which increases the demand for agriculture and transportation (Cebotari, *et al*., 2017). The value chain of renewable energy projects is detailed below.

2.2.1. Renewable Energy Project Value Chain

Common to all three technologies are the steps of project realization and the supporting processes that enable the project to reach commercial operation and generate electricity. Figure 5 details the steps in the value chain, each with varying amounts of value creation for the economy. Each of the links along the value chain adds value to the economy in which it occurs and the extent to which the local economy benefits from a project depends on the extent to which these linkages are localised in the target economy (IRENA, 2017a). The variations in the value chain between the three technologies, solar PV, wind, and biomass, result in the cost differences in these technologies.

The costs of these technologies are an important economic consideration and has often been cited as a barrier to entry for renewable energy. Achieving economies of scale, by increasing the size of the power plant, reduces the per unit cost price of these projects but it also requires significant capital investment upfront and requires a high degree of specialization to manufacture, which can exclude small businesses from participating as they are either inexperienced in this field or struggle to raise the needed finance. This has been particularly noted in South Africa (Painuly, 2001) (Nhamo & Ho, 2011). Globally, there is an oversupply of renewable energy manufacturing capacity which has contributed to the reduction in the cost of renewables, but which has made the profitability of establishing local manufacturing facilities difficult- thus limiting the potential for fledging renewable energy industries to localise their renewable energy value chains (Eberhard, *et al*., 2014).

Figure 5: Renewable Energy Project Value Chain and Supporting Services.

Source: IRENA & CEM (2014).

The size and infancy of the renewable energy industry impacts how localised each of these segments are in a given economy. In a newly established industry, project development, manufacturing and installation all show low localisation potential due to the complex nature of these steps which require high degrees of specialisation and skills (IRENA & CEM, 2014). In a small country with a newly established renewable energy industry, the demand may be too small to make the establishment of a manufacturing industry feasible for domestic use only. This is compounded by the fact that there is already excessive manufacturing capacity available globally in wind and solar PV (IRENA, 2017a) (IRENA, 2017b); however, industries not specifically involved in the renewable energy industry can be leveraged to localise value-add in renewable energy projects. For example, the structures and equipment used in renewable energy projects require usable steel which can be localised if a local steel processing industry exists (MWGSW, 2011), or if debt financing is required local banks can provide this service to projects.

The accumulated value creation from each of these segments culminates in the overall value-add and employment (both direct and indirect) of the renewable energy project. The more localised the value-chain of a project, the greater the positive impact on economic growth in that country. Hence, the portion of the capital expenditure that is spent in the target country is reflective of the economic benefit that country receives from the project. For the purpose of this research, the economic impacts of renewable energy projects mentioned in the sections above can be condensed to the following:

1. Capital expenditure which ultimately determines the project cost for each of the technologies;
2. The electricity tariff committed to by each project;
3. The source of finance for the renewable energy projects; and
4. The extent to which the capital costs of the project are sourced from local suppliers and therefore contributing to local economic growth.

The social impacts of solar PV, wind, and biomass projects in this research are concentrated on the following:

1. The employment generated by each technology, and the portion of employment that is derived from Black citizens and Community members; and
2. The contributions of these projects towards community trusts and/or local development organisations from project earnings, as a measure of community benefit.

To this end, an evaluation on the available literature on the costs, local content, employment and community benefit of renewable energy projects shall be reviewed below before outlining the commitments made for these parameters by developers under the REIPPPP.

2.2.2. The Costs of Solar PV, Wind, and Biomass

One method of quantifying the total costs of a given energy technology is the levelised cost of electricity (LCOE) which factors in the total costs of a project throughout its lifespan and dividing this by the total energy production of the power plant throughout its economic life (IDC, 2012). This yields a cost per unit of energy produced and allows for the effective comparison of the various energy technologies. The LCOE is therefore strongly influenced by the upfront costs and the economic lifespan of the project, as well as the project capacity factors, renewable resources (radiation, feedstock and wind), and efficiency losses in operation (IRENA, 2015).

The Capex of a renewable energy project comprises all the costs incurred during project planning, installation and grid connection, including the finance costs and contingencies during construction (IRENA, 2018). Overnight capital per unit capacity is often listed when comparing the upfront Capex of the different energy technologies but it must be noted that overnight capital does not include finance costs (IEA, 2015) (IRENA, 2018); hence overnight capital represents the total Capex costs of a projects minus the cost of finance, which includes interest during construction. This interest during construction predictably has a much greater impact on projects with longer lead times, such as coal or nuclear, versus technologies with shorter lead times such as solar PV. The Capex costs of a given technology varies by project location and project size due to differences in the equipment/technology used, cost of capital, import tariffs, transport costs, and labour costs, among many others. Seeing as though none of the projects being examined in this research are operational at the date of writing, the Capex is the metric that will be used to compare the costs of the Large and Small projects of the three technologies.

The Opex costs for these technologies will include the costs of all permanent labour, cleaning, maintenance, security and fuel costs in the case of the biomass plants. Solar PV has the lowest Opex costs while biomass and wind energy have a similar Opex costs relative to the overall project cost (IRENA, 2012c) (IRENA, 2012b). Opex is expressed as fixed and variable, with fixed O&M costs being dependent on the capacity of the project including labour, routine maintenance, insurance etc. Variable O&M is dependent on the amount of energy produced and expressed as a cost per unit energy produced and includes replacement parts, scheduled and unscheduled maintenance costs (IRENA, 2012b). Biomass power plants also have additional fuel costs to consider, which adds to the LCOE from this technology.

For solar PV plants, the Capex costs have historically comprised the majority of the total cost. The O&M costs are significantly lower for this technology as there are no moving parts and the relatively simple engineering (IFC, 2015). The solar PV modules typically comprise 30% of the total project CAPEX and up to 60% falling under the Balance of System (BoS), which includes the mounting structures, cabling, grid connection, and installation costs. The BoS expenses can often be localised which represents a significant opportunity for solar PV projects to stimulate the local economy and create indirect jobs (IRENA, 2017b).

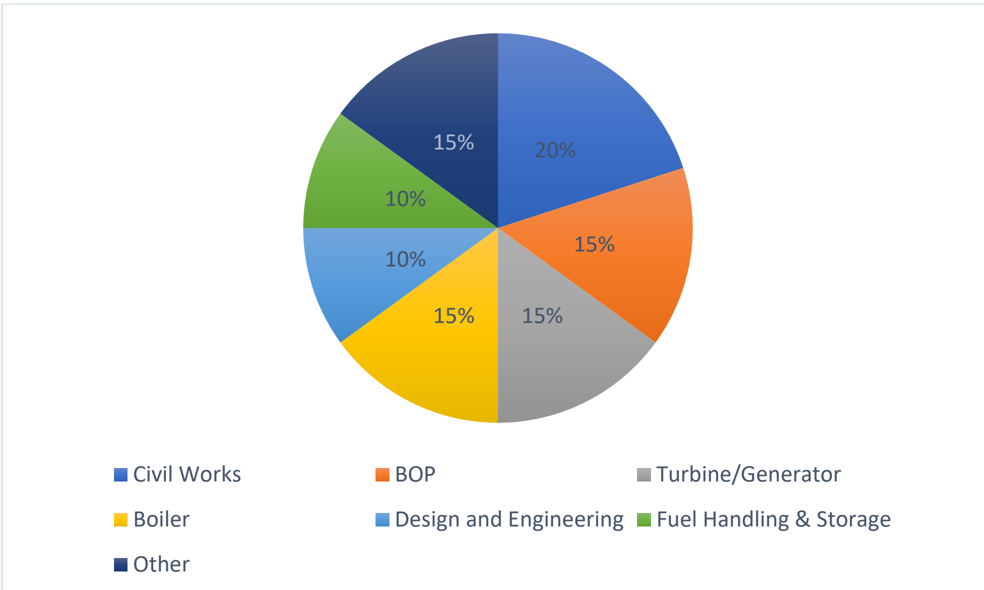
When it comes to wind energy, the main costs during construction is attributable to the manufacture and installation of the wind turbines. These two components in the value chain represent up to 84% of the Capex costs (Slattery, *et al*., 2011) (IRENA, 2017a). The tower (26%), rotor blades (22%), and gearbox represent the most value-add in the wind turbine (Blanco, 2009). It is thus evident that in order to receive significant local economic benefit from wind energy development in a country, the localisation of these components is the obvious priority.

Wind energy has become increasingly cost competitive and now offers some of the lowest electricity prices on the market, including conventional electricity generation technologies. While not decreasing at the same aggressive rate as solar PV since 2010, wind energy has seen the average LCOE drop substantially (IRENA, 2015). Moreover, most wind projects developed today fall within the LCOE range of new-build fossil-fuelled technologies, such as coal and gas.

Biomass for electricity generation incorporates a wide variety of technologies, some of which are mature, highly cost-competitive and dispatchable. The SP-IPPP RFP makes a clear distinction between biomass, biogas, and landfill gas suggesting that biomass cannot make use of landfill gas or anaerobic digestion technologies even though these fall under the broad definition of biomass plants (Department of Energy (DoE), 2013f). As such, biomass technologies for this research include direct combustion boilers, co-firing, combined heat and power (CHP) plants, and gasification plants. The LCOE of a biomass plant is dependent on the type of technology used and the feedstock, which varies depending on availability and the quality (moisture and energy content) (IRENA, 2015). The cost of feedstock is paramount for a biomass project as it can make up 40-50% of the LCOE for the project (IRENA, 2012c).

The Capex is broken down as depicted in Figure 6, and shows that the costs are a lot more evenly spread for a biomass plant than for a solar PV or wind project, especially the latter. The biggest component accounts for 20% of the overall investment cost versus the turbines which can contribute to over 80% of the investment cost. It could be argued that this gives a greater opportunity for localisation in this value chain as the value-add is a lot more diverse and spread across multiple sectors (manufacturing, construction, logistics, finance etc.) which could leverage existing industries and skills from other sectors. It must be noted, however, that the Capex represents a smaller portion of the LCOE for biomass energy. The IFC (2017) found that biomass plants exhibited notable cost reductions with increasing capacity, suggesting that greater viability is achieved at projects 1 MW and greater.

Figure 6: Capex breakdown for a utility-scale biomass plant.



Source: Adapted from IFC (2017)

These three technologies (wind, solar PV, and biomass), at utility-scale, are all able to compete within the cost range of conventional fossil-fuel technologies currently, particularly nuclear plants and diesel engines (Lazard, 2017). Achieving cost parity is a major barrier for renewable energies as the economies of scale, high transaction costs, non-consideration of externalities, and conventional energy subsidies have undermined the viability of renewable energy historically (Painuly, 2001). Viability is indeed a necessity for the widespread adoption of these technologies; however, dispatchability and the socioeconomic impacts of a technology in a country like South Africa are also high on the agenda when evaluating the value of a given technology. To this end the socioeconomic impact, in terms of job creation and local economic impact, shall be discussed below.

2.2.3. Renewable Energy Job Creation

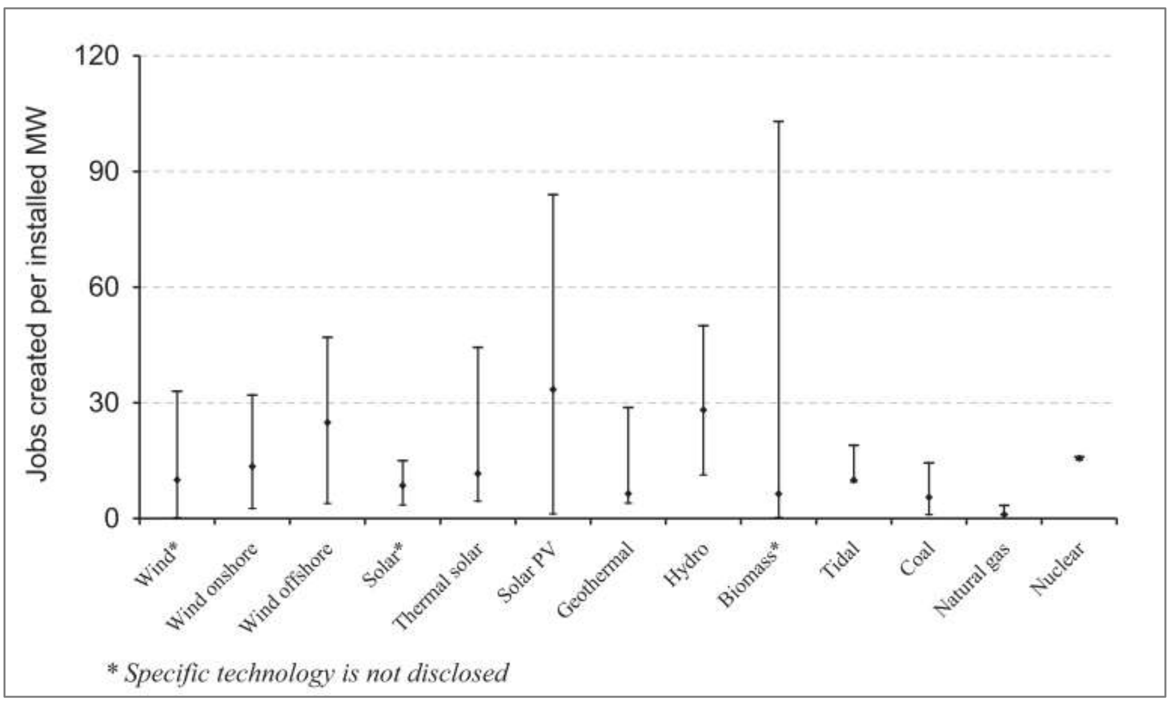
Renewable energy deployment can have numerous economic and social benefits in the territories where they are located. The major socioeconomic impact of renewable energy development is the impact it has on jobs in the energy sector. Some studies have found the job intensity, that is jobs per MW, of renewable energies to be greater than that of conventional power plants and up to four times more than coal (Llera, *et al*., 2013). Moreover, renewable energies, due to the lower energy densities of their inputs (radiation, wind and biomass fuel) compared to fossil-fuels, tend to be located in more rural and isolated areas. During construction and operation, these projects provide an economic and employment impetus in these rural areas which boosts the economy in that community, provided employment and procurement of goods are directed at the community. This is important for countries trying to curb high rates of urbanisation and increase the role of rural areas in the economy.

Jobs are created in each stage of the value chain, but to varying degrees. The construction, installation and commissioning stage creates a high number of jobs, but these jobs are of temporary nature (Llera, *et al*., 2013). Conversely, the O&M phase creates stable (permanent) jobs, however in a smaller volume. When reporting job creation statistics for renewable energies the construction jobs are often reported as full-time equivalent (FTE) or as person years (PY) per MW, where one PY represents a person working 160 hours per month for a 12-month period (Stands, 2015). Jobs in the O&M phase are often reported simply as jobs per MW. Some studies report job creation as jobs (FTE) per GWh of energy produced by the technology. Furthermore, studies may total the jobs created in the construction, manufacturing and installation (CMI) and O&M phases and aggregate it over the lifespan of the projects (between 20 and 30 years), yielding simply a jobs/MW result.

Direct jobs refer to all the people employed in project activities, such as manufacturing, planning and development, installation, commissioning, and O&M. Indirect job creation includes the job creation in the processing and extraction of the project materials (steel, silicon, copper) and the tertiary (finance and legal experts) services provided to the project. Lastly, induced jobs are the jobs created by the expenditure of salaries from those employed by the project and are often in the hospitality, food and beverage, and general services industries (Simas & Pacca, 2014) (Cameron & Van der Zwaan, 2015). For the purpose of this research the job creation figures for each technology and project represent direct employment as defined in the REIPPPP RFPs (Stands, 2015). Hence, the employment impact evaluated here represents the first level ('Direct') in Figure 4, and does not reflect the wider, indirect and induced impacts that these projects may have on the local economy.

Figure 7 illustrates how wide the variations in the employment factors are for each technology due to variations in project countries, installed capacity, and the data included (direct, indirect and induced jobs) (Simas & Pacca, 2014). Biomass has a significant range of employment due to the variety of technologies under this category, each with varying employment factors. The diamonds represent the mean value for each technology, and it can be seen here that renewable energies have, on the par, higher overall employment factors than their fossil-fueled counterparts, with solar PV creating the most jobs. This research, however, requires a more detailed breakdown of the jobs created by each of these technologies, which is done in the sections below.

Figure 7: Overall job creation ranges for various energy technologies.



Source: Simas & Pacca (2014).

Construction Phase Job Creation

The installation and grid connection phase offer the greatest potential for localisation of jobs, even though it is not the most job intense phase of the solar PV value chain. This is because labour from the construction and electrical services industries, which are low- to medium-skilled personnel and thus readily available in many countries, can be used here (IRENA, 2017b).

Simas & Pacca (2014) reported that construction, not including manufacturing, created the most jobs in wind development, while Slattery *et al*. (2011) found that turbine and supply chain activities were responsible for 58% of jobs in the CMI phase on their case studied wind farms.

The manufacturing segment of the value chain, while offering more employment potential than the installation and grid connection segment, is dominated by Asian countries who export the equipment used in many solar PV projects globally (Llera, *et al*., 2013). The dominance of Asian countries regarding wind turbine manufacture has also been found by Cameron & Van der Zwaan (2015), which has limited the ability of projects to localise employment in this segment of the wind value chain too.

Importing the equipment threatens the local employment factors of these renewable energy technologies and in the case of wind power, imports could reduce up to 40% of all local jobs (Simas & Pacca, 2014). Localisation is further inhibited by the current overcapacity in solar equipment production which has been responsible for the declining prices of these materials, especially the solar PV modules (IRENA, 2014). This is why local job creation as opposed to total job creation is highly important when evaluating the local economic impact of a renewable energy project, as the jobs created abroad add very little economic value to the host country.

An average CMI employment factor for solar PV of 31 PY/MW has been calculated when considering the results from Barros *et al*. (2017), Cameron & Van der Zwaan (2015), IRENA (2017b), IRENA (2014), Maia (2011), Kammen *et al*. (2004), Llera *et al*. (2013), Moreno & Lopez (2008), and REN21 (2011). Aggregating the findings from (Simas & Pacca, 2014), (Cameron & Van der Zwaan, 2015), (Hondo & Moriizumi, 2017) and (IRENA, 2017a), wind CMI employment is estimated at around 9.6 PY/MW in the CMI phase. Lastly, biopower was estimated to generate 8.7 PY/MW in the CMI phase according to (Barros, *et al*., 2017) (Kammen, *et al*., 2004) (Singh, 2001).

Operation Phase Job Creation

Findings from studies on employment in renewable energy technologies estimate the O&M phases to contribute to between 40% and 60% of the overall employment generated by solar PV energy projects, the balance being generated in the CMI phase (IRENA, 2017b) (Llera, *et al*., 2013) (Hondo & Moriizumi, 2017).

Studies relating to wind power employment reported that the O&M phase, while not job intensive, contributes significantly to the overall employment potential. IRENA (2017a) estimates the O&M phase to contribute as much as 43% of the overall FTE jobs and Hondo & Moriizumi (2017) reported a figure of 50%.

In terms of localisation, installation and O&M jobs are noted as having a high propensity to use local labour, while manufacturing in many cases has been imported from abroad and therefore does not have much impact on local job creation (Cameron & Van der Zwaan, 2015). In fact, OEMs may stipulate in their warranty conditions that their employees be used for maintenance, which with an increasing degree of automation in the operations means that local O&M job creation may only become apparent after the OEM warranty period is complete (Munday, *et al*., 2011).

Biomass power plants, unlike solar PV and wind, are reliant on a sustainable and suitable supply of fuel, be it wood, straw, agricultural waste among other things, which provides additional opportunities for job creation in its value chain. It has been said that biomass energy generates more permanent jobs due to the linkage with the agricultural sector for its operation than wind energy, where the jobs are often temporary for construction and abroad for component manufacture (del Rio & Burguillo, 2008).

To this end, they found up to 90% of employment opportunities (using wood) were created in the O&M phase (including fuel) and that the form of employment offered was ongoing and regular in nature. Lastly, biomass fuel value chain has been reported to be more job intensive than that of non-renewable fuels, due to the fact that biomass feedstocks have a lower energy density per unit mass than their fossil-fuel counterparts which increases the biomass power plants' fuel consumption (Barros, *et al*., 2017).

The average annual O&M employment factor for solar PV is 0.73 jobs/MW/annum using the results from Barros *et al*. (2017), Cameron & Van der Zwaan (2015), IRENA (2017b), IRENA (2014), Maia (2011), Kammen *et al*. (2004), Llera *et al*. (2013), Moreno & Lopez (2008), and REN21 (2011). Wind energy estimates averaged to 0.32 Jobs/MW/annum in the O&M phase according to Simas & Pacca (2014), Hondo & Moriizumi (2017), Cameron & Van Der Zwaan (2015), and IRENA (2017a). Biomass, as expected due to the link to agricultural inputs mentioned above, had the highest aggregated O&M employment estimate of 2.15 Jobs/MW/annum (Barros, *et al*., 2017) (Kammen, *et al*., 2004) (Singh, 2001).

While job creation is a major socioeconomic indicator for infrastructure and indeed renewable energy projects, it is not the only measure of the local economic benefit that these projects can deliver. As mentioned in Section 2.1 above, procurement expenditure and the expenditure and/or reinvestment of project earnings are fundamental in determining the economies which benefit from the project. The local impact of renewable energy projects is thus determined by the amount of local jobs created and also procurement expenditure, and socioeconomic contributions made by the project from inception to decommissioning. Localisation of procurement expenditure for renewable energy projects is explored in the sections below.

2.2.4. Local Economic Impact of Renewable Energy Projects

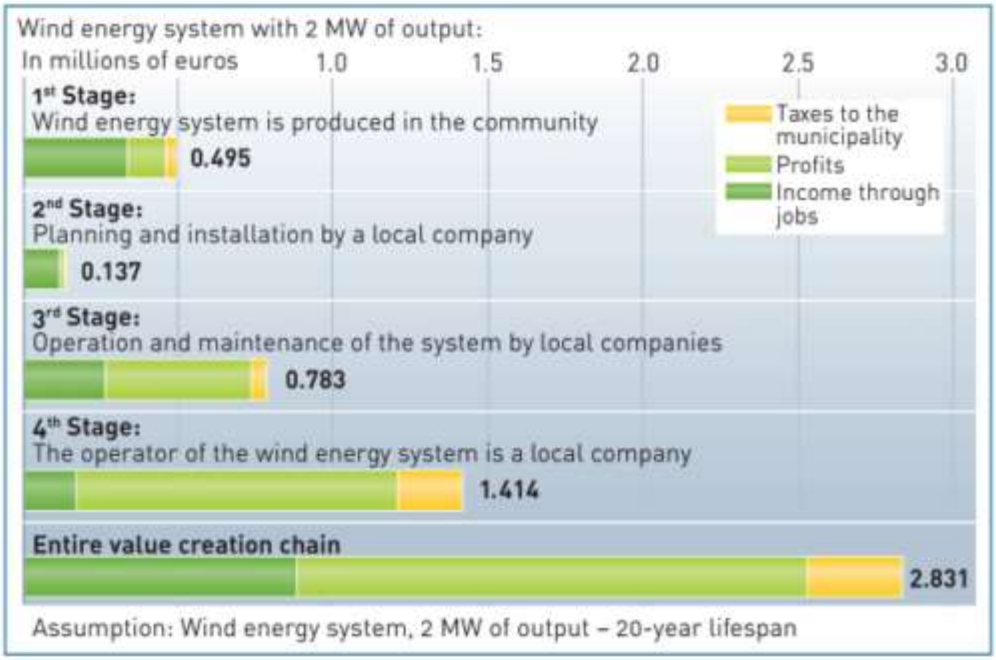
In addition to the jobs created by a renewable energy project, these projects contribute towards the diversification of the rural economy, local production, integration of rural communities into the national economy, reduction in energy dependence, and investment into social and economic infrastructure (including schools, healthcare, enterprises, roads etc.) (Shoaib & Ariaratnam, 2016) (del Rio & Burguillo, 2008).

For the purpose of this study, we are looking specifically into the expenditure of projects in local businesses, ie. local procurement and the socioeconomic funding reinvested into the communities from the project.

The extent to which developers procure components and labour locally is largely determined by the availability and cost of local parts and labour, and the extent to which local content is mandated in the bidding regulations.

Figure 8 breaks down the economic impact of each stage in the value chain if these companies were to be located and owned within the local municipality. The value derived from localising the ownership of the operator (developer) represents the majority (approximately 53%) of the total economic impact of the project over its lifespan (Muhlenhoff, 2010). This emphasises the importance of local ownership of these renewable energy projects, as the bulk of the value created is derived through the profits or dividends flowing from the project. The next best scenario for the local economy is to localise the O&M contractor which represents 28% of the overall value created by the project and offers much higher profit margins (overall) than the CMI phases in this figure. The income of the employees in the project represent approximately a third of the total economic impact, highlighting how important localising the projects is for realizing local economic benefit from these renewable projects, due to the direct and indirect employment generated in the value chain.

Figure 8: Local value creation from a 2 MW wind project in Germany.



Source: Muhlenhoff (2010).

A study by Allan *et al.* (2011), using a Social Accounting Matrix (SAM), found that a 5% increase in local content (up to 20%) corresponded to an average GDP increase of 1.37% and an average increase in local employment of 13.5%. Highlighting how increasing local demand for goods and services ripples through the local economy and adding value economically and socially. 'Local' in this context refer to province in which the projects were constructed which would fall outside the community definition in the REIPPPP and SP-IPPPP but would still be considered 'local' (national) in terms of the project's Economic Development reporting.

Community Benefit Funds

Utility-scale renewable energy projects can exhibit foreign inward investment which sees ownership and components sourced from outside the community and the meaningful employment given to foreign residents who are skilled and employed by the OEMs (Munday, *et al*., 2011). Due to this, community residents can be apprehensive towards new projects and hinders their social acceptance (Okkonen & Lehtonen, 2016). To counter this, projects often use community benefit funds which channels a portion of the revenues from the projects towards community organisations and enterprises. These community benefit funds generally receive applications from community organisations for interventions or activities that need financial assistance, such as renovating a school or church, purchasing medical supplies etc., and the RE projects then review the applications against their own criteria before granting the funds.

Redirecting a percentage of the project revenues into community trusts, if done effectively, can improve the social acceptance of the project and have a meaningful impact on the local economy through the provision of capital to enterprises, which in turn generate employment and economic stimulus (Okkonen & Lehtonen, 2016). That being said, community benefit schemes can also turn into a box ticking exercise wherein the developers, in an effort to comply with regulations, pursue the easiest interventions when dispersing their SED funds (WWF-SA & Greencape, 2015). Without effective engagement and inter-project cooperation, the funding does not address the most pertinent needs of the community and does not allow for collaboration and resource sharing between developers, both of which reduce the positive impact these community benefit funds have for the community.

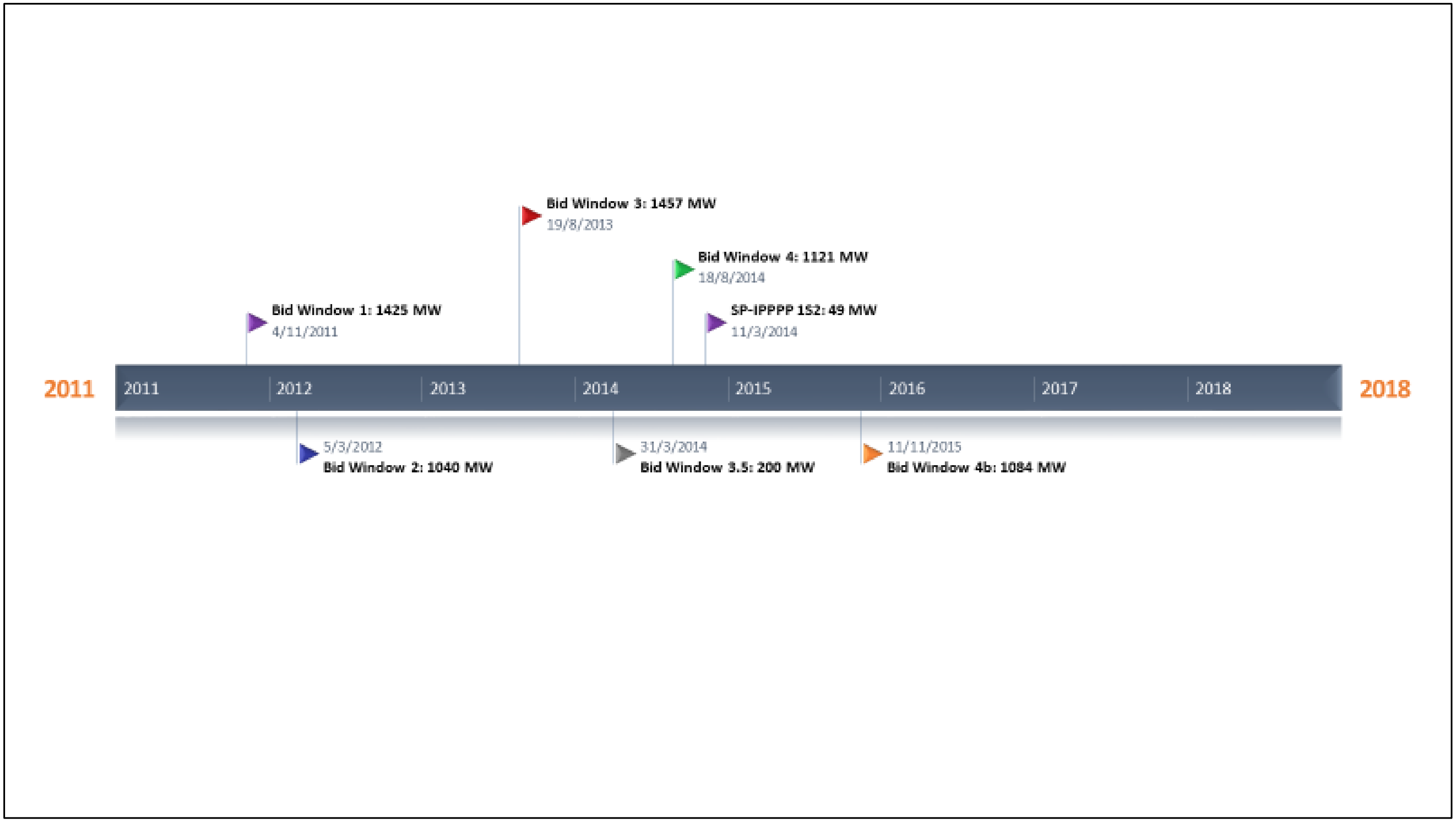
The literature above highlights the economic and social impacts of renewable energy development with particular focus on the cost, local content, job creation and community benefit from these renewable energy developments. Primarily, this research seeks to position the economic and social commitments of the SP-IPPPP in light of the REIPPPP using a cross-case synthesis, to determine the extent to which the price premiums for the smaller-scale projects are justified by these socioeconomic co-benefits provided. The REIPPPP as a case study, provides the most comparable findings to the SP-IPPPP due to the linked nature of the tendering process, consistency in reporting metrics, and the temporal synchronicity of these programmes. As such, an assessment of the literature available on the REIPPPP in these topics is necessary for this synthesis and is detailed below.

2.3. The REIPPPP Projects

The REIPPPP (excluding the SP-IPPPP rounds) has, to date, held six bidding windows (BW) that have procured 6327 MW of renewable energy. Solar PV and wind have accounted for the majority of this capacity, 2292 MW and 3357 MW, respectively (DoE, 2017). Biomass capacity remains low at only 42 MW from 2 projects. Figure 9 visually outlines the bid submission dates under the REIPPPP and the capacities allocated to each BW. BW 3.5 was purely dedicated to CSP and as such the data for these projects has not been considered in this research. BW 4b is the Expedited round which allowed previous unsuccessful project developers to have another opportunity to bid in the REIPPPP (Eberhard & Naude, 2016b).

The first two bidding windows were implemented within a short period of each other following which a year and a half lapsed before the BW3 submission date. The capacities allocated to each BW are fairly evenly distributed between the windows, except for the CSP round, which is positive for creating a sustained and stable demand in the industry. Unfortunately, projects after the BW 3, excluding 1 from BW 3.5, have not reached financial close to date (November 2018) due to an impasse between the IPPs and Eskom, as the Single Buyer of the electricity, despite receiving approval from then President Jacob Zuma and press releases by energy ministers that these remaining projects would, in fact, reach financial close (Groenewald, 2017). This means that these 27 pending projects (37 if the SP-IPPPP projects are included) totalling 2305 MW (2354 MW with the 10 SP-IPPPP projects) are yet to commence construction and are effectively idle until financial close is reached. It also means that the economic and social benefits from these projects have also not been realised.

Figure 9: Timeline of the submission dates in the seven bidding windows in the REIPPPP and SP-IPPPP First Stage Two.



Source: DoE (2017).

The identification of renewable energy as ‘inherently excellent for achieving positive socio-economic objectives’ (DoE, 2011) has led to the structuring of the tendering process in a manner that mandates prospective bidders to disclose and report on various socioeconomic impacts from their projects. Figure 10 outlines the socioeconomic indicators that are measured in the REIPPPP. The threshold reflects the minimum requirements for prospective bidders to be considered as ‘Preferred Bidders’ and ultimately to be able to develop renewable energy projects in the programme. The IPPs, once financial close is reached, have to report on these indicators quarterly to the DoE, and if found to be underperforming on their obligations, will incur financial penalties and/or termination points. Termination points, according to the Implementation Agreement (IA) between the IPP and the DoE, accumulate where the IPP performs below the threshold limits (minimums) and can result in the DoE terminating the contract.

Job creation (25%), Local content (25%), Ownership (15%), and Socio-economic development (SED) (15%) account for the majority (80%) of the Economic Development (ED) criteria in the REIPPPP. Together, these indicators account for 24% of the total bidding evaluation, using the 70/30 Price to ED weighting employed by the REIPPPP (Ettmayr & Lloyd, 2017). These indicators signify the priority objectives of government when developing the REIPPPP and is the reason why these topics in particular form the basis of this inquisition.

As in the sections above, the REIPPPP data for these projects are going to be assessed based on costs, local content, job creation, ownership, and community benefit in the sections below.

2.3.1. Project Cost

As in the literature above, the O&M for the REIPPPP projects is a relatively small percentage of the overall cost of the project. Eberhard & Naude (2016b) reported the O&M costs for these projects to account for between 20-25% of the LCOE. The REIPPPP employs a competitive tender approach that incurs various bid development costs, most notably the grid connection cost, financial and technical advice, permits, authorizations, and to a lesser extent the legal costs. Eberhard & Naude (2016b) estimate the development costs, excluding the grid connection costs, at between R5 million and R15 million for REIPPPP projects (4-5% of Capex costs). For solar PV and wind projects between BW 1 and 4, engineering, procurement and construction (EPC) costs (which includes procurement of materials and equipment, transportation, and installation of the entire project) accounted for 74% of the total Capex, with interest during construction contributing 5-6% of Capex costs.

Figure10: Socioeconomic impact indicators mandated in the REIPPPP tenders for projects under BW 3 and BW4.

Element (weighting)	Description	Threshold (%)	Target (%)
Job creation (25%)	RSA-based employees who are citizens	50	80
	RSA-based employees who are black people	30	50
	Skilled employees who are black people	18	30
	RSA-based employees who are citizens and from local communities	12	20
	RSA-based citizens employees per MW of contracted capacity	N/A	N/A
Local content (25%)	Value of local content spending	40–45[a]	65
Ownership (15%)	Shareholding by black people in the seller	12	30
	Shareholding by local communities in the seller	2.5	5
	Shareholding by black people in the construction contractor	8	20
	Shareholding by black people in the operations contractor	8	20
Management control (5%)	Black people in top management	-	40
Preferential procurement (10%)	BBBEE procurement[b]	-	60
	QSE & SME procurement [b]	-	10
	Women-owned vendor procurement [b]	-	5
Enterprise development (5%)	Enterprise development contributions [c]	-	0.6
	Adjusted enterprise development contributions [c]	-	0.6
Socio-economic development (15%)	Socio-economic development contributions [c]	1	1.5
	Adjusted socio-economic development contributions[c]	1	1.5

a. Depending on technology. 45% for solar PV, 40% for all other technologies.
b. As percentage of total procurement spend.
c. As a percentage of revenue.

Source: Eberhard & Naude (2016)

Table 3: Capex per MW installed capacity in Rand for REIPPPP solar PV, wind and biomass projects across the bid windows.

Bid	Solar PV	Wind	Biomass
Window	R million/MW	R million/MW	R million/MW
1	37.6	21.4	-
2	33.2	24.7	-
3	18.7	21.6	62.5
4	20.5	19.9	47.8
4b	21.0	22.3	-

Source: Adapted from Eberhard & Naude (2016).

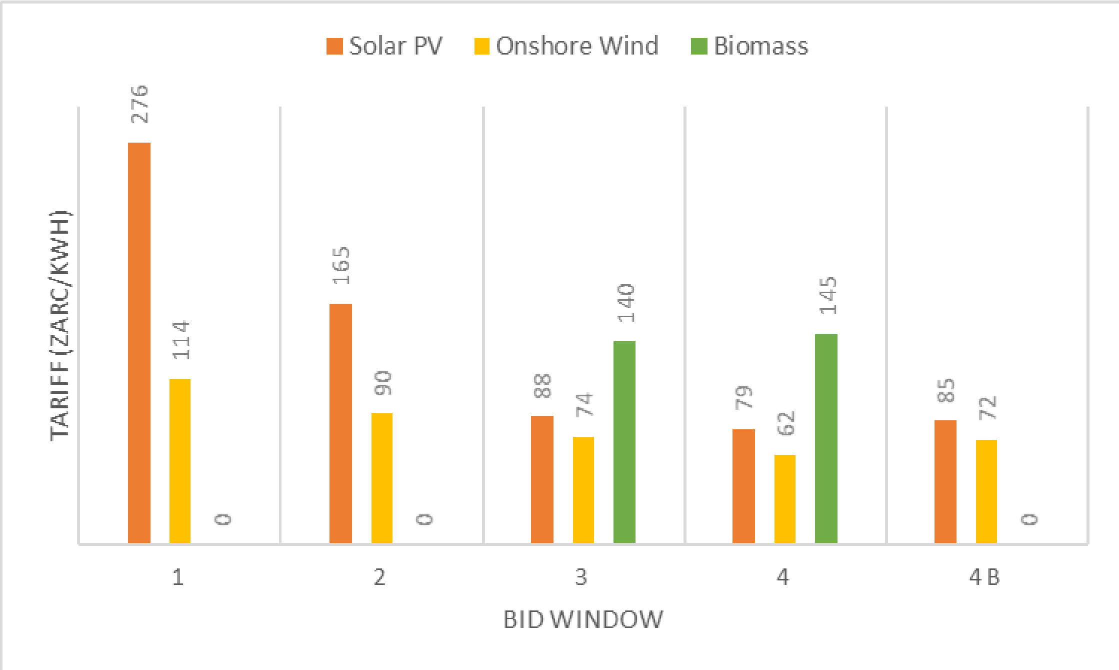
Table 3 highlights how the Capex cost for solar PV projects in particular dropped between BW 1 and BW 3. This represents a 50% drop in costs over less than two years and is a remarkable achievement. What is evident here is that the Capex cost for solar PV and wind power have become very similar; however, wind remains more cost efficient using a LCOE due to the greater capacity factors achieved by this technology- 30% versus that of solar PV which is around 20% (DoE, 2013a). Looking at Capex alone, biomass could be expected to be significantly more costly than solar PV or wind power plants, as these projects cost R47.8 million/MW in BW 4; however, these plants are assumed to operate at an 85% capacity factor, meaning this power is dispatchable and suitable as a baseload provider (IRENA, 2012c). Additionally, the BW 3 project uses bagasse as a feedstock whereas the BW 4 project uses wood waste which may have also been a factor affecting the Capex costs of each (Barradas, 2014) (Sherrard, 2018).

LCOE for REIPPPP projects has not been well documented, perhaps due to the recency of their commencement, and as such the project's bid tariffs represent a usable measurement for the overall cost of these renewable energy projects. These figures represent the selling price for the electricity generated from each of the technologies and are inclusive of generation costs and the internal rate of return (IRR), real post-tax return for the equity shareholders, of the developers (DoE, 2013b). As with the cost reductions in the Capex of solar PV, so too the cost per KWh saw a notable reduction between BW 1 and BW 4, as depicted in Figure 11.

Solar PV realised a nearly 72% decrease in tariffs, while wind power recorded a 46% reduction in their weighted average electricity tariffs. Biomass projects, which were only procured in BW 3 (one project) and BW 4 (one project), came in with considerably higher electricity tariffs in the REIPPPP than wind projects, to the tune of an 81% in BW 3 and 133% increase in BW 4; suggesting that even with higher capacity factors, the Capex and fuel costs for this technology make it uncompetitive with wind or solar PV at these scales, at least financially (Eberhard & Naude, 2016). Of interest here is that the biomass projects saw a nominal increase in price from BW 3 to BW 4, which was not seen in any of the other technologies (except hydropower) across any of the bid windows, despite the drop in Capex as seen in the Table above – highlighting the impact that the cost of feedstock has on the LCOE of biomass projects. The tariffs illustrated in Figure 11 represent the weighted average tariffs for these technologies at the time of bidding, so the BW 1 tariffs represent the tariffs paid in 2011 while BW 4 represents tariffs paid in 2014.

As highlighted earlier in this chapter, the economic and social benefits of infrastructure development predominantly accrue to the jurisdictions in which the Capex and Opex flow, meaning that in order to determine the direct benefit of these projects to the South African economy, the portion of these costs that were directed to local suppliers needs to be examined. Additionally, the localisation of the funding and capital in the projects also drives local benefit from these developments, as the project earnings and interest payments accrue to these financiers, provided the project is successfully commissioned. The localisation of the REIPPPP finance is explored below.

Figure 11: Weighted average tariffs from BW 1 to BW 4b for solar PV, wind, and biomass in the REIPPPP.



Source: Adapted from Eberhard & Naude (2016)

The weighted-average tariff increase between BW 4 and 4b goes against the trend for BW1 to BW4. The reason for this anomaly could be attributed to the fact that there were 'Returning Compliant Bidders' under BW 4b were those that submitted compliant bids in previous rounds but who were unsuccessful. These bidders were offered a second opportunity to submit a revised bid some of which were successful under BW 4b. Naturally, these projects were not as competitive as those under BW 4 otherwise they would have been selected as Preferred Bidders the first time around; hence the slight price increase in BW 4b.

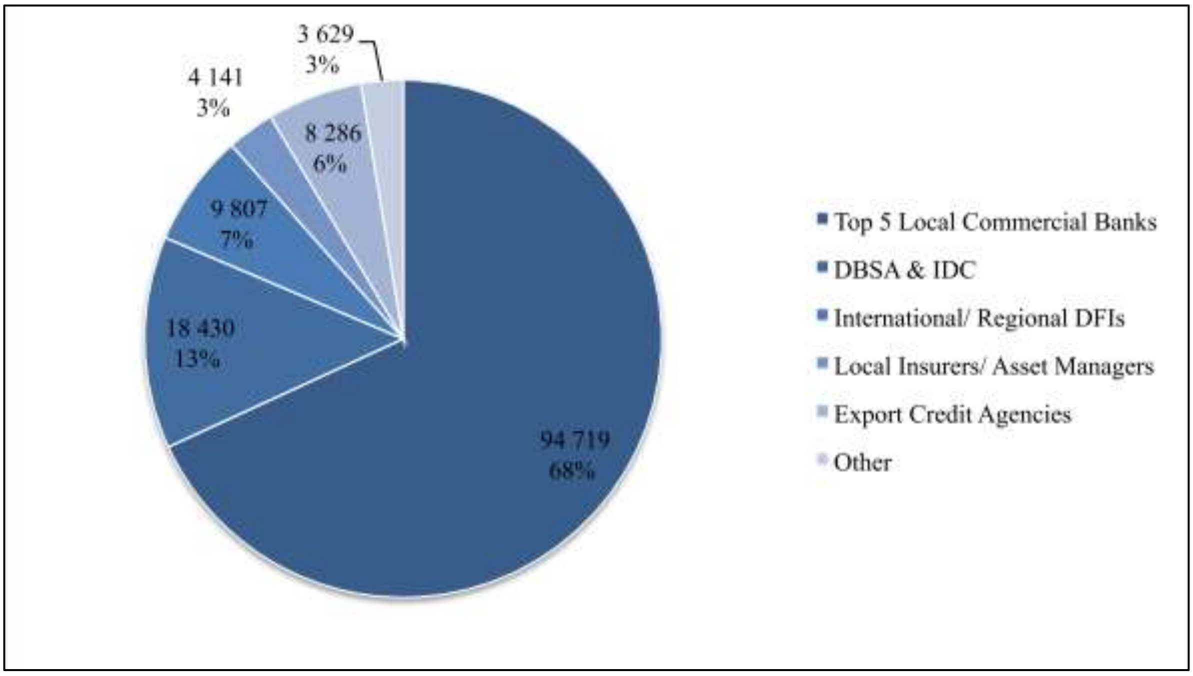
2.3.2. Local Finance

Between BW1 and BW3 88% of the IPPs were project financed, making this the most popular form of finance in the REIPPPP (Baker, 2015). These projects are typically structured using a 70:30 debt to equity ratio; however, some REIPPPP projects were found to have up to 80% debt funding. This is eloquently described by Baker (2015, 150) who said, "the more debt there is, the lower the average cost of funding, the lower the tariff and the cheaper the project". Corporate finance, however, has become more popular since BW3 which saw 35% of the projects use this form of finance. These corporate financed projects were all developed by an Italian multinational utility which was able to obtain loans using their balance sheet as collateral. It has been reported that corporate finance affords the developer less stringent loan requirements than that of a commercial bank project financing a project (Baker, 2015). Eberhard & Naude (2016b) further emphasise this notion by stating that corporate finance tends to be cheaper than project finance for a large, financially healthy company. From this it can be deduced that small developers would likely not source funding from commercial banks with stringent loan requirements and a keener interest in large projects; however, they may struggle to obtain corporate finance if they do not have sufficient assets on their balance sheet. It is for these reasons, as well as inexperience and high barriers to entry, that small developers struggle to obtain funding for their projects (Kolver, 2014).

Figure 12 breaks down the source of debt funding in the first four BWs of the REIPPPP. The value given is the amount of funding per category in millions of Rand. This shows that, of the project financed projects, around 84% of the funding was sourced from local commercial banks, insurers/asset managers and Development Finance Institutions (DFIs). This shows that the REIPPPP has been successful in localising the debt funding in the projects to date. Although when looking at corporate finance, the funding has come strictly from a single foreign-owned company. Considering that corporate finance has become a lot more popular since BW3, this could represent a shift away from locally sourced funding in future towards foreign-owned corporate finance which is cheaper and easier to obtain than project finance from a local financier.

Localising the funding is just one element of the overall localisation of a project. Wholistic localisation sees domestic players getting involved in the finance, ownership, procurement, and job creation and is an important socioeconomic objective for a programme seeking to maximise the benefit of these projects to the local economy. Localisation of the procurement expenditure in the REIPPPP is evaluated in the following section.

Figure 12: Sources of debt funding for projects in the first four BWs of the REIPPPP.



Source: Eberhard & Naude (2016b).

2.3.3. Local Content

Mandating local content as it has been done in the REIPPPP has been found in literature to increase local product demand in specific industries which in turn increases demand for staff, thus increasing employment (UNCTAD, 2014) (Ettmayr & Lloyd, 2017) (Kuntze & Moerenhout, 2013). It has also been found to increase global competition as there are more market entrants which drives down costs and increases innovation. In addition to boosting local manufacturing capacity and overall demand, the LCR policy in the REIPPPP was also intended to accelerate the transfer of skills and technology from leading international companies to the South African industries (Ettmayr & Lloyd, 2017). Unfortunately, LCRs in South Africa were reported to have increased the cost of renewables which may have knock-on effects such as reduced employment in the projects to recoup costs and less capacity installed due to the potentially uncompetitive environment.

Additionally, LCRS under the REIPPPP were expressed in value terms, as a percentage of total procurement, which does not consider the labour intensity in the value chain. Critics recommend giving priority to sectors in the value chain which offer considerable (and meaningful) job creation with regard to local content instead of a value-based LCR (Eberhard, *et al*., 2014). Ettmayr & Lloyd (2017) interviewed IPP developers and EPC contractors on their perceptions of the LCRs in the REIPPPP and found that these participants did not find the LCRs too prohibitive for market entry and

80% of the international respondents thought that the LCRs would increase manufacturing capacity in South Africa. Although, it was reported that manufacturing would only persist as long as the LCRs are in place, due to the fact that the respondents didn't believe that South Africa was globally competitive in renewable energy manufacturing. This meant that the LCRs were found to increase the price of renewable energy development; however, the positive impact on investment and job creation were noted as benefits of implementing the LCR in the case of the REIPPPP.

The government prioritised local content, local being goods and services procured in South Africa (nationally), in manufacturing in BW 2 into wind turbine blades and towers, PV modules, PV inverters, and the metal structures for solar PV plants. The REIPPPP can be said to have been successful in this regard as wind tower manufacturers, in the form of DCD Wind Towers (Coega) and Gestamp (Atlantis) established factories in South Africa; however, due to the delays in reaching financial close for the 37 outstanding projects, DCD Wind Towers closed down in 2016 which resulted in 115 job losses (Matavire, 2018). In terms of PV modules, there are a few module assemblers in the country such as SunPower, Solairedirect, SET Solar, Jinko, and ARTsolar, which import the raw silicon cells and assemble the modules locally (Greencape, 2015) (Frost & Sullivan *et al*., 2013). Inverter manufacturing capacity has also been bolstered since the implementation of the REIPPPP. International companies such as AEG and SMA have established manufacurting plants in South Africa, in addition to local inverter manufacturers such as MLT Drives and Microcare (EScience Associates, 2013).

The LCRs in the REIPPPP are summarised in Table 4. The LCRs for wind and biomass technologies were the same throughout the bidding rounds, both of which were less than that of solar PV plants. This suggests that localisation along the value chain of these two technologies is more difficult than that of solar PV. This is understandable in the case of wind power based on the literature that shows up to 84% of the project cost is concentrated in the turbine components, which are highly specialised and often imported (IRENA, 2017a).

Table 4: REIPPPP local content requirements from BW 1 to BW4 for solar PV, wind, and biomass.

	BW 1		BW 2		BW 3		BW 4	
Technology	Threshold (%)	Target (%)	Threshold (%)	Target (%)	Threshold (%)	Target (%)	Threshold (%)	Target (%)
Solar PV	35	50	35	60	45	65	45	65
Wind	25	45	25	60	40	65	40	65
Biomass	25	45	25	60	40	65	40	65

Source: Adapted from Ettmayr & Lloyd (2017).

Table 5 summarises what these projects achieved or committed to achieving according to their bidding documents. Expectedly, in BW 1 the projects' local content commitments were marginally higher than the threshold as these were the first utility-scale projects to be developed in the country making renewables a very infant industry. Within a year (in BW 2) local content in solar PV and wind projects jumped 15% and 20% respectively. Bidders were judged on a sliding scale wherein no points were awarded to bidders only achieving the local content thresholds, increasing to the maximum point allocation to bidders who achieved the local content target. With local content being given a 25% weighting in the ED criteria, bidders were strongly incentivised by this sliding scale to do more than just meet the thresholds.

To emphasise the importance of local content in terms of the local (national) economic impact, the wind projects between BW 1 and BW 2 saw a 16% nominal increase in the Capex costs per MW installed but due to the increased local content, the local expenditure increased by over 100% per MW (nominally). Biomass, on a per MW basis, appears to offer the most local value (R23.7 million per MW on average) of these three technologies; although the absolute value of these projects is significantly less than that of the solar PV and wind projects due to the smaller capacities. Also, the fact that there have only been two biomass projects to reach Preferred Bidder status makes this a very small sample on which to rely. Wind energy, although offering the most absolute local value in BW 4, offers the least relative value to the economy, due to lower local content percentages in these projects.

Table 5: Local content commitments across the bidding windows under the REIPPPP for solar PV, wind, and biomass.

Technology	Measurement	Bid Window			
		1	2	3	4
Solar PV	Local Content (%)	38.4%	53.4%	53.8%	62.3%
	Local Content (R million)	9047	7391	4382	5298
	Local Content (Rm/MW)	14.4	17.7	10.1	12.8
Onshore Wind	Local Content (%)	27.4%	48.1%	46.9%	44.4%
	Local Content (ZAR million)	3802	6630	7959	5979
	Local Content (Rm/MW)	5.9	11.9	10.1	8.8
Biomass	Local Content (%)	0%	0%	40%	47.8%
	Local Content (ZAR million)	0	0	425	571
	Local Content (Rm/MW)	0	0	25	22.8

Source: Adapted from Eberhard & Naude (2016).

The value in terms of the amount of funds spent within South Africa is important to calculate and understand the economic impact of these projects in South Africa through additional demand for goods and services. The DoE (2017) reported that the local content spend across all projects and bidding rounds came in at 3% less than what was committed in their collective bids, and amounts to R 29 billion. This additional demand creates additional employment in these sectors which is an indirect economic benefit of these projects. In addition to this benefit, these projects also employ South Africans directly.

It must be noted that the local procurement and employment benefit derived from renewable energy projects has been found to be notably less than the benefit derived from project earnings. This means that in order to maximise the local (national) economic and social benefits in a country, the ownership of the projects needs to be localised so that project earnings are retained in the local economy. In fact, Berka and Creamer (2018) reported that sourcing project capital from local funds, i.e. local shareholders, increased total (local) GDP impacts by 35% compared to projects relying on commercial debt. Ownership structures in the REIPPPP are complex, transient and opaque according to Baker & Wlokas (2015), and the ownership of projects is not fixed, which makes it difficult to say with confidence how much is still locally owned. The REIPPPP allows for shares to be sold on or restructured after three years, which means the ownership structures in the RFPs could change dramatically after this period. For this reason, as well as the inability to obtain sufficient data on the ownership structures of the SP-IPPPP projects, project ownership as a unit of analysis has been excluded in this research. That said, the units of analyses included in this research are considered sufficient to make reasonable conclusions. The employment generated by the REIPPPP projects is explored below.

2.3.4. Job Creation in the REIPPPP

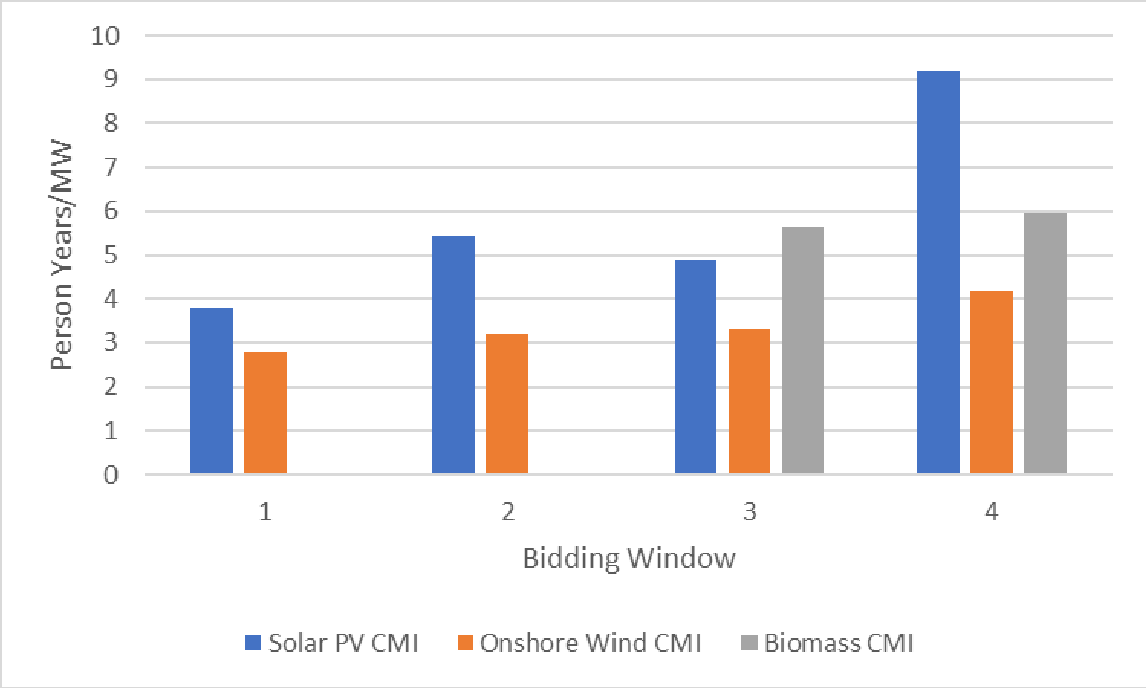
The REIPPPP gave job creation equal weighting to local content when evaluating the bid commitments for each IPP, highlighting how important these two categories were to those who developed this programme. In addition to the overall jobs, measured in person months in the REIPPPP, sub-criteria including the amount of 'black citizen', 'skilled black citizen', and local community jobs created were evaluated. Person months in the REIPPPP refers to one person working for 160 hours (as FTE) which can be converted into PY by dividing the number of person months by 12. According to the REIPPPP, a minimum of 30% of the jobs must go to 'black citizens', 18% to 'skilled black citizens', and 12% to local communities for all projects from BW 1 to BW 4 (Stands, 2015).

Specific data, other than aggregated data on all projects under the REIPPPP as reported by the DoE, on the employment factors of each technology with regard to 'black citizen', 'skilled black citizens', and local community employment has not been researched, instead research has been aimed at the overall job creation of these technologies in South Africa. What has been reported is that 'black citizens', 'skilled black citizens', and local community employment has exceeded the targets considerably (2.5 fold for O&M employment of local community members); however, it is unknown which projects were responsible for these results (DoE, 2017).

Technology, and bidding round, specific employment factors have been pooled in Figure 13 and Figure 14 below. The trends observed here suggest an increasing employment factors with each successive bidding round under the REIPPPP. BW 4 saw notable increases in the CMI employment factors of solar PV (88% increase over BW 3 and a 142% jump over BW 1), as well as a more than 4.5-fold increase in the O&M employment factor for biomass projects over BW 3. This massive difference could be an error by Del Rio (2016), or it could be due to the variation in employment factors associated with the different feedstocks of these two projects – again the limitations to just these two projects makes it difficult to state with certainty that these figures are representative of biomass projects in South Africa. This measurement will be verified in this research to identify the cause of this discrepancy. The fact that the employment figures appear to be increasing with each consecutive bidding round could also be a reflection of the increasing pressure the REIPPPP has placed on developers to improve their project's ED contributions.

In the REIPPPP, bidders must include jobs that are "seconded to or in direct relation to" the project but it remains unclear if these jobs include manufacturing, transport or other jobs in the value chain (DoE, 2013c, pp. 44); however, it is assumed that direct jobs (as mentioned in the sections above) are included under this nomenclature as indirect jobs (such as those involved in mining and mineral processing) are not directly related to the project activities. This is aligned with the methods employed in the global job creation literature above, which did not include indirect or induced job creation for each technology.

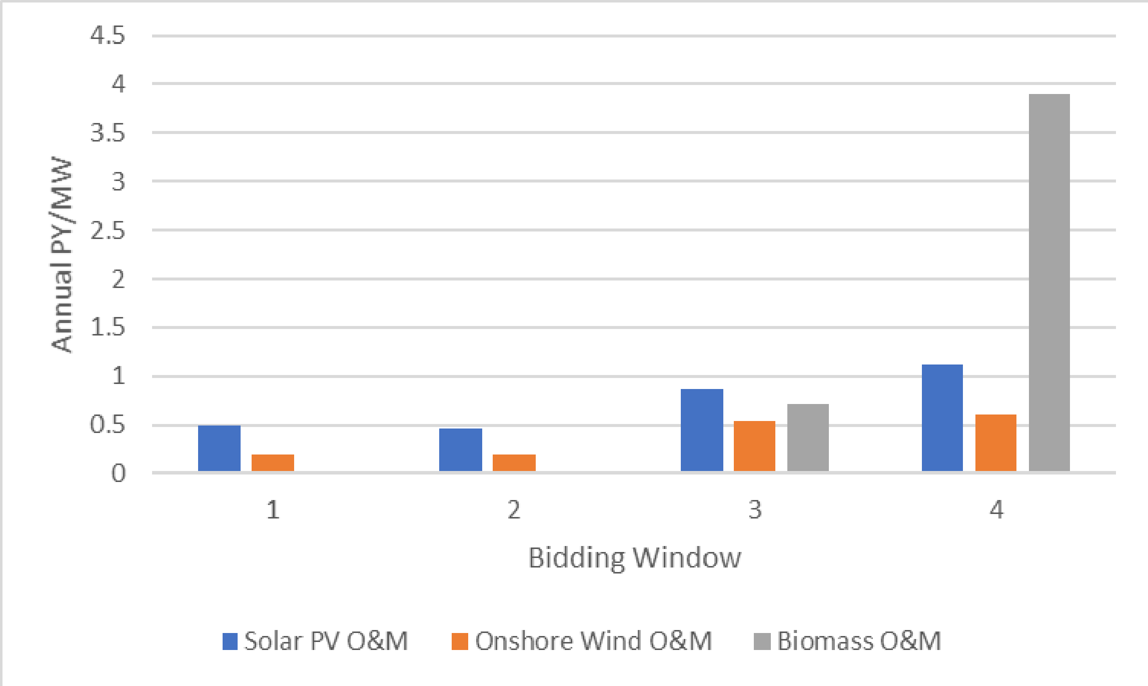
Figure 13: CMI employment factors for solar PV, wind, and biomass projects under the REIPPPP.



Source: Adapted from Stands (2015), del Rio (2016), Eberhard & Naude (2016).

In the literature on community-owned renewable energy projects, particularly wind projects, Lantz & Tegen (2009) reported that projects that were owned, at least partially, by community trusts or community organisations showed up to 3.1-times higher employment factors in the CMI phase and 1.8-times greater O&M phase employment than absentee-owned (owned by multinational energy companies) projects in certain states of the US. This study concluded that the extent of local (state) economic impact was a function of local (state) ownership and return on investment, i.e. earnings from the project and how and where it is distributed. This is seconded by Strachan *et al*. (2015), Munday *et al*. (2011), and Šahović & Pereira de Silva (2016). To this end, local ownership and community benefit, in the form of SED and ED funding, under the REIPPPP are assessed below, and linkages between local ownership and job creation evaluated.

Figure 14:O&M employment factors for solar PV, wind, and biomass projects under the REIPPPP.



Source: Adapted from Stands (2015), del Rio (2016), Eberhard & Naude (2016).

2.3.5. Socio-Economic Development and Enterprise Development Funding

Although it has been stated that local ownership, particularly community ownership, has been found to have the greatest impact to the local economy, payments made to community organisations (those within 50km of the project site) from procured projects (including the SP-IPPPP bidders) will amount to R 20.6 billion in SED funding and R 6.4 billion in ED funding (DoE, 2017). Unlike dividends paid to shareholders in the projects, which will only become significant approximately 7-years after the project is commissioned as debt needs to be paid down before distributions can be made to shareholders, these funds are available from the first year of operation (Wlokas, 2015). The REIPPPP bidding requirements mandates a minimum of 1% (target of 1.5%) of projected project revenue to be dispersed as SED funds and 0.6% as ED funds (Baker & Wlokas, 2015). To further highlight the additional benefit of ownership over SED and ED funding, Wlokas (2015) reported that the dividend flow to communities (as a result of community ownership) from the projects procured in BW 1 to BW 3 would amount to R 35.8 billion over the project lifespan. This is considerably more (33%) than the combined SED and ED spend of these projects over their lifespan.

In terms of the SED and ED spend by projects that have been awarded 'Preferred Bidder' status, the average SED contribution across all technologies is 2.2% of revenue (R404 million of which has been realised); while the ED spend averaged 0.7% of revenue (R130 million of which has been realised)

(DoE, 2017). Eberhard & Naude (2016b) outlined the ED and SED spend for the various technologies across the bidding rounds to date, and these figures are presented in the tables (Table 6 and Table 7) below. SED contributions have amounted to significantly more money (overall) than ED contributions, which is expected considering the SED has a 15% weighting in the RFP scorecard versus ED spend which has a 5% weighting. The wind projects appear to have dominated the ED and SED contributions, while the biomass projects, due to the small amount of capacity relative to the wind and solar PV projects, have committed to the least ED and SED spend. This research seeks to build on these findings by evaluating the ED and SED spend for each project and give a weighted average spend for each technology so that they can be compared on a like-for-like basis.

Table 6: ED contributions by Preferred Bidders under the REIPPPP.

ED Spend (ZAR millions)	BW 1	BW 2	BW 3	BW 3.5	BW 4	Total
Solar PV	516	373	295	-	694	1878
Wind	216	319	715	-	2593	3841
Biomass	-	-	0	-	78	78

Source: Adapted from Eberhard & Naude (2016b).

Table 7: SED contributions by Preferred Bidders under the REIPPPP.

SED Spend (ZAR millions)	BW 1	BW 2	BW 3	BW 3.5	BW 4	Total
Solar PV	1278	797	908	-	2043	5026
Wind	795	904	2466	-	7029	11194
Biomass	-	-	78	-	196	274

Source: Adapted from Eberhard & Naude (2016b).

The above sections give insight into the economic and social commitments of the REIPPPP projects for solar PV, wind and biomass technologies. BW3 and BW4, due to their bid submission date and inclusion of these technologies, have been selected as the primary cases of comparison in this research. The bidding structure between these cases and the SP-IPPPP is very similar and provides the opportunity to a telling comparison between them. There are, however, a few differences in the RFPs which would affect the commitments made by the bidders under each programme. To this end, the

SP-IPPPP bid requirements will be analysed with reference to the REIPPPP requirements, and a review of the available findings regarding the SP-IPPPP commitments in the following section.

2.4. The SP-IPPPP

The SP-IPPPP was designed and administered in a very similar manner to the REIPPPP. As mentioned earlier, the timeline of the first bid window of the SP-IPPPP and BW3 and BW4 of the REIPPPP are similar. The First Stage 2 (1S2) submission date was on November 3rd, 2014 and the Second Stage 2 (2S2) was on 14 June 2016 (DoE, 2017a). The SP-IPPPP has divided the bidding procedure into two stages in order to minimise the cost-at-risk for smaller developers. The first stage is a prequalification stage focussing on high level criteria. This prequalification ensures the project is properly conceived and that the developer has the technical and commercial capacity to implement and operate the Project(Department of Energy (DoE), 2013f). It does not include any financial requirements and allows those bidders found to be underprepared or under-resourced to be removed early in the process, without these small developers incurring significant bid costs with little chance of success.

Bidders that are successful in the Stage 1 qualification are nominated as 'Selected Bidders' and can proceed to the next evaluation stage. The second stage is a complete bid evaluation and includes the qualification criteria in Part B and Part C of the RFP, including the legal agreements, technical requirements, and financial requirements, and the evaluation criteria which encompass the pricing and economic development commitments in Part D of the RFP (DoE, 2013d).

The major departures of the SP-IPPPP qualification criteria from the REIPPPP qualification criteria that are of interest to this research are detailed in the Table below. The size limitation is the defining feature of the SP-IPPPP and is a major departure point between the two programmes. The allowance of operating periods from five years may have affected the structure of the Small projects in terms of debt, which would have required longer periods to repay; however, this may have suited biomass projects in particular as it has often been found that long term security of biomass feedstock supply is an issue (Frost & Sullivan; *et al.*, 2013). The requirements that limit developer success payment and SME participation are relevant as these may affect the overall costs and the localisation of the projects under the SP-IPPPP.

Table 8: Differences in SP-IPPPP and REIPPPP qualification criteria.

Qualification Criteria	SP-IPPPP	REIPPPP
Capacity Limit (MW)	1-5	Wind: 1-140 Solar PV: 1-75 Biomass: 1-25
Scheduled Operating Period (Years)	5-20	20
Developer Success Payment	2.5%	No limit
SME Shareholding	10%	N/A

Source: DoE (2013d), Eberhard & Naude (2016b).

In addition to the qualification criteria differences, there are also differences in the Economic Development criteria between the programmes. Table 10 shows that in many instances the minimum threshold was removed for bidders under the SP-IPPPP, however in almost every criteria (barring Management Control) the target is greater than that of the REIPPPP. This highlights that the SP-IPPPP is hoped to have greater Economic Development (socioeconomic) benefits than those of the REIPPPP as the targets are greater for almost all of the evaluation criteria. The removal of the minimum thresholds signifies that the government recognised the pressure that meeting these socioeconomic criteria may have on the profitability of the Small bidders and that leniency should be given in that respect.

The inclusion of SME participation in the SP-IPPPP is fundamental to the programme's objectives and the importance of this can be seen in the adjustments to the weightings given to the Economic Development criteria in Table 9. These two programmes cannot be compared on SME participation, however, as it was not mandated in the REIPPPP RFP and as such has not been included in the analysis of this research. The exclusions of ownership, management control, preferential procurement and SME participation in this research is not to say that these are not important elements to consider when comparing the two programmes. It is more as a result of the (lack of) availability of data and the direct comparability between the two programmes on these measures.

Table 9 highlights the weightings given to the different elements in both programmes while Table 10 depicts the thresholds and targets within each of the elements in both programmes. Table 10 shows that across all ED elements, the SP-IPPPP has equal or greater targets than the REIPPPP, again reaffirming the intent of the SP-IPPPP to afford greater relative socio-economic benefits to the local economy.

With the above literature on the costs, prices, job creation, localisation, and community benefit associated with solar PV, wind, and biomass technologies detailed and the structural departures between the SP-IPPPP and the REIPPPP assessed, the relevance of these parameters to the policies and programmes in this research has been described. A description of the approach and manner in which this research can now be conducted to ensure that the findings and the outcomes of this research are replicable and testable. This research approach is detailed in the following chapter.

Table 9: Difference in the Economic Development criteria weighting between the SP-IPPPP and the REIPPPP.

Element	REIPPPP	SP-IPPPP
Job Creation	25%	20%
Local Content	25%	20%
Ownership	15%	15%
Management Control	5%	5%
Preferential Procurement	10%	10%
Enterprise Development	5%	5%
Socioeconomic Development	15%	15%
SME Participation	N/A	10%

Source: Adapted from DoE (2013c) and Ettmayr & Lloyd (2017).

Table 10: Differences in the Economic Development criteria between the SP-IPPPP and the REIPPPP.

Element (Weighting)		REIPPPP		SP-IPPPP	
	Description	Threshold	Target	Threshold	Target
JOB CREATION	RSA Based employees who are citizens	50%	80%	-	90%
	RSA Based employees who are Black people	30%	50%	-	60%
	Skilled employees who are Black people	18%	30%	-	50%
	RSA based employees who are citizens and from local communities	12%	20%	-	30%
	RSA based citizens employees per MW of Contracted capacity	N/A	N/A	N/A	N/A
LOCAL CONTENT	Value of local content spending	40% – 45%*	65%	50%	70%
OWNERSHIP	Shareholding by Black People in the Seller	12%	30%	-	40%
	Shareholding by Local Communities in the Seller	2.5%	5%	-	10%
	Shareholding by Black people in the Construction Contractor	8%	20%	-	30%
	Shareholding by Black people in the Operations Contractor	8%	20%	-	30%
MANAGEMENT CONTROL	Black people in Top Management	-	40%	-	40%
PREFERENTIAL PROCUREMENT	BBBEE Procurement**	-	60%	-	70%
	QSE & SME Procurement**	-	10%	-	20%
	Women Owned Vendor Procurement**	-	5%	-	10%
ENTERPRISE DEVELOPMENT	Enterprise Development Contributions***	-	0.6%	-	1.0%
	Adjusted Enterprise Development Contributions***	-	0.6%	-	1.0%
	Enterprise Development Contributions on SMEs	N/A	N/A	0.5%	1.0%
SOCIO ECONOMIC DEVELOPMENT	Socio-Economic Development Contributions***	1%	1.5%	-	3.0%
	Adjusted Socio-Economic Development Contributions***	1%	1.5%	-	3.0%
SME PARTICIPATION	Key components &/or Equipment & Balance-of-Plant spend on SMEs	N/A	N/A	30%	60%

**Depending on technology. 45% for solar PV, 40% for all other technologies.*
***As percentage of total procurement spend.*
****As a percentage of Revenue*

Source: Eberhard & Naude (2016b)

3. METHODOLOGY

The above sections provide a comprehensive overview encompassing the following socioeconomic indicators: electricity prices, project costs, local content, employment creation, and community benefit as it relates to solar PV, wind, and biomass power plants. This research seeks to evaluate the selected case studies, the First Stage 2 (1S2) of the SP-IPPPP and BW3 & 4 of the REIPPPP, in terms of these indicators in order to answer the primary research question: In relation to Large Projects, what is the predicted cost and price premium for various technologies of Small renewable energy projects (<5 MW) in South Africa and can this premium be justified by the improved socioeconomic co-benefits committed to by these projects? This chapter will outline how this research proposes to answer this question.

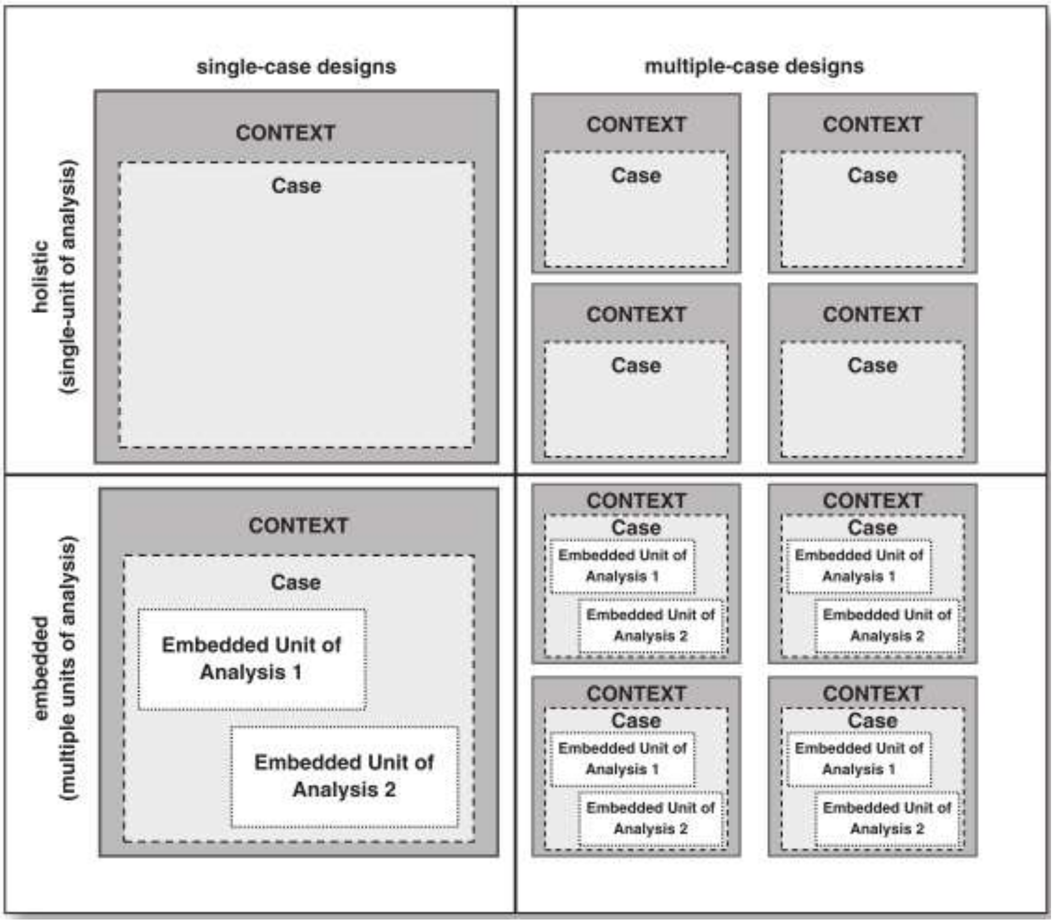
3.1. Research Design

This exploratory case study will make use of the bidding commitments made by prospective bidders in the SP-IPPPP and the REIPPPP to analyse how these projects are expected to perform in terms of these indicators. As mentioned earlier, the Preferred Bidders are contractually bound to these commitments upon financial closure (Papapetrou, 2014), which gives credibility to this data as a precursory measure of socioeconomic performance for these projects. The same contractual obligation exists in the REIPPPP, as well as near-identical ED requirements to the SP-IPPPP which allows for an accurate and informative cross-case synthesis between the SP-IPPPP and the REIPPPP. The literature described above has provided a contextual setting within which the empirical results of this case study can be placed using what Yin (1984) calls analytical generalization. This refers to the positioning of the findings in this case study within a broader research setting in an effort to contrast and substantiate current knowledge and provoke further research on the topic.

The case is therefore designed as an embedded, multiple-case study (Yin, 2012). This research has six embedded units of analysis or socioeconomic categories, which make up each case as depicted in Figure 16 and Table 11 below. These units of analysis are embedded within the holistic cases that are the SP-IPPPP and the REIPPPP, in that they are categories of data that sum together to answer the primary research question. For example, the Project Cost and Electricity Tariff units of analysis are embedded within the SP-IPPPP and REIPPPP case studies as data sets that allow these cases to be compared in terms of their cost competitiveness. The context for this study is the South African energy industry and the political and economic considerations that shaped the structure of the SP-IPPPP and the REIPPPP. Using the same units of analysis for a cross-case synthesis, the SP-IPPPP First Stage 2 (1S2) commitments and the BW3 and BW4 commitments in the REIPPPP will be detailed and reviewed.

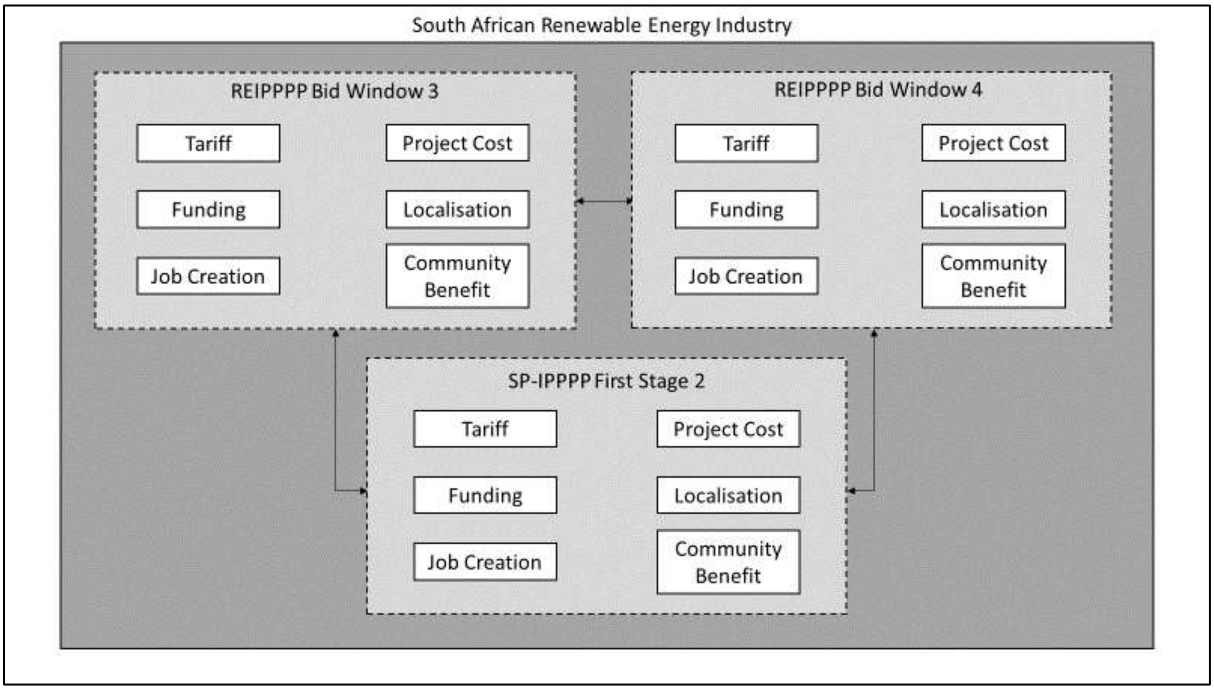
Yin (2012) outlines typical case study designs for research as depicted in Figure 15. Pursuant to these designs, Figure 16 outlines this research design with the embedded units of analyses for each case.

Figure 15: Types of research designs for case studies.



Source: Yin (2012).

Figure 16: The embedded, multiple-case study design.



In answering the primary research question, there are estimates for each unit of analysis that need to be calculated to substantiate the comparison between the Small Projects and the Large Projects. The primary research question can thus be broken down into the following sub-questions:

1. What is the expected price of the electricity from these projects for each technology?
2. What is the expected total project cost per MW for each technology, and how is it broken down between EPC, development costs and interest during construction?
3. What type of funding is to be used for each technology and what will be the major source of finance for each technology?
4. What percentage of the procurement for each technology will be spent locally, and how much?
5. How many jobs (in person-years) are to be created by each technology and for whom? How many jobs will be created in the CMI phase versus the O&M phase?
6. What are the predicted SED and Enterprise Development spend for each technology?

Hence, we can divide the indicators and their metrics as follows:

Table 11: Units of analysis, estimates and metrics for the case study.

Unit of Analysis	Estimates	Metric
Project Cost	Total Project Cost	ZAR/MW
	EPC	ZAR/MW
	Development Cost	ZAR/MW
	Interest during Construction	ZAR/MW
Electricity Price	Bid Tariff	Rc/KWh
Finance	Type of funding	% Project Finance and % Corporate Finance
	Source of funding	% of Total Debt
Local Content	Local Expenditure	ZAR/MW
	Relative Local Expenditure	% Total Expenditure
Job Creation	CMI Jobs	PY/MW
	Community CMI Jobs	PY/MW
	Black CMI Jobs	PY/MW
	O&M Jobs	PY/MW/annum*
	Community O&M Jobs	PY/MW/annum*
	Black O&M Jobs	PY/MW
Community Benefit	SED Funding	ZAR/MW
	ED Funding	ZAR/MW

* The O&M job creation in PY/MW/annum assumes a project lifespan of 20 years, as per the REIPPPP RFP (DoE, 2013c).

With these parameters and sub-questions in mind, the following hypotheses have been made in this research:

1. The Small Projects will have a higher EPC and development costs, as well as higher interest during construction (IDC) costs due to the reduction in the economies of scale and higher cost of credit for the smaller developers.
2. The higher costs for the Small projects will then translate into a higher bid tariff for these projects when compared to the Large (>5 MW) Projects.
3. The Small Projects will source their finance primarily from local DFIs due to the reluctance of commercial banks to provide project finance to projects of this size (Kolver, 2014). The DFI financiers will likely be local and/or government funded due to the higher risk of smaller projects. Meaning that the funding for Small Projects would be more localised than those under the REIPPPP.
4. These Small Projects will have greater local content expenditure due to the fact that there are higher minimum thresholds in the bidding criteria.
5. The job creation per unit MW installed will be greater for the Small projects, due to the increased targets in the RFP and due to economies of scale (Stands, 2015).

6. Community benefit (SED and ED spend) per unit power installed will not be significantly different to that of the Large Projects as the revenue may be lower for the Small Projects which would lower the SED & ED spend per unit power, but the bidding requirements encourage more ED and SED spend relative to revenue which should spur on greater SED & ED spend relative to revenue.

3.2. Methods of Collecting Data

In order to test these hypotheses, data in the form of the bid commitments for each project was needed. Project developers submit their bids during the allocated bidding windows to the IPP Office. As per the Economic Development (ED) criteria laid out in the SP-IPPPP and REIPPPP RFPs, prospective bidders are required to detail their commitments to each of these units of analysis. Bidders are ranked, by the IPP Office, according to their financial and ED scores (70/30) and those that offer the most competitive projects are classified as 'Preferred Bidders'. The major difference here is that the SP-IPPPP conducts the RFPs in a two-stage bidding process, in order to reduce the cost-at-risk should the project not be considered as a Preferred Bidder in the first stage (DoE, 2013d). The sections within these bidding documents that are of interest for this research are shown in Figure 17 and Figure 18 below.

Figure 17: Appendix G5-1 detailing the financial specifications of the prospective project.

G5-1

Financial information

FIELD DESCRIPTION	UNIT	VALUE
Project details		
Proposed effective date	Date	
Proposed COD	Date	
Duration of construction period	Months	
Price		
Fully indexed price	Rand/MWh	
Partially indexed price	Rand/MWh	
Uses of funds		
EPC costs (excluding VAT)	Rand	
Contingencies included in EPC costs (excluding VAT)	Rand	
Contingencies not included in EPC costs (excluding VAT)	Rand	
Grid connection costs included in EPC costs (excluding VAT)	Rand	
Grid connection costs not included in EPC costs (excluding VAT)	Rand	
Other construction/installation costs (excluding VAT)	Rand	
Professional fees (excluding VAT)	Rand	
DOE development fee	Rand	
Development cost	Rand	
Success Payments	Rand	
Net VAT input VAT on construction costs less VAT refunds expected during construction period	Rand	
Interest during construction	Rand	
Borrowing costs (arranging fees, facility fees, etc.) (excluding VAT)	Rand	

Source: DoE (2013b).

Figure 18: Appendix G5-8 detailing the socioeconomic commitments of prospective projects.

Economic Development Information Sheet

FIELD DESCRIPTION	UNIT	VALUE
Job Creation		
Job Creation during the Construction Measurement Period		
Total RSA Based Employees jobs created during the Construction Measurement Period	Person-months	
RSA Based Employees who are Citizens during the Construction Measurement Period	Person-months	
RSA Based Employees who are Black People during the Construction Measurement Period	Person-months	
Skilled Employees during the Construction Measurement Period	Person-months	
Skilled Employees who are Black People during the Construction Measurement Period	Person-months	
RSA Based Employees who are Citizens from Local Communities during the Construction Measurement Period	Person-months	
Job Creation during the Operating Measurement Period		
Total RSA Based Employees jobs created during the Operating Measurement Period	Person-months	
RSA Based Employees who are Citizens during the Operating Measurement Period	Person-months	
RSA Based Employees who are Black People during the Operating Measurement Period	Person-months	
Skilled Employees during the Operating Measurement Period	Person-	
	months	
Skilled Employees who are Black People during the Operating Measurement Period	Person-months	
RSA Based Employees who are Citizens from Local Communities the Operating Measurement Period	Person-months	
Value of Local Content		
Value of Local Content during the Construction Measurement Period		
Total Project Value during the Construction Measurement Period	Rand	
Local Content during the Construction Measurement Period	Rand	
Ownership		
Shareholding (%) by Black People in the Seller	%	
Shareholding (%) by Local Communities in the Seller	%	
Shareholding (%) by Black People in the Contractor responsible for Construction	%	
Shareholding (%) by Black People in the Operations Contractor	%	
Top Management		
Top Management during the Construction Measurement Period		
Total Top Management during the Construction Measurement Period	Person-months	
Black People who are males in Top Management during the Construction Measurement Period	Person-months	
Black People who are females in Top Management during the Construction Measurement Period	Person-months	
Top Management during the Operating Measurement Period		
Total Top Management during the Operating Measurement Period	Person-months	
Black People who are males in Top Management during the Operating Measurement Period	Person-months	
Black People who are females in Top Management during the Operating Measurement Period	Person-	
Enterprise Development		
Enterprise Development during the Operating Measurement Period		
Value of Revenue during the Operating Measurement Period	Rand	
Unadjusted Enterprise Development Contributions based in Local Community during the Operating Measurement Period	Rand	
Unadjusted Enterprise Development Contributions based in Province where project is located during the Operating Measurement Period	Rand	
Unadjusted Enterprise Development Contributions based in rest of RSA during the Operating Measurement Period	Rand	
Unadjusted Enterprise Development Contributions based in all other during the Operating Measurement Period	Rand	
Enterprise Development Contributions on SME's		
Total unadjusted Enterprise Development Contributions during the Operating Measurement Period	Rand	-
Socio-Economic Development		
Socio-Economic Development during the Operating Measurement Period		
Unadjusted Socio-Economic Development Contributions based in Local Community during the Operating Measurement Period	Rand	
Unadjusted Socio-Economic Development Contributions based in Province where project is located during the Operating Measurement Period	Rand	
Unadjusted Socio-Economic Development Contributions based in rest of RSA during the Operating Measurement Period	Rand	
Unadjusted Socio-Economic Development Contributions based in all other during the Operating Measurement Period	Rand	
Total unadjusted Socio-Economic Development Contributions during the Operating Measurement Period	Rand	

Source: DoE (2013b).

The IPP Office compiled and collated the commitments and specifications from all of the Preferred Bidders under the REIPPPP and the SP-IPPPP using these appendices, among many others. The use of this existing data for this research means that this research is secondary in nature. The IPP Office provided the University of Cape Town's Graduate School of Business with the values for all the fields in the Appendix G5-1 and Appendix G5-8 for each of the REIPPPP and SP-IPPP projects to date, excluding the SP-IPPPP second phase projects. The data was received in an Excel spreadsheet that was transferred to the author of this research for use, provided that the information be safeguarded and deleted upon completion of the research and used only for academic purposes. A confidentiality agreement between the author and the Management Programme in Infrastructure Reform and Regulation (MIR) at the Graduate School of Business was signed in order to have access to this data.

The data required for this case study includes the Preferred Bidder commitments from the REIPPPP BW3 and BW4, in addition to the commitments from the First Stage 2 phase in the SP-IPPPP. This data will allow a like-for-like comparison between these projects as the commitments are reported using the same measures. The projects from BW3 and BW4 were chosen for two reasons. Firstly, these projects were bid for at a similar time as the SP-IPPPP, BW3 in August 2013 and BW4 in August 2014. Secondly, these bid windows include commitments from the same three technologies as the SP-IPPPP making it possible to compare each technology evenly. The values used in this research are therefore nominal and represent the values at the time of bidding for each project, i.e. there has been no time-adjustment done to the values.

There are additional sections on the SME participation, management control, and preferential procurement under the SP-IPPPP bidding documents; however, due to the need to compare the projects like-for-like with those in the REIPPPP and due to this data not being made available for this research, these units of analysis have not been included here. Furthermore, details on the local content value for each of the major components in each project as well as the ownership structures for each project were desired and requested for this research; however, due to time restrictions and complications with the IPP Office, industry and Eskom pertaining to signing off on the PPAs for these projects, this data could not be obtained from the IPP Office.

The number of projects under each case is detailed in the Table below. It is recognised that due to the fact that there are only two Small biomass and two Small wind projects under the SP-IPPPP, and two biomass projects under the REIPPPP, the sample size is small. Hence, a statistical generalization with projects outside of South Africa may not be credible; however, these are the only projects of this technology type under this programme and these findings therefore represent the whole population for Small wind and biomass projects in South Africa, and their use in an analytical generalization between the REIPPPP projects and the SP-IPPPP projects the data does offer useful information.

The use of these findings outside the South African context is thus limited by the statistical significance of wind energy and biomass energy sample sizes. The findings are therefore exploratory and the scale-up scenarios do not consider possible learning and economies of scale as the SP-IPPPP develops. Hence, this research should be viewed as an initial inquiry into this topic, upon which future research (as more projects are procured) can build on to generate a statistically significant sample that can be used for international comparisons. This research is intended to review these programmes and the predicted outcomes based on the project commitments in order to inform policy makers on the most suitable technology types to include in the SP-IPPPPP in future.

Table 12: Number of Preferred Bidders in each case study.

Bidding Window	Technology	Number of Projects
REIPPPP BW3	Solar PV	6
	Wind	7
	Biomass	1
REIPPPP BW4	Solar PV	12
	Wind	12
	Biomass	1
SP-IPPPP First Stage 2	Solar PV	6
	Wind	2
	Biomass	2

Source: DoE (2017).

3.3. Analysing the Data

In order to conduct a cross-case synthesis, standard variables need to be determined for both cases to allow for like-for-like comparisons (Burns, 2012). The standard variables are known for the REIPPPP; however, additional information is needed for community jobs/MW and SED & ED spend per technology. For greater accuracy and validity, the commitments from Preferred Bidders in BW3 and BW4 will be reviewed and presented in the same format as those of the SP-IPPPP Preferred Bidders. This allows for consideration of standard deviation for each metric and acts as a proofing mechanism on the available literature.

Due to the confidentiality agreement signed, the data for each project must be aggregated by technology to protect the proprietary information of the bidders. This means that the findings in each metric for individual projects cannot be presented for confidentiality reasons. The findings for each technology will therefore include aggregated values of the above-mentioned units of analysis. Aggregation of data for each technology will be done using a weighted arithmetic mean for each metric as well as a simple standard deviation on this weighted average. The formula for obtaining the weighted average for a given metric is as follows:

$$\overline{X} = \frac{\sum_{i=1}^{n}(X_i * W_i)}{\sum_{i=1}^{n}(W_i)}$$

Where:

X_i is the observed value

W_i is the projects power capacity in MW

This will be done for projects from each of the REIPPPP bidding windows and the SP-IPPPP First Stage 2 (1S2) bidding window and for each metric being measured. This aggregated data for the three technologies is the data that has been reported and used in Chapter 4. The aggregated data is available as an appendix in the form of a spreadsheet.

Once this information has been detailed for each technology a two-step analysis will then be created to argue the justification of the potential price premiums for these Small projects. The first step in the justification will provide direct comparisons and trade-offs for the different technologies. This simply compares the findings for each unit of analysis between the REIPPPP and the SP-IPPPP to see the face-value differences between the Small and Large projects.

The next step in the analysis is to calculate the blended price (weighted price according to the technology capacity allocations) and co-benefits of the Small projects according to its current committed capacity (49 MW) and then scale-up the capacity to the full allocation given to Small projects in the ministerial determinations (400 MW) (DoE, 2017). By extrapolating these findings to greater scales, it allows one to view the potential impact the SP-IPPPP would have on the committed electricity price (from the REIPPPP BW3 and BW4 projects) and the socioeconomic benefits that the price increase could 'buy' as a justification for these Small projects. This research does not seek to provide an economic cost-benefit analysis for the small projects, but instead seeks to argue the political and moral justification for the predicted Small project price premiums.

Extrapolation and Blended Price

Extrapolation here simply refers to multiplying the per MW values for each of the units of analysis to the desired capacity in each scenario. This has been done using Microsoft Excel and the aggregated input data acquired from the IPP Office. The extrapolation scenarios will include the Current SP-IPPPP, SP-IPPPP 400, SP-IPPPP Biomass 400, SP-IPPPP No Wind 400, and the REIPPPP 400. These scenarios are hypothetical capacities that have varying ratios of each of the three technologies reviewed in this research. They have been chosen due to their deviations in socioeconomic commitments and prices at capacities of 400 MW which offer interesting trade-offs and suggestions for the future of the SP-IPPPP. The details of each of these scenarios are shown below:

Current SP-IPPPP: 49 MW of capacity apportioned as awarded in the 1S2 window of the SP-IPPPP using Small projects data;

SP-IPPPP 400: 400 MW of capacity apportioned as awarded in the 1S2 window of the SP-IPPPP using Small projects data;

SP-IPPPP No Wind 400: 400 MW of capacity apportioned equally between solar PV (200 MW) and Biomass (200 MW) technologies using Small projects data;

SP-IPPPP Biomass 400: 400 MW of capacity apportioned strictly to biomass projects using Small projects data;

REIPPPP 400: 400 MW of capacity apportioned as awarded in BW3 and BW4 of the REIPPPP using Large projects data.

The blended price has been calculated by multiplying the average electricity tariff of a given technology, according to the Small Projects data, by the amount of capacity allocated in each extrapolation scenario to give a technology weighted-average price for that scenario. For example, in the SP-IPPPP No Wind 400, the average electricity price for the Small biomass projects will be multiplied by 200 MW and the average electricity price of the Small solar PV projects will be multiplied by 200 MW capacity. This total will be divided by 400 MW to yield a blended price for 400 MW of Small projects in this scenario. So, the calculations for the blended price are the average fully-indexed bid tariff for each technology multiplied by the capacity of each technology in the respective scenario, divided by the total capacity of all technologies in the scenario. The blended price is therefore only the hypothetical weighted-average price of electricity from the technologies in the scenario.

Finally, the price effect of the scaled-up scenarios on the overall price of electricity from the SP-IPPPP programme (400 MW) and BW3 and BW4 (3440 MW in total) will be done to determine what impact the Small projects (according to their hypothetical technology ratios) will have on the price of electricity from these renewable projects in South Africa. The price effect is therefore the sum of the weighted-average electricity tariff from all technologies in BW 3 and BW4 and the blended price of the chosen scenario, divided by the total capacity of projects in BW 3, BW 4 and the capacity allocated in the chosen scenario. For example:

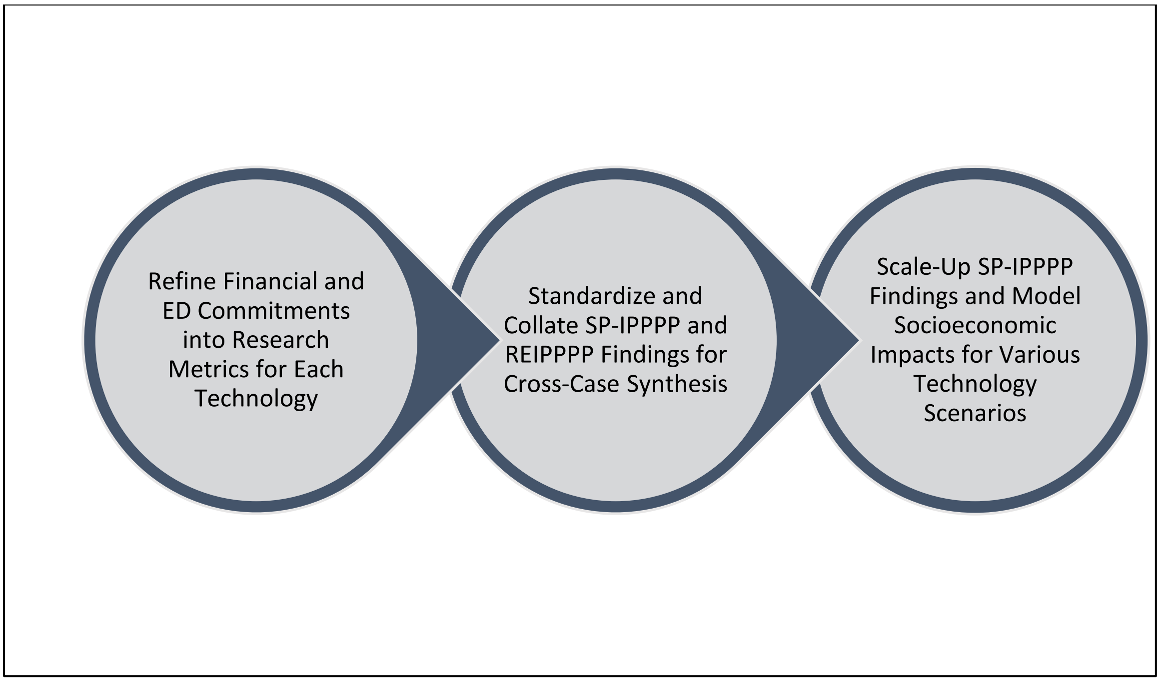
The weighted average electricity tariff for all projects under BW 3 and BW 4, representing 3440 MW, is 74.4 ZARc/KWh. Under the SP-IPPPP Biomass 400 Scenario, 400 MW of Small biomass capacity is used at an average tariff of 140 ZARc/KWh. The blended price for the SP-IPPPP Biomass 400 Scenario is therefore (140 ZARc/KWh*400)/400, which is 140 ZARc/KWh. The price effect is calculated as (74.4*3440+140*400)/3840.

This shows what additional benefits the consumers in South Africa would effectively be 'buying' from these Small projects and whether it could be argued that the price premium is acceptable given the increased co-benefits on offer. This is an important political consideration as the pressure on government to increase jobs, reduce poverty and stimulate the local economy (as detailed above) must be done at an acceptable cost so as not to dampen the demand for the electricity due to high prices.

Due to the fact that in the REIPPPP there was only one Preferred Bidder for biomass technology in each bidding window, the data from these two projects has been aggregated to protect the confidentiality of the projects. Therefore, an analysis between the cases, being the BW3 and BW4 of the REIPPPP and the SP-IPPPP, cannot be done for this technology and instead the analysis will focus on the REIPPPP (being the aggregated data from BW3 and BW4) and the SP-IPPPP.

As an exploratory case study, this research can be considered as a prelude to further research and aims to lay a foundation rather than prove/disprove existing theories on the topic (Tellis, 1997). The cross-case synthesis will thus look as follows:

Figure 19: Research procedure.



It is noted that the units of analysis and their metrics are based on commitments and not accomplished results, and that, due to the delays in the signing of the PPAs, these Small Projects have yet to be commissioned. These commitments are, however, contractually binding as mentioned in the sections above. Additionally, according to the DoE (2017) the operational REIPPPP projects as a whole have met or exceeded their ED commitments with the exception of local content spend which was 3% less than planned. Therefore, the use of socioeconomic commitments is noted as being precursory but is also regarded as an accurate proxy for the purpose of this research.

In terms of biases or shortcomings from this data source it is assumed that the data submitted to the IPP Office has been recorded accurately and without prejudice. The IPP Office, since the second bidding window, is funded by the development fees paid by the project developers and not from the National Treasury. Additionally, it is an ad-hoc institution acting at arm's length to the DoE which reduces potential for conflicts of interest in its operations (Eberhard, *et al*., 2014).

Using the information from the two-step analysis, the extent to which the price premiums (if applicable) at the time of bidding, that is without time adjustments, are justified by the co-benefits of the respective technologies can be argued. Ultimately, a recommendation for the most suitable technology mix under the SP-IPPPP regarding price and overall benefit to South Africa will be determined using these scenarios.

4. THE CASE STUDIES

The units of analyses will first be explored in isolation before being synthesised in the analysis. Each unit of analysis, with its listed measures and metrics will be given according to the bid commitments from the Preferred Bidders. All of the findings detailed in this chapter are derived from the aggregated data committed to by developers in each of the technologies according to the formula in Section 3.3 above. The sections below will cover the capacity weighted average values for each of the cases according to each technology type.

4.1. Project Cost

Under this unit of analysis, the pertinent metrics include the total project cost (TPC)/MW, the EPC costs/MW, the development cost/MW, and the interest during construction (IDC)/MW. The first technology group is solar PV and is displayed in Table 13 below, followed by wind project costs and finally biomass project costs. Biomass projects showed the least total cost premium for the Small Projects, being just 1.5% more costly than the Large Projects in the REIPPPP; however, the EPC costs were 26% more than the Large Projects. Notably, the development cost and the IDC are considerably lower in the Small Projects for the biomass projects, by 45% and 68% respectively. The lower IDC/MW for Small Projects is seen across the three technologies, with the exception of the BW4 wind projects which had a 27% increase in the IDC/MW over the Small Projects.

The development costs/MW of the Small Projects, as hypothesised were (with the exception of the beforementioned biomass projects) greater than that of the Large Projects. The Small wind projects recorded 3 times and 5.2 times increase in the per MW development costs over BW3 and BW4 projects, respectively. This coupled with the >46% EPC cost/MW increase resulted in the Small wind projects being 62% and 66% more expensive than their Large Project counterparts from BW3 and BW4, respectively. These findings suggest that the cost premium for Small Projects is less apparent for solar PV and biomass technologies in South Africa; however, there is a notable cost premium for Small (<5 MW) wind projects over their Large counterparts. It must be noted that the difference in the weighted average capacity between the REIPPPP BW3 and BW4 projects and the Small Projects was substantial as the Small projects were just 4% of the average capacity of the Large wind projects.

The Small solar PV projects reported an 18% and 88% increase in the development cost/MW over the BW3 and BW4 projects, respectively, and a 46% increase in development cost/MW over the REIPPPP projects on average. It appears from these findings that the Large solar PV and wind projects from

BW4 managed to drive down development costs significantly, as in both technologies the BW3 development cost/MW were reduced by 37% and 42% in BW4, respectively.

As a portion of TPC, it is evident that the EPC cost is the most significant, accounting for more than 70% of TPC in all cases except the Large biomass projects where it accounted for just under 60%. The development cost as a percentage of TPC for the REIPPPP projects is 3% on average, whereas, for the Small projects it is 5%; however, IDC cost as a percentage of TPC for the Large project-financed IPPs are, on average, 7% while the Small project-financed IPPs reported an average of 4%.

Table 13: Solar PV project costs across the three cases.

IPP Programme	Capacity (MW)	TPC/MW (ZAR)	EPC Cost/MW (ZAR)	Development Cost/MW (ZAR)	IDC/MW (ZAR)
REIPPPP BW3	72.5	18,723,742	15,393,554	902,725	918,166
REIPPPP BW4	67.7	20,749,225	15,662,154	564,689	1,302,135
SP-IPPPP 1S2	5.0	22,614,703	18,040,104	1,063,192	811,635

Table 14: Onshore wind projects costs across the three cases.

IPP Programme	Capacity (MW)	TPC/MW (ZAR)	EPC Cost/MW (ZAR)	Development Cost/MW (ZAR)	IDC/MW (ZAR)
REIPPPP BW3	112.4	21,559,453	15,774,840	849,414	1,416,062
REIPPPP BW4	113.6	21,129,642	17,551,920	493,175	1,058,164
SP-IPPPP 1S2	4.5	34,985,689	25,642,005	2,581,422	1,342,115

Table 15: Biomass project costs across the three cases.

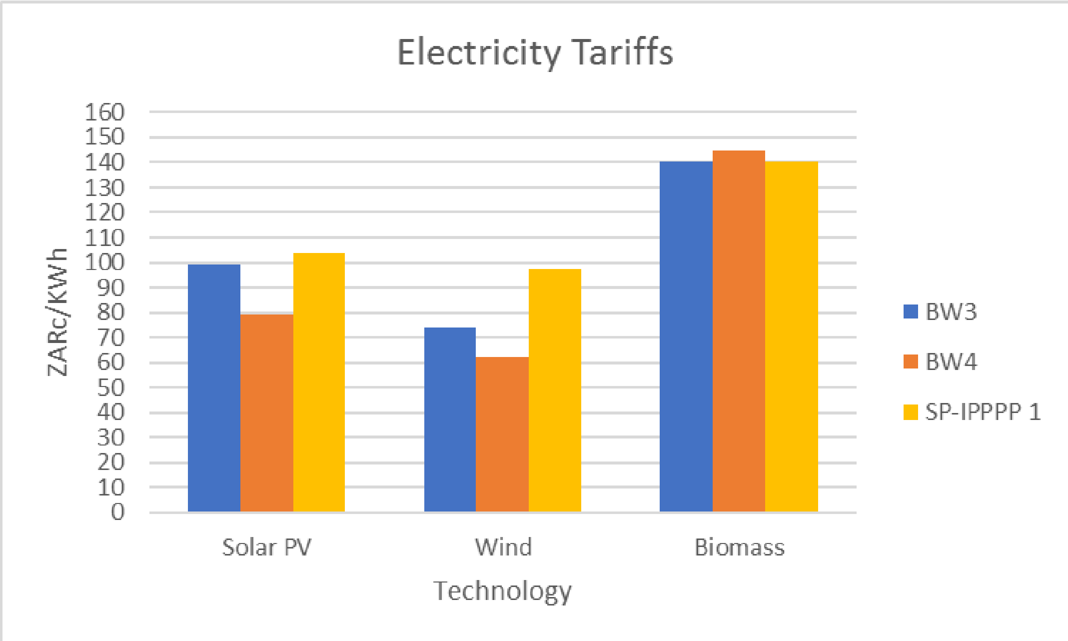
IPP Programme	Capacity (MW)	TPC/MW (ZAR)	EPC Cost/MW (ZAR)	Development Cost/MW (ZAR)	IDC/MW (ZAR)
REIPPPP BW3 & BW4	20.75	54,373,656	31,822,457	6,846,436	6,032,180
SP-IPPPP 1S2	5	55,210,932	43,200,001	3,796,096	1,928,427

4.2. Electricity Price

As expected, the electricity tariff is reflective of the project costs and the findings in the difference in the price of electricity from these projects mirrors those in the above section. It is observed that the Small wind projects had a 31% and 57% price premium over the Large Projects in BW3 and BW4, respectively- the most of all three technologies. Interestingly, the biomass projects under the SP-IPPPP came in 3.5% cheaper than in BW4 and equal to the project in BW3. It appears that biomass projects do not have a price premium for projects with a capacity of 5 MW; however, both projects were 5 MW and it cannot be deduced from these findings whether projects smaller than this share this same outcome.

The solar PV projects under the SP-IPPPP achieved similar electricity tariffs (5% more expensive) to those of BW3 in the REIPPPP despite being just 7% of the size of these projects, on average. However, there was a 31% price premium for the Small solar PV projects over the BW4 projects.

Figure 20: Electricity tariffs from the Preferred Bidders under the three cases.



4.3. Finance

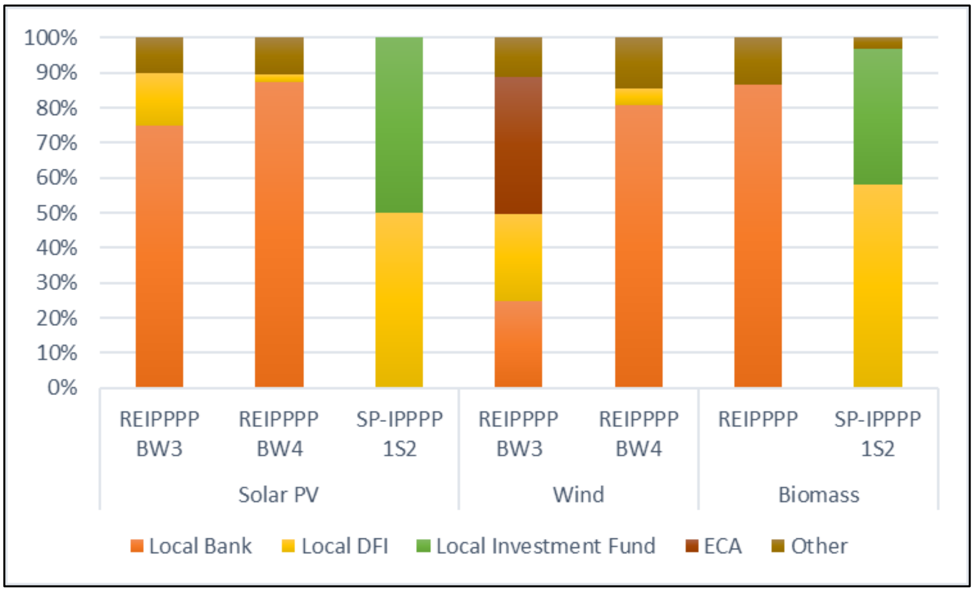
All of the biomass projects in the REIPPPP and the SP-IPPPP were project financed. The same is true for all of the solar PV projects in BW4. Corporate finance was prolific, as mentioned by Eberhard & Naude (2016b), in the SP-IPPPP wind (100%) and solar (50%) projects. Of the 16 projects that were corporate financed in the three cases, only one project was funded by a local corporation, and that was in the SP-IPPPP. 15 of the 16 corporate financed projects were funded from the balance sheets of foreign-owned companies and represent 99.6% of the corporate financed capacity and 34% of the total capacity in these three bidding windows.

In total, 67% of the projects in these three cases were project financed, making this type of funding the most popular among the Preferred Bidders. Figure 21 breaks down the sources of funding for IPPs that were project financed. The wind projects under the SP-IPPPP 1S2 were excluded due to them being corporate financed. It is immediately evident how involved the local banks were in the REIPPPP bidding windows for all but the wind projects in BW3. In the SP-IPPPP window, however, none of the capacity was funded by the commercial banks. Instead the vast majority of the funding came from a local development finance institution (DFI), 53%, and a local investment fund, 45%.

Therefore, 98% of the project financed Small IPP funding came from local financiers. For the REIPPPP projects, 90% of the solar PV capacity that was project financed received their funding from local financiers, of which 83% was from local commercial banks. 72% of the project financed Large wind capacity sourced funding from local financiers; however, these projects made use of Export Credit Agencies (ECA) for a larger portion of their funding (19%), as only 60%, on average, came from local commercial banks.

When looking at the REIPPPP projects overall (BW3 and BW4), the local participation in funding is broken down as 46.5% commercial banks and 5.5% DFIs bringing total local funding to 52% of the capacity. A further 34% was financed by foreign-owned corporate funding and the remainder being attributed to ECAs and shareholder loans. For the Small projects, localisation of funding amounted to 28% from DFIs and 22% from an investment fund. A further 10% of total funding came from local corporate finance, bringing the total localisation of funding for the Small projects to 60% of capacity and foreign corporate finance to 39% of funding.

Figure 21: Source of funding for IPPs that were project financed.



4.4. Local Content

It was hoped that data in the form of the cost and local content value for each of the key components for each technology would be obtained from the IPP Office, but unfortunately this data was not made available. If that data could have been retrieved, an EPC breakdown similar to those done for the three technologies in Chapter 2, and the findings for these projects in relation to this literature could have been discussed. The data that was obtained provides the overall local content value for each Preferred Bidder in these cases, which has been aggregated below.

The project value listed in this section is approximates the total project cost, but excludes items such as finance charges, land costs and other fees (DoE, 2013). The local content value per MW is therefore a function of the project value per MW, and the greater the local content percentage the more benefit the projects have to the South African economy. In the Large Projects, solar PV offers the greatest opportunity for localisation as reflected in the superior local content percentages in these projects. Both the wind and biomass Large Projects did not manage to get half of the total project value spent on local suppliers.

In terms of the Small Projects, however, the two biomass projects achieved the highest percentage of localisation commitments under the SP-IPPPP and represents a 61% increase in local content spend per MW over the Large biomass projects. The Small wind projects also committed to significant local content spend per MW, to the tune of 56% and 59% over the BW3 and BW4 projects, respectively. For Small solar PV projects, however, this improved localisation was not seen as the local content percentage was around 5% less under the SP-IPPPP than the REIPPPP BW4. That said, the actual local content per MW value of the Small solar PV projects was still greater than those in the REIPPPP purely because the projects had greater project value (read project cost) than the Large Projects.

Table 15: Local content commitments for the three technologies across the cases.

Technology	IPP Programme	Project Value/MW (ZAR)	Local Content Value/MW (ZAR)	Local Content (%)
Solar PV	REIPPPP BW3	15,787,382	8,500,210	53.50%
	REIPPPP BW4	16,187,750	10,086,995	62.34%
	SP-IPPPP 1S2	20,563,597	11,782,917	57.61%
Wind	REIPPPP BW3	17,012,030	7,982,254	47.3%
	REIPPPP BW4	17,616,900	7,822,395	44.1%
	SP-IPPPP 1S2	24,911,356	12,459,301	50.0%
Biomass	REIPPPP	37,466,296	16,676,808	44.7%
	SP-IPPPP 1S2	44,415,000	26,788,458	60.0%

4.5. Job Creation

Job creation has been separated into two broad measures here, the first being CMI jobs and the second being O&M jobs. CMI jobs are temporary in nature and cease once the project has been successfully commissioned. The O&M jobs, however, run for the duration of the project lifespan and are considered as permanent. As such, the lower per annum values for the O&M job creation should be read with the knowledge that these values are sustained over a period of up to 20 years.

As can be seen in Figure 23, Table 16 and Table 17 below, the wind projects in all the cases have committed to the lowest employment factors of the three technologies. The REIPPPP BW4 solar PV projects committed to more job creation in the construction phase than the Small Projects, which is the only technology to see this result. Moreover, these projects committed to more Black jobs and Community jobs than the BW3 or the Small Projects, on average.

Table 16: CMI job creation across the three cases.

Technology	IPP Programme	SA Citizens PY/MW	Black Citizens PY/MW	Community PY/MW
Solar PV	REIPPPP BW3	4.87	3.55	2.09
	REIPPPP BW4	8.10	6.58	4.83
	SP-IPPPP 1S2	7.25	5.50	3.46
Wind	REIPPPP BW3	3.32	2.71	1.44
	REIPPPP BW4	3.78	3.33	1.68
	SP-IPPPP 1S2	5.35	4.41	2.27
Biomass	REIPPPP	5.90	4.40	2.55
	SP-IPPPP 1S2	22.22	16.97	9.29

The Small biomass projects committed to the highest job creation figures of the three technologies with regard to the O&M phase. In fact, biomass projects in all cases committed to more O&M employment than the other technologies. The Small solar PV projects committed to very similar O&M job creation to the Large biomass projects, and (importantly) 134% more permanent Community jobs than the BW4, which exhibited greater construction employment. Hence, Small solar PV projects can be said to create less construction employment than the Large projects per MW installed, but to significantly more permanent employment in the O&M phase. The opposite can be said with wind projects. The Small wind projects committed to 30 % less total permanent employment per MW than the Large projects and 45% less community employment per MW; however, in the construction phase, the Small projects beat the Large project employment commitments, on average.

Table 17: O&M job creation across the three cases.

Technology	IPP Programme	SA Citizens PY/MW/a	Black Citizens PY/MW/a	Community PY/MW/a
Solar PV	REIPPPP BW3	0.86	0.78	0.67
	REIPPPP BW4	1.01	0.91	0.80
	SP-IPPPP 1S2	2.24	2.09	1.87
Wind	REIPPPP BW3	0.54	0.48	0.39
	REIPPPP BW4	0.69	0.52	0.31
	SP-IPPPP 1S2	0.44	0.28	0.23
Biomass	REIPPPP	2.63	2.41	2.06

	SP-IPPPP 1S2	5.28	3.73	2.94

In all technologies, the annual O&M employment factors are lower than the respective CMI employment factors; however, it must be noted that these O&M jobs are sustained for up to 20 years for these projects. Figure 22 highlights just how significant the O&M employment phase is in terms of its contribution to the overall employment. In all technologies, O&M employment accounts for the majority of the overall person years generated by the renewable energy project. For the biomass projects it can be seen that around 85% of the total jobs created (in PY) are in the O&M phase. The solar PV projects committed approximately 80% of their employment to O&M jobs across the project lifespan, and the wind projects just over 70%. This emphasises how the low annual O&M phase employment factors (as in Table 17) can mislead the impact that this phase has on the overall job creation in the projects.

Figure 22: Contributions of CMI and O&M employment to total employment.

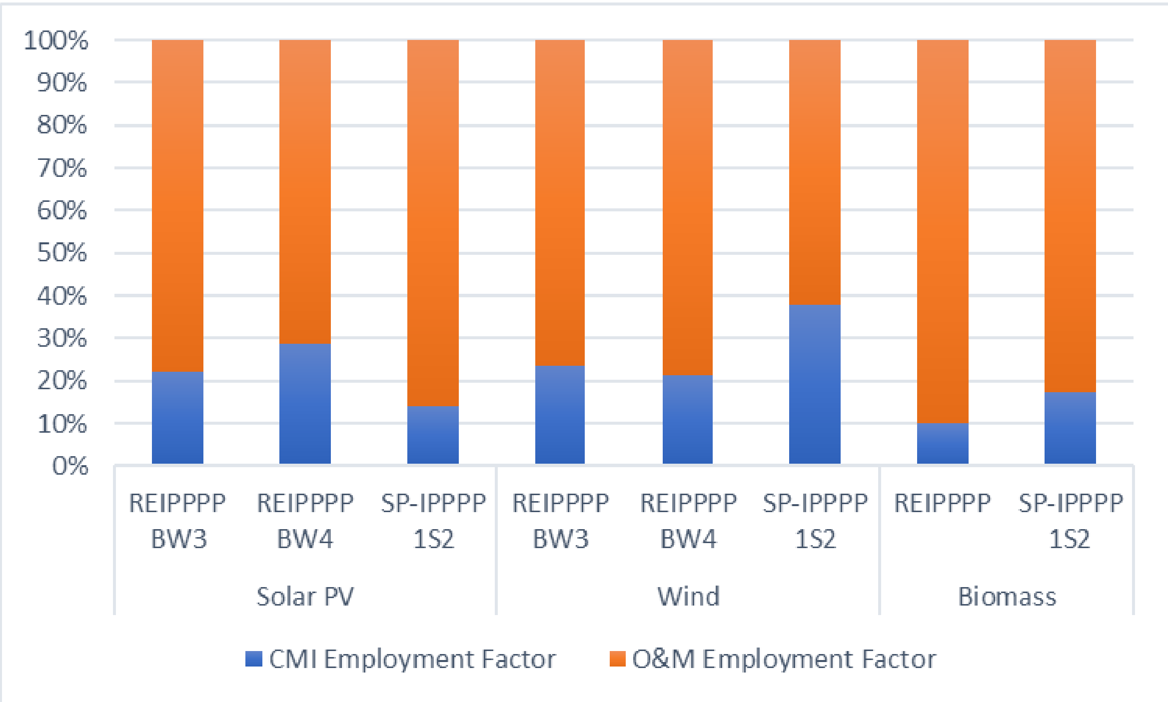
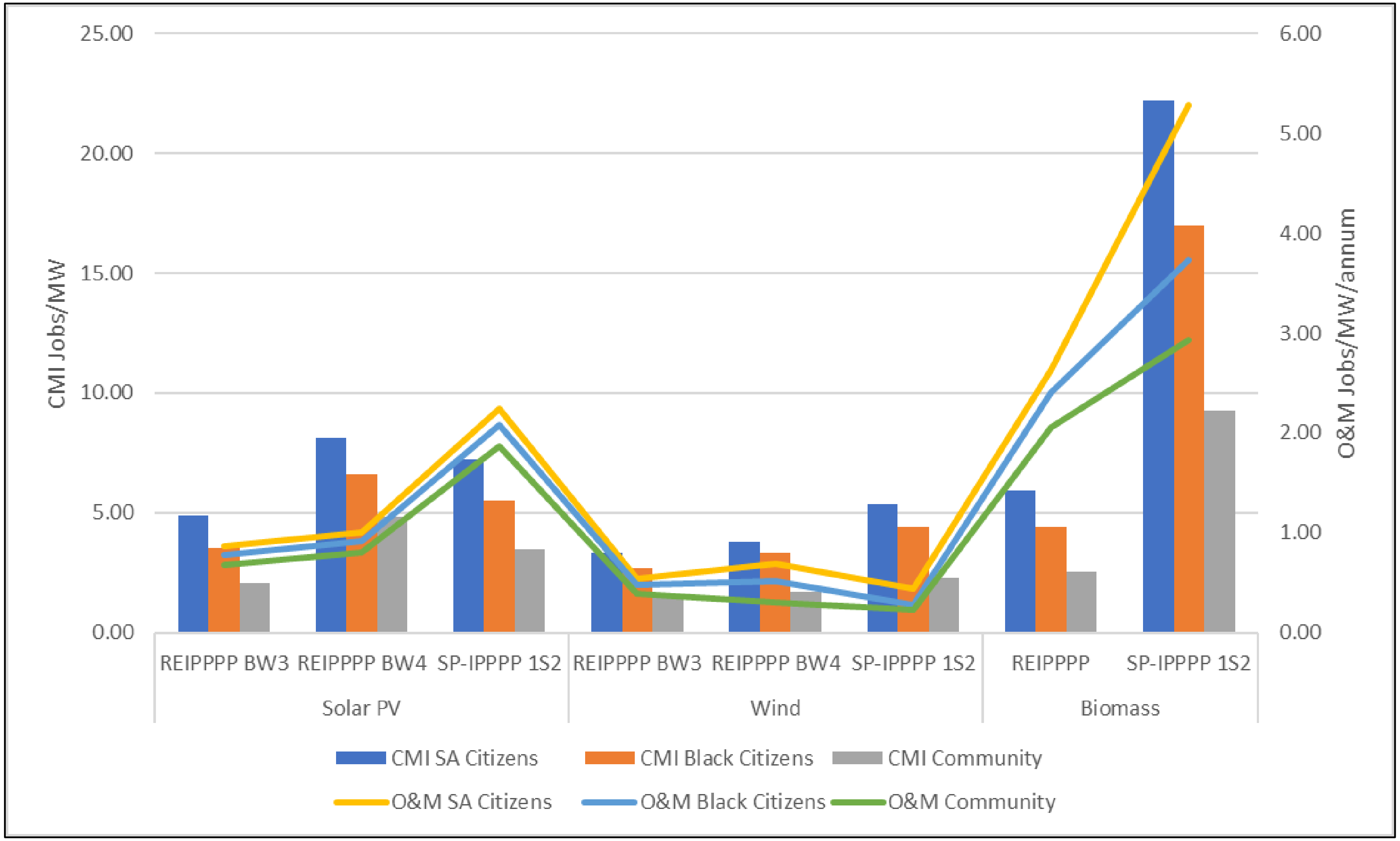


Figure 23: Job creation commitments in the CMI and O&M phases of the three cases.



4.6. Community Benefit

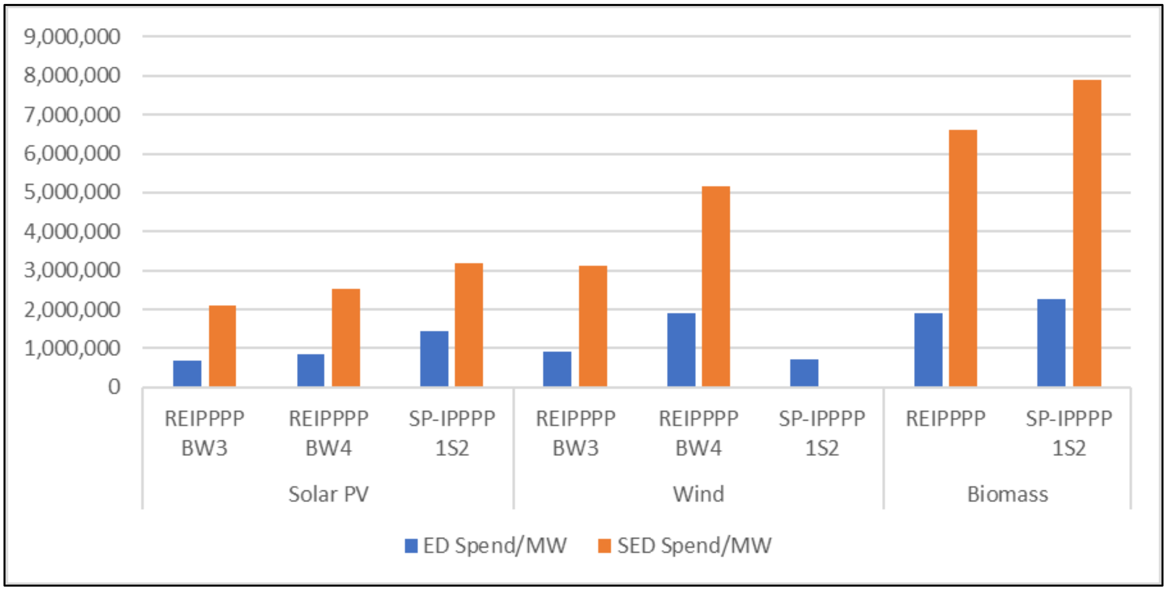
Community benefit is comprised of the ED Spend/MW and the SED Spend/MW for the three cases. As per the RFP requirements of the REIPPPP and the SP-IPPPP, there is a minimum requirement for SED spend in the REIPPPP but not in the SP-IPPPP. The Small biomass projects committed to the greatest amount of SED Spend/MW in all cases and technologies, on average; followed by the Large biomass projects. For the Small solar PV projects, the SED spend/MW was on average 53% and 27% greater than the BW3 and BW4 commitments, respectively. Hence, it is only with wind technology where the Small projects do not beat the Large projects in terms of SED Spend/MW committed. These projects did not specify SED spend in the data received and as such their commitments were assumed to be zero. The Large wind projects, however, committed to the second most SED Spend/MW of the three technologies, on average.

In terms of ED Spend/MW committed, again the Small wind projects reported lower figures than the Large projects on average. The Small solar PV and biomass projects both outperformed the Large projects in terms of committed ED Spend/MW, on average. Hence, it can be said that the Small solar PV and biomass projects offered more community benefit per MW than that of the Large solar PV and biomass projects. The findings of this unit of analysis are presented in tabular and graphic form below.

Table 18: Community benefit measured as ED spend/MW and SED Spend/MW across the three cases.

Technology	IPP Programme	ED Spend/MW	SED Spend/MW
Solar PV	REIPPPP BW3	R 678,398	R 2,087,518
	REIPPPP BW4	R 853,490	R 2,512,645
	SP-IPPPP 1S2	R 1,436,702	R 3,201,034
Wind	REIPPPP BW3	R 907,881	R 3,133,614
	REIPPPP BW4	R 1,902,356	R 5,157,415
	SP-IPPPP 1S2	R 718,626	R 0
Biomass	REIPPPP	R 1,887,589	R 6,598,204
	SP-IPPPP 1S2	R 2,264,628	R 7,898,168

Figure 24: Community benefit in the form of ED and SED Spend/MW for each technology.



5. CROSS-CASE SYNTHESIS

The analysis seeks to use the findings in Chapter 4 to answer the question of whether the increased cost premium for Small projects is justified by increased socioeconomic benefits in the form of job creation (including black employment and community employment), local content, and community benefit. For this analysis the above metrics for the REIPPPP BW3 and BW4 IPPs has been aggregated to give a weighted average per technology for the Large projects.

5.1. Employment Benefit

As above, the employment values for these technologies are broken down into CMI (temporary) jobs and O&M (permanent) jobs. First, CMI employment factors will be analysed for these three technologies. For solar PV projects, the 13% cost premium between the Small projects and the Large projects is not justified in terms of CMI employment. The total employment is 3.9% greater for the small projects but there is a downward trend for both Black citizen and Community employment. Community CMI employment dropped almost 11% for the Small solar PV projects.

Small wind projects reported a 64% cost premium on average over the Large wind projects; however, the CMI employment factors committed to were 48% higher in total and around 42% greater for Black citizens and Community members. Small biomass projects, on the other hand, reported a nominal increase in TPC (1.5%) and a minimum of 265% increase in CMI employment, on average. This represents a substantial increase in job creation commitment over a negligible cost premium.

When looking at O&M employment figures things change dramatically for solar PV projects. The Small solar PV projects committed to 135% more O&M employment per MW in total than the Large solar PV projects. More importantly, these projects committed to 141% and 146% more Black and Community employment than the Large projects, which is the inverse of the CMI employment trend for the Small solar PV projects.

The opposite trend was observed with Small wind projects, wherein permanent job creation slumped 45% for Black citizens and 31% for Community members. The major point of interest here is the reduction in Black citizen employment in the O&M phases for the Small wind projects which showed a more rapid decline between the Small wind projects and the Large projects.

Lastly, the Small biomass projects maintained their employment benefit over the Large projects in the O&M phase as these projects committed to 55% and 43% more Black and Community employment, respectively.

5.2. Local Content Benefit

For this section, focus has been given to the local content percentage and not the Rand value, due to the fact that the Rand value is a direct function of the total project value and thus the TPC. Therefore, even with a drop in local content percentage, the local content value could still be higher for Small projects, purely because there is a cost premium which inflates the local content value.

When viewed in the context of the justification of the cost premiums via local content benefit the Small biomass projects, again, have the greatest justification of the three technologies. These projects committed to 34% more local content in their procurement, on average. Similarly, the wind projects also reported an increase in local content for the Small projects, although this was to a lesser degree (10%). Interestingly, the Small solar PV projects committed to nearly 3% less local content in their procurement than the Large projects; however, it must be noted that the BW4 solar PV projects committed to the highest local content percentage across all bid windows (including the SP-IPPPP), on average.

It should be noted that in all three cases and across all three technologies, the local content value of the Small projects is greater than that of the Large projects. This means that the national economic benefit per MW is greater for the Small projects as there is more impetus into goods and services procurement relative to the Large projects; however, the absolute local value of the Small projects amounts to just 2.5% of that of the Large projects.

5.3. Community Benefit

Community benefit, as measured by ED Spend and SED Spend, reflects the same trends as the O&M employment benefits. Small solar PV and biomass IPPs committed to greater ED and SED spend/MW than the Large projects- particularly the solar PV projects which committed to 81% and 35% more ED and SED spend/MW, respectively. The small biomass projects committed to 20% more ED and SED spend/MW than their Large projects.

The Small wind projects faired a lot worse in their community benefit metrics than the Large wind projects and was the only technology to show a decline in community benefit per MW. The SED spend/MW is not comparable as there is no value assigned to the Small wind projects for this metric; however, the ED spend/MW showed a 53% decline between the Large wind projects and the Small. It must be noted that there are only two wind projects in the SP-IPPPP 1S2 window and that there are Large projects that did not commit to any ED spend, making the zero value for the Small wind SED spend/MW not in isolation for these cases. It is just that the greater number of projects in the REIPPPP windows offsets these zero values when averaged.

In Table 19 below, the differences across the indicators between the Small projects in the SP-IPPPP and the Large projects in the REIPPPP are depicted. Positive values reflect an increase in the weighted-average value for that indicator in the Small projects versus the Large projects, and vis versa for the negative values. For project cost and electricity price it is desirable to have a negative value (meaning more affordable projects) but for the other socioeconomic indicators it is desirable to have positive values.

This table clearly shows how the aggregated data points towards wind energy being the least suited to scales below 5 MW under these programmes as the project cost and electricity prices are considerably higher than those in the REIPPPP while committing to less O&M employment and community benefit, although CMI employment had greater commitments. A difficult question arises from these findings, and that is which jobs (CMI or O&M) should be prioritised in these programmes? O&M jobs tend to be permanent in nature which offers sustained (20 year) benefits to those involved in the project and the indirect benefits from this income to the wider community; however, CMI jobs are more intensive per MW of capacity built meaning that more people in a given community could find a job, even if it is only for one or two years. This question would potentially mean the difference between giving Small solar PV preference over Small wind when looking at the CMI and O&M employment as in Table 19. Biomass, in all measures here, appears to be the most suited technology for procurement at scales below 5 MW. Offering negligible price and cost premiums, with considerable socio-economic benefit.

Table 19: Trade-offs for Small solar PV, wind, and biomass projects versus Large solar PV projects.

Unit of Analysis	Estimate	Metric	Solar PV Difference	Wind Difference	Biomass Difference
Project Cost	Total Cost	TPC/MW	12,8%	64,4%	1,5%
Electricity Price	Project Tariff	ZARc/KWh	20,9%	47,0%	-2,1%
CMI Job Creation	SA Citizens	PY/MW	3,9%	48,2%	276,5%
	Black Citizens	PY/MW	-0,4%	42,0%	285,9%
	Community Members	PY/MW	-10,6%	42,2%	264,5%
O&M Job Creation	SA Citizens	PY/MW/a	134,6%	-30,3%	100,6%
	Black Citizens	PY/MW/a	140,7%	-44,6%	54,7%
	Community Members	PY/MW/a	146,4%	-31,3%	42,5%
Local Content	Relative Local Expenditure	%	-2,8%	10,4%	34,2%
Community Benefit	ED Funding	ED spend/MW	81,3%	-53,3%	20,0%
	SED Funding	SED spend/MW	35,4%	-100,0%	19,7%

5.4. Extrapolation Scenarios

In all of the scenarios here it is important to note that each technology has a different load factor which affects the amount of electricity that is produced by the power plants over its lifetime. In the IRP, solar PV is assumed to have a load factor of 19.4%, while wind had 30% and biomass 85%; meaning that a biomass project of 5 MW would produce significantly more electricity over a 20-year lifetime than a 5 MW solar PV plant. The blended price illustrated in these scenarios does not consider the amount of energy produced over the lifespan of each technology as the energy forecast data was not available; instead, it represents the weighted average price based on the capacity of each technology installed and their fully indexed price. Therefore, the blended price is the price of electricity coming from solar PV, wind and biomass projects in BW3 and BW4 of the REIPPPP and the 1S2 of the SP-IPPPP according to the weighted-average fully-indexed bid price for each technology. The blended price is not the national price of electricity. These scenarios have been calculated using Microsoft Excel to multiply the aggregated data for each technology to a greater scale (400 MW).

Using the scenarios illustrated below it is evident that at a scale of only 49 MW, as in the 1S2 window of the SP-IPPPP, the impact of the price premiums on the overall price from these three cases is negligible (0.5 ZARc/KWh) which is expected considering the capacity of the Small projects in this window are 1.4% of the capacity of the REIPPPP windows. The co-benefits also only reach just over 4% (under jobs created) of the co-benefits from the REIPPPP at the most. At this scale, the Small projects contribute a proverbial drop in the ocean compared to the 3440 MW of capacity from the Large projects in terms of both a price difference and co-benefits to the economy.

When scaled-up to 400 MW, however, the co-benefits of the Small projects appear to become more apparent, while still only increasing the overall blended price by under 4 ZARc/KWh. For a price increase of 4 ZARc/KWh South Africa would receive over 24,000 more jobs (over the project lifespan), nearly R6 billion in local content spend and over R2 billion in community benefit spend in absolute terms. This is before considering the indirect job creation and economic impetus from this R8 billion injection into the South African economy.

If Small wind is stripped out of the SP-IPPPP going forward, as in the No Wind 400 Scenario, the blended price increases by around 12 ZARc/KWh versus the SP-IPPPP 400 case where wind accounts for 18% of the capacity. The co-benefits, however, are notably greater than with wind in the mix as every socioeconomic measure increases substantially. This perfectly highlights the trade-off apparent between the technologies in this research. Wind energy offers the most competitive electricity price, but at the expense of local content spend and jobs in particular. In the No wind 400 Scenario, a considerable portion of co-benefits are derived from the increased allocation to biomass, which although the most expensive of the three technologies, offers the highest job creation, local content spend, SED and ED spend.

This is evident when looking at the Biomass 400 Scenario which allocates all the 400 MW capacity to biomass projects. The overall price impact is less than 7 ZARc/KWh more expensive, but there is a dramatic increase in the number of jobs created in the renewable industry. For this 7 ZARc/KWh, South Africa would receive 51,000 jobs (a 73% increase in total employment from the 3440 MW of Large projects), over R 10.7 billion in local expenditure, and over R 4 billion in community benefit spend over a 20 year project lifespan.

When looking at the Small projects scaled-up to 400 MW (as per the ministerial determination) adjacent to the REIPPPP project data downscaled to the same 400 MW you can get a sense of the impact that the Small projects would have when compared to the Large projects. This is just a theoretical exercise as the Large projects would not be able to achieve the prices if they were to be downscaled to this capacity in reality, it simply allows for a better cross-case synthesis. The most striking difference between these two scenarios is in the amount of jobs created by the Small projects versus that of the Large projects. In this scenario the Small projects would generate almost 3 times the amount of jobs over the project lifespan than the REIPPPP projects would. Additionally, the local economy would see R2.5 billion more in stimulus from project expenditure.

Table 20: Extrapolation scenarios for the Small Projects

Scenario	SP-IPPPP Current	SP-IPPPP 400	No Wind 400	Biomass 400	REIPPPP 400	REIPPPP Current
Blended Price (ZARc/KWh)	109.9	109.9	121.8	140	74.4	74.4
Total Jobs (Person Years)	2,970	24,244	35,999	51,157	8,152	70,100
Total Local Content Spend (Rand)	R 733,505,803	R 5,987,802,472	R 7,714,274,999	R 10,715,383,200	R 3,434,223,906	R 29,532,387,091
Total ED Spend (Rand)	R 72,214,957	R 589,509,853	R 740,265,892	R 905,851,130	R 508,677,625	R 4,374,356,044
Total SED Spend (Rand)	R 175,012,706	R 1,428,675,148	R 2,219,840,473	R 3,159,267,305	R 1,479,088,101	R 12,719,369,160

Scenario	Overall Price (ZARc/KWh)
Current	74.9
SP-IPPPP 400	78.1
No Wind 400	79.4
Biomass 400	81.2

6. DISCUSSION

The findings of this research have, in some cases, supported and disagreed with the hypotheses made. The hypotheses, looking back, were rather broad and did not take into account possible variations between the findings within each technology group. This chapter will review how the results of the cases studies supported the hypotheses made, as well as positioning the cases within the context outlined in Chapter 2.

6.1. Project Cost and Finance

It was postulated that the Small projects for all three technologies would have higher EPC, development and IDC costs than the Large projects. The results supported this notion for Small solar PV and wind projects. For both technologies, the TPC, EPC cost, and development cost per unit capacity installed was higher for Small projects than the Large projects. The Small wind projects saw a notable increase in the TPC, EPC cost, and development cost per MW, and when compared to the aggregated IDC/MW for the REIPPPP projects, these projects were also costlier relative to their capacity.

The hypothesis was not supported in respect of the IDC cost for solar PV and biomass plants, and the TPC, and development cost for the Small biomass projects. The Small biomass projects reported just 1.5% higher overall project cost versus the Large biomass projects, 45% less development cost, and 68% less IDC than the Large projects. The lower IDC cost for the Small solar projects makes sense when considering the type of finance used in the projects. Half of the projects were corporate financed and reported no IDC cost, suggesting that these projects were funded directly from the balance sheet of the developer, without the need for additional funding from financiers. This would have lowered the aggregated IDC/MW for these projects. An important consideration regarding the overall costs of biomass projects is that they could be an augmentation of an existing enterprise, such as a sugar mill or a sawmill. In such cases the overall cost of development would be expected to be lower than for stand-alone projects as there could be significant synergies and cost-savings in these biomass projects.

The role of DFI funding for the Small projects is seen as a primary driver for lowering the cost of credit, and by extension reducing the IDC/MW by giving concessionary rates that would otherwise not be attainable from the commercial banks. This notion further supports the findings of the higher IDC/MW for the Large projects, as the majority of the funding for these projects (that were project funded) came from local commercial banks, which are expected to have charged higher interest rates than the DFIs.

These cost parameters were reflected in the electricity tariffs for each technology. The Small wind projects reported a 31% and 57% electricity price premium over the BW3 and BW4 projects, respectively, and confirms the hypothesis. Bearing in mind that the average size of the Small wind projects was 4.5 MW and the Large wind projects 113 MW, the fact that this technology showed the greatest cost and price premium is unsurprising. It would be interesting to know the size of the turbines to be used in the Small wind projects, as this would certainly impact the cost efficiency of the projects. It was perhaps envisaged by the DoE that the Small wind projects would make use of more smaller capacity turbines (around 500 KW) that would be easier to install and erect than the a few 2-3 MW turbines produced by international OEMs. Having only one or two turbines installed means that when one is being serviced or is experiencing issues, the power plant's output is effectively halved for that down period. This problem is negated with diversification through installing numerous turbines. It would seem that wind projects are better suited to Large scale projects, for this reason among others, and due to the fact that the average size of the wind projects throughout the REIPPPP has increased between the bidding windows.

With regard to the Small solar PV projects, there was not a significant price premium between the Small projects and the BW3 projects (5%), and for all intents and purposes this can be said to be an acceptable increase if there was socioeconomic justification for the Smalls. There was, however, a 31% price premium over the BW4 projects, even though the Small projects were bid for 77 days after the bid submission date for the BW4 projects. This means that the Small solar PV projects had the same learning curve potential as the BW4 projects and were still 31% more expensive in terms of electricity price. This means that for the Small solar PV and wind projects, the research hypothesis was correct regarding the electricity price premium for the Small projects.

The Small biomass projects, however, not only showed very little cost premium in construction but were equal in tariff to the BW3 project and 3.5% cheaper than the BW4 project, on average. It seems that Small biomass projects do not come at a cost or price premium to the Large projects in these cases.

The finance hypothesis partially supported to be correct in the findings. While the role of DFIs in the funding of the Small projects was dominant in this case, the amount of funding provided by the local investment fund was surprising. The role of local investment funds in future renewable bidding windows could be interesting, as these financiers appear to be more willing to take on the risk associated with these Small projects than the commercial banks are. These small renewable projects may appeal to private investors with larger risk appetites looking for income-yielding alternative investments that commercial banks might deem too risky. Perhaps, judging by these findings, the commercial banks will continue to dominant the funding of the Large projects going forward (as they have done in the past); whereas, the less risk-averse investment fund industry could continue capitalizing on this funding gap in search of higher returns. Niched investment funds aimed at sustainable infrastructure and responsible investing would be more likely to finance these renewable projects than commercial banks due to the fact that they are mandated to invest in projects such as these; whereas the banks would simply be looking at investments with suitable risk-return profiles.

In terms of localisation of funding, the Small projects can be said to have achieved a greater degree of local involvement in project funding. The only local corporate funded project was under the SP-IPPPP programme, presumably due to the fact that local developers are still emerging and cannot finance a project the size of those in the REIPPPP using their balance sheet, either directly or as collateral for debt. The remaining corporate financed Small projects were funded from a subsidiary of a foreign-owned company that had the resources to do such but cannot be said to be truly locally financed. All of the corporate financed REIPPPP projects in BW3 and BW4 were funded by a large multinational developer that represents 35% of the overall capacity in those windows. The Small projects thus managed to get local financiers more involved in the programme; however, it was only marginally (60% of capacity versus 52% of REIPPPP capacity) and there was no involvement from commercial banks in these projects.

Interestingly, the Small solar PV projects reported lower Capex costs than was anticipated in the SP-IPPPP bidding document (DoE, 2013e), and 25% less than the estimated Capex in the IRP Update report (DoE, 2013a). A similar outcome is seen with the wind projects. The DoE expected, in the SP-IPPPP bid documents, that the Capex for Small wind projects would be around R25m/MW, ranging up to R35m/MW (DoE, 2013e). In reality, these projects tended towards the R35m/MW mark and were thus more expensive than anticipated by the DoE.

Biomass, having a variety of electricity generating mechanisms (as mentioned earlier), has a much wider range in terms of Capex and LCOE. The REIPPPP and SP-IPPPP projects tend towards the upper estimates of Capex costs in the literature and again the DoE (2013e) again underestimated the Capex cost of the Small biomass projects by about 10%. Hence, it was only for the Small solar PV projects that the DoE (2013e) slightly over-estimated the Capex cost.

Finally, the positioning of renewable energy in South Africa as having a substantial role in achieving socioeconomic goals can be said to be placing excessive pressure on the industry to perform beyond its primary function that is to provide clean electricity to the country. With all of these socioeconomic considerations and commitments, it is expected that the projects will not be as cost effective as these projects could be without these additional elements for developers to consider. It seems that even with these socioeconomic obligations in the REIPPPP and the SP-IPPPP, these projects are competitive and even cheaper in some instances than estimated- signifying the potential that this industry has for South Africa.

6.2. Local Content

Although the Small projects all committed to more actual local content spend per MW than the Large Projects, in relative terms (as a percentage of total project value) they did not commit to as much as anticipated. The Small solar PV projects actually committed to a lower percentage of local content than the Large projects, and the Small wind projects were only 10% greater than that of the Large projects. When considering the 64% cost premium for these Small wind projects, this marginal benefit does not seem justifiable.

The Small biomass projects committed to a sizeable amount more relative local content than the Large projects. It was surprising how low the local content percentage was for the REIPPPP projects, considering this technology is essentially a thermal power plant with much the same mechanisms as a coal power station, the only major difference being the fuel source. South Africa has considerable experience with coal power stations and one would expect the equipment used in a biomass plant would be easier to source domestically than the other technologies. The difference between these technologies lies in the O&M phase, wherein the biomass plants require fuel to be purchased to generate the power. It would be interesting to see the value of feedstock procurement in these projects and how much of the total project value lies in this phase versus the other two technologies. The procurement of feedstock for the biomass plants would undoubtably be recognised as locally produced and could significantly improve the local content spend for this technology type. The data on the total and local content value for each component in the project, as desired, would be invaluable for this analysis and would shed a lot of light on where in the renewable energy value chain South African suppliers are adding considerable value, and where there needs to be more support.

The hypothesis regarding the local content expenditure of the Small projects was supported by the findings, although in the case of the solar PV and wind projects it was purely as a result of the increased project cost per MW and less to do with improved percentages. The Small projects' local content percentage (with the exception of the abovementioned Small biomass plants) did not increase notably over the Large projects and as such this unit of analysis has not proved to be justifying the cost premium for the Small solar PV and wind projects.

Another important thing to note here is that the REIPPPP and the SP-IPPPP have other socioeconomic criteria to adhere to, which may place additional financial constraints on the projects. If the cost of local components is greater than imported, there is a cost premium for localisation. When this is your only socioeconomic criteria to adhere to, these costs can be absorbed better than if the projects are still required to contribute ED and SED funding.

Lastly, localisation is also highly dependent on the country having the required capacities, skills and resources to manufacture, assemble, deliver and install power plant components. Countries like China, USA, France, and India have significantly larger electricity sectors with more established manufacturing facilities than South Africa, which makes localizing the value chain easier than in a country with a fledging renewables industry and less capacity in the pipeline to justify investment in said facilities.

6.3. Job Creation

The hypothesis on job creation under Small projects can by and large be said to have been supported. CMI job creation in wind and biomass projects increased under the SP-IPPPP and there was a slight increase in the overall CMI employment in the solar PV projects versus the aggregated REIPPPP findings. Permanent job creation, however, decreased dramatically for the Small wind projects, which is alarming considering how much of the total employment for renewable projects lies in the O&M phases. A possible reason for this peculiar outcome could be that these services were outsourced to an external company and those person years were not included in the bids; although, it would be to the detriment of the bidder not to include those jobs in their bid as they could be classified as jobs that have been 'seconded to' (Stands, 2015) by the project. This notable decline in O&M job commitments for the Small wind projects, coupled with the importance of job creation in the programme, detracts from the justifiability for this technology type in a Smalls programme. Lastly, the low O&M employment for Small wind here could again suggest that these projects used few, large capacity turbines instead of many smaller capacity ones. If there are only two turbines to service and maintain, the employment will be sporadic and temporary as a technician will only be needed for mandated servicing and for faults.

The Small solar PV and biomass projects, on the other hand, committed to significantly greater permanent employment than their Large counterparts, particularly the solar PV projects. As a policy maker, the prioritization of these units of analysis is inevitably going to decide which technology type to pursue with the SP-IPPPP and how to structure the programme in future. Considering the permanent nature of the work and the unemployment crisis being faced, prioritizing permanent job creation in renewables should undoubtably be one of the top priorities for policy makers. Considering the job creation benefit in the O&M phase for Small solar PV and biomass projects, these technologies should be given priority going forward.

Particular mention must be given to the job creation benefits of the Small biomass projects. For both the CMI and O&M phases the job creation commitments were higher (and significantly for that matter) and with very little cost premium their justification is clearly evident. Given the weighting of job creation and local content in the ED requirements of the SP-IPPPP in relation and how much greater the Small biomass projects' commitments were than those of the REIPPPP projects, this technology in particular seems to offer the most socioeconomic benefit for the least cost premium.

The Small wind projects committed to greater employment factors than the IRENA (2017a), Kammen *et al*. (2004), REPP (2001) and Slattery *et al*. (2011) studies in both the CMI and O&M phases. The SP-IPPPP wind projects appear to have higher than average O&M employment when looking at the international findings, which means the REIPPPP wind projects have committed to well above average O&M employment. This could be attributed to the infancy of the industry and as a result of job creation criteria within the RFPs, among other things. It is expected that more people are employed in an infant industry than in a mature market, due to learning curves and automation that reduce the employment intensity over time. The job creation requirements in the RFPs incentivise bidders to elevate employment figures in order to submit a more competitive bid, which could have buoyed the employment factors for the REIPPPP and SP-IPPPP projects over their international counterparts.

The Small wind project CMI employment, although better than the few studies mentioned above, was lower than the others. A few of the studies here quoted figures of between 10 and 15, and one up to 27 PY/MW, which are notably higher than those of the South African projects. The issue between comparisons between South African projects and those internationally lies in the recording of jobs created by a project. As mentioned in the REIPPPP and SP-IPPPP, bidders are allowed to include direct jobs and those 'seconded to' which is open to interpretation. Would 'seconded to' include jobs labelled as 'indirect' in other studies, or just under 'direct' jobs created. The difference is considerable depending on what is included in this measure and getting clarity on the inclusions and exclusions of this measure are important.

Job creation for South African solar PV projects, in the CMI phase, appears to be below the findings in literature; however, the O&M employment figures per MW are greater than the averages found internationally, with the exception of the Moreno & Lopez (2008) study. From this, it could be deduced that South Africa does not have the same local capacity for the CMI phase of renewable energy as the

European and Asian countries, meaning that less job opportunities are afforded to South Africans during this phase, as the jobs are created where the equipment is manufactured. This would explain the lower CMI employment figures for the solar PV and wind projects in these cases versus the international findings. The jobs/MW reported under the SP-IPPPP and the REIPPPP are for SA citizens in particular, meaning that there could be manufacturing jobs attributed to foreign citizens that are not included in these programmes. The O&M phase would require employees to be permanently based in the project location and does not rely, as much, on imported components as in the CMI phase. This explains the higher O&M phase employment figures in the REIPPPP and SP-IPPPP cases versus international studies where South African residents perform more of the work and are therefore included in the measure of jobs created.

Overall it seems that South African solar PV and wind projects do not employ as many people during the CMI phases, possibly due to the lower localisation along the value chain than in international cases, as mentioned in the preceding section. Although, the O&M employment for South African projects, for all three technologies, appears to be higher than those listed in the international studies. When looking at total employment for each technology, findings from these case studies suggest solar PV and wind project see only 15%-35% of the employment occurring in the CMI phase, and even less for biomass. This highlights the importance of the O&M phase for overall employment in these projects. South African biomass projects appear to offer a higher employment factor all phases of the project than in international studies, although there is much variation in this technology which can distort the findings for this technology group.

6.4. Community Benefit

The research hypothesis regarding community benefits was proven to not be supported, according to the findings. In the case of Small wind projects, the removal of the minimum threshold for SED funding resulted in Preferred Bidders reducing their contributions under this criterion, presumably to better meet other bid obligations. Hence, there was a substantial difference between the community benefit commitments for these projects versus the REIPPPP wind projects. This seems odd due to the fact that SED funding is given a 15% weighting under the SP-IPPPP RFP versus ED funding which is given 5% weighting (DoE, 2013c), which would make SED funding the lower hanging fruit; however, the SP-IPPPP documents did mandate a minimum of 0.5% of revenue to be set aside for ED funding aimed at Small and Micro Enterprises (SMEs). Perhaps these bidders were pressed to meet the minimum threshold for SME ED funding to be successful, even though this criterion had a lower overall weighting than the SED contributions.

The Small biomass projects reported a modest increase in community benefit commitments when compared to the Large projects and the Small solar PV projects reporting the largest positive disparity under this measure. The design of the RFP regarding the weighting of the ED criteria is reflected in the findings where these Preferred Bidders, with the exception of Small wind projects, contributed more SED spend/MW than ED spend/MW in order to score better on their ED scorecards.

This community benefit, when looked at in relative terms (per MW), shows that Small solar PV and biomass projects would outperform the Large projects. This impact is eroded somewhat when viewed holistically. The SP-IPPPPP projects represent just 1.4% of the installed capacity of the Large projects, and in terms of community benefit committed to 1.62% of the total ED funding and 1.36% of total SED funding for all three cases. Which, relative to their size, means they are expected to achieve greater ED contributions and almost equal SED contributions to the Large projects. In Rand value this amounts to R72,215,000 in ED spend and R175,012,706 in SED spend for the Small projects cumulatively. To put this into perspective, 18 of the 39 projects (46%) in BW3 and BW4 committed more than this in ED Spend and 25 of the 39 projects (64%) committed more in SED spend in Rand values.

It seems illogical to require the Small projects, representing a fraction of overall installed capacity, to contribute a portion of the already stressed revenue towards community benefit, when in reality the Rand value is a proverbial drop in the ocean when compared to the REIPPPP contributions. It may be more prudent to remove the ED and SED requirements for Small projects in order to make them more financially competitive which would make access to credit and funding easier through reduced risk and could encourage more local developers to tender for these projects, given the improved returns. Commercial- and industrial-scale renewable projects are becoming more popular, globally and in South Africa, and do not have to adhere to these socioeconomic criteria which erode profits margins. As of July 2017, there are approximately 27 privately-owned solar PV energy projects between 1 MW and 5 MW in South Africa (Rycroft, 2017), meaning there are renewable projects currently operating with similar capacities to those bid for under the SP-IPPPP but procured independently. What would motivate a developer to bid for a project under the SP-IPPPP knowing that the returns are going to be squeezed through community benefit contributions, when they could build projects for private clients without an onerous bidding procedure and without contributing to socioeconomic funding? Rycroft (2017) estimated that there was 144 MW of private solar PV capacity at the end of 2016, which amounts to more than both SP-IPPPP bidding window capacities combined. With this in mind, the criteria of the SP-IPPPP regarding community benefit should be considered as it may deter potential (local) developers from investing in such a programme, as private projects could offer better returns.

6.5. Price Premium Justification

To what extent the price premium of the Small projects is justified by the co-benefits is an open-ended question with no definitive answer. This is because, especially in a country facing unemployment and poverty challenges, paying even slightly more for this basic human right might be unattainable. Such is the sensitivity and complexity of electricity in South Africa. On one side policy makers and government are committed to achieving climate change targets, boosting the local economy and reducing unemployment, which necessitates attracting private investment for sustainable developments such as these renewable energy projects. On the other hand, procuring electricity from these projects has historically been more expensive than conventional (fossil-fuelled) projects which could make it unaffordable for the poor and hinder the competitiveness of business due to the increased costs of production.

Recently, however, when looking at the price of electricity coming from new coal projects such as Medupi and Kusile, these renewable energy technologies are competitive if not cheaper, whilst being less carbon intensive and more job intensive per unit of installed capacity (Simas & Pacca, 2014). In fact, looking at the findings of this research and comparing the electricity price of the Small and Large renewable projects with the price estimates for Medupi and Kusile by Steyn, *et al*. (2017), all of them are more affordable than either of these projects.

Moreover, according to Eskom's Integrated Report for the 2016/2017 year, the average electricity price was 84 ZARc/KWh. When one looks at the secnarios for the SP-IPPPP programme in the analysis, in all cases the overall price from the REIPPPP projects and various Small Project scenarios are below this figure. Even if the 400 MW capacity for the SP-IPPPP were to be allocated to biomass (the most expensive technology of the three), as in Biomass 400 Scenario, the overall price from all of these projects would be 81 ZARc/KWh, three cents cheaper per KWh than Eskom's average selling price.

When viewed in this regard, it appears that there is in fact no price premium for these Small projects as in any case the overall electricity price from BW3, BW4 and 400 MW of Small projects would be less than the average Eskom selling price. Meaning that the co-benefits from these projects can be realised without a significant impact to the price of electricity in South Africa, in which case the Small projects are most definitely justified by their social and economic benefit for the country. It is, however, recognised that the electricity from these projects (with the exception of biomass) is not necessarily dispatchable and thus suitable for baseload electricity, meaning that the grid might not be sustained on these technologies alone. That said, with only 400 MW of capacity allocation, the

SP-IPPPP was never going to be the cornerstone of the South African grid but is instead a programme that seeks to procure sustainable electricity in a manner that increases local participation, generates employment opportunities and boosts the local manufacturing capacity in this field.

With this in mind and seeing how negligible the impact of 400 MW of Small capacity is in terms of the overall electricity price, it seems prudent to procure the technology with the most socioeconomic benefits for the country in this programme. From these findings, it appears that biomass is the most suited technology option for the SP-IPPPP. Firstly, the shortened operating period allowed in the SP-IPPPP (five years) is well suited to biomass technologies as the long term (20-year) security of feedstock supply has been documented as a challenge for this technology (Frost & Sullivan, *et al*., 2013). Secondly, the total project cost and the price of Small biomass electricity is broadly in line with that of the Large projects, meaning that there is no premium for the smaller capacities (to 5 MW) in this technology.Lastly, this technology in the SP-IPPPP offered the most co-benefits for the local economy with considerabaly more employment than the other two technologies.

Small-scale solar PV projects, similar in size to these Small projects, appear to be gaining attraction privately or 'behind the fence' in South Africa, as detailed above. Perhaps, with further research needed, these projects afford the developers greater returns with less barriers to entry than being procured through a programme like the SP-IPPPP. Although, in the second bid window of the SP-IPPPP, all 50 MW were procured from solar PV suggesting that there is still interest in the SP-IPPPP from developers, suggesting that even with the LCRs and community benefit requirements, the developers can achieve competitive prices.

It must be said that the Small wind projects had the least justification for their price premium in these cases. With the trend in the REIPPPP for wind projects to have higher capacities and the significant price premium of the Small projects over these Large counterparts, without much improvements in the co-benefits, it appears that wind energy is better suited to large-scale projects. With the trade-off between electricity price and socioeconomic benefits most pronounced with this technology, as seen in the No Wind 400 Scenario and the lower employment intensity, wind energy is potentially more appropriate under the REIPPPP. Given that the price of electricity coming from wind energy projects is so competitive (at large scales), it makes sense that these projects are used to maintain the low blended electricity price for renewables versus trying to develop local, small-scale capacity for this technology.

Perhaps, in order to improve the socioeconomic performance of the Large wind projects, the REIPPPP should prioritise community ownership over LCRs and community benefit requirements, as pointed out in sections 2.3.4 and 2.3.5. Figure 8, Lantz & Tegen (2009) and Allan, *et al*. (2011) highlight the importance of prioritizing community ownership over LCRs and community benefit funding, as revenues from these projects if reinvested in local community interventions afford a greater local economic impetus and contribute more meaningfully to rural upliftment than LCRs. Munday, *et al*. (2011) further emphasise the importance of ownership highlighting how profits gained 'greatly exceed the sums of [community benefit funds] being offered by commercial wind famrs' (pp9). The localisation and job creation incentives can then be maintained in the solar PV and biomass projects which appear to be better suited for such.

7. CONCLUSION AND FURTHER RESEARCH

The results of this research, while based on commitments rather than achievements made, have nonetheless provided some pertinent insight into the pros and cons of Small grid-connected renewable projects when compared to the Larger projects. It appears that not all the technologies procured at large-scales (>5 MW) are suited to being downscaled in an attempt to reap further socioeconomic benefits for the country. It appears that certain technologies are more suitable at projects greater than 5 MW of capacity, while other technologies offer considerable socioeconomic benefits when the projects are smaller than 5 MW (as in the SP-IPPPP). In particular, the Small wind projects reported a considerable (64%) construction cost and (up to 57%) price premium over the Large wind projects. This could be expected considering the size difference between the Small (4.5 MW) and the Large projects (113 MW) was the greatest of the three technologies. These premiums were not justified in the case of the Small wind projects through socioeconomic benefits, as the permanent job creation and community benefit were actually lower than the Large wind projects per MW. The CMI job creation and local content were higher than those of the Large wind projects; however, both were lower than the other two technologies and the benefits increased by less than what the cost and price increased.

On the other hand, the biomass projects appear to be the most suitable technology for use in the SP-IPPPP, due to the fact that the cost and price premiums over the Large projects were negligible and negative in the case of the electricity tariff. Furthermore, the socioeconomic benefits derived from the smaller-scaled projects, most notably the job creation commitments, were dramatically improved and when compared to biomass projects globally it appears that the SP-IPPPP projects committed to greater employment than most other countries. Local content and community benefits also saw increased commitments for this technology making it undeniably beneficial. That said, the sample size for the wind and biomass projects was small (four projects) and additional bidding rounds with a focus on biomass technology would provide a much-needed increase in the sample size for analysis.

Small solar PV projects also appear to be suited for inclusion under the SP-IPPPP. Considering that the second bidding window of the SP-IPPPP saw this as the only technology procured, it seems logical that these findings are similarly aligned. There was a cost (13%) and price (21%) premium for the Small projects, however, the permanent employment for Black citizens and Community members increased by more than 1.4 times when compared to the Large projects. Although there was a slight decrease in the local content commitment for the Small projects, the local content percentage is still relatively high. The BW4 solar PV projects committed to over 62% local content which is the highest, on average, of any of the prior bid windows across all three technologies. The Small solar PV projects had a greater local content commitment than the BW3 solar PV projects.

Overall the South African solar and wind projects committed to less CMI employment on average than those in the literature, but on the par committed to more permanent employment than those projects included in the literature. A review of the job creation methodology used by the IPP Office could be telling in this regard to evaluate which jobs in the value chain are permitted to be included and which jobs are not.

In terms of community benefit, once again the Small biomass and solar PV projects outperformed their Large counterparts in their commitments. Unfortunately, the same cannot be said about the Small wind projects community benefit commitments. The relevance of including the ED and SED funding as socioeconomic criteria in the SP-IPPPP has been questioned in this research. Given the negligible impact of the SP-IPPPP projects' community benefit funding in relation to the REIPPPP projects' funding, wherein the total contributions of the SP-IPPPP projects amount to just 1.6% and 1.4% of the REIPPPP projects' contributions. The exclusion of these criteria would improve the profitability of the Small projects which would assist in improving the bankability and therefore the access to credit for these projects, which as seen by the absence of commercial bank funding, is an issue for these projects. Instead, it is argued that community ownership in the renewable energy projects should be prioritised, due to the greater flows of money generated from project profit versus community benefit allocation and due to the wider economic benefit associated with project ownership over other socioeconomic mechanisms.

When scaling-up the Small projects to their allotted 400 MW, it is evident that the price premium for the these projects makes only a small difference in the overall electricity price from the RE projects in the three cases. The co-benefits provided by the Small biomass and solar PV projects in particular, can be argued to justify the price increase. Looking at the No Wind 400 and the Biomass 400 Scenarios, for a respective 5 ZARc/KWh and 7 ZARc/KWh overall renewable price premium, the South African society would receive an additional 36,000 or 51,000 jobs (as person years) over the project lifetime, and the economy would receive R 10.6 billion or R14.8 billion in project expenditure and community benefit over the project lifetime, respectively. These figures do not include the indirect and induced employment and the resulting economic benefit that would result from these scenarios, which are substantial. Considering that this price premium, when looking at the overall electricity cost in South Africa for 2017, is not actually a price premium, it can be said that these

Small projects, particularly biomass and Solar PV technologies, are justified by their socioeconomic benefits to the country.

7.1. Further Research

This research has brought about many questions regarding the socioeconomics of renewable energy in South Africa and has identified areas that require further research in order to fully understand this topic. Firstly, the proliferation of embedded generation renewable energy capacity in the country suggests that the economics have become favourable for these energy technologies. In particular, solar PV has seen a surge in the recent years (Rycroft, 2017). It would be interesting to evaluate the cost of small-scale embedded solar PV and biomass projects and how these costs compare with projects in the SP-IPPPP. Moreover, looking at job creation and localisation in these embedded projects and conducting a similar comparison could prove telling. It could be the case that with the creation of PowerX, an electricity wheeling company established in 2013/2014 (Slabbert, 2018), small-scale projects such as those under the SP-IPPPP would rather operate in the free market than tender for the SP-IPPPP bidding windows. The SP-IPPPP requires onerous (and costly) bidding procedures and socioeconomic commitments that the private projects would not have.

Secondly, an area of interest is in the local content expenditure of the REIPPPP and SP-IPPPP projects. Within the bidding documents, bidders are required to indicate the total value of key components and the local content value for each. An interesting topic of research would be to review this information for the operational projects and identify areas in the renewable energy value chain that have seen significant localisation and areas where localisation has been poor. This could then advise policy makers on the sectors that should be supported and inform a localisation roadmap for renewables in South Africa.

The literature mentioned in sections 2.6 and 2.7 highlights the importance of community (being within 50km of the project site) ownership in improving the socioeconomic benefits derived from these energy projects. The data on project ownership for these Small projects was not available for this research but it may offer interesting findings into the socioeconomic performances of these projects in the future. Ownership, as mentioned, can be opaque and ever-changing which makes this topic difficult to isolate, but if the ownership structure of these projects could be identified one could analyse the correlation between project ownership and the commitments of the other socioeconomic parameters to support/challenge the findings in the literature above.

Another worthwhile topic of research would be an investigation into the consecutive increase in employment factors across the technologies under the REIPPPP bid windows. This goes against what one may think as mature industries tend to see a reduction in employment factors as lessons are learnt and inefficiencies eliminated (REN21, 2017). Perhaps the developers have been overstaffing projects to outcompete other bidders and improve their chance of being selected as Preferred Bidders? Or perhaps the 'vague' description and enforcement of the job creation (Stands, 2015) under the REIPPPP has allowed developers to overestimate their employment potential. In any case, a description from Preferred Bidders on this topic could prove interesting and useful to government regarding the structure and enforcement of ED requirements in the REIPPPP and SP-IPPPP going forward.

Lastly, as follow-up research, an evaluation of the actual performance with regard to the costs, job creation, local content, and community benefit of the SP-IPPPP projects versus that committed to in the RFP would give insight into the accuracy of these commitments in reality. This is presuming that these Small projects are signed-off and are constructed in future. It may be that the Preferred bidders are unable to meet their commitments and need to negotiate penalties with the IPP Office, or these commitments may be bested in reality, given that so much time passed between their bid submission and their execution date.

8. REFERENCES

Aliyu, A., Modu, B. & Tan, C., 2017. *A Review of Renewable Energy Development in Africa: A focus on South Africa, Egypt and Nigeria,* s.l.: Renewable and Sustainable Energy Reviews.

Allan, G., McGregor, P. & Swales, K., 2011. The Importance of Revenue Sharing for the Local Economic Impacts of a Renewable Energy Project: A Social Accounting Matrix Approach. *Regional Studies,* 45(9), pp. 1171-1186.

Baker, L., 2015. The Evolving Role of Finance in South Africa's Renewable Energy Sector. *Geoforum,* Volume 64, pp. 146-156.

Baker, L. & Wlokas, H., 2015. *South Africa's renewable energy procurement: A new frontier?,* Cape Town: Energy Research Centre, University of Cape Town.

Barradas, S., 2014. *Mkuze Biomasss Project, South Africa.* [Online]
Available at: https://www.engineeringnews.co.za/article/mkuze-biomass-project-south-africa-2014-03-21
[Accessed 12 August 2018].

Barros, J. *et al*., 2017. Comparative analysis of direct employment generated by renewable and non-renewable power plants. *Energy,* Volume 139, pp. 542-554.

Berka, A. & Creamer, E., 2018. Taking stock of the local impacts of community-owned renewable energy: A review and research agenda. *Renewable and Sustainable Energy Reviews,* 3(82), pp. 3400-3419.

Bhorat, H. & Rooney, C., 2017. *State of Manufacturing in South Africa,* Cape Town: Development Policy Research Unit.

Blanco, G. *et al*., 2014. *Climate Change 2014: Mitigation of Climate Change. Drivers, Trends and Mitigation,* Cambridge: Cambridge University Press.

Blanco, M., 2009. The economics of Wind Energy. *Renewable and Sustainable Energy Reviews,* 13(6-7), pp. 1372-1382.

Burns, J., 2012. Cross-Case Synthesis and Analysis. In: A. Mills, G. Durepos & E. Wiebe, eds. *Encyclopedia of Case Study Research.* Thousand Oaks, CA: SAGE Publications, pp. 265-266.

Cameron, L. & Van der Zwaan, B., 2015. Employment factors for wind and solar energy technologies: A literature review. *Renewable and Sustainable Energy Reviews,* Volume 45, pp. 160-172.

Cebotari, S., Cristea, M., Moldovan, C. & Zubascu, F., 2017. Renewable energy's impact on rural development in northwestern Romania. *Energy for Sustainable Development,* Volume 37, pp. 110-123.

Creamer, T., 2017. Eskom's New R174bn Grid Plan Includes R18bn for IPP Connections. *Engineering News*, 19 October, URL: https://www.engineeringnews.co.za/article/eskoms-new-r174bn-grid-plan-includes-r18bn-for-ipp-connections-2017-10-19/rep_id:4136 [Accessed 20 May 2018].

del Rio, P., 2016. *Auctions for Renewable Energy Support in South Africa: Instruments and lessons learnt,* s.l.: AURES.

del Rio, P. & Burguillo, M., 2008. Assessing the impact of renewable energy deployment on local sustainability: Towards a theoretical framework. *Renewable and Sustainable Energy Reviews,* Issue 12, pp. 1325-1344.

Department of Economic Development, 2011. *The Green Economy Accord,* Pretoria: Department of Economic Development.

Department of Energy (DoE), 2013f. Request for Qualification and Proposals for New Generation Capacity Under the Small Projects IPP Procurement Programme. Part A: General Requirements, Rules and Provisions. *Tender NO.: 004/13/14*, 21 August.

Department of Environmental Affairs, 2014. *GHG Inventory for South Africa,* Pretoria: DEA.

Department of Mineral and Energy, 1998. *White Paper on the Energy Policy of the Republic of South Africa,* Pretoria: DME.

DoE, 2011. Request for qualification and proposals for new generation capacity under the IPP Procurement Programme: Part A: General Requirements, Rules and Provisions. *Tender No.: DOE/001/2011/2012*, 3 August.

DoE, 2013a. *Integrated Resources Plan for Electricity (IRP) 2010-2030: Update Report,* Pretoria: Department of Energy.

DoE, 2013b. Request for Qualifications and Proposals for New Generation Capacity under the Small Projects IPP Procurement Programme: Volume 4: Financial Requirements. *TENDER NO. 004/13/14*, 21 August.

DoE, 2013c. *Implementation Agreement. Renewable Energy IPP Procurement Programme: Bid-Window Round Three.,* Centurion: Department of Energy.

DoE, 2013c. Request for Qualifications and Proposals for New Generation Capacity under the Small Projects IPP Procurement Programme. Volume 5: Economic Development Requirements. *TENDER NO: 004/13/14*, 21 August.

DoE, 2013d. Request for Qualification and Proposals for New Generation Capacity under the Small Projects IPP Procurement Programme. Part D: Stage 2 Evaluation Criteria.. *TENDER NO: 004/13/14*, 21 August.

DoE, 2013e. Information Document in respect of the Request for Qualification and Proposals in respect of the Small Projects IPP Procurement Programme. *6681679_1*, 29 August, pp. 1-75.

DoE, 2013. *Implementation Agreement: pursuant to the Small Projects Renewable Energy Independent Power Producer Procurement Programme.* Pretoria: Department of Energy.

DoE, 2015. *The State of Renewable Energy in South Africa,* Pretoria: Department of Energy.

DoE, 2016. Integrated Energy Plan. *Government Gazette No. 40445*, 25 November.

DoE, 2017a. *Small Projects IPP Procurement Programme.* s.l., Department of Energy.

DoE, 2017. *Independent Power Producers Procurement Programme (IPPPP): An Overview.* [Online] Available at: https://ipp-projects.co.za/Publications
[Accessed 8 October 2017].

DoE, 2018. *Energy Price Report,* Pretoria: Department of Energy.

Eberhard, A., 2013. Feed-In Tariffs or Auctions?. *Viewpoint*, April.

Eberhard, A., Kolker, J. & Leigland, J., 2014. *South Africa's renewable energy IPP procurement program: Success factors and lessons,* Washington DC: Public-Private Infrastructure Advisory Facility.

Eberhard, A., Kolker, J. & Leigland, J., 2014. *South Africa's Renewable Energy IPP Procurement Programme: Success Factors and Lessons,* Washington D.C.: Public-Private Infrastructure Advisory Facililty.

Eberhard, A. & Naude, R., 2016b. *The South African Renewable Energy IPP Procurement Programme: Review, Lessons Learned & Proposals to Reduce Transaction Costs,* Cape Town: Graduate School of Business, University of Cape Town.

Eberhard, A. & Naude, R., 2016. The South African Renewable Energy Independent Power Producer Procurement Programme: A Review and Lessons Learned. *Journal of Energy in Southern Africa,* 27(4), pp. 1-14.

Ecofys, 2017. *Climate Action Tracker: South Africa.* [Online]
Available at: http://climateactiontracker.org/countries/southafrica/2017.html
[Accessed 29 August 2017].

EScience Associates, 2013. *The localisation potential of Photovoltaics and a strategy to support the large scale roll-out in South Africa,* s.l.: South African Photovoltaic Industry Association.

Eskom, 2017. *Integrated Report,* Johannesburg: Eskom Holdings SOC Limited.

Ettmayr, C. & Lloyd, H., 2017. Local content requirements and the impact on the South African renewable energy sector: A survey-based analysis. *South African Journal of Economic and Management Sciences,* 20(1), pp. 1-11.

Fedderke, J. & Garlick, R., 2008. *Infrastructure Development and Economic Growth in South Africa: A Review of the Accumulated Evidence,* Cape Town: University of Cape Town: School of Economics.

Frost & Sullivan; Emergent Energy; 3E; Townsend, N.; Ahlfeldt, C., 2013. *Development of a Customised Sector Programme for Small Scale Renewable Energy in South Africa,* Cape Town: Department of Trade and Industry, WWF.

Greencape, 2015. *Market Intelligence Report,* Cape Town: Greencape.

Groenewald, Y., 2017. Kubayi's: Eskom must sign IPP agreements by end of October. *Fin24*, 01 September.

Hondo, H. & Moriizumi, Y., 2017. Employment creation potential of renewable power generation technologies: A life cycle approach. *Renewable and Sustainable Energy Reviews,* Volume 79, pp. 128-136.

IDC, 2012. *Green Economy Report: The Cost Evolution of Renewable Energies,* s.l.: Department of Research and Information.

IDC, 2016. *Economic Overview: Recent Developments in the South African Economy and Drivers of Growth Over the Medium-Term,* s.l.: Department of Research and Information.

IEA, 2015. *Projected Costs of Generating Electricity,* Paris: International Energy Agency.

IFC, 2015. *Utility-Scale Solar Photovoltaic Power Plants,* Washington D.C.: International Finance Corporation.

IFC, 2017. *Converting Biomass to Energy: A Guide for Developers and Investorsq,* Washington D.C.: International Finance Corporation.

IRENA & CEM, 2014. *The socio-economic benefits of large-scale solar and wind: an econValue report,* Abu Dhabi: International Renewable Energy Agency.

IRENA, 2012a. *Renewable Energy Technologies: Cost Analysis Series: Solar Photovoltaics ,* Abu Dhabi: International Renewable Energy Agency.

IRENA, 2012b. *Renewable Energy Technologies: Cost Analysis Series: Wind Power,* Abu Dhabi: International Renewable Energy Agency.

IRENA, 2012c. *Renewable Energy Technologies: Cost Analysis Series: Biomass for Power Generation,* Abu Dhabi: International Renewable Energy Agency.

IRENA, 2014. *The Socio-economic Benefits of Solar and Wind EnergyL: an econValue Report,* Abu Dhabi: International Renewable Energy Agency .

IRENA, 2015. *Renewable Energy Generation Costs In 2014,* Abu Dhabi: International Renewable Energy Agency.

IRENA, 2017a. *Renewable energy benefits: Leveraging local capacity for onshore wind,* Abu Dhabi: International Renewable Energy Agency.

IRENA, 2017b. *Renewable Energy Benefits: Leveraging Local Capacity for Solar PV,* Abu Dhabi: International Renewable Energy Agency.

IRENA, 2018. *Renewable Power Generation Costs in 2017,* Abu Dhabi: International Renewable Energy Agency .

Johnson, O., 2015. Promoting green industrial development through local content requirements: India's National Solar Mission. *Climate Policy,* 16(2), pp. 178-195.

Kammen, D., Kapadia, K. & Fripp, M., 2004. *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?,* Berkeley: University of California .

Keynes, M., 1936. *General Theory of Employment, Interest and Money,* London: Cambridge University Press.

Kolver, L., 2014. Small-scale IPP developers facing finance challenges. *Engineering News*, 20 June.

Kruyswijk, G., 2012. *Renewable Energy Finance: Webinar Session 1,* s.l.: Industrial Development Corporation.

Kuntze, J. & Moerenhout, T., 2013. *Local Content Requirements and the Renewable Enery Industry- A Good Match?,* Geneva: International Centre for Trade and Sustainable Development.

Lantz, E. & Tegen, S., 2009. *Economic Development Impacts of Community Wind Projects: A Review and Empirical Evaluation.* Chicago, National Renewable Energy Laboratory .

Lazard, 2017. *Lazard's Levelised Cost of Energy Analysis: Version 11.0,* Houston: Lazard.

Llera, E., Scarpellini, S., Aranda, A. & Zabalza, I., 2013. Forecasting Job Creation from Renewable Energy Deployment through a Value-Chain Approach. *Renewable and Sustainable Energy Reviews,* Volume 21, pp. 262-271.

Macatangay, R., 2016. Optimal Local Content Requirement Policies for Extractive Industries. *Resources Policy,* Volume 50, pp. 244-252.

Maia, J. *et al*., 2011. *Green Jobs: An estimate of the direct employment potential of a greening South African Economy.,* Johannesburg: Industrial Development Corporation, Development Bank of Southern Africa, Trade and Industrial Policy Strategies.

Matavire, M., 2018. IDC wants to revive Coega wind energy project. *Fin24*, 28 January.

Mathews, J. & Reinert, E., 2014. Renewables, Manufacturing and Green Growth: Energy Strategies Based on Capturing Increasing Returns. *Futures,* Volume 61, pp. 13-22.

Moreno, B. & Lopez, A., 2008. The effect of renewable energy on employment. The case of Asturias (Spain). *Renewable and Sustainable Energy Reviews,* 3(12), pp. 732-751.

Muhlenhoff, J., 2010. Value Creation for Local Communities through Renewable Energies. *Renews Special*, December, Issue 46.

Munday, M., Bristow, G. & Cowell, R., 2011. Wind farms in rural areas: How far do community benefits from wind farms represent a local economic development opportunity. *Journal of Rural Studies,* Issue 27, pp. 1-12.

MWGSW, 2011. *Opportunities for Economic Value Creation along the Solar and Wind Value Chain.* [Online]
Available at:
http://www.cleanenergyministerial.org/Portals/2/pdfs/Input_Paper_Economic_Value_Creation.pdf
[Accessed 27 November 2017].

National Planning Commission, 2012. *Our Future - Make it Work: National Development Plan 2030,* Pretoria: The Presidency.

National Treasury, 2017. Preferential Procurement Policy Framework Act, 2000: Preferential Procurement Regulations. *Government Gazette: No. 40553*, 20 January.

Ngandu, S., Garcia, A. & Arndt, C., 2010. *The Economic Influence of Infrastructural Expenditure in South Africa: A Multiplier and Structural Path Analysis.* Johannesburg, Development Policy Research Unit.

Nhamo, G. & Ho, S., 2011. Renewable energy policy landscape in South Africa: moving towards a low carbon economy. *WIT Transactions on Ecology and the Environment,* Volume 143, pp. 265-276.

Okkonen, L. & Lehtonen, O., 2016. Socio-economic impacts of community wind power projects in Northern Scotland. *Renewable Energy,* Volume 85, pp. 826-833.

Pahle, M., Pachauri, S. & Steinbacher, K., 2016. Can the Green Economy deliver it all? Experiences of renewable energy policies with socio-economic objectives. *Applied Energy,* Volume 179, pp. 1331-1341.

Painuly, J., 2001. Barriers to Renewable Energy Penetration: a framework for analysis. *Renewable Energy,* Volume 24, pp. 73-89.

Papapetrou, P., 2014. *Enabling Renewable Energy in South Africa: Assessing the Renewable Energy Independent Power Producer Procurement Programme,* s.l.: WWF: Climate and Energy.

Perkins, P., 2011. *The Role of Economic Infrastructure in Economic Growth: Building on Experience,* Johannesburg: Helen Suzman Foundation.

Perkins, P., Fredderke, J. & Luiz, M., 2005. An Analysis of Economic Infrastructure Investment in South Africa. *Journal of Economics,* 73(2), pp. 211-228.

REN21, 2011. *Renewables 2011 Global Status Report,* Paris: Renewable Energy Policy Network for the 21st Century.

REN21, 2017. *Renewables 2017 Global Status Report,* Paris: Renewable Energy Policy Network for the 21st Century.

Reporter, A., 2015. Zuma Commits SA to Agenda 2030. *IOL*, 28 September, pp. https://www.iol.co.za/news/politics/zuma-commits-sa-to-agenda-2030-1921732.

Republic of South Africa, 2003. *White Paper on Renewable Energy,* Pretoria: Department of Minerals and Energy.

Republic of South Africa, 2011. *Integrated Resource Plan for Electricity 2010:2030,* Pretoria: Department of Energy.

Rycroft, M., 2017. Small scale solar PV: Current status and future prospects.. *Energize*, 27 September.

Šahović, N. & Pereira da Silva, P., 2016. Community Renewable Energy - Research Perspectives -. *Energy Procedia,* Issue 106, pp. 40-58.

Sherrard, A., 2018. *BioEnergy International.* [Online]
Available at: https://bioenergyinternational.com/heat-power/epc-consortium-get-go-ahead-for-ngodwana-energy-biomass-power-plant
[Accessed 5 September 2018].

Shoaib, A. & Ariaratnam, S., 2016. A Study of Socioeconomic Impacts of Renewable Energy Projects in Afghanistan. *Procedia Engineering,* Issue 145, pp. 995-1003.

Simas, M. & Pacca, S., 2014. Assessing employment in renewable energy technologies: Acase study for wind power in Brazil. *Renewable and Sustainable Energy Reviews,* Volume 31, pp. 83-90.

Singh, V., 2001. *The Work that goes into renewable energy,* Washington DC: Renewable Energy Policy Project.

Slabbert, A., 2018. Electricity trading is alive and growing in South Africa. *Moneyweb*, 12 February, URL: https://www.moneyweb.co.za/news/south-africa/electricity-trading-is-alive-and-growing-in-south-africa/ [Accessed 12 July 2018].

Slattery, M., Lantz, E. & Johnson, B., 2011. State and local economic impacts from wind energy projects: Texas case study. *Energy Policy,* Issue 39, pp. 7930-7940.

Stands, S., 2015. Utility-Scale Renewable Energy Job Creation: An Investigation of the South African Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). *Faculty of Economic and Management Sciences, Stellenbosch University*, March.

StatsSA, 2017. *Quaterly Labour Force Survey.* [Online]
Available at: http://www.statssa.gov.za/?p=9960
[Accessed 30 August 2017].

Steyn, G., Burton, J. & Steenkamp, M., 2017. *Eskom's Financial Crisis and the Viability of Coal-Fired Power in South Africa: Implications for Kusile and Older Coal-Fired Power Stations.,* Cape Town: Meridian Economics.

Stone, S., Messent, J. & Flaig, D., 2015. *Emerging Policy Issues: Localisation Barriers to Trade,* Paris: OECD Trade Policy Papers.

Strachan, P. *et al*., 2015. Promoting Community Renewable Energy in a Corporate Energy World. *Sustainable Development,* Issue 23, pp. 96-109.

Tellis, W., 1997. Application of a Case Study Methodology. *The Qualitative Report,* 3(3), pp. 1-19.

Trading Economics, 2017. *South Africa Unemployment Rate.* [Online]
Available at: https://tradingeconomics.com/south-africa/unemployment-rate
[Accessed 8 November 2017].

Tregenna, F., 2008. The Contributions of Manufacturing and Services to Employment Creation and Growth in South Africa. *Journal of Economics,* 76(2), pp. 175-204.

UN General Assembly, 2015. *Transforming Our World: The 2030 Agenda for Sustainable Development,* New York: United Nations.

UNCTAD, 2014. *Local Content Requirements and the Green Economy,* Geneva: United Nations.

Van Wyk, W., 2014. *Assessing the Financial Viability of Renewable Independent Power Production in South Africa,* Potchefstroom: University of Potchefstroom.

Vukeya, V., 2015. *The Impact of Infrastructure Investment on Economic Growth in South Africa,* Richards Bay: University of Zululand: Faculty of Commerce, Administration and Law.

White, S., 2016. Regulating for Local Content: Limitations of legal and regulatory instruments in promoting small scale suppliers in extractive industries in developing countries. *The Extractive Industries and Society,* Volume 4, pp. 260-266.

Wlokas, H., 2015. *A Review of the local community development requirements in South Africa's renewable energy procurement programme,* s.l.: WWF.

Wlokas, H., Boyd, A. & Andolfi, M., 2012. Challenges for local community development in private sector-led renewable energy projects in South Africa: an evolving approach.. *Journal of Energy Southern Africa,* 23(4), pp. 46-51.

WWF-SA & Greencape, 2015. *Improving socio-economic development and enterprise development under the REIPPPP.* Johannesburg, WWF.

Yin, R., 1984. *Case study research: Design and Methods (1st ed.),* Beverly Hills, CA: Sage Publishing.

Yin, R., 2012. A (Very) Brief Refresher on the Case Study Method. In: V. Knight, ed. *Applications of Case Study Research.* Los Angeles: SAGE, pp. 3-20.

Yuen, K., 2014. *REIPPP - A New Dawn for South African Renewables?.* Paris: Sciences Po, Paris School of International Affairs.