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New Roles for South African Municipalities in Renewable Energy - A Review of Business Models

Discussion Paper

South African-German Energy Partnership

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Abstract

The growth of renewable energy technologies is re-shaping energy systems across the globe. In South Africa, which relies on coal-fired power plants for 90% of electricity generation, this trend suggests a critical shift in dynamics, generating numerous risks and opportunities at all levels of the value chain.

This is particularly the case for South Africa's municipalities. The re-definition of South Africa's electricity systems indeed commands the need to better understand the business models available to municipalities to maximise benefits arising from this transformation while mitigating risks and balancing trade-offs. Business models are understood as maps, frameworks and plans that structure how investments are designed, implemented, managed, and financed. Business models are constructed in response to an opportunity (that arises or is foreseen) in such a way that the business (i.e. the municipality) extracts maximum value from this opportunity.

This report reviews possible business models for South African municipalities to seize arising opportunities and minimise potential risks associated with the introduction of renewable energy technologies in the domestic electricity system. It proposes a typology of available business models for municipalities to seize emerging opportunities arising from renewable energy technologies. Three overarching roles, spilt into seven business models, are considered for municipalities: building electricity generation capacity; procuring electricity; and playing a facilitation function. Based on a three-pronged methodological framework taking into account the drivers of the business models; their techno-economic potential; and their ability to manage risks (regulatory, financial and socio-political); this report reviews each business model, highlighting their strengths and weaknesses.

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List of Acronyms and Abbreviations

DoE	**Department of Energy**
ERA	**Electricity Regulation Act No. 4 of 2006**
GHG	**greenhouse gas**
IPP	**independent power producer**
kW / kWh / kW_p	**kilowatt / kilowatt-hour / kilowatt-peak**
MW / MWh / MW_p	**megawatt / megawatt-hour / megawatt-peak**
MFMA	**Municipal Finance Management Act No. 56 of 2003**
NERSA	**National Energy Regulator of South Africa**
PPA	**power purchase agreement**
PPP	**public-private partnership**
PV	**photovoltaic**
REIPPPP	**Renewable Energy Independent Power Producer Procurement Programme**
SSEG	**small-scale embedded generation**

Executive Summary

South Africa's electricity sector is in the midst of a multi-faceted transformation. Energy security concerns, rising electricity prices, the emergence of renewable energy technologies and the introduction of independent power producers are some of the key issues at hand. In light of these dynamics, municipalities are compelled to re-define their role in the electricity value chain and adapt their funding and operating models. This report reviewed possible business models for South African municipalities to seize arising opportunities and minimise potential risks associated with the introduction of renewable energy technologies in the domestic electricity system.

South African municipalities are faced with a number of options, i.e. business models, to respond to the opportunities arising from renewable energy technologies. These can be organised based on the role to be carried out by the municipality. The first set of business models revolves around the opportunity for municipalities to operate their own generation capacity. While this model has already been tested in various forms in South Africa, it has been progressively phased out for large-scale operation. In the last few years, an increasing number of municipalities have however embarked on the installation of small-scale, embedded generation capacity on their own facilities. The second set of business models positions municipalities as procurer of electricity, rather than power plant builder and operator. Such business models have also been experimented with in South Africa. Two types of electricity generators can be contracted by municipalities, namely embedded generators (also known as prosumers) and larger independent power producers (which do not self-consume). Besides building generation systems and procuring electricity, a third set of business models strategically locates municipalities as bridging agents. This facilitation role can take three different forms, namely aggregating and trading electricity, providing storage facilities and providing electricity services. Such business models have been largely unexplored in South Africa.

The development and/or extension of these business models is driven by a multitude of factors, which vary from one business models to another. Environmental sustainability is a common driver behind all but one of these business models. All business models are also particularly fit-for-purpose, insofar as they can be implemented by municipalities of any size (although to a lesser extent for the two models based on large-scale power systems). Energy security, notably the postponement of grid expansion, as well as grid strengthening, further constitute strong drivers for the implementation of renewable-energy based business models in most cases. Although all business models can arguably lead to positive financial results, financial benefits, primarily through cost savings, are only one consideration for business models involving large power systems. In most cases, the business models would require notable adjustments of municipal systems as well as the recruitment and/or development of new skills and competencies. As a result, the ease of implementation is only a main driver for business models that are mostly aligned with existing functions (i.e. building embedded generation, playing a trading role, and providing storage facilities). Customer retention, which is becoming a challenge with the rollout of privately-owned embedded generations, is a key driver for business models that interact directly with customers, i.e. procuring from embedded generators, playing a trading role and providing electricity services. Last but not least, while all business models would contribute to municipalities leading by example and/or facilitating the development of renewable energy technologies in South Africa, it is really a driver only in the cases where municipalities build their own embedded generation.

Most business models have a strong techno-economic potential, although this is highly dependent on the technology and the modalities of implementation. Business models based on small-scale and/or highly adaptable systems moreover see their technical potential remaining largely constant (in proportion) irrespective of the size of the municipalities. While all business models involving the building of generation capacity and the procuring of electricity appear economically viable in the long run, large-scale plants benefit from stronger financials. The impact of financing options, particularly the high costs of debt-funding, must be noted in this respect. From a municipal perspective, it is therefore preferable to purchase electricity from IPPs rather than to build large-scale power systems. Moreover, all business models bring indirect benefits, such as customer retention and the postponement of grid investment. These secondary factors are essential to ensure the viability of procuring from embedded generators. The techno-economic potential of business models structured on municipalities playing a facilitation role is difficult to ascertain due to their novelty. The potential of trading activities is limited by the prerequisite to buy the electricity at Eskom's tariff or lower or, if procured at a higher price, to sell it to specific interested consumers at a premium. The development of storage facilities is limited to heat storage and hydroelectric pumped storage at the moment. Other technologies are still too expensive for most applications and only of use under specific circumstances. The provision of electricity services, which could be combined with the procurement of electricity from embedded generators, could have significant potential in the long run. While the viability of such a business model has been proven in foreign contexts, it is uncertain to what extent it forms part of municipalities' mandate as defined by the Constitution.

From a risk management perspective, all business models face a number of financial and/or regulatory hazards. The installation of embedded power systems on municipal infrastructure appears to be the easiest business model to implement. In a number of cases (such as procuring from IPPs, trading and providing electricity services), the regulatory framework still constitutes an explicit hurdle (despite many pilot projects), preventing municipalities from pursuing such options with ease. In other cases, financial regulations pose problems to the implementation of business models. This is particularly the case for building stand-alone power plants and procuring from embedded generators. While the regulations do not prevent such business models, they make their financing particularly difficult. In the case of the provision of storage facilities, the absence of regulatory framework could be both a hindering factor and an opportunity to be leveraged by municipalities.

At the socio-political level, the resistance to municipalities developing new roles and functions, or even extending their reach on existing prerogatives, is relatively high. However, business models revolving around small-scale systems have some support. While only the rollout of embedded generation on municipal buildings gathers widespread municipal support, the growing importance of small-scale embedded generation (SSEG) in the country has obliged all stakeholders to provide support for municipalities to tap into this business model. Significant resistance by national entities (government departments and the utility alike) is however experienced to business models based on large-scale power plants, which is seen as a national responsibility. The extension of municipal roles to more business-like activities, such as trading and the provision of electricity services, is largely opposed at this stage, as is the development of these activities in the country altogether. The provision of storage facilities by municipalities (beyond already existing schemes, such as pumped storage facilities), while not opposed, is not supported from leading stakeholders. This situation may largely be explained by the novelty of the idea and the high cost of storage solutions. The development of time-of-use tariffs may constitute an opportunity to build support in the medium to long term.

Going forward, the analysis of these business models raises a number of policy implications for the stakeholders involved in South Africa's electricity sector. First, further work is required by municipalities to better understand the implications as well as the operationalisation channels of each business models. Second, municipalities, in collaboration with relevant parties, should further unpack each business model with the objective of clarifying the regulatory frameworks. Third, further in-depth discussions are required on the funding models of South Africa's municipalities. Fourth, from the perspective of electricity planning, greater consideration should be given to the role of municipalities by national government and the national utility. There is an opportunity for national structures to leverage the privileged, i.e. local, positioning of municipalities to facilitate their integration in South Africa's electricity networks. Fifth, municipalities should progressively develop new skills and competences, in line with the business models which are being pursued. Last but not least, municipalities could actively embark on experimenting with all the business models, building business cases and developing projects and programmes. Actively implementing (or at least starting to operationalise) the business model would enable municipalities to adequately gauge the costs and benefits of each business model as well as facilitate engagement with national authorities on any policy and regulatory barriers. Table 30, on page 43, provides a summary assessment of the main barriers faced by each business model and proposes possible solutions, as well as possible next steps towards the operationalisation of the business models.

Ultimately, the novelty of the business models, combined with the fluidity of the domestic policy and regulatory environment, makes experimentation and 'learning by doing' critical to any meaningful progress. South African municipalities ought to take the lead in shaping and defining the future of the country's electricity sector. This is the core springboard for transforming South African municipalities' role in the electricity sector and achieving energy sustainability.

1. Introduction

Energy systems have historically been built around security of supply concerns, i.e. reliability and affordability considerations. In the last decades, the rising awareness of sustainability challenges has driven the need to clean energy systems, at least from the perspective of greenhouse gas (GHG) emissions. The resulting growth of renewable energy technologies is re-shaping energy systems across the globe.

In South Africa, which relies on coal-fired power plants for 90% of electricity generation, this trend suggests a critical shift in dynamics, generating numerous risks and opportunities at all levels of the value chain. This is particularly the case for South Africa's municipalities. This report reviews possible business models for South African municipalities to seize arising opportunities and minimise potential risks associated with the introduction of renewable energy technologies in the domestic electricity system.

Indeed, South Africa's electricity sector has embarked on a multi-faceted transformation over the last two decades. Energy insecurity has triggered massive new generation capacity build programmes, in turn triggering a trebling of electricity tariffs over the 2009/2010-2017/2018 period (NERSA, 2013, 2010). Along with sustainability factors, electricity shortages and inefficiencies within the energy system have also opened the door for the introduction of independent power producers (IPPs) and an energy trader in the sector. Energy security threats and rising electricity prices, associated with decreasing technology costs and increasing product quality, have spurred a growing interest in embedded generation technologies, particularly solar photovoltaic (PV) systems.

These intertwined dynamics have radical implications for municipalities that are being compelled to re-define their role in the electricity value chain and adapt their funding and operating models. Historically, municipalities' roles have been largely limited to the distribution function (known as reticulation), upon which most municipalities' funding models are based. Municipalities licensed for electricity distribution generate, on average, about 26.8% of their revenues through a mark-up on the electricity bought from the national utility (Statistics South Africa, 2016). Most municipalities earn a surplus on these electricity sales, which is notably used to cross-subsidise other local activities (NT, 2011). This trend persists despite falling net surplus generated by electricity sales (Das Nair et al., 2014).

The re-definition of South Africa's electricity systems commands the need to better understand the business models available to municipalities to maximise benefits arising from this transformation while mitigating risks and balancing trade-offs. Business models are understood as maps, frameworks and plans that structure how investments are designed, implemented, managed, and financed. Business models are constructed in response to an opportunity (that arises or is foreseen) in such a way that the business (i.e. the municipality) extracts maximum value from this opportunity. This report proposes a typology of available business models for municipalities to seize emerging opportunities arising from renewable energy technologies. Three overarching roles are considered for municipalities: building electricity generation capacity; procuring electricity; and playing a facilitation function. Based on a three-pronged methodological framework taking into account the drivers of the business models; their techno-economic potential; and their ability to manage risks (regulatory, financial and socio-political); this report reviews each business model, highlighting their strengths and weaknesses (see Annexure 1 for further details on the methodological approach).

The remainder of the report is structured as follows: Section 2 presents the typology of business models which are investigated in this report; Sections 3, 4 and 5 respectively review business models associated with municipalities building generation capacity, procuring electricity and playing a facilitation role; Section 6 concludes with a discussion of policy implications.

1 POWERX has a trading license from NERSA (TR01/ELC/09) to purchase clean and green power from generators and sell it on to end users. See http://www.powerx.energy for more information.

2. The Realm of Possible Business Models

South African municipalities are faced with a number of options, i.e. business models, to respond to the opportunities arising from renewable energy technologies. Business models are defined by the following variables:

- the role of the municipality: builder/generator, procurer or facilitator;
- the size of the power systems: small or large;
- the connectivity: on-site use (self-consumption) or grid-tied (feed in); and
- the modality of operation: financing models, partnership agreements and fee structure.

Based on these variables and a review of existing literature (see eThekwini Municipality, 2013; Gulati et al., 2015; Jones, 2016; Unlimited Energy, 2016), Table 1 maps a set of seven business models available to South African municipalities to play a driving role in the rollout of renewable energy in South Africa.

Table 1: The realm of possible business models

Roles	Business models	Modalities
Building generation capacity	Building embedded power systems (e.g. installing rooftop solar PV systems on municipal buildings with or without feeding into the municipal grid)	Financing through the municipality's balance sheet Financing through debt Financing through grants
	Building stand-alone power plants (e.g. building a large wind farm or solar park on municipal land used for municipal grid with possibility of on-selling to Eskom)	Financing through debt/grants Entering into a public-private partnership (PPP) Sign a Build-Operate-(Own)-Transfer agreement Set up a special purpose vehicle with other munici-palities / partners
Procuring energy	Procuring electricity from embedded generators (e.g. procuring electricity from rooftop PV systems installed by residential customers)	Purchase based on feed-in tariff / net metering / net billing
	Procuring electricity from an independent power producer (e.g. procuring electricity from an inde-pendent solar park / wind farm in the vicinity of the municipality)	Purchase based on a power purchase agreement (PPA)
Playing a facilitation role	Playing a trading/aggregating role (e.g. buying elec-tricity from local producers for on-selling to willing customers at a premium)	Billing through the electricity tariff (with potential premium)[2]
	Operating a storage facility (e.g. store electricity in time of excess and sell it in time of high demand)	Billing through the electricity tariff (with potential premium)
	Providing electricity services (e.g. installing power systems, providing maintenance)	Billing based on a service fee or energy savings

Source: Authors' composition

2 An example is using an additional wheeling charge for the use of the municipal electricity network and/or an administrative charge.

3. Business Models Structured on Building Generation Capacity

The first set of business models revolves around the opportunity for municipalities to operate their own generation capacity. This model has already been tested in various forms in South Africa. A number of metropolitan municipalities, such as Johannesburg, Cape Town and Bloemfontein, have owned and operated utility-scale power plants in the last decades. This model has however been progressively phased out. As illustrated in Box 1, in the last few years, an increasing number of municipalities have by contrast embarked on the installation of embedded generation capacity on their facilities.

These two business models, i.e. the building and operation of embedded generation capacity on the one hand and the building and operation of stand-alone municipal-owned power plants on the other hand, are being investigated in this section. Embedded installations are installed at other projects, plants or buildings and the energy generated is mainly for own use or the installation provides additional service delivery assistance. Examples of this type of installation are rooftop solar photovoltaic and biogas digesters at sewerage plants. Stand-alone municipal-owned power plants refer to projects that are installed on green fields with the explicit purpose of generating energy only, such as photovoltaic power plants or wind farms.

3.1. Building embedded power systems

Driver for business model

A business model structured on municipalities building embedded generation capacity, for example in the form of rooftop solar PV systems on municipal buildings, or generating biogas using biomass, is an attractive option for multiple factors. The assessment of the drivers for this business model is presented in Table 2.[3]

Such a business model would enable municipalities to reduce their carbon footprint (by decreasing electricity-related GHG emissions), contributing to sustainability objectives. Importantly, the implementation of this business model would set an instrumental example for other customers by demonstrating the feasibility and viability of embedded generation.

Due to its embedded nature, this business model is attractive for municipalities of any size. Placing municipalities as project developers, this business model could be initiated and executed within any municipal department and does not necessarily have to form part of a larger programme (Gulati et al., 2015). It also enables municipalities to leverage existing infrastructure (such as buildings and energy systems). With

Table 2: Assessment of drivers for building embedded power systems

Drivers	
● Environmental sustainability	● Cost savings
● Lead by example	● Energy security / Grid expansion postponement
● Fit-for-purpose	● Grid strengthening / stability
● Ease of implementation	● Customer retention

Source: Authors' assessment

Note about the colour coding: green indicates a primary driving force, orange indicates a secondary but strong driving force, yellow indicates a peripheral/weak driving force, and red indicates the absence of any driving force. Drivers are further explained in Annexure 2.

3 The definition for each driver can be found in Annexure 2

Box 1: Examples of embedded municipal projects in South Africa

A number of municipalities have tapped into the opportunity linked to generating embedded renewable energy-based power. The Wallacedene taxi ranks in Cape Town, the eThekwini's landfill gas-to-electricity project and the Northern wastewater works biogas-to-energy project in Johannesburg are three such examples.

The Wallacedene taxi rank uses a rooftop solar PV system comprising 78 panels for electricity generation of 250 W each (19 500 W in total). The system has a maximum daily output potential of 130 kWh, which is able to meet the electricity needs of the entire facility. The system is supported by 24 large batteries with storage capacity of 72 kWh to ensure uninterrupted electricity supply at night or on cloudy days. It is worth noting that the installation of the PV and battery system was included in the capital budget as part of the overall project. It is estimated that the capital cost of this solar installation will be recovered within 6 to 10 years in monthly electricity cost savings.

The Northern Works Biogas-to-Energy Project, completed in 2012, was built as well as operated by a project developer, WEC Projects, on behalf of Johannesburg Water. The plant produces electricity and heat from biogas (collected from digesters) using cogeneration (or combined heat and power) gas engines. The electricity is produced for own-use within the wastewater treatment works and runs in parallel of the incoming Eskom grid. At present, the plant is capable of producing 1.1 MWe, which provides 10% of the energy requirements of the plant. Once the digesters are refurbished, the system will be able to produce up to 4.5 MWe, which will provide approximately 56% of the power requirement of the plant. The total capital costs stood at ZAR 36 million (including some of the costs for the proposed 4.5 MWe upgrade) while operational costs are equivalent to ZAR 0.30/kWh.

Source: SA Good News, 2014 and Franks et al., 2015a

the limited regulatory hurdles, as detailed below, these features make this business model particularly relevant and easy to roll out.

In the long run, as illustrated in the following techno-economic assessment, this business model is also expected to reduce operational costs by bringing electricity costs down for municipalities, by substituting electricity bought from Eskom with own generation.

Techno-economic potential

The techno-economic potential of this business model for each renewable energy resource and technology is summarised in Table 3. The estimated capital cost for each technology for this business model can be seen in Annexure 2. Importantly, as stressed in Box 2, any techno-economic assessment deeply varies based on numerous specific factors, and the assessment provided in this report is purely for discussion purposes.

This business model primarily displays a real techno-economic potential for solar-based technologies. Due to the complexity of these specifics and for the purposes of illustration, two solar PV installations are considered as examples in this business model. These are a small-scale system of 50 kWp and a larger system of 1 MWp. For each of these systems, financial feasibility indictors are presented in Table 4 and cashflow projections are plotted in Annexure Figures 1 and 2. Calculations are based on a number of business model assumptions, detailed in Annexure 1, and are purely illustrative. For each scenario, a comparison is made between a fully self-funded project (which could include a grant portion from NT or any funding scheme), a 50% loan-funded project and a 100% debt-funded project. The self-funding is treated as upfront available capital for the project.

Box 2: Methodological considerations for techno-economic assessments

The techno-economic viability of each business model depends on numerous factors, namely:

- the space availability (strength, suitability, size);
- the resource availability (solar, wind, biomass, waste-heat, solid waste, etc.);
- the design of the system (in relation to the space and resource availability);
- the system installation cost;
- the system operation and maintenance cost;
- the cost of the energy resource (i.e. for biomass to energy);
- financing options (such as grant or debt);
- the electricity usage profile of the site;
- the generation profile of the plant;
- the plant availability; and
- applicable electricity tariffs.

As these differ substantially, not only between the different resources and technologies, but also between different sites and applications, the specifics can only be determined with certainty through pre-feasibility studies. An example of such a study is the one conducted for Drakenstein Municipality in the Western Cape (WWF, 2014). In this report, an indicative techno-economic assessment is conducted for illustrative and discussion purposes.

Source: Authors' composition

Table 3: Techno-economic potential per renewable energy technology

Resource	Technology	Technological potential	Economic Potential
Solar	Rooftop PV	High	Low to high, depending on site and electricity usage profile
	Solar water heater (low pressure)	High	High
	Solar water heater (high pressure, small units)	High	High
	Solar water heater (high pressure, large units)	High	Low to high, depending on current fuel use (high for electricity, low for coal use)
Wind	Small wind turbines	Low, due to permits for height and noise	Low, very expensive for on-grid applications
Biomass	Anaerobic digestion (with biogas as a product)	Dependent on feedstock / permits needed	Medium to high
Hydro	Small hydro	Site specific	Medium, depending on site

Source: Authors' composition

This business model primarily displays a real techno-economic potential for solar-based technologies. Due to the complexity of these specifics and for the purposes of illustration, two solar PV installations are considered as examples in this business model. These are a small-scale system of 50 kWp and a larger system of 1 MWp. For each of these systems, financial feasibility indictors are presented in Table 4 and cashflow projections are plotted in Annexure

Figures 1 and 2. Calculations are based on a number of business model assumptions, detailed in Annexure 1, and are purely illustrative. For each scenario, a comparison is made between a fully self-funded project (which could include a grant portion from NT[4] or any funding scheme), a 50% loan-funded project and a 100% debt-funded project. The self-funding is treated as upfront available capital for the project.

Financial projections based on best-case assumptions for solar PV (notably a strong annual electricity generation of 1 600 kWh/kWp and low capital investment costs) indicate that this business model is economically viable as it generates a long-term cumulated saving for municipalities. In the long run, the levelised cost of the electricity generated from the solar PV systems is also expected to be lower than Eskom's tariffs. The payback period can however be particularly long, notably in the case of loan-funded projects. Self-funded projects display a payback period of 12-13 years, against more than 20 years for loan-funded initiatives, due to the high financing costs. These long payback periods are primarily linked to the low cost of electricity from Eskom, the capital investment required to install the solar PV technology and the time value of money.

Techno-economic potential

Building embedded generation capacity is an attractive business model for municipalities as it opens up the possibility to avoid having to obtain a generation licence. Notably, in terms of the Electricity Regulation Act No. 4 of 2006 (ERA), a municipality would not be required to apply for a generation licence or an exemption letter from the National Energy Regulator of South Africa (NERSA) in the case where electricity would be generated for 'own use', for

Table 4: Financial feasibility indicators for building embedded power systems: 50 kWp and 1 MWp solar PV systems

Indicator	Fully self-funded	50% loan-funded	Fully debt-funded
50 kW_p solar PV system			
Initial capital cost	R800 000		
Total cost over project lifetime	R 1 400 156	R 1 939 833	R 2 479 510
Avoided expenditure from active energy charge[5]	R 2 816 384 over 25 years		
Payback period (in years)	13 years	16 years	24 years
Levelised cost of energy of PV energy over duration of project	ZAR 1.00	ZAR 1.16	ZAR 1.33
Levelised cost of Eskom energy over duration of project	ZAR 1.25		
1 MW_p solar PV system			
Initial capital cost	R 14 500 000		
Total cost over project lifetime	ZAR 26 215 087	ZAR 35 996 732	ZAR 45 778 378
Avoided expenditure from active energy charge[6]	ZAR 56 327 680 over 25 years		
Payback period (in years)	12 years	15 years	22 years
Levelised cost of PV energy over duration of project	ZAR 0.92	ZAR 1.07	ZAR 1.22
Levelised cost of Eskom energy over duration of project	ZAR 1.25		

Source: Authors' composition

4 'Grant funding' refers to a grant from National Government. These figures can be used as the business case to present the project to National government. The "grant funded" scenarios are equivalent to own funding.

5 If the monthly electricity consumption peak occurs while the PV system is generating electricity, there could be an additional capacity charge saving. This is, however, more often not the case. In addition to this, when a saving does occur, the extent of it is case specific. This potential capacity charge saving is therefore not considered here.

6 *Idem*

example with solar PV or small wind turbines on the roof of a municipal building when the electricity generated by the system is consumed by the electricity use of the building in real time.

However, as of February 2017, the definition of the term 'own use' has not been clearly defined by the regulator. This lack of clarity presents regulatory risks, which ought to be taken into account in project development. For example, it is not clear whether the generation by a municipality for sale to its own consumers would be considered 'own use'. Another example is the case where the electricity department of a municipality installs a renewable energy system on the facilities of a municipal non-electricity department. In this case as well, it is not clear whether this would be considered generation for own use. Currently, municipalities which have used this business model have interpreted 'own use' as net consumption and have allowed for excess electricity to be fed into the grid (eThekwini Municipality, 2013).

Clarity may be provided in the near future. The Department of Energy (DoE) published a Draft Licensing Exemption and Registration Notice on 2 December 2016 (DoE, 2016a), which qualifies and supersedes NERSA's draft regulatory rules for SSEG[7] published for consultation in February 2015. The Draft Notice, currently open for public comments, provides that "generation facilities with a capacity of no more than 1MW will not require a licence but will rather be subject to registration with NERSA" (DoE, 2016b), irrespective of their use (but within certain conditions). It further indicates that "generation facilities with a capacity of between 1MW and 10 MW will require a licence but no ministerial approval for deviation from the IRP" (DoE, 2016b), provided that the generation system is licensed before a certain national allocation (to be specified in the IRP) is reached. Such regulations, when adopted, would practically facilitate the rollout of embedded generation.[8]

Financial risk management

In this business model, although some of the project risks could be outsourced through external contracts and partnerships, ultimately the municipality takes on the financial and technical risk (Unlimited Energy, 2016).

From a financial perspective, the first risk arises from the high upfront cost of renewable energy installations. The investment required for the installation of a renewable energy plant could be financed through the municipal capital expenditure budget (consisting of retained income, debt and grant funding). However, it can be assumed that most municipalities do not have sufficient funds to pay for a renewable energy system from their regular budgets. Projects are also likely to compete with other municipal initiatives for available funding, which may have a higher priority or enjoy internal support (Unlimited Energy, 2016). In this case, obtaining appropriate financing might be challenging if the lack of regulatory clarity explained above persists.

In addition, financing institutions might hesitate to approve loans and other financial agreements, putting the payback at risk, if the relevant regulation is not entirely clear. Therefore, regulatory clarity must be sought in order to apply for the necessary financing of the upfront cost of renewable energy systems.

In this regard, the City of Johannesburg has been lauded internationally for listing the first-ever green bond on the Johannesburg Stock Exchange in June 2014. Johannesburg is also the first city in the C40 Cities Climate Leadership Group to issue a green bond. The listing of the ZAR 1.46-billion bond, priced at 185 basis points (1.85%) above the R2023 South African government bond, was a success and 150% oversubscribed. This bond has not only assisted the City in diversifying its funding instrument portfolio, but also attracted new types of investors, thereby providing potential market for future issuances. The green bond has notably been used to finance programmes aimed at implementing renewable sources of energy, contributing to the GHG reduction targets set by the City of Johannesburg as well as reducing demand on strained energy resources (C40 Cities, n.d.; JSE, 2014)

The second risk arises from the difficulty in predicting with any accuracy the future cost of Eskom or municipal electricity. Determining the exact financial advantage that installing a renewable energy system might have over purchasing electricity from Eskom or the municipality using conventional energy systems is hardly possible. This need for estimates introduces a degree of risk to the calculation of the financial viability.

Third, even if financing can be obtained, the Municipal Finance Management Act No. 56 of 2003 (MFMA) poses a risk for the installation of renewable energy systems. In most cases, the installation, operation and maintenance of renewable energy systems will require long-term financing contracts. The MFMA requires municipalities to obtain approval for contracts longer than three years. In the case of long-term budgetary implications, there is a consultative process at the end of which the municipal council must grant approval and assert that the contract is of "significant financial or financial economic benefit to the city". As mentioned above, the financial viability of a renewable energy project is hard to determine due to the uncertainty of future costs of energy. This consultative process would thus add to the complexity of project development.[9] It also does not take into consideration the environmental benefits of renewable energy systems and thereby neglects an important factor, i.e. avoided externality costs, in the reasoning for renewable energy.

Socio-political risk management

This business model faces little socio-political resistance at all levels and is already pursued by a number of municipalities, as shown in Box 1. As a result, the socio-political acceptability of the business model, as detailed in Table 5, appears relatively high.

In a nutshell

This business model is attractive for municipalities of all sizes and largely within the control of municipal entities. The role of the various entities for building embedded power systems at the municipal level are discussed in Table 6. It has a strong technical potential, which moreover remains largely constant (in proportion) irrespective of the size of the municipalities. Despite the required upfront investment costs, the business model is economically viable in the long run, generating noteworthy cost savings for the municipalities. The techno-economic feasibility of this business model remains nevertheless highly dependent on the technology choice and site selection, and the business model appears more appropriate for solar-based and biomass technologies

Table 5: A socio-political acceptability assessment of building embedded power systems

Stakeholders	Negative factors	Positive factors
Department of Energy / NERSA	While not being negative, the DoE has not shown particular enthusiasm for this business model. Arguably, the publication of the Exemption Notice does mark an important step forward.	The increasing interest from all stakeholders and the energy benefits arising from the business model have strengthened the case to the DoE and the regulator.
Solar water heater (low pressure)	Municipal energy generation is not a core competency, with limited (if any) expertise. The skills and capacity to develop, project manage and oversee the delivery of this business model are not likely to be available within all municipal structures and would have to be developed over time.	This business model would confer a stronger role to municipal electricity utilities/departments, bringing benefits in terms of energy security and grid management.
Eskom	The national utility would face some revenue losses due to lower electricity sales. The constrained nature of the business model would however appear to have a minimal impact.	This business model aligns with Eskom's demand-side management initiatives. This business model would not confer a new and/or additional role to municipalities, but merely contribute to optimising their energy profile.
Treasury departments	The upfront investment required for this business model may face resistance from National Treasury. This would not however appear to constitute an insurmountable deadlock.	In the long run, this business model would constitute a cost-saving initiative and be beneficial to the finances of the municipality and the fiscus.
Municipal electricity customers	No impact on municipal electricity tariffs is expected from this business model, unless the electricity is procured at a higher cost than from Eskom.	No impact on municipal electricity tariffs is expected from this business model, unless the electricity is procured at a lower cost than from Eskom. Municipal installations could set an example and stimulate private installations.
Independent power producers	No impact on independent power producers is expected from this business model.	No impact on independent power producers is expected from this business model.

Source: Authors' assessment

9 Once the required internal support is secured, submitting the project proposal into the budget approval cycle is lengthy and can take up to 18 months (Unlimited Energy, 2016)

Table 6: Roles of the various entities for building embedded power systems

Entity	Role
Municipality (Treasury)	Approve the transaction in compliance with Section 33 of the MFMA
Municipal electricity utility/ department	Commission the installation of the system; Provide for O&M as well as monitoring services
Municipal property management department	Provide access to municipal buildings
DoE	Set licensing exemption policy / legislation
NERSA	Provide a generation license for systems larger than 1 MW
National Treasury	Provides views and recommendations on the transaction (along with the DoE and the Department of Cooperative Governance and Traditional Affairs)
Municipal electricity customers	Participate in public consultation if required.
Private company	Procured to provide, design and install the system

Source: Authors' assessment

at the moment. From an implementation perspective, a number of regulatory and financial risks must be taken into account. The installation of small systems (i.e. less than 1 MW of generation capacity) largely mitigate such risks by reducing the financial requirements and exempting it from the need for a generation licence. At the socio-political level, the business model faces little resistance at both national and local levels, due to the expected co-benefits.

3.2. Building stand-alone power plants

Driver for business model

The second business model structured around municipalities building generation capacity focuses on the potential of stand-alone power plants. Historically, a number of municipalities have experience with this model, owning and operating power plants (such as the Kelvin coal-fired power plants in Johannesburg). This model has fallen into disuse with the centralisation of South Africa's electricity supply industry but could be revived due to its numerous benefits.

The assessment of the drivers for this business model is summarised in Table 7. Similar to embedded generation, this business model, based on renewable energy technologies, would enable municipalities to improve their energy sustainability. Municipal plants can also be instrumental to local energy security and grid stability strategies, as illustrated by the Ekurhuleni Metropolitan Municipality's solar plant at the OR Tambo Precinct in Wattville. From a techno-economic perspective, large plants also benefit from better financials than embedded systems.

Large-scale power plants are however mostly suitable for large metropolitan areas, although medium-size systems can be envisaged by most municipalities. The eThekwini municipality for example owns and operates two landfill gas-to-electricity plants of 1 and 6.5 MW respectively.

Techno-economic potential

This business model offers a strong techno-economic potential across most technologies, provided a critical size is

Table 7: Assessment of drivers for building stand-alone power systems

Drivers	
● Municipal environmental sustainability (green)	● Fit-for-purpose (orange)
● Energy security / Grid expansion postponement (green)	● Ease of implementation (yellow)
● Grid strengthening / stability (green)	● Lead by example (red)
● Cost savings (green)	● Customer retention (red)

Source: Authors' assessment

Note about the colour coding: green indicates a primary driving force, orange indicates a secondary but strong driving force, yellow indicates a peripheral/weak driving force, and red indicates the absence of any driving force. Drivers are further explained in Annexure 2.

Table 8: Techno-economic potential per renewable energy technology

Resource	Technology	Technological potential	Economic Potential
	Solar park	High	High
	Solar water heater (high pressure, large units)	High, if there is a need for heat	High
	Solar thermal – high temperature (concentrated solar power)	High	Low to medium
	Large wind park	High	High
Biomass	Anaerobic digestion (with biogas as a product)	Dependent on amount of the feedstock available/permits needed	Medium to high
	Combustion/incineration	High	Low – expensive
Hydro	Small hydro	Site specific	Medium, depending on site
Ocean Energy	Ocean current	Site specific, but not mature technology	Low
	Tidal	Site specific	Low
	Wave	Site specific	Low

Source: Authors' composition

reached for the power system and the plant can be procured at a low capital cost. The techno-economic potential of this business model for each renewable energy resource and technology is summarised in Table 8.

The most suited technologies for this business model are solar PV and wind. Anaerobic digestion plants using municipal solid waste and municipal sewage sludge for biogas production is also attractive, as the feedstock is already owned by municipalities and its disposal via anaerobic digestion route creates further environmental advantages.

Due to the complexity of the specifics and for the purposes of illustration, two power plants are shown here as illustration: a 50-MWp solar PV park with a solar PV electricity yield of 1 700 kWh/kWp and a 50-MWp wind farm with a capacity factor of 40%.[10] For each of these power plants, financial feasibility indictors are presented in Table 9 and cashflow projections are plotted in Annexure Figure 3 and 4. Calculations are based on a number of business model assumptions, detailed in Annexure 1, and are purely illustrative.

Financial projections based on best case assumptions for solar PV (notably a strong annual electricity generation of 1 700 kWh/kWp and low capital investment costs) indicate that this business model is economically-viable as it generates a long-term cumulated saving for municipalities. In the long run, the levelised cost of the electricity generated from the solar PV systems is also expected to be lower than Eskom's tariffs. The payback periods for both power plants are also acceptable, staying below seven years. These short payback periods are primarily linked to the low capital cost, free energy resource and the rising cost of Eskom electricity.[11]

Similarly, financial projections based on best-case assumptions for a wind farm (notably a strong annual wind capacity factor of 40% and low capital investment costs) indicate that this business model is economically viable, generating large cumulated savings for municipalities. In the long run, the levelised cost of the electricity generated from the wind farm is also expected to be lower than Eskom's tariffs. The payback period is moreover relatively short, reaching a maximum of seven years in the case of self-funded projects. Similar to solar PV, these short payback periods are primarily linked to the low capital cost, free energy resource and the rising cost of Eskom electricity.

10 In the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), solar PV projects are capped at 75 MW and wind-based projects are capped at 140 MW. In this simulation, both plants have a capacity of 50 MW in order to allow comparison.

11 Tariffs for Round 4.5 of the REIPPPP for wind as well as solar PV were set at ZAR 0.62 per kWh (indexed for 2016), which is already in line with the blended tariff from Eskom.

Table 9: Financial feasibility indicators for a 50-MW_p solar PV park and a 50-MW_p wind farm[12]

Indicator	Fully self-funded	50% loan-funded	Fully debt-funded
50-MW_p solar PV park			
Initial capital cost	ZAR 550 million[13]		
Total cost over project lifetime	ZAR 1 102 149 817	ZAR 1 473 177 753	ZAR 1 844 205 690
Levelised cost of energy of PV energy over duration of project	9	8	6
Levelised cost of Eskom energy over duration of project	ZAR 0.74	ZAR 0.85	ZAR 0.97
Levelised cost of Eskom energy over duration of project	ZAR 1.25		
50-MW_p wind farm			
Initial capital cost	ZAR 950 million[14]		
Total cost over project lifetime	ZAR 1 578 960 134	ZAR 2 219 826 569	ZAR 2 860 693 005
Payback period (in years)[15]	7	7	<1
Levelised cost of PV energy over duration of project	ZAR 0.56	ZAR 0.65	ZAR 0.75
Levelised cost of Eskom energy over duration of project	ZAR 1.25		

Source: Authors' composition

Note: If the monthly electricity consumption peak occurs while the PV system is generating electricity, there could be an additional capacity charge saving. This is, however, more often not the case. In addition to this, when a saving does occur, the extent of it is case specific. This potential capacity charge saving is therefore not considered here.

Regulatory risk management

From a regulatory perspective, this business model would be more onerous than building embedded power systems. It would require an electricity generation license from NERSA under the ERA or an exemption of licensing through a ministerial determination. In particular, the process of seeking exemptions appears cumbersome, time consuming and uncertain.

Another set of regulatory risks arise from the model that municipalities chose to build the stand-alone power plant. The municipality can either own the process, carrying out all technical and financial planning, and managing and implementing the project internally, or opt for a PPP model. The latter needs to follow the procurement process laid down under the Municipal Systems Act No. 32 of 2000 and the MFMA. Since any PPP would extend beyond three years, additional compliance is required under the MFMA. Meeting the requirements of these legislations creates several uncertainties under this option, particularly when the process has to be followed independently for every stand-alone power plant.

Financial risk management

On the financial side, the underlying assumption in this

12 Due to the discounting of future payments together with the projected rise in Eskom's electricity price, the payback period for the loan funded scenarios are shorter, even though the levelised costs for these scenarios are higher.

13 This capital cost corresponds to ZAR 11 000 per kWp.

14 This capital cost corresponds to ZAR 19 000 per kWp.

15 The levelised cost for the PV energy is lower than Eskom's levelised cost of energy in all three scenarios. For the capital cost and solar resource in these cases, the loan repayment would be less than the blended Eskom Megaflex tariff that would have been paid, making the project financially viable from year 1.

16 See (Gulati et al., 2015) for more details on these requirements.

Box 3: The landfill gas-to-electricity plant in Ekurhuleni and eThekwini Metropolitan Municipalities

eThekwini launched Africa's first landfill gas-to-electricity project in 2007, based on the extraction of methane from three council-owned landfill sites for electricity generation. Electricity generation capacity of 0.5 MW, 1 MW and 6.5 MW was installed at La Mercy, Mariannhill and Bisasar respectively, although the smallest site was later abandoned due to the low volume of methane emissions. Overall, the project had an estimated payback period of four years, thanks to both the sale of electricity generated and the sale of Certified Emissions Reductions to the World Bank as part of the Clean Development Mechanism. Project drivers included the city's Electricity Department, a champion in the city's Cleansing and Solid Waste Department, good internal communication and buy-in at the highest (i.e. mayoral) level of municipal government.

In 2007, Ekurhuleni Metropolitan Municipality established Energy and Climate Strategy objectives, including the target of achieving 10% green energy supply by 2020. As part of this strategy, the city built, in 2014, the Simmer and Jack landfill site gas-to-electricity grid-tied power plant with a capacity of 1 MW. The project is owned, developed and financed entirely by the Ekurhuleni Metropolitan Municipality. The funds came from the municipality's capital expenditure budget. The electricity generated by the landfill gas-to-electricity plant entirely feeds back into the municipal grid. More recently, in September 2016, a tender was issued by the city of Ekurhuleni for project proposals under the Ekurhuleni Energy Generation Programme. Projects will be offered at power purchase agreement of at least 20 years.

A major challenge for municipalities in South Africa in the procurement of green energy power plants has been the need to obtain a generation license in the case that the electricity is not for own use. The landfill projects, which feeds electricity into the municipal grid, was interpreted as 'own consumption' and exempted from generation licensing requirements.

Sources: Franks et al., 2015b and eThekwini Municipality, 2014

option is that the investment would be financed through the municipal capital expenditure budget. Municipalities may either not have sufficient funds for such capital investment or are likely to have multiple competing priorities for available funding. Seeking funding from financial institutions might be challenging in the absence of a clear regulatory framework.[17] Moreover, the lack of clarity about the constitutional mandate of municipalities to engage in generation activities is a risk for financial institutions. This risk can be mitigated in cases where a generation project is linked to other municipal obligations, such as waste management for a landfill-based project.

The second risk revolves around procurement issues. Since projects would involve debt financing and commitment for a period greater than three years, municipalities would have to comply with the MFMA. Once again, given that the compliance under the MFMA would need to be sought on a case by case basis, this could be an expensive and lengthy option.

Socio-political risk management

While this business model is not new in South Africa, it has been progressively phased out and faces strong socio-political resistance at national levels of government. As a result, the socio-political acceptability of the business model, as detailed in Table 10, appears relatively low.

17 A municipality may only borrow funds, in terms of the MFMA, for the purpose of acquiring assets, improving facilities or infrastructure to provide service delivery (in accordance with Section 135 of the Constitution). In addition, municipalities' gearing ratio must be below 50% and debt service cost less than 10% of their annual operating budget, which limits the extent to which they can borrow.

Table 10: A socio-political acceptability assessment of building stand-alone power systems

Stakeholders	Negative factors	Positive factors
Department of Energy / NERSA	The involvement of municipalities in large-scale projects is rejected by the DoE, primarily on the basis of the single buyer model. Only Eskom and IPPs are sanctioned to build large power plants. Municipalities' involvement in generation is controversial at the national level.	This business model is not new in the country and some ad hoc projects have occurred in the past. These could be leveraged to argue for a mandate extension.
Municipal electricity utility/ department	Building power plants carries significant risks. The skills and capacity to develop, project manage and oversee the delivery of this business model would not be available within municipal structures.	This business model would confer a much stronger role to municipal electricity utilities/ departments.
Eskom	The implementation of this business model would directly conflict with Eskom's generation business. It would also constitute a revenue loss for the national utility.	This business model would contribute to reducing the utility's financial burden associated with new electricity generation and maintenance as well as possible grid expansion expenses.
Treasury departments	The significant upfront investment required for this business model would face resistance from Treasury departments. It would require municipalities to raise dedicated funding.	In the long run, this business model would in theory be neutral on the fiscus and beneficial to the finances of the municipality. By conferring a generation building role to municipalities, it would redirect revenues from the national power utility to municipalities.
Municipal electricity customers	No impact on municipal electricity tariffs is expected from this business model.	No impact on municipal electricity tariffs is expected from this business model.
Independent power producers	No negative impact on independent power producers is expected from this business model.	Independent power producers would directly benefit from this business as project developers and partners.

Source: Authors' assessment

In a nutshell

This business model is mostly attractive for large municipalities. The roles of the various entities for building stand-alone power systems are summarised in Table 11. While being highly dependent on the technological choice and site selection (like all business models), it has a strong technical potential across a number of technologies, notably solar- and wind-based systems. Despite the required upfront investment costs, the business model is economically viable in the long run, generating sizeable cost savings for municipalities. From a risk mitigation perspective, this business model faces numerous hurdles. Regulatory and financial risks are marked, primarily due to the need to obtain an uncertain generation licence or a ministerial exemption. Procurement challenges are also hampering the operationalisation of this business model. Indeed, the business model faces strong socio-political resistance at the national levels, rendering the likelihood of overcoming the regulatory obstacle particularly small.

Table 11: Roles of the various entities for building stand-alone power systems

Entity	Role
Municipality (Treasury)	Approve the transaction in compliance with Section 33 of the MFMA
Municipal electricity utility/ department	Procure the construction (and operation) of the power plant; Manage the integration of the plant in municipal systems
NERSA	Provide a generation license
Eskom	Ensure grid connection (if the project requires Eskom's grid)
National Treasury	Provide views and recommendations on the transaction (along with the Department of Energy and the Department of Cooperative Governance and Traditional Affairs)
Independent power producers	No particular role
Private company	Build the power plant and transfer it to the municipality

Source: Authors' assessment

4. Business Models Structured on Procuring Electricity

This second set of business models positions municipalities as procurer of electricity, rather than power plant builder and operator. Two types of electricity generators can be contracted by municipalities, namely embedded generators (also known as prosumers) and IPPs.

Such business models have been experimented within South Africa. Electricity procurement from small-scale embedded generators is progressively entering South Africa's energy landscape with 18 municipalities in 5 provinces, mainly from Western Cape at the forefront (as of November 2016). The purchase of electricity by municipalities from IPPs is rare but not unseen. The relationships of Johannesburg with the Kelvin coal-fired power stations and Bethlehem in the Free State with two hydroelectricity schemes are interesting precedents.

4.1. Procuring electricity from embedded generators

Driver for business model

This business model is nascent but rapidly expanding in South Africa. It aims to extend the installation of embedded generation to all municipal customers (both residential and commercial). It focuses on the potential to rollout SSEG within municipal areas and turn consumers into producers (also known as prosumers).

It would constitute a proactive approach to retain customers, which may otherwise get off the grid. It allows municipalities to maintain revenues through connection fees and electricity sales. This business model would also play an important role in the ability of municipalities to tap into business models associated with the provision of energy services (see Section 5.3), making it particularly fit-for-purpose.

This business model, which relies on the procurement of electricity based on renewable energy technologies, would enable municipalities to improve their energy sustainability, primarily from an environmental perspective.

Techno-economic potential

The techno-economic potential of this business model depends on numerous factors, similar to those indicated in Box 1. Most municipalities with net-billing tariffs pay for the electricity at an equivalent price to the Eskom Megaflex blended tariff. With this approach, there would be minimal impact on municipal revenue due to the electricity fed into the grid, as the electricity is 'bought' at the same price as if it had been bought from Eskom. The municipalities would, however, lose electricity sales due to self-consumption of electricity generated by the customer. This impact can only be determined with detailed studies.

Some municipalities, such as the Nelson Mandela Bay Municipality, have had a net metering tariff in place and in effect paid for electricity at the municipal selling price. This tariff structure, although perceived as fairer by customers, might have a higher impact on municipal income from electricity sales. This is, however, also dependent on other tariffs, such as capacity, peak use and monthly set charges.

It is important to note that with embedded generation on customers' properties, the municipality gains from

Table 12: Assessment of drivers for procuring electricity from embedded generators

Drivers	
● (green) Customer retention	● (orange) Energy security
● (green) Fit-for-purpose	● (yellow) Ease of implementation
● (green) Environmental sustainability	● (yellow) Cost savings
● (orange) Grid stability	● (red) Lead by example

Source: Authors' assessment

Note about the colour coding: green indicates a primary driving force, orange indicates a secondary but strong driving force, yellow indicates a peripheral/weak driving force, and red indicates the absence of any driving force. Drivers are further explained in Annexure 2.

the added generation, which could open up capacity for new connections without additional investment in grid infrastructure. This capacity gain is achieved with no capital expenditure to the municipality as the cost is borne by the customer.

The impact on the municipal finances would moreover depend on the resource and the electricity usage profiles of the embedded generators. As illustrated in WWF-SA's case study of the Drakenstein municipality with embedded generation from rooftop PV, the impact on the finances of the municipality is minimised if embedded generation is paid for at Eskom's Megaflex tariff. The lost sale of electricity due to the self-consumption of the embedded generator is also similar to other energy efficiency and/or energy saving technologies (Kritzinger et al., 2015). In the future, the benefits could moreover be sizeable if SSEG feed-in tariffs are kept constant or raised at a slower pace than Eskom's tariffs.

However, municipalities should take care to incentivise electricity users (through the tariff structure) to register their installations. The non-registration of installations is especially rife in the residential market, where most installations are not known by the municipalities. In these installations, excess electricity is either stored in on-site batteries, which is still relatively expensive, or fed into the grid illegally by letting the spin meter run backwards, which has obvious safety implications for the grid and network operations.

Regulatory risk management

Electricity generated by an embedded generator is mostly consumed directly at the site, particularly in the case of commercial users. However, there are times when generation exceeds consumption and municipalities could procure this electricity by allowing consumers to feed this excess electricity onto the grid. This is where regulatory risks arise.

First and foremost, there is limited clarity on who would procure electricity from such generators, despite a number of municipalities already engaging in such operations. The Draft Licensing Exemption and Registration Notice published by the DoE on 2 December 2016 (DoE, 2016a) refers to a cap on embedded generation in the IRP. However, the IRP 2016 does not have a specific allocation for embedded generation, nor does it mention such a cap.

Second, there has been a policy hiatus on the subject of SSEG for the last two years. The framework for embedded generation depends on NERSA's regulations for SSEG and the conditions for municipalities or Eskom to purchase excess electricity from small-scale embedded generators. NERSA issued a consultation paper on the regulatory rules for SSEG in February 2015 (NERSA, 2015). However, the regulator has not yet finalised the associated regulatory rules. In December 2015, NERSA indicated that the regulations would be finalised only after the finalisation of the Licensing Regulations by the DoE (Creamer, 2015). NERSA's reasoning was that these Regulations would provide the overarching framework within which all electricity generation activities including SSEG would be regulated. As indicated earlier, the DoE published Draft Licensing Exemption and Registration Notice for public comment on 2 December 2016 which, if approved in their draft form, would clarify the situation going forward (DoE, 2016a).

Financial risk management

From a financial perspective, the predominant risk lies in the manner in which tariffs are set. Municipalities could set a renewable energy tariff for embedded generators, but these tariffs are only valid for a year. This provides little long-term security for investors. NERSA's approval is furthermore required for all electricity tariffs. NERSA has been approving tariffs from July 2016 as an interim measure while policy and regulatory aspects are being finalised. As of November 2016, there was 12 municipalities with approved SSEG tariffs.

Additionally, the tariffs paid for the electricity fed back to the grid cannot normally be more than Eskom's Megaflex rate. However, some municipalities, such as Drakenstein (Drakenstein Municipality, 2016) and Nelson Mandela Bay (Nelson Mandela Bay Municipality, 2016), have NERSA-approved SSEG feed-in-tariffs higher than Eskom's Megaflex rate. The City of Cape Town also followed this 'pilot tariff' approach with net metering for their initial three embedded generation customers for the first few years, before setting a lower SSEG tariff, where electricity is bought at a blended Megaflex tariff plus a monthly fixed charge.

Socio-political risk management

This business model is explored by a growing number of municipalities in South Africa, which have started to allow feedback into the grid based on approved SSEG tariffs. While some resistance to this business model have been displayed by national authorities, the ineluctable and increasing roll-out of embedded generation by residential, commercial and industrial customers is progressively mobilising the necessary support from all stakeholders.

In a nutshell

This business model is relevant to all municipal utilities. Table 14 highlights the roles of the various entities for procuring electricity from embedded generators. The model has a strong technical potential, which remains largely constant (in proportion) irrespective of the size of the municipalities. The economic viability of the business model is predominantly ensured by indirect benefits, such as customer retention and the postponement of grid investment. From an implementation perspective, the main risk is associated with the lack of clarity about the regulatory framework. The recent publication of the DoE's Licensing Exemption Notice however lays the foundation for the regulatory framework to be clarified in 2017. At the socio-political level, the growing importance of SSEG in the country, despite regulatory and financial risk, has constrained all stakeholders to support municipalities in developing this business model.

Table 13: A socio-political acceptability assessment of procuring electricity from embedded generators

Stakeholders	Negative factors	Positive factors
Department of Energy / NERSA	The DoE and NERSA has protracted the development of these business models by not establishing the necessary regulatory framework. The recent progress in terms of the Exemption Licence is however a significant step forward.	The increasing number of electricity customers and municipalities experimenting with this business model increases the urgency for the DoE and NERSA to establish an enabling regulatory framework.
Municipal electricity utility/ department	Procuring from embedded generators is a new function. The skills and capacity to develop, project manage and oversee the delivery of this business model are not likely to be available within all municipal structures and would have to be developed over time.	This business model would confer a stronger role to municipal power companies/departments. This business would also contribute to municipal sustainability objectives.
Eskom	The implementation of this business model does not directly conflict with Eskom's business. It would result in some revenue loss for the national utility.	This business model would contribute to reducing the utility's financial burden associated with new electricity generation and maintenance. It could contribute to optimise load management.
Treasury departments	The financial implications of this business model would be highly dependent on the tariff offered to prosumers. SSEG are generally designed to limit the financial liability of the municipalities. Only net consumers are normally eligible.	This business model would allow municipalities to retain customers and maintain revenues from a service charge and net consumptions. SSEG tariffs also provide the opportunity to buy some power below Eskom's rates.
Municipal electricity customers	No negative impact on municipal electricity customers is expected from this business model.	Municipal electricity customers which participate will directly benefit from lower electricity bills and feed-in tariffs.
Independent power producers	No negative impact on independent power producers is expected from this business model.	No positive impact on independent power producers is expected from this business model.

Source: Authors' assessment

Table 14: Roles of the various entities for procuring electricity from embedded generators

Entity	Role
Municipality (Treasury)	Assist / manage the tariff setting to ensure that appropriate tariffs are in place
Municipal electricity utility/ department	Procure electricity from embedded generators Implement and monitor bi-directional metering systems
Municipal property management department	No particular role
NERSA	Approve municipal tariffs
Eskom	No particular role
National Treasury	Review and provide recommendations on tariffs
Municipal electricity customers	Generate and sell electricity to the municipality
Independent power producers	No particular role
Private company	Install and maintain systems installed on consumers properties

Source: Authors' assessment

4.2. Procuring electricity from independent power producers

Driver for business model

IPPs are playing an increasingly important role in South Africa's electricity supply industry, as a result of the government-led IPP procurement programmes. The programmes have demonstrated the benefits of opening the construction and operation of power plants to private operators. Some pioneering projects, such as the 3-MW Sol Plaatje and 4-MW Merino hydro-electric power plants which sell their power to the municipality of Bethlehem in the Free State as well as Eskom (see Box4), have paved the way. However, municipalities have not yet been in a position to directly tap into this potential on a large scale.

Table 15 presents the assessment of the drivers for municipalities to procure electricity from IPPs. Apart from having the potential to make a meaningful contribution to environmental sustainability, this business model is particularly interesting as it would transfer the investment costs to the private sector, relieving municipalities from the capital expenditure burden. Generally operated under 20-year PPAs, IPP plants provide long-term certainty to municipalities in terms of production and tariffs. The medium- to large-scale nature of the plants also results in lower prices than smaller outlets. Similarly, their contribution to energy security and grid stability would be more substantial.

Contrastively, the size of the projects would potentially limit the scope of the business model to large and medium-size municipalities, in terms of electricity requirements, the need to secure long-term uptake and managerial capacity.

Table 15: Assessment of drivers for procuring electricity from independent power producers

Drivers	
● Customer retention (green)	● Energy security (orange)
● Fit-for-purpose (green)	● Ease of implementation (yellow)
● Environmental sustainability (green)	● Cost savings (red)
● Grid stability (green)	● Lead by example (red)

Source: Authors' assessment

Note about the colour coding: green indicates a primary driving force, orange indicates a secondary but strong driving force, yellow indicates a peripheral/weak driving force, and red indicates the absence of any driving force. Drivers are further explained in Annexure 2.

Box 4: The Bethlehem Hydro experience

The Bethlehem Hydro project includes the 3-MW Sol Plaatje and 4-MW Merino hydro-electric power plants in the Free State. The plants sell their power to the municipality of Dihlabeng Municipality (through a 15-year PPA signed in 2009) as well as Eskom. Bethlehem Hydro generates income by selling electrical power and capacity and by selling Certified Emission Reductions (the Bethlehem Hydro project was successfully registered as a Clean Development Mechanism project in October 2009).

The Sol Plaatje and Merino greenfield projects were respectively commissioned in 2009 and 2011 by REH Project Development (then NuPlanet), a producer and developer of hydro power in South Africa. The ownership of the projects is held through Bethlehem Hydro (Pty) Ltd, which also operates the plants. The financing of the project was arranged through project finance, with the debt being provided by the Development Bank of Southern Africa and equity investment by the Mertech Group and Hydro Women of South Africa, a broad-based black economic empowerment investment group.

Sources: Bethlelem Hydro, n.d.; Botes, 2013; Renewable Energy Holdings, n.d.

Techno-economic potential

The techno-economic potential of this business case is similar to the business model based on municipalities building their own stand-alone plant (Section 3.2). In this business model, however, the municipalities would procure directly from IPPs, similar to Eskom procuring via the REIPPPP at present. This means that no capital budget would be required and the electricity would only be bought when delivered.

The most applicable South African reference point as to the techno-economic potential of this business model comes from the REIPPPP. The most recent prices per kWh, indexed for October 2016 per technology, are listed below:

- Solar PV: ZAR 0.63 per kWh;
- Wind: ZAR 0.63 per kWh;
- Concentrated solar power: ZAR 1.84 per kWh (x 2.7 in peak hours and ZAR 0.00 overnight);
- Landfill gas: ZAR 1.14 per kWh;
- Biomass: ZAR 1.65 per kWh; and
- Small hydro: ZAR 1.27 per kWh

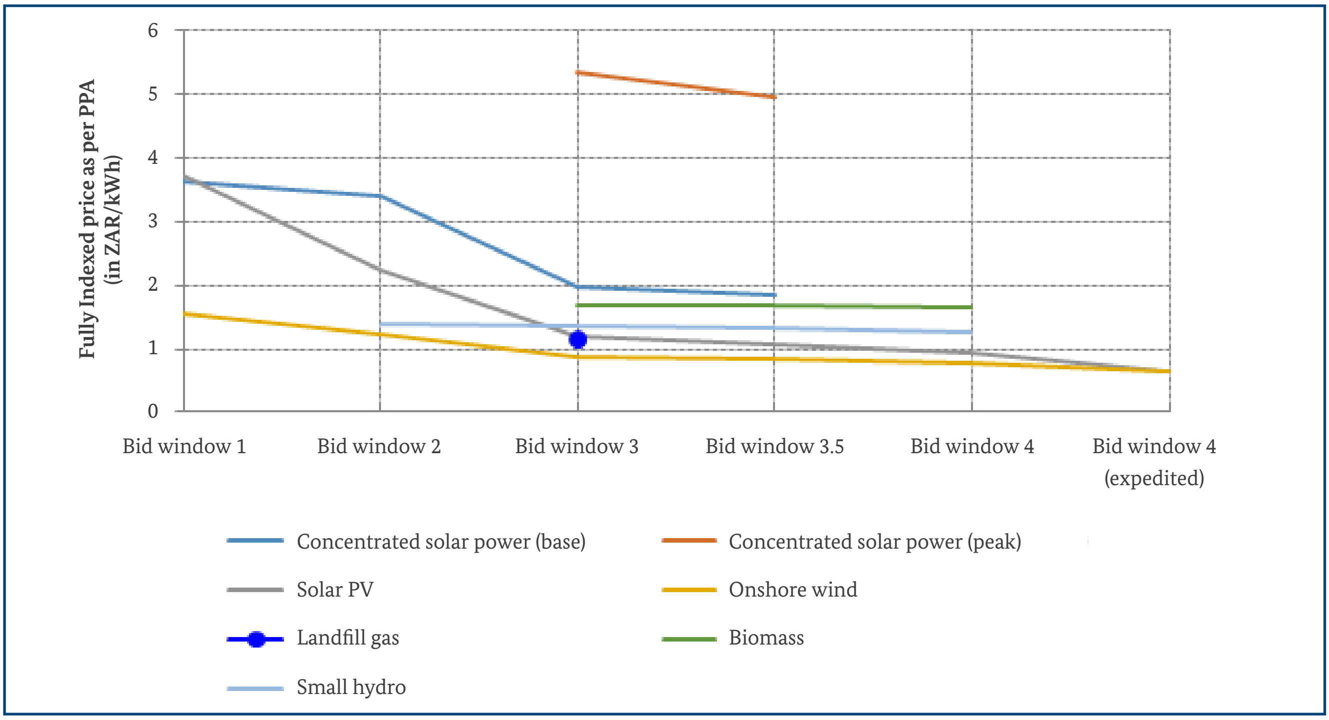
As depicted in Figure 1, prices for most technologies have experienced a downward trend, reaching relatively low prices. This is particularly true for wind and solar PV technologies that are realising active energy tariffs lower than the blended Megaflex tariff that municipalities pay Eskom. In addition, these prices have profit margins for the owners and operators built in, and it is possible that municipalities could realise lower active energy costs. For comparison, Eskom's average price per kWh per customer group for the 2003-2016 period can be seen in Figure 2.

Regulatory risk management

While this business model has several advantages, as highlighted earlier, it is fraught with regulatory risks. First, there is no mandate for municipalities to purchase power from IPPs over a long-term period. Long-term procurement of energy from IPPs is governed by the ERA and the New Generation Capacity regulations of the DoE. These regulations mandate that buyers can only purchase electricity from a renewable energy-based project that is approved to be part of the REIPPPP. Projects outside of the REIPPPP would not be allowed to supply the grid. Furthermore, Eskom is designated as the 'central buyer of power' from IPPs, preventing municipalities from taping into this business model. Unless this is revoked or amended, the opportunity to buy from IPPs is not a possibility for municipalities at this stage. Indeed, existing projects in the country happened under a different regulatory framework, before the first IRP and the REIPPPP, or explicitly as demonstration projects (for the 2011 United Nations Climate Change Conference in Durban for example). A possible way to avoid this risk is to undertake shorter-term procurement under MFMA processes and with NERSA's approval of the tariff. However, this avenue would also not be free of challenges, as long-term off-take is required to secure funding for large-scale projects.

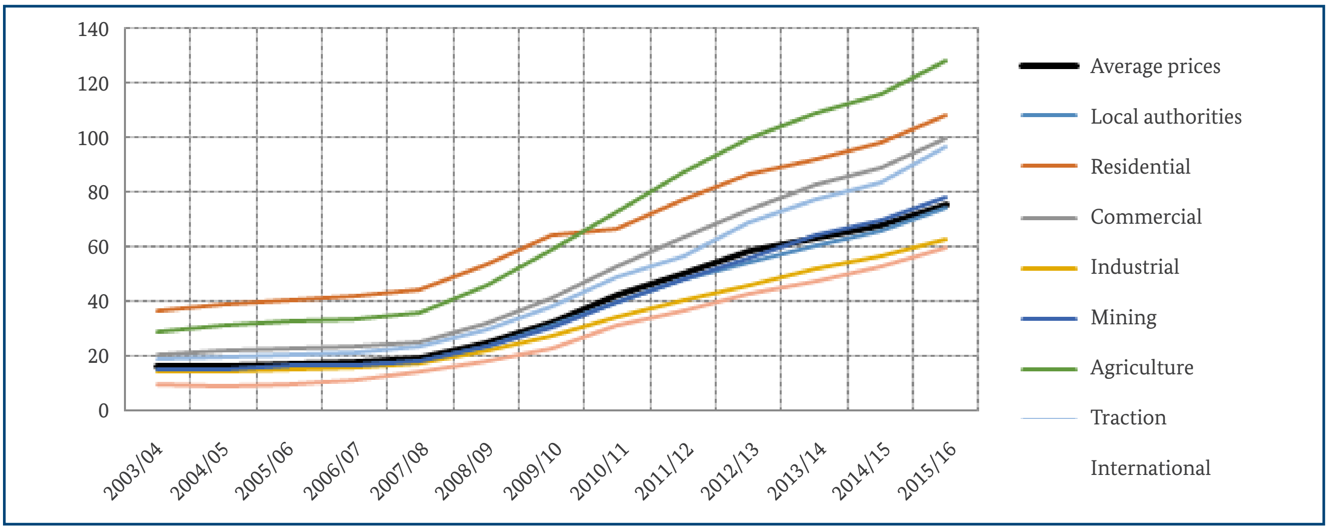
Second, renewable energy-based IPP projects need a generation licence in line with the provisions of the ERA and the Electricity Regulation Amendment Act No. 28 of 2007, coupled with the electricity policy framework laid down in the IRP 2010 and draft 2016 IRP update. However, a generation license can be obtained only if the projects fall within the IRP process, unless a ministerial exemption

Figure 1: Movement of prices per technology for the REIPPPP (in ZAR per kWh)



Source: Author's composition, based on data from the DoE for bid windows 1 – 4, indexed for October 2016, and from the CSIR for bid window 4 (expedited), indexed for October 2016.

Figure 2: Eskom's average price in ZAR cents per kWh from 2008 to 2016



Source: Authors' composition, based on Eskom data

is sought for the project. There is no clarity at the time of writing as to whether the exception can be made on a case-by-case basis or if a precedent could be set, exempting a whole group of generation activities. As raised earlier, the DoE published a Draft Licensing Exemption and Registration Notice on 2 December 2016 (DoE, 2016a), which may clarifies this situation in 2017.

One of the ways to mitigate this risk is to explore the legal possibility of a municipality obtaining a licensing exemption for renewable energy projects within its boundaries regardless of their modalities (size, ownership, etc.), which would considerably shorten the time and effort needed to increase the supply of renewable energy.

Financial risk management

This business model presents strong advantages from a financial perspective since it would not entail any capital outlay on the part of the municipality. Nevertheless, this option is not free of risks.

First, the MFMA compel municipalities the "best value for money". In the traditional sense, this requires municipalities to purchase electricity from IPPs at or below Megaflex rates, which impacts the investment case for renewable energy projects and creates financing barriers for developers. This is also the case if municipalities opt for shorter contract periods. Nevertheless, a case could be made to take into account added benefits and externalities into the assessment of projects.

Second, the precarious financial health of the majority of municipalities in the country means that procurement from IPPs would necessitate payment guarantees to IPPs. While options such as escrows and hypothecation of revenues from electricity sales can be explored to eliminate payment risks for IPPs, these options are unlikely to work given that earnings from electricity sales are used by municipalities to subsidise other municipal activities. Moreover, the rising problem of non-payment of electricity bills would make these options unviable. It is also unclear if IPPs would accept such forms of payment guarantees. This means that municipalities would need to secure payment guarantees for IPPs from National Treasury. Given the regulatory risks and the existing large exposure of the government to sovereign guarantee, municipalities would have to build a compelling case for National Treasury to approve such a scheme.

Third, another risk arises from the fact that contracts with IPPs would normally fall in the category of operational expenditure under the MFMA (by opposition to capital expenditure). This is because municipalities do not make capital investments into IPP projects and only purchase electricity from these projects. Although the MFMA does not explicitly prohibit the sort of long-term contracts required with IPPs, typically 20 years, it requires due processes of securing public participation, council approval and endorsement by the National Treasury to be followed for contracts that have financial implications beyond three years. Assuming no financial implication beyond three years means that tariffs would be tied to Eskom rates (or lower).

Table 16: A socio-political acceptability assessment of procuring electricity from independent power producers

Stakeholders	Negative factors	Positive factors
Department of Energy / NERSA	This business model is not supported by the DoE, in line with the single buyer principle. Municipalities' involvement in generation is controversial at the national level.	Some recent projects have been allowed by the DoE and NERSA. These could be leveraged to argue for more enabling framework.
Municipal electricity utility/ department	The skills and capacity to develop, project manage and oversee the delivery of this business model are not likely to be available within all municipal structures and would have to be developed over time. The large-scale nature of the projects may also not suit small municipalities.	This business model would confer a stronger role to municipal power companies/departments. This business would also contribute to municipal sustainability objectives. This business model would contribute to procuring low-cost, sustainable electricity.
Eskom	The implementation of this business model would directly conflict with Eskom's generation business. It would also constitute a revenue loss for the national utility.	This business model would contribute to reducing the utility's financial burden associated with new electricity generation and maintenance.
Treasury departments	The need for long-term power purchase agreements (20 years) and contractual guarantees would in all likelihood face some resistance for treasury departments. The cost saving nature of the arrangement could however mitigate these concerns.	This business model does not require capital investment from the municipalities, easing the burden on municipal finances. In the long run, this business model would in theory be beneficial to the fiscus.
Municipal electricity customers	No negative impact on consumers is expected from this business model.	No positive impact on consumers is expected from this business model, although it may result in lower prices and increase energy security in the long run.
Independent Power Producers	No negative impact on independent power producers is expected from this business model.	Independent power producers would directly benefit from this business as project developers and partners.

Source: Authors' assessment

Such an arrangement is unlikely to attract renewable energy IPP investments even with 20-year contracts. Moreover, this process would be far too cumbersome and financially onerous for every IPP contract on an on-going annual basis.

Socio-political risk management

This business model faces some strong resistance from national entities, primarily the DoE and Eskom. While the financial viability of such a business model and the existence of some projects could be leveraged, the socio-political settlement does not appear likely to change in the foreseeable future.

In a nutshell

This business model faces difficult conditions, despite its numerous benefits. While being highly dependent on technology and site selection (like all business models), it has a strong technical potential across a number of technologies, notably solar- and wind-based systems. The absence of upfront investment costs also presents some advantages to municipalities. However, current regulatory and financial risks, coupled with the lack of support from socio-political dynamics, prevent this business model from being implemented at this stage. Table 17 discusses the role of the various entities for procuring electricity from IPPs.

Table 17: Roles of the various entities for procuring electricity from independent power producers

Entity	Role
Municipality (Treasury)	Approve the transaction in compliance with Section 33 of the MFMA
Municipal electricity utility/ department	Procure the construction and operation of the power plant;
Municipal property management department	No particular role
NERSA	Provide a generation license
Eskom	Ensure grid connection (if the project requires Eskom's grid) and possibility purchase excess power
National Treasury	Provide views and recommendations on the transaction (along with the Department of Energy and the Department of Cooperative Governance and Traditional Affairs)
Municipal electricity customers	No particular role
Independent power producers	Build and operate the power plant (at minimum)
Private company	No particular role

Source: Authors' assessment

5. Business Models Structured on Playing a Facilitation Role

Besides building generation systems and procuring electricity, a third set of business models strategically locates municipalities as bridging agents. This facilitation role can take three different forms, namely aggregating and trading electricity, operating storage facilities and providing electricity services.

Such business models have been largely unexplored in South Africa. Electricity trading remains at a pilot stage with one sole example in the Nelson Mandela Bay Municipality. The provision of electricity services and storage facilities (beyond hydroelectric pumped storage) have not been implemented in the country as yet.

5.1. Playing a trading/aggregating role

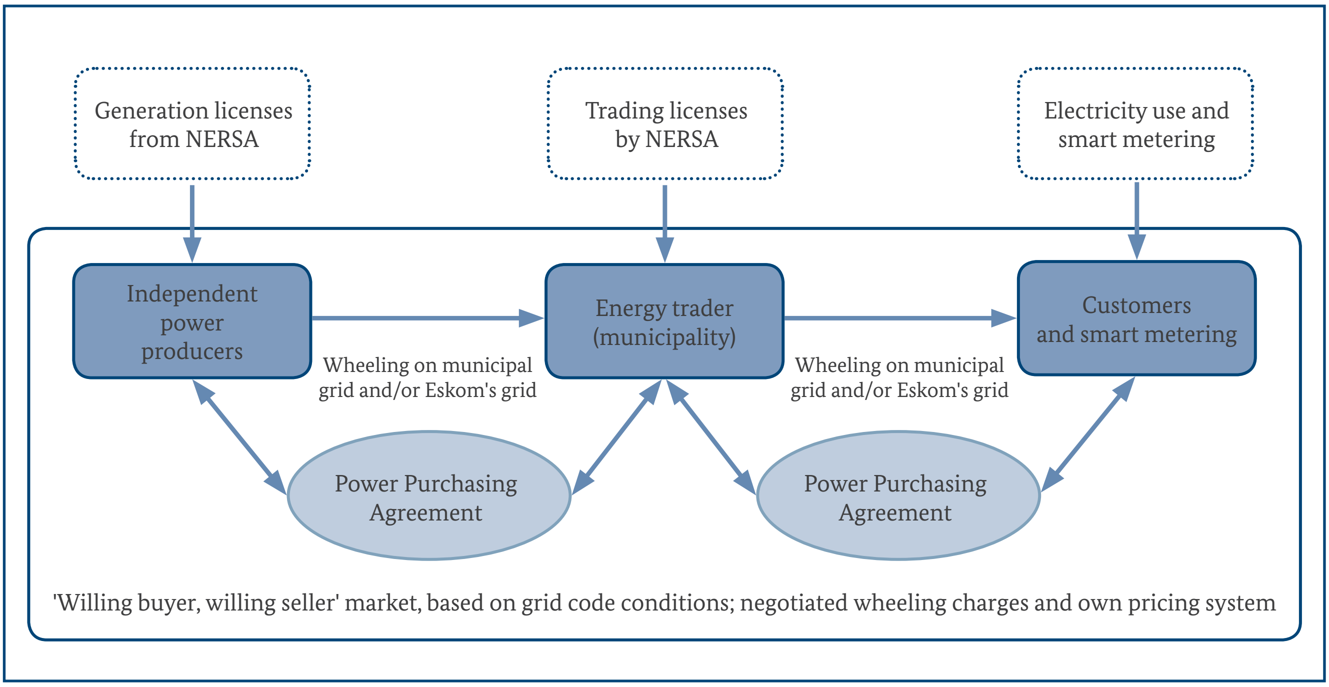
Driver for business model

Energy trading has been successfully implemented in South Africa but remains at its infancy. This business model involves trading electricity on a voluntary 'willing-buyer, willing-seller' market, and differs from the distribution function carried out by municipalities. It is schematically depicted in Figure 3 below. In this scenario, the municipality operates as an aggregator and trader, by making the link between generators of clean power and electricity users interested in buying electricity from renewable energy-based sources.

POWERX, previously known as Amatola Green Power, is the sole energy trading company licensed by the national regulator. While in operation since 2006, the model has not yet been replicated in the country.

In addition to enabling renewable energy technologies, therefore contributing to environmental sustainability, this business model would provide an interesting platform for municipalities to engage and retain customers. By offering another avenue to prosumers, municipalities would propose a new service to electricity generators as well as consumers interested in procuring clean energy.

Figure 3: Representation of the trading business model from a municipal perspective



Source: Authors' composition

Box 5: Energy trading benefits for municipalities

Local government and municipalities are constantly under pressure as far as the supply and demand of power is concerned. By entering the trading space, municipalities can manage their power requirements better, provide clean energy to their consumers, ensure sustainable growth in their municipalities and protect their revenues.

Due to the ever increasing electricity prices, embedded generation is becoming more and more a prolific answer to power users resulting in a progressive loss of income for municipalities. The trading business model provides an additional stream of revenue for municipalities. At minimum, it covers the costs associated with the use of the system and the distribution network. The focus is on establishing municipalities as green nodes as follows:

- stimulating power generation within the municipal network and thereby assisting in stabilising the grid and reducing the notified maximum demand for that municipality;
- unlocking developmental projects that are currently energy constrained;
- stimulating local economic development and job creation as well as local beneficiation;
- creating an acceptable national model where municipalities are guaranteed a fixed income stream as a 'wires/system charge', thereby enabling accurate forecasting and planning for their service delivery needs; and
- unlocking the financing for the development of power plants, as municipalities provide a balance sheet to IPPs to make their projects bankable.

Sources: Montmasson-Clair et al., 2014; POWERX, n.d.

Table 18: Assessment of drivers for playing a trading/aggregating role

Drivers	
● (green) Fit-for-purpose	● (yellow) Financial benefits
● (green) Customer retention	● (yellow) Grid stability
● (green) Environmental sustainability	● (yellow) Energy security
● (orange) Ease of implementation	● (red) Lead by example

Source: Authors' assessment

Note about the colour coding: green indicates a primary driving force, orange indicates a secondary but strong driving force, yellow indicates a peripheral/weak driving force, and red indicates the absence of any driving force. Drivers are further explained in Annexure 2.

The localised nature of the business model, which would be embedded within the municipal systems (to the extent that both producers and consumers operate on the municipal grid), would enable municipalities of any size to implement energy trading. The financial viability of the scheme (which could also be designed on the basis of cost neutrality) would further facilitate the operationalisation of the business model. Extending the operations beyond the municipal grid, which would be necessary to meaningfully roll out such a business model, would nevertheless require the negotiation of wheeling agreements with Eskom

Techno-economic potential

Even though some electricity users might be willing to pay more for renewable energy than their regular tariff, this business model is most often premised on a lower tariff for electricity from a renewable energy-based power plant. As the active energy charge paid by electricity users is often higher in municipal areas than in Eskom's supply areas, these are often the areas where it makes more financial sense to implement such a scheme.

In this business model, the energy trader (in this case, the municipality) would buy electricity from a renewable energy-based power plant and sell it to a willing buyer.[18] As municipalities are already selling electricity to their customers, and already buying electricity from Eskom, it is possible for them to procure from other power generators, depending on the price it is offered at.[19]

In order for the business model to be viable, the municipality would have to at least cover its costs. The municipalities would have to sell the electricity at least at the price it is bought, and accordingly include a payment for wheeling costs to Eskom (if it is the grid operator) or add a charge for the use of the municipal grid infrastructure.

If the electricity buyer is willing to pay a premium for the clean electricity, the municipality could sell it at a higher tariff than it normally would. This was the business plan envisaged for the electricity procured from the Darling Wind Farm by the City of Cape Town, which was sold as green energy certificates to willing buyers (Cape Town Green Map, 2010). However, it was hard to sell these certificates. Furthermore, in a study conducted by eThekwini municipality, the willingness to pay a premium for green electricity is considered low for all electricity customers (Kritzinger, 2014). It is thus more likely that the municipality would will only be able to sell the green electricity to consumers at the normal tariff. In order for the operation to be financially neutral or beneficial, the electricity from the renewable energy-based power plant would thus have to be bought by the municipality at a price that is lower or equal to that of Eskom's Megaflex tariff. This is already possible for some wind and solar PV power plants in South Africa, but not a general situation at this stage.

Regulatory risk management

This model would necessitate that municipalities obtain a license from NERSA to trade power within the framework of the voluntary 'willing buyer, willing seller' market. From a replicability or scaling up perspective, the POWERX experience is seen as unique and no license for municipal electricity trading has yet been issued. Municipal utilities would have to build a case for such licences to become the norm from a regulatory perspective.

Municipalities are currently not permitted to enter into commercial activities, such as trading, to generate revenues. According to the Municipal Systems Act No. 32 of 2000, municipalities are solely entitled to "finance the affairs of the municipality by (i) charging fees for services; and (ii) imposing surcharges on fees, rates on property and, to the extent authorised by national legislation, other taxes, levies and duties".

Financial risk management

As highlighted on in the techno-economic assessment, the financial viability of this business model lies on the ability to match power generators and interested buyers. This match-making exercise is based on either procuring electricity at prices lower than Eskom's tariffs and/or finding customers willing to buy clean power at a premium.

This is particularly important due to the need to add a charge for the use of the network (for wheeling on the municipal grid) and possibly a charge for wheeling the electricity through the national grid. Eskom has approved a detailed wheeling framework while NERSA has proposed rules around network charges, providing a degree of certainty. These networks charges can however make wheeling schemes uneconomical.

Socio-political risk management

This business model would move municipalities towards the function of trading, which is currently prohibited. It has

18 This differs from the role played by the Nelson Mandela Bay Municipality in the POWERX model, in which the municipality simply wheels the power for the energy trader against a charge.

19 Municipalities are however not allowed to take part in the REIPPPP, as discussed in Section 4.2.

Table 19: A socio-political acceptability assessment of playing a trading/aggregating role

Stakeholders	Negative factors	Positive factors
Department of Energy / NERSA	The emergence of this new role for municipalities would in all likelihood be resisted by DoE and NERSA. The limited expansion of the business model so far supports this perspective.	The operationalisation of the POWERX experience could be leveraged to argue for the opportunity to replicate it in other municipalities.
Municipal electricity utility/ department	Skills and competencies to manage this business model are not available at municipal level.	This business model would empower the municipality with a stronger role and an interesting new revenue stream.
Eskom	This business model would possibly face resistance from Eskom due to the introduction of competition. This would materialise through the negotiation of wheeling agreements in cases where Eskom's grid is necessary.	This business model would constitute a revenue stream for Eskom when its grid is used.
Treasury departments	The need for long-term agreement (20 years) may face some resistance from municipal treasuries. The transaction does not however impose any financial obligations on the municipality and is not affected by MFMA constraints.	This business model does not require capital investment from the municipalities, easing the burden on municipal finances. In the long run, this business model would in theory be beneficial to the fiscus by representing an additional revenue stream for municipalities.
Municipal electricity customers	No negative impact on consumers is expected from this business model.	Consumers would benefit through the possibility of procuring clean energy. Prosumers would benefit from an increased ability to sell their excess power.
Independent Power Producers	No negative impact on independent power producers is expected from this business model.	Independent power producers would directly benefit from this business as electricity generators.

Source: Authors' assessment

faced strong reluctance from a socio-political perspective, as illustrated by the limited rollout of energy trading in the country. This appears unlikely to change in the near future, narrowing down the window of opportunity for this business model.

In a nutshell

This business model, while attractive on a number of levels for municipalities engaging in distribution, faces significant constraints. The role of the various entities involved in this business is described in Table 20. The regulatory framework, which currently does not enable municipalities from engaging in trading activities, is a major hurdle. The economic viability of the business model, which is largely founded on charging electricity at a premium, also raises limitations. The socio-political resistance, which has limited the emergence of this business model in the country, further weakens the likelihood of this business model playing a strong role in the foreseeable future.

Table 20: Roles of the various entities for playing a trading/aggregating role

Entity	Role
Municipality (Treasury)	No particular role
Municipal electricity utility/ department	Provide wheeling services to the trading entity Aggregate electricity from producers and manage the trading operations (if possible)
Municipal property management department	No particular role
NERSA	Provide a trading license to the company and/or the municipality
Eskom	Provide a wheeling agreement if required
National Treasury	Provide views and recommendations on the transaction (along with the Department of Energy and the Department of Cooperative Governance and Traditional Affairs)
Municipal electricity customers	Procure electricity through the trading entity
Municipal electricity prosumers	Generate and sell electricity to the trading entity
Independent power producers	Generate and sell electricity to the trading entity
Private company/service provider	Provide the trading services in agreement with the municipality

Source: Authors' assessment

5.2. Operating storage facilities

Driver for business model

Energy can be stored in many forms. Even though chemical storage mostly springs to mind when energy storage is discussed, the most commonly storage schemes used in South Africa are in the form of potential energy in pumped-storage hydroelectric facilities and as heat in solar water heaters and concentrated solar power plants. Municipal biogas plants could also play a type of storage role where the gas produced is stored and only used for combined heat and power in the hours of peak demand.

Importantly, any energy storage system, no matter how efficient, will always be a net user of energy. As a result, although energy storage systems could assist with the roll out of renewable energy technologies, these in themselves are not renewable.

This business model is therefore not novel in itself, as South Africa has been operating pumped-storage schemes for several decades. The rise of renewable energy sources of electricity has however prompted increasing discussions about the role of storage technologies and mechanisms (over and beyond pumped storage), in order to bridge the gap between generation periods and consumption profiles and increase the reach of intermittent, renewable energy-based electricity.

The provision of storage facilities would bring substantial benefits in terms of energy security, including black-start capacity, and grid stability (both in terms of load and

Table 21: Assessment of drivers for operating storage facilities

Drivers	
● Energy security (green)	● Financial benefits (yellow)
● Grid stability (green)	● Customer retention (yellow)
● Fit-for-purpose (green)	● Environmental sustainability (red)
● Ease of implementation (orange)	● Lead by example (red)

Source: Authors' assessment

Note about the colour coding: green indicates a primary driving force, orange indicates a secondary but strong driving force, yellow indicates a peripheral/weak driving force, and red indicates the absence of any driving force. Drivers are further explained in Annexure 2.

frequency management). The nature of the business model does not preclude small municipalities to participate in such activities and would provide noteworthy benefits to all municipal electricity departments.

The ease of implementation of the business model, which would form part of grid investment, could be an additional positive factor. This would nevertheless be conditioned to the existence of a market for energy arbitrage (i.e. storing cheap electricity to be sold at peak times), which is not the case in South Africa with the exception of pumped storage schemes.

Techno-economic potential

As energy storage systems can fulfil many more functions than mere energy arbitrage, it is often better to think of storage systems in terms of value, and not in terms of pure costs. The costs and efficiency of storage technologies are shown in Table 22 for reference purposes.

The value of the functions that these systems fulfil can then be stacked and compared to the cost to determine whether the storage system is a cost efficient way of solving the problem. These use cases for storage systems are, inter alia, the provision of ancillary services, the deferral of capital investments and improvements to the distribution or transmission grid, energy arbitrage and improvements in power quality.

Regulatory risk management

This business model essentially involves storing electricity for later use in the electricity sector. In order to contribute to energy sustainability, this would consist in storing excess electricity generated from renewable resources, such as hydropower and solar systems. From a utility perspective, it is within the mandate of municipalities to provide storage facilities and municipalities can easily put storage capacity onto their grid.

From a regulatory perspective, this model would be allowed as long as storage is viewed as a grid service, i.e. the deferral of grid expansion in specific cases, the strengthening of lines, and the provision of auxiliary services, such as frequency and voltage support. It has precedence and is the typical

Table 22: Cost, life span and efficiency of different storage technologies

Technology	Cost per capacity	Life Expectancy	Turnaround efficiency
Lead Acid (AGM)	ZAR 2 200 / kWh	4 years	75%
Lead Acid (Flood)	ZAR 1 800 / kWh	3 years	75%
TESLA (Lithium Ion)	ZAR 4 200 / kWh	8 years	92%
Vanadium-Redox Flow	ZAR 8 000 / kWh	>10 years	75%
H_2 – Fuel Cell	~ZAR 37 500 / kWh	5 years	45%

Source: Authors' composition

Box 6: The Steenbras pumped-storage hydroelectric scheme of the City of Cape Town

The 180-MW Steenbras pumped-storage scheme, linked with the Steenbras Dam above Gordons Bay, near Cape Town, was opened in 1979 to supplement the municipality's electricity supply during periods of peak demand. The plant is one of the key components of the City's energy security and cost control strategies.

During periods of peak demand, when buying electricity from Eskom is most expensive, water from the upper dam is channelled through the turbine generator to create electricity. This water is then pumped up to the upper dam at night using low-cost surplus national generating capacity, with the net effect being that the City saves money by reducing the amount of electricity it has to buy from Eskom at peak rates.

Although the facility is primarily employed for peak shaving, the scheme has also been used outside of peak windows in 2014 and 2015 to prevent load-shedding. The capacity was notably used to offset load-shedding in Stage 1 or reduce a stage, for example from Stage 2 to Stage 1.

Source: Cape Town Green Map, 2015

use case for pumped storage schemes, such as the Steenbras pumped-storage hydroelectric scheme of the City of Cape Town detailed in Box 6 (Greyling et al., 2015). Beyond grid services, storage has not yet found a place in the policy and regulatory landscape in the electricity sector.

This is primarily because the main business case for setting up storage facilities lies in using electricity storage as a hedging mechanism to produce when cheap and use when expensive. It allows the storage of electricity when the marginal cost of power generation is low, i.e. during off-peak periods and the discharge of electricity when the marginal cost of power generation is high, i.e. during peak periods. It also provides a platform for consumers to use electricity during peak periods in order to avoid penalties for exceeding the contractual peak demand.

The widespread development of this business model would however require the presence of an electricity market that allows for energy arbitrage. In the absence of such a market, as is the case in South Africa, this model would have limited reach. Municipal electricity departments could perform such an arbitrage within their own jurisdiction, choosing between using Eskom's power or power from their storage facility. This could be beneficial to municipalities during peak times, particularly since most residential customers are not on time-of-use tariffs. Beyond pumped storage, storage technologies are however too expensive at this stage for such schemes to take off. Similarly, while most large customers already pay a time-of-use tariff for active energy and a peak demand charge for the highest use in the month and could benefit from such business model, batteries are currently too expensive and not durable enough to make it cost effective. This situation may change in the future, potentially ahead of policy and regulatory frameworks.

Nevertheless, this business model should not be completely discarded. Future developments in the electricity sector may make this model relevant for municipalities from the perspective of greater integration of renewable energy. Several initiatives are currently underway to examine the use cases of energy storage and examine the techno-economic case for energy storage. One such study is the USTDA-funded South Africa Energy Storage Technology and Market Assessment led by the IDC. The early results of this study[20] indicate no need for storage on the national grid for the foreseeable future, even with aggressive new renewable energy installations. However, it was identified that an opportunity might exist for small-scale installations of energy storage systems on the distribution grid to postpone capital investments and alleviate bottlenecks. More studies are, however, needed to confirm this finding.

Financial risk management

From a technology perspective, the financial case and risks associated with storage depends on the strength and reliability of the specific technology employed as well as that of the company backing it up. From a user case perspective, storage can provide different services. The business case and risks for each use case would need careful examination as and when such services are introduced in the sector.

More generally, it is difficult to comment on the financial case and the associated financial risks for storage facilities as a business model given that the storage is not on the policy and regulatory radar of the electricity sector. What is known is that NERSA plans to generalise time-of-use tariffs, as already implemented by most municipalities and Eskom for their industrial and commercial customers. Time-of-use tariffs would make the case for storage for energy arbitrage more financially attractive. However, without changes in tariffs structures and in the absence of a market, the country is currently not well-structured or prepared for the efficient adoption of storage as a business model.

Socio-political risk management

Due to the novel aspect of this business model, the socio-political landscape is rather unfavourable. The introduction of a new role for municipalities and the creation of dedicated market for electricity storage is conditioned to the support (or at least approval) by national government as well as the national utility. The emphasis towards better energy management, notably through time-of-use tariffs, could however be leveraged in the future, at least to develop energy arbitrage at the municipal level.

In a nutshell

This business model constitutes a novelty in the South African context (with the exception of pumped storage), particularly in a configuration involving a trading market. It would bring a number of benefits, facilitating energy arbitrage and the introduction of renewable energy technologies into the electricity system. The techno-economy potential is debatable due to the high cost and doubtful need in the current landscape, with the exception of heat storage and hydroelectric pumped-storage. The regulatory, financial and socio-political conditions for the emergence of this business models have not emerged yet due to its innovative nature. The move towards time-of-use tariffs may provide an interesting platform to introduce and

20 The results of this study will only be available in the second quarter of 2017.

Table 23: A socio-political acceptability assessment of providing storage facilities

Stakeholders	Negative factors	Positive factors
Department of Energy / NERSA	The emergence of a new role for municipalities, such as active trading on an electricity market, would in all likelihood be resisted by the DoE. The classification of the operation as grid investment could mitigate the problem	The business model brings energy-related benefits which could be leveraged. The move towards time-of-use tariffs also constitutes an opportunity to showcase its potential.
Municipal electricity utility/ department	Skills and competencies to manage this business model in the case of active market trading (i.e. beyond the use of storage systems) are not available at municipal level.	In the case of grid investment, this business model would not confer a new role to municipalities and would be easily implementable.
Eskom	This business model would possibly face resistance from Eskom due to the introduction of a new role for municipalities.	In the current setting, Eskom would be the primary purchaser. The national utility could reap benefits from this business model through better load management and reduced investment in generation capacity.
Treasury departments	The upfront investment required would possibly face resistance from municipal treasuries. While the business case in the absence of a market is problematic, the existence of a market would further ease the resistance.	In the instance of a market-based business case, this business model would in theory be beneficial to the fiscus by representing an additional revenue stream for municipalities and contributing the financial sustainability of the municipality.
Municipal electricity customers	No negative impact on consumers is expected from this business model.	Consumers would benefit through the possibility of procuring clean energy. Prosumers would benefit from an increased ability to sell their excess power.
Independent power producers	Independent power producers would directly benefit from this business as electricity generators.	No negative impact on independent power producers is expected from this business model.

Source: Authors' composition

Table 24: Roles of the various entities for operating storage facilities

Entity	Role
Municipality (Treasury)	No particular role
Municipal electricity utility/ department	Manage the installation and operation of storage facilities Manage the trading of electricity
Municipal property management department	No particular role
NERSA	No particular role
Eskom	No particular role
National Treasury	No particular role
Municipal electricity customers	Purchase electricity from the municipality
Municipal electricity prosumers	Generate and sell electricity to the municipality
Independent Power Producers	Generate and sell electricity to the municipality
Private company	No particular role

Source: Authors' assessment

discuss such a business model in the near future. The roles of the various entities for operating storage facilities is detailed in Table 24.

5.3. Providing electricity services

Driver for business model

The provision of energy services, both related to renewable energy and energy efficiency, has been essentially spearheaded by national government and Eskom. Municipalities have not yet entered this space.

Municipalities would in essence operate as an energy service company (ESCo). The array of services which could be provided under such a business model is vast. Municipalities could install and maintain energy systems (such as smart metering systems, rooftop solar PV systems or solar water heaters) against a service fee (fixed or related to electricity savings), facilitate and/or provide energy efficiency services (energy audits, design and implementation of energy savings opportunities), retrofitting, energy conservation, energy infrastructure outsourcing, power generation and energy supply, financing options and risk management (GreenCape, 2015; IDC, 2013).

This business model could create an ideal springboard for municipalities to further engage customers by providing a new spectrum of energy services. Different degrees of involvement could be envisioned. On the one hand, municipalities could restrain their involvement to playing a bridging role between ESCos and customers. Such facilitation functions could for example take the form of 'on-bill financing' of energy services. On the other hand, municipalities could develop new competencies and consider providing energy services to customers directly (IDC, 2013).

Given the nature of the services envisioned, the business model would contribute to environmental sustainability through an increased rollout of renewable energy technologies and improved energy efficiency. The local feature of the services provided would allow any municipalities to tap into this business. The novelty and complexity of the business model, which would require municipalities to build a complete new set of skills and competencies, would nevertheless limit the reach.

Further benefits would arise from the profitable nature of the business model as well as an indirect contribution to improve energy security and grid stability. The establishment of an ESCo unit within municipalities would however require a large and sustained effort in the short term, which would be bring further benefits as municipalities retain more customers and gain on experience and credibility.

Techno-economic potential

As the potential and specific financials of this model would depend on the specific services that municipalities decide to take up and the market for such services, it is difficult to quantify the techno-economic potential of this model.

In any event, the technical potential of this business is significant in South Africa. A 2012 estimate from Eskom assessed the energy efficiency potential in South Africa at 12 933 MW, including 8 762 MW in the residential sector (see Table 26).

A ball-park estimate from the Industrial Development Corporation quantified in 2013 the market potential for ESCOs between ZAR 2.6 and 7.8 billion over a 10-year period, depending on market penetration (see Table 27).

Regulatory risk management

In terms of Section 156(5) of the Constitution, a municipality has the right to exercise any power concerning a matter reasonably necessary for, or incidental to, the effective performance of its functions. Schedule 4, which covers the 'functional areas of concurrent national and provincial

Table 25: Assessment of drivers for providing electricity services

Drivers	
● Customer retention (green)	● Grid stability (orange)
● Environmental sustainability (green)	● Energy security (orange)
● Fit-for-purpose (green)	● Ease of implementation (yellow)
● Financial benefits (orange)	● Lead by example (red)

Source: Authors' assessment

Note about the colour coding: green indicates a primary driving force, orange indicates a secondary but strong driving force, yellow indicates a peripheral/weak driving force, and red indicates the absence of any driving force. Drivers are further explained in Annexure 2.

Table 26: Energy demand savings potential in South Africa in MW

Technology	Residential	Commercial	Industrial	Total
Efficient lighting	939	115	116	1 170
Solar water heating	3 713			3 713
Domestic cooking conversion	2 144			2 144
Infrared heating	766			766
Heat pumps	960	224	569	1 753
Showerhead and restrictors	240	160		400
Load management		9	200	209
HVAC		14	70	84
Agricultural initiatives		144		144
Efficient compressed air			1 255	1 255
Motor efficiency			408	408
Variable speed drives			417	417
Fan, pumps			530	530
Total	**8 762**	**666**	**3 565**	**12 933**

Source: Eskom, 2012 in (IDC, 2013)

Table 27: Estimates of the market potential of ESCOs in South Africa

Indicators	Low market penetration (10%)	Medium market penetration (20%)	High market penetration (30%)
Potential demand reduction	6 000 MW		
Load factor	50%		
Energy saved	26 million GWh		
Cost	ZAR 1 per kWh		
Market potential over 10 years	ZAR 2.6 billion	ZAR 5.2 billion	ZAR 7.8 billion

Source: (IDC, 2013)

legislative competence', lists 'electricity and gas reticulation' as a local government matter (see Part B). It would seem that, if whatever trade or commercial activity proposed supports this outcome, municipalities could be able to pursue it. On a cautionary note, however, it must be noted that South African courts interpret such implied powers very intently, demanding a clear demonstration that the commercial activity is a logical consequence to the powers granted or reasonably required to exercise the powers granted.[21] The question then becomes whether one can argue that the provision of services by municipalities, such as the installation and maintenance of rooftop PV panels or consumers purchasing PV panels through municipalities from specific suppliers, would satisfy such a test.

Therefore, from the regulatory perspective, it is unclear whether municipalities can operate as traders. This means that, until clarity is obtained on the legality of trading activities, municipalities cannot offer the types of services envisaged under this business model. Municipalities can only be facilitators rather than actual service providers. Facilitation services do not however constitute a business model, but simply the provision of match-making, bridge-building services, connecting interested customers with existing ESCOs.

Another issue is that for each service offered by the municipality, it would be necessary to understand the boundaries of ownership between municipalities and consumers. These boundaries would be key to determining the extent and the nature of activities that municipalities undertake while providing services to consumers. Although different from the business model analysed here, the experience of the City of Cape Town in trying to use ESCOs to perform services within the municipality, described in Box 7, also brings some important insights into the

21 See Johannesburg Municipality v Davies and Another 1925 AD 395, 402-3 for example.

Box 7: Cape Town's energy performance contracting experience

The City of Cape Town opted for energy performance contracting to manage its relationship with ESCos. Energy performance contracting refers to the practice of requiring an energy management service provider to guarantee that the full costs of a suite of energy efficiency interventions that it implements will be paid back through the energy savings that result from the interventions. By definition, the future savings must be greater than or equal to the costs.

The typical implementation of an energy performance contract involves the service provider raising the funds to undertake the implementation of energy saving interventions on behalf of their client. Once the implementation of interventions is complete, the service provider is then paid by the client out of the monthly savings achieved by the interventions. Payments continue until a specified contract period is complete.

In this form of energy performance contracting, the client is not required to pay for the cost of the interventions at the outset. In addition, the client only pays from the savings achieved, so in cases where the savings are less than expected the client is not required to top up the payments and the service provider suffers the financial consequence of non-performance.

Owing to the unique operating environment of South African municipalities, the City of Cape Town has developed its own approach to the implementation of performance contracting. Primarily because of internal accounting procedures for the payment of electricity, it is not possible for the City of Cape Town to ring-fence savings and pay those to a service provider. Instead, the City of Cape Town pays the service provider for the interventions up front, but requires the service provider to provide a financial guarantee that the projected savings will be achieved. If the agreed savings are not achieved, the service provider's performance guarantee is used to reimburse the difference to the municipality.

Source: McKenzie and Diederichs-Mander, 2014

regulatory challenges associated with the remuneration for energy services.

Financial risk management

An ESCo can generally be defined based on three characteristics:

- it guarantees energy savings and/or the provision of the same level of energy service at a lower cost to their customer;
- it can finance, or assist in arranging financing for the operation of an energy system by providing a savings guarantee; and
- the remuneration of ESCos is directly tied to the energy savings achieved (ESCos accept some degree of risk for the achievement of improved energy efficiency).

Clearly, for municipalities to provide services, such as those envisaged under this business model, municipalities will need strong financial backing. Given the current poor financial health of municipalities, municipalities are unlikely to be able to fund such service provision from internal resources. The fact that municipalities are not allowed to provide such services from the regulatory perspective means that external sources of funding are moreover unlikely to come by.

Socio-political risk management

From a socio-political perspective, this business model would confer a brand-new function to municipalities. In addition to being prevented from the existing regulatory framework, the internal capacity for municipalities to rollout this business is likely to generate strong resistance. The provision of facilitation services, while easily implementable, has limited economic viability and appears more as a municipal service than a business model. More broadly, the emergence of ESCOs in South Africa has been relatively slow due to the lack of governmental support, further impeding the change that municipalities be allowed to enter this space.

In a nutshell

This business model could, in many respects, represent the future of municipalities in the energy space. Their role of municipalities and other entities in this business model are outlined in Table 29. It could allow strong client retention and bring new streams of revenues to municipal budgets.

At the moment, there seems to be a level of uncertainty as to what municipalities are legally able to do, making the regulatory and financial case for this business model fragile. The socio-political landscape is furthermore not supportive of the development of ESCOs, let alone municipalities playing a role in the energy services industry. The absence of a strong energy services industry in South Africa could in turn be an opportunity for municipalities to build a case on playing a stronger role on the energy services market.

Table 28: A socio-political acceptability assessment of for providing electricity services

Stakeholders	Negative factors	Positive factors
Department of Energy / NERSA	This business model requires municipalities to compete with the private sector, which is not allowed by the regulatory framework.	This business model constitutes a customer retention strategy and a new revenue stream for municipalities. It would also offer municipalities ways to operate in a more cost-efficient and 'business-oriented' fashion.
Municipal electricity utility/ department	The business model would be entirely new at the municipal level and the skills and capacity to develop, project manage and oversee the delivery of this business model are not available within municipal structures.	This business model would confer a stronger role to municipal electricity utilities/departments. It would generate new skills and competencies, moving municipal energy departments into the ESCO space.
Eskom	No negative impact on Eskom is expected from this business model	No positive impact on Eskom is expected from this business model
Treasury departments	The need for the municipality to carry some additional risks associated with the provision of energy services could be resisted by treasuries.	In the long run, this business model would be beneficial to municipal finances and the fiscus. This business model represents a customer retention strategy and a new revenue stream for municipalities.
Municipal electricity customers	No negative impact on consumers is expected from this business model.	Customers would be direct beneficiaries of such a business models when an increased access to energy services and long-term energy cost savings.
Independent Power Producers	No negative impact on independent power producers is expected from this business model.	No positive impact on independent power producers is expected from this business model.

Source: Authors' assessment

Table 29: Roles of the various entities for providing electricity services

Entity	Role
Municipality (Treasury)	No particular role
Municipal electricity utility/ depart-ment	Facilitate the provision of energy services from ESCOs to customers Provide energy services to municipal customers
Municipal property management department	No particular role
NERSA	Regulate municipal operations in line with national policy
Eskom	No particular role
National Treasury	No particular role
Municipal electricity customers	Commission energy services through the municipalities
Independent Power Producers	No particular role
Private company	Provide energy services in partnership with municipalities
Private company	No particular role

6. Conclusions

The role of South African municipalities in the energy space is in rapid evolution. A number of business models can be conceptualised to assist municipalities in seizing opportunities arising from renewable energy technologies. Seven business models, split into three broad categories, were reviewed and analysed in this report. Going forward, the analysis of these business models raises a number of policy implications for the stakeholders involved in South Africa's electricity sector.

First, municipalities are encouraged to **pursue the identified business models**, particularly to better understand their implications (i.e. costs and benefits) as well as operationalisation channels. While some have already been experimented with in the South African context, business models structured around municipalities playing a facilitation role are new and largely unexplored. Municipalities are recommended to adopt a strategic approach to prioritise implementation and/or further investigation. Indeed, although the business models are not mutually exclusive in nature, it would appear impractical for municipalities to pursue all options at the same time. In this respect, South African municipalities should consider the vast international experience, such as from Germany (Badelt, 2017), to inform their assessment.

Second, municipalities, in collaboration with relevant parties, should further **unpack each business** model with the objective of clarifying the regulatory frameworks. It is imperative to reach clarity as well as long-term certainty about the regulatory frameworks, both from a financial management and an institutional perspective. In a number case, the operationalisation of business models is hampered by the absence of regulatory framework (e.g. for the procurement for embedded generators or the provision of storage facilities) and/or the lack of clarity about existing rules and regulations (e.g. financial management). Ultimately, a complete overhaul of legislation, from an energy and municipal management perspective, is required. This include numerous regulations (such as on New Generation Capacity and SSEG), laws (such as the ERA, the MFMA and the Municipal Systems Act) as well as the Constitution. Further clarity should be provided by the DoE, NT and NERSA on the regulatory framework. A series of structure roundtables could be organised with municipalities to jointly work through each business model and map a clear way forward from a regulatory perspective.

Third, further **in-depth discussions are required on the funding models of South Africa's municipalities.** The business models discussed in the report could be used as an input into these discussions. South Africa's finances are increasingly under pressure from rising electricity prices and the uncontrolled development of embedded generation at the consumer level. The current pattern of tariff cross-subsidisation appears particularly at jeopardy. At the same time, business models that carry the most promising potential to create new revenue streams, such as the provision of electricity services, are currently prevented and, as a result, largely unexplored. Such a discussion could be closely linked to reflections about the future roles of municipalities, particularly as the functions of municipalities are determined by the Constitution and national policies. Led by National Treasury, but including all relevant departments and entities (such as the DoE) having an impact on the role and functions of municipalities, a working group could be created to address the transition to South African municipalities to new funding models.

Fourth, **from the perspective of electricity planning, greater consideration should be given to the role of municipalities** by national government and the national utility. South African municipalities, through SALGA and AMEU, could provide structured inputs into the IRP and IEP processes, with the aim of securing a mandate for further action at the local level. The consideration of embedded generation as a future scenario in the draft IRP 2016 is a first step in this direction. Municipalities can play an active role towards improving the efficiency and efficacy of South Africa's electricity systems, contributing to improved energy sustainability. The rollout of embedded renewable energy technologies, which carries immense potential, is largely located at the local level. There is an opportunity for national structures to leverage the privileged positioning of municipalities to facilitate their integration in South Africa's electricity networks. Municipalities are arguably better positioned than national government and Eskom to monitor and control the rollout of embedded generation in South Africa.

Fifth, municipalities would do well by progressively **developing new skills and competences**, in line with the business models which are being pursued. Most business models envisaged in the report require municipal personnel to build new skills, if not establish new teams. This is notably the case for the development of energy services, a new but promising areas for municipalities. In this respect, municipal can proceed by experimentation and increment, engaging in pilot projects and leveraging capacity building programmes, including from multilateral and bilateral development institutions.

Last but not least, municipalities should actively **embark on experimenting with some of the business models**, building business cases and developing projects and programmes. Actively implementing (or at least starting to operationalise) the business model will enable municipalities to adequately gauge the costs and benefits of each business model as well as facilitate engagement with national authorities on any policy and regulatory barriers. Table 30 provides a summary assessment of the main barriers faced by each business model and proposes possible solutions. Next steps towards the operationalisation of the business models are also proposed.

Ultimately, the novelty of the business models, combined with the fluidity of the domestic policy and regulatory environment, makes **experimentation and 'learning by doing' critical to any meaningful progress.** South African municipalities could take the lead in shaping and defining the future of the country's electricity sector. This is the core springboard for transforming South African municipalities' role in the electricity sector and achieving energy sustainability.

Table 30: Assessment of barriers and possible way forward for each business model

Business model	Barriers	Possible way forward	Next steps towards implementation
Building embedded power systems	Projects require long-term contracts (for the installation, operation and/ or maintenance of systems), triggering additional procedures under the MFMA	Use short-term contracting periods when possible Follow the required consultative process as per legislation, building a case of both the financial and economic benefits of the project Rely on conservative assumptions in financial modelling exercises to account for the lack of certainty about the price trajectory Lobby Treasury for the environmental benefits of renewable energy systems (i.e. avoided externality costs), to be taken into account in project assessment.	Pursue the installation of embedded (small-scale) power systems on municipality-owned buildings
	Projects require capi-tal investment	Lobby Treasury departments for dedicate funding (in light of the financial and economic benefits of the business model) Investigate alternative funding channels (DFIs, multilateral funds, etc.) and innovative mechanisms to raise funding (Green Bonds)	
	Projects' costs must be equal to or lower than Eskom	Procure at an electricity cost equal to or lower than Eskom over the long term and/or sell to willing buyers at a higher tariffs for green electricity Favour plants which do not require the use of the Eskom grid (in order to limit wheeling costs)	

Business model	Barriers	Possible way forward	Next steps towards implementation
Building stand-alone power plants	Projects may need to obtain a generation licence from NERSA or a ministerial exemption	Lobby DoE for projects to be included in national energy plans (IRP / IEP), then enabling a generation licence application to NERSA	Pursue with the installation of biogas digesters at sewerage works Continue engaging the DoE and NERSA on the finalisation of licensing framework
	The mandate and/ or framework for municipalities to engage in this business model remain unclear	Build a business case to lobby national government for a clear municipal mandate Lobby DoE and NERSA to ensure that the upcoming Licensing Exemption and Registration Notice and subsequent regulatory rules favourably clarify the situation	
	Municipalities have no mandate to operationalise this business model	Obtain legal opinion on the Constitutional mandate of municipalities (if necessary) Lobby national government for municipal mandate Further build the case for the business model, notably through pilot projects and experimentation	
	Projects require long-term contracts (for the installation, operation and/ or maintenance of systems), triggering additional procedures under the MFMA	Use short-term contracting periods when possible Follow the required consultative process as per legislation, building a case of both the financial and economic benefits of the project Rely on conservative assumptions in financial modelling exercises to account for the lack of certainty about the price trajectory Lobby Treasury for the environmental benefits of renewable energy systems (i.e. avoided externality costs), to be taken into account in project assessment.	
	Projects require capital investment and in most cases municipalities will not be able to finance the projects from their own budget	Lobby Treasury departments for dedicate funding (in light of the financial and economic benefits of the business model) Investigate alternative funding channels (DFIs, multilateral funds, etc.) and innovative mechanisms to raise funding (Green Bonds)	
	Skills and competences are not available at the municipal level	Progressively build internal skills and competencies through pilot projects and experimentation, and technical assistance opportunities	

Business model	Barriers	Possible way forward	Next steps towards implementation
Procuring electricity from embedded generators	Projects require long-term contracts (in the case of feed-in tariff schemes), triggering additional procedures under the MFMA	Use short-term contracting periods when possible Follow the required consultative process as per legislation, building a case of both the financial and economic benefits of the project Rely on conservative assumptions in financial modelling exercises to account for the lack of certainty about the price trajectory Lobby Treasury for the environmental benefits of renewable energy systems (i.e. avoided externality costs), to be taken into account in project assessment.	Pursue with the installation of biogas digesters at sewerage works Continue engaging the DoE and NERSA on the finalisation of licensing framework
	Projects' costs must be equal to or lower than Eskom	Procure at a cost equal to or lower than Eskom over the long term and/or sell to willing buyers at a higher tariffs for green electricity	
Procuring electricity from an IPP	Projects may need to obtain a generation licence from NERSA or a ministerial exemption	Lobby DoE for projects to be included in national energy plans (IRP / IEP), then enabling a generation licence application to NERSA Explore the legal possibility of a municipality obtaining a licensing exemption for renewable energy projects within its boundaries regardless of their modalities	Continue engaging the DoE and NERSA on the finalisation of licensing framework Further engage national government about the role of municipalities in the electricity supply industry
	Municipalities have no mandate to operationalise this business model	Obtain legal opinion on the Constitutional mandate of municipalities (if necessary) Lobby national government for municipal mandate Further build the case for the business model, notably through pilot projects and experimentation	
	Projects require long-term contracts, triggering additional procedures under the MFMA	Use short-term contracting periods when possible Follow the required consultative process as per legislation, building a case of both the financial and economic benefits of the project Rely on conservative assumptions in financial modelling exercises to account for the lack of certainty about the price trajectory Lobby Treasury for the environmental benefits of renewable energy systems (i.e. avoided externality costs), to be taken into account in project assessment. Explore the possible support role of the IPP Office to facilitate such transactions	
	The business model may require a strong financial backing	Lobby National Treasury for a guarantee scheme for municipal projects	
	Projects' costs must be equal to or lower than Eskom	Procure at a cost equal to or lower than Eskom over the long term and/or sell to willing buyers at a higher tariffs for green electricity Favour plants which do not require the use of the national grid (in order to limit wheeling costs)	

Business model	Barriers	Possible way forward	Next steps towards implementation
Playing a trading/ aggregat-ing role	Projects may need to obtain a generation licence from NERSA or a ministerial exemption	Lobby DoE for projects to be included in national energy plans (IRP / IEP), then enabling a trading licence application to NERSA Explore the legal possibility of a municipality obtaining a licensing exemption for renewable energy projects within its boundaries regardless of their modalities	Set up and pursue trading through pilot projects and experimentation within municipal boundaries
	The mandate and/ or framework for municipalities to engage in this business model remain unclear	Build a business case to lobby national government for a clear municipal mandate Lobby DoE and NERSA to ensure that the upcoming Licensing Exemption and Registration Notice and subsequent regulatory rules favourably clarify the situation	
	Municipalities have no mandate to operationalise this business model	Obtain legal opinion on the Constitutional mandate of municipalities (if necessary) Lobby national government for municipal mandate Further build the case for the business model, notably through pilot projects and experimentation	
	Projects require long-term contracts, triggering additional procedures under the MFMA	Use short-term contracting periods when possible Follow the required consultative process as per legislation, building a case of both the financial and economic benefits of the project Rely on conservative assumptions in financial modelling exercises to account for the lack of certainty about the price trajectory Lobby Treasury for the environmental benefits of renewable energy systems (i.e. avoided externality costs), to be taken into account in project assessment.	
	The business model may require a strong financial backing	Lobby National Treasury for a guarantee scheme for municipal projects	
	The national/regional market is limited or does not exist	Continue implementation within municipal boundary and explore the possibility of establishing a national and/or regional market with DoE and SAPP	
	Customers display a limited appeal to pay a premium for 'green' electricity	Ensure the procurement of electricity by the municipality at a price that is lower or equal to that of Eskom's Megaflex tariff	
	Skills and competences are not available at the municipal level	Progressively build internal skills and competencies through pilot projects and experimentation, and technical assistance opportunities	

Business model	Barriers	Possible way forward	Next steps towards implementation
Operating a storage facility	The business model is unexplored and/or is not financially viable	Pursue pilot projects and experimentation to further explore economic viability Continue the rollout of time-of-use tariffs to improve the financial profile	Pursue with the rollout of time-of-use tariffs Experiment with energy arbitrage within municipal boundaries
	The national/regional market is limited or does not exist	Continue implementation within municipal boundary and explore the possibility of establishing a national and/or regional market with DoE and SAPP	
	Skills and competences are not available at the municipal level	Progressively build internal skills and competencies through pilot projects and experimentation, and technical assistance opportunities	
Providing electricity services	Municipalities have no mandate to operationalise this business model	Obtain legal opinion on the Constitutional mandate of municipalities Build a business case to lobby national government for a clear municipal mandate Lobby DoE and NERSA to ensure that the upcoming Licensing Exemption and Registration Notice and subsequent regulatory rules favourably clarify the situation Further build the case for the business model, notably through pilot projects and experimentation	Set up facilitation offices to connect ESCOs and customers and experiment partnerships with the private sector
	The business model may require a strong financial backing	Lobby National Treasury for a guarantee scheme for municipal projects	
	The business model is unexplored and/or is not financially viable	Pursue pilot projects and experimentation to further explore economic viability Continue the rollout of time-of-use tariffs to improve the financial profile	
	Skills and competences are not available at the municipal level	Progressively build internal skills and competencies through pilot projects and experimentation, and technical assistance opportunities	

Source: Authors' assessment

Annexures

Annexure 1: The methodological framework

This report follows a three-pronged methodology to review the typology of available business models, namely a review and analysis of the drivers, the techno-economic potential and the risk management framework (covering regulatory, financial and socio-political risks).

First, the drivers underpinning the business model, i.e. the forces and motivations, are discussed. These range from financial benefits and sustainability objectives to energy security concerns and socio-economic development.

Second, the techno-economic potential of the business model is assessed. These assessments are based on a qualitative analysis of the technical possibility as well as the modelling of the cashflows associated with the business model. The financial indicators are calculated using the assumptions as detailed in Annexure Table 1.

Third, risks associated with the business model and the ability to mitigate them are reviewed and analysed. Risks related to the policy/regulatory framework, the financial viability and the socio-political acceptability are considered.

Annexure 2: A drivers framework

Business models are analysed against a set of drivers. For each business model, drivers are considered a primary driving force (green coding), a secondary but strong driving force (orange coding), a peripheral/weak driving force (yellow coding) or not a driving force (red coding). Importantly, the analysis considers the driving power of each factor, rather than its impact. For example, while most business models would result in municipalities leading by example, it is only a driving force of one business model. Drivers are further explained in the below table.

Drivers	Explanation
Environmental sustainability	The business model is driven by the reduction of greenhouse gas emissions from the decreased consumption of fossil fuel and/or the postponement and/or abandon of the commission of new fossil fuel-based power plants
Lead by example	The business model is driven by municipalities setting the example and building a business case to be replicated by other stakeholders.
Fit-for-purpose	The business model is driven by its suitability and adequacy with the objective of municipalities seizing opportunities associated with renewable energy technologies
Ease of implementation	The business model is driven by its ability to be easily implemented, from an institutional perspective, by municipalities
Cost savings	The business model is driven by the generation of financial benefits, either through cost savings or the creation of new revenue streams
Energy security / Grid expansion postponement	The business model is driven by benefits associated with energy security and the postponement of grid expansion, such as increased security of supply. This may reduce electricity consumption as well as the need for investment in distribution networks.

Drivers	Explanation
Grid strengthening / stability	The business model is driven by benefits linked to the strengthening and/or increased stability of the grid. This may lead to an improved resilience of electricity systems, reduce maintenance and investment needs.
Customer retention	This business model is driven by its ability to retain customers and/or create new op-portunities for municipalities to raise revenues.
Private company	Provide energy services in partnership with municipalities
Private company	No particular role

Source: Authors' composition

Annexure 3: Additional financial modelling information for power plants

The below tables and figures further details the financial modelling presented in Sections 3.1 and 3.2.

Annexure Table 1: Cross-cutting assumptions used for the calculation of the Net Present Value of business models

Variable	Assumption
Variable	Assumption
Lifespan	25 years
Panel degradation	1% per year
Inflation over 25 years	6% per annum
Blended tariff[22]	ZAR 70c / kWh, increased with 12% in year 1, 10% in years 2 to 6 and 8% in years 7 to 25
Annual electricity increase	10% in year 1, 8% for the next 5 years and 6% for the remaining years
System installation cost for 50kW$_p$ – Solar PV	ZAR 16 000 per kW$_p$
System installation cost for 1 MW$_p$ – Solar PV	ZAR 14 500 per kW$_p$
System installation cost for 50 MW$_p$ – Solar PV	ZAR 11 000 per kW$_p$
Annual electricity generation – Solar PV	1 600 kWh / kW$_p$[23] in Year 1
Capacity factor – Wind	40%
System installation cost for 50 MW$_p$ – Wind	ZAR 19 000 per kW$_p$
Funding scenarios	Fully self-funded, 50% loan-funded and 100% loan-funded[24]
Inverter replacement cost (Year 10)	ZAR 3.20 / W$_p$
Operation and maintenance costs	0.35% of initial project cost annually
Discount rate	6%
Lending rate	10%
Loan term	20 years

Source: Authors' composition

22 Estimate of the Eskom Megaflex rate for municipalities.

23 Electricity generation in year 1 for selected locations: Kimberley – 1 854 kWh / kW$_p$, Johannesburg - 1 736 kWh / kW$_p$., Paarl - 1 624 kWh / kW$_p$, Cape Town - 1 621 kWh / kW$_p$, Durban - 1 409 kWh / kW$_p$, George - 1 366 kWh / kW$_p$

24 The grant funding will be treated as upfront available capital for the project. National government will possibly award grant funding for this project and thus the grant-funded cases presented can be used as the business case to present this project to National government.

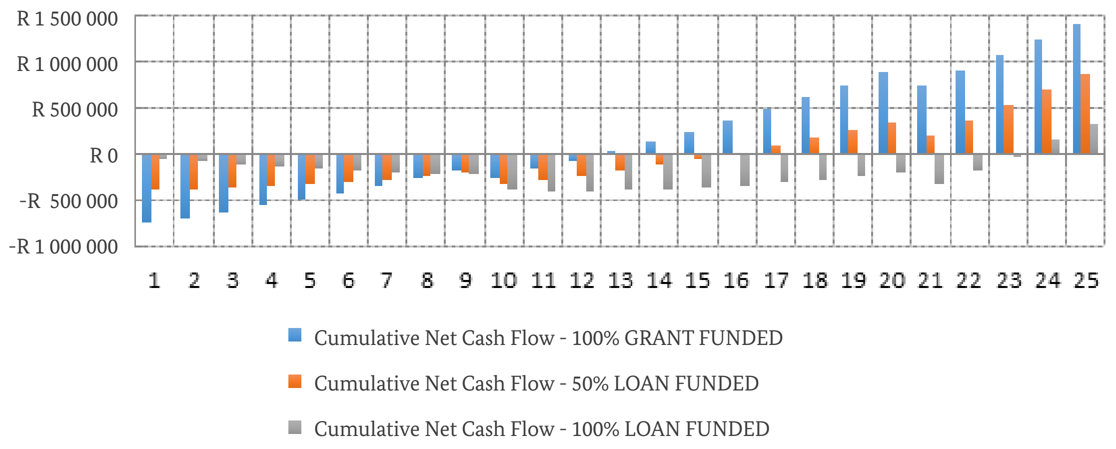
Annexure Table 2: Indicative capital and operating costs per renewable energy technology

Resource	Technology	Capital cost	Operating and Feedstock cost
Solar	Small rooftop Solar PV (up to 10kWp)	~R20 000 / kWp	0.35% of CAPEX annually
	Medium rooftop Solar PV (up to 50kWp)	~R16 500 / kWp	0.35% of CAPEX annually
	Large rooftop Solar PV (larger than 50kWp)	~R14 500 / kWp	0.35% of CAPEX annually
	Large solar park (stand alone, larger than 50MWp)	~R9 000 / kWp	0.35% of CAPEX annually
	Low-pressure solar water heater (up to geysers of 100 litres)	~R7 000	0.35% of CAPEX annually
	High-pressure solar water heater (up to geysers of 300 litres)	~R20 000 to R40 000	0.35% of CAPEX annually
	High-pressure solar water heater (large systems)	~R9 000 to R23 000 per m² installed	0.35% of CAPEX annually
	Parabolic trough concentrated solar power	~R110 million per MW, including 9 hours storage	0.35% of CAPEX annually
	Central receiver concentrated solar power	~R125 million per MW, including 15 hours storage	0.35% of CAPEX annually
Wind	Small wind turbines	~R40 000 / kWp	0.35% of CAPEX annually
	Large wind turbines	~R19 000 / kWp	0.35% of CAPEX annually
Biomass	Biogas	~R35 000 /kWe	
	Combustion	R25 to R40 million per MW	Biomass needed: ~1 ton per hour per MW installed Biomass cost: R500 to R800 per ton Operational cost: 10% of CAPEX per year Maintenance cost: 0.35% of CAPEX per year

Source: Authors' composition

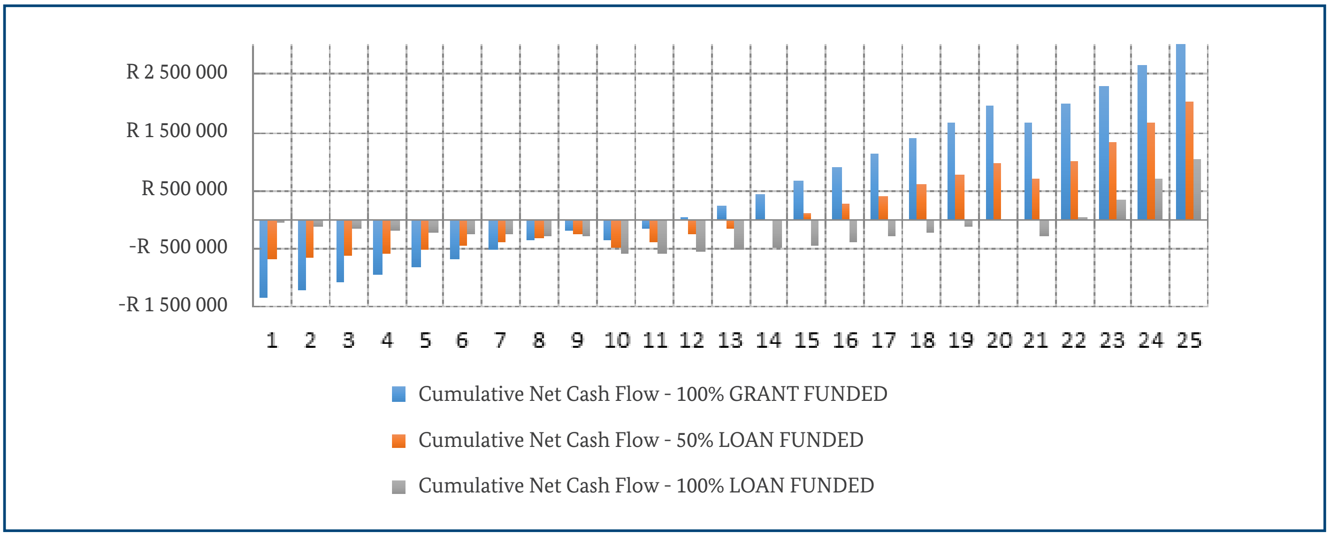
Note: technologies applicable to the 'Building embedded power systems' business model are highlighted in green while technologies applicable to the 'Building stand-alone power plants' business model are highlighted in light green

Annexure Figure 1: Cumulated net cashflow for building an embedded 50-kW$_p$ solar PV system based on various funding models



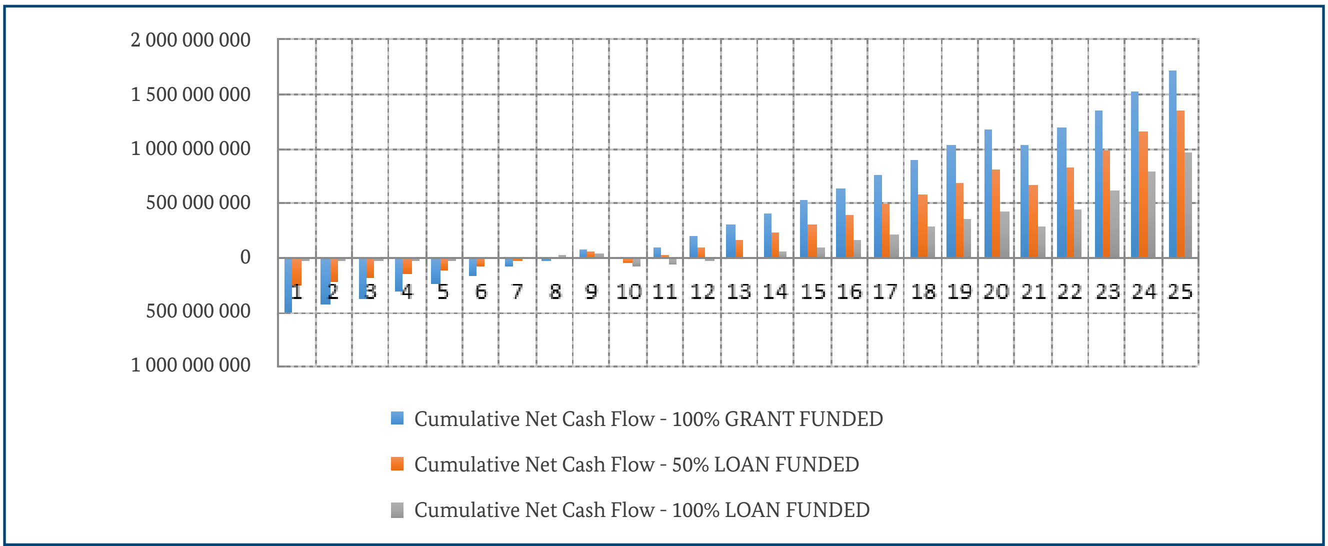
Source: Authors' calculations

Annexure Figure 2: Cumulated net cashflow for building an embedded 1-MW_p solar PV system based on various funding models



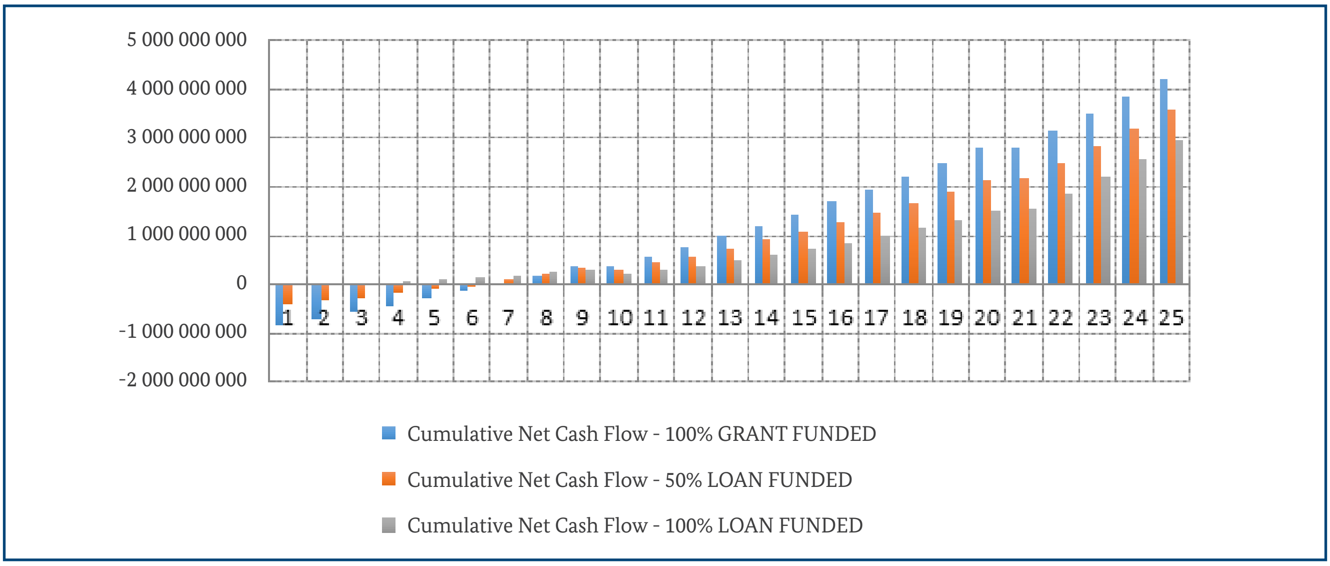
Source: Authors' calculations

Annexure Figure 3: Cumulated net cashflow for building a 50-MW_p solar PV park based on various funding models



Source: Authors' calculations

Annexure Figure 4: Cumulated net cashflow for building a 50-MW_p wind farm based on various funding models



Source: Authors' calculations

References

Badelt, G., 2017. New business models for municipalities in electricity and energy sector: German approaches. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Pretoria.

Bethlelem Hydro, n.d. Project History [WWW Document]. Bethlelem Hydro. URL http://www.bethlehemhydro.co.za/project.html

Botes, A., 2013. Reinvigorating Small-Scale Hydro: The Bethlehem Hydro Project [WWW Document]. Urban Earth. URL http://www.urbanearth.co.za/articles/reinvigorating-small-scale-hydro-bethlehem-hydro-project

C40 Cities, n.d. Johannesburg - Green Bond [WWW Document]. C40 Cities. URL http://www.c40.org/awards/3/profiles/56

Cape Town Green Map, 2015. Steenbras storage scheme helps to offset loadshedding [WWW Document]. Cape Town Green Map. URL http://www.capetowngreenmap.co.za/blog/steenbras-storage-scheme-helps-offset-loadshedding

Cape Town Green Map, 2010. Capetonians can now buy green electricity [WWW Document]. Cape Town Green Map. URL http://www.capetowngreenmap.co.za/blog/capetonians-can-now-buy-green-electricity

Creamer, T., 2015. Nersa says rules for embedded generators to be included in DoE Licensing Regulations. Engineering News.

Das Nair, R., Montmasson-Clair, G., Ryan, G., 2014. Regulatory Entities Capacity Building Project Review of Regulators Orientation and Performance: Review of Regulation in the Electricity Supply Industry. University of Johannesburg and Trade and Industrial Policy Strategies, Johannesburg and Pretoria.

DoE, 2016a. Draft Licensing Exemption and Registration Notice. Department of Energy, Pretoria.

DoE, 2016b. Summary Note: Draft Licensing and Registration Notice. Department of Energy, Pretoria.

Drakenstein Municipality, 2016. Tariffs. Drakenstein Municipality, Paarl.

eThekwini Municipality, 2014. Project Summary Document: Durban Landfill-Gas to Electricity Project. eThekwini Municipality, Durban.

eThekwini Municipality, 2013. Policy Review of Municipal Renewable Energy Framework. eThekwini Municipality, eThekwini.

Franks, L., Euston-Brown, M., Ferry, A., Giljova, S., 2015a. Municipal Waste Water Treatment Works - Biogas to Energy (Co-generation). City of Johannesburg Project: Northern Works Biogas to Energy. South African Local Government Association, Deutsche Gesellschaft für Internationale Zusammenarbeit and Sustainable Energy Africa, Pretoria and Cape Town.

Franks, L., Euston-Brown, M., Ferry, A., Giljova, S., 2015b. Municipal Landfill Gas to Electrcity. Ekurhuleni Metropolitan Municipality Project: Simmer and Jack Landfill Site grid- tied electricity generation. South African Local Government Association, Deutsche Gesellschaft für Internationale Zusammenarbeit and Sustainable Energy Africa, Pretoria and Cape Town.

GreenCape, 2015. Energy Efficiency – 2015 Market Intelligence Report. GreenCape, Cape Town.

Greyling, L., Cargill, J., Rice, E., 2015. Energy Security Design Lab 2 (Presentation). Western Cape Government, Cape Town.

Gulati, M., Madlala, T., Montmasson-Clair, G., Scholtz, L., 2015. South African Municipalities and Renewable Energy: A Case Study on Solar Photovoltaic Technologies in the City of Johannesburg. Policy and Regulatory Review. Worlwide Wildlife Fund South Africa and Trade & Industrial Policy Strategies, Cape Town and Pretoria.

IDC, 2013. Developing a vibrant ESCO Market - Prospects for South Africa's energy efficiency future. Industrial Development Corporation, Johannesburg.

Jones, B., 2016. Municipal Renewable Electricity Options. City of Cape Town, Cape Town.

JSE, 2014. The Johannesburg Stock Exchange Lists its First Green Bond [WWW Document]. Johannesburg Stock Exchange. URL https://www.jse.co.za/news/the-johannesburg-stock-exchange-lists-its-first-green-bond

Kritzinger, K., 2014. Green Electricity Tariffs for the eThekwini Municipality: Willingness to Pay Study. eThekwini Municipality, Durban.

Kritzinger, K., Meyer, I., Van Niekerk, J.L., Scholtz, L., 2015. Potential for integration of distributed solar photovoltaic systems in Drakenstein municipality. World Wide Fund for Nature South Africa, Cape Town.

McKenzie, M., Diederichs-Mander, N., 2014. Driving Energy Efficiency and Renewable Energy in Municipalities - Energy Performance Contracting: Experiences from the City of Cape Town. South African Local Government Association, Pretoria.

Montmasson-Clair, G., Moilwa, K., Ryan, G., 2014. Regulatory Entities Capacity Building Project Review of Regulators Orientation and Performance: Review of Renewable Energy Regulation. University of Johannesburg and Trade and Industrial Policy Strategies, Johannesburg and Pretoria.

Nelson Mandela Bay Municipality, 2016. The Nelson Mandela Bay Municipality Electricity Tariff for the 2016/17 financial year (All Prices are VAT Exclusive). Nelson Mandela Bay Municipality, Port Elizabeth.

NERSA, 2015. Small-Scale Embedded Generation: Regulatory Rules (Consultation Paper). National Energy Regulator of South Africa, Pretoria.

NERSA, 2013. NERSA's Decision on Eskom's Revenue Application for the Third Multi-Year Price Determination Period 2013/14 to 2017/18. National Energy Regulator of South Africa, Pretoria.

NERSA, 2010. NERSA's Decision on Eskom's Required Revenue Application - Multi-Year Price Determination 2010/11 to 2012/13 (MYPD 2). National Energy Regulator of South Africa, Pretoria.

NT, 2011. Local Government Budgets and Expenditure Review: 2006/07 – 2012/13. National Treasury, Pretoria.

POWERX, n.d. Municipalities [WWW Document]. POWERX - Africa's Green Energy Exchange. URL http://www.powerx.energy/benefits/municipalities

Renewable Energy Holdings, n.d. Projects [WWW Document]. Renewable Energy Holdings. URL http://www.rehgroup.co.za/projects/

SA Good News, 2014. Cape Town unveils South Africa's first "green" taxi rank [WWW Document]. South Africa - The Good News. URL http://www.sagoodnews.co.za/categories/35-environment/6299-cape-town-unveils-south-africas-first-green-taxi-rank.html

Statistics South Africa, 2016. Financial census of municipalities for the year ended 30 June 2015. Statistics South Africa, Pretoria.

Unlimited Energy, 2016. The Role of Municipalities in Renewable Energy Generation. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Pretoria.