Municipal energy transition: Opportunities for new business models and revenue streams

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Abstract:

The energy transition being experienced globally and now in South Africa introduces new challenges and opportunities for municipalities, with requisite changes in business models and tariffs. The creation of municipal energy master plans (MEMPs) is a critical foundation to determine what type of energy to procure when to procure and boundary conditions for procurement. Such municipal energy master plans form the business case for the municipal role in the sustainable energy transition, leveraging municipal competencies and integrating availability of spatially dependent local resources.

1. Introduction

In South Africa's context, the objective of energy master planning is to articulate a national vision and setting goals and roadmaps for addressing energy requirements while remaining cognisant of key developmental challenges facing the country. An accelerated development and utilisation of renewable energy could assist in achieving this. Translating this national vision to local municipal level is where the development of municipal energy master plans is intended to fit. This can be achieved by developing comprehensive platforms for establishing renewable energy policies, providing legal instruments, technologies, manpower, infrastructure and markets so as to ensure that the visions and targets are realised. This is the intention of developing Municipal Energy Master Plans (MEMPs).

Many municipalities have sustainable energy intentions informed by high-level strategies that identify opportunities in waste-to-energy, renewable energy and energy efficiency. The opportunities available are largely known but progress on implementation is generally slow. This is largely as a result of limited insights into optimal business cases, prioritisation, procurement approaches, regulatory requirements and more.

Some other considerable challenges include regulatory approvals and licenses for municipalities to procure energy from IPPs as well as MFMA constraints and national level approvals (National Treasury) to enter into long term contracts; Municipal capabilities and experience in energy procurement; Support from Council (requires sensitisation and alignment); Multiple stakeholders (SALGA, AMEU, COGTA, NERSA, DoE, Treasury, Department Public Works, Department Economic Development Tourism & Environmental Affairs and others); Municipalities working in isolation and Departments in municipalities working in siloes; Budget constraints to develop strategies, plans and execution; Uncertainty on how to access available funding for climate change mitigation initiatives; Empowering under resourced municipalities and stimulating local economic development opportunities in renewable energy.

2. A local energy transition

The country is demanding solutions for increased energy, delivered in new and better ways for a low-carbon future. The main sources of renewable energy are sunlight, wind, water, tides, rain, geothermal heat, and organic waste. Renewable energy technologies have proven to be cost competitive in comparison to fossil fuels. Advancements in materials, manufacturing and installation techniques, mass manufacturing, increased demand, potential removal of the regulatory barriers to decentralised energy and the potential for further innovation are expected to further drive the costs down. MEMPs are intended to work towards reducing localised greenhouse gas emissions over time in the most optimal manner.

Electricity used in South Africa is currently provided by centralised, predominately coal-fired power generation plants. This results in a highly carbon intensive electricity used accounting for 80% of total greenhouse gas emissions in South Africa. In these coal-fired thermal power stations, more than two thirds of primary energy is lost in the form of waste heat. Power also needs to be transported across large distances via transmission and distribution networks spanning most of the country, resulting in considerable network losses. Adjusting energy supply technologies to those not requiring combustion in a decentralised manner can reduce the carbon content of our electrical energy supply and reduce losses.

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3. Transforming Local Energy

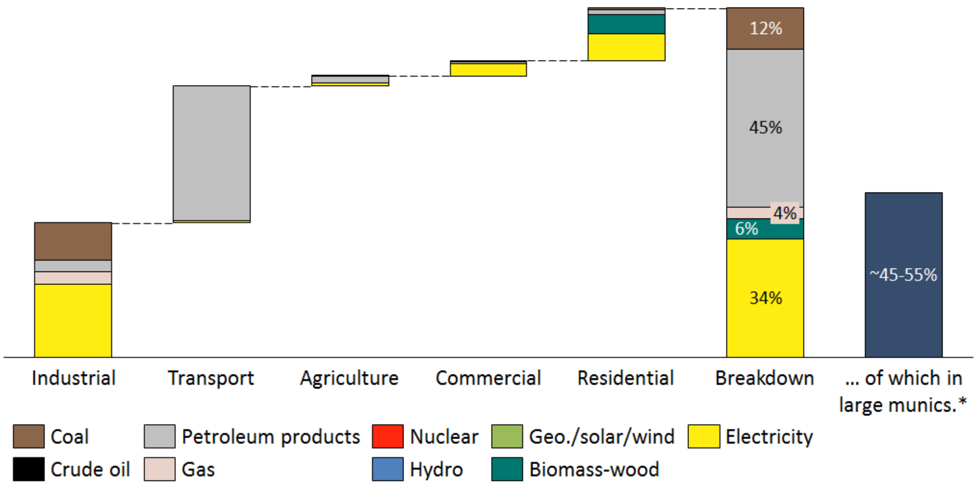

Figure 1: South African energy sector consumption is dominated by liquid fuels in transportation, and electricity in industrial and building sectors (commercial/residential)

In South Africa the rising demand for energy is an opportunity to capacitate municipalities in developing informed electricity supply strategies. Energy transitions provide an opportunity to transform the provision of energy by committing to deliver lower cost solutions, improving products and services, and creating low carbon businesses. The crucial challenge is to accelerate new supply options at the municipalities and how they will play a role in the national supply mix.

National level energy end-use in South Africa is summarised in Figure 1 and it should be noted that only 34% of total energy usage is electricity whilst 45% of energy consumption is based on petroleum products (predominately linked to the transport sector). Roughly half of total national energy consumption occurs in large municipalities. The pace of change in the power sector is already gaining momentum and there are now credible technical and economic pathways towards zero-emissions power systems emerging. The last decade has seen accelerating technological progress, with growth in solar PV and onshore wind in particular being the mainstream renewable energy technologies being deployed. Most new investment in power generation capacity is now going into renewable energy technologies. The total energy investment worldwide, including capital spending on energy supply and improvements in end-use energy efficiency, in 2017 is estimated to have amounted to 1.8 trillion USD, accounting for 1.9% of global GDP, a lower share compared with the previous two years [5]. Investment in all sectors of the economy as a share of GDP has been stable, suggesting that availability of capital generally has not been a constraint. "The power generation sector accounted for most of the decline, due to fewer additions of coal, hydro and nuclear power capacity, which more than offset increased investment in solar PV. Capital spending on fossil fuel supply also stagnated at 34% below 2014.

To better inform decision-makers about the nature of energy transitions, end objectives and the state of interdisciplinary forces at play, a robust fact base is necessary to understand the status quo and to identify systemic reforms that will enable an effective energy transition.

4. Optimising the transition

Effective energy transitions should ensure a timely transition towards a more inclusive, sustainable, affordable secure global energy system that provides solutions to global energy related challenges, while creating value for business and society.

Local government can play a significant role in making sure that the transition will also supply the growing population in South Africa at a local level. As shown in Figure 2, the trend in population and urbanisation is expected to continue in South Africa. As shown in Figure 3, while substantial progress has been made on electrification, 2.38 million households still need to be provided with electricity access.

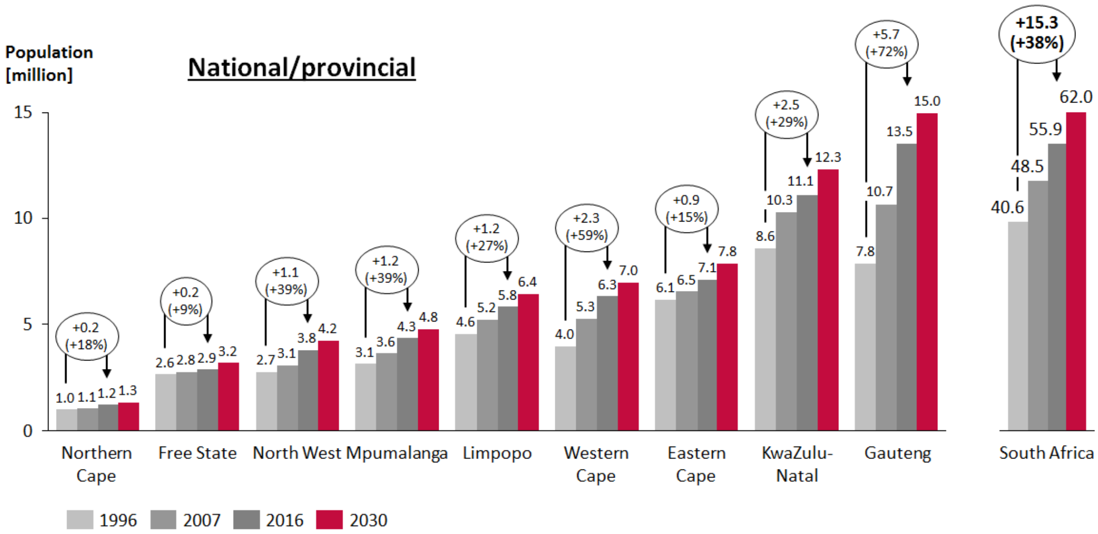

Figure 2: South African population statistics and growth forecast, Source: Stats SA

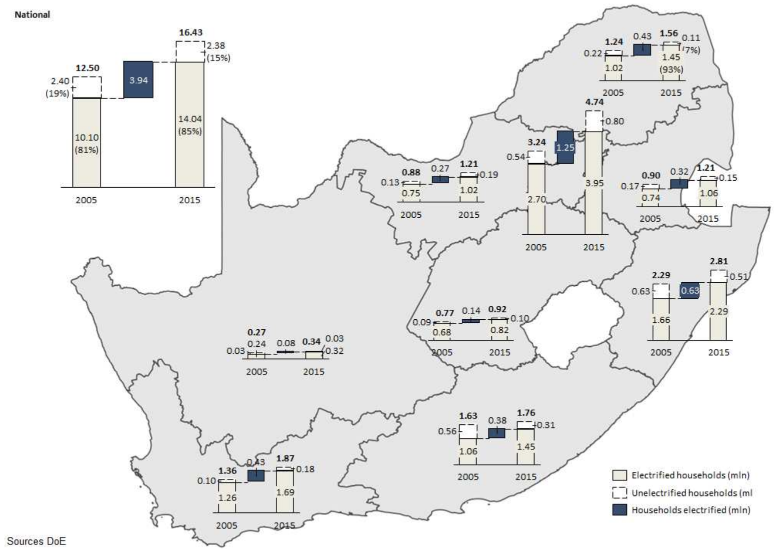

Figure 3: South African national electrification statistics, Source: DOE

The electricity supply industry in South Africa is vertically integrated, with municipalities purchasing energy from the national utility (Eskom) and retailing to end consumers through local distribution networks. A significant increase in Eskom tariffs over the last 10 years is placing consumer and municipal revenues under increasing pressure.

The challenges faced with increasing electrical energy costs, must be seen as an opportunity for municipalities where they are uniquely positioned to benefit from the disruptive market impacts of particular renewable energy technologies such as:

a. Rooftop space (PV)
b. Reduced emissions and revenue growth as transportation is moved to electricity
c. Fuel for waste-to-energy
d. Extensive grids (improved energy trading)

The South African municipal electricity distributor business model is presently fundamentally based on recovering costs (and generating surplus) based on a mark-up on the Eskom bulk supply tariffs via retail tariffs raising energy, demand and service charges and with a illustrative surplus and deficit. The design of tariffs in this vertically integrated business model has been premised on the direct coupling of revenue and surplus with the volume of energy sales. The tariff design inherently includes cross subsidies between poor and rich consumers. Grid and other operational and fixed costs are largely recovered in energy volume elements of the tariffs even though the cost structure of these elements is actually fixed (and not volumetric/variable).

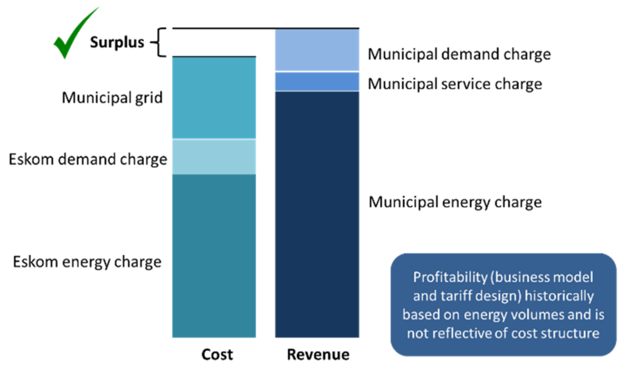

Figure 4: Present municipal electricity distributor business model – illustrative profit and loss where energy volumes are sufficient to generate surplus

The increasing cost effectiveness of embedded technologies such as rooftop solar PV and battery energy storage are driving the business case for traditional customers to supplement their electrical energy requirements with locally generated and stored energy. As illustrated in Figure 5, increasing utility tariffs drives an improved business case for customers to install these embedded systems. Such embedded systems typically reduce energy consumption, but still depend on the utility for capacity and energy for periods when local resources do not generate and storage is depleted. As such, the utility fixed cost structure in the form of grid costs and Eskom demand charges are typically not reduced, yet energy sales reduce and hence revenue declines. In order to balance costs and revenues the utility may look to increase retail tariffs, but doing so (dependent on tariff design) may further drive the consumer business case to increase self-sufficiency, and possibly even drive grid defection. This is the well-known “utility death spiral”. The further untenable consequence of such an outcome is that the customers that presently subsidise poorer customers will typically be the early adopters of such embedded solutions, and the ability to cross subsidise the poor will be impacted.

In a scenario of reducing energy sales volumes (but fixed grid and operational costs) the present municipal business model and tariff design can lead to under recovery of costs, and the municipal electricity business (if not changed) can become a loss making entity.

5. Focus areas

A landscape assessment was performed to assess the extent to which municipalities are looking at new revenue streams and opportunities associated with renewable energy. The results are summarised as follows:

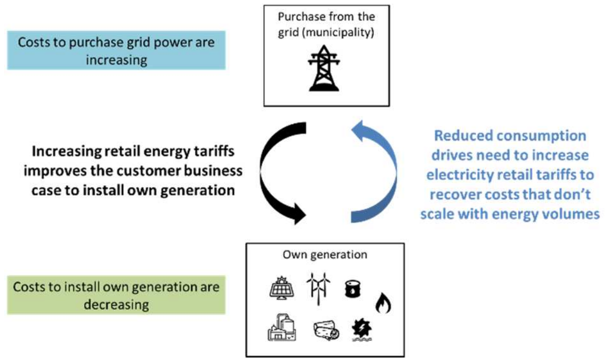

Figure 5: Summary of the interplay between utility tariffs and prosumer business cases to install own supply side, demand side and storage solutions

a. Many municipalities have sustainable energy plans/intentions that identify opportunities in waste to energy, renewable energy and energy efficiency.
b. The opportunities are largely known but progress on implementation is generally slow.
c. There are in general limited insights as to optimal business cases, prioritisation as to where to start, procurement approaches, regulatory requirements etc.

Sustainability Energy Africa (SEA) drafted the SALGA energy efficiency and renewable energy strategy in 2013 [1]. The strategy provides clear guidance for the sustainable energy transition in South African municipalities. Some extracts of the “Strategic Priorities” of the strategy are as follows:

a. “Good governance through the development of local, flexible and integrated energy plans and leadership that can engage in applicable national energy-related development planning”
b. “Efficient institutions able to manage energy consumption in their own facilities and operations and transform local waste to energy where viable”
c. “All households have access to affordable, safe and clean energy sources”
d. “Renewable energy options are a significant component of local energy supply where they are technically and economically feasible, contributing to low carbon development and local economic growth/sustainability”
e. “Sustainable electricity service delivery that can accommodate and promote access to electricity, efficiency and renewable energy development”.

6. Municipal Energy master Plans (MEMPs)

Integrated MEMP's and electricity supply procurement strategies in Metropolitan and intermediate city level are a key focus in improving the business case for municipalities' role in the sustainable energy transition and future municipal energy supply. The CSIR and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) have partnered in exploring MEMPs. The scope is to capacitate municipalities in developing informed electricity supply strategies.

The objective of the MEMP modelling approach is to determine an optimised combination of wholesale electricity supply (from the national grid) coupled with local (within the municipal grid) distributed energy resources including embedded and distributed generation and energy storage. The modelling will be done in a least-cost manner, seeking to optimise the cost/benefit of both the national and municipal energy systems, while quantifying the local economic development opportunities in municipalities.
A steering committee is being established to manage the alignment with expectations including the selection of the targeted municipalities.

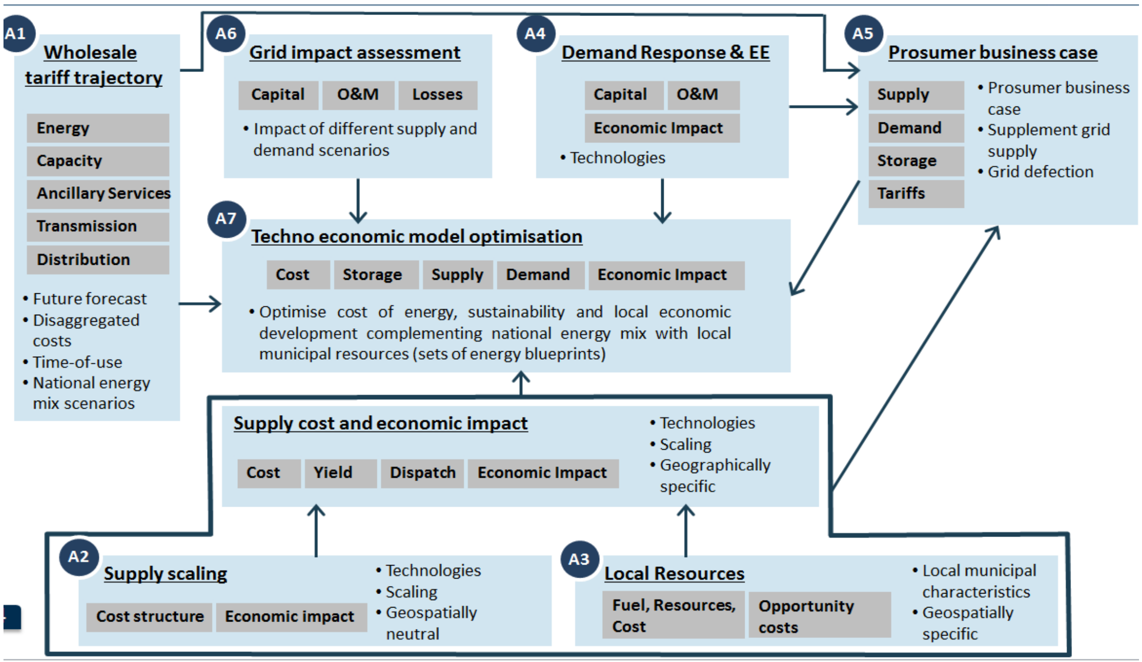

Figure 6: MEMP activity interdependencies

As shown graphically in Figure 6, activities will include:

A1. Wholesale tariff trajectory - Prediction of future bulk electricity system costs in terms of energy, capacity, ancillary services and transmission grid, including time of use structure for different national generation mix scenarios.

A2. Supply option scaling and economic impact assessment - Develop models and costing for the scaling (sizing e.g. PV utility scale to PV rooftop) of different supply side technologies, how cost elements scale with project size, and the anticipated local economic impacts for different scaling approaches

A3. Local resource assessment and modelling - Match supply side models with spatial municipal resource models to create site specific supply models covering costs, yields and local economic impact

A4. Demand side options and economic modelling - Develop models and costing for different demand side models and the anticipated local economic impacts

A5. Prosumer business case and tariff analysis - Develop models of consumer self-sufficiency, and local optimisation of supply, demand and storage to assess the consumer business case for a range of retail tariffs, feed-in tariffs, cost assumptions and other forecasted parameters

A6. Grid impact assessment - Assess the costs of municipal distribution grid capex, opex and losses for penetration levels of supply and demand side options as part of scenarios considered

A7. Techno economic model optimisation - Techno economic optimisation of the municipal electrical energy system considering the wholesale tariff trajectory, supply options, demand options, prosumer business case and grid costs. This will be performed for assumed electricity demand forecasts as understood by municipalities.

Workshops and discussions with municipalities and broader stakeholders will be held to disseminate the project approach, progress, findings, learnings and recommendations. Such will include activities to support municipal resource involvement in modelling activities (for skills transfer) and developing and managing the formal calls for interest in the program envisaged to be run by SALGA and supported by the DoE to select supported municipalities. This will also include the dissemination of municipal electricity supply plans to national government and the proposing of suitable metropolitan/city generation allocations to the national IRP updating process (metropo litan/city determinations).

7. Conclusion

The procurement of energy from local energy sources is an attractive option for municipalities, and South African municipalities are being approached by potential IPPs looking to enter into commercial arrangements to buy and sell power, as well as customers looking to install generation for own-use. Power generation technologies identified in municipal energy master plans for electricity (MEMPs) can provide a range of transformative, clean and reliable energy solutions to local governments, with lower greenhouse gas emissions and localised pollution effects. The modelling being undertaken will provide deep insights as to an optimal blend of wholesale electricity supply complemented with embedded distributed resources within the municipal electricity grid. The results will create an understanding of the future municipal energy system in South Africa, as can then inform the design of municipal electricity/energy business models, services and tariffs.

Acknowledgements

The authors would like to thank the CSIR Energy Centre and GIZ for supporting this work.

References

[1] Sustainable Energy Africa (SEA) – “Local Government Energy Efficiency and Renewable Energy Strategy: Full Strategy Document”

[2] Udochukwu B. Akuru, and Ogbonnaya I. Okoro “Renewable Energy Investment in Nigeria: A Review of the Renewable Energy Master Plan”

[3] McKinsey & Company (WEF) – “Fostering Effective Energy Transition: A Fact-Based Framework to Support Decision-Making”

[4] BP: Munken Polar Smooth paper and board “Advancing the Energy transition”

[5] International Energy Agency –“World Energy Investment 2018”

[6] Frederikshan Kommune –“Master plan for Renewable Energy 2030”