Climate Change and Just Energy Transition in Municipalities: Incorporating the fundamentals of Just Energy Transition into Renewables and Energy Efficiency Initiatives By Municipalities

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Abstract

Addressing the challenges of climate change are not new to public officials and solution providers in South Africa and internationally. The critical issue locally at municipal level is incorporating the broad principles of Just Energy Transition into both Renewable Energy and Energy Efficiency projects that have been utilised over the years as carbon reduction measures. Most municipalities procure almost 100% of their bulk electricity requirements from Eskom, which in turn, generates about 95% of the total electricity in South Africa through coal-based power stations. Therefore, municipalities must reduce their bulk electricity requirements as allowed by Regulations through embarking on energy efficiency audits to determine savings potentials and cost versus benefits analysis, in addition to implementing interventions where possible across municipal owned plants, facilities, and buildings, together with entering into large- and small-scale renewable energy projects. These projects must ultimately incorporate the fundamentals of Just Energy Transition, keep municipalities sustainable and accountable to their customer base. This paper aims to explore how municipalities can incorporate Just Energy Transition into Renewable Energy and Energy Efficiency initiatives, bearing in mind the complexity of South Africa's economic and socio-political factors.

Keywords: Municipality, Energy Efficiency, Renewable Energy, Just Energy Transition and Smart Grids.

1. Introduction

South Africa is signatory to the Paris Agreement on reaching the global warming target of below 2 degrees Celsius above pre-industrial levels[1]. The implementation of the Paris Agreement requires both economic and social transformation for individual countries based on their peculiar circumstance. These countries need to develop plans indicating how they will meet their targets. South Africa has developed the National Determined Contribution (NDC) plan which indicates emissions reduction target by 2025 ranging between 398 and 510 Mt CO^2, and 2030 target ranging between 398 and 440 Mt CO^2[2]. To achieve this target, South Africa needs to invest in lower CO^2 emitting technologies, shift from coal-powered stations to generate electricity and also adopt Distributed Generation (DG) by customers within the boundaries of municipalities, in addition to municipalities procuring directly from Independent Power Producer hence, an introduction of Just Energy Transition (JET). The April 2022 floods that took the lives of 443 people and displaced another 40,000 others, is an indication that Climate Change is real and will occur more frequently over the next few years[3]. JET is defined as a shift from our current energy systems to one that is better, taking into consideration sustainability, environmental impact, climate change, human health, economics, job creation and social equity[4]. JET in the South African context has 5 building blocks, namely: **(i) Access & affordable electricity (ii) Corporate and business reforms (iii) Shift in ownership of energy (iv) Empowerment of workers & communities (v) Environmental restoration & protection**. This paper provides an insight into the challenges faced by South African municipalities, while also proposing measures and potential roles that municipalities can play as South Africa's energy system transitions into a cleaner and sustainable energy alternatives. Furthermore, this paper provides an insight into renewable energy case studies and energy efficiency initiatives currently being implemented by the Department of Mineral Resources and Energy, in partnership with the South African National Energy Development Institute and various municipalities over the years. These initiatives if adopted by municipalities have the potential to improve current conditions such as; rising energy and operational cost as well as significant reduction in the carbon footprint of the energy sector. This in turn, will have a rippling effect of addressing socio-economic issues plaguing communities within municipalities, a significant issue in South Africa. Recommendations are made based on the lessons learned during programme implementation, in addition to looking into the

district development model for solutions that can be easily adopted.

2. Municipalities and the Balancing Act

South African municipalities are demarcated into eight metropolitans, 44 districts and 205 locals. Their main objectives are to provide infrastructure and services, and to focus on growing the local economies. In terms of electricity services, municipalities have the mandate for the distribution and reticulation of electricity; they purchase electricity in bulk from Eskom and resell it to their customers. As directed by the Constitution, the Local Government: Municipal Structures Act of 1998 contains criteria for determining when an area must have a category A municipality (metropolitan municipalities) and when municipalities fall into categories B (local municipalities) or C (district municipalities).Most municipalities are in search of solutions that addresses their numerous challenges that continues to disrupt their business model. There is little done at a national level to coordinate effort to address issues or the implementation of interventions that reduce the impact of climate change at municipal level. South African metropolitan municipalities subscribe and take seriously the Climate Action Plan (CAP), which sets the target of net-zero emissions and resilient city by 2050. An example is, City of Johannesburg's Climate Action Plan of 2021, where the City outlines its net-zero emissions targets, pledges its support and commitment to green its municipal infrastructure and create a sustainable urban environment for the business community, youth, civil society and all other relevant stakeholders. To achieve the CAP over the long-term, a substantial introduction of renewable energy into the electricity grid at both transmission and distribution grid level is necessary. The distribution grid in particular, which includes all networks/grids operating at 132kV level and below, will be critical in the realisation of this objective. Without a substantial level of grid intelligence, the renewable energy opportunities cannot be effectively pursued. Several studies on the status of the electricity distribution grid have revealed under-investment in maintenance, refurbishment and strengthening of the infrastructure. This phenomenon is applicable across most of the distribution networks (municipalities) in South Africa including Eskom's Distribution. Furthermore, the shortage of skilled individuals and the lack of ideal deployment of technology amongst other factors, were identified. It is acknowledged that it is beneficial to take a holistic industry view on the situation in terms of generation capacity and the balance between demand and supply of electricity in South Africa. The South African electricity distribution industry managed by municipalities is confronted with numerous and significant challenges that impact directly on the sustainability of the power sector and its ability to provide a reliable service to electricity customers.

Some reasons why municipalities owing billions of Rands to Eskom are due to the following factors[5]:

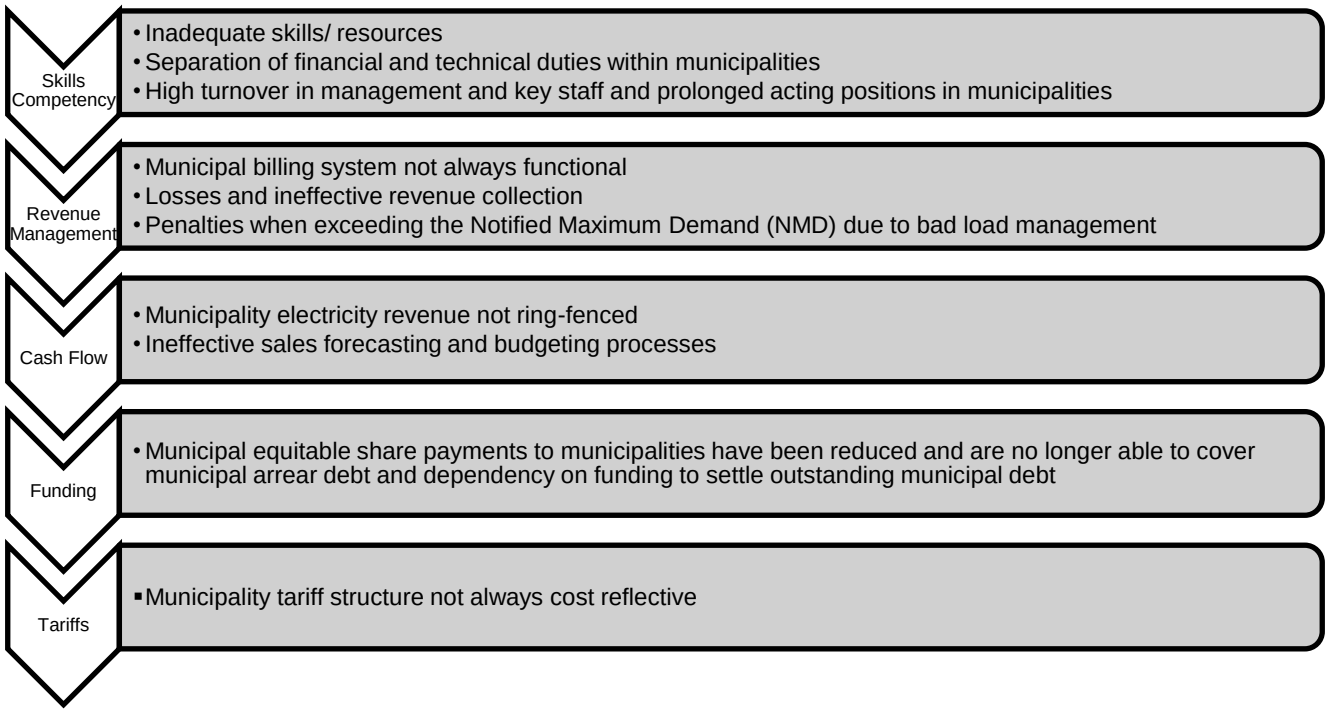

Figure 1: Municipalities Response towards Eskom Debts.

3. The Municipal Business Model and Embracing Change

Municipalities whether Metros, District or Local Municipal Councils are faced with a business model that must change to embrace the future. Digitalisation of the electricity grid (smart grids) and demand management in additions to distributed generation are going to be the new normal within the boundaries of municipalities. Municipal strategic planning and investment compacts, by-laws, systems and processes need to realign to incorporate all of these technologies and changing customer expectations whilst ensuring that the principles of Just Energy Transition are always accommodated. It is not going to be easy to incorporate the fundamentals of JET within municipal programmes for there is direct link to tackling energy poverty and green economic development for municipalities that have coal mines and communities that need to transition into cleaner forms of energy[6]. Municipalities need Integrated Resource Plans (IRP) which accommodates the future customer demand, energy efficiency and renewable energy technologies to meet customer demand, taking into consideration carbon emission target. Municipalities potential to incorporate JET fundamentals is discussed further in other sections of this paper.

The District Development Model (DDM) recently initiated by the President in 2019 and JET have similar objectives and principles. They both address service delivery challenges, alleviation of poverty and unemployment and governance. The DDM is designed to address problems with service delivery by allowing all spheres of government, from local municipalities to national government, to work together in a more effective and coordinated way.

3.1 Energy Efficiency (EE)

Municipalities have the potential to conduct energy audits within municipal buildings, water or wastewater services infrastructures and industries to understand electricity consumptions and recommend energy efficiency interventions for implementation. Municipalities are required to participate in the electricity demand side management initiative by ensuring that there is controlled demand in their jurisdictions.

Meeting the nationally defined target of 10% decrease in electricity usage would result in a fall in electricity sales and hence revenue for local government, as municipalities derive surcharges on electricity sales[7]. Also, additional costs would be incurred in implementing energy saving initiatives, such as implementing the use of energy saving light bulbs (CFLs), solar geysers and smart meters with ripple control features. Municipalities will also be required to make various adjustments and improvements to existing electricity distribution systems to cope with switching-off systems (partially or fully) where scheduled load shedding is being carried out. To implement such initiatives, municipalities would be required to make appropriate adjustments to their budgets to cater for these costs. The South African National Energy Development Institute (SANEDI) alongside the Department of Minerals Resources and Energy (DMRE) have been involved in various energy efficiency projects as outlined in Figure 2: the Energy Efficiency in Public Buildings and Infrastructure Programme framework.

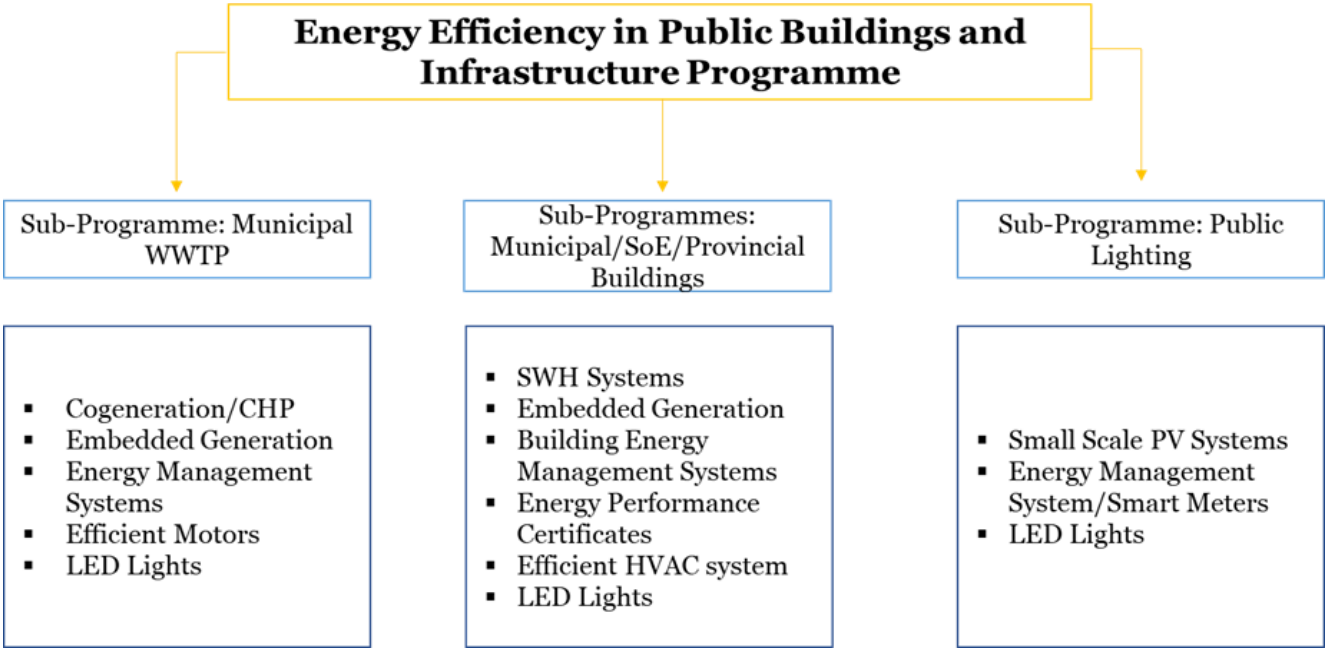

Figure 2: Energy Efficiency in Public Buildings and Infrastructure Programme Framework.

The Department of Mineral Resources and Energy and the South African National Energy Development Institute through the National Treasury's General Budget Support (GBS) programme are currently implementing Energy Efficiency (EE) interventions in public buildings and wastewater treatment plants. The implementation comprises of EE retrofits and deployment of small-scale renewable energy systems by appointed Energy Service Companies (ESCo's). These projects are in line with the post-2015 National Energy Efficiency Strategy (NEES) and are expected to contribute to the target of 20% reduction in energy intensity of municipal services provision.

Looking at the framework in Figure 2 on page 3, buildings are identified as an area requiring EE interventions, therefore, in the effort to achieve energy efficiency in buildings, the Minister of Mineral Resources and Energy under section 19(1) (b) of the National Energy Act of (2008) issued and promulgated the Regulations for Mandatory Display and Submission of Energy Performance Certificates for Buildings (EPC). EPCs are now mandatory for private sector, non-residential buildings with a total net floor area of over 2000m² and government owned or occupied buildings of over 1000 m²[8]. EPCs must be displayed at the building's main entrance; and must be submitted to SANEDI with the due date of December 2022. The aim of EPCs is to ensure that buildings become more energy efficient, and that their energy intensity is reduced over their lifecycle.

Achieving Net-zero Energy of Wastewater Treatment Plants in South Africa

This component of the programme is focused on achieving net-zero energy in Wastewater Treatment Plants (WWTPs). Wastewater treatment plants are identified as one of the largest energy consumers. The electricity consumption of wastewater treatment plants is estimated to be about 25% of total electricity consumptions within a municipality. Reducing this value within WWTPs is crucial, but in order to do this, we need to identify the energy drivers within these plants, hence, energy audits are required. Factors such as increased electricity and fuel costs, interrupted power supply, as well as a growing environmental awareness require that municipalities pay attention to facilities of this nature. Optimising the energy efficiency of these facilities could therefore, result in a significant reduction in the carbon footprint and operating cost savings. Energy audits of wastewater treatment is largely reliant on the collection of data and information pertaining to the plant. Dataset such as the inlet flow rates, monthly electricity bills either as metered by the municipality or directly by Eskom, available process information, must be collected. Municipalities must ensure that they have this level of visibility on their plants by gathering the datasets in addition to analysing them for relevant insights such as understanding the operations of the plant, overall energy demand and operational costs pertaining to energy use. In addition, on-site assessment is required to take inventory of energy consuming and energy-generating equipment's.

SANEDI and the DMRE carried out energy audits in fourteen (14) wastewater treatment plants across the country. The programme incorporated the aspect of Just Energy Transition that deals with empowerment of workers & communities by bring on board twenty-eight (28) unemployed youth to support with the data collection as fieldworkers. It was a requirement that fieldworkers be locally based within the municipal wards where the wastewater treatment plants are situated. Extensive training was carried out to capacitate the fieldworkers on the task of collecting energy data within a wastewater treatment plants. Fieldworkers worked side by side with municipal officials to collect historical data and information for analysis.

Energy audits are only the first phase of the programme, they help determine a performance baseline and identify energy efficiency opportunities. In the second phase, the complied energy audit report is used to develop an implementation plan to achieve the already established targets. Three (3) wastewater treatment plants which had previously undergone prefeasibility studies were selected for retrofits. The energy efficiency retrofits based on the overall performance of the plant include the replacement of old inefficient motors with efficient IE3 motors, the installation of Variable Speed Drives (VSDs), replacement of light bulbs with efficient LED light in the buildings and mast within the plants. City of Mbombela in Mpumalanga, Drakenstein Local Municipality in the Western Cape and iLembe District Municipality in KwaZulu-Natal were three of the municipalities that collaborated on the programme as beneficiaries.

Improving Energy Performance of Government Buildings

The buildings and buildings' construction sectors combined are responsible for almost one-third of total global final energy consumption and nearly 15% of direct CO2 emissions according to the International Energy Agency [9]. Energy Performance Certificates is a component of the GBS programme previously outlined in Section 3.1. Carrying out energy audits in municipal owned buildings, either to determine energy savings potential or to simply establish the buildings' energy performance is crucial. The Regulations on the mandatory display of Energy Performance Certificates of certain classifications are as shown in Figure 3 below.

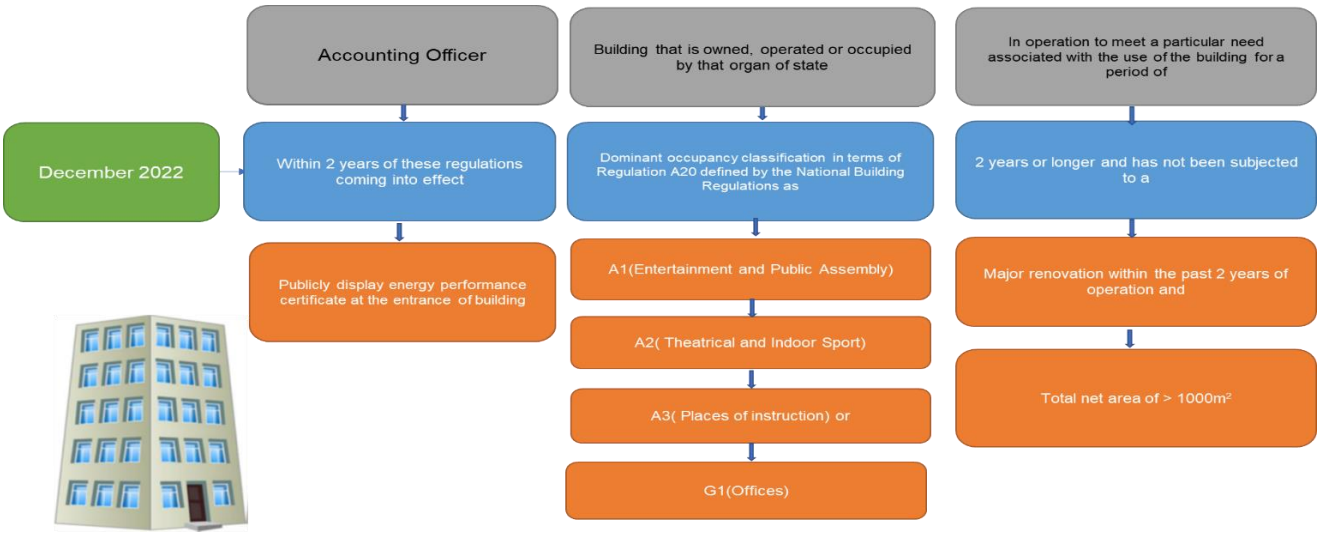

Figure 3: Overview on Energy Performance Certificate for Organs of State and Building Classifications.

Energy efficiency in buildings is not a new concept, and has been of major importance for building owners such as municipalities, in establishing energy footprint for their buildings. Under the DMRE's Energy Efficiency Directorate and SANEDI, an integrated approach is used, where Energy Efficiency measure are considered as a first fuel alternative that supports moving away from the Business As Usual (BAU) approach to further greening the buildings energy source by installing rooftop solar systems to augment grid supply. We must keep in mind that buildings have a very considerable lifespan running into decades, EPCs are targeting the current building stock of over 2 years old and above. Incorporating first, energy efficiency to achieve the lowest energy consumption possible then implement small-scale renewable energy in correlation with achieved levels of energy efficiency in government buildings can be significant to energy management and use in buildings. A systems approach to integrating energy efficiency measures in buildings to reduce the amount of energy consumed while maintaining or even improving the quality of services provided in the building is required. Municipalities can take advantage of the trends in technology and Regulation to address technical, economic, and institutional barriers if they become early adopters of energy efficiency and small-scale renewable energy technologies themselves. In addition to fully addressing operational issues, the integration will also establish viable business models for incorporating these technologies into capacity planning, grid operations, and demand-side management.

Through the DMRE and SANEDI programme, energy performance improvements in 20 public buildings was implemented over an 8 months period, these buildings were mainly G1 - office types buildings. inclusive of seven municipalities. This initiative directly aligns with implementation targets as set out in the post 2015 National Energy Efficiency Strategy (NEES) for energy consumption reduction within government buildings by 50% 2030. This target is based on an assumption that successive tightening's of building Standards through already existing building codes like SANS 10400XA:2021 will result in reductions in specific energy consumption of 49% for half of the new buildings added between now and 2030, and 67% for the other half[10]. The weighted mean of these improvements across the whole 2030 building stock gives an overall reduction in specific energy consumption of 50%.

The Energy Efficiency and Demand Side Management Programme - EEDSM

Newly developed data-processing tools (grid analytics) permit municipalities to analyse large volumes of information that will help improve the performance of the electric distribution system. To this end Distribution Management System (DMS), enable the electricity distribution departments to optimise the performance of electric systems and derive significant benefits, including real time access to grid related management information which facilitates the provision of solutions to core business problems. This promotes more efficient energy use among customers and also allows municipalities make more efficient use of grid infrastructure. The Energy Efficiency Demand Side Management (EEDSM) programme supports municipalities in their efforts to reduce their energy consumption through the optimisation of the use of energy. This programme is managed by the DMRE where selected municipalities are given grants for the planning and implementation of energy efficient technologies which covers all infrastructure under the jurisdiction of the municipality ranging from traffic, street lighting, municipal owned buildings and water and wastewater treatment plants. The estimated savings potential for traffic lights is up to 80%, for streetlighting is between 40% - 70%, for municipal owned office buildings is between 20% – 30% and for pumps within water and wastewater treatment plants is between 15% - 25%[11]. Below are some of the EEDSM best practices within participating municipalities

Table *1* on Page 6:

Table 1: EEDSM Best Practices within Participating Municipalities.

Municipality	EE Intervention	Energy Savings	Payback period
Swartland	Technical measures on traffic lights and is implementing energy efficiency technologies for LED streetlighting.	29 MWh/a	6,5 years
Nelson Mandela Bay Metropolitan	Currently installing and 360 latest technology LED high mast lights in its townships,	1050 MWh/a	6,5 years.
Mafube District Municipality	has implemented an exchange program for mercury vapour lights to more efficient HPS lamps.	639 MWh/a	6,2 years
Polokwane Local Municipality	Has implemented 36 new high-pressure pumps with variable speed drives	2322 MWh/a	3,9 years

3.2 Renewable Energy (RE)

The municipal electricity distribution business model recovers costs and generates surpluses, based on a mark-up on the Eskom bulk supply tariff[12]. However, lately with the introduction of energy efficiency and implementation of the Small-scale Embedded Generation (SSEG), there is a stagnant electricity sales growth. The SSEG is defined as a generator installed by electricity customers on residential, commercial, agricultural, or industrial properties, connected to the customer's electrical network behind the electricity meter[13]. The implementation of SSEG allows the customers to generate their own electricity mostly for own consumption and ability to trade with municipality using the SSEG tariffs approved by the National Energy Regulator of South Africa (NERSA). The deployment of SSEG reduces the reliance on electricity from coal-powered stations to more renewable and least cost technologies. The municipalities have a great infrastructure to purchase some bulk of electricity from Independent Power Producers (IPP's) or generate their own and resell to consumers at a lower cost.

Municipalities can purchase electricity from the IPP's who generate electricity from renewable energy technologies to reduce their carbon footprint. Municipalities need to have a Power Purchase Agreement (PPA), which describes the volume, price, and contract length for the electricity that will be sold. The benefit of this agreement is that municipalities does not need a high Capital for financing, construction, and operations of the generating facility as it is covered by the project developer, which is the IPP[14]. They are two types of PPA's that municipalities can partake such as Physical PPA and Virtual PPA. The differences between the two Power Purchase Agreements are listed below.

Table 2: Physical and Virtual Power Purchase Agreements[14]

Physical PPA's	Virtual PPA's
Renewable electricity source and customer must both be in the same grid region.	Renewable electricity source and customer do not have to be in the same grid Region.
Limited to jurisdictions permitting retail choice	Customer may be in any state but renewable electricity source must be connected to a wholesale power market.
Electricity rate locked in for the contract term.	Electricity rate is fixed in the contract, but customer payments to developer will depend on the difference between the fixed contract price and local retail price in the project's market.

Municipalities can also go into wheeling agreements. Wheeling is defined as the delivery of electricity generated by a private operator in one location to a buyer or off-taker in another location via a third-party network (Eskom or municipality)[15]. The wheeling agreement takes into consideration the use of the electricity network, including connection costs, maintenance, operations, refurbishment, customer services, administration, as well as surcharges, such as electrification and rural subsidy charges[16]. Municipalities have the potential to purchase electricity from IPP's located far from the connection point, using the wheeling agreement.

Municipalities have published wheeling tariff structures and enter into wheeling agreements with third parties due to the following[15]:

- Several larger metros have made commitments to be carbon neutral by 2050 which would almost certainly require them to enable/encourage alternative sources of renewable electricity.
- Given emerging technology disruptions, most

utilities recognise the need to move from an energy units-based business model to selling grid services. Setting a wheeling tariff framework is a first step in this direction. Wheeling is the delivery of electricity generated by a private operator in one location to a buyer or off-taker in another location via a third-party network (Eskom or municipality).

- Linked to the above, larger distribution utilities are increasingly seeing their future in effective load and demand management. Wheeling of embedded generation offers an important opportunity here and reduces costly transmissions costs.
- Supply disruptions have been a feature of the system since 2013 and 3rd party supply enhances security.
- Rural and secondary local municipalities can have districts that are very expensive to supply (marginal cost of additional capacity) with grid electricity from Eskom injection points and wheeled power from local generation sources may offer a cheaper alternative.

Smart Grids (SG) is defined as an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – to efficiently deliver sustainable, economic, and secure electricity supplies[17]. Municipalities needs to deploy SG technologies, as an enabler to realise the JET benefits. The current municipalities challenges such as aging distribution infrastructure which raises technical losses and frequency of equipment failure, lack of maintenance and refurbishment creating growing capital backlogs and technical skills gaps and high non-technical losses from electricity theft, meter tampering and corruption needs to be addressed, for municipalities to reap the benefits of the JET at a full scale[12].

Benefits of Smart Grids (SG) within municipalities which aligns with the energy transition are improved operational efficiency, opportunities for energy efficiency improvements, improved customers satisfaction and enhanced ability to respond to the National Green Agenda as shown in Figure 4 [17].

3.3 Smart Distribution Grids

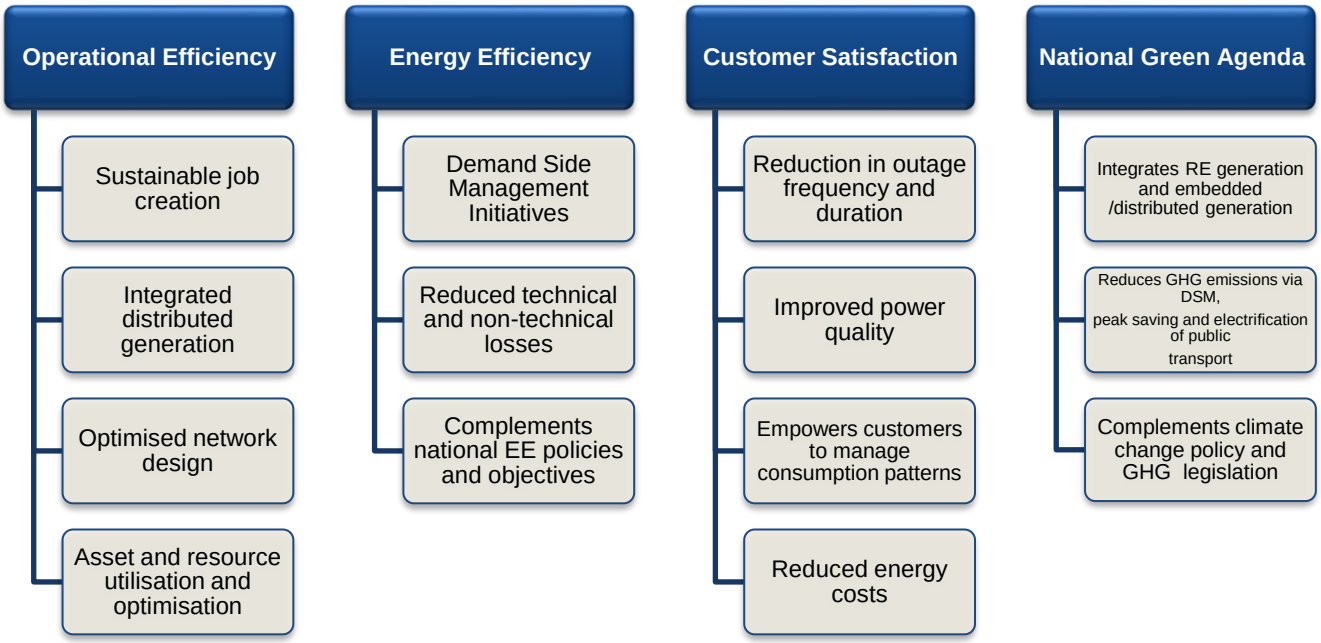

Figure 4: Smart Grids as an enabler for Just Energy Transition.

Through the EU Donor Funded Smart Grids Programme completed in 2018, SANEDI implemented pilot projects, aimed at improving business sustainability within the operations of 10 municipal electricity departments. The projects focused on 4 priority areas: asset management, revenue enhancement, advanced metering infrastructure and active network management. Through these pilot projects, SANEDI has implemented 12,200 smart meters across these municipalities. Such improvements to the electricity infrastructure must now be leveraged upon my municipalities to smarten their grids, improve on the socio-economic enabler towards energy transition.

4. Recommendations

The findings and recommendations made in this paper are focused around the experience gather over the years from programmes managed jointly by the DMRE and SANEDI. President Mr. Cyril Ramaphosa stated in 2019 during his Presidency Budget Speech "*it has been identified that there is a pattern of operating in silos which led to lack of coherence in planning and implementation and has made monitoring and oversight of government's programme difficult*." The President called out for the rolling out of an integrated district – based approach " **District Development Model**" to addressing service delivery challenges, this in our opinion ties in well with adopting JET fundamentals.

Below are the recommendations made with an understanding that the adoption of these recommendations in isolation of other good practices will lead to unsatisfactory results:

- Foster a practical interdepartmental relations mechanism to plan initiatives during inception.
- Budget and implement initiatives jointly in order to provide a coherent services for the people (solve silo's, duplication and fragmentation) maximise impact.
- Strengthening coordination and JET fundamentals in Supply Chain Management practices.
- Integrate aspects of poverty, unemployment and inequality particularly amongst women, youth and people living with disabilities when RE and EE programmes are been rolled out.
- Adopt digitalisation particularly in the electricity department to support municipal service delivery.
- Strengthen monitoring and evaluation of all programmes and publish results granting public access.
- Roll out energy efficiency initiatives and deployment of renewable energy technologies in an integrated manner using DDM.
- Extending the existing Municipal EEDSM programme of the DMRE to other municipalities.
- DMRE and other relevant government Departments to develop training programmes in order to boost the adoption EE, RE and DSM initiatives.
- Municipalities especially Metros, should be bold to address the electricity crises by embarking on renewables through direct procurement from IPPs.
- Advanced Metering Infrastructure is ging to be key to unlocking RE, EE and EPC potentials, municipalities have to transform their electricity networks as such.
- Skills deficit, revenue management and adequate funding must be addressed in order to sustain EE and RE programmes.

5. Conclusion

There is a potential for an accelerated uptake of EE and embedded generation both through deployment of small and large-scale renewable energy systems within municipalities. This uptake of Energy Efficiency and DG initiatives will unlock new local economic opportunities such as job creation, skills development and empowering of small and medium sized enterprises whilst contributing to the reduction in carbon emissions. Municipalities needs to deploy smart grids technologies, as an enabler to realise the benefits of the interventions in a sustainable manner. Municipalities need to develop a JET framework that incorporates into EE and RE and infrastructure programmes that provides clear guidance, develop roadmaps that considers diversifying the economy from a municipal level, create municipality green energy skills, and training programmes. Municipalities must set JET targets and policies to monitor and evaluate progress with the implementation of service delivery mandates that speak to their Integrated Development Plan (IDP).

6. Reference

[1] R. Hägele, G. I. Iacobu, and J. Tops, "Addressing climate goals and the SDGs through a just energy transition? Empirical evidence from Germany and South Africa," *Journal of Integrative Environmental Sciences*, pp. 1–36, Aug. 2022, doi: 10.1080/1943815X.2022.2108459.

[2] "Proposed updated Nationally Determined Contribution," 2021.

[3] Government Communications, "National State of Disaster In Numbers - 18 April 2022," *Government Communications and Information System (GCIS)*, Apr. 18, 2022.

[4] "A Just Energy Transition for South Africa." [Online]. Available: www.90by2030.org.za

[5] ESKOM, "Presentation to the Energy Portfolio Committee ESKOM PERSPECTIVE: EDI BRIEFING Content."

[6] "What are strategic priorities for just energy transition in the Western Cape?"

[7] "2008 LOCAL GOVERNMENT BUDGETS AND EXPENDITURE REVIEW Current and future developments in the electricity supply industry," 2008.

[8] DMRE, "Regulations for the mandatory display and submission of Energy Performance Certificates for Buildings 43972," 2020. [Online]. Available: www.gpwonline.co.za

[9] I. Energy Agency, "Energy Efficiency 2021," 2021. [Online]. Available: www.iea.org/t&c/

[10] "DEPARTMENT OF ENERGY NOTICE 948 OF 2016." [Online]. Available: www.gpwonline.co.za

[11] South African Cities Network (SACN), "Energy-Efficiency-Potential-Short-Report2014," 2014.

[12] R. Goode, "Development Bank of Southern Africa Working Paper Series Nov 2020 Municipal Power Procurement and Generation," 2020.

[13] SALGA, "STATUS OF SMALL SCALE EMBEDDED GENERATION (SSEG)," 2020. [Online]. Available: www.salga.org.za

[14] J. Leung and A. Bailey, "HOW CITIES BENEFIT FROM POWER PURCHASE AGREEMENTS POLICY," 2018.

[15] Sustainable Energy Africa, "Wheeling Discussion Paper A guide for municipal electricity distributors," 2020. [Online]. Available: http://www.eskom.co.za/CustomerCare/TariffsAndCharges/Documents/18671_not13981.pdf

[16] "Green Power Purchase Agreements (PPA)," 2020.

[17] SANEDI, "Strategic National Smart Grid Vision for the South African Electricity Supply Industry DRAFT SUBMISSION."