Nelson Mandela Bay, South Africa

Embedded generation in Nelson Mandela Bay

ICLEI Local Governments for Sustainability

Nelson Mandela Bay Municipality has been a leader in small scale embedded generation in South Africa. From the onset, the Municipality has opted to focus on the contribution that small-scale embedded generation can make towards achieving key constitutional mandates such as economic growth and development, sustainable service delivery, and ensuring a safe and healthy environment.

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Summary

In 2008, the Nelson Mandela Bay Municipality (NMBM) connected a small-scale embedded generation pilot site to their energy grid. In September 2011, the National Energy Regulator of South Africa (NERSA) approved the Standard Conditions for Small-Scale (<100kW) Embedded Generation within Municipal Boundaries. Various other South African municipalities have subsequently developed specific requirements for their areas of jurisdiction.

Because embedded generation is inherently local, municipalities have an important role to play in terms of creating an environment which allows for small-scale embedded generation, and regulates its use to ensure optimal reticulation of electricity. Local authorities have a Constitutional mandate to drive economic growth and development, deliver services to the community, while ensuring a safe and healthy environment. By facilitating the uptake of embedded generation, the NMBM is laying a foundation for low carbon urban development, both economic and socio-economic, through the diversification of the local energy mix, and working alongside citizens to do so.

Meeting electricity demand with small-scale renewable energy

In 2007, South Africa's electricity demand outstripped supply. This prompted Eskom, the public electricity provider, to implement the practice of load shedding (the planned interruption of service in targeted areas) in 2008 in order to protect against destabilization of the national electricity grid. These actions, however, have not lessened the stress on the national grid. This stress, together with growing concerns about rising greenhouse gas emissions and global climate change, has generated increased dialogue on the viability of renewable energy.

Local governments are responsible for working with citizens and groups within the community in order to find sustainable ways to meet their social, economic and material needs. Energy is a key component of quality of life, as it is inextricably linked to socio-economic wellbeing. It is also, however, connected to carbon emissions, which have contributed to global climate change, one of the greatest developmental challenges of our time. Small-scale renewable energy has numerous benefits, such as: the reduction of load on the grid; creation of low emissions development investment opportunities in the local economy; improved resource efficiency through the reduction of transmission and distribution related losses; and the involvement of consumers in energy supply-chain.

Facts & Figures

Population / Land area
1,150 million/1, 950 km² (2014)

Municipal budget
$722,000 million USD (2014)

Greenhouse gas inventory
Yes (2014)

Total GHG emissions (CO_2e/year)
183,200 (2014)

Nelson Mandela Bay has been a member of ICLEI since 2006

URBAN LEDS
URBAN LOW EMISSION DEVELOPMENT STRATEGIES

The Urban-LEDS Project

An Urban Low Emissions Development Strategy (Urban LEDS), or Low Emissions Urban Development Strategy, defines a pathway to transition a city to a low emission, green and inclusive urban economy, through its integration into city development plans and processes.

The Urban-LEDS project, funded by the European Commission, and implemented by UN-Habitat and ICLEI, has the objective of enhancing the transition to low emission urban development in emerging economy countries by offering selected local governments in Brazil, India, Indonesia and South Africa a comprehensive methodological framework (the GreenClimateCities methodology) to integrate low-carbon strategies into all sectors of urban planning and development.

Nelson Mandela Bay's motivation for alternative energy

It is the responsibility of the Nelson Mandela Bay Municipality (NMBM), as the local authority, to drive economic growth and development, deliver services to the community, while providing a safe and healthy environment for constituents. With these three mandates in mind, NMBM has placed considerable focus on energy. Energy plays a key role in local economic development, and is relevant to socio-economic issues through its ability to improve quality of life and education.

The load shedding introduced in 2008, and subsequently, the national requirement to reduce the electricity demand by 12 percent, brought about an awareness of the true cost of electricity and the limitations with regard to coal fired power stations (the predominant method for energy production in the area). This awareness resulted in a number of realizations, including.

- There is a pressing need for greater reliance on renewable energy sources and increased energy efficiency,
- Because of its high costs, electricity is a commodity that consumers are looking to access less expensively, and, in some cases, choosing to access illegally;
- If consumers are going to increasingly seek out unregulated energy sources, the longer the NMBM waited to regulate these sources, the more difficult it would be to manage them most effectively;
- Renewable energy installations coupled to the public grid can become a tool for multiple parties, not just for the generator or the utility;
- There is a need to augment the electricity supply in Nelson Mandela Bay and diversify the mix of energy sources;
- Renewable energy will be less expensive in the longer term; and
- Renewable energy stands to benefit to the economy through the creation of investment opportunities and platforms for local economic development, and can potentially work to establish Nelson Mandela Bay as an investment hub.

Small-scale embedded generation: An essential component in low carbon urban development

In 2005, motivated by the White Paper on Renewable Energy (2003), NMBM started investigating renewable energy possibilities for the municipality. In 2008, NMBM was granted approval from the National Energy Regulator of South Africa (NERSA) to pilot a small-scale embedded generation residential site. The pilot system consisted of both wind (1kW) and solar (initially 1kW, later increased to 5kW). At the time, the conclusion was that small-scale embedded generation, although technically feasible, was not financially viable. However, the cost of renewable energy generation equipment decreased considerably in the years following 2008. This, combined with the increase in coal-fired electricity tariffs, made pursuing small-scale embedded generation an increasingly viable option.

In 2010, NMBM approached NERSA for their reaction on small-scale embedded generation within the municipal area. In September 2011, NERSA approved the Standard Conditions for Embedded Generation within Municipal Boundaries. Under these conditions, providers with generation systems smaller than 100kW can produce electricity in the absence of a generation license. Following this approval, the NMBM Electricity and Energy Directorate submitted a proposal to the NMBM Infrastructure, Engineering and Energy Committee in May 2012, recommending that the previously proposed Green Economy Business Plan be revised to incorporate embedded generation. On 29 June 2012, a Mayoral Resolution was signed by the Executive Mayor.

Following the Mayoral Resolution, the Electricity and Energy Directorate drafted the NMBM Application for the Connection of Small-Scale Embedded Generation (SSEG) and Interim Requirements for Small-Scale Embedded Generation (SSEG), which details the process, requirements, specifications and standards that producers must adhere to.

In the absence of a thorough cost analysis and tariff study, and in order to kick-start the project, the NMBM set the export cost of electricity into the grid equal to the import cost, with the only additional costs to the generator being that of the procurement and installation of the bi-directional meter. For accessibility, the process was kept simple:

- The generator determines the size of the system in accordance with NRS 097-2-3, and performs the installation.
- The installation needs to be signed off by either a professional electrical engineer (Pr Eng) or an electrical technologist (Pr Tech Eng) who is appointed by the generator, and who will be required to complete a Certificate of Compliance (CoC). Any system connected to the grid must adhere to legislation, standards and normative references, all of which is contained in the NMBM's Interim Requirements for Small-Scale Embedded Generation. A prospective generator thus requires a professional to verify any application.
- The application form, once completed and approved, is submitted to Customer Care by the generator, along with the application fee.
- Once the application has been entered into the system, it is passed on to the NMBM Electricity & Energy Metering Division by Customer Care. On receipt of the application and CoC, the NMBM Metering division installs a web-based net meter on site and connects the installation to the grid.
- The generator is then provided with a unique password to enable viewing of consumption via the NMBM's online energy management system. The net-metering is calculated over a period of one calendar month. Both the amount of electricity imported from, and exported to the grid is indicated on a generator's monthly municipal bill.

In March 2013 the first small-scale generation system, a 3.8kW solar PV ground mounted system, was installed and officially connected to the grid.

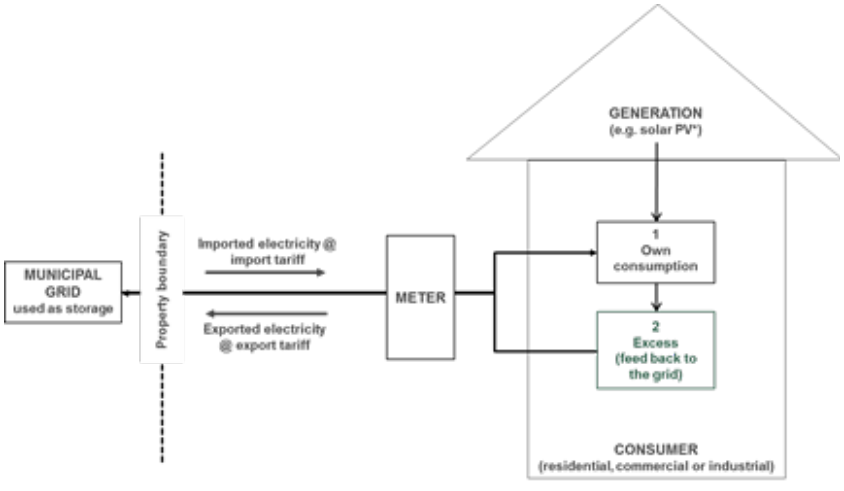
The NMBM is allowing embedded generation, and although they are not actively promoting it due to the perceived lack of long term financial viability of the current approach, they are facilitating it through minimal cost requirement and a simple application process. The NMBM plans to refine both its approach and tariff structure, but believed it was necessary to start regulating renewable energy connections to the grid as soon as possible, so as to curb illegal connections.

Net-metering

Net metering refers to the ability of small scale generators to be rewarded for energy that they produce and export into the municipal grid. The final bill that is thus received by such clients is for the net quantity of energy that was consumed from the municipal grid (the total import from the municipal grid minus the total export onto the municipal grid) over a set billing period (usually a calendar month).

A net-metering client can export and import electrical energy. The tariffs for export and import can either be the same or different. Exported electricity is generally capped to the value of imported electricity (no net payment possible), but can be traded with willing buyers directly (as is the case in Nelson Mandela Bay).

Schematic: Original by Aurelie Ferry (SALGA), modified by Elana Keef (Afri-Coast)



Net-metering at a glance

Costs and Financing

The NMBM recognizes that electricity cannot remain the primary source of municipal revenue, and that sustained investment into Nelson Mandela Bay is very important. Thus, the NMBM is currently not concerned about the loss in revenue experienced with embedded generation (this explains the one-for-one offset, wherein generators export electricity at the same tariff at which they import electricity – whether residential, commercial or industrial).

Instead, the NMBM has incorporated embedded generation into a long term perspective, and are focusing on maintaining control over the grid, enabling economic development and investment opportunities associated with embedded generation, and establishing Nelson Mandela Bay as renewable energy manufacturing hub.

Energy profile indicators	
% of pop. with access to electricity	**90.5%**
% of pop. living in slums	**12%**
Total municipal energy use	**1 093 000 000 MJ (2014)**
Energy source providing the largest part of energy supply	**Coal**
Energy use by energy carrier	**Electricity (38.6%), diesel (29.3%), petrol (28.0%), heavy furnance oil (2.6%)**
Percentage of annual primary energy requirements covered by renewables	**0.36% (SWH)**
Annual energy consumption per inhabitant (MJ/person/year/)	**30630 MJ/person//year**

At present, standard domestic and commercial tariffs are applied as is, without additional fees. The tariff structure currently applied by the NMBM does not reflect the real cost of embedded generation, as it does not address aspects such as grid maintenance and administration costs. In order to ensure a sustainable platform for energy investment, distributing entities need to maintain the infrastructure, and generators cannot expect to use the electrical grid as storage without contributing to its maintenance and upgrade. The NMBM will amend the tariffs and fees in the future, but not until a thorough tariff study and cost analysis has been performed.

From a directly financial perspective, small-scale embedded generation will only really benefit the NMBM once cost effective storage is available; from a local economic development perspective small-scale embedded generation is foundational in terms of low emissions development and sustained investment into Nelson Mandela Bay.

Results

To date, 27 embedded generation systems have been connected to the grid, with 25 of these systems being smaller than 100 kW. The NMBM also allows generation systems of 100kW to 5 MW to connect to the grid, provided they have a generation license from NERSA.

The primary direct impact of the NMBM facilitating embedded generation is the retention of control over the electrical grid through regulated grid connection. Generators are going to connect to the grid, whether regulated or not. Permitting and facilitating embedded generation, and making the process simple and cost effective, is encouraging regulated grid connection.

The primary indirect impacts include the role that embedded generation plays in laying a foundation for both the diversification of the NMBM energy mix, and decreased reliance on coal, which has a limited lifespan and negatively impacts the environment. It also figures into future economic development and investment opportunities, and the overarching goal of establishing Nelson Mandela Bay as a renewable energy manufacturing hub.

Organizations involved in energy production in South Africa

The **Department of Energy (DoE)** is responsible for ensuring exploration, development, processing, utilisation and management of South Africa's mineral and energy resources. The DoE is responsible for energy policy in South Africa, and is the custodians of, amongst others, the Integrated Resource Plan (IRP) for South Africa.

The **National Energy Regulator of South Africa (NERSA)** was established in 2005, subsequent to the promulgation of the National Energy Regulator Act, 2004 (Act No. 40 of 2004), for the purpose of regulating the electricity, piped-gas and petroleum pipelines industries in South Africa. In terms of the Act, NERSA sets national best practice standards for the general functioning and conduct of all role-players in the electricity, pipe-gas and petroleum pipelines industries. NERSA is tasked with implementing government energy policies, plans and acts.

Eskom is the South African electricity utility and currently provides approximately 95% of the country's electricity. It is the primary generator of electricity, and is responsible for all transmission and some of the distribution within South Africa. Eskom became a public company (state-owned enterprise) in July 2002. Eskom is currently the primary buyer of electricity within South Africa. It is important to note that Eskom has many different tariffs and tariff structures which is applied to different customers and which is updated annually.

An unexpected outcome of the process has been an improvement of consumers' opinions of the NMBM. Good relationships between the NMBM and generators have proven to be a cornerstone in a cooperative future characterized by amongst others, the generation of a significant portion of Nelson Mandela Bay's electricity by numerous localized renewable energy generation systems of varying sizes, and the involvement of the local community (both residential and business) in energy generation. Once the demand for distributed generation becomes too big and/or the cost of renewables dips below that of Eskom, municipalities will be able to buy from generators other than Eskom, which will necessitate greater levels of cooperation between generators and the NMBM.

Lessons learned

The application and approval process can be confusing. The current process is by default just following existing application processes (e.g. the application for the installation of new electricity meters). As a result there is not a single coordinator for the process to ensure consolidation of the process from application to connection. There are also limitations in terms of staff capacity, particularly with regards to compliance monitoring. The NMBM plans to develop a formal internal procedure for receiving and processing applications for small-scale embedded generation. In the interim the NMBM have appointed a consultant to manage the process and do the required monitoring.

Energy production is not fully understood. There are concerns and fears around small-scale embedded generation as it is still very new, with the lack of education and awareness around the technical complexities making it difficult for the average person to understand.

Short term perspectives on capital expenditure persist. Many residents and businesses have short term perspectives (around 3 years) in regard to capital expenditure, whereas renewable energy systems require 7 to 12 years. Organizations that can benefit from the process are thus reluctant to the initial capital outlay. For many businesses, electricity is not yet a big enough cost-center to warrant immediate action. Yet this might change if electricity outages as a result of load shedding become a more regular occurrence, as the cost of unserved electricity, which is currently estimated at R75/kWh, is significantly more than the than the additional cost to supply the energy not served. For small-scale photovoltaics, the cost can now be as little as R0.81/kWh for a large residential system.

The approach currently applied by the NMBM lacks long term financial viability. The tariff and fee structure for embedded generation makes it so that the long term benefit gained from facilitation within Nelson Mandela Bay is of greater importance than the loss in revenue and other costs not currently recovered such as the cost of grid maintenance and upgrade. In order to ensure financial viability and the protection of the grid, it is important to understand and recover the real costs of embedded generation as well as the technical implications of connections to the grid.

Ideally, embedded generation needs to be regulated by the local authority. National government preferably needs to deregulate

Amatola Green Power

In 2013 the NMBM signed a 15 year wheeling agreement with Amatola Green Power (AGP) which allows AGP to buy and sell renewable energy within Nelson Mandela Bay, using the NMBM's grid infrastructure. Nelson Mandela Bay is currently the only city in South Africa within which such an agreement exists. Generators thus have the option to trade any excess electricity through AGP.

Amatola Green Power (AGP) is the first private sector energy trader licensed by NERSA to buy and sell renewable energy in South Africa. AGP operates independently from Eskom and from local municipalities and trades in clean energy by connecting willing buyers to willing sellers. AGP is therefore not limited to the Eskom price of electricity.

AGP, as a trading platform, enables a generator to size their generation system according to their peak winter demand, which is the most expensive electricity, or according to future needs, knowing that any excess electricity generated can be sold through AGP. In doing so a generator mitigates a potential loss on a renewable energy investment.

Photo: D. Liebenberg)

Inverters and generation control from a small-scale project installed in NMBM (2008)

some, or all of South Africa's energy needs in order to allow greater involvement of local authorities in terms of regulating energy generation and trading at a local level. This presents the possibility of local authorities having more control over local energy supply and planning, and gives independent power producers fair access to both the national and local grid.

Regardless of the above, in order to ensure the effective roll-out of embedded generation within Nelson Mandela Bay, closer cooperation between the various municipal directorates and/or sub-directorates (i.e. Building Inspectorate, and Air Pollution & Noise Control) is required. The NMBM should aim to resolve any process related issues during this initial stage while the uptake is still relatively slow in order to have an effective process in place once the rate of uptake increases as the concept matures

Replication

There are important aspects that a municipality needs to consider before allowing small-scale embedded generation:

- **Understand the financial implications.** A municipality must calculate the real cost of embedded generation in order to ensure recovery of these, and determine the tariffs accordingly.
- **Guarantee that the municipality's billing system can accommodate the necessary credit adjustments.** Moreover, a municipality should make sure that there is a net metering system in place, and be prepared to provide systems for measuring and monitoring the contribution of SSEG to total energy supply.
- **Ensure that installations are done in adherence to relevant standards and requirements.** In these circumstances, individual embedded generation systems should have little or no impact on the grid. There is, however, still uncertainty as to the cumulative impact that embedded generation systems will have if multiple systems are generating simultaneously. It is important to be aware of the technical implications associated with connections to the grid, especially in terms of voltage fluctuations outside of acceptable limits and harmonics, which could damage both the electrical appliances and equipment of consumers and the municipal grid infrastructure, and to ensure that this is addressed before approving an installation.
- **Be aware of their capacity for risk**. In light of the current national embedded generation context, from a legislative, experience and capacity point of view, if a municipality wants to not just allow, but facilitate embedded generation within their municipal area, there will be risk involved including, but not limited to, the cumulative impact of multiple generation systems exporting electricity onto the grid, and financial risks associated with potential additional network maintenance and upgrades.
- **Have a strategy in place for dealing with the use of inferior/unlawful equipment.** In the case of the NMBM there is an Electricity Supply By-Law which authorizes the NMBM to disconnect any installation that is deemed illegal according to the by-law.

References

Standard Conditions for Embedded Generation within Municipal Boundaries. Reasons for Decision. NERSA.

Cost of Unserved Electricity (COUE) – IRP 2010 Input Parameter information sheet (supply input). NERSA. www.doe-irp.co.za/factsheet.html

NRS Information Brochure, Electricity Suppliers Liaison Committee. 2006.

Unlocking the rooftop PV market in South Africa. Centre for Renewable and Sustainable Studies. Reinecke, J. et al. 2013

Nelson Mandela Bay Interim Requirements for Small Scale Embedded Generation (SSEG). 1 July 2014.

Application for the Connection of Small Scale Embedded Generation (SSEG). NMBM Electricity & Energy Directorate.

Electricity Supply By-Law. Nelson Mandela Metropolitan Municipality.1990.

eThekwini Municipality Residential Embedded Generation Tariff (REG Tariff) -http://www.durban.gov.za/City_Services/electricity/Tariffs/Documents/REGtariff.pdf

eThekwini Municipality http://www.kznenergy.org.za/download/forum_meetings/workshop_on_role_of_munics_in_embedded_generation/eThekwini_Electricity_Department_Guidelines_for_connecting_to_the_grid.pdf

Presentation: Small scale embedded generation the road to approved grid connection in Cape Town. Brian Jones.

Presentation: Small scale renewable energy generation in the City of Cape Town. Brian Jones. Presented at the 14th annual African Utility Week. 13 – 14 May 2014.

Presentation: Analysis of the impact on municipal electricity revenues of an increased scale of energy efficiency and small scale own and embedded generation. Hilton Trollip. Presented at the South African Economic Regulation Conference (SAERC). 21 Sept 2012.

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