



CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

Small Scale Embedded Generation The Road to Approved Grid Connection in Cape Town November 2014

Utility Services/Electricity Services/BJones

Making progress possible. **Together.**

Cabinet decision- 5 September 2007

[Home] [Speeches & statements]

Statement on Cabinet meeting of 5 September 2007

 [Audio](#) [mp3]

6 September 2007

Cabinet held its ordinary meeting in Cape Town yesterday morning, 5 September 2007.

Cabinet resolved that **Eskom be designated as the single buyer of power** from Independent Power Producers (IPPs) in South Africa. Eskom will be responsible for ensuring that adequate generation capacity is made available and that 30% of the new power generation capacity is derived from IPPs. This policy will ensure that the responsibility and accountability for the construction of power generation capacity is co-ordinated and provide certainty to the private providers.

1

Electricity Policy, Legislation, Regulation

Government policy

- White Paper on Renewable Energy
- Single Buyer- cabinet decision
- Electricity Regulation Act
 - New Generation Regulations
 - IRP (2010)
- MFMA
 - S33
 - Fruitless and Wasteful Expenditure
- Municipal Supply By laws. (In Cape Town's case, no one may connect in parallel with the grid without prior written consent of the Director of Electricity)

Role of Munics
unclear

There is no mandate allowing Municipalities or Eskom to purchase excess generated electricity from small scale embedded generators.

MFMA s62

62. (1) The accounting officer of a municipality is responsible for managing the financial administration of the municipality, and must for this purpose take all reasonable steps to ensure-

- (a) that the resources of the municipality are used effectively, efficiently and economically;
- (b) that full and proper records of the financial affairs of the municipality are kept in accordance with any prescribed norms and standards;
- (c) that the municipality has and maintains effective, efficient and transparent systems-
 - (i) of financial and risk management and internal control; and
 - (ii) of internal audit operating in accordance with any prescribed norms and standards;
- (d) that unauthorised, irregular or fruitless and wasteful expenditure and other losses are prevented;



MFMA s33

Contracts having future budgetary implications

33. (1) A municipality may enter into a contract which will impose financial obligations on the municipality beyond a financial year, but if the contract will impose financial obligations on the municipality beyond the three years covered in the annual budget for that financial year, it may do so only if— 30

(iv) any written views and recommendations on the proposed contract by the National Treasury, the relevant provincial treasury, the national department responsible for local government and any national department referred to in paragraph (a)(ii)(cc); and

(c) the municipal council has adopted a resolution in which— 5

(i) it determines that the municipality will secure a significant capital investment or will derive a significant financial economic or financial benefit from the contract;

(ii) it approves the entire contract exactly as it is to be executed; and

(iii) it authorises the municipal manager to sign the contract on behalf of the municipality. 10



Electricity Regulation Act

Activities requiring licensing

8. (1) No person may, without a licence issued by the Regulator in accordance with this Act—

- (a) operate any generation, transmission or distribution facility;
- (b) import or export any electricity; or
- (c) be involved in trading.

(2) Notwithstanding subsection (1), a person involved in an activity specified in Schedule II need not apply for or hold a licence issued by the Regulator.

SCHEDULE 2

EXEMPTION FROM OBLIGATION TO APPLY FOR AND HOLD A LICENCE

1. Any generation plant constructed and operated for demonstration purposes only and not connected to an inter connected power supply
2. Any generation plant constructed and operated for own use
3. Non-grid connected supply of electricity except for commercial use

Grid code: Responsibility of Distributors

8.2 Responsibilities of Distributors to the Embedded Generators

- (1) If requested by the *Embedded Generator*, the *Distributor* shall provide information relating to the *Distribution System* capacity and loading to enable the *Embedded Generator* to identify and evaluate opportunities for connecting to the *Distribution System*. The *Distributor* may charge the *Embedded Generator* a reasonable fee for such information.
- (2) The *Distributor* shall treat all applications for connection to the *Distribution System* by potential *Embedded Generators* in an open and transparent manner that ensures equal treatment for all applicants.
- (3) The *Distributors* shall be responsible for the installation of the bidirectional metering equipment between the *Distributor* and the *Embedded Generator's* generation facility.
- (4) The *Distributor* shall develop the protection requirement guide for connecting *Embedded Generators* to the *Distribution System* to ensure safe and reliable operation of the *Distribution System*.



Grid Code: Responsibility of Embedded Generators

8.1 Responsibilities of *Embedded Generators* to *Distributors*

- (1) The *Embedded Generator* shall enter into a connection agreement with the *Distributor* before connecting to the *Distribution system*.
- (2) The *Embedded Generator* shall ensure that the reliability and *quality of supply* complies with the terms of the connection agreement.
- (3) The *Embedded Generator* shall comply with the *Distributor's* protection requirement guide detailed in this section as well as protection of own plant against abnormalities, which could arise on the *Distribution System*.
- (4) The *Embedded Generator* shall be responsible for any dedicated connection costs incurred on the Transmission System or *Distribution System* as a result of connection of the *Embedded Generation* facility to the *Distribution System* in compliance with the Tariff Code.
- (5) The *Embedded Generator* shall be responsible for synchronizing the generating facility to the *Distribution System* within pre-agreed settings.



Current National RE Policy and Programmes

- Cabinet decision 5 September 2007 – Eskom designated as the “central buyer of power from IPP’s”
- Role of Municipalities regarding RE is undefined- excluded from IPP definition and IRP2010
- DOE New Generation Capacity IPP Procurement Programme (Large Scale > 5 MW)
- DOE New Generation Capacity IPP Procurement Programme (Small Scale 1- 5 MW) (RFI issued) Max 100 MW
- Eskom Integrated Demand Management (IDM) 100 kW- 1 MW “Standard Offer” pilot (R1.20/kWh) Max 10 MW Pilot terminated.
- NERSA’s “Standard Conditions for small scale (< 100kW) embedded generation within municipal boundaries)
- IRP 2010 being revised
- NERSA has advised that a “policy document” on SSEG will be issued early in 2015.

Net Metering- definition- from “Nersa Guidelines”

Net Metering refers to the ability of ..small scale generators to be rewarded for the energy that they produce to which goes out onto the municipal network.....
The final bill that will be received is for the Nett quantity of energy that they consume.....that is, their total import from the municipal network minus their total exports onto the municipal network (subject to any relevant metering periods in operation) (from Nersa’s “Standard Conditions for small scale (< 100kW) embedded generation within municipal boundaries)

Standard Conditions for small scale (< 100kW) embedded generation within municipal boundaries

- Guidelines only, no consultations held.
- Need clarification and updating
- Connection to the Eskom grid is omitted
- Imply that generator licenses are not required for net metering applications
- “Should” have smart meters with bi directional metering
- Sets guidelines regarding net metering tariffs
- Sets out requirements regarding record keeping and reporting

Extract from Nersa “Standard Conditions”- (impacts tariffs and metering solution)

17. The lowest cost metering solution would be where power exports are allowed to reverse the meter reading. By charging a fixed monthly charge for network services and administration and an energy rate for power purchased such metering would be cost reflective. However the Energy Regulator should require the municipalities to install smart metering which can:-

- a) handle the separated measurement of bidirectional power flows;
- b) handle the different Time of Use (ToU) metering periods;
- c) measure and record peak demand in the different periods.

This should not be an onerous requirement as the municipalities are already required to fit this class of metering to customers with a demand of more than 1000kWh by 1 January 2012.

IRP2 -2010

- 6.15 Net metering, which allows for consumers to feed energy they produce into the grid and offset this energy against consumed energy, should be considered for all consumers (including residential and commercial consumers) in order to realise the benefits of distributed generation. The impact of such a policy on subsidies needs to be considered.

7 RESEARCH AGENDA FOR NEXT IRP

Distributed generation, smart grids and off-grid generation

- 7.1 An independent study on solar PV technologies suggests that before 2015 the levelised cost of the PV installation (without storage) would be the same, if not cheaper, than residential prices (especially at municipal retail tariffs). This possibility suggests that distributed generation should be seriously considered in future iterations of the IRP with additional research into the technology options for distributed generation and the impact on networks, pricing and residual demand on centrally planned generation.

- 7.2 The growth of distributed generation has a bearing on the development and operations of the network (predominantly the distribution network), especially if some, if not most, of the distributed generation is variable technology. The development opportunity of smart(er) grids and storage solutions – which can help in integrating variable renewable technologies – should also be considered, alongside the system's balancing capability (and ancillary services). There could be an initial focus on smart metering and the ability to manage demand.



National Strategy- Comments to Revised IRP

“A standard offer approach is developed by the Department of Energy in which an agency similar to Eskom’s Single Buyer Office purchases energy from embedded generators at a set price (with a self-correcting mechanism based on uptake) so as to render municipalities indifferent between their Eskom supply and embedded generators and thus support small scale distributed generation”

National Strategy- Comments to Revised IRP

- Comments to IRP revision foresees potential of 30GW of rooftop PV by 2050
- IRP- proposal - SSEG to be revenue neutral for municipalities
- Suggestion of standard offer- ??80c per kWh paid by Eskom to generators, munics compensated for (estimated?) loss of revenue
- Metering solution for the above -most likely will be a bi directional meter, with “standard estimation” of PV gross output (only requires one meter)
- “Standard offer” could also support larger generation e.g. bio-gas to energy 500kW as an alternative to IPP wheeling to Eskom across municipal network
- **Administratively challenging**

Solar Potential

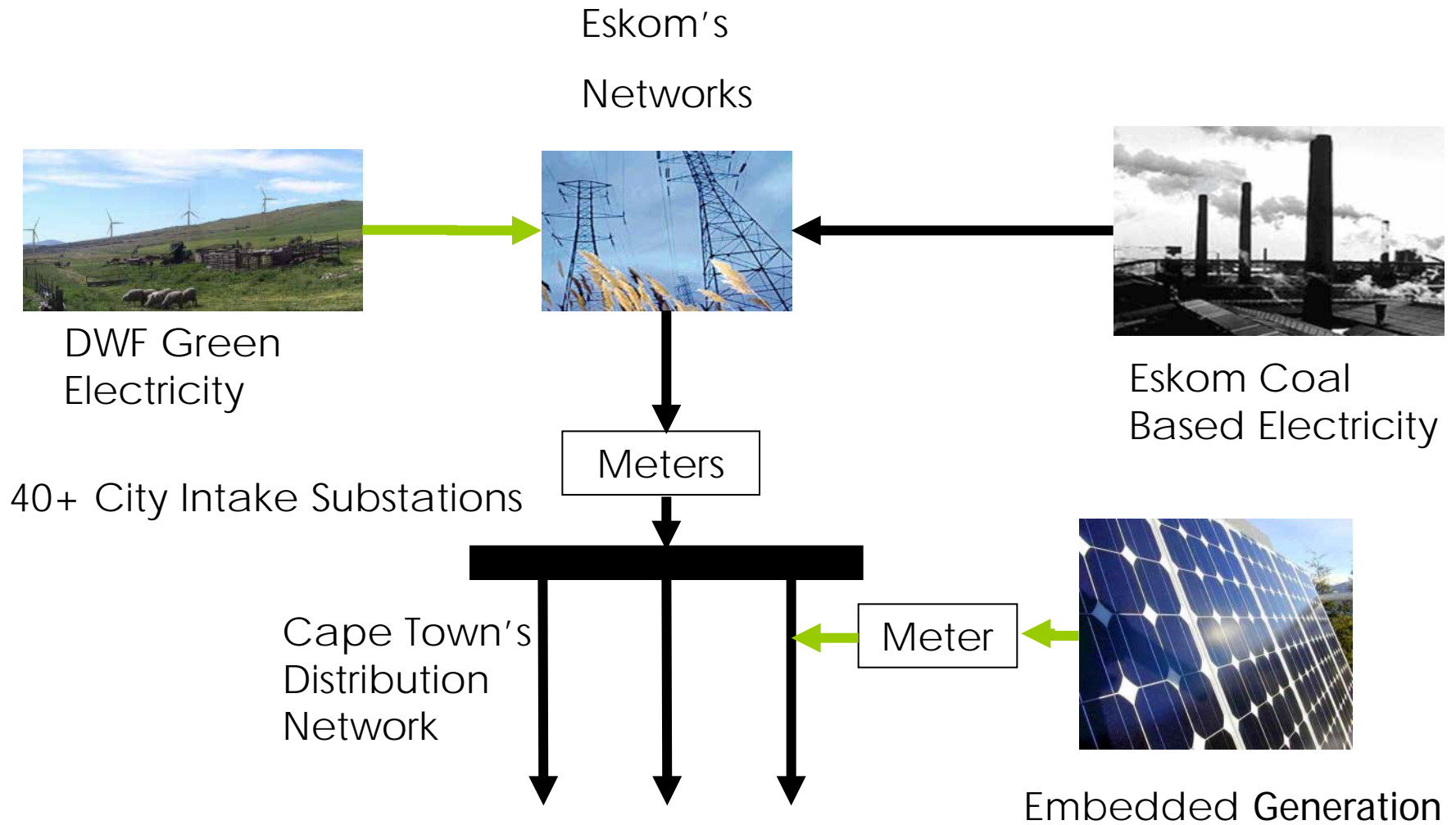
- Sunlight (power) falling on an area 6 km x 6 km equivalent to 36 GW national peak energy demand @ nominal 1 kW/m²
- PV modules 15% efficient (> 40% in laboratory)
- Costs plummeting
- Sun shines only at daytime- energy storage is the “Holy Grail”



Module size 1 x 1.6 m



Renewable Generation- Network Arrangements



Examples of Embedded Generation (is that PV or SWH?)



PV



SWH



Examples of Embedded Generation Small Wind Turbines



Horizontal axis

Wind speed minimum 2.5 m/s



Vertical axis

Wind speed minimum 1 m/s



Electricity Services HQ 100 kW system



Module size
1 x 1.6 m



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Context

From the perspective of a Municipality with an Electricity Distribution license:

- Decreasing price of RE
- Increasing price of Eskom Electricity and hence
- Increasing municipal electricity prices
- Approaching convergence of prices (IRP2010- 2015)
- Green economy agenda- job creation, green agenda, climate change moral prerogative
- Proliferating unauthorised grid tied PV connections

Public Demand

- Many enquires (almost daily)
- Few (+-10) serious applications (process too costly/onerous for residential consumers)
- Also, reverse power not yet allowed- this is suppressing demand
- However- claims of 500+ illegal grid tied installations by one supplier.

Notable installations to date:

- Black River Parkway
 - Phase 1: 2875 panels, Phase 2 : 2050 panels
 - Total 1.2 MWp- Will cover 14000m²
- Vodacom Building
 - 542 kWp



The Main Issues in Grid- Connecting SSEG

Legal mandate (Policy, Legislation, Regulation, Generation licences)

Technical Standards

- Voltage, Harmonics
- Islanding/automatic disconnection
- Type testing

Metering solution- Residential, Commercial and Industrial

Tariffs

- Structure
- Quantum
- Rules

Billing processes- through prepayment, or direct invoicing as for Rates

VAT

Connection agreement

Customer guidelines

Other (non-electricity) municipal departmental approvals

Cape Town Electricity By-Law

39. Consumer's electricity generation equipment

(1) No electricity generation equipment provided by a consumer in terms of any Regulations or for his own operational requirements shall be connected to any installation without the prior written consent of the Director.



City of Cape Town's Phased Approach

- First - 4 limited scope pilots:
 1. 1x Commercial no reverse power flow
 2. 3 x Residential pilots with reverse power flow
- Then allowed grid connection without any instantaneous reverse power flow
- Finally allowed grid connection with instantaneous power flow- consumer over an averaged period must be a "net consumer" and not a "net generator."

Technical Specifications

- Low voltage: NRS 097-2-1 (2010 version)
- Medium voltage: Eskom specification Eskom 240-61268576 / DST 34-1765: (will be superseded by NRS 097-1 when finalised)
- Grid code for renewable electricity
(grid code will override other specifications where there are clashes)
- NRS 097-2-3 (for simplified utility connection criteria)

Outstanding:

- NRS 097-2-1 (2014 revision)
- NRS 097-2-2 (2014 edition in particular type-testing requirements)
In the interim inverters must be type-tested by an accredited test house.
- NRS 097-2-4 (implementation procedures and application – future development)

Consumers connecting now will need to prove compliance with new standards as they emerge.

What is NRS 097-2?

- Set of industry standards that define:

- the utility interface,
- generator requirements and
- utility implementation guidelines

- for the interconnection of small scale embedded generators (SSEG<100kW) to LV distribution networks of a utility.

- The standards cover:

- Utility interface requirements (NRS 097-2-1 - published, being reviewed)
- Embedded generator requirements (NRS 097-2-2 - draft)
- Utility framework (NRS 097-2-3 – SABS for publishing)
- **Procedures for implementation and application (NRS 097-2-4)**

Update on NRS 097-2-series

Gerhard Botha
Research, Testing and Development

2014/06/26

2014/06/26

6



Technical Specifications cont'd

SANS 10142-1

- Compulsory specification SANS 10142-1 does not cover dc circuits but does cover connection of generators to the grid.
- SANS 10142-3 is being drafted and will cover the dc requirements. In the interim the City will require a professional engineer and a COC sign-off of all SSEG's.

Technical Requirements cont'd

- Specialist grid impact studies
- Inverter type testing requirements – **no Test House in RSA at present**
- Electricity design and installation certified by a professional engineer.
- On-site commissioning and handover
- Certificate of Compliance

- Status- in progress – Multi-party workgroup- Eskom, Munics, Industry
- Cape Town- interim standards and requirements- at developer's risk.

Comments submitted to Nersa/DOE regarding 100kVA standard guidelines, - recommended inter alia no licence required up to 1 MVA.

Type Testing- inverters

Comment from Eskom Grid Tie specialist:

“This is a sensitive subject for which the electricity suppliers do not have a simple answer in my view. We as utilities do not carry the sole responsibility to resolve these issues either. These are matters where the SA industry, SA government and its organs such as SABS, DTI and others may well need to take hands to assist local suppliers.”

Metering Solution- considerations

Commercial and Industrial- 4 quadrant AMI meters

Residential

- Electro-mechanical meters “turning backward” are not acceptable-
 - they are not certified to be accurate turning backwards,
 - They also do not provide data on forward and reverse power flow.
- City policy is to move to prepayment meters
 - Prepayment meters decrement on both forward or reverse power flow (a small percentage trip and lock out on reverse power flow)
- Use existing billing and vending systems as far as possible.
- Same solution required for single and three phase customers
- Billing MUST be automated
- Solution must be “understandable” - e.g. potential confusion with recovery of daily service charge through the Prepayment system (clog up the call centers)

Metering Solution- Residential

- The City started working with suppliers to develop a prepayment meter with a reverse power flow credit register which could be remotely read
- The intention was to bill daily service charge and excess generation refund directly as done for rates account
- Suppliers were only prepared to develop a single phase unit- wanted guaranteed purchase volumes if 3 phase unit developed.
- Also the challenge of prepayment meters decrementing on reverse power flow (which is a “revenue protection” feature.)
- Problem of linking metering device to be loaded on both SAP based credit meter billing system with Prepayment STS coupon vending system.

In the end decided to use the same AMI meter as used for Commercial and Industrial applications.

Residential Smart Metering Solution – “still a bit down the road”

- Smart meter which can operate in prepaid and post paid modes
- Can accommodate Time of use tariffs?
- Local keyboard for coupon loading of units if communication line is down.
- Residential load control- challenge of response times/data volumes
- Main barriers-
 - open communication protocol to prevent one supplier getting a monopoly,
 - cost of replacing all meters and installing a communication infrastructure
 - security (hack free)

Tariffs for SSEG

- Tariffs to be approved annually by Municipal councils and NERSA
- In theory consumers can end up with no net consumption at the end of each month
- There is a cost to provide, maintain and administer the electrical network
- NERSA < 100kW guidelines require monthly fixed service charge to cover network and admin charges, and an energy charge for consumption and 1 for 1 unit exchange.

- The City initially established “one for one” net metering tariffs with a daily service charge.
- (The devil is in the detail)- practical implementation of the tariff was too problematic-
 - Business processes for accounting for “net” units and banking excess (net generation) units- “stock control”
 - Issue of arbitrage - rolling excess units into a new financial year (new higher tariff)

2014/2015 SSEG tariffs approved, not yet implemented (inc vat)

Residential

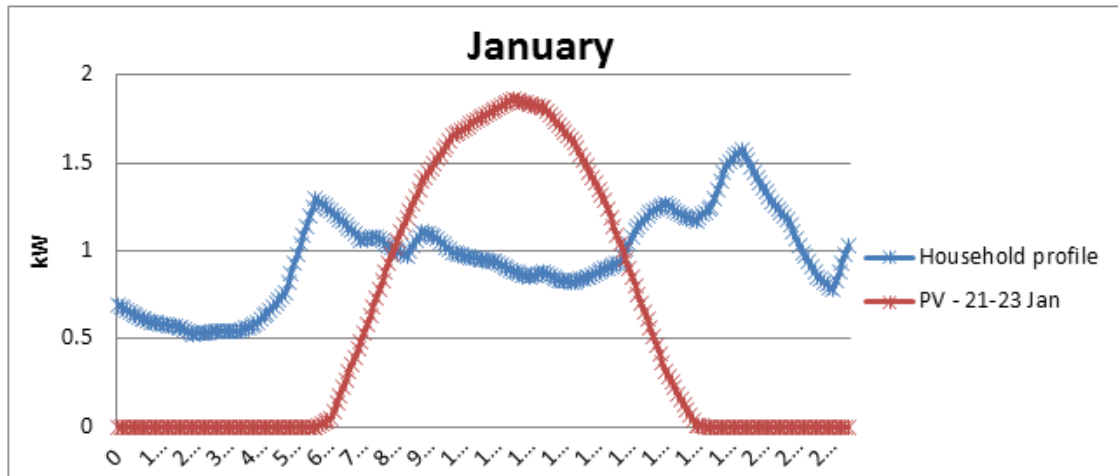
- Daily service charge (R13.03per day)
- Energy consumption charge (109.17c per kWh) (normal tariff is 153.63/186.81c per kWh)
- Energy generation purchase tariff (49.72c per kWh) **(EX VAT)**

Commercial

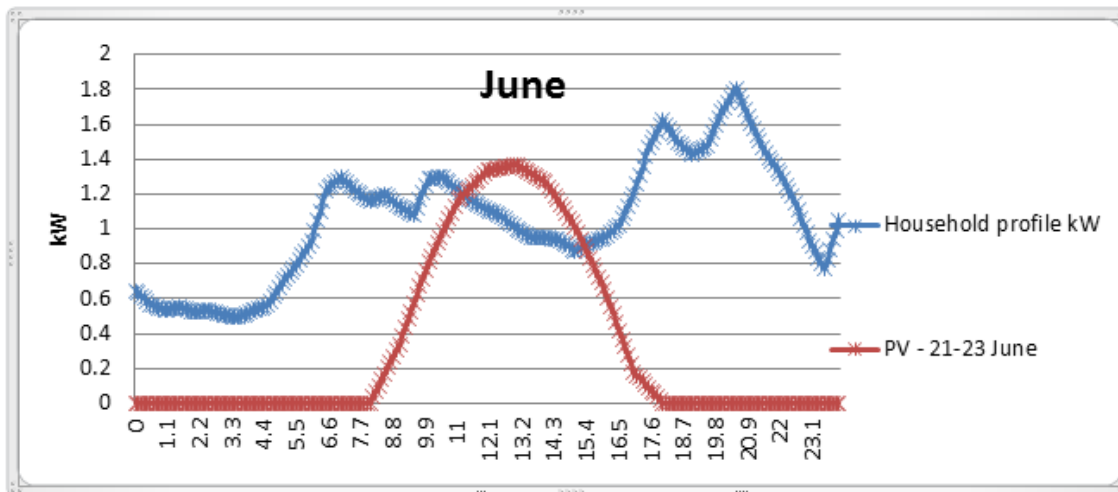
- Must be on a tariff with a daily service charge
- Tariff is the same as the pure consumption tariff, with Energy Generation purchase tariff as for Residential consumers (56.68c per kWh)

A big advantage of setting the excess generation tariff lower than the energy purchase tariff is the incentive to shift load out of the evening peak to daytime when PV generation occurs.

Typical Generation and Consumption Profiles



Generation: from 2 kW (peak) DC array

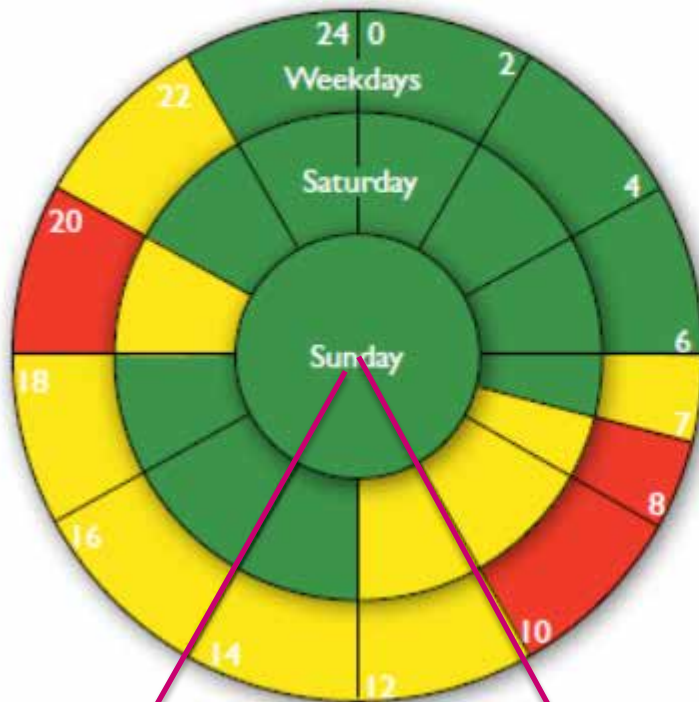





Consumption: average of 25 households which use 748kW per month

[Source: from data generated by PVWatts2 and provided by Davis3]



Time of Use tariff Periods- Megaflex tariff (>66kV & <132kV)



	Summer	Winter
 Peak	82.64	253.35
 Standard	56.87	76.74
 Off-peak	36.08	41.68

c/kWh inc VAT

What the City will allow

- C&I: Grid Connection with LIMITED* reverse power flow, must be on SSEG tariff (which includes a daily service charge)
- Residential:
 - Grid Connection with NO reverse power flow (blocking relay installed)- no tariff or meter change required . Expect that daily service charges will be reintroduced across the country for non indigent residential consumers in the future.
 - OR on SSEG tariff with LIMITED * reverse power flow(must be bona fide generator)- at City's discretion.

*Limited at application approval stage to being "net consumers" over a year's averaging period

Generation size limitations

Residential

(no grid studies required ito NRS 097-2-3)

1	2	3	4
Number of Phases	Service Circuit Breaker Size (A)	Notified Maximum Demand (kVA)	Maximum Individual Generation Capacity (kVA)
1	40	9.2	2.3
1	60	13.9	3.5
1	80	18.5	4.6
3	40	27.7	6.9
3	60	41.6	10.4
3	80	55.4	13.9
3	100	69.3	17.3

Commercial & Industrial

All LV grid connected as per NRS097-2-3 (< 1 MVA)

All MV connected (< 1 MVA)
-will depend on grid capacity, consumer load & generation size in grid context- special grid studies may be required

> 1 MVA MUST have NERSA generation licence, connection terms to be separately determined- cannot participate in SSEG tariff scheme.

Billing

- Accounts to be rendered monthly for customers on the SSEG tariff.
- VAT- Consumers do not have to issue the City a VAT invoice for payment for excess generation.
- Vat on payments for excess generation only payable to registered VAT vendors (excludes residential customers)
- Any credit balance will be carried forward and not paid out

Generation licences

- Electricity Regulation Act requires all generators to have a generation licence from NERSA unless generation is “for own use.”
- “Own use” not defined: If someone exports at times onto the grid, but their net power flow is consumptive- are they generating “for own use”?
- NERSA Guidelines for generation less than 100kW imply that a licence is not required. However they are ONLY GUIDELINES. They cannot override the Act
- The City will allow grid connection up to 1 MW without evidence of a generation licence.
- >1 MW: City will demand a generation licence before processing application
- The City will report all embedded generation to NERSA.
- Consumer is responsible to NERSA- and takes risk if NERSA requires, and then refuses, to issue generation licence

Business Processes

Business Processes being implemented to :

- Integrate with other supply applications processes
- Initiate Grid capacity studies when required
- Track and record design, testing and handover approvals and Supply Agreements
- Handle reading dual meter registers and manage billing
- Provide data for NERSA reporting etc.
- Provide consumer advice

Application and Acceptance Process

Application

- Consumer guidelines posted on the City's web
- Consumer must complete and submit an application form
- Consumer must sign a special supply connection contract
- Grid studies may be required for C&I applications
- Customer pays for all related costs (network studies, metering and network changes, tests ...)
- No grid approval without prior approval of installation by other City departments
- No grid connection allowed until letter giving consent to connect is issued.

Acceptance

- Installation compliance with all requirements to be signed off by a professional engineer/technologist
- Certificate of Compliance required
- Inverters set in accordance with NRS 097-2-1

Website where SSEG Guidelines posted

- <http://www.capetown.gov.za/en/electricity/Pages/ServiceApplicationForms.aspx>

Other Municipal Requirements

Approval of generators required from other Municipal Departments:

- Noise (wind turbines, generator exhausts)
- Other interference (flickering shadows from wind turbines)
- Air pollution (bio mass generation/incineration, exhaust gases)
- Waste management
- Building regulations (e.g. small wind turbines, PV panels)
(including sign off of structural design)
- Servitudes for power lines and cables

Nema (EIA), Water,

General Considerations

Wheeling

- Administratively burdensome
- Monthly adjustment of two meter readings- consumer's and at intake sub
- Multiple agreements to be negotiated (6 or more)

- Far easier for munics to purchase directly and either recover the cost from the Central Buyer's Office or from Eskom, or through their own tariff.
- Nersa have introduces rules for cost recovery for wheeling- they are to be revised.
- Eskom allow wheeling at MV or higher
- Cape Town is starting to "work on the same".

Contribution Towards System Load and Electricity Sales Income

- Cape Town has about 550 000 residential consumers (250 000 middle/upper income (non-lifeline)) and a yearly overall consumption of 11 Terawatt hours (11 000 000 kWh)
- Assume 100 000 3kWp units installed (350 kWh ave per month/unit)
- 100 000 units will generate 0.42 TWh per year or about 3.8% of Cape Town's consumption
- Impact on electricity sales income will be higher.
- A net metered 3kWpk PV panel together with a 200l SWH will provide about 550 kWh/month- most of the electricity needs of a middle income household!
- PV generation makes little or no contribution towards reducing the evening peak unless accompanied with load shifting to outside peak periods

Communication from Ethekwini

EThekwini's small scale embedded generation tariff (page 6 of tariff booklet) to be implemented as of 01 July 2014 has not been approved by the regulator. The following was the response by the NERSA:

- *"Please note that we are currently engaging internally to develop the embedded generation framework. I do understand the pressure from your side, but it is something that one cannot take to the Regulator without the established framework. Once the framework is approved it will help to deal with the application of this nature."*

Subsequent to this, a letter was drafted to the regulator (attached) to approve the tariff in the interim until a framework is implemented. We are awaiting a response in this regard.

- We need answers as the pressure from customers are mounting. We should place a little pressure to get a response to the proposal as submitted to the Regulator. Articles like these create an expectation out there and it becomes difficult to deal with customers in the absence of regulatory guidelines !!



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Thank You

For queries contact green.electricity@capetown.gov.za

Making progress possible. Together.