

Bi-directional prepayment meter

A pilot project to enable domestic users of photovoltaic solar systems to feed their excess electricity into the grid



IDP LINKAGES



Caring city



Inclusive city



Opportunity city



Well-run city

The Integrated Development Plan is a plan for how the City will prioritise its budget spending over a five-year cycle. The IDP is agreed between local government and residents, and is adjusted to accommodate changing needs.

SUMMARY

The Electricity Services Department has embarked on a project to develop a smart pilot system that supports a prepayment meter that is bi-directional. This means a meter that can both supply energy that has been paid for, and accept credit for surplus energy generated by the user that is fed back into the grid.

Users of photovoltaic systems (which convert sunlight directly into electricity and are possibly the cleanest renewable energy system available) may produce more electricity than they need. If a user of this system has excess electricity stored, they can, technically, feed it back into the electricity grid and receive credit. The pilot was begun in 2012 with three domestic households which use photovoltaic power.

The system requires a robust and reliable power line communication between the customer's prepaid device, the meter installed in street furniture and concentrators connected via GPRS to the City's backend SAP billing and metering systems. Though great progress has been made, a solution is not yet available.

BACKGROUND

Recent advances in photovoltaic technology (solar power that converts sunlight directly into electricity) makes domestic electricity generation feasible. Using grid-connected technology, these devices become more cost-effective and environmentally-friendly since no batteries are required. The City is preparing its systems and processes to accommodate these small scale embedded generation (SSEG) requirements.

The City's current policy is to move all domestic customers to prepaid metering, thus a solution is required that can correctly meter SSEG systems as well.

ENABLERS

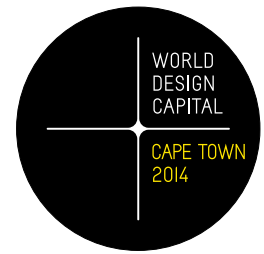
Utility Services Directorate

Electricity Services Department

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This case study describes one of the City of Cape Town's innovative projects that demonstrates how the City applies **design-led-thinking** to support City strategies and goals and help to improve the lives of residents. For more, scan the QR code alongside or see www.capetown.gov.za/WDC2014/



A technical specification for a smart prepayment meter was compiled and a request for proposals issued in February 2010. A small pilot project was awarded in mid-2011 to Landis + Gyr for the installation of 600 split prepayment meters, concentrators (which collect data), check meters, geyser control relays and a master station. The pilot project installation has been completed without the possibility of providing bi-directional prepayment meters and their integration with back-end systems.

A memorandum of understanding was also been signed with three SSEG participants (three Cape Town households which use photovoltaic power) and check meters were installed as part of the pilot project. A cautious approach was adopted to establish robust technical solutions and business processes.

Learning from the pilot installations has provided Electricity Services with a clear understanding of the technical challenges, and it was decided to focus on a single-phase solution as the majority of domestic installations are of this type. The market was tested and Itron (designers and manufacturers of electricity meters) was able to provide a prepayment solution with both forward and reverse energy registers, as well as remote capability.

In the bi-directional metering model, electricity produced by a renewable energy system, such as photovoltaic panels, can flow into the utility grid and be metered. These electricity meters would react in different ways if energy is produced for the grid: They can run in reverse; they can be stopped; or they can be made to run forward (or decrement). The current prepayment meter design runs forward (decremental units) if reverse fed to protect the City from fraud.

In the current revenue model the prepayment meter will run as a normal prepayment meter at the home of the customer. If the customer reverses the energy direction without obtaining approval from Electricity Services the meter will decrement. Once approval is obtained the meter will be programmed with a detent or backstop if the tariff is not taken up. If the customer decides to take the SSEG tariff, the meter will be remotely read automatically and the correct calculation and tariff applied in the billing system.

Prepayment infrastructure in South Africa is a challenge which is being addressed through this pilot project. In order to transform the current grid system, a substantial initial capital investment is necessary. The City's Integrated Development Plan supports investment in infrastructure that will promote sustainable growth and ensure that there is sufficient capacity to support development. The development of a net metering system (crediting the customer for feeding electricity to the grid) will substantially improve Cape Town's capacity to respond to rising electricity costs and to increase reliance on renewable energy sources.

Bi-directional prepayment metering is hindered by several challenges, including integration into the institutional billing system, the lack of active standards development and a lag in terms of industry production. Despite this, the City is ahead of other municipalities in South Africa.

The project is a learning experience for the City but it is hoped that as technology advances, optimal and reliable solutions will be available. SSEG can play a significant role in the green economy, as it incentivises the use of renewable energy sources. This is an important aspect of the City's Energy and Climate Change Strategy target to provide 10% of its total energy supply from renewable sources by 2020.

The City recognises that in future, embedded generation is going to play an increasingly greater role in the supply of power to the country. This pilot project is the precursor to potential adoption of domestic embedded generation by willing residents.

Research and development is on-going with meter suppliers for the provision of a three phase bi-directional prepayment meter as well.

INTEGRATED DEVELOPMENT PLAN LINKAGES

- **CARING CITY:** The project is focused on reducing Cape Town's carbon footprint by using renewable energy, such as photovoltaic, for the generation of electricity. This supports the City's Energy and Climate Change Strategy target to provide 10% of its total energy supply from clean and renewable sources by 2020.
- **INCLUSIVE CITY:** The same prepayment meter will be rolled out to all residents, irrespective of income or demographic status. For those using the bi-directional option, additional costs will be applicable to

DESIGN THINKING

Design-led thinking is a collaborative and user-centric process through which challenges are identified and creatively addressed to deliver innovative and relevant solutions. With the responsibilities placed on a city administration, the core driver for embracing design-led thinking is the improvement of the quality of life of citizens, the ethos that underpins the World Design Capital programme.

DESIGN TOOLS

For an explanation of the key constructs which support design-led thinking in project conception, design and implementation, see the [Toolbox](#).

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remotely read and bill the meter, and these will be reflected in a tariff available to all where grid conditions permit.

- **OPPORTUNITY CITY:** Customers will be given the opportunity to install small scale embedded generation systems (such as photovoltaic solar panels) and connect these to the electricity supply grid, thus being credited for their electricity generated and provided.
- **WELL-RUN CITY:** The aim is to develop an efficient bi-directional prepayment metering solution for renewable energy site grid consumption and generation, linked to backend systems with the provision of efficient and seamless billing.

HOW HAS DESIGN BEEN USED?

Of the key tools which support design-led-thinking in project conception, creation and implementation, the following are fundamental to the success of the bi-directional prepayment meter project:

- + **INNOVATION CO:** Electricity Services' Measurement Section drives the project, in close co-operation with the Vending Department and IS&T's SAP ERP specialists.
- + **DREAM TEAM:** Departments from Electricity Services and Information Systems and Technology, together with representatives from the Green Energy Efficiency Fund and Itron, formed the core multi-disciplinary team.
- + **CONSULTATION/COMMUNICATION:** The pilot Itron meter was installed in a SSEG participant dwelling. This end-user provides continued feedback about the use of the meter. Other participants have three-phase supply and all their contribution are taken into consideration for technical requirements, tariffs and seamless backend system operability.
- + **EVOLUTIONARY APPROACH:** A memorandum of understanding was signed with the participants of the pilot project after much iteration. This agreement allows for flexibility and ongoing assessment.
- + **QUICK DELIVERY:** The meter produced for the pilot is reliable and was successfully integrated with the City's meter data, unification and synchronisation (MDUS) platform and SAP Quality Assurance.
- + **OPEN ACCESS TO INFORMATION:** There is continued internal and external stakeholder liaison and the sharing of the pilot SSEG sites' grid consumption and generation.
- + **EXECUTIVE MANAGEMENT TEAM:** The mandate to develop SSEG bi-directional prepayment metering was given by the director of Electricity Services, who provides full support to the core team. The next steps will involve making use of Green Energy's contribution for the project initiation document, to build a seamless automated business solution.
- + **INNOVATION CHAMPS:** Electricity Services' Cornie Malan had the initiative and perseverance to provide a technical solution for a functional need. He compiled specifications and tenders, liaised with external role-players and suppliers to find solutions, and is working closely with the City's SAP ERP team.
- + **BIG THINKING, LOCALISED IMPACT:** A bi-directional prepayment meter solution is needed nationally and internationally in emerging markets. This initiative will impact on many communities.
- + **COMMUNITY AT THE CENTRE, CREATIVITY ON THE FRINGE:** The three SSEG participants are dedicated renewable energy role-players in South Africa. Dr Anthony Keen, in particular, provided continued feedback what users' needs were, and assisted the technical testing process.

FURTHER INFORMATION

Contact: electricity@capetown.gov.za

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