IMPACT OF EMBEDDED GENERATION

What will PV installations cost the municipality?

Sharing Of Renewable Energy And Energy Efficiency Innovations And Benefits: Small Scale Embedded Generation Workshop

CENTRE FOR RENEWABLE AND SUSTAINABLE ENERGY STUDIES

Karin Kritzinger

25 November 2014

Victoria Hall, Caledon

UNIVERSITEIT STELLENBOSCH UNIVERSITY

science & technology
Department: Science and Technology
REPUBLIC OF SOUTH AFRICA

NRF National Research Foundation

Eskom

sasol reaching new frontiers

RENEWABLE & SUSTAINABLE ENERGY STUDIES

UNIVERSITEIT STELLENBOSCH UNIVERSITY

The Centre for Renewable and Sustainable Energy Studies was established in 2007 to facilitate and stimulate activities in renewable energy study and research at Stellenbosch University.

The Department of Science and Technology has been funding the Renewable and Sustainable Energy (RSE) Hub at Stellenbosch University since its establishment in August 2006. The aims of the RSE Hub are to develop human capital, deepen knowledge, and stimulate innovation and enterprise in the field of RSE. Currently the DST is still sponsoring the work of the Centre with an annual grant administrated by the National Research Foundation.

Stellenbosch University was designated as the Specialisation Centre in Renewable Energy Technology as part of the Eskom Power Plant Engineering Institute (EPPEI). The research and teaching activities sponsored by Eskom focus on concentrating solar power (CSP) and wind energy and also includes the Eskom Chair in Concentrating Solar Power.

The Sasol Technology group sponsored the new facilities for the Centre for Renewable and Sustainable Energy Studies as well as the work and facilities of the Solar Thermal Energy Research Group at Stellenbosch University.

science & technology
Department: Science and Technology
REPUBLIC OF SOUTH AFRICA

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Eskom

sasol reaching new frontiers

Outline

- Background
- Studies
- Load Profiles
- Individual data
- Investment decision

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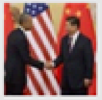
Background

News24 | OLX | PriceCheck | Property24 | Kalahari.com | Careers24 | Spree

news24
Breaking News. First
News24.com Home 4-11-24, 22:32



US and China announce 'historic' climate accord
The US and China have announced an action plan on greenhouse emissions as part of a 'historic' pact that was acclaimed by climate scientists but denounced by US

News | Opinions | Business | Sport | Tech | Motoring | Travel | Lifestyle | Video

74 000m² Cape office park goes solar

2014-02-03 14:56

Vernon Pillay

Cape Town - With electricity prices increasing substantially commercial sectors are investing in multimillion rand solar systems hoping to decrease the dependence on electricity, an office park in Cape Town is in the process of installing a R22m solar system.

Black River Park. (Sola Future Energy)

Black River Park is a 74 000m² office space and is home to various brands.

The Black River Park solar PV (photovoltaic) system consisted of an initial 700kW solar-panel arrangement. The second phase will consist of an additional 500kW system that will cover most of the remaining roofs at the park.

Sola Future Energy is behind this initiative and argues that there is enormous worth in PV systems for commercial buildings. Sola's managing director Chris Haw says that the PV system works especially well with buildings that

Background

HOTEL & RESTAURANT

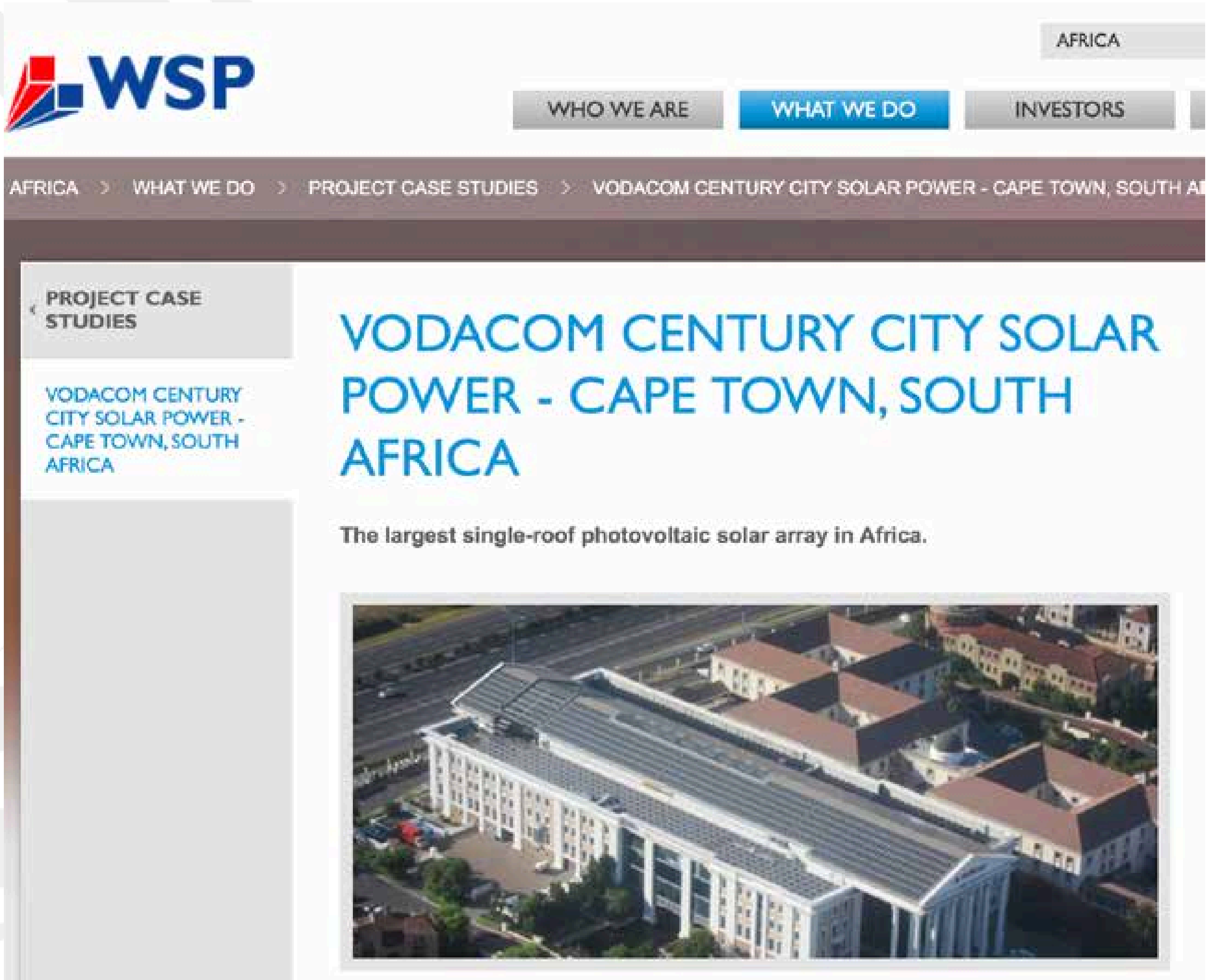
HOME BEVERAGES COLUMNIST ENVIRONMEN
RESTAURANTS CSI TECHNOLOGY TOURISM

3P - 17.3151 ▲ (1.08) ICE:BRENT CRUDE NEAR - 79.520 ▼ (-0.20) Provided By INET

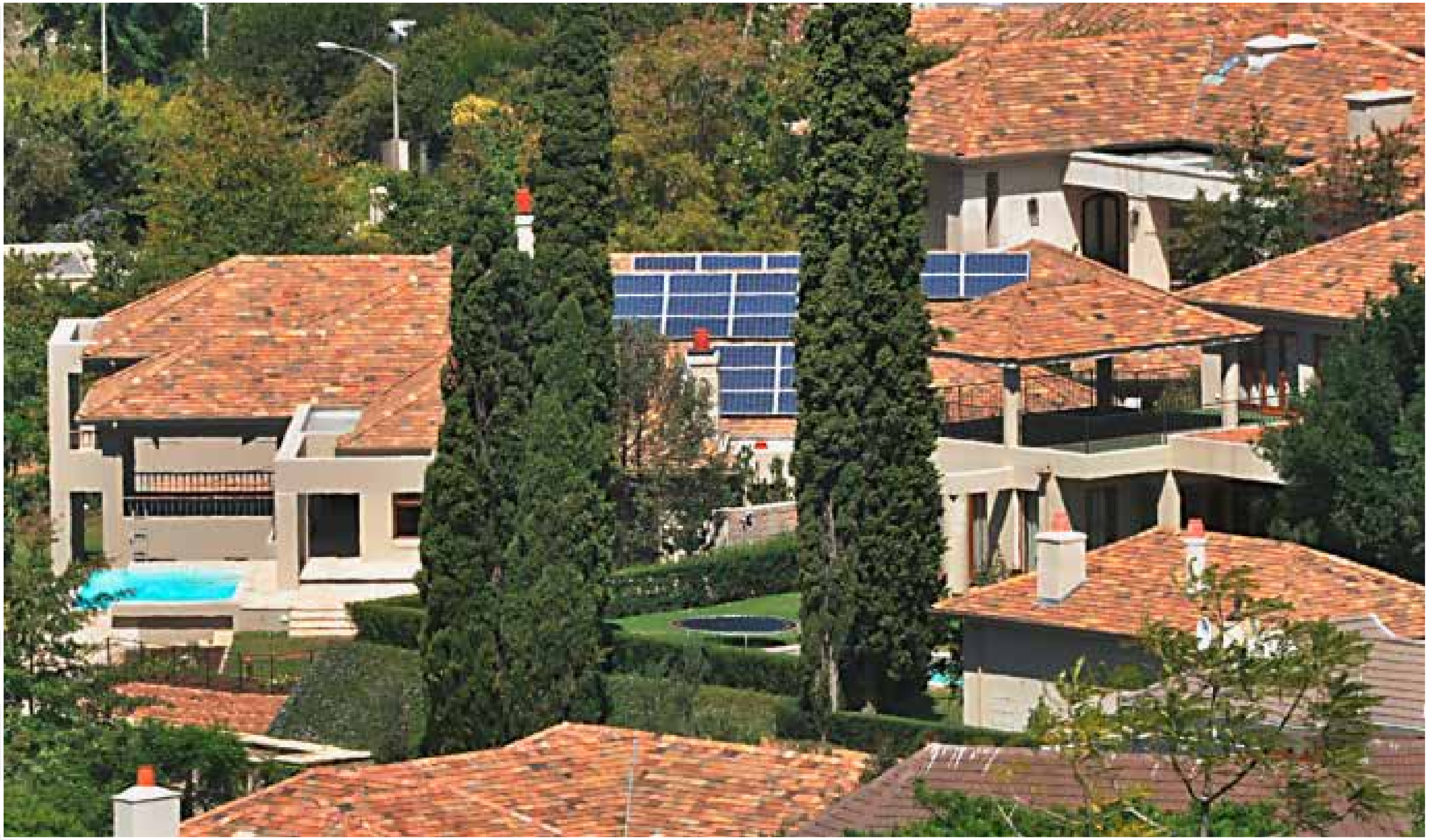
Lourensford invests in solar energy for wine

October 1st, 2014 by Andrew Moth | Categories: beverages, environmental, government, industry, products, restaurants, technology, tourism

Background


AFRICA
WSP
WHO WE ARE
WHAT WE DO
INVESTORS
AFRICA › WHAT WE DO › PROJECT CASE STUDIES › VODACOM CENTURY CITY SOLAR POWER - CAPE TOWN, SOUTH A
PROJECT CASE STUDIES
VODACOM CENTURY CITY SOLAR POWER - CAPE TOWN, SOUTH AFRICA
VODACOM CENTURY CITY SOLAR POWER - CAPE TOWN, SOUTH AFRICA
The largest single-roof photovoltaic solar array in Africa.

Background



Background

Background

Background

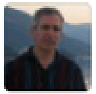
Background

Background

You've got 3 questions right?

1. What did it cost ?
2. What does it do ?
3. What does it entail?

If you're interested in turning your meter backwards;



David Lipschitz
Yesterday

Suppose you could save 30% on your electricity bill, but the City of Cape Town said no! And suppose they have been saying no since 2003?

Would you be prepared to save 30% of your bill and pay 1/2 of this (ie save 15% of your bill) to the City and let the City NOT buy some electricity?

The overall saving is still 30% in electricity. 15% is for your account and 15% is for the City for allowing this to happen.

Example: you are paying R3,000 per month in electricity. You can save R900 per month, but the City won't let you do it, because they might lose money (there are other variables at play but the City isn't interested in them).

So you have R900 per month overall savings and you give R450 per month to the City for allowing you to save the other R450. If the City makes 100% profit on electricity sold to you then the profit on R3000 is R1500. If you save 30%, then the City only makes R1,050, but then you pay R450 (of your R900 savings) and the City makes R1,500. The City still makes R1,500 per month from you but you save R450 per month!

Any takers?

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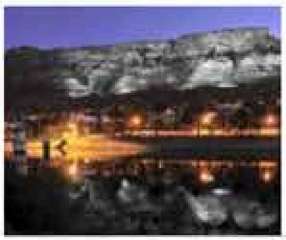

South Africa

Author: Antoinette Slabbert | 12 June 2014 00:05

Metro to "punish" residents for switch to renewable energy

Cape Metro requests tariff hike above Nersa guideline.

Article tools

PRINT ARTICLE

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FEEDS

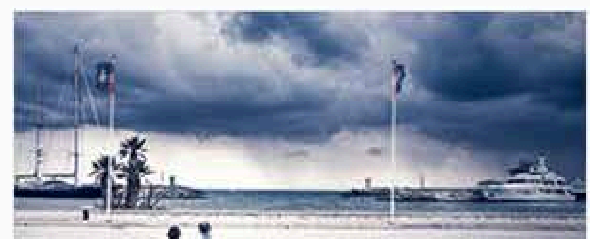
PRETORIA - Residents of Cape Town need to pay more for electricity to compensate for decreased sales as high-end domestic customers switch to renewable energy – with full support of the city council.

This was the argument put forward during public hearings held by the National Energy Regulator (Nersa) about municipal applications for electricity tariff increases that exceed the guideline of 7.39%. Cape Town applied for an increase of 7.63%. Tariff increases at all municipalities take effect on 1 July.

Leslie Recontre, Cape Town director of electrical services told the hearing that while commercial sales

Popular | Commented | Radio | Editor's Pick

1 Eskom expected to miss another Medupi deadline
2 Telkom finally 'gets' convergence
3 The changing nature of the JSE
4 Magnus Heystek got it very wrong
5 Bridge's creditors looks at 18c in the rand



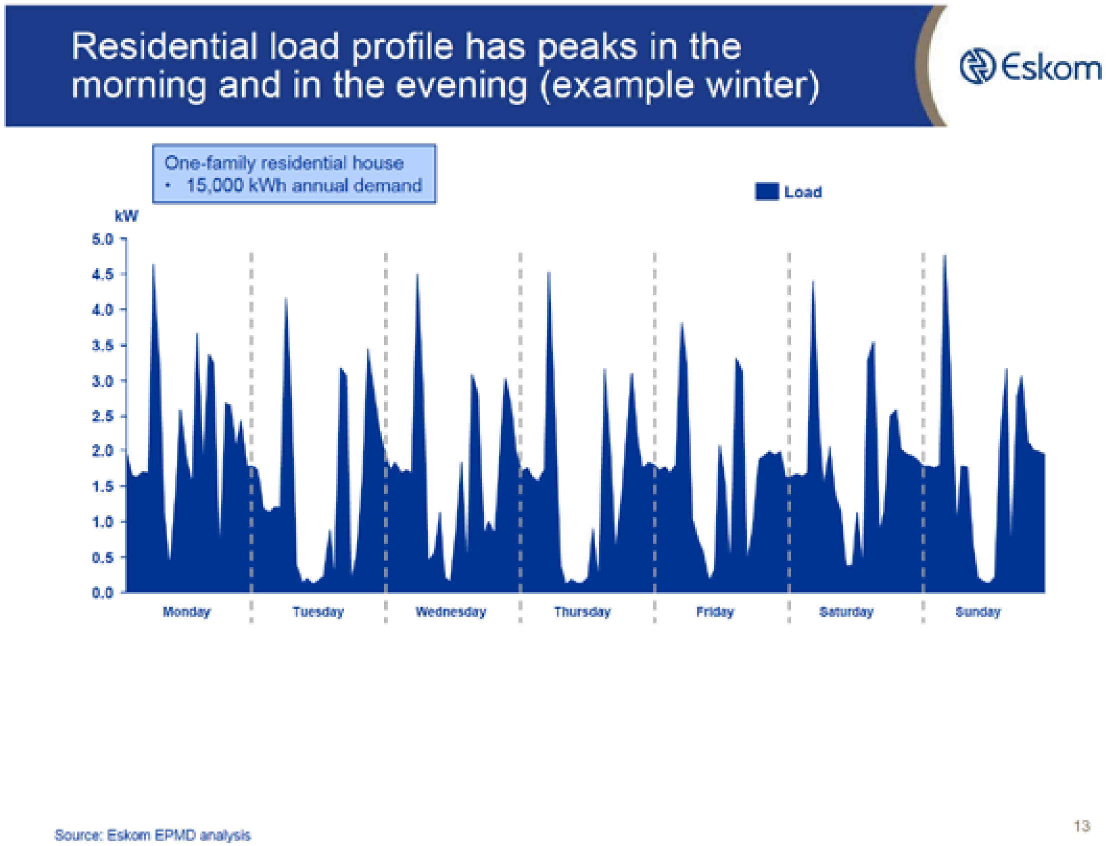
Wildpoldsried produces 321% more energy than it needs

Wildpoldsried, a small village in Germany produces 321% more energy than it needs, and sells it for $5.7 million.

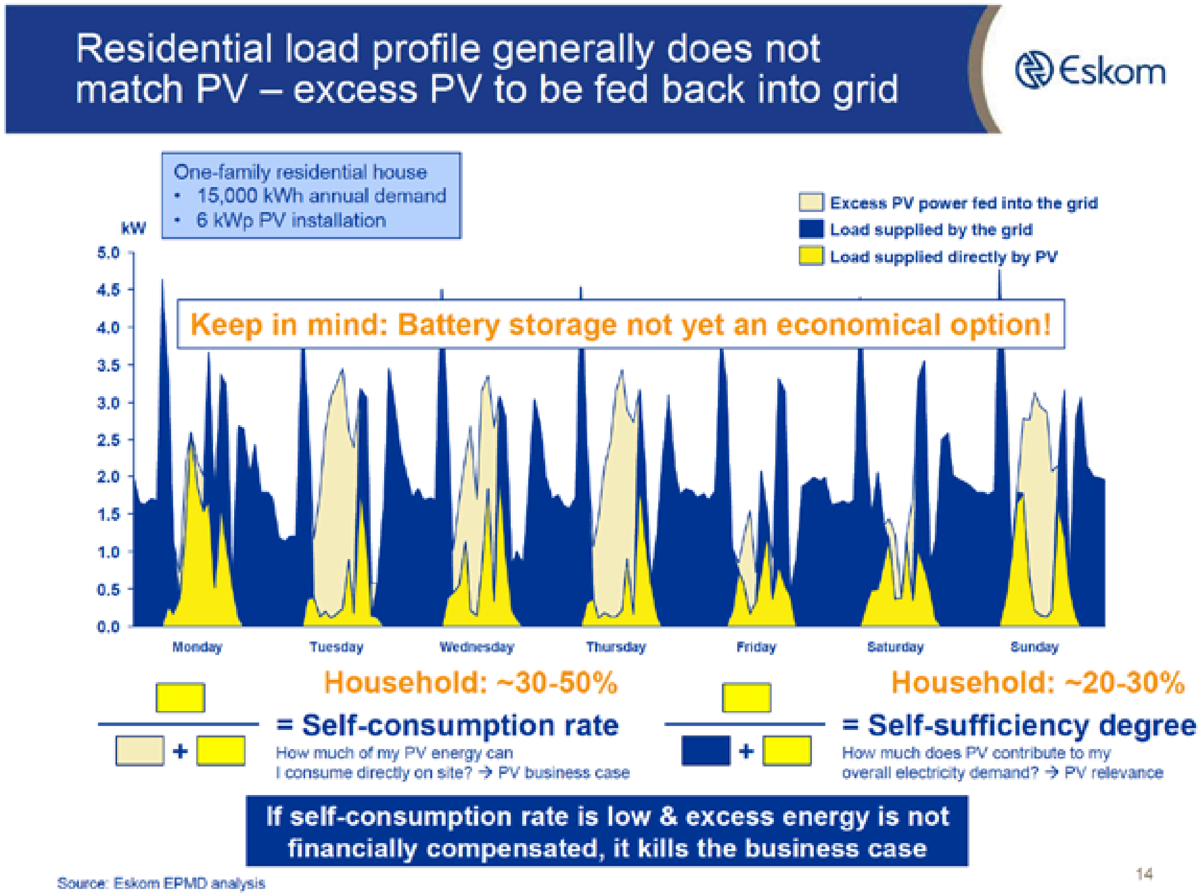
Outline

- Background
- Studies
- Load Profiles
- Individual data
- Conclusion

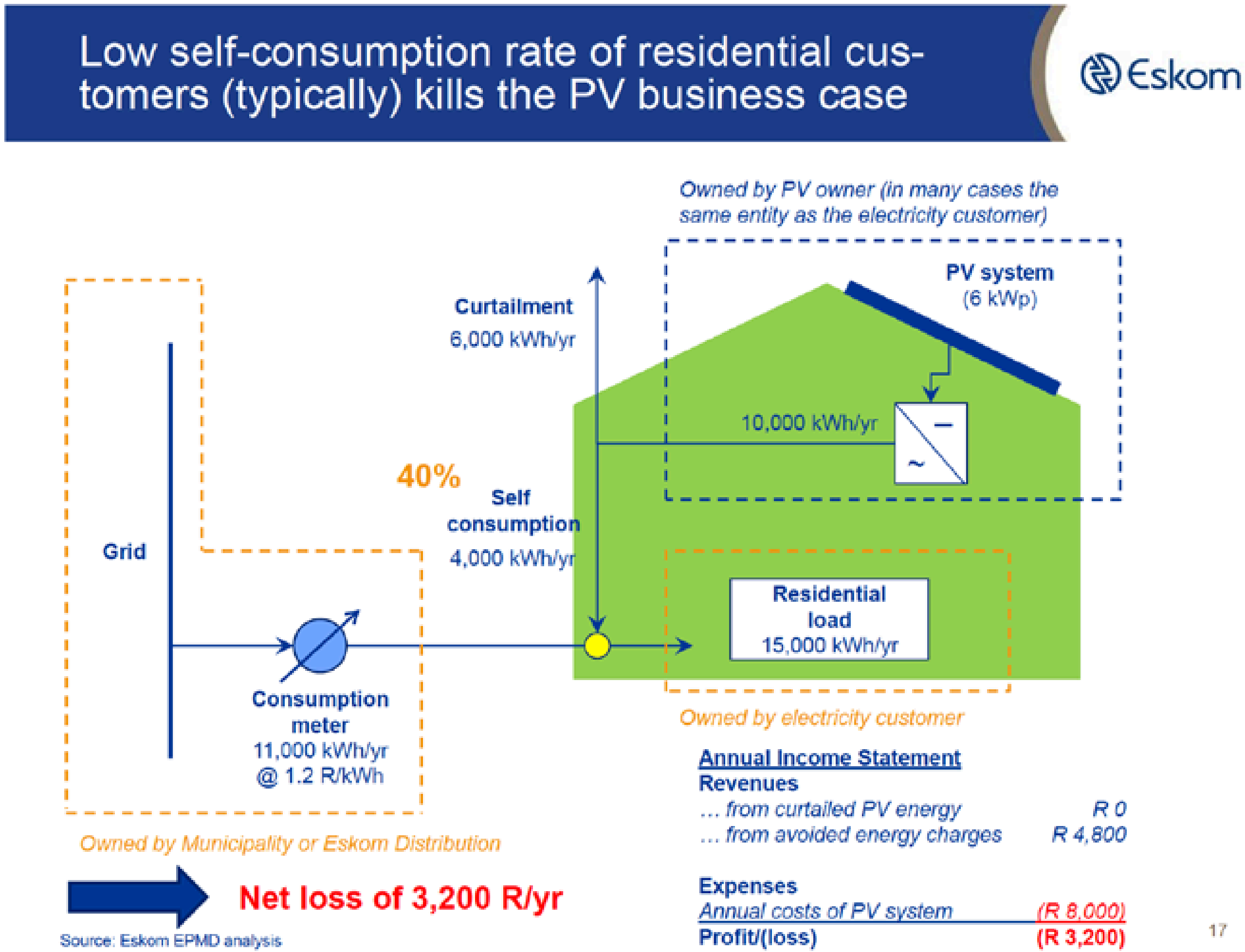
Eskom – Tobias Bischof- Niemz



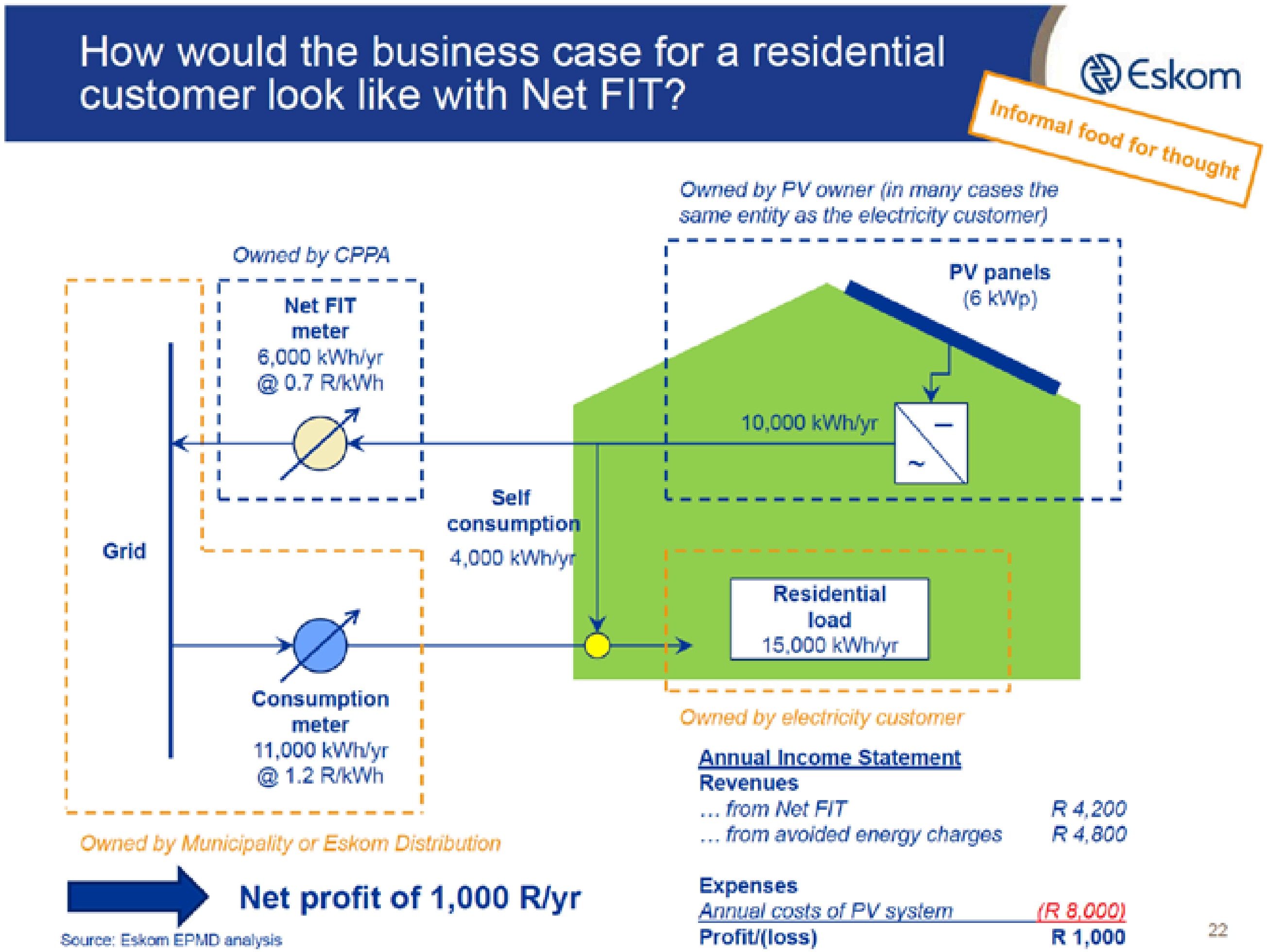
Eskom – Tobias Bischof- Niemz



Eskom – Tobias Bischof- Niemz



Eskom – Tobias Bischof- Niemz



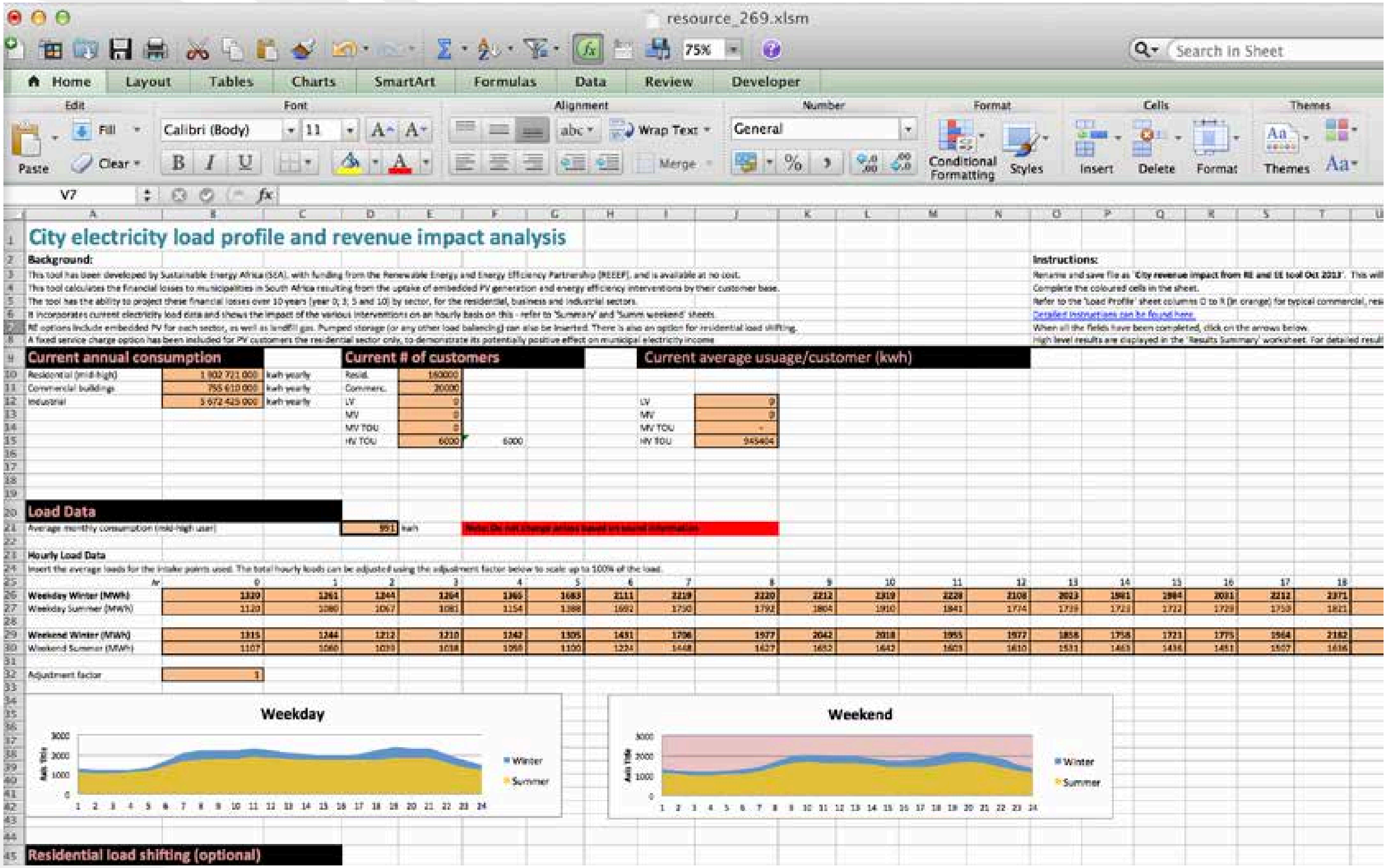
Eskom – Tobias Bischof- Niemz

Proposal: Net Feed-in Tariff with nation-wide central off-taker ("CPPA")

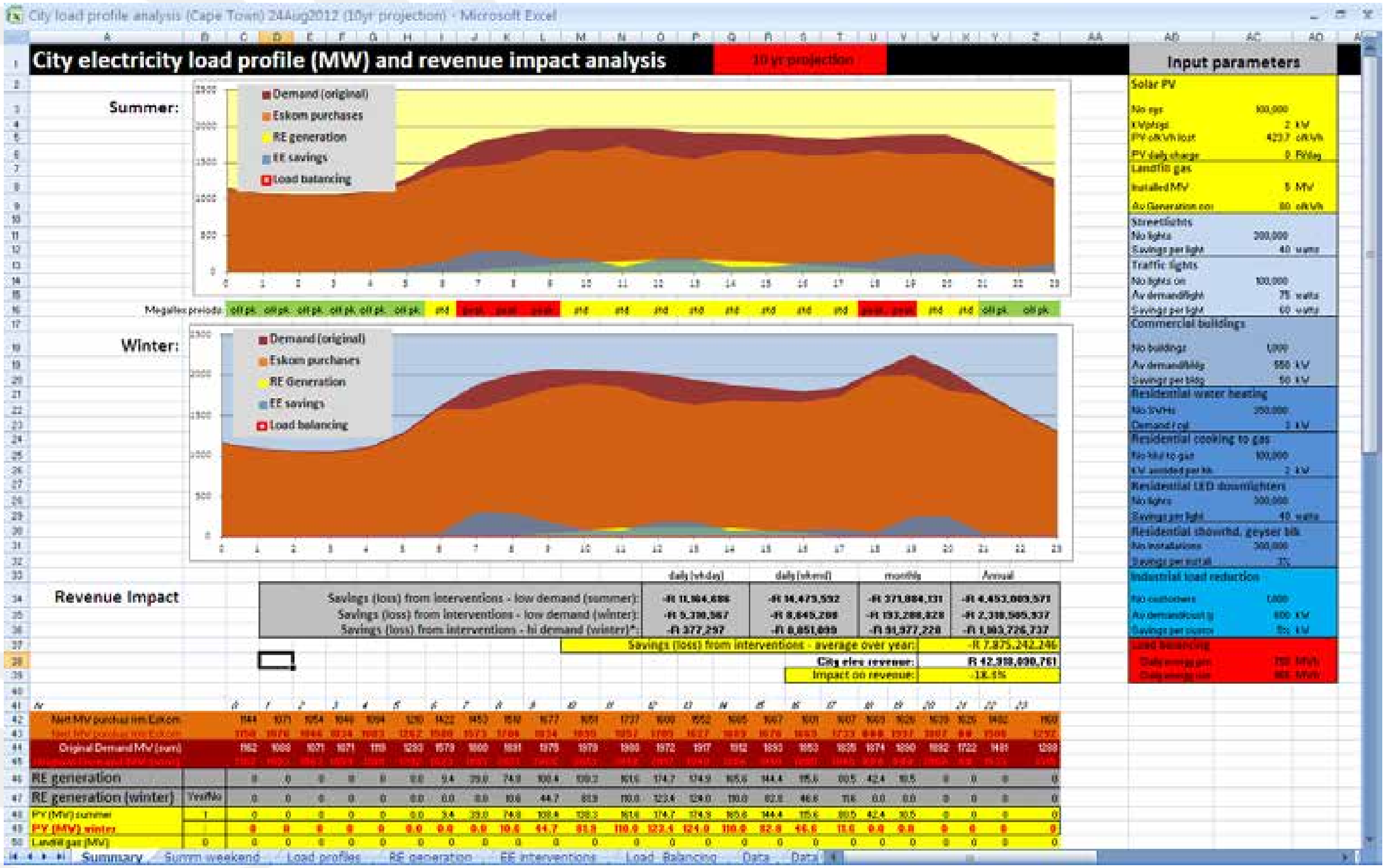
Eskom

Informal food for thought

SEA – Revenue Impact model



SEA – Revenue Impact model



SEA – Revenue Impact model

A 50-85% uptake of EE interventions would be realised across all the economic sectors over the next 10 years.

PV uptake varies between municipalities – Cape Town 15-50% residential; 15-50% commercial; 3-15% industrial. EThekwini 3-15% residential; 15-50% commercial; 3-15% industrial. Ekurhuleni – 2-15% residential; 15-50% commercial; 15-50% industrial. Large scale uptake is only expected thereafter, as the financial case improves.

Uptake of PV in the commercial sector could be as high as 15-50% if current tariff conditions continue to apply.

Assuming the above uptakes, the overall revenue losses in 10 years' time for the metro electricity departments are projected to be between 3-11% (Cape Town), 5-15% (Ekurhuleni) and 8-15% (eThekwini). The main areas where these losses will occur are residential solar water heating and EE across all the economic sectors. The impact of PV is relatively minimal, except potentially in the sections of the commercial sector where the energy tariff is particularly high (usually small commercial tariff customers).

The overall impact of revenue loss on the poor is a question of political decision making, but up to 80% of the cross subsidisation of the low income tariff could be affected, or up to half of the total amount of revenue allowed to be transferred to the rates account.

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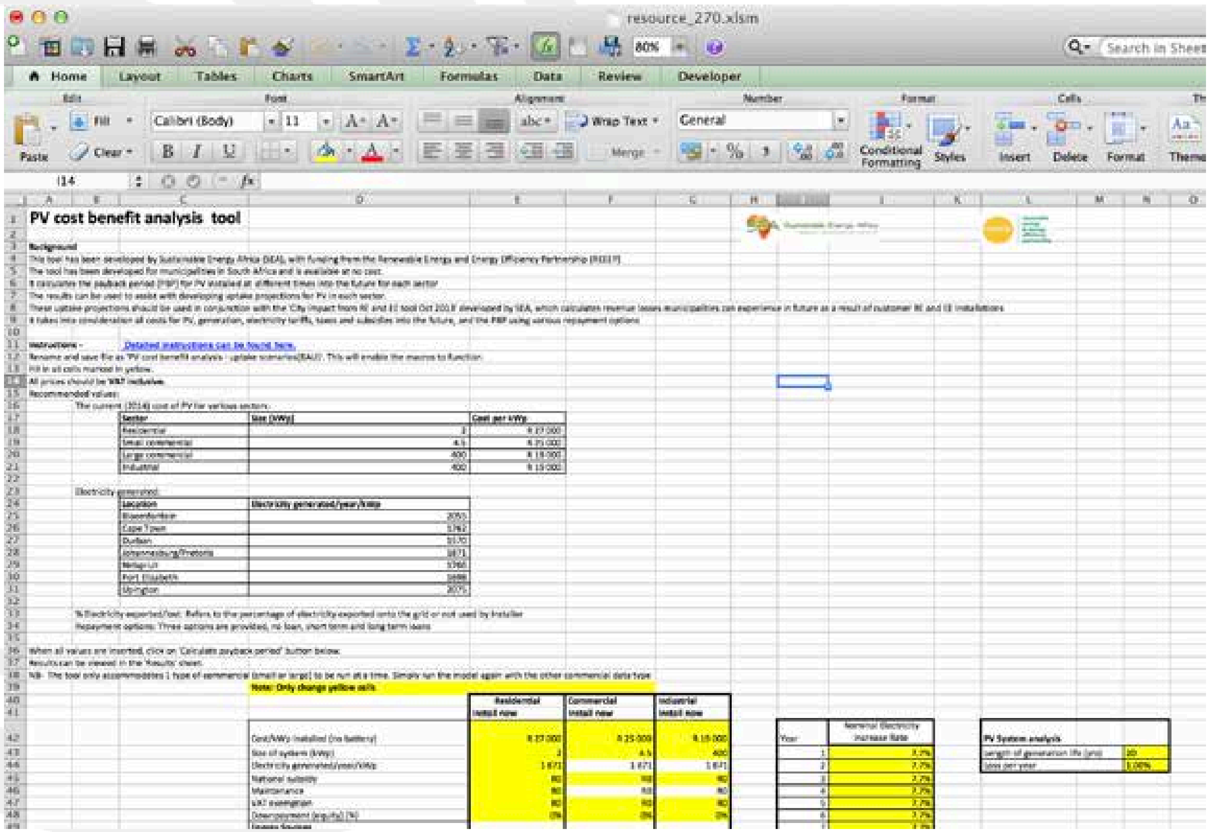
SEA – PV financial feasibility model



GreenCape

A PERSPECTIVE ON DISTRIBUTED GENERATION IN MUNICIPAL NETWORKS
THE REVENUE IMPACT OF SOLAR GENERATION

LEADING THE ELECTRICITY DISTRIBUTION INDUSTRY

AMEU

Author and Presenter: Kevin Kotzen B.Sc Elec Eng - Researcher at GreenCape
Co-Authors: Bruce Raw, Peter Atkins

GreenCape

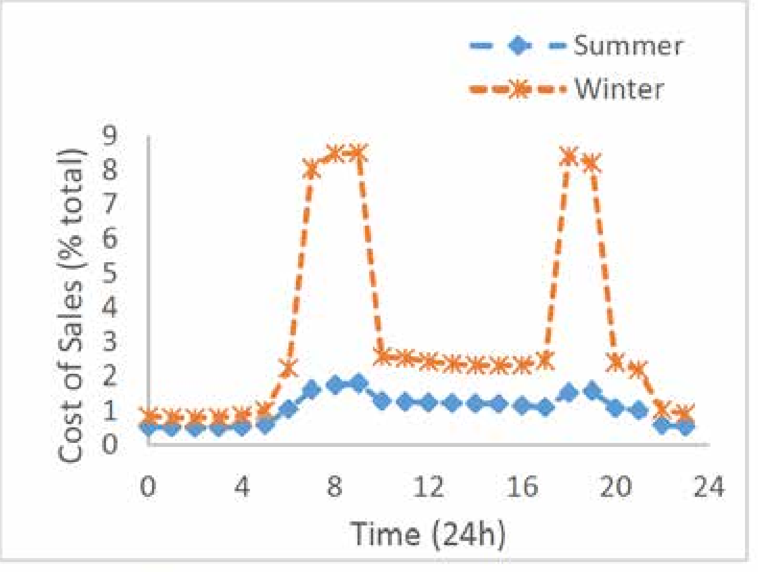


Figure 6: Municipal cost of sales throughout the day. Cost is shown as a percentage of the total daily expenditure.

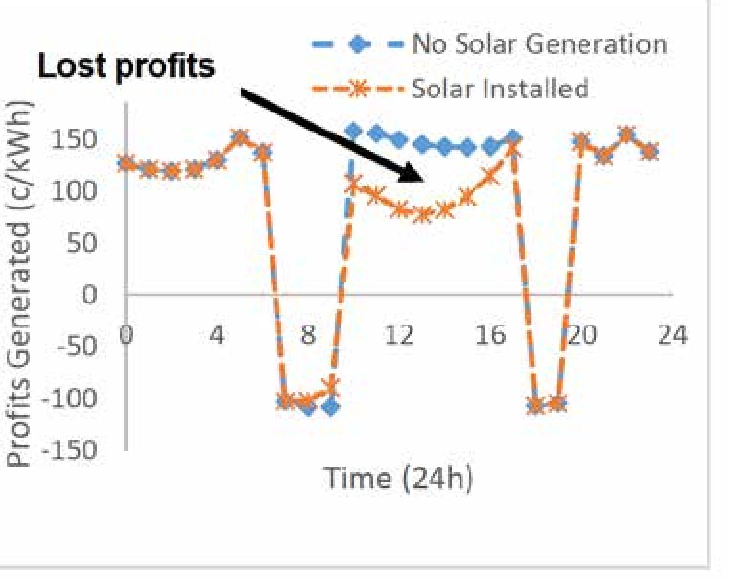


Figure 10: High demand (winter) unit profits generated with and without solar embedded generation

Mott McDonald

SMALL SCALE ON-GRID SOLAR PHOTO VOLTAIC EMBEDDED GENERATION

IN SOUTH AFRICA

METHODOLOGIES TO STIMULATE THE MARKET

LEADING THE ELECTRICITY DISTRIBUTION INDUSTRY

AMEU

Author & Presenter: Paul Tuson PrEng BSc MSc MBL – Studies Team Leader -

Mott McDonald South Africa

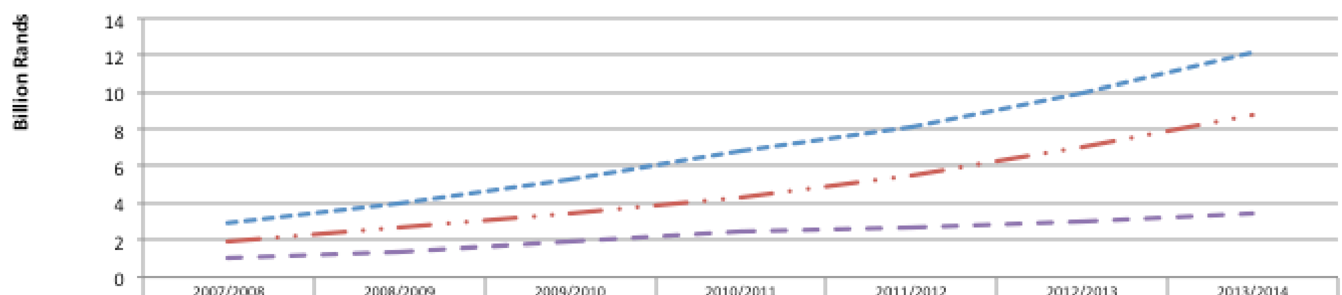
The author of this paper proposes that all three SSPVEG mechanisms (self-consumption, Net-Metering and FIT) are adopted in South Africa but that a phased approach may be less threatening to all stakeholders involved.

City of Cape Town

Potential impact on municipal revenue of small scale own generation and energy efficiency

Hilton Trollip, Vivienne Walsh, Sumaya Mahomed, Brian Jones

Cape Town Electricity Department framing budget
Source - BUDGET For the financial period 2010/11 to 2012/13



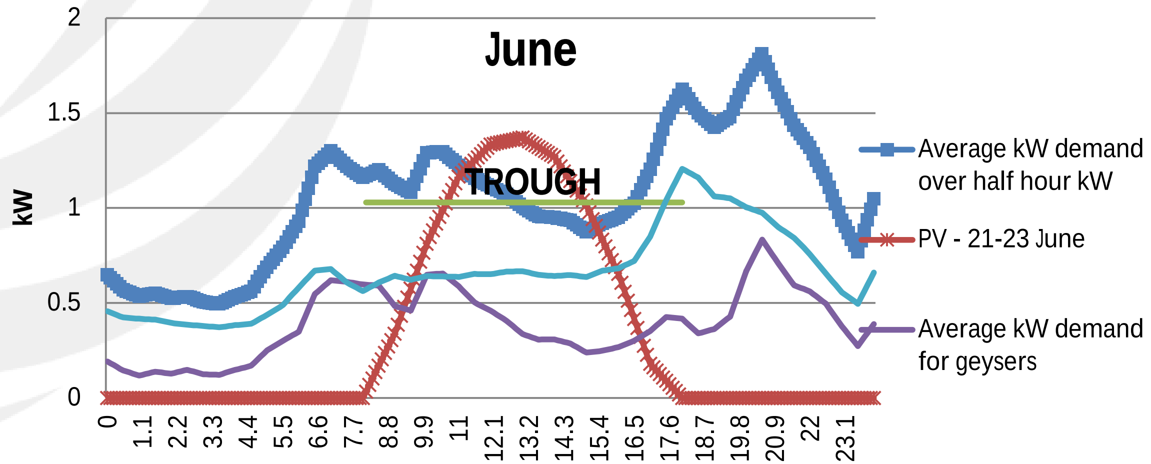
	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014
Electricity Revenue	2.92	3.98	5.34	6.77	8.13	9.95	12.20
Bulkpurchases	1.91	2.62	3.39	4.35	5.47	7.00	8.80
ESD operating expenses = revenue - bulk purchases	1.01	1.36	1.94	2.42	2.66	2.95	3.40

City of Cape Town

Presenting PV own-generation as a most-costly option among other renewable energy/energy efficiency options that could be adopted at significant scale suggests that a combination of PV and other options could lead to **revenue losses of between 17% and 25% of ESD operating expenses from the residential sector alone** and significant additional potential losses driven by similar dynamics in the commercial sector.

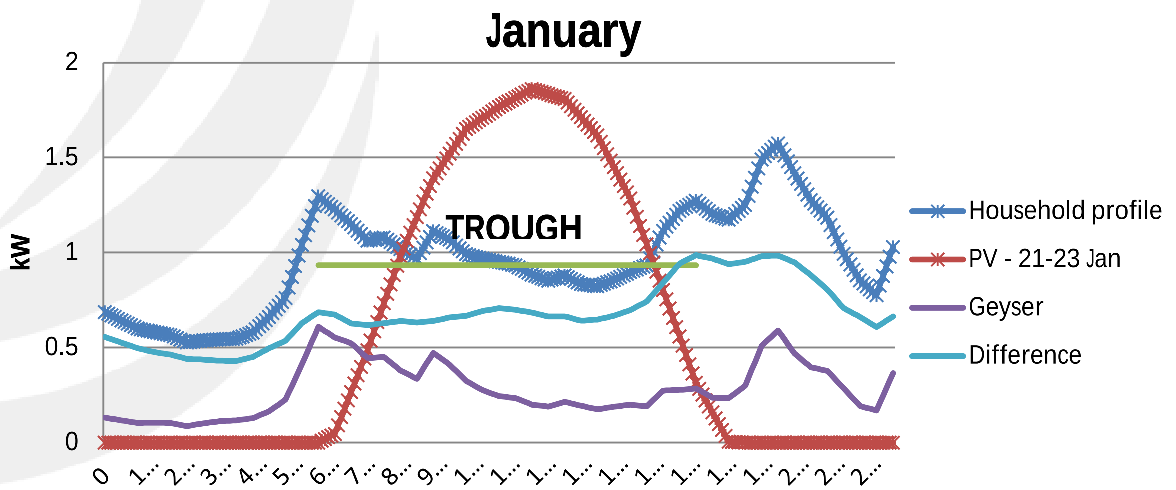
City of Cape Town

Figure 7 – Average typical PV production winter profile overlap with household load profile

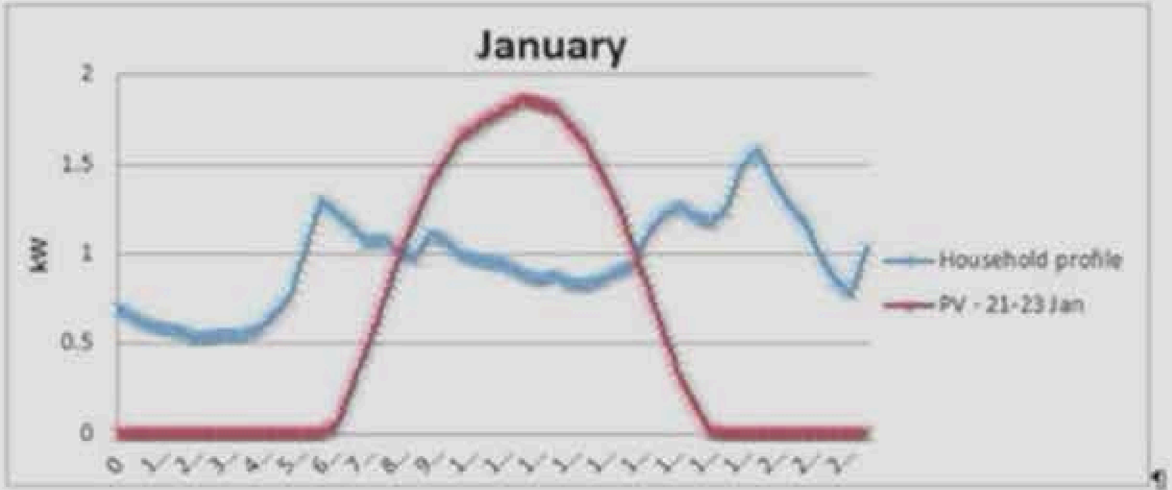


City of Cape Town

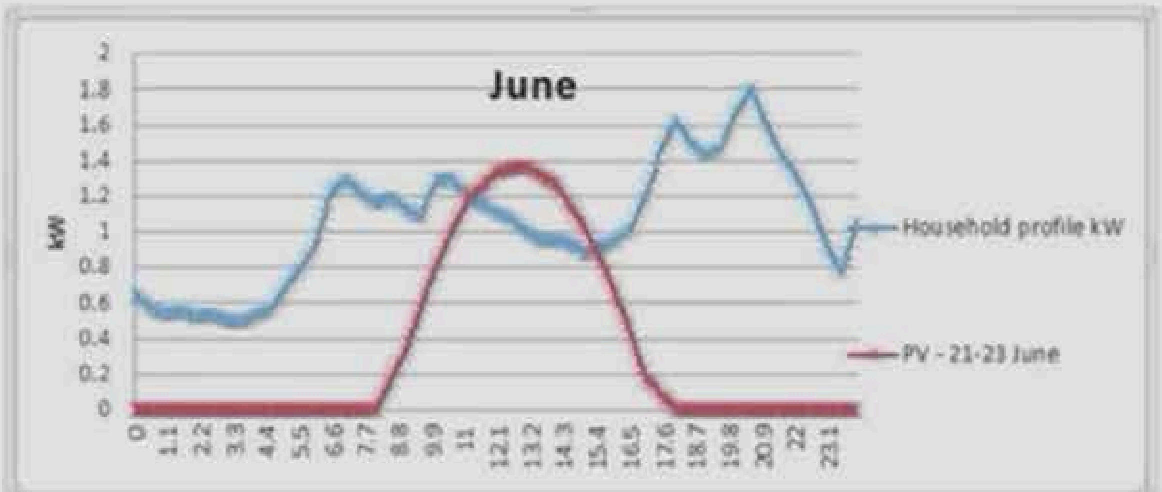
Figure 8 – Average typical PV production mid-summer profile overlap with household load profile



Typical Generation and Consumption Profiles



Generation: from 2 kW (peak) DC array



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

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

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

Brian Jones.

CENTRE FOR RENEWABLE AND SUSTAINABLE ENERGY STUDIES

Unlocking the Rooftop PV Market in South Africa

March 2013

Josh Reinecke

Corli Leonard

Karin Kritzinger

Dr Bernard Bekker

Prof Johannes L van Niekerk

Joschka Thilo

Centre for Renewable and Sustainable Energy Studies

Faculty of Engineering • Fakulteit Ingenieurswese
Private Bag / Privaat Sak X1 • Matieland, 7602 • South Africa / Suid-Afrika,
Tel: +27 (0) 21 808 4069 • Fax / Faks: +27 (0) 21 883 8513
crses@sun.ac.za
http://www.sun.ac.za/crses

Potential uptake of rooftop PV

Conservative		Erven	PV ins (kWp)	Gen (kWh)
	Residential Single Phase	3	6	8 874
	Residential Three Phase	0	0	0
	Light Commercial	2	20	29 582
	Heavy Industrial	3	120	177 496
Total		8	146	215 954

Table 8-3: Conservative uptake scenario

Generous		Erven	PV ins (kWp)	Gen (kWh)
	Residential Single Phase	15	30	44 374
	Residential Three Phase	1	8	20 412
	Light Commercial	5	50	73 957
	Heavy Industrial	9	360	422 022
Total		30	448	560 765

Table 8-4: Generous uptake scenario

Impact of PV on Riversdale

- Rooftop PV will reduce electricity sales
- By how much?
  - Understand Riversdale's current electricity revenue
  - Understand potential uptake of rooftop PV in Riversdale
- By only a small amount
  - Conservative uptake – 146kWp: 0.2% of electricity sales
  - Generous uptake – 448kWp: 0.66% of electricity sales
  - All rooftops – 9 840kWp: 11% of electricity sales
  - Note: max 1 384kWp allowed for Riverdale (NRS097-2-3)

ELECTRIC POWER RESEARCH INSTITUTE

Load Forecasting in the New Era of Uncertainty

Omar Siddiqui
Senior Technical Executive

Research Advisory Committee
Phoenix, Arizona
October 28, 2014

Load Forecasting – The Story in Brief

Status Quo Methods

- Econometric regressions of variables highly correlated to electricity demand
  - Population
  - Weather
  - Economics
- Decades of successful practice in utility planning
  - Short term (week ahead)
  - Long term (years ahead)

Challenges

- Traditional variables becoming less correlated
- Disruptive technologies gaining effect on load
  - Rapid pace of change
  - Sparse data or experience with these new variables
- Demand becoming more variable, *less predictable*
- Unprecedented changes

Implication

Load forecasting methods must adapt to new era of uncertainty or risk continued divergence from reality and sub-optimal investment and planning decisions

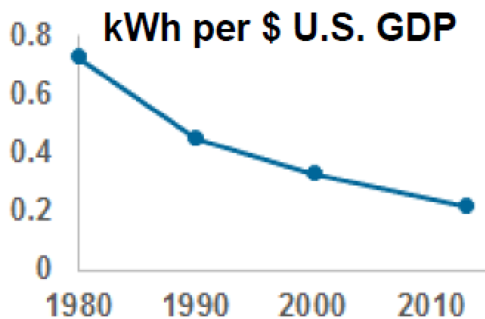
ELECTRIC POWER RESEARCH INSTITUTE

New Era of Load Uncertainty – Macro Drivers

Structural Changes in Economy

Load growth decoupling from economic growth

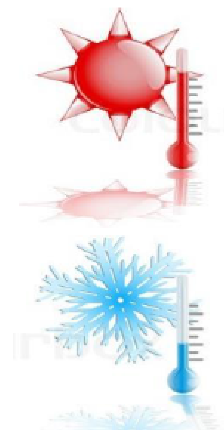
Sustained effect of recession: "new normal" stagnation



Weather Anomalies

Increasing frequency of extreme weather occurrences

Diminishing predictive value of historical weather data

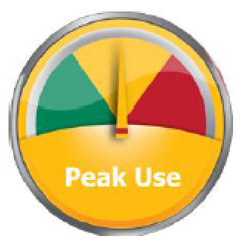


Peak Demand Outpacing Energy

U.S. 1.2% peak demand growth vs. 0.8% energy growth (next 10 years)

Greater penetration of central air conditioning

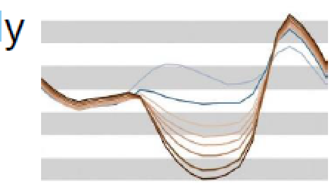
Localized needle peak phenomenon



Ramping for Renewables

Increasing solar and wind penetration puts pressure on other resources (supply and demand) to flex

"Duck curve" effect – steepening ramp rates



Disruptive Changes in Electricity End Use

Energy Efficiency

$6 Billion spent on EE programs in 2012 in U.S.

8 – 11% energy savings potential from EE programs in 2035 (EPRI)

Codes & Standards: 7% energy savings impact of EISA in 2030

Variable Speed Heat Pumps

Over 30% energy savings in EPRI field studies

Flexible operation for DR, but may *increase* peak demand at max loading conditions

Enhanced comfort and control

Consumer Electronics

Proliferation of chargeable devices

TVs more efficient, more ubiquitous; 2.9 TVs per home (2.5 people per home)

Power is the limiting factor

Energy Controls

Growth of sophisticated, intuitive devices and apps for energy and demand management

Reshaping load curves

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Disruptive Changes in Electricity End Use (Cont'd)

Plug-in Electric Vehicles

PEV sales growing faster than hybrids a decade earlier

200,000+ PEVs sold in U.S.

Projected to exceed 5% of new vehicle sales by 2020

Solar Photovoltaic

More solar installed in U.S. in last 18 months than prior 30 years

5x increase projected in U.S. over next 3 years

New residential PV system installed in U.S. every 4 minutes

Capacity value – questionable

Electrification

Advances in electric process heating, separations, and heat pump technologies for emissions reduction and productivity improvement

Natural Gas DG

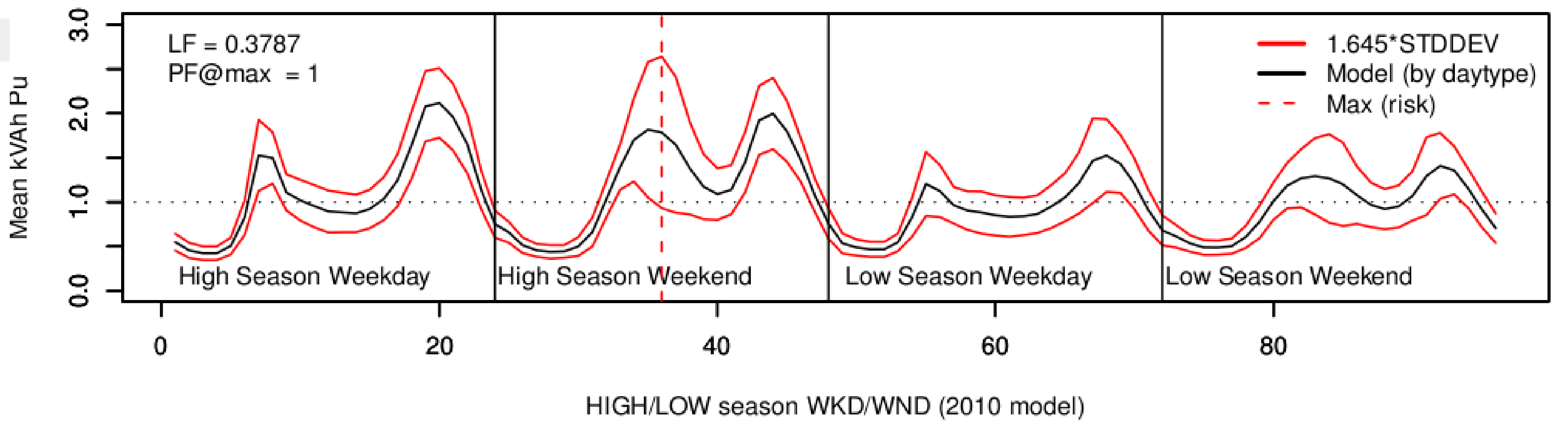
Impact of $4/MMBtu wholesale prices on economics of natural gas DG

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Outline

- Background
- Studies
- Load Profiles
- Individual data
- Investment decision

Profile view

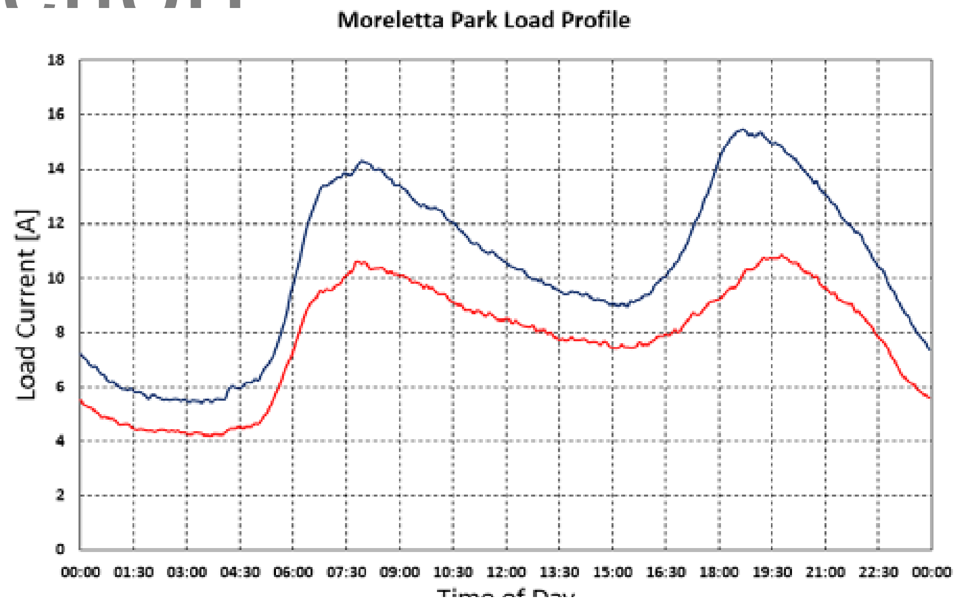


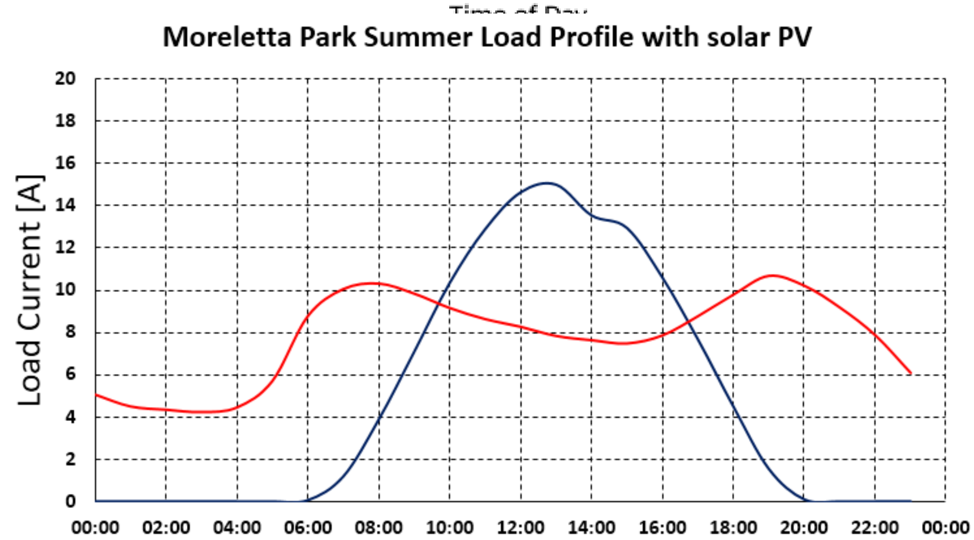
- A "seasonal version" of same DPET load shape will be found in GLF load sub-class library.
- A "localised" version of GLF will be found in DProfile mixer for same given consumption level
- All the tools referencing this consumer class (ie demographic) are based upon same underlying load models.
- Their visualisation may differ depending upon the analytic required for their application.

Scenarios Selection

- Characteristic load profiles
  - LSM 7-8
  - Variation of load and generation
  - Single-phase vs. three-phase
  - Solar Water Heating

    (Excluded in first phase)



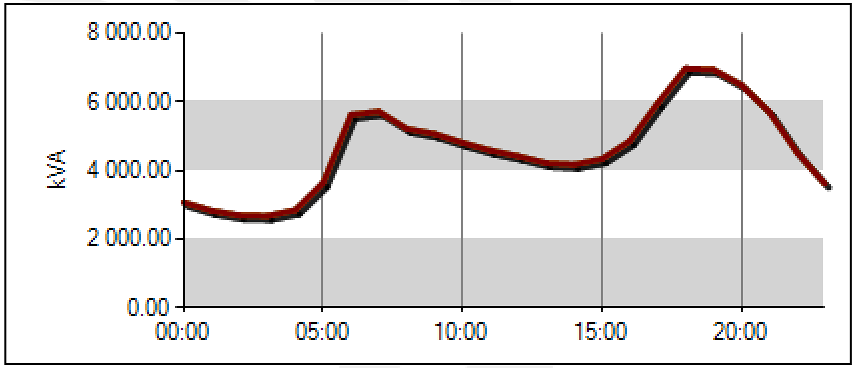


Dr Gerhard Botha - Eskom

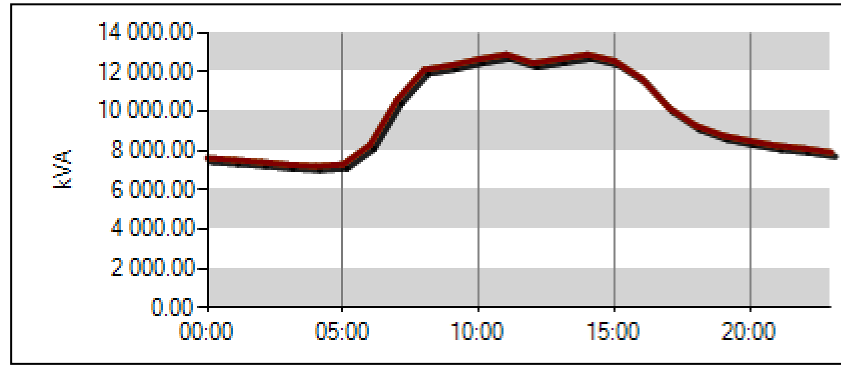
Supply Options and Resultant Profiles

Option 1

Transformer 1: HI Res, Low Income, Med Income

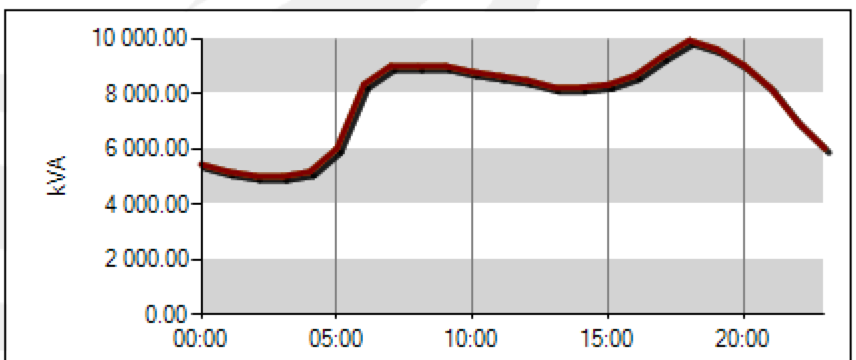


Transformer 2: Industrial, Office Park, CBD

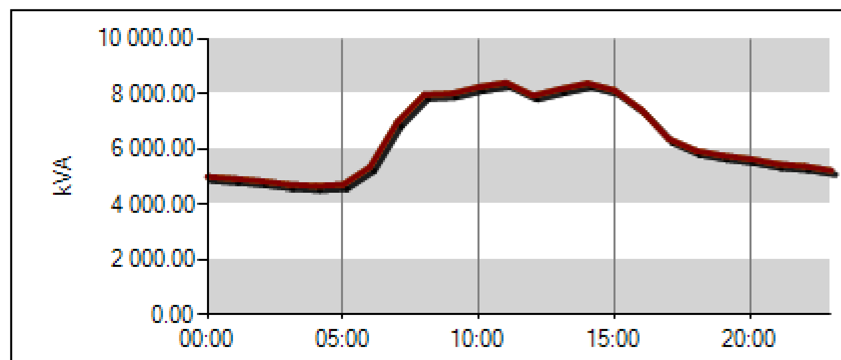


Option 2

Transformer 1: CBD, HI Res, Low Income

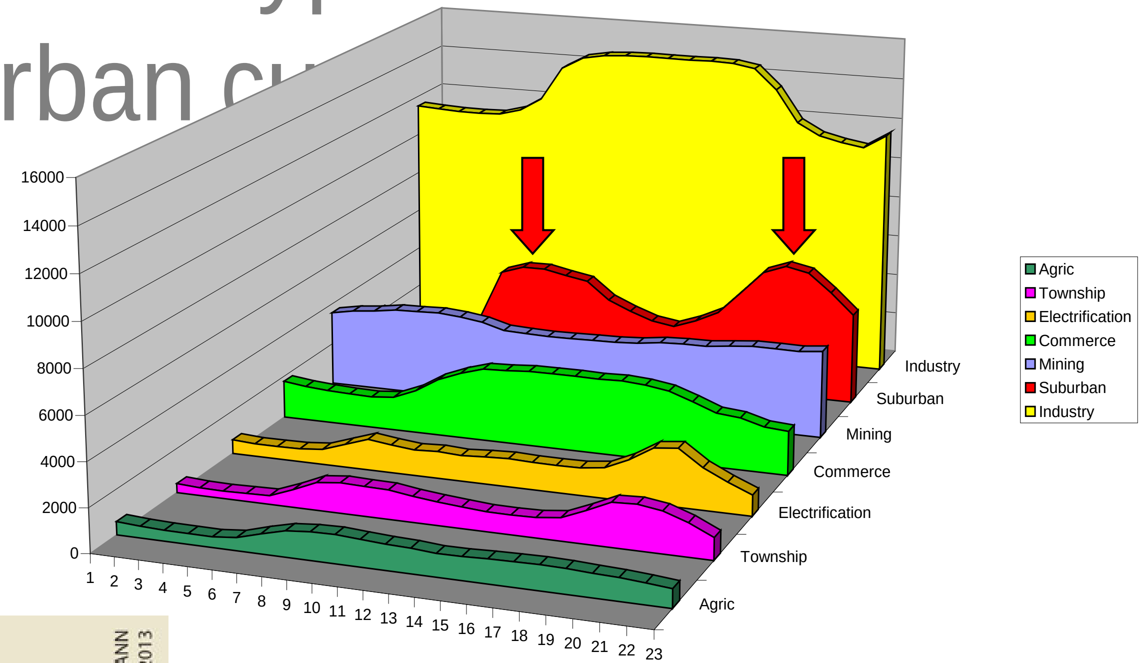


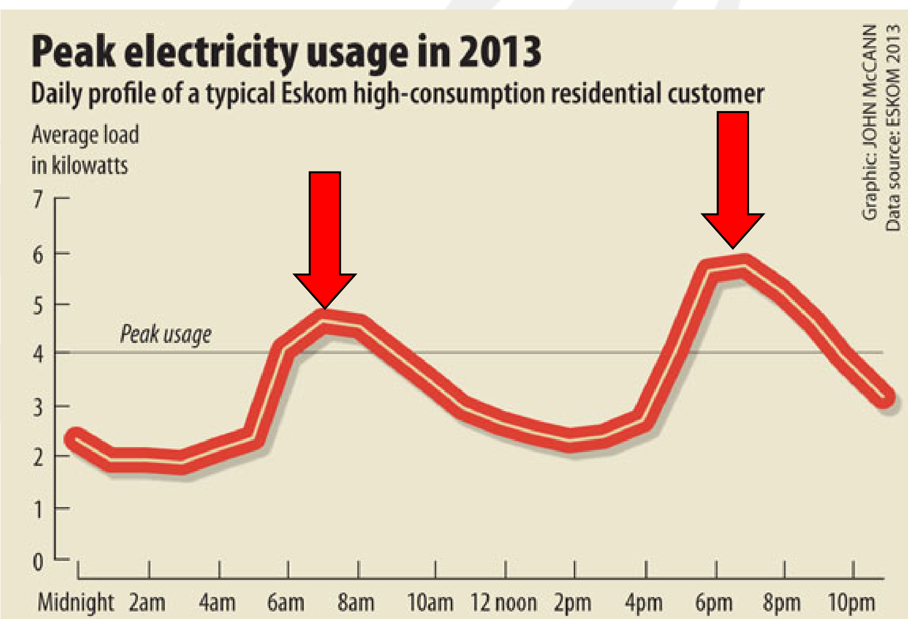
Transformer 2: Industrial, Office Park, Medium Income



Average weekday peak electricity usage of a typical residential suburban cu

- The residential sector uses about 17% of the total electricity generated in South Africa





- From 7am to 10am in the morning, and 5pm to 9pm in the evening – periods of peak demand in South Africa – residential demand is up to 35% of the total demand required.

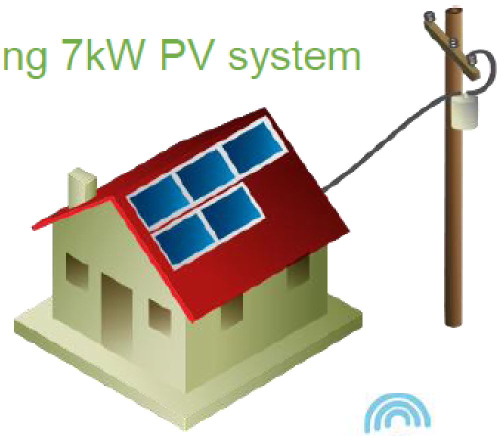
Source:
- Total End Use Consumption – Eskom ISEP/DSM
- Eskom Integrated Demand Management

Vashna Singh

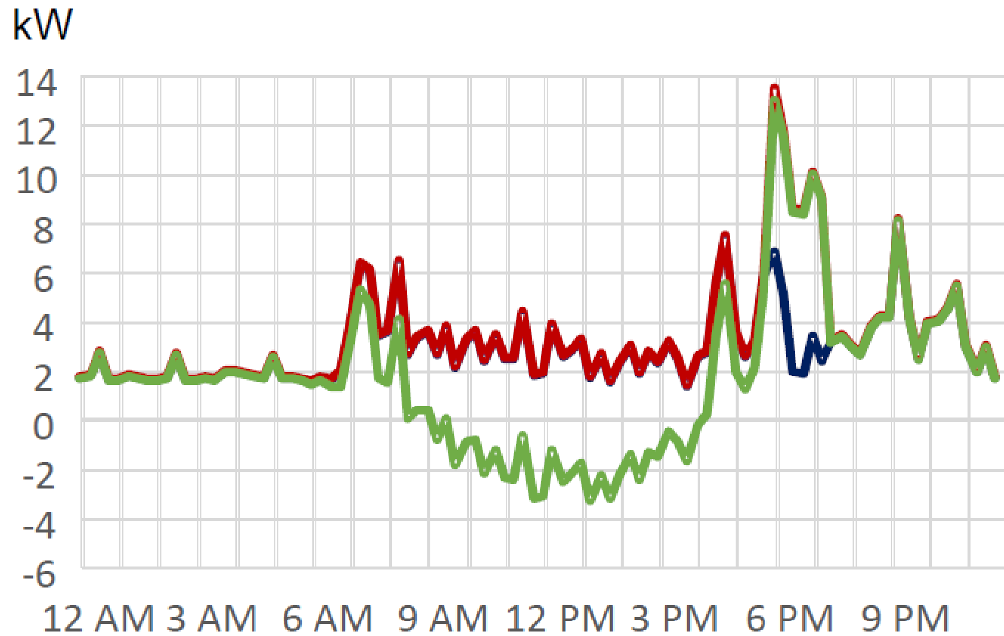
New Residential Resources

Household Load

Adding 7kW PV system



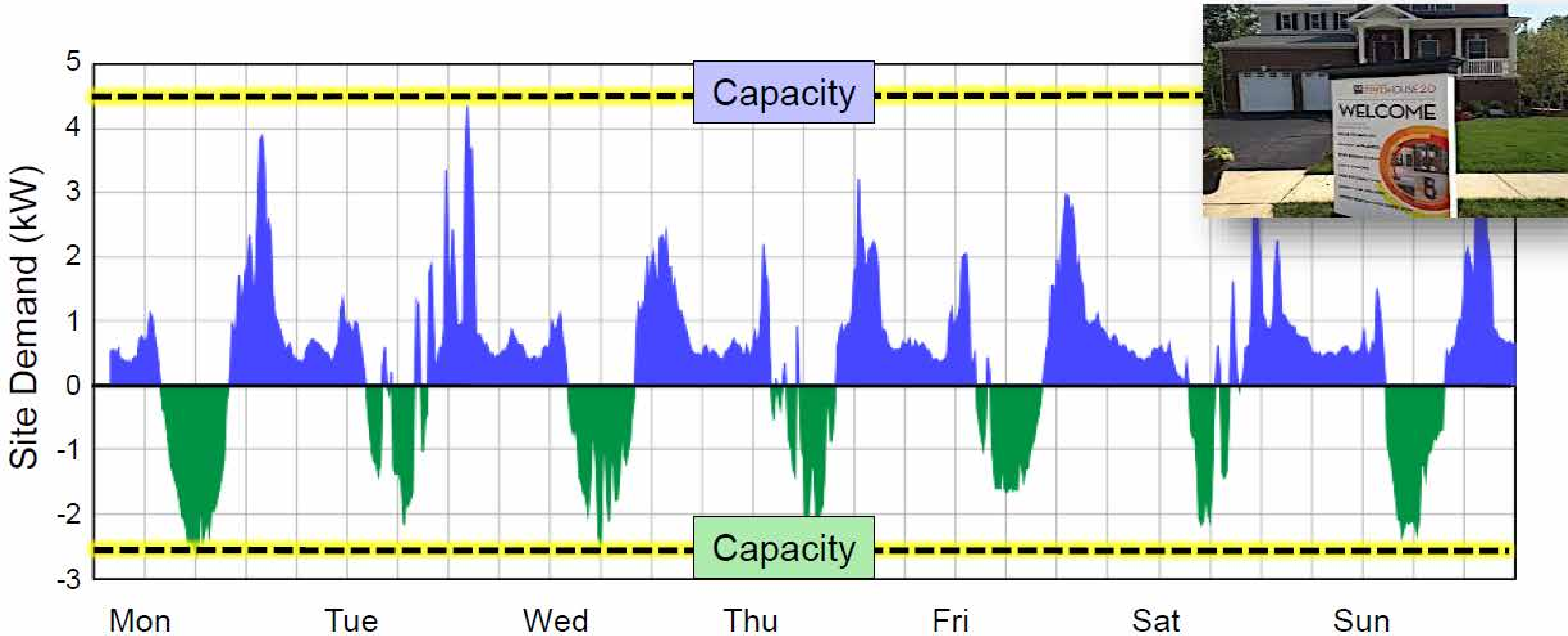
Adding an electric vehicle on a 6.6kW charger



Grid-supplied energy	18.46kWh
Peak 15-minute demand	12.02kW

- New types of sources and loads may alter required capacity and energy
- Lack of diversity in generation/use increases capacity requirements

Zero Energy Home but Not Zero Capacity Home

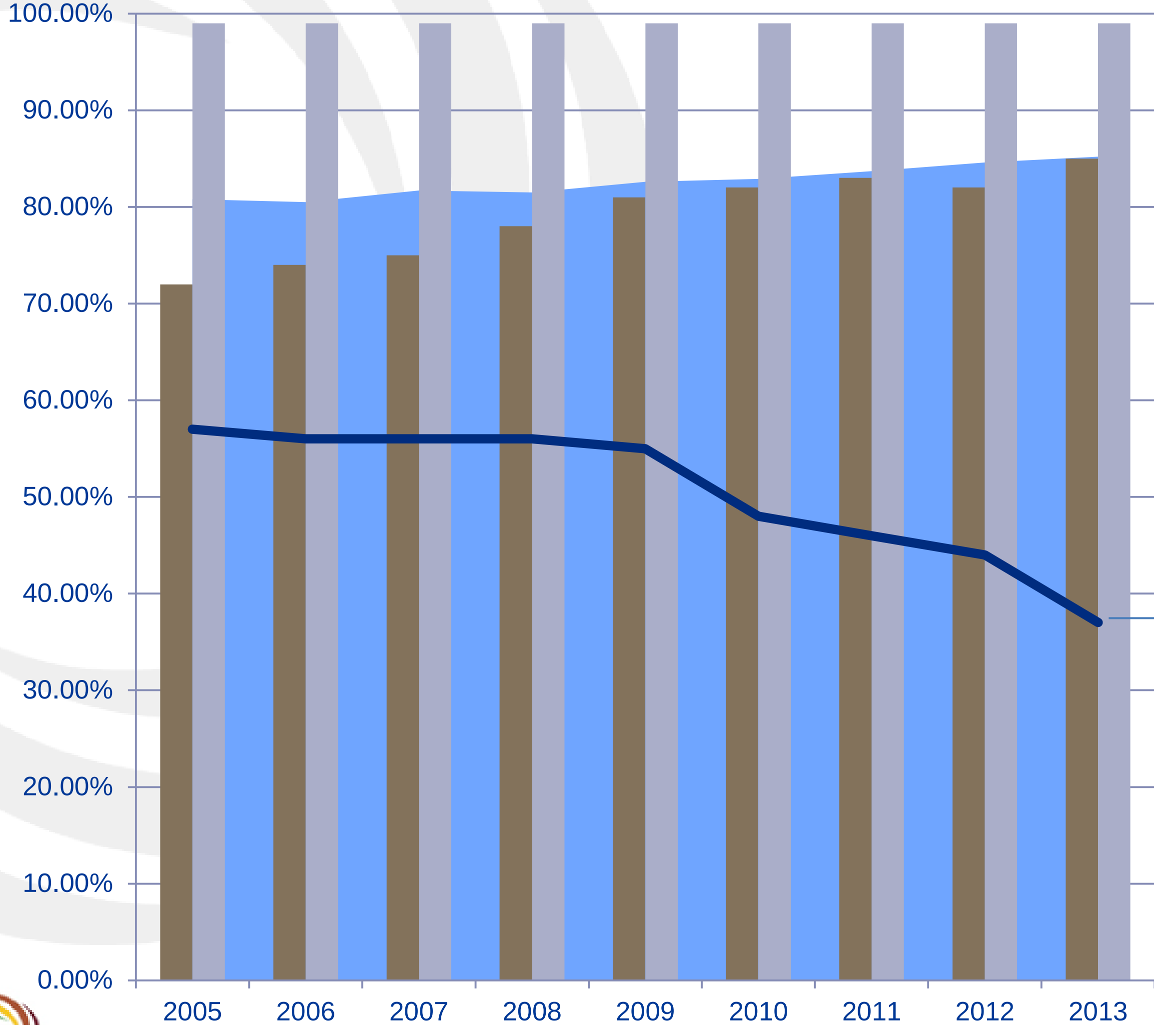


Customer Sited Generation Will Impact Local and System Level T&D Infrastructure Planning

Barry McColl

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Households usage of electricity

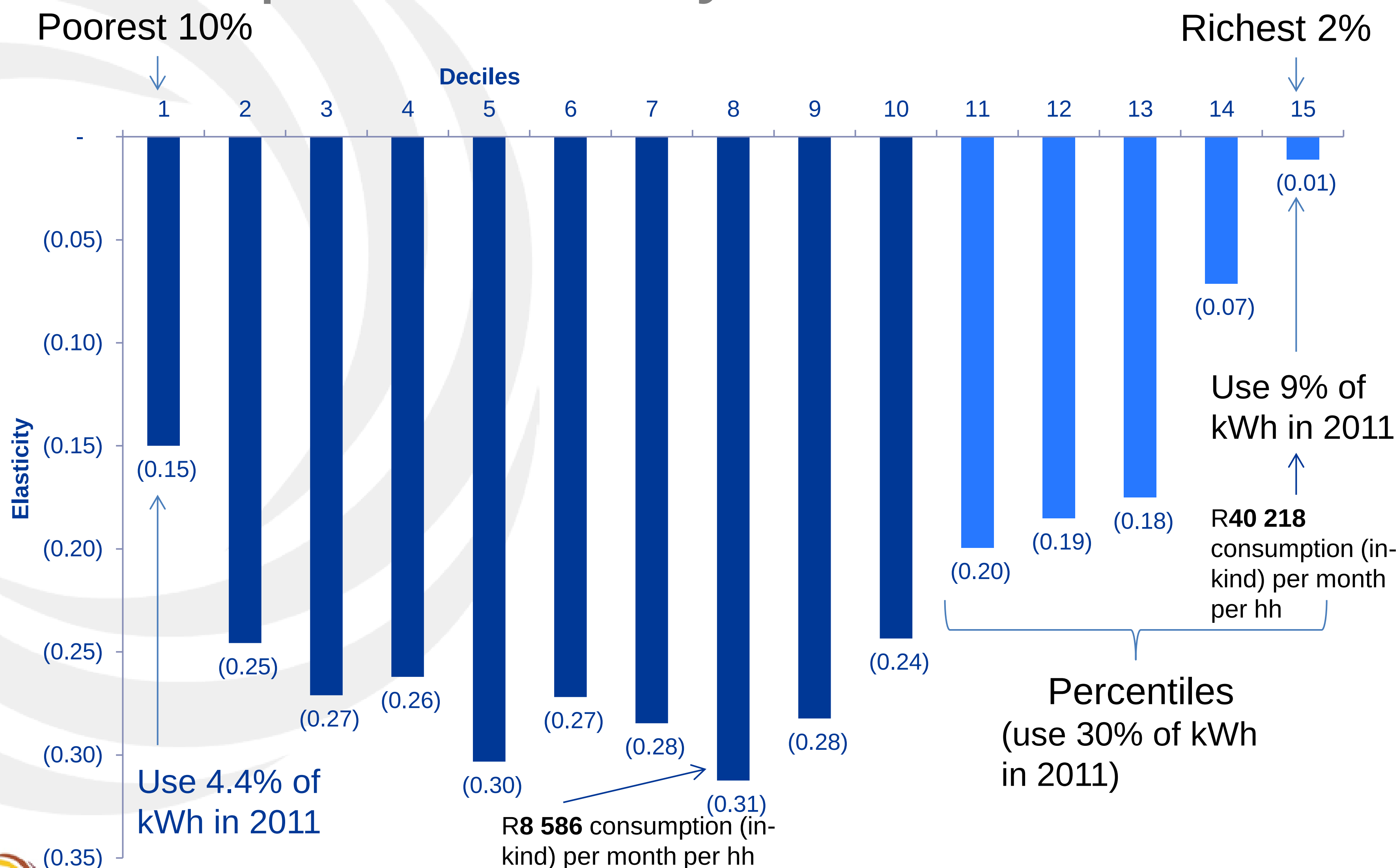


Note: Cooking, lighting and space heating expressed as a percentage of households that are connected to electricity supply.

Decrease from 57% in 2005 to 37% in 2013

Choice of energy usage for space heating as 'none' increased from 12.2% in 2006 to 46% in 2013.

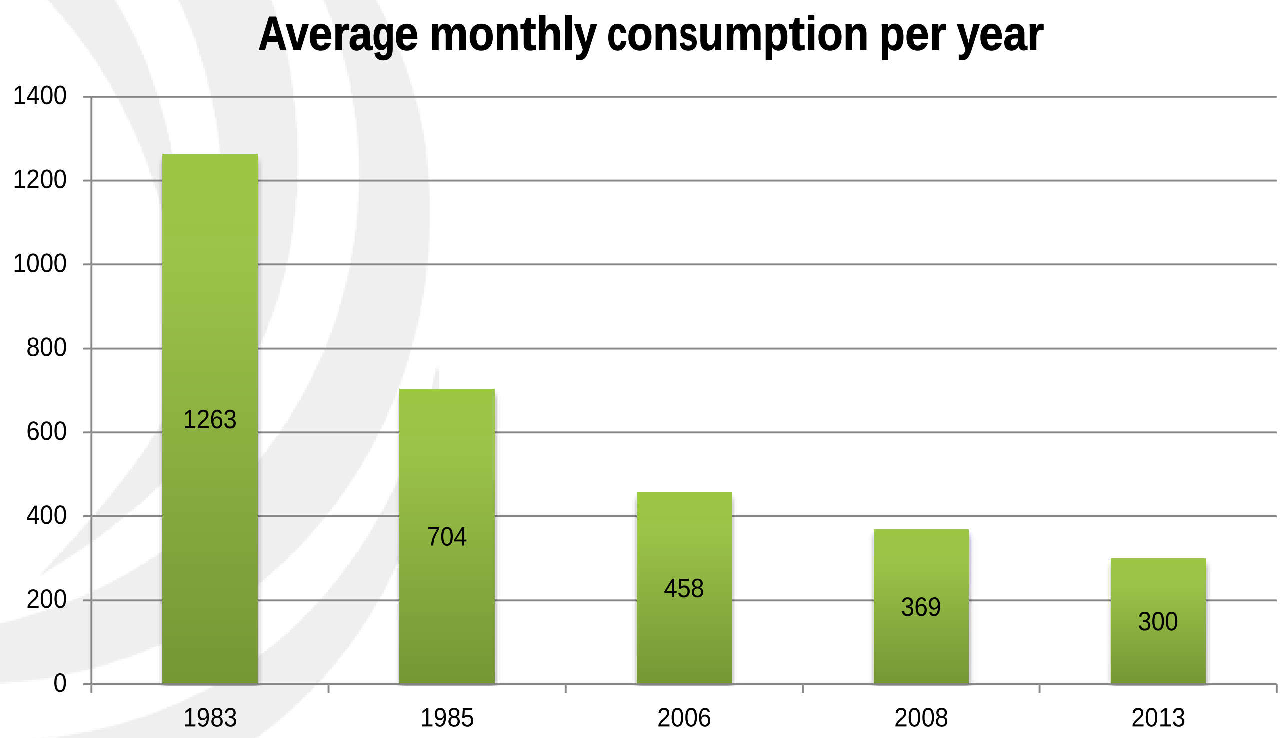
Direct price elasticity of demand



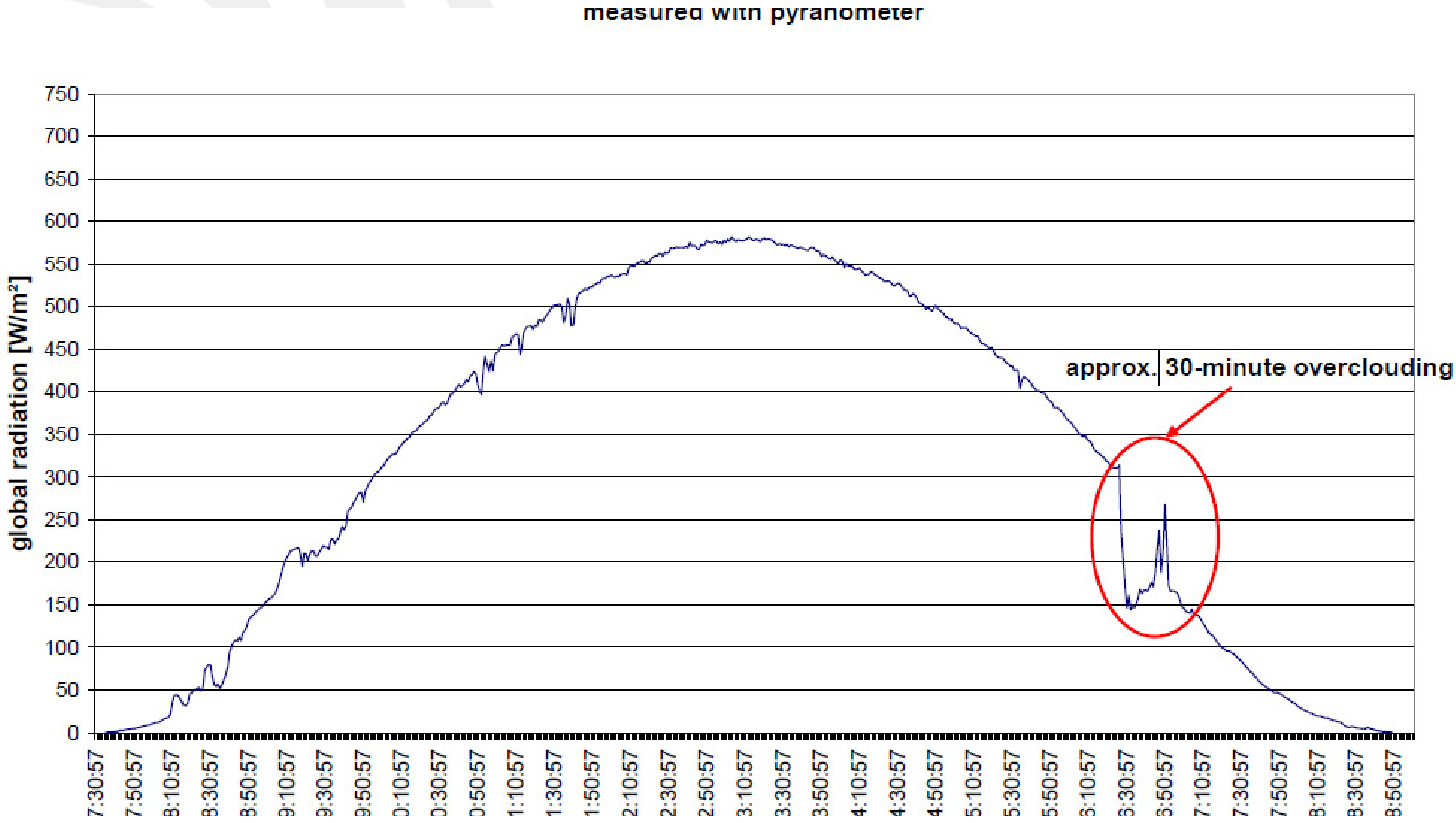
Outline

- Background
- Studies
- Load Profiles
- Individual data
- Investment decision

Energy Efficiency



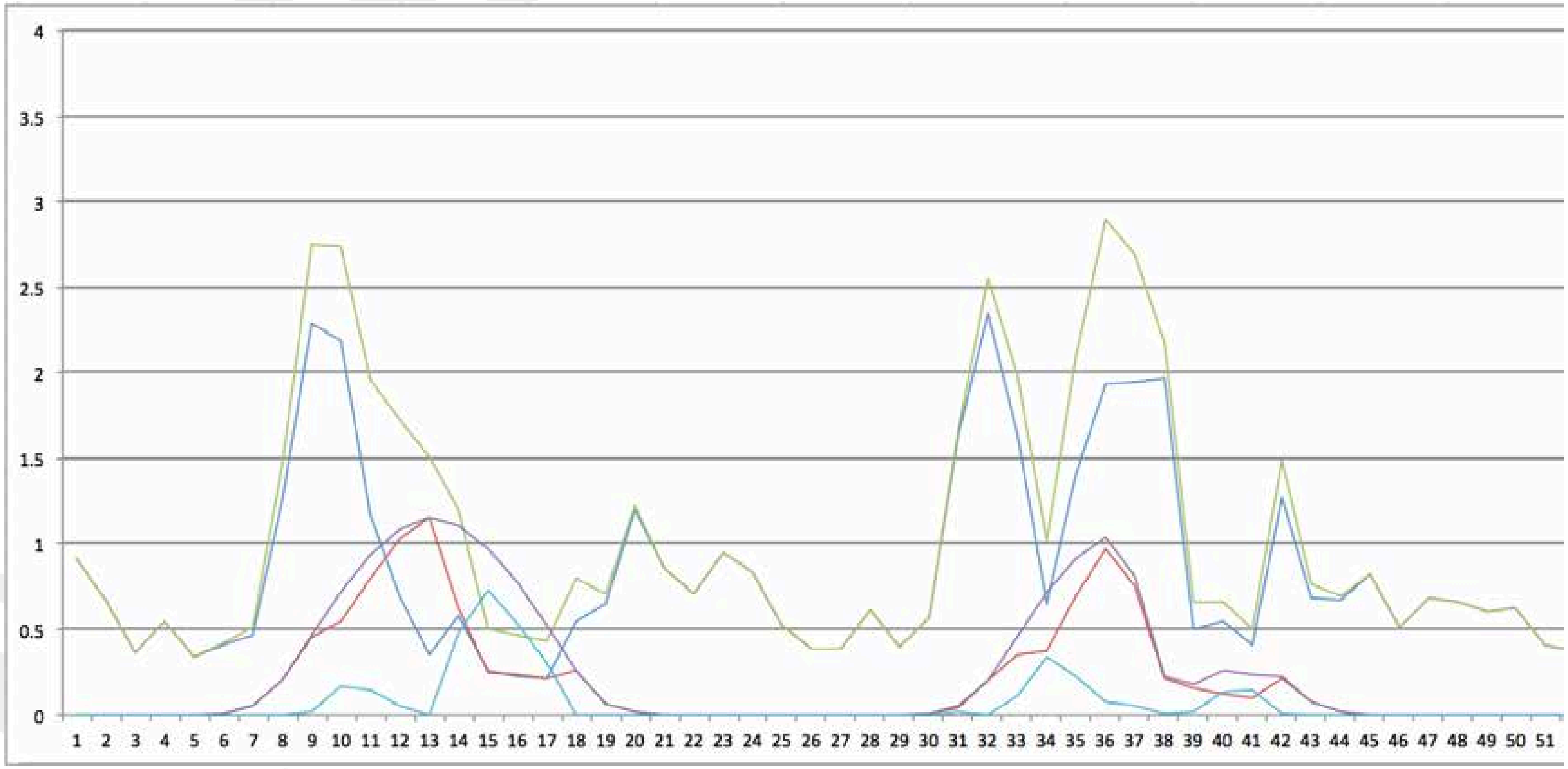
PV generation and load



PV generation and load

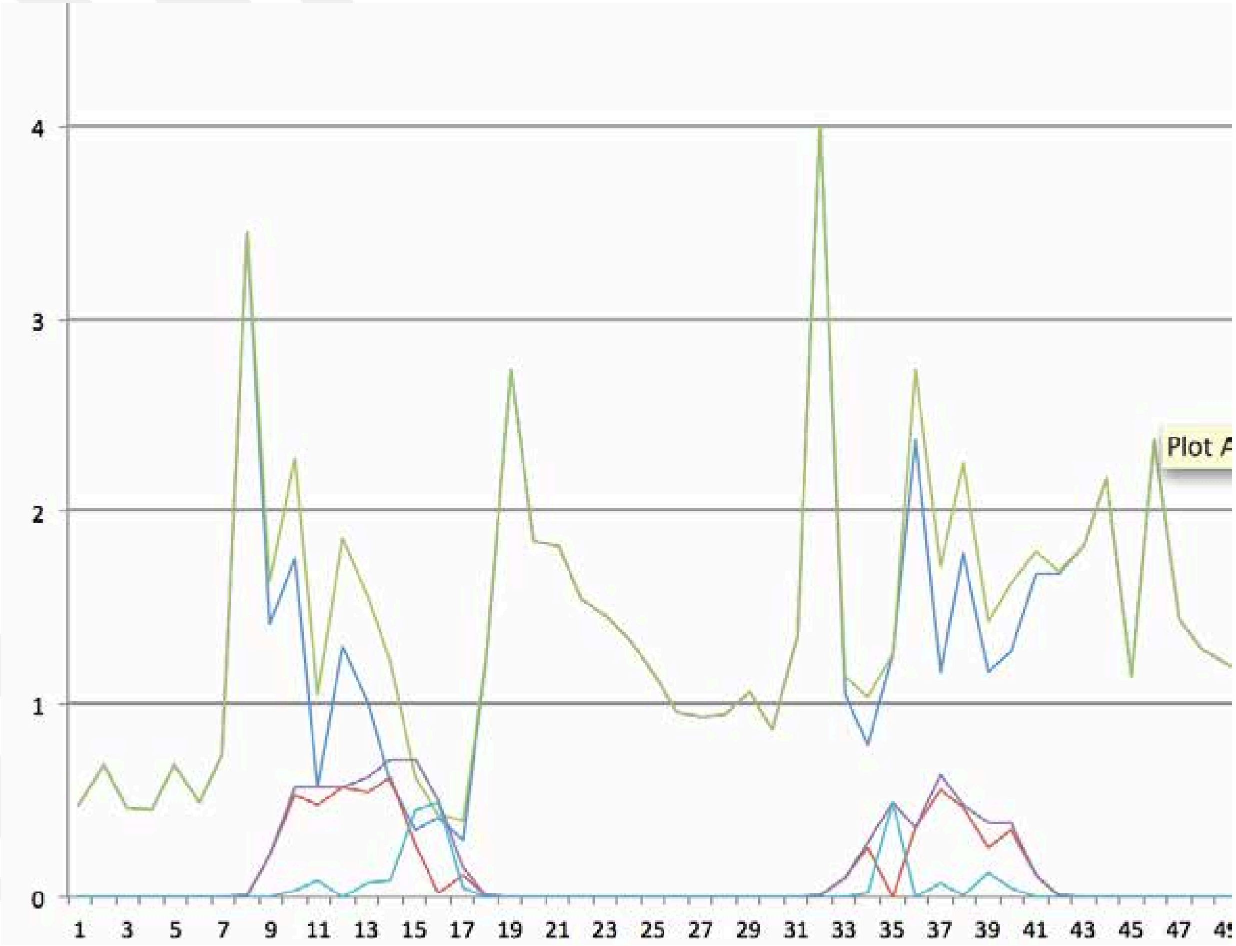
	Consumption from CoCT	Consumption from PV	Total Consumption	PV Production	PV Fed in
Dec-13	506	127	633	219	92
Jun-14	898	89	988	150	60

Dec 1 & 2



4
3.5
3
2.5
2
1.5
1
0.5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51

June 1 & 2



4
3
2
1
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47
Plot A

Outline

- Background
- Studies
- Load Profiles
- Individual data
- Investment decision

Investment decision

- Installation cost
- Admin cost (time)
- New meter
- Sign off
- Tariff

Thank you

karink@sun.ac.za