

Revenue Impact from RE and EE interventions tools –

Instructions for Use

The two tools described in this Instruction Document have been developed by Sustainable Energy Africa (SEA), with funding from the Renewable Energy and Energy Efficiency Partnership (REEEP). The first tool is a photovoltaic (PV) cost benefit analysis tool, and the second is a tool which calculates the impact of energy efficiency (EE) and renewable energy (RE) on municipal finances over a 10 year period. Both tools have been developed for municipalities in South Africa and are available at no cost.

PV cost benefit analysis tool

Background

This tool calculates the payback period (PBP) for PV installed at different times into the future for the residential, commercial and industrial sectors. The results can be used to assist with developing uptake projections for PV in each sector. These uptake projections should be used in conjunction with the 'City impact from RE and EE tool Oct 2013' developed by SEA, which calculates revenue losses municipalities can experience in future as a result of customer RE and EE installations. The PV cost benefit analysis tool takes into consideration all costs for PV, generation, electricity tariffs, taxes and subsidies into the future, and the PBP using various repayment options.

Instructions

Download the tool from <http://www.cityenergy.org.za/category.php?id=3#1> (Solar PV cost benefit spreadsheet tool). **NB:** Save the file as “PV cost benefit analysis - uptake scenarios(BAU)”. If you do not save it exactly as is, the macro will not run.

Fill in all cells marked in yellow.

All prices should be **VAT inclusive**.

Recommended values:

The current (2014) cost of PV per kWp installed for various sectors:

Sector	Size (kWp)	Cost per kWp
Residential	2	R 27,000
Small commercial	4.5	R 25,000
Large commercial	400	R 19,000
Industrial	400	R 19,000

Expected electricity generated by 1kWp of north facing PV based on average solar radiation for the region:

Location	Electricity generated/year/kWp
Bloemfontein	2055
Cape Town	1762
Durban	1570
Johannesburg/Pretoria	1871
Nelspruit	1766
Port Elizabeth	1698
Upington	2075

% Electricity exported/lost: Refers to the percentage of electricity exported onto the grid or not used by installer due to over generation. This typically will affect residential users over commercial and industrial users, although the latter two may export during weekends or holidays. As a result a default setting of 30% losses for residential is assumed, while commercial and industrial users are set at 15% feed in.

Repayment options: Three options are provided, no loan, short term and long term loans. These can be adjusted as per your need, but the default settings are:

- i. Cash up front (no financing)
- ii. Short term loan from a retail bank (18% interest over 5 years)
- iii. Long term loan from a retail/commercial bank (8.5% interest over 10 years-typically an access bond)

There is also the facility to make a **down payment** on each of these options. In other words, specify the down payment in the **Down payment (equity) %** cell as a **percentage**. For example, if you pay 10% of the installed cost of the system up front, then specify this in the cell, and the spreadsheet will take this into account.

If your municipality has established a feed in tariff for embedded generators with a service charge, then insert these values in the following cells:

- i. Embedded gen tariff (purchase) – insert the rate at which the customer will purchase electricity from the municipality
- ii. Embedded gen tariff (feed in) – insert the rate at which the municipality will purchase surplus generation from the customer (this can be 0 if that is the municipality's decision)
- iii. Monthly fixed charge – insert the monthly fixed (or service) charge amount that the embedded generator will pay the municipality
- iv. Average monthly consumption – this figure can be used to determine the feasibility range for the tariff option provided. Start with 950kWh which is a typical mid – high income household consumption figure. However, a higher (1500 kWh) and lower (600 kWh) figure should be subsequently run to see impact on a range of consumer types
- v. Domestic tariff (1st 600 kWh) – insert current low domestic block tariff

- vi. Domestic tariff (above 600kWh) – insert current high domestic block tariff (make these tariffs identical if no inclining block tariff being used)

If your municipality has not established a feed in tariff, then insert information into the following cells:

- i. Embedded gen tariff (purchase) – insert the standard domestic rate at which the customer will purchase electricity from the municipality (if linked to inclining block tariff (IBT) choose the highest tariff of the current domestic tariff structure.
- ii. Embedded gen tariff (feed in) – insert the rate at which the municipality will purchase surplus generation from the customer (this can be 0 if that is the municipality's decision)
- iii. Monthly fixed charge – set to zero
- iv. Average monthly consumption – set to zero
- v. Domestic tariff (1st 600 kWh) – set to zero
- vi. Domestic tariff (above 600kWh) – set to zero

When all values are inserted, click on 'Calculate payback period' button below.

Results can be viewed in the 'Results' sheet. Results are shown with payback periods (PBPs) for 3 time periods i.e. if installed at these times, Now, in 5 or 10 years. Favourable PBPs are highlighted. These are those that are less than 3 years, or have a monthly loss that is less R100. The monthly loss refers to the difference between your monthly instalment and your savings from electricity saved. A negative monthly loss is a gain i.e. the customer will be saving that amount.

NB- The tool only accommodates 1 type of commercial (small or large) to be run at a time. Simply run the model again with the other commercial data type.

City Revenue Impact from RE and EE tool

Recommended use (for easy calculation of potential revenue losses)

1. Download the tool from <http://www.cityenergy.org.za/category.php?id=3#1> (Impact of renewable energy and energy efficiency on municipal revenue spreadsheet tool).
2. Open the tool in Microsoft Excel.
3. **NB:** Save the file as "City revenue impact from RE and EE tool Oct 2013". If you do not save it exactly as this, the macro will not run.
4. The tool will open on the 'Input' worksheet. If this is not the case, click on the 'Input' tab at the bottom of the spreadsheet. The tool has several worksheets. However you will only need to input information specific to your municipality on the 'Input' worksheet.
5. There are several coloured input cells on the 'Input' page. Only a few of the cells **MUST** be filled in with information specific to individual municipalities. (Many of these cells can be left as they are considered adequate figures for use around the country)
6. The following cells **MUST** be filled in
 - a. **Current annual consumption by sector in kWh**
 - i. mid-high residential (i.e. those not currently on an indigent type tariff)
 - ii. small commercial*
 - iii. industrial (LV, MV, ToU customers).
 - b. **Current number of customers per sector**
 - i. mid-high residential (i.e. those not currently on a lifeline type tariff)
 - ii. small commercial
 - iii. industrial (LV, MV, ToU customers)
 - c. **Current average use/customer in kWh/year**

This input requires the municipality to calculate the average energy annual use by LV, MV and ToU industrial customers. This is simply done by

 - i. taking the total annual LV sales and dividing it by the number of LV customers
 - ii. taking the total annual MV sales and dividing it by the number of MV customers
 - iii. taking the total annual ToU sales and dividing it by the number of ToU customers

NOTE: If any of these categories do not apply, then insert a 0 into the cell.

*The tool only allows one type of commercial user e.g. small or large commercial to be run at a time. Refer to pt 6 below for instructions on how to include large commercial.

d. Hourly Load Data

Average monthly consumption (mid-high user) is calculated automatically. Do not change unless based on sound information.

Input the overall municipal electricity hourly load data for summer and winter. This can be a typical winter (July) and summer (January) month, or an average of June-August (winter) and Sept-May (summer) in MWh.

The adjustment factor refers to the factor you need to insert to scale the load up to 100% i.e. in order to calculate the average hourly loads you may have only used representative municipal intake points which is a portion of the total.

e. Residential load shifting

This refers to the percentage of residential customers with PV who load shift to middle of the day as a result of their PV installations.

f. Embedded Generation

Click on the drop down menu located in cell B53 and select the nearest City to your municipality. This will insert the solar radiation data which best matches your municipality. By doing so an accurate impact of RE and EE can be calculated.

Insert typical PV system sizes for each sector. Typical sizes are:

Residential – 2kWp

Small commercial- 4.5kWp

Large commercial – 400kWp

Industrial- 400kWp

% of PV used by household – this refers to the variability of demand of households during the day. PV consumption is estimated to be between 40-70%¹.

Insert landfill gas and load balancing details if this applies to your municipality.

g. PV Net Metering

If you want to include the option of net metering, i.e. feeding excess energy into the grid, insert '1' or '0' to turn this option off. NB you can use this option regardless of whether customers will be financially compensated.

h. Number of installations

Insert current and future installations for each intervention. If there are no installations or the sector does not apply, leave cell blank.

Penetration rates – the penetration rate assumes an 'S' curve i.e by year 3, 10% of the total installations projected for year 10 will occur, and by year 5, 35% of total installations projected.

i. Financials

- i. Insert predicted Eskom tariff increase over next 10 years
- ii. Insert predicted Municipal Electricity tariff increase net of Eskom purchases as a percentage (i.e. take full income, subtract Eskom repayments and determine % annual increase of the remaining component)
- iii. Insert predicted electricity consumption growth/reduction over the next 10 years as a percentage
- iv. Insert CPI forecast

¹ BSW Solar, communications 2013

j. Tariffs

- i. The spreadsheet currently has megaflex tariffs inserted. If you are on a different tariff plan, please update these cells
- ii. Insert your current municipal tariffs for winter and summer. Only fill in the coloured cells. Note: if your tariffs do not change seasonally, fill in the same tariffs for winter and summer.
- iii. Feed in tariff option is included. This is the amount the municipality will reimburse/credit the customer per kWh for feed in. No seasonal differentiation is provided.
- iv. Fixed charge (optional) – applicable to customers with PV only and charged per kWp per day

k. Distribution losses

NB – this refers to technical losses only

7. You are ready to calculate!

- i. Scroll down to the bottom of the 'Inputs' page and you will see some arrows. Click on the 'Run all Macros' Arrow. If this is the first time you are doing this, you will need to enable macros on your computer. Once you have clicked on the arrow, a 'Security Warning' tab will open. Click on 'Options' and select 'enable this content'. Click the arrow again.
- ii. The macro will now calculate the results based on your inputs. It will finish in the 'Results Summary' page which will tell you the potential impact of EE and RE over the next 10 years.
- iii. For detailed results click on the 'Results' worksheet. The revenue losses are calculated as a percentage of total and operational losses.

City revenue impact from RE and EE tool Oct 2013 - Microsoft Excel

Results detailed												
Revenue loss (R)												
year	Residential				Commercial		Industrial		Landfill gas	Load bal.	Street & Traffic lights	All interv. (no fixed Charge)
	Res PV fixed charge	Res PV no fixed charge	SWHs	Other res EE*	Comm PV no fixed charge	Commercial EE	Ind PV no fixed charge	Industr EE				
0	R 1,965	-R 1,676	-R 2,034	-R 3,507,731	-R 4,249	-R 4,758	-R 148,193	-R 128,153	R 0	R 12,234,937	R 40,497,507	R 48,935,651
3	R 17,640,393	-R 12,772,820	-R 27,711,593	-R 14,876,892	-R 3,493,786	-R 6,679,340	-R 2,651,813	-R 1,476,831	R 0	R 19,890,367	R 67,084,587	R 17,911,879
5	R 76,048,032	-R 53,042,178	-R 116,708,748	-R 47,050,970	-R 14,442,514	-R 27,685,949	-R 9,725,960	-R 5,230,296	R 0	R 24,950,476	R 88,063,669	-R 162,425,911
10	R 289,483,903	-R 227,658,921	-R 466,205,139	-R 176,514,008	-R 59,797,201	-R 112,389,134	-R 42,862,970	-R 22,789,839	R 0	R 97,399,366	R 121,469,078	-R 926,602,466
Revenue loss (of total revenue) %												
year	Res PV fixed charge	Res PV no fixed charge	SWHs	Other res EE*	Comm PV no fixed charge	Commercial EE	Ind PV no fixed charge	Industr EE	Landfill gas	Load bal.	Street & Traffic lights	All interv. (no fixed Charge)
0	0.00%	0.00%	0.00%	-0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.14%	0.46%	0.56%
3	0.13%	-0.10%	-0.21%	-0.11%	-0.03%	-0.05%	-0.02%	-0.01%	0.00%	0.15%	0.50%	0.13%
5	0.45%	-0.32%	-0.70%	-0.28%	-0.09%	-0.17%	-0.06%	-0.03%	0.00%	0.15%	0.53%	-0.97%
10	1.20%	-0.83%	-1.83%	-0.73%	-0.14%	-0.47%	-0.18%	-0.09%	0.00%	0.14%	0.61%	-3.85%
Bulk purchases vs operational revenue												
year	Total revenue*	Bulk purchase %*	Op revenue %	Op revenue est								
0	8,721,600,000	63%	37%	3,226,992,000								
3	13,407,049,377	67%	33%	4,385,125,990								
5	16,733,246,565	69%	31%	5,188,672,144								
10	34,139,395,036	67%	33%	11,902,083,918								
* Total revenue from 'Projections' worksheet.												
Revenue loss (of operational revenue) %												
year	Res PV fixed charge	Res PV no fixed charge	SWHs	Other res EE*	Comm PV no fixed charge	Commercial EE	Ind PV no fixed charge	Industr EE	Landfill gas	Load bal.	Street & Traffic lights	All interv. (no fixed Charge)
0	0.00%	0.00%	0.00%	-0.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.38%	1.25%	1.52%
3	0.40%	-0.29%	-0.63%	-0.34%	-0.08%	-0.15%	-0.06%	-0.03%	0.00%	0.45%	1.53%	0.39%
5	1.47%	-1.02%	-2.25%	-0.91%	-0.28%	-0.53%	-0.19%	-0.10%	0.00%	0.48%	1.70%	-3.13%
10	3.65%	-2.32%	-5.90%	-2.57%	-0.74%	-1.43%	-0.56%	-0.25%	0.00%	0.42%	1.66%	-11.89%

Details on how the revenue losses are calculated:

Net Metering

Consumption: Current annual consumption data is used to calculate the hourly consumption during each time period (each season and weekday/ weekend) using the % consumption.

This is done for each sector. Refer to 'Load Profiles' columns O to R.

In the 'Net Metering' sheet, the hourly consumption and generation profile is shown for the three sectors according to time of year (seasonally, and weekday/end). The effect of some households load shifting is also included. Consumption and generation amounts are based on uptake projections.

EE interventions

In the 'EE interventions' sheet, the cumulative savings from each EE intervention is shown on an hourly basis (and seasonally) where applicable. For these the daily profile is estimated e.g. for Streetlights summer – lights are off between 6am-7pm, in winter it is off between 7am -6pm.

Commercial EE- factor of 5 is used for night hours as only a fraction of lights are on at night. Residential SWH savings are calculated using ADMD of SWHs against ADMD of conventional geysers. The effect of load shifting of those with SWHs is also built into this calculation. The savings from load shifting is compared between the SWH ADMD of those who load shift. (ADMD factor for SWH is calculated by incorporating total ADMD of those who load shift and those that don't.)

Domestic appliances load shifting to daylight hours

Load shifting is only applied to a percentage of those households that have PV. Savings from load shifting is calculated using the difference in electricity consumption of those who have load shifted against those who have not. For the appliances included, it is assumed that 50% of these are used during peak, and 50% during the day already).

RE generation

Radiation data is sourced from 20 year observations. If you want to change this data, go to 'RE generation' sheet and scroll down to row 80. Find your city below row 80 and you can change the average monthly kWh/kWp (columns C to M). Winter is June-August.

RE generation per hour is calculated for each sector (not each installation) using radiation amounts and takes into consideration losses in the system. These losses are set at 18% but can be changed in cell B8.

Load Balancing

See 'load balancing' profile. Average energy consumption and generation is split into daily profile. Net load balancing profile is included in the energy mix on 'summary- and 'summary weekend' sheets.

Projections

Refer to 'projections' sheet. This is where the municipal finances, Eskom growth, tariffs, customer growth projections occur.

Tariffs

The tariffs include IBTs and accommodate the effect of reduced consumption and thus reduced tariff (block 1 IBT) for residential customers.

Two scenarios are provided, one with current tariff structures (Non-fixed charge scenario) and the other is with a decoupled electric structure (Fixed charge scenario). The macro runs both scenarios, and the results are presented in the 'Results' and Results summary' sheets.

Finance

The spreadsheet uses nominal growth as the basis for revenue calculations into the future. Therefore nominal projections for Eskom electricity cost increases and City operational increases for the next 10 years need to be included. These increases are then applied to the current baseline for revenue paid to Eskom and the baseline for electricity department operational costs respectively. Growth in consumption is directly linked to growth in operational costs and the cost of electricity purchased from Eskom i.e. 1% consumption growth with increase operational costs by 1% and repayments to Eskom by 1%.

Revenue calculations

The 'summary' and 'summary weekend' sheets show the calculations for revenue losses occurring during weekdays and weekends respectively. On these two sheets, all the energy savings from RE and EE calculated in the rest of the spreadsheet are summarised and translated into financial losses and gains at that time of day. This includes the tariff purchased from Eskom during that time of day and the TOU rates to MV/HV customers. The difference in electricity sales between Eskom and the municipal are accounted for, as well as the demand charges that arise from electricity bought from Eskom and distribution losses.

In addition, revenue lost from PV feed-in tariffs, and energy gained from PV feeding in and then being resold is accounted for.

Losses and savings (from reduced purchases from Eskom) are tallied and shown annually as summer (9 months); winter high demand (1/8th of year).

Decoupled tariff scenario: Using this scenario, the municipality can determine at what decoupled tariff rate i.e. fixed charge (R/kWp/day) and the energy charge (c/kWh), it can use to mitigate its losses from PV SWHs and EE. This scenario produces an output for the residential sector only and is used to illustrate the positive effect a decoupled tariff can have on municipal revenue. The results are shown in the 'Results Summary' sheet under the 'revenue reductions from reduced sales' section.