DOES RENEWABLE ENERGY HAVE A PLACE IN THE SOUTH AFRICAN SUN?

15 February 2011

presented by

Jon Adams

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

Solar energy




Wind power




Waterpower

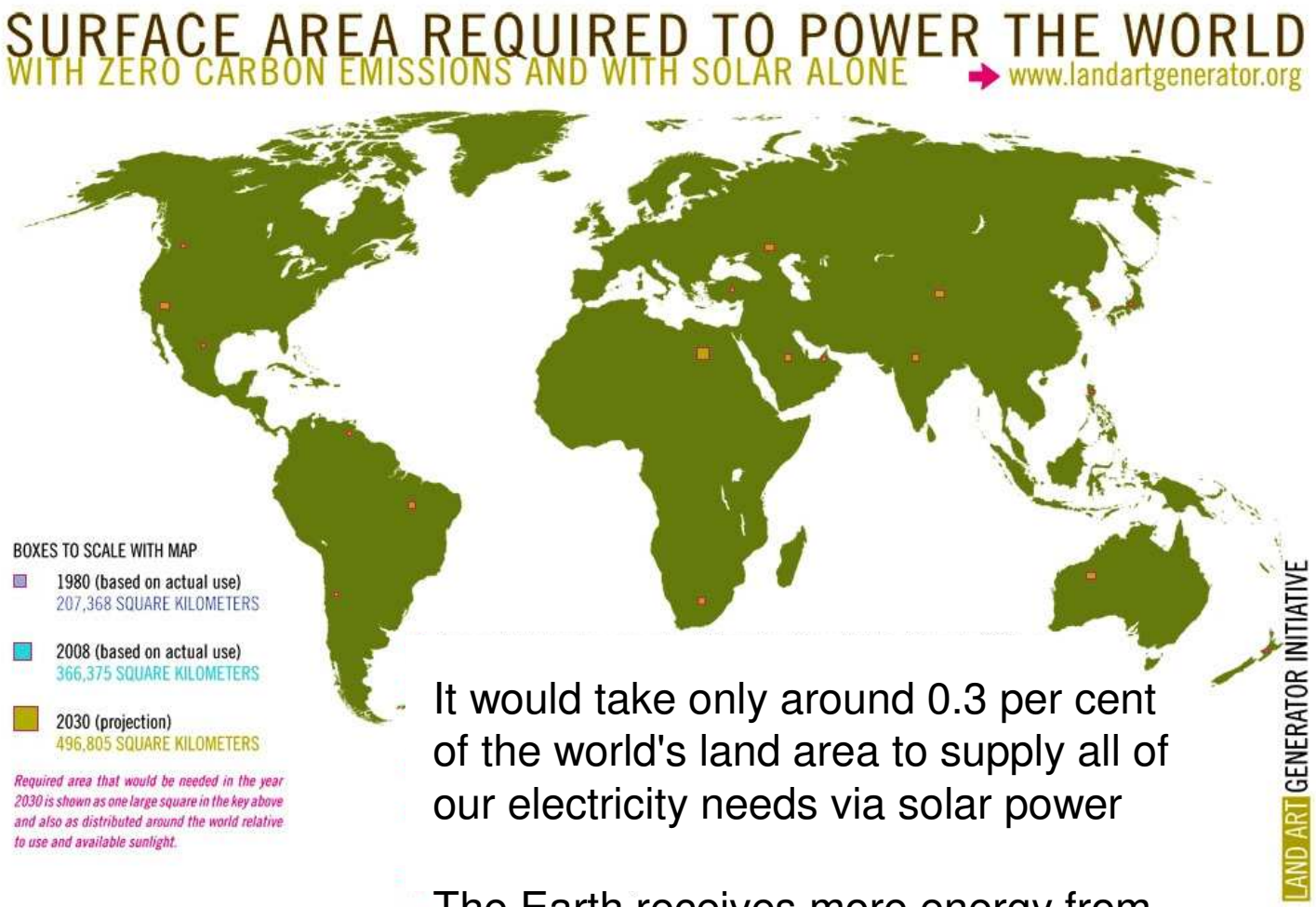



Biofuels




the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?



It would take only around 0.3 per cent of the world's land area to supply all of our electricity needs via solar power

The Earth receives more energy from the sun in an hour than is used in the entire world in one year

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

Government Commitments

Government commits itself to implementing reasonable legislative and other measures, within its available resources, to progressively realise Universal Access to electricity.

Government will co-ordinate the electrification programme, including the setting of realistic targets, determination of allocation criteria and priority areas, ensuring allocation and management of funds, financing and subsidisation of projects and the determination of an appropriate mix between grid and non-grid technologies.

Government will establish a National Electrification Fund to provide electrification subsidies.

The National Electrification Fund will subsidise a portion of the capital costs of connections made towards meeting electrification targets.

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

Government Commitments

Government will fund a National Electrification Fund on budget, from a dedicated electrification levy, the level of which will be determined annually, as part of the budgetary process.

The National Electricity Regulator will regulate domestic electricity tariffs in order to rationalise the large variety of tariffs available in South Africa and ensure that a suite of supply options with progressive capacity-differentiated tariffs and connection fees are available to domestic customers

The Task "WAS" - Universal Access by 2010

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

The solution to remote un-electrified areas giving the hope of universal access.

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

Corporate Social Investment (CSI) project – clinic in Kwa-Zulu Natal outside Underberg

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

But Africa deals some hard blows, its not a place for sissies.

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

The lights were turned on again and a new vaccine fridge was provided for the village of Indawana.

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

Can it work in South Africa

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

It works in Germany

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

It works in Germany

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

Year	Forecasted Demand (MW)	Operational Capactity as at 1 Jan. 2008 (MW)	New Build (Per Year) (MW)	New Build (Cumulative) (MW)	Imports from HCB (MW)	Total Operational Capacity (MW)	Reserve Margin (%)	Ideal Operating Capacity (15% Reserve Margin) (MW)	Shortfall (MW)
2008	38,287	38,524	2,024	2,024	1,200	40,548	5.91%	44,030	3,482
2009	40,158	38,524	1,915	3,939	1,200	42,463	5.74%	46,182	3,718
2010	41,671	38,524	1,892	5,831	1,200	44,355	6.44%	47,922	3,566
2011	43,238	38,524	181	6,012	1,200	44,536	3.00%	49,724	5,188
2012	44,665	38,524	1,003	7,015	1,200	45,539	1.96%	51,365	5,826
2013	46,430	38,524	2,422	9,437	1,200	47,961	3.30%	53,395	5,433
2014	48,624	38,524	2,363	11,800	1,200	50,324	3.50%	55,918	5,594

Slide - J. Moroga former CEO Eskom

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

It works for me!

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

It works for me!

the power company

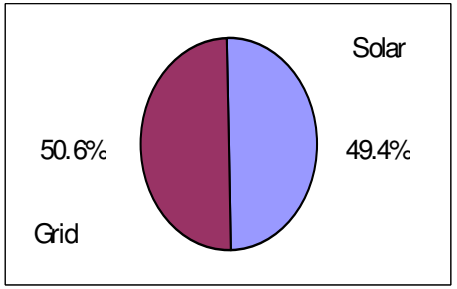
DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN? It works for me!

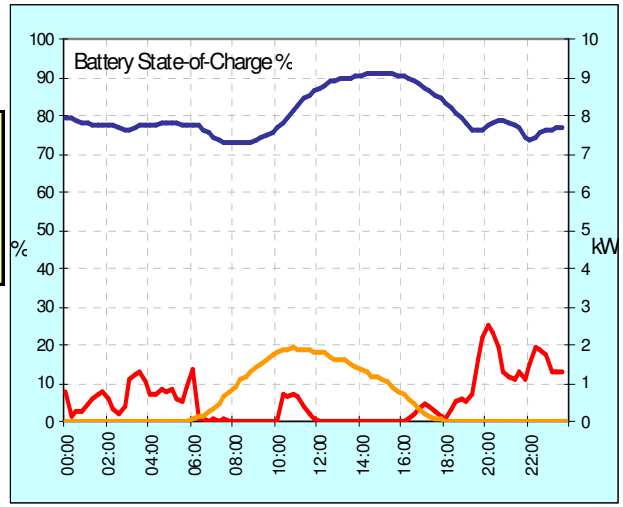
the power company

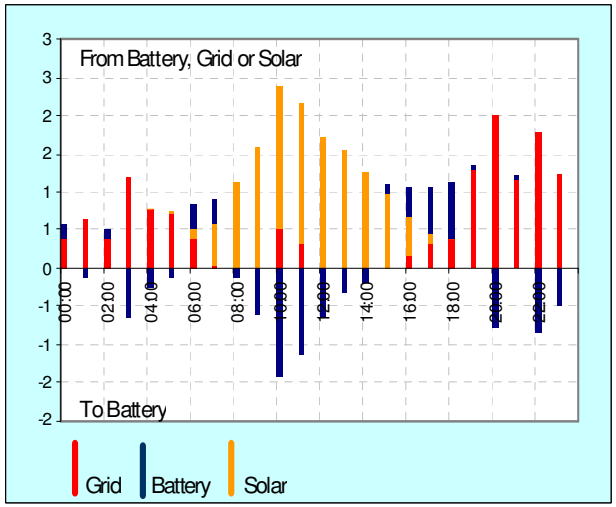
0 Select Date (Average = 0)

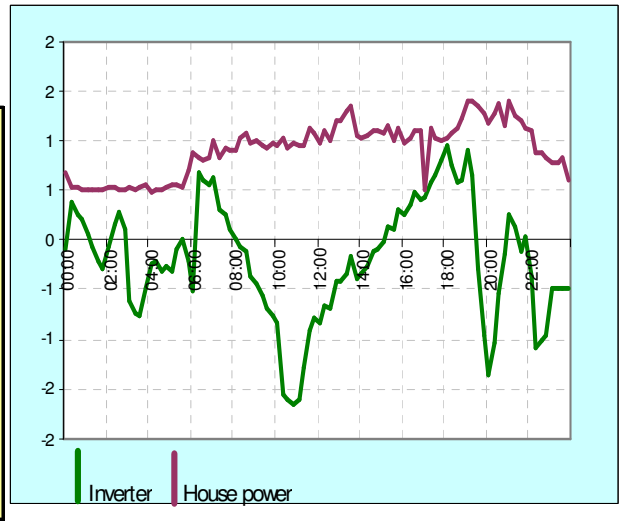
31 Maximum Days in Month

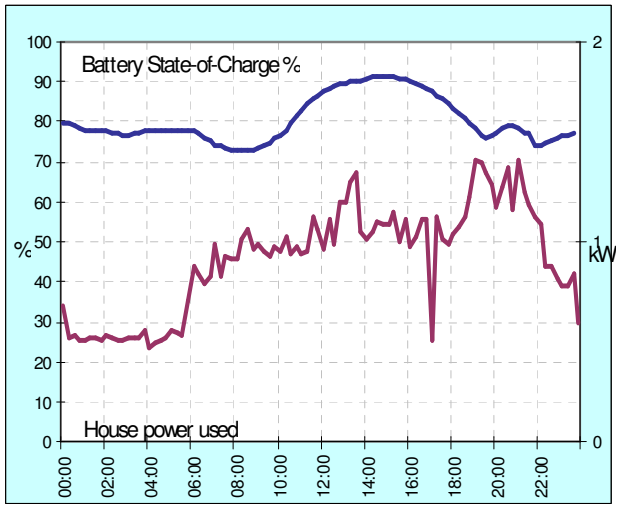
Power consumption in the house was 836.12 kWh for the month of October. - Solar power generated to the house was 412.97 kWh. - Grid power supplied to the house was 423.15 kWh.











Notes:

October Average

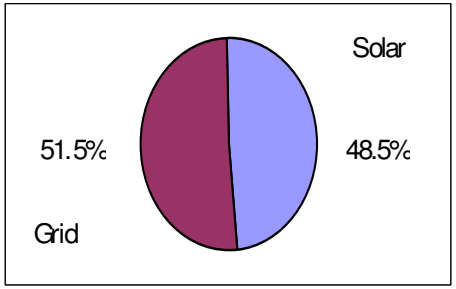
The house has a 2,8 kW peak solar array and 19.2kW battery storage. A 5kW inverter/battery charger plus a 3.3kW grid inverter is installed. Solar water heating is coupled to a 200 liter geyser with a pump. The hot water supply has gas back-up. Cooking is on gas. Heating in winter is with gas. Water heating uses ~40% of electrical energy in a house with cooking using a further ~15%. Calculations show >75% of electrical energy has been displaced.

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN? It works for me!

6 Select Date (Average = 0)

31 Maximum Days in Month

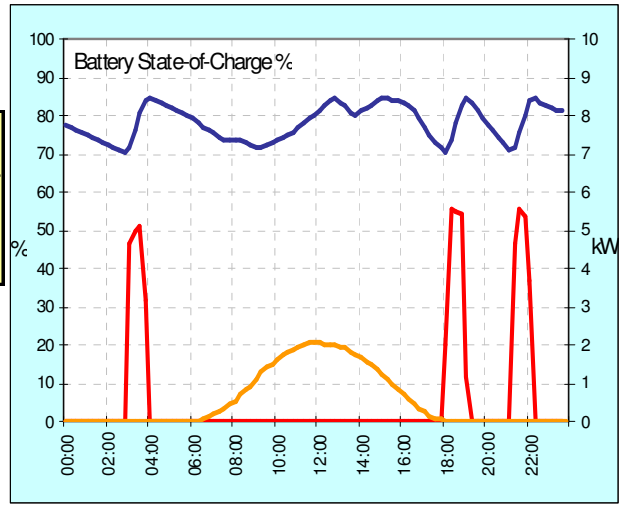
Power consumption in the house was 27.65 kWh on Mon - 6 October 2008. - Solar power generated to the house was 13.4 kWh. - 14.25 kWh from the grid was supplied.

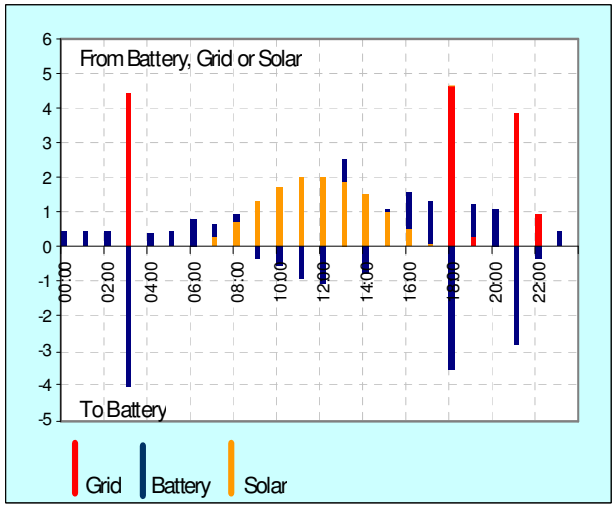


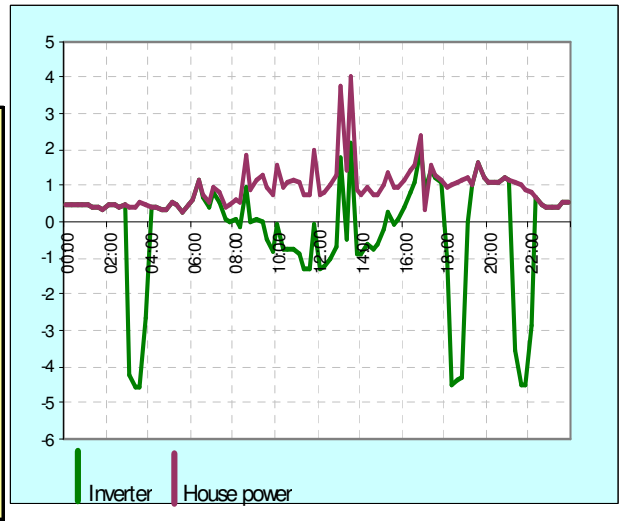
Notes:

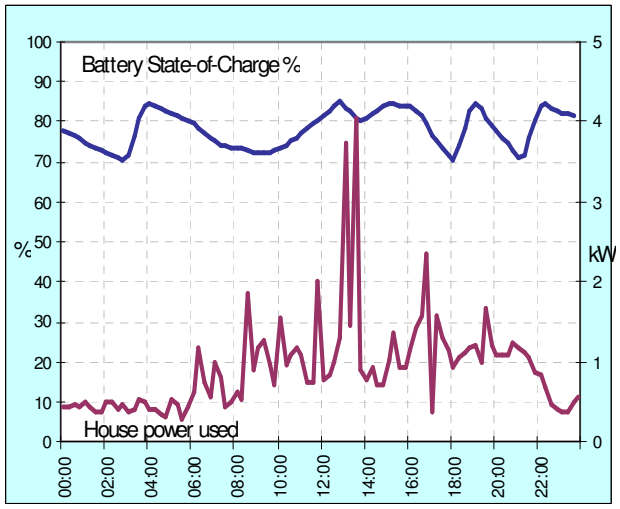
Mon - 6 October 2008

Another good solar day. The house loads can be seen to be fairly erratic and can be ascribed the use of cleaning equipment. Monday is a cleaning day. The battery shows a good regime of charge and discharge.









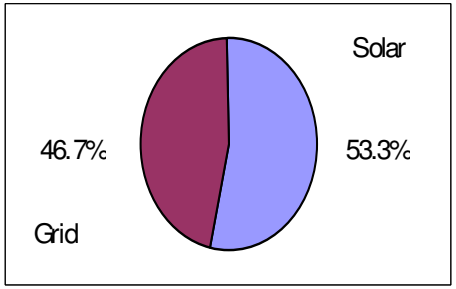
DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN? It works for me!

the power company

17 Select Date (Average = 0)

31 Maximum Days in Month

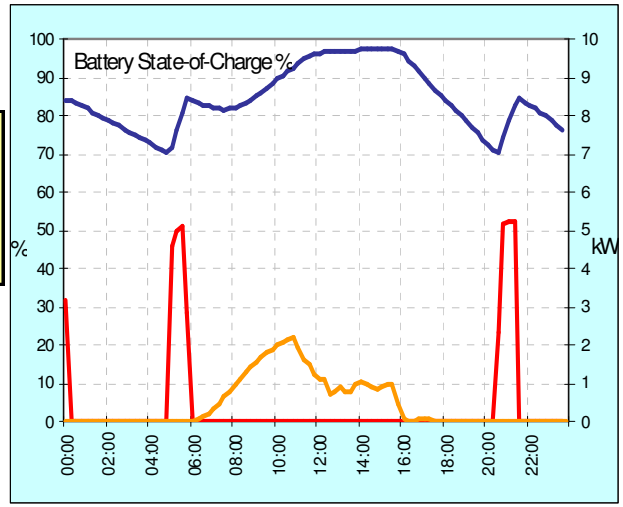
Power consumption in the house was 20.73 kWh on Fri - 17 October 2008. - Solar power generated to the house was 11.04 kWh. - 9.69 kWh from the grid was supplied.

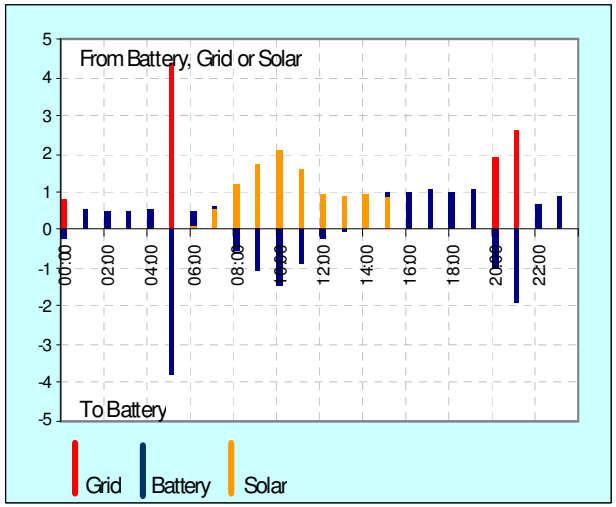


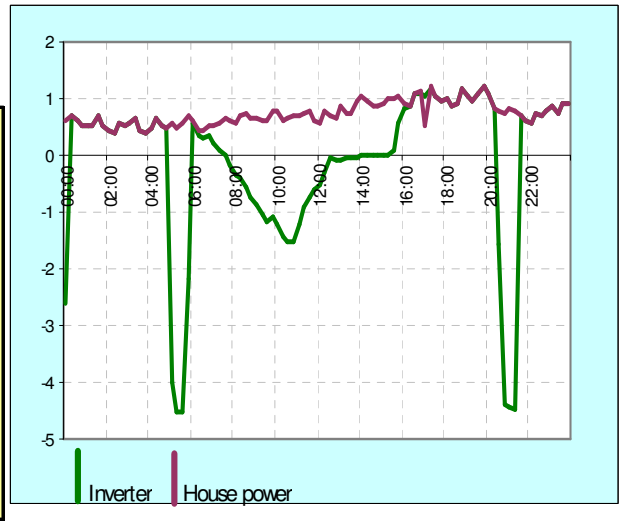
Notes:

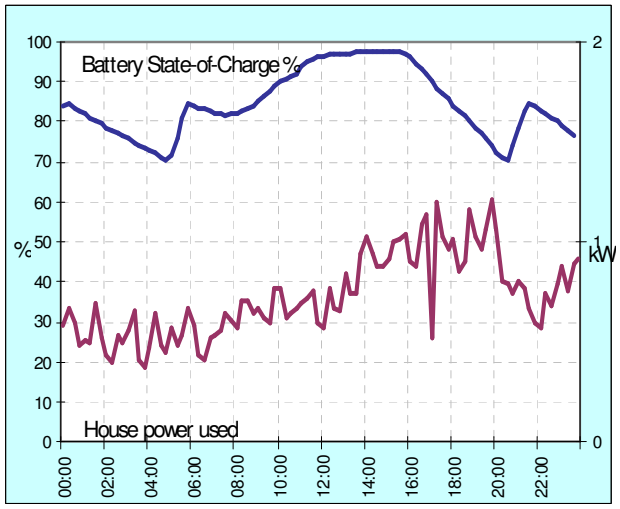
Fri - 17 October 2008

House load was almost at constant with most of the energy being supplied from the solar array. Again the battery was well charged and therefore the solar power was automatically reduced.





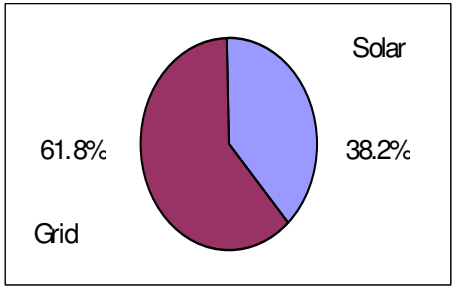




DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN? It works for me!

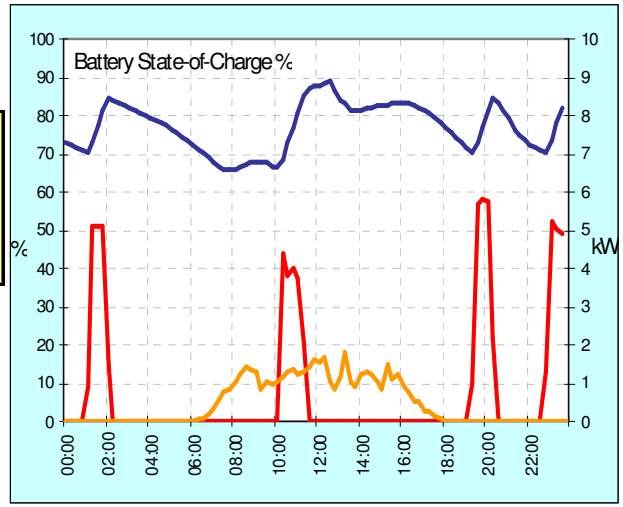
19 Select Date (Average = 0)
31 Maximum Days in Month

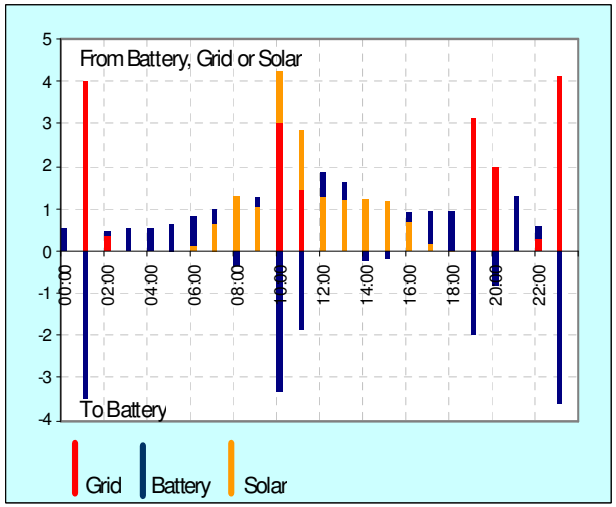
Power consumption in the house was 29.92 kWh on Sun - 19 October 2008. - Solar power generated to the house was 11.42 kWh. - 18.5 kWh from the grid was supplied.

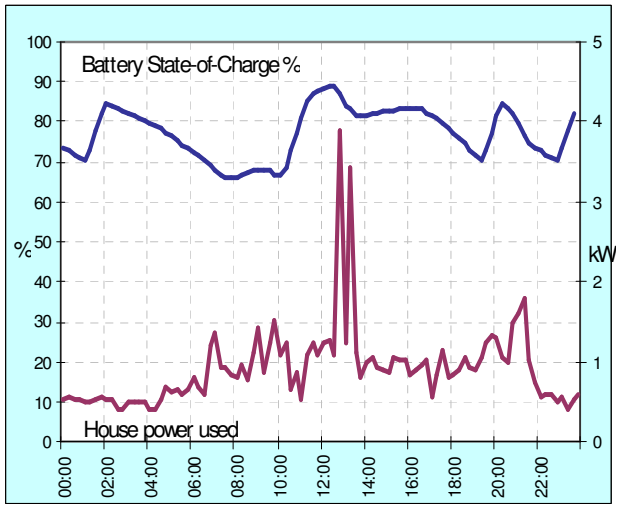


Notes:

Sun - 19 October 2008
Although no rain was measured the cloud cover resulted in the grid being activated at 10h00 to recharge the battery.





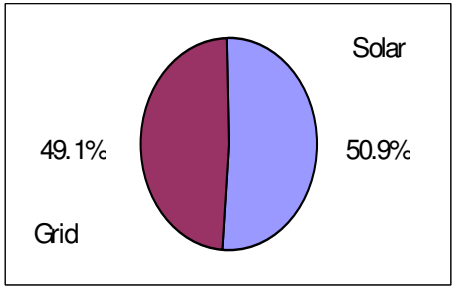


DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN? It works for me!

21 Select Date (Average = 0)

31 Maximum Days in Month

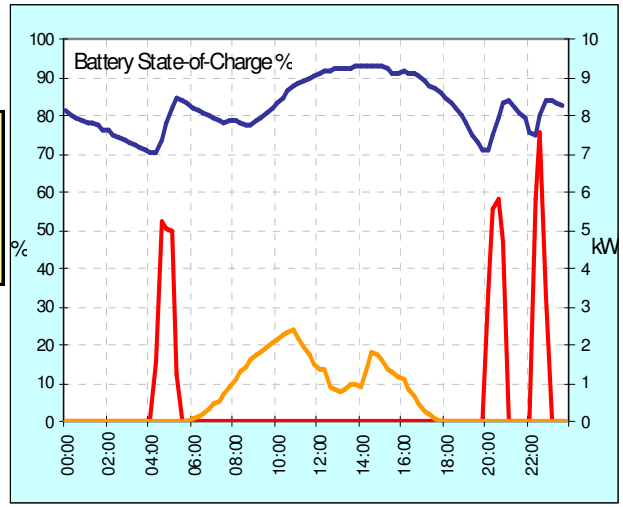
Power consumption in the house was 27.62 kWh on Tue - 21 October 2008. - Solar power generated to the house was 14.06 kWh. - 13.56 kWh from the grid was supplied.

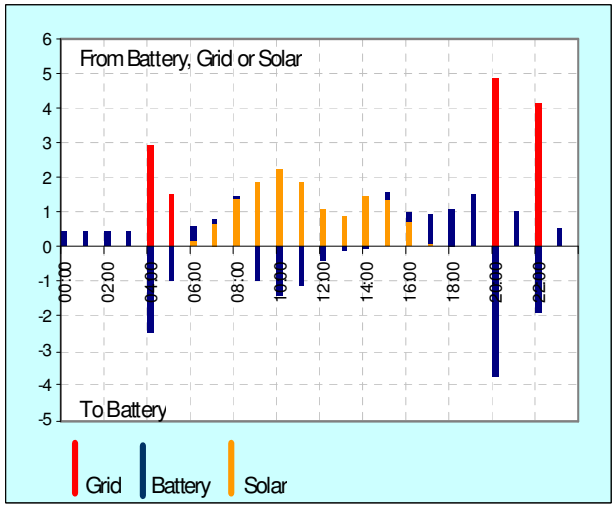


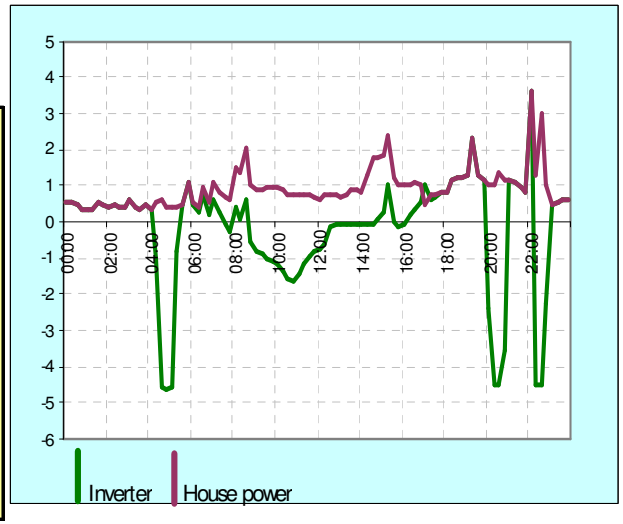
Notes:

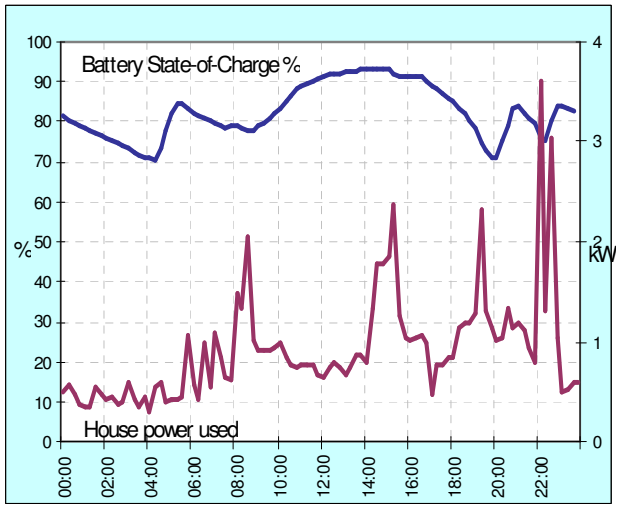
Tue - 21 October 2008

The solar charge was not optimised as the battery was on float mode. The solar increase just after 14h00 is charachterised by the increase in house consumption due to an appliance being turned on.





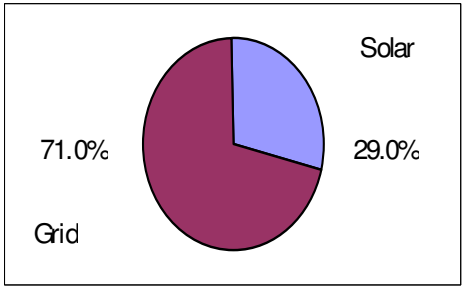




DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN? It works for me!

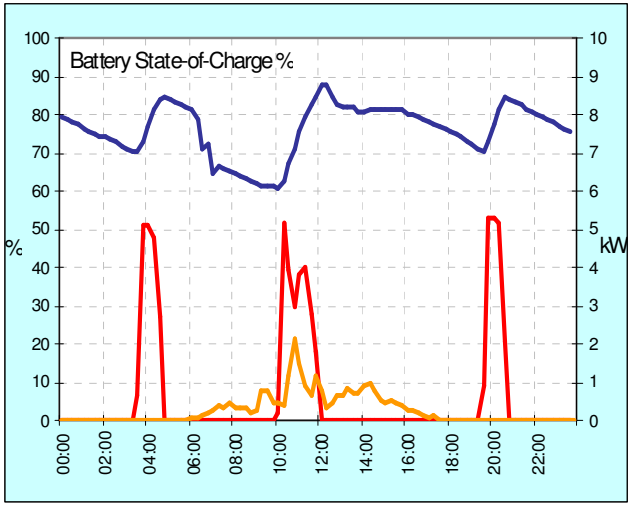
24 Select Date (Average = 0)
31 Maximum Days in Month

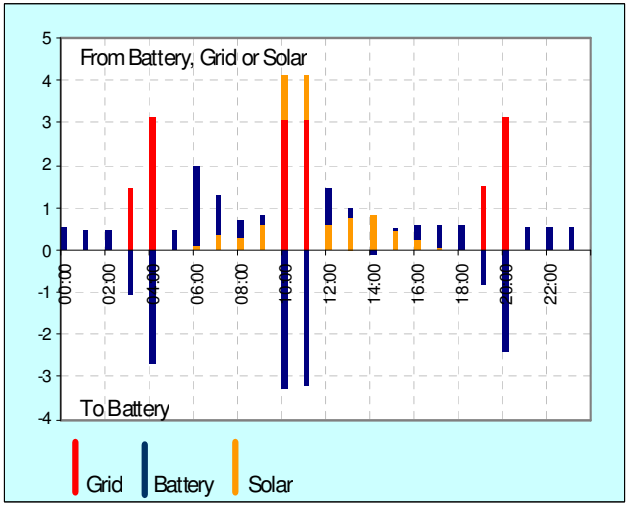
Power consumption in the house was 21.77 kWh on Fri - 24 October 2008. - Solar power generated to the house was 6.32 kWh. - 15.45 kWh from the grid was supplied.

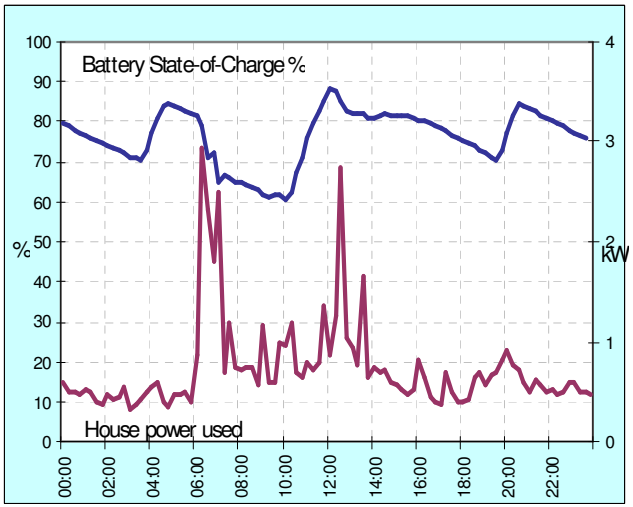


Notes:

Fri - 24 October 2008
There was 14mm rain on this day which is indicated by the low and varied solar power. At 10h00 the clouds cleared for a period which reduced the grid input as the solar climed. It can be seen that as the solar started to reduce at 11h00 the grid gained power to compensate.





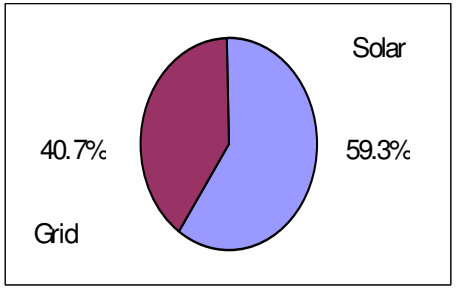


DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN? It works for me!

the power company

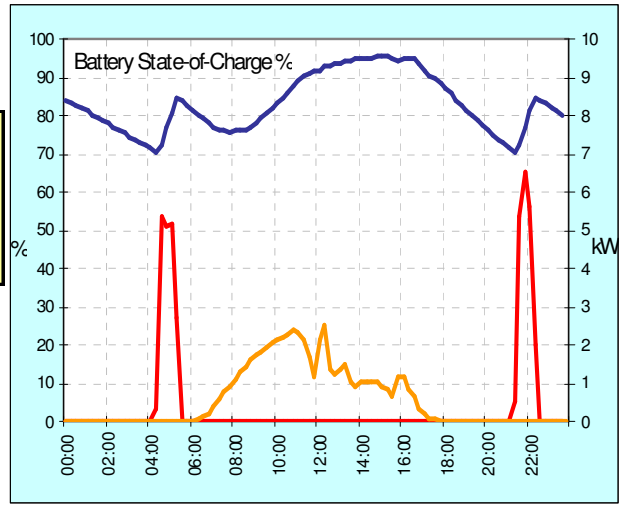
28 Select Date (Average = 0)
31 Maximum Days in Month

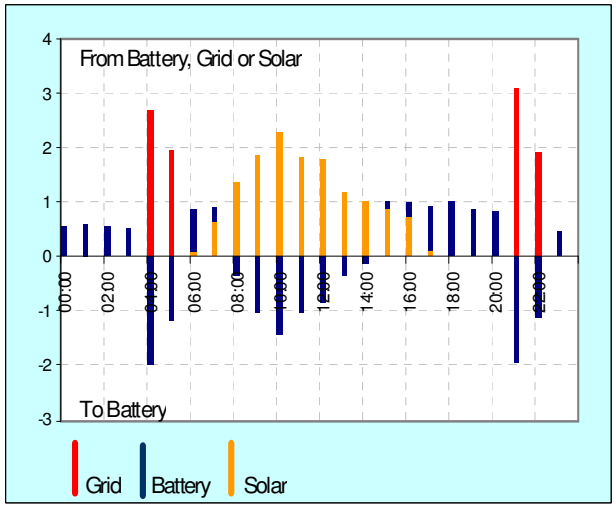
Power consumption in the house was 23.79 kWh on Tue - 28 October 2008. - Solar power generated to the house was 14.11 kWh. - 9.68 kWh from the grid was supplied.

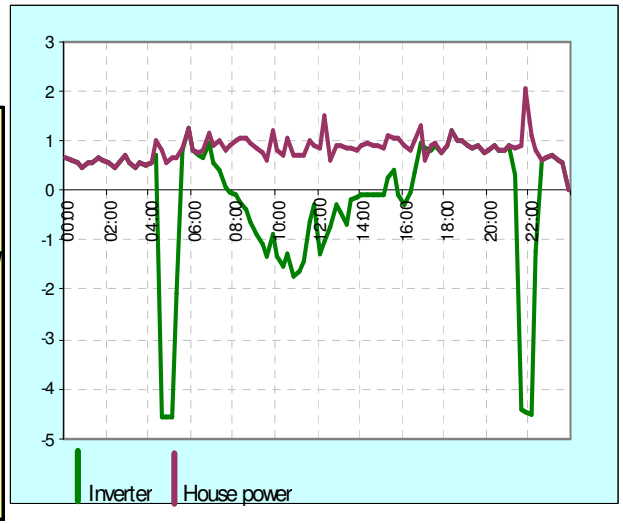


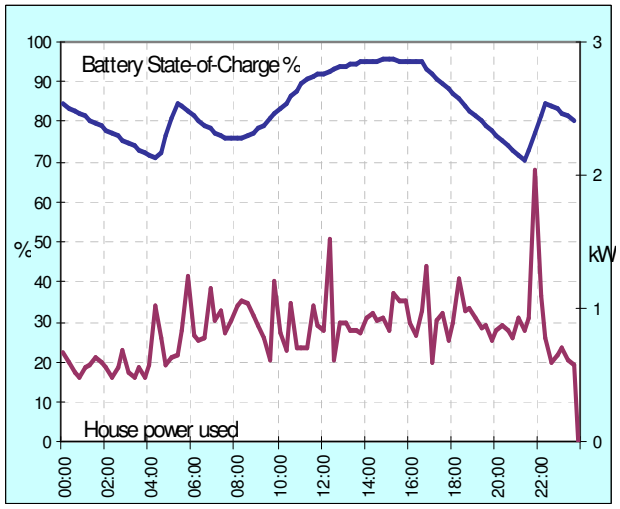
Notes:

Tue - 28 October 2008
Good solar day with unmaximised power capture that is being "wasted" or reduced by the battery reaching high charge levels. Generally the house energy was around 1kW continuous.







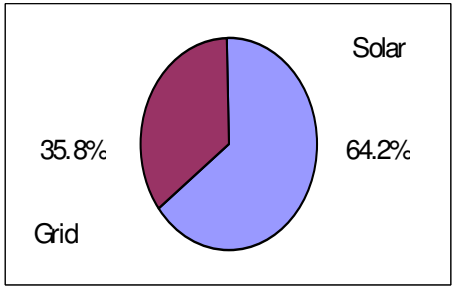


DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN? It works for me!

31 Select Date (Average = 0)

31 Maximum Days in Month

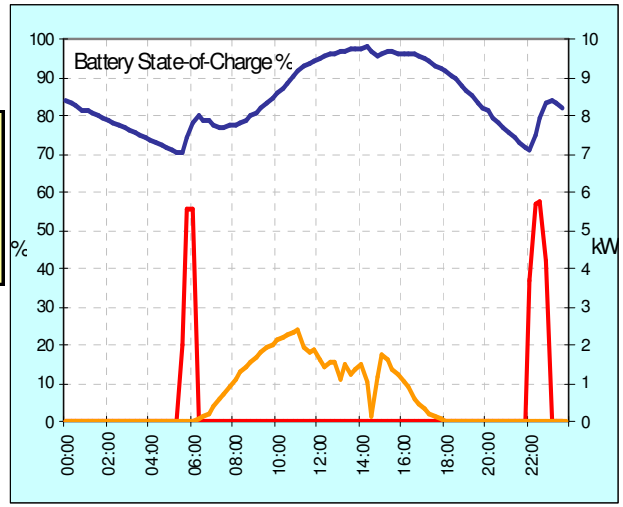
Power consumption in the house was 22.65 kWh on Fri - 31 October 2008. - Solar power generated to the house was 14.53 kWh. - 8.12 kWh from the grid was supplied.

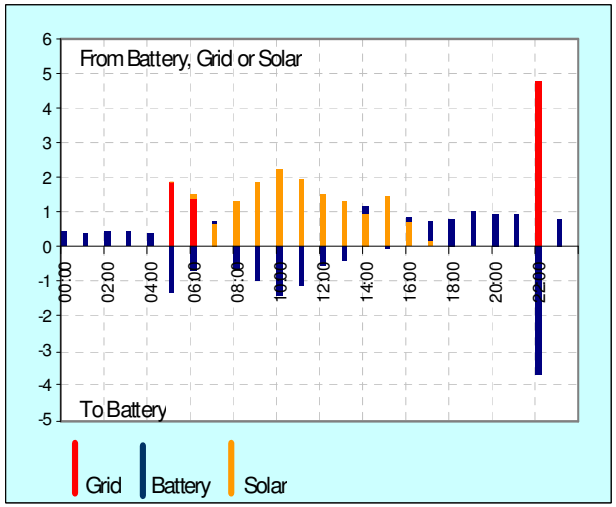


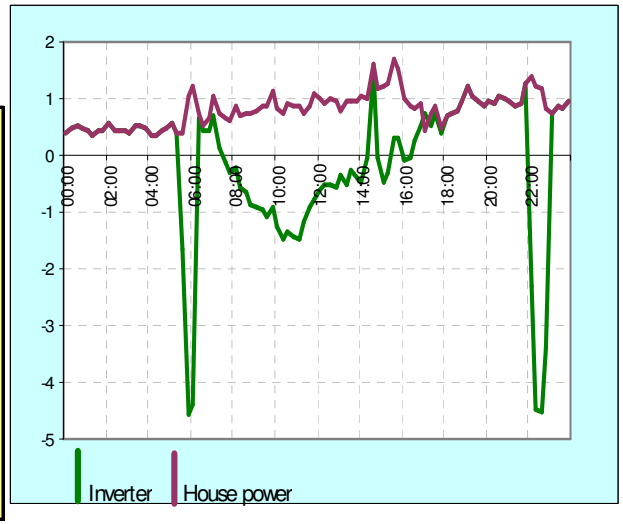
Notes:

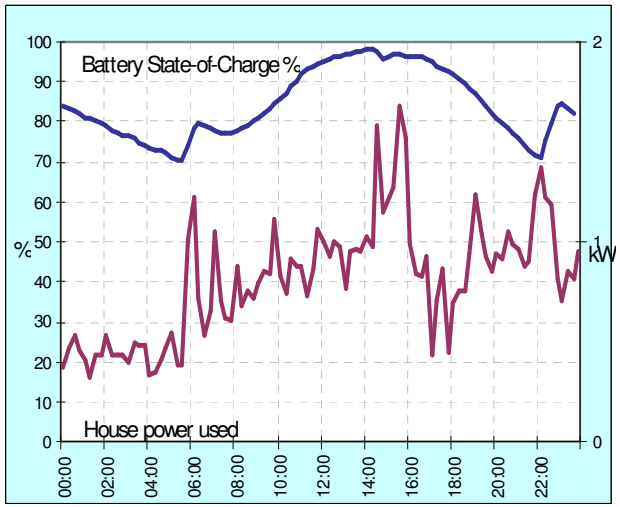
Fri - 31 October 2008

This day is similar to many others with the possible generation of solar being reduced by battery capacity constrainsts. It is difficult to calculate the "wasted potential power" from not being able to feed excess energy into the grid, but graphically it can be seen in this chart and many of the previous days. The introduction of a REFIT Tariff would reduce the system pay back time









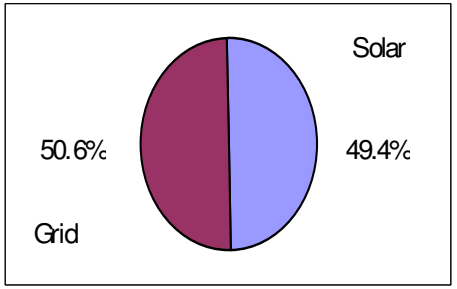
DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN? It works for me!

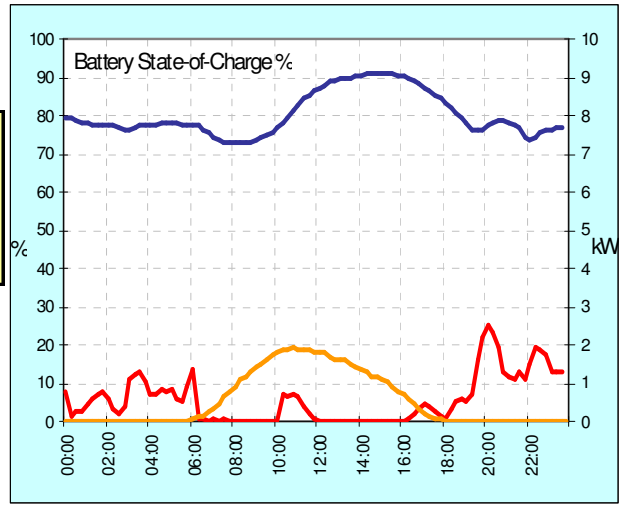
the power company

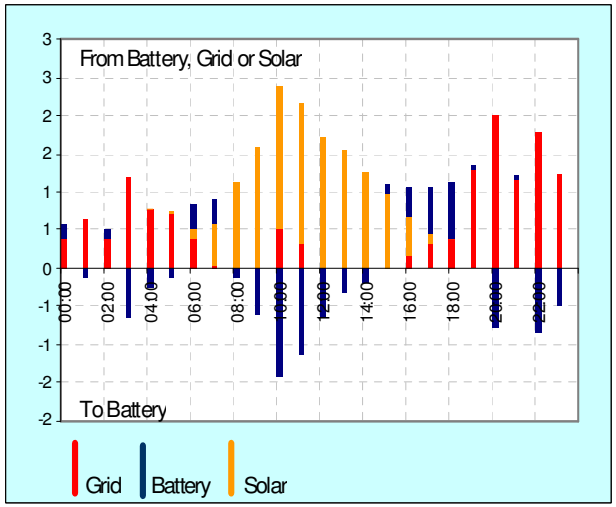
0 Select Date (Average = 0)

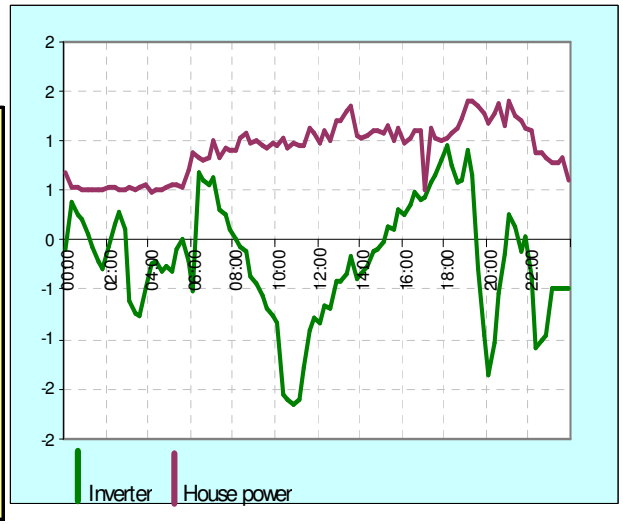
31 Maximum Days in Month

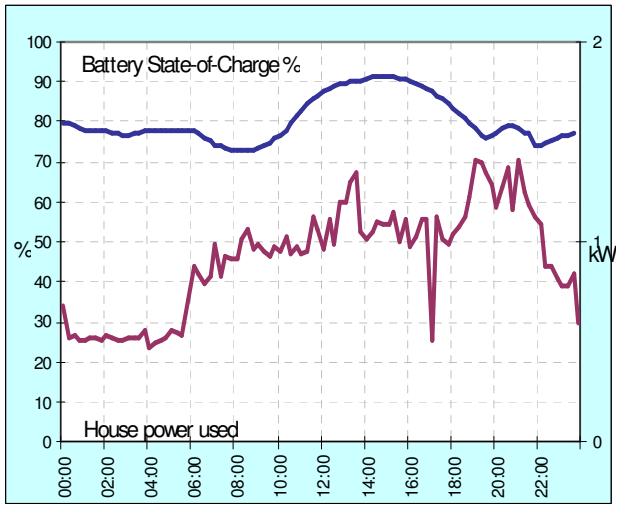
Power consumption in the house was 836.12 kWh for the month of October. - Solar power generated to the house was 412.97 kWh. - Grid power supplied to the house was 423.15 kWh.











Notes:

October Average

The house has a 2,8 kW peak solar array and 19.2kW battery storage. A 5kW inverter/battery charger plus a 3.3kW grid inverter is installed. Solar water heating is coupled to a 200 liter geyser with a pump. The hot water supply has gas back-up. Cooking is on gas. Heating in winter is with gas. Water heating uses ~40% of electrical energy in a house with cooking using a further ~15%. Calculations show >75% of electrical energy has been displaced.

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN? It works for me!

Electrical power displacement

Can the electrical energy savings be calculated? – July 2007 – July 2010

Using the data from the solar power generation, stored in the inverter, a direct saving can be measured.

= 11,600 kWh

Using the LPG consumption and converting it to kWh it is possible to calculate the electrical energy displaced.

513 kg	=	950 lt
950 lt x 35 MJ	=	33,250 MJ
33,250 MJ / 3.6	=	9,236 kWh

From an earlier SWH calculation the displaced energy was ~57% of the total required to heat water. (Eskom SWH50)

water heated	=	180 lt rise 30ºC
energy needed	=	6.27 kWh
efficiency @ 90%	=	6.97 kWh
57%	=	3.97 kWh
1095 days	=	4,347 kWh

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

It works for me!

Electrical power displacement

Electrical self generation and savings

Solar electric generation	11,600 kWh
LPG gas alternative	9,236 kWh
Solar thermal generation	4,347 kWh
Total	**25,183 kWh**

Additional savings

Climate savings
(Eskom data 7-8-2008)

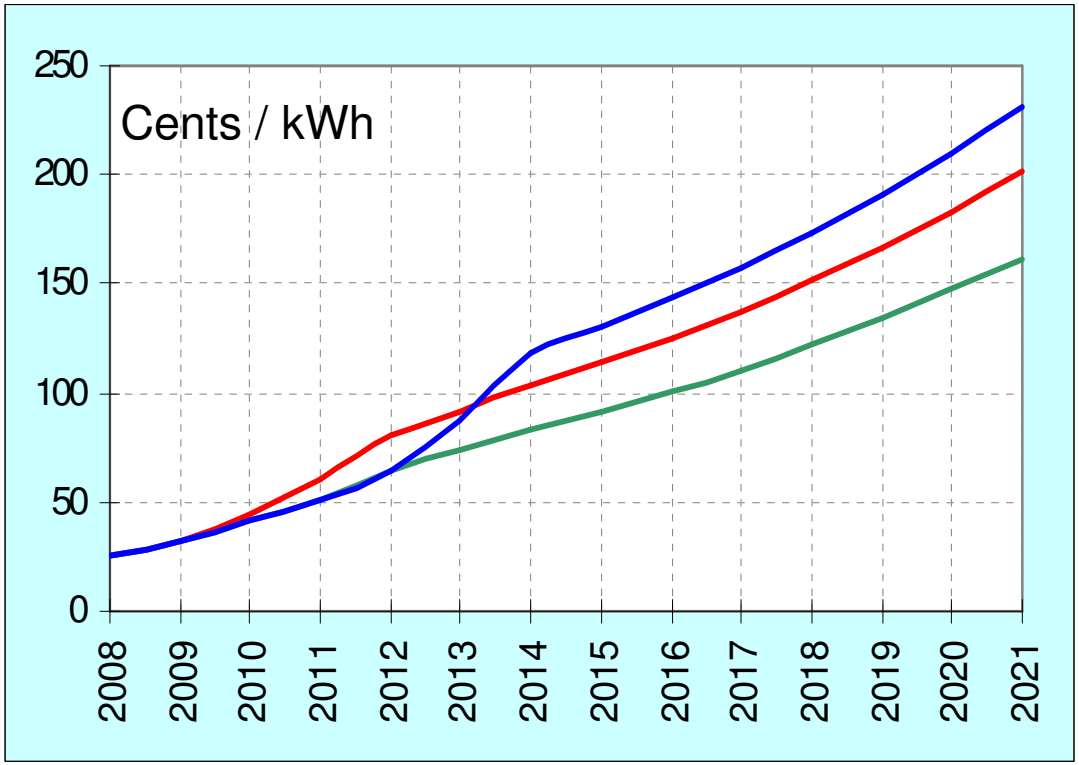
Coal	14,102 kg
Water	36,263 lt
Ash	4,054 kg
Particulate	5.79 kg
CO_2	25,183 kg
SO_x	218 kg
NO_x	110 kg

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

Will it work for you?

Brace yourself – the electricity price trajectory to come .....



DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

PV Power Plants – a REFIT opportunity

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

PV Power Plants – a REFIT opportunity

POWER PLANTS

DECISION

On the 29th of October 2009 the Energy Regulator **approved**:

1. the Renewable Energy Feed-in Tariffs (REFITs) Phase II, based on the Levelised Costs of Electricity (LCOE), as listed in Table 1 below:

Table 1: REFIT Tariffs – 2009 (R/kWh)

Technology	Unit	REFIT
Concentrated Solar Power (CSP) trough without storage	R/kWh	3.14
Large scale grid connected PV systems (≥ 1 MW)	R/kWh	3.94
Biomass solid	R/kWh	1.18
Biogas	R/kWh	0.96
CSP Tower with storage of 6 hrs per day	R/kWh	2.31

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

PV Power Plants – a REFIT opportunity

POWER PLANTS

DECISION

On the 29th of October 2009 the Energy Regulator **approved**:

1. the Renewable Energy Feed-in Tariffs (REFITs) Phase II, based on the Levelised Costs of Electricity (LCOE), as listed in Table 1 below:

Table 1: REFIT Tariffs – 2009 (R/kWh)

Technology	Unit	REFIT
Concentrated Solar Power (CSP) trough without storage	R/kWh	3.14
Large scale grid connected PV systems (≥ 1 MW)	R/kWh	3.94
Biomass solid	R/kWh	1.18
Biogas	R/kWh	0.96
CSP Tower with storage of 6 hrs per day	R/kWh	2.31

REFIT approved for installations >1MW. Power Purchase Agreements (PPA's) need to be signed with ESKOM. Price is fixed for agreement period which is a maximum of 20 years. If less it could be more readily accepted.

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

PV Power Plants – a REFIT opportunity

POWER PLANTS

POWER PLANT DESIGN **University of Geneva PVSYST V5.02**

Simulation parameters

Collector Plane Orientation	Tilt	30°	Azimuth	0°
Horizon	Free Horizon			
Near Shadings	No Shadings			

PV Array Characteristics

PV module Si-mono	Model	**NU-180E1**		
	Manufacturer	Sharp		
Number of PV modules	In series	17 modules	In parallel	353 strings
Total number of PV modules	Nb. modules	6001	Unit Nom. Power	180 Wp
Array global power	Nominal (STC)	**1080 kWp**	At operating cond.	966 kWp (50℃)
Array operating characteristics (50℃)	U mpp	359 V	I m pp	2692 A
Total area	Module area	**7862 m²**		

Inverter	Model	**Sunny Mini Central 9000 TL**		
	Manufacturer	SMA		
Characteristics	Operating Voltage	335-500 V	Unit Nom. Power	9 kW AC
Inverter pack	Number of Inverter	107 units	Total Power	963 kW AC

PV Array loss factors

Thermal Loss factor	Uc (const)	29.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m², Tamb=20°C, Wind velocity = 1m/s.)			NOCT	45 ℃
Wiring Ohmic Loss	Global array res.	2.2 mOhm	Loss Fraction	1.5 % at STC
Serie Diode Loss	Voltage Drop	0.7 V	Loss Fraction	0.2 % at STC
Module Quality Loss			Loss Fraction	2.5 %
Module Mismatch Losses			Loss Fraction	2.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05

User's needs : Unlimited load (grid)

Equipment stated is indicative

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

PV Power Plants – a REFIT opportunity

POWER PLANTS

POWER PLANT DESIGN **University of Geneva PVSYST V5.02**

Simulation variant

Balances and main results

	GlobHor kWh/m²	T Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	EffArrR %	EffSysR %
January	122.1	11.67	166.4	162.1	157410	154023	12.03	11.77
February	141.8	13.52	180.0	175.4	166346	162760	11.76	11.50
March	160.1	18.29	199.2	193.8	181308	177364	11.58	11.33
April	206.1	24.40	200.5	194.3	175644	171831	11.14	10.90
May	228.8	28.62	201.8	194.7	173301	169432	10.92	10.68
June	238.2	30.55	199.1	191.6	169085	165232	10.80	10.55
July	242.1	31.36	206.6	199.1	175068	171191	10.78	10.54
August	229.4	30.82	214.3	207.2	181605	177618	10.78	10.54
September	198.9	28.27	210.5	204.5	181464	177525	10.96	10.72
October	175.8	22.90	215.4	210.1	191400	187223	11.30	11.05
November	130.8	18.35	176.6	172.2	161122	157653	11.61	11.36
December	111.0	13.23	153.9	149.8	145177	142078	12.00	11.74
Year	2205.1	22.73	2324.3	2254.8	2058930	2013933	11.27	11.02

Legends:

GlobHor	Horizontal global irradiation	EArray	Effective energy at the output of the array
T Amb	Ambient Temperature	E_Grid	Energy injected into grid
GlobInc	Global incident in coll. plane	EffArrR	Effic. Eout array / rough area
GlobEff	Effective Global, corr. for IAM and shadings	EffSysR	Effic. Eout system / rough area

the power company

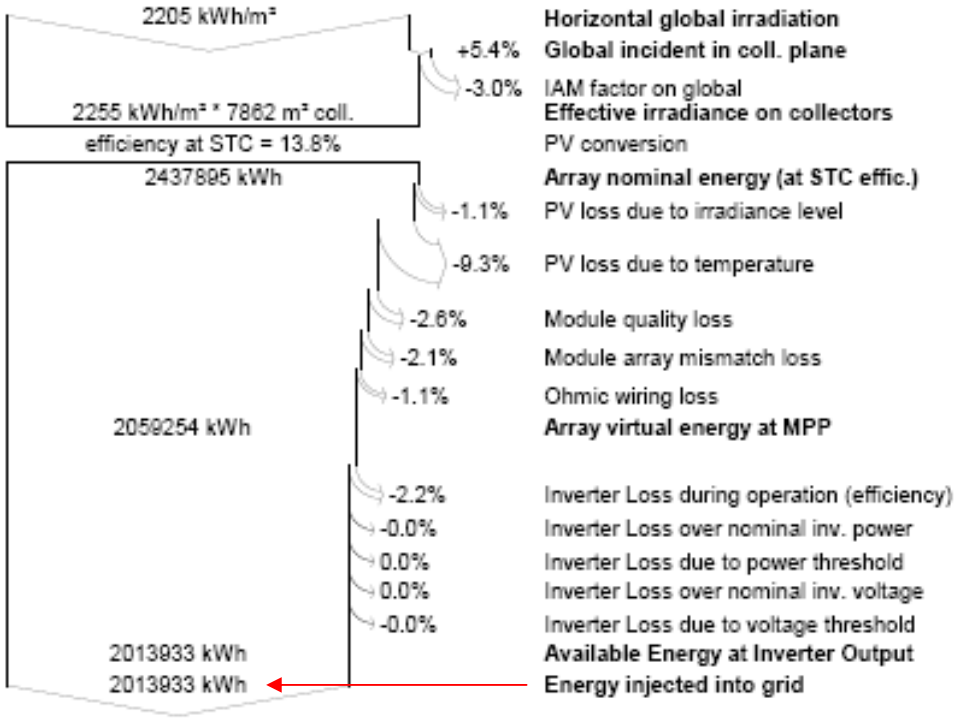
DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

PV Power Plants – a REFIT opportunity

POWER PLANTS

POWER PLANT DESIGN **University of Geneva PVSYST V5.02**

Loss diagram over the whole year



These are assumed maximum figures

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

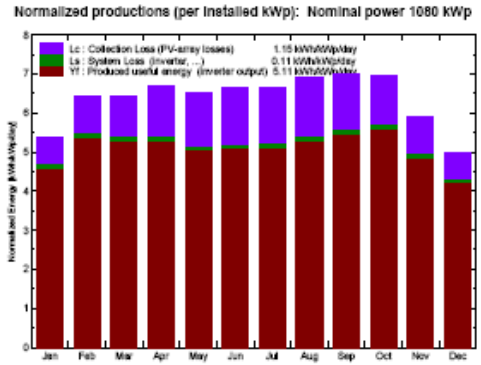
PV Power Plants – a REFIT opportunity

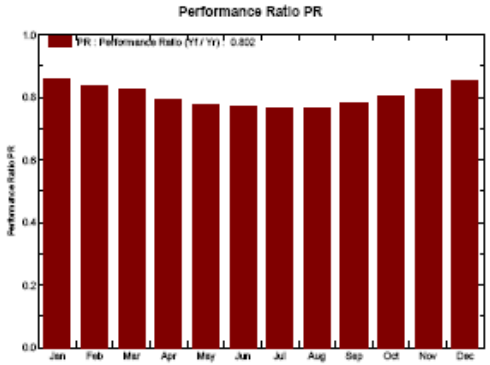
POWER PLANTS

POWER PLANT DESIGN **University of Geneva PVSYST V5.02**

Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	tilt	30°	azimuth	0°
PV modules	Model	NU-180E1	Pnom	180 Wp
PV Array	Nb. of modules	6001	Pnom total	**1080 kWp**
Inverter	Model	Sunny Mini Central 9000 TL	Pnom	9.0 kW ac
Inverter pack	Nb. of units	107.0	Pnom total	**963 kW ac**
User's needs	Unlimited load (grid)			

Main simulation results				
System Production	**Produced Energy**	**2014 MWh/year**	Specific prod.	1864 kWh/kWp/year
	Performance Ratio PR	80.2 %		





the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

PV Power Plants – a REFIT opportunity

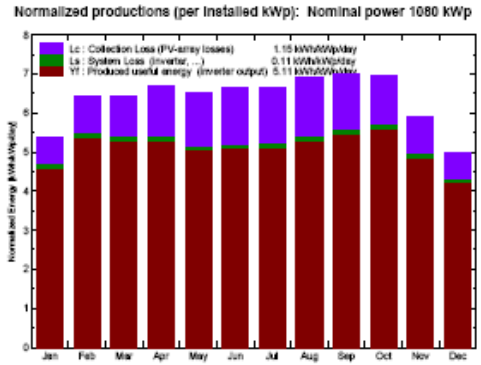
POWER PLANTS

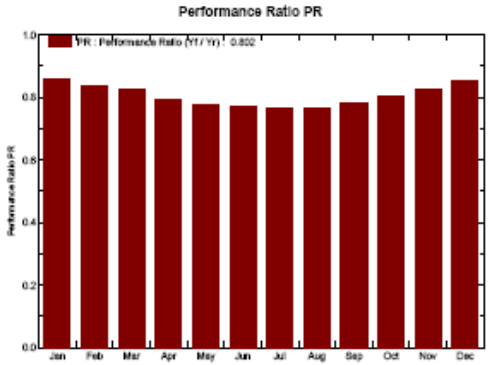
POWER PLANT DESIGN **University of Geneva PVSYST V5.02**

Main system parameters	System type	**Grid-Connected**		
PV Field Orientation	tilt	30°	azimuth	0°
PV modules	Model	NU-180E1	Pnom	180 Wp
PV Array	Nb. of modules	6001	Pnom total	**1080 kWp**
Inverter	Model	Sunny Mini Central 9000 TL	Pnom	9.0 kW ac
Inverter pack	Nb. of units	107.0	Pnom total	**963 kW ac**
User's needs	Unlimited load (grid)			
Main simulation results				
System Production	**Produced Energy**	**2014 MWh/year**	Specific prod.	1864 kWh/kWp/year
	Performance Ratio PR	80.2 %		

Solar array size

Calculated generated power MWh per year





DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

YES IT HAS

- Renewable energy can and must be part of the main stream energy mix
- Policy issues need to be balanced and commitments kept
- Don’t be afraid to stand up and be counted

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

Thought to take away with you

by Marianne Williamson from
A Return To Love: Reflections on the Principles of A Course in Miracles

" Our deepest fear is not that we are inadequate.
Our deepest fear is that we are powerful beyond measure.
It is our light, not our darkness that most frightens us.
We ask ourselves, Who am I to be brilliant, gorgeous, talented, fabulous?
Actually, who are you *not* to be? You are a child of God.
Your playing small does not serve the world.
There is nothing enlightened about shrinking so that other people won't feel insecure around you.
We are all meant to shine, as children do.
We were born to make manifest the glory of God that is within us.
It's not just in some of us; it's in everyone.
And as we let our own light shine, we unconsciously give other people permission to do the same.
As we are liberated from our own fear, our presence automatically liberates others."

the power company

DOES RENEWABLE ENERGY HAVE A PLACE IN THE IN SOUTH AFRICAN SUN?

CHEERS

jon@thepowercompany.co.za
011 462 9665