



# Energy Matters

## Wind Power Systems

Presenter Rob Wells

# Systems Types



- Wind grid feed systems
- Solar grid feed systems
- Remote area power systems
- Water Pumping

# Wind Power Grid Connect



## **What are they?**

A grid interactive system involves the installation of a Wind Turbine and a grid interactive inverter. The energy generated is fed into the Inverter and either used up in the household or fed back into the local supply grid this is then credited at the same rate for systems up to 10 KW against the charges on your next electricity bill. Electricity is drawn back from the grid whenever there is no wind or the load exceeds the wind input. The electricity supplier provides a new meter which records power imported and exported. A read out provides both power imported and exported.



# 2.4 KW Skystream turbine

- Average daily output 18 KWH
- Installed cost \$27,500
- Energy saving per year \$1,800
- Payback 15 years
- Avg. wind speed 6.2 mtr/sec



# 3 x 2.4 KW Skystream at Sorell



Low wind speed of 4.5 meter per second  
Average daily output 6 KWH

# 5 KW Verticle axis wind turbine

Not ideal, low tip speed





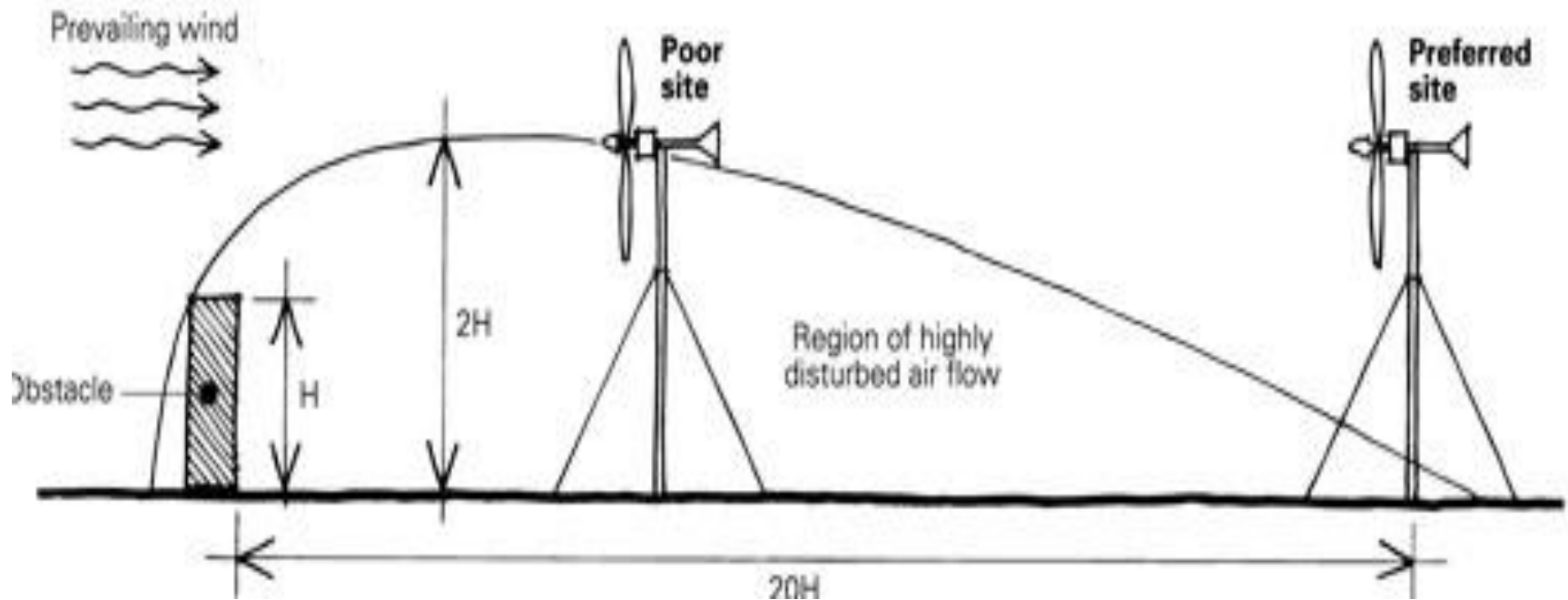
# SITE ASSESMENT TERRAIN

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## **Ideal sites are flat clear ground**

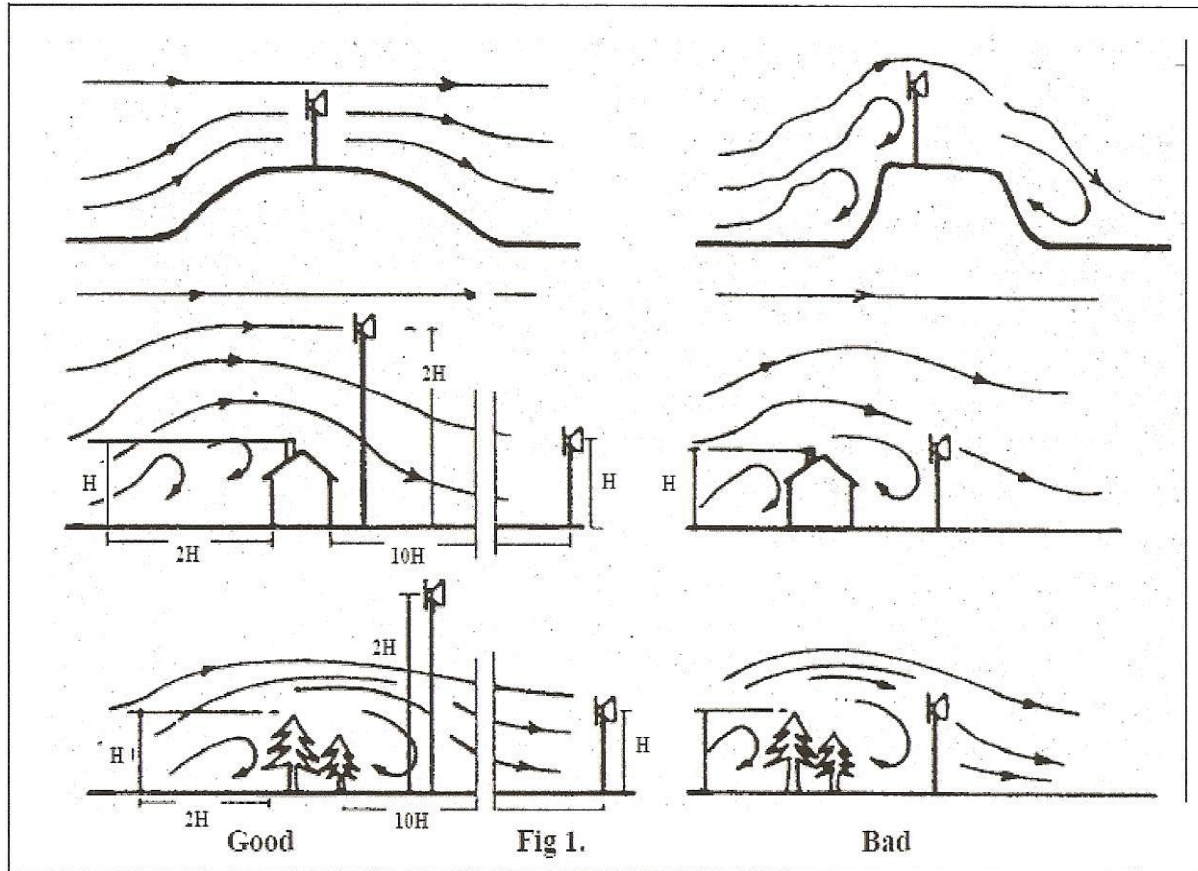
- Tree's and buildings cause turbulence
- Wind Turbine needs to 10 meters above anything within 100 meters at least
- A clear flat rounded hilltop may be suitable

# WIND AROUND BUILDINGS





# Siting

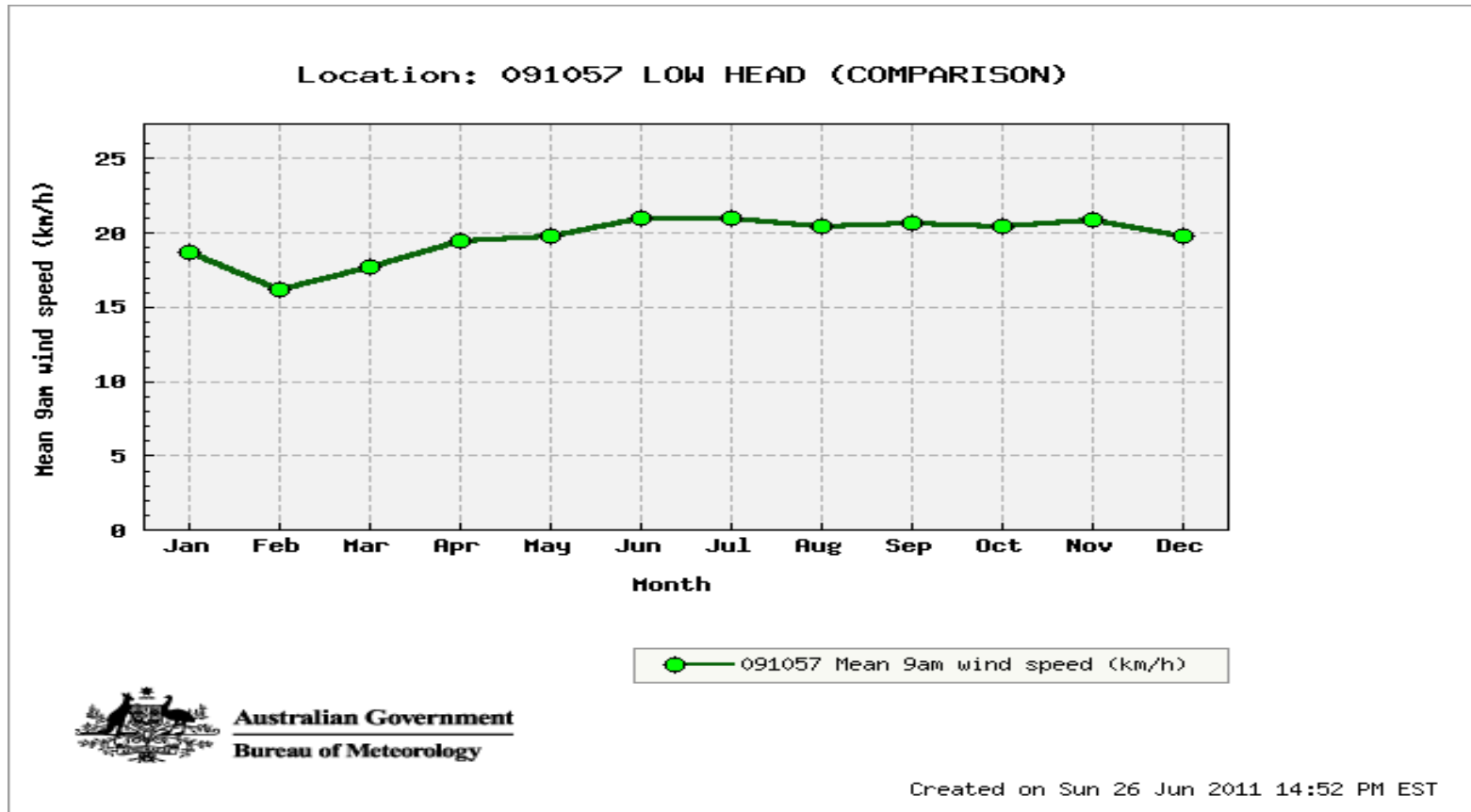


# Site assessment Wind Speed

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- **Viability**
- Will depend on available wind speed
- Price paid for the power you produce
- Cost of the installation

# Wind Speed Low Head 9.00am

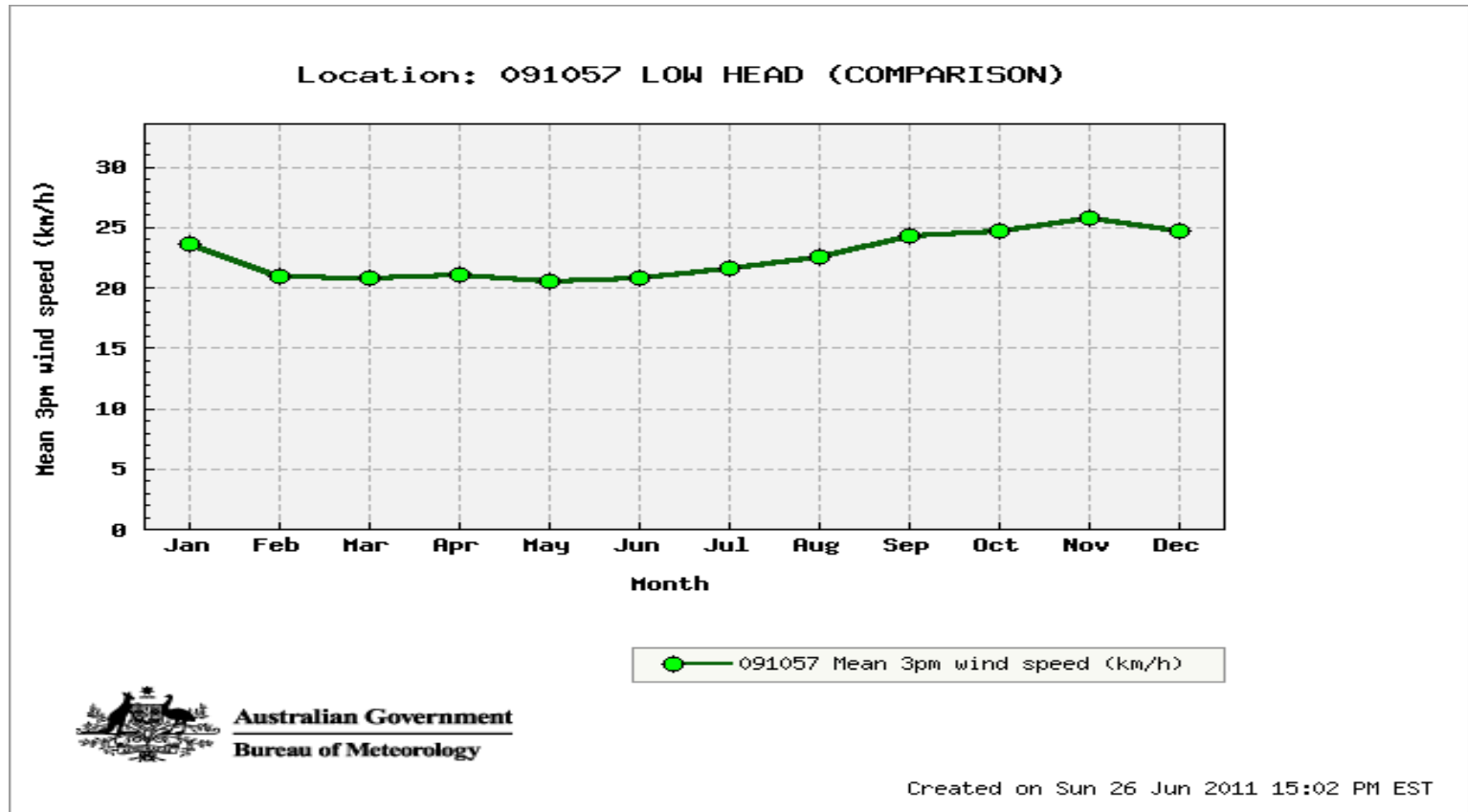


# Wind speed conversion at 9.00am

- **Worst month** lowest wind speed average
- February            16.2 KMH = 4.5 M/S
  
- **Best month**
- June                 21 KMH = 5.83 M/S



# Wind Speed Low Head 3.00pm



# Wind speed conversion at 3.00pm

- **Worst month** lowest wind speed average
- June                      20.5 KMH = 5.69 M/S
  
- **Best month**
- December                25.8 KMH = 7.17 M/S

# Wind speed converter online

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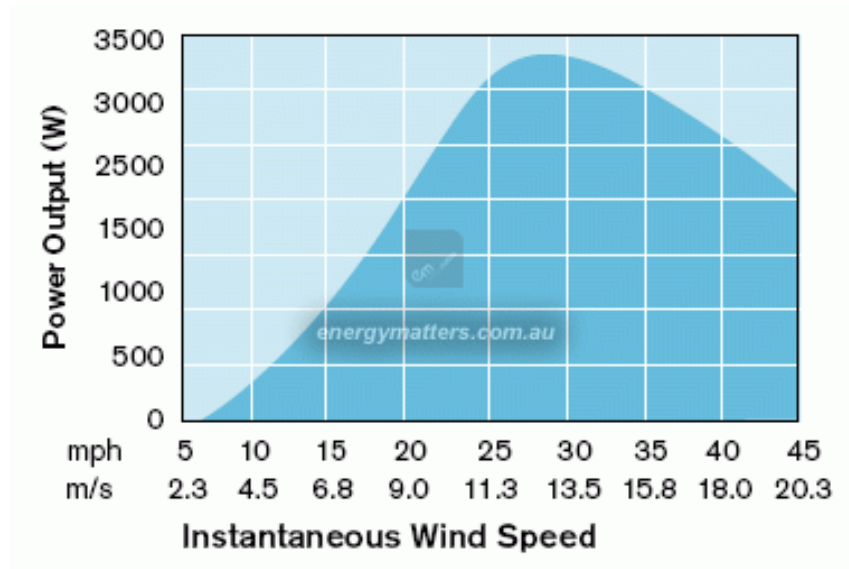
<http://www.hpc.ncep.noaa.gov/html/windspeed.shtml>

Bureau of metrology climate data Whitemark

[http://www.bom.gov.au/climate/averages/tables/cw\\_099005.shtml](http://www.bom.gov.au/climate/averages/tables/cw_099005.shtml)

# 3 KW Whisper wind turbine

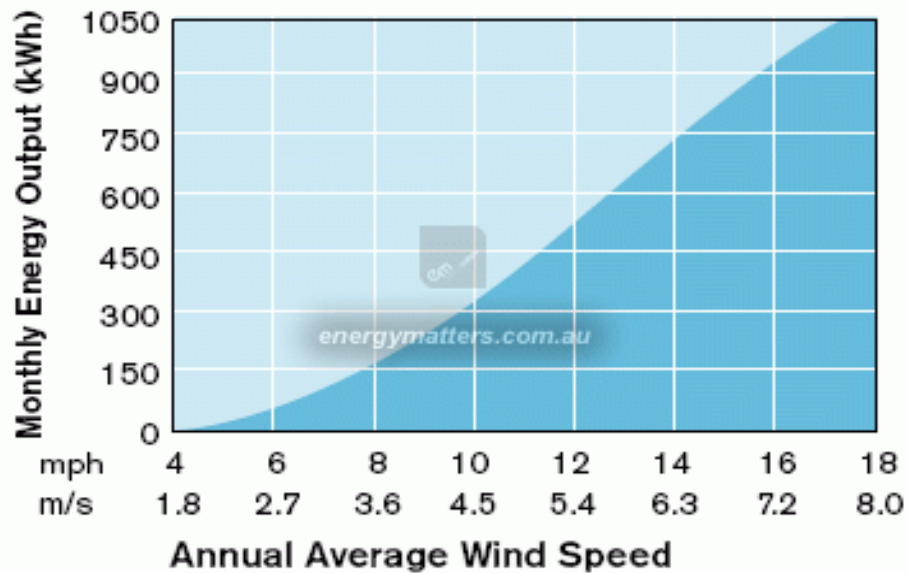
- Instantaneous wind speed output



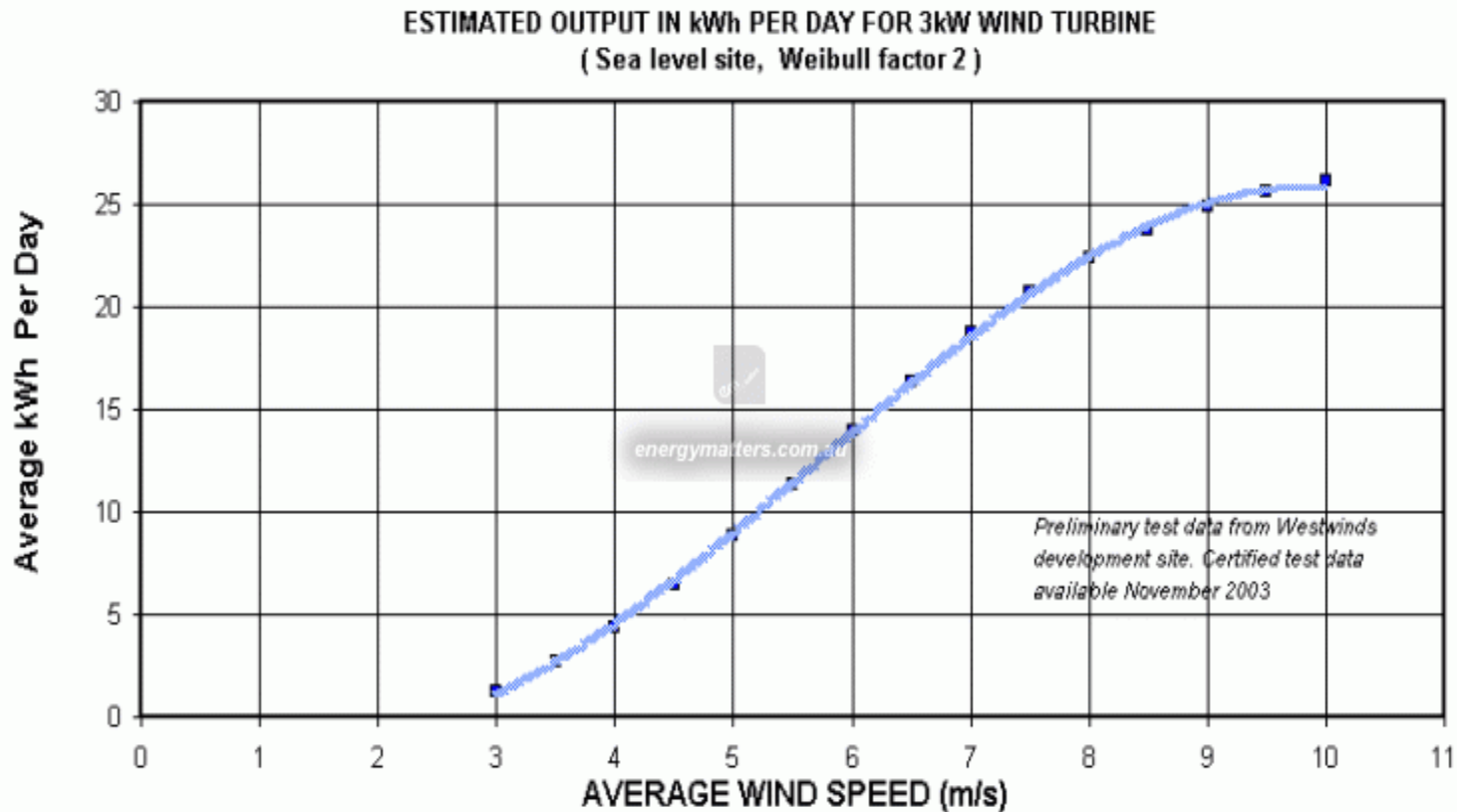


# 3 KW Whisper wind turbine

- Average monthly output



# Average KWH per day 3 KW Turbine



# 2.5 KW Skystream wind turbine

**Installed cost \$27,500**

**Average wind speed M/S**

**Annual KWH - Saving**

<input type="checkbox"/>	4.5	2,400	\$625
<input type="checkbox"/>	5.0	3,600	\$935
<input type="checkbox"/>	5.5	4,800	\$1250
<input type="checkbox"/>	6.0	5,400	\$1425
<input type="checkbox"/>	6.5	6,000	\$1550
<input type="checkbox"/>	7.5	7,350	\$1925

# 6 KW Ampair wind turbine

**Installed cost \$45,000**

**Average wind speed M/S      Annual KWH- Saving**

4.5	7,000	\$1850
5.0	8,500	\$2210
5.5	11,000	\$2860
6.0	13,000	\$3380
6.5	15,000	\$3900
7.5	17,500	\$4550



# Costing and Payback 2.5 KW wind

- At average **6.2** meter per second wind speed
- Turbine installed on 14 meter tower \$27,500
- Less REC rebate for first 5 years -\$ 1,570
- Less REC rebate for yr 6 to 10 -\$ 285
- Less REC rebate for yr 11 to 15 -\$ 285
- Cost over 15 years not inc maintenance \$25,360
- Electricity saved at **26c**/KWH over **15yr** \$27,000
- Saving with annual power increase's \$36,500

# Costing and Payback 6 KW wind

- At average **6** meter per second wind speed
- Turbine installed on 12 meter tower \$45,000
- Less REC rebate for first 5 years -\$ 2,565
- Less REC rebate for yr 6 to 10 -\$ 1,280
- Less REC rebate for yr 11 to 15 -\$ 1,280
- Cost over 15 years not inc maintenance \$39,875
- Electricity saved at **26c**/KWH over **15yr** \$50,700
- Saving with annual power increase \$66,800

# Metering

## **Net metering** (TAS at .26c)

- Electricity company only pays you for what you sell to them, some of the power generated will be used in the house

## **Gross metering** (ACT at .45c)

- Electricity company pays you for all the power you produce whether you use it or sell it
- Vic, SA, Qld, WA, NSW have **net** metering

# Livestock ignore Wind Turbines



Cattle continue to graze as they did before

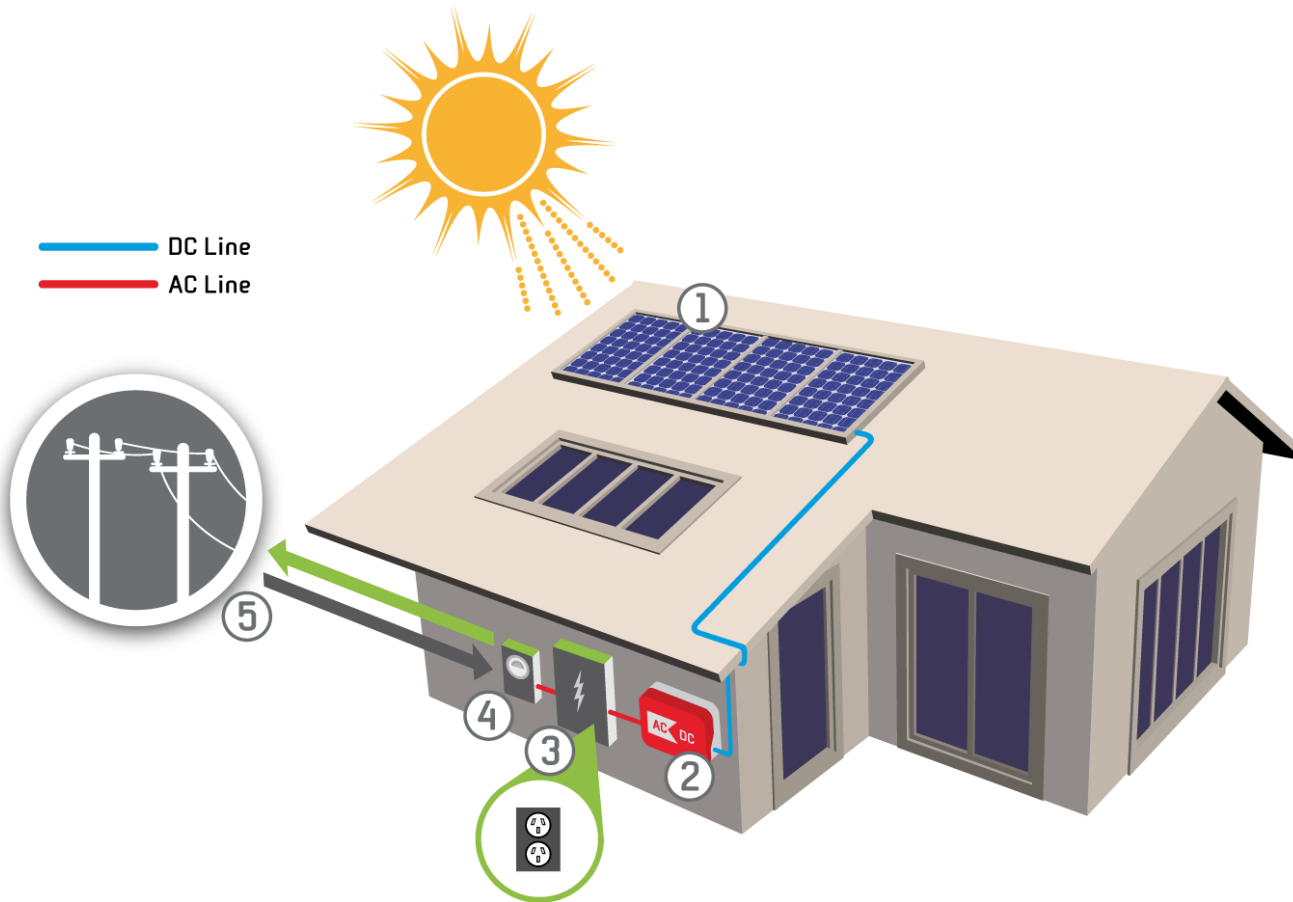


# Energy Matters

## Solar Power Systems

Presented by Rob Wells

# How a Grid Connect System Works



## 1. Photovoltaic modules

Also known as solar panels, directly convert energy in the form of sunlight into direct current (DC) electrical energy.

## 2. Inverter

An inverter changes the solar DC power into 240V alternating current (AC) ready to be fed back into the grid or used in your home.

## 3. Switch board

AC power from the inverter goes through the switch board for use in your home.

## 4. Electricity meter

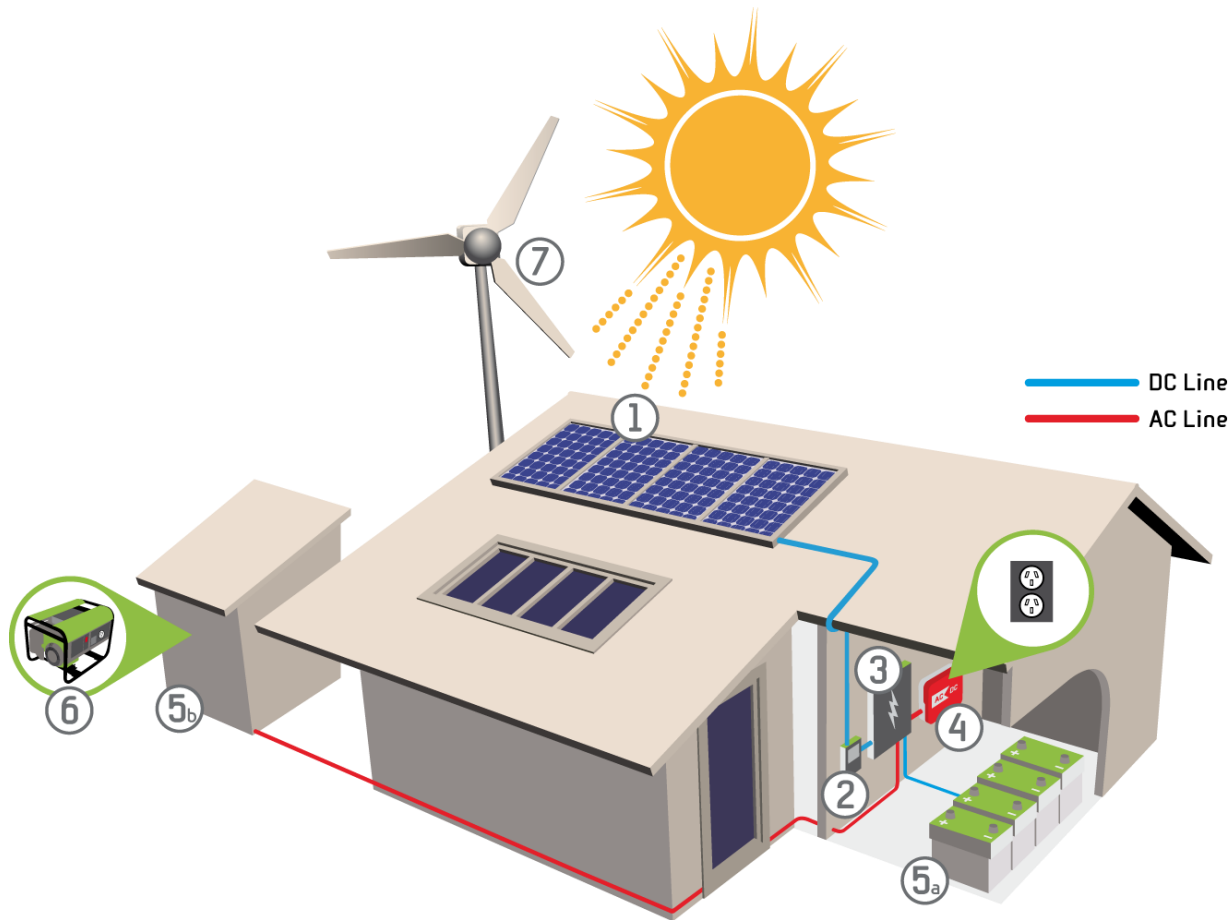
The meter records the energy sent to the grid from your solar system as well as the energy consumed from the grid.

## 5. The electricity mains grid

Any surplus electricity being generated simply flows through into the mains grid for use elsewhere.



# How an Off Grid System Works



## 1. Photovoltaic modules

Also known as solar panels, directly convert energy in the form of sunlight into direct current (DC) electrical energy.

## 2. Regulator

DC electricity flows via the regulator which prevents the batteries overcharging.

## 3. Control board

Controls DC and AC power and houses the switching and isolation control devices.

## 4. Inverter

The inverter changes the solar DC power into 240V alternating current (AC) ready to be used in the home.

## 5. Batteries

The battery bank stores the electrical energy there by allowing you to collect energy during the day and store it until you need to use it. These can be installed either inside the house (a) or in an external battery shed (b).

## 6. Generator

The generator is used as backup during cloudy or low wind conditions.

## 7. Wind turbine

As with solar PV, a wind turbine can be used to charge your batteries.

# Financial Implications of Investing in Solar

» A 5 kW system produces an average of 20 kWh per day

Installed cost \$15,000

» If you leave only a fridge on (1kWh) during the day this means that 19 kWh can feed directly into the electricity grid.

»  $20 \times 26c = \$5.20$  per day.

»  $\$5.20 \times 365 = \$1,898$  per year

»  $\$15,000.00$  divided by  $\$1,898 =$  payback time of 7.9 years

» Considering that solar panels last for 40-50 years, this is an attractive investment (especially in these economic times!)

With expected 5% annual increases in power prices payback is much less





# Carbon Reduction

Electricity prices right across the world are increasing sharply as power companies struggle to maintain expensive infrastructure and boost shareholder returns. What's more, our reliance on fossil fuels to produce that electricity means we face a growing chorus of criticism over the impact that coal mining and pollution from power stations is making on our environment.

- » Each kWh of electricity produces approximately 1.3 kg of CO<sub>2</sub>
- » Each mWh of power produced from diesel
- » If the average household uses 16 kWh per day, this equals approximately 7,592 kg (7.5 tonnes!) of CO<sub>2</sub> per year





# Energy Matters

## Solar Power Systems Case Studies

# Case Studies: Grid Connect

**Project:** Knox Leisure Works

**System size:** 5kW

**Panels:** Suntech 175W x 30

**Inverter:** SMA Sunny Mini Central 6000 + Comms





# Case Studies: Community Centre Grid Connect



**Project:** Latrobe City Council Intergenerational Hub

**System size:** 7kW

**Panels:** Solarfun 175W x 40

**Inverter:** SMA Sunny Mini Central 6000

**Other:** Sunny Beam wireless monitor

# Case Studies: Stand Alone Mini Grid



**Project:**

South Long Island Nature Resort (Whitsundays)

**System size:**

6.5 kW Mini Grid Connect Hybrid System

**Panels:** Suntech 175W x 18

Sharp 80w + BP 80w (existing)

**Inverter:** Grid Connect Sunny Boy x 3

Sunny Island inverter charger x 2

**Batteries:** 2 x 48V banks 2400 amp hours

**Other:** 13 KVA Diesel Generator

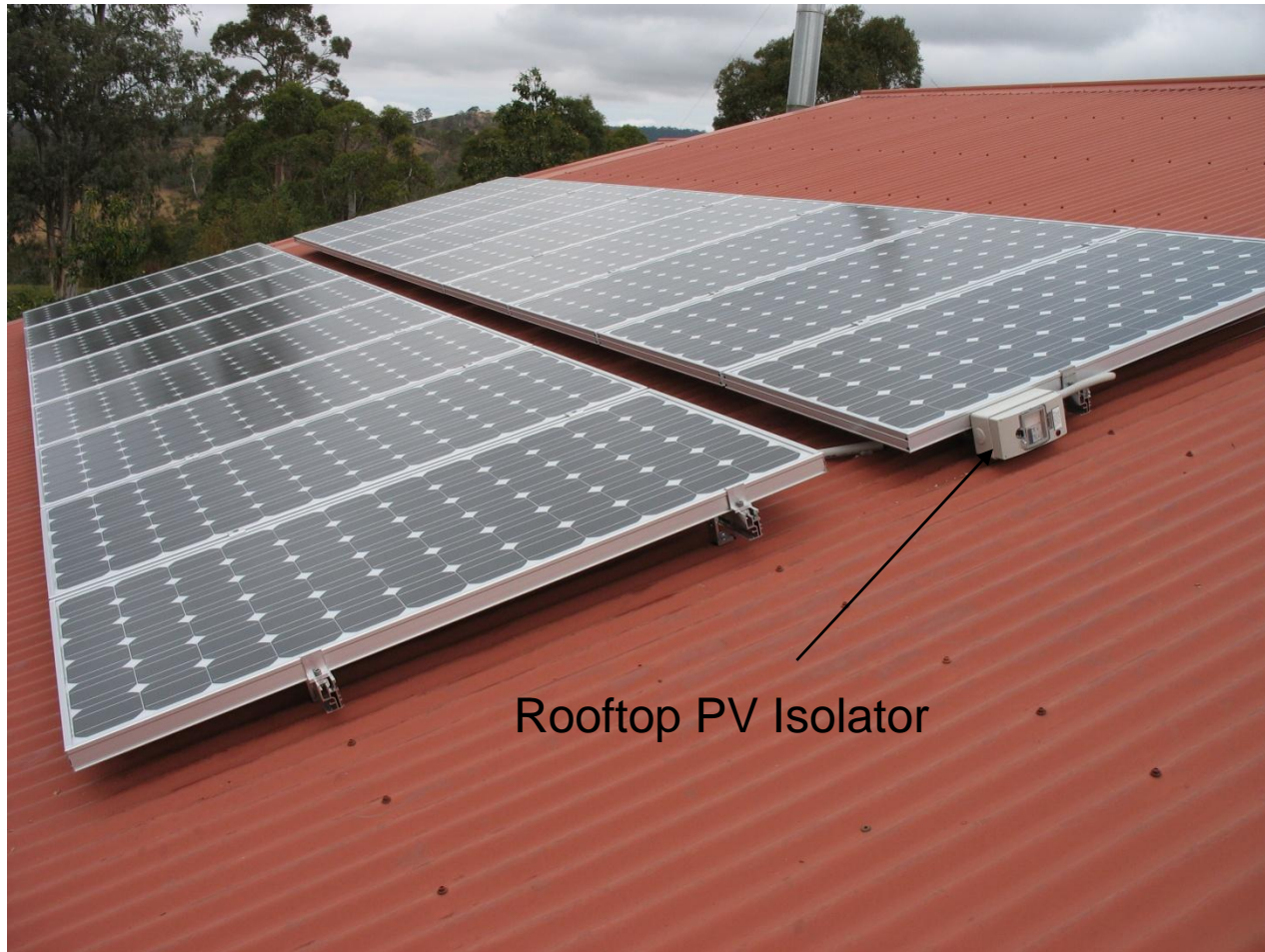
Sunny Webbox Data Logger

Internet monitoring

**Notes:** System supplies power to 12 cabins, staff quarters, restaurant and kitchen

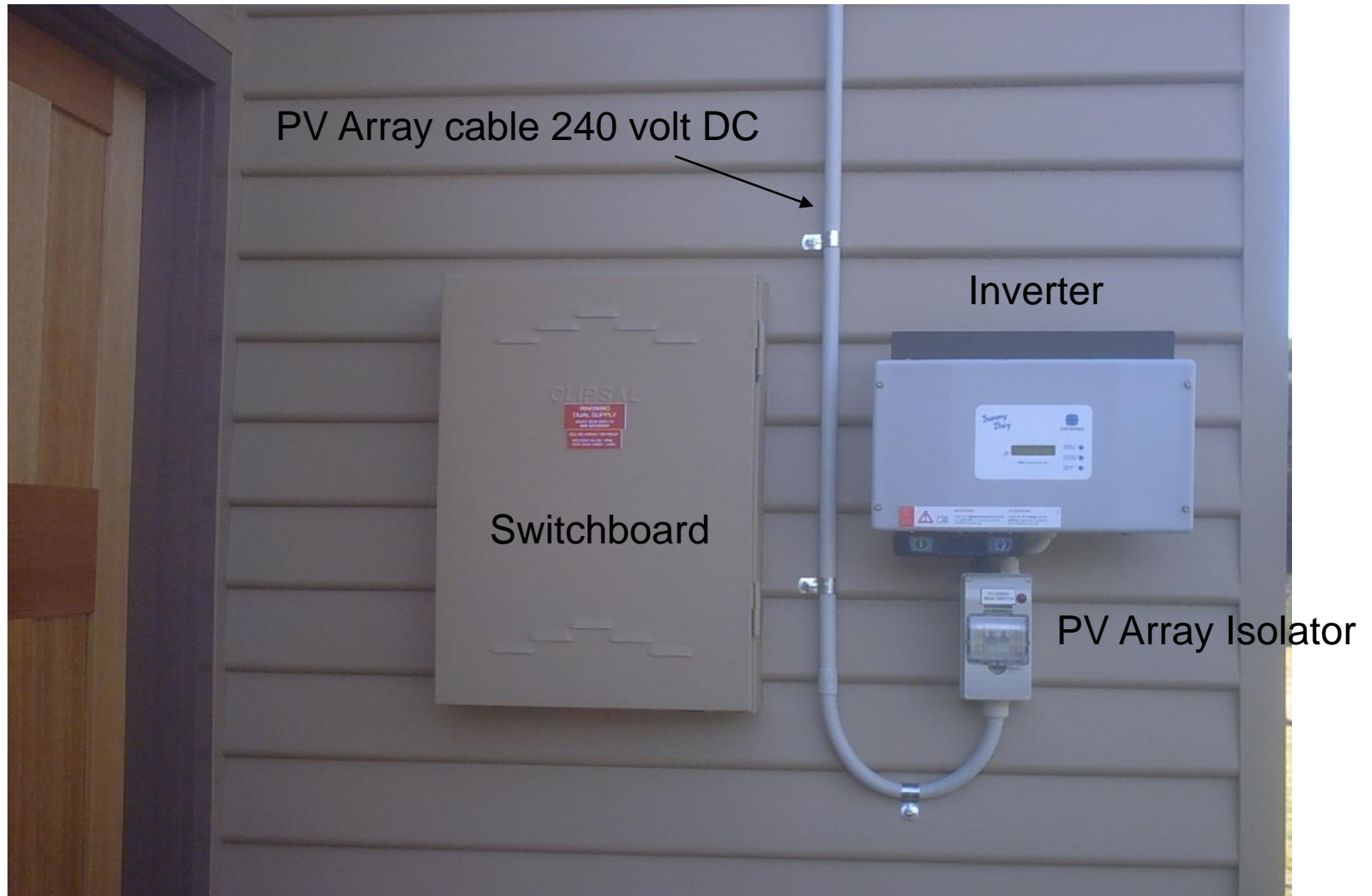


# Rooftop PV Array Isolator

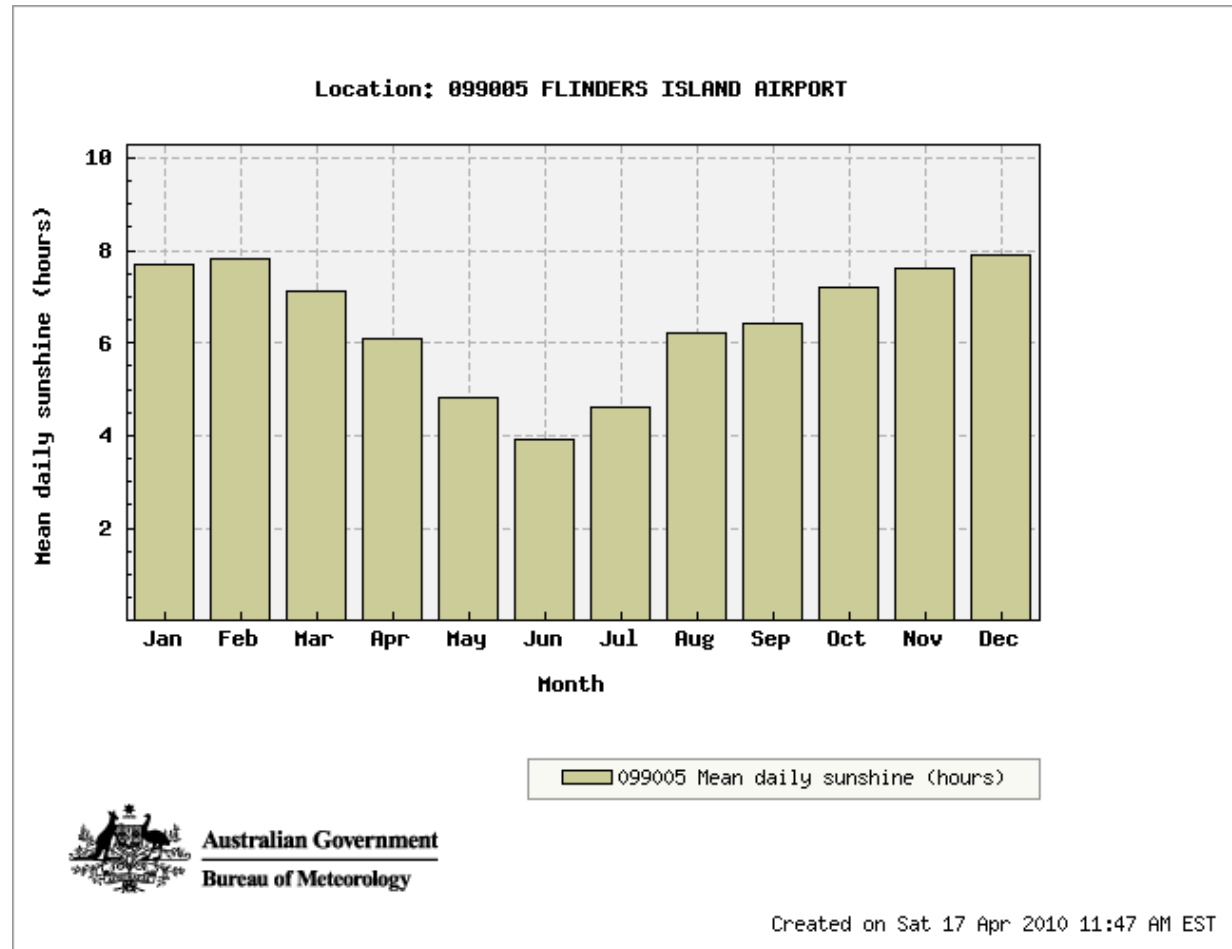


Rooftop PV Isolator

# Inverter and Switchboard



# Peak Sunshine hours Whitemark





# Solar Grid Connect

□ Size	Installed cost after REC rebate	Saving/YR @ .26c
□ 3.0 KW	\$8,500	\$1140 7.5
□ 5.0 KW	\$15,000	\$1898 7.9
□ 7.5 KW	\$22,500	\$2,850 7.9
□ 10.0 KW	\$29,500	\$3,795 7.7

# Payback period for Solar Grid

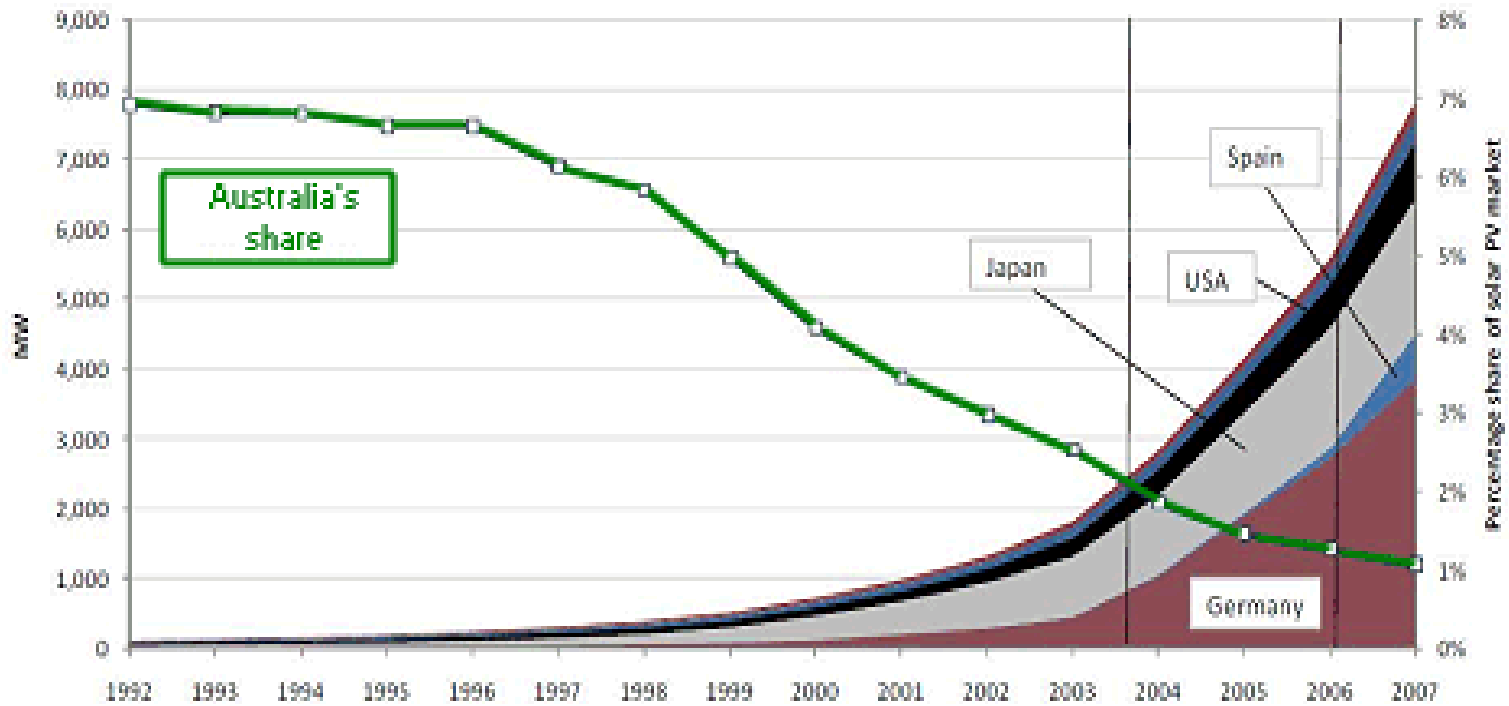
- Currently around 7.5 years with .26c feeding tariff
- Other things to consider power prices will increase by an average of 5% per annum, lowering payback period.
- **A 2.1 KW system will save 4 tonnes of CO2 per year**  
based on generation by coal fired power station.

# Money in the bank

- Is it worth it
- Interest on \$8,500 per annum      \$510
- Interest on \$15,000 per annum      \$900
- Interest on \$22,500 per annum      \$1350
- Interest on \$29,500 per annum      \$1770

# Global solar installed

GLOBAL SOLAR PV INSTALLATIONS (CUMULATIVE)



Source: IEA (2008)

Other Europe USA JPN ESP GER

# For Assistance



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