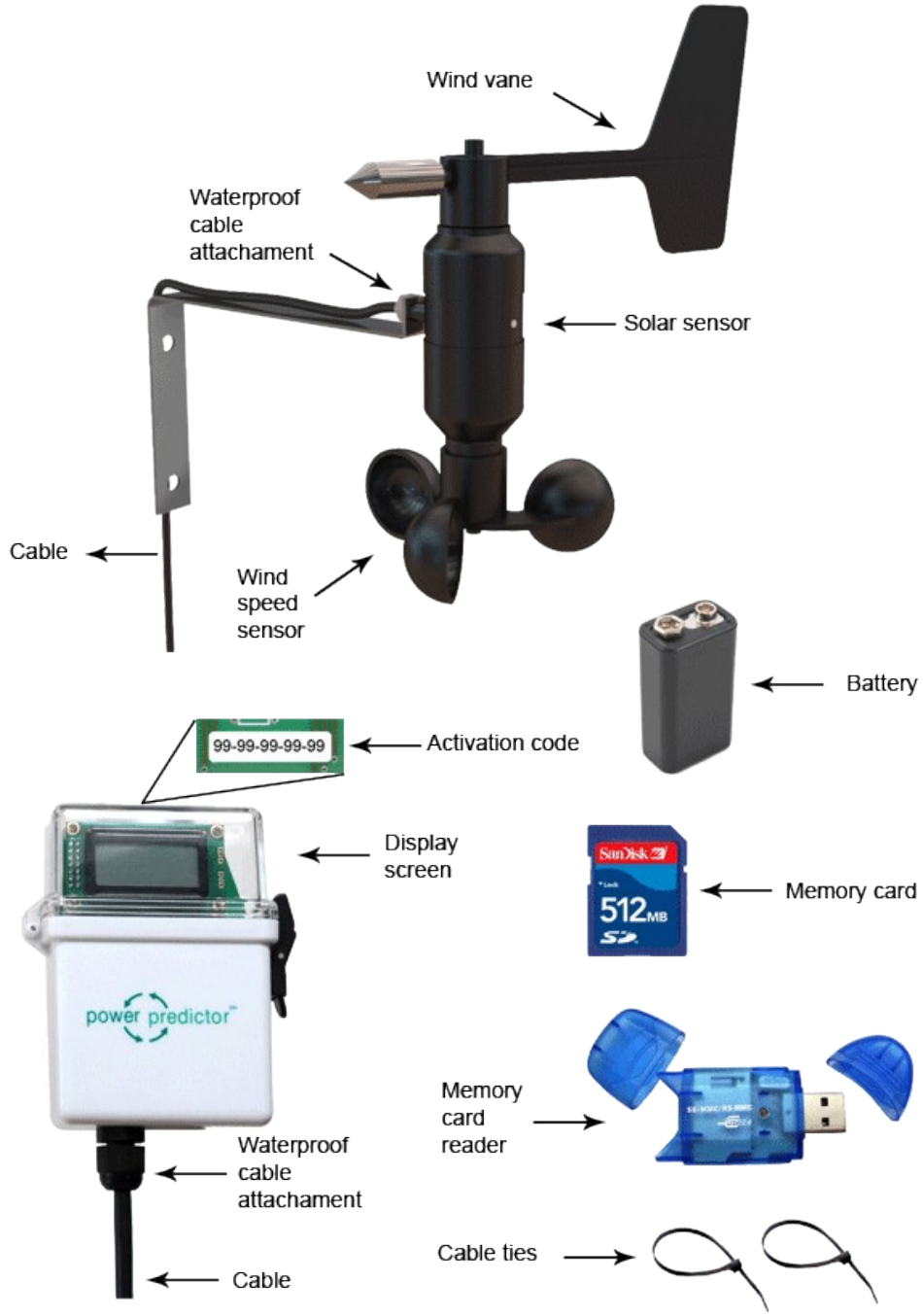
Power Predictor Technical Specification

This document sets out the detailed technical specification for the Power Predictor hardware and software. The kit contains the following items:

Kit contents



power predictor™

Overview

Instrument type	Five channel wind and solar data logger kit including sensors analysis software
Application	Wind and solar resource assessment for small microgeneration sites
Digital channels	One
Analogue channels	Four
Functions	Data is collected in time & date stamped, ten minute average samples, which are analysed by the accompanying web software
Sampling interval	10 seconds, fixed
Averaging interval	10 minutes, fixed
Real time clock	User programmable date and time, adjusts for leap years
Storage medium	Non-volatile, removable 512MB SD memory card, capable of storing many years of data. USB converter included in pack
Maximum data storage	Data storage equates to only around 3 MB per year so the memory card supplied provides excessive space
Parameters recorded	Date Time / Wind pulses per 10 minute interval / Raw wind direction average / Raw solar average / spare channel / Raw temperature average / Wind direction variance (beta)
File format	Tab delimited ASCII directly compatible with Excel, although Power Predictor software is required to apply correct conversion factors of raw data collected.
Software	Fully featured analysis software including high resolution graphing, summarising and individual wind turbine power output forecasting
Software licensing	Twelve months software license included in the kit. Annual renewal costs 10 GBP or local equivalent.
LCD display User Interface	2 line, 8 character LCD shows 10 second sample of wind speed (m/s), raw solar check and current time. 'R' signal on screen indicates recording is active. Screen sleeps by default to conserve battery life
Configurable parameters	Time, Date, Screen timeout period
Supply voltage	Nominal 9V DC, minimum 3.3V DC
Current consumption	Average of 24uA
Battery	9V Alkaline PP3 battery supplied, (6LF22-9V-AM6) Estimated lifespan 3 – 6 months depending on operating temperature. Use of higher specification battery recommended for longer unattended logging or extreme environments
Mounting	Logger: Velcro attachment supplied, user to select appropriate means of fixing according to situation Sensor: bracket supplied with fixing holes. Screws or cable ties can be used to secure to mounting pole
Operating temperature range	-10 °C to 50 °C. Recommend logger is positioned in the shade to reduce UV damage and effect on battery life
Operating humidity range	0 – 100% RH non condensing
Weight	Boxed Power Predictor kit including 5m cable: 1.5kg

	Sensor: 400g Logger: 200g
Dimensions	Vane: 230mm x 120mm Anemometer cups 120mm diameter Bracket: 170mm Logger: 120mm x 100mm x 40mm
Materials	Bracket: stainless steel Body: ABS plastic Logger enclosure: hinged plastic lid, waterproof rubber O-ring seal
Anemometer maximum survival wind speed	50 m/s
System Failure per Million Hours	9.7
Overall System FIT	9707.9
Overall System MTBF	103009.0 hours

Data logger

- Self contained waterproof data logger engineered for very low power operation
- LCD screen shows set time, live windspeed and solar indication.
- Screen automatically enters sleep mode to save power
- 512 MB SD memory card included, which will store several years worth of wind and solar data as a timestamped text file
- PP3 9V battery supplied, lasts several months in normal conditions

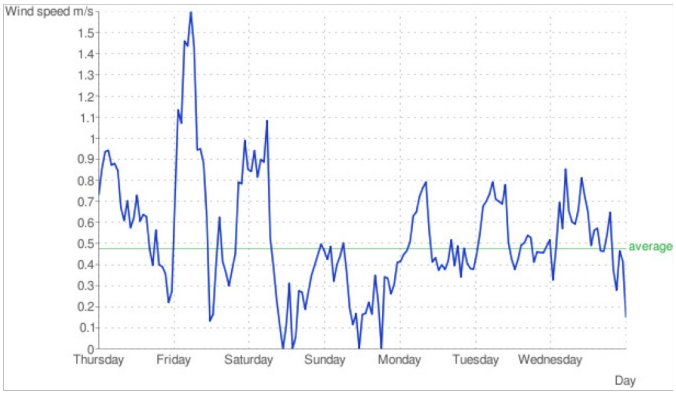
Sensor

- 3 cup, pulse anemometer, accurate to +/- 3% in independently verified tests
- Assembly built around two low friction bearings (delivering 1.3 m/s start up speed)
- Balanced wind vane for measuring prevailing wind direction
- Rugged mounting bracket
- Index of wind turbulence on separate data channel (beta only)
- Sensor for recording solar energy hours
- Five metres UV balanced cable included
- Requires USB 1.0 or 2.0 port on your computer
- Minimum 30 days data required before software report generated
- Rugged UV resistant ABS plastic
- RoHS compliant and fully CE certified
- Mast pictured is available separately in a range of different heights to suit your project.

Web application

- Power Predictor web application works through your browser (PC or Mac)
- Data file is uploaded from the memory card into powerpredictor.com, which generates instant graphs
- Once more than thirty days worth of data is collected, a payback forecast is generated

Wind calculations



- Raw data collected is processed by the Power Predictor software to calculate an estimate of the total energy that could be generated at that site by a range of wind turbines

Annualising wind resource forecasts

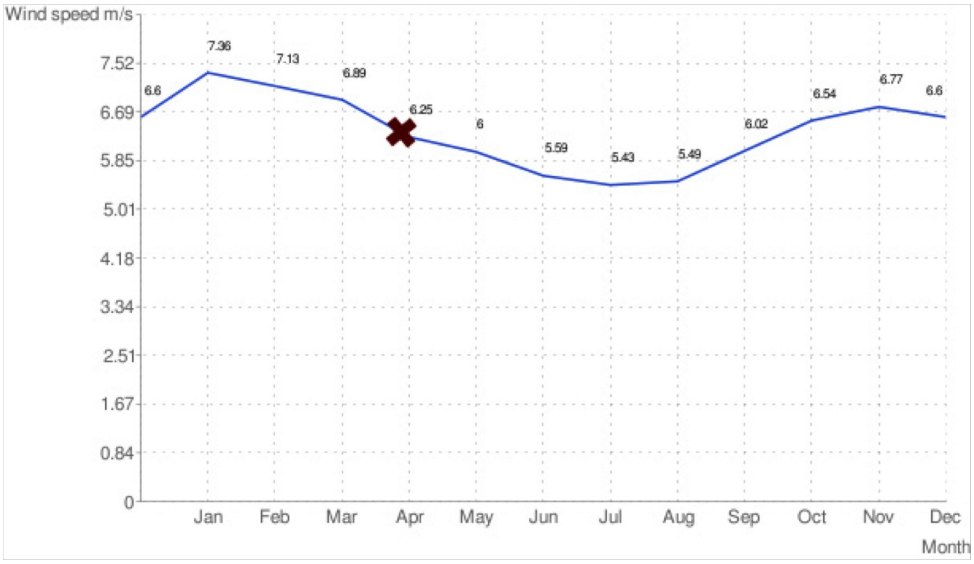
- Most users can best understand the economics of a wind turbine by looking at the information annually, i.e. *annual* energy bill savings, *annual* electricity generation in kWh.
- We advise measuring wind speeds for as long a period as possible – the more data gathered, the better the forecast is likely to be
- The Power Predictor software configuration allows for two methods of annualising the data sample collected, depending whether local seasonal trend data is available for that territory
- Where trend data is available, users can choose between two report types.

- In territories where seasonal data is not available, the Power Predictor

presents results as a 'Real time report'

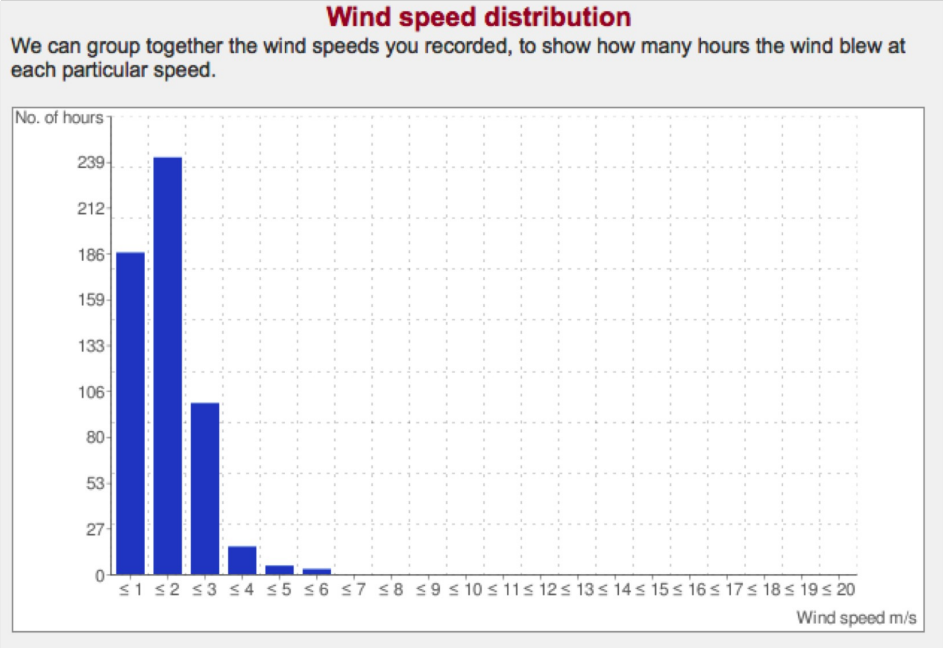
Seasonally Adjusted Report

- The Seasonally Adjusted Report calculates an annual power output by mapping the average of the first 30 days of data collected to known trends for that territory. For example if you gathered 30 days of data in June, the report would forecast more wind in December, so that your forecasted power over the year would be more realistic.
- This process creates twelve monthly mean wind speed figures. These twelve values are then converted wind speed distribution profiles for each month, using a well-known industry formula called the Weibull distribution.
- These twelve profiles are combined to provide an annual wind distribution profile for the site



Real Time Report

- Where seasonal trend data is not available for a territory, we calculate a 'Real Time Report' which is solely based on the actual data collected
- Raw data uploaded by the user is sorted into interval 'bins' to generate a wind speed distribution profile for the site - in other words, how many hours the wind has blown, at which speeds during the period measured.



Continuing the calculations

- The wind speed profile as generated by either above methodology is then multiplied against the wind turbine power performance curves we have in our database for each wind turbine system. Note that these power curves are those supplied by the manufacturers and have not been independently verified by Better Generation Ltd
- A number of minor adjustments are made, concerning air density, altitude and likely maintenance downtime, to give a total forecasted power generation figure for that period, in kWh. This is shown in the summary table, in the 'Annual energy output' column for each wind turbine presented
- The monetary value of the Annual energy output is calculated using a user-configurable price per kWh of grid electricity (15p/kWh for the UK). The system will also suggest a default price suitable for each country or territory.
- The value of the Annual cost savings is then divided into the typical installed equipment cost (the Capital cost), of each device to produce a Payback estimation for that product option at that site.

Name	Payback ▲	Capital cost	Annual energy output	Annual CO_2 savings	Annual cost savings	
Proven 15kW	5 years	£58,000	59,135 kWh	31,755 $kgCO_2$	£10,644	Get quote
Gaia Wind 11kW	6 years	£50,600	44,474 kWh	23,882 $kgCO_2$	£8,005	Get quote
Proven 6kW	7 years	£25,000	19,173 kWh	10,296 $kgCO_2$	£3,451	Get quote
Iskra R9000 Wind Turbine	7 years	£24,500	18,303 kWh	9,828 $kgCO_2$	£3,294	Get quote

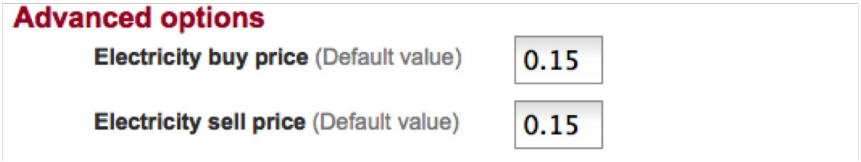
- The annual CO2 savings are also calculated, based on the carbon intensity

of the normal grid electricity supplanted by the renewable electricity generated.

Future development

We have development underway which will refine these calculations, to take advantage of the complexities of the Feed In Tariff system and similar fiscal support in different countries. This will enable:

- Manual configuration of electricity buy & sell prices, grants, and cash back schemes.
- Factoring in of cost of capital, and assumed grid electricity price inflation rates
- Selection from pre-defined geographic databases of electricity tariffs and subsidy programs to apply to the calculations (for example, SunEdison's TREES database in the which stores all US utility electricity tariff rates)



Measure-Correlate-Predict

Site assessment for industrial-scale wind turbines uses a technique called Measure-Correlate-Predict (MCP). This is used to derive the long-term wind characteristics from a short measuring period. The short-term measurement is correlated with a long-term data set, usually from a nearby reference meteorology station. The obtained relation is then applied to the long-term data.

Applying MCP techniques could improve the quality of the Power Predictor forecasting, but relies on the availability of local reference datasets, which will be highly sporadic, and in addition are often expensive and difficult to obtain where they do exist.

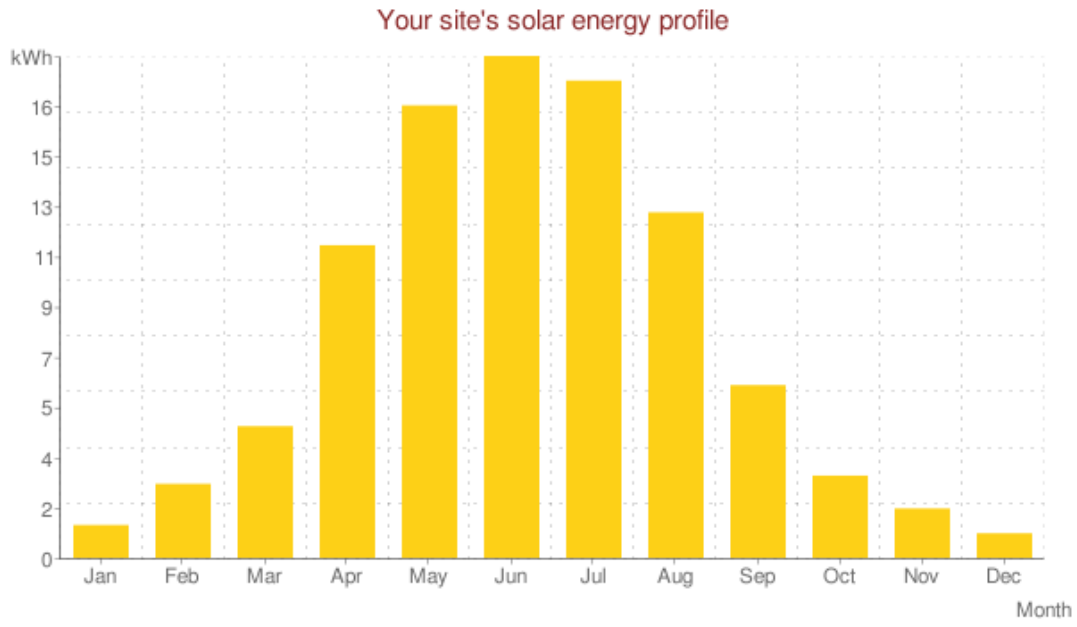
We are in talks with an aggregator of wind data in the UK to explore whether there is a centralised and automated/low cost way of doing this for at least the UK, and likewise in the US and Australia

Micro siting

There is significant evidence from studies -such as the Warwick Wind Trials- that siting differences of only a few metres can have a huge impact on the performance of wind turbines. We are working with an Australian specialist company to develop a micro-siting software tool which will enable the modelling of wind flows as an additional added-value product to complement the Power Predictor. This will help users to work out the best position on their site for a technology.

Solar calculations

- The Power Predictor includes a simple solar sensor, which the customer is asked to face South.
- Data collected by this sensor is also graphed in the Power Predictor software as a visual indication of solar intensity only
- It is important to note that the sensor used is for measuring hours of full sunlight vs. overcast, and is not equivalent to expensive laboratory pyranometers
- Solar insolation, unlike wind, can be much more reliably modelled, factoring in the angle of the sun on each day of the year for your latitude.
- The reports system which you will see once you have 30 days worth of data runs off one of these solar models with around a +/-2% confidence on the annual power results.
- The two online models are called upon by the Power Predictor, with permission, are called PVGIS (Europe) and PV Watts (North America and ROW)
- They use known solar insolation datasets for the required latitude and longitudes to model typical solar PV panel performance data, adjusting for the sun angle on each day of the year and the orientation of the roof.
- Annual power output from these models are included in the Power Report summary table and ranked alongside the wind turbine systems



Future Development

As outlined elsewhere, we will be launching a version two of the Power Predictor in January 2010 which will include a real solar PV silicon cell to improve the quality of the solar measurements and forecasts carried out by the Power Predictor.

Technology protection

The innovative nature of the Power Predictor technology means it is likely that at some stage, copycat products may emerge. Investigation into Patent protection is underway, but experience indicates that this alone is unlikely to really represent much of a barrier for a potential rival – there are always ways around it on technicalities. Whilst competition is inevitable with any successful product, we have three major strengths that protect us :-

1. Our ultra-lean supply chain via our partners in Chengdu, China, means that we are very unlikely to be beaten on hardware cost price.

2. The web software component, whilst not impossible to replicate, represents the culmination of several years R&D, and with the technical equipment parameters database, a very significant barrier to entry.

3. Our position as market leader means we are already ahead of the game. As long as we keep innovating and bringing out improved versions of the product, we will be hard to 'catch'.

In addition, the following protects us from user or distributor abuse or circumvention of the Power Predictor software platform:-

- The inherent variability of wind resources within only a few metres gives us protection against the risk of installers using a single Power Predictor to site a number of turbines in a neighbourhood: each site requires its own analysis.

- The site license restrictions associated with each Power Predictor means we can ensure that a single device is not reused on many sites without paying us extra fees for generating the reports.

- The data saved to the memory card is not in a form that can be used for direct analysis in Excel. It requires conversion formulae which are held securely within the software application. This protects us from people circumventing the software component of the Power Predictor. Users can download converted data back into Excel, but must use the software with an active site license to do so.

Third Party Endorsements

"A vital first step in deciding whether solar or wind power is right for you" **Kevin McCloud, Grand Designs**

"A must for anyone thinking about installing a wind turbine" **Peter Osbourne, FuturEnergy (Wind turbine manufacturer).**

"an essential tool for anyone considering changing to renewable energy at home. It calculates the time it takes to recover the costs of installing renewable-energy equipment" **The Independent**

"Could help you choose the most efficient device for your home." **The Sunday Times**

"Site assessment equipment like this will be invaluable in helping householders and businesses generate their own clean, green, renewable energy" **Alex Murley, British Wind Energy Association**

"The product that everyone has been after...If you want a long term, remote, easy to install data logging device - this is for you." **http://www.anemometers.co.uk**

Brilliant bit of kit. Informative pack - easy to use - perfect for our customer base... The Power Predictors are now SPRINTING out the door! **Tristan Haskins, BHIP Ltd (distributor)**