GreenMeter (TM)

Technical Description

Hybrid Power Monitoring System

for

On-grid and Off-grid

Applications

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Introduction

Short Introduction

The GreenMeter is the only energy monitoring system you will ever need for your renewable energy system. The GreenMeter can remotely monitor power from your PV system, utility, battery backup or weather station information.

Figure 1. Photo of GreenMeter

Long introduction

This easy to install wall mounted GreenMeter installs near your homes circuit breaker panel. Sensors attach to the wires coming into the home and wires coming out of your inverter. Software on your computer displays power produced from your solar system and power purchased from your utility. For off grid applications the advanced battery state of charge algorithm gives a precise indication of the health of your battery backup system. The GreenMeter also contains weather related accessories that allow measurement of wind speed, irradiance and temperature.

Each GreenMeter comes with its own built in Ethernet port and networking software so that you may look at the power and weather data remotely from any part of the world over the internet. There is also an optional web page for you to show the world how much green power you are producing.

Technical Specification Summary

- Monitors
  - Up to four DC power sources eg. Volts, amps
  - Up to four AC power lines eg. kilowatts and kilowatt hours

- o Battery state of charge eg. Amp hours, amp hours remaining
- Measures temperature, irradiance and reads anemometer data
- Calculates greenhouse gas saving, cost savings, revenue generation
- Powered by AC or DC power
- This wall mounted product is Internet ready
- Measurements: 8x8x4 inches
- Data storage; up to one year on the GreenMeter; unlimited on your hard-drive

General Operation

The GreenMeter is an energy management system. It can be compared to a data logger but it is much more. It can be compared to the utility meter on the side of your house or the computer on your desk. The applications and comparisons can be extended to include weather stations and battery monitors. The combination of advanced computing power and software allows the GreenMeter to be a window to your energy demands.

Simply put the GreenMeter uses sensors to collect data. This data is then time-stamped and stored for immediate presentation and for historical analysis. Data storage is performed on the unit itself, on your computer and on ICP's servers, so access is never a problem.

A fully equipped GreenMeter will monitor four AC power points, four DC power points and three weather related devices.

- Monitors
  - o Up to four DC power sources; Volts 0-70Vdc, Amps 130A
    - ▪ Battery state of charge eg. Amp hours, amp hours remaining
  - o Up to four AC power lines eg. kilowatts and kilowatt hours
  - o Measures temperature, sun/irradiance and wind speed

Web based monitoring service for your solar energy system includes:

- Personalized Sunsei solar lifestyle home page
- Financial analysis tools for investment, revenue and payback period
- Green house gas saving tools that describes your Carbon Footprint
- Daily email reports on performance

PC software(GUI) description

This PC based application will appeal to the more technical user or those not connected to the internet. The software will run in your web browser(IE/Firefox/Safari) but you do not need to be connected to the

internet. Simply connect an Ethernet cable (or crossover cable-for direct connect). Many of the capabilities of this software are described below.

This software offers complete flexibility of remote monitoring of your renewable energy system. The Java based software application will run on most modern browsers including internet explorer, Firefox and Safari. Users should insure that they have the latest version of Java installed on their computer.

Data Storage
The GreenMeter measures and logs data at 15 minute intervals for all external sensors and can store this data for up to one year. In parallel, the GreenMeter communicates to a computer based software package that logs and stores data on your computer's hard-drive. The software provides graphical analysis of real time and historical power production.

Other key software features:
- Data download to Excel file
- Variable data transmission interval for GSM network flexibility
- Battery monitoring; including time remaining in hours, amp hours remaining and watt hours remaining, as well as voltage.
- Green House Gas(GHG) savings; measured in pounds of CO_2 diverted from the environment because you invested in a solar system
- Cost savings: displays the amount of cost you have diverted from your annual electricity bill
- Alarming; users can set thresholds to monitor so alarms conditions are set when thresholds are crossed
- Messaging; users can input their email or cell phone numbers and receive messages on system performance

Data Interval

Sometimes you may want to connect the GreenMeter on a network that is very busy or very expensive. The software allows you to vary the interval for data transmission so that, for example, if you were using a GSM network you would pay per bit of transmitted data and you might like to slow down the transmission rate to save money.

One-to-Many

The one-to-many software allows industrial customers to access up to 100 GreenMeters on your network. This software is a connection oriented and has single instance capabilities. That is, from the same window there is a pull down menu where you will find a list of the GreenMeters you have access to. When you select a GreenMeter from this menu, a connection is established and you are able to view the parameters of this GreenMeter.

Networking capability

Each GreenMeter has a standard Ethernet port to be used for connection to a networked device like a router or Ethernet switch using a standard Ethernet cable. Using the Ethernet port users can connect their computer directly to the GreenMeter using an ethernet 'cross over cable'.

Wireless Capability

Through the GreenMeter's standard Ethernet port user can connect external devices like a GSM data modem so sites that are 'unconnected' but still near populated areas or major motorways and highways can be monitored. Eg. Multitech makes a GSM compatible modem that when equipped with a SIM card from your local GSM provider can be connected for GreenMeter monitoring.

Web Software Description

This hosted service will appeal to users who want to demonstrate or show off their commitment to the environment by maintaining a permanent webpage dedicated to logging and displaying the power production of your renewable energy system. Kids can compare their home installations from their classrooms. Companies can use a widescreen TV in their lobby to show the power being produced on their rook tops.

The hosted monitoring service allows viewing of your system performance on any computer that is connected to the internet. You can book mark the URL and access whenever you want or even set it as your home page. Data is stored on ICP servers. The web and the GUI can be used simultaneously.

Live output and status	
Power and capacity	

Carbon Footprint	
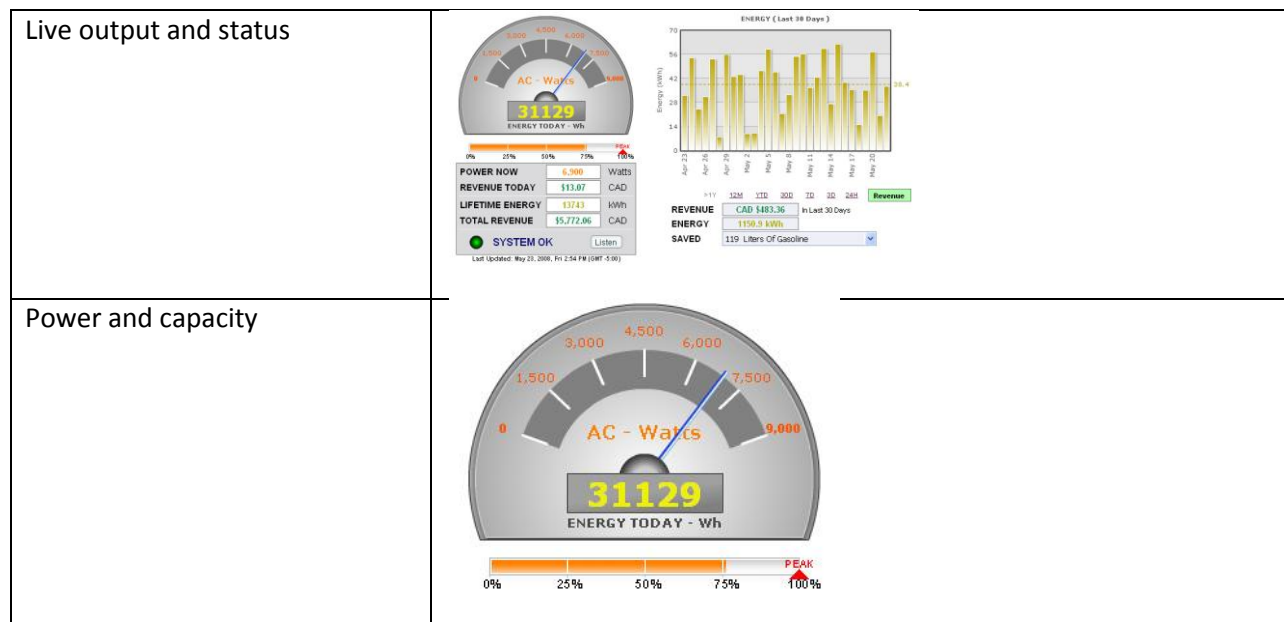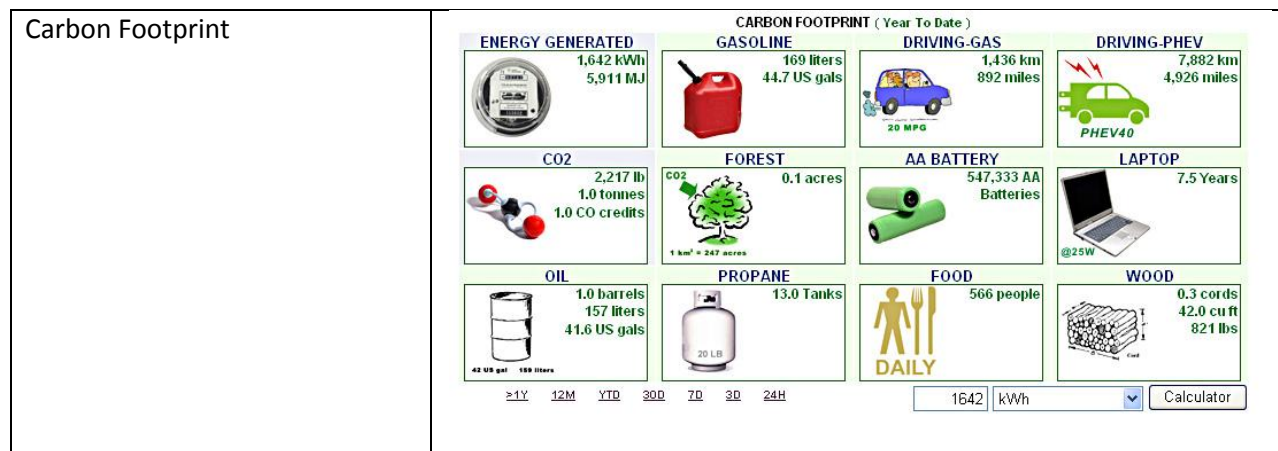
Applications and Application Kits

Some distributors and resellers may choose to "kit" GreenMeter packages that suit high volumes application like DC only or AC only or Weather kits. These are intended as examples only.

DC Power Measurement Kit

Order this kit if you intend to measure DC power only. The kit includes a GreenMeter and a dual DC sensor. This sensor can be used to monitor up to two DC power points. (an additional two DC power points can be measured if you purchase separately a DC sensor-61100)This could be used for a single PV array and/or battery backup system monitoring. In this case you would use your battery system to power the GreenMeter.(2 power cables included) You will also receive a CD for the PC software and Installation manual, and a cable to connect the DC sensor to the GreenMeter.

AC Power measurement Kit

Order this if you intend to measure AC power only. The kit includes a GreenMeter and a dual AC sensor Y cable. This sensor can be used to measure up to two AC power points. (an additional two AC power points can be measured of you purchase separately a AC sensor-61300)These sensors are most often used to measure the renewable power coming from your inverter. The second kits can then be used to measure power purchased from the grid. In this case you would power the GreenMeter using the AC-DC adapter included. You will also receive a CD for the PC software and Installation manual, and a cable to connect the DC sensor to the GreenMeter.

Weather Measurement Kit

Order this kit of you intend to measure weather parameters only. The kit includes a GreenMeter and three weather sensors and an AC-DC adapter. You will also receive a CD for the PC software and Installation manual, and a cable to connect the DC sensor to the GreenMeter.
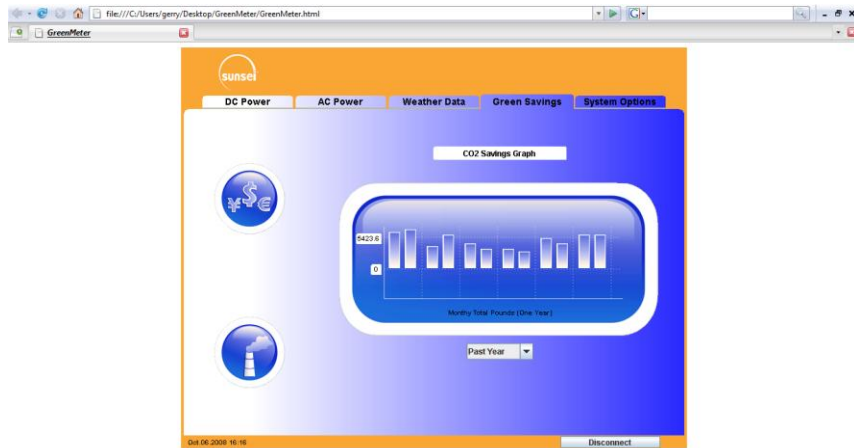
Monitoring Weather

The GreenMeter will need external sensors for the collection of weather related data. Customer can order a Greenmeter Weather kit, that will include a Greenmeter and three of the sensors below.

- A <u>temperature sensor</u> can be used to measure the temperature of the battery or the ambient temperature. Only one temperature sensor is allowed per GreenMeter.

- An <u>irradiance meter</u> can be used to measure the intensity of the sun so that you may correlate the output power of your PV system with the measured power of the sun. Only one per GreenMeter.

- An <u>anemometer</u> can be used to measure wind speed so that you may correlate the output power of your PV system with the measured power from you small wind turbine. Only one per GreenMeter.

GreenHouse Gas Savings

System Configuration Capabilities

<u>Off Grid or DC configuration</u>

The GreenMeter will need at least one DC sensor to be ordered for monitoring your PV system for you battery system or both. A second dual DC sensor can be ordered for multiple solar systems or a hybrid wind system. Up to four DC ports can be supported on the GreenMeter via 2 DC sensor modules. In this configuration the GreenMeter should be powered by your battery system using the cables provided. The DC sensor includes cables to connect it to the GreenMeter. The DC sensors are normally installed as close as possible to your battery. The sensors do not care if they monitor battery or solar or wind systems as they measure current and voltage. It's the GreenMeter software that will present this power information according to how you configure it. The DC sensors can measured up to 150 amps per power source. They can handle up to 70Vdc.

DC Sensor Dual*	DC power cables-10-70Vdc

*note this DC sensor is intended to be integrated into a larger system that will have its own enclosure. IT is not intended to be left in the open as, just like a shunt, there is exposed wiring.

<u>On grid or AC Power Measurement</u>

The GreenMeter will need at least one AC sensor kit to be ordered for AC monitoring. Each AC sensor kit is supplied with 2 split core current transformers. Normally one kit is enough to monitor the output of an inverter or incoming power to your home. A second AC senor can be purchased to monitor both your AC and inverter. Up to four AC ports can be supported on the GreenMeter via 2 AC sensor kits.

AC sensor kits measure the current passing through the wiring of your electrical system. The system does not measure voltage. You must enter your system voltage on your GreenMeter. The software then calculates the power level by multiplying current by voltage.

AC Sensor kit; Split core current transformer	AC Adapter US 120Vac or 220/240 Vac

<u>Hybrid or combined configuration</u>

The GreenMeter can also be configured for a combined on grid off grid configuration as described in the two sections above. Just keep in mind the maximum configuration of four DC sensors and four AC sensors.