EcoVision : A Cooperative Resource Management Solution

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ABSTRACT

Electricity grid capacity constraints and the prospect of an increased share of intermittent renewable energy generation in the electricity mix underscores the importance of technology which can improve the supply / demand balance between utilities and their customers[i]. Through cooperative demand side management practices, consumers at all levels can benefit through rebates from electricity utilities by subscribing to voluntary load shedding schemes.

In addition if end users are given high resolution feedback on their overall energy and water consumption patterns they become empowered to change their behaviour which typically can result in savings of 10 - 20%. Technology supporting these objectives is currently being trialed by technology company EcoVision Solutions in two of Australia's leading sustainable urban developments and several commercial facilities.

1 ENERGY AND WATER EFFICIENCY THROUGH REAL TIME DISPLAY

By showing patterns and trends in resource consumption, a real time monitoring system increases awareness and encourages and supports the end user to take responsibility and respond to the impact of lifestyle choices on a day to day basis. This also enables an appreciation of seasonal impacts and year to year variations that may result from changes in living circumstances such as replacement of appliances or fluctuations in occupancy levels.

EcoVision Solutions has produced a home touchscreen interface which provides consumers with real time feedback (10 sec updates) of electricity, potable water, recycled water and gas usage. Greenhouse gases relating to resource consumption are displayed in graphical form as well as photovoltaic or other forms of renewable energy generation.

EcoVision can be set up to provide a suite of customised screens to provide feedback according to the needs of various occupants. This provides a unique educational opportunity for child and adult alike by demystifying resource consumption and improving understanding of the factors that most impact it.

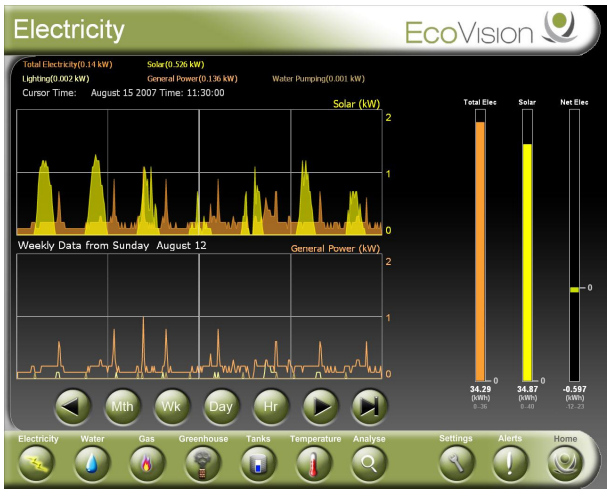

Figure 1 – One Week of PV Generation against Domestic Consumption

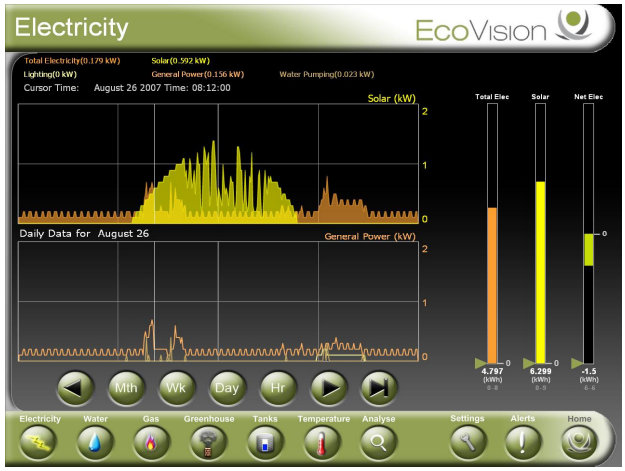

Figure 2 – Display of One Day of PV Generation against Domestic Consumption

Energy use can be monitored at circuit level (eg lighting separate from general power) or at discrete appliance level with the overall objective being to break down total load into the largest contributing components such as air conditioners, pool pumps and so on. Anecdotal evidence from early installations is that users become aware of their appliance "energy signatures" very quickly recognizing "business as usual" events such as refrigerator compressor cycling, air conditioner cycles and dishwasher operation.

As a result erroneous actions such as leaving a heater or an electric iron on are quickly detected. In addition longer term data (eg one year or more) can be accessed via internet and used for broader trends in consumption and evaluation of PV performance dust to shading and surface dust build up.

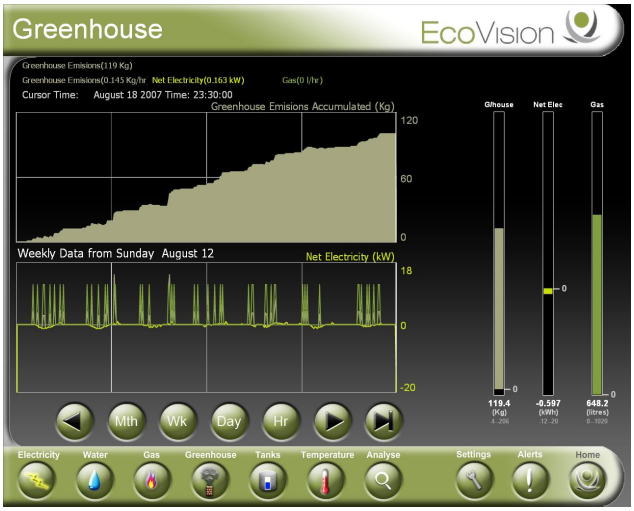

Figure 3 – Display of Week's Accumulated Greenhouse Gas Emissions

Similar options are available for water circuits, for example independent monitoring of mains water, recycled water or tank water consumptions.

Figure 4 – One Week's Aggregated Water Consumption

2 ECOVILLAGE AT CURRUMBIN

EcoVision is currently installing its real time monitoring systems at the widely acclaimed Ecovillage at Currumbin www.theecovillage.com.au, a 144 lot community / residential development on Queensland's Gold Coast. This project which is widely recognized as one of the most sustainable residential developments in the world won the 2008 FIABCI International Prix D'Excellence and is now the subject of a considerable body of research, much of which will draw on the data collected through EcoVision.

Through a mandate underwritten via the community Architectural and Landscape Codes, all homes and community and commercial premises in the village are required to abide by rigorous energy efficiency requirements and must have an EcoVision system installed. In addition community infrastructure such as the on site water treatment plant is rigorously monitored using the technology. All of the data gathered by EcoVision is sent to a central server via the community network for use by the Body Corporate, enabling comparison of performance in different households and benchmarks to be set.

3 COMMERCIAL BUILDING APPLICATIONS

Over $4 billion is spent every year on energy for commercial buildings in Australia alone and this is growing at about 4% per annum. Commercial buildings are a major contributor to greenhouse gas emissions and 1990 levels are projected to have doubled by 2010. Improving energy efficiency in buildings not only reduces costs and environmental impacts, but offers competitive marketing benefits as well. Indeed a 2008 report by McKinsey and Co[ii] identified energy efficiency improvements in the commercial building sector as one of most cost effective paths available to greenhouse gas abatement.

EcoVision provides a unique means of showcasing green initiatives in the built environment. This may mean prominent display of energy consumption & greenhouse gas emission data, rainwater capture & use, and LEED or Green Star credentials in the building foyer and/or real time resource consumption feedback for individual tenants to provide the level of feedback necessary to get buy in from the building occupants themselves. This reinforces initiatives to increase efficiency and reduce energy and water wastage and helps in the commercial evaluation /ranking of possible energy improvement initiatives.

Real time feedback and inventories of energy consumption is also being driven by the need to secure access to multi property corporate carbon emission inventories. The latter is of particular interest in Australia where large emitters are already required to declare emissions under the government's National Greenhouse and Energy Reporting legislation which has been introduced as a precursor to the introduction of an emissions trading scheme.

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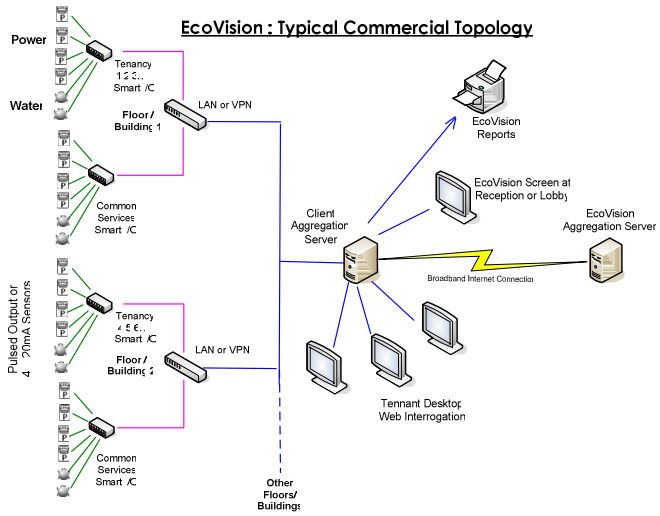

Figure 5 – EcoVision Architecture for Commercial Buildings

4 DEMAND SIDE MANAGEMENT

There are many electrical appliances in homes, offices and other buildings – especially heating and cooling applications - which are only mildly time-critical and can be managed to control loads with no loss of amenity to the customer.

The conventional means to make these loads assist with grid management has focused on providing a price signal to customers using a 'smart meter' that can show the price of electricity varying though the day, but this is a slow and blunt instrument. (Off peak hot water is a good example of this.) A faster response could assist in the management of the short-term dynamics of renewable energy. EcoVision can unlock the speeds of response required for such tasks.

In establishing the requirements for the architecture of EcoVision's load control product, the designers decided to build a system which would not be restricted in its scalability and which in fact had the data handling capability to manage demand across Australia's entire electricity grid using less than ten servers.

The result is an end to end system which enables occupants to offer demand side capacity back to the utility via the web at times of network constraint, typically including switching of major loads such as air conditioners, pool pumps and refrigerators which all contribute significantly to coincident peak demand. As a result distribution utilities will be able to derive significant benefits via reduced outages and extended asset life. The cooperative nature of this approach is important in that it allows the end user to voluntarily subscribe to load management programs rather than being forced heavy handedly to participate.

5 LOCHIEL PARK DEVELOPMENT

Lochiel Park www.lochielpark.com.au is a 108 home residential community in Adelaide South Australia, a part of the country which experiences considerable peaks in electricity demand, particularly, but not exclusively due to high air conditioner use on the hottest days of the year.

In this project the objective was to trial a cooperative demand side management scheme in a residential context by offering occupants the opportunity to interact with the electricity utilities requirements.

In addition to some comprehensive monitoring capability the EcoVision system being deployed here has the capability of managing 6 loads at the discretion of the end user.

The following load management / load shedding regime has been conceived:

- Pool Pump
- Air Conditioner
- Washing Machine and Clothes Dryer
- Oven
- Dishwasher
- Kitchen Other (Not Fridge)

Permission for the electricity utility to shed these loads and the priority under which this is done can be set by the Home Owner.

The Peak Load Management will have two levels of Subscription, the Community Peak Load Set Point and the Utility Peak Load Set Point. The home owner can select to subscribe to the Community and / or the Utility Set Points. If both are selected then the load management will use the lower of the two peak load Set Points. If neither is selected then no load management will be executed.

The selection and de-selection of the community and utility load management subscriptions will be logged and passed through to the utility. In order to reward the home owner for their participation, the electricity unit cost will be updated to reflect the status of their selection.

REFERENCES

[i] Climate Risk, 2007 "Towards a High-Bandwidth, Low-Carbon Future: Telecommunications based Opportunities to Reduce Greenhouse Gas Emissions"
[ii] McKinsey & Co, 2008 "An Australian Cost Curve for Greenhouse Gas Reduction"