

Electrotechnology & Water Skills Board

A look into the future



SUMMARY

1 Energy Efficiency

Energy efficiency (EE) is the first step in effecting climate change. There are many ways in which it can be achieved both with technology and behaviour change. This complicates the value of incentives for energy efficiency and so far there is no formal incentives for technologies other than reduced energy costs. Since energy costs are low, energy efficiency is limited to customers and businesses who care about their carbon footprint. Recently state governments have introduced EE schemes like REES (residential energy efficiency scheme in SA where retailers are compelled to increase their customers efficiency by 10%. As part of this, they are compelled to carry out over 5000 customer audits with nearly 50% being low income households. Similar schemes are operating in NSW and other states are in different stages of implementation.

The clean technologies applicable to energy efficiency include:

a) Automation

The first, most economical, technology to apply is automation of building management to prevent thermostats fighting each other. The majority of thermostats are independent but still act on the same building space through zones. Often systems are both heating and cooling to maintain an average

temperature. DCS (distributed control systems) are required to minimise this inefficiency but often are not installed due to the marginal increased cost.

b) Lighting

Lighting accounts for 18% of building energy use and is the easiest to reduce. It represents the low hanging fruit for energy savings companies which change the fittings to T5 and introduce automatic switching off with PIR sensors. Fluorescent lighting introduces power factor distortion which is compensated by fitting ballasts. More recently LED lighting is becoming affordable and has the advantage of being able to be powered by small amounts of renewable energy from local solar PV

c) Design (building)

Passive building technologies are essential to energy efficiency. These consist of thermal insulation and thermal storage. Lack of roof insulation is primary source of energy inefficiency, followed by windows and walls.

Thermal storage is important in terms of retaining heat or cool. Storage comes from thermal capacity of walls or equipment designed to retain heat. Cooling capacity can be stored in PCM's (phase change materials) like ice banks.

d) Air-Conditioning

Air-conditioning accounts for nearly 50% of building energy load in Australia and more importantly over 80% during peak times. Current air-conditioning systems are grid killers during peak and even inverter systems are not significantly more efficient under peak loads. There are numerous systems to overcome the problem of packaged air-conditioners but little change is likely while the true costs are not passed on to the consumer at purchase. The true cost is that 10 times the cost of the air-conditioner is in the generators, poles and wires to supply the electricity. This cost is paid by the network charges which comprise of over 50% of electricity tariffs.

e) Distributed generation

The current centralised electrical grid is being challenged by distributed generation which is more energy efficient. Although the basic generator set is of similar efficiency to the large centralised power stations, efficiencies are gained through reducing transmission losses and local heat recovery to hot water, chilled water (adsorption chillers) and water recovery.

SCADA (supervisory control and data acquisition) systems overcome the traditional impediments to implementation of co-generation (heat recovery), tri-generation (heat & cooling recovery) and CHP (combined heat and power).

1. Smart Grid

The smart grid or intelligent grid is regarded as the next important step in effecting climate change. The Obama administration intends to spend over \$400 billion in upgrading the US electricity grid and includes the plan to have over 20% of cars plugged in to balance the grid.

The peak demand which occurs for less than 2% of the time triggers more than 50% of new investment in electricity network. An estimated \$33b could be saved by avoiding these peaks in Australia. Some of the technologies for the smart grid are being trialed now and extensive rollout of smart metering and demand response devices are to be expected in the near future

a) Smart meters

The 2.7 million smart meter rollout in Victoria is the largest in the world and is expected to bring a number of benefits in terms of a smart grid. A little known fact

is that each meter has a wireless connection (Zigbee) to home automation. Smart meters replace the need for an off-peak J-tariff meter as it records energy use every half hour.

b) Demand management

The air-conditioner manufacturers have been working on a demand response interface which will be eventually fitted to every air-conditioner sold in Australia. This will enable the compressor (80% of the load) to be switched off while leaving the fan running.

CPP (critical peak pricing) tariffs are being considered as an incentive for demand management.

Typically these increase the cost of power to \$1 per kWh during peak times and reduce the tariffs by 20% at all other times. Automation and notification through smart grid technologies will be essential to make demand management work.

c) V2G

The era of the electric car is coming faster than most people think. It is the most significant event for the smart grid as the cars will have batteries capable of running the whole house for short periods of time. Running costs will be at least half that of petrol but if they are allowed to charge during peak times will cause more problems than they solve.

d) Monitoring

It is often said that you cannot control what you can't measure. Recent surveys have shown that 95% of customers want more information on their energy use but less than 20% are prepared to pay for it. Google and other companies wanting to supply free energy information are facing transparency and security issues from traditional utility companies.

2 Renewables

a) Solar (PV thermal)

Although solar energy contributes less than 1% of our energy requirements at the moment, solar power is expecting rapid growth in the next few decades as the costs of these systems come down. Currently growth is driven by incentives and other government programs.

b) Wind

Wind power is affordable but intermittent. The electricity retailers have a monopoly of access to this discounted power and sells it at a premium as green power even if the wind is not blowing. Even though it is not possible to store electricity on the grid, the retailers are allowed under the current rules to do this through offsets and still keep the REC's (renewable energy credits) to meet their future obligations under MRET (mandatory renewable energy targets).

c) Geothermal

There are two forms of geothermal (source and sink). Sources of geothermal heat are usually far from the customer demand and deep underground. Geothermal power stations are one of the only renewable base loads generators. Geothermal sinks are local and shallow (<10m deep). They use the thermal capacity of the earth to reduce heating and cooling loads. Domestic versions exist.

d) Wave/Tidal

Although wave and tidal potential is large like wind, it is more unobtrusive and steady. Tidal is predictable and holds potential for storage depending upon environmental impact studies. Tidal technologies are being developed which hold excellent future renewable energy potential.

e) Bio-fuels

Environmentalists often state that over 20% of our energy needs could come from recycling our waste. This is the best source for bio-gas (methane) for the future and can be achieved in many ways. Recently, bio-fuels from food sources has lost its momentum due to food demand. Algae sources are 18 times more efficient and holds the most potential for the future.

2 Water

a) Potable

Potable or drinking water is becoming an increasingly valuable resource. Desalination with reverse osmosis costs more than 4-5 kWh per kL. Alternative technologies as presented at OzWater 09 and distillation by waste heated salt water from existing sources such as power generators may be part of the solution to providing more affordable potable water.

b) Recycled

Storm water capture is an immediate activity being undertaken by councils to increase our water supply. Although not potable when it goes below ground, storm water is suitable for most other needs.

c) Grey

A number of new grey water treatment systems are now coming on to the market. These need the correct application and approvals to be accepted for wide acceptance. Correct maintenance is needed.

d) Black

Sewer mining has now been approved for some states and a number of small systems are being developed.

3 Gas

To be added

4 Standards

a) Auditing (residential, commercial)

Nabers and Greenstar are the commercial auditing standards while the states have a number of different standards for residential.

b) Communications

Communication standards for energy management are being examined by the iGrid group comprising of several universities and CSIRO. Eventually these will be standards under the control of the AER (Australian Energy Regulator)

c) ETS

The CPRS legislation is a cap and trade system with free permits given to EITE (emission intensive trade exposed industries) which seems to be the main point of negotiation. It is currently set by the number of tons of CO₂ (includes 6 greenhouse gases) and is initially valued at \$25 per ton

d) Building codes

Each state has different building codes but the trend is to mandate greater than 5 star rated buildings. The methods of rating differ and [generally do not include the appliances which make a major difference to the energy used by the building](#). The national rebates for insulation will help stabilise local residential building codes.

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