

Report to EE-OZ

By the Executive Officer Electrotechnology & Water Skills Board SA,
 After attendance at the iGrid Forum in Adelaide on 5 December 2008.
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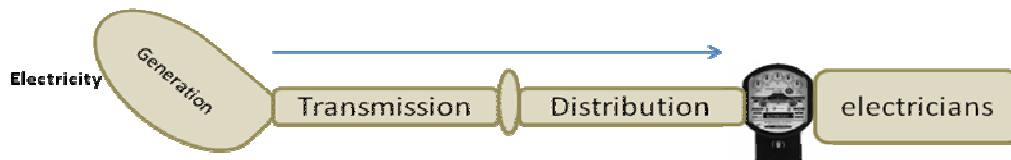
This report is to identify the new requirements for training and skills development from the “Intelligent Grid” and Distributed Energy resources discussed in the iGrid Industry Forum.

The Intelligent Grid (iGrid) Research Program is a three-year program of CSIRO and five leading Australian universities under the CSIRO Energy Transformed Flagship.

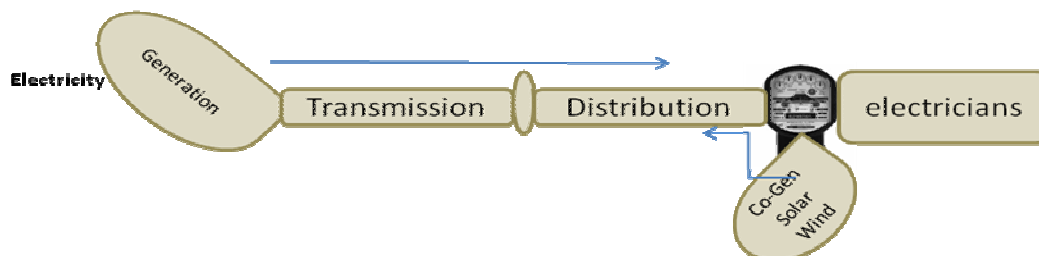
The challenges of climate change and energy security are shifting infrastructure away from base load fossil fuel power stations and transmission networks. In its place, is the “Intelligent Grid” that will use low-emission, distributed generation (DG) and advanced metering infrastructure.

Background

In the traditional Electricity Distribution system developed over the last 40 years, Utilities have generated electricity centrally, Transmitted it to substations where Distribution has occur to the resident or business: After the meter, Electricians have completed the extension to general power outlets or lighting or other needs in the dwelling or business. Currently the skill standards reside in the Generation package, the Transmission & Distribution package, and the Electrotechnology training package.



A decade or so ago saw the emergence of **Distributed Energy** in the form of Solar, Wind and Co-Generation grid connected systems. This added a degree of complexity to the system especially requiring Distribution Linespersons to not only isolate the feeder down-stream but also to check that there is not another hanging on the end of the line as well.



At the same time the widespread rollout of refrigeration especially domestic refrigeration dramatically changed the usage profile over a hot day. Peak electricity was the topic of conversation as electricity distributors were increasingly required to meet availability standards and that meant bigger *everything*: Transformers, wires,

and a bigger network. And a bigger network meant greater capital works resulting in greater prices but exacerbated by this peak.

Distribution networks began to examine **Demand Side Management** of loads by sending control signals over power lines to control load, or alternatively the customer's voluntarily load control. Many electricity retailers awarded lower priced contracts to customers if they de-loaded between 12 and 6PM on the ten hottest days of the year. High usage companies could either shut down ten days a year at midday or put in co-generation for themselves (not grid connected).

There are a number of Demand side Technologies not evaluated in this forum but the subject of discussion and trials in various distribution companies as part of IGrid.

The verification that load had decreased on peak days needed to be conformed at each customer location if possible. Various technologies emerged to verify load change and the Smart Electricity Meter or Interval meter emerged as one source of conformation (though not the only option)

Smart meters can provide load details on intervals that can be set for example 30 minutes, or 15 minutes or 10 minutes. The profile of this data allows customers to identify apparatus that might contribute to peak load and high average load and to experiment with options to reduce overall load and peak load. Sometimes phase correction was included in this area of IGrid development.

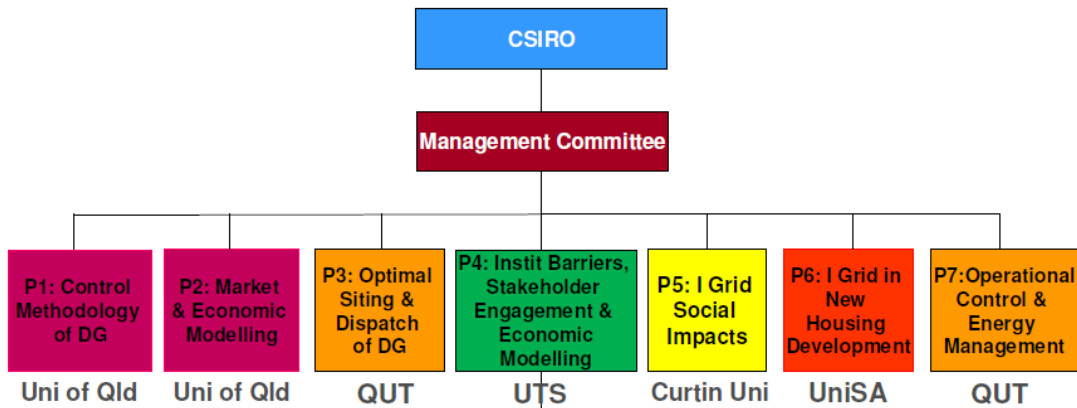
In some jurisdictions broadband internet was carried over power line adding to the complexity of the reporting requirements in isolating a feeder – you were cutting off the broadband as well as their electricity.

It is interesting President Obama seeks harmonization with the electric car initiative proposed to in order to stabilise the electricity grid. "It's now clear that Obama intends to stimulate the economy through large direct government spending on infrastructure projects as well as through business and individual tax cuts," said Mr. Bledsoe, now an official of the National Commission on Energy Policy, a nonpartisan research group in Washington. "He is advocating things like guaranteeing every American a college education, wiring the entire country for Internet, putting in a smart electric grid."

Harmonization is about **saving infrastructure costs** through multifunctional investments. There is an immediate global need for distributed electricity generation from gas. Harmonization principles dictate that distributed generation and V2G needs can be met at the same time with little additional costs.

Base load generation transmission and distribution means that only the electricity production can be used. Compare that to distributed energy by multiple co-generation units networked together where the **closed cycle** operation means that the heat is used as well as electricity to heat and cool a building. Some predict distribution will emerge as 20% of the loads and others say the 20% will be a combination of Distributed generation and renewable distribution.

The Structure of the iGrid Research Program is illustrated below



Distributed Generation

The “Intelligent Grid” refers to an electricity network that uses “distributed energy” resources and advanced communication and control technologies to deliver electricity more cost-effectively, with lower greenhouse intensity

“Distributed Energy” means electricity generation and management of energy use applied at the consumer or distribution network level. It includes distributed generation, load management and energy efficiency options.

Distributed energy resources involve heating, cooling and powering a commercial building using a combination of solar panels, micro generation, energy efficiency and load control. Distributed generation includes wind farms, solar panels and cogeneration (combined heat and power).

Distributed Generation (DG) using Combined Heat and Power (CHP) units improves building energy performance while cutting the energy footprint and CO2 emissions compared to a centralised electricity supply. DG can be seen as a local energy “hub”, using natural or bio-gas to provide CNG, electricity and heat. Local generation is more efficient and therefore more greenhouse friendly than using power from the grid. It also is usually more economical than grid power, especially at peak times.

Demand management technologies built-in to the DG ensure that the mix of grid power, gas power and local renewable power (solar panels, wind turbines etc.) is optimal depending upon the conditions to provide the best economic and environmental benefit.

REF: http://www.igrid.net.au/sites/igrid.net.au/files/images/igrid_california.pdf

V2G doesn't reduce energy usage in a strict sense, but it could reduce greenhouse gas emissions in using smart grid technologies to integrate plug-in hybrid cars and wind power and other intermittent renewable resources into the grid.

Monica Oliphant (OpenEnergy) spoke about trends home demand and how users fall into three categories. She also spoke in regard to solar for the home and sees the electric car development which will unleash a new industry with multiskilling requirements from home automation to vehicle mechanics.

There are many initiatives in US, Brazil, Europe and AGL has announced that it will put 250,000 charging stations in the iGrid network.

Demand Management

Demand and response systems, seek to control the use of power to avoid blackouts and reduce peak-time consumption. Enhanced levels of "demand and response" control use two-way communication (to verify it was done).

The attendees were shown over Lochiel Park where Internet control is a part of SA first Fibre to the Home network. Residents are provided with load limiting devices – this Distributor (ETSA) initiative has yet to be trialled. Demand response will be delivered by Internet, wireless and RF connectivity.

Demand management will be helped by the smart meter rollout which will enable devices to be placed and controlled in the home. These technologies include one way and two way devices on air-conditioners (communicating thermostats and condenser switching). ETSA intends to pay customers to put these devices in and will cycle the condensers while leaving the fan on for ducted systems.

Demand management also covers zoning down to living room and kitchen during peak. SA has the peakiest load curve with network load above 80% less than 3% of the time. Demand responses will also come in the form of starting/stopping compressors, electric car charges and other discretionary loads which may be switched.

Open Energy principals recommend loading up the grid when surplus wind and solar are available, storing sufficient energy during these times and drawing down on these stored energy resources when the network is at peak.

Smart meters

The conference was told in Victoria a roll-out of 2.3 million Smart meters is occurring. United Energy told the IGrid Forum that they are currently installing **Zigbee** interval meters at the rate of 1000 per day.

Advanced interval meters will allow new types of control and management methodologies for the electricity grid can also make it operate more efficiently. These include, for example, advanced control systems and "smart" electricity meters that

show real-time use and costs and can respond to remote communication and dynamic electricity pricing.

That's direct energy feedback display devices, or systems that provide homeowners with information on how much electricity they are paying for at any given time.

Traditionally smart meters have been using the mobile phone network with payments directed to Telcos. The smart meter rollout uses either powerline or RF as communications. The RF solution is broken down into Zigbee, WiFi and Wimax. These are mesh technologies with their own pro and cons and further analysis may show which to follow from a technology perspective, but likely that all will be seen in the IGrid.

The main **Advanced Metering Infrastructure** (AMI) groups are rolling out Wide Area Networks, Neighbourhood Networks, and Home Networks. The WAN is the domain of Utility as is the NAN normally. Councils, ESCOs and developers could get into neighbourhood energy automation using this infrastructure. The HAH however is the enabler of a mass home automation market and will enable Zigbee devices, for example, to talk to in-home displays, energy switches, pumps and thermostats to be installed. In theory, open standards like Zigbee, WiFi, WiMax enable multiple vendors to participate in this new opportunity as they are open systems.

Mass home automation because of smart metering was seen as the enabler to start this market.

Monitoring and Auditing

It was reported that Lochiel Park and Mawson Lakes were the UniSA monitoring, recording and reporting projects used for the data analysis. As well as analysing energy use based on that data, it is being analysed to provide the lowest cost and most effective method for saving energy and greenhouse gas emissions – customer awareness.

The data mainly came from interval metering analysis with supplementary individual measurements made to break down the component sources of energy wastage.

After achieving good results with one customer – a later occupier of the same house had nearly doubled the energy use through wasteful behaviour. Automation with displayed current usage information would give the greatest warning signals to residents but behavioural change is a community process.

Auditing is a large and growing new employment opportunity as governments want more information to set standards and rules for green home loans etc. It was reported some states are changing home resale requirements to include the energy footprint of the dwelling. Lower footprint will increasingly improve sale value all other factors being even. But that raises the veracity of the Audit process.

It was also discussed that commercial auditing is also in high demand due to the emission reporting requirements. Automation of the monitoring functions are significant opportunities as is more accurate methods of analysing the data. For example the method recommended by Open Energy at the conference analyses energy use against the emission factor of the grid at the time the energy is used. This

enables a customer that turns on when the grid is green and turns off when the grid is red (constrained) would have a lower carbon footprint even though they may have consumed the same amount of energy.

The IGrid will enable ESCO's to can communicate with large commercial buildings to monitor how efficiently equipment is using electricity: Called "continuous foot-printing," which tracks large energy users. Examples are air-conditioning systems to make sure they're being powered at their most efficient level – and communication to building managers when they are not. Energy saving of 15% was reported.

Other savings can come from "enhanced measurement and verification of energy efficiency programs put in place by utilities and their customers – checking to find out which ones are best at saving power and money – as well as from more precise regulation of voltage going to homes from a residential substation", he said.

IGrid technologies reduce greenhouse gas emissions lead to independence from fossil fuel baseload or at least reduction. Vehicles with plug-in electrics are seen as breakthrough for solar. It was reported by OpenEnergy's that conduits have been fitted into the Park and Ride's facilities at Mawson and Oaklands railway interchanges to prepare for such changes.

Solar

Representation from the solar industry shared the ups and downs of the industry in the last 6 months. The rebate changes cause massive order reductions followed by large orders suspected coming from those near the \$100,000 income limit and likely to toggle over in the following year. It gives a distorted view of demand.

There were issues raised about paperwork and other teething problems, but the system is generally working well. The emerging trend is towards solar farms and the first one in Berri was presented as a viable commercial proposition on the SA feed-in tariff. The largest size allowed is 30kW (10 per phase). Solar farms will emerge where the feed-in is reasonable and Gross not Net.

Government policy

As each of these technological changes roll out, these affect **policy by government and regulators**. Much of the conference centred on these issues. For example a distributor who is guaranteed a return on Investment is better off maximising capital works and will not seek *demand side reduction* in peak times. So the very policy to regulate for the good of the wider community conspires against CPRS.

If distributed energy were to reach (say) 20% we are told that some of the peak pricing would reduce retuning lower prices to the consumer or greater profits to the Distributor.

In some cases whole communities will not be drawing on Base Load grid power it was reported. The Greater London council is planning on this method.

Skilling issues

Clearly new skilling will be needed.

- Existing distribution staff will need up-skilling in each of these technologies as they arise,
- In some cases competencies won't need to be changed but the RTO lecturers will need to understand better the enterprise environment and ensure that contextualisation occurs, and this will be crucial in the range statement of competencies, and the on-the-job verification,
- New apprentice distribution linespersons and electricians, and anyone installing in dwellings and businesses will need new competencies,
- Linespersons may need to know about broadband, Zigbee, WIFI, WYMAX and other techniques or at least know what their purpose is.
- Some linespersons will be carrying broadband as well as electricity,
- Demand side management technologies will need to be understood and connections may have to test the system so both Lines and home technologists will be involved,
- The Home hub technologists connecting smart home systems with smart meters to provide the home digital signatures will be new skills or occupations
- In some cases the distribution grid will be not linked to the base load and in other cases building owners will want to share their distributed generation at times of maintenance. This is a policy / governance as well as technological skilling issue of switching.
- SCADA technologies will be used to link the iGrid so that raises up-skilling of trade staff to the Cert 4 in Electrotechnology "industrial electronics and control", and resources will need to be released to created e-learning of SCADA and such technologies to up-skill nearly every electrician, every refrigeration and air conditioning mechanic, every data communication technician in such technologies. These are skill shortage trades and day release for up-skilling is not an option, so to effect such a widespread change e-learning / blended learning resources will be needed. The financial mechanisms of PPP will be available but blended resources will be needed so that off-line studies can form the majority of the training rather than face to face studies,
- In regard to auditing – every home, every dwelling and office will need to be audited, and audits will affect sale price, the veracity of the audit will be paramount. Auditing is a key CPRS occupation and whilst passive architectural improvements will be important, by far the greatest carbon contributor will be apparatus installed by electrotechnology tradespersons who can advise on technologies to improve CPRS,
- Finally If we are going to put a price on carbon trading, instrumentation will be involved together with the calibration of instruments. A wide up-skilling of electrotechnology operators will be needed and resources be found to create such e-learning to effect such a wide-scale up-skilling.

End.