

The Impact of Renewable Energy: The NEM, Technology and the Future

Power Careers in Focus Presentation II

Sharon Tissai-krishna

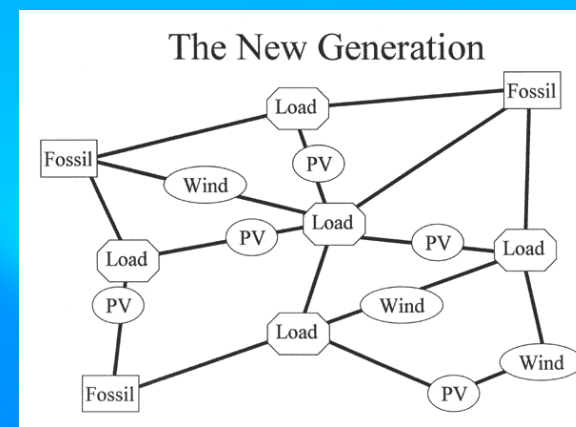
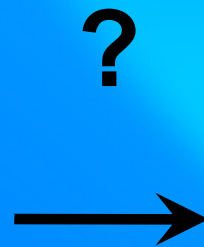
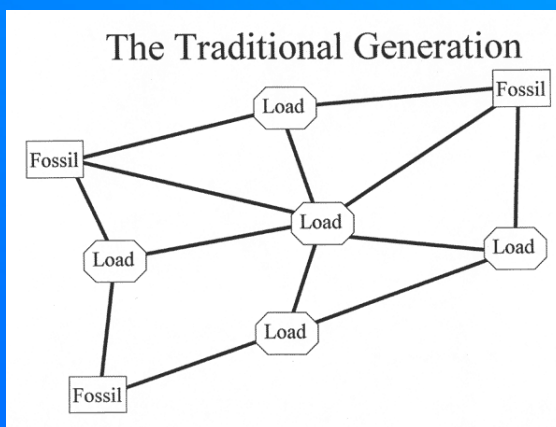
Tom Butler

Econnect Asia-Pacific



Technical limits to amount of renewable energy absorbed by NEM

- Variable energy source – variable energy output
- Balancing supply, demand of energy, reserve capacity
- Fault recovery



Variable Energy Output

Frequency instability caused by frequent rate of change of energy output by generator

Solution 1: Frequency Control Ancillary Services (FCAS)

Solution 2: Renewable Energy Forecasting

Solution 3: Inertial control of Renewable Generators

Balancing Supply and Demand

- NEM - real time balancing of supply/generation and demand/load
- Requires accurate forecasting of load and available generation capacity

Solution 1: Load Following Ancillary Services

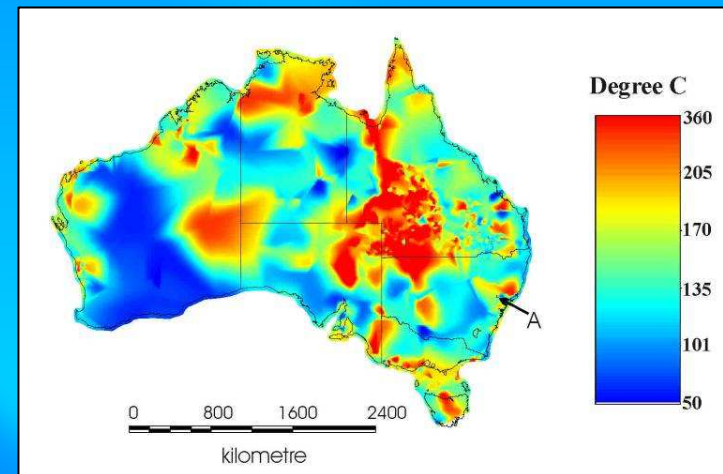
Solution 2: Increased Reserve Capacity under high RG penetration

Fault Recovery

- Concern that modern RG devices cannot ride through faults, particularly wind turbines
- Voltage dip would cause RG to disconnect from network
- Could potentially cause cascade of all RG to disconnect from network and possible system collapse
- Reactive support plant can aid fault ride through of renewable generators

RE Applicable Technologies

- Some technologies that are widening the scope of renewable generators in both application and cost
 - **HVDC** – enables low-loss long distance transmission from large generators to load centres
 - Typical for the best renewable resources to be a long way from load centres
 - Readily applicable to
 - Geothermal
 - Solar thermal and PV
 - Offshore wind



Estimated temperature at a depth of 5km across Australia

[Source: <http://hotrock.anu.edu.au/resource.htm> - 26/7/08]

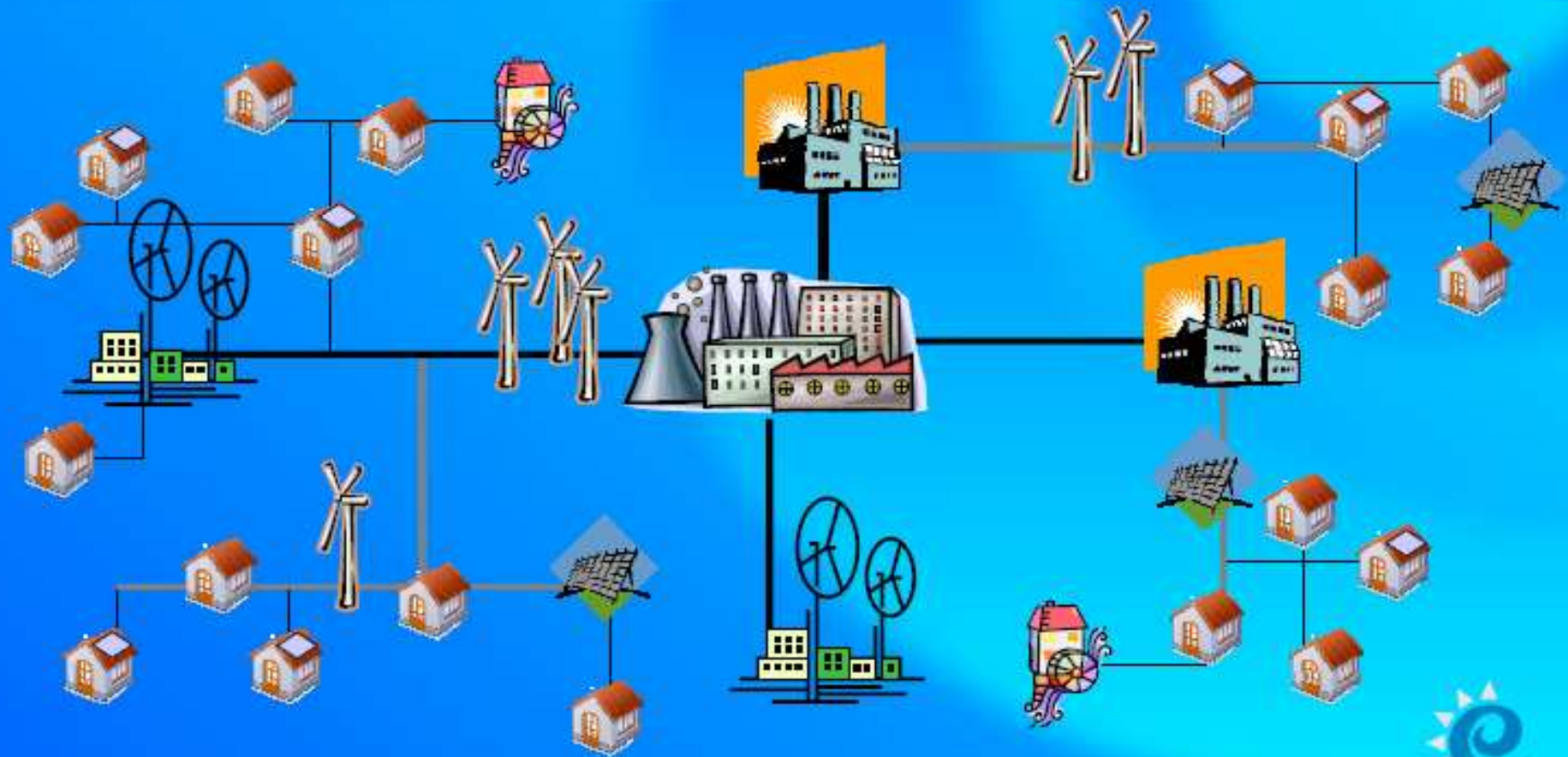
RE Applicable Technologies

- **Active ‘Smart’ grids**

- Already applicable to small ‘island’ grids and incorporates existing technology for
 - Demand side management; and
 - Active generator control systems
- Enables the maximum utilisation of renewable energy available
- Can easily be combined with pumped storage to smooth out lulls in resource availability when penetration levels become significant_[1]

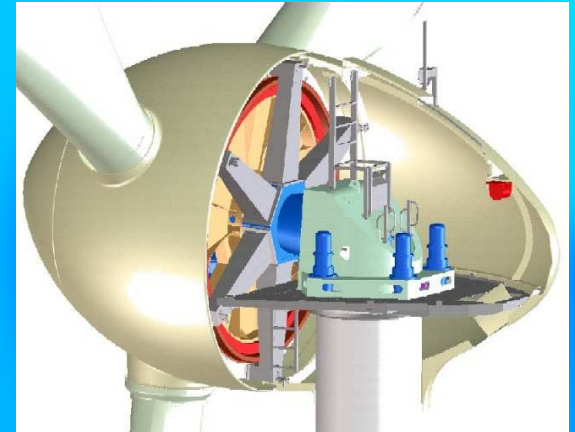
RE Applicable Technologies

- Active grids



RE Applicable Technologies

- **Generator Technologies**
 - Full converter turbines
 - PV industry growth rates – average of 23% p.a. for 20 years^[1]
 - Geothermal and wave energy generators bordering commercial development



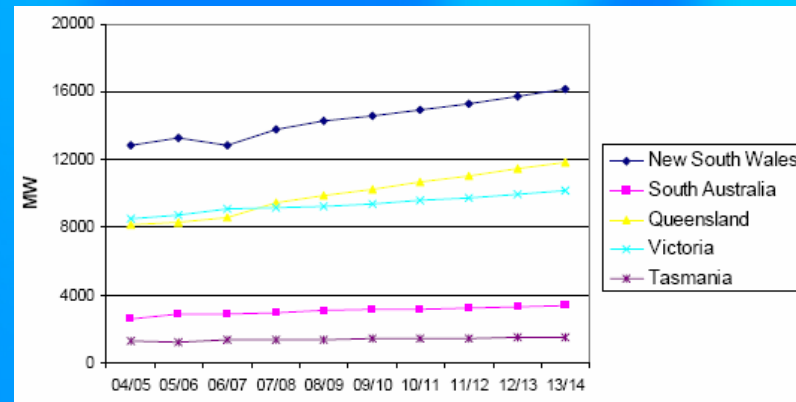
08/08/2008

Images: Martina Calais – Murdoch University (WA)

Embedded Generation

- Traditional distribution networks – Centralised Generation
 - Why? To begin with it was distributed.

- Electricity boom
 - More electronics
 - Electric car
 - More computers
 - ...Robots??



Source: www.transgrid.com [27/7/08]



Source:

<http://en.wikipedia.org/wiki/ASIMO> [27/7/08]

- The case for a return to a generation-by-load system is strong as loads continue to place strain on existing infrastructure
- Generator efficiencies have come a long way
- Generation options are plentiful and losses are reduced
- Power electronics technologies have the capacity to maintain power system operating points
- Point: Islanding. If generation meets load why not?

08/08/2008

Any Questions?

08/08/2008



References

- [1] Radio transcript from "*Big Ideas: Tackling the target parts one and two*",
- [2] Intelligent Energy Europe, 2007, "PV upscale Project", Deliverables 4.1 and 4.2, Accessed: www.pvupscale.org, [26/7/08]
- [3] Dr Tony Morton, 2005, "*Maximising the Penetration of Intermittent Generation in the SWIS*", Econnect Asia Pacific Ltd.
- [4] Morren, J., Pierik, J., de Haan, S.W.H., 2005, "*Inertial Response of Variable Speed Wind Turbines*", Available: Science Direct, Murdoch University Library, Accessed 26/7/08.
- [5] Carr, G., 2008, "Special Report - The Future of Energy", The Economist, Vol: 387, No:8585.