Centre for Energy and Environmental Markets

UNSW
THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA



Integration of distributed and renewable power generation into the electricity industry

Iain MacGill
CEEM, University of NSW

informa: Decentralised Energy Conference
Sydney, 24-25 June,2010

www.ceem.unsw.edu.au

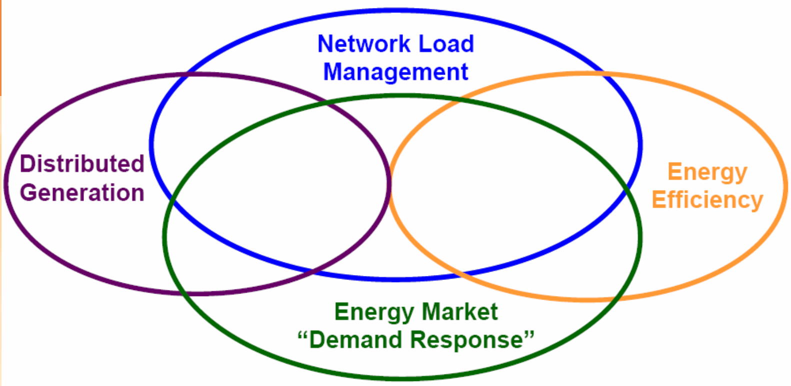
CEEM

- *A formal collaboration between the* **Faculties of Engineering, Business (Economics and Management),** also Arts and Social Sciences, Science, Law
- *through a UNSW Centre* aiming to provide Australian research leadership in interdisciplinary analysis + design of energy and environmental markets
- *focussing in the areas* of
  - Energy markets within restructured electricity industries: including the successful integration of new energy technology options
  - Related environmental markets: emissions trading, renewable obligations, energy efficiency trading, Greenpower…
  - Wider technology assessment and deployment, regulatory and policy, and social decision making frameworks and innovation for achieving overall energy objectives

Outline

- The complex opportunities and challenges of DE
- Decision making regimes for renewable and distributed energy integration in the Australian NEM
  - Governance
  - Technical
  - Security and Commercial
- Options to enhance the NEM's ability to facilitate DE
  - Advanced Metering Infrastructure and 'smart grids'
  - Energy Service Companies (ESCOs)
- Wider policy and institutional needs for DE

Distributed Energy options



(Dunstan, *Developing Demand Response in NSW*, October 2005)

- *Technical options within Dx that actively participate in EI decision making*
  - renewable energy sources including solar thermal, photovoltaics (PV) smaller-scale wind, biomass
  - small-scale fossil fuelled generation, combined heat and power (CHP) plants powered with engines, gas turbines or fuel cells,
  - direct energy storage; chemical 'battery' technologies, super-conducting magnetic systems, flywheels
  - electrical end-uses that actively respond to changing EI conditions; eg. 'smart' buildings that control heating & cooling to exploit thermal energy storage; also end-use energy efficiency options:
- A range of possible *functional* roles – network, market, customer-related
- *Note: generation and demand are relatively fungible wrt physical electrical network flows but not yet in a regulatory, commercial or institutional sense*

DE's complex yet promising characteristics

- Complex technical issues
  - Diverse technical characteristics – eg. intermittent renewable energy flows
  - Generation, storage or demand… can be fungible wrt industry operation
  - Small unit scale yet large numbers could aggregate to significant resources
  - Location in the distribution system
- Complex economics: "study of choices as affected by incentives & resources"
  - Wide range of potential decision makers – end users key, but also Network Service Providers (DNSP), Retailers, Energy Service Companies
  - Potential ownership by end-users & close integration with their processes & equipment; eg. Cogen… *and they may have little interest in energy decisions*
  - Location near the end of the energy industry value chain
- Potentially valuable characteristics
  - Some cost-effective alternatives to centralised supply and network options
  - Environmental benefits from renewable energy or highly efficient fossil-fuel use
  - Opportunities for greater end-user engagement in achieving energy services
- Challenge is to maximise total energy, environmental + social values of DE
- *Key issue: Is DE complexity manageable? Even if yes, is it worth the effort?*

Challenges and opportunities for Distributed Energy

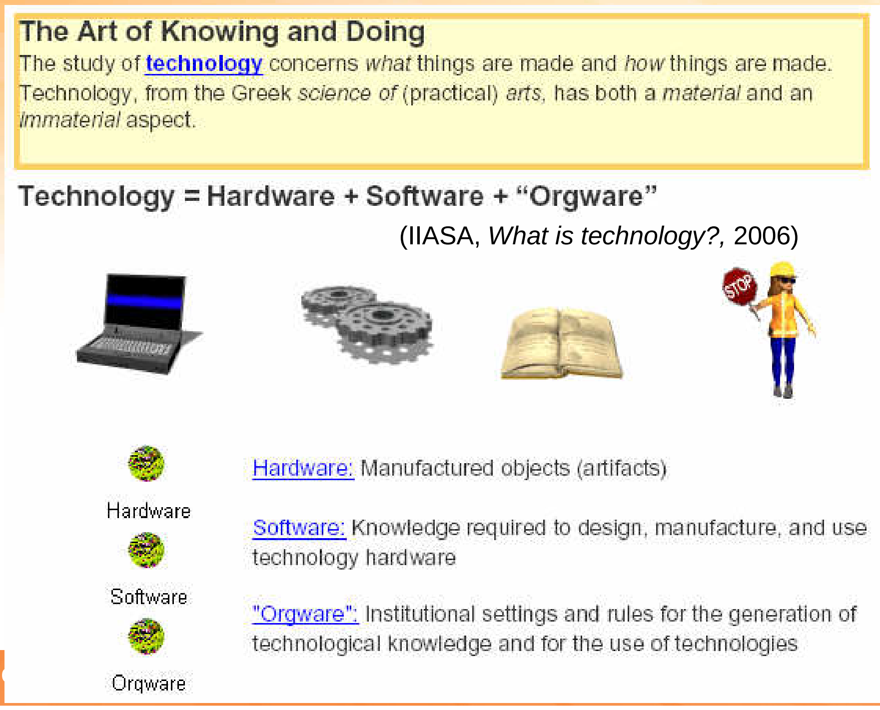
- How well do energy industry and associated arrangements establish, and allow DE to suitably receive
  - Energy and network values (costs and benefits)
    - Locational, time varying + contingent value of energy and necessary network flows: *spot but also future value b/c decisions now impact on later decisions*
  - Environmental values (costs and benefits)
    - 'command and control' regulation yet also possible schemes including ETS, eRET and feed-in tariffs that internalise environmental & social externalities
- In restructured industries a question of wholesale & retail market design, network regulation & policy frameworks
  - Challenges of technology and participant neutrality for emerging DE options that have very different technical & economic characteristics, location near and ownership by end-users
  - *Retail markets where DE resides are the 'unfinished' business of many electricity industry restructuring processes*
  - *Intersection of regulated network and competitive supply/demand options invariably complex and imperfect*
  - No serious efforts yet in most jurisdictions to address environmental, energy security and wider social externalities of energy markets

National Electricity Law: *Overall objective for the National Electricity Market (NEM)*

- *NEL Section 7:*
  - *The national electricity market objective is to promote efficient investment in, and efficient use of, electricity services for the long term interests of consumers of electricity with respect to price, quality, reliability and security of supply of electricity and the reliability, safety and security of the national electricity system*
- Security and Lack of environmental and wider sustainability objectives is a **design choice**
- *If societal desire that NEM contribute to achieving sustainability objectives then governments have to implement 'external' policies that will drive such changes Not an imposition but an obligation for market participants…*
- …and the NEM needs to facilitate technical, institutional and behavioural change towards such changes

What will it take to facilitate DE? **Software+Orgware**

- DE poses significant challenges for existing industry knowledge and capabilities, and institutional frameworks



Hardware often arrives before software and orgware

Garrett under fire over dodgy solar installations

By Samantha Hawley for AM (www.abc.net.au, 2010)

Updated Thu Feb 18, 2010 9:38am AEDT

As Environment Minister Peter Garrett grapples to control his home insulation program, there are now concerns about the potential for house fires because of badly-installed solar panels.

ABC's Lateline program has revealed that up to 2,000 homes could be at risk of electrical fires from poorly installed roof-top solar panels, and Mr Garrett's department is now considering an audit into the scheme.

Ted Spooner, from Standards Australia's committee on renewable energy, has told Lateline that there is no restriction to stop panels which do not meet the Australian standards being imported into Australia.

Mr Spooner says there needs to be more inspectors and an audit of the scheme.

"There is very, very limited inspection of houses to make sure they actually meet those requirements," he said.

"If you have poor quality modules, you can have fractures in electrical joints, and that can lead to arcs and then fires, and these burn at quite high temperatures."

Peter Marshall from the United Firefighters Union of Australia says there are concerns faulty panels could cause high voltage fires.

"The problem is, there's been a rush towards installing this type of equipment," he said.

There have not been any solar panel fires in Australia yet, but it is understood that the Dep Environment is looking into whether an audit is needed.

Up to 2,000 homes could be at risk o from poorly installed roof-top solar p file photo)

VIDEO: Dodgy solar panels spark fi (Lateline)

AUDIO: More Garrett woes with qu solar panel installation (AM)

RELATED STORY: Industry rejects su insulation claims

RELATED STORY: Garrett phones mu insulation death

getsolar.com

Home | Residential Solar | Commercial Solar | Why Solar? | C

Australia's Solar Panel Safety Debacle

Posted by Margaret Collins in Thursday, February 18th 2010 under: International Solar, Residential solar Tags: Australia, safety, solar installation

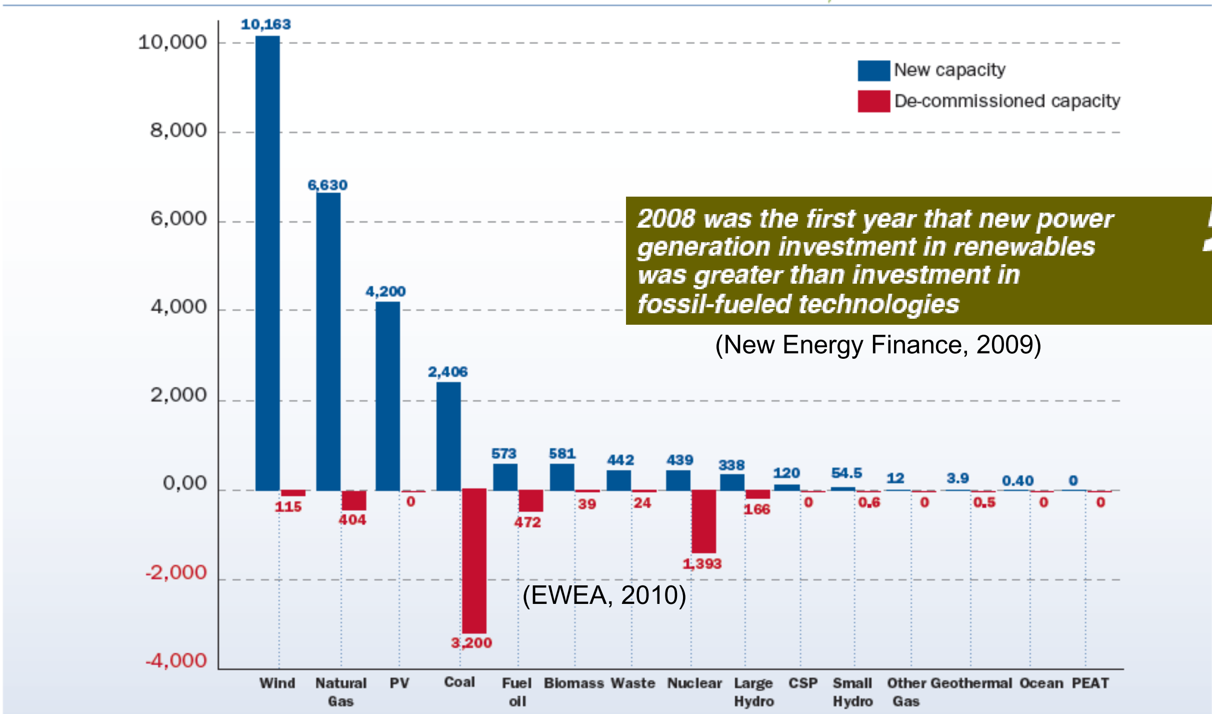
Australian Environment Minister Peter Garrett has been under fire for a home insulation scheme gone wrong in which as many of 400,000 properties may have received below-grade insulation-and three installers have died of electrocution. And now, the safety of solar panel installations in the country has been called into question as well.

The insulation initiative was a result of economic stimulus monies for energy efficiency/insulation spurring a huge boom in the number not only of installations, but of installers; many of whom were poorly–if at all–qualified to do the work at hand. Plentiful government subsidies coupled with lack of oversight and training led to shoddy projects which now need to be reviewed en masse.

Home solar installations have also been funded by generous government subsidies in the past, and the fear now is that many of these–and more to come–will slip through similar cracks in regulatory oversight and safety standards. Garrett, backed by Prime Minister Kevin Rudd, is calling for a nationwide audit of solar panels to address these concerns. According to ABC, "The Clean Energy Council has raised fears that some of the panels – used to generate electricity – were wired with the wrong circuit breakers, which could overheat and cause a fire if the system was turned off for maintenance." If this turns out to be true, it's a serious and amateurish flaw–any experienced solar installer or electrician should be able to appropriately size a circuit breaker. This is the type of mistake most common to absolute beginners, and even then should be caught by a safety inspector before the system would be allowed to go live.

Renewables becoming increasingly significant regionally and globally

NEW INSTALLED CAPACITY AND DE-COMMISSIONED CAPACITY IN EU 2009 IN MW. TOTAL 25,963 MW — FIGURE 1.2



(EWEA, 2010)

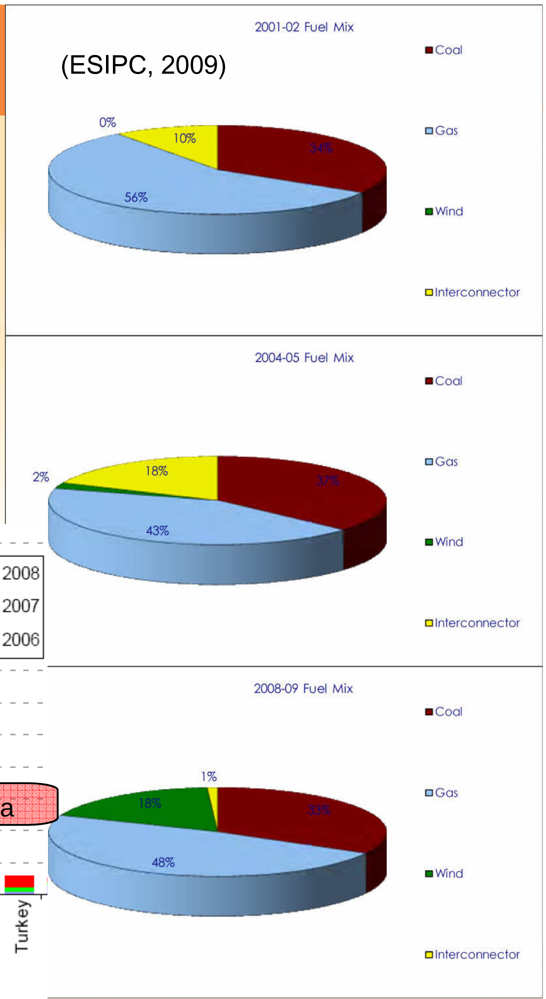
2008 was the first year that new power generation investment in renewables was greater than investment in fossil-fueled technologies ”

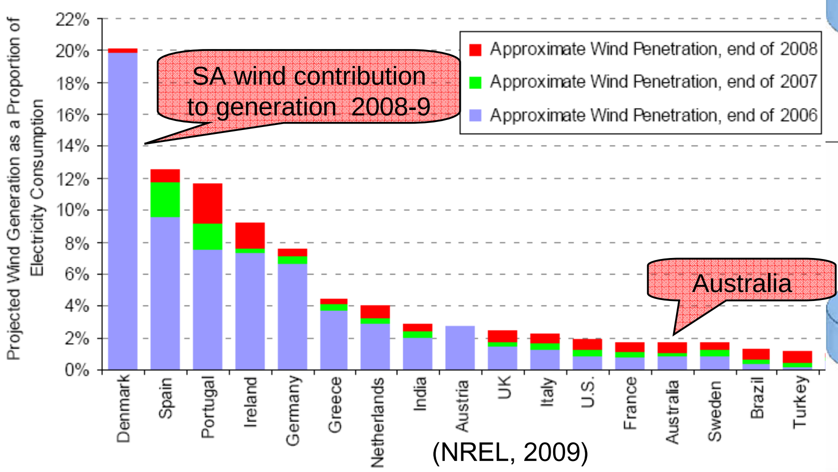
(New Energy Finance, 2009)

Centre for Energy and Environmental Markets

South Australia

- A world leading jurisdiction for assessing wind integration challenges and options
  - A large and rapid deployment driven almost entirely by proactive RE policy; MRET and eRET
  - A necessarily proactive framework for managing this integration within the NEM
    - MCE, AGO / DRET, ESIPC, NEMMCO / AEMO, AEMC, AER, SA Government
  - High wholesale spot/ancillary service market transparency

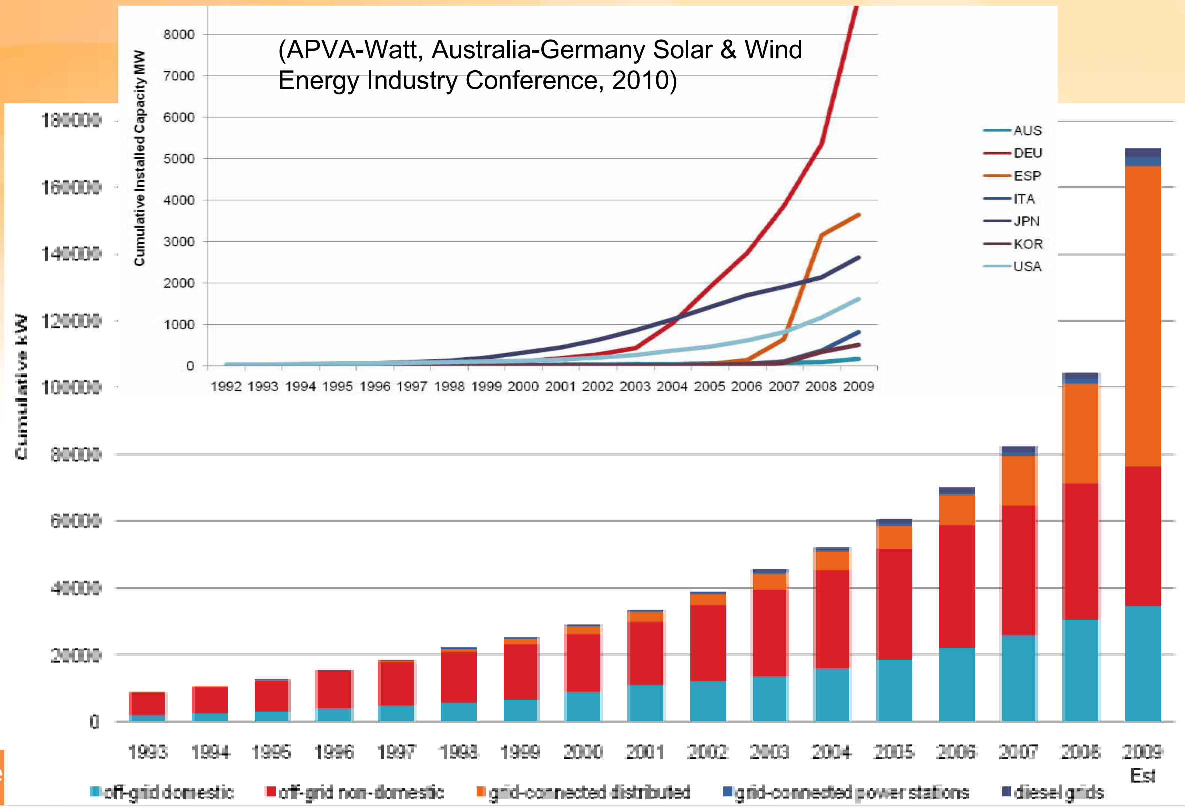




Centre for Energy and Environmental Markets

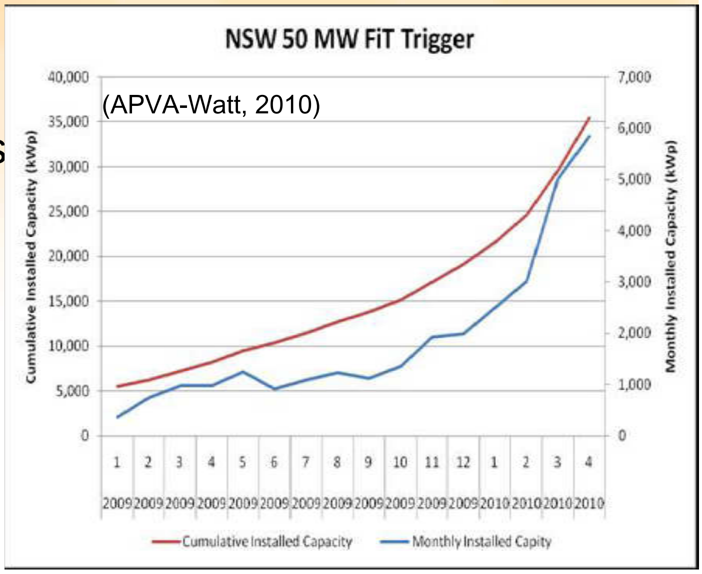
UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

PV uptake in Australia to date



… and policy drivers

- eRET (4000GWh small-scale?)
- Flagships
  - 400MW of centralised PV?
  - 400MW of CSP?
- Jurisdictional feed-in tariffs

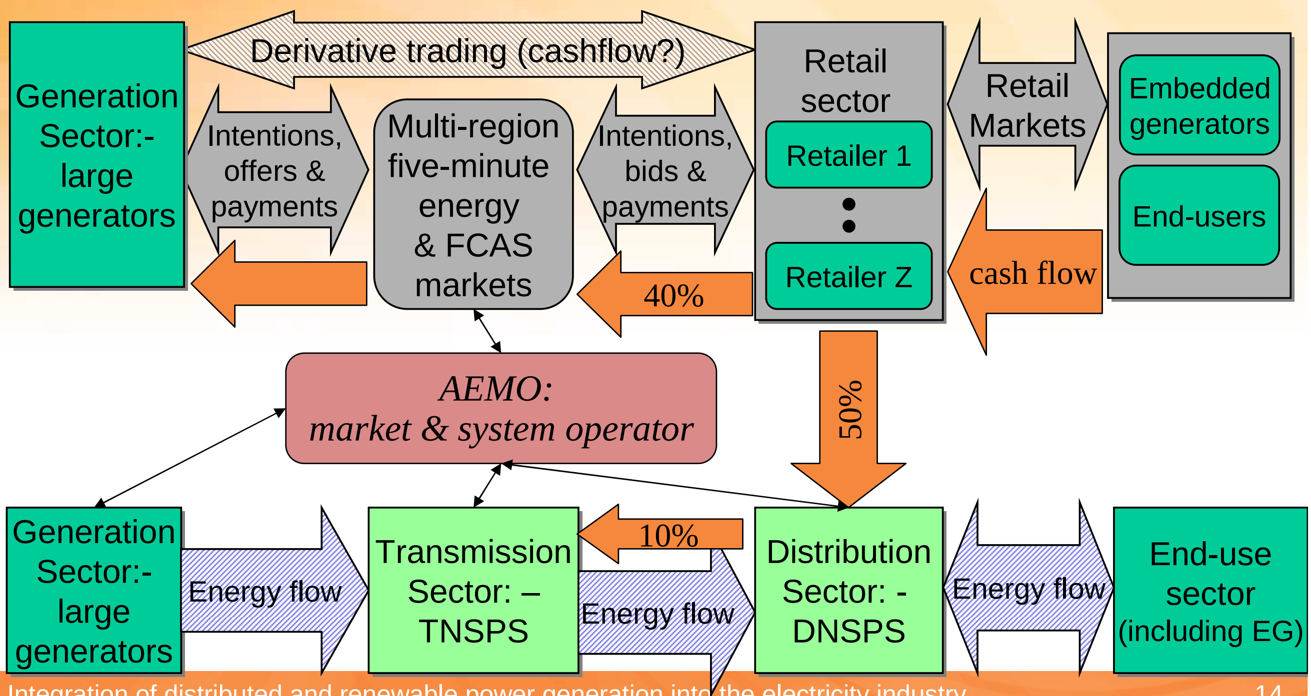


State	Size Limits	Rate c/kWh	Duration Years	Type
Victoria	5 kW	60	15	Net
South Australia	10 kW	44	20	Net
Australian Capital Territory	< 10 kW	50.05	20	Gross
	10 - 30 kW	40.04		
Northern Territory (Alice Springs Solar City)	$5 per day cap	45.76	20	Gross
Queensland	10 kW	44	20	Net
New South Wales	10 kW	60	7	Gross

45.7c

The Australian NEM

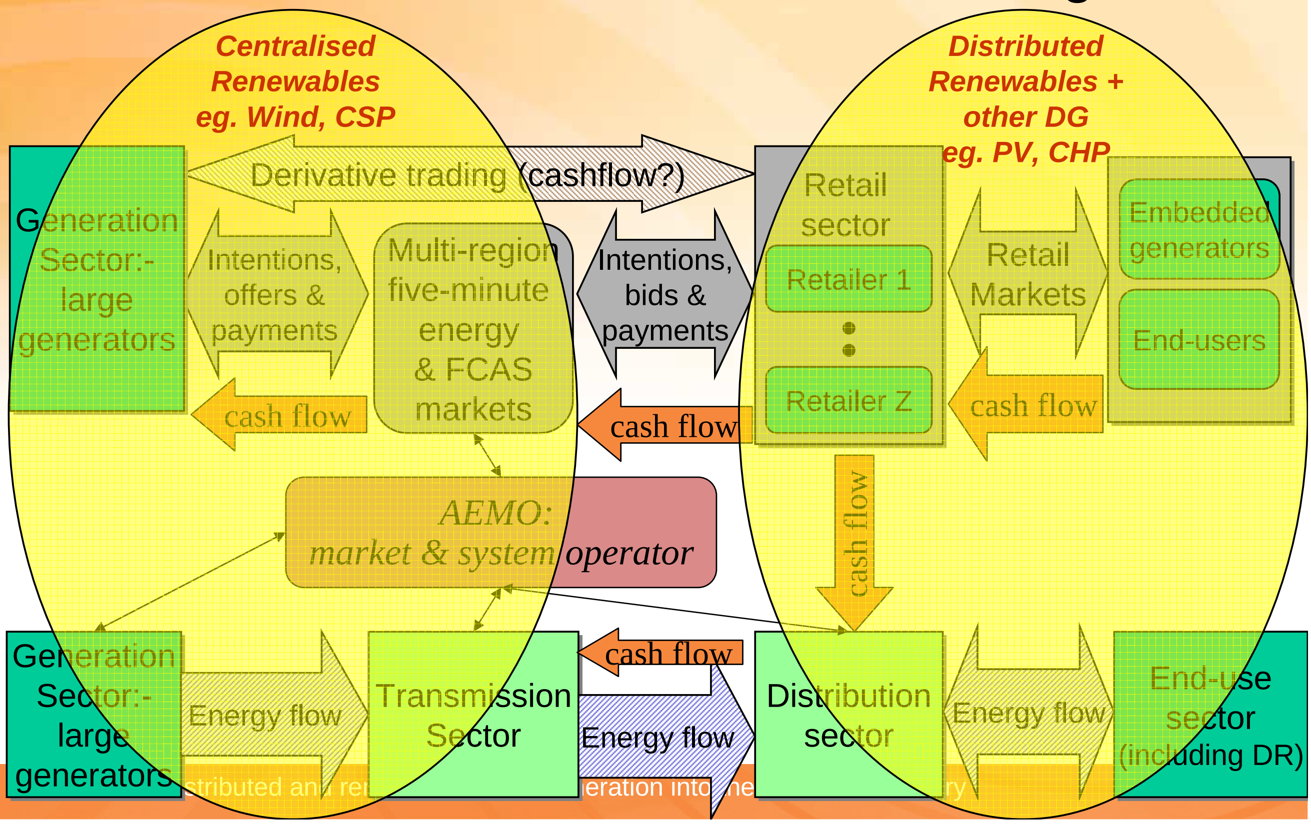
(Outhred, 2010)



Centre for Energy and Environmental Markets

UNSW

Two ‘worlds’ for renewables and DE integration



Centre for Energy and Environmental Markets

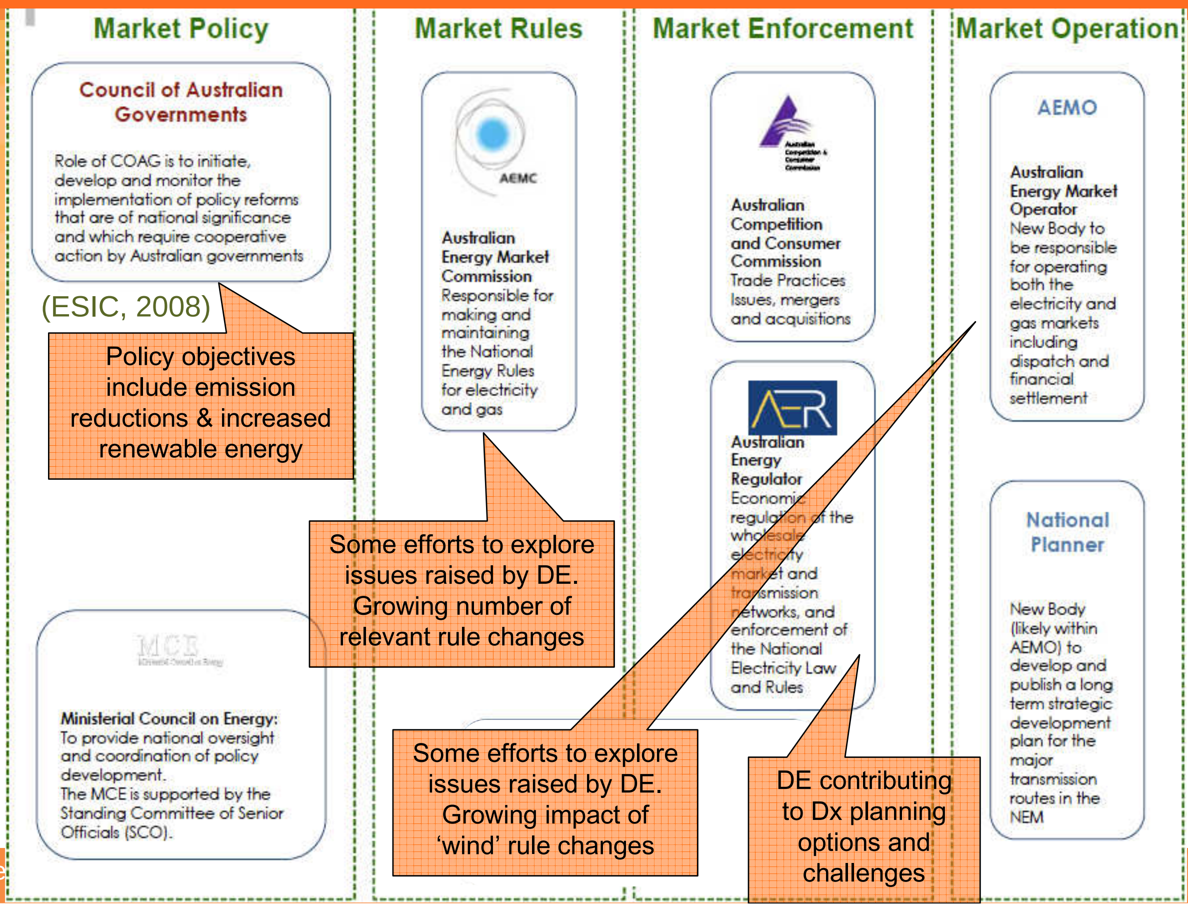
UNSW

Decision-making framework ‘software’ and ‘orgware’ for a restructured energy industry

(Outhred, 2008)

Governance regime	▪ Formal institutions, legislation & policies ▪ *Informal social context including politics*
Security regime	▪ Responsible for core integrity on local or industry-wide basis, with power to override
Technical regime	▪ To allow connected industry components to function as industry-wide machine
Commercial regime	▪ To coordinate decentralised decision-making according to commercial criteria ▪ Includes formally designed markets

Aust. stationary energy sector governance



Centre for Energy and Environmental Markets

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

DE and relevant Governance regimes

- For the NEM
  - Significant progress in governance for the integration of renewables into the NEM wholesale market arrangements
  - Arrangements remain supply-side focussed; DE a disruptive set of technologies for these arrangements
  - Significant asymmetries between resources, knowledge and motivation of centralised vs DE participants
  - Insufficient attention to complex realities of end-user decision making
  - Immature gas market arrangements, DE equipment markets and more…
- More widely…
  - Poor governance in design of related environmental markets – proposed CPRS and eRET
  - Many relevant institutional and regulatory arrangements not supportive of DE – eg. planning laws, solar access, regional air quality and more

Some recent NEM developments for DE

- AEMC Review of Demand-Side Participation in the NEM, Nov 09
  - in the context of the current technology that supports DSP and subject to a number of proposed amendments to the NERs, the NEM framework does not materially bias against the use of DSP. We have found that overall the costs and opportunities to participate provided by the framework are appropriate. However, this finding is made in an environment where the vast majority of electricity use is not capable of being measured, priced, and controlled in real time. This limitation is likely to considerably constrain the ability for the demand-side to participate at low cost..."
- AEMC Review of Energy Market Frameworks wrt Climate Change Policies, Sept 09
  - "The existing Demand Management Incentive Allowance under the National Electricity Rules should be expanded to accommodate connections of embedded generators"
  - The AEMC Reliability Panel should take account of the likely interactions between the electricity and gas markets when reviewing reliability market standards and settings
  - MCE should review the existing timetable of the AEMC retail competition reviews."
- AEMC Review National Framework for Electricity Dx Planning & Expansion, Sep 09
  - "… each DNSP would establish and maintain a Demand Side Engagement Strategy. This strategy would involve DNSPs publishing a demand side engagement facilitation process document, establishing and maintaining a database of non-network case studies and proposals, and establishing and maintaining a Demand Side Engagement Register… It builds on current industry practice, and promotes a constructive working relationship between the distribution businesses and non-network providers. The strategy would work together with the Distribution Annual Planning Report and RIT-D to address a perceived failure by DNSPs to assess non-network alternatives in a neutral manner."

DE and the NEM technical regime

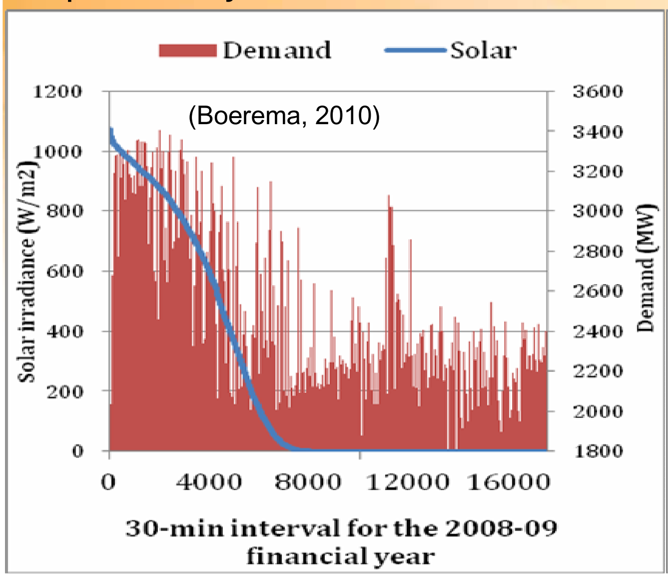
- *EI requires high levels of coordination and 'good behaviour'*
- Standards
  - **System:** required security, reliability & quality levels
  - **Access:** levels of plant performance required to connect. Technology standards that assure compliance with Access
  - *Challenges in appropriate alignment of system and access standards*
- Considerable challenges for new technologies
  - Rules generally evolve from historical practice and technologies
  - Potentially more onerous standards for new entrants than incumbents
- Ongoing efforts underway and likely to continue
  - Technical Standards for Wind Generation and other Generator Connections (2007). *DG<5MW not required to register with AEMO*
- Technically immature and inadequate interface to end-users
- More general standards challenges for novel DE equipment

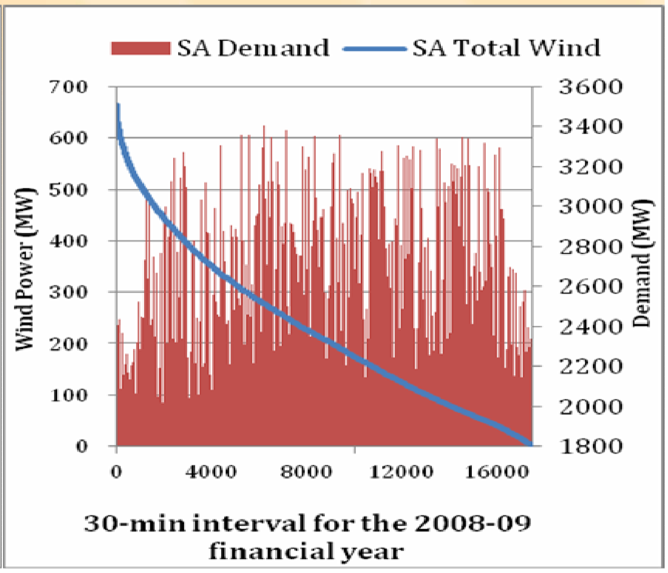
DE and NEM Security/Commercial Regimes

- NEM wholesale spot and ancillary service markets
  - appear to have performed reasonably well to date in securely & reasonably efficiently supplying growing demand & peak demand, integrating modest levels of novel technologies & managing brief periods of energy constraints
  - However, appears to be increasingly stressed and significant structural changes including 'gentailing'
- Network expenditure has grown considerably
- And retail markets where most DE resides
  - Immature competitive arrangements with inadequate metering for many end-users, simplified energy and network tariffs from flat, inclining block, TOU through to TOU and peak demand on energy and network
  - Little support for informed end-user decision making
  - *The unfinished business of restructuring*

RE integration and security implications

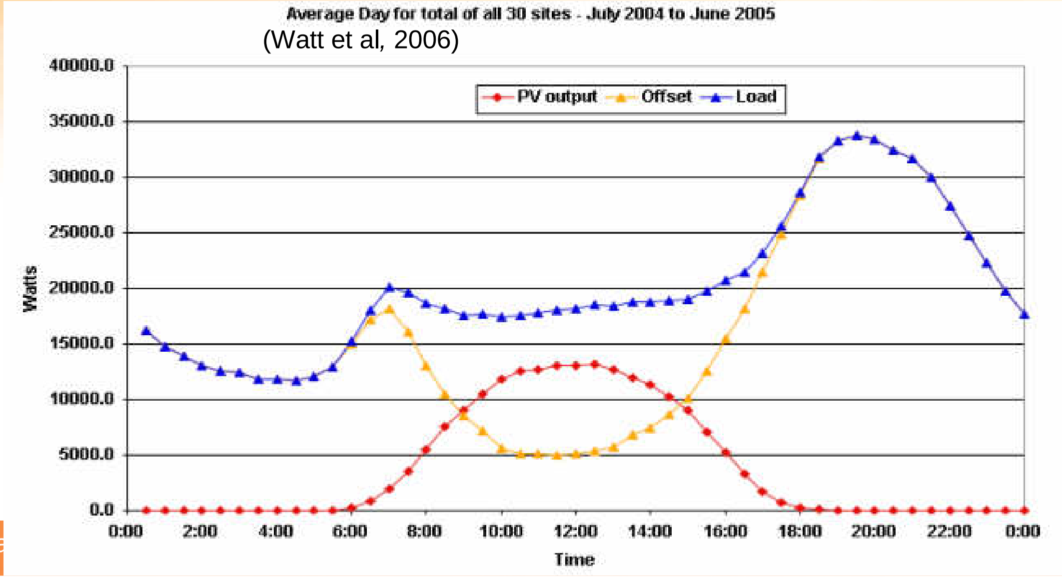
- Periods of high demand and low renewable generation availability, particularly notable with wind





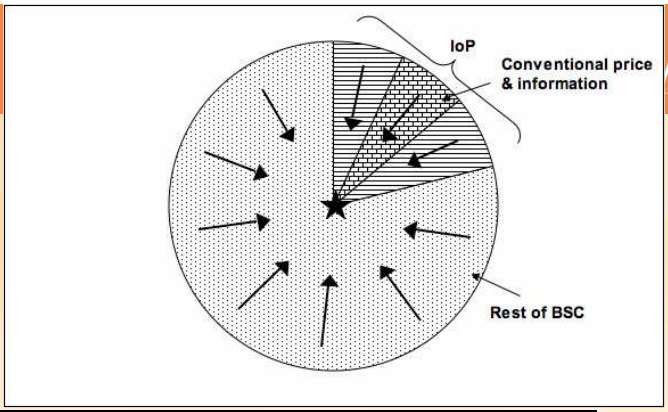
PV and network management implications

- Residential load not necessarily well matched to PV generation for peak demand reduction; *commercial feeders more prospective*
- Also, potential power quality implications – voltage regulation and reactive power flows through the network



Decision-making influences

(Passey et al, *Economics of Distributed Energy,* 2009)



Prices & Information	▪ Appreciation of available options, anticipated costs and benefits subject to current commercial arrangements
Infrastructures of Provision	▪ Available options subject to infrastructure, linked markets, knowledge & wider institutional frameworks
Broader Social Context	▪ Decision making driven by factors far beyond rational preferences; learned behaviours, habits and practices

Centre for Energy and Environmental Markets

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

Energy service objectives in practice?

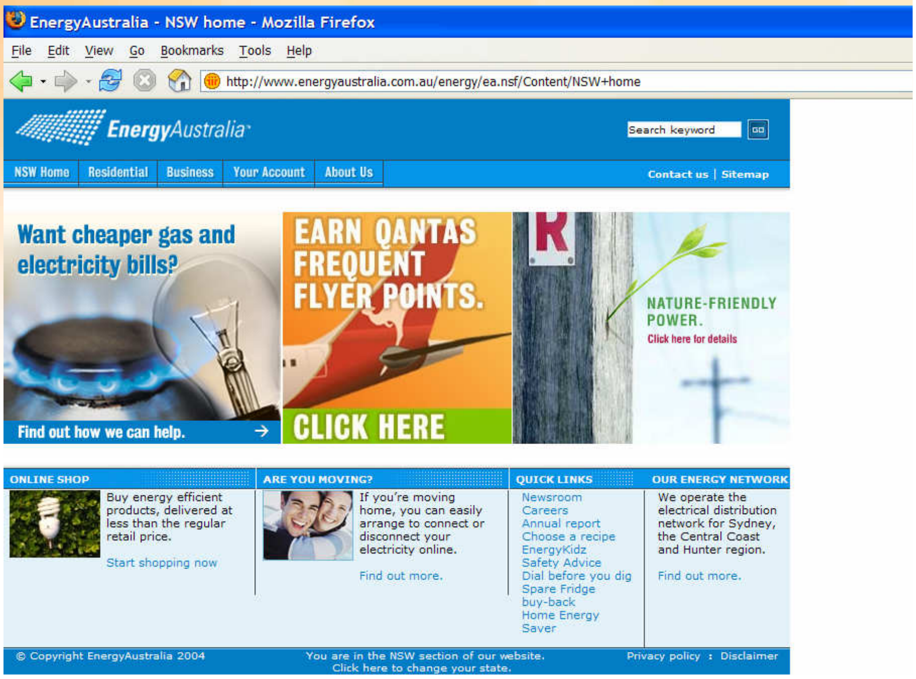
- "Efficient use of electricity services…for an individual consumer occurs when the value from using electricity exceeds to cost of producing and delivering it to the consumer."
  (NERA Consulting, *Draft Report: Review of the role of DSP in the NEM*, March 2008)
  - *What if we can deliver same or greater energy service value for lower supply costs?*
- "For electricity use to be efficient customers should face the marginal network and generation costs of providing electricity services to them"
  - *Key question is impact of decisions made now, particularly investment decisions, on future costs: derivative markets to price the future have a key role*
- *Focus needs to be on pricing policy rather than 'price' & the context within which these prices sit*

Centre for Energy and Environmental Markets

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

Current Full Retail Competition limited

". an important reason there is effective competition in Victoria is "Because the provision of energy is viewed as a homogenous, low engagement service… "
AEMC, *Effectiveness of Competition in Victoria,* 2008



Current measures of competition have questionable relevance
Retail transfers – churn?
Price spreads – sticky market consumers?

Centre for Energy and Environmental Markets

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

A complex commercial context for DG in NEM

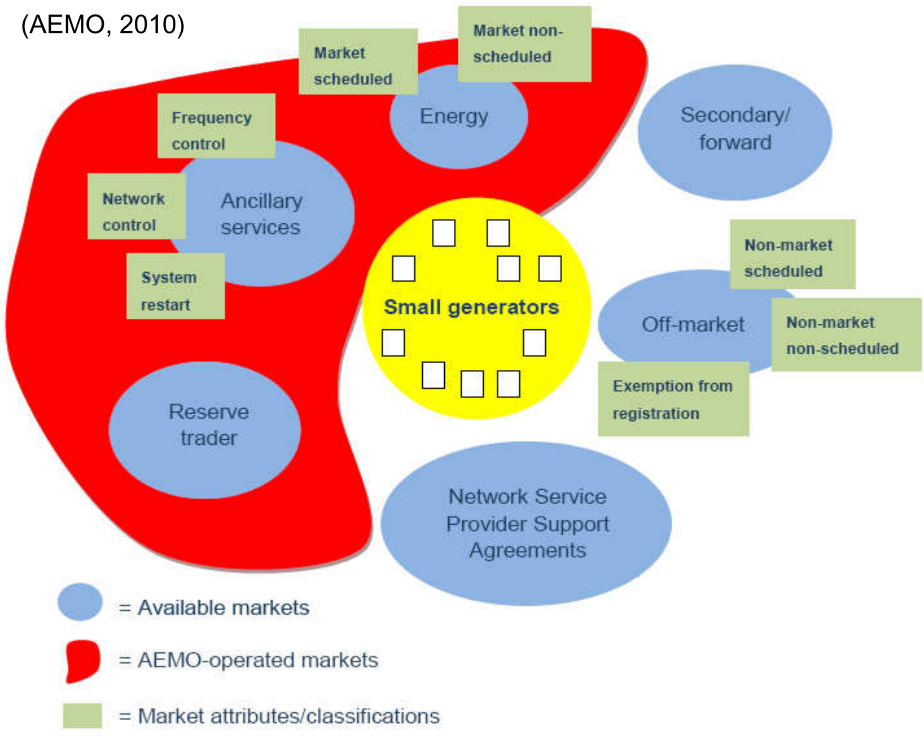
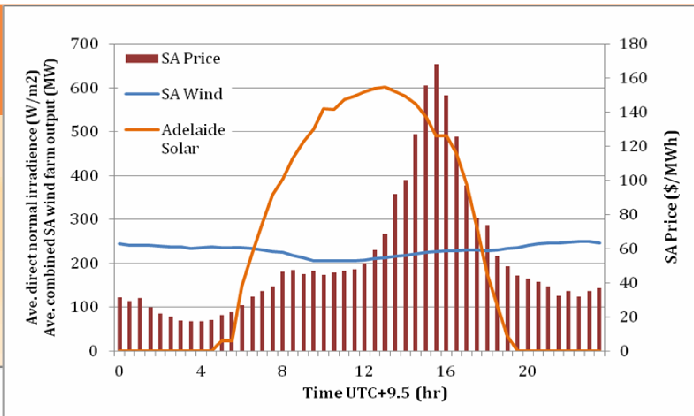


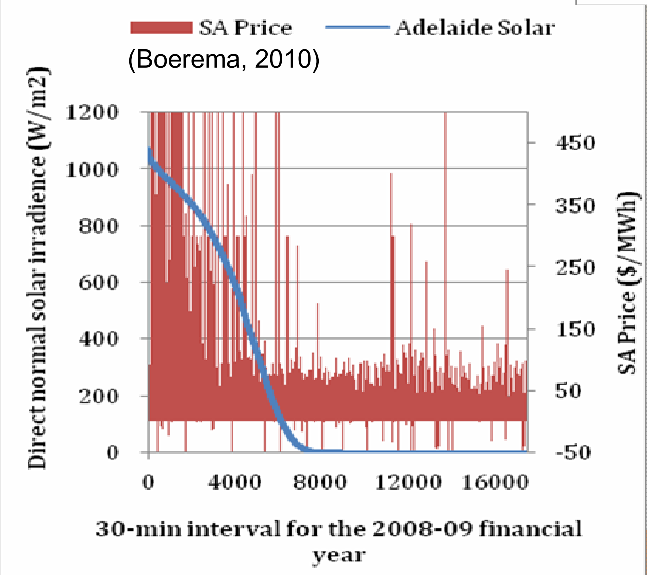
FIGURE 2: POTENTIAL MARKETS FOR SMALL GENERATORS IN THE NEM

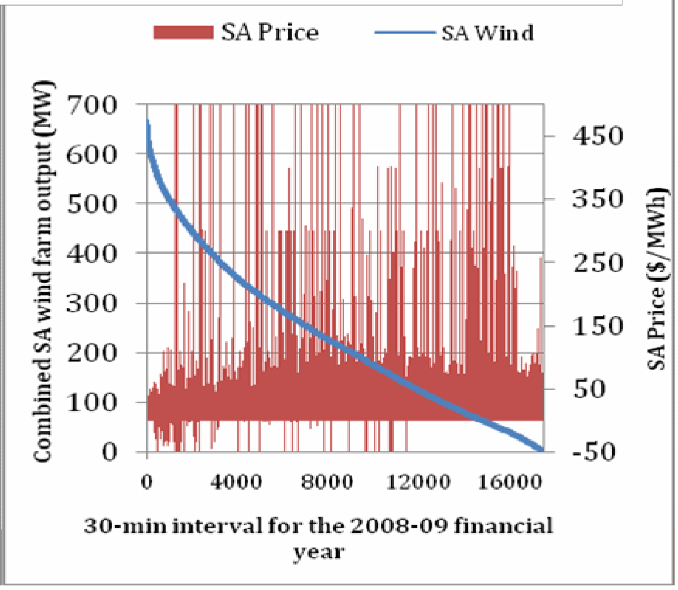
Centre for Energy and Environmental Markets

RE integration and commercial issues

- In 2008-9, a PV plant may have earned spot revenue >$100/MWh or 2X Wind $/MWh



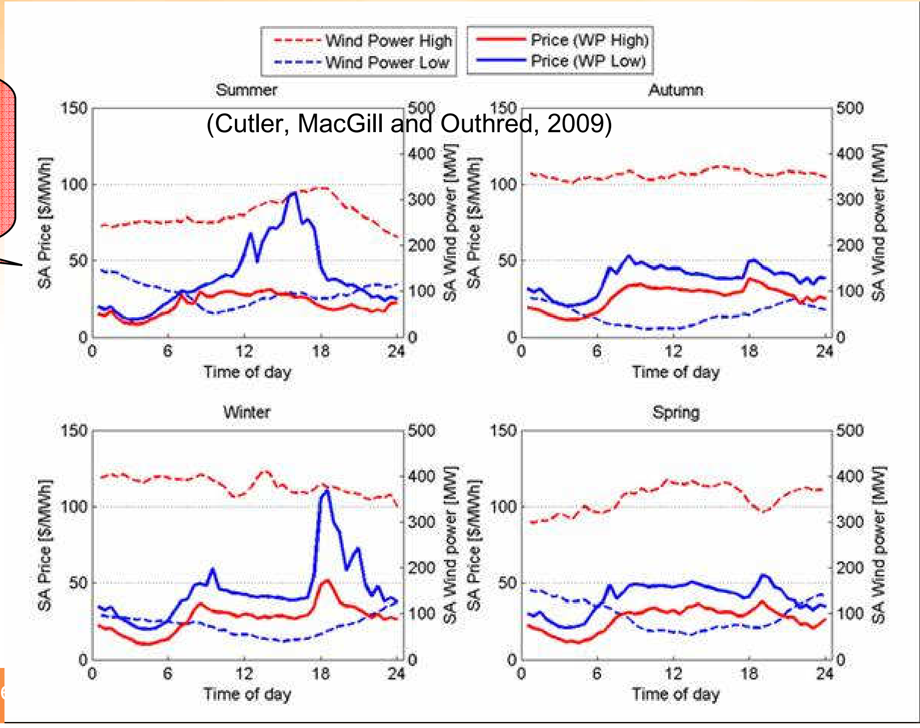




Q: Is wind generation in SA impacting on prices?

- Apparently yes eg. Top quartile and bottom quartile average wind generation for week-days and associated SA regional prices

Prices capped at $415/MWh to remove impacts of highly infrequent but very significant high price events on average prices



(Cutler, MacGill and Outhred, 2009)

Other commercial drivers: MRET/eRET 'designer' mkt

... will succeed or fail on quality of governance

The objects of this Act are:

(a) to encourage the additional generation of electricity from renewable sources; and

(b) to reduce emissions of greenhouse gases; and

(c) to ensure that renewable energy sources are ecologically sustainable.

RE Certificates representing 1 MWh of new 'renewables'

non-zero baseline if pre-1997

REC providers

Deliver certified new Renewables to create RECs

RE Certificate trading

To improve economic efficiency

Liable parties

Obliged to acquit RECs as part of societal obligation

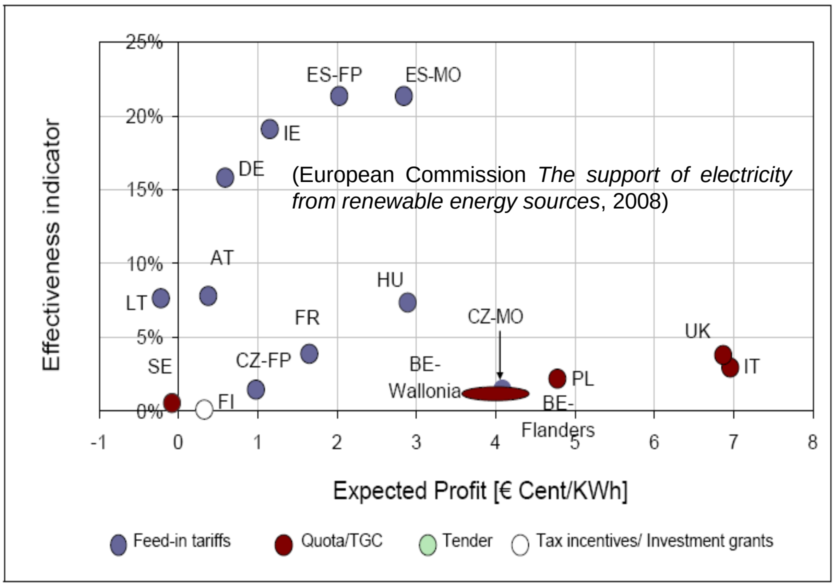
Initially set as 9500 GWh/yr 2010-20. Now 45,000 GWh/yr 2020-30

Certify Certificates | Maintain register | Ensure liable parties oblige

Scheme administrator

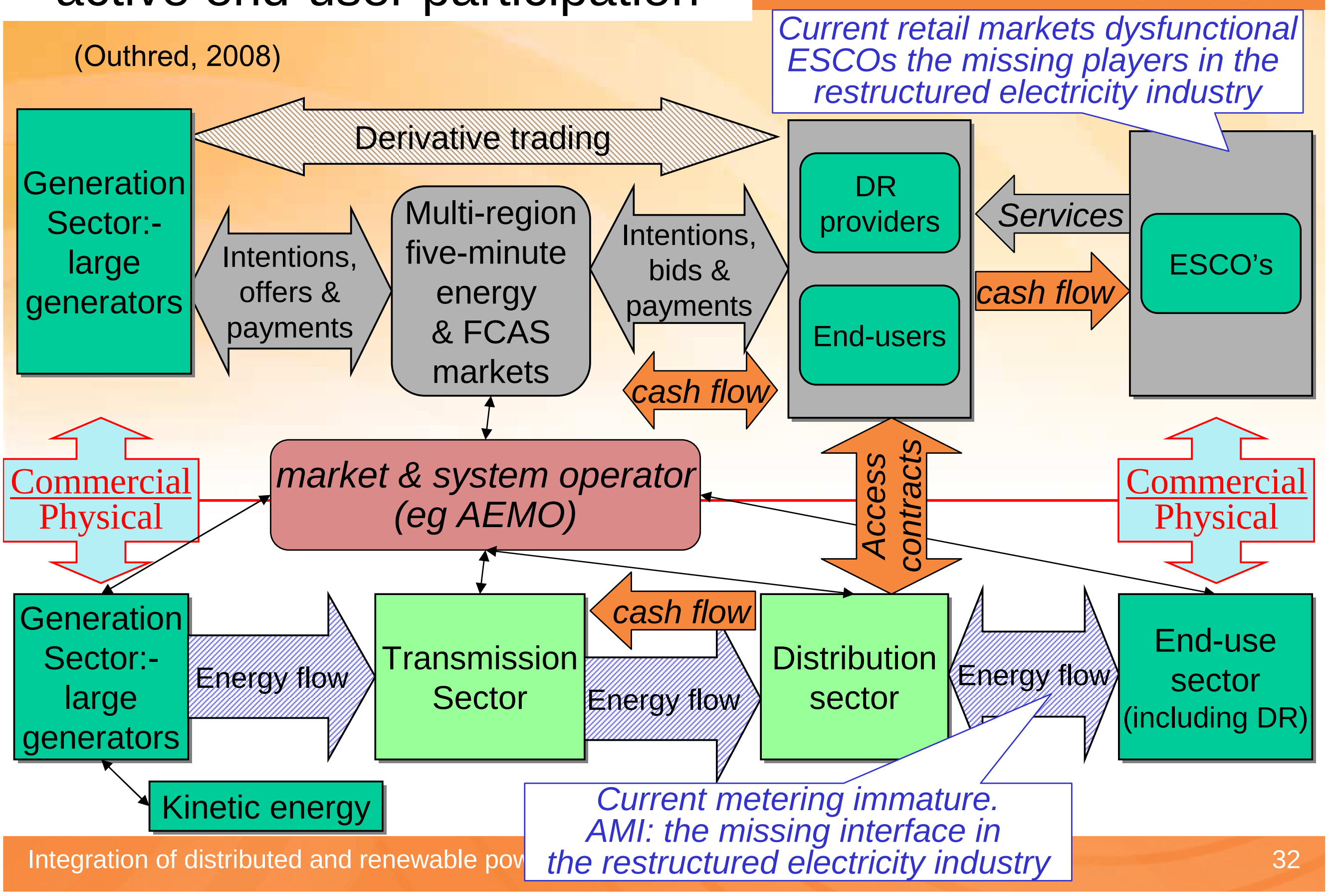
MRET performance to date… and for 2020?

- **To date:** modest ramping target easily met + considerable new investment with apparent efficiency – low subsidy $/MWh by international standards
- **Yet:** international experience generally poor with certificate schemes for reasons that seem to include governance capture by incumbents, risks for developers, market power on 'buy' side, single price for all
- **NEM** increasingly stressed infrastructure, changing structure including gentailers
- **Hence,** past modest success no guarantee of future performance with a significant target



Enhanced NEM structure with active end-user participation

(Outhred, 2008)

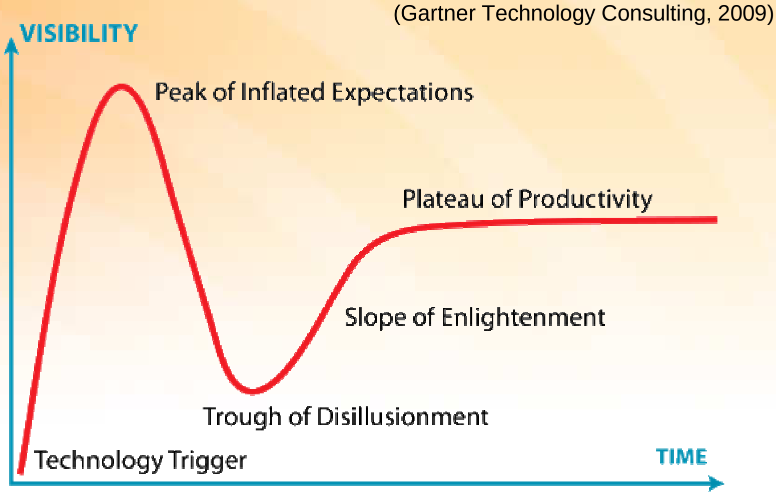


Advanced Metering Infrastructure (AMI)

- Metering:
  - Interval metering should be provided for all participants:
    - Record energy flow level (30 minute energy), quality & availability
    - Provide data read-out for participant & market operator
  - Profiling could be used to calculate default CFD volumes
- Communication between market/system operator, participants & network service providers:
  - Locational spot prices for 30-minute average energy flow & for network access
  - Participant 30-min. ave. P, Q, V, availability
  - Feeder P&Q flows & voltage profiles (for quality & security management & price setting)

Smart grids and the hype cycle

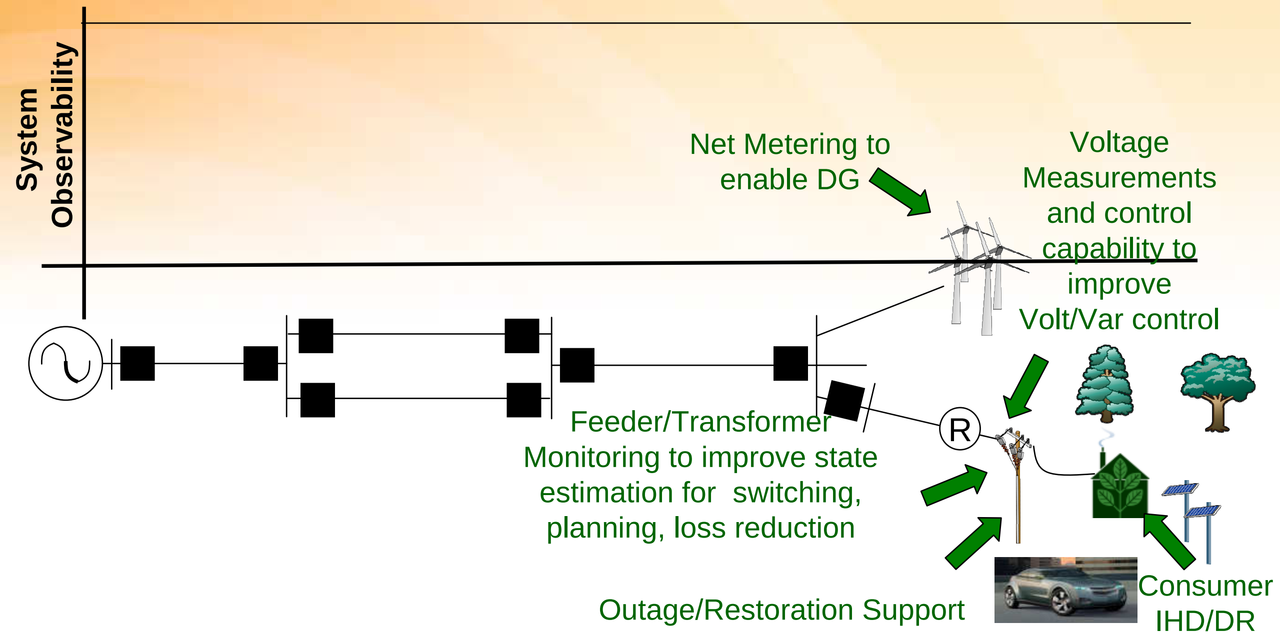
(Gartner Technology Consulting, 2009)



- Technology Trigger: A potential technology breakthrough kicks things off. Early proof-of-concept stories and media interest trigger significant publicity. Often no usable products exist and commercial viability is unproven.
- Peak of Inflated Expectations: Early publicity produces a number of success stories—often accompanied by scores of failures. Some companies take action; many do not.
- Trough of Disillusionment: Interest wanes as experiments and implementations fail to deliver. Producers of the technology shake out or fail. Investments continue only if the surviving providers improve their products to the satisfaction of early adopters.
- Slope of Enlightenment: More instances of how the technology can benefit the enterprise start to crystallize and become more widely understood. Second- and third-generation products appear from technology providers. More enterprises fund pilots; conservative companies remain cautious.
- Plateau of Productivity: Mainstream adoption starts to take off. Criteria for assessing provider viability are more clearly defined. The technology's broad market applicability and relevance are clearly paying off.

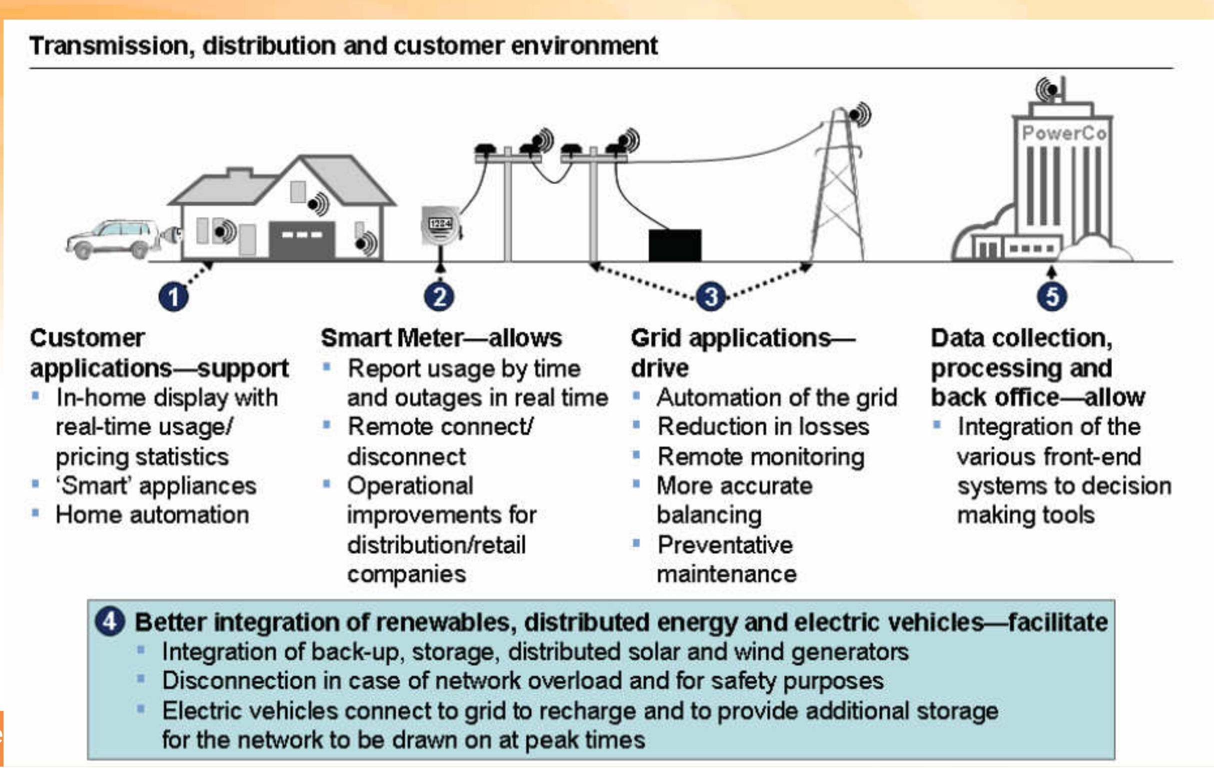
The first challenge – defining ‘smart grids’

- Possible network led perspectives
  (IEEE, *Smart Grid Overview*, 2009)

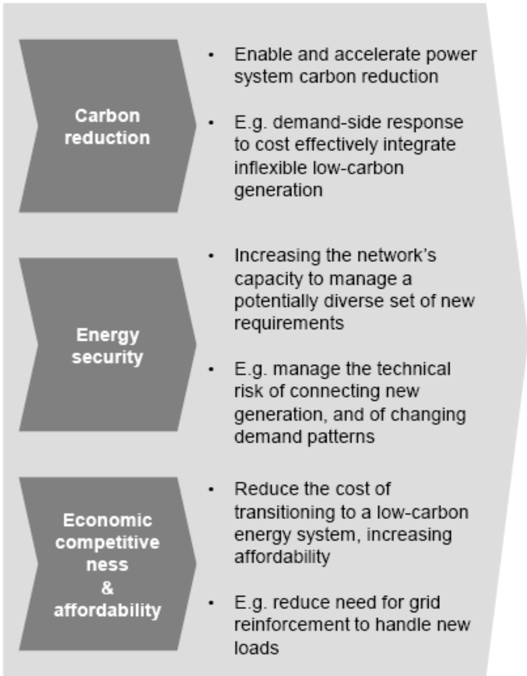


Centre for Energy and Environmental Markets
UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

- Smart grids, smart cities perspective…



UK ENSG, Smart Grid Routemap perspective …



"The UK's smart grid will develop to support and accelerate a cost-effective transition to the low-carbon economy. Smart grid will help the UK meet its 2020 carbon targets, while providing the foundations for a variety of power system options out to 2050.

The Vision sets out how smart grids may, directly or indirectly: maintain or enhance quality and security of electricity supply; facilitate the connection of new low- and zero-carbon generating plants, from industrial to domestic scale; enable innovative demand-side technologies and strategies; facilitate a new range of energy products and tariffs to empower consumers to reduce their energy consumption and carbon output; feature a holistic communications system that will allow the complete power system to operate in a coherent way, balancing carbon intensity and cost, and providing a greater visibility of the grid state; allow the cost and carbon impact of using the networks themselves to be optimised."

One possible perspective on Smart Grids

- A wide range of claimed opportunities, many representing useful yet modest extensions to current industry arrangements
- The key objective for the "smart grid" concept should be:
  - Coordinated, decentralised investment in and operation of distributed energy resources to deliver net societal benefits from an industry requiring significant low-carbon transformation

    Improved power quality + reliability, reduced costs as lower priorities
- Key requirements in achieving this objective are: (Outhred, 2008)
  - Advanced metering and 'smart grid' infrastructure including communications, distributed intelligence
  - A formal decision-making framework to allocate authority & accountability to key decision-makers, *ESCOs for decision support*
  - A formal set of incentive/penalty and regulatory regimes to align the incentives of decentralised decision-makers with societal objectives

DE and Energy Service Companies (ESCOs)

- Role is to support end-users in meeting their energy service requirements in the most appropriate manner
- The complexity of some DE options is near overwhelming for the end-users who will often own and operate the equipment
- ESCOs can help manage this complexity through specialist knowledge and motivation that end-users lack
- Find it easier to work with commercial & industrial end-users (eg. via energy contracting) than residential end-users
- Require efficient energy market pricing – spot and forward – and hence the ability to receive appropriate value from DE options
- Require appropriate wider policy frameworks that recognise the wider values of DE options

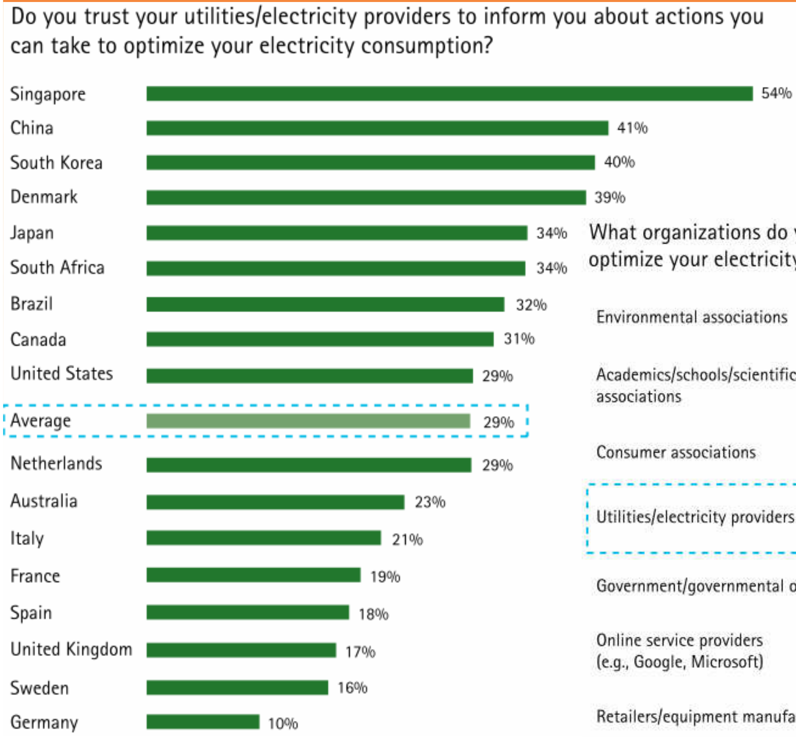
- *ESCOs the missing institutional interface between end-users and the energy industry. From where might these ESCOs come? – DNSPS, retailers, equipment providers, Energy Performance Contracting?*

Some Australian experience with commercial DE opportunities

- "THE THREE CASE STUDIES PARTICULARLY HIGHLIGHT THE KEY ROLE OF IOP INFLUENCES OTHER THAN STRICT PROJECT FINANCIALS IN DRIVING DECISION MAKING. FOR EXAMPLE:
  - Cogeneration presents excellent opportunities but delivering projects is hampered by poor information on network issues, onerous assessments of possible local air quality impacts, overly strict regulation of operation and poorly defined processes (Property Council, 2009)
  - Innovative HVAC options have been hampered by a lack of technical capacity and knowledge from local equipment suppliers, measurement and verification challenges and significant risk aversion by owners and occupiers (DMPP, 2006)
  - Backup generators have been identified as a Demand Management opportunity yet opportunities are extremely context specific, much of the existing plant isn't technically appropriate for connection while network protection and fault ratings can also preclude projects, Development Approvals, operating licences and EPA requirements may restrict operation to emergency standby and the planning process is highly onerous (DMPP, 2006; Orbis, 2006)"

Passey and MacGill (2009) *Economics of Distributed Energy*, Report to CSIRO.

Currently some 'trust' issues for electricity providers



(Accenture, 2010)

Work underway – eg. ETSA air-conditioning trial

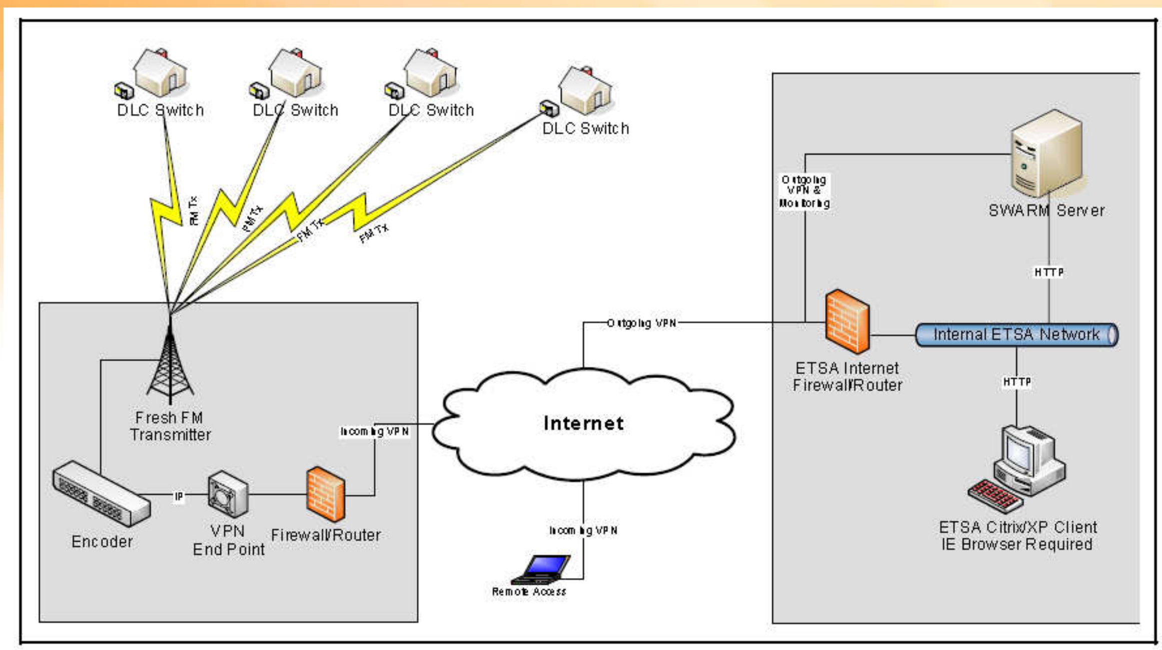


Figure 5. Communication System for the ETSA Utilities Air Conditioner DLC Phase II Project

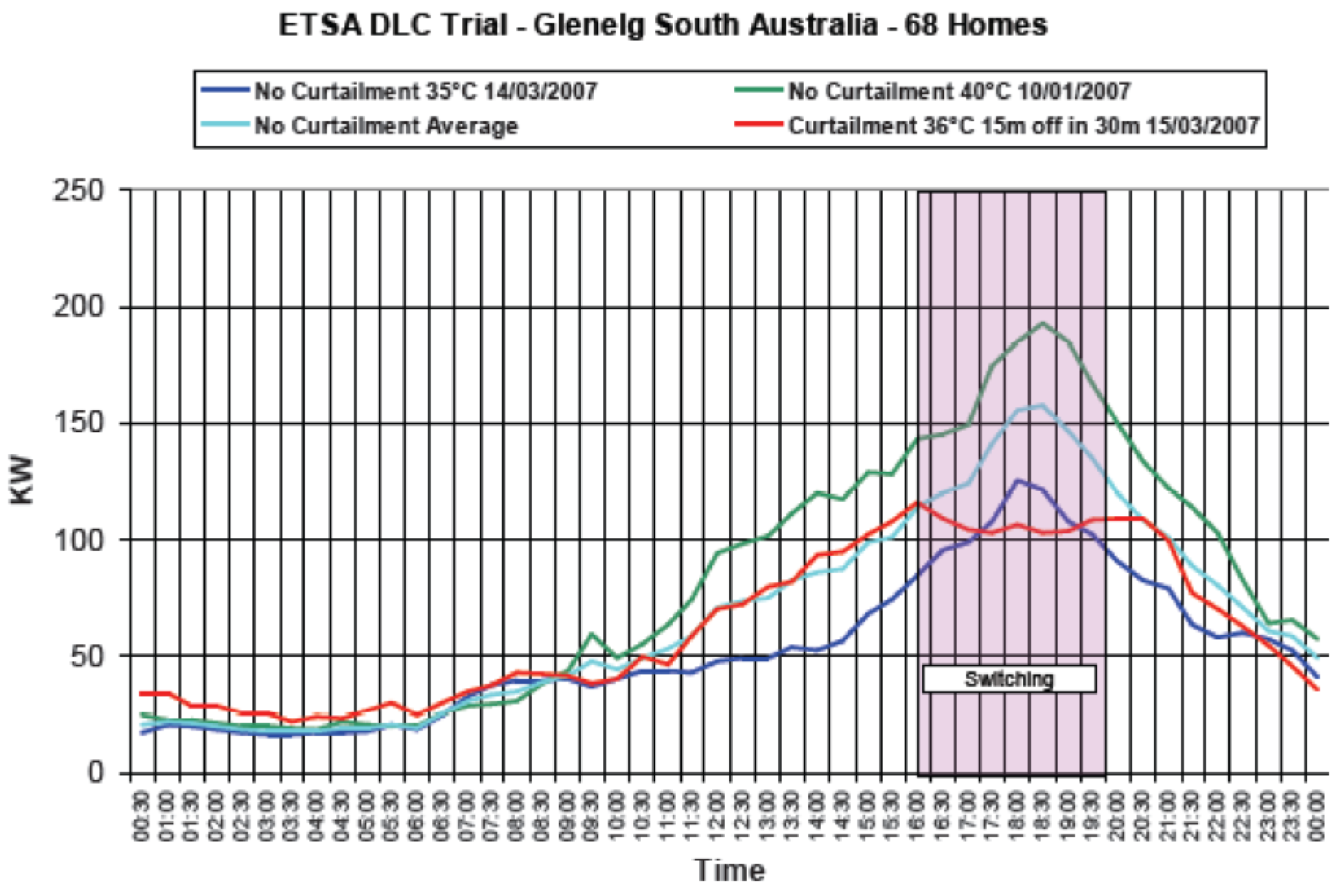


Figure 8. Load Reductions Achieved in the

Country Energy - Completed Home Energy Efficiency Trial

Customer Response Trial using an in home display and time of use tariffs with Critical Peak Pricing (CPP).

Critical peak events were called by Country Energy when the load on the local network was reaching maximum capacity or when high price events occurred in the competitive wholesale electricity market. Critical peak events could be called for a maximum of 12 times per year; customers were given a minimum 2 hours notice. Notice was sent to the IHD and via SMS.

Tariff	Critical Peak (c/kWh)	Peak (c/kWh)	Shoulder (c/kWh)	Off peak (c/kWh)
	37.74	18.87	12.7	7.03

Number of homes: 150
Length of trial: 18 months

Lessons Learnt:

- Demand reductions of 30% during the CPP
- Average total energy use reduction of 4% (Median 8%)
- Ongoing customer education was important

Energy Australia - Strategic Pricing Study - Customer Behaviour

(Information found in The Role of Advanced Metering and Load Control in Supporting Electricity Networks on the internet)

The study included about 750 residential customers and 550 business customers. All had a smart meter and some had an in-house display.

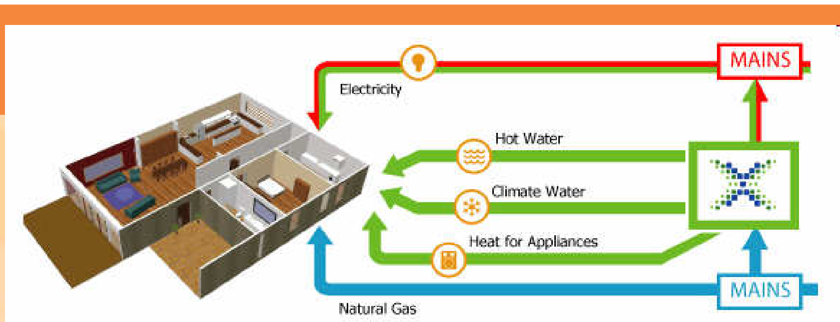
The experimental groups comprised:

- a control group;
- a group provided only with information about peak load reductions;
- a group placed on a seasonal TOU tariffs;
- one group placed on a medium critical peak pricing tariff with an in-home display;
- two groups placed on a high critical peak pricing tariff with and without an in-home display.

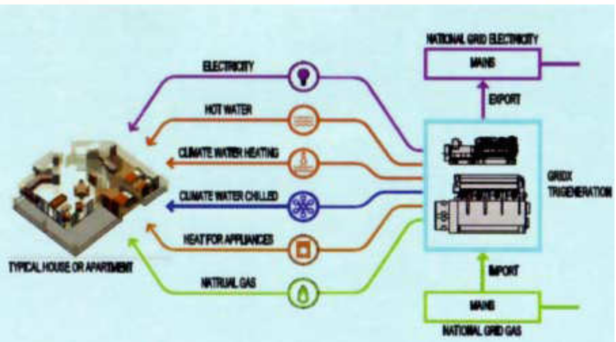
Tariff	Peak (c/kWh)	Shoulder (c/kWh)	Off peak (c/kWh)
PowerAlert Medium DPP-M	100	9.5	7.5
PowerAlert high DPP-H	200	8.5	6.5

Lessons Learnt:

- Energy consumption during the CPP was between 21% and 25% of the total average daily consumption on non-critical peak day.
- Not a great deal of difference with and without IHD



Other possible ESCO players eg. GridX Systems



	Traditional Grid Power	GridX Power
COST	In most locations in (Australia) delivered grid power cost between 7 and 18 cents/kWh	The GridX Power system with a good fuel cost/availability can be under 10 cents per kWh. ✔
FUEL EFFICIENCY	Delivered grid power is less than 35% efficient depending on the mix of power plants used.	The GridX Power system with CCHP will be 70 - 80% efficient and even more so with the delivered chilling. ✔
RELIABILITY	Grid power is on average 99.97% reliable.	The fully integrated GridX Power system can achieve even higher reliability than the mains grid. ✔
EMISSIONS	Traditionally, Australia relies on brown and black coal power stations which have very high CO_2 emissions.	The GridX Power system relies on natural gas which by comparison emits about 33% less emissions than the grid for the same given output*. ✔
SECURITY	Damage to a few major transmission lines can cause regional blackouts affecting millions of customers.	Severe damage to any portion of the GridX Power system may only affect that section of homes. The GridX Power system is able to operate any portion of its infrastructure independently and in isolation to minimise inconvenience. ✔
CONSTRUCTION CONSTRAINTS	It is difficult to build new transmission lines and substations because of NIMBY ("Not In My Backyard Syndrome") and the high costs involved.	The GridX Power system can be a solution to overloaded and constrained T&D systems. The GridX generators are designed to be out of sight and discretely operated upon the development. ✔

Wider policy frameworks to address externalities

- Emissions trading to date largely a debacle
  - EU ETS has had very limited impact on emissions yet sending extraordinary cashflows to large emitters and other major mkt players
    - Little support for DE beyond higher yet increasingly uncertain energy prices – will this be sufficient to drive major change?
- Renewables deployment
  - Some measures have achieved far greater success in reducing emissions, establishing new industries & beginning transformation of electricity industries
  - Challenge of finding policy approaches that maximise electricity industry value of DE while driving transformation
    - Mixed experience with some Green Certificate schemes
    - Feed-in tariffs demonstrated success but 'hide' energy market signals
- Distributed Energy
  - Diversity of technologies and opportunities will require comprehensive & coherent policies wrt information, regulation & incentives sufficient to overcome existing barriers – *time to get to work*

Thank you… and *questions*

Comments, suggestions and corrections regarding this presentation are all welcome. Please contact Iain at i.macgill@unsw.edu.au

This and many other of our publications and presentations are available at: www.ceem.unsw.edu.au