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Smart Grid Challenges and Opportunities

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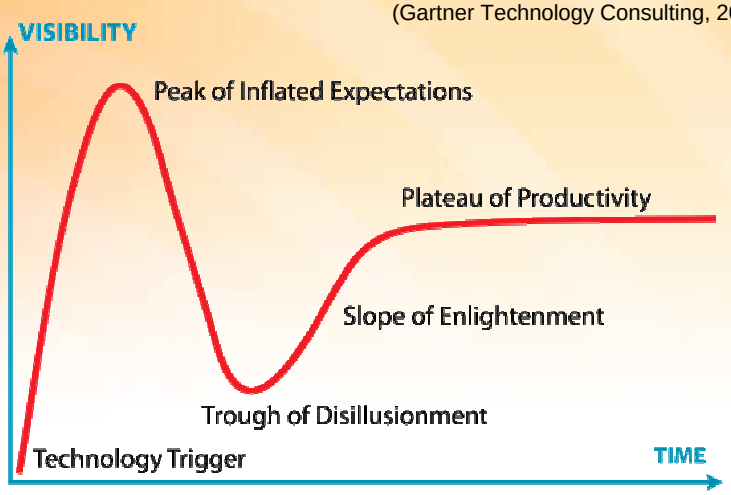
Smart grids and the hype cycle

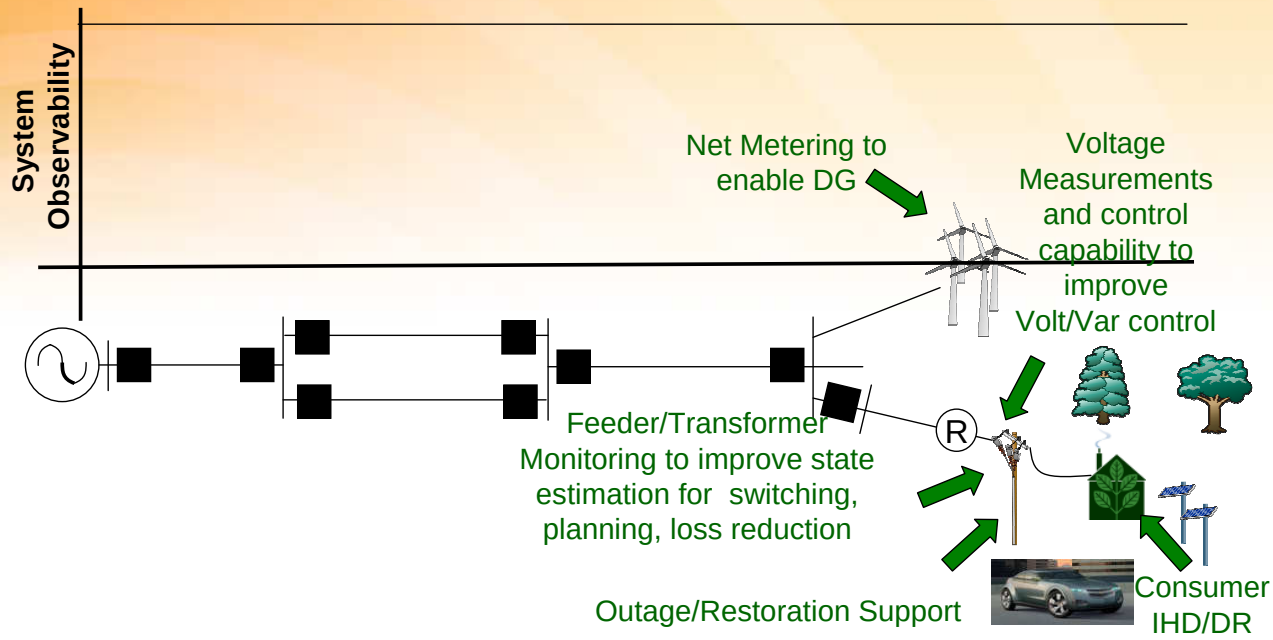
(Gartner Technology Consulting, 2009)



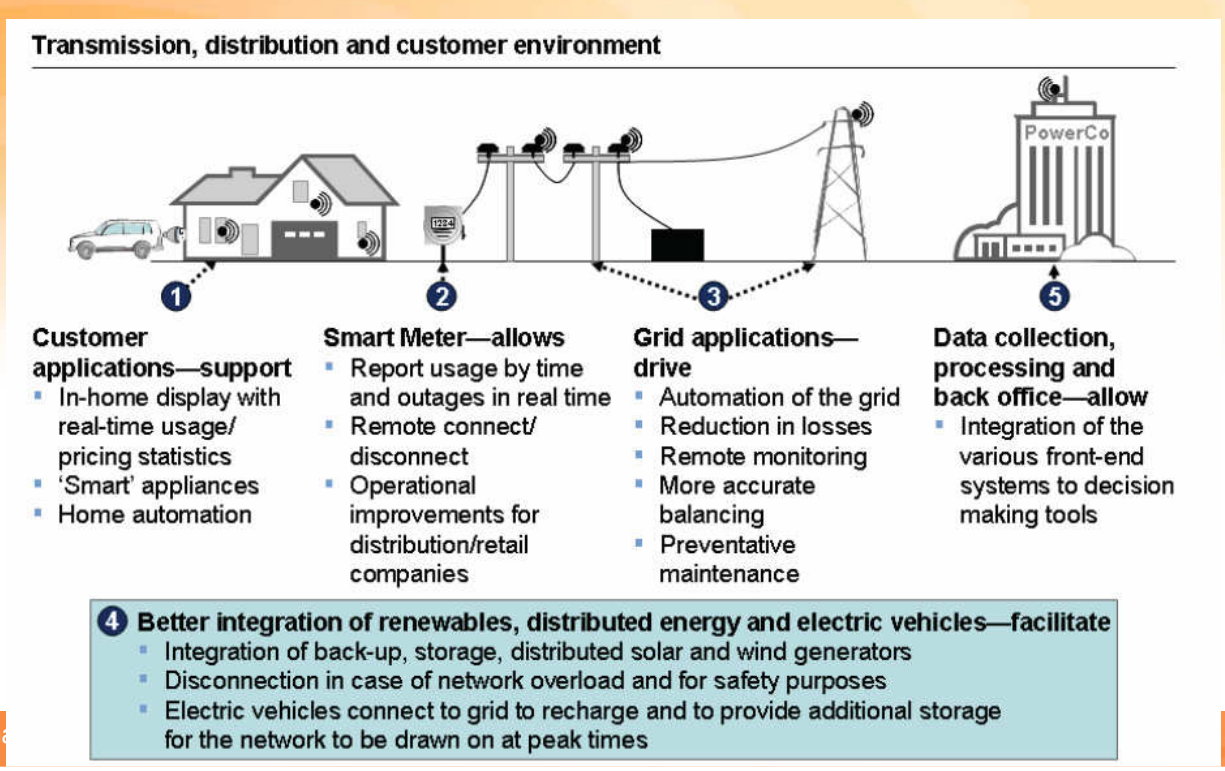
- Technology Trigger: A potential technology breakthrough kicks things off. Early proof-of-concept stories and media interest trigger significant publicity. Often no usable products exist and commercial viability is unproven.
- Peak of Inflated Expectations: Early publicity produces a number of success 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'

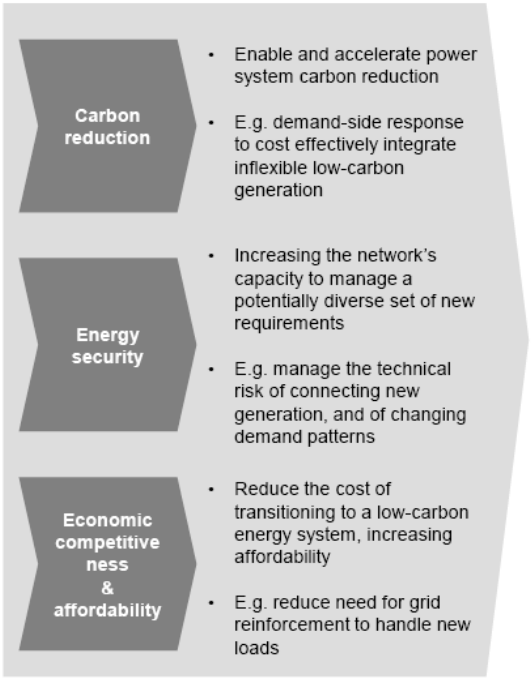
- Possible network led perspectives
  (IEEE, *Smart Grid Overview*, 2009)



- 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."

CEEM perspective on Smart Grids

- A wide range of claimed opportunities, many representing modest extensions to current industry arrangements
- **Our view**, the key objective for the "smart grid" concept is:
  - 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 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's complex yet promising characteristics

- Distributed Energy Resources
  - Small-scale renewables, efficient fossi-fuel generation, storage and 'smart' loads
- have complex technical issues
  - Diverse technical characteristics – eg. intermittent renewable energy flows
  - Small unit scale yet large numbers could aggregate to significant resources
  - Location in the distribution system
- and 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*
- but also, fortunately, some 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?*

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

- DE and enabling 'smart grids' pose significant challenges for existing industry knowledge and capabilities, and institutional frameworks

The Art of Knowing and Doing

The study of technology concerns *what* things are made and *how* things are made. Technology, from the Greek *science of* (practical) *arts*, has both a *material* and an *immaterial* aspect.

Technology = Hardware + Software + "Orgware"

(IIASA, *What is technology?,* 2006)

Hardware

Software

Orgware

Hardware: Manufactured objects (artifacts)

Software: Knowledge required to design, manufacture, and use technology hardware

"Orgware": Institutional settings and rules for the generation of technological knowledge and for the use of technologies

Hardware often arrives before software and orgware

Garrett under fire over dodgy solar installations

By Samantha Hawley for AM

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 Department of Environment is looking into whether an audit is needed.

Up to 2,000 homes could be at risk of electrical fires from poorly installed roof-top solar panels (ABC News, file photo)

VIDEO: Dodgy solar panels spark fire concerns (Lateline)

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

RELATED STORY: Industry rejects substandard insulation claims

RELATED STORY: Garrett phones mum after son's insulation death

Relevant current + proposed CEEM work within context of decision-making regimes for NEM *(Outhred, 2008)*

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

- CEEM / ICCLP / IES *Facilitating major RE deployment* (Betz, MacGill, Leary, Healy, Diesendorf, Twomey)
- CERPA / CEEM Collaboration with Better Place on *EV integration* (MacGill, Betz, Twomey)
- CSIRO *Economics of Distributed Energy*, WA SEDO *Grid-connect PV*, IEA Task 14 *High PV penetrations in electricity grids* (Passey, MacGill, Watt, Outhred, Bruce, Spooner)
- Standards work for PV, grid connection (Spooner)

Some Australian experience with commercial DE opportunities CEEM (2009) *Economics of Distributed Energy*

- "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)"

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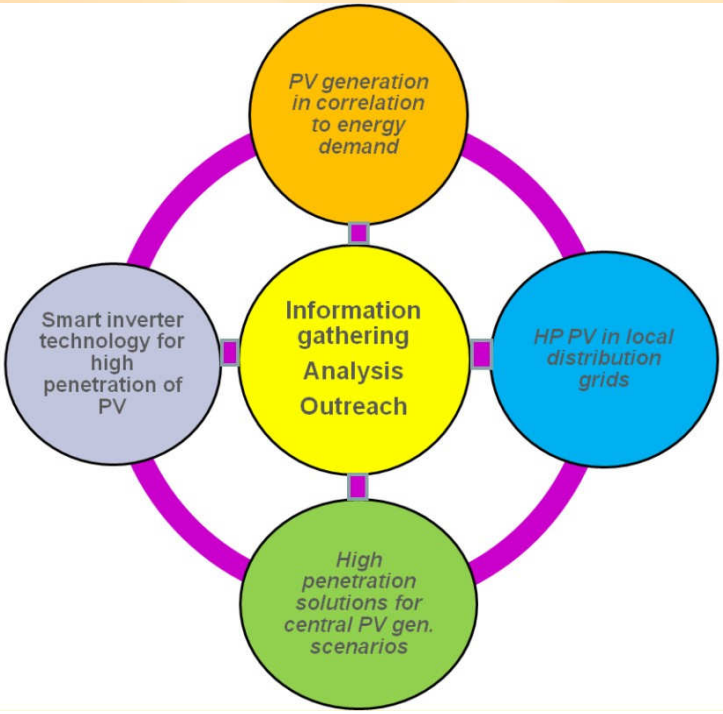
Study of Grid PV - Benefits, Opportunities, Barriers and Strategies (Passey, Watt, Outhred, Spooner and Snow, 2008)

- Aim to characterise PV's ability within WA (SWIS and remote) to:
  - Offset large-scale conventional generation
  - Provide capacity
  - Defer network augmentation
  - Reduce line losses
  - Offset small-scale conventional generation

Benefit	Approximate average value /W [a]		Approximate average value /kWh	
	North	West	North	West
Offsetting convent. gen.	$1.20	$1.20	7.8c	8.6c
Providing firm capacity [b]	$0.55	$0.75	3.5c	5.1c
Deferring network aug [c]	$0.12	$0.12	0.8c	0.8c
Reducing line losses	$0.22	$0.21	1.4c	1.6c
Total	$2.09	$2.28	13.5c	16.1c

IEA PVPS Task 14 – high penetrations of PV in electricity grids

- Running from 2010-14
- Current Australian involvement includes APVA, CEEM, Ergon Energy… *seeking additional partners*
- Five proposed subtasks



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Thank you… and *questions*

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

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