



The shock of the new

Potential implications of disruptive energy technologies for markets

Iain MacGill

Associate Professor, School of Electrical
Engineering and Telecommunications
Joint Director (Engineering), CEEM

Energy in WA Conference
Perth, Australia
August 2013

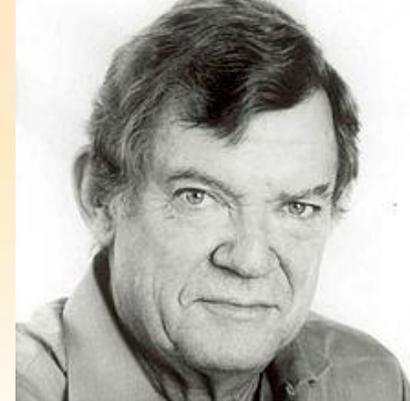
Another elephant in the room – Climate Change

- Currently a lack of domestic and international progress, apparent loss of public and political interest and will
- ... but even a dead elephant in the room is a problem



What is 'the shock of the new'

- ***The Shock of the New*** is a 1980 documentary TV series written & presented by Robert Hughes ... It addressed the development of modern art since the Impressionists (*wikipedia*)
-
- Also, a question of the potential impacts of disruptive technology innovation on incumbents, markets, policy making
- Shared insights
 - No facts about the future, only the past (and even these often disputed)
 - *Hence forward looking technology innovation exploration inherently an 'art' as well as a science*



Many forecasts to choose from

NATIONAL ELECTRICITY FORECASTING REPORT

For the National Electricity Market

2013

EXECUTIVE SUMMARY

Annual energy

Electricity demand across the National Electricity Market (NEM) in 2013–14 is forecast to be 2.4% lower than estimated under the medium economic growth scenario in the 2012 NEFR.

Continued increases in rooftop photovoltaic (PV) systems and energy efficiency savings from new building regulations have offset growth in residential, commercial and light industrial annual energy.

Lower-than-expected growth in most industrial sectors reflects the closure of the Kurri Kurri aluminium smelter in New South Wales, changes in operating levels of Victoria's Wonthaggi desalination plant, and the Olympic Dam mine expansion deferral in South Australia. A high Australian dollar in recent years also contributed to the dampening in annual energy growth.

Under the same medium economic growth scenario, the 10-year outlook (2013–14 to 2022–23) sees annual energy forecast to grow by 1.3%.

The main growth drivers over this period are the three large industrial liquefied natural gas (LNG) projects in Queensland, population growth in most NEM regions, and an easing in electricity price growth over the 10-year outlook period.

Maximum demand

Maximum demand (MD) forecasts see a combined 728 MW reduction across the NEM for 2013–14 under the medium economic growth scenario in the 2012 NEFR.

This is due to a rise in solar PV installations; increased energy efficiency projections as a result of building standards; and changes in industrial operations, including a revised timing of LNG and new mining projects, reduced operation at Wonthaggi desalination plant and the indefinite deferral of the Olympic Dam mine expansion.

The real executive summary of every technology forecast is the same



NATIONAL ELECTRICITY FORECASTING REPORT

Important Notice

This document is subject to an important disclaimer that limits or excludes AEMO's liability for reliance on the information in it.

Please read the full disclaimer on page D1 before you read the rest of this document.

The 2013 National Energy Forecasting Report has been prepared by the Australian Energy Market Operator Limited (AEMO) in connection with its national transmission planning and operational functions for the National Electricity Market. The report is based on information available as at 3 April, 2013, unless otherwise specified.

Disclaimer

This report contains data provided by or collected from third parties, and conclusions, opinions, assumptions or forecasts that are based on that data.

AEMO has made every effort to ensure the quality of this report but cannot guarantee that the information, forecasts and assumptions in it are accurate, complete or appropriate for your circumstances. This report does not include all of the information that an investor, participant or potential participant in the National Electricity Market might require, and does not amount to a recommendation of any investment.

Anyone proposing to use the information in this report should independently verify and check its accuracy, completeness and suitability for purpose, and obtain independent and specific advice from appropriate experts.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees, consultants and other contributors to this report:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this report; and
- are not liable (whether by reason of negligence or otherwise) for any statements, opinions, information or other matters contained in or derived from this publication, or any omissions from it, or in respect of a person's use of the information in this report.

Promising but still emerging energy technologies

- Don't always emerge
- Can emerge into a changed, no-longer appropriate context
- Can discover that the competition has left them behind
 - “A future technology whose time has passed”
- May be trying to enter a relatively low innovation context
- May actually be re-emerging
- May come from a surprising place, new players
- May not even be thought of as an energy technology
- May not actually add net societal value
- Might not emerge from ‘standard’ market competition
- May need government facilitation
- May well need government protection from incumbents

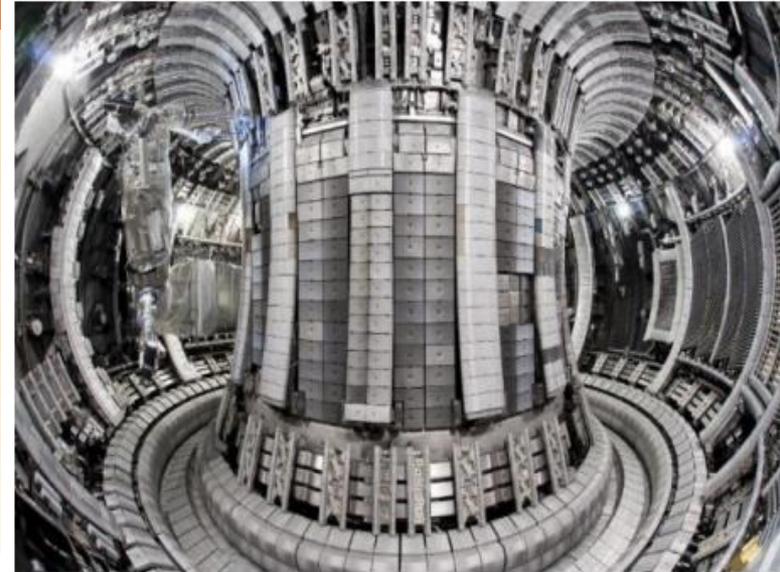


Fusion

- “50 years away for 50 years”
- Progress not always an issue of \$
- ITER – expected completion 2020 \$20b, targeting 500MW for 1000s in 2027.. *& if it does work, so what?*

Clean, limitless fusion power could arrive sooner than expected

By Sebastian Anthony on October 8, 2012 at 1:45 pm | 95 Comments

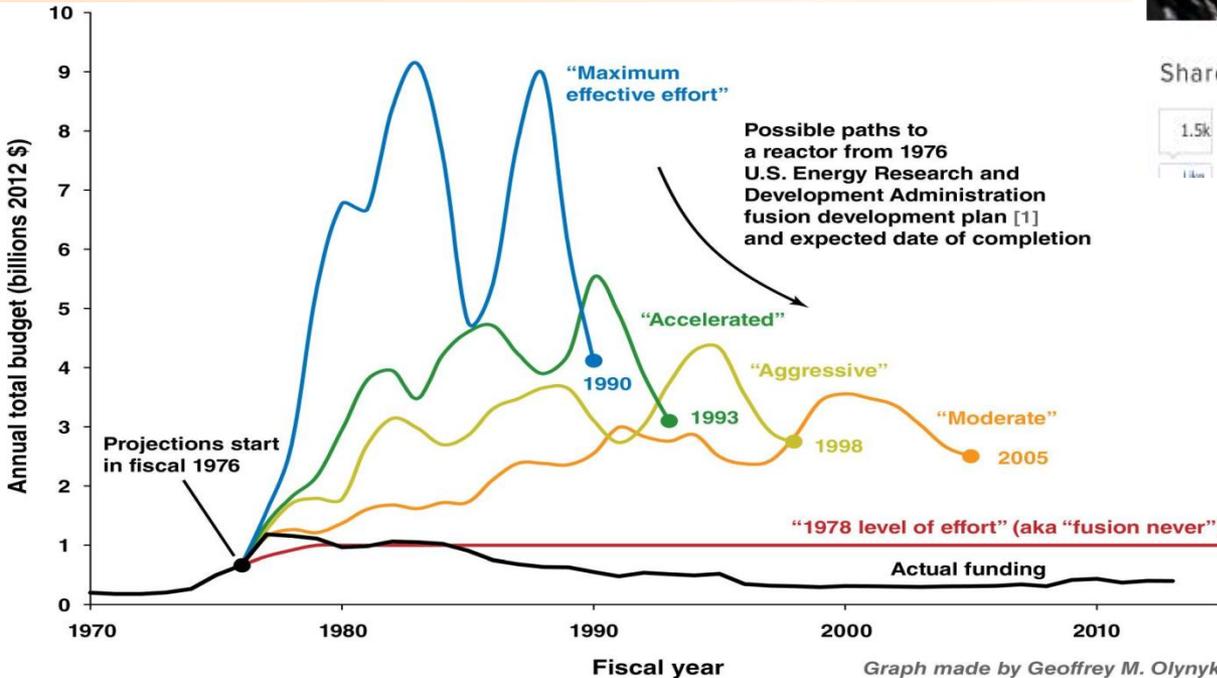


Good news, denizens of Earth: If the findings from two premier research labs are to be believed, commercial nuclear fusion is feasible — and could arrive sooner than expected.

Share This Article

1.5k 295 227 8

Like Tweet Share



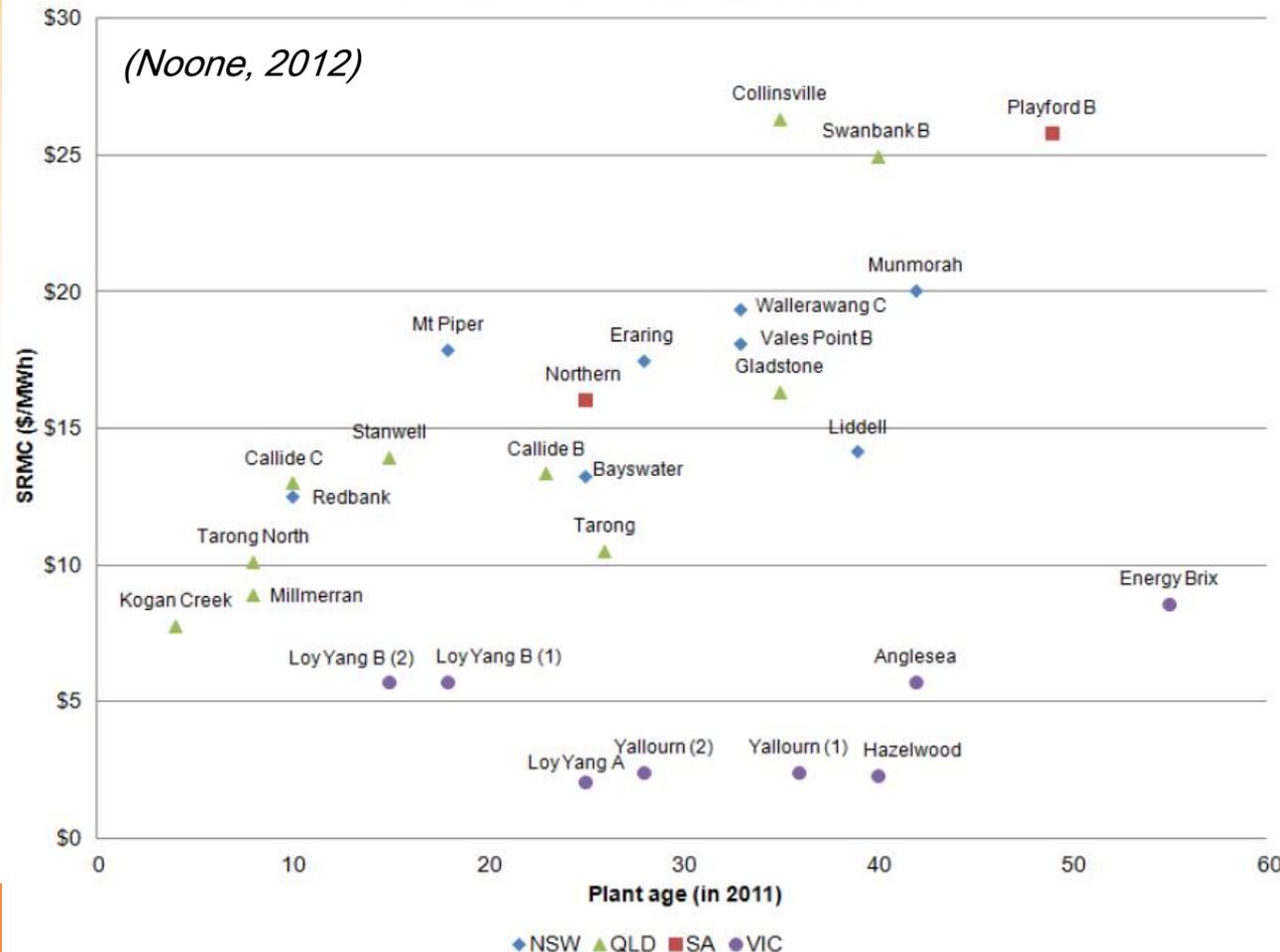
[1] U.S. Energy Research and Development Administration, 1976. “Fusion power by magnetic confinement: Program plan” ERDA report ERDA-76/110. Also published as S.O. Dean (1998), *J. Fus. Energy* 17(4), 263–287, doi:10.1023/A:1021815909065

NEM generation – old often cheap

- ‘Steam punk’ alive and well in the electricity industry – one of the few industries where 50 yr old technology still competitive

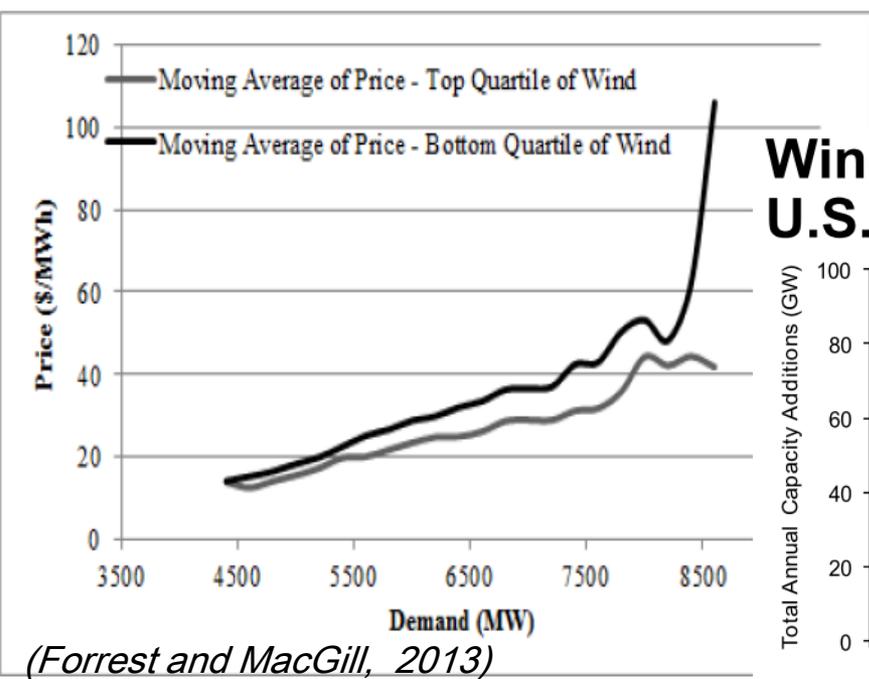
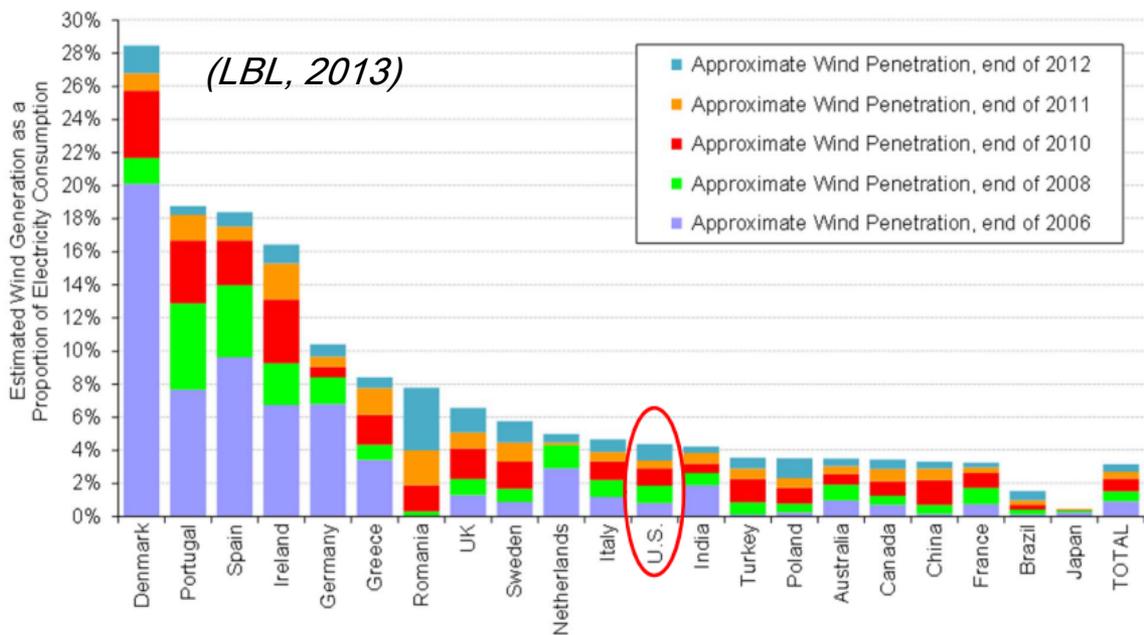


Plant age versus SRMC for coal plants

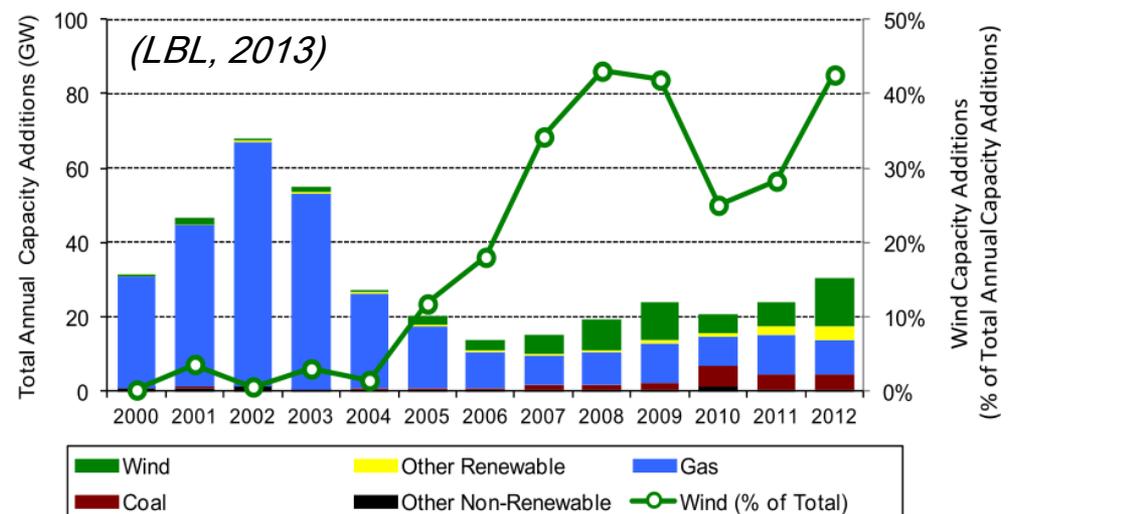




Wind surprising growing penetrations, major investments and now proving to be a wholesale market game changer lowering prices



Wind Power Was the Largest Source of U.S. Generating Capacity Additions in 2012





Nothing so new or even smart about smart grid

JOURNAL

OF THE

SOCIETY OF

Telegraph-Engineers and Electricians.

Founded 1871. Incorporated 1883.

Vol. XVII.

1888.

No. 73. ^

The One Hundred and Seventy-seventh Ordinary General Meeting of the Society was held at the Institution of Civil Engineers, 25, Great George Street, Westminster, on Thursday, April 12th, 1888—Mr. EDWARD GRAVES, President, in the Chair.

The minutes of the previous meeting were read and approved.

The names of new candidates were announced and ordered to be suspended.

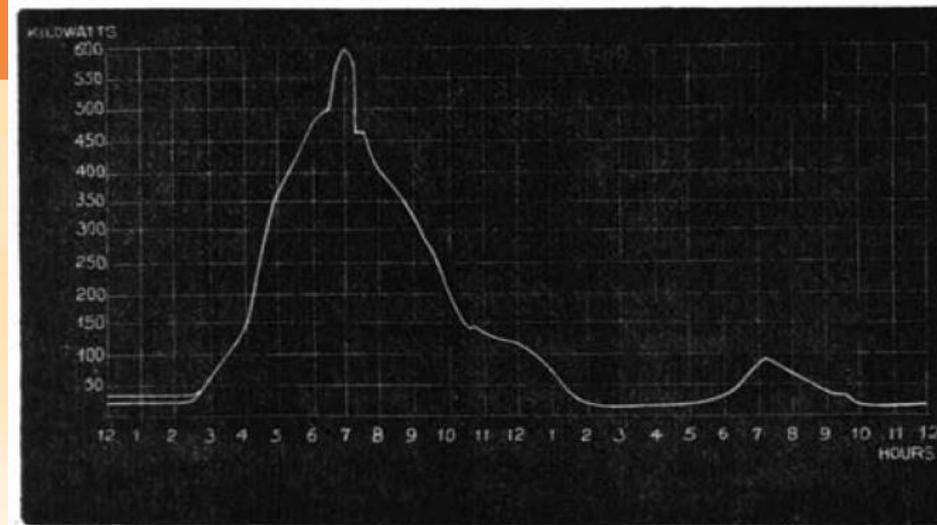
Donations to the Library were announced as having been received since the last meeting from Messrs. J. B. Bailliére et Fils; Messrs. De La Rue & Co.; C. H. W. Biggs, Member; and R. H. Krause, Member; to whom the thanks of the meeting were heartily accorded.

The following paper was then read:—

CENTRAL STATION LIGHTING: TRANSFORMERS V. ACCUMULATORS.

By R. E. CROMPTON, Member.

The present paper is the outcome of the discussion which took place on Messrs. Kapp's and Mackenzie's papers on transformers, recently read before this Society. I was asked to give facts and figures in support of the statement I then made, that I believed the distribution of electricity by transformers offered no special advantages over other methods, particularly over distribution by means of accumulators used as transformers.



COST OF 10,000 LIGHT, OR 600-KILOWATT, PLANT.

A.T.—ALTERNATING TRANSFORMER DISTRIBUTION.		B.T.—ACCUMULATOR TRANSFORMER DISTRIBUTION.	
Generating Station, Buildings, Chimney Shaft, Water Tanks, and General Fittings	£ 11,000	Generating Station, Buildings, Chimney Stack, Water Tanks, and General Fittings	£ 8,000
Dynamos and Exciters—865 Kilowatts, including spare sets, divided as convenient ...	5,540	Dynamos—600 Kilowatts, in 6 sets of 100 Kilowatts each...	4,800
Motive Power, i.e., Engines, Boilers, Steam and Feed Connections, Belts, &c., at £8 12s. per I.H.P.	12,470	Motive Power, i.e., Engines, Boilers, Steam and Feed Connections, &c., at £8 12s. per I.H.P.	8,600
500 Transformers, i.e., one to every pair of houses, at £15 each	7,500	4 Groups of Accumulators, in all 240 cells, in series, at £40 per cell, including Stands ...	9,600
2,000 yards Primary or Charging Main, exterior to area of supply, at £308 per 100 yards	6,160	2,000 yards Charging Main, at £306 17s. 6d. per 100 yards (see Table 2)	6,137
20,000 yards Distributing Main, 50 m/m. sectional area, at £91 7s. (see Table 1)	14,270	20,000 yards Distributing Main, 161.25 m/m. sectional area, at £100 12s. 6d. (see Table 2) ...	20,125
Regulating Gear	500	Regulating Gear	2,500
	<u>£57,440</u>		<u>£59,762</u>

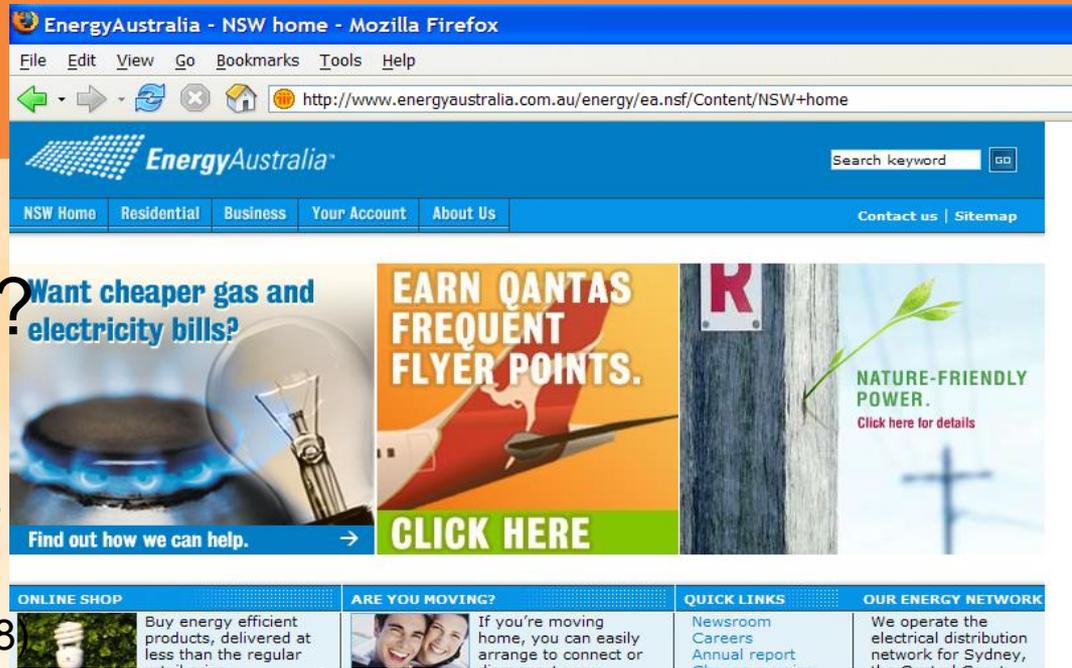


Innovation through competition: retail mkts?

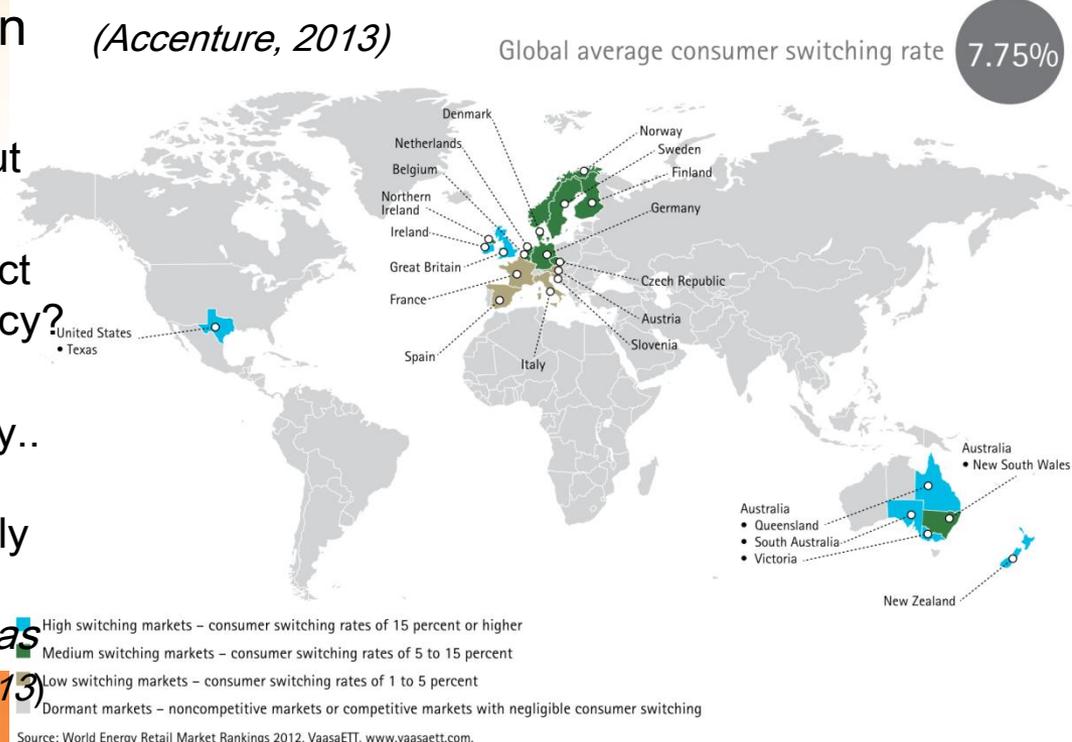
- Little focus on energy services
 - “... an important reason there is effective competition in Victoria is .. because the provision of energy is viewed as a homogenous, low engagement service” (AEMC, 2008)

■ Current measures of competition might miss key issues

- Yes, NEM high switching rates – but real customer choice or just churn?
- Yes, NEM price spreads – but reflect competition, stickiness, or govt policy?
- “The thing about the energy retail market is it’s effectively an oligopoly.. There are a small number of large players—three—who are effectively providing a commodity.” *Jim Myatt, founder of Australian Power and Gas on its sale to AGL (crikey.com.au, 2013)*



(Accenture, 2013)





Retail markets: real competition

- DG - PV, cogen/trigen
- Energy efficiency and demand-side participation
- Others coming...

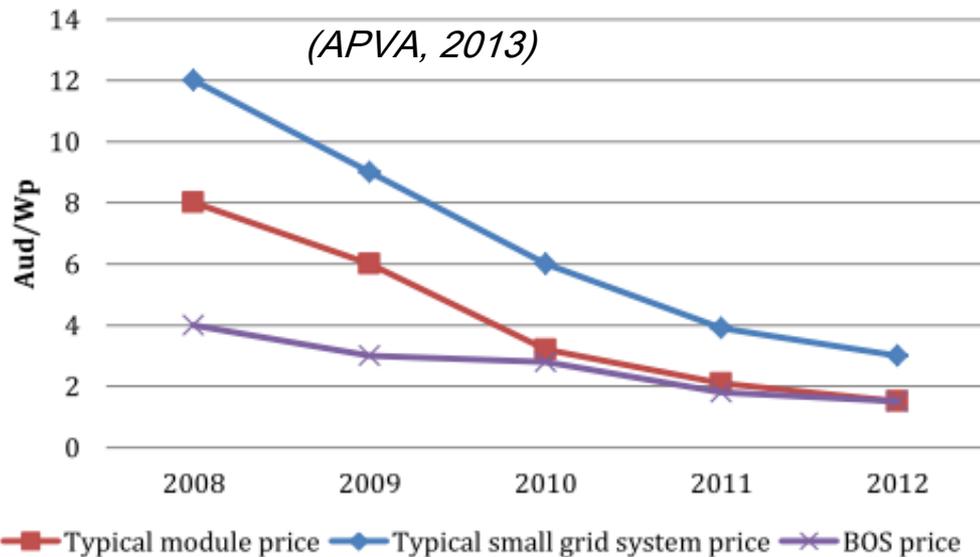


Figure 2: Typical module, system and balance of system costs Australia 2008-2012

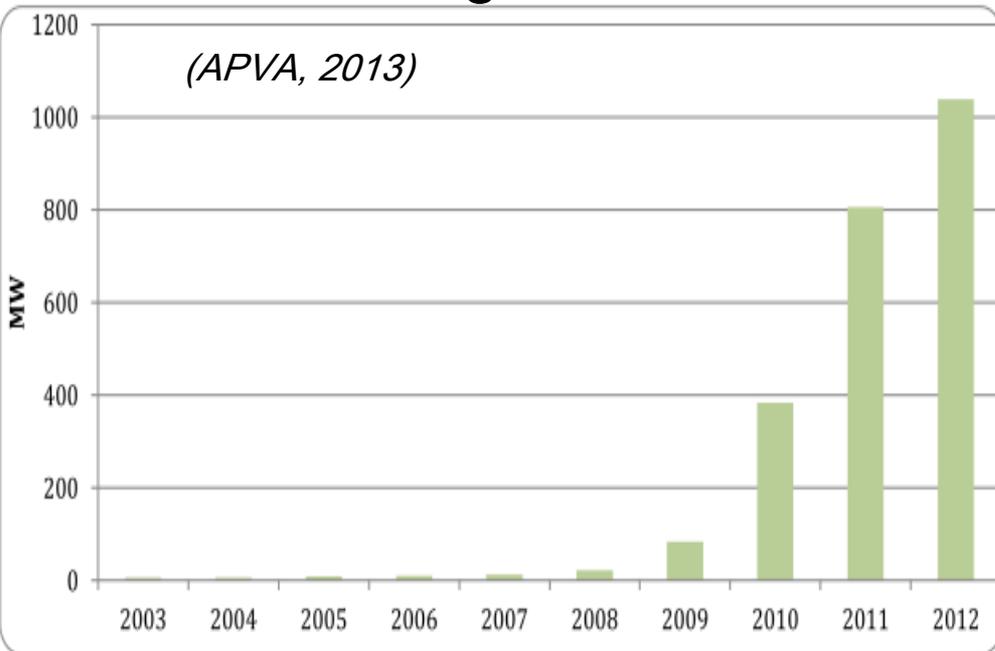
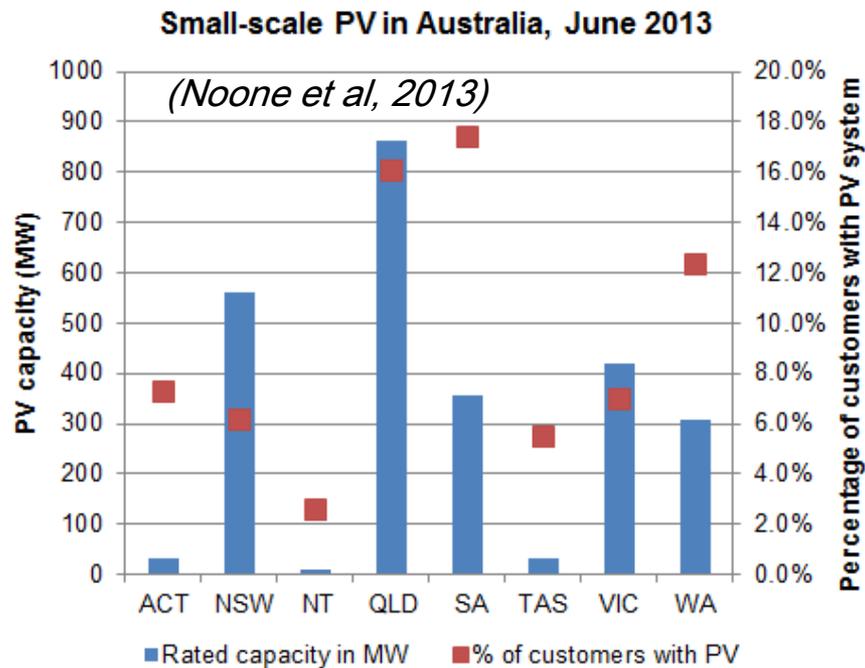


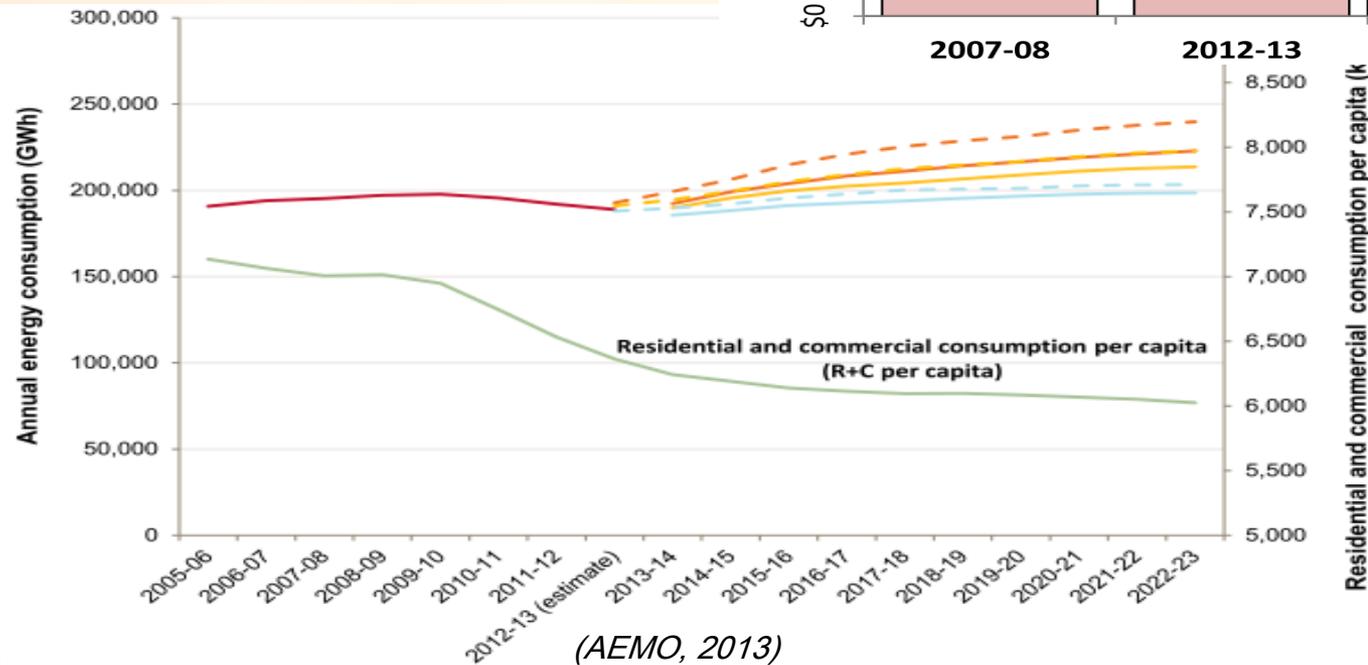
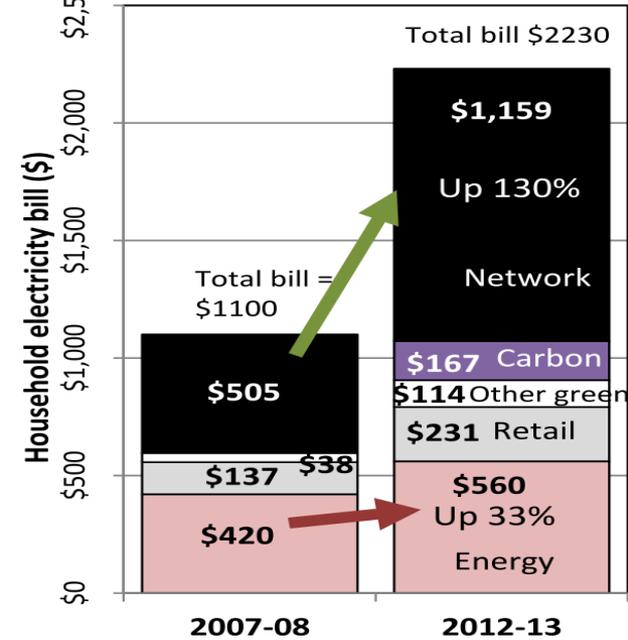
Figure 1: Annual PV installations, Australia 2003-2012





A disruptive energy technology - the heat pump

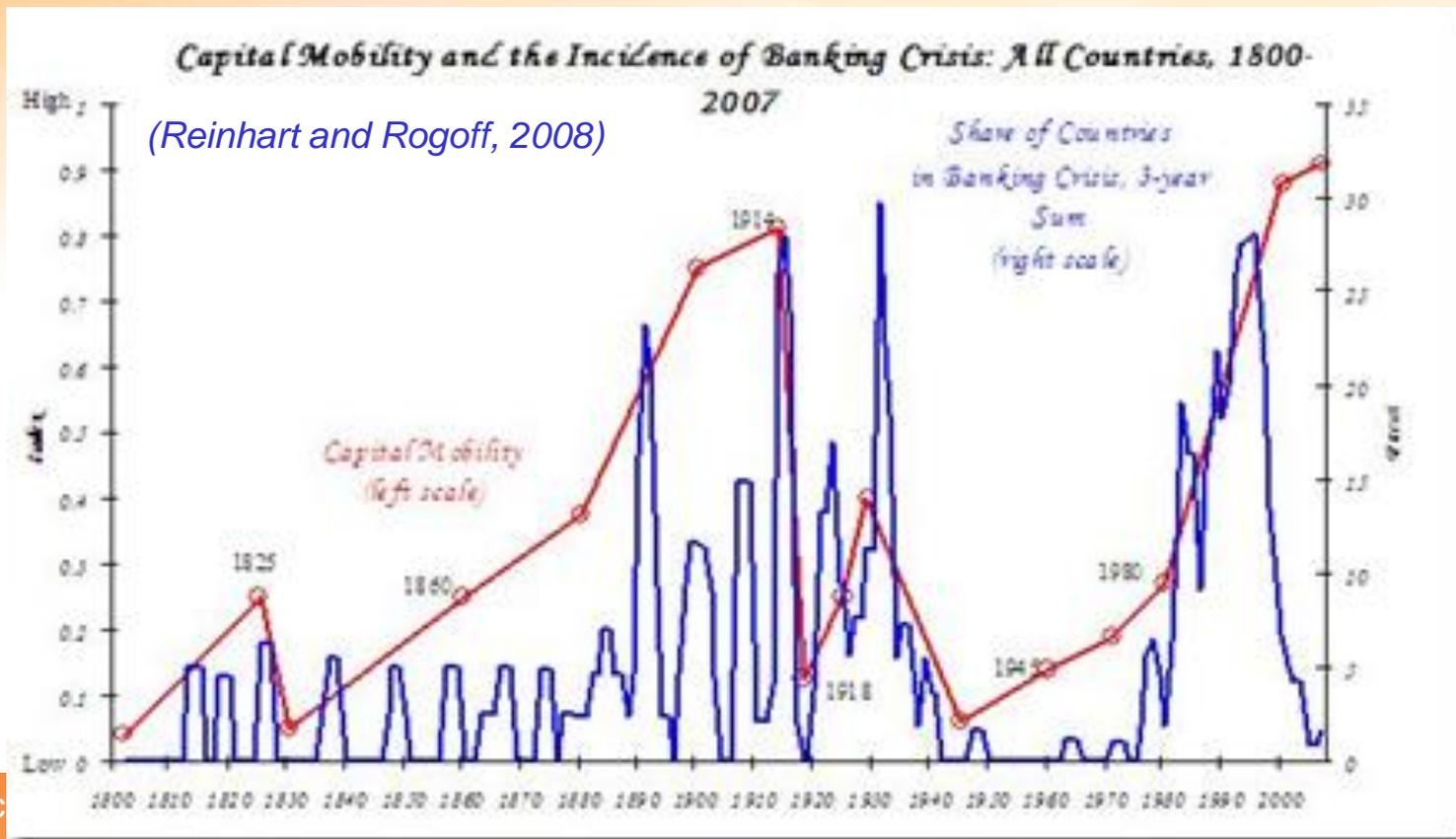
- Driving peaks (air-conditioning) and hence network expenditure
- Reducing energy consumption (200-400% efficient hot water systems)



— 2013 High — 2013 Medium — 2013 Low — Actuals
- - - 2012 High - - - 2012 Medium - - - 2012 Low — R+C per capita

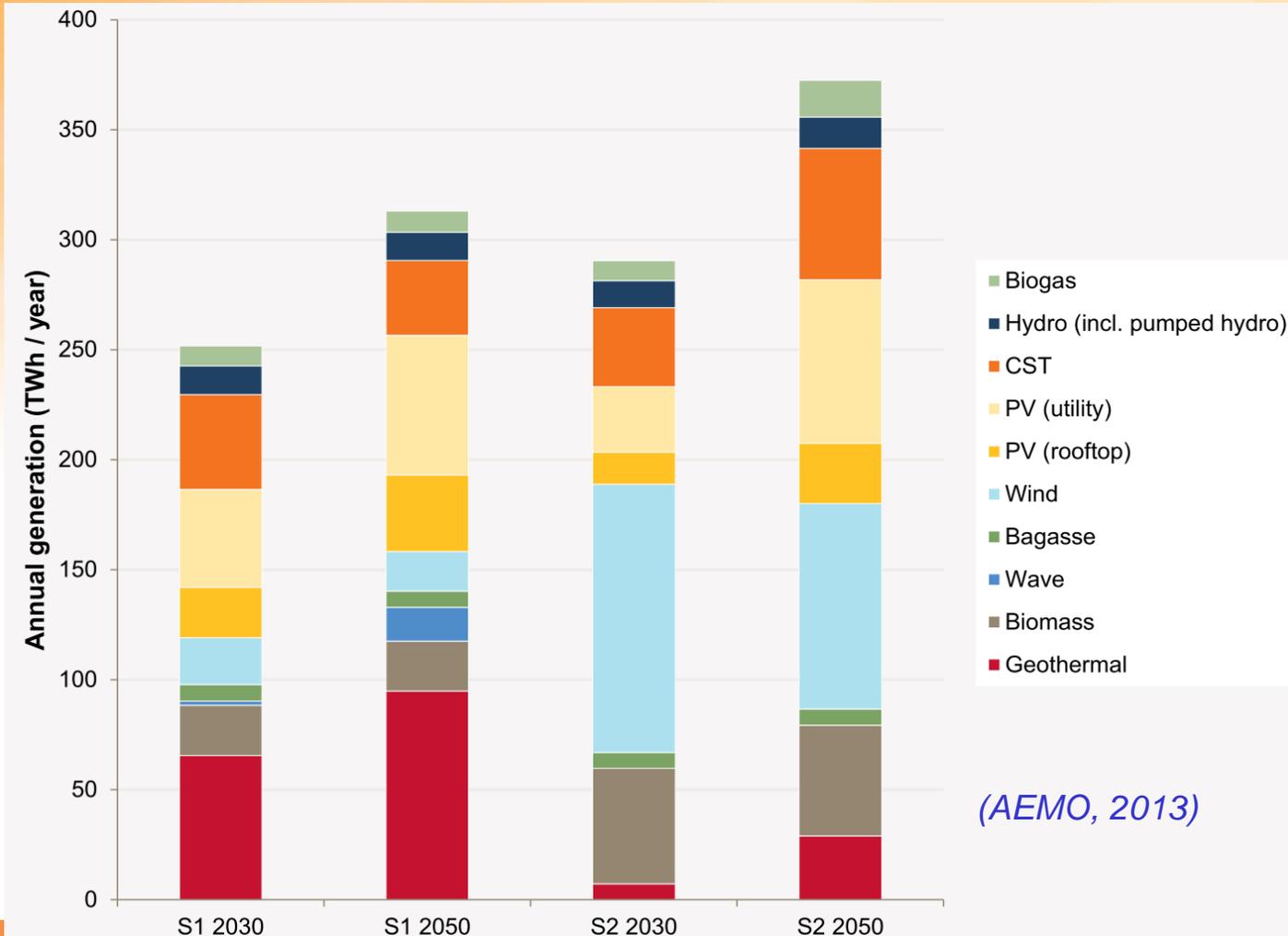
Is innovation always socially useful

- *Q: Is 'reform' always a good thing? A: Yes, by definition*
- Certainly possible to have socially –value energy 'innovation' as seen with socially damaging financial 'innovation' in GFC

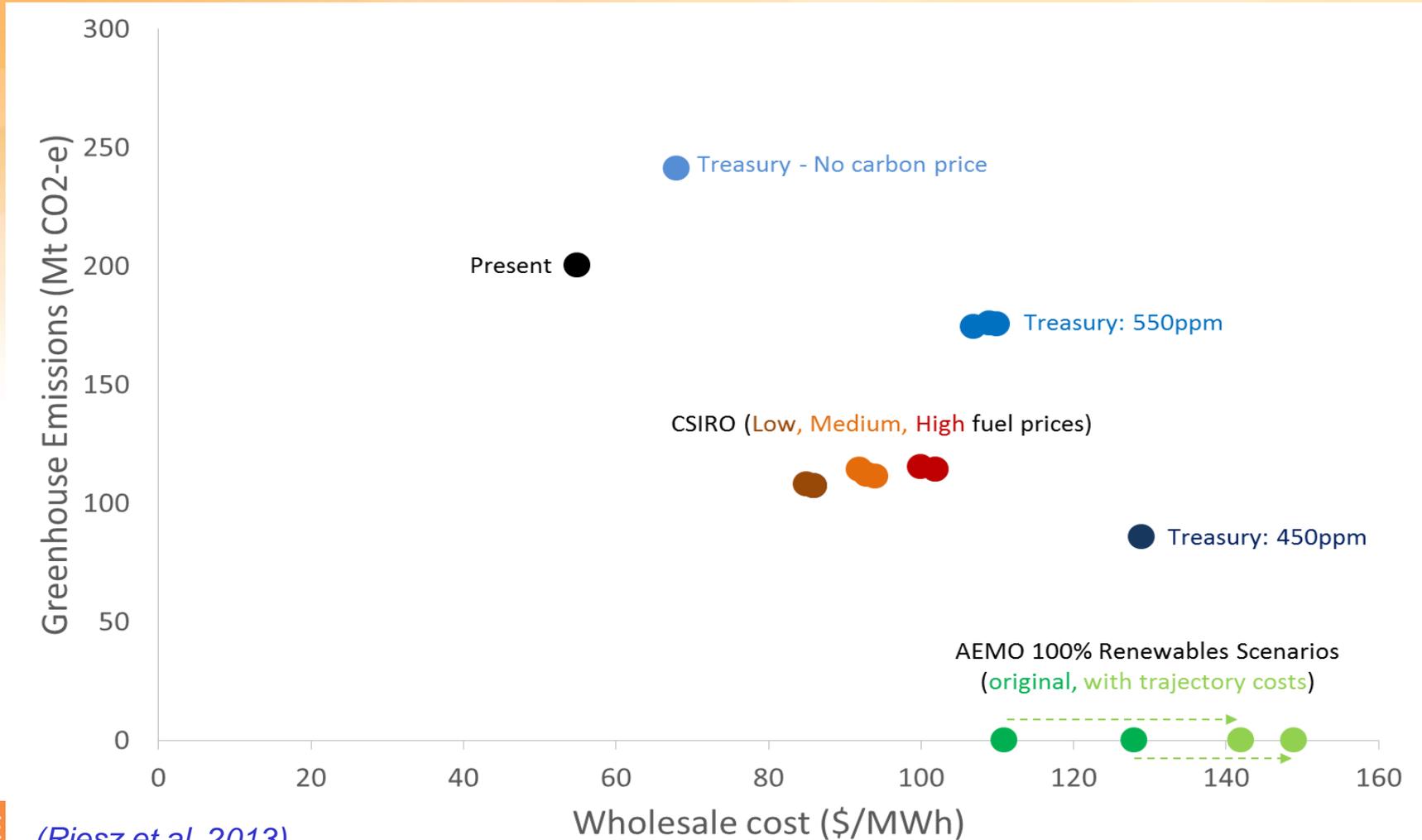


Some changing future perspectives

AEMO 100% RE – least cost generation mix



Major climate targets and high cost gas – what future for gas and CCS ??



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, 2001)



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

Key roles for governments

- Protection of the public interest
- Facilitation of socially useful technologies

- ... and protection of these socially valuable technologies from incumbents, perhaps even from some governments
 - arrangements that are technology and participant neutral
 - support dynamic efficiency – efficiency towards transformational change



Some recent developments

Power supply shake-up

Daniel Mercer, The West Australian, July 15, 2013

Hundreds of thousands of WA households could be hit with higher electricity prices under a proposed shake-up of bills by the popularity of rooftop solar panels.

Hundreds of thousands of WA households could be hit with higher electricity prices under a proposed shake-up of bills aimed at recovering the massive cost to the system of rooftop solar panels.

WA's energy chiefs are understood to be pushing for a change in the way that customers pay more in fixed charges.

At present, most of a householder's electricity bill stems from the actual costs, such as the supply charge, make up about 15 per cent of the bill. For those households, cutting revenue to State-owned utilities including retailer Synergy and network operator Western Power.

The trend has been highlighted as one of the big issues facing the energy sector. Minister Mike Nahan has been warned that if nothing is done the cost of electricity for either households without solar panels would be left to pick up the tab, or electricity providers would be financially crippled.

WA's take-up rate of photovoltaic cells - initially fuelled by generous state and federal incentives - stands at more than 10 per cent of households and this figure is expected to double within years.

“The ESAA estimated the current total of PV ‘avoided’ costs at \$340 million, or around \$30 per household. To put this into context, this sum is – according to the ESAA’s own data – just one eleventh of the cross-subsidy paid by households with no air conditioning. The ESAA estimates these air con network costs at \$330 per household, and it is certainly not “hidden”, because it has been one of the key reasons why networks have been “supersizing” their grids over the last few years, at an aggregate cost of nearly \$40 billion.” (*RenewEconomy, 2013*)

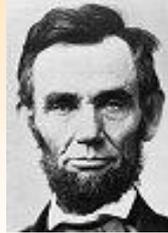
Do we want our electricity market to continue current cross subsidies for air-conditioning but target smaller cross-subsidies for clean and green PV?

Do we want predominantly fixed charge network tariffs that recover costs but don't send appropriate 'investment' price signals to end users?

Where next?

"The best way to predict your future is to create it!"

-- Abraham Lincoln





Centre for Energy and
Environmental Markets

UNSW
THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA

Thank you... and *questions*

Many of our publications are available at:

www.ceem.unsw.edu.au