



Centre for Energy and
Environmental Markets

UNSW
THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA



Opportunities and challenges facing network businesses in the Australian NEM: some CEEM research perspectives

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Visiting delegation seminar
UNSW, 16 June 2015

CEEM

- *A formal collaboration between **Faculties of Engineering, Business**, also Arts and Social Sciences, Science, Law*
- *through UNSW Centre aiming to provide Australian research leadership in interdisciplinary analysis + design of energy and env. markets, associated frameworks*
- *focussing in the areas of*
 - Energy markets within restructured electricity industries: including the successful integration of new energy technology options
.... and retail / distributed energy markets with appropriate network interface now key in this
 - Related environmental markets: black, green + White certificates
... less significant as clean energy competitiveness improves?
 - Wider regulatory, market, policy + social decision making frameworks
given complexity, uncertainties, community expectations for sector



AEMC perspective

*Retail, networks and
gas are the unfinished
business of electricity
Industry restructuring*

Market Reviews & Advice

In our reviews we take a long term view of what needs to be done to assure consumers of reliable, efficiently priced electricity and gas services.

STATUS	All	Open	Completed	REVIEWED BY	All	AEMC	Reliability Panel
SUMMARY	88 Market reviews		4 Accepting submissions		0 Recently updated		0 Accepting public hearing registrations
Title ▶	Date Initiated ▶	Stage ▶	Date Completed ▶	Submissions Close ▶	Reference ▶		
Review of the Victorian Declared Wholesale Gas Market	04-03-15	Initiation			GPR0002		
East Coast Wholesale Gas Market and Pipeline Frameworks Review	20-02-15	Consultation on Draft Report		29-05-15	GPR0003		
Implementation advice on the Shared Market Protocol	18-12-14	Preparation of Draft Report		12-02-15	EMO0029		
Template for Generator Compliance Programs Review 2015	13-11-14	Publication of Draft Report		07-05-15	REL0054		
2015 Retail Competition Review	31-10-14	Preparation of Draft Report		19-02-15	RPR0003		
Last Resort Planning Power - 2014 Review	01-07-14	Review completed	06-11-14		EPR0042		
2014 Residential Electricity Price Trends	10-03-14	Review completed	11-12-14		EPR0040		
Optional Firm Access, Design and Testing	06-03-14	Consultation on Draft Report		30-04-15	EPR0039		
Distribution Reliability Measures	30-01-14	Review completed	18-09-14		EPR0041		
2014 Retail Competition Review	17-01-14	Review completed	22-08-14		RPR0002		
Advice on linking the reliability standard and reliability settings with VCR	29-10-13	Review completed	20-12-13		EMO0026		
Annual Market Performance Review 2013	02-09-13	Review completed	07-05-14		REL0052		
Review of Electricity Customer Switching	07-08-13	Review completed	10-04-14		EPR0038		
Framework for open access and communication standards	25-07-13	Review completed	10-04-14		EMO0028		
Last Resort Planning Power - 2013 Review	15-05-13	Review completed	05-12-13		EPR0037		
Gas market scoping study	09-05-13	Review completed	27-09-13		GPR0001		
Reliability Standard and Settings Review 2014	09-05-13	Publication of Final Report	16-07-14		REL0051		
Advice on Best Practice Retail Price Regulation Methodology	09-05-13	Review completed	27-09-13		EMO0027		
Management of Negative Inter-regional Settlements Residues	18-04-13	Review completed	20-02-14		EPR0032		
Differences between actual and forecast demand in network regulation	14-02-13	Review completed	26-04-13		EPR0035		
Review of the national framework for distribution reliability	08-02-13	Review completed	27-09-13		EPR0033		
Review of the national framework for transmission reliability	08-02-13	Review completed	01-11-13		EPR0028		
2013 Residential Electricity Price Trends	19-12-12	Review completed	13-12-13		EPR0036		
Review of Competition in the Retail Electricity and	13-12-12	Review completed	31-10-13		RPR0001		

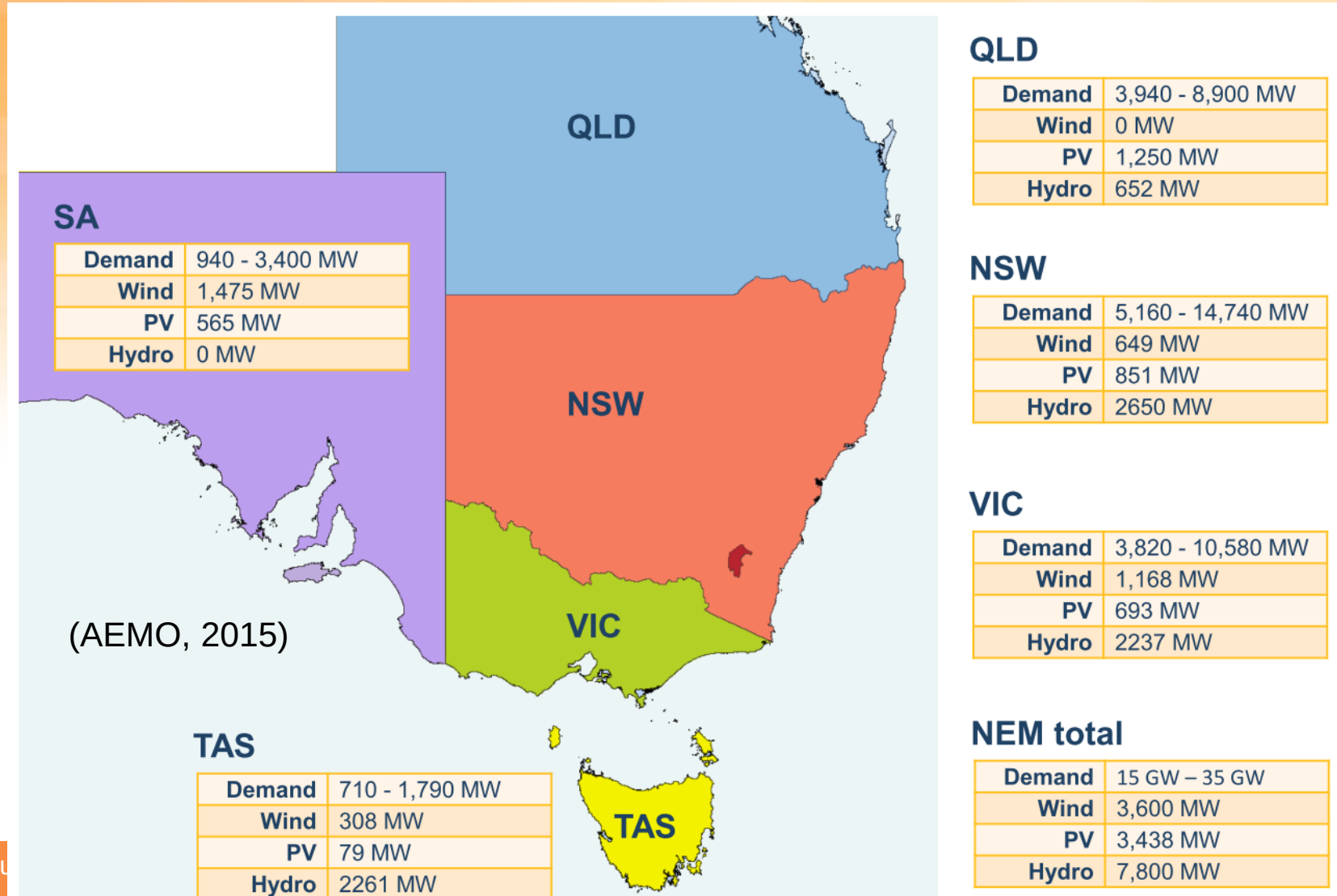
Federal Government Perspective: *Energy White Paper, 2015*

- The case for privatisation
 - *“evidence is that privately owned energy assets are more productive”*
 - But even if true, public not ‘on board’
- Retail competition
 - *“...development of market frameworks to encourage innovative products & services that give consumers more choice in managing bills & support greater competition” “Regulation should generally encourage competition & consumer choice, not stifle it”*
 - A challenge for incumbents
- Energy productivity
 - New and welcome, but requires greater coherence with market reform
 - *“Artificially low prices do not encourage gas users to use gas more efficiently or encourage innovation in use of alternative fuels/processes”*

Challenges and opportunities for Distributed Energy

- How well do electricity industry arrangements establish and allow DE to suitably receive
 - Energy and network values, and costs
 - Environmental values
- 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

Current renewables deployment



4,000,000

2015-03

Reported installed capacity (kW): 4,177,148

Estimated installed capacity (kW): 4,266,682

3,000,000

2,000,000

1,000,000

0

APVI

2002

2003

2004

2005

2006

2007

2008

2009

2010

2011

2012

2013

2014

2015

30%

APVI

SA

Estimated percentage of dwellings
with PV installations: 27.8%

22.5%

15%

7.5%

0%

SA

QLD

WA

NSW

VIC

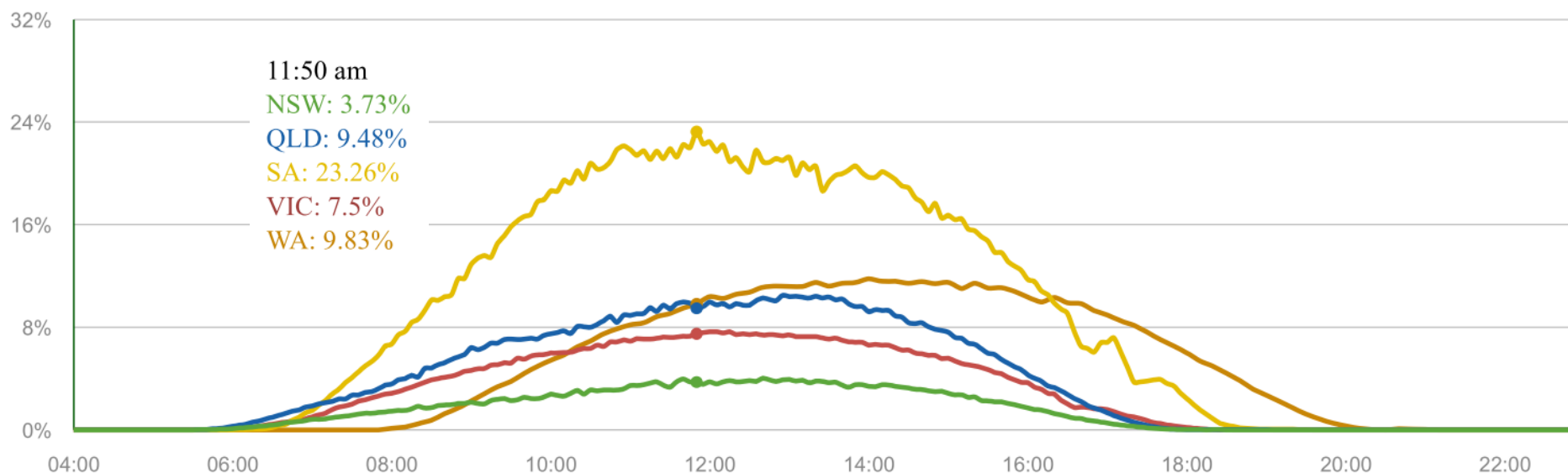
ACT

TAS

NT

Residential PV penetrations now having industry-wide impacts in some States

(eg. Estimate of PV contribution to electricity demand by State, 5 October 2014)

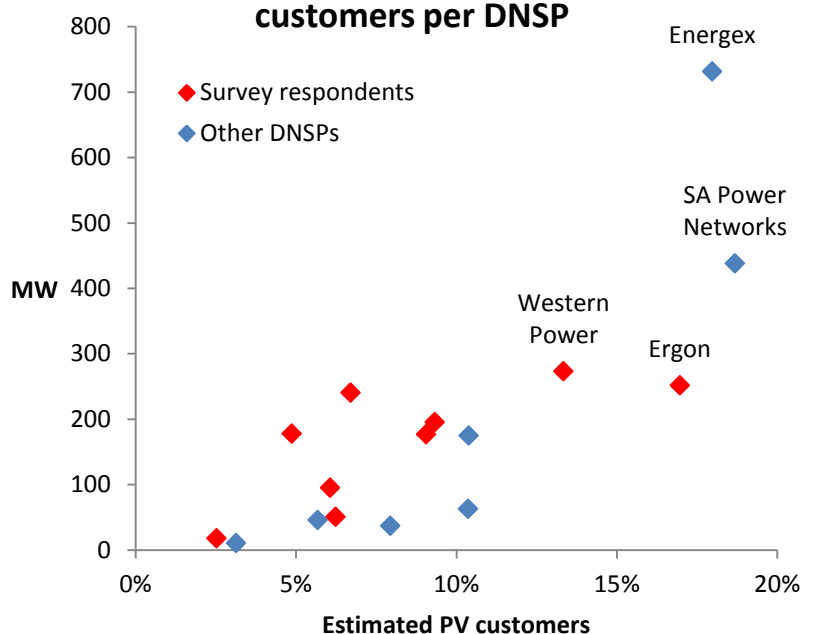


(APVI, *Solar map website*, 2014)

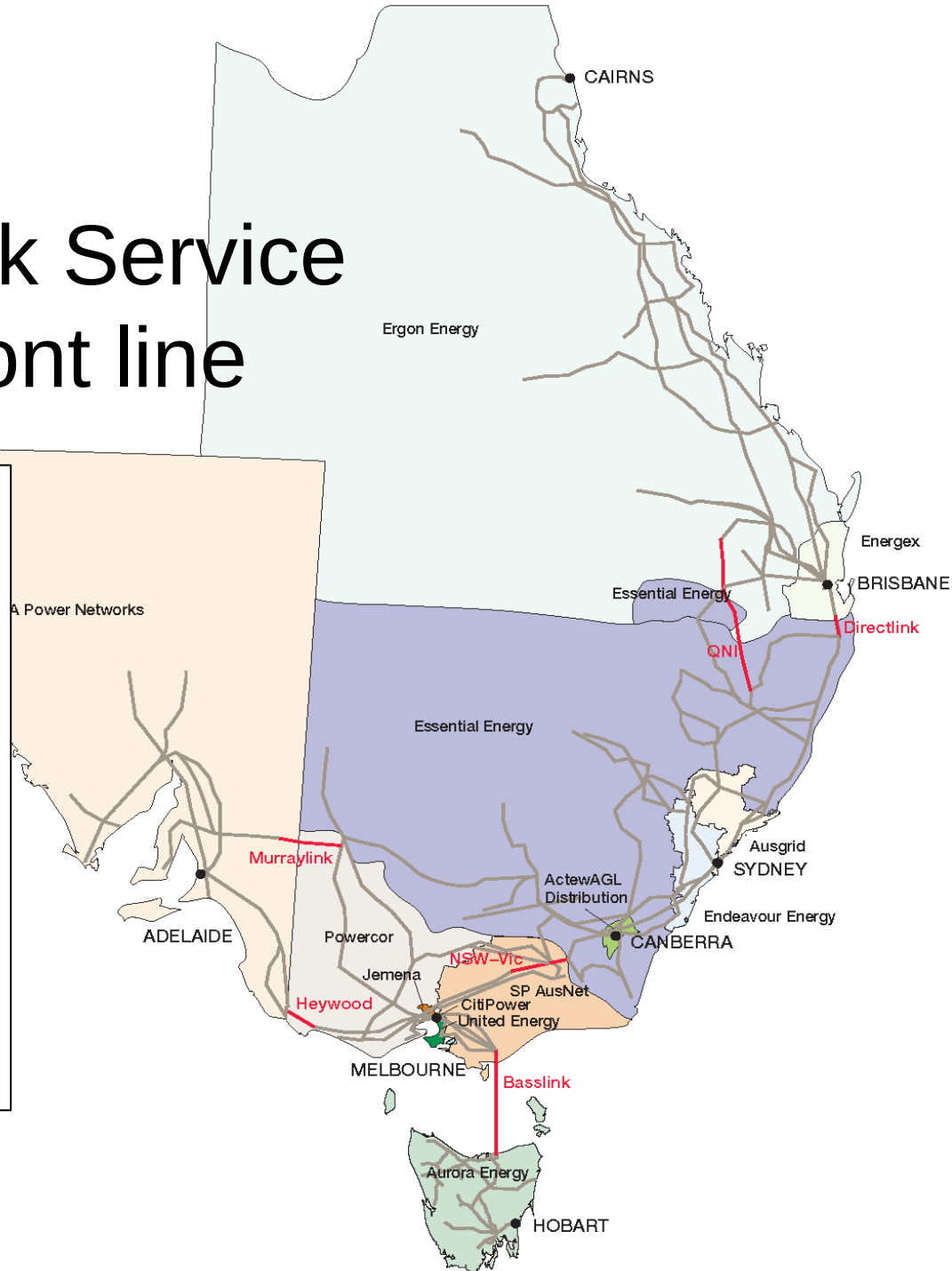


Distribution Network Service Providers on the front line

**Estimated PV capacity and % PV
customers per DNSP**

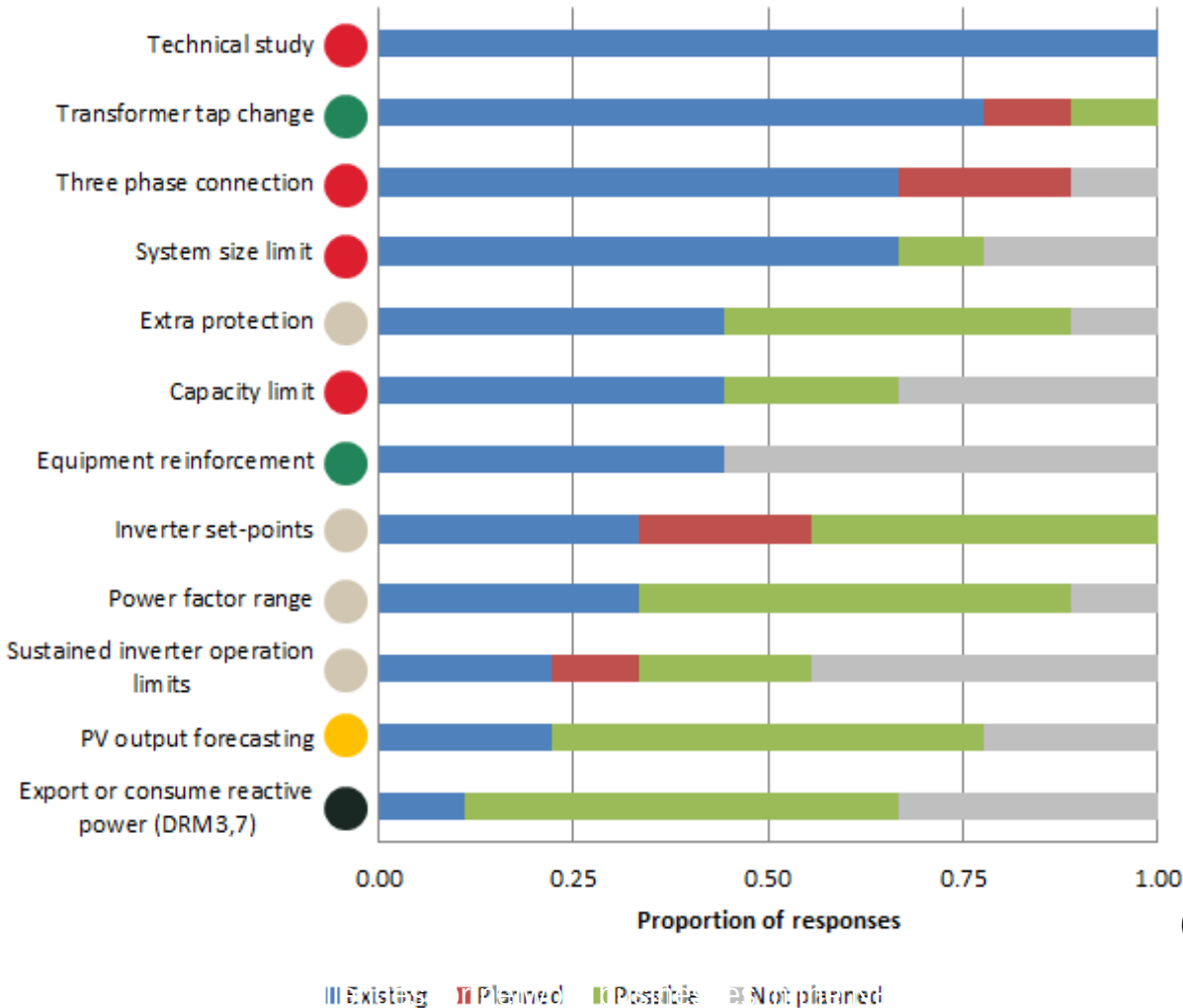


(Noone, APVI/CEEM report, 2014)



Management strategies – existing, possible

PV management strategies (top half)



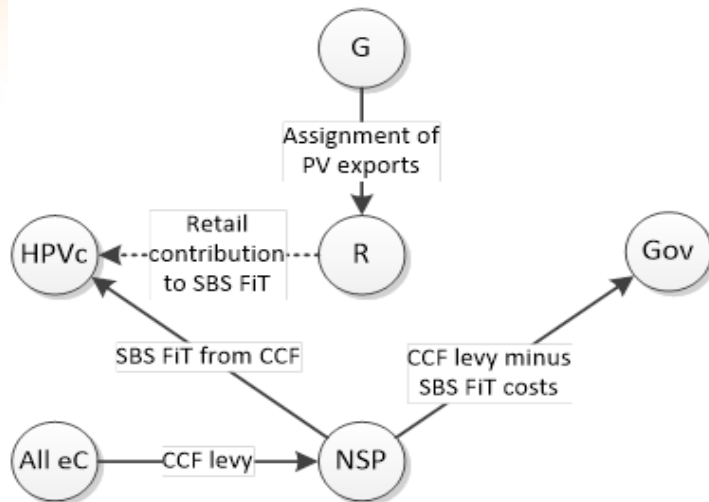
Category	Description
System operation	Activities that can be undertaken by the DNSP
PV operation	Requirements on how PV systems interact with the network
Demand response	Relating to the proposed AS4777 demand response functions or a price signal
Forecasting	Forecasting of PV system output
Storage	Energy storage by either the DNSP or the customer
Deployment regulations	Requirements pertaining to initial connection of the PV system
Generation	Applicable to mini-grid situations only

(Noone, APVI/CEEM report, 2014)

Residential PV now net-metered and definitely reducing network and retailer revenues

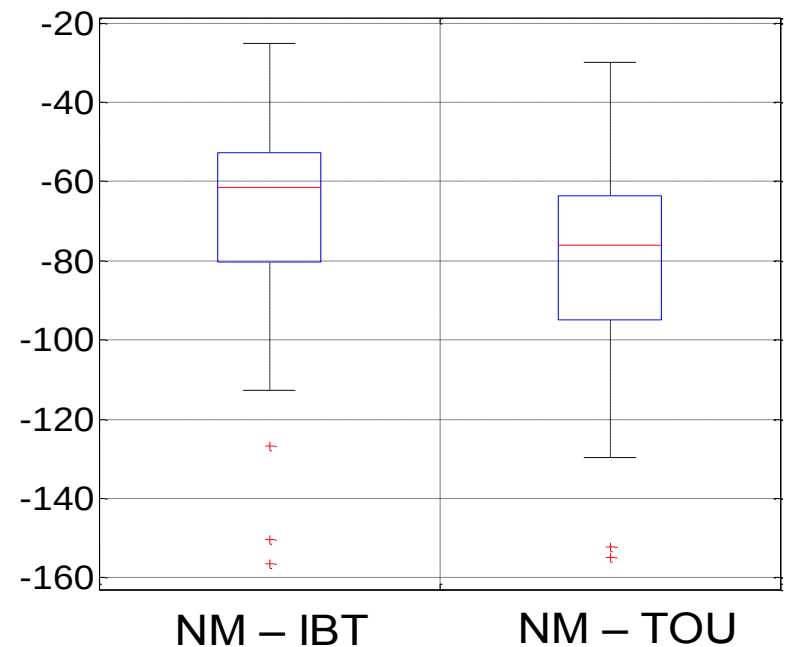
(Oliva, 2014)

Cash flows due to addition of PV under GM

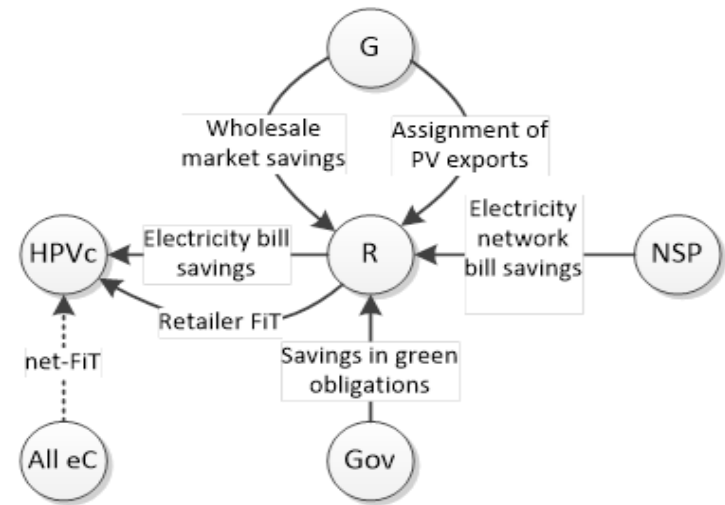


HPVc: Household PV customers
R: Electricity retailers
NSP: Network service providers

NSP revenue impacts in FY2013 [\$ /kW/year]



Cash flows due to addition of PV under NM



G: Generators
Gov: NSW government
All eC: All electricity customers

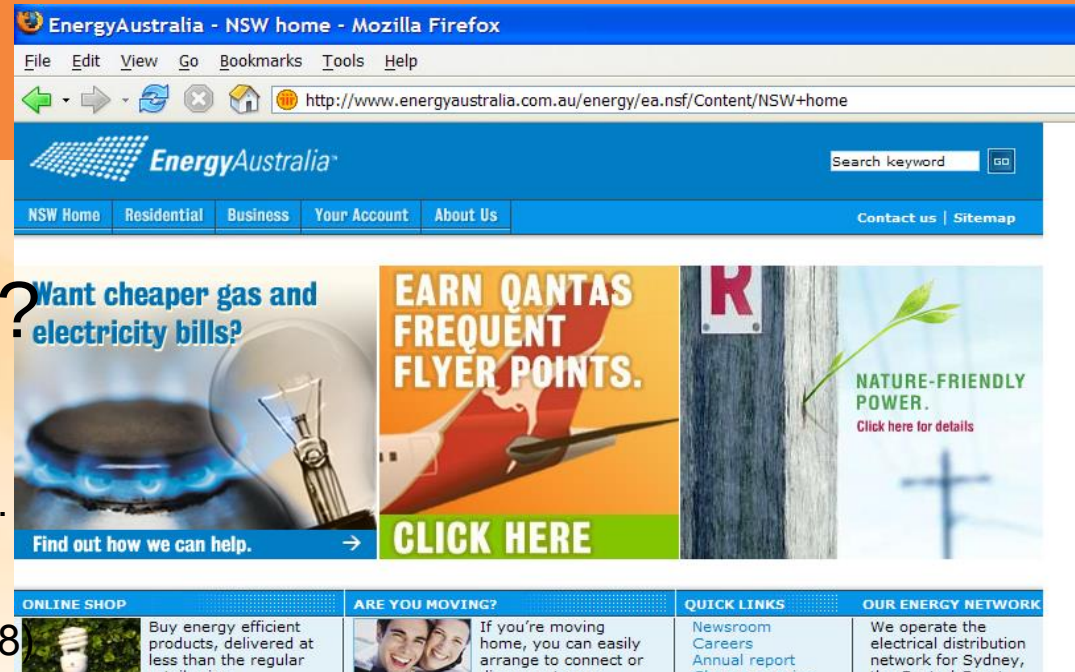


Innovation through competition: retail mkts?

- 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)

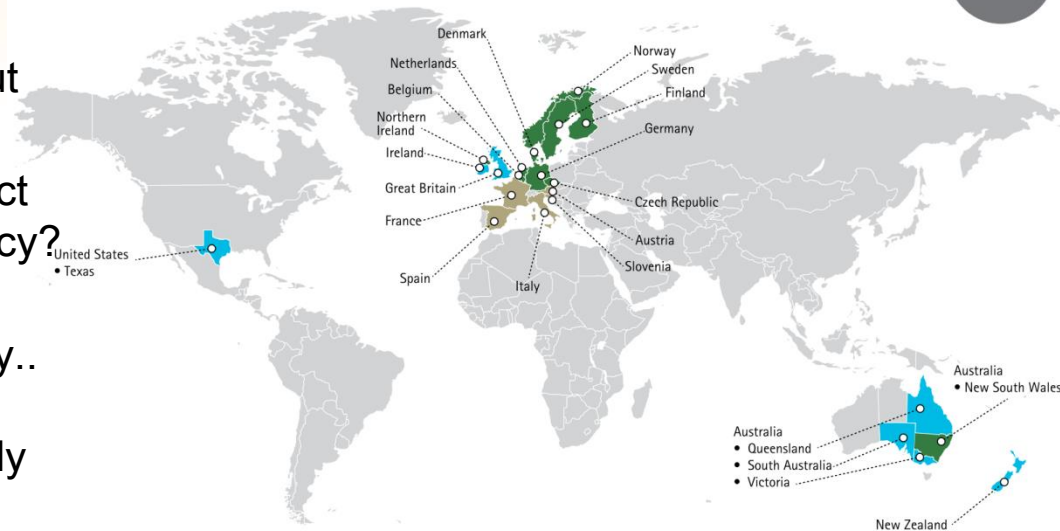
- Current measures of competition might miss key issues

- 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)

Global average consumer switching rate 7.75%



High switching markets – consumer switching rates of 15 percent or higher

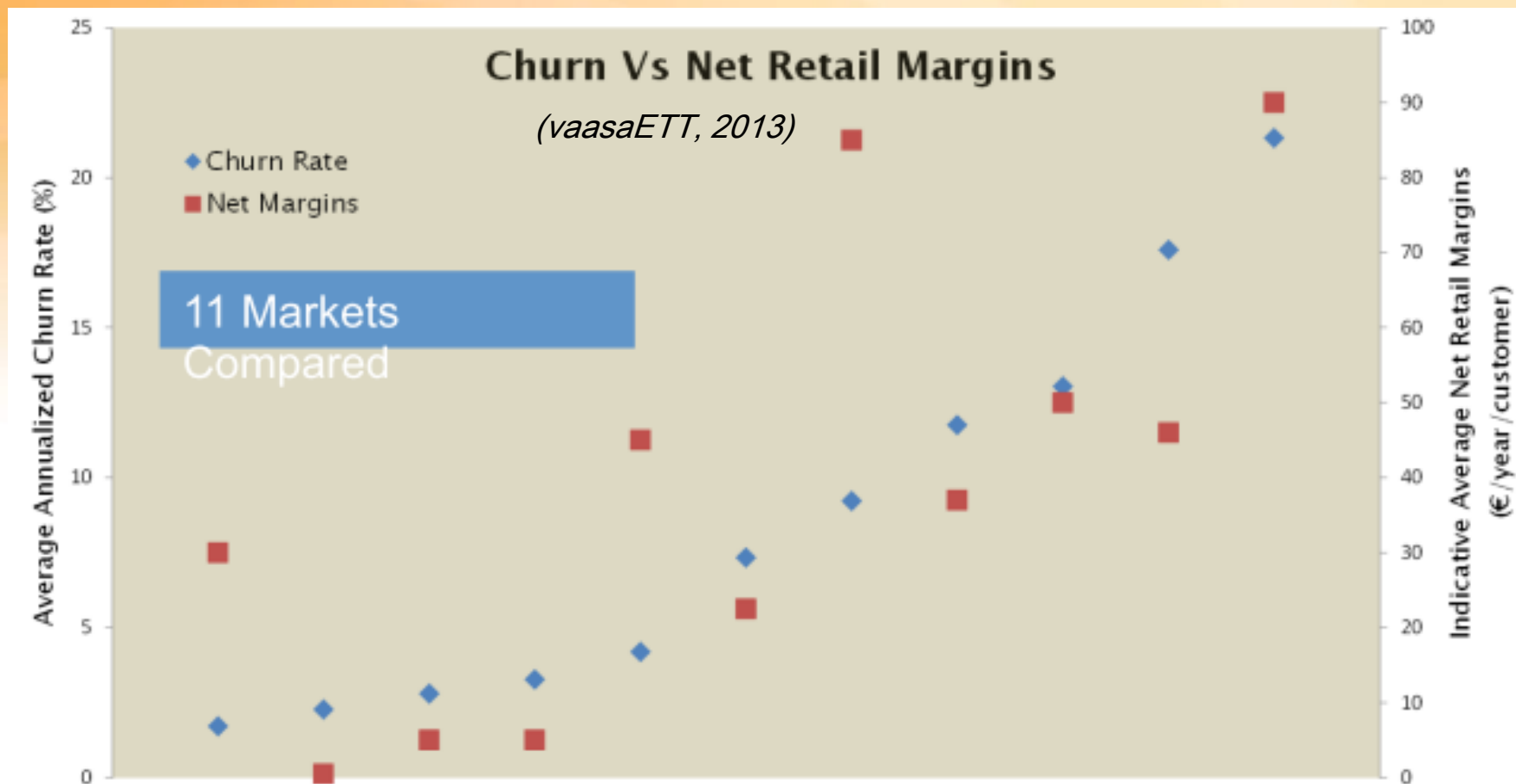
Medium switching markets – consumer switching rates of 5 to 15 percent

Low switching markets – consumer switching rates of 1 to 5 percent

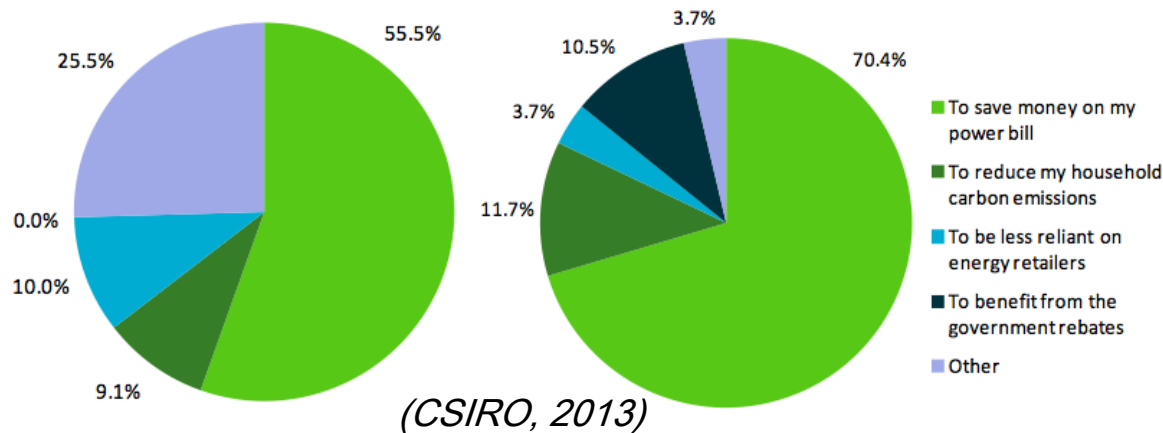
Domestic markets – non-competitive markets or competitive markets with negligible consumer switching

Source: World Energy Retail Market Rankings 2012, VaasaETT, www.vaasaett.com.

More competition?

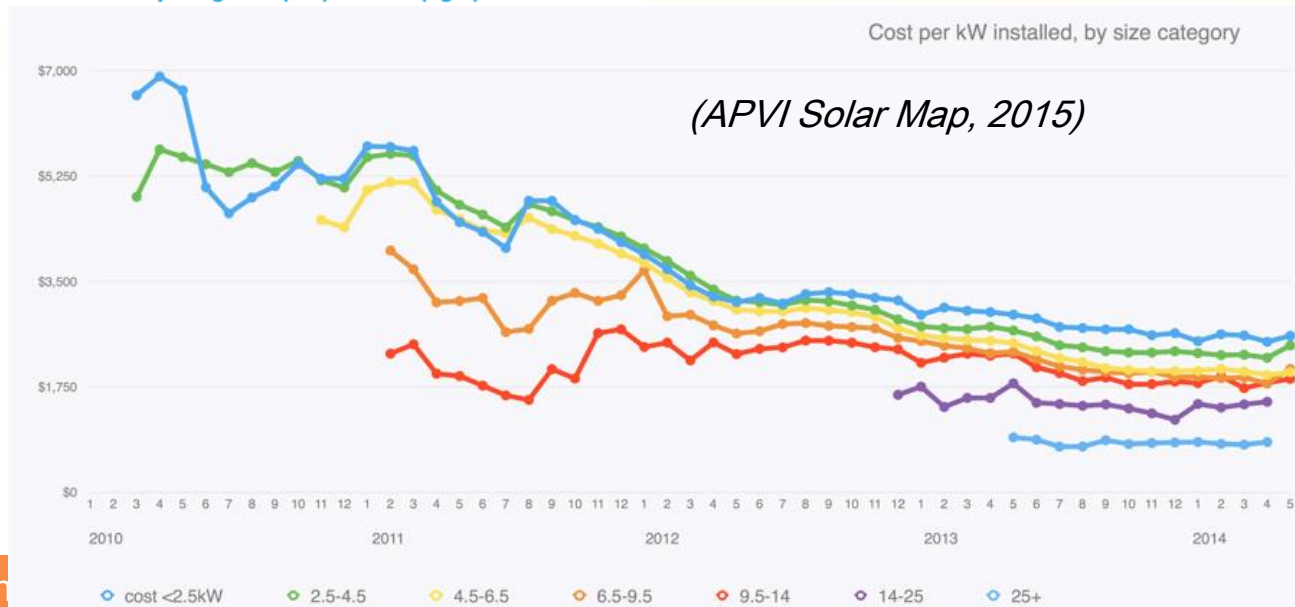


Renewable options are a 'market' response



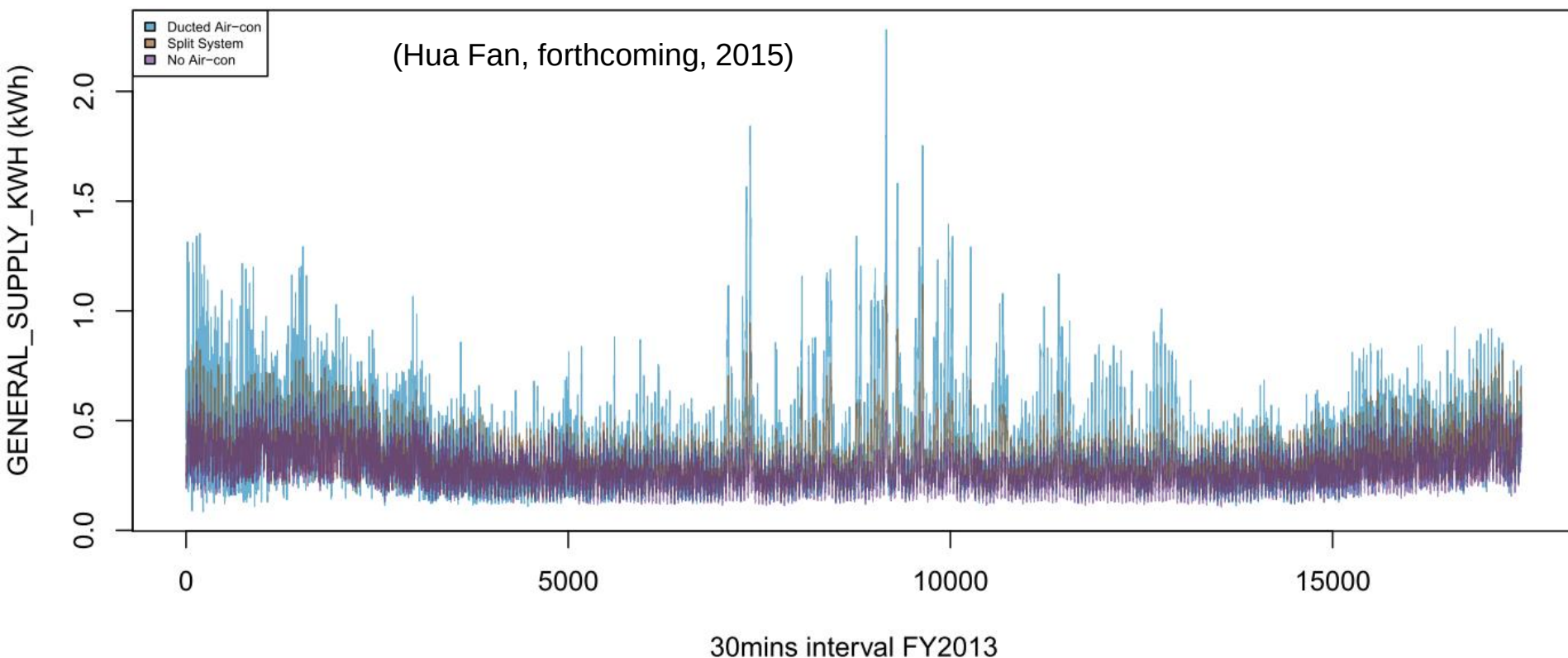
(CSIRO, 2013)

Figure 10 Motivation for distributed energy systems by households already using SHW (left) and SPV (right)



(APVI Solar Map, 2015)

Loads need management too





Nothing so new about distributed storage

But new players such as Tesla, Emphase bring experience, scale and 'smarts'

JOURNAL

OF THE

SOCIETY OF

Telegraph-Engineers and Electricians.

Founded 1871. Incorporated 1883.

VOL. XVII.

1888.

No. 73. A

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. Baillière 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.

Generating Station, Buildings, £	
Chimney Shaft, Water Tanks, and General Fittings	11,000
Dynamos and Exciters — 865 Kilowatts, including spare sets, divided as convenient ...	5,540
Motive Power, i.e., Engines, Boilers, Steam and Feed Connections, Belts, &c., at £8 12s. per I.H.P.	12,470
500 Transformers, i.e., one to every pair of houses, at £15 each	7,500
2,000 yards Primary or Charging Main, exterior to area of supply, at £308 per 100 yards	6,160
20,000 yards Distributing Main, 50 m/m. sectional area, at £91 7s. (see Table 1)	14,270
Regulating Gear	500
	£57,440

B.T.—ACCUMULATOR TRANSFORMER DISTRIBUTION.

Generating Station, Buildings, £	
Chimney Stack, Water Tanks, and General Fittings	8,000
Dynamos — 600 Kilowatts, in 6 sets of 100 Kilowatts each...	4,800
Motive Power, i.e., Engines, Boilers, Steam and Feed Connections, &c., at £8 12s. per I.H.P.	8,600
4 Groups of Accumulators, in all 240 cells, in series, at £40 per cell, including Stands ...	9,600
2,000 yards Charging Main, at £306 17s. 6d. per 100 yards (see Table 2)	6,137
20,000 yards Distributing Main, 161.25 m/m. sectional area, at £100 12s. 6d. (see Table 2) ...	20,125
Regulating Gear	2,500
	£59,762

Distributed storage has a range of possible value propositions

- Improved customer reliability
 - Reduced network peak demand, hence expenditure
 - Reduced generation capacity requirements
 - Facilitating integration of generation technologies with energy storage challenges – PV, but also ‘baseload’ plant
 - Ancillary service provision
 - ‘leaving the grid’ options
- *But note there are other means of providing all of these services - electricity industry functioning ok without it*

Commercial context supports only some of these value propositions at present

- Improved customer reliability – UPS market well established
- Customer arbitrage around their TOU tariffs and peak demand charges... if they face these
- Increased self-consumption of PV generation paid a low 'export' rate, the current context for new household PV

However

- Network value?
- Ancillary services?
- Contingency management?

Numerous and growing assessments of commercial viability in Australia

- Appears to be a highly prospective market

However

- All market forecasts are wrong
 - Those that are least wrong sometimes just chance
 - But they can still be useful
-
- Require making assumptions about future commercial context... but this context is changing eg. Network tariffs

Leaving the grid

- The grid is a very valuable asset – not because we've spent a lot of money on it, but because of the service it provides
- Do not under-estimate the costs and challenges of off-grid supply
- *However, distributed storage and generation providing an increasingly attractive option and alternative – will discipline network pricing*

Nothing new about the 'death spiral'?

Argued that rising prices
encourage end-users to reduce
consumption or even leave,
meaning fixed costs have to be
recovered from less and less
consumption and/or customers

*Savings from demand reduction
depend critically on
energy/network tariffs*

*End-user departure depends
critically on DG technology
progress, particularly storage*

*More of an issue for electricity or
gas?*

(via google news archive)

Thursday, August 4, 1983 — THE NEWS — Page 7A

Utilities grapple new enemy: a rate increase 'death spiral'

By Jack Danforth
Orlando Sentinel

TACOMA, Wash. — There is a new buzz word surfacing in Pacific Northwest electric utilities these days. It is the "death spiral." The concept is simple, and consumers of electric power from Florida to Alaska have recognized it for years.

A death spiral occurs during periods of rising electric rates. The theory is that as electricity demand increases, electric utilities are forced to build expensive new power plants.

This causes electric rates to rise and consumers to use less power. Electric utilities have large fixed costs, so as demand — thus revenue — is reduced, rates must be increased again, causing further reductions in consumption, and the cycle is repeated: a death spiral.

The recent collapse of the Washington Public Power Supply System, also known as Whoops, has focused attention on the death spiral. In this region, electric rates for some utilities have tripled during the past three years.

The increases and the Whoops collapse have forced utilities, for the first time in the industry's history, to come to grips with the possibility that they have reached the limits of their customers' pocketbooks.

It long has been known that there is a finite amount of money available in the family budget for the electric bill. Consumers have different limits, but when taken as a whole there clearly is an economic wall that electric utilities cannot go past.

For the past 30 years, energy prices have been so low and relative incomes so high that the "wall" was far

alternative sources: gas-fired fuel cells, photovoltaic cells and a more efficient end-use of conventional resources, all of which are distinct possibilities within the next decade.

The old days of building more power plants regardless of the cost are gone. Utilities that continue that philosophy ultimately will be priced out of the market.

Conservation still is a vital cog in our energy policy of the 1980s. It is a dangerous oversimplification to say that conservation at a time of surplus energy only further reduces utility revenues, thus causing higher rates.

Programs as simple as the rebate program in Kissimmee, Fla., are one of the most cost-effective methods of stimulating energy efficiency in the country.

The rebate program concept originated there in 1961 and now is being used successfully by such major utilities as Pacific Gas & Electric in California. In these programs, utilities help customers pay the cost of conservation improvements, which is cheaper than building another expensive plant.

But consumers must understand that it is not a contradiction to promote more use of electricity, more industry and conservation at the same time. In many areas, thousands of kilowatts of electricity are available during off-peak times without building another plant. That results in a lower average cost of energy production.

There are times, of course, in a growing economy, when a new generating plant must be built. But that should not be done until the utility has explored all the cheaper alternatives — conservation and helping industries generate their own power from wasted

Smart grids and Demand-Side Participation can improve our options for clean energy

4.5 Smart grid technologies

(IEA, 2012)

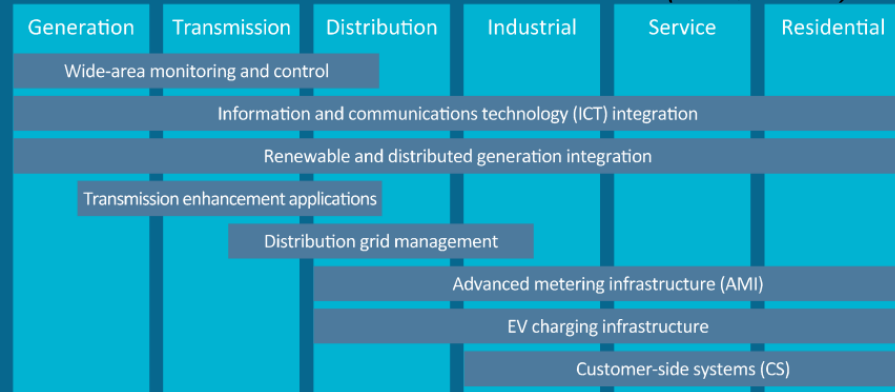


Table 15.1 Emissions reductions and investment needs in the 2DS, by technology

Sector	(IEA, 2012)	CO ₂ savings (Gt) 2050	Cumulative CO ₂ savings (Gt) 2010 to 2050	Investment needs (USD trillion) 2010 to 2050
Power generation				
Bioenergy for heat and power		1.7	20.4	0.5
CCS in power generation		3.3	57.0	2.6
Concentrating solar power		1.7	22.5	2.6
Geothermal for heat and power		0.5	7.1	1.3
High efficiency, low emissions coal		n.a.	n.a.	1.9
Hydropower		0.9	19.4	3.0
Nuclear		3.2	59.6	4.0
Smart grids		1.7	36.4	5.0 to 6.0
Solar photovoltaic (PV)		1.7	27.7	3.9
Wind		3.0	61.0	5.9

4.2 Global cumulative smart meter installations

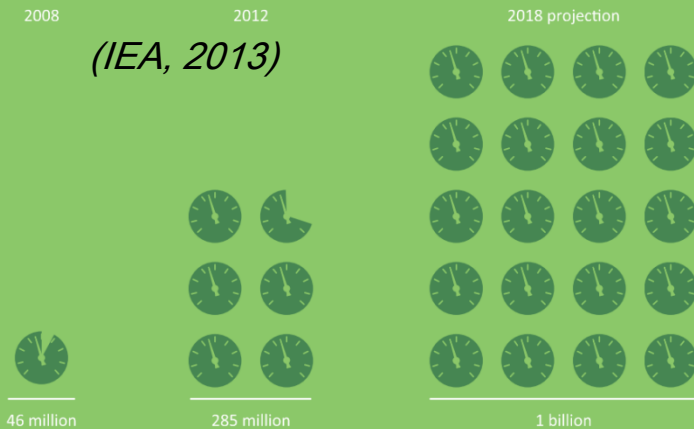
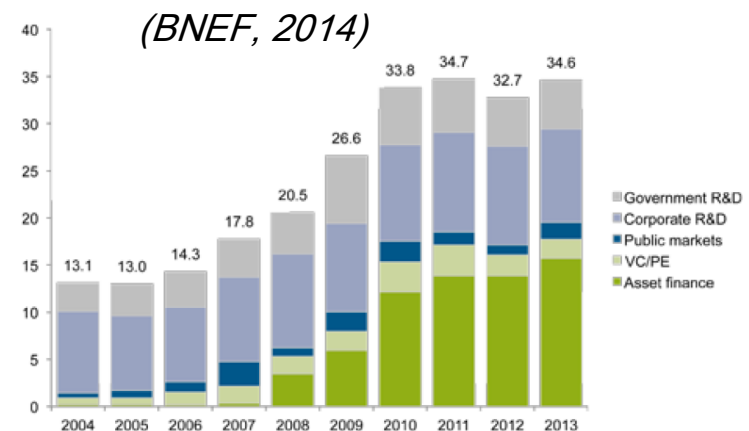


FIGURE 27. NEW INVESTMENT IN ENERGY-SMART TECHNOLOGIES, 2004-2013, \$BN



Asset finance includes smart grid and power storage only, excludes roll-out of efficiency and advanced transportation products

Source: Bloomberg New Energy Finance



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Thank you, questions and discussion

www.ceem.unsw.edu.au