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Can EV's Save the Grid?

AIE Presentation 12/6/14

## University of Queensland 1.2MW

- Largest Rooftop Installation in Australia
- Involvement with University R&D projects.
- Includes flush, tilt and tracker mounted PV and CPV

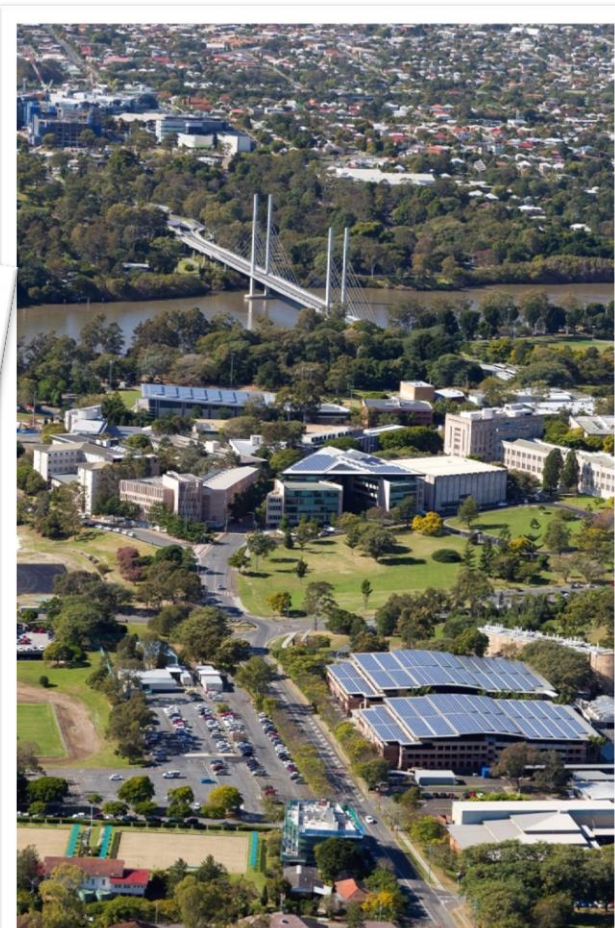


*"It is nice to see German quality engineering and construction in Australia"*

**WIRSOL AG**

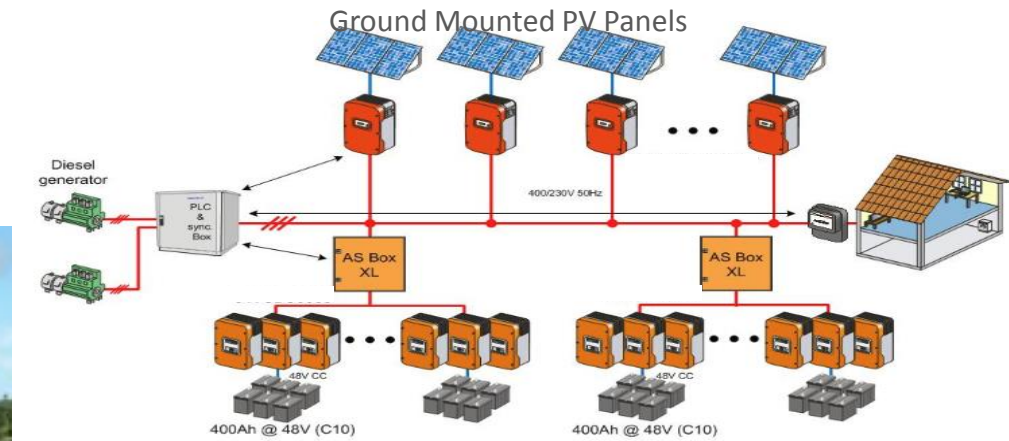
*"One of the best examples of quality installation I have seen world wide."*

**Power-One**

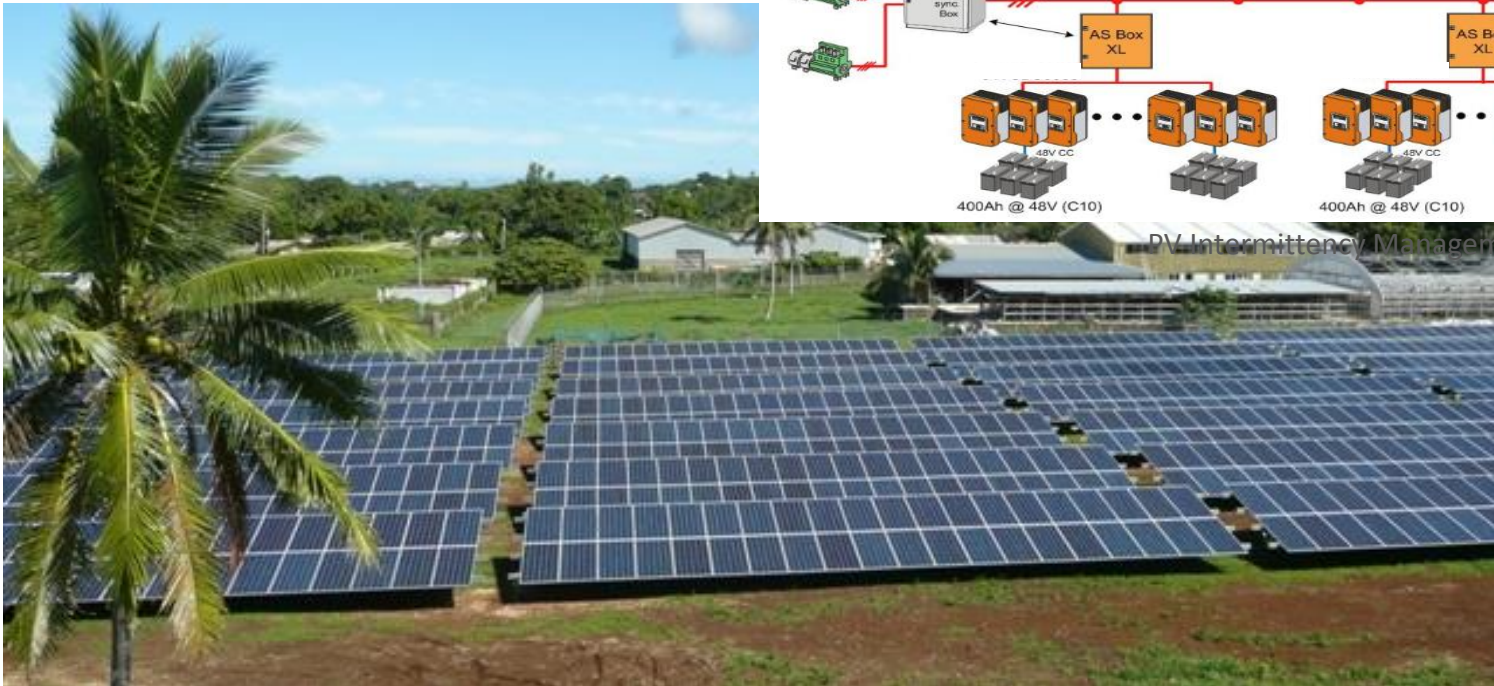


# Tonga Vava'u Solar Project

- One of the largest solar/diesel grid projects to date world wide
- Up to 70% penetration solar penetration into a diesel mini-grid



PV Intermittency Management







## KJM, Edinburgh Park – 500kW



## Kangaroo Island – Solar + EV project



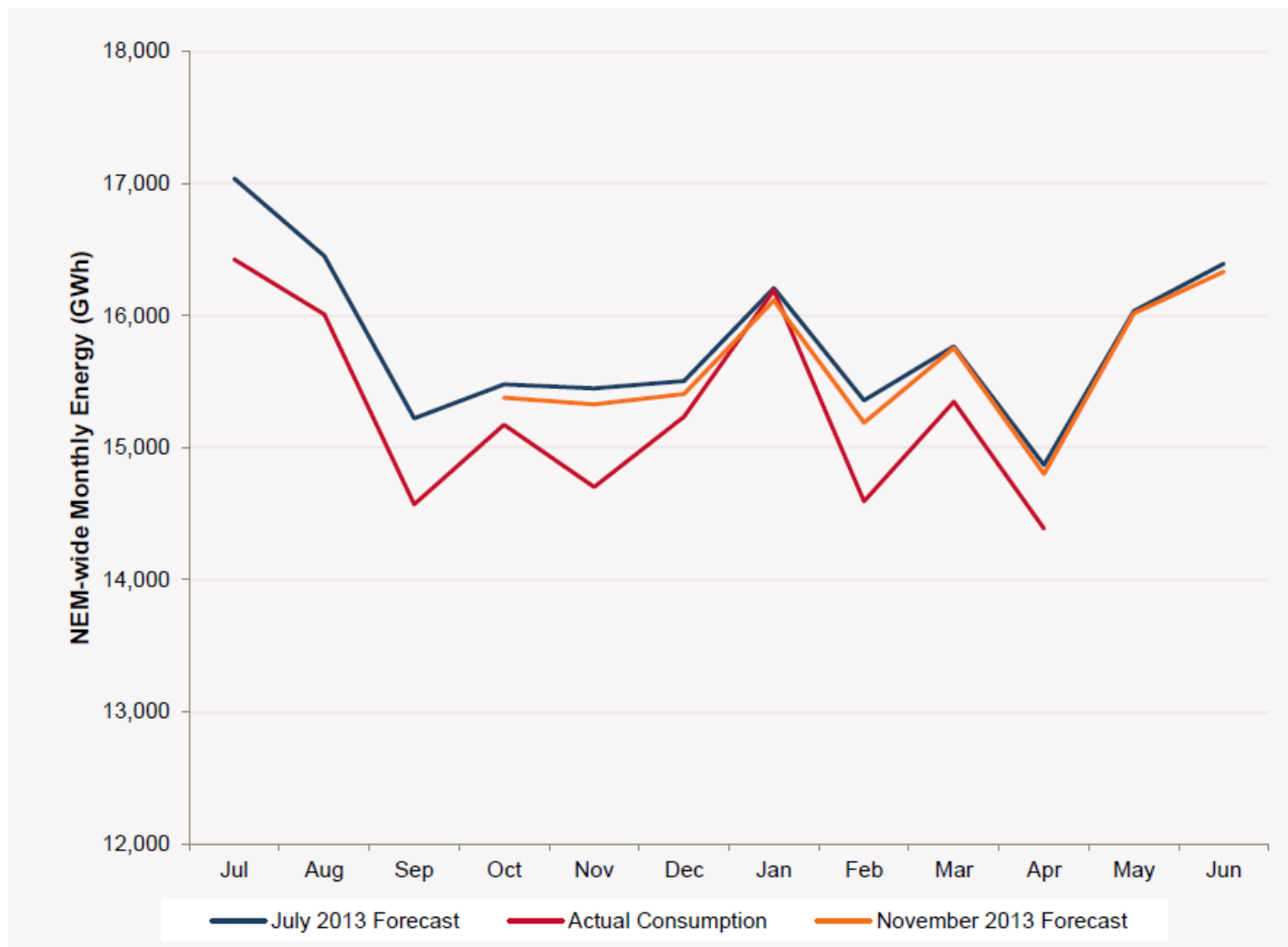


# Can EV's Save the Grid?

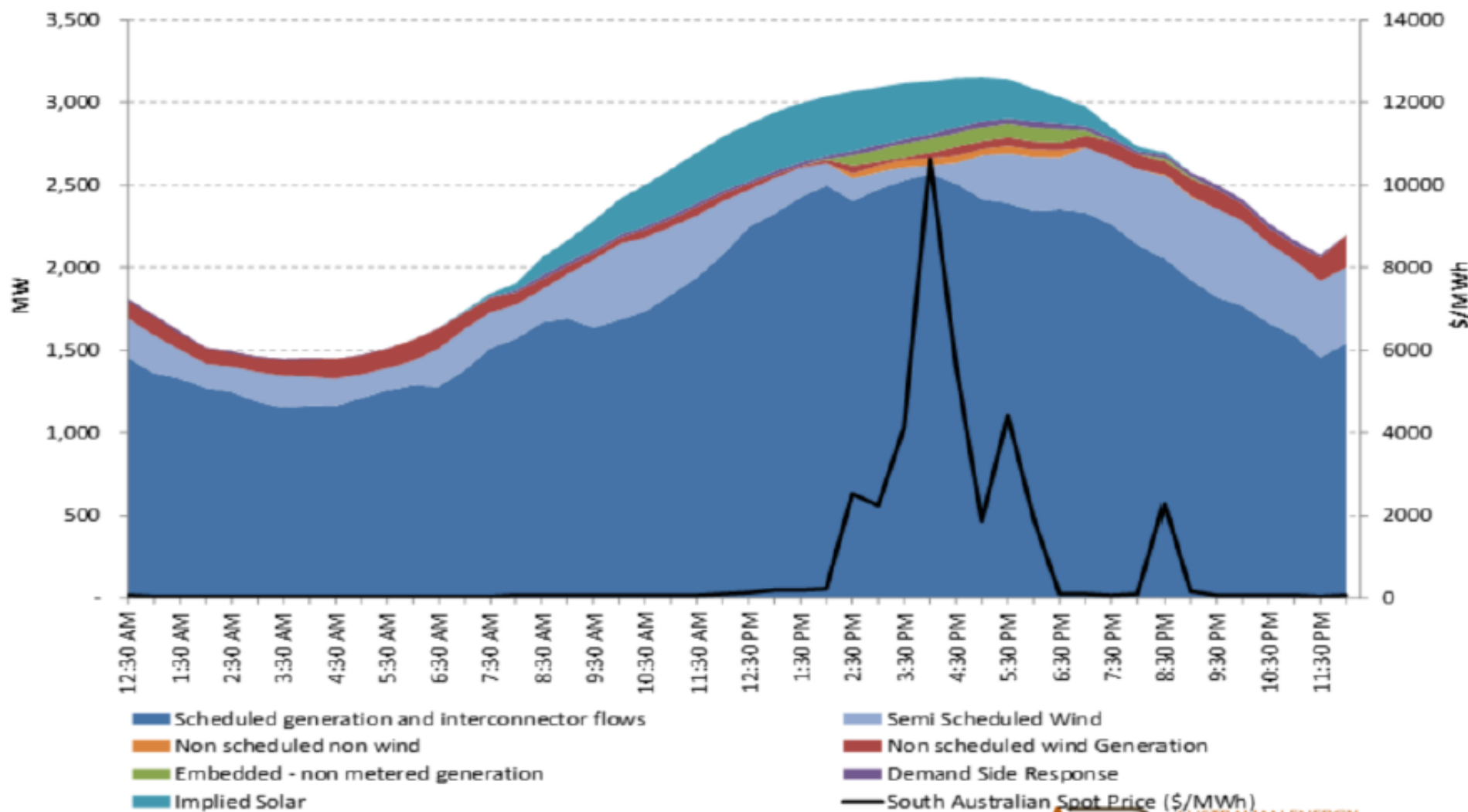


# Falling demand in the NEM

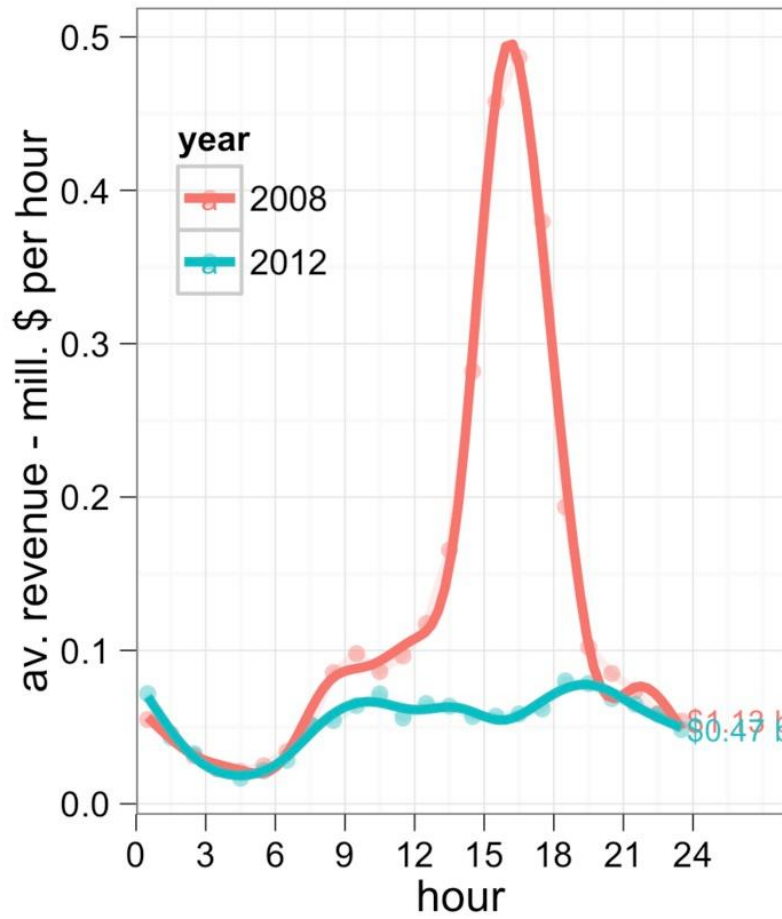
Figure 1 — Comparison of monthly energy forecasts and actual consumption for 2013–14



## South Australia 19 December 2013







# Are we headed for a Death Spiral?

## Massive losses hit EnergyAustralia as demand falls, solar soars

Energy Australia has slumped to a **loss of \$350M for 2013** after slashing the value of its Yallourn brown coal generator and some of its gas fired generation assets. It blamed the result mostly on an “**Unprecedented**” **fall in demand, and the popularity of solar PV.**

## AGL profit falls on unfavourable conditions

AGL Energy's 1<sup>st</sup> half **net profit down 27.1%** to \$261 million

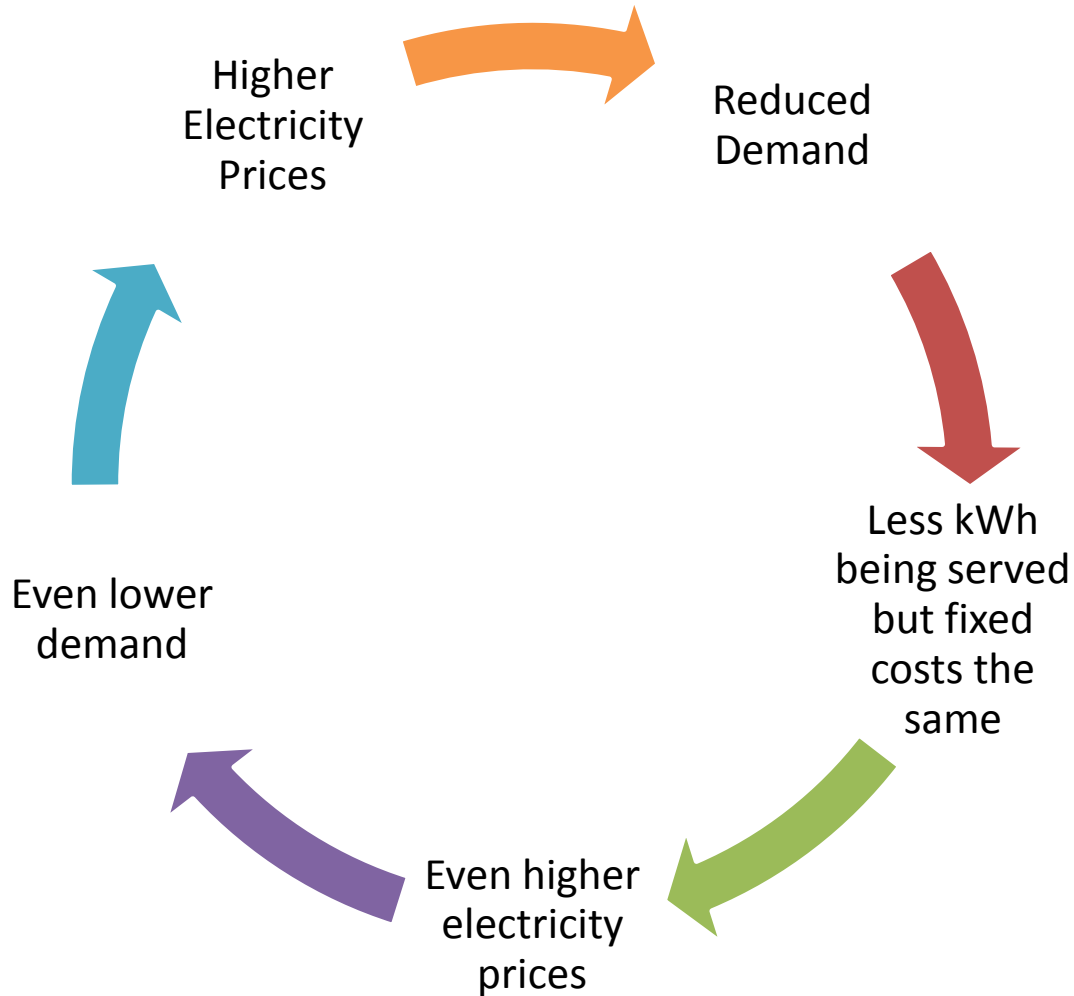
- Warmest winter on record
- Businesses and Households becoming **more energy efficient**



## Death spiral begins for Australian electricity companies

Energy demand is now lower than in 2006, but with **billions in infrastructure investment needing to be recouped by network operators**, energy **prices are now double** what they were only 5 years ago. Making alternatives like solar PV more attractive.

# What is a Death Spiral?





# Can EV's help?

Potential  
grid storage (?)



New source of  
electricity  
consumption



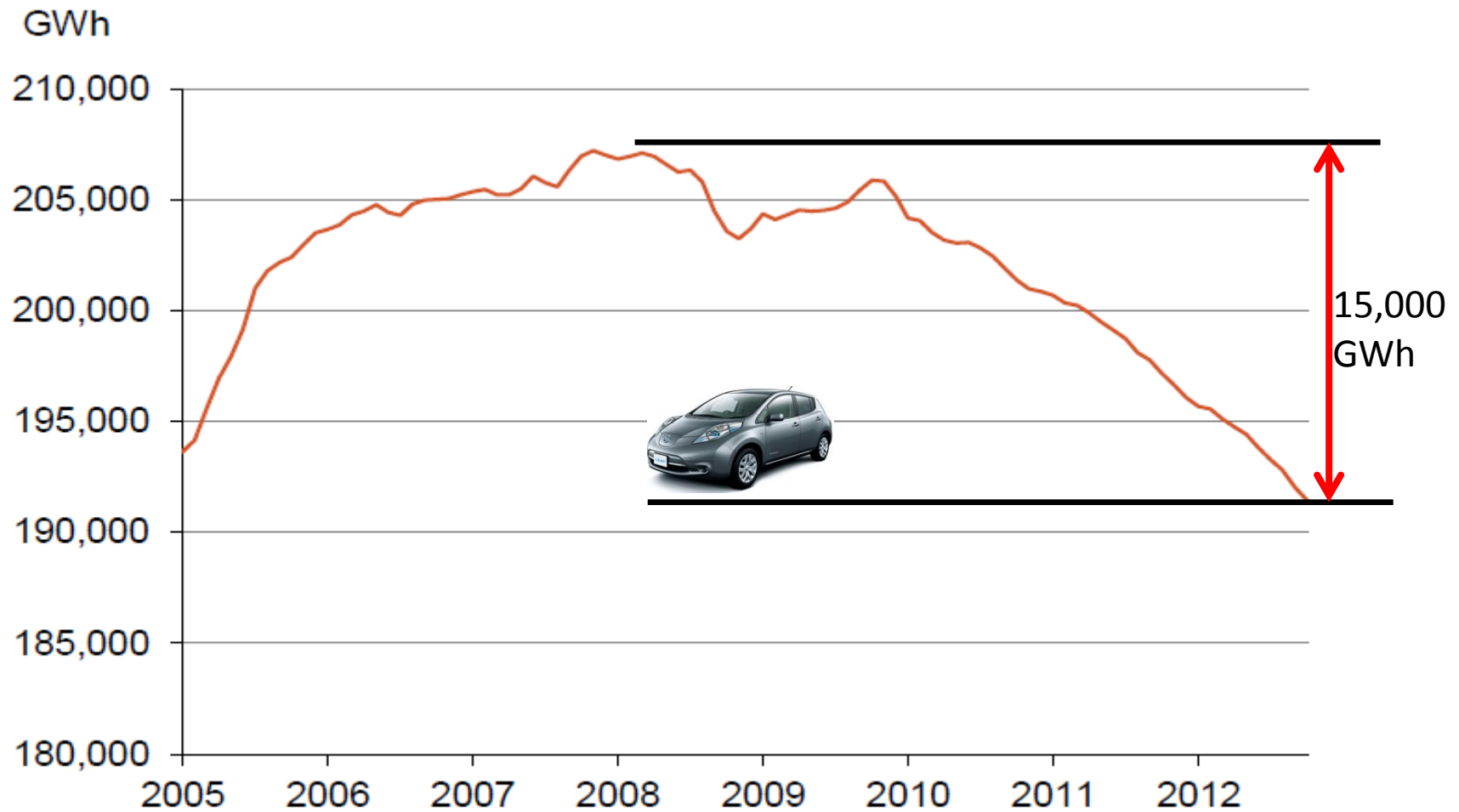
FCAS (?)



Flexible  
Demand





# Can EV's reverse declining demand?



Source: AEMO (1998-2013)

# Let's do the maths:

- Average passenger car = 13,197km p.a.
- A  consumes 0.161kWh / km
- So an average  consumes 2,125 kWh p.a.

*How many EV's,  
each consuming 2,125kWh p.a.  
do you need to replace 15,000GWh of demand in the grid?*

- $15,000\text{GWh}/2125\text{kWh} = \dots$





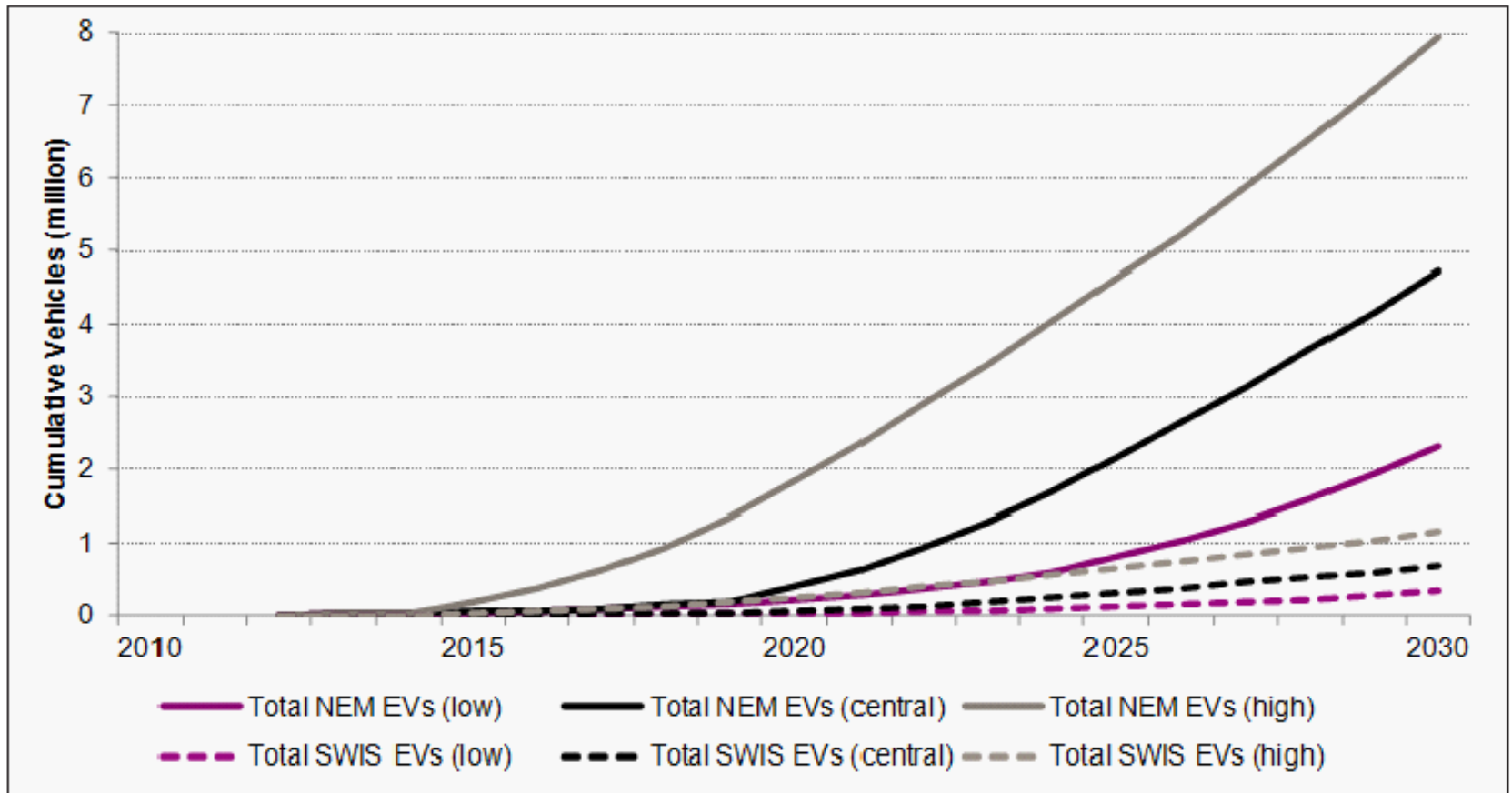
7million

# In Context

- ~1.1 million new vehicles sold each year in Australia
- 13 million passenger vehicles in the national fleet
- About 44,00 PHEV and BEV vehicles in 2014
- We'd need EV's to account for about **50%** of the existing fleet to stem loss of demand on its own.

# EV forecasts

Figure 2: Estimated number of electric vehicles in NEM and SWIS

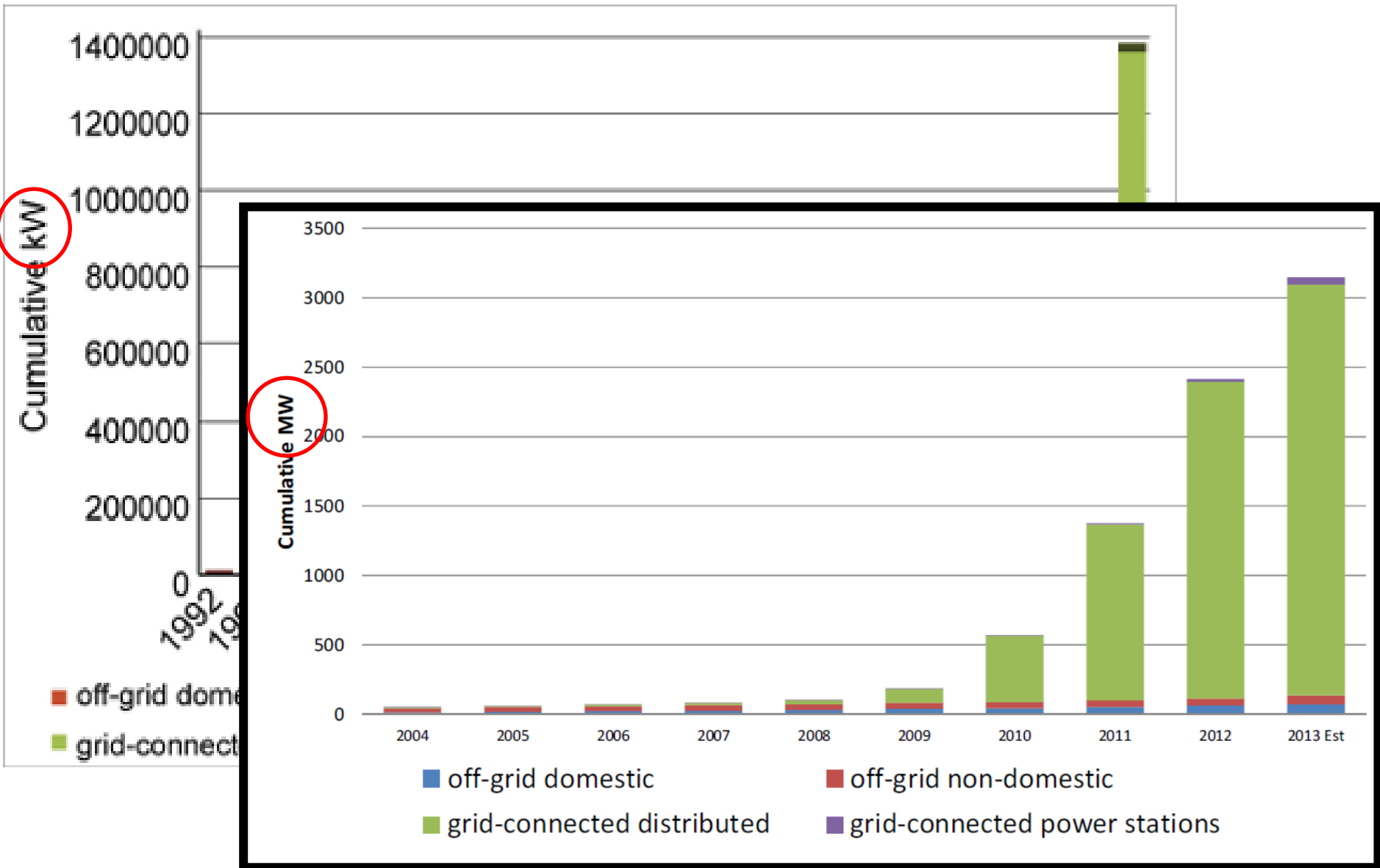


Source: AECOM

\*includes PHEV and BEV's

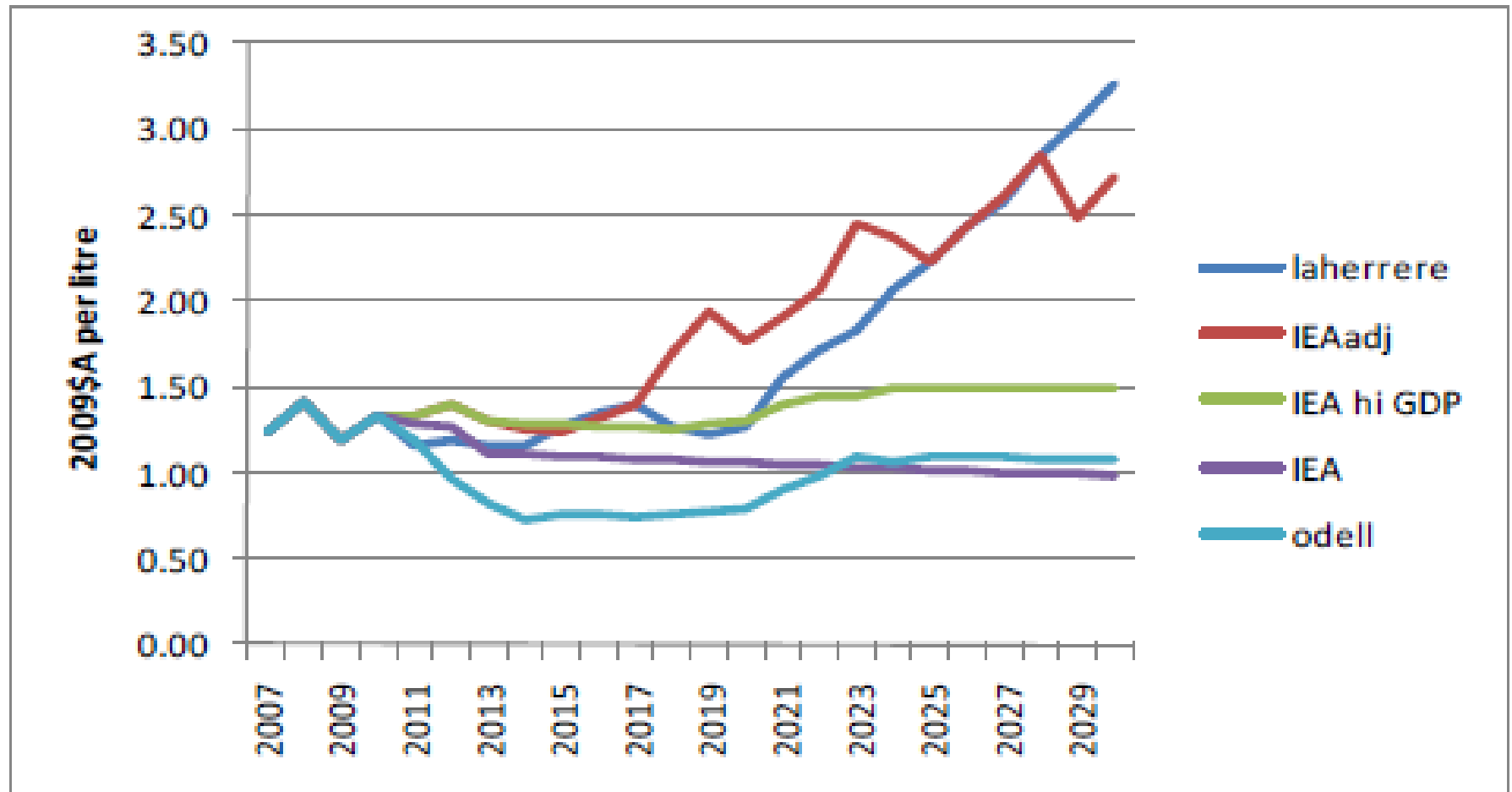


# Never be a forecaster!



# Factors affecting EV uptake

Figure 12 Australian retail petrol price scenarios



# Key Takeaways:

- EV's: half a million within 5 years (4% of the fleet)
- Uptake: Likely to be non-linear
- Not enough to replace falling demand

**BUT**

- **Big enough to create opportunities, or further problems for Retailers/Distributors**



# Can EV's help?

Potential  
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New source of  
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FCAS (?)

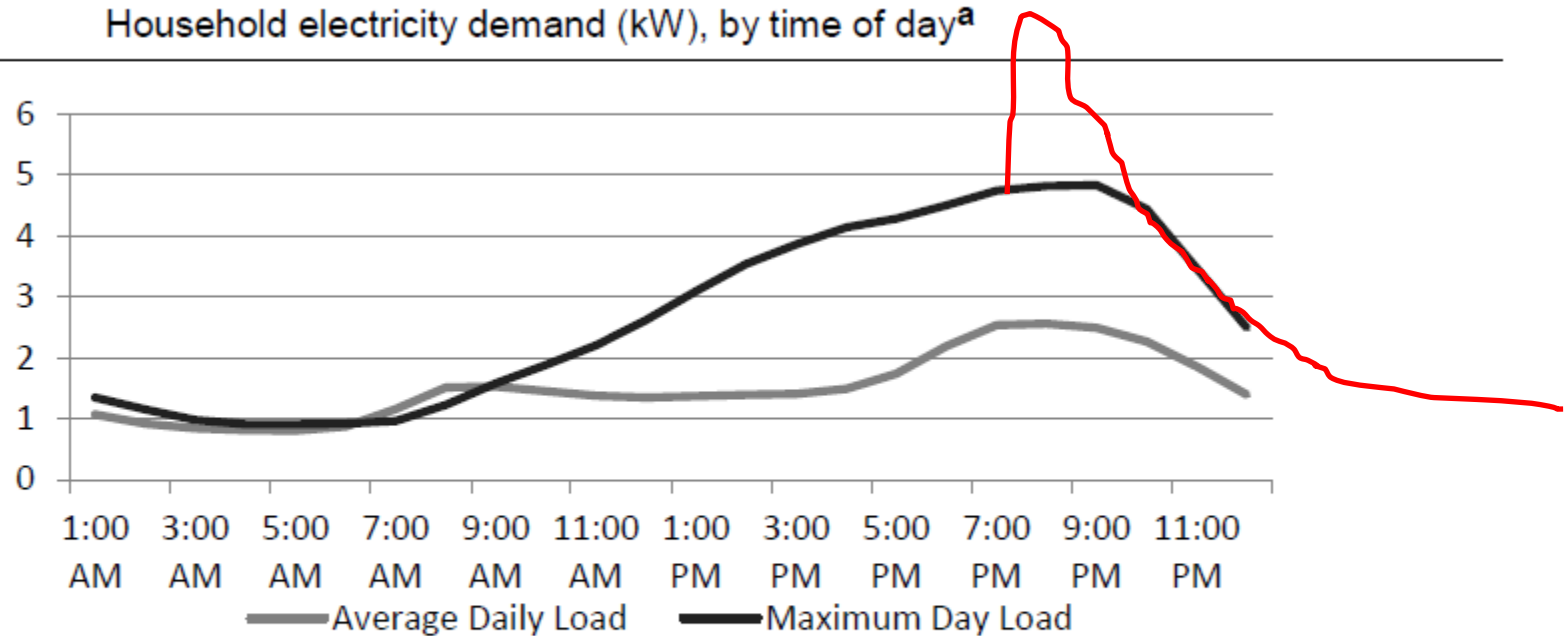


Flexible  
Demand



# Smart Charging

Figure 9.6 **Household peak loads are very peaky**  
Household electricity demand (kW), by time of day<sup>a</sup>



<sup>a</sup> Based on interval meter data from 3000 Sydney households in the financial year 2010. The maximum day load is the load profile for the day of maximum peak demand for the financial year, while the average daily load is the average for all days in that year.

Data source: Simshauser (2012).

# Could Electric Cars Threaten the Grid?



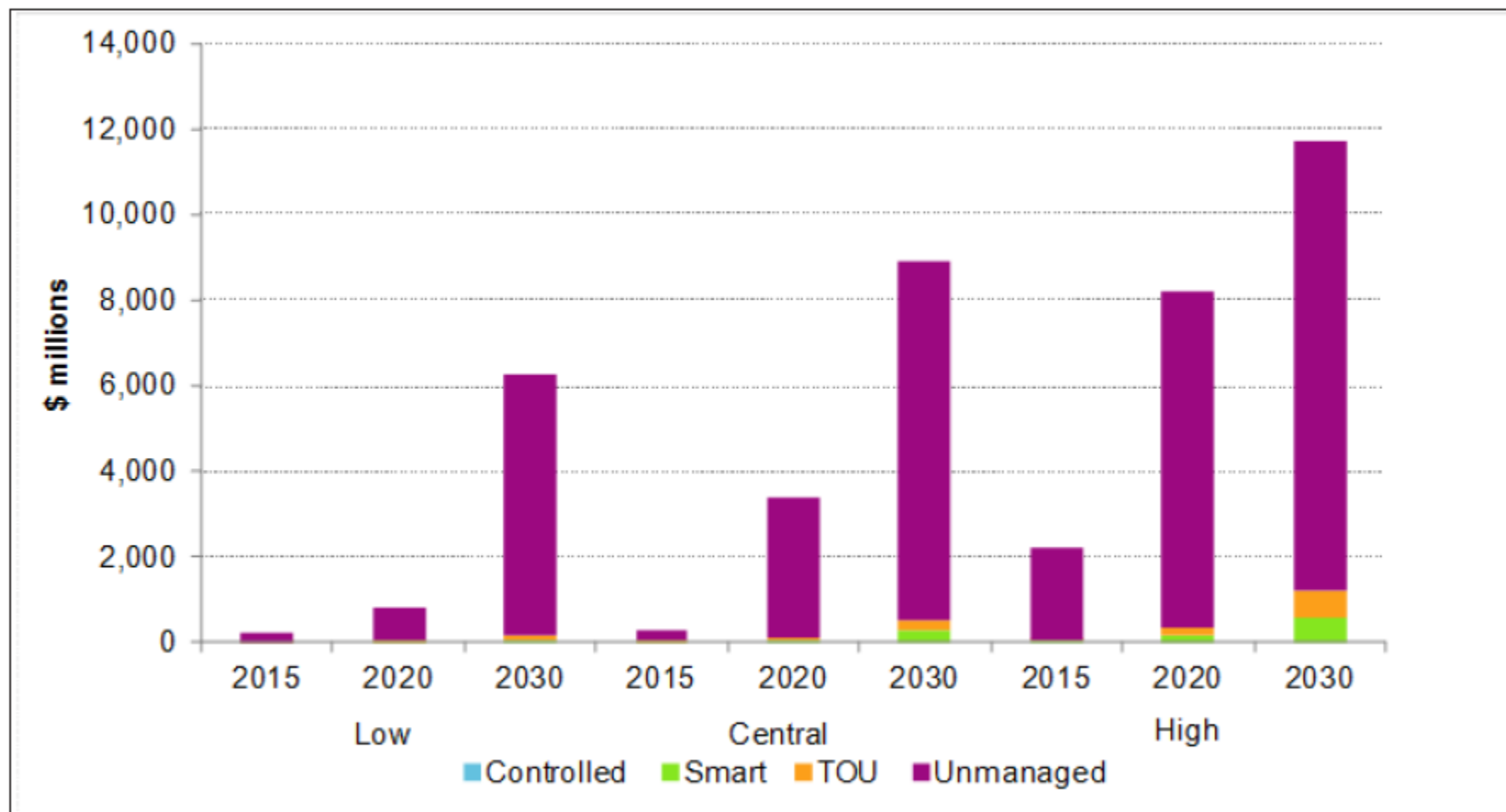
Some neighborhood grids just aren't built for huge spikes in power demand. The rise of the electric car has utilities scrambling to adjust.

Plugging in an electric vehicle is, in some cases, the equivalent of adding three houses to the grid. That has utilities in California – where the largest number of electric vehicles are sold – scrambling to upgrade the grid to avoid power outages.

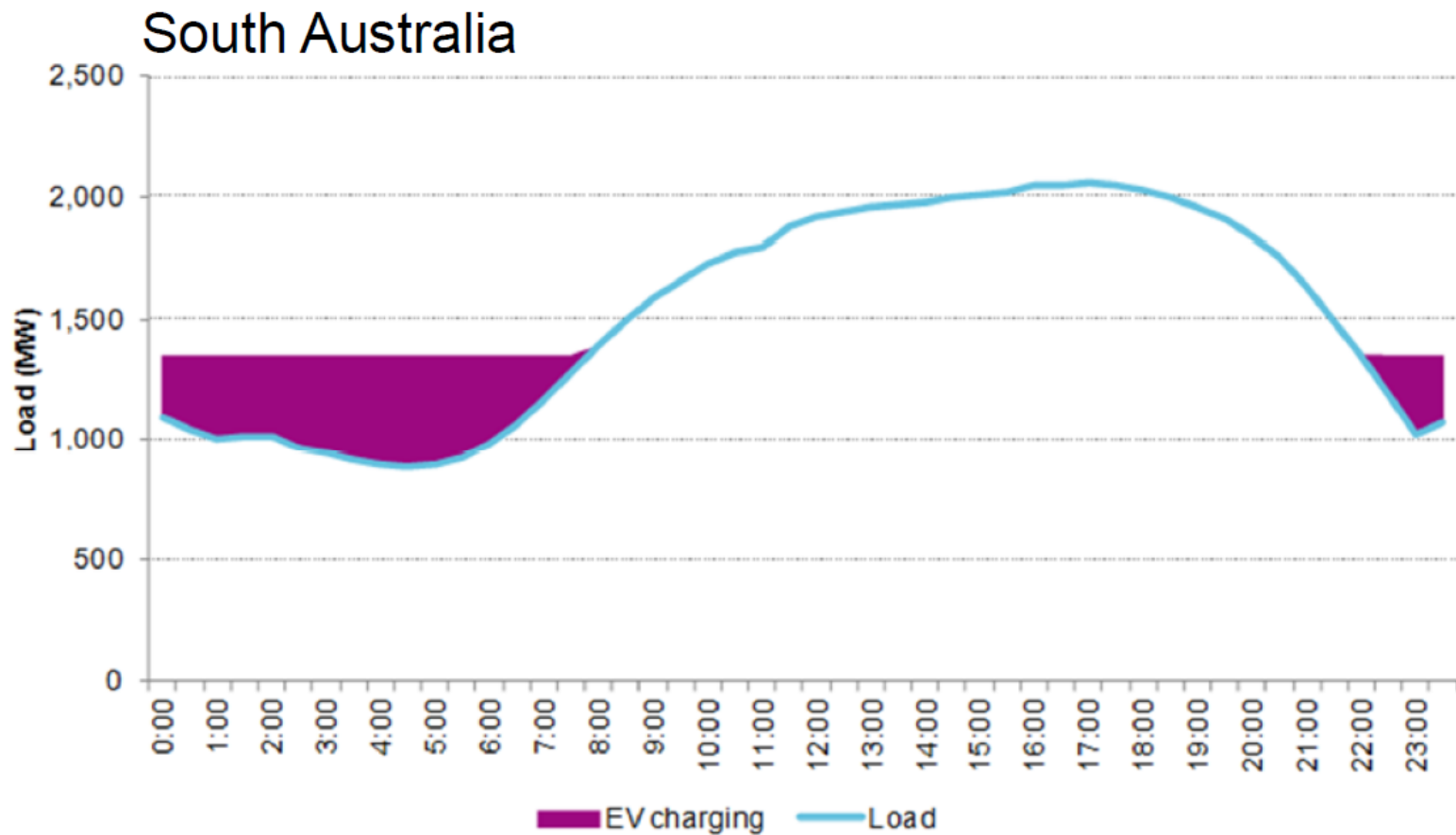


# The cost of charging

Figure 5: Estimated cost (for both generation and network upgrades) of additional peak demand in NEM (\$ millions undiscounted)



# Smart charging = improved network utilisation at no additional cost



Source: Net System Load Profiles from AEMO (2011a), EV charging AECOM

# Demand Response – 1.0



# Demand Response 2.0





# Key Takeaways

- EV's can either be a help or a hindrance – it depends on how we manage them
- Standardised solution is needed for DR now
  - AEMC, Retailers, Utilities , EV providers
- Aggregators or 'Energy Service Providers' may provide a key pathway to DR
- EV load volume needs to be large enough to matter

# Can EV's help?

Potential  
grid storage (?)



New source of  
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consumption



FCAS (?)



Flexible  
Demand



# Vehicle-2-Grid (V2G)





# V2G trials





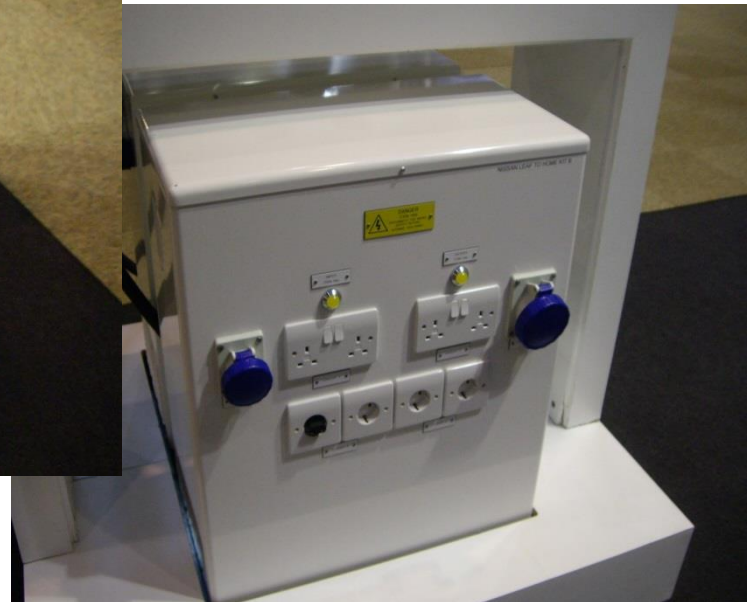
# Potential Flexible EV load

Table 31 Potential flexible EV load (with all EVs connected)

	Low			Central			High		
	2015	2020	2030	2015	2020	2030	2015	2020	2030
Level 1 charging (15 amps) - MW									
NEM	55	184	1,366	66	737	1,935	485	1,788	2,552
SWIS	7	24	208	9	101	295	63	251	389
Level 2 charging (32 amps) - MW									
NEM	117	393	2915	140	1571	4127	1035	3815	5445
SWIS	15	51	444	18	215	630	134	536	830

Source: AECOM

# V2H



# Conclusions

- EV's are coming ~ 500,000 by 2020
- Potential for Huge network costs or benefits
  - We need to choose now which ones we want
- Energy Services Companies and smart consumer-friendly aggregators may beat energy retailers to the main game
- V2G has potential in the context of a high renewables NEM, but smart charging is likely to precede bi-directional charge/storage and FCAS
- We may need to look elsewhere for rapid demand growth in the NEM