

**HOW TO DESTROY A  
PERFECTLY GOOD  
ELECTRICITY GRID IN  
3 EASY STEPS**

Why?

South Australia

New South Wales

Victoria

# The joy of blackout







# The challenge



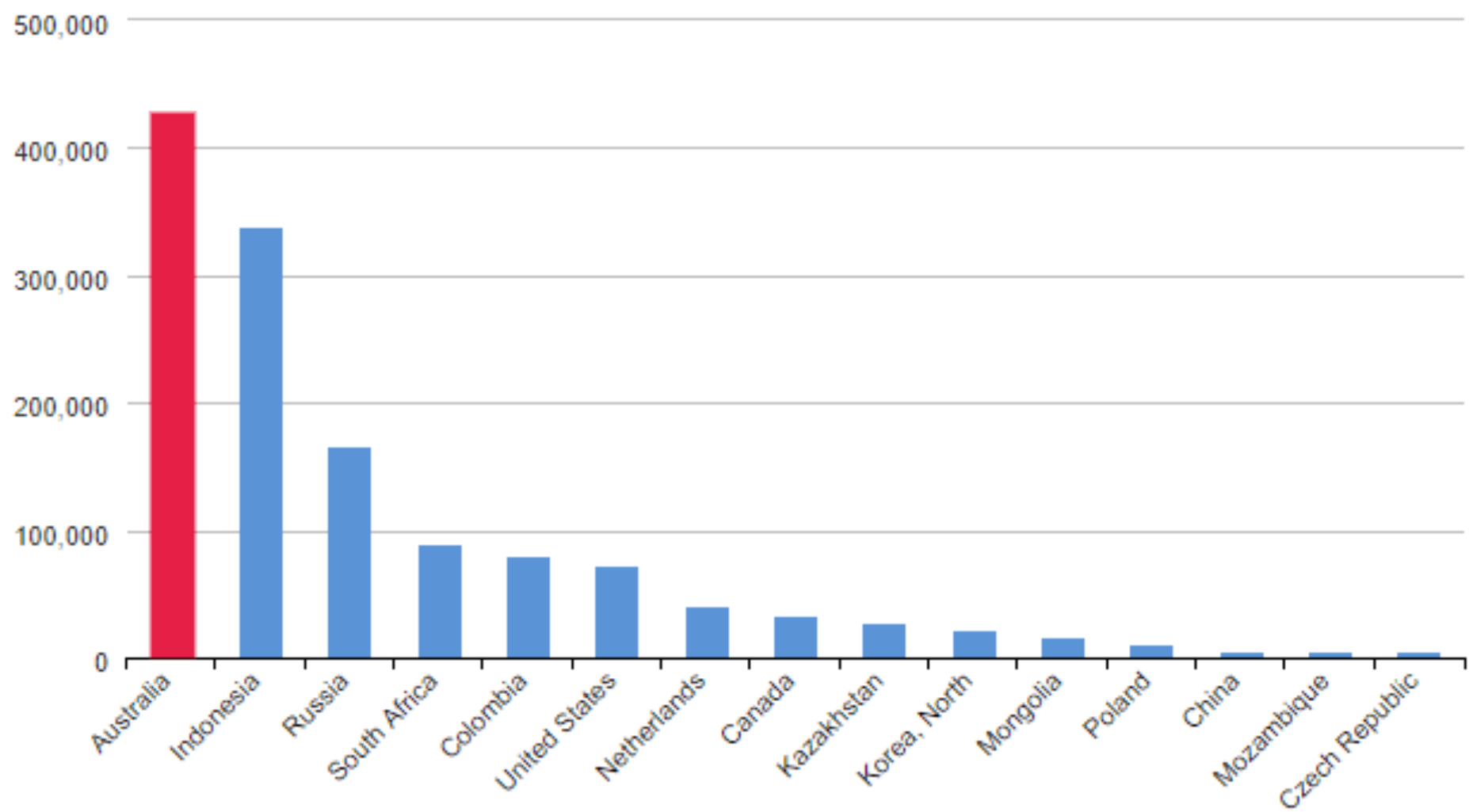
# Coal

Codrington, Stephen. *Planet Geography 3rd Edition* (2005)

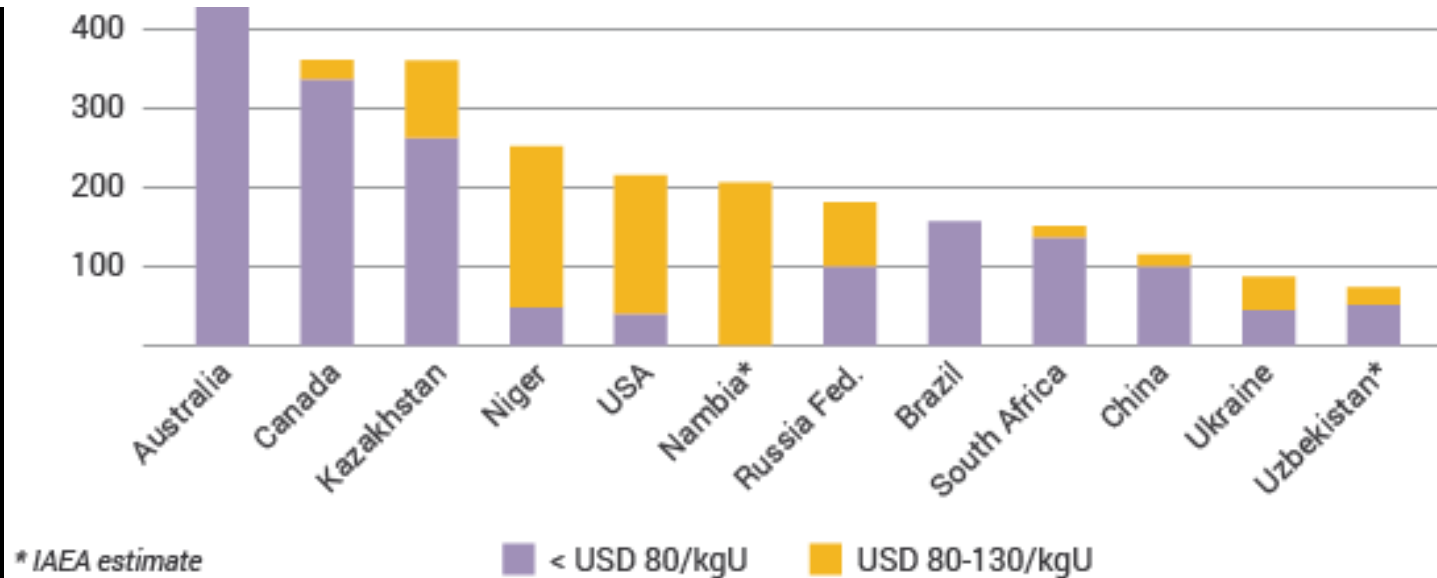
# Coal Recoverable Reserves



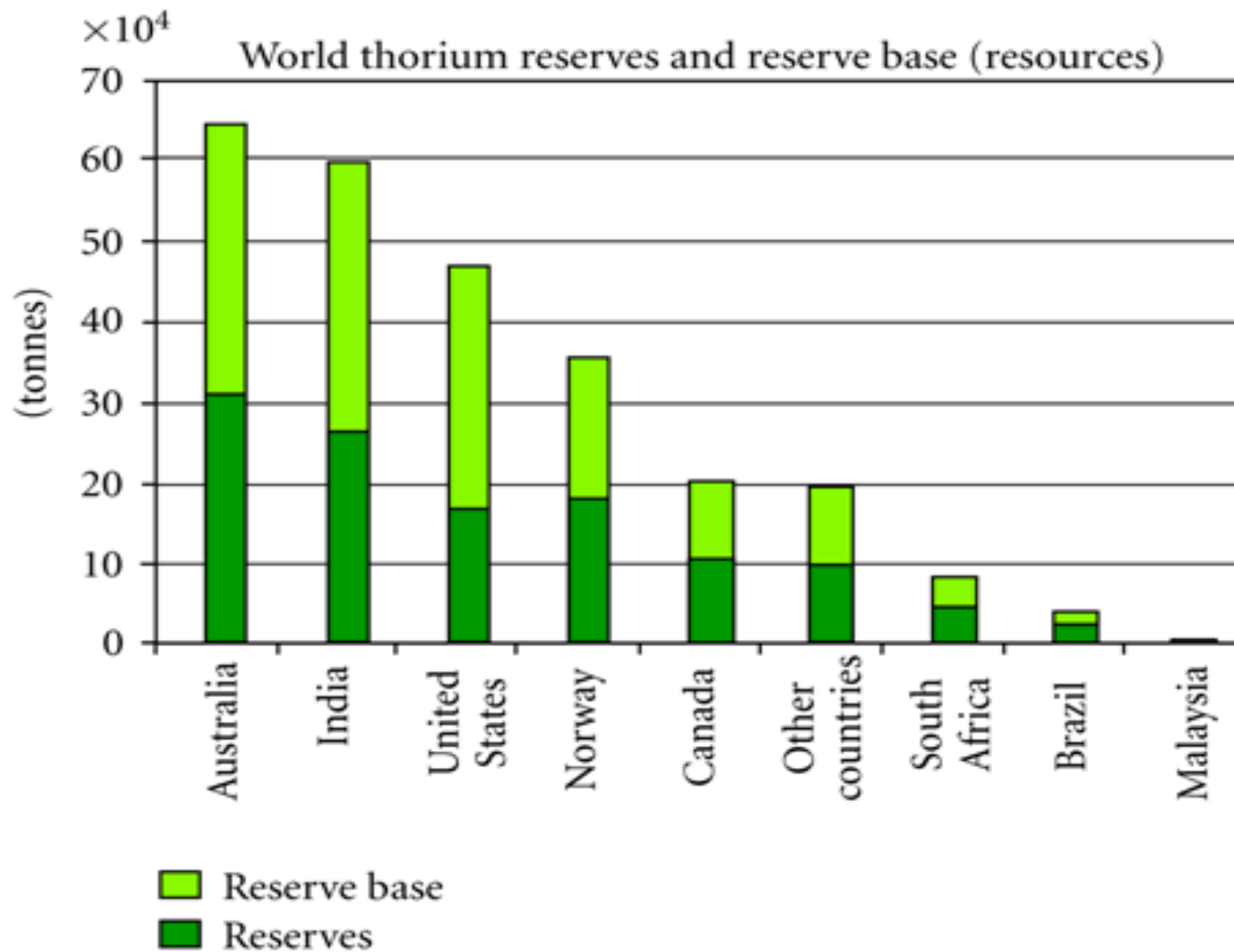




EIA Primary Coal Exports 2015



# Uranium



# Thorium



## REAL ELECTRICITY PRICES - AUSTRALIA

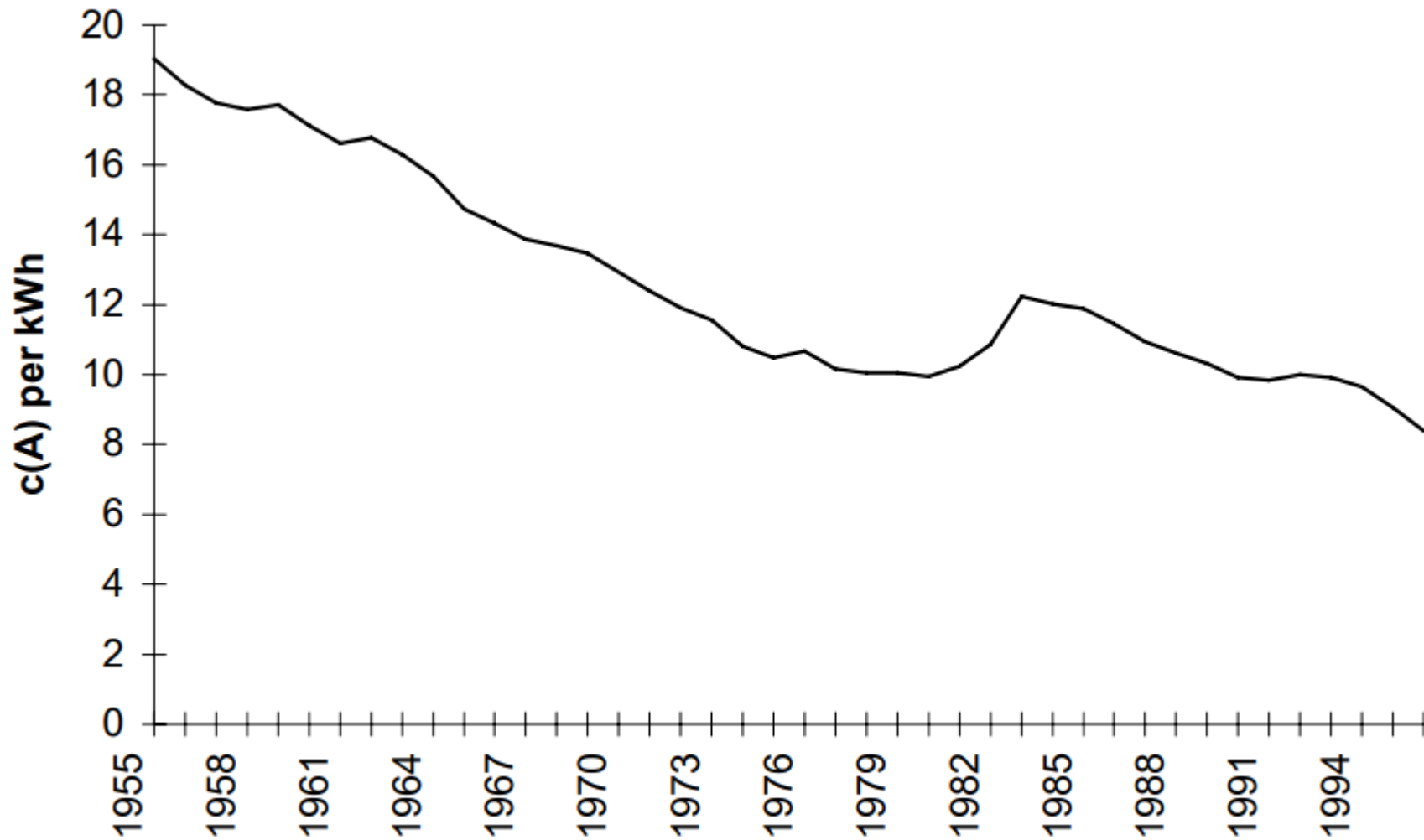


Fig 4 Price movement in Real terms - average selling price - cents (A) per kWh

Industrial average prices for 1995, compared with other OECD countries are shown in Fig 6.

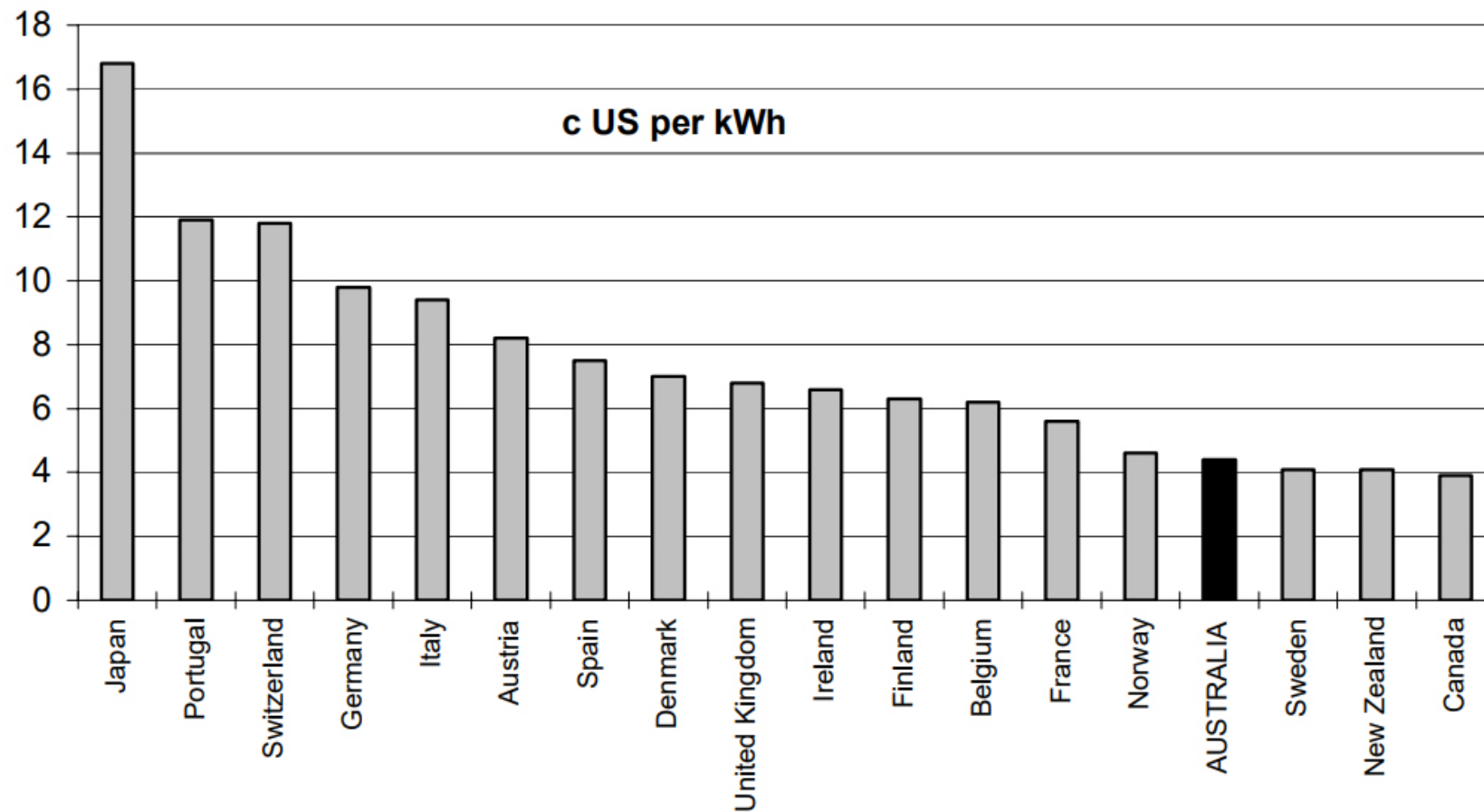
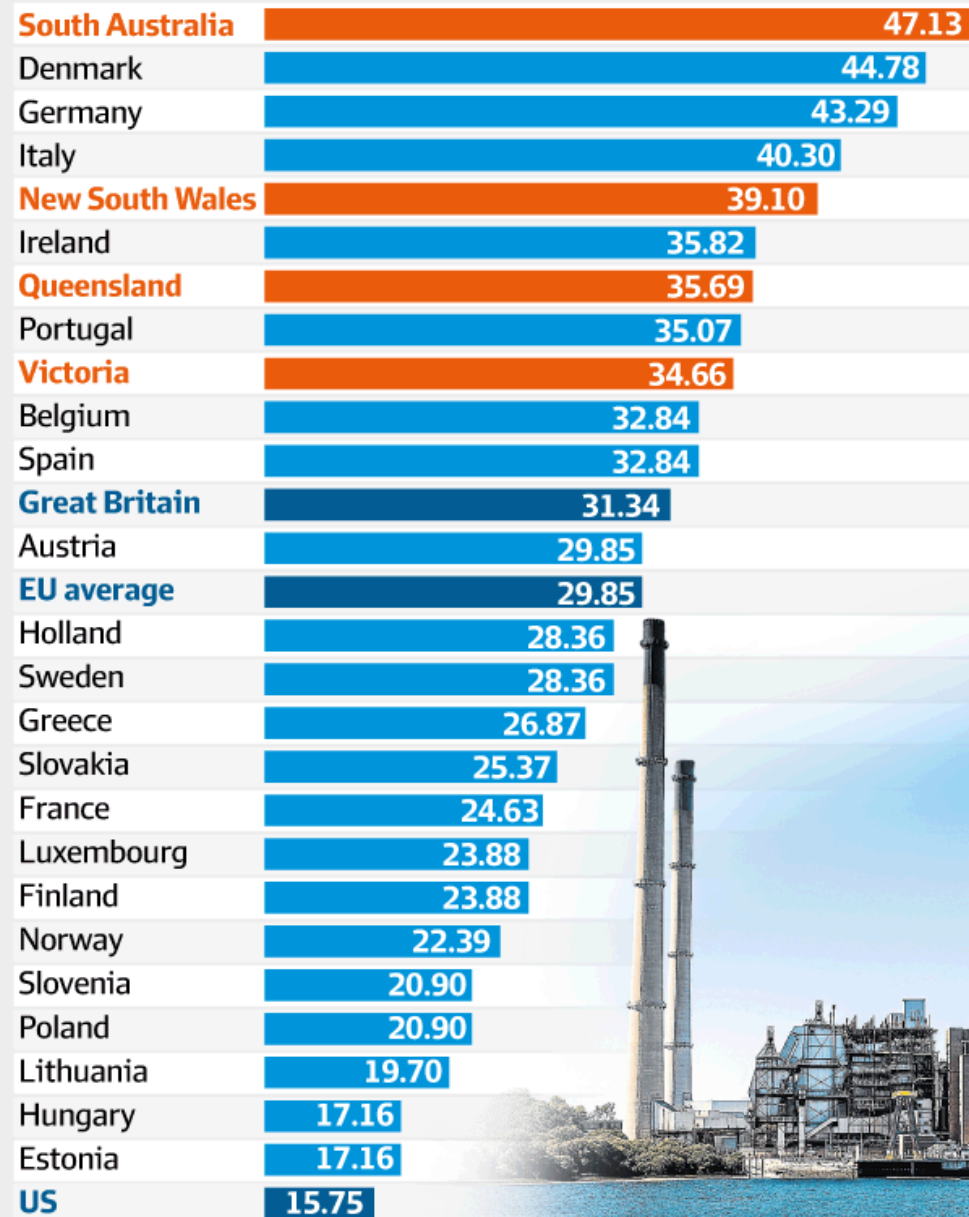


Fig 5 Industrial average prices, OECD countries 1995

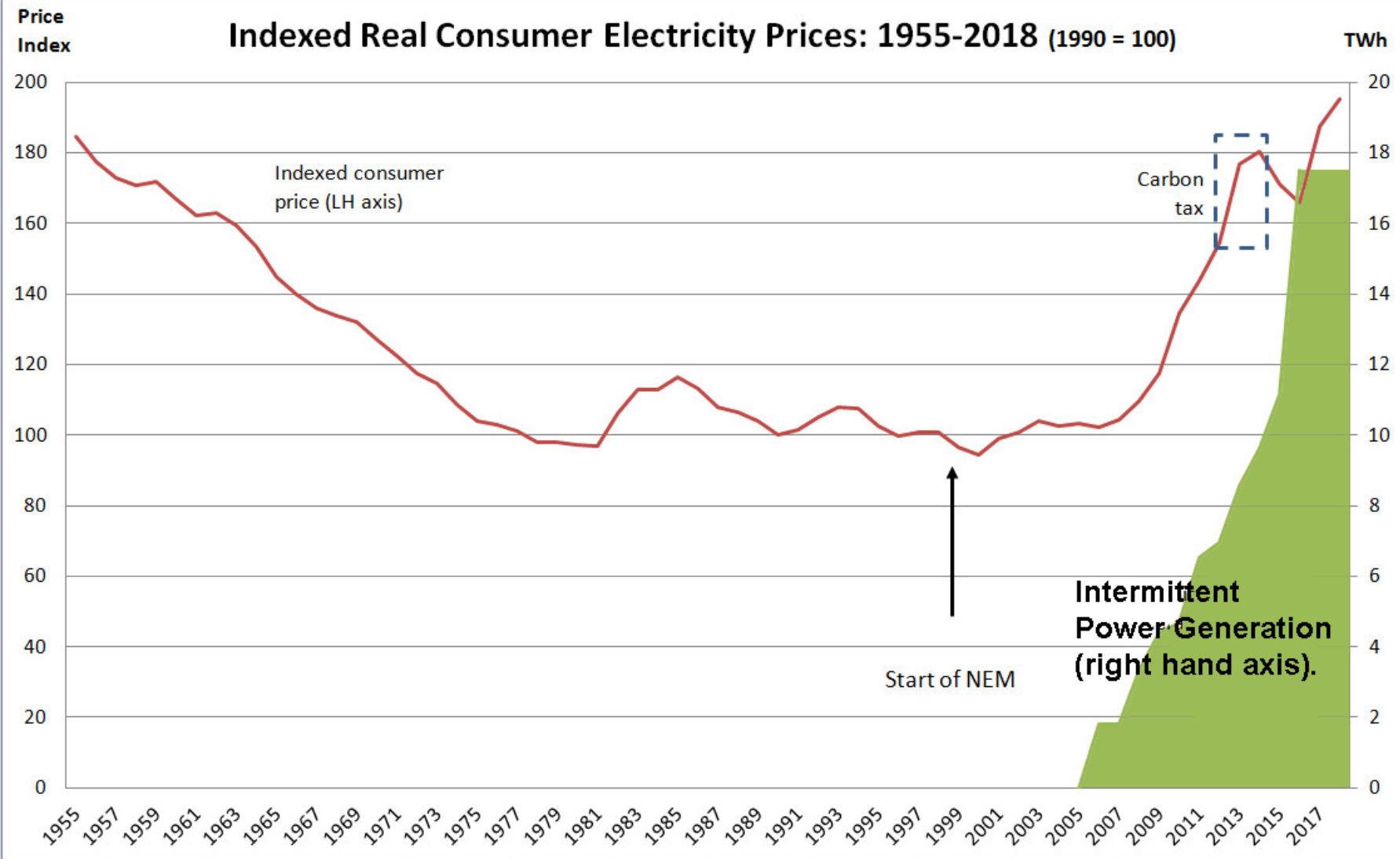
Our achievements  
so far



Retail electricity prices of NEM states, including taxes, compared to selected countries (¢ per kWh)



SOURCE: MARKINTELL, US ENERGY INFORMATION ADMINISTRATION



**Sources**

*Original: Dr Michael Crawford*

**Prices** 1955 - 1980: *Electricity in Australia*, prepared for CIGRE by Frank Brady AM (former CEO, Electricity Commission of NSW), 1996

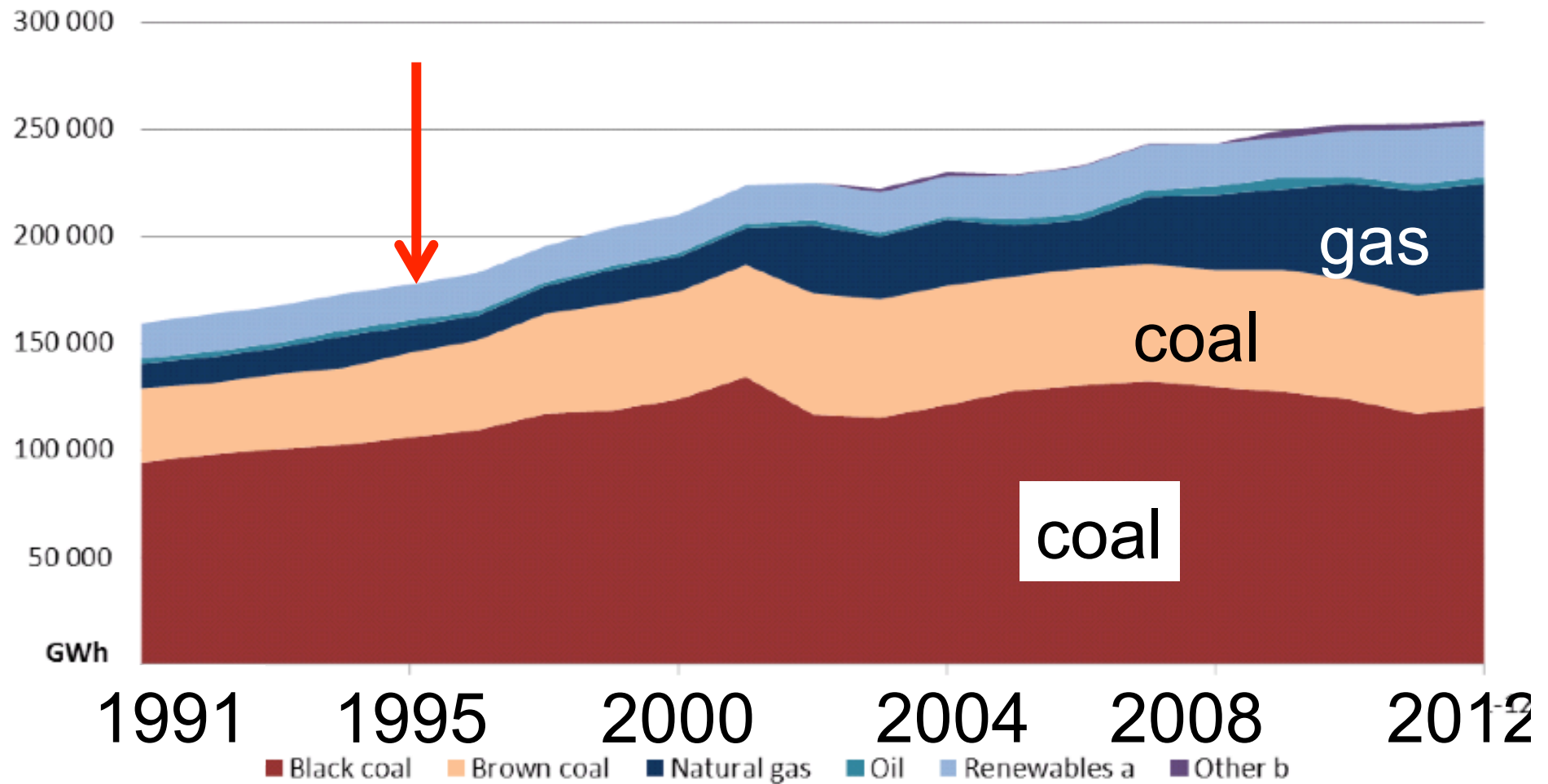
1980 - 2016: ABS 6401.0 Consumer Price Index

2017 - 2018: Adjustment (15% nominal increase) to take account of price increases announced by major elect distributors in June 2016

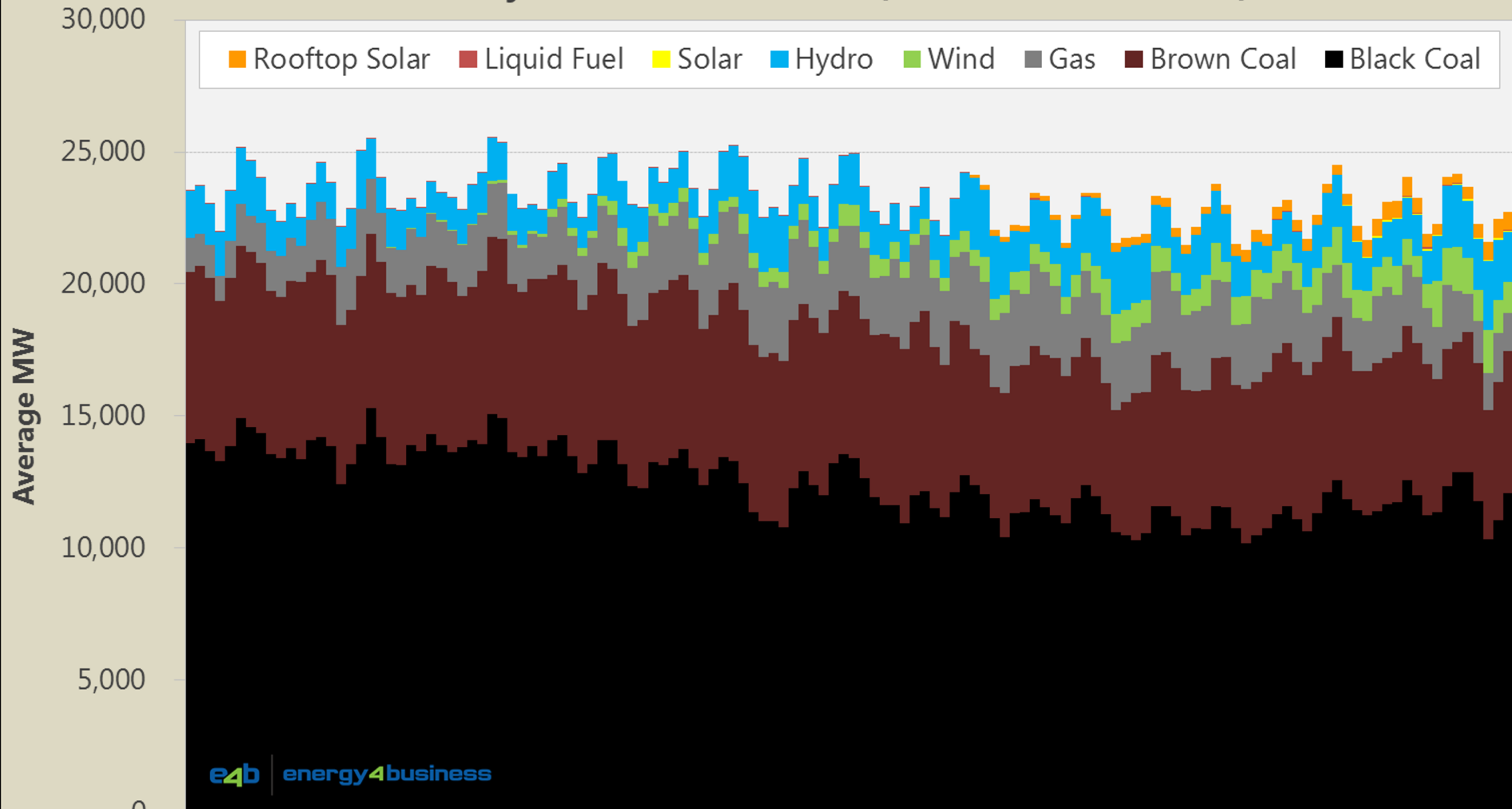
**Intermittent power generation** (Terra Watt hours, TWh) from Figure 4.2 in *Independent Review into the Future of the National Electricity Market*

The mysterious price rise?

# Electricity Generation in Australia



# NEM Electricity Generation Fuel mix (Jan 2006 to Dec 2016)



2006

2011

2016

Create jobs in...

# Haikou Hengshui

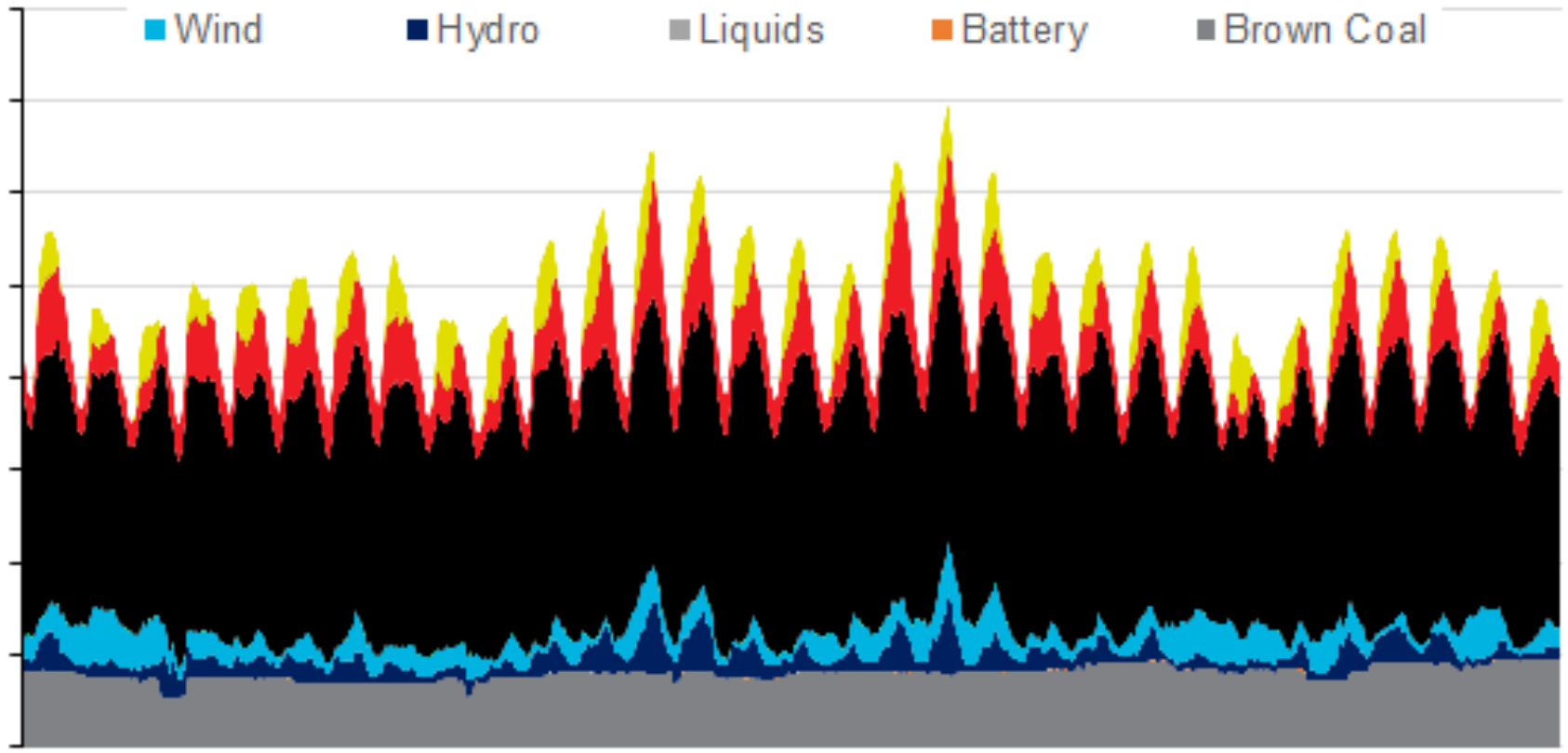
Yingli Solar production facilities



Megawatts

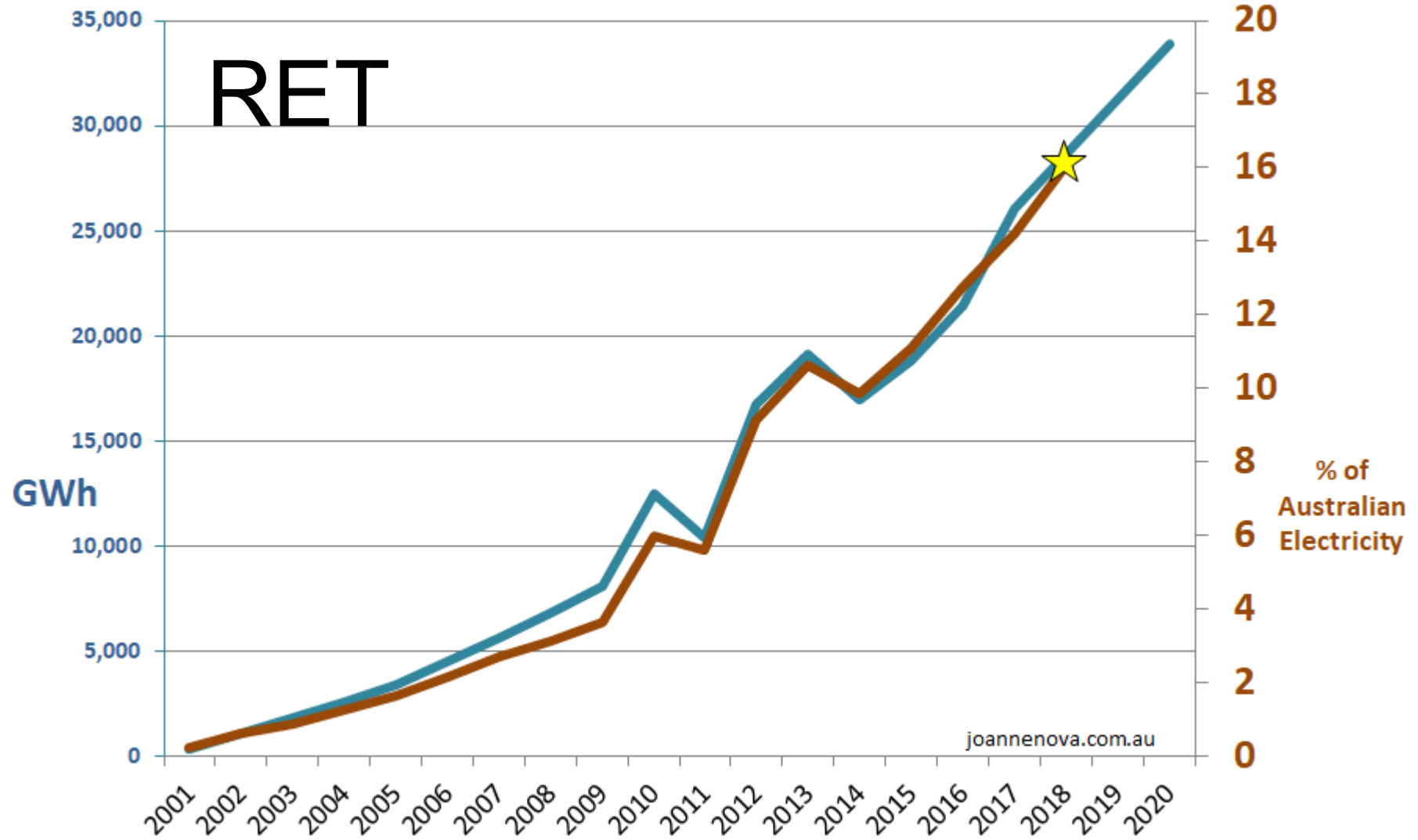
40,000  
35,000  
30,000  
25,000  
20,000  
15,000  
10,000  
5,000  
-

- Roof solar
- Solar
- Gas
- Black Coal
- Bioenergy
- Wind
- Hydro
- Liquids
- Battery
- Brown Coal





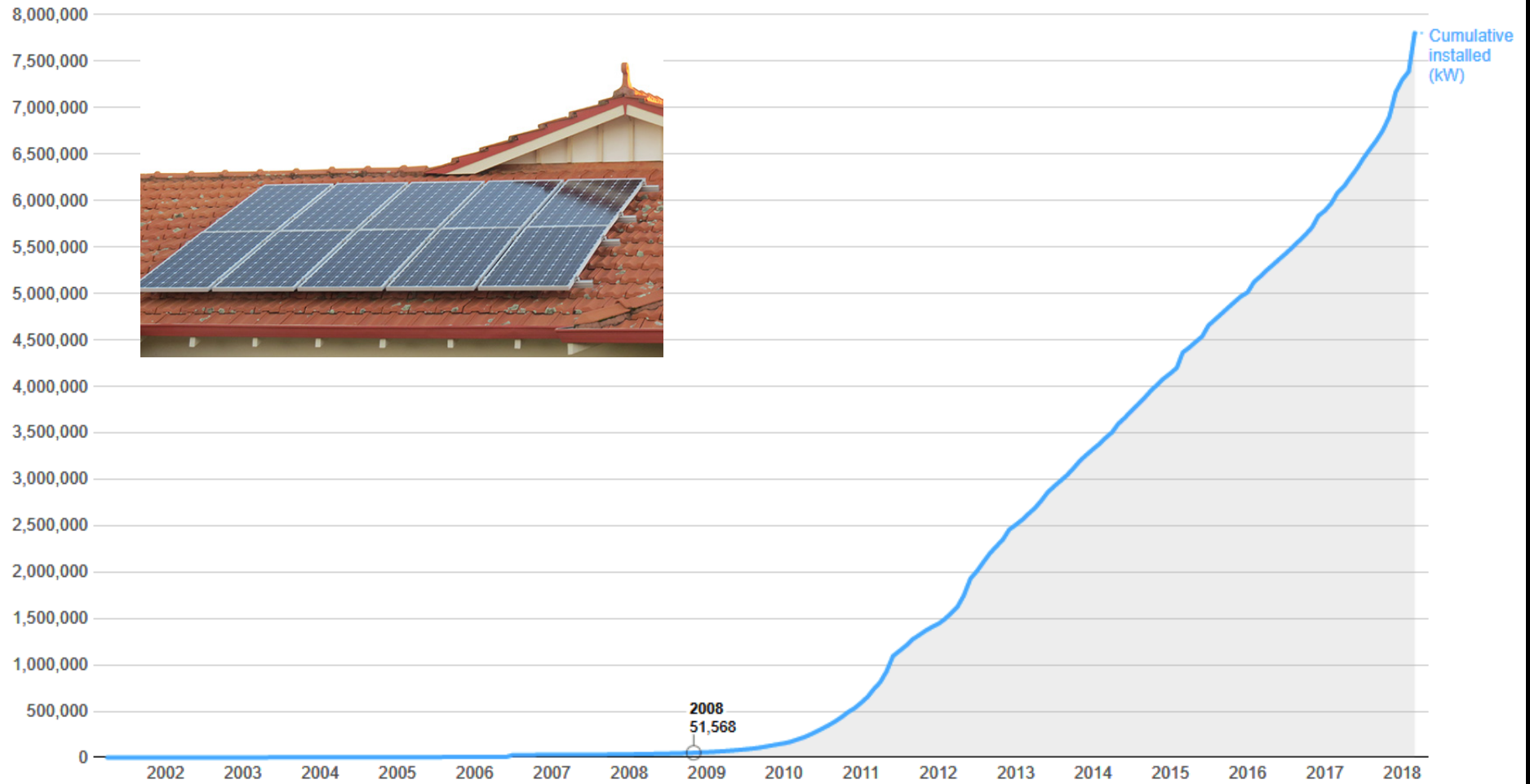
# The Australian Renewable Energy Target is rising



Source: Clean Energy Regulator

joannenova.com.au

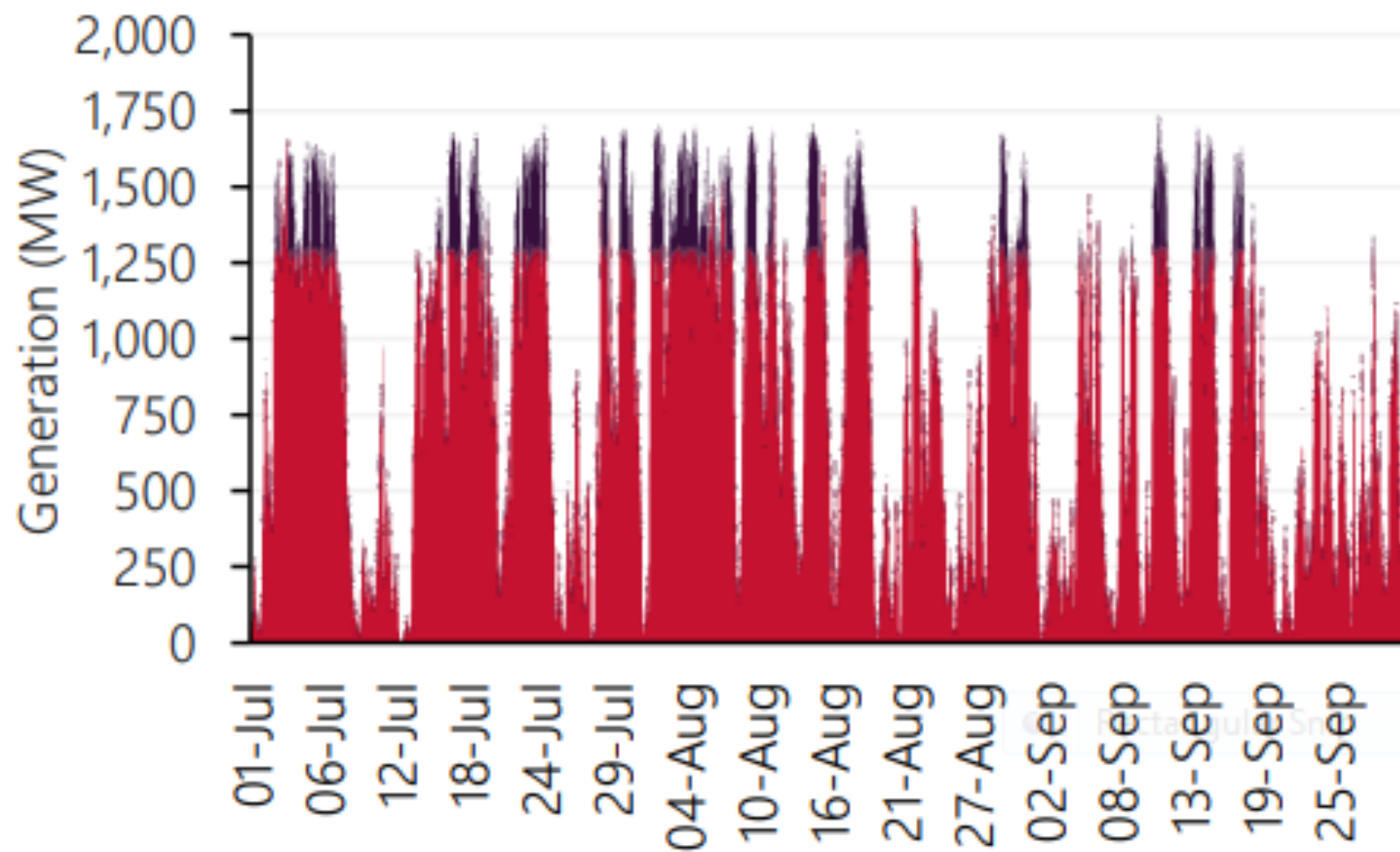
# The total capacity of solar power installed in Australia has surged in the past decade



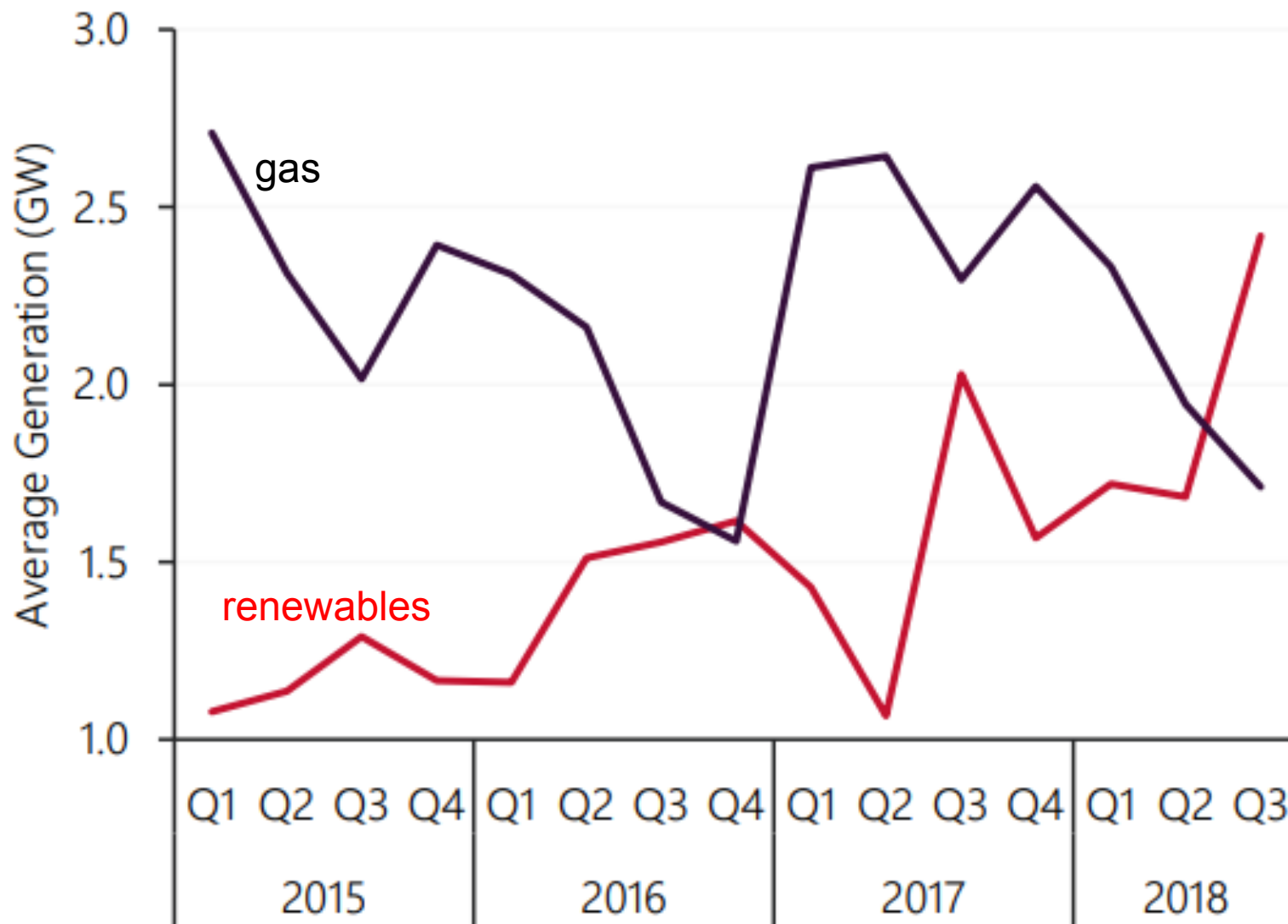
Australian PV installations since April 2001: total capacity (kW)

Source: Australian PV Institute • [Get the data](#) • [Embed](#)

**Figure 6** Generation and curtailment of non-synchronous units in South Australia

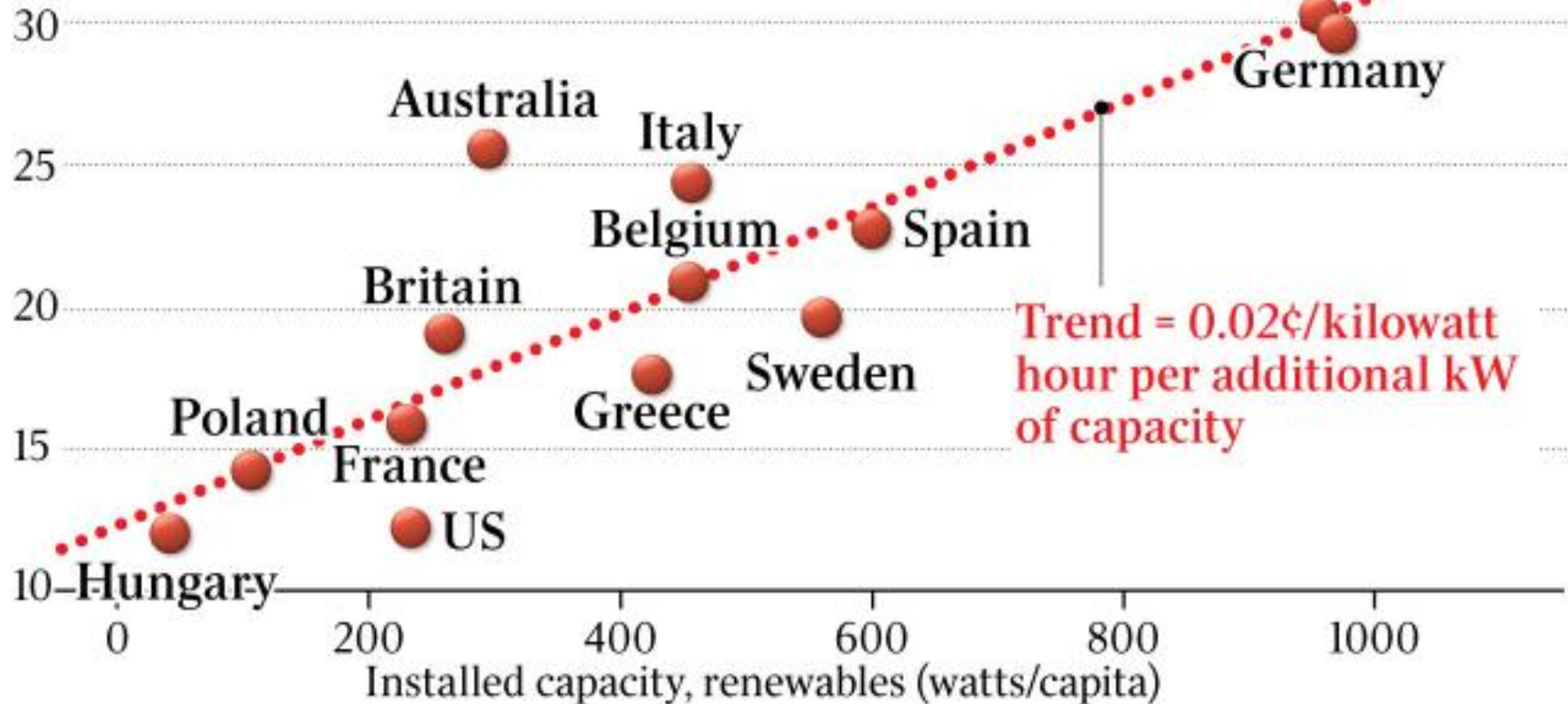


**Figure 14 Relationship between GPG and VRE output**

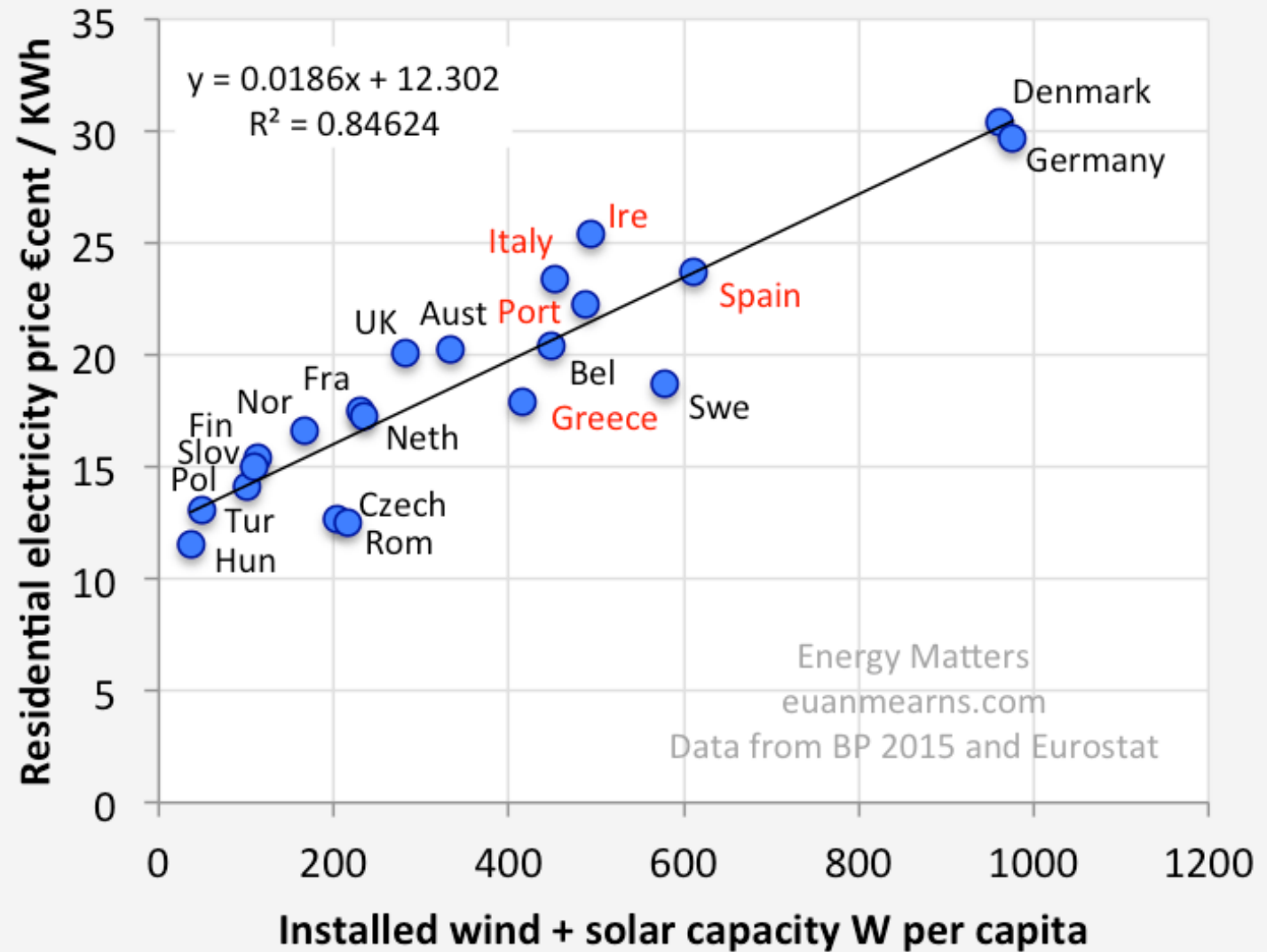


# OUT OF LINE ON RENEWABLES

Electricity costs (¢ per kilowatt hour)



# Europe Electricity Price v Installed Wind + Solar Capacity



No hydro power  
No Biomass





Cashmoney



# Cost of blackouts

- South Australia Sept 28<sup>th</sup>: **\$472 m**
- Tasmania, Basslink Cable : **\$560 m**

It takes a lot of money...

\$3.7b federally in 2016

\$1.2b in states

Table 6 Subsidies to renewables



---

1822
240
154
239
674
69
~500
<b>3698</b>
350
317
6
439
62
<b>1172</b>
<hr/> <b>4870</b>

JoNova

Step 1:

Industrial Electrical Generation Plant  
Global Climate Controller







Image: Jenny Dowell



Yallourn Coal plant, Victoria

Philip Jessop



# Better generators



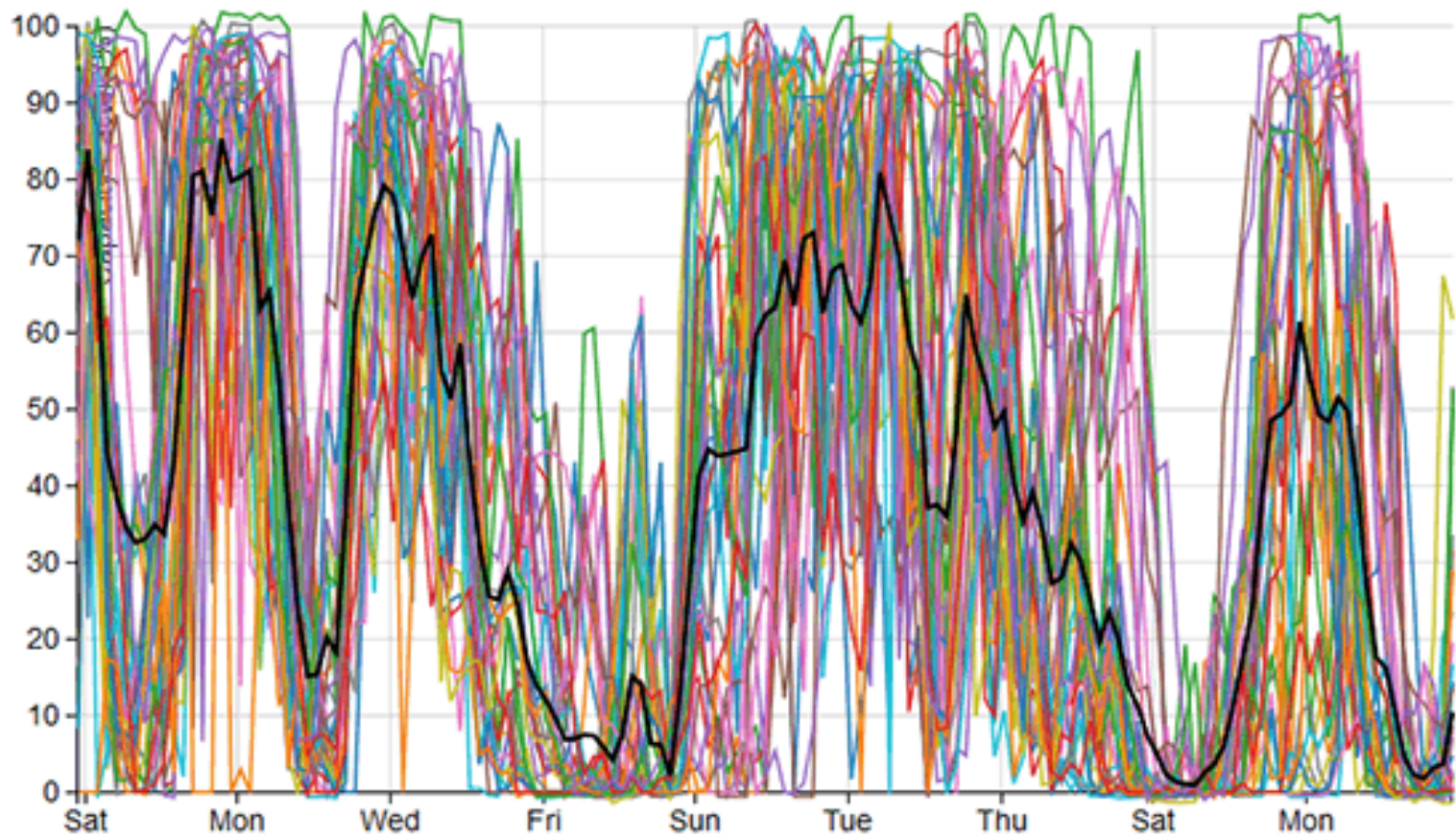
# Step 2:

Pick intermittent,  
unreliable, and inefficient  
ways to do it.

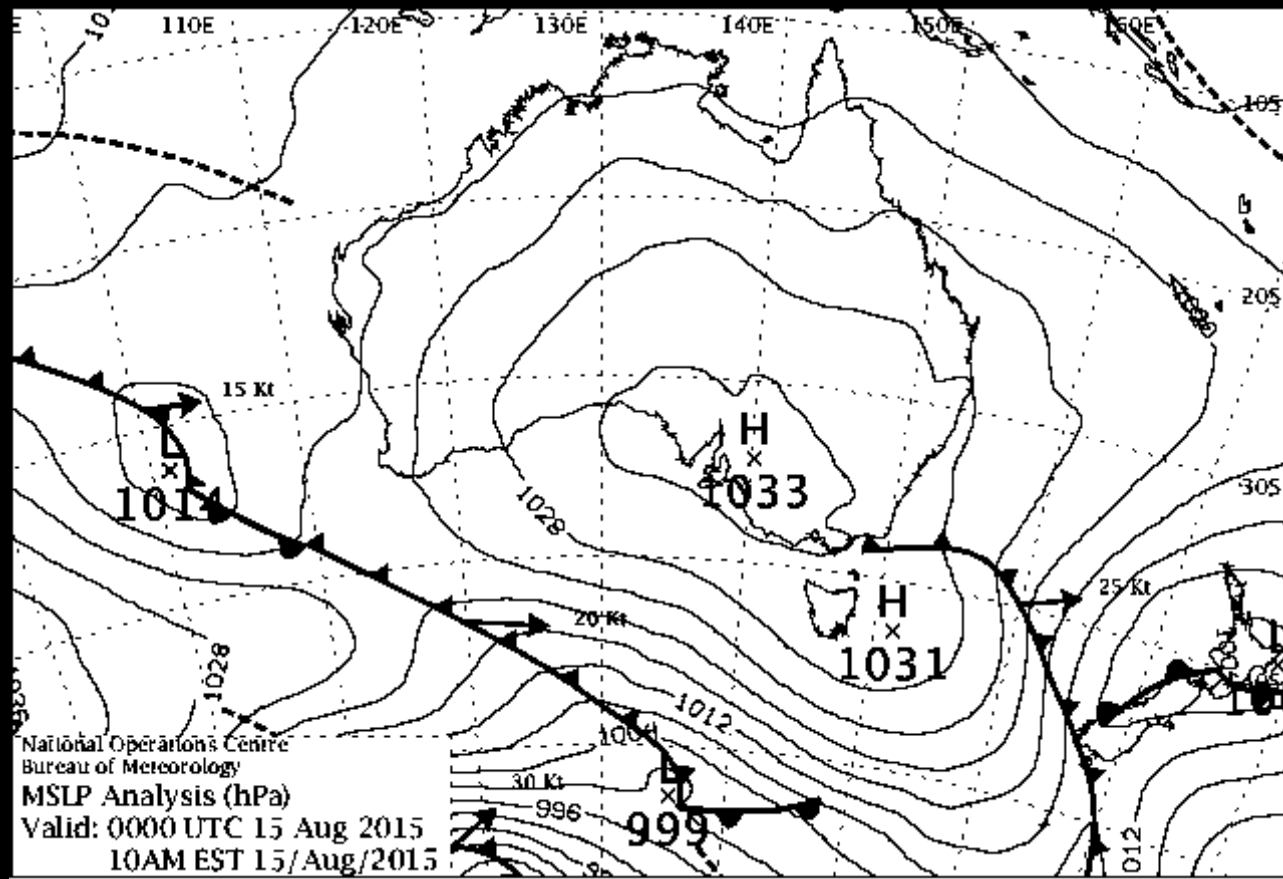


# Wind Energy Production During August 2015

% MW



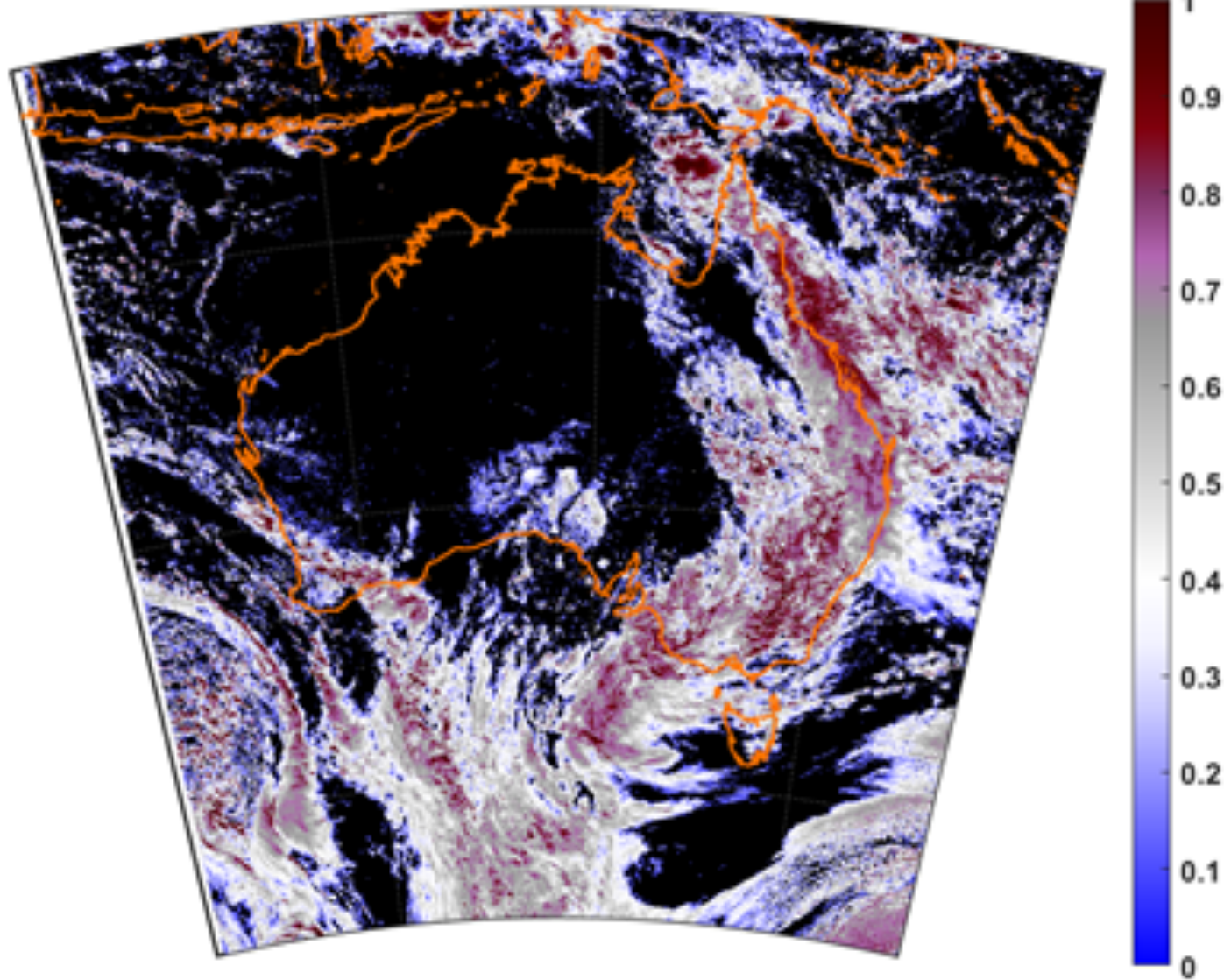
- |  |  |  |  |  |  |
|--|--|--|--|--|--|
| <input checked="" type="checkbox"/> BOCORWF1 | <input checked="" type="checkbox"/> CAPTL_WF | <input checked="" type="checkbox"/> CULLRGWF | <input checked="" type="checkbox"/> GULLRWF1 | <input checked="" type="checkbox"/> GUNNING1 | <input checked="" type="checkbox"/> TARALGA1 |
| <input checked="" type="checkbox"/> WOODLWF1 | <input checked="" type="checkbox"/> BLUFF1   | <input checked="" type="checkbox"/> CATHROCK | <input checked="" type="checkbox"/> CLEMGPWF | <input checked="" type="checkbox"/> CNUNDAWF | <input checked="" type="checkbox"/> HALLWF1  |
| <input checked="" type="checkbox"/> HALLWF2  | <input checked="" type="checkbox"/> LKBONNY1 | <input checked="" type="checkbox"/> LKBONNY2 | <input checked="" type="checkbox"/> LKBONNY3 | <input checked="" type="checkbox"/> MTMILLAR | <input checked="" type="checkbox"/> NBHWF1   |
| <input checked="" type="checkbox"/> SNOWNTH1 | <input checked="" type="checkbox"/> SNOWSTH1 | <input checked="" type="checkbox"/> SNOWTWN1 | <input checked="" type="checkbox"/> STARHLWF | <input checked="" type="checkbox"/> WATERLWF | <input checked="" type="checkbox"/> WPWF     |
| <input checked="" type="checkbox"/> MUSSELR1 | <input checked="" type="checkbox"/> WOOLNTH1 | <input checked="" type="checkbox"/> BALDHWF1 | <input checked="" type="checkbox"/> CHALLHWF | <input checked="" type="checkbox"/> MACARTH1 | <input checked="" type="checkbox"/> MERCER01 |
| <input checked="" type="checkbox"/> MLWF1    | <input checked="" type="checkbox"/> OAKLAND1 | <input checked="" type="checkbox"/> PORTWF   | <input checked="" type="checkbox"/> WAUBRAWF | <input checked="" type="checkbox"/> YAMBUKWF | <input checked="" type="checkbox"/> Subtotal |
| <input checked="" type="checkbox"/> Total    |  |  |  |  |  |
| <input checked="" type="checkbox"/> ACT1     | <input checked="" type="checkbox"/> NSW1     | <input checked="" type="checkbox"/> QLD1     | <input checked="" type="checkbox"/> SA1      | <input checked="" type="checkbox"/> TAS1     | <input checked="" type="checkbox"/> VIC1     |



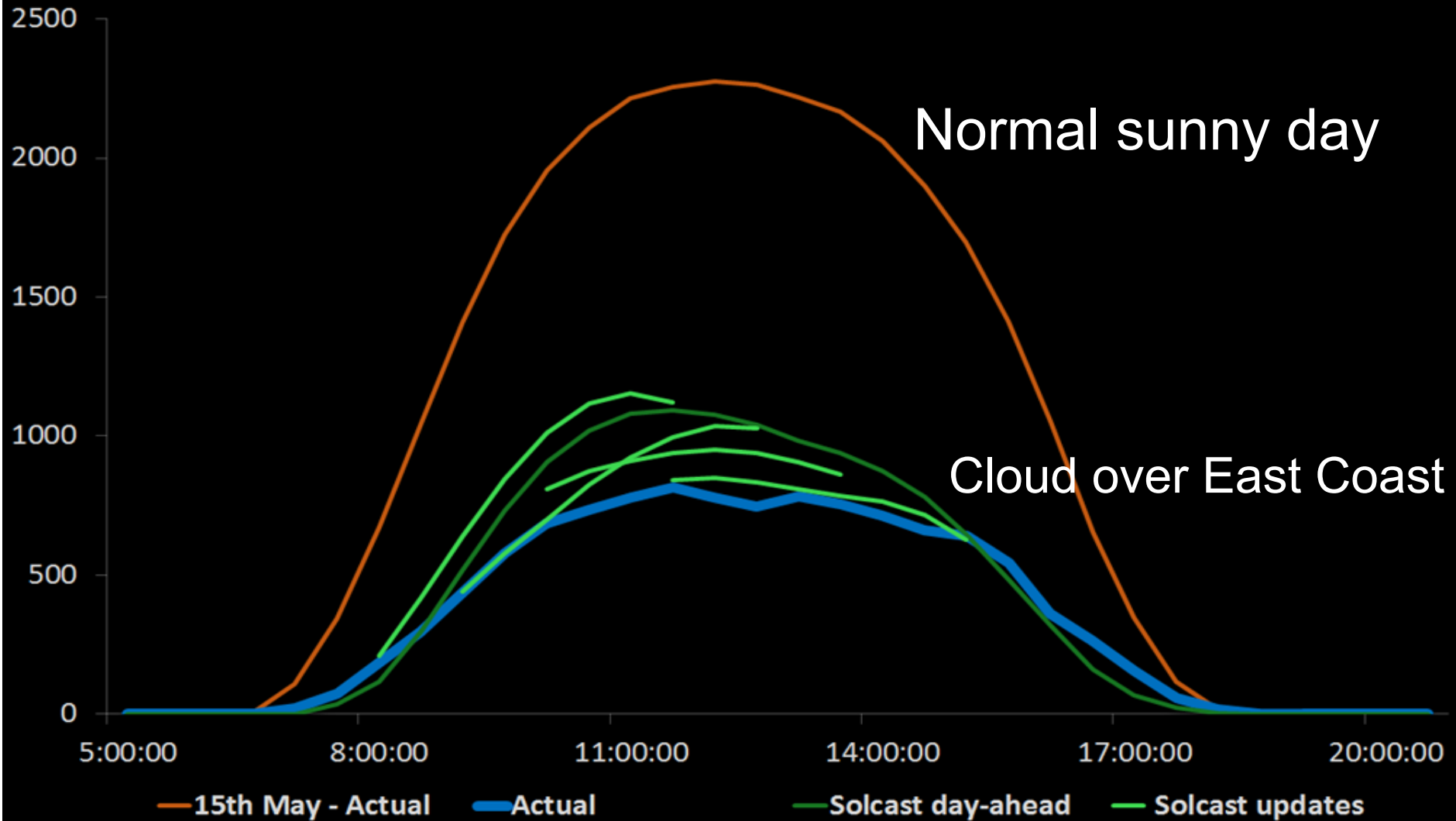
- Australian synoptic chart, August 15th, 2015.

# Solar power

Satellite Cloud Opacity - Solcast 1200 AEST 19th May 2017



# NEM Total Rooftop PV (MW) - 19th May 2017









Step 3:

**Big Government**

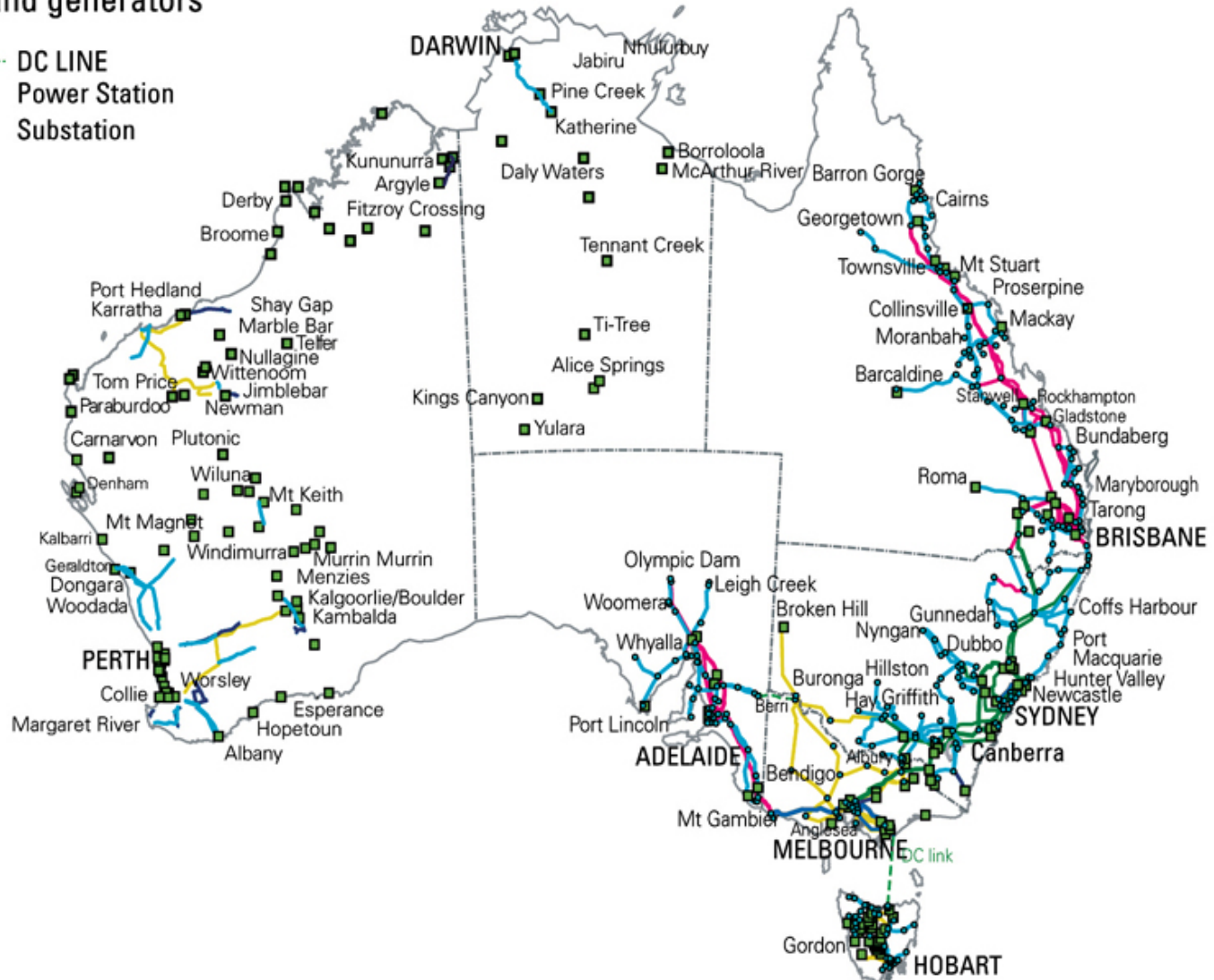


1900 Trams on King St

# Energy in Australia 2009

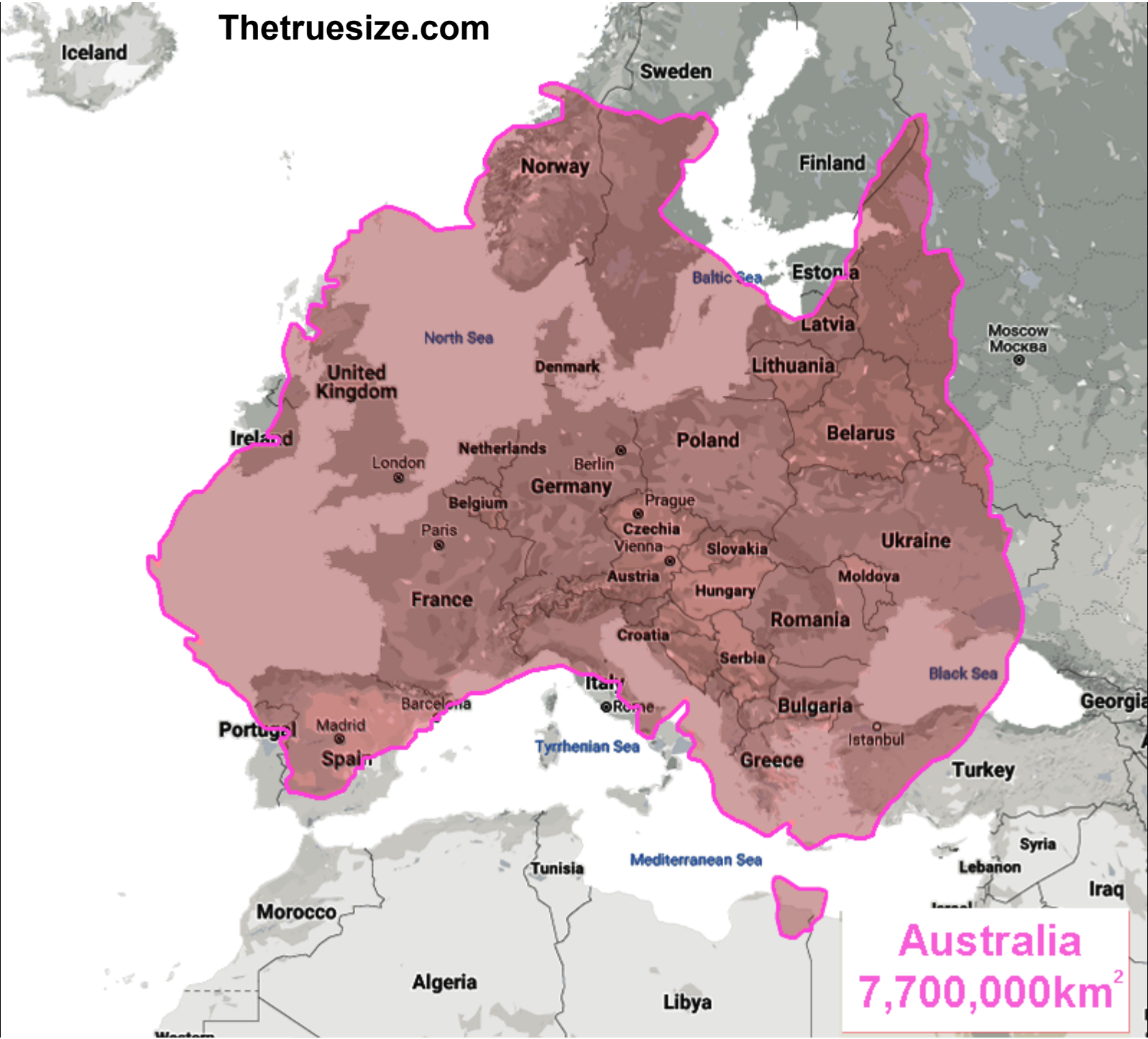
## Transmission lines and generators

- 500 kV
- 330 kV
- 275 kV
- 220 kV
- 132 / 110 kV
- 66 kV
- 33 / 22 kV
- - - DC LINE
- Power Station
- Substation



Locations are indicative only.

Sources: NEMMCO, NT PowerWater, WA Office of Energy



# Pick the right person



Audrey Zibelman

“I believe we’re the last generation on earth who can really do something about climate change.”

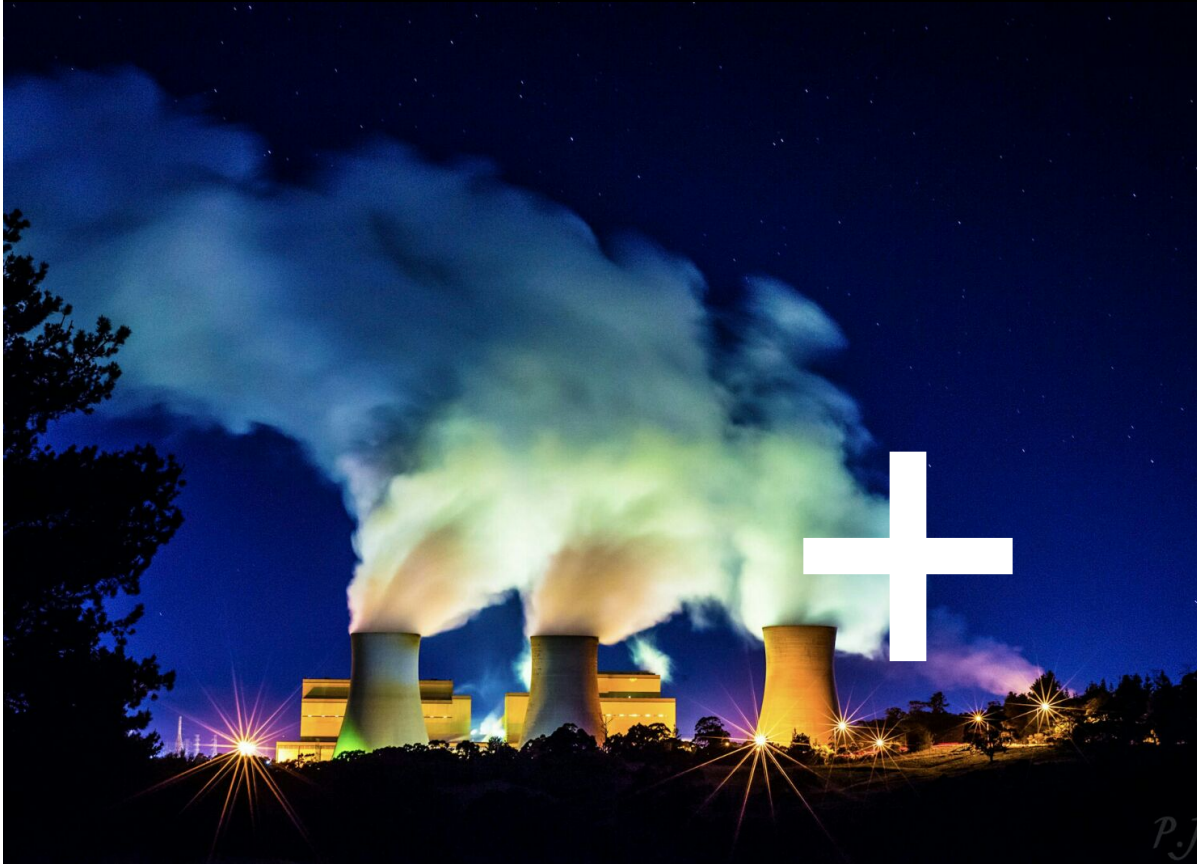
“...technology has changed, and resisting this change is a little like trying to resist the internet.

“... we don’t have to worry about sacrificing economics for good environmental policy.”



Step 4:

Cripple the free market.



*P.J.*

Yallourn Coal plant, Victoria  
Phillip Jessop

Mattinbgn

8C +

Crypto  
from  
China



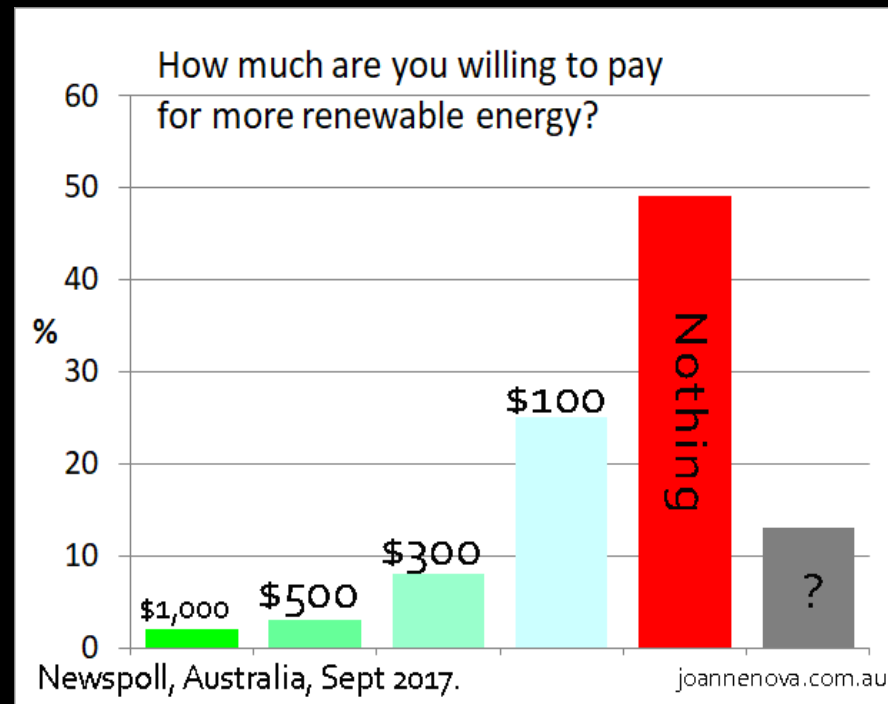
P.J.

# “Big fear”

- Big players may leave the grid.
- Leaving fewer customers to pay for the cost.



62% of  
Australians don't  
want to pay even \$10  
a month for  
renewables

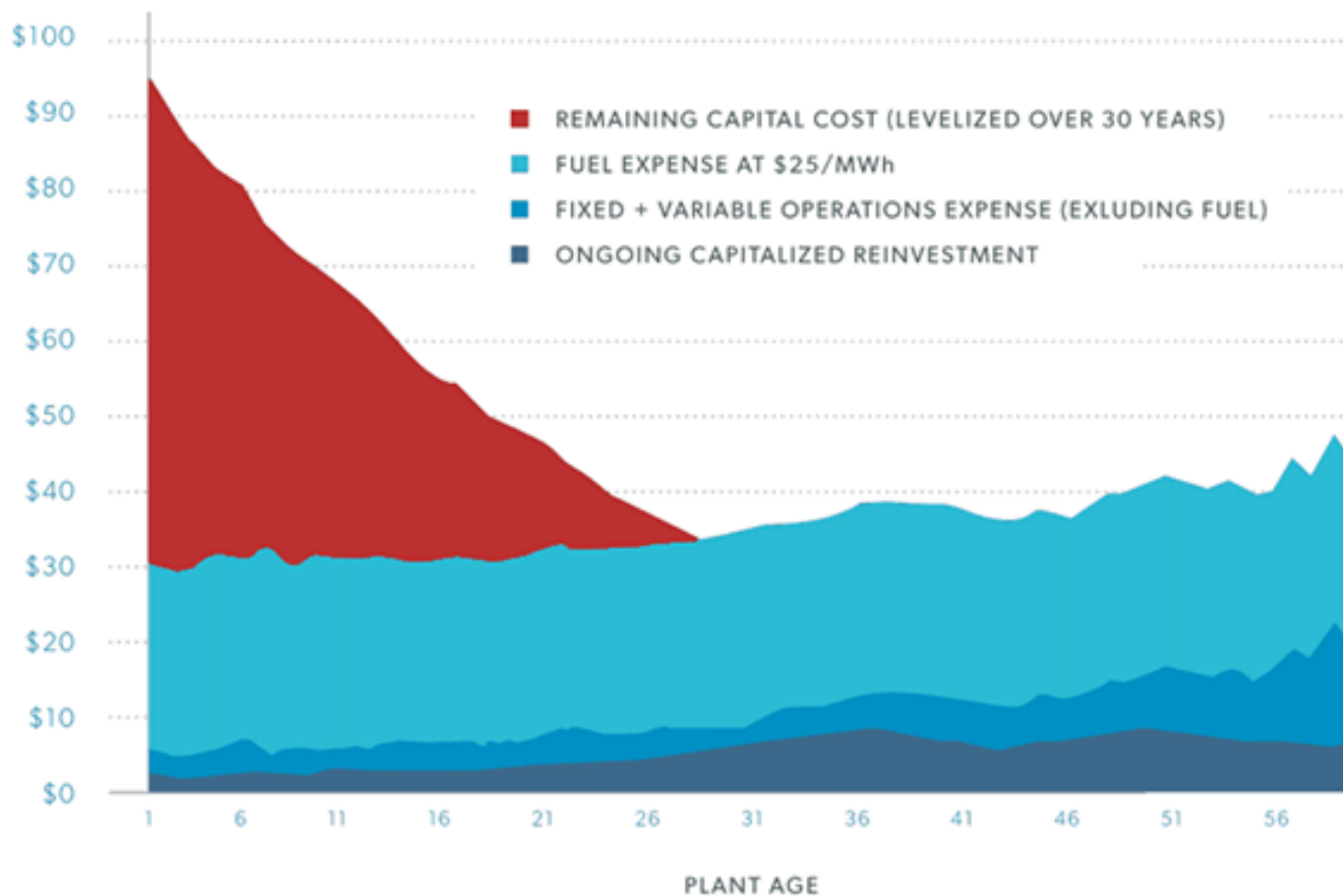


61% of Germans don't want to pay one more euro  
cent....

42% of US adults don't want to pay even \$1  
a month to stop climate change



## LCOE FROM COAL IN 2012 \$/MWh BY PLANT AGE 30 YEAR OUTLOOK



Stacy, T. Taylor, G. (2015) [The Levelized Cost of Electricity from Existing Generation Sources](#), Institute for Energy Research (IER), based on EIA figures in the USA.

ersPower  
IAHON  
VICES





Liddell

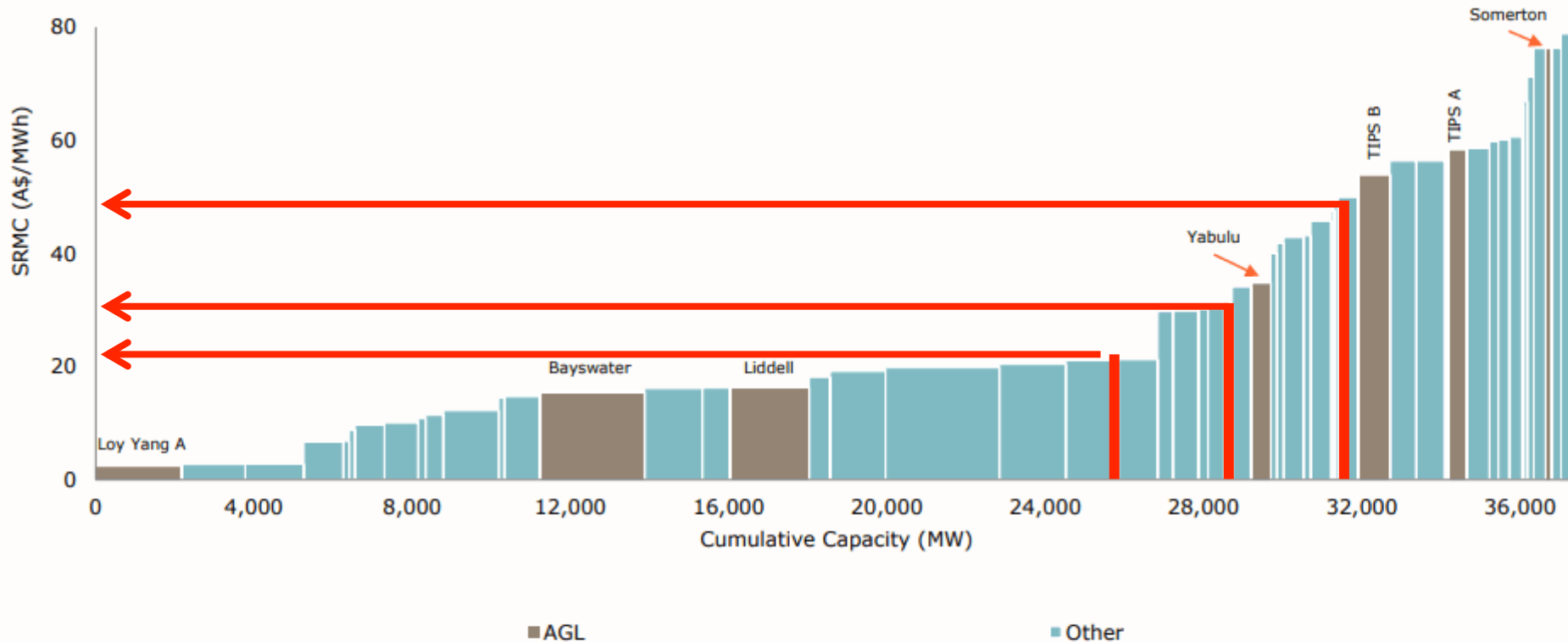


Hazelwood Power Station

Simpsonsfan66



NEM Thermal Merit Order (Carbon Exclusive)<sup>1,2</sup>



- > Macquarie Generation Acquisition
- > 20 August 2014
- > AGL External

1. Source: AEMO 2013 Planning Studies – Existing Generator technical Data Summary as at 23 May 2014. Real June 2013
2. Excludes plants with SRMC > \$350/MWh including Angaston, Snuggery, Port Lincoln, Mt Stuart and Mackay

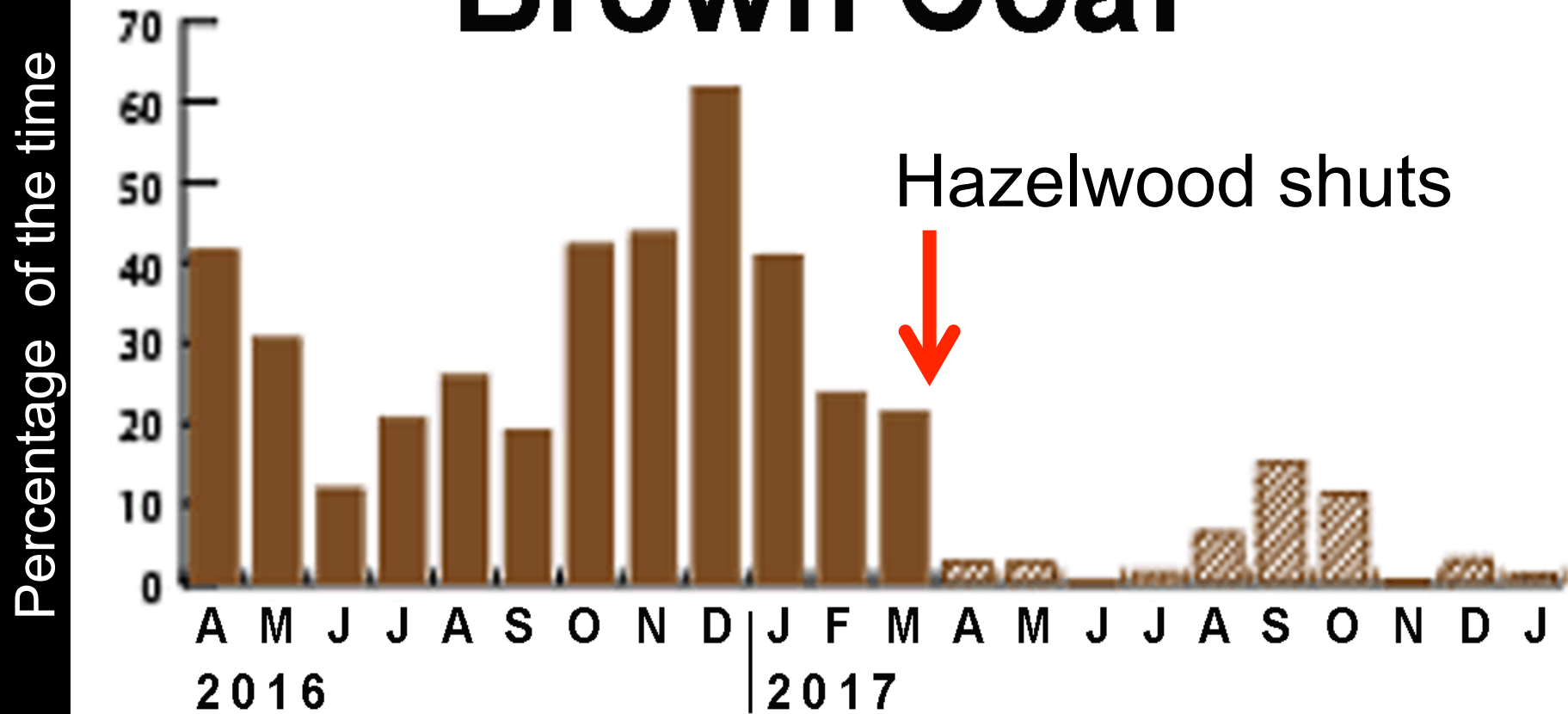


NOT FOR DISTRIBUTION OR RELEASE IN THE UNITED STATES

\* Not graphed, most diesel plants costing more than \$350/MWh



# Brown Coal



Price setting in Victoria

Signs of  
success



# BLUESCOPE

“...energy costs in the United States were up to 10 times lower than this company pays  
...” -- Paul O'Malley, CEO

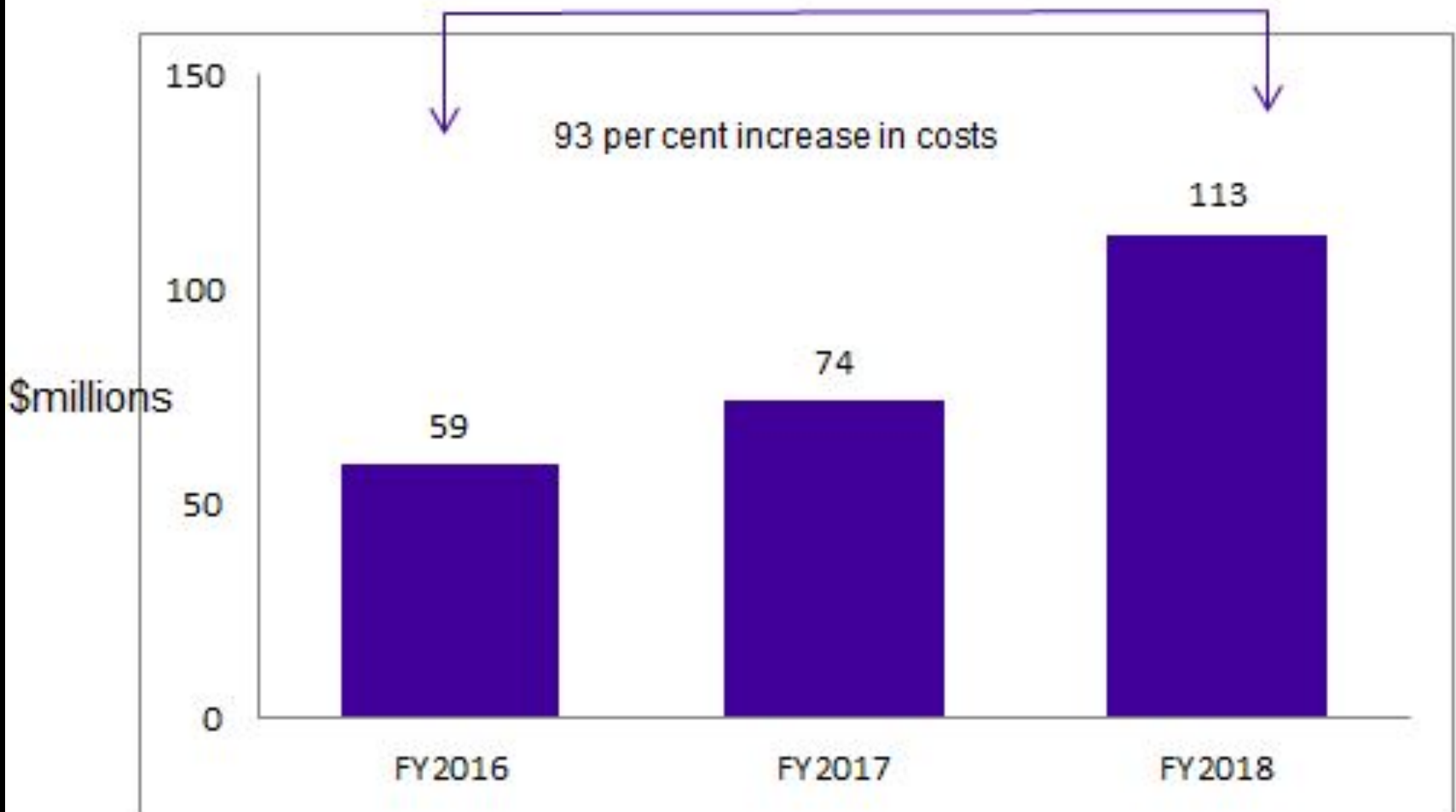
[VIEW ALL](#)

[BLUESCOPE NEWS](#)

[VIEW ALL](#)

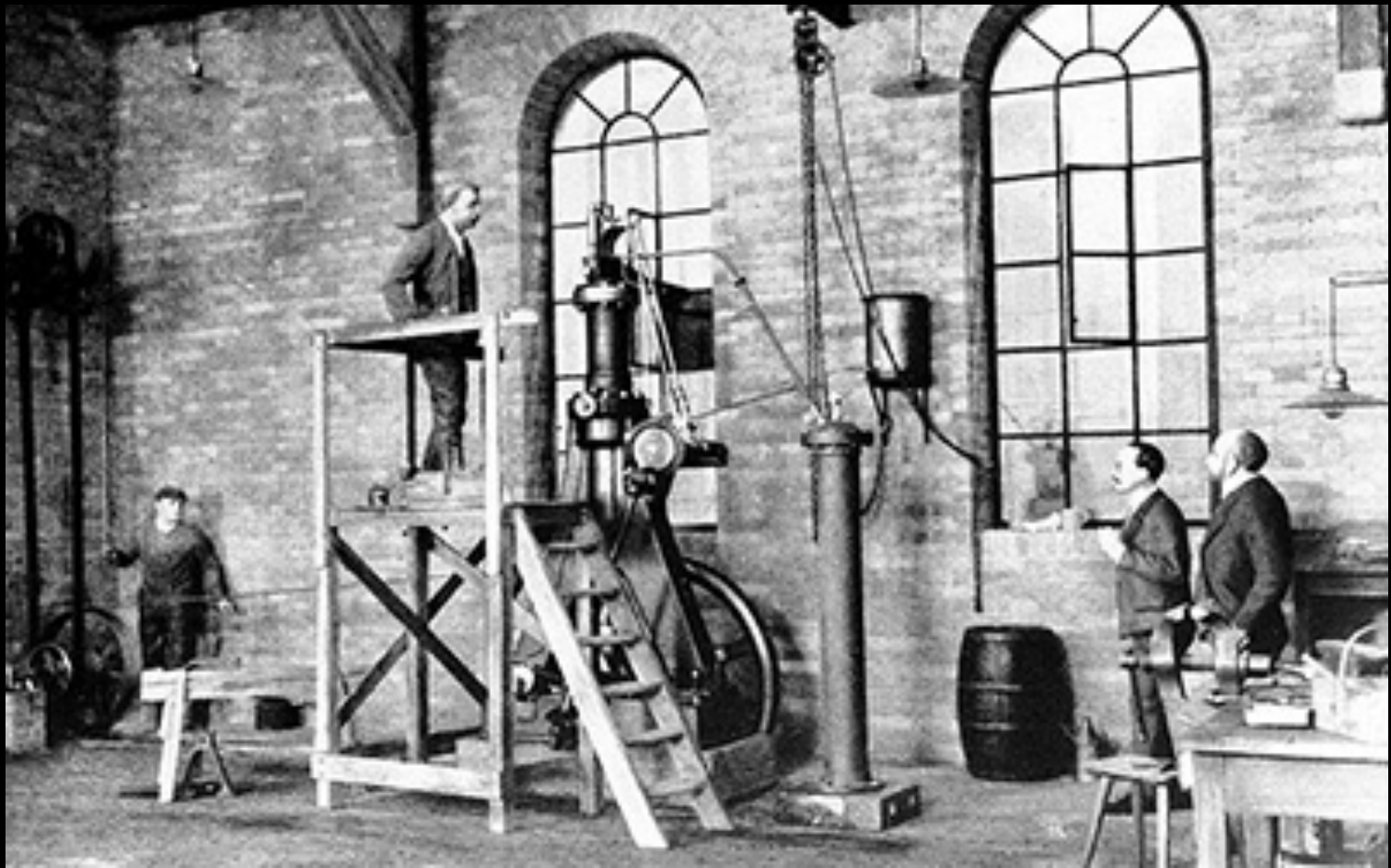
[VIDEOS](#)











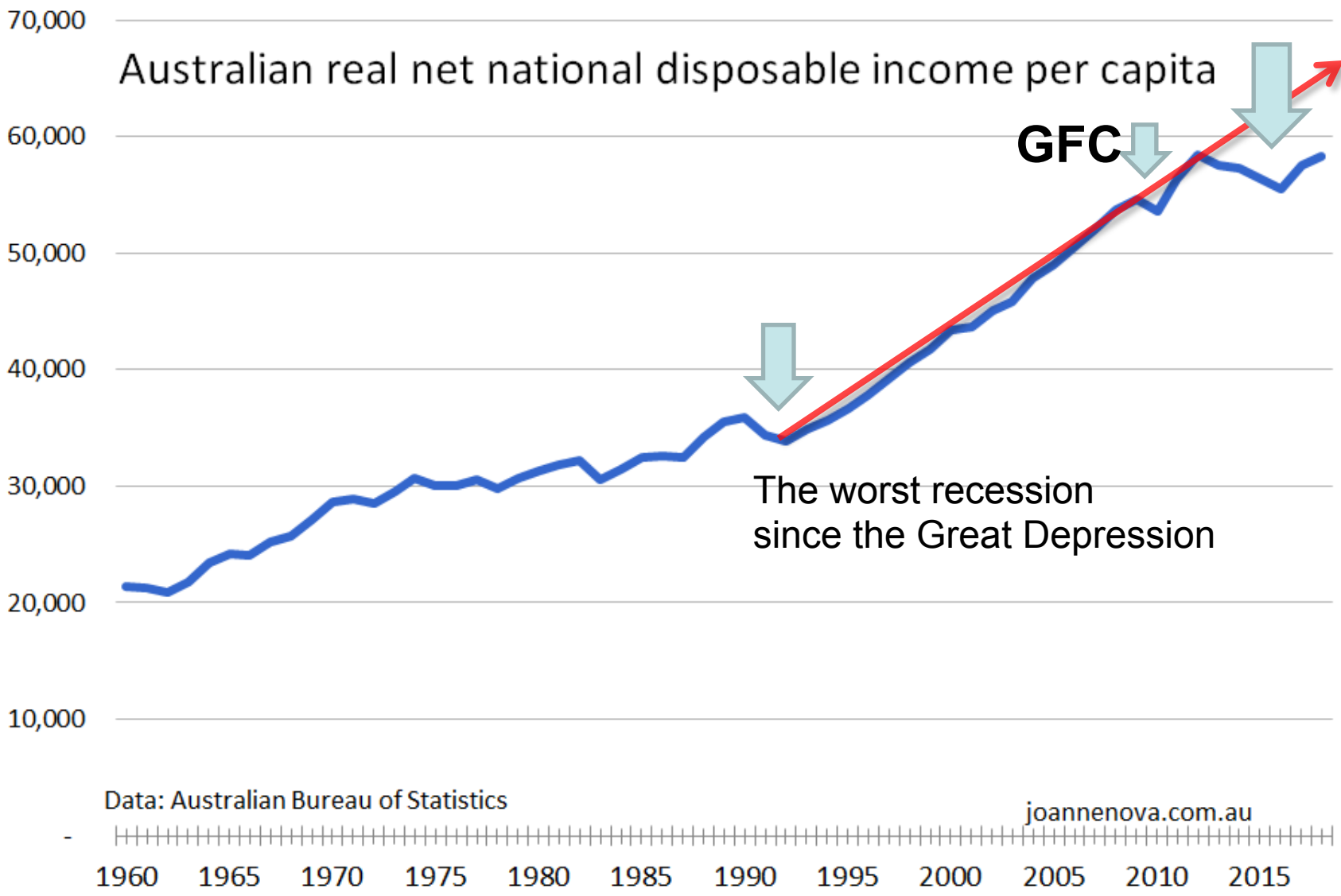
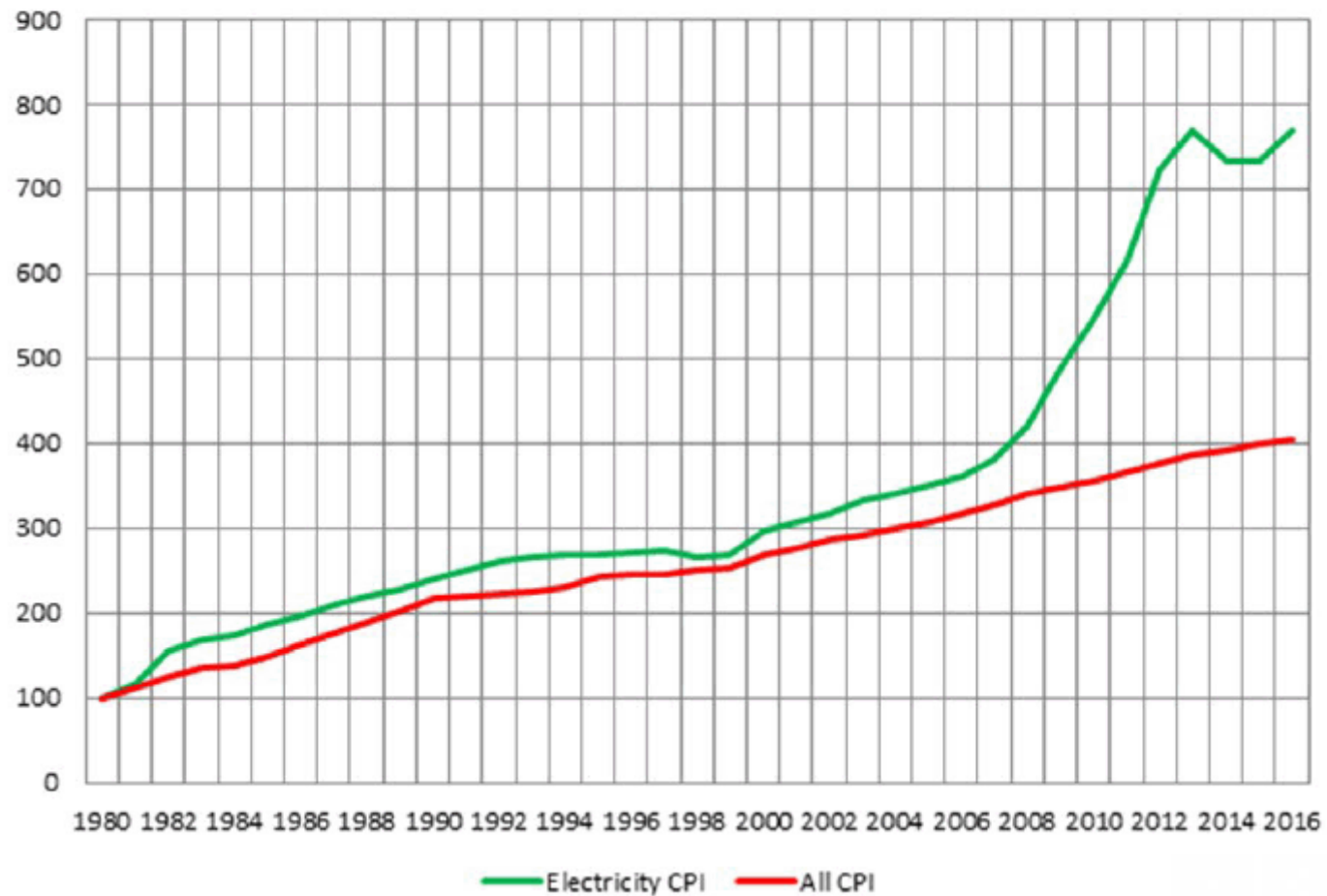
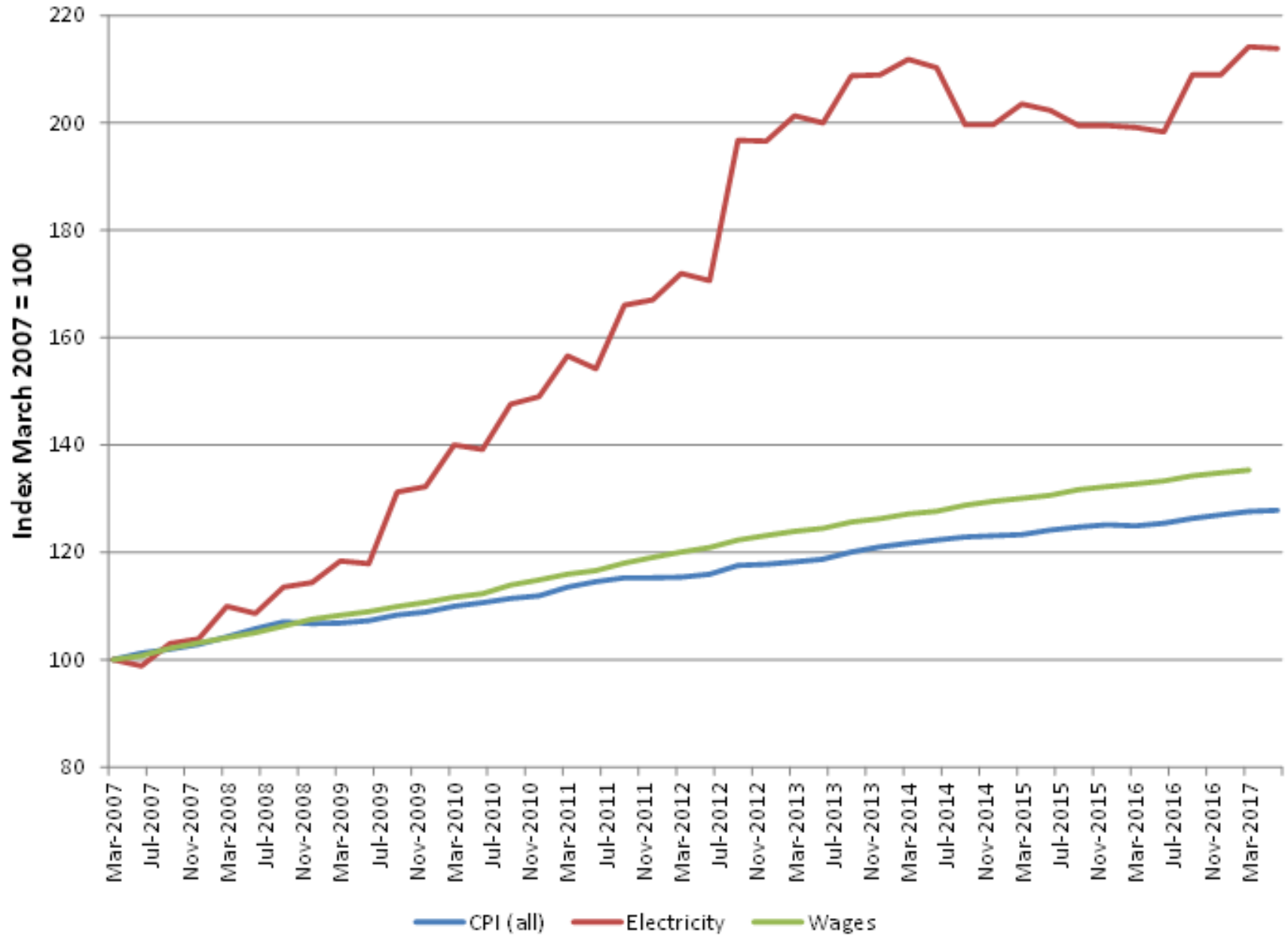


Figure 1 Electricity prices

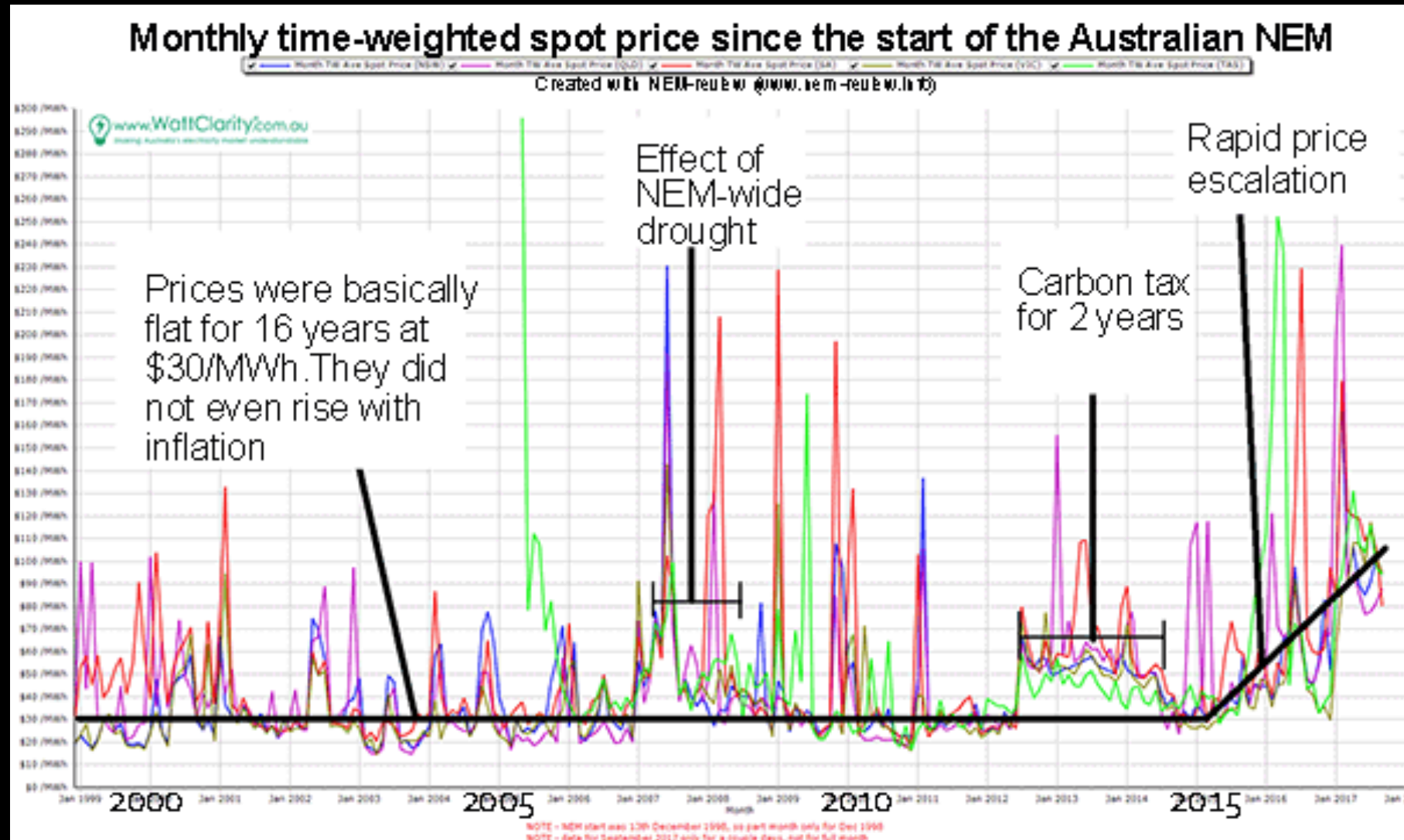
CPI All & Electricity | Dec-on-Dec Accumulation |  
Source ABS: 1980=100



### CPI for electricity compared with other sectors and wage growth

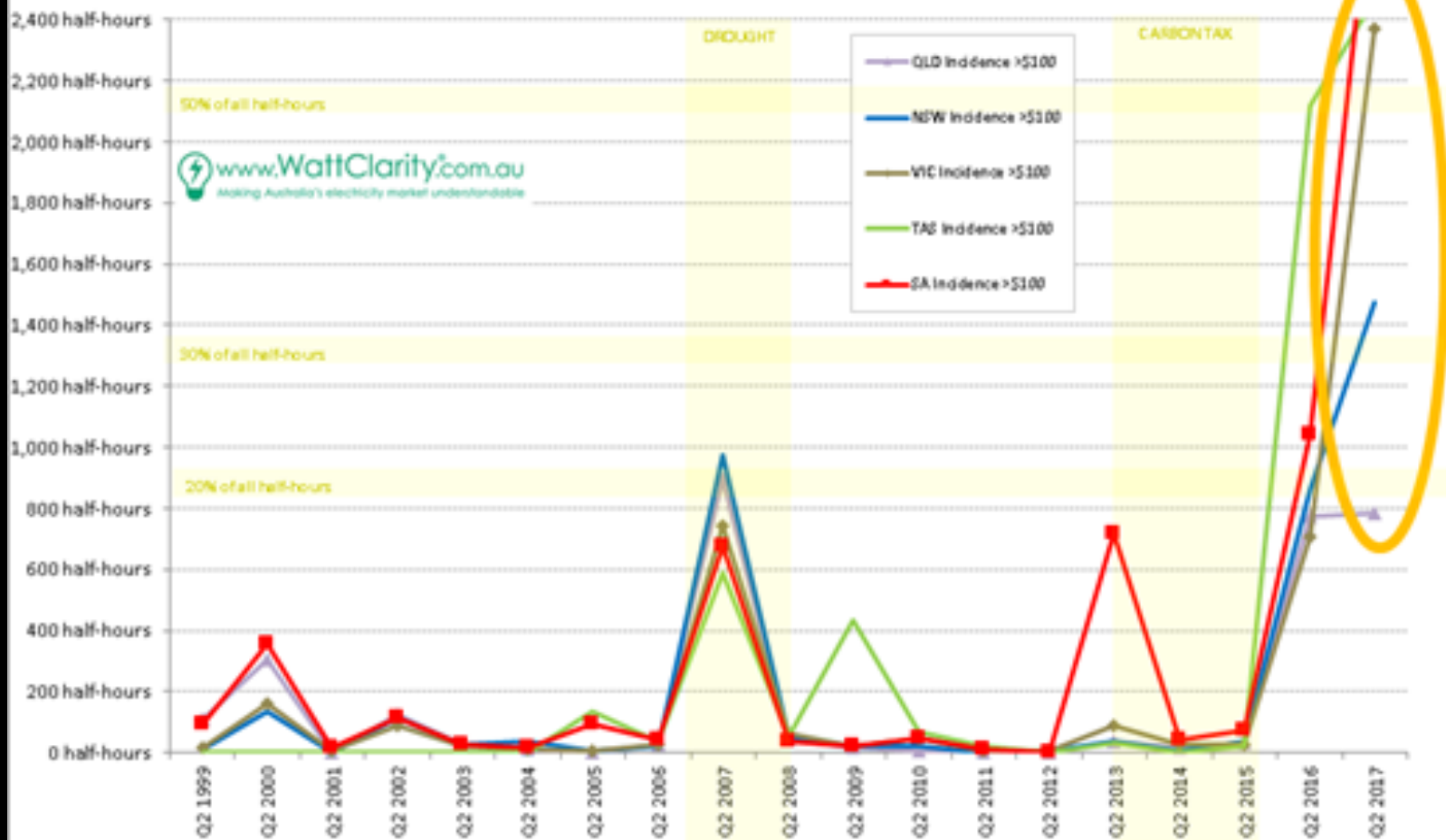


# Prices did not even rise with inflation





**Trended Incidence of Prices >\$100/MWh**  
 all 5 Regions, for Q2 in each year since NEM start  
 with data extracted from NEM-Review ([www.NEM-Review.info](http://www.NEM-Review.info))



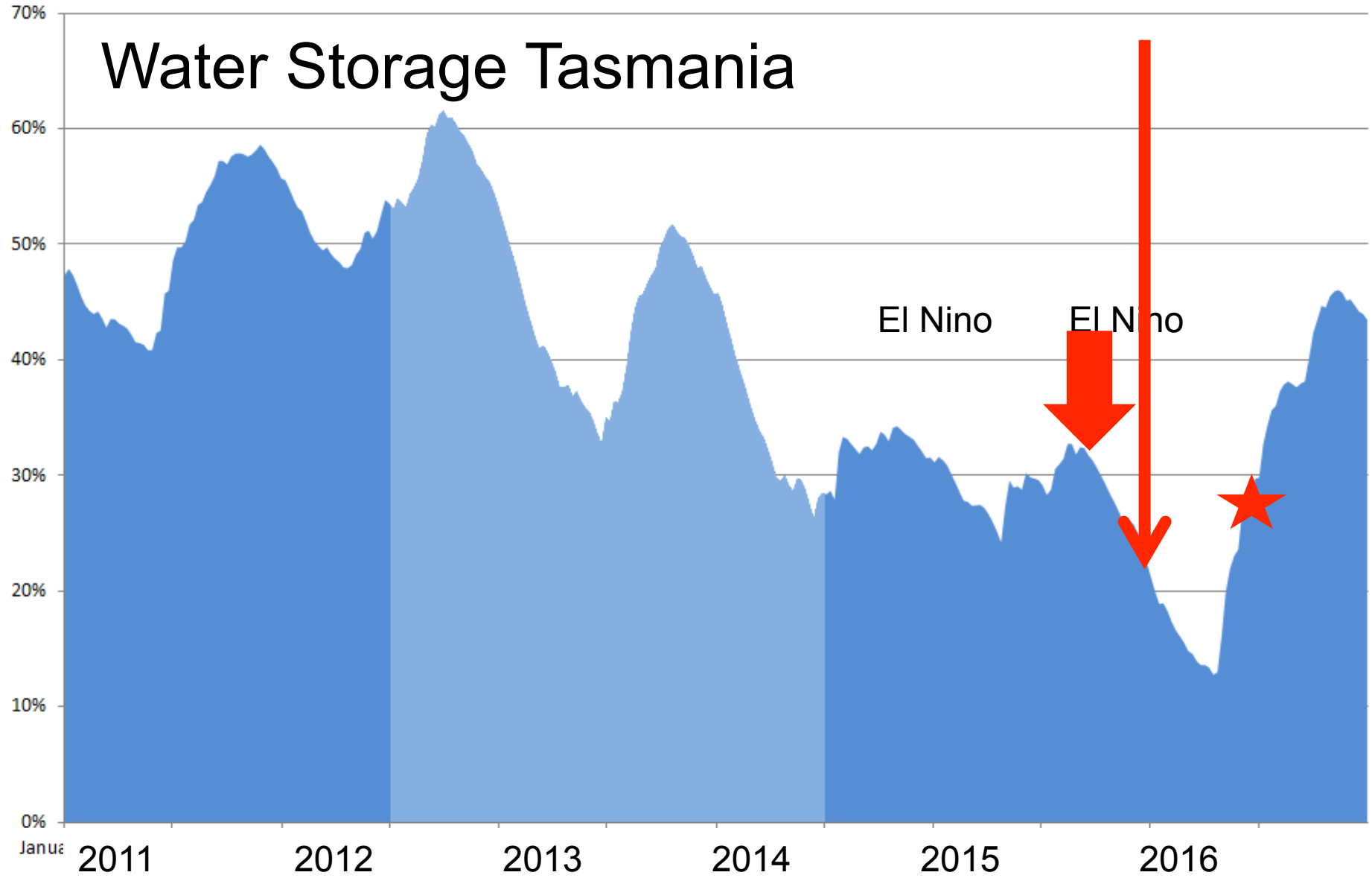
# Flinders Island

- Diesel
- In the “Roaring Forties”
- Ideal for tidal energy.
- when they achieve 100% “renewable” prices *won't be going down.*





# Water Storage Tasmania



- Tamer Valley gas station

Built in 2009:  
\$230 m





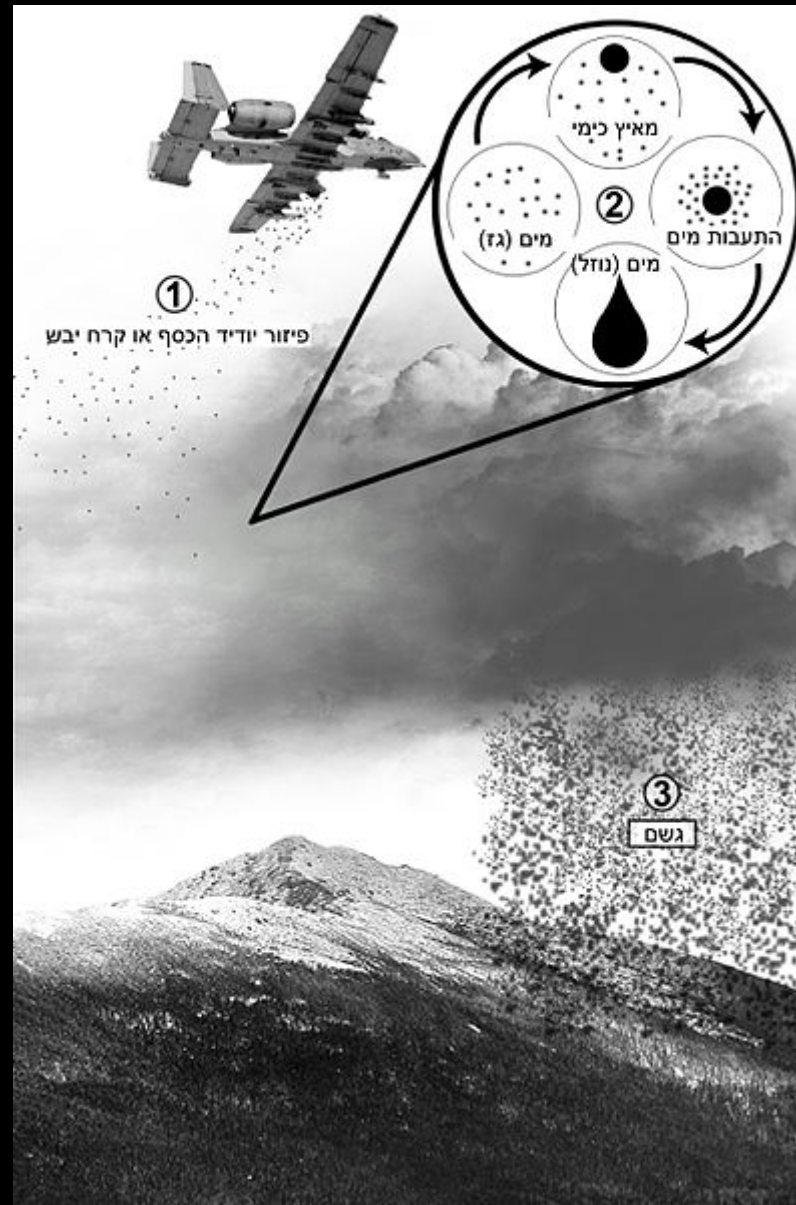








Picture: Jakob De Zwart

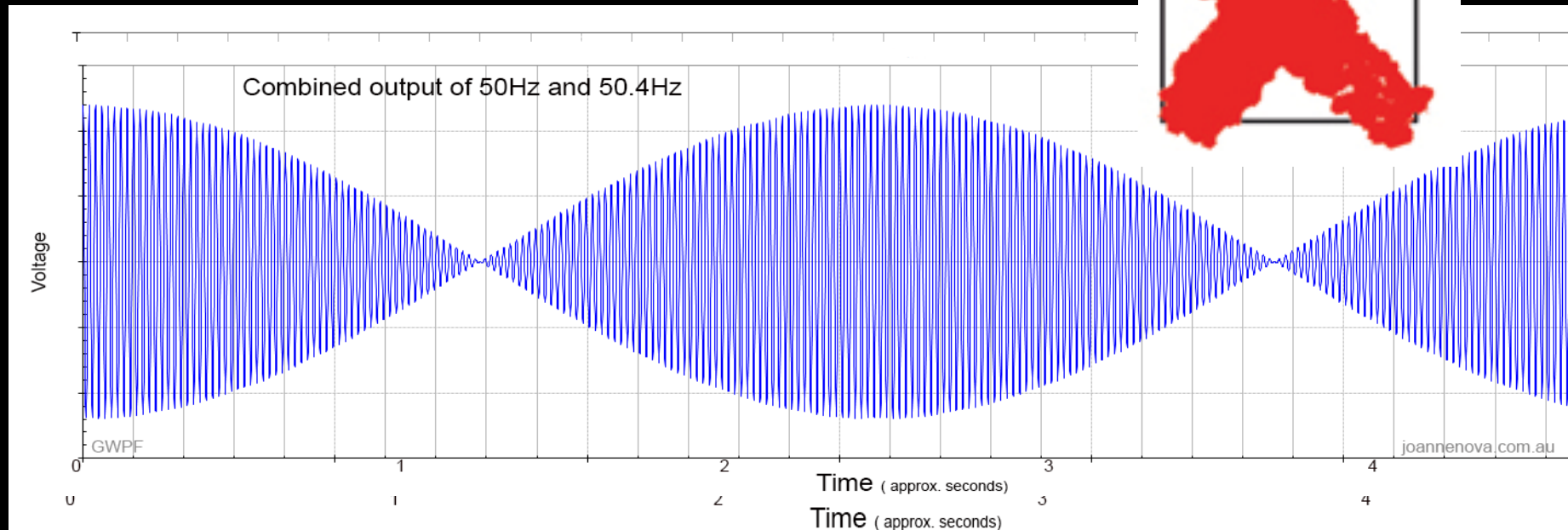


# Grid Basics



“Frequency”

50Hz + 50.4Hz



0

1

2

3

4



48.85 – 50.15 Hz

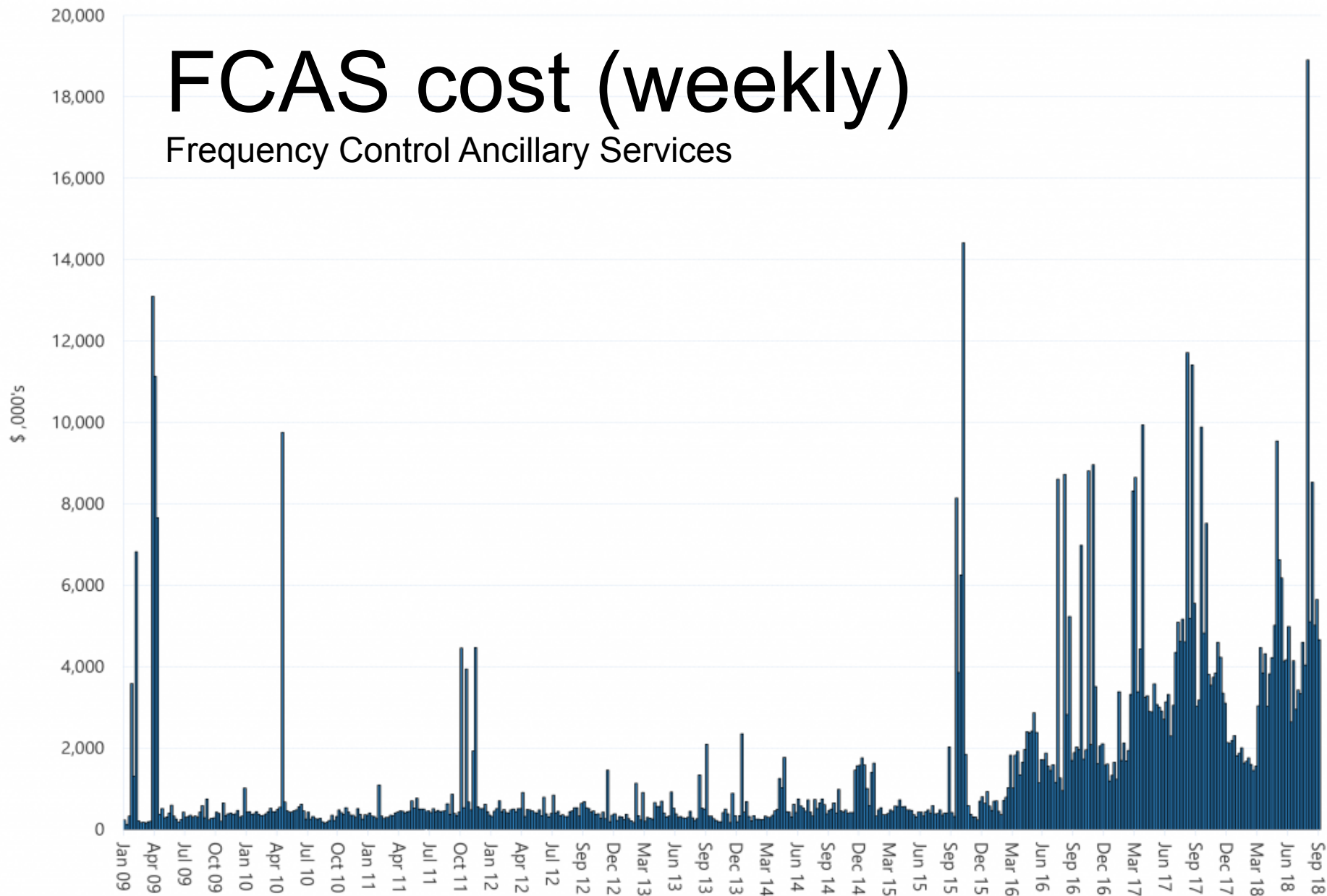


USC 1000MW unit at Shanghai Waigaoqiao III Power Plan



# FCAS cost (weekly)

Frequency Control Ancillary Services

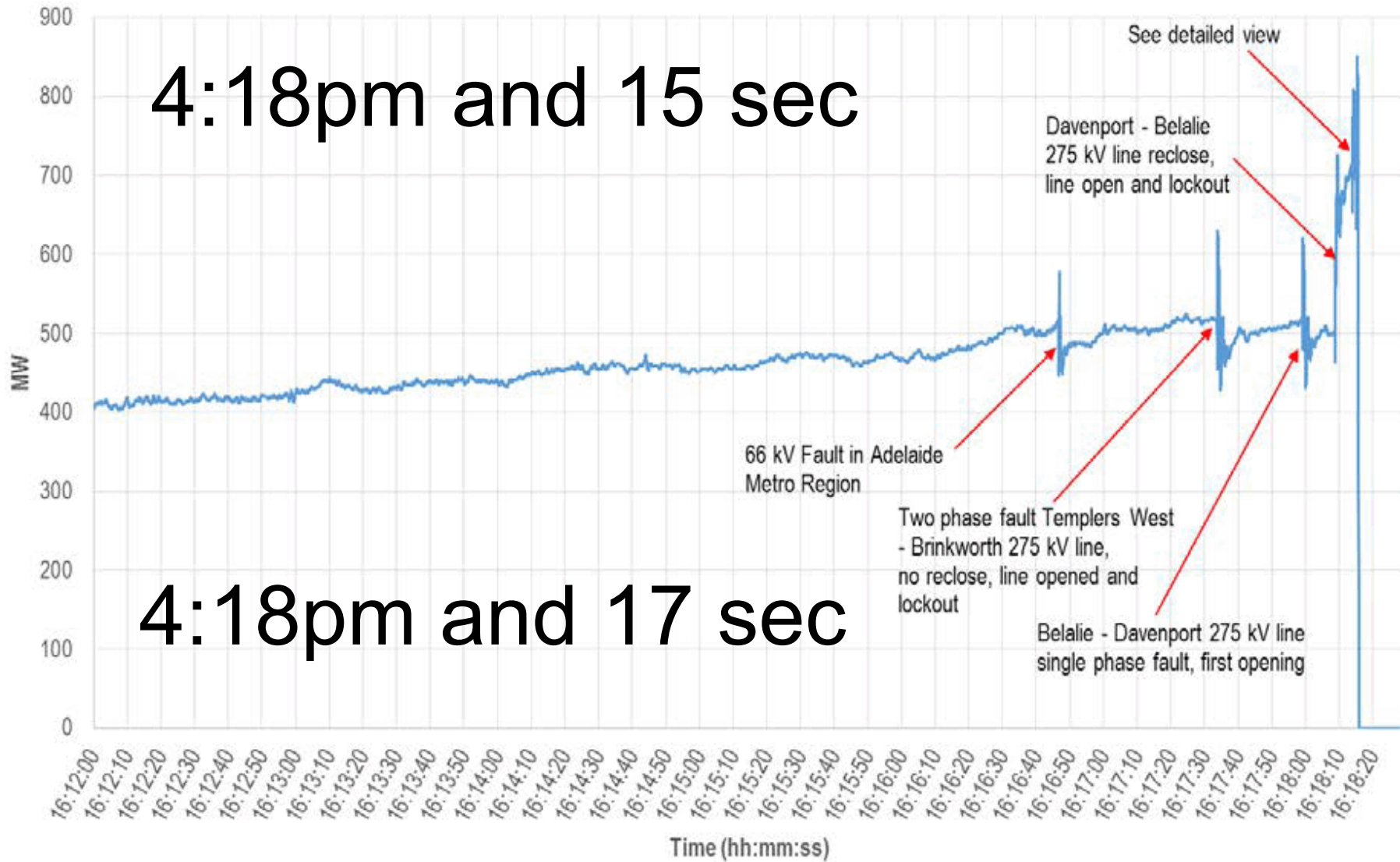




Fragile

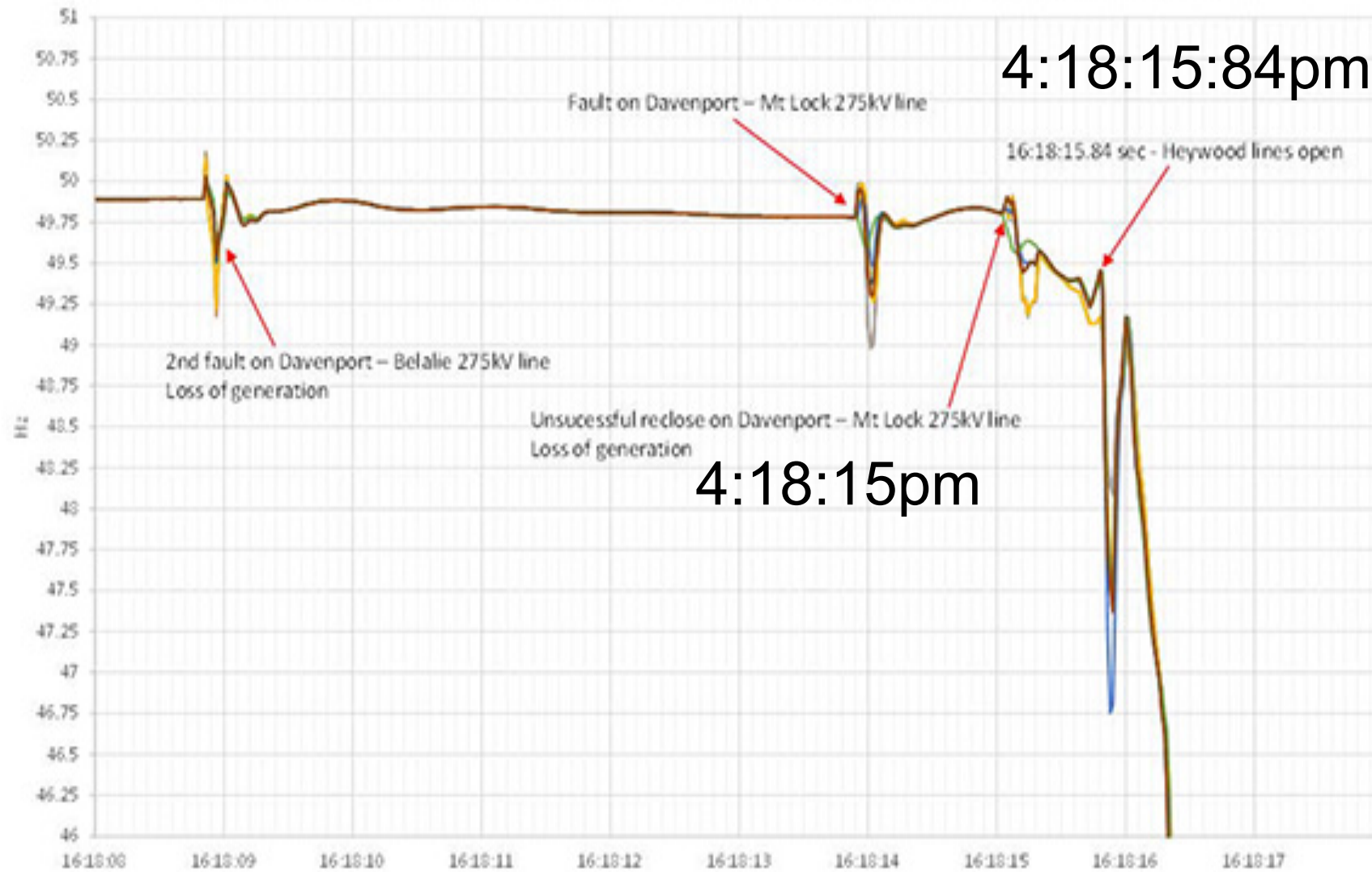
Heywood Separation 28/9/16 16:18 AEST  
HYTS - SESS Line MW Flow

4:18pm and 15 sec



4:18pm and 17 sec

SA Frequency - Davenport / Robertstown / Para Disturbance Recorders - 28/9/16 - 16:18



4:18:15:84pm

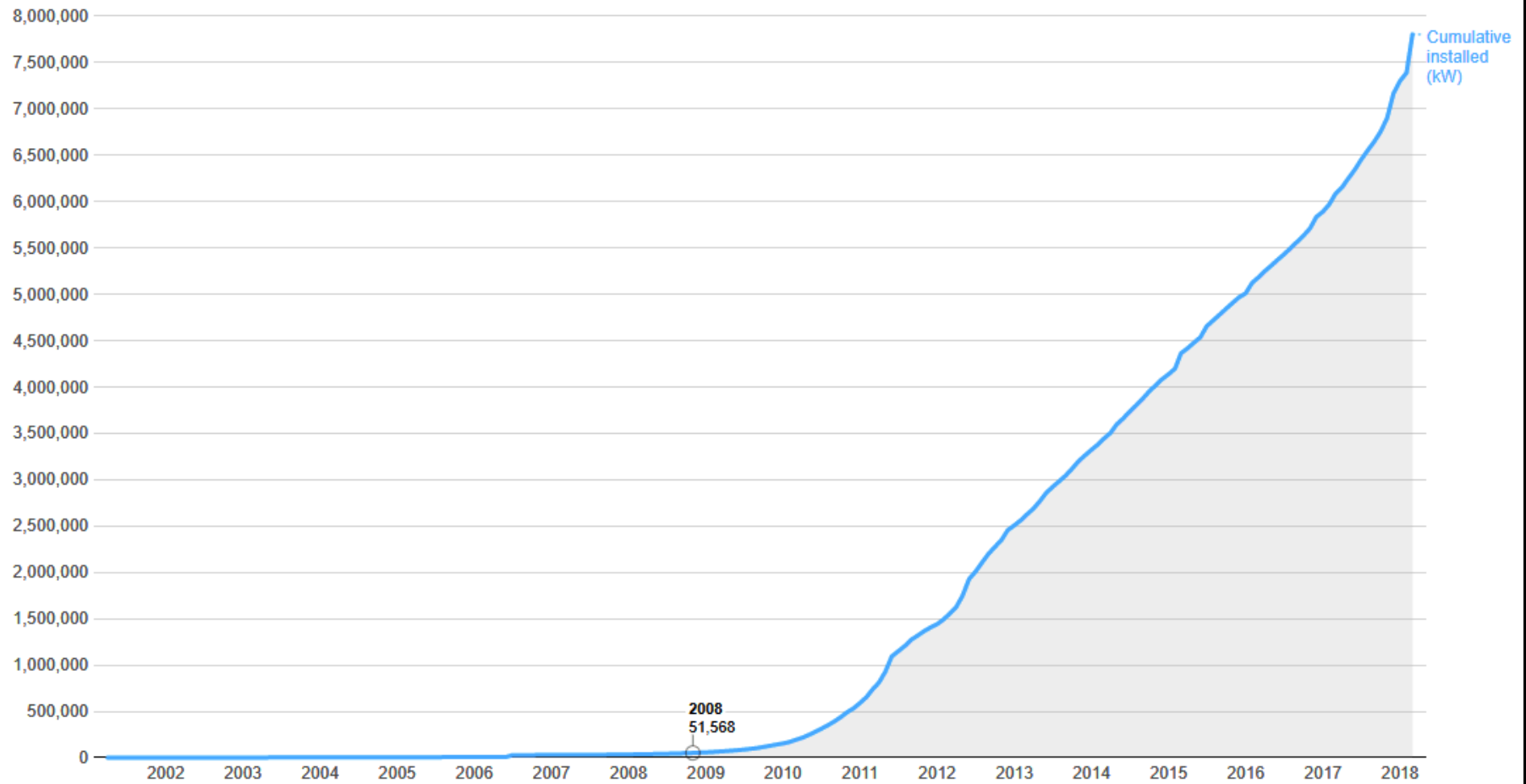
4:18:15pm

- Davenport - Bungama Hz
- Davenport - Brinkworth Hz
- Davenport - Cullana Hz
- Davenport - Olympic Dam Hz
- Para - Tunjillo Hz
- Para - PGW Hz
- Rtown - Tunjillo Hz
- Rtown - Mokota Hz

# Solar



## The total capacity of solar power installed in Australia has surged in the past decade



Australian PV installations since April 2001: total capacity (kW)

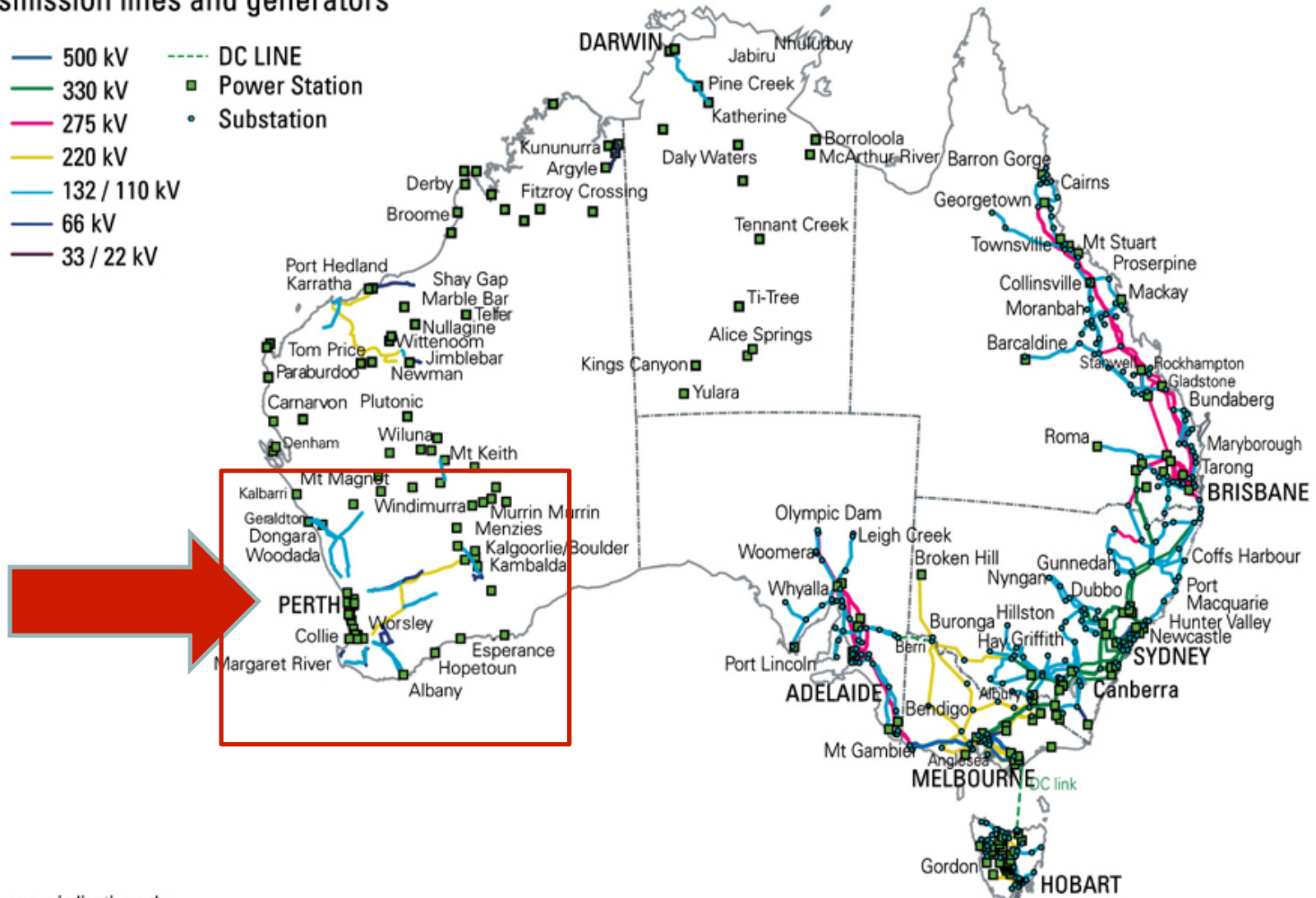
Source: Australian PV Institute • [Get the data](#) • [Embed](#)



# Energy in Australia 2009

## Transmission lines and generators

- 500 kV
- 330 kV
- 275 kV
- 220 kV
- 132 / 110 kV
- 66 kV
- 33 / 22 kV
- - - DC LINE
- Power Station
- Substation



Locations are indicative only.

Sources: NEMMCO, NT PowerWater, WA Office of Energy

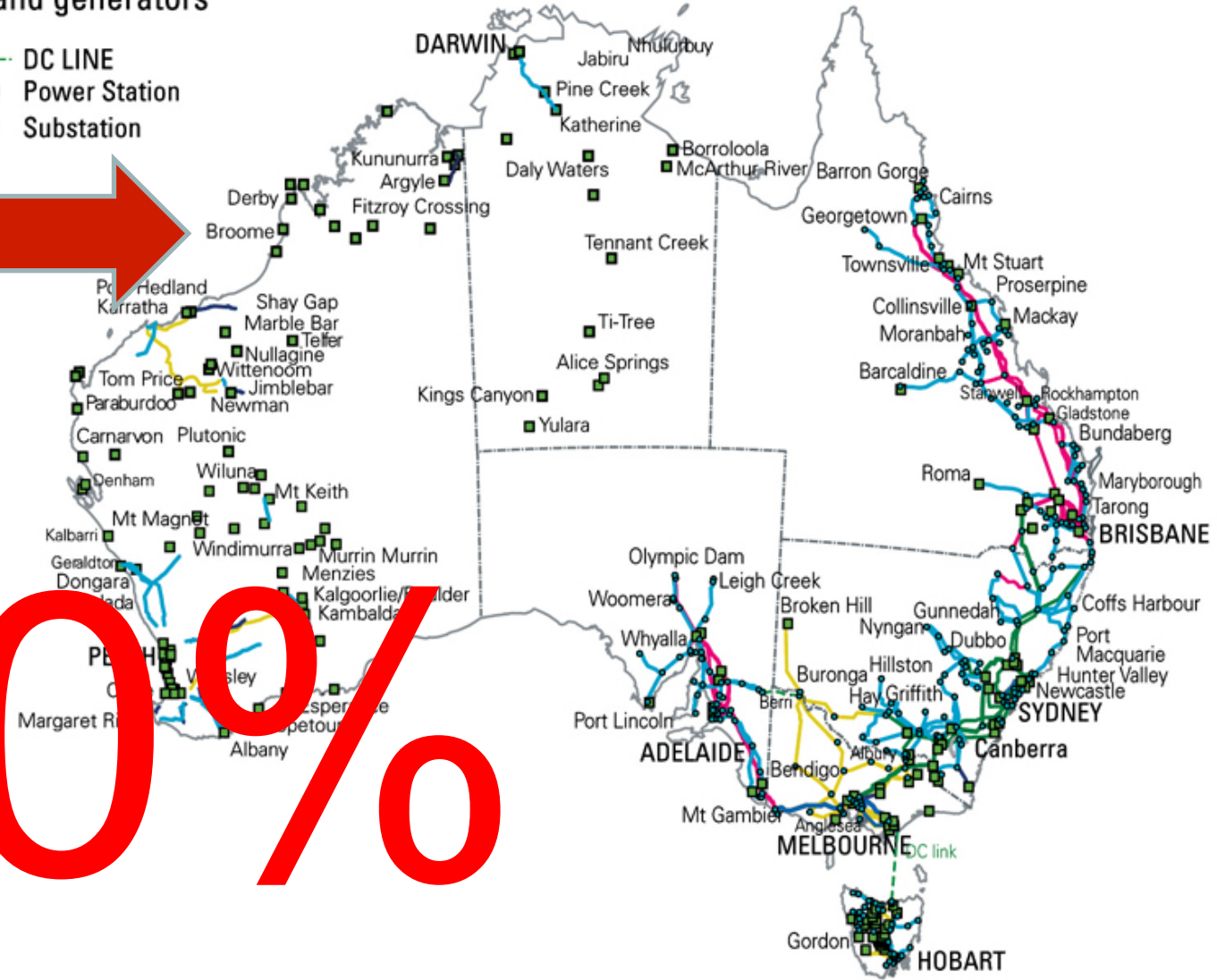


# Energy in Australia 2009

## Transmission lines and generators

- 500 kV
- 330 kV
- 275 kV
- 220 kV
- 132 / 66 kV
- 33 / 22 kV
- - - DC LINE
- Power Station
- Substation

100%



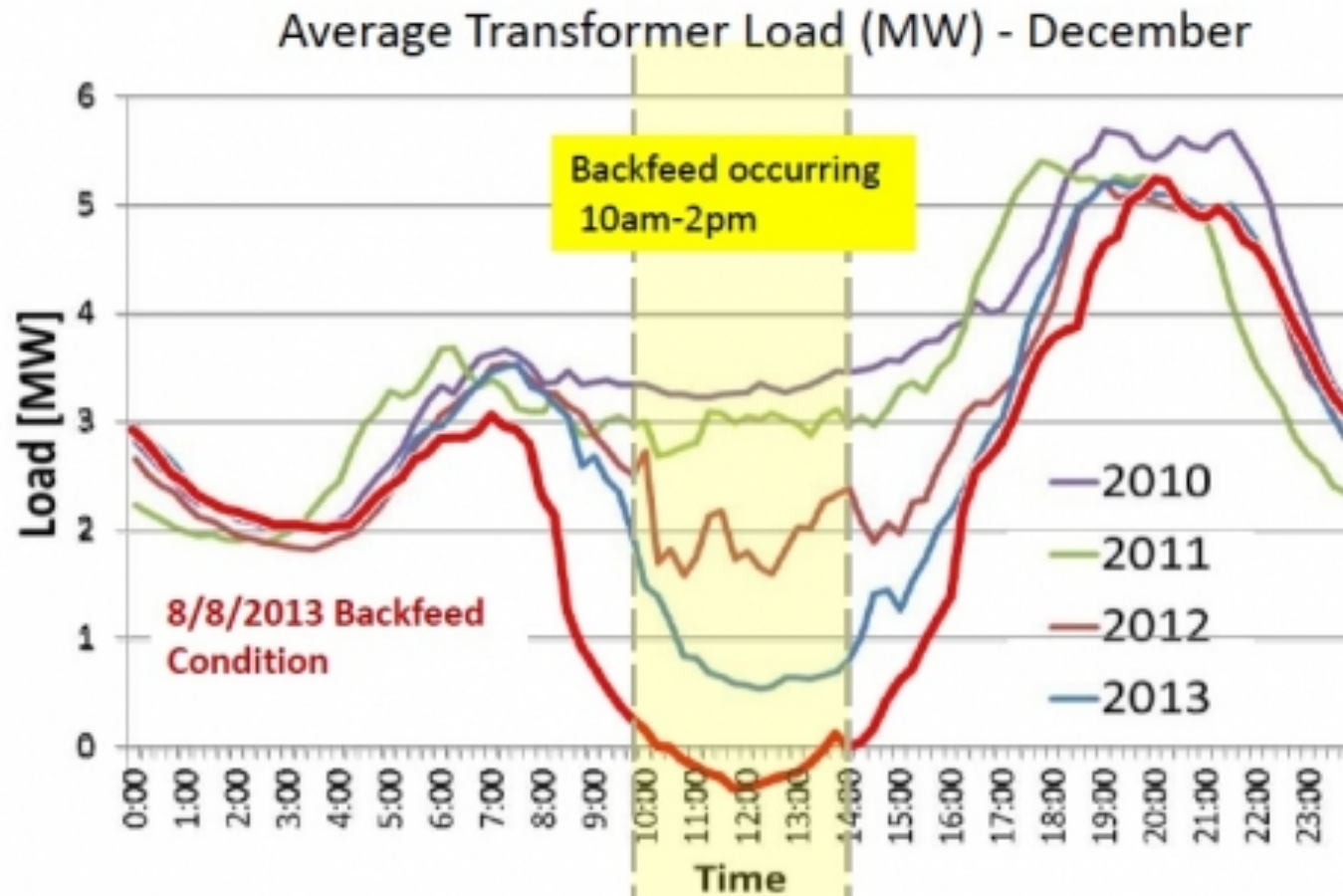
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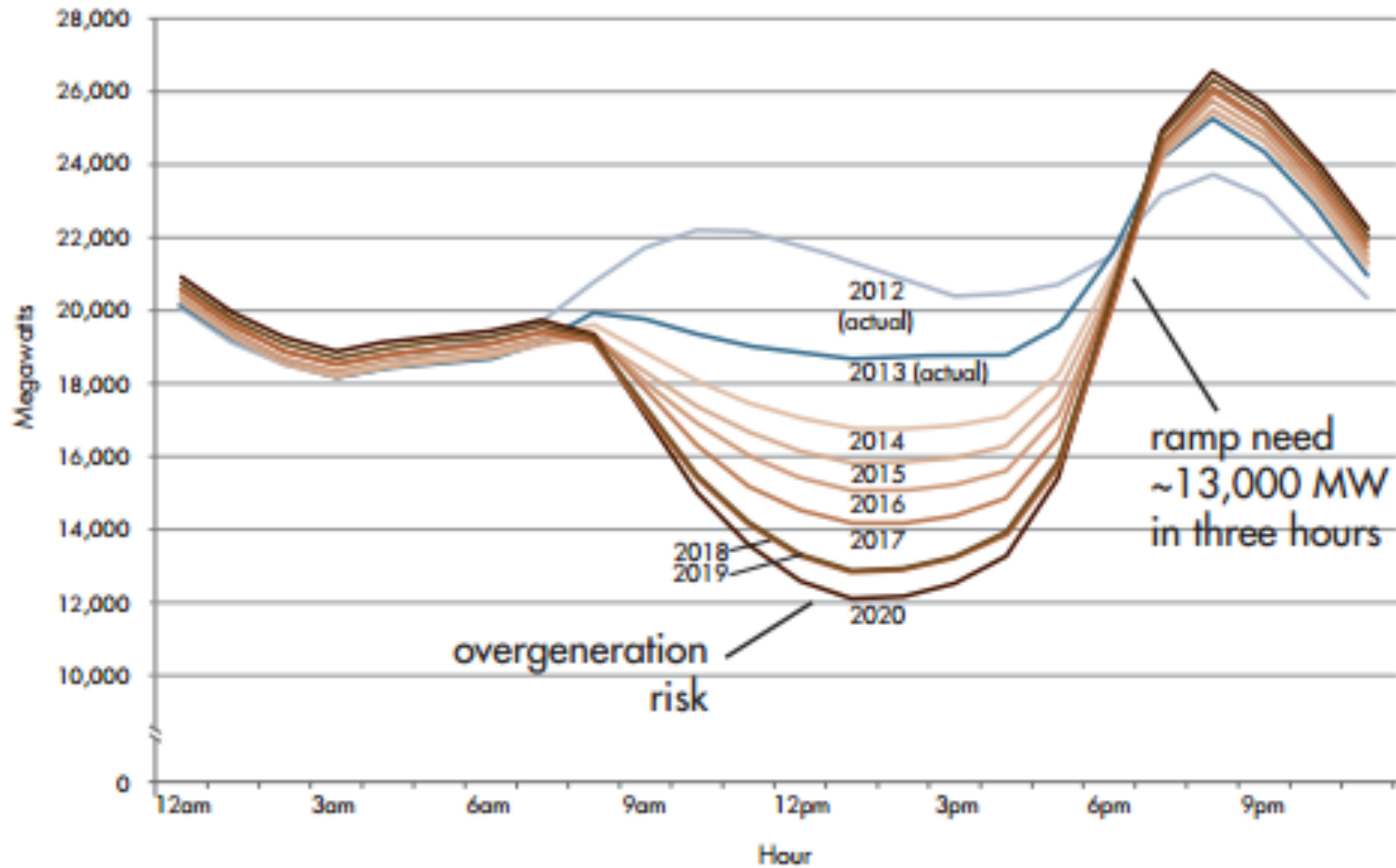
# “The Duck Curve”

## Tracking Change – 46kV Level

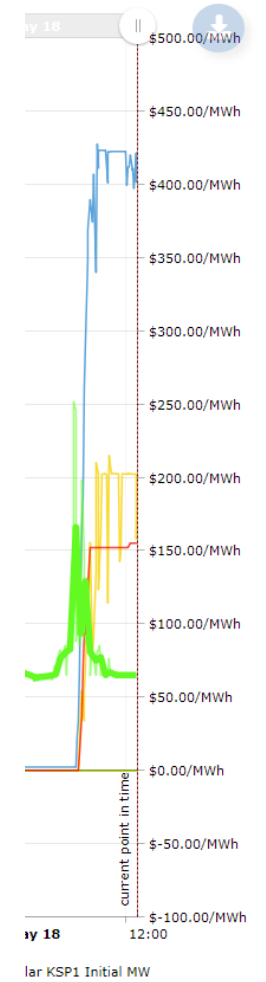
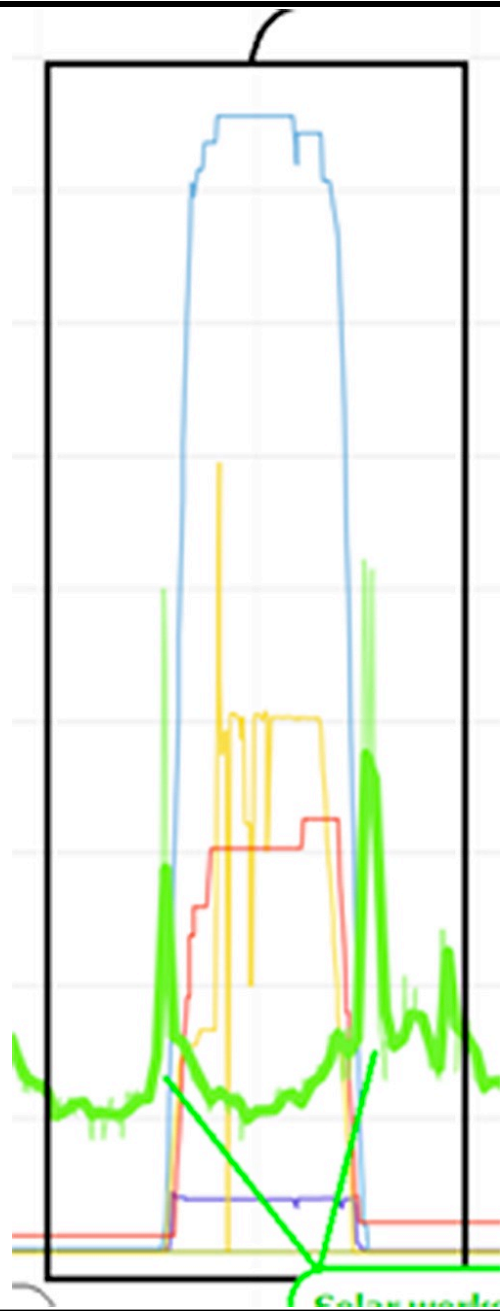
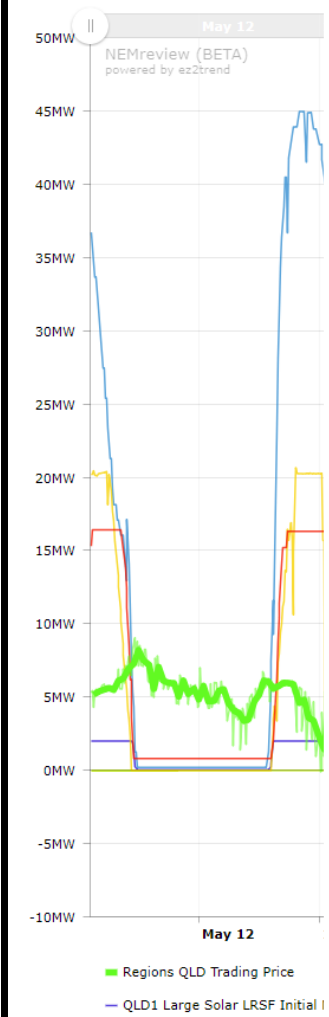


Hawaiian Electric  
Maui Electric  
Hawai'i Electric Light

# Net load - March 31







• The

South Australia, 17<sup>th</sup> Sep 2017

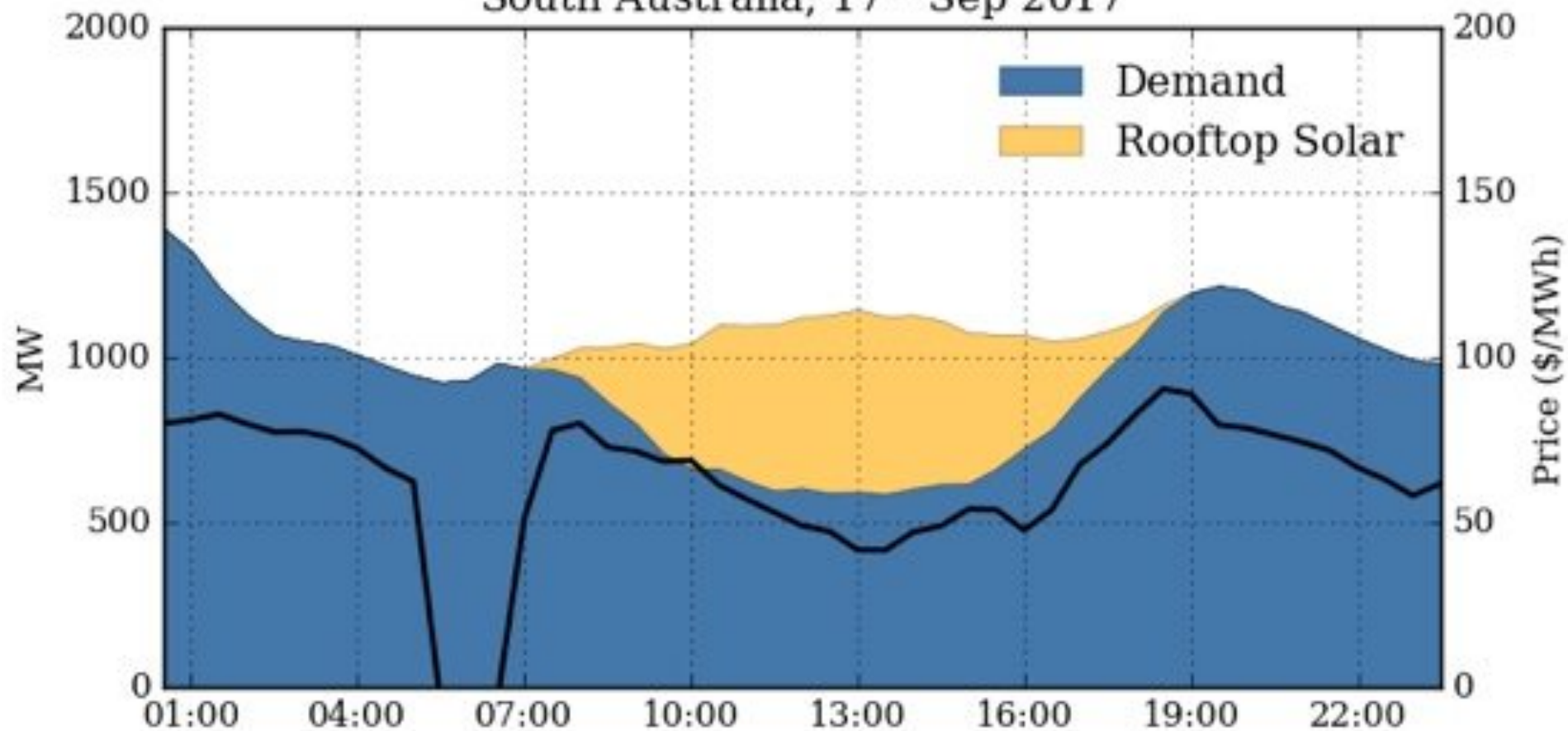
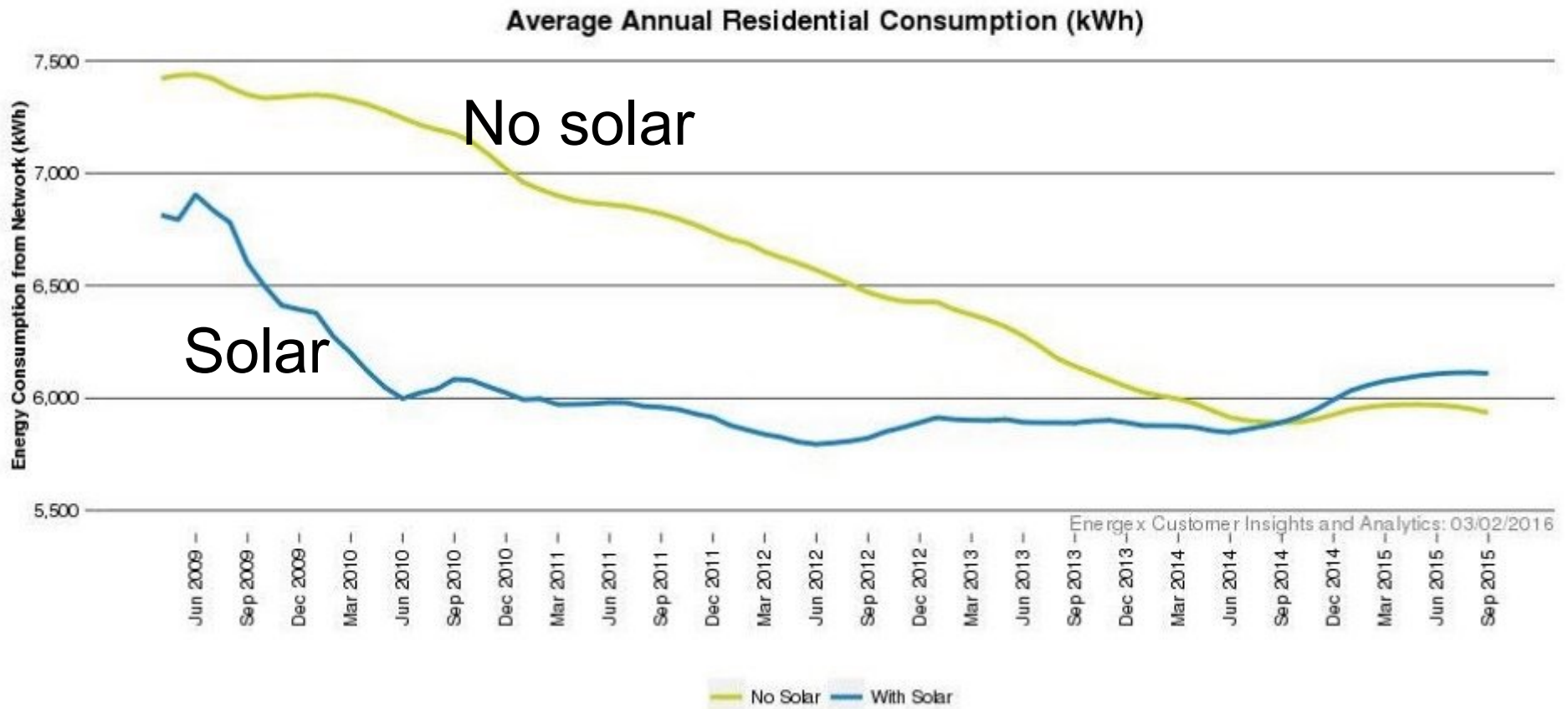


Figure 1.24: Consumer Survey—Average effective unit price, by region, c/kWh, real \$2016-17, excluding GST



Source: ACCC analysis based on Colmar Brunton survey data.

# Energy consumption has been decreasing in the SEQ home



From October 2014 in Queensland, the average grid electricity use of solar homes started to exceed the average use of people without solar power....

The future is...

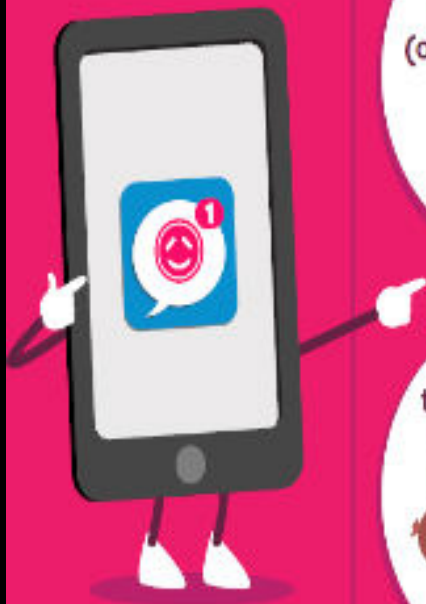
...load shedding



# CURB YOUR POWER

**1**

You receive a message to Curb Your Power.



**2**

You take action.

Set your air-con to 23°C instead of 17°C (or off altogether).



Switch off all lights and appliances not in use.



Use gas or the BBQ instead of the electric oven to cook.

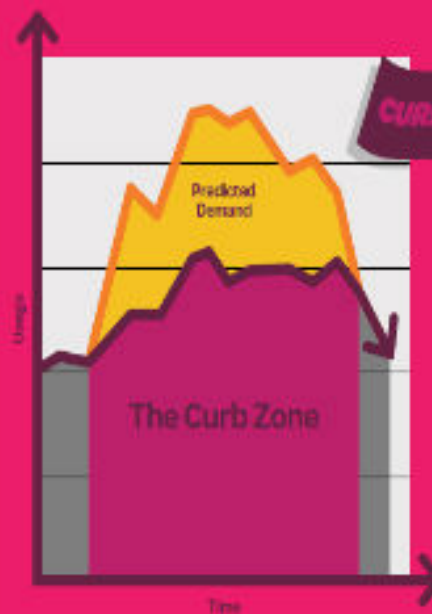


Turn off as much as possible and go to a shopping centre, a cinema or the beach for the arvo.



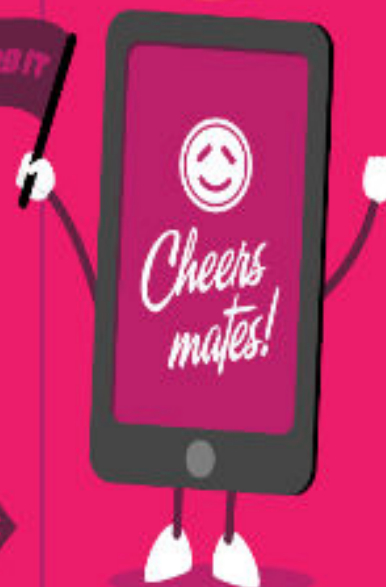
**3**

Demand on the grid is reduced.



**4**

You're rewarded.



Everybody wins!

Find out more:

[powershop.com.au/curb-your-power](http://powershop.com.au/curb-your-power)

**GREATER UNION**  **BIRCH CARROLL & COYLE**

Cinema 09

GEORGE

**THE HANGOVER (MA15)**

Tues Jun 16, 2009 01:30 PM - 3:24 PM

H 8

Adult: \$10.00  
GEORGE | c20090616131100 | u390781 | 1187809/001 | PCSH

What do you call it when your  
electricity grid doesn't have  
enough energy?

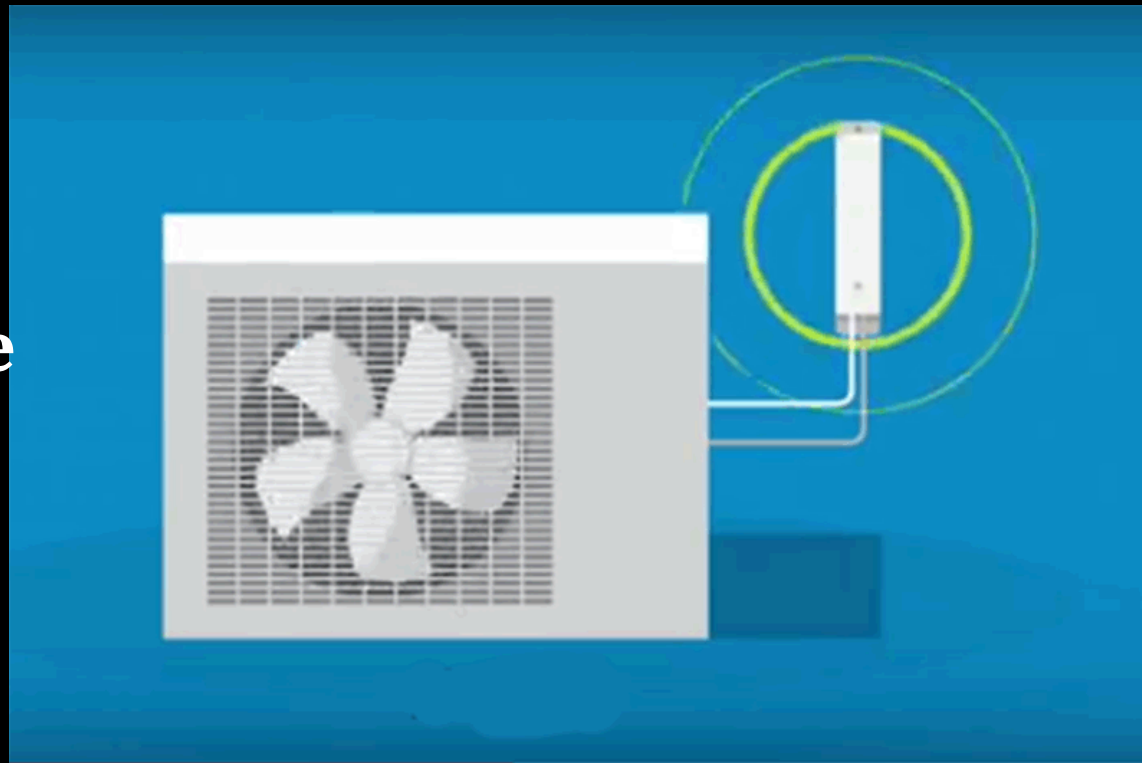
“Peaksmart Event”



positive energy

# PeakSmart air-conditioning

**“...you  
won't  
notice a  
difference  
to your  
comfort.”**



# “demand management”

Pay people \$1.5m to  
“switch off” at peak  
periods

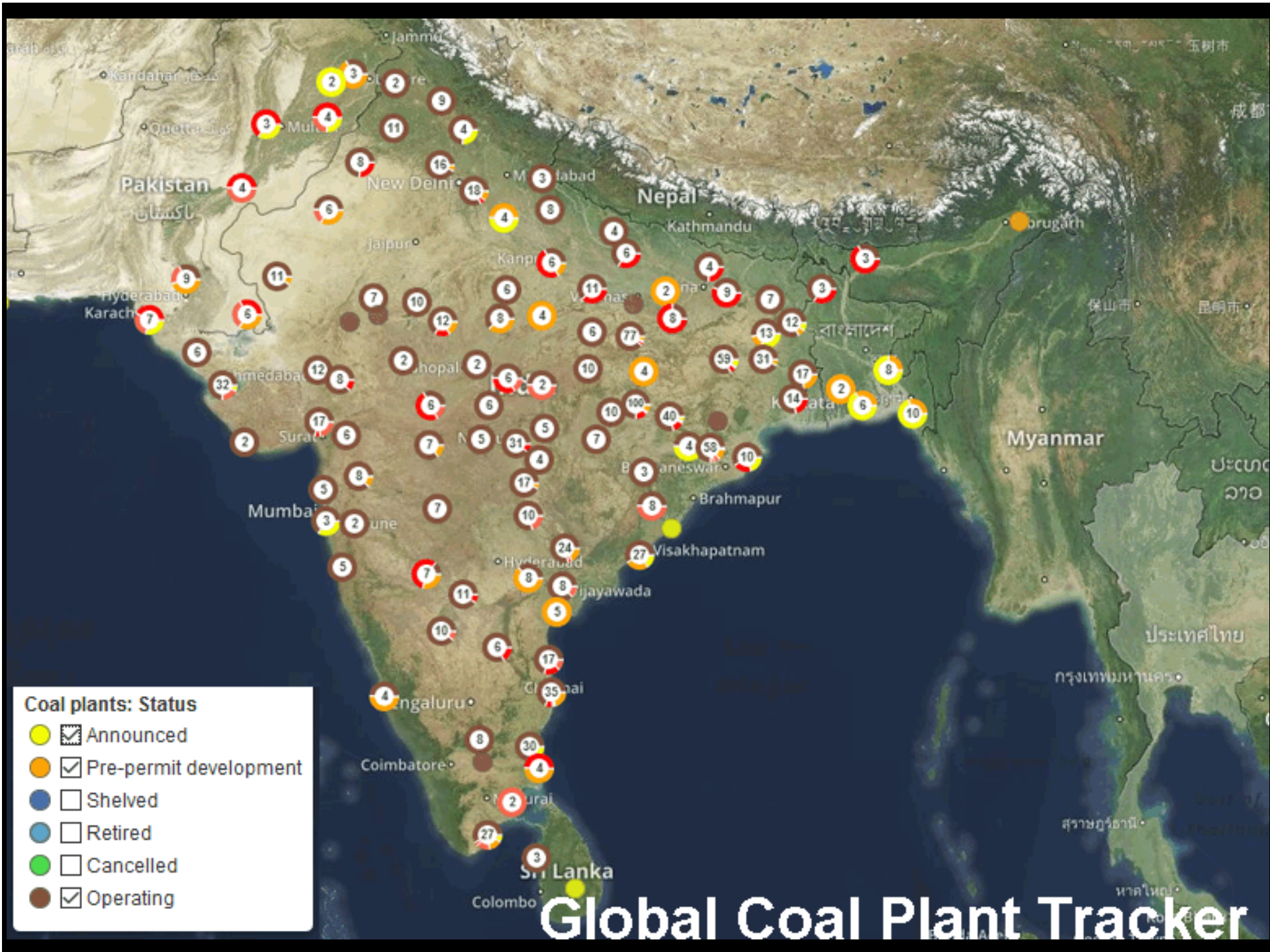


Coal



# Global Coal Plant Tracker







• Surabaya

Papua  
New Guinea  
Port Moresby

Solomon  
Islands

Darwin

Vanuatu  
• Port Vila

Fiji

Nu

• Townsville

Qld.

Alice Springs

W.A.

**Australia**

15

6

• Brisbane

Perth

14

2

• Adelaide

N.S.W.

16

• Sydney

• Melbourne

18

Vic.

Tas.  
Hobart

Auckland

2

New Zealand

• Wellington

• Christchurch





# Global Coal Plant Tracker



What's the  
cost of  
complexity?

## Step 6:

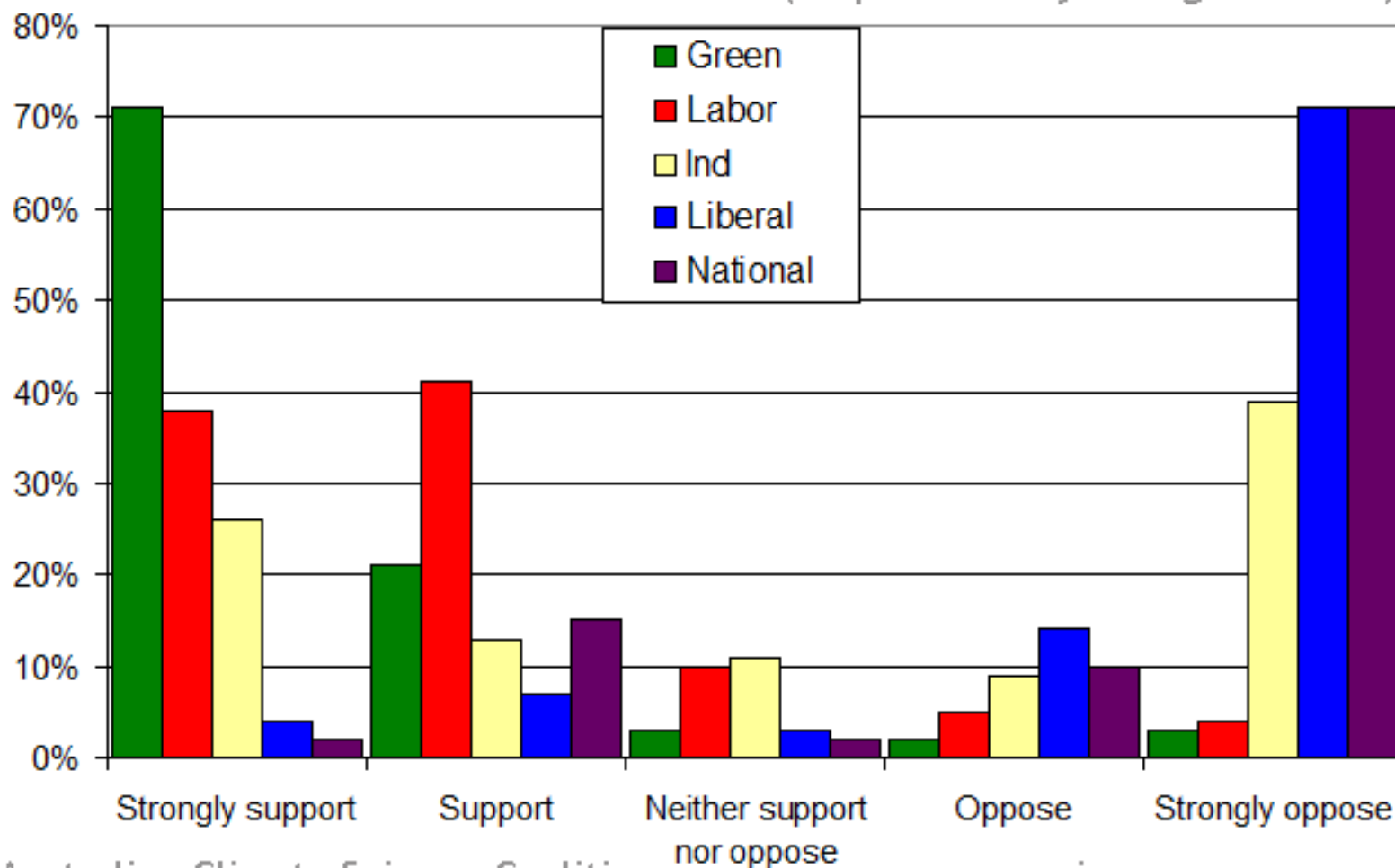
- Stop people asking questions

“Denier”

Bullying

## Australian voters are polarised

Should Australia adopt measures to curb CO2 emissions irrespective of what the rest of the world does? (Respondents by voting intention)



Australian Climate Science Coalition

joannenova.com.au



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warming when we should be  
preparing for cooling?

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Peter Ridd



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