HOW TO DESTROY A PERFECTLY GOOD ELECTRICITY GRID IN A MILLION EASY STEPS

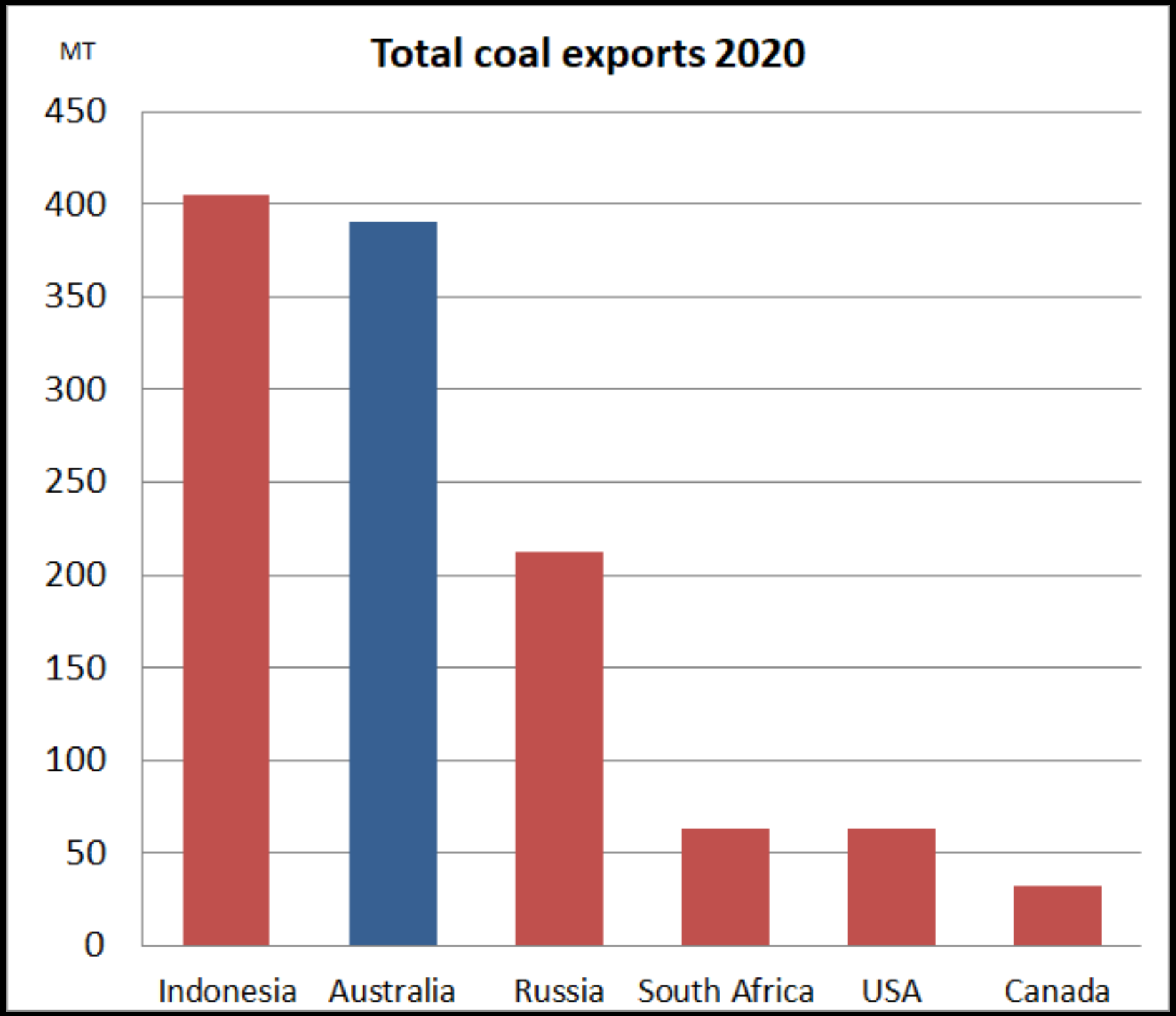
Renewables and Energy Security

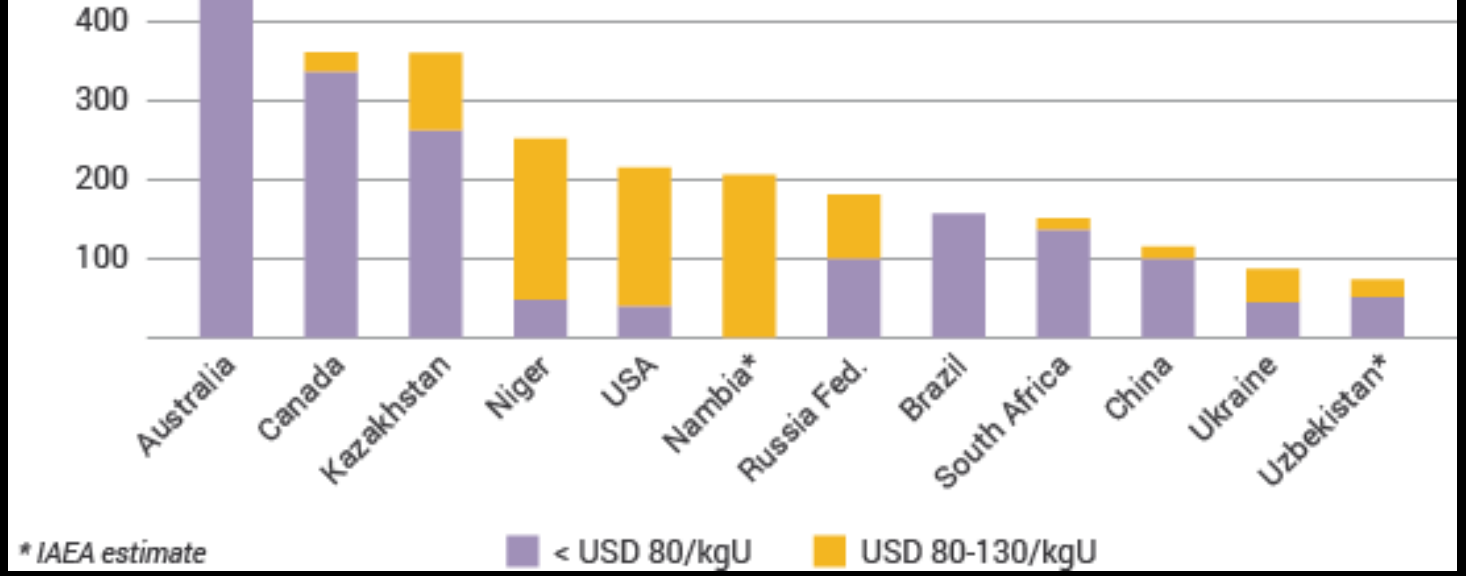
The joy of blackouts

Coal

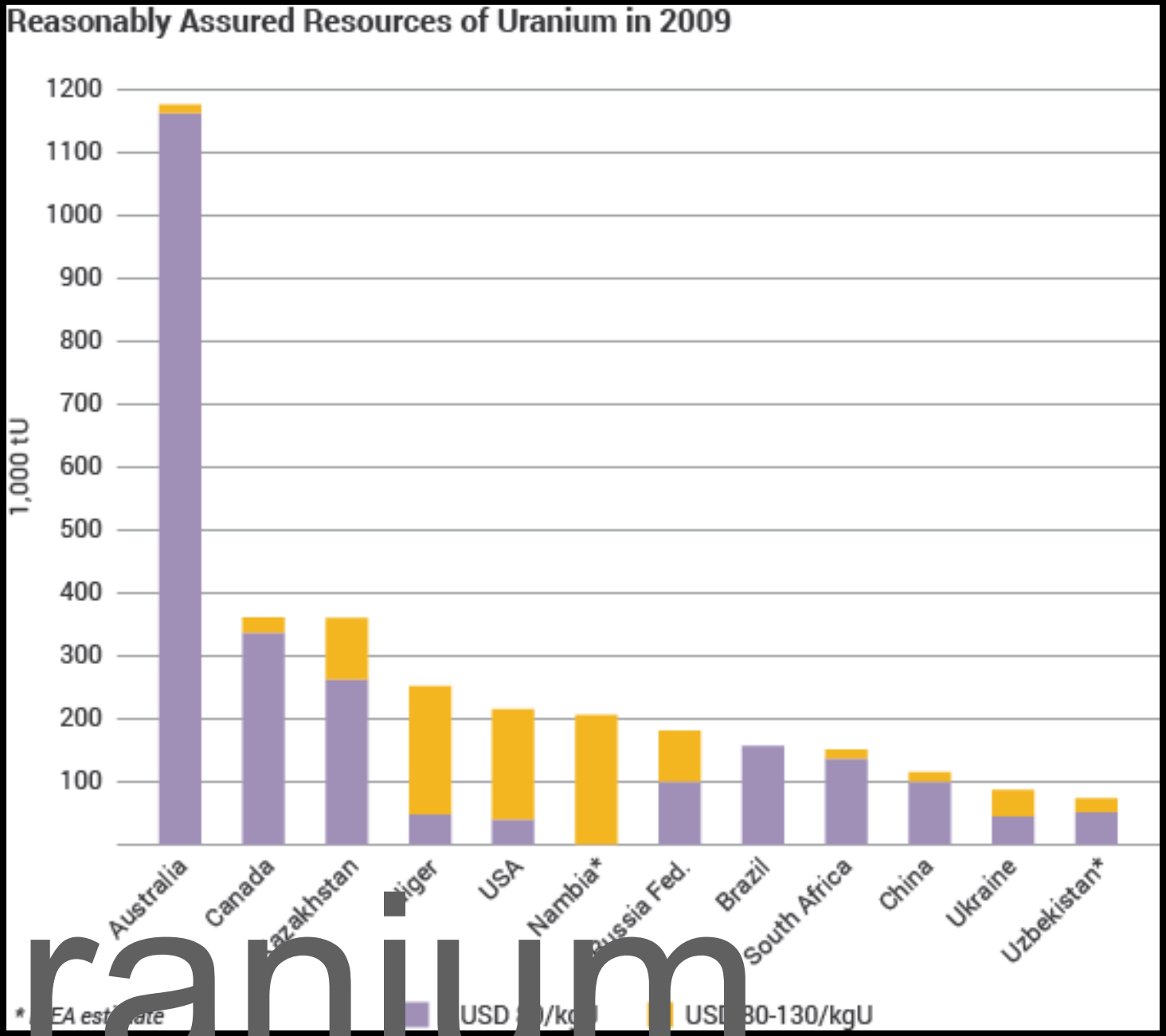
Codrington, Stephen. *Planet Geography 3rd Edition* (2005)

Coal Recoverable Reserves

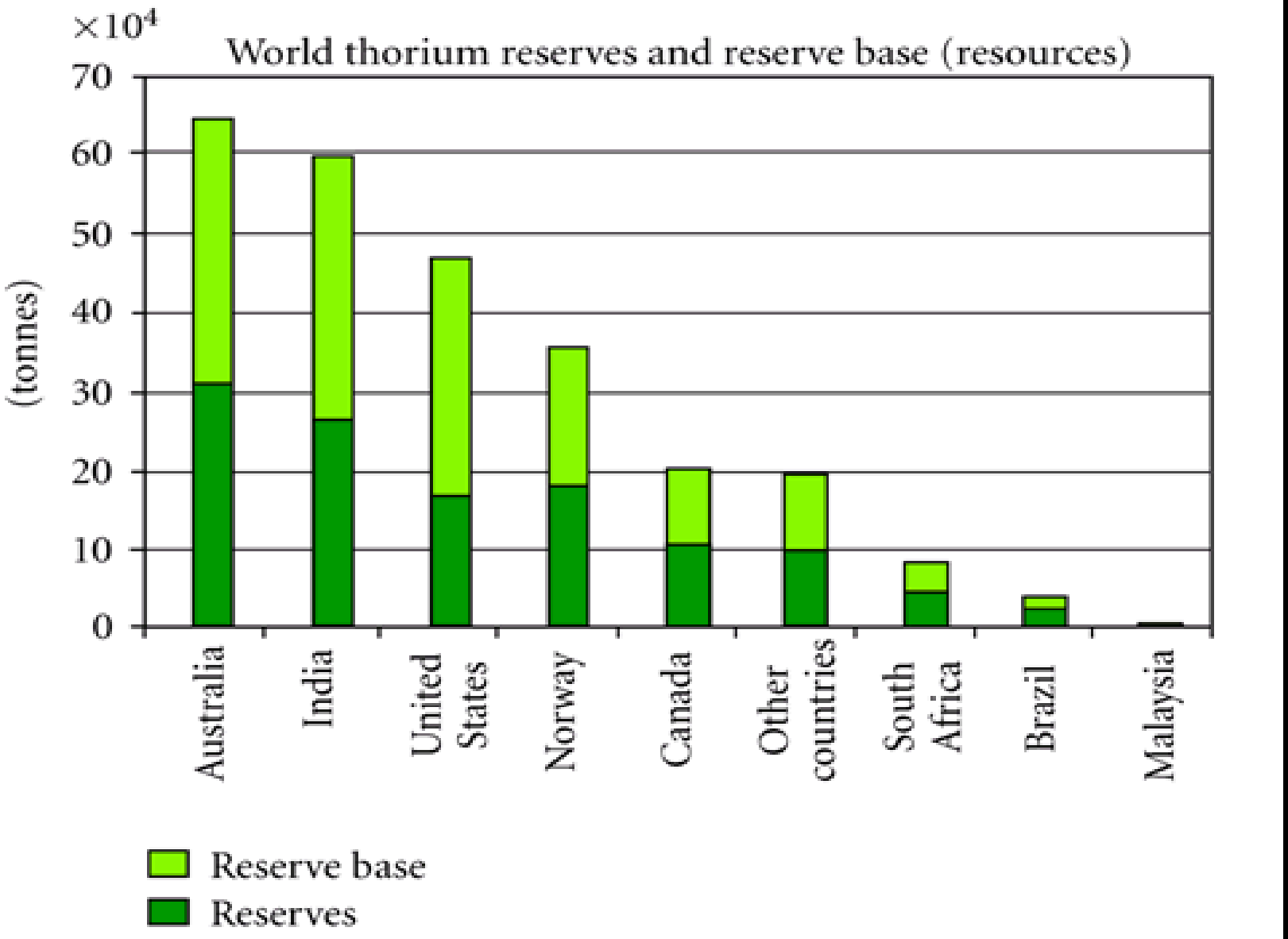

MT
Total coal exports 2020
450
400
350
300
250
200
150
100
50
0
Indonesia
Australia
Russia
South Africa
USA
Canada


400
300
200
100
Australia
Canada
Kazakhstan
Niger
USA
Namibia*
Russia Fed.
Brazil
South Africa
China
Ukraine
Uzbekistan*
* IAEA estimate
< USD 80/kgU
USD 80-130/kgU

Uranium


Reasonably Assured Resources of Uranium in 2009
1,000 tU
1200
1100
1000
900
800
700
600
500
400
300
200
100
Australia
Canada
Kazakhstan
Niger
USA
Nambia*
Russia Fed.
Brazil
South Africa
China
Ukraine
Uzbekistan*
* IAEA estimate
USD 80/kgU
USD 80-130/kgU

Uranium


World thorium reserves and reserve base (resources)
×10⁴
70
60
50
40
30
20
10
0
(tonnes)
Australia
India
United States
Norway
Canada
Other countries
South Africa
Brazil
Malaysia
Reserve base
Reserves

Thorium

Is Australia really succeeding?

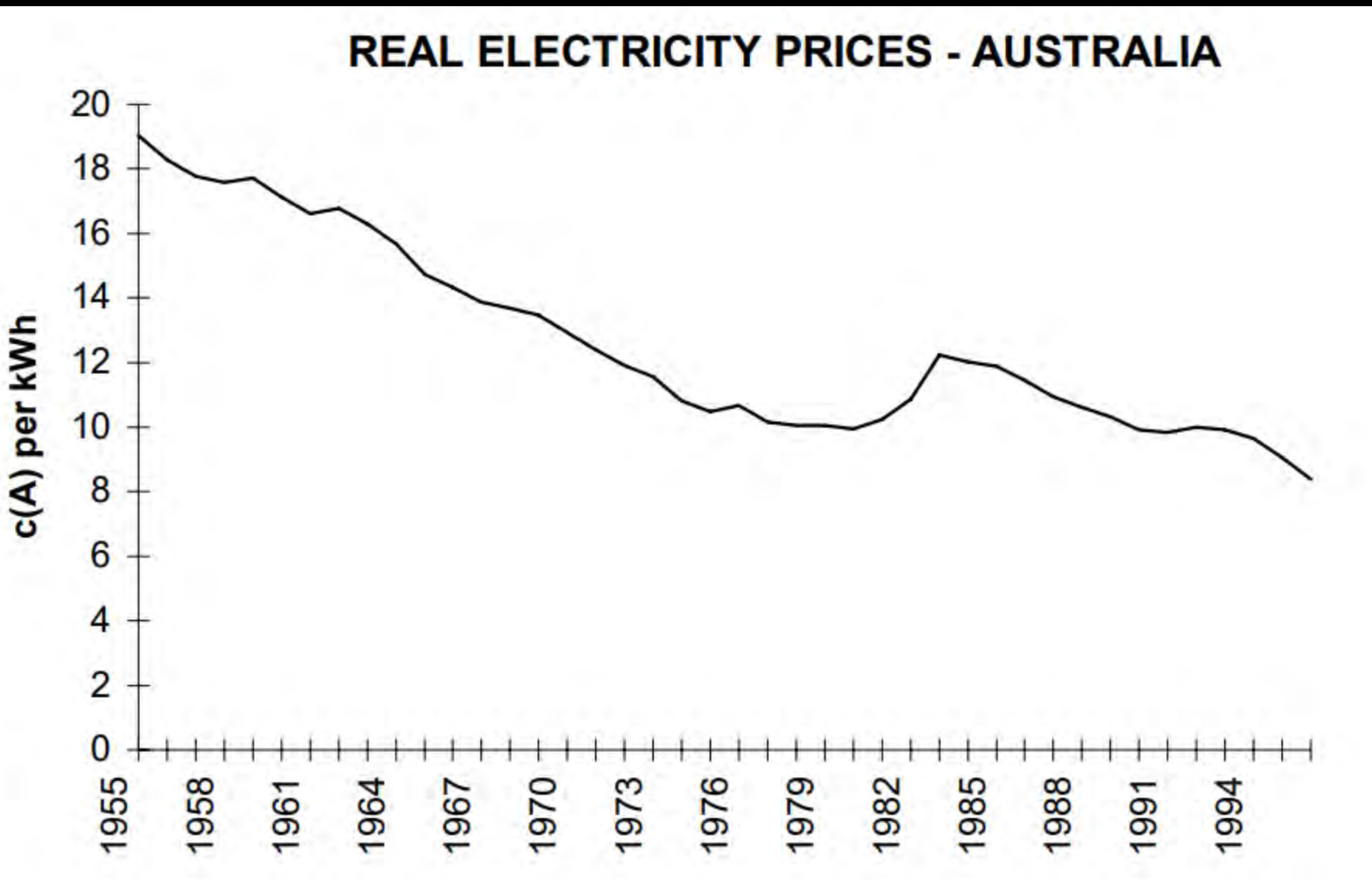
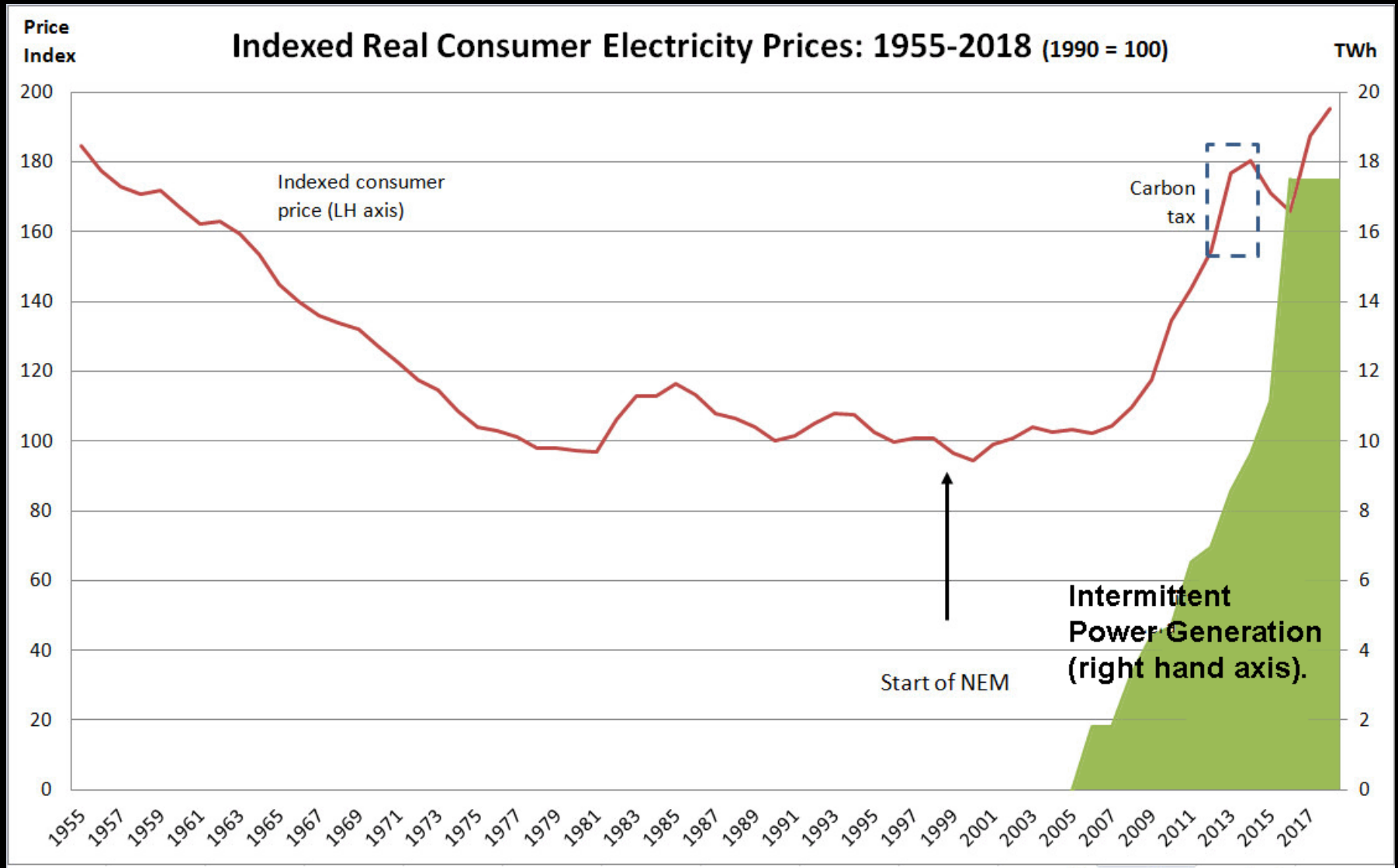


Fig 4 Price movement in Real terms - average selling price - cents (A) per kWh



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*

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

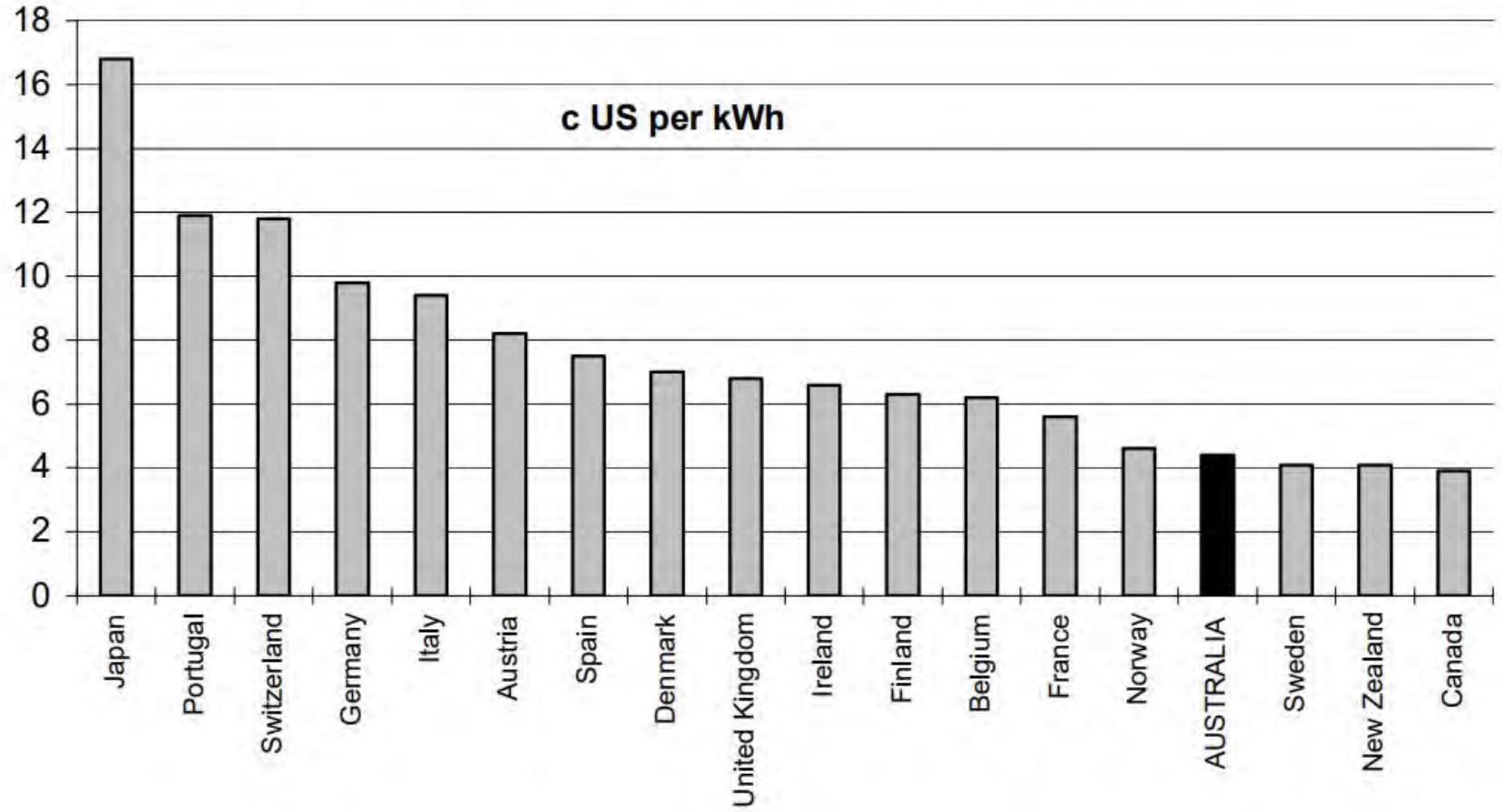
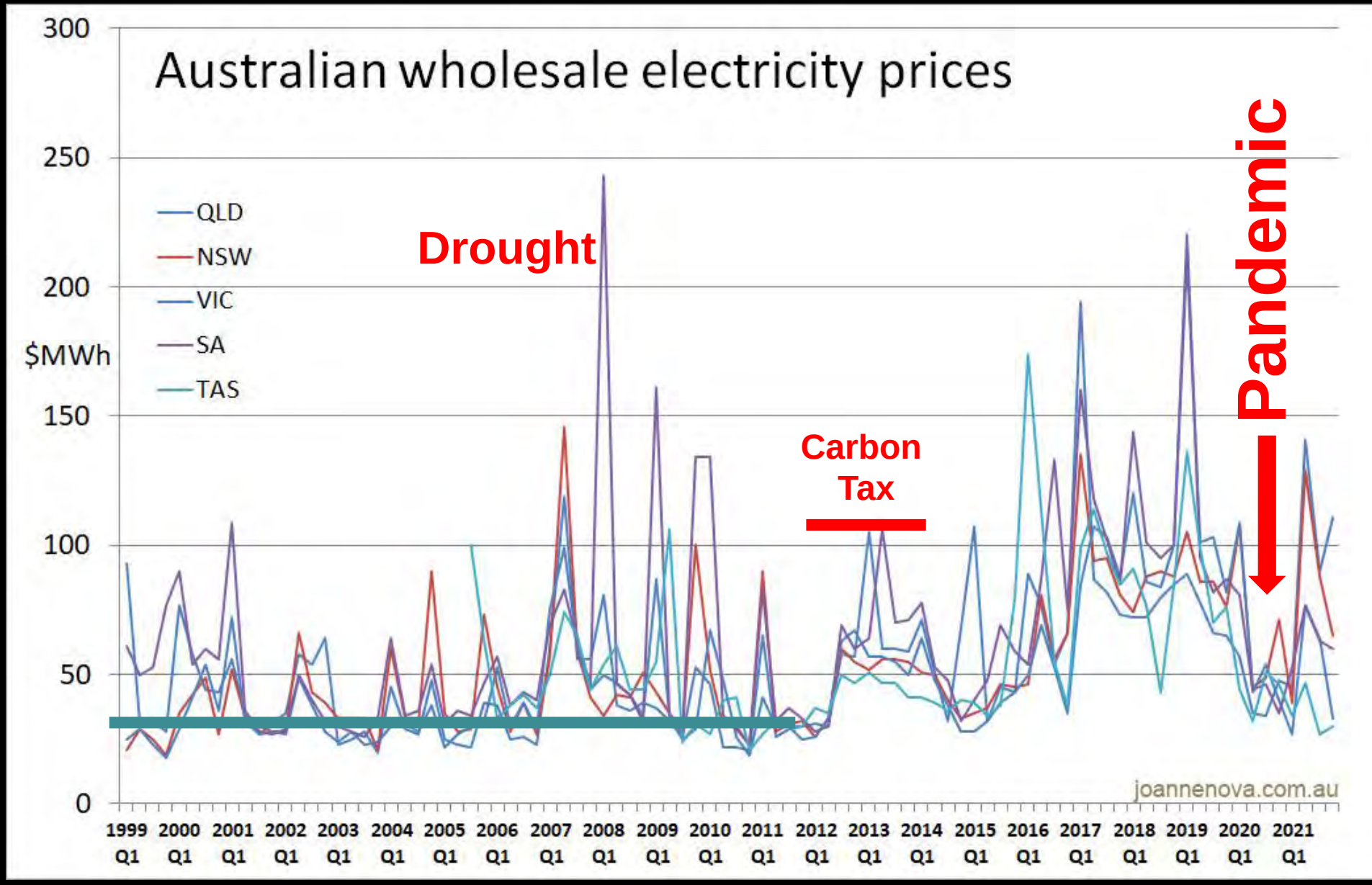
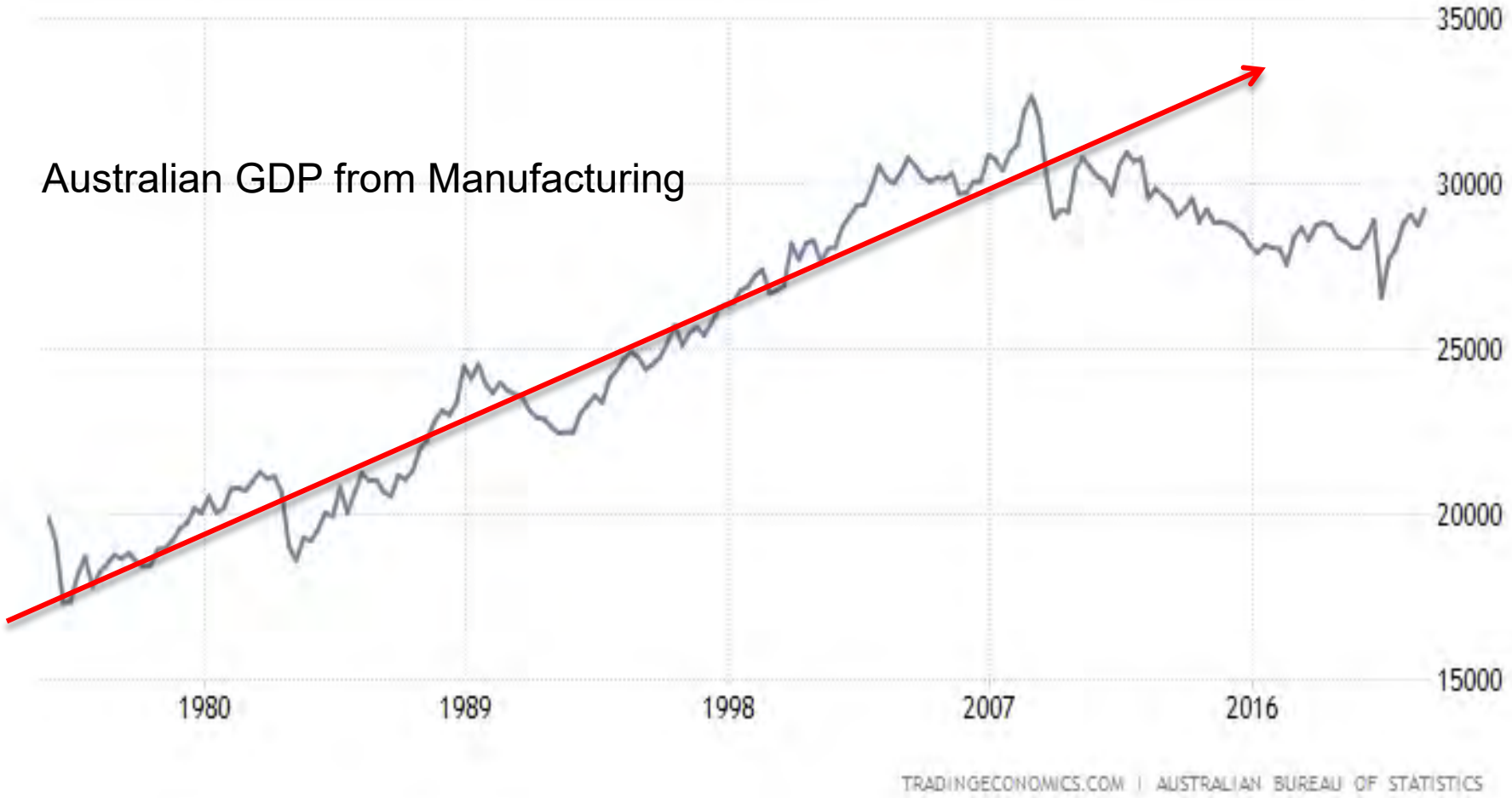


Fig 5 Industrial average prices, OECD countries 1995

Energy Prices and Taxes IEA 1995


Australian wholesale electricity prices
300
250
200
150
100
50
0
$MWh
QLD
NSW
VIC
SA
TAS
Drought
Carbon Tax
Pandemic
joannenova.com.au
1999 Q1
2000 Q1
2001 Q1
2002 Q1
2003 Q1
2004 Q1
2005 Q1
2006 Q1
2007 Q1
2008 Q1
2009 Q1
2010 Q1
2011 Q1
2012 Q1
2013 Q1
2014 Q1
2015 Q1
2016 Q1
2017 Q1
2018 Q1
2019 Q1
2020 Q1
2021 Q1

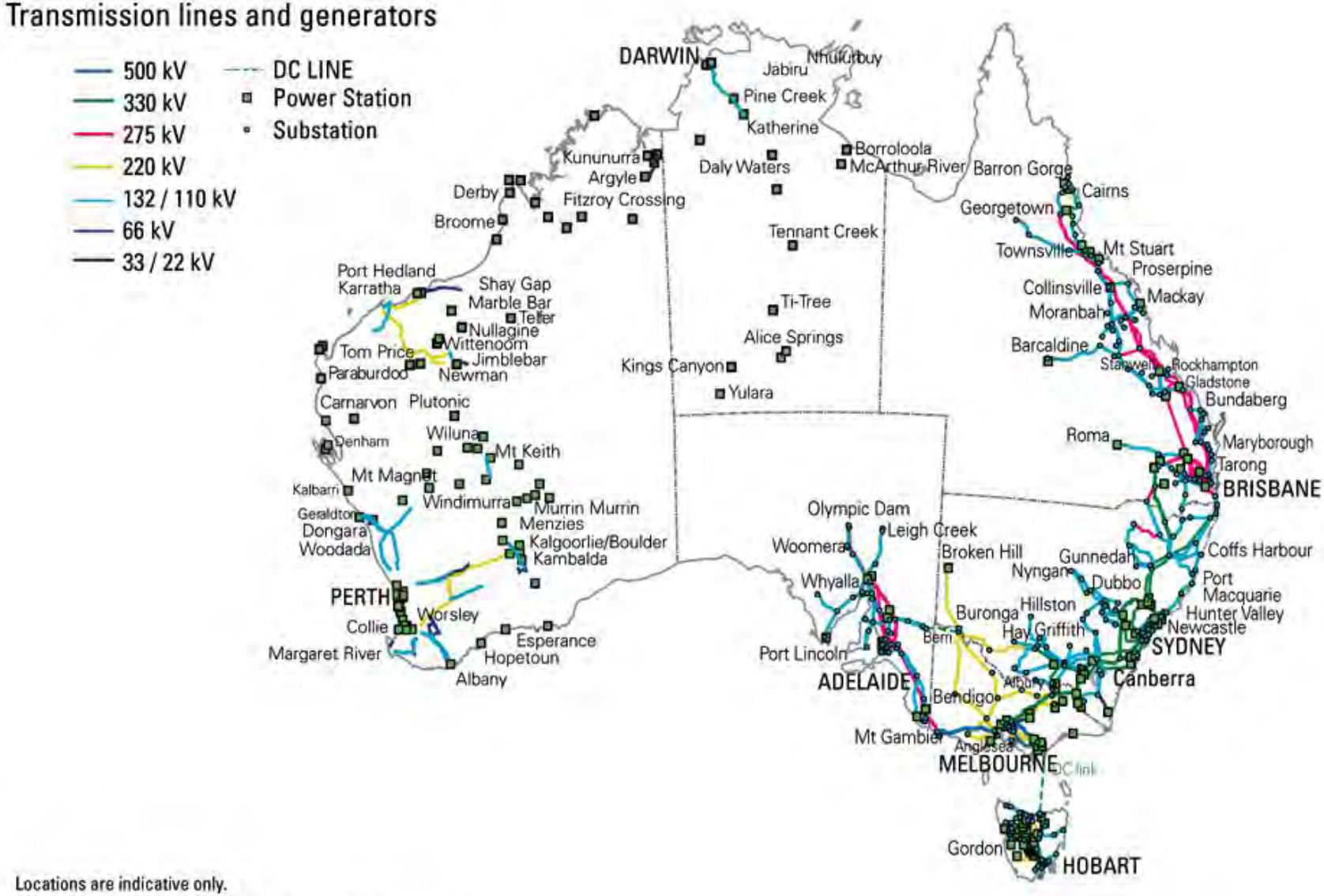
Australian GDP from Manufacturing



To wreck a grid we really need to understand it

Thetruesize.com

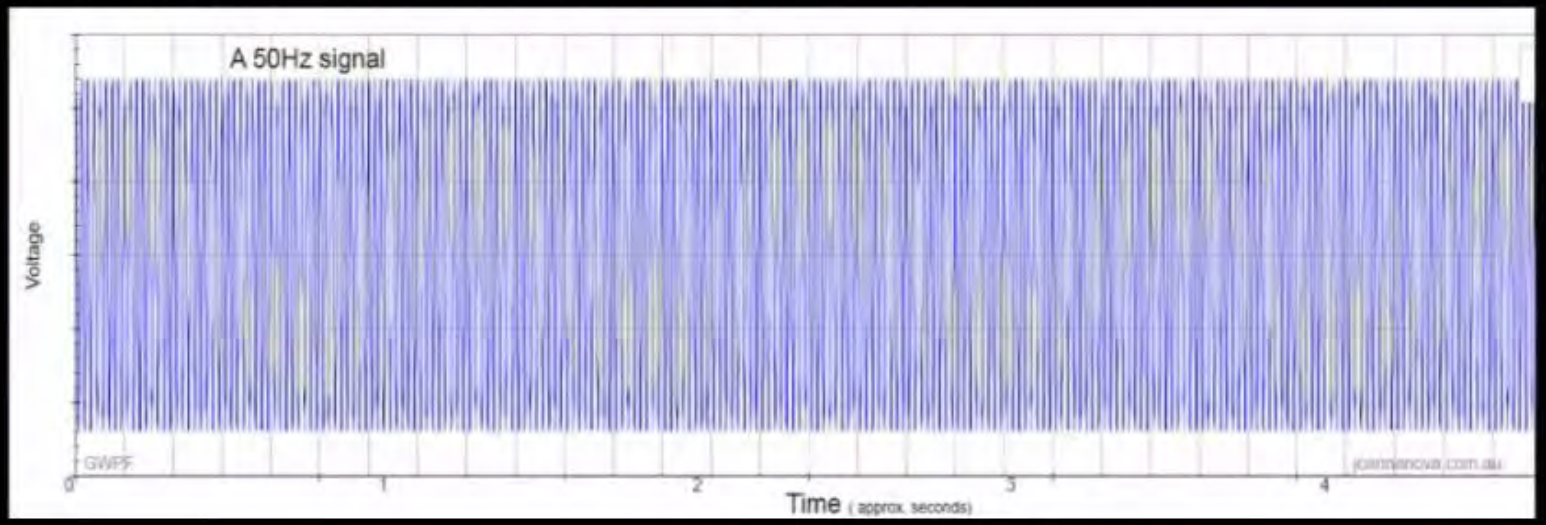
Energy in Australia 2009



Locations are indicative only.

Sources: NEMMCO, NT PowerWater, WA Office of Energy

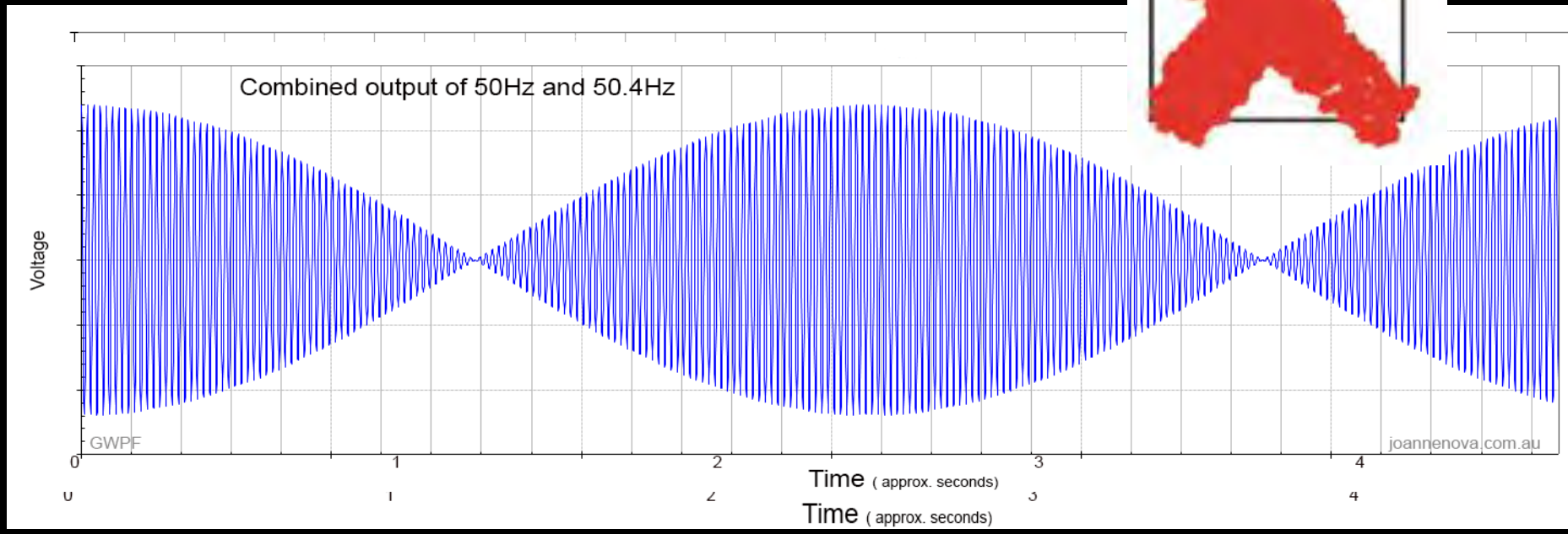
50Hz + 50.4Hz



0 1 2 3 4

49.85 – 50.15 Hz

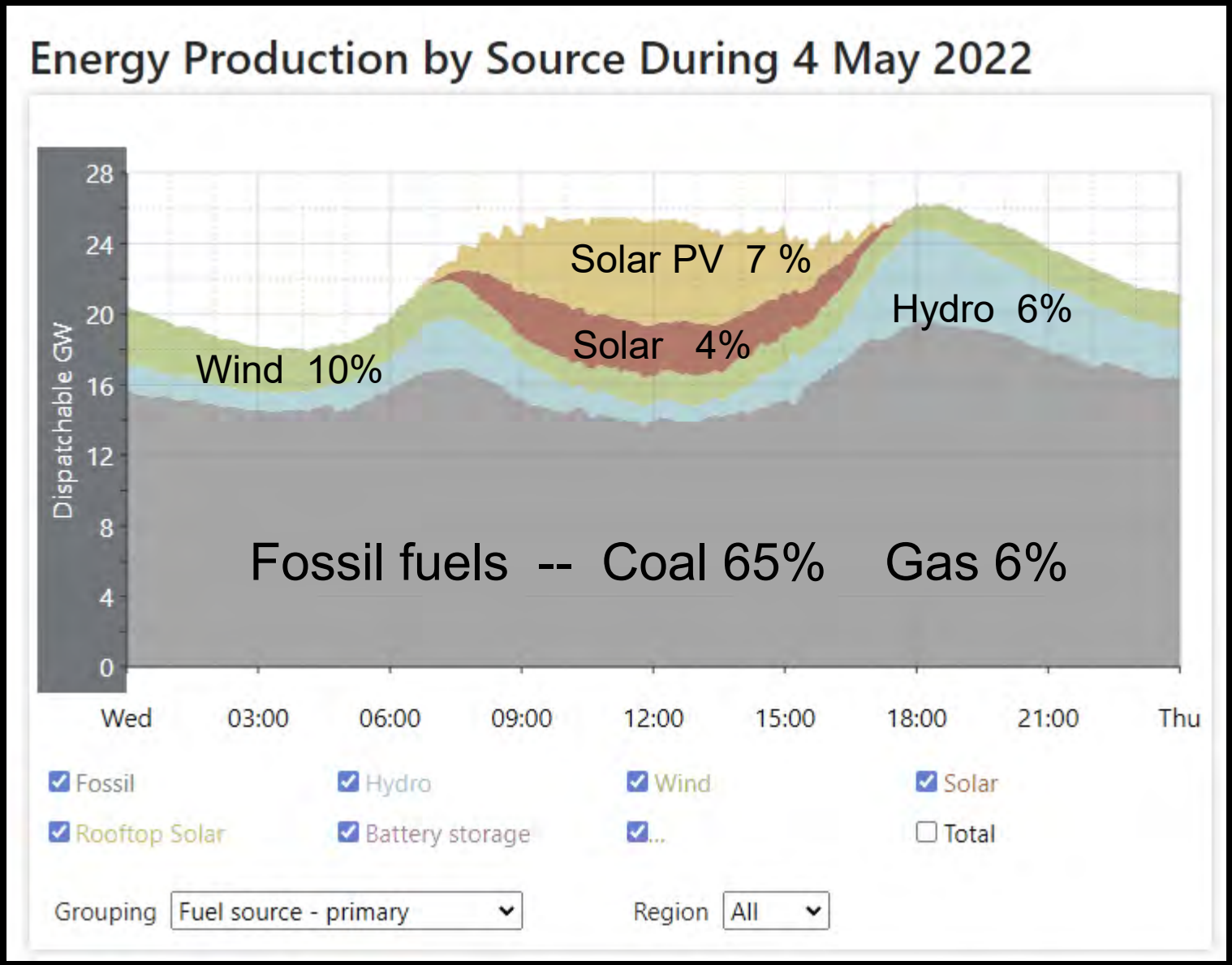
50Hz + 50.4Hz



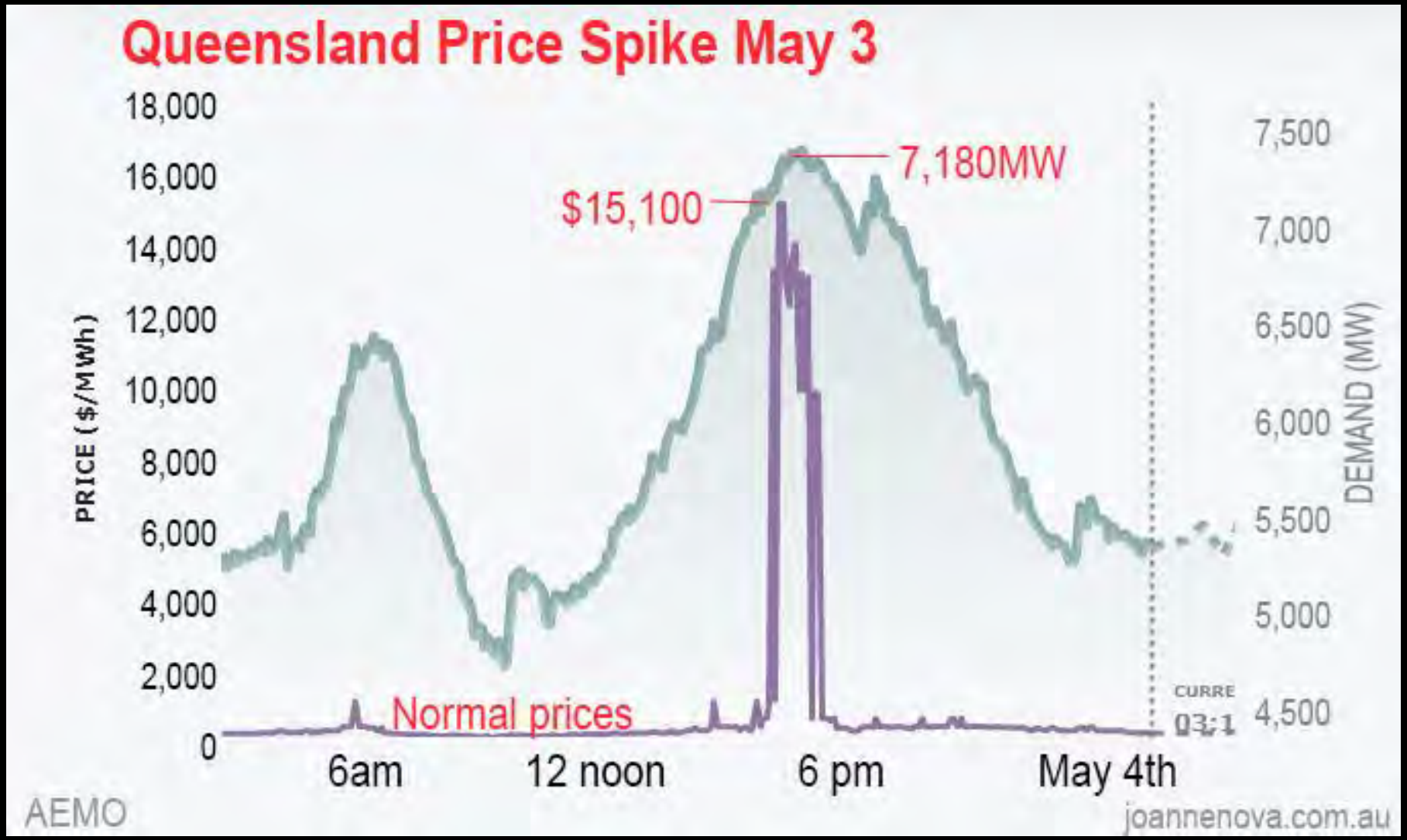
0 1 2 3 4

49.85 – 50.15 Hz

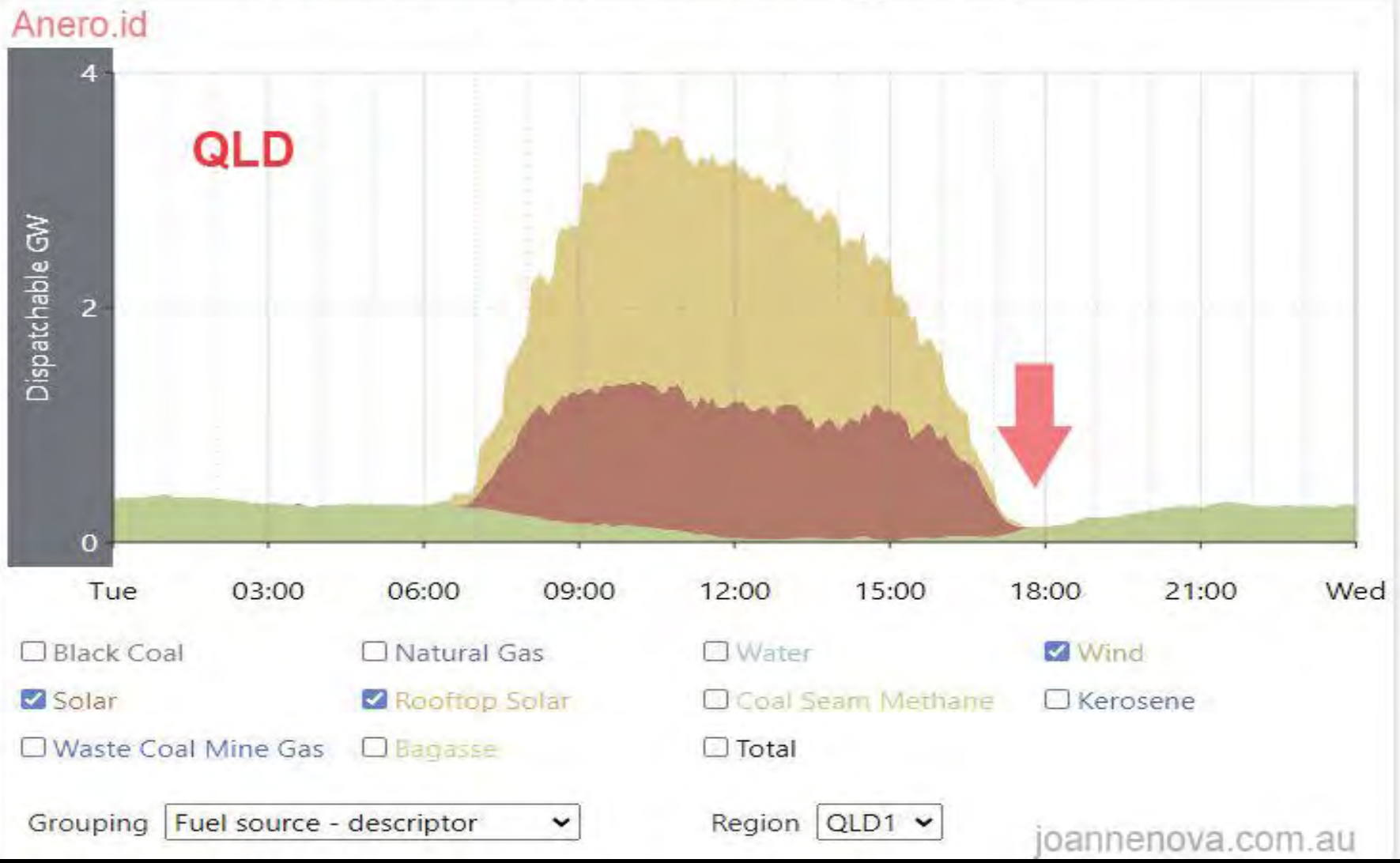
USC 1000MW unit at Shanghai Waigaoqiao III Power Plan


Energy Production by Source During 4 May 2022
Dispatchable GW
28
24
20
16
12
8
4
0
Solar PV 7 %
Solar 4%
Hydro 6%
Wind 10%
Fossil fuels -- Coal 65% Gas 6%
Wed
03:00
06:00
09:00
12:00
15:00
18:00
21:00
Thu
Fossil
Hydro
Wind
Solar
Rooftop Solar
Battery storage
...
Total
Grouping
Fuel source - primary
Region
All

Anero.id


Queensland Price Spike May 3
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
PRICE ($/MWh)
7,500
7,000
6,500
6,000
5,500
5,000
4,500
DEMAND (MW)
7,180MW
$15,100
Normal prices
6am
12 noon
6 pm
May 4th
AEMO
joannenova.com.au

Energy Production by Source During 3 May 2022



Wholesale power prices soared 141 per cent, year on year, and households should brace for more

By energy reporter Daniel Mercer

Posted 19h ago, updated 10h ago

ABC NEWS

Step 1:

- Take that industrial infrastructure and repurpose it…

Global Climate Controller


Surabaya
Papua New Guinea
Solomon Islands
Port Moresby
Darwin
Vanuatu
Port Vila
Fiji
Townsville
N.T.
Qld.
Alice Springs
W.A.
Australia
Brisbane
S.A.
Perth
N.S.W.
Sydney
Adelaide
A.C.T.
Vic.
Melbourne
Auckland
Wellington
New Zealand
Tas.
Hobart
Christchurch
3
15
6
14
2
16
18
2
Coal plants: Status
Announced
Pre-permit development
Shelved
Retired
Cancelled
Operating


Coal plants: Status
Announced
Pre-permit development
Shelved
Retired
Cancelled
Operating
Global Coal Plant Tracker


Coal plants: Status
Announced
Pre-permit development
Shelved
Retired
Cancelled
Operating
Global Coal Plant Tracker

Better generators


PRIVATE JETTY
ENTER AT OWN RISK

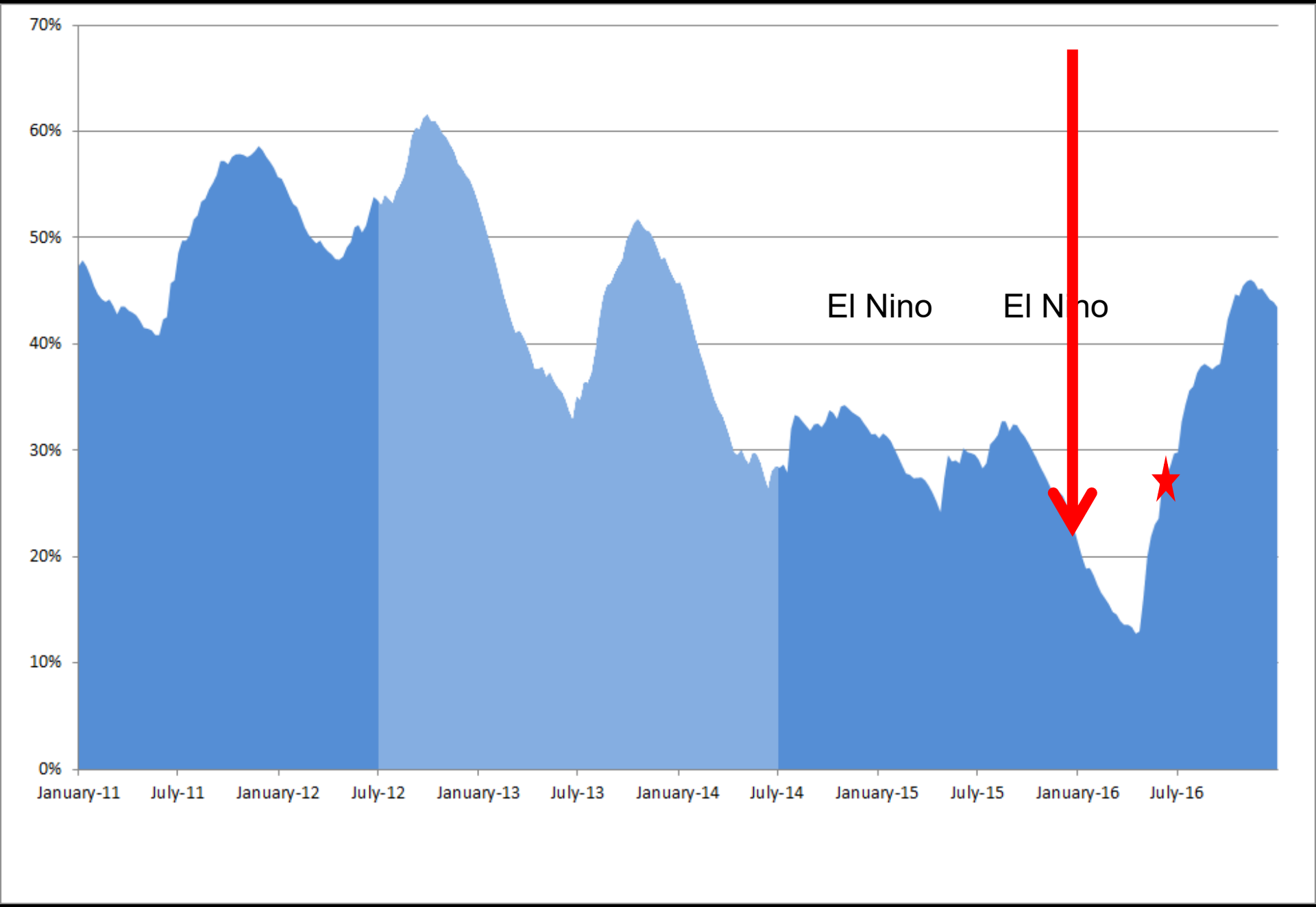
Step 2

- Centralized control

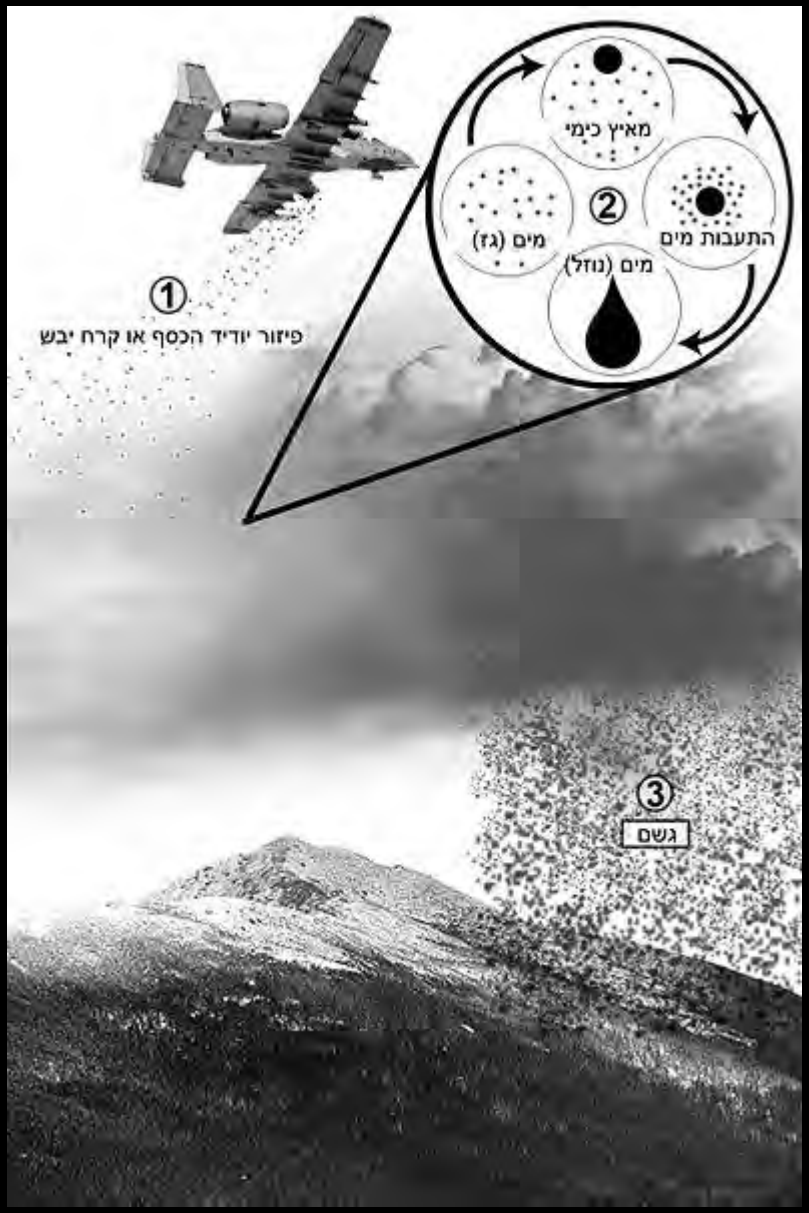
1900 Trams on King St

- Tamer Valley gas station

Built in 2009:
$230 m


70%
60%
50%
40%
30%
20%
10%
0%
January-11
July-11
January-12
July-12
January-13
July-13
January-14
July-14
January-15
July-15
January-16
July-16
El Nino
El Nino

Picture: Jakob De Zwart


מאיץ כימי
התעבות מים
מים (נוזל)
מים (גז)
2
1
פיזור יודיד הכסף או קרח יבש
3
גשם

Step 3

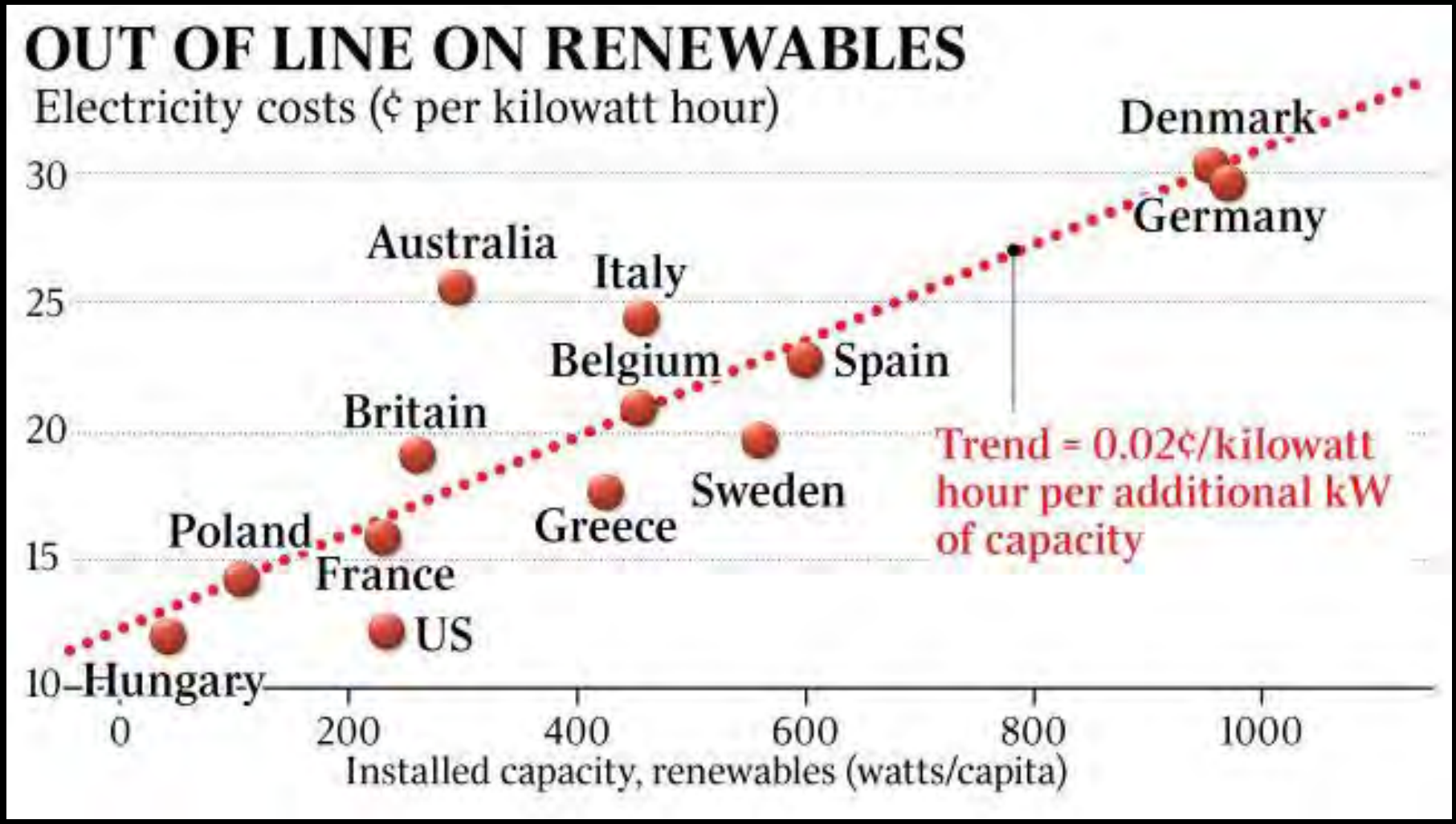
Ministry of Truth

"Renewables *are* cheap"
"CO_2 is pollution"

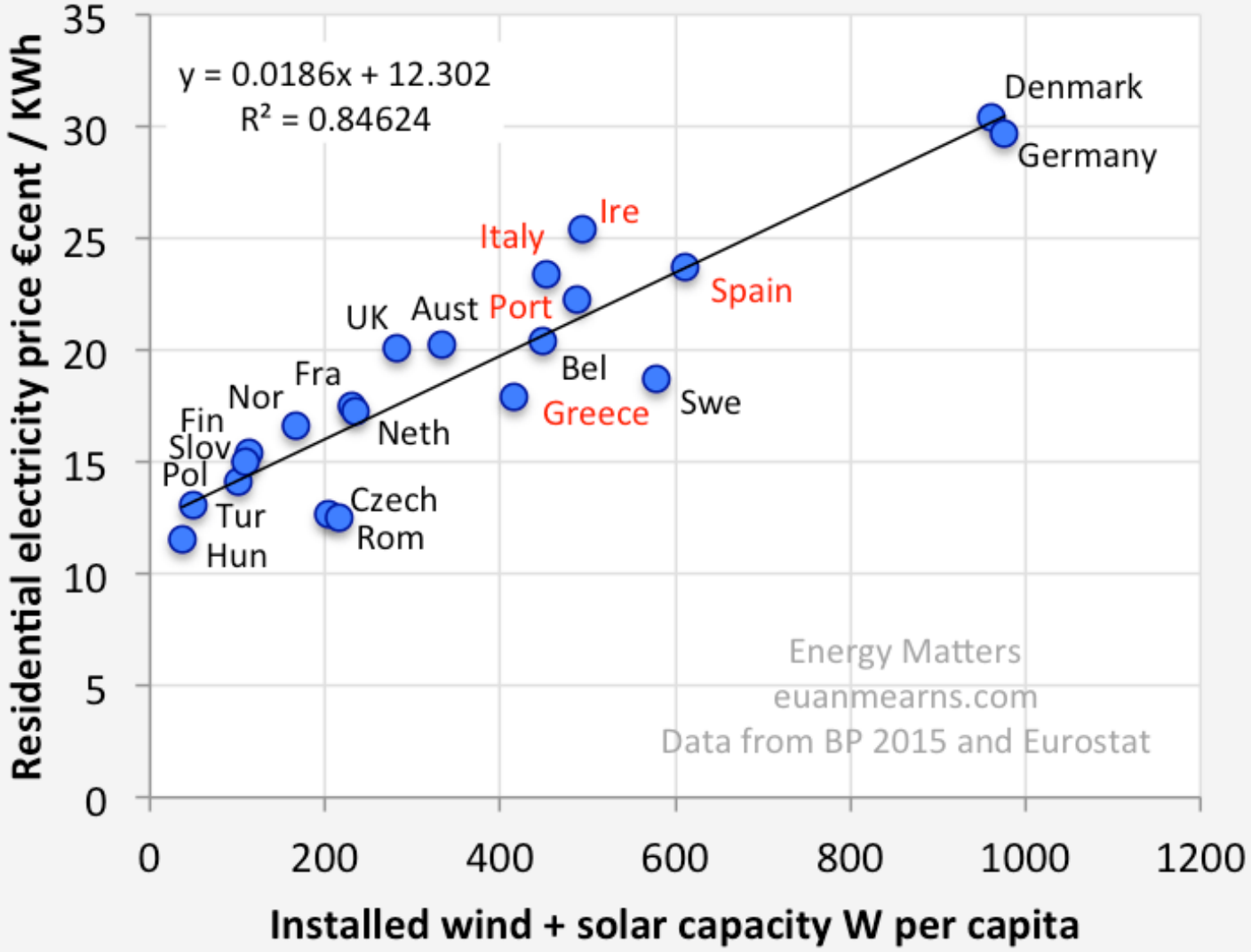
Sell it as a done deal

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

Audrey Zibelman
CEO -- AEMO


OUT OF LINE ON RENEWABLES
Electricity costs (¢ per kilowatt hour)
30
25
20
15
10
Denmark
Germany
Australia
Italy
Belgium
Spain
Britain
Sweden
Greece
Poland
France
US
Hungary
Trend = 0.02¢/kilowatt hour per additional kW of capacity
0
200
400
600
800
1000
Installed capacity, renewables (watts/capita)

Europe Electricity Price v Installed Wind + Solar Capacity



No hydro power
No Biomass

Flinders Island

- Diesel
- In the “Roaring Forties”
- Ideal for tidal energy.
- Average 60% renewables in 2018!
- Sometimes 100% “renewable”
- …prices “won’t be going down”.

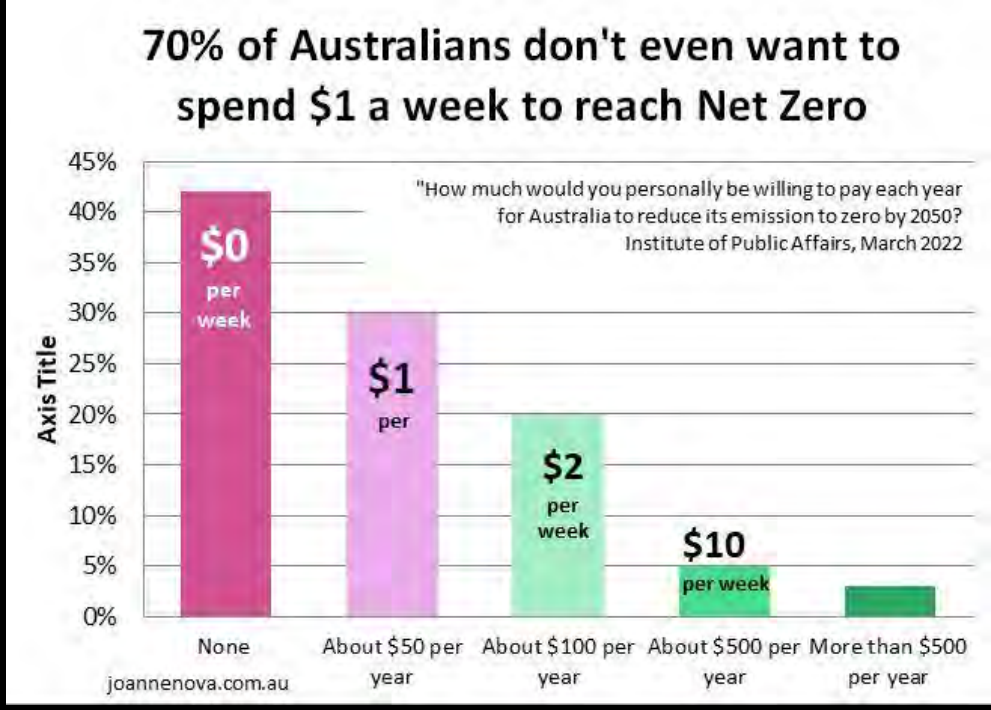
Hide the cost

Cost of blackouts

- South Australia Sept 28th: **$472 m**
- **Tasmania,** Basslink Cable **: $560 m**

Study by Alan Moran
Commissioned by Senator Malcolm Roberts

70% of Australians don't want to pay even $1 a week 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


IN GOD WE TRUST
ONE
jonova

THE AUSTRALIAN
Thursday, May 5, 2022 | Today's Paper | Mind Games

Modelling shows real cost of no net-zero carbon emissions

Scott Morrison arrives for Bert Newton's state funeral in Melbourne on Friday. Picture: Daniel Pockett

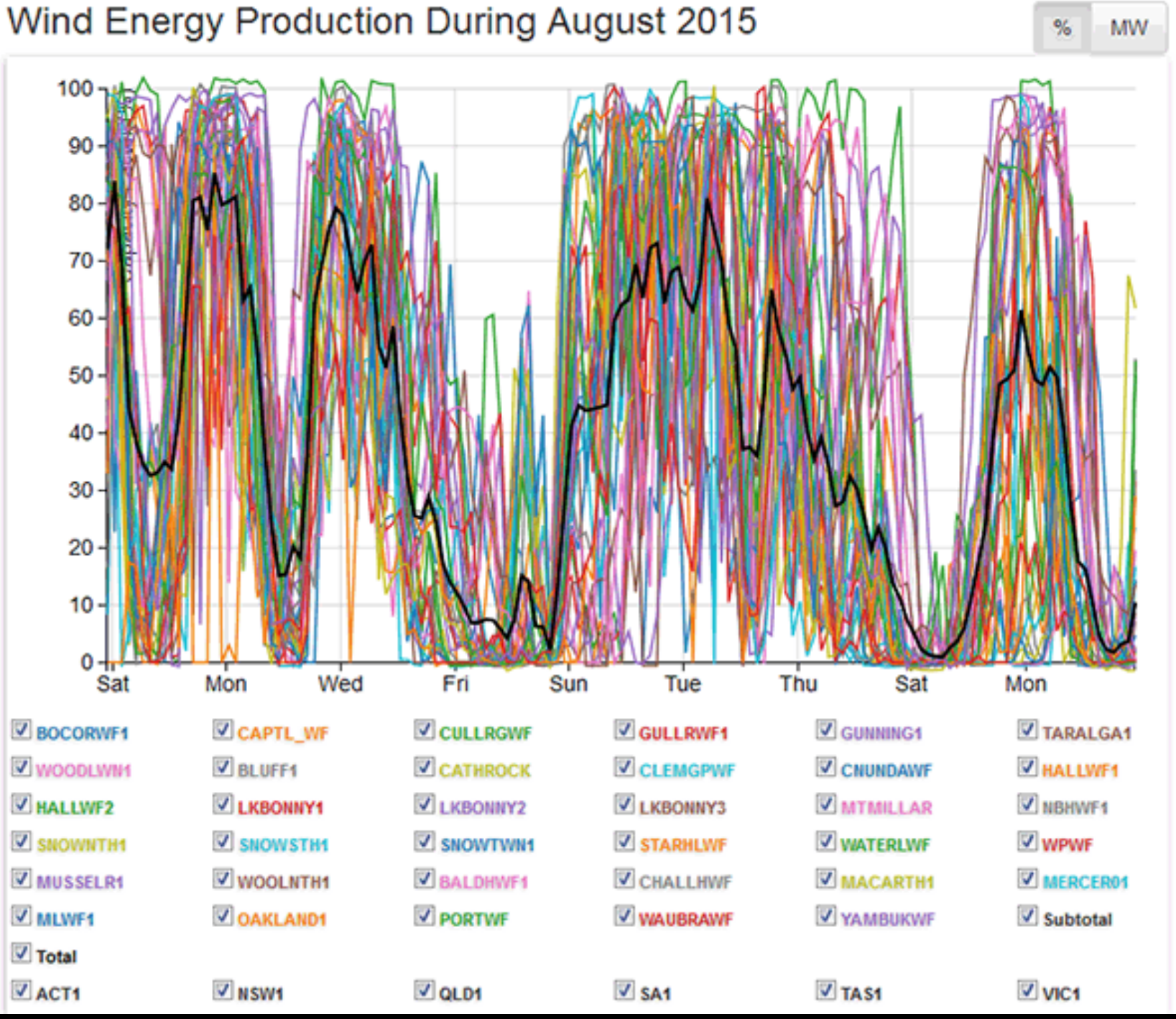
Businesses and households would have faced interest rate hikes of up to 1.5 per cent under expected penalties imposed by global financiers if the government had failed to adopt net zero emissions by 2050, modelling for the Glasgow climate package shows.

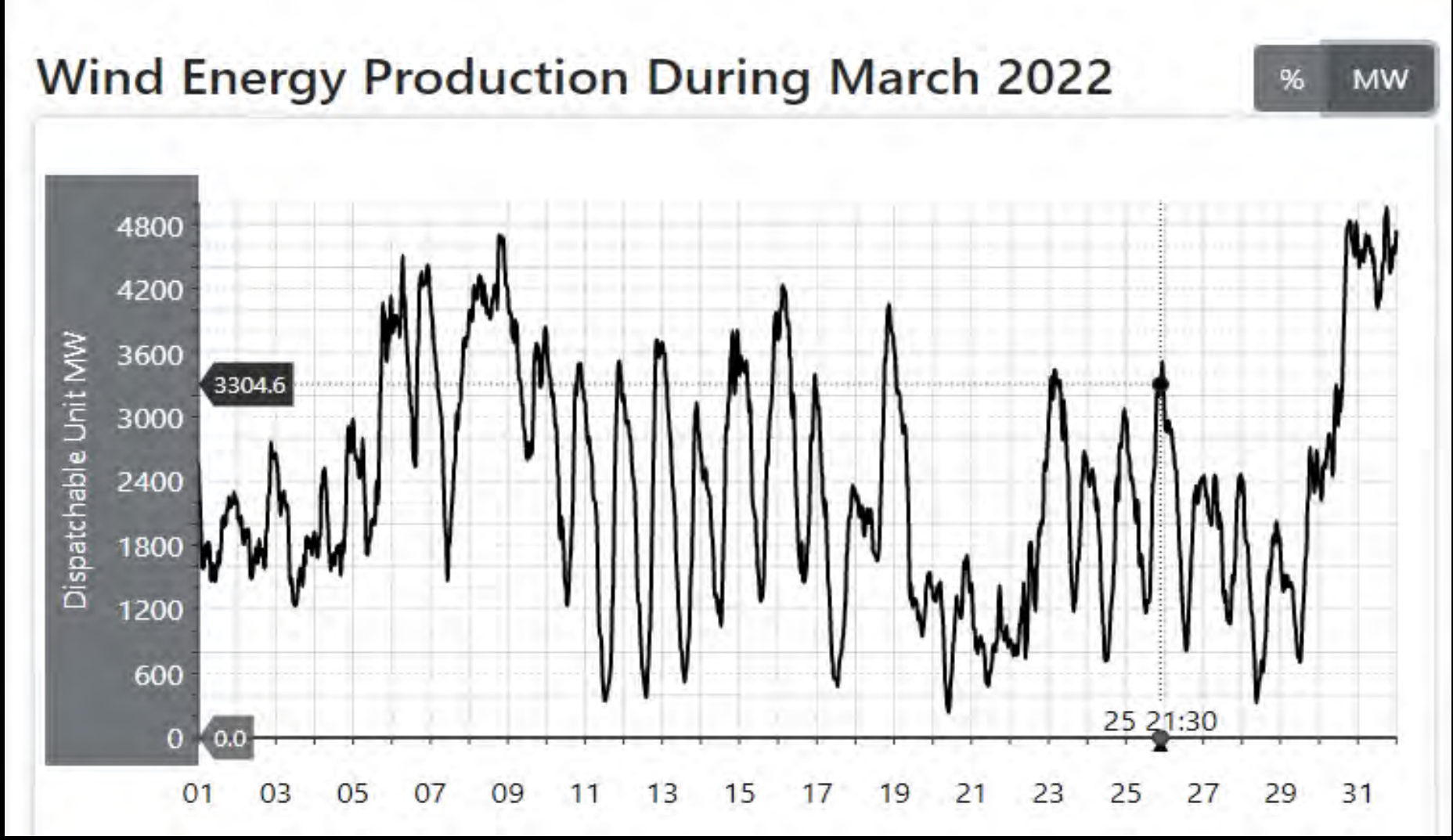
The penalty regime would have sparked a 17 per cent investment collapse by the middle of the next decade, cutting 0.9 per cent from gross domestic product and making each Australian more than $650 poorer.

Step 5:

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

Wind Energy Production During August 2015

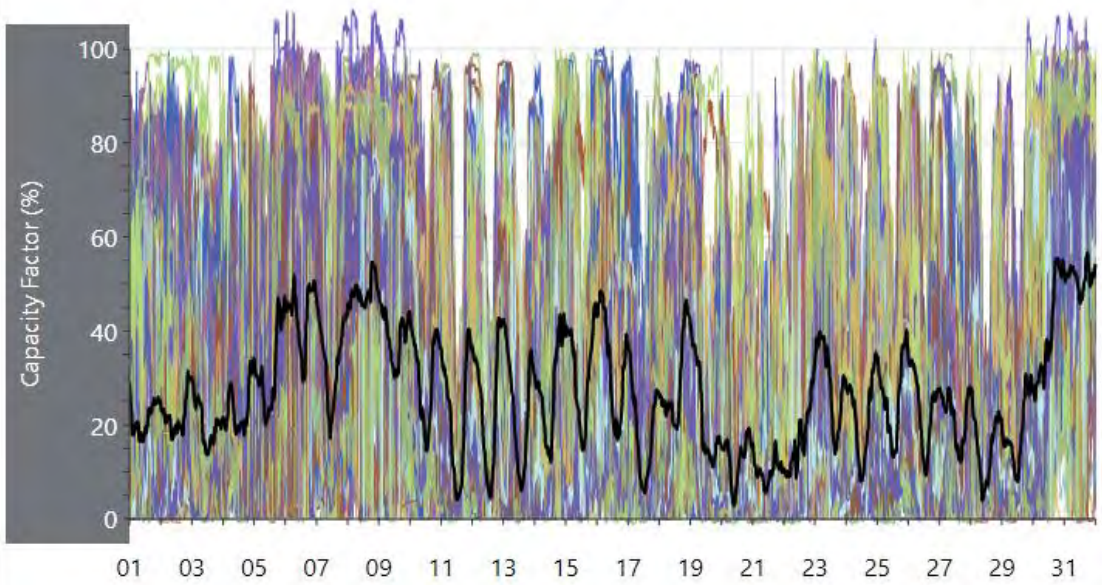



Wind Energy Production During March 2022
%
MW
Dispatchable Unit MW
4800
4200
3600
3304.6
3000
2400
1800
1200
600
0
0.0
25 21:30
01
03
05
07
09
11
13
15
17
19
21
23
25
27
29
31

Anero.id

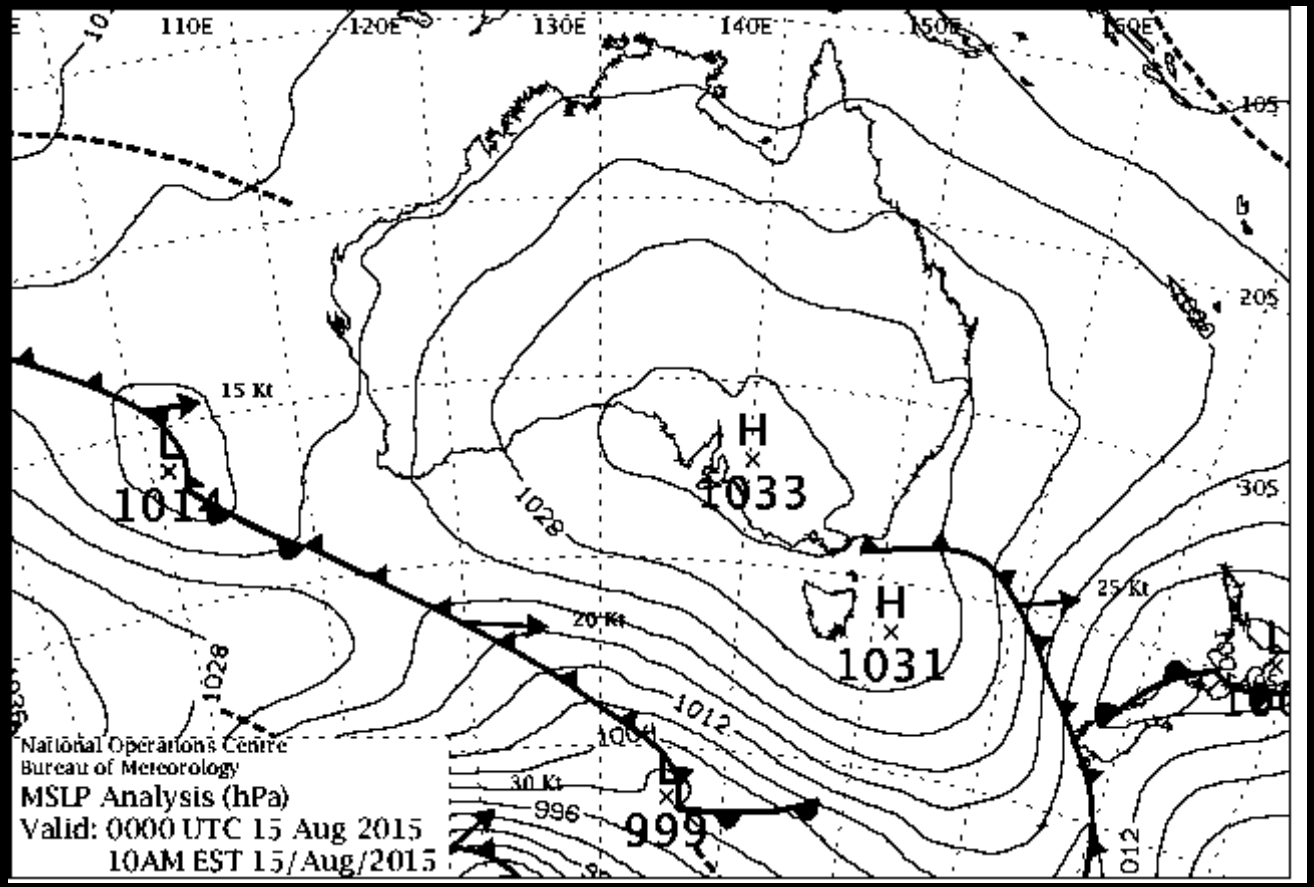
Wind Energy Production During March 2022

% MW

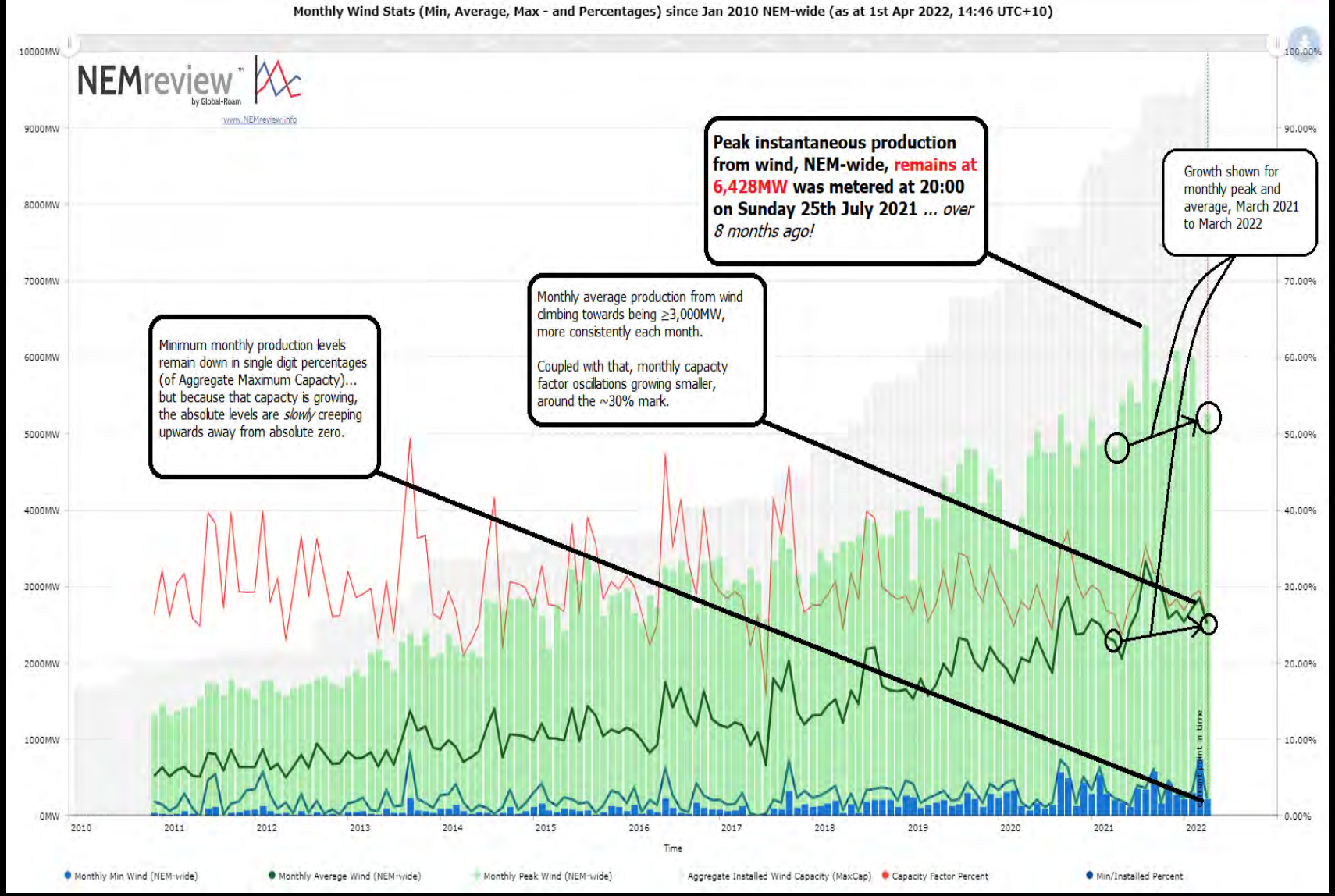


BANGOWF1	BOCORWF1	BODWF1	CAPTL_WF	COLWF01	CROOKWF2
CRURWF1	CULLRGWF	GULLRWF1	GULLRWF2	GUNNING1	SAPHWF1
STWF1	TARALGA1	WOODLWN1	WRWF1	COOPGWF1	MEWF1
BLUFF1	CATHROCK	CLEMGPWF	CNUNDAWF	HALLWF1	HALLWF2
HDWF1	HDWF2	HDWF3	LGAPWF1	LKBONNY1	LKBONNY2
LKBONNY3	MTMILLAR	NBHWF1	SNOWNTH1	SNOWSTH1	SNOWTWN1
STARHLWF	WATERLWF	WGWF1	WPWF	CTHLWF1	GRANWF1
MUSSELR1	WOOLNTH1	ARWF1	BALDHWF1	BRYB1WF1	BULGANA1
CHALLHWF	CHYTWF1	CROWLWF1	DUNDWF1	DUNDWF2	DUNDWF3
ELAINWF1	KIATAWF1	MACARTH1	MERCER01	MLWF1	MOORAWF1
MTGELWF1	MUWAWF1	OAKLAND1	PORTWF	SALTCRK1	WAUBRAWF
YAMBUKWF	YENDWF1	YSWF1	Subtotal	Total	

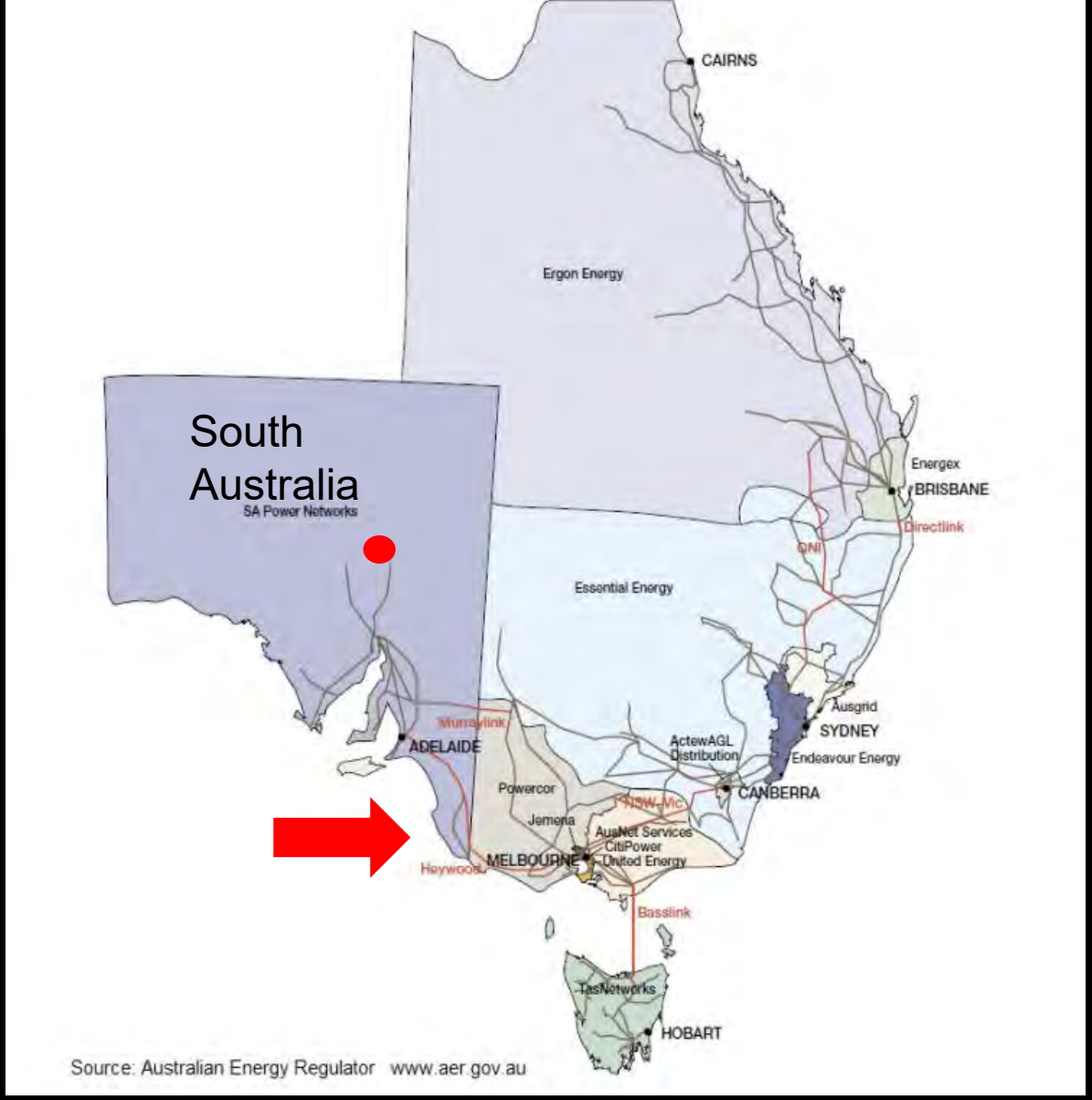
NSW1	QLD1	SA1	TAS1	VIC1



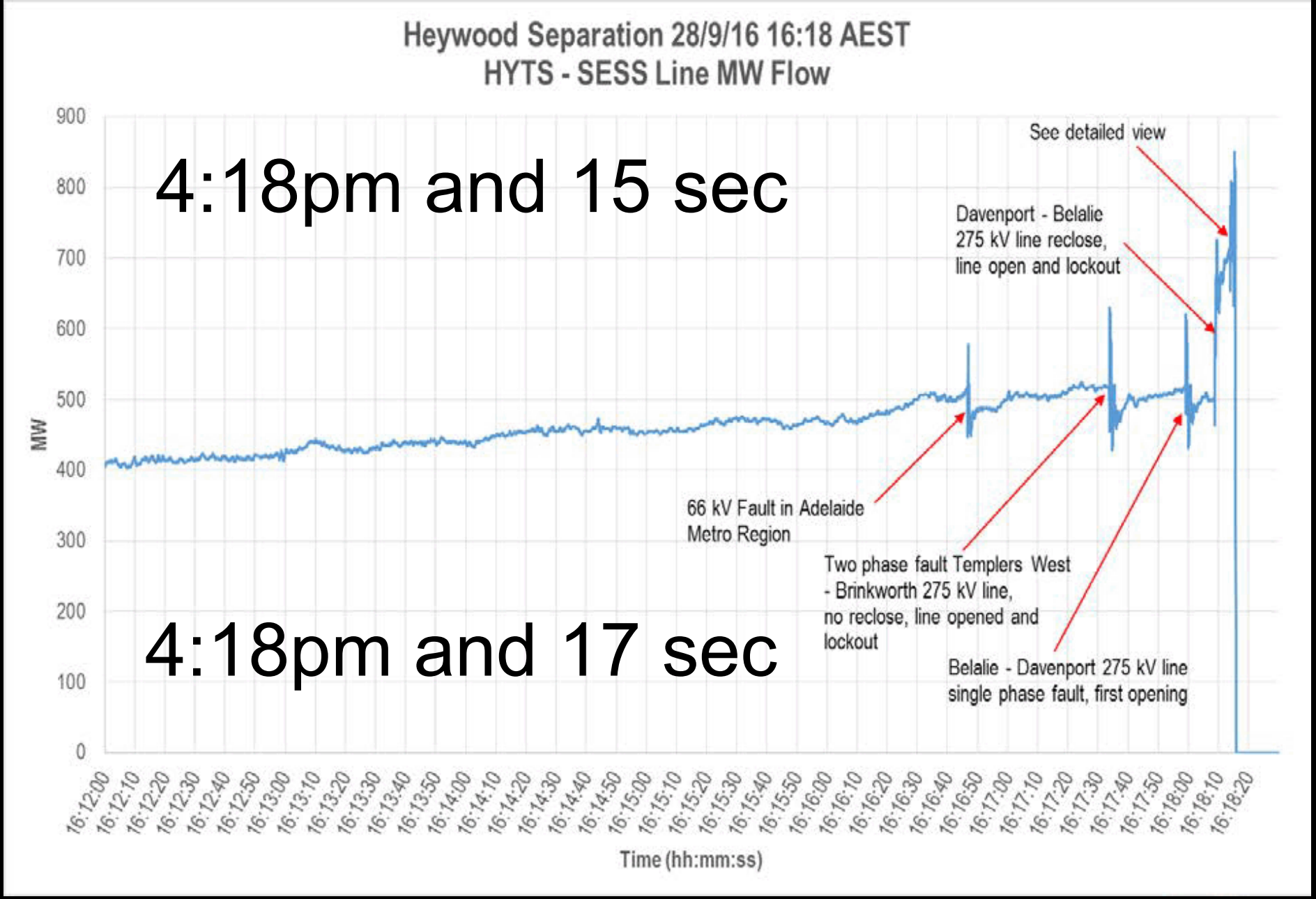
- Australian synoptic chart, August 15th, 2015.

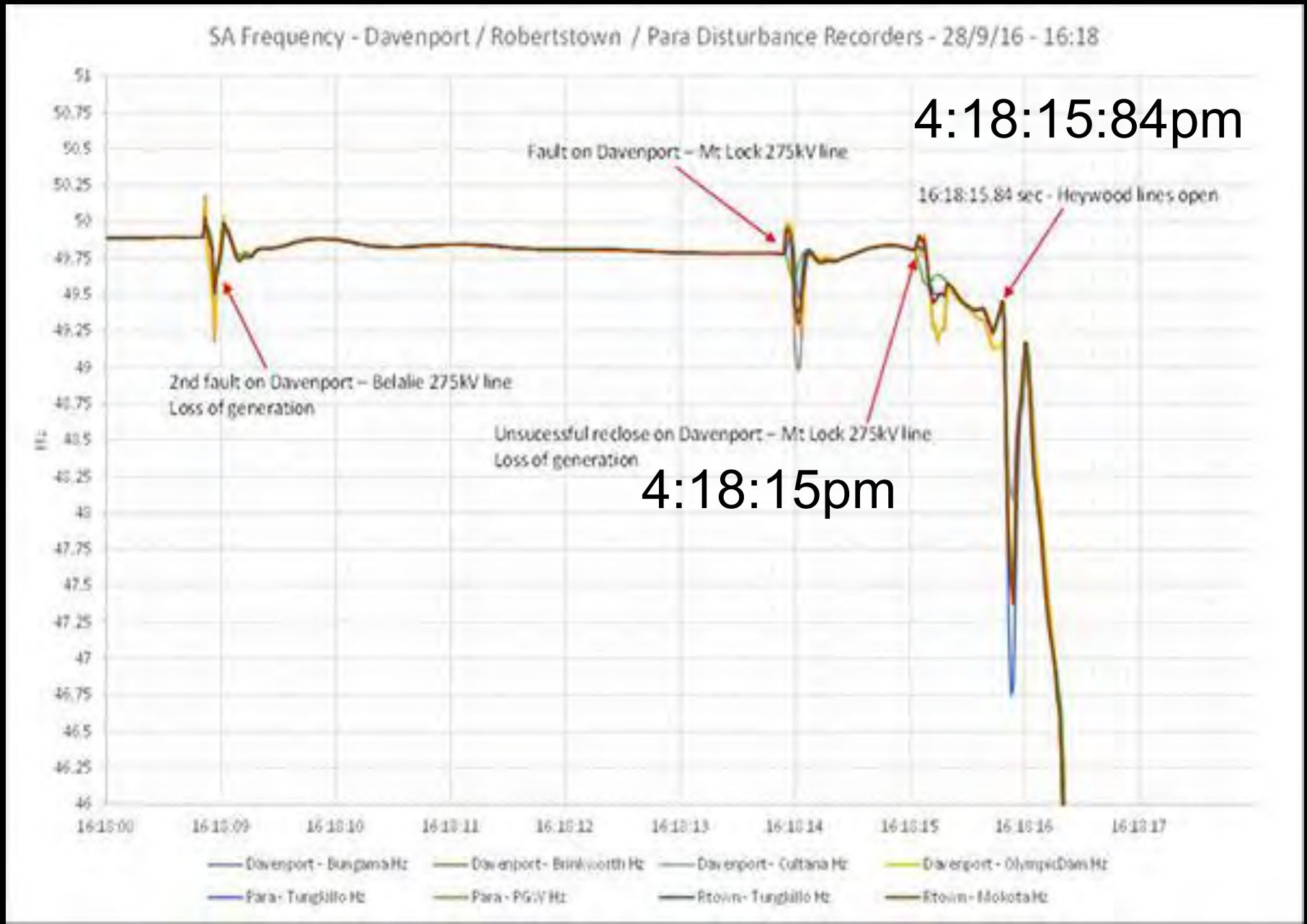

Monthly Wind Stats (Min, Average, Max - and Percentages) since Jan 2010 NEM-wide (as at 1st Apr 2022, 14:46 UTC+10)
NEMreview
by Global-Roam
www.NEMreview.info
Peak instantaneous production from wind, NEM-wide, remains at 6,428MW was metered at 20:00 on Sunday 25th July 2021 ... over 8 months ago!
Growth shown for monthly peak and average, March 2021 to March 2022
Monthly average production from wind climbing towards being ≥3,000MW, more consistently each month.
Coupled with that, monthly capacity factor oscillations growing smaller, around the ~30% mark.
Minimum monthly production levels remain down in single digit percentages (of Aggregate Maximum Capacity)... but because that capacity is growing, the absolute levels are slowly creeping upwards away from absolute zero.
10000MW
9000MW
8000MW
7000MW
6000MW
5000MW
4000MW
3000MW
2000MW
1000MW
0MW
100.00%
90.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Time
Monthly Min Wind (NEM-wide)
Monthly Average Wind (NEM-wide)
Monthly Peak Wind (NEM-wide)
Aggregate Installed Wind Capacity (MaxCap)
Capacity Factor Percent
Min/Installed Percent

Small generators are fragile


CAIRNS
Ergon Energy
South Australia
SA Power Networks
Energex
BRISBANE
Directlink
QNI
Essential Energy
Ausgrid
SYDNEY
Murraylink
ADELAIDE
ActewAGL Distribution
Endeavour Energy
Powercor
CANBERRA
NSW-Vic
Jemena
AusNet Services
CitiPower
Heywood
MELBOURNE
United Energy
Basslink
TasNetworks
HOBART
Source: Australian Energy Regulator www.aer.gov.au

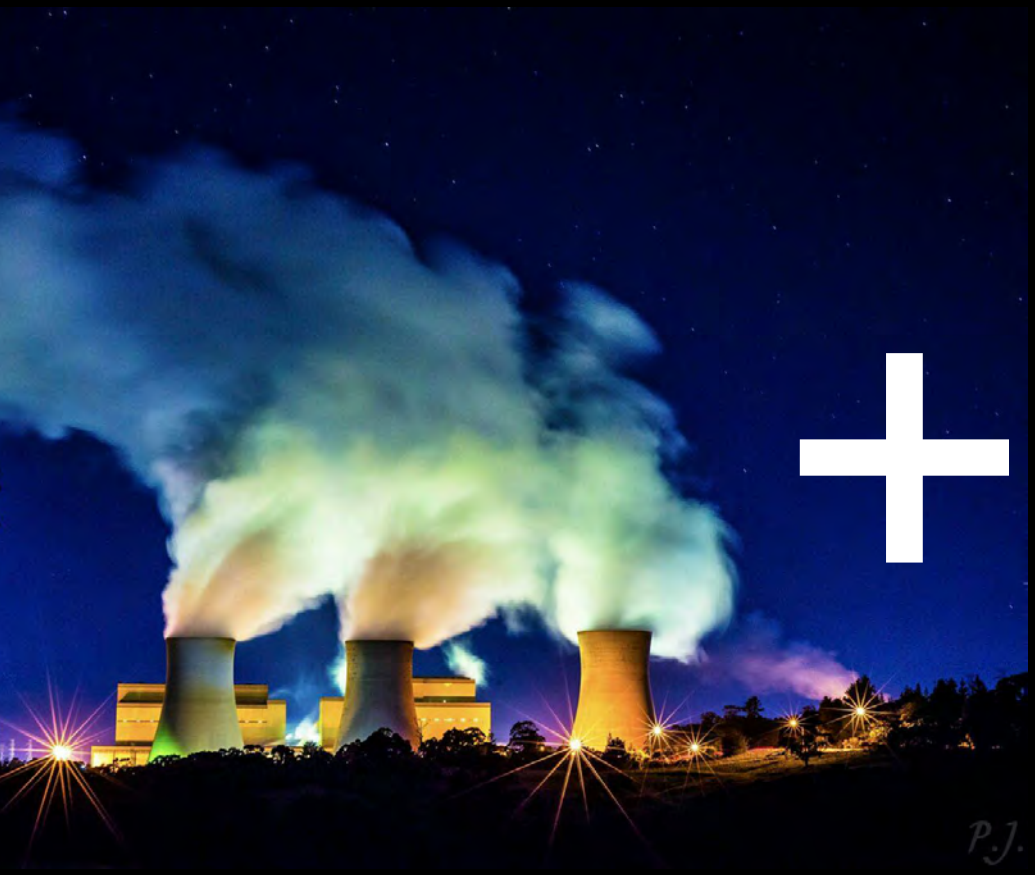
Olympic dam


Heywood Separation 28/9/16 16:18 AEST
HYTS - SESS Line MW Flow
4:18pm and 15 sec
4:18pm and 17 sec
See detailed view
Davenport - Belalie 275 kV line reclose, line open and lockout
66 kV Fault in Adelaide Metro Region
Two phase fault Templers West - Brinkworth 275 kV line, no reclose, line opened and lockout
Belalie - Davenport 275 kV line single phase fault, first opening
MW
Time (hh:mm:ss)


SA Frequency - Davenport / Robertstown / Para Disturbance Recorders - 28/9/16 - 16:18
4:18:15:84pm
Fault on Davenport – Mt Lock 275kV line
16:18:15.84 sec - Heywood lines open
2nd fault on Davenport – Belalie 275kV line
Loss of generation
Unsucessful reclose on Davenport – Mt Lock 275kV line
Loss of generation
4:18:15pm
Hz
51
50.75
50.5
50.25
50
49.75
49.5
49.25
49
48.75
48.5
48.25
48
47.75
47.5
47.25
47
46.75
46.5
46.25
46
16:18:00
16:18:09
16:18:10
16:18:11
16:18:12
16:18:13
16:18:14
16:18:15
16:18:16
16:18:17
Davenport - Bungama Hz
Davenport - Brinkworth Hz
Davenport - Cultana Hz
Davenport - OlympicDam Hz
Para - Tungkillo Hz
Para - PGW Hz
Rtown - Tungkillo Hz
Rtown - Mokota Hz

Step 6:

- Cripple the free market.



+

Yallourn Coal plant, Victoria

Phillip Jessop

Mattinbgn

PEDESTRIAN GROUP

TECH

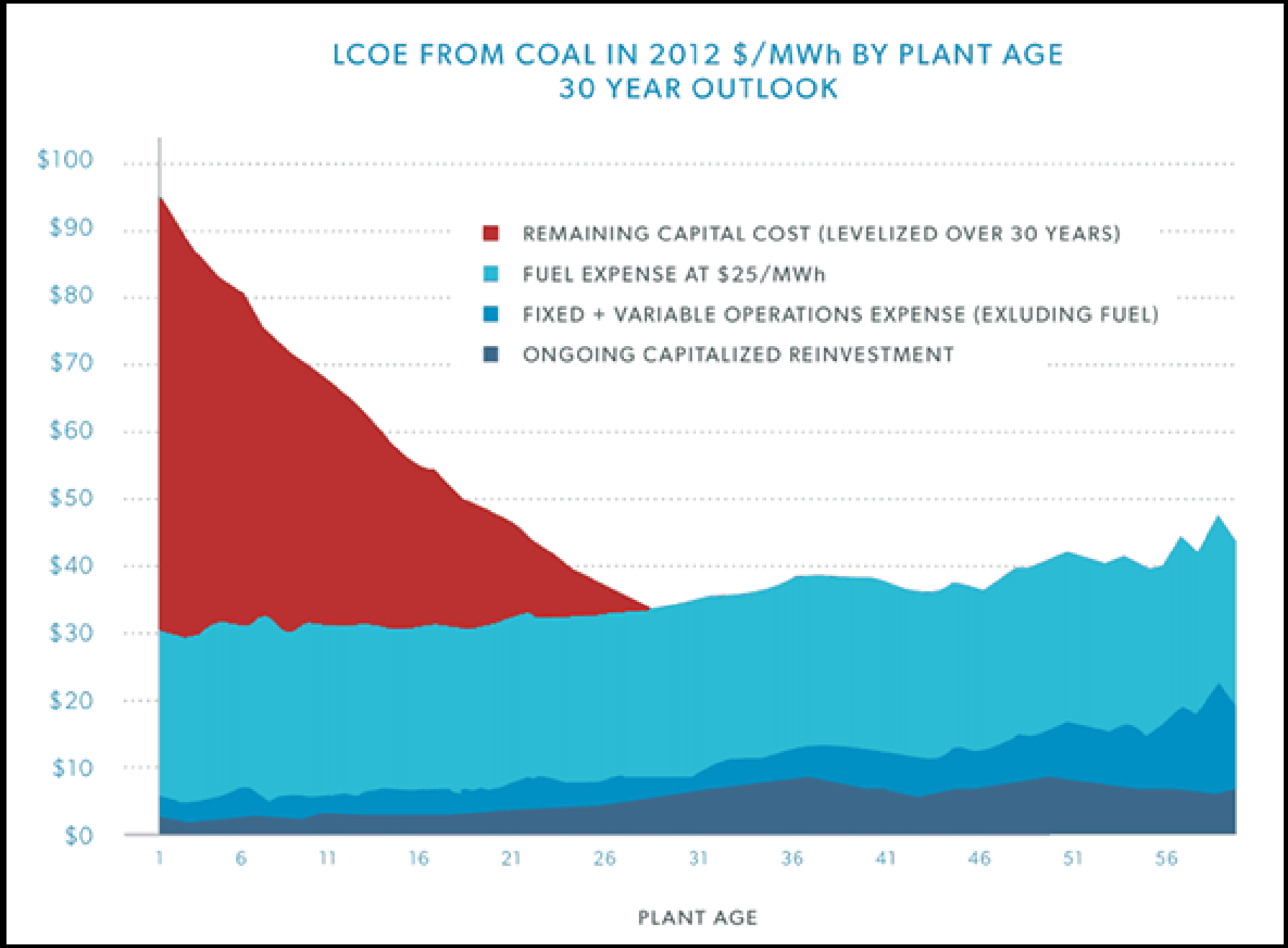
A coal-fired Hunter Valley power station could be brought back online to provide cheap power for cryptocurrency miners

Peter Farquhar Apr. 10, 2018, 4:14 PM

Hunter Valley power can be cheap. Picture: Getty Images

8c

- Hunter Energy proposing to recommission Redbank station over the next 12 months.
- IOT Group signs agreement to develop Blockchain Application

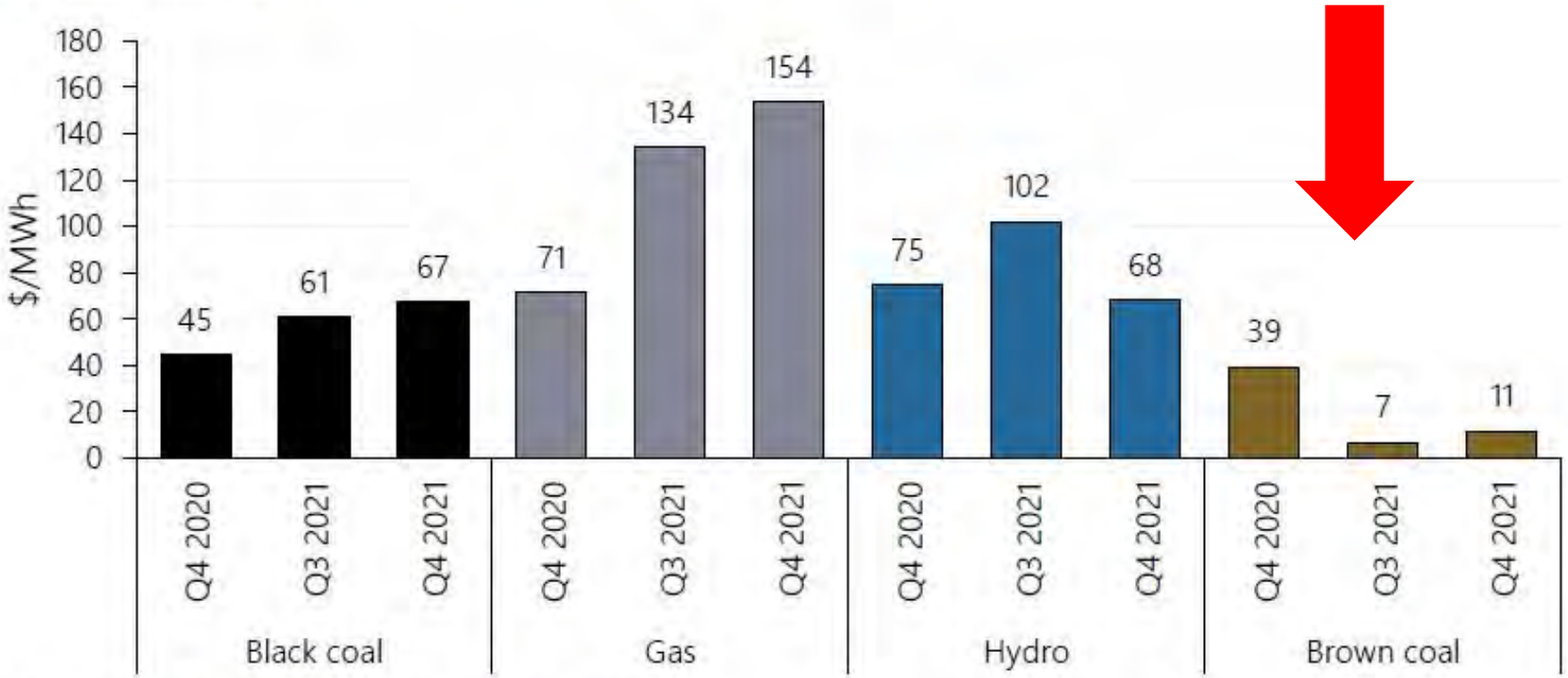


Stacy, T. Taylor, G. (2015) The Levelized Cost of Electricity from Existing Generation Sources, Institute for Energy Research (IER), based on EIA figures in the USA.

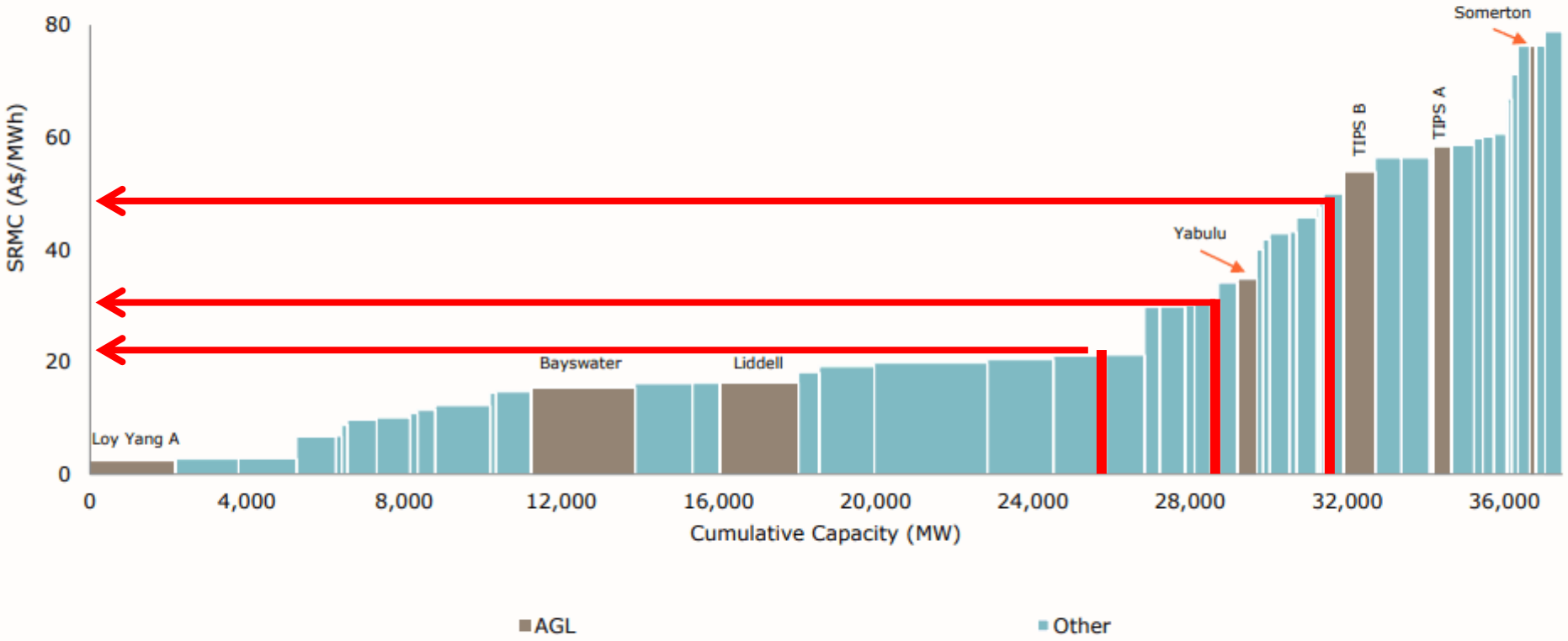

ersPower
MAHON
VICES

Figure 27 Black coal and gas offers setting higher prices in Q4 2021

Average prices set by fuel type



NEM Thermal Merit Order (Carbon Exclusive)[1,2]



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 graphed, most diesel plants costing more than $350/MWh

Liddell Coal Generator

2,000 MW

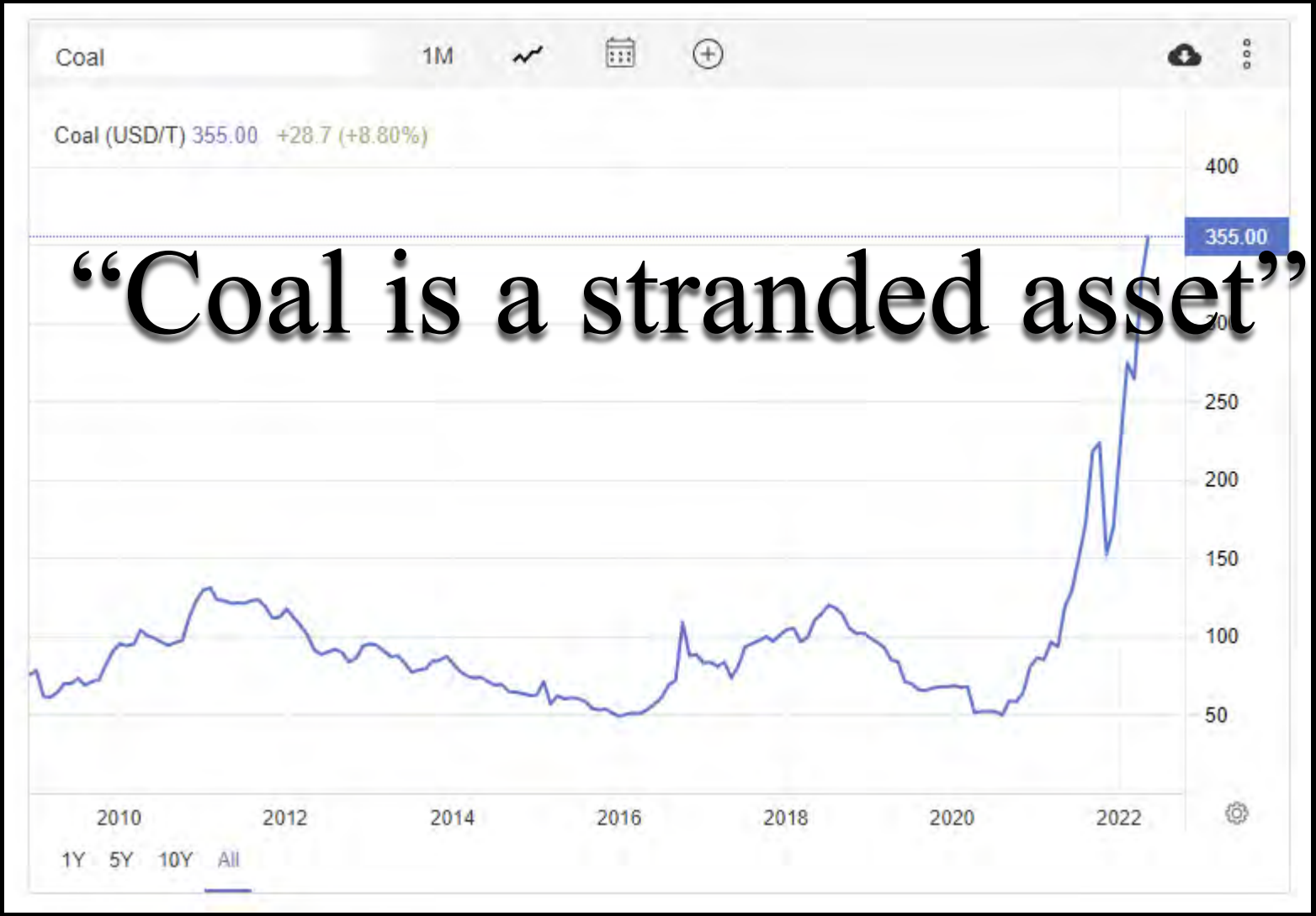
End of Australia's coal export boom to China is 'imminent'

Jacob Greber
Senior correspondent

Apr 21, 2022 – 5.00am

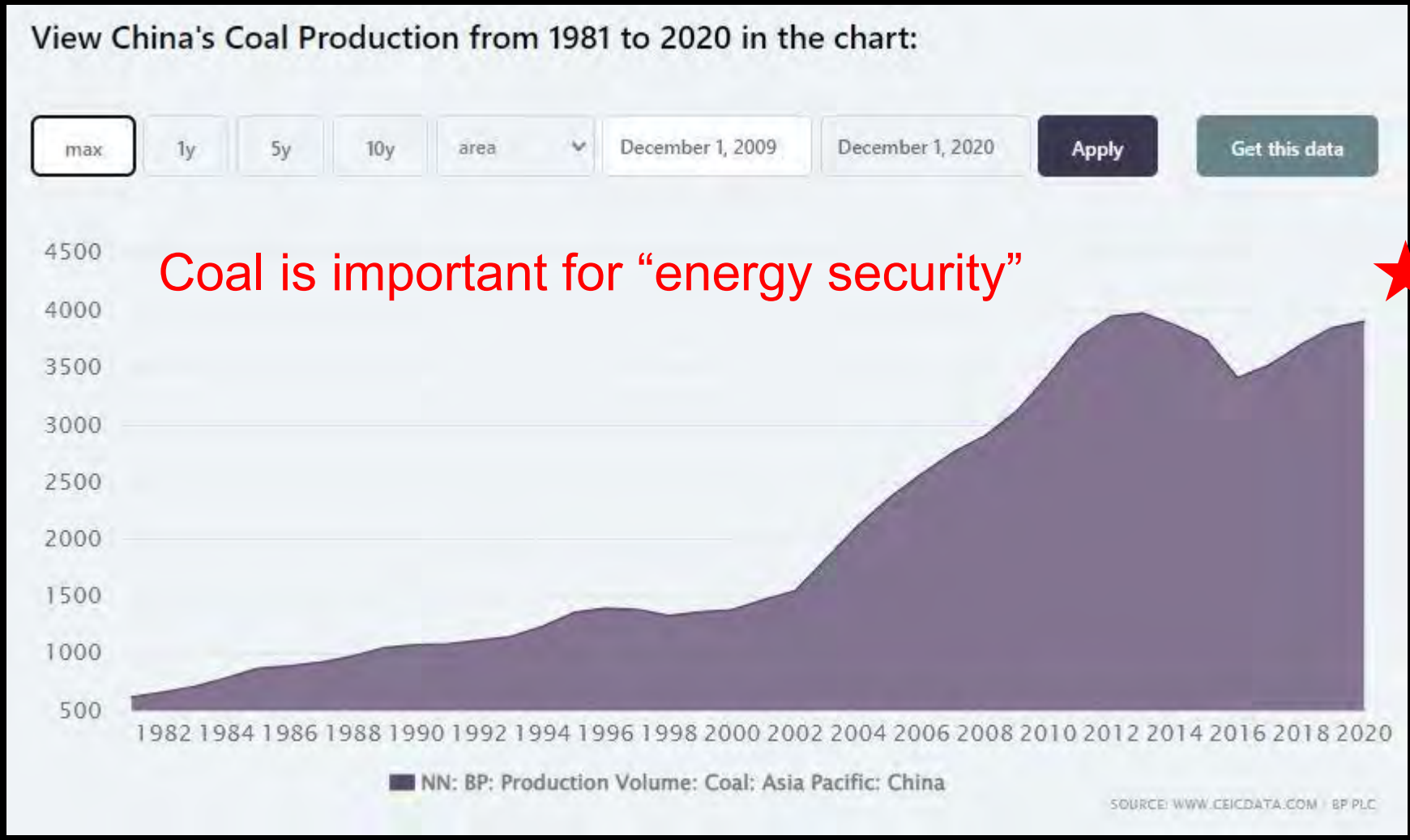
China is weaning itself off Australian coal faster than expected, according to a new study that puts renewed pressure on both sides of politics to explain to marginal seat voters in Queensland and the Hunter how they will manage the transition.

Warning that there will be no return to the boom days that preceded China's imposition of an import ban on Australian coal, the report predicts thermal coal shipments will fall between 26 per



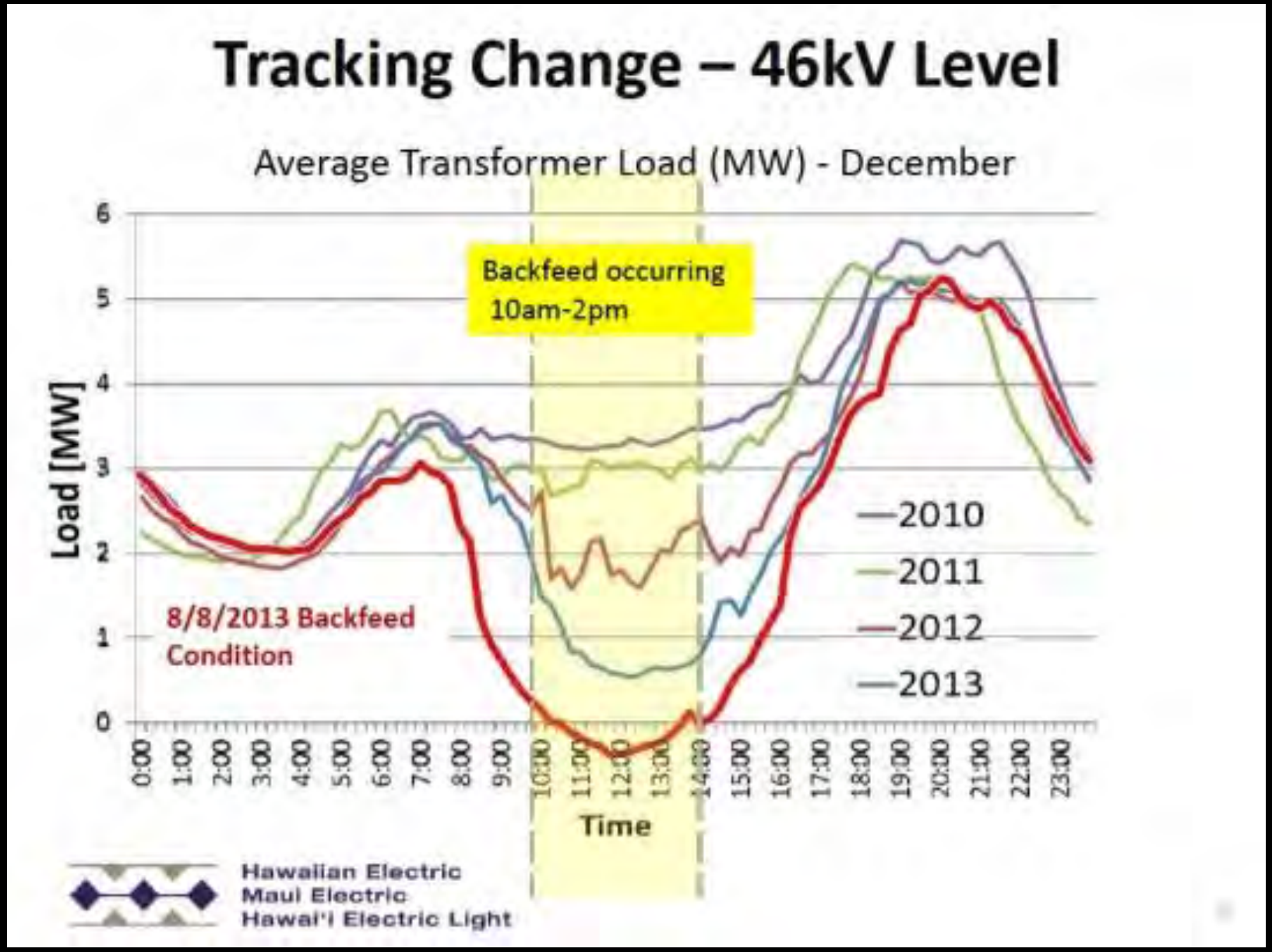
“Coal is a stranded asset”

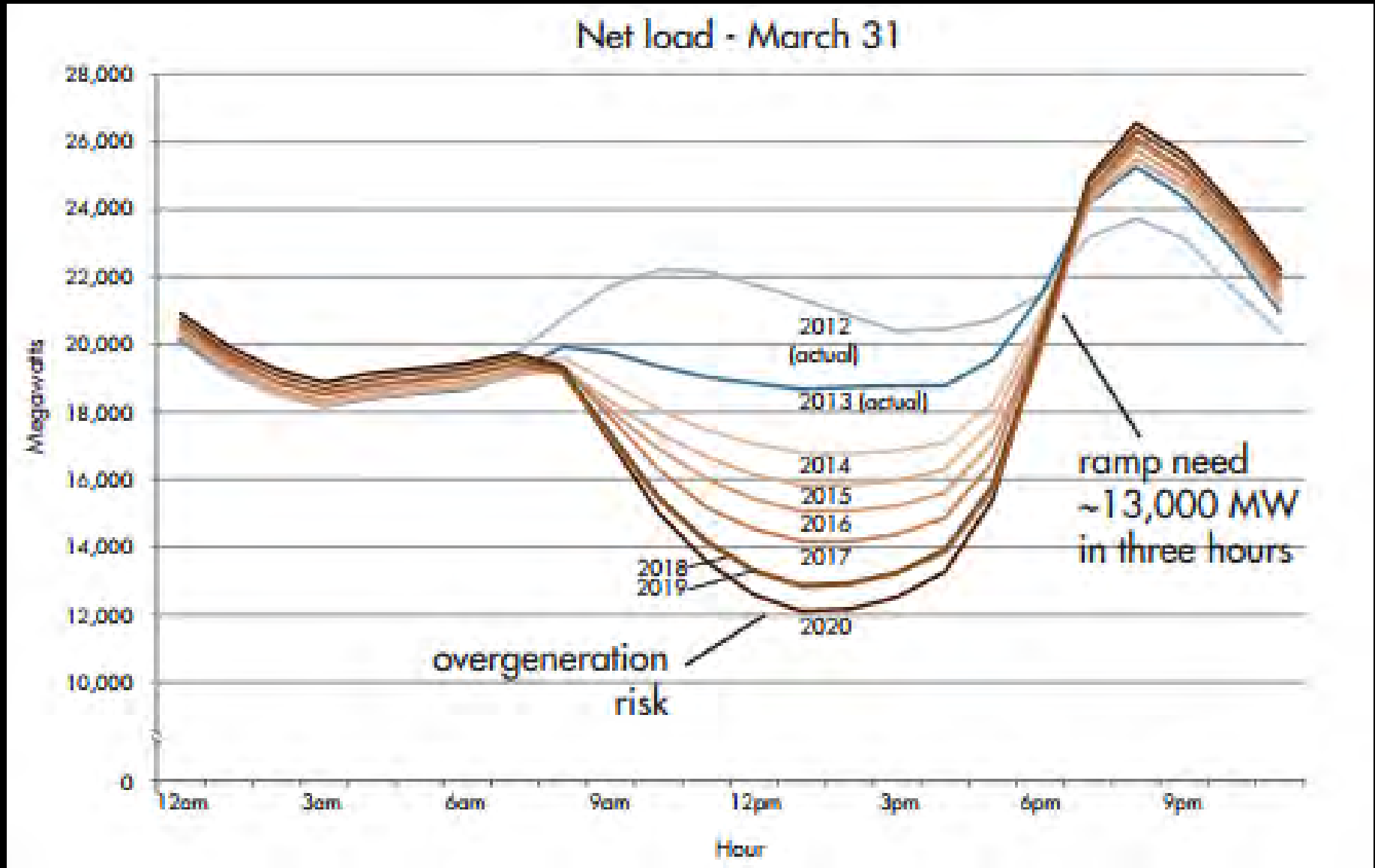
https://tradingeconomics.com/commodity/coal


View China's Coal Production from 1981 to 2020 in the chart:
max
1y
5y
10y
area
December 1, 2009
December 1, 2020
Apply
Get this data
Coal is important for “energy security”
4500
4000
3500
3000
2500
2000
1500
1000
500
1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020
NN: BP: Production Volume: Coal: Asia Pacific: China
SOURCE: WWW.CEICDATA.COM / BP PLC

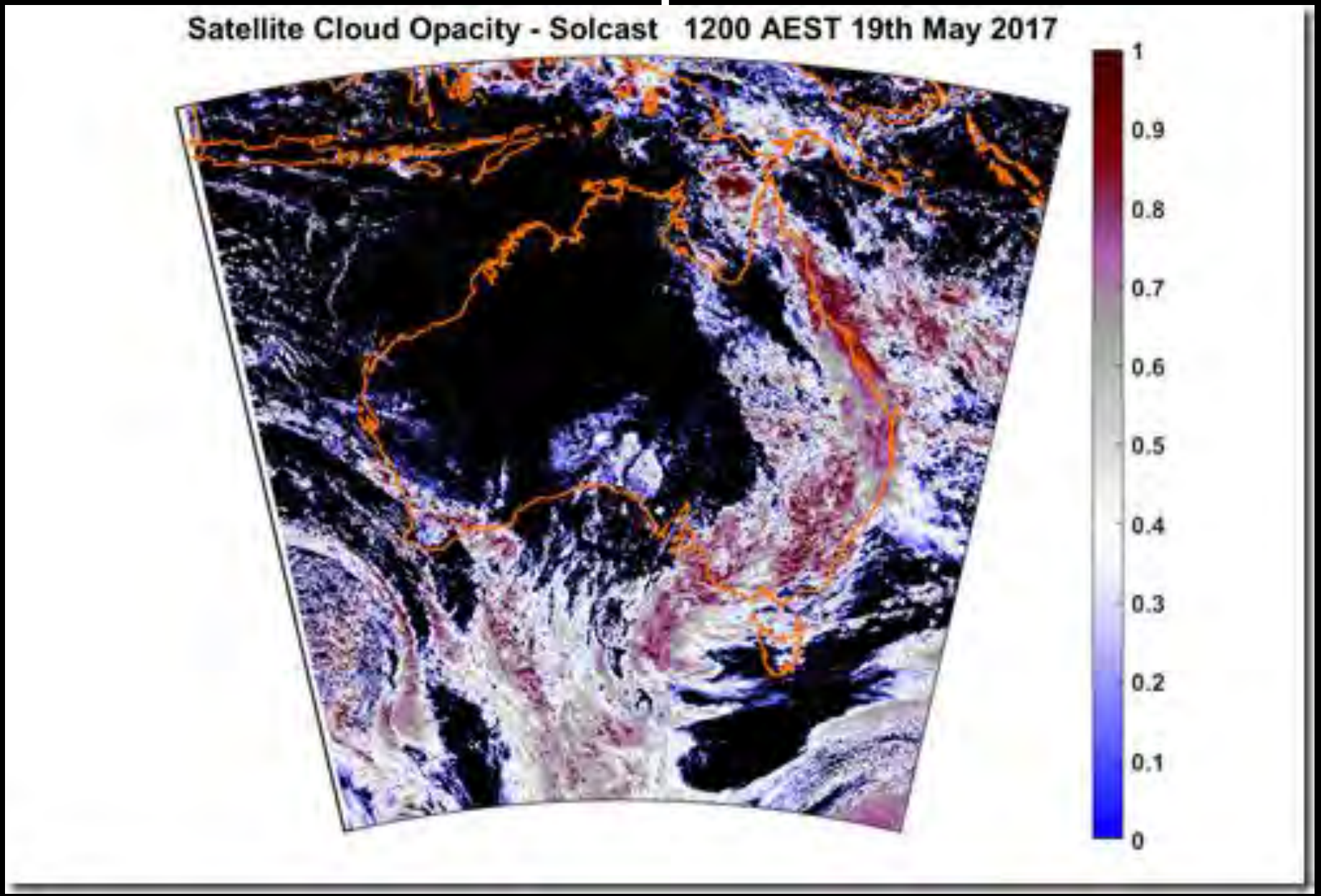
Solar

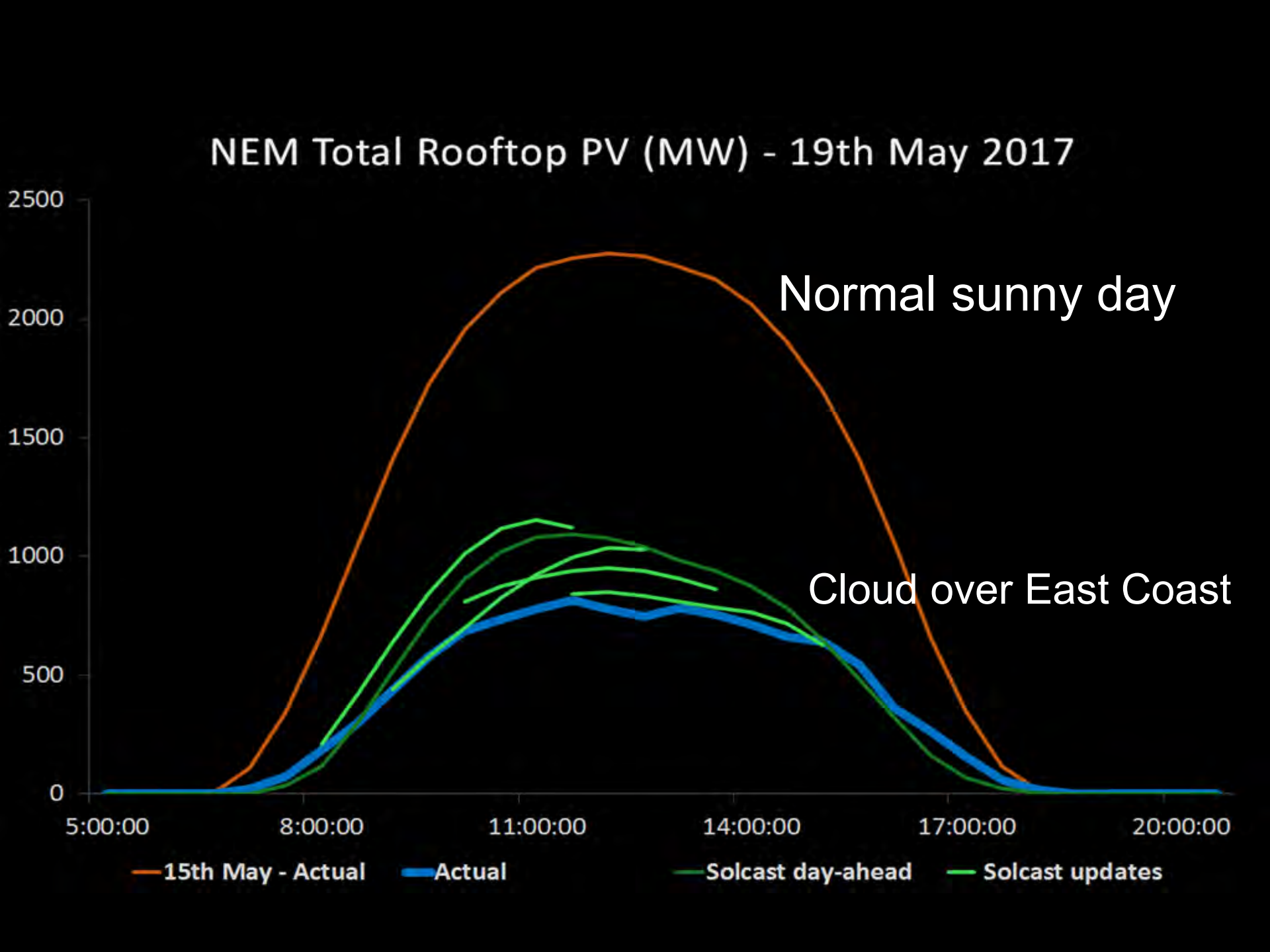
“The Duck Curve”




Net load - March 31
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
0
Megawatts
12am
3am
6am
9am
12pm
3pm
6pm
9pm
Hour
2012 (actual)
2013 (actual)
2014
2015
2016
2017
2018
2019
2020
ramp need ~13,000 MW in three hours
overgeneration risk

Solar power

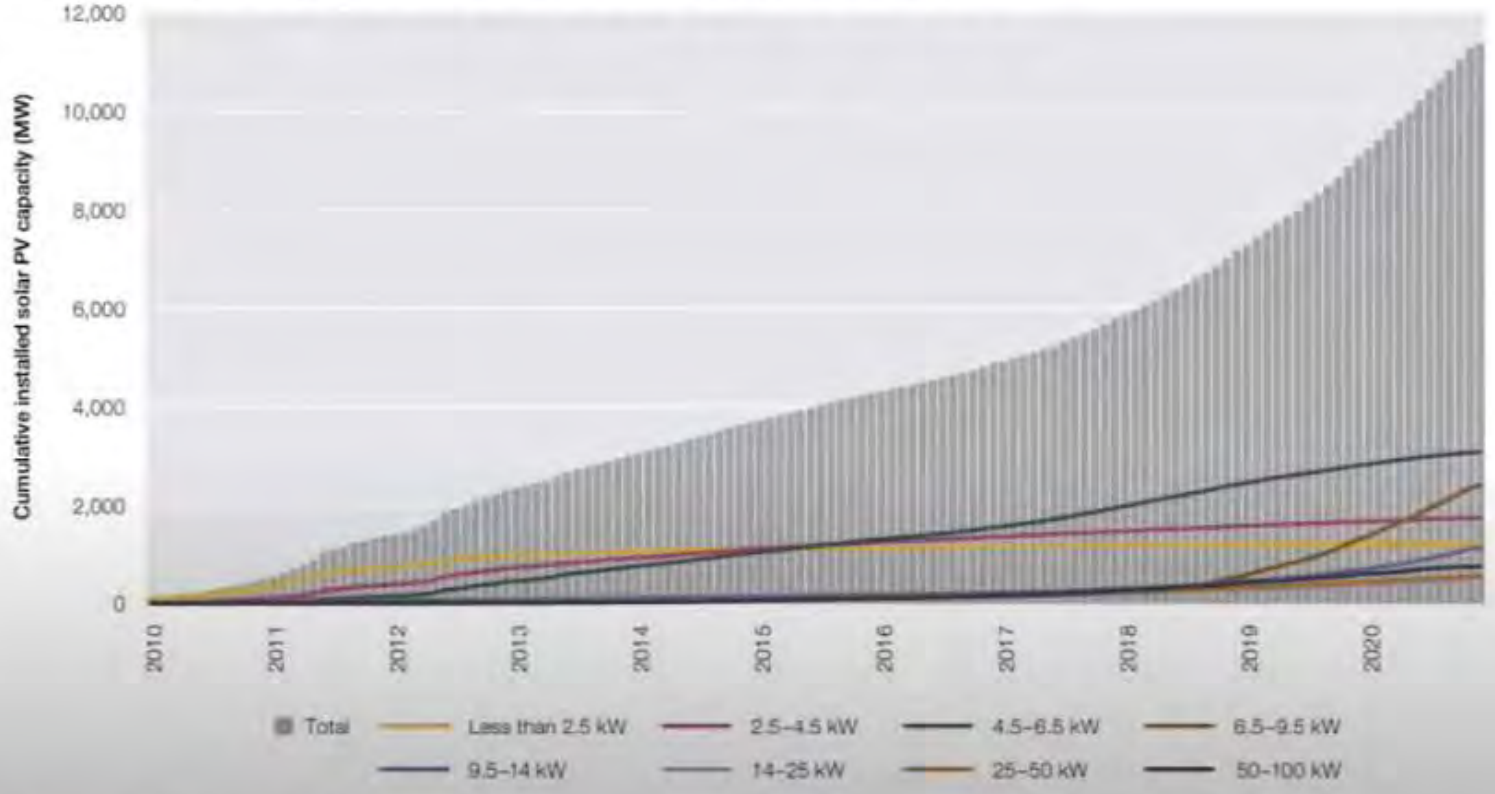

Satellite Cloud Opacity - Solcast 1200 AEST 19th May 2017
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


NEM Total Rooftop PV (MW) - 19th May 2017
2500
2000
1500
1000
500
0
5:00:00
8:00:00
11:00:00
14:00:00
17:00:00
20:00:00
Normal sunny day
Cloud over East Coast
15th May - Actual
Actual
Solcast day-ahead
Solcast updates

Search

The uptake of rooftop solar PV systems has grown exponentially in the past decade (figure 3.19). As a result of this rapid growth, DER integration now presents a significant, emerging area of expenditure.

Figure 3.21 Cumulative installed small scale solar photovoltaic capacity

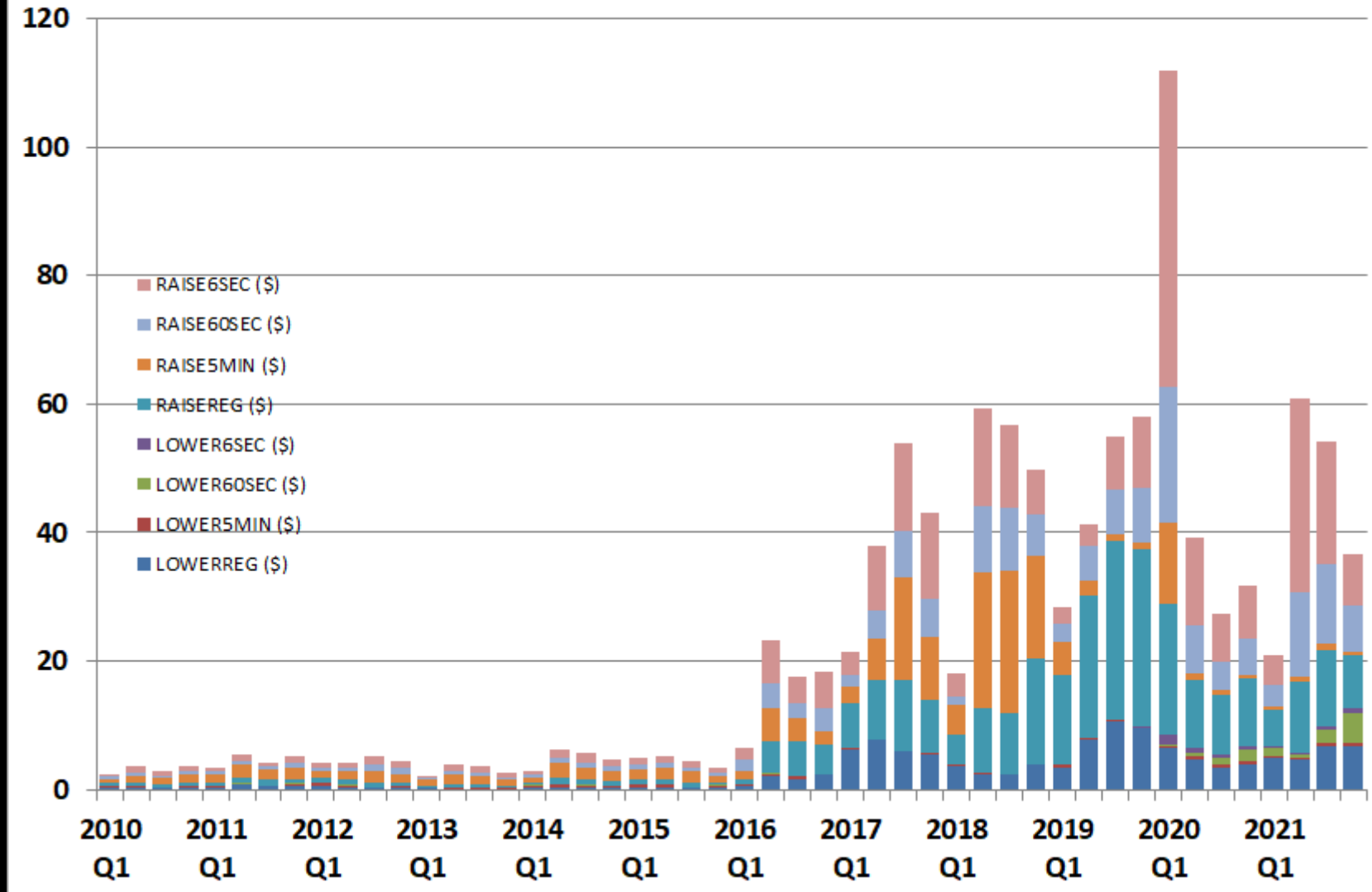


kW: kilowatts; MW: megawatts; PV: photovoltaic.

Note: Includes installations of PV systems up to 100 kW in size. Data covers all of Australia.

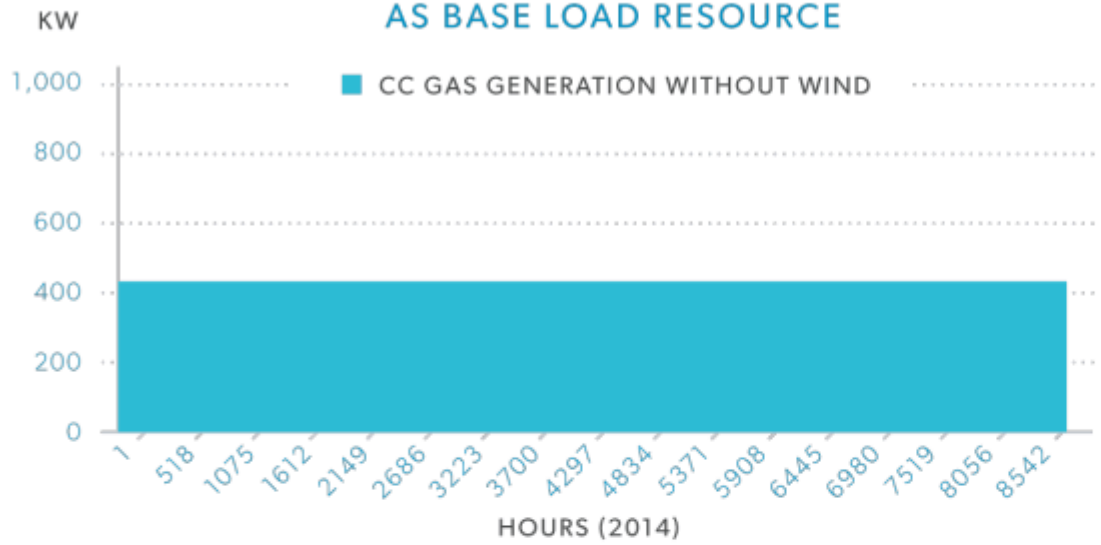
Source: AER analysis of postcode data from the Australian PV Institute, collected on 24 February 2021.

Quarterly global FCAS costs by services

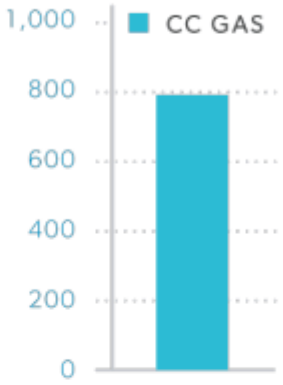


More hidden costs

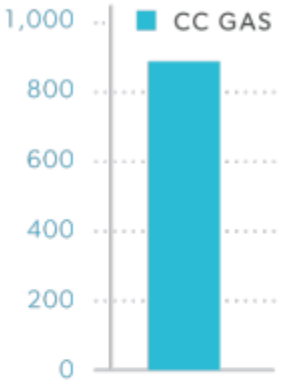
CC GAS GENERATION AT 47.8% CAPACITY FACTOR AS BASE LOAD RESOURCE



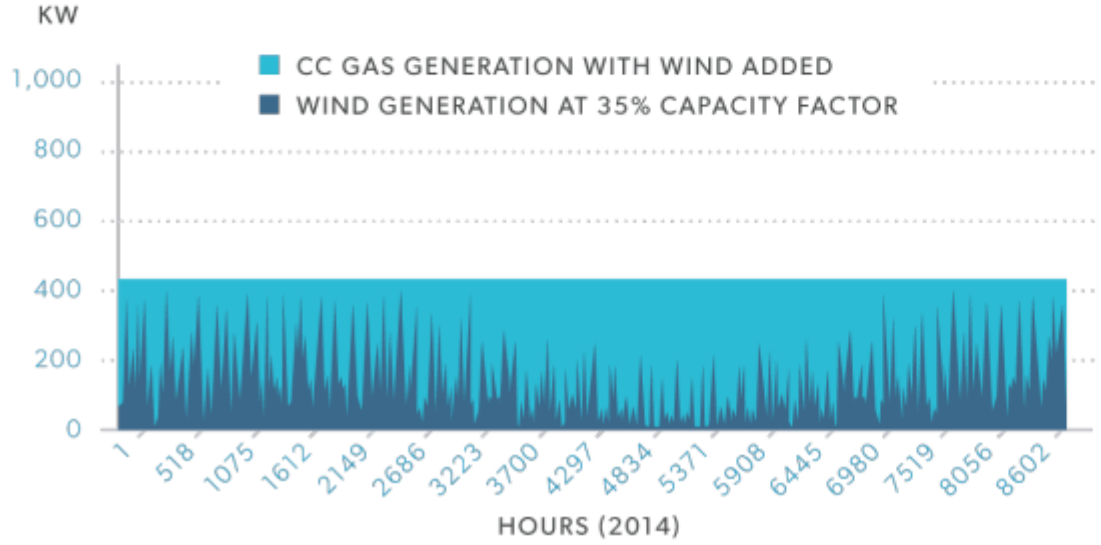
SUMMER CAPACITY



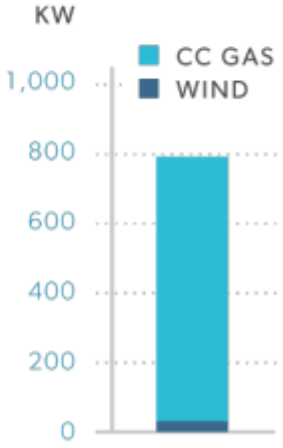
NAMEPLATE CAPACITY



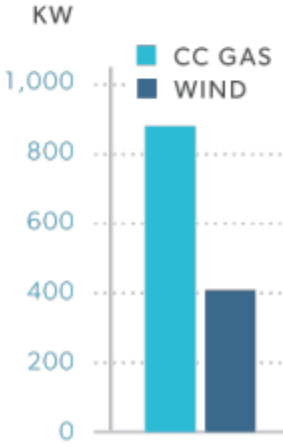
CC GAS AT 47.8 CF + WIND AT 33.9% CF AS BASE LOAD RESOURCE



SUMMER CAPACITY

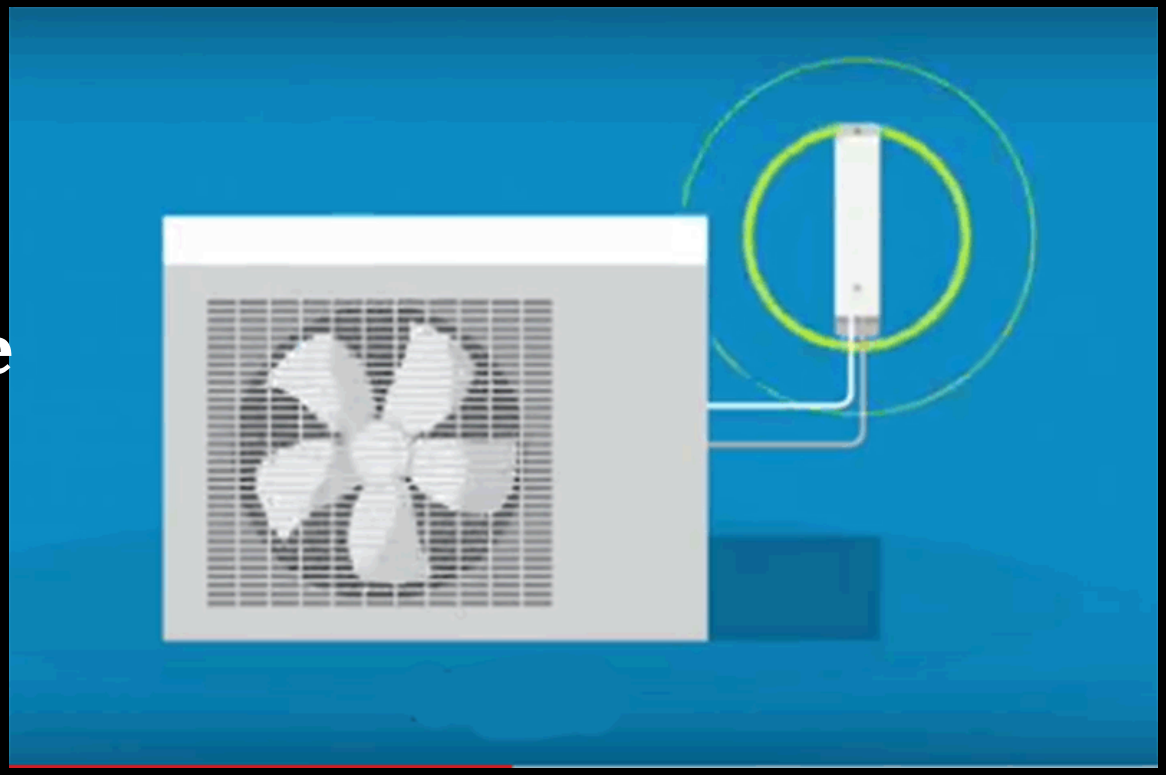


NAMEPLATE CAPACITY



PeakSmart air-conditioning

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



HOW TO DESTROY A PERFECTLY GOOD ELECTRICITY GRID IN A MILLION EASY STEPS

Stop people asking questions

“Denier”

Bullying

joannenova.com.au