

Energy alternatives for Adelaide (and SA)



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Structure



- Climate change as a “wicked problem”
- 5 reasons to focus on energy
- Why a “little” action might mean an awful lot



We can't “solve” climate change



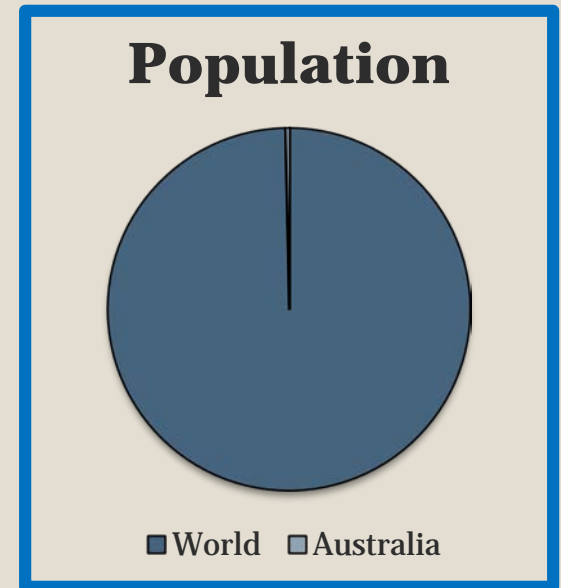
- Climate change is a “wicked problem” which cannot be solved (Grundmann, 2016).
- Like crime, education and health, will have to be “solved” over and over again
- This liberates our thinking: embrace risk and be brave



Why energy/Why (South) Australia?



1. Australia is vulnerable to climate change
2. Responsibility
 - Australia is a high level emitter
3. Energy is so important
4. Economic benefit
 - Early adoption of policy will be of great economic benefit
5. Marginal efforts may be really important



Why? 1: Australia is vulnerable to climate change



- 2011 Qld Floods: \$30 billion
- 2002-2003 Australian drought: ~\$10 Billion
- 2009 Victorian bushfires: \$1 Billion
- 2009 Victorian heatwave: ~350 deaths
- 2013 NSW bushfires: \$180 million



Nelson St Port Adelaide during a "king tide" Oct 2007

(www.adelaidenow.com.au)

Sources: Lynne Turner, Queensland Climate Change Centre of Excellence; Cooper (The Age, 6/4/09), IPCC 2007; www.news.com.au

Short Articles:

<https://theconversation.com/bushfire-season-in-new-south-wales-grows-longer-and-stronger-33245>

<https://theconversation.com/angry-summer-shaped-by-a-shifting-climate-12580>

Why? 2: Responsibility



Selected carbon dioxide emissions (tonnes per person/year)

Qatar: 36.9

United States: 17.3

Australia: 17.0

Russia: 11.6

Germany: 9.3

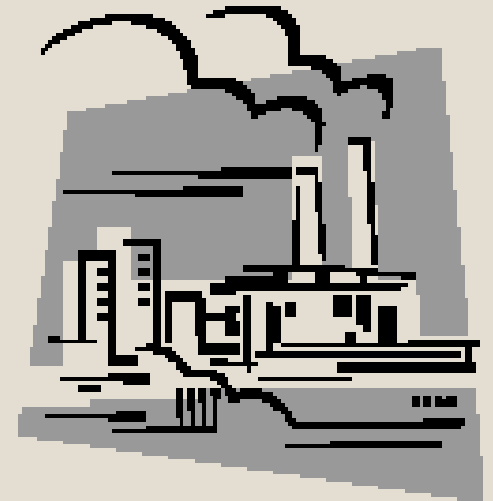
UK: 7.8

China: 5.4

World average: 4.5

India: 1.4

Africa average: 0.9



Also: Australia ranks in top 15 for total **current** and **historical** emissions

Why? 3: Energy is so important: 1



Recent growth in carbon dioxide emissions

- ⦿ Energy : 145%
- ⦿ Transport: 120%
- ⦿ Land use : 40%
- ⦿ Agriculture: 27%

An insight into the likely ways in which mitigation will operate (e.g. reafforestation not sufficient)

- Decarbonising the economy will happen fastest in relation to energy (vs. transport, building efficiencies)
 - Bruckner et al. (2014) IPCC 5AR WGIII

Energy in Australia



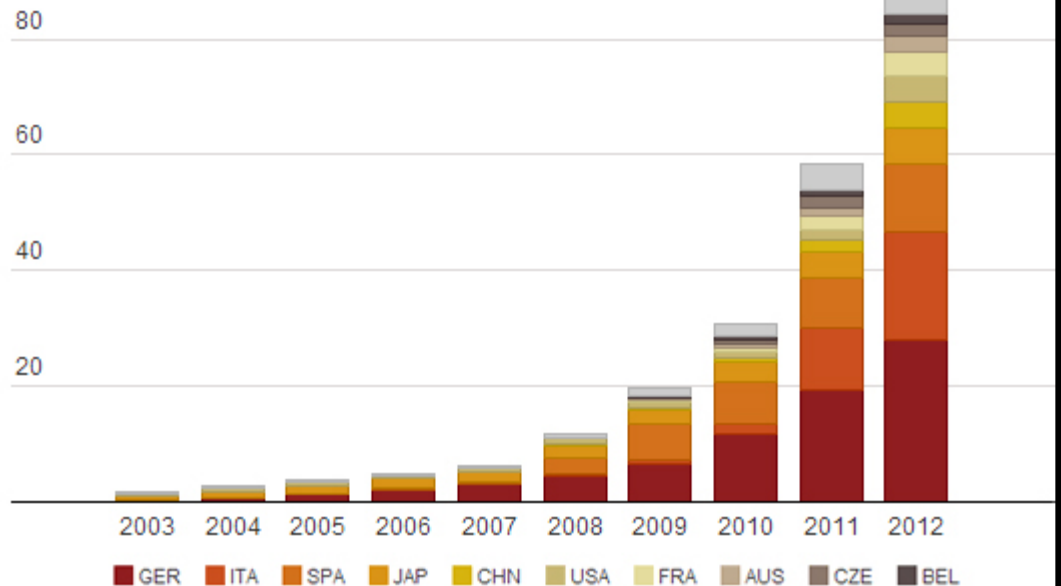
- 50% of emissions
- Sectors related to energy (electricity, mining and transport): 11% of GDP and $\frac{1}{2}$ of Australia's exports
- GDP and energy consumption have been strongly related historically
- Some improvement, incremental

Why? 4: Economic benefit



- There has been **massive** uptake of renewable energy at global scale
- Initiatives to facilitate this are needed.
- Venture capital may fail in this space
- “*the aggregated global technical potential for RE [renewable energy] as a whole is significantly higher than global energy demands.*” Bruckner et al. (2014)

Global Solar Generation: 2003-2012 (TWh)



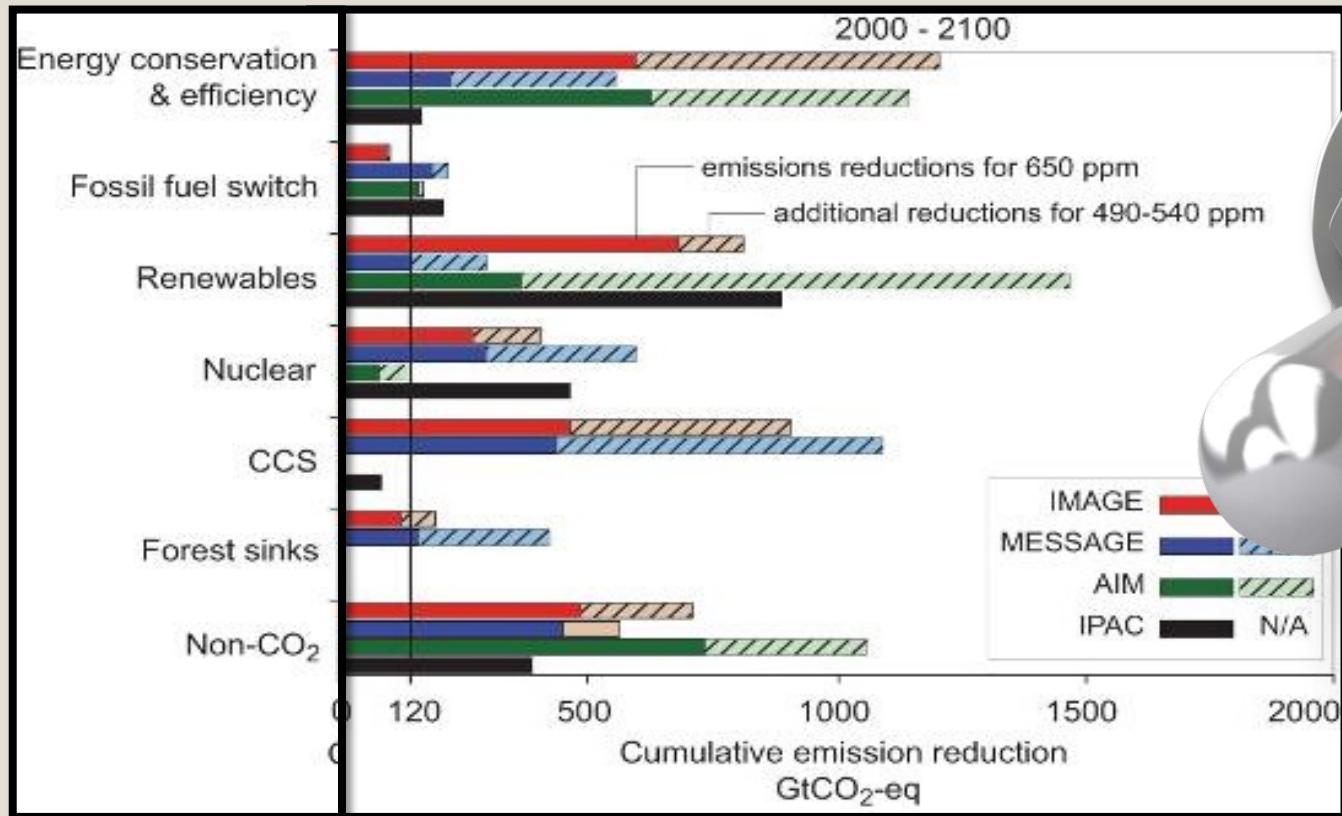
Source: BP Energy Outlook 2012

shrinkthatfootprint.com

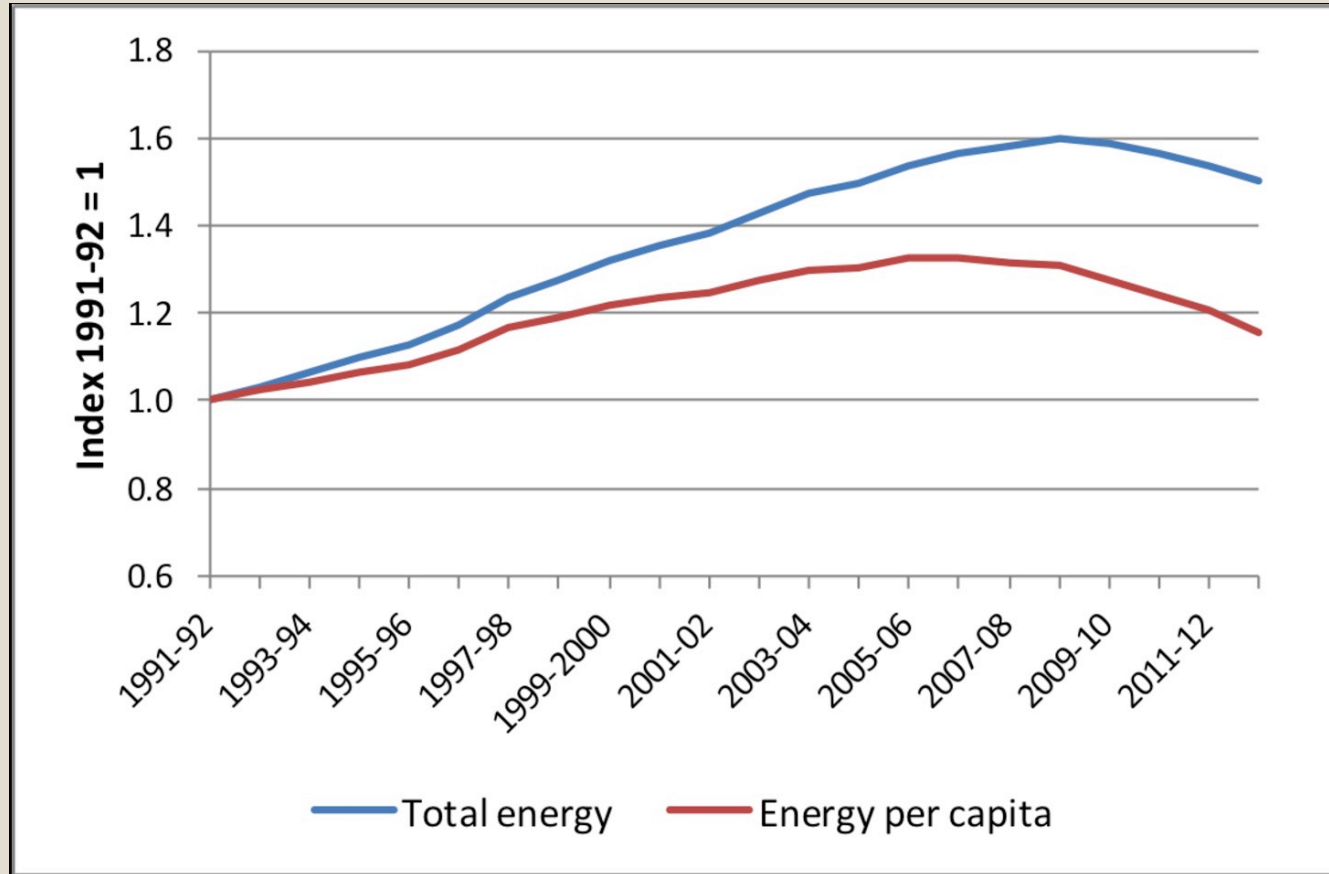
Also need...



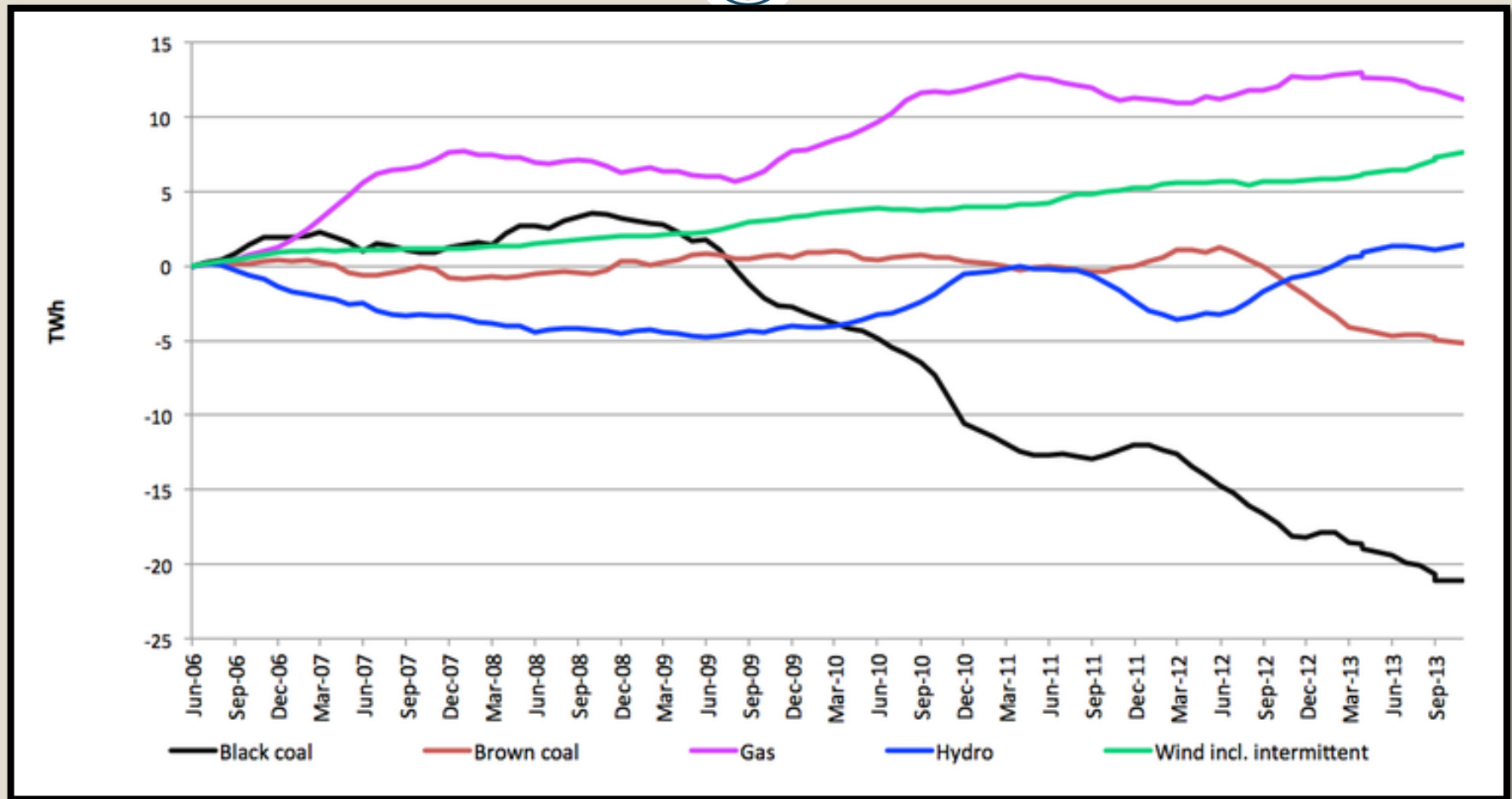
- Demand reduction



Australian electricity consumption



Australian electricity generation



South Australia/Adelaide...



- **Primate nature of Adelaide as a city provides real possibility**
 - Distributed energy is problematic for generation and delivery
 - 75% of South Australia's population is in greater Adelaide
- **Mimics global situation (to some extent)**
- **C40 cities:**
 - 25% of global GDP
 - 1 in 12 people worldwide
 - Already: hundreds of millions of tonnes of greenhouse gas abatement (Pitt and Sherry, 2015)

Need...



- **Consistent, co-ordinated policy approach at state and federal level**
 - Desalination plant: very high energy usage
 - Mine expansion
 - Carbon pricing
- **Accept risk and mistakes**
 - Remember: climate change is a wicked problem

South Australia



- South Australia has a renewable energy target of 50% by 2025
- South Australia leads the way in wind energy and solar energy generation
 - ~30% of households have solar panels
 - >30% of energy from wind farms (AEMO, 2016b)

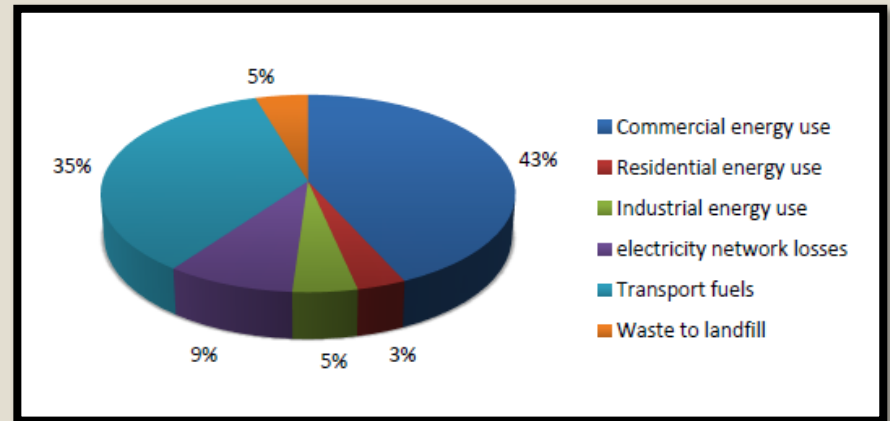


Windfarm tourist drive,
Millicent, south-east SA

Adelaide



- State government and Adelaide City Council have target of being carbon neutral by 2020
- Energy consumption is the biggest source of emissions in the city
 - Transport is an important 2nd

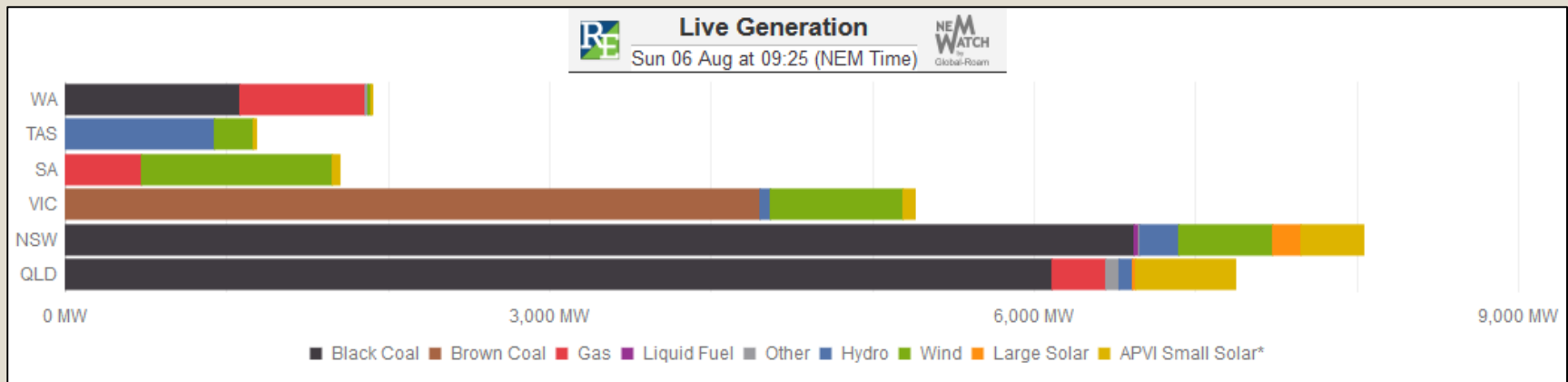


Greenhouse gas emissions by sector
(Pitt & sherry, 2015)

Reasons for (substantial) optimism



- South Australia's energy mix on Sunday morning...



Win-win outcomes



- **Carbon neutral Adelaide leads to:**
 - Reduced energy cost
 - Reduced noise and air pollution
 - Better health outcomes (via increased personal mobility)
- **Early innovation leads to:**
 - Economic growth (via technological leadership)
 - A better climate!

Risks...



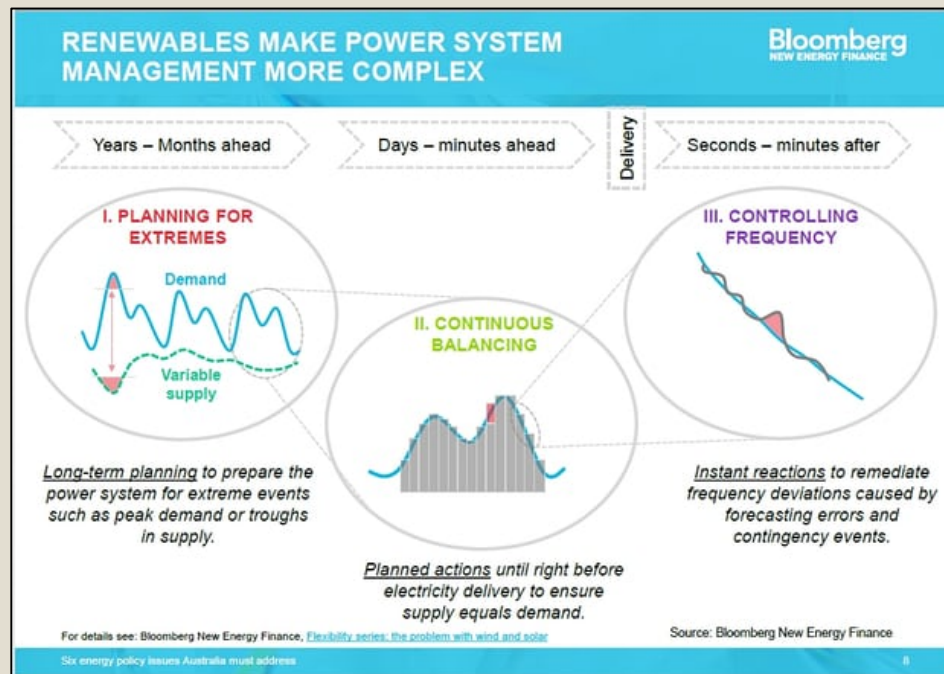
- Transition to decarbonised economy results in marked changes to possibilities
 - Some heavy industries are less viable
- Power outages more likely
 - “likelihood that a region - wide blackout would follow a non-credible islanding event has increased” (AEMO 2016a)



Battery backup...



- “Criticising South Australia’s battery for not meeting peak demand is akin to raging at your smartphone because it can’t send a fax” (Joshi 2017)



Why? 5: marginal differences important



- Range in projected climate change means that marginal differences may be really important
- Two examples:
 - Different estimates of the “sensitivity” of the climate?
 - Avoiding “tipping points”?



31 JAN 2002



17 FEB 2002



5 MAR 2002



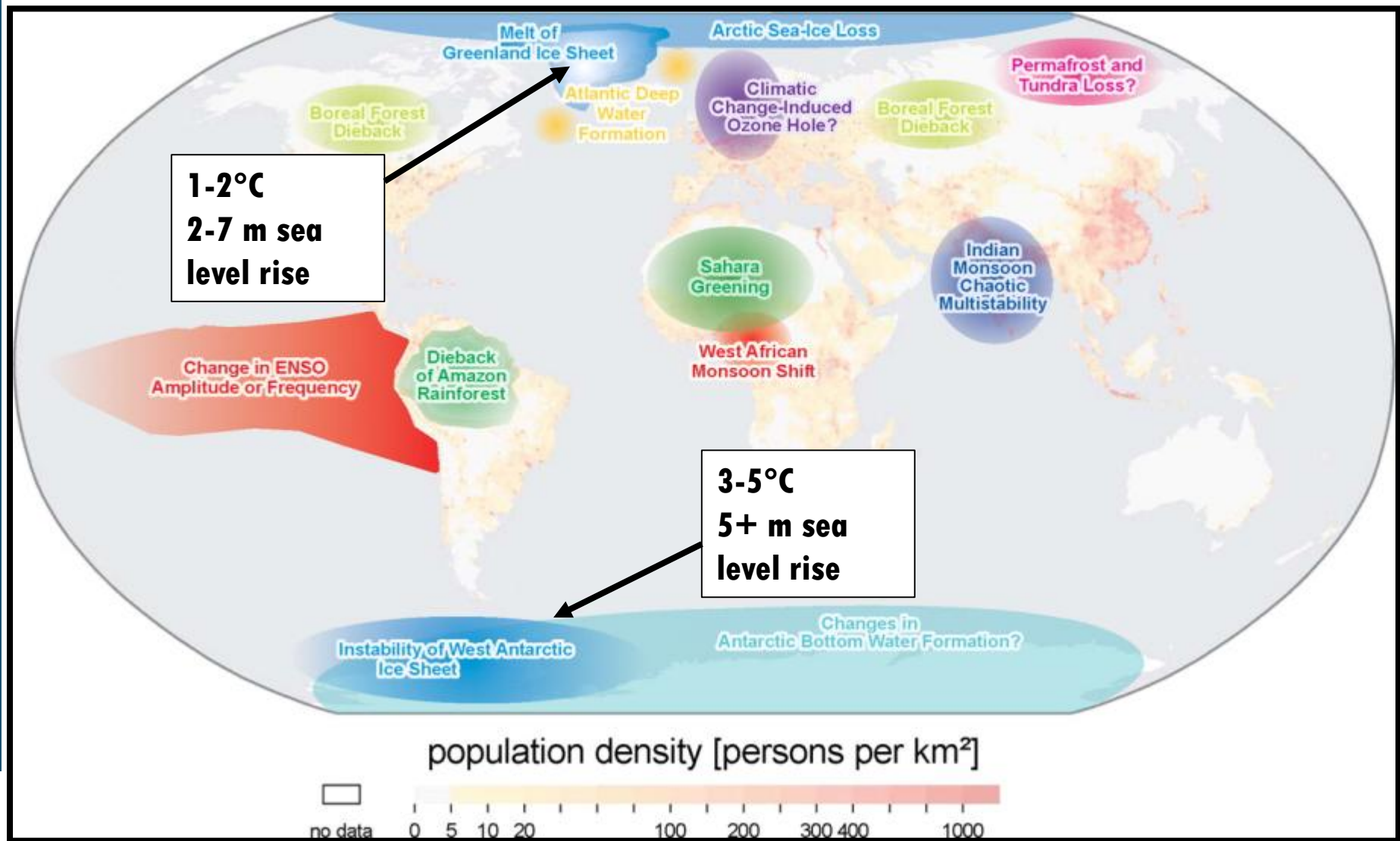
7 MAR 2002

Climate sensitivity in computer models

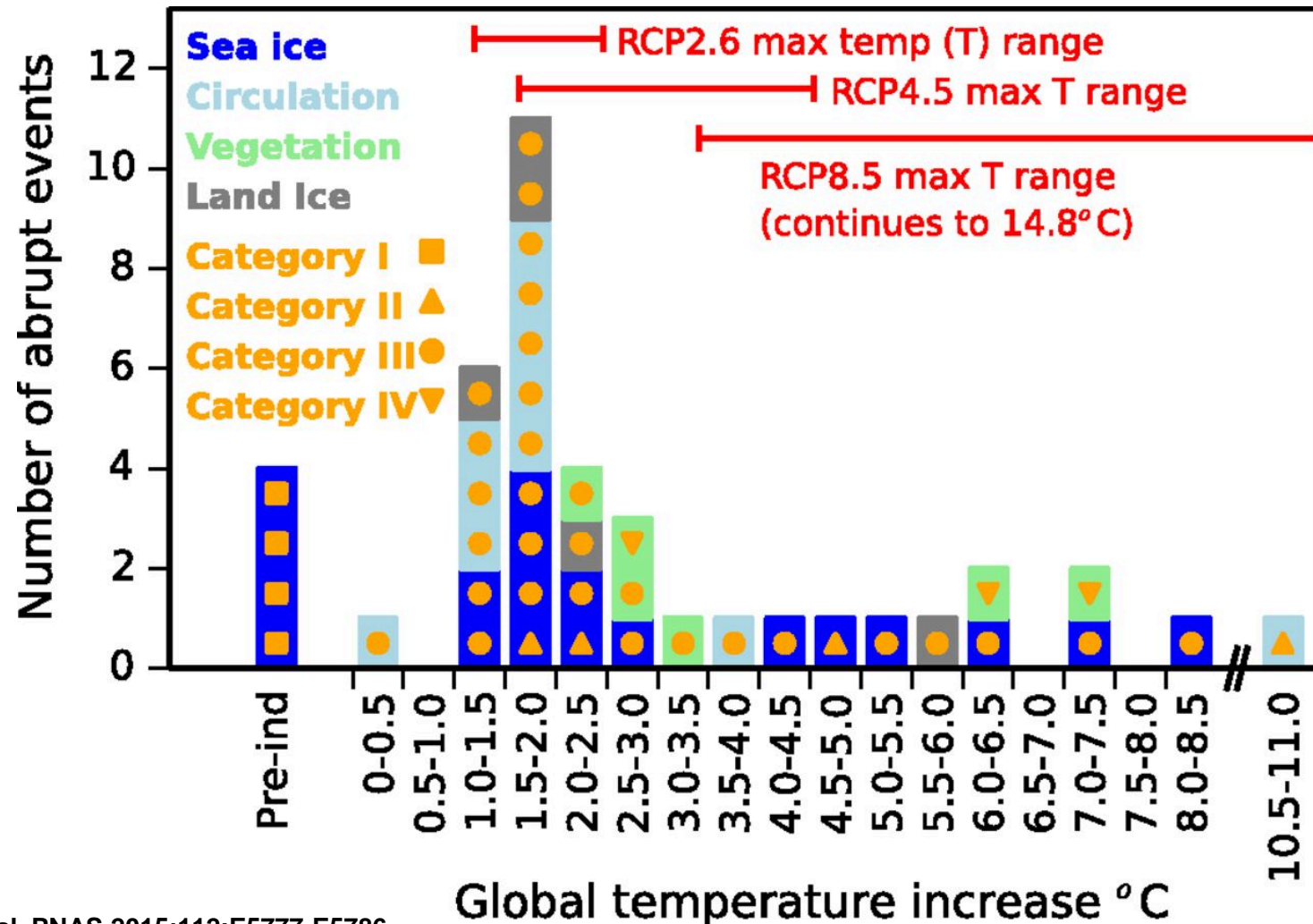


Climate model	Sensitivity
INM-CM4	2.08
GFDL-ESM2G	2.39
GFDL-ESM2M	2.44
MRI-CGCM3	2.6
MIROC5	2.72
NorESM1-M	2.8
CNRM-CM5	3.25
MPI-ESM-P	3.45
MPI-ESM-LR	3.63
CanESM2	3.69
GFDL-CM3	3.97
CSIRO-Mk3-6-0	4.08
IPSL-CM5A-LR	4.13
HadGEM2-ES	4.59
MIROC-ESM	4.67

Tipping points...



1.5 vs 2.0°C matters a lot



Drijfhout et al. PNAS 2015;112:E5777-E5786

Conclusion



- Challenges experienced by Adelaide (and SA more broadly) reflect those experienced in other parts of developed world
- We have a responsibility and an opportunity to make an incredible difference

Information sources (not listed elsewhere)



- *Australian Energy Market Operator (AEMO) 2016a. SOUTH AUSTRALIAN ELECTRICITY REPORT. Australian Energy Market Operator: http://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/SA_Advisory/2016/2016_SAER.pdf.*
- *Australian Energy Market Operator (AEMO) 2016b. SOUTH AUSTRALIAN RENEWABLE ENERGY REPORT. Australian Energy Market Operator*
- Bruckner T., I. A. Bashmakov, Y. Mulugetta, H. Chum, A. de la Vega Navarro, J. Edmonds, A. Faaij, B. Fungtammasan, A. Garg, E. Hertwich, D. Honnery, D. Infield, M. Kainuma, S. Khennas, S. Kim, H.B. Nimir, K. Riahi, N. Strachan, R. Wiser, and X. Zhang, 2014: Energy Systems. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Grundmann R. (2016) Climate change as a wicked social problem. *Nature Geosci*, **9**, **562-563**.

Information sources (not listed elsewhere)



- Joshi, K. (2017) Commentators who don't understand the grid should butt out of the battery debate. *The Guardian* Wednesday 12th July.
https://www.theguardian.com/commentisfree/2017/jul/12/commentators-who-dont-understand-the-grid-should-butt-out-of-the-battery-debate?CMP=soc_567