Energy is about a lot more than supply:

Integrating Energy Efficiency into Demand Response and Distributed Energy Systems

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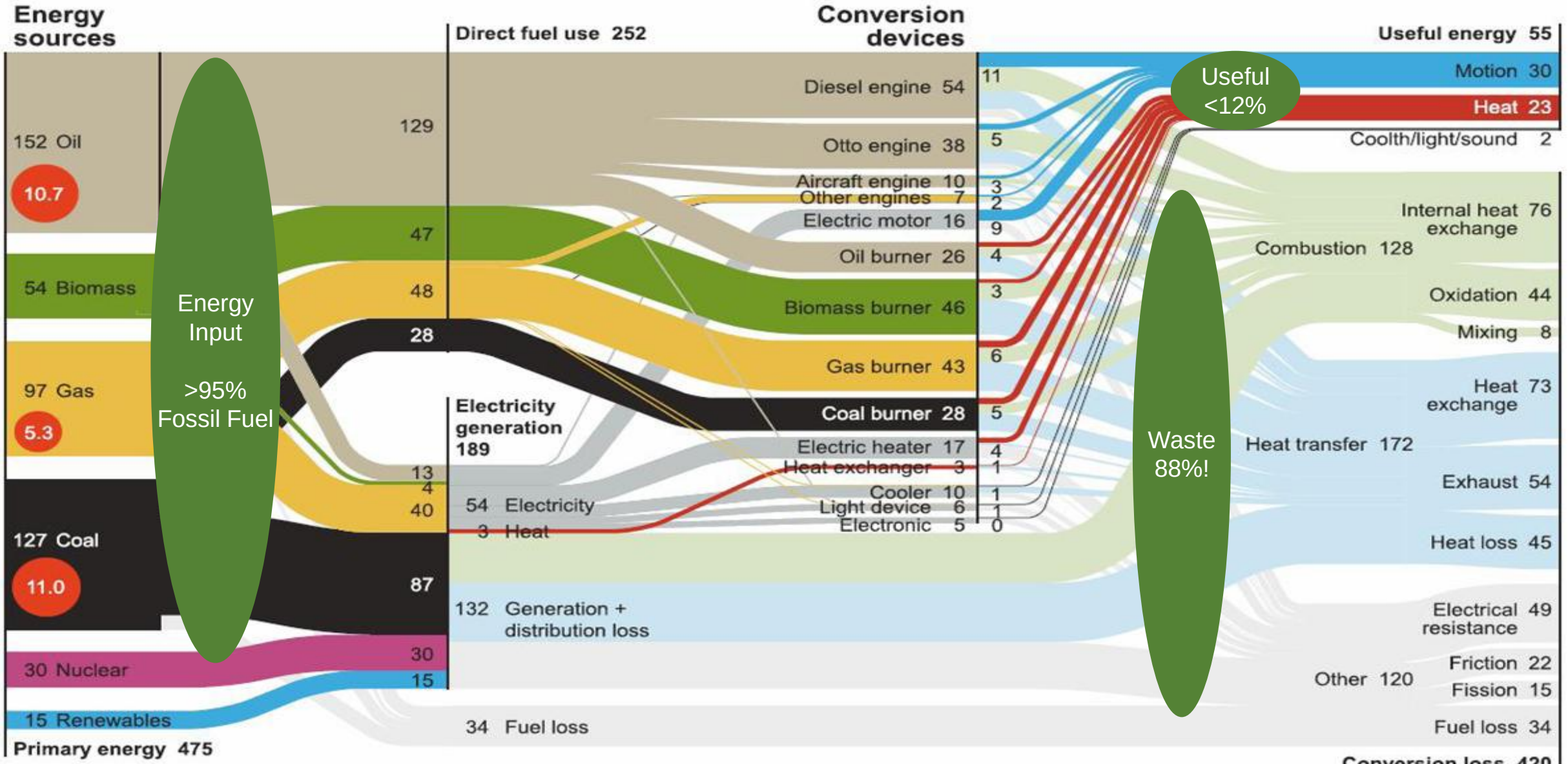
Important to reduce the load (use less energy) before the energy supply system can work well!

http://www.bajiroo.com/dont-overload-a-donkey-cart-16-funny-photos

Thanks to Soren Hermansen from Samso, Denmark for the picture idea

Opportunity to save: **88% waste in delivery of useful services!**



Global energy demand in 2005, total = 475 EJ

Global carbon emissions in 2005, total = 27 Gt CO_2

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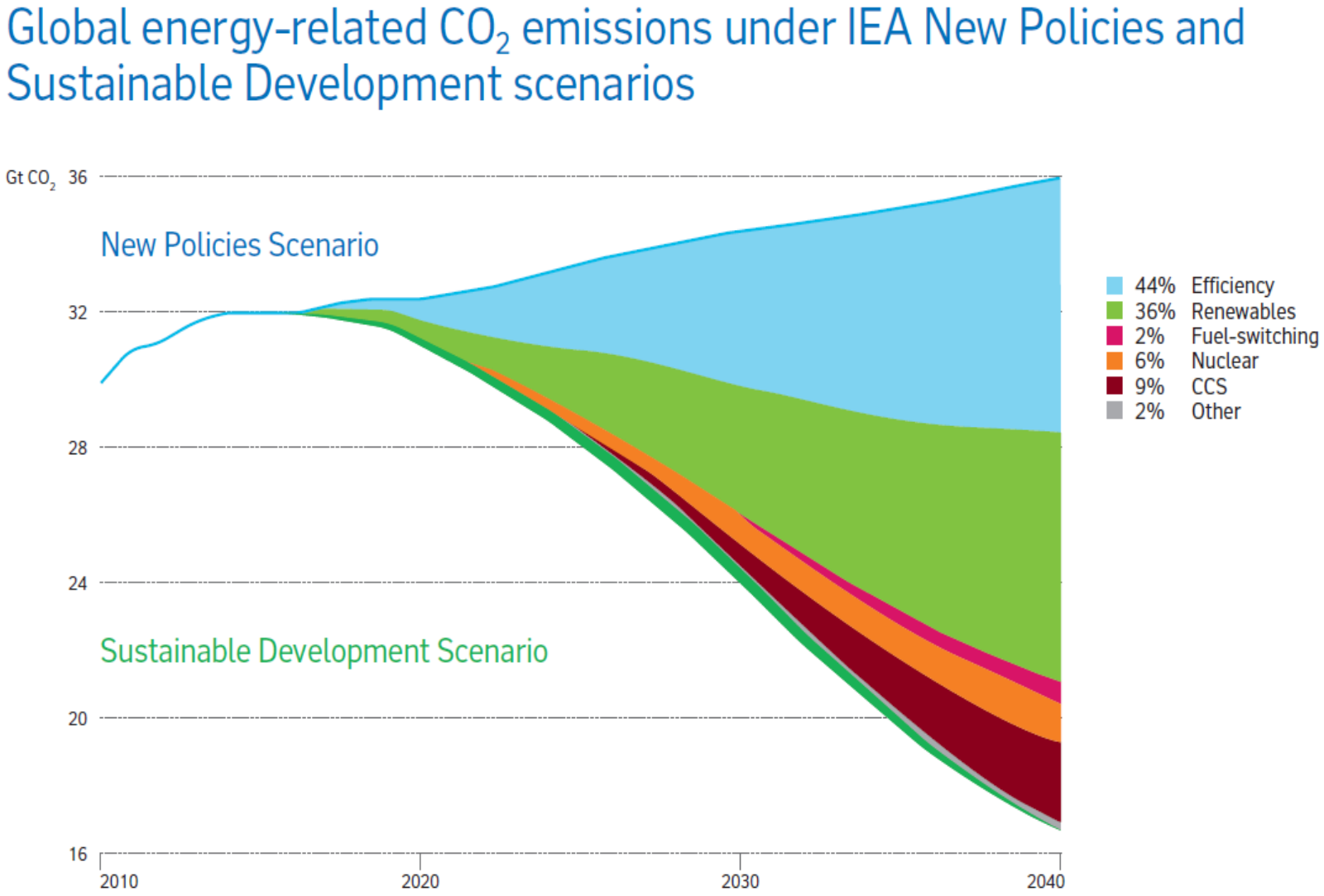
Energy Efficiency, the International Energy Agency's 'first fuel'

- Potential: **commercially available, cost-effective technologies exist for energy intensity improvement rate of 3%, more than double today**
- Reduces physical scale and capital costs of new energy supply and storage investment
- Enhances resilience, cuts peak energy demand
- Underpins much innovation, productivity improvement
- Delivers multiple financial, social and environmental benefits



Energy efficiency and renewables account for 80% of the cumulative CO_2 emissions savings in the Sustainable Development Scenario – IEA World Energy Outlook 2017

International comparisons of countries:
American Council for an Energy-Efficient Economy Energy Efficiency Scorecard

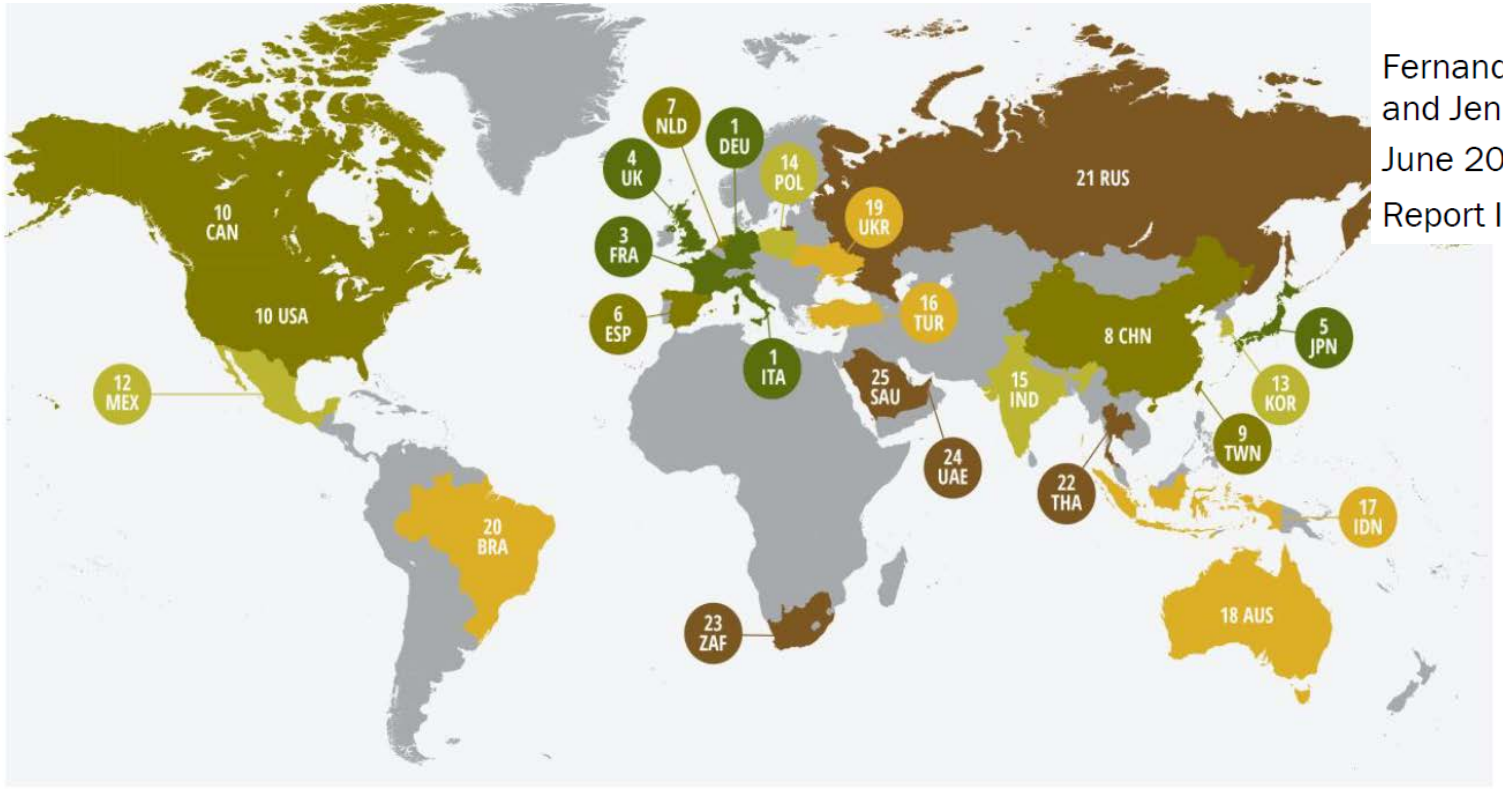


Figure ES1. Rankings by country

The 2018 International Energy Efficiency Scorecard

Fernando Castro-Alvarez, Shruti Vaidyanathan, Hannah Bastian, and Jen King

June 2018

Report I1801

Rankings over time:

YEAR	AUSTRALIA
2014	10/16
2016	16/23
2018	18/25

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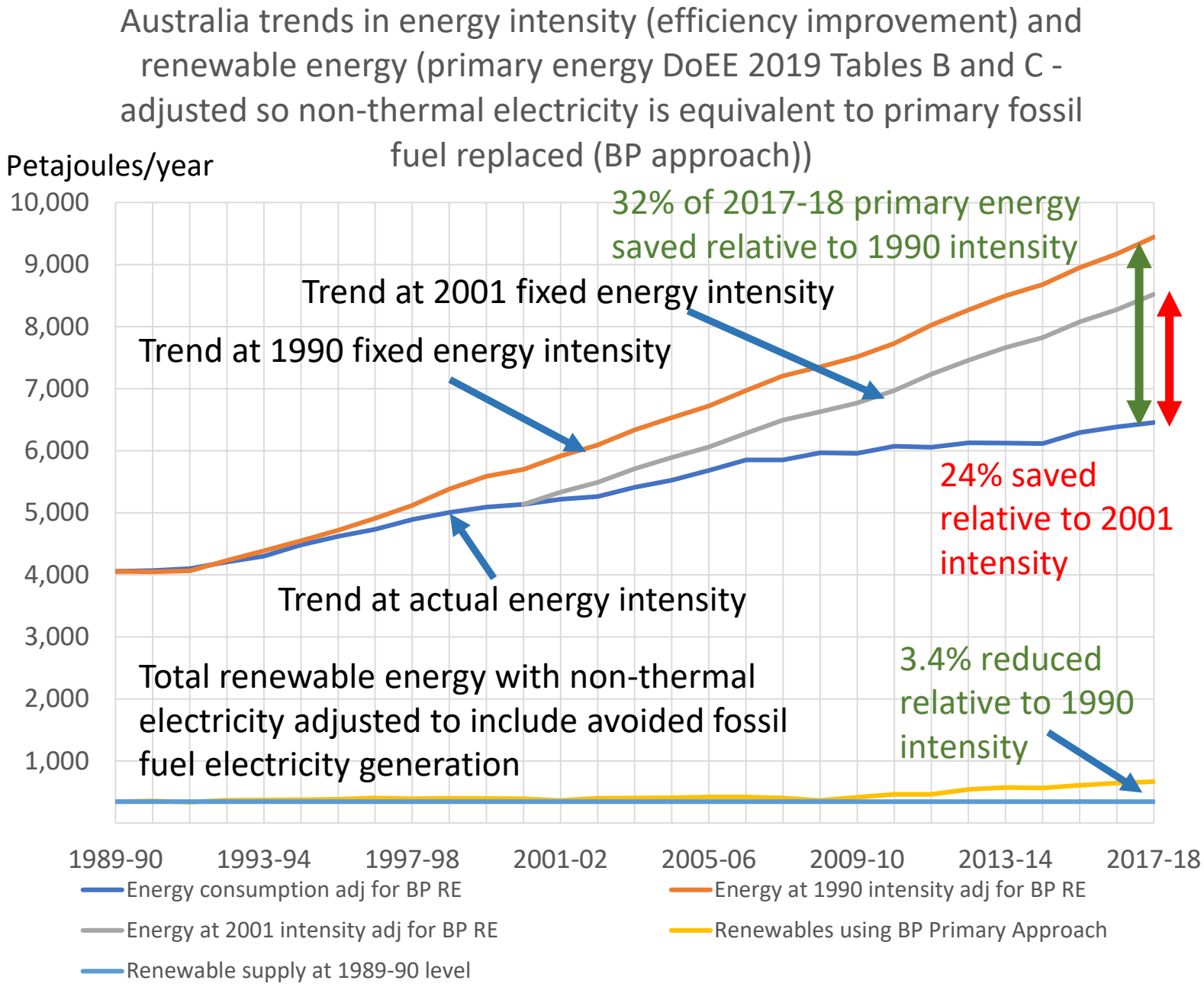
Rankings by World Economic Forum on energy transition (https://www.weforum.org/reports/fostering-effective-energy-transition-2019) rate Australia 43rd out of 115 countries, among the lowest of developed countries

Australian track record: primary energy reduction from EE and RE

Energy productivity/efficiency improvement in Australia has delivered 7 to 9 times as much reduction in primary energy use as renewable energy – and we haven't even been trying on EE/EP!

RELATIVE IMPACT PJ/year in 2017-18	**1990**	**2001**
EE saving from base year	2,987	2,065
RE growth from base year adj to BP approach	323.7	273.8
No of times larger EE/RE	**9.2**	**7.5**

NOTE: I use BP World Review approach: each unit of non-thermal renewable electricity is equivalent to amount of fossil fuel displaced from electricity generation (factor 3.1 to 2.9). IEA and DoEE treat each unit of non-thermal RE as 1 unit of primary energy. The IEA/DoEE approach gives EP/EE 18 to 20 times the impact of renewable energy



ELECTRICITY: Risk for supply-side investors

Disruptive changes in demand and supply, need to address climate change. We must understand and manage long-term demand side issues much better

Figure 41 Operational consumption forecasts versus actual, 2010-18

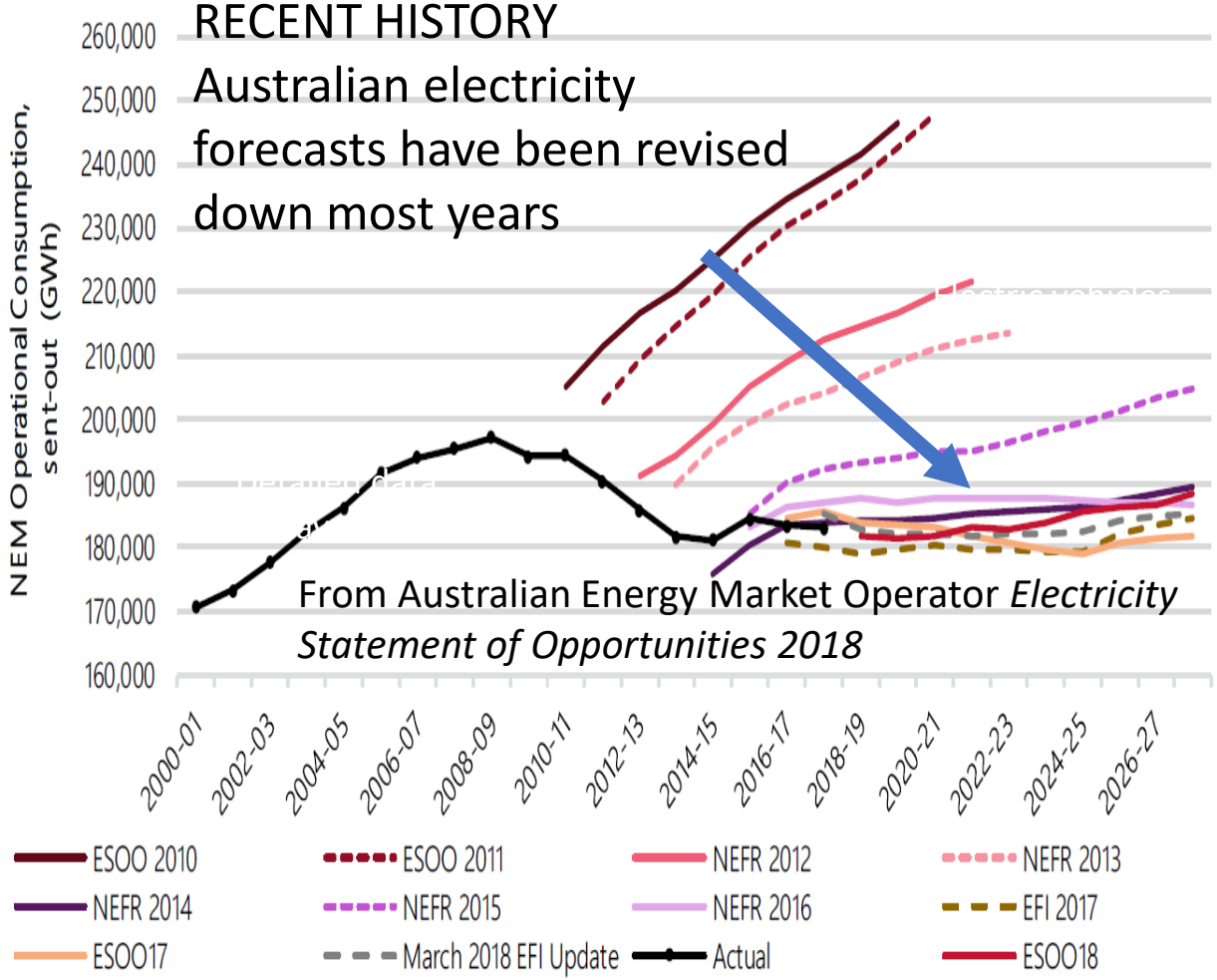
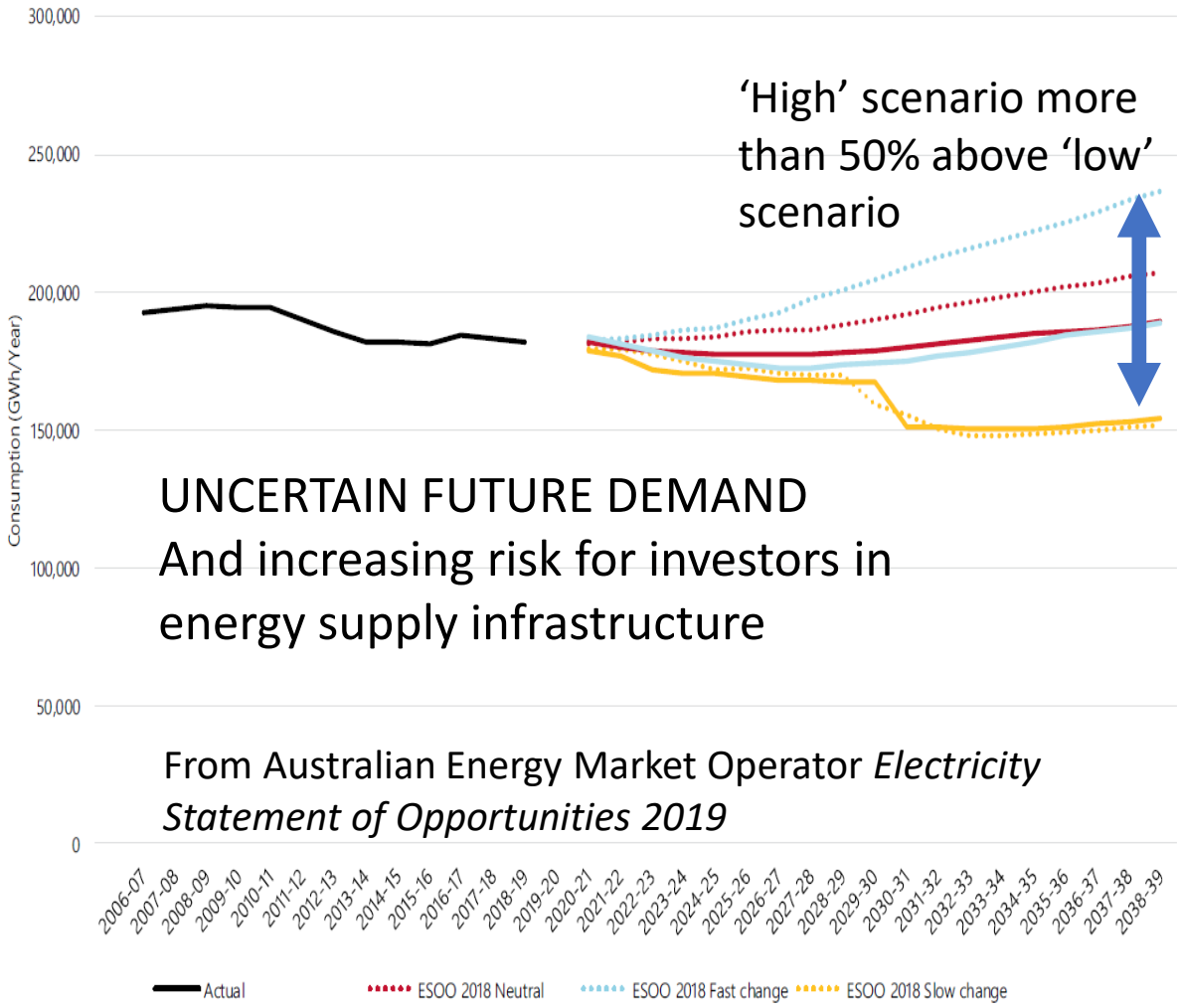


Figure 17 Forecast NEM operational consumption as sent out, actual and forecast, all scenarios, 2006-07 to 2038-39, for the 2019 ESOO and compared to the 2018 ESOO

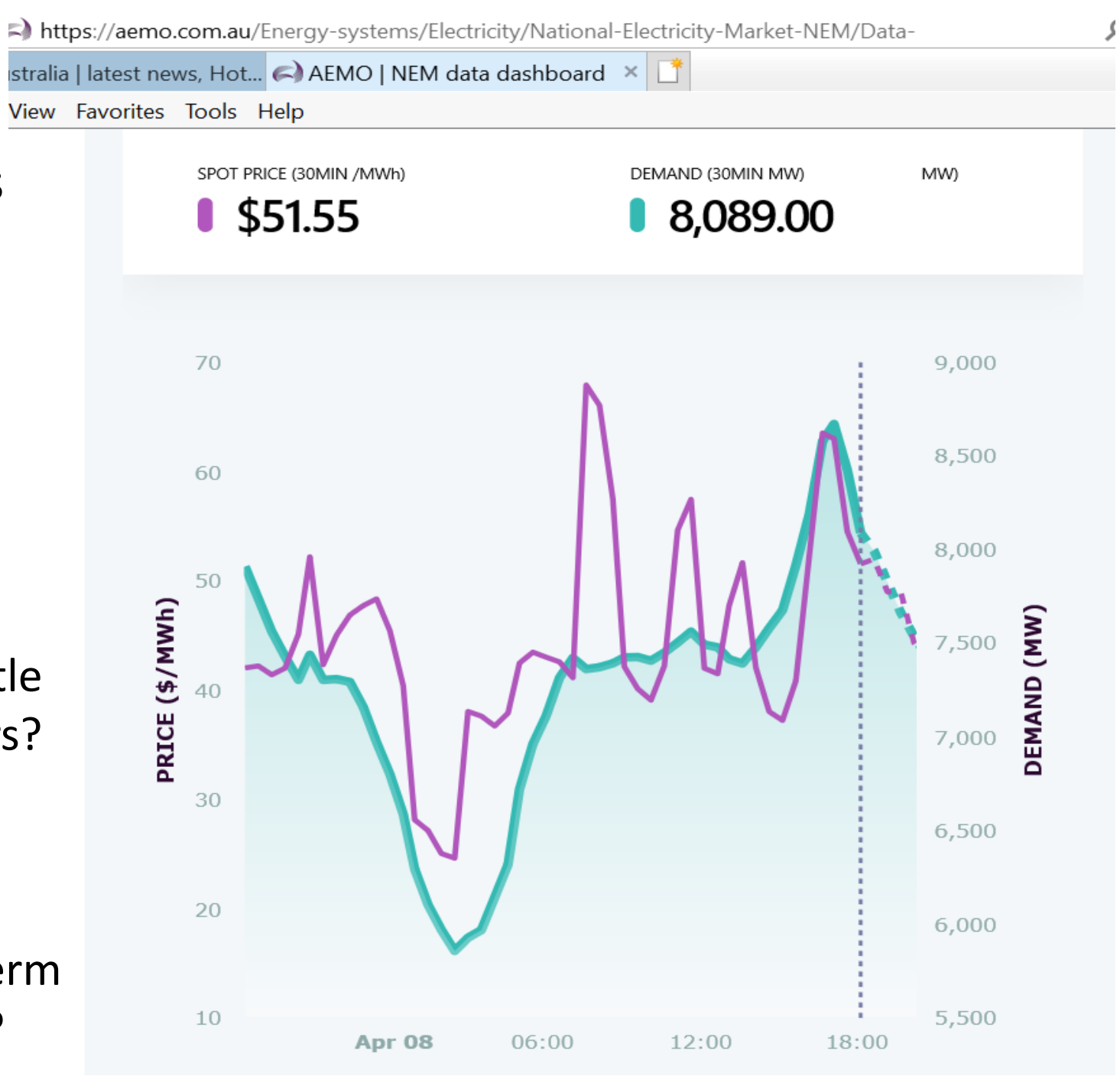


Wholesale + network value of energy AND energy savings varies over time (minutes, hours, days, seasons and **years**).

Price and value are **very imperfectly** reflected in retail tariffs

Why does an industry that invests in assets with 30-50 year lives focus so little attention on demand trends and drivers?

Whose job is it to strategically manage long-term demand? And deliver on the National Electricity Objective of long-term benefit to consumers on demand-side?

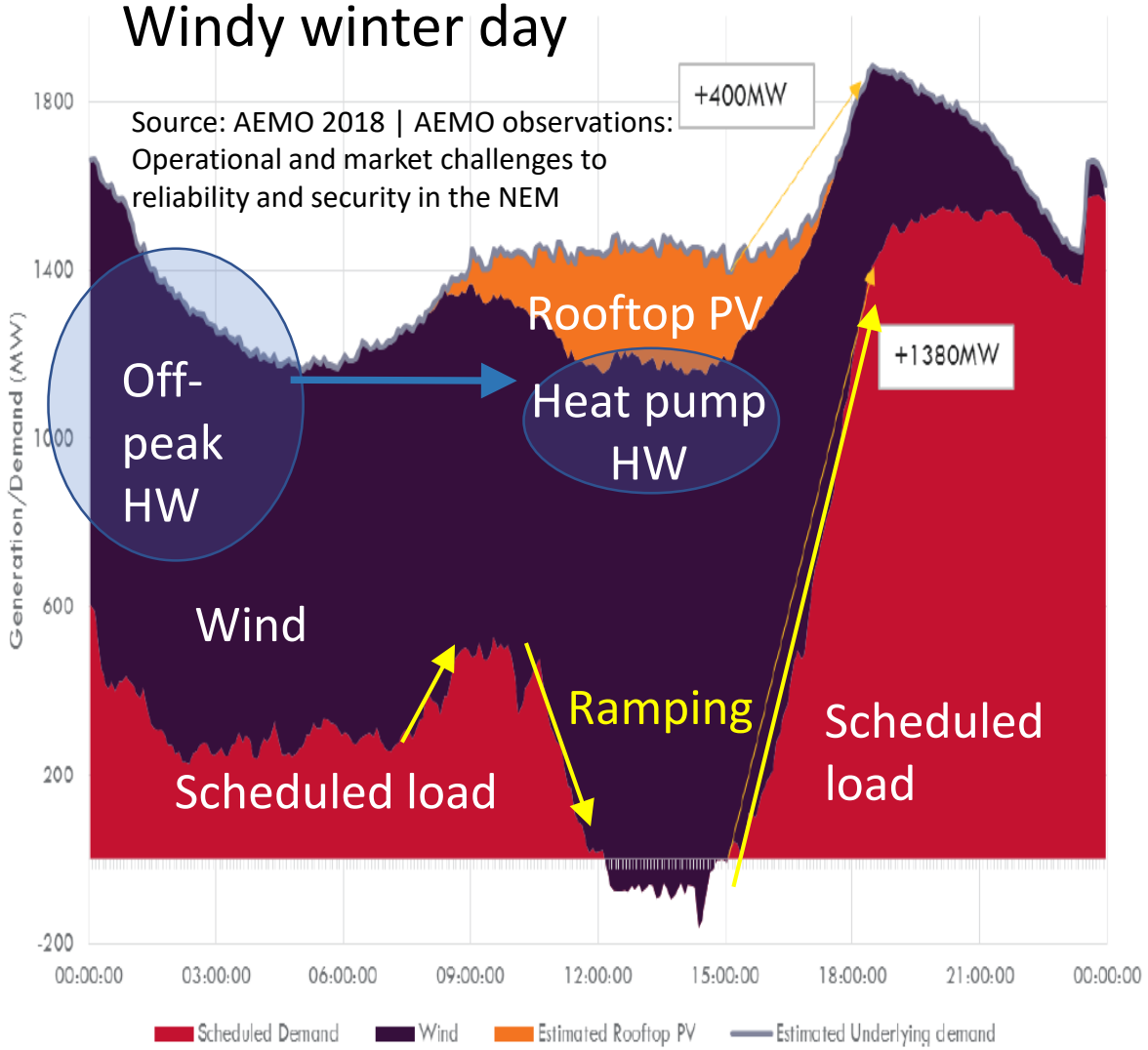


Emerging trends of scale and timing of demand and steep ramping of dispatchable supply on hot, cold and low demand days? How do EE, DM, DR help?

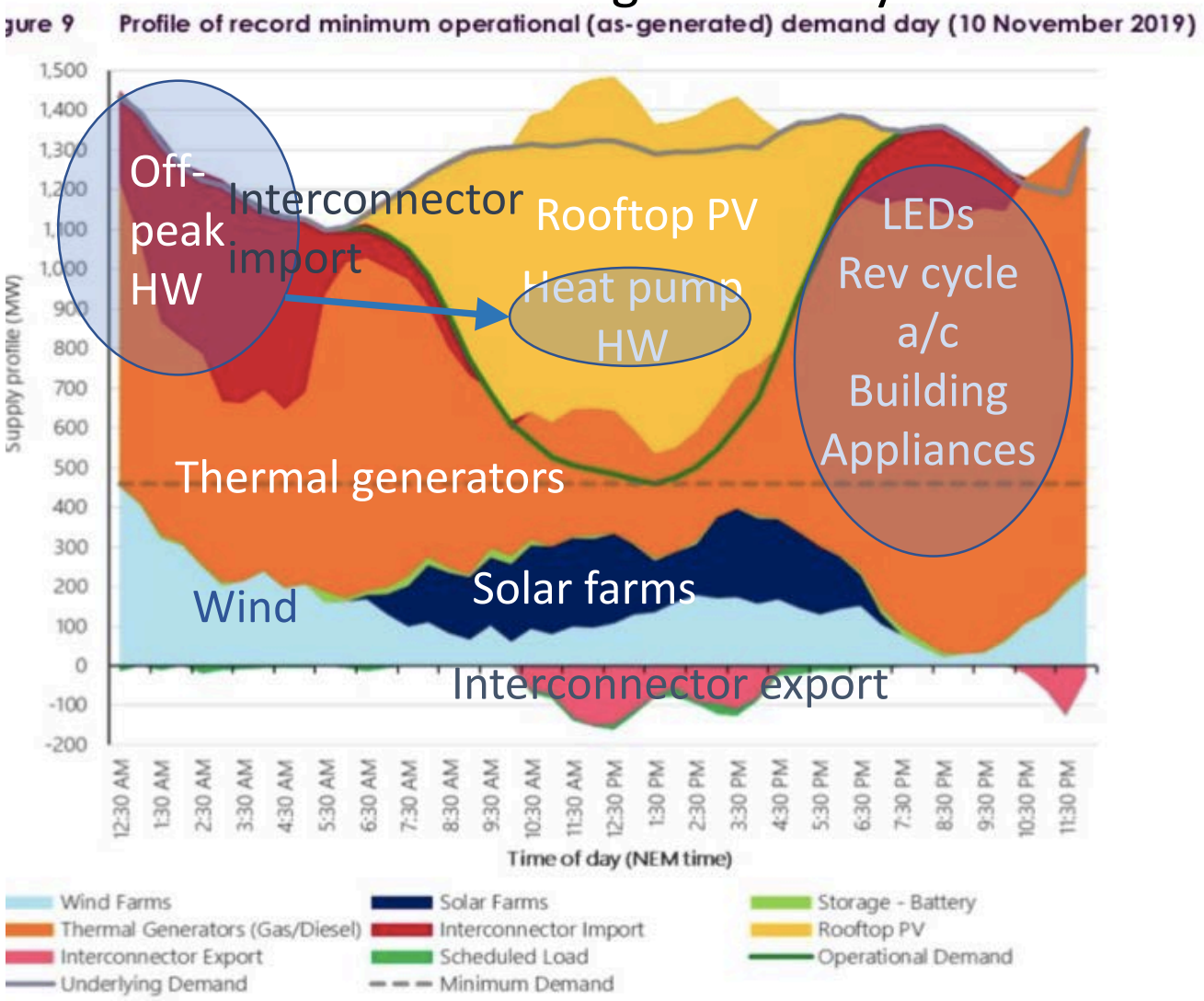
https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/SA_Advisory/2019/2019-South-Australian-Electricity-Report.pdf p.26 – source for 'low load day'

Figure 28 Flexible plant ramping, South Australia, Sunday 23 July 2017 (case study 2)

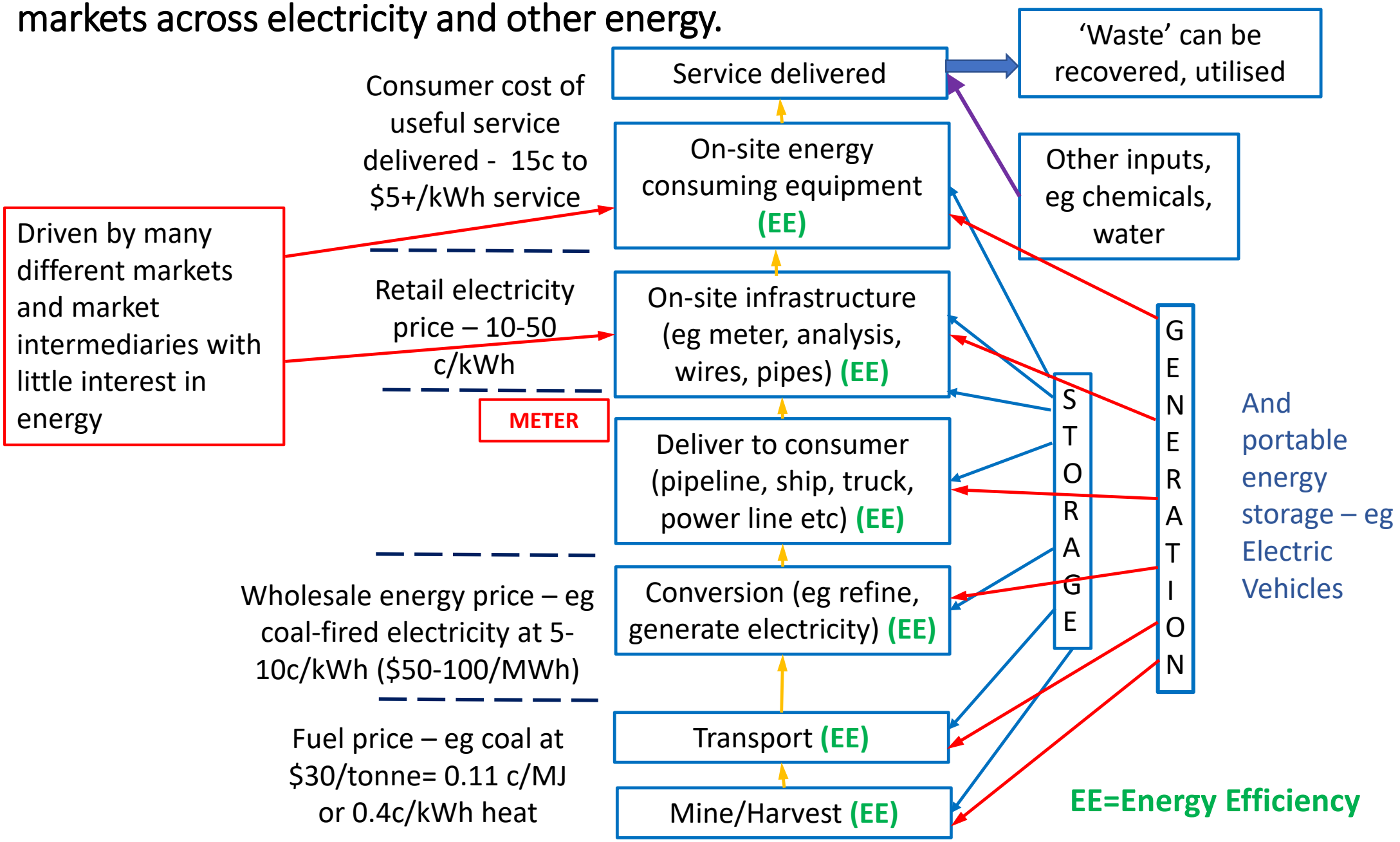
Windy winter day



Low load high solar day

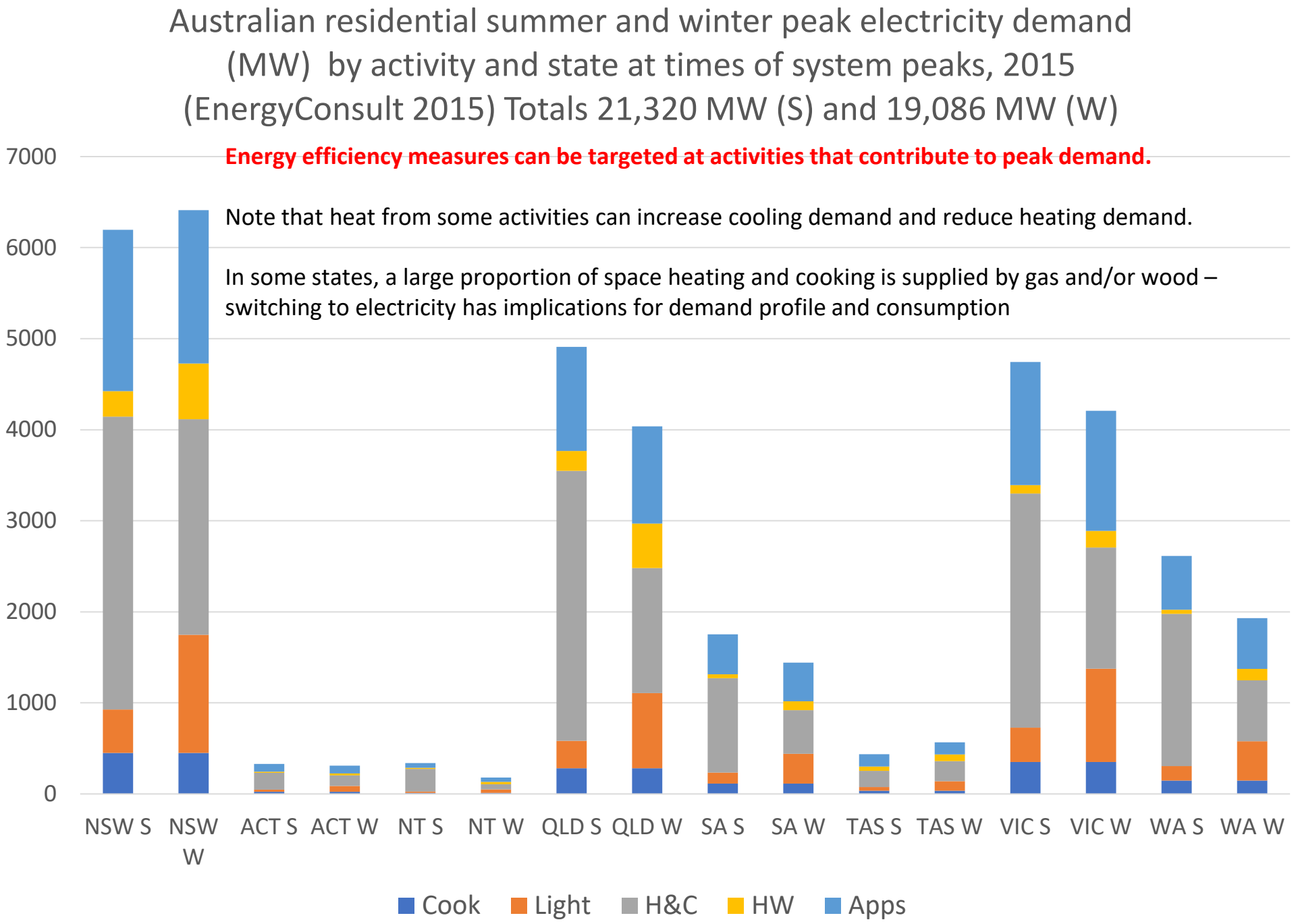


Energy efficiency, clean energy, storage and smarts compete and complement in all stages and markets across electricity and other energy.



Targeted energy efficiency can cut peak demand

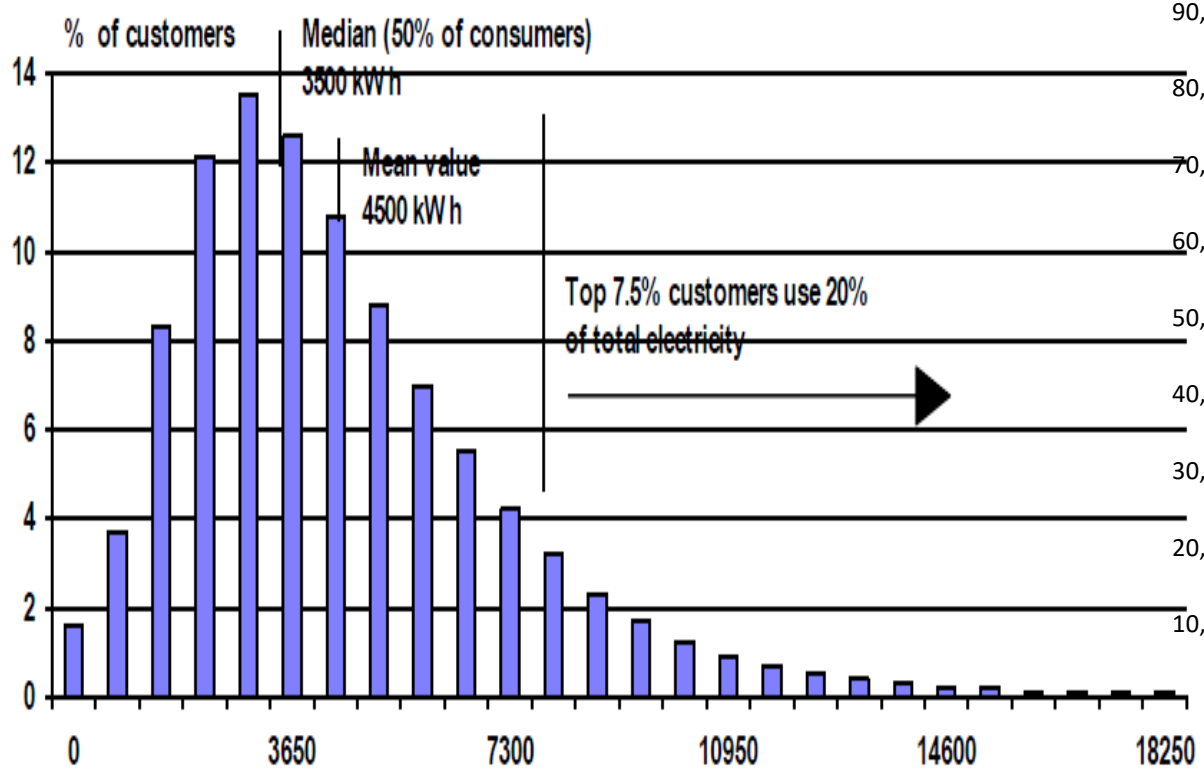
In uncertain times, incremental, modular solutions have lower risk



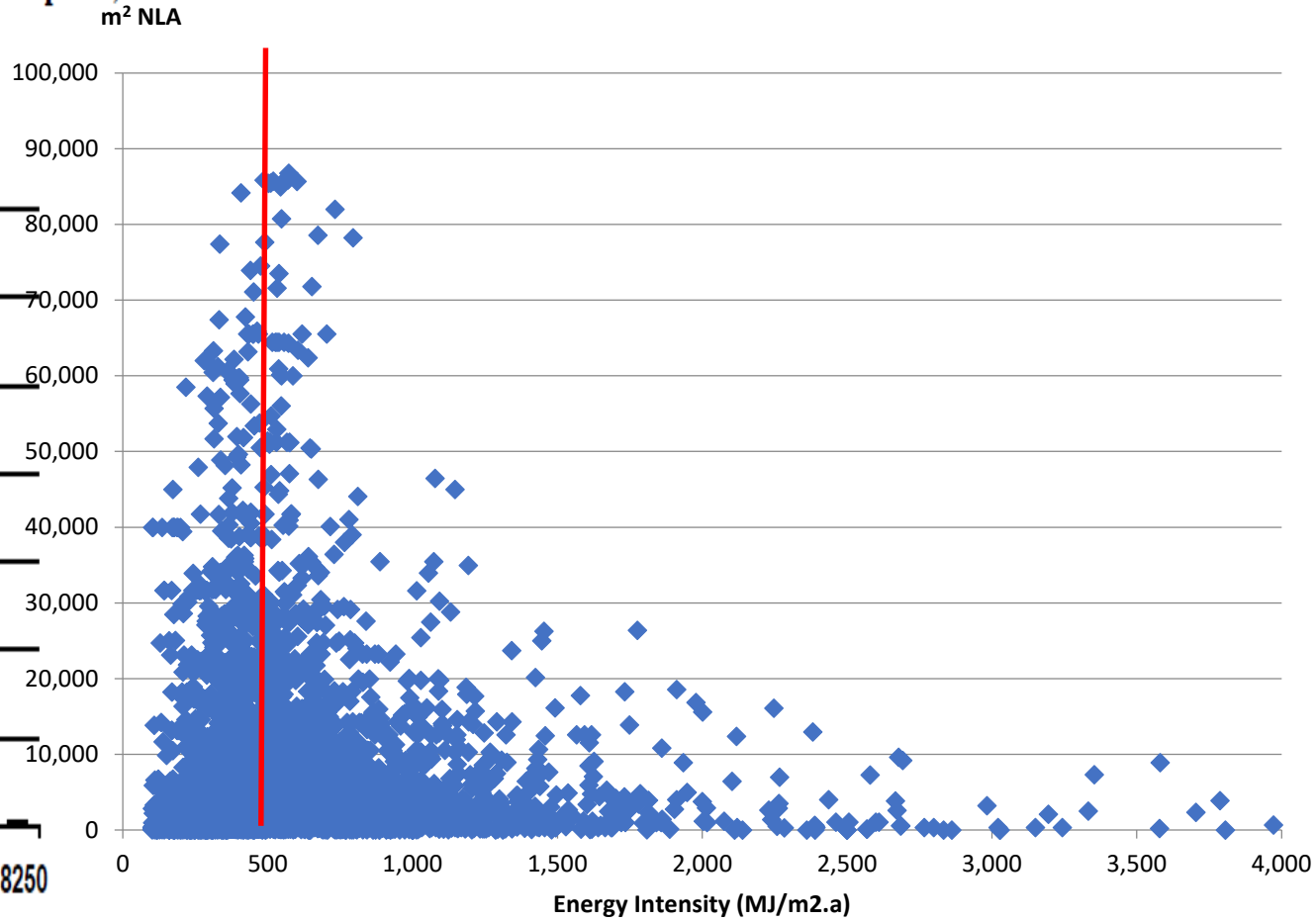
Why have few programs targeted the highest consumers? Retailers and network operators know who they are

Figure 7. Typical profile of residential sector energy customers by annual electricity consumption, 1997 (anon)

Residential customers



Office buildings: energy intensity of Australian office base buildings – Area weighted average 532 MJ/m2: wide variation (p.36 Fig 5.3 Pitt&Sherry 2012)

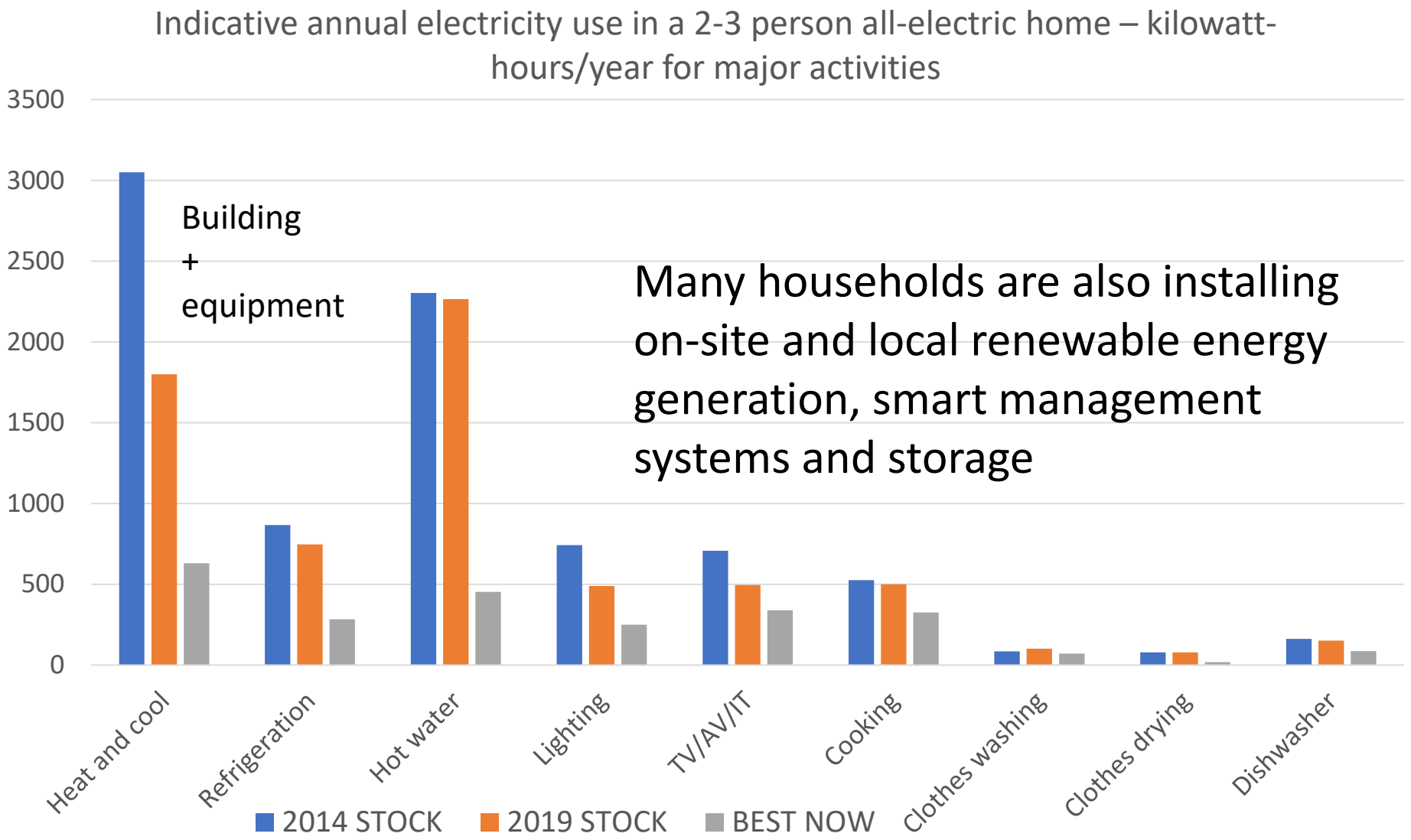


Residential: Technology transformation to cut energy use

(Based on Pears presentation to Sydney A2SE Workshop, April 2014, updated 2019, 2014 and 2019 stock energy use based on data from 2015 *Residential Baseline Study Worksheets* www.energyrating.gov.au)

Priorities:

- Identify and replace inefficient and old appliances and equipment with 'best available'
- Stronger MEPS to remove poor performers from market+ stronger incentives
- Build-in smart diagnostics so equipment can alert use to emerging problems
- Build-in capacity to 'talk' to home management systems
- Support ongoing RD&D and supplier, sales staff training
- Identify and upgrade poor buildings, drive 8 star+ performance in new homes with focus on summer performance

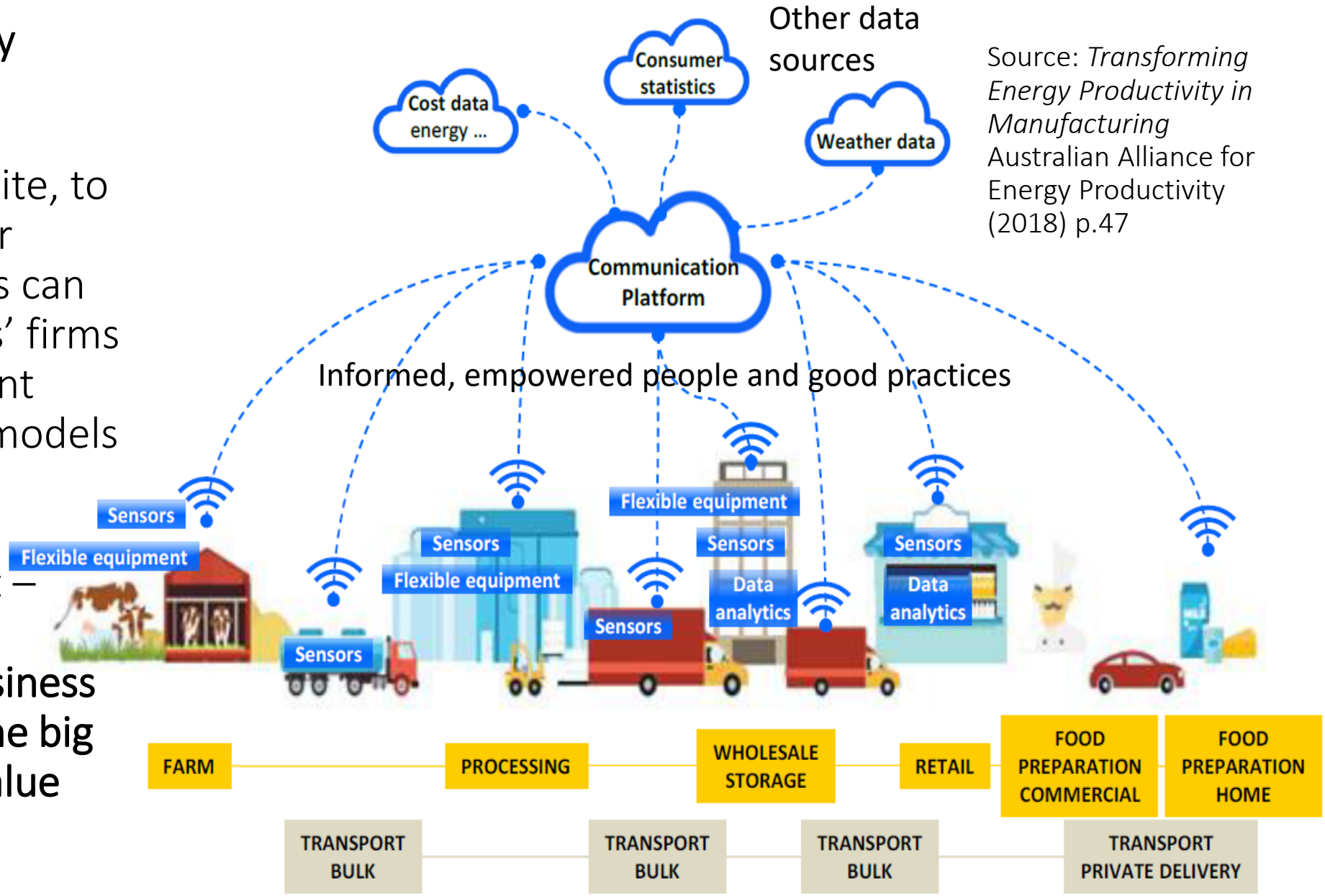


Digital Transformation underpins energy/ resource efficiency and productivity

Interconnection within a site, to information sources, other businesses and consumers can help to capture the 'prizes' firms value, and support different production and business models

This facilitates energy productivity improvement – **EE/EP provides tools and mechanisms to deliver business productivity and value – the big 'prizes' decision-makers value**

Inter and intra-organisation information flow across interfaces using I4.0 technologies in the food value chain

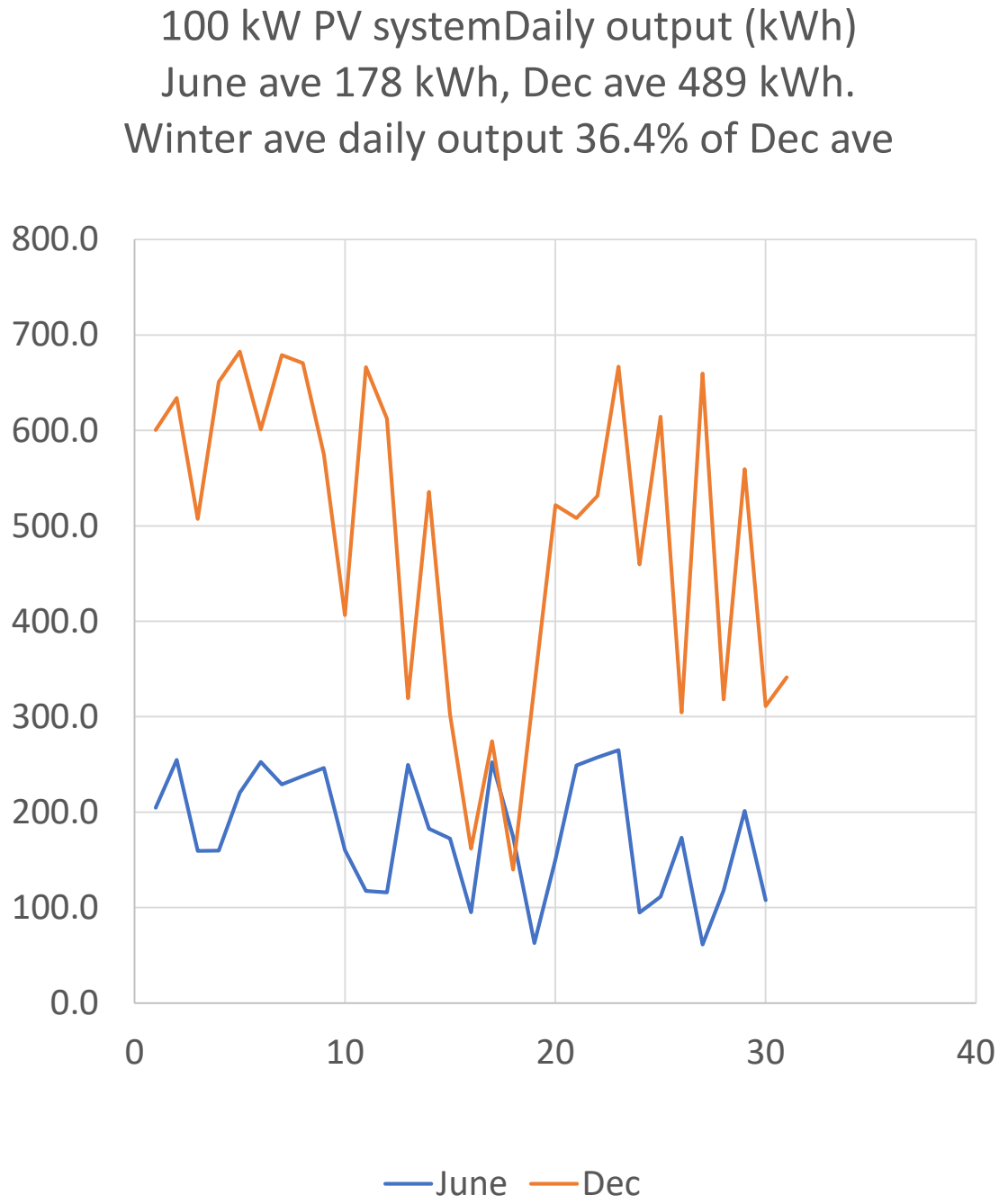


Source: *Transforming Energy Productivity in Manufacturing* Australian Alliance for Energy Productivity (2018) p.47

Integrated approach offers best outcome:

* **Energy efficient**, flexible, smart, connected equipment and systems to provide services
* Smart **demand response** and management
* **Energy storage** (electric, thermal, part-processed product, gravity etc)
* **Energy production** on-site, local
* Review **energy tariffs/contracts** to maximise benefit from above
* **Trading** energy, demand response and other services, Power Purchase Agreements, etc

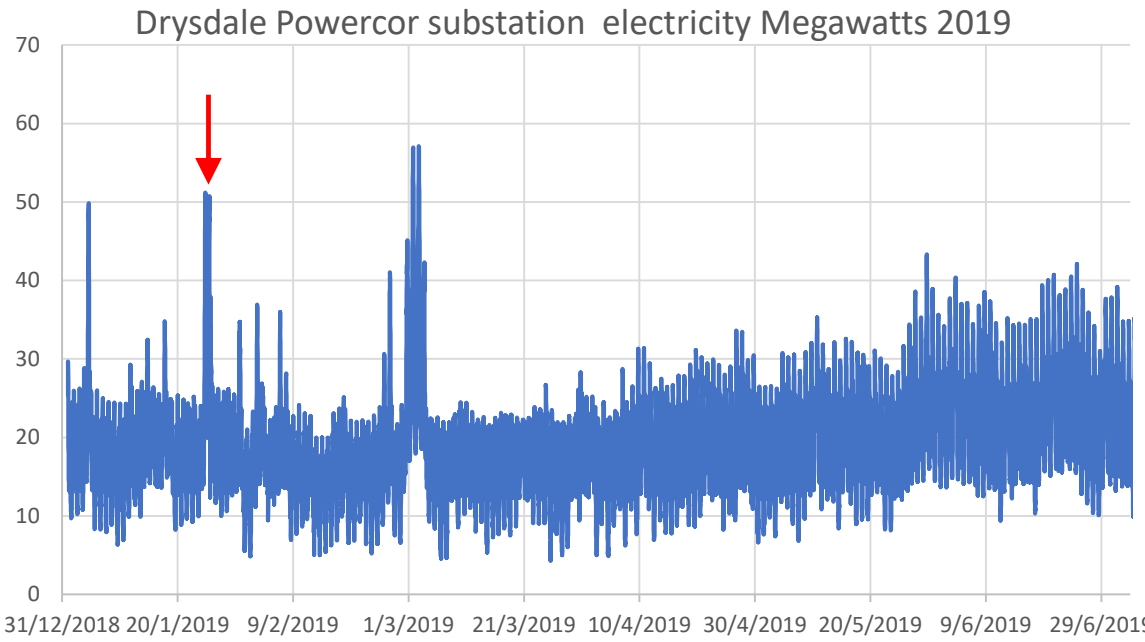
The Sunulator (at https://renew.org.au/resources/sunulator/ is a free analysis tool for grid-connected PV evaluation. https://pvwatts.nrel.gov/ is also useful.

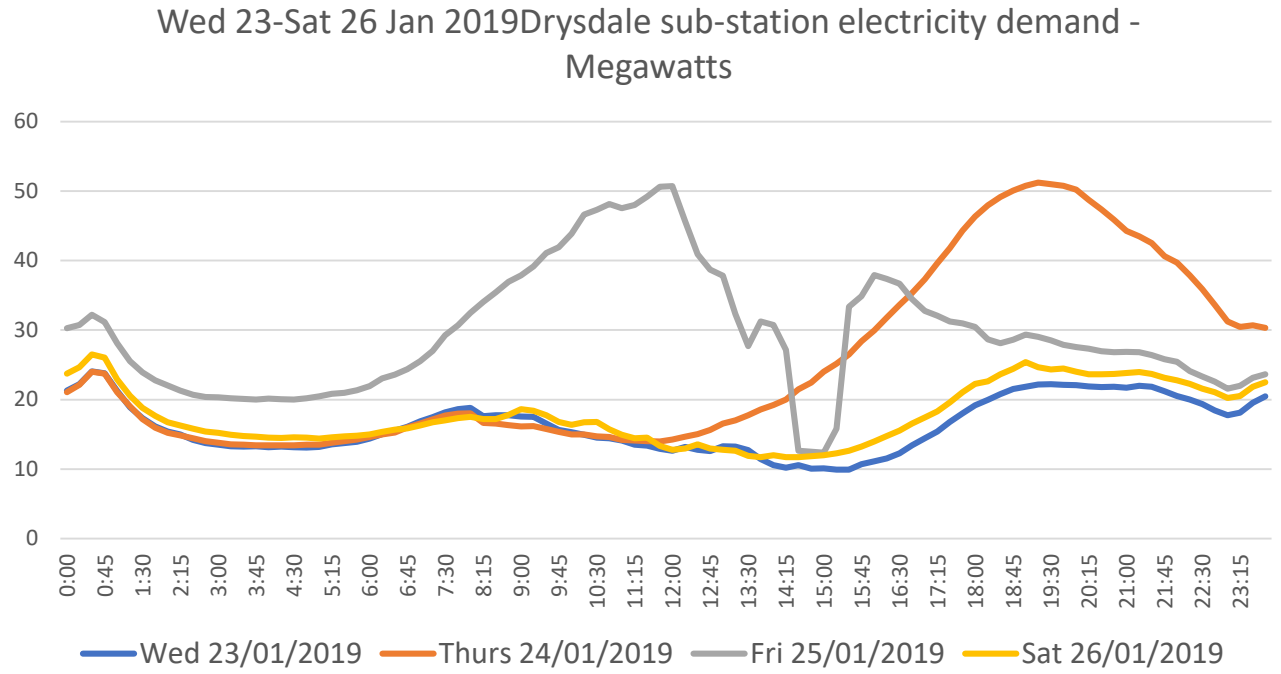


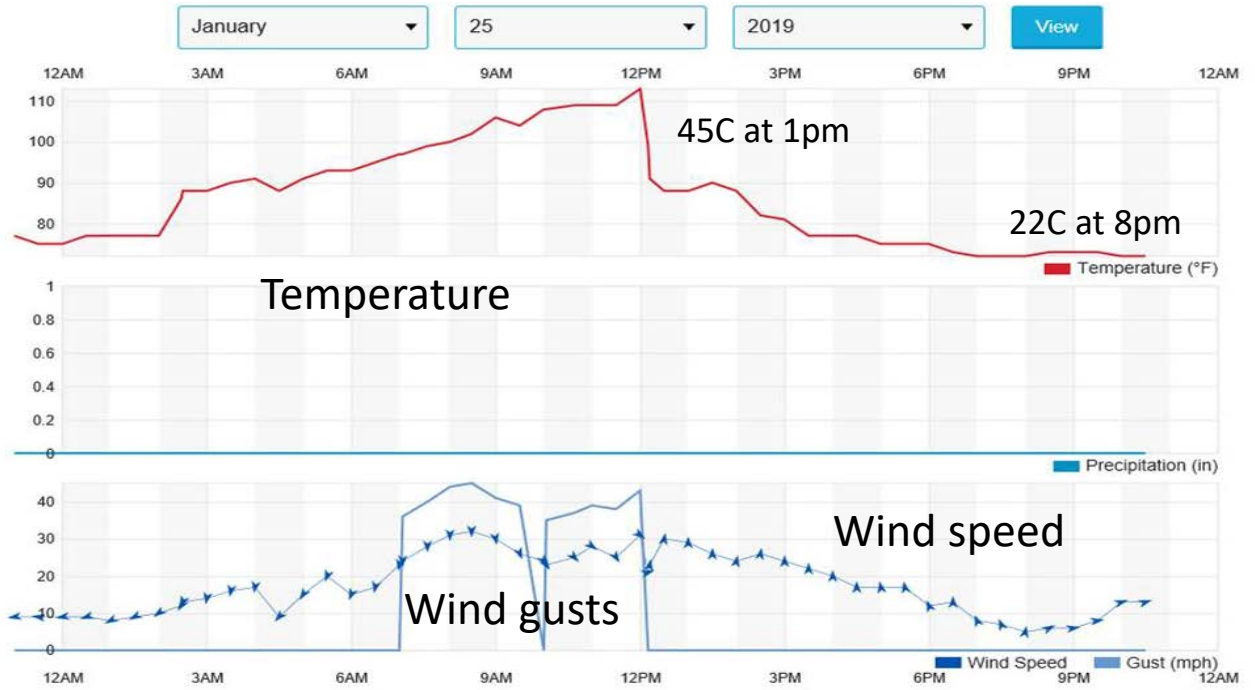
The fineprint – eg Queenscliff

Data sources weatherspark.com (24/1) www.wunderground.com (25/1) for Avalon Airport and Powercorcom.au (electricity data from Drysdale substation near Queenscliff)

- 24/1 hot day >35C 3-7pm after overnight min of 17C – maybe some evening arrivals of holiday-makers?
- 25/1 First day of long weekend: after overnight min of 24C, very hot (45C at 1pm) with gusty wind before early afternoon change drops electricity demand to similar level to Wed and Sat. Steep increase in demand from 3pm could have many causes, eg cafes etc preparing for evening rush, cloud cutting PV output, people going home to TVs etc after weather change??







How to drive electricity (and energy) efficiency?

- Sort out institutional responsibilities and financial arrangements, annual “EE Statement of Opportunities”, ‘EE First’ policies, formal recognition of ‘multiple benefits’ and time-related value of EE, reshape retail energy pricing/tariffs and billing
- Reframe EE as key part of a ‘toolkit’ to help business and households to capture benefits they value with minimum cost, social and environmental impacts
- Incentivise or regulate energy retailers, network and transmission operators and generators to fund EE – based on delivered performance
- Incentivise consumers to make appropriate investments in EE
- Incentivise and educate ‘market intermediaries’ (tradies, financial and tax advisers, sales people, etc) to drive EE
- Also see Energy Efficiency Council *Policy Handbook* and numerous International Energy Agency reports on energy efficiency, digitalisation, multiple benefits, etc