Home energy and emissions: context and strategies to ‘futureproof’ your home

Alan Pears AM

Senior Industry Fellow RMIT,

Fellow Climate & Energy College
University of Melbourne

Healesville CoRE

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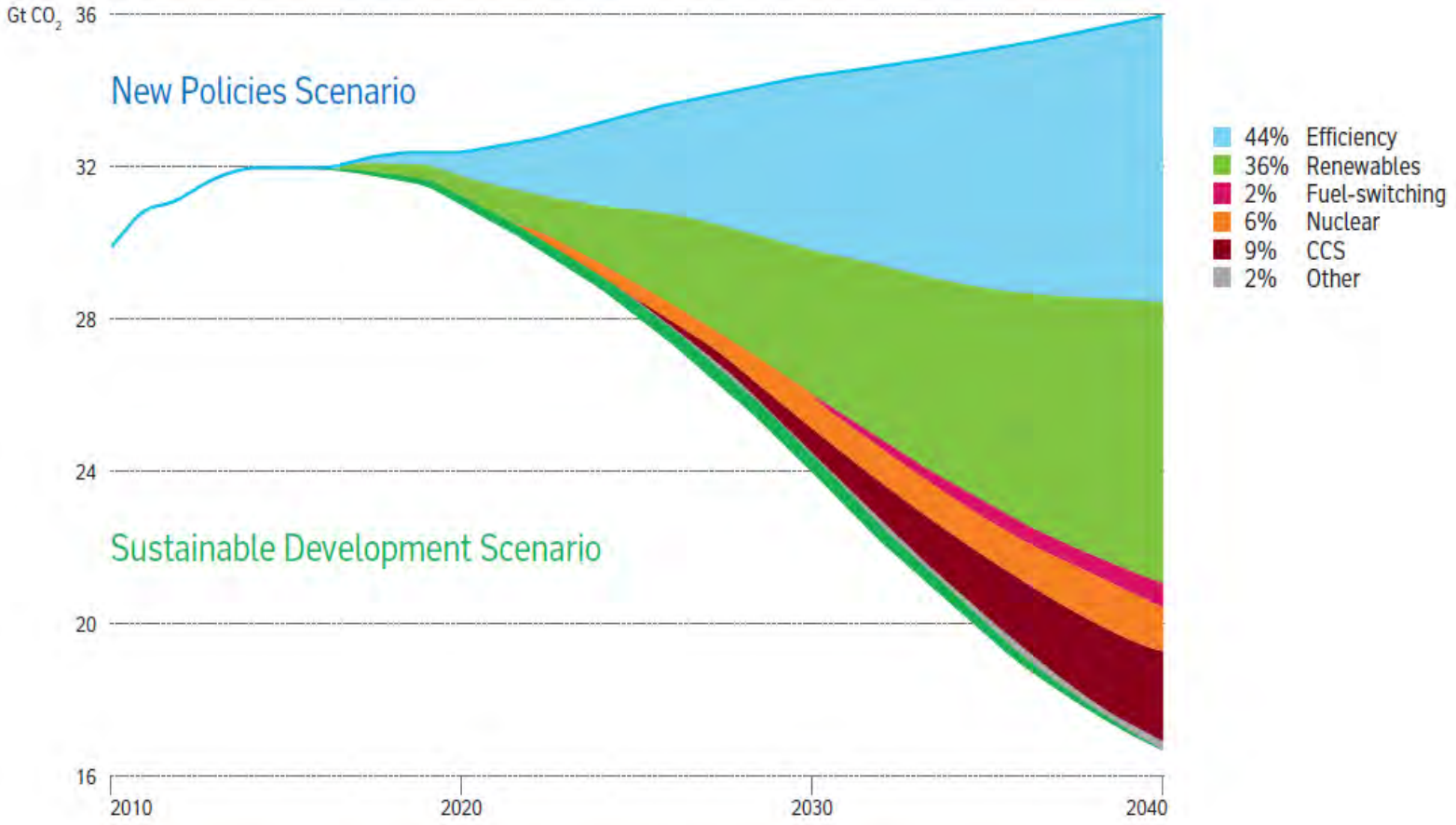
Global energy-related CO_2 emissions under IEA New Policies and Sustainable Development scenarios



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

Emission intensity of electricity is falling; gas is another story

AEMO Integrated System Plan 2020 (https://aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp#Final 2020 ISP) p.98

Electricity emissions are falling, increasing numbers of consumers are installing 'behind-the-meter' generation and storage

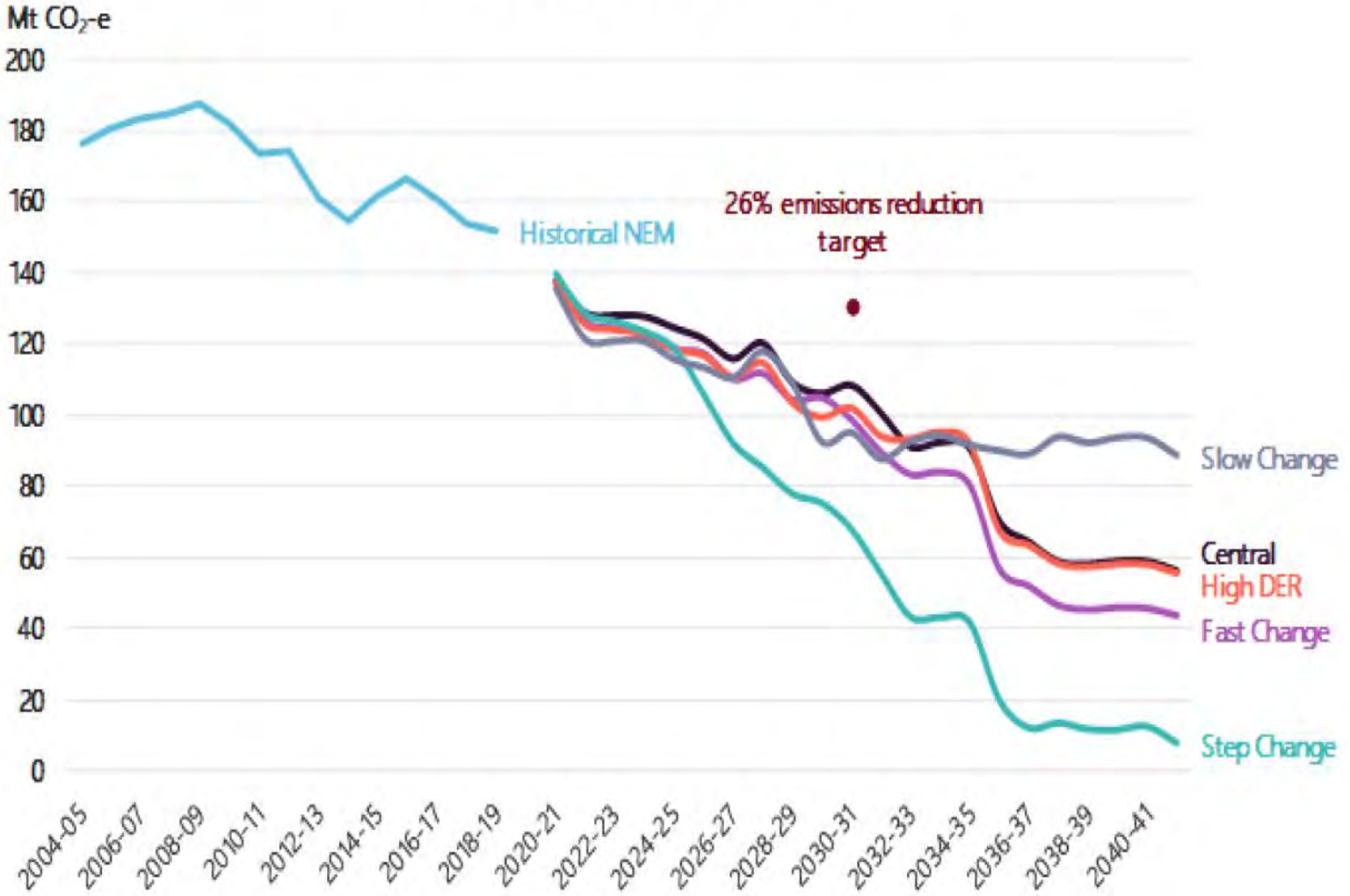
Fossil gas emission impact is increasing due to:

- Shift to Coal Seam Gas and new gas fields with higher CO2 content and significant methane leakage

In short term:

- Methane (leakage) 3 times higher climate impact over 20 years than 'official accounting period' of 100 years (even then, it is ~25 times more impact than CO2)
- Using gas to produce hydrogen increases emissions until Carbon Capture & Storage, biogas or renewable H2 are introduced

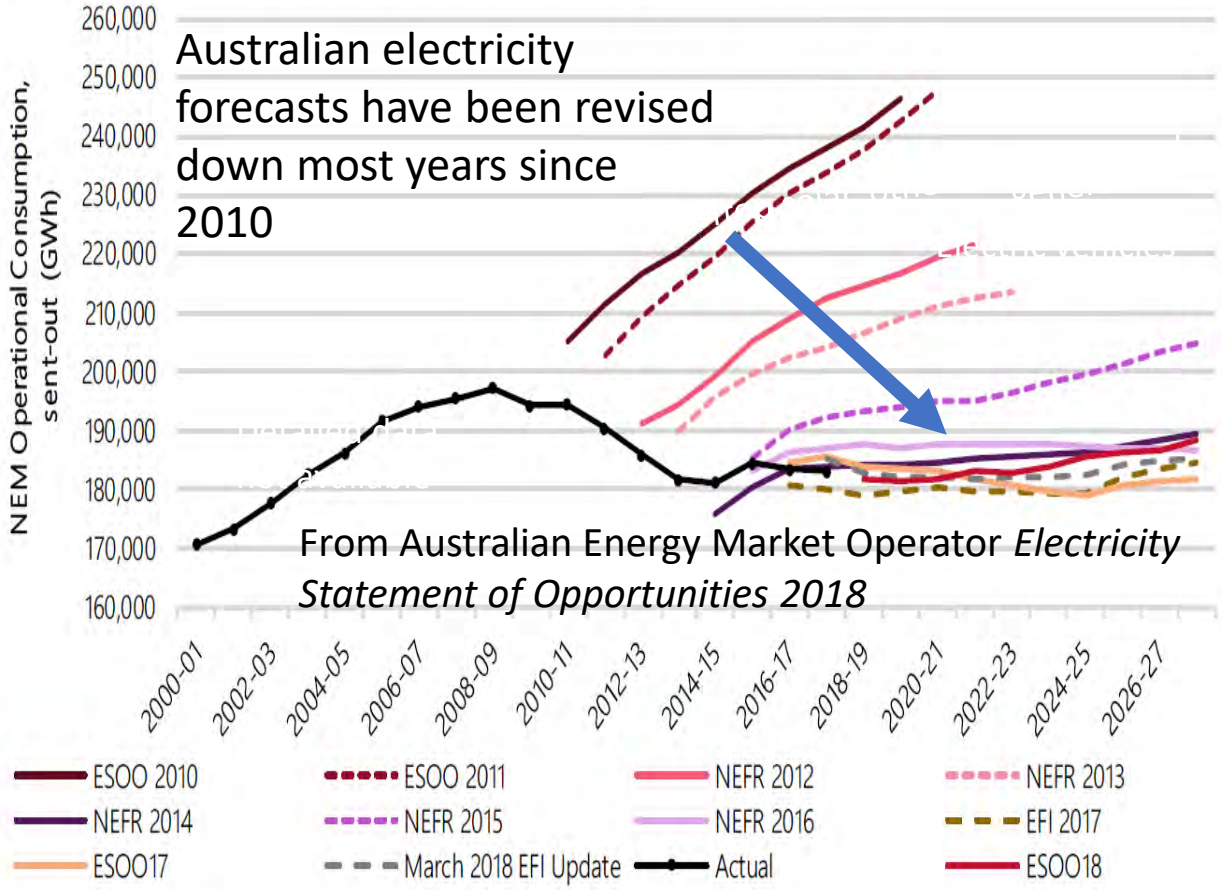
Figure 31 Australia's emission reduction target is met under all scenarios



Future demand for energy is increasingly uncertain, due to disruptive changes in demand and supply, and the need to address climate change.

Energy Efficiency reduces demand in a predictable way, can smooth peaks and cut consumer costs

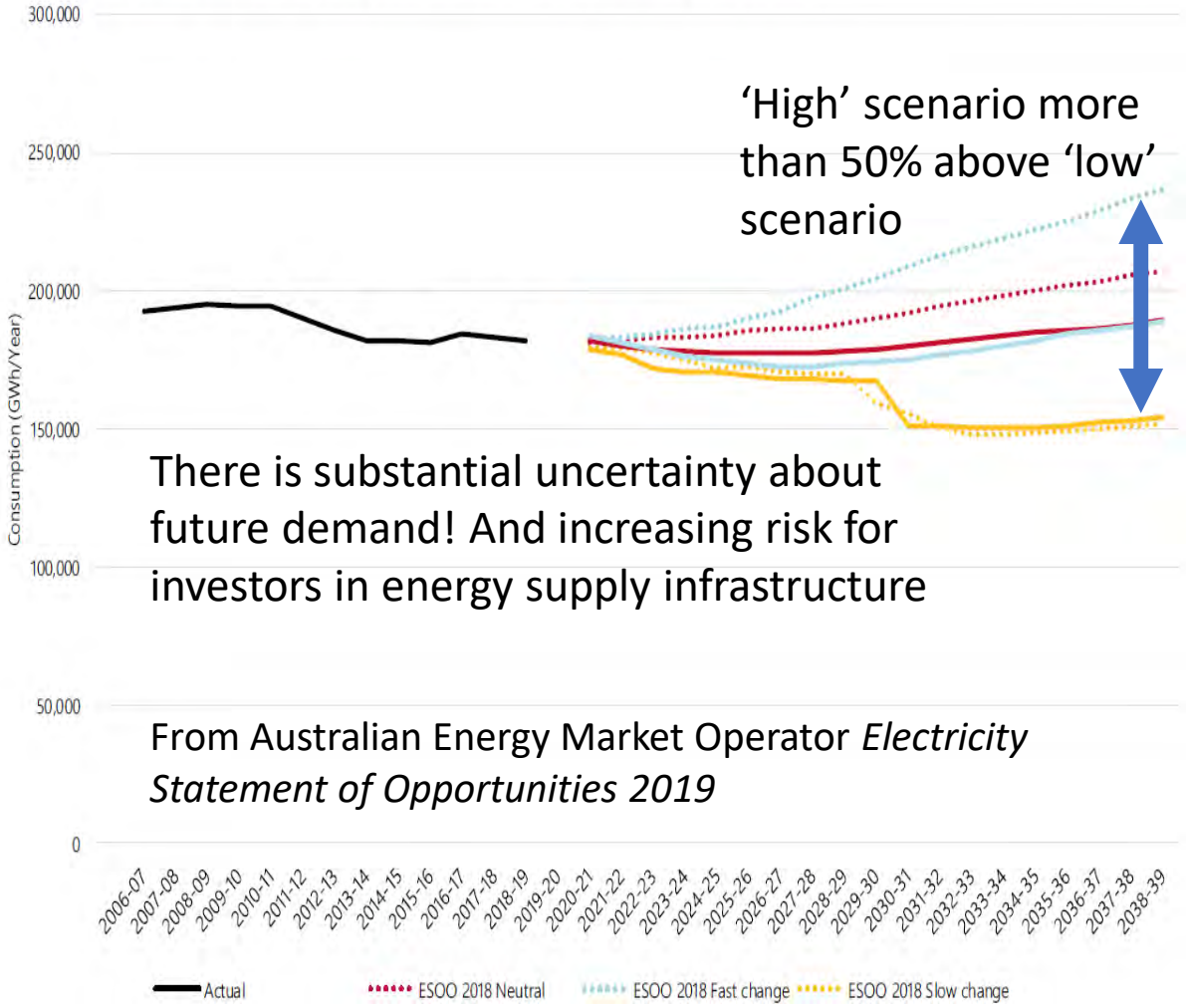
Figure 41 Operational consumption forecasts versus actual, 2010-18



Australian electricity forecasts have been revised down most years since 2010

From Australian Energy Market Operator *Electricity Statement of Opportunities 2018*

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



'High' scenario more than 50% above 'low' scenario

There is substantial uncertainty about future demand! And increasing risk for investors in energy supply infrastructure

From Australian Energy Market Operator *Electricity Statement of Opportunities 2019*

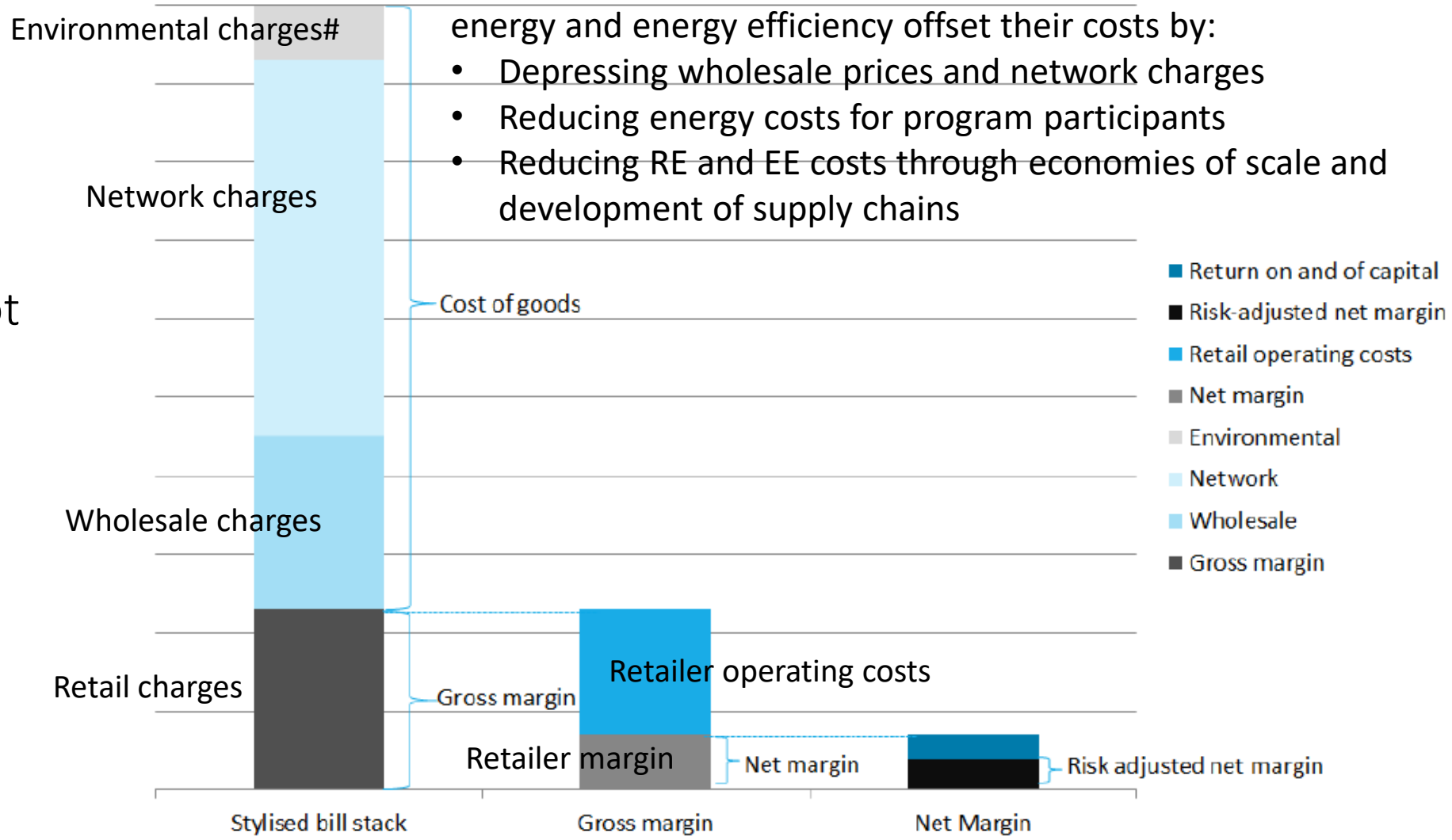
AEMC (2018) *Retail Competition review* p.230

Wholesale price is just one part of retail price paid by most consumers

Larger consumers may not pay network charges and may buy direct from wholesale markets

Over 90% of black-outs are due to network problems – and many gas appliances won't work without electricity!

Figure 10.1 Components of a retail electricity bill, and gross, net and risk-adjusted net margins



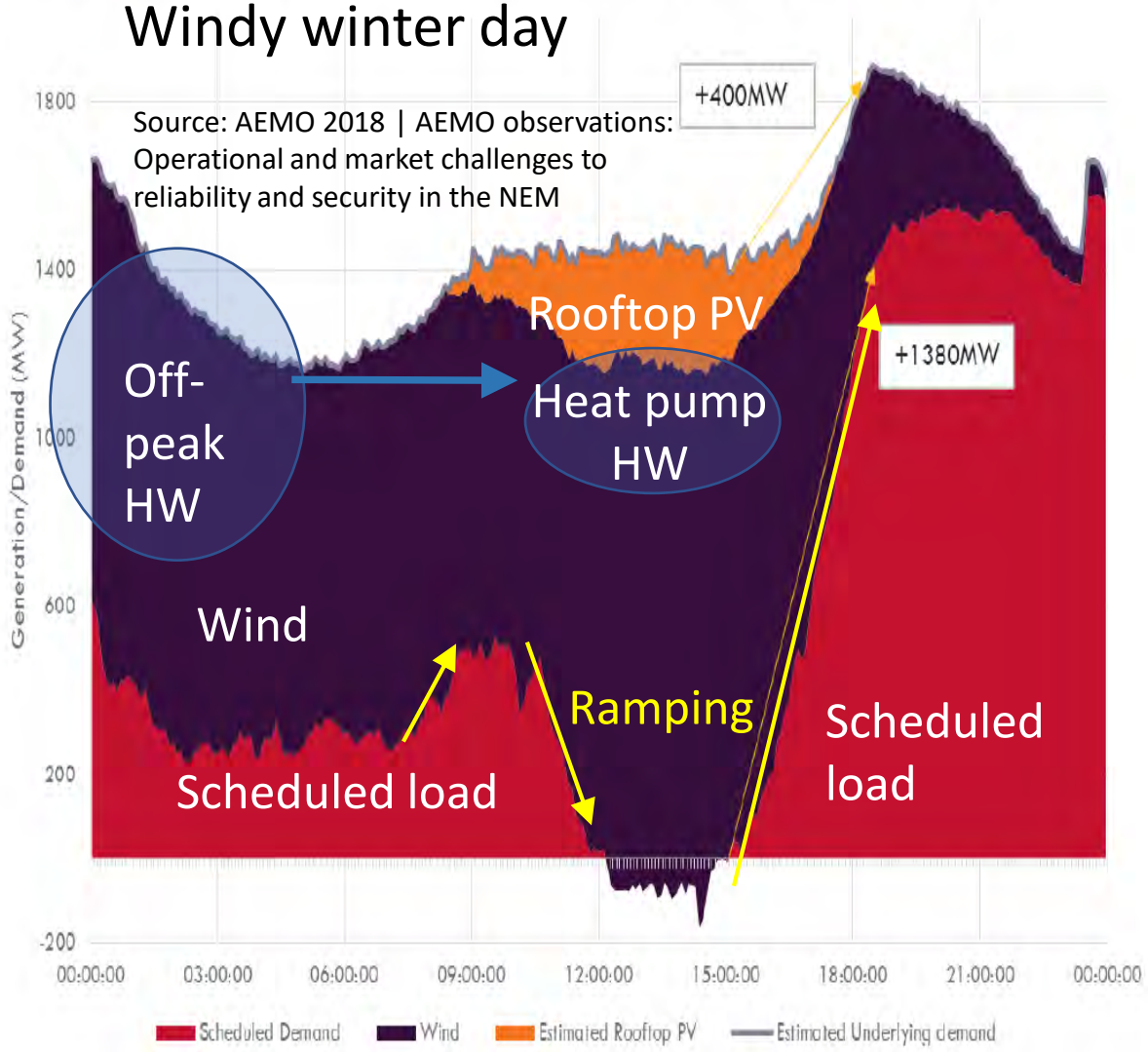
Emerging trends of scale and timing of demand and steep ramping of dispatchable supply on hot, cold and low demand days are creating new problems How do EE, DM, DR help?

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'

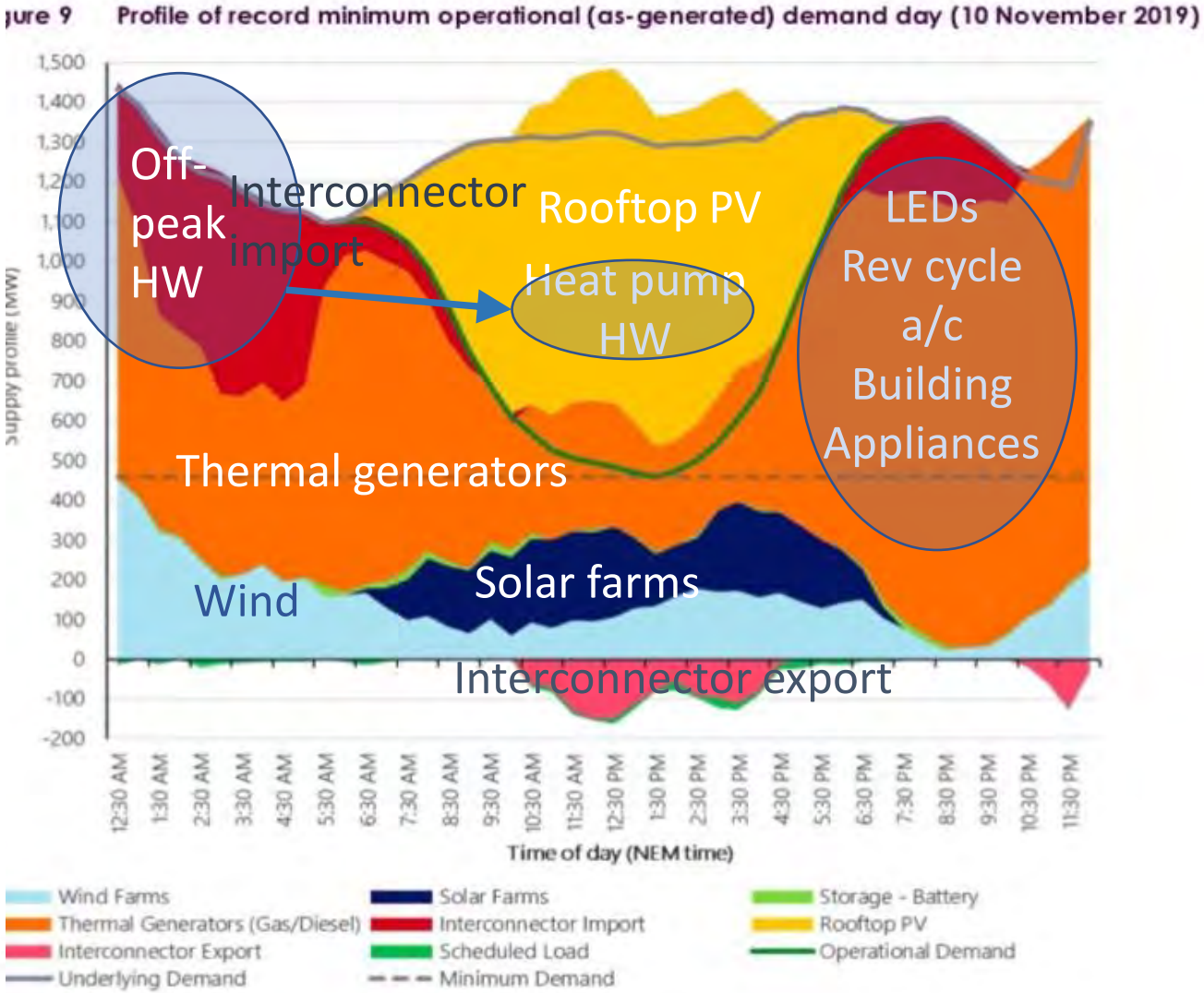
Figure 28 Flexible plant ramping, South Australia, Sunday 23 July 2017 (case study 2)

Windy winter day

Source: AEMO 2018 | AEMO observations: Operational and market challenges to reliability and security in the NEM



Low load high solar day

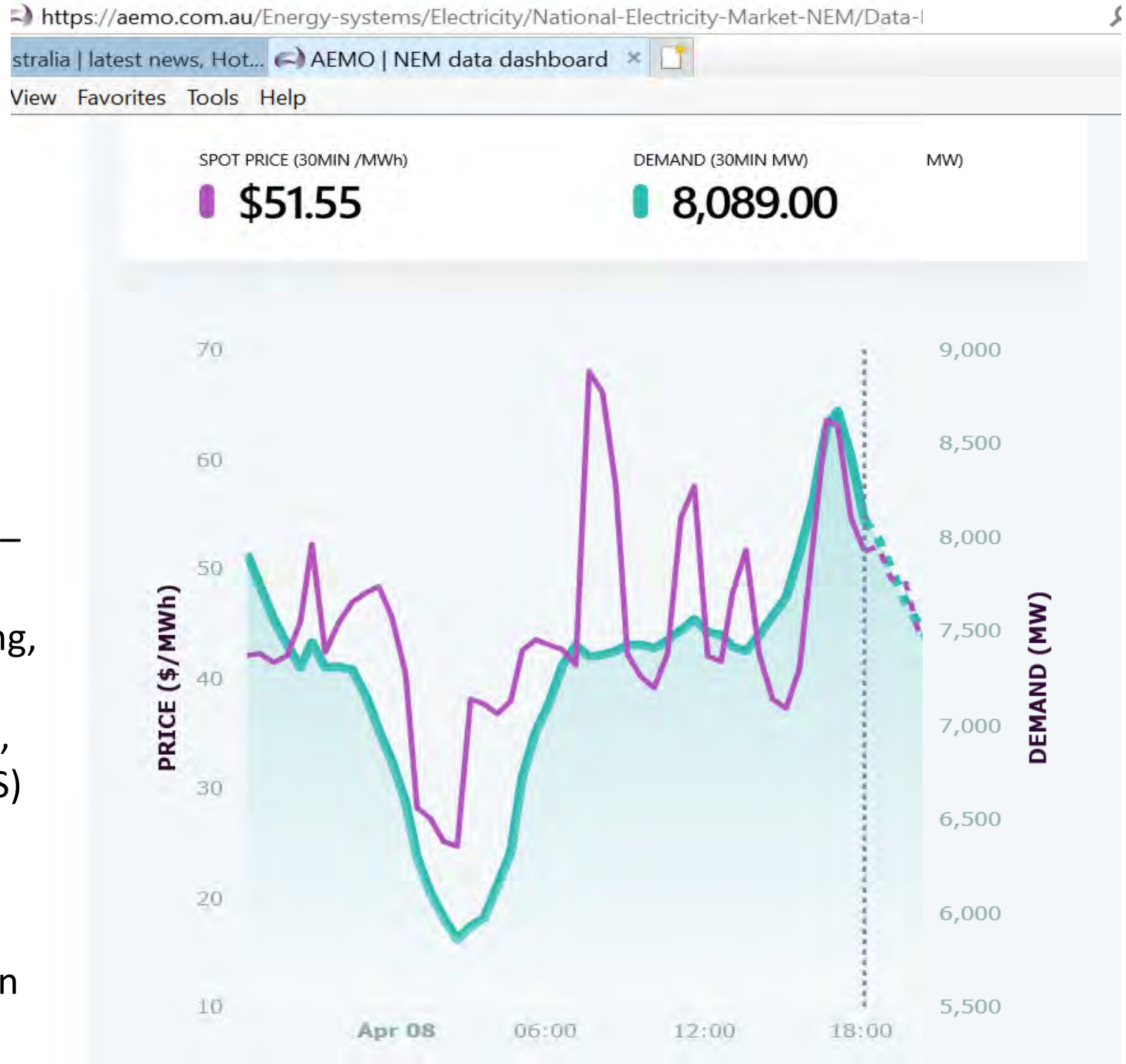


Wholesale + network value of energy AND energy savings varies over time (minutes, hours, days, seasons and **years**).

Price and value are **very imperfectly** reflected in retail tariffs and feed-in prices

‘Excess’ solar around middle of day drives down wholesale prices, may increase network charges – impacts on PV owners. Options include:

- Energy efficiency targeting activities at evening, morning peaks and overnight
- Shift demand away from peaks and overnight, into (sunny) daytime periods (eg heating HWS)
- Short term ‘Demand Response’ – adding or cutting demand in response to price
- Energy storage: battery, heat, part-processed product (eg cook in bulk, defrost in fridge then microwave)



Fossil gas demand and supply

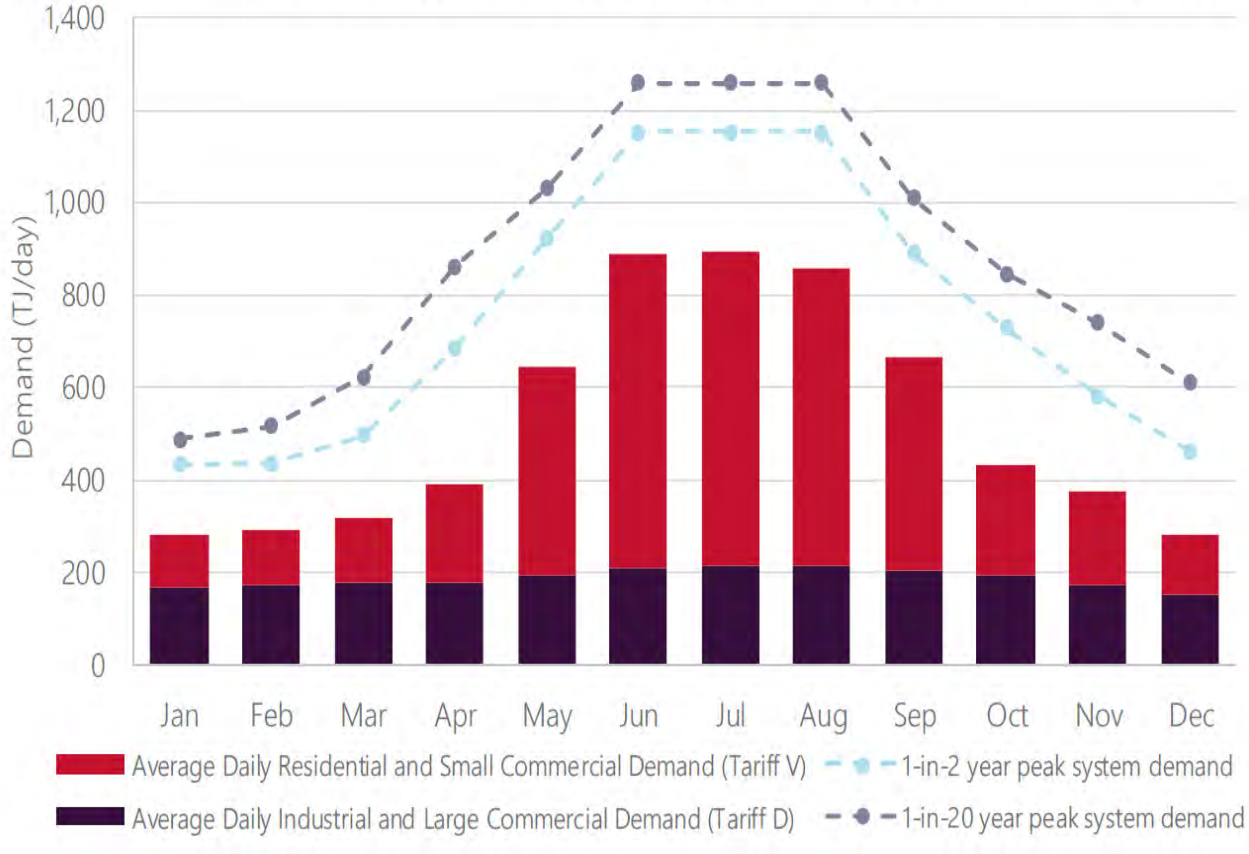
AEMO 2019 *Victorian Gas Planning Report*

Demand peaks in winter, driven mainly by building heating and extreme weather

Average daily demand: residential 305 TJ/day, commercial 99.5 TJ/day

NOTE: gas for electricity generation is additional (~15 TJ/day)

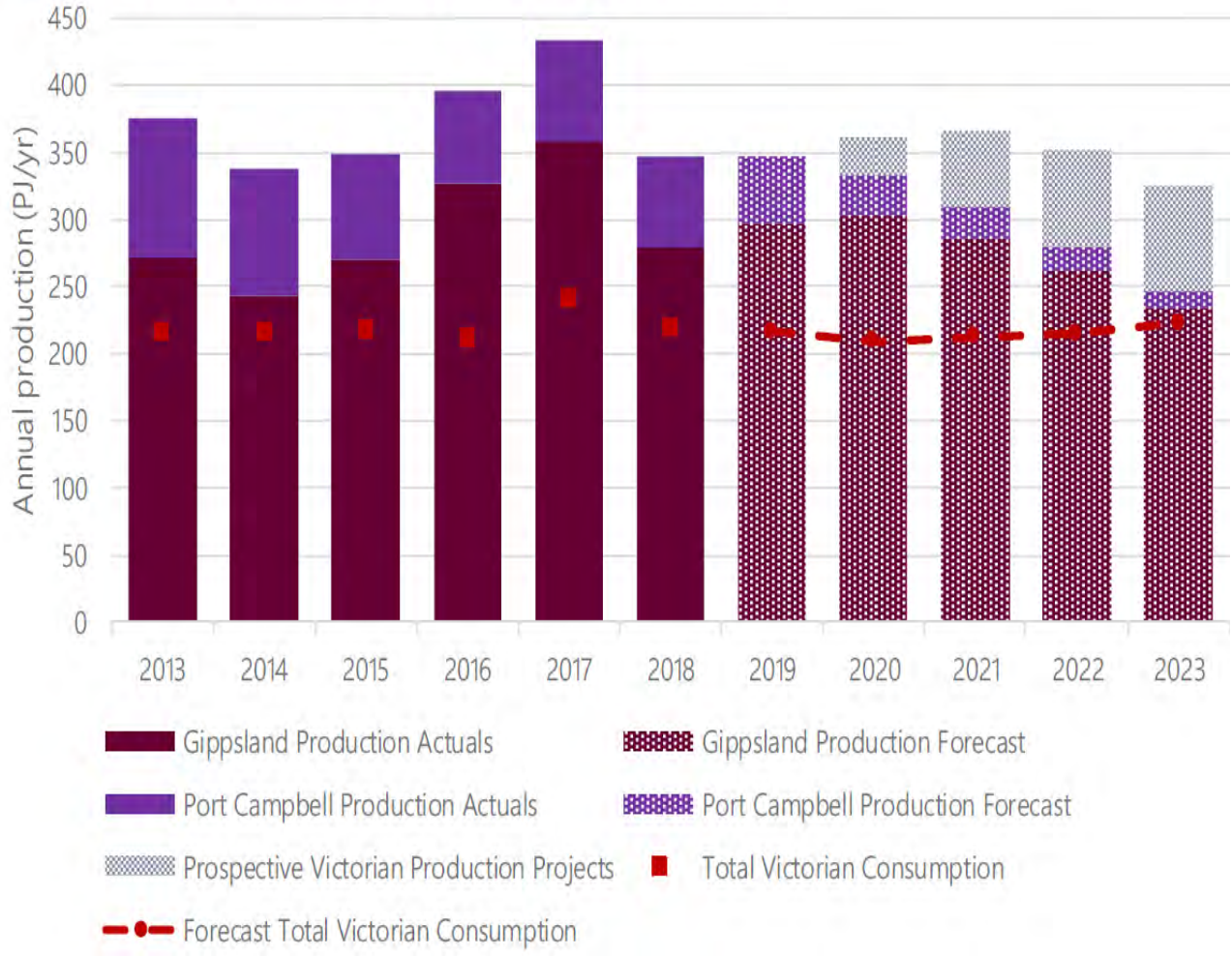
Figure 3 Average daily demand by month with 1-in-2 and 1-in-20 peak day demand forecasts (TJ/d)



Victorian gas production is expected to decline, creating pressure to find more gas, import LNG or cut exports to other states/LNG producers

NOTE demand includes Victorian gas-fired electricity generation

Figure 1 Annual production (petajoules per year) by location



A strategy helps planning

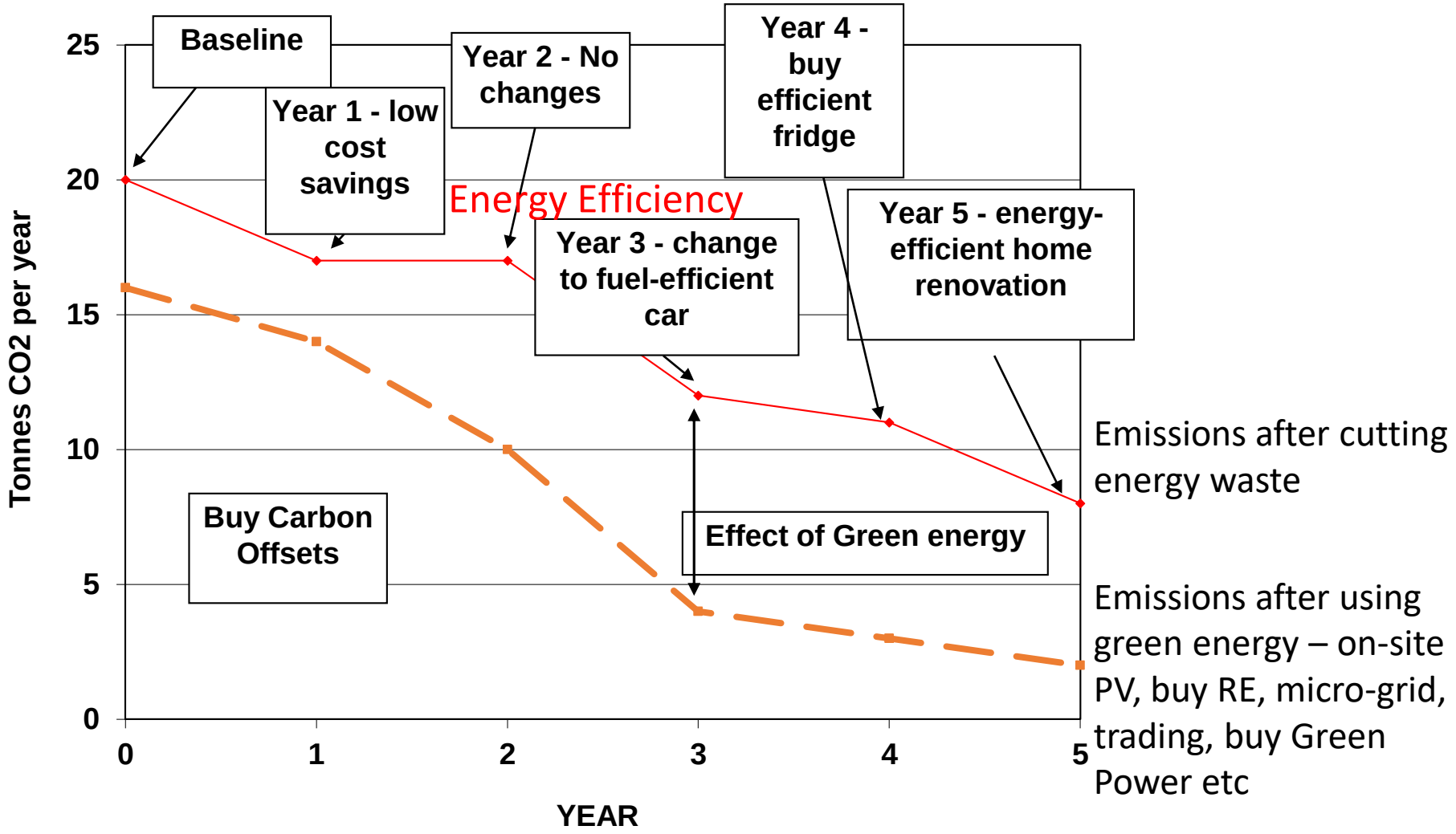
Example of a personal zero emission strategy for household energy-related emissions – some or all of remaining emissions can be offset each year. Plan ahead to avoid crises

To estimate base year and ongoing emissions:

ENERGY/fuel: use billing data and emission factors from **National Greenhouse Accounts Factors - August 2019** or options below ENERGY, FOOD, WASTE, GOODS, etc: NGAF (above), https://www.climateactive.org.au/

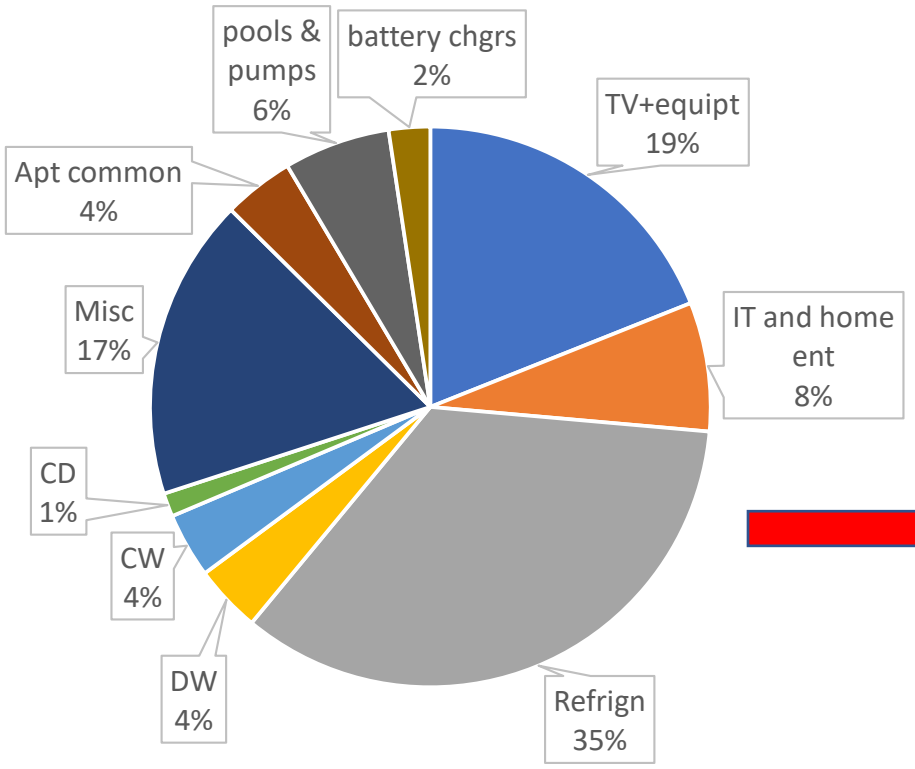
EPA Vic calculator (till Dec 2020) https://apps.epa.vic.gov.au/AGC/home.html only works with Internet Explorer or if Flash enabled); https://www.carbonfootprint.com/calculator.aspx (US EPA); https://carbonneutral.com.au/carbon-calculator/ (log-in for detail)

Also consider your emissions from 'upstream' (materials, food) and services (air travel, deliveries, etc)



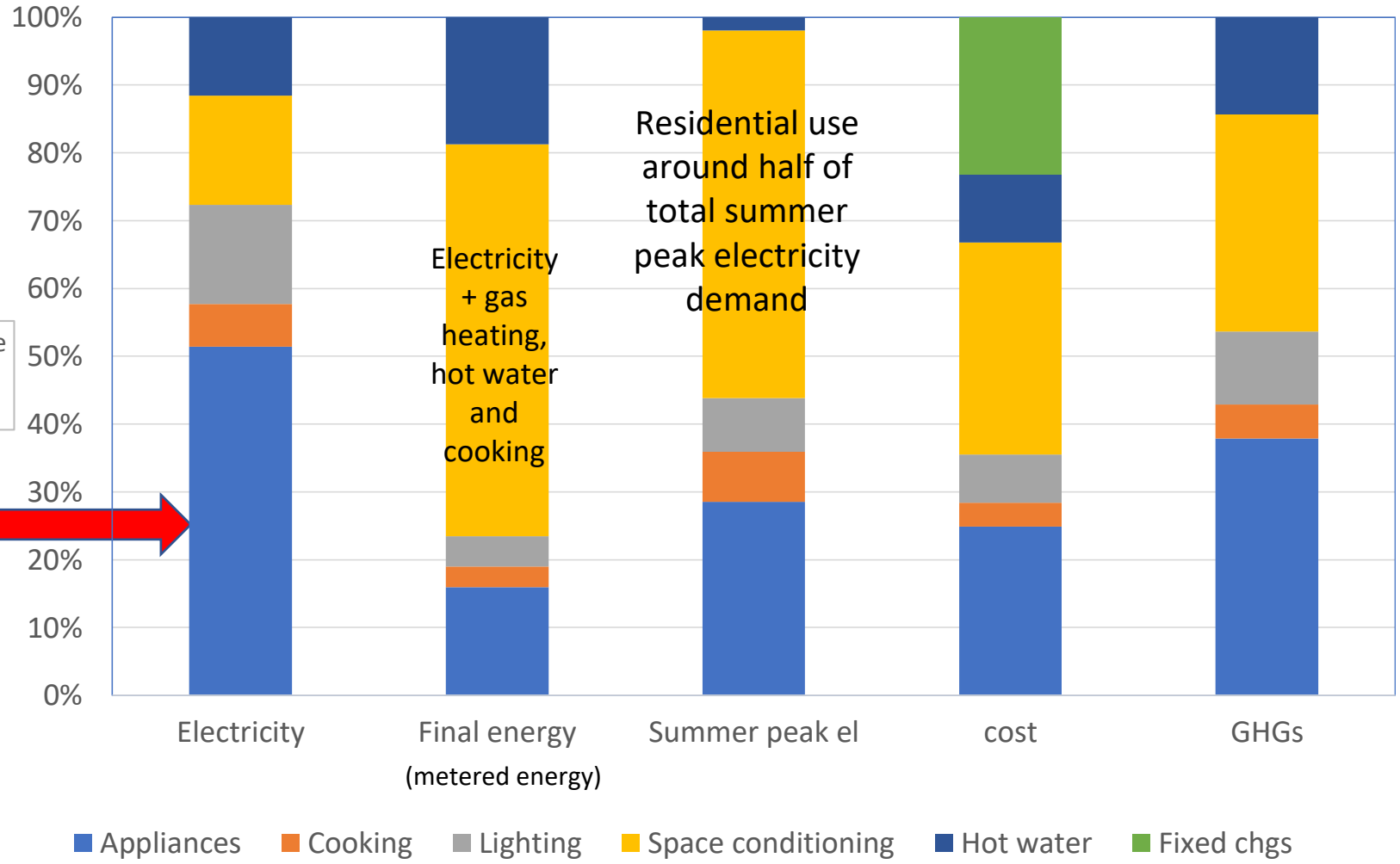
What do we use energy for? Different indicators give different insights

Appliance energy use Victoria



NOTES: wide variation in level of energy use among households!

Victorian residential energy and related factors (all approximate): electricity 42 PJ (11.6 GWh); summer peak electricity 4700 MW, gas 94 PJ; final energy 136 PJ; primary energy 268 PJ; cost $6.7 billion ($2750/hhold); GHGs 19.5 Mt (8 tonnes/hh)



Residential contribution to summer and winter electricity system peak demand

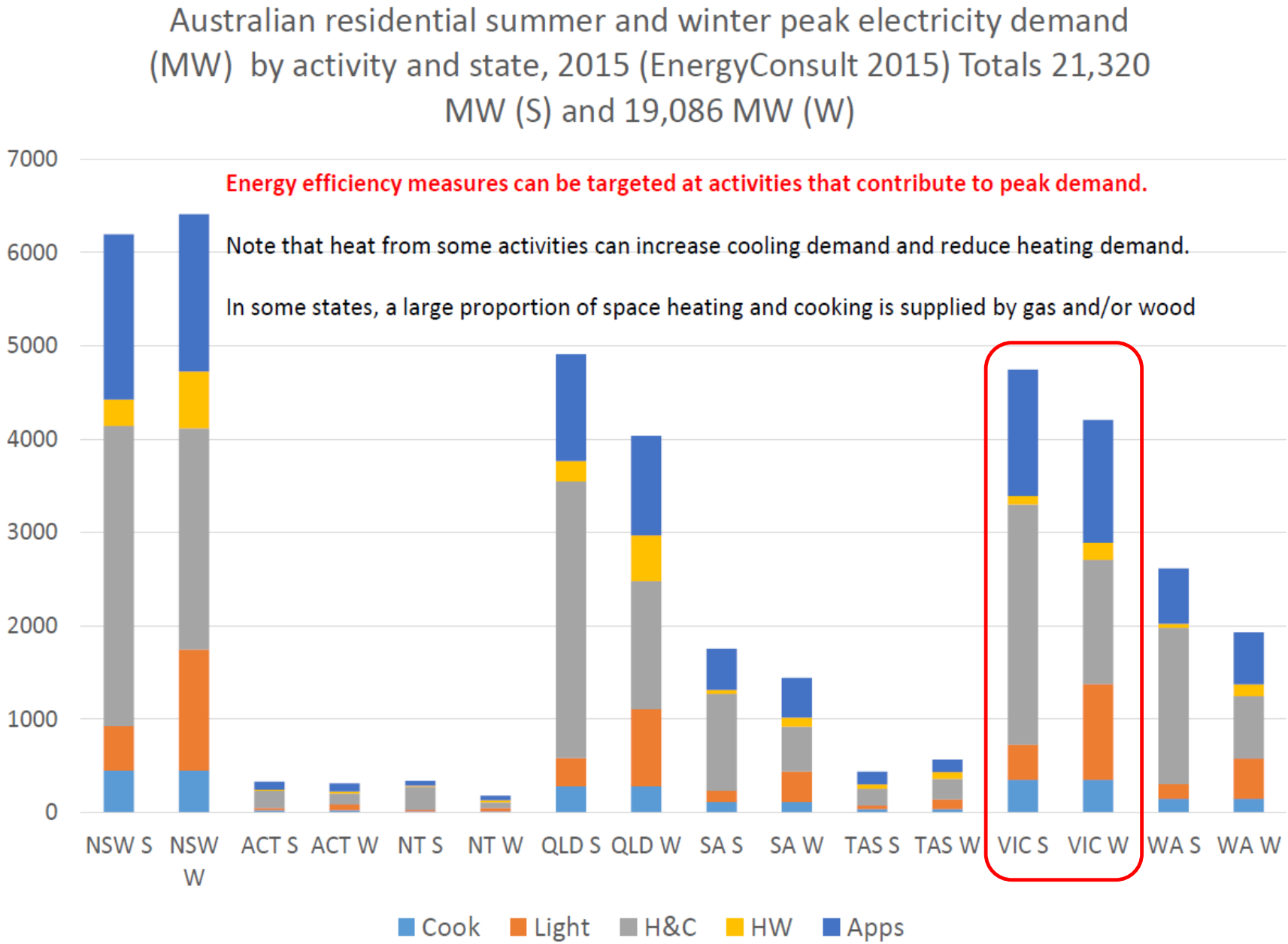
Cooking S&W – will increase if many switch from gas – unless more efficient, smarter, manage peak demand

Lighting W but some summer – LEDs (increasing efficiency), smart controls and 'sensible' numbers installed, behaviour

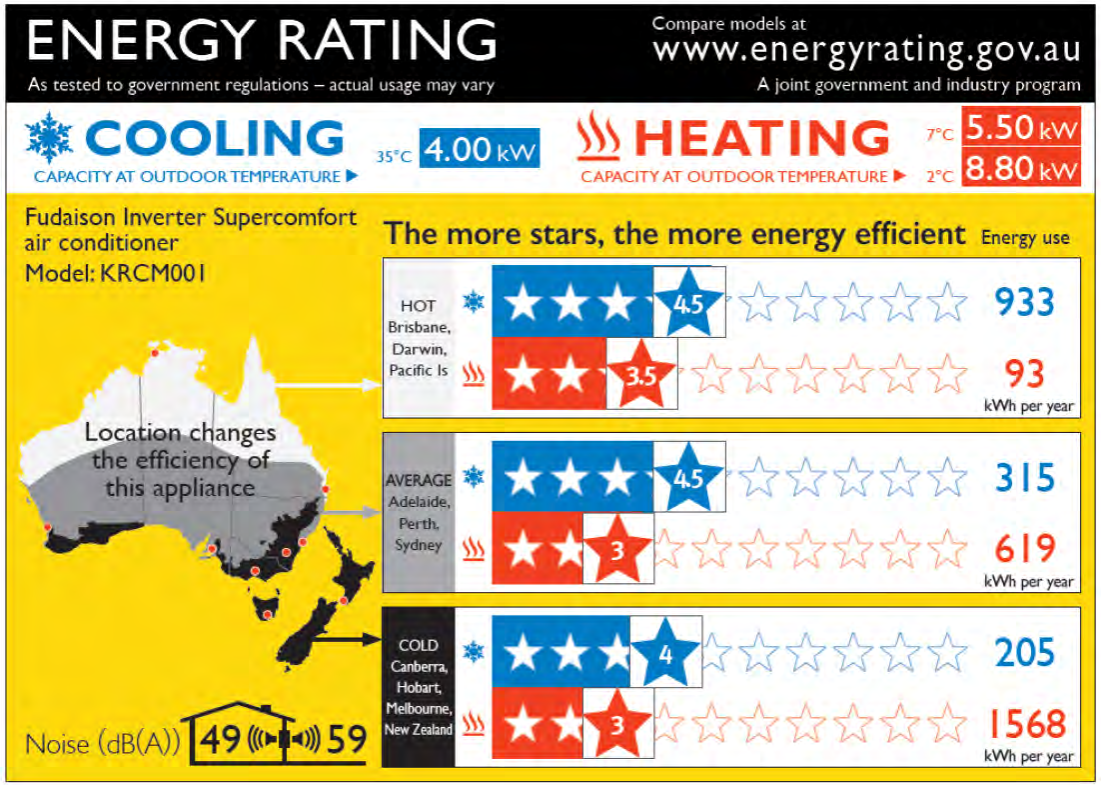
H&C S&W with W increase as many switch from gas and in S with climate change – unless high eff homes, high eff Rev Cycle a/c, zoning, behaviour, storage

Hot Water W but some summer – smart controlled heat pumps, water efficiency

Appliances S&W – TVs, IT big but big eff potential; high eff fridges; smart high eff pool pumps; DW&CW time managed+ high eff; misc cut standby+eff.



‘Best on market’ appliances typically use 50-80% LESS energy than worst available: an extra star means 15-30% energy saving



Appliance efficiency programs are saving an average Australian household $300 each year on energy bills.

Product lists are at www.energyrating.gov.au and an ‘app’ is now available.

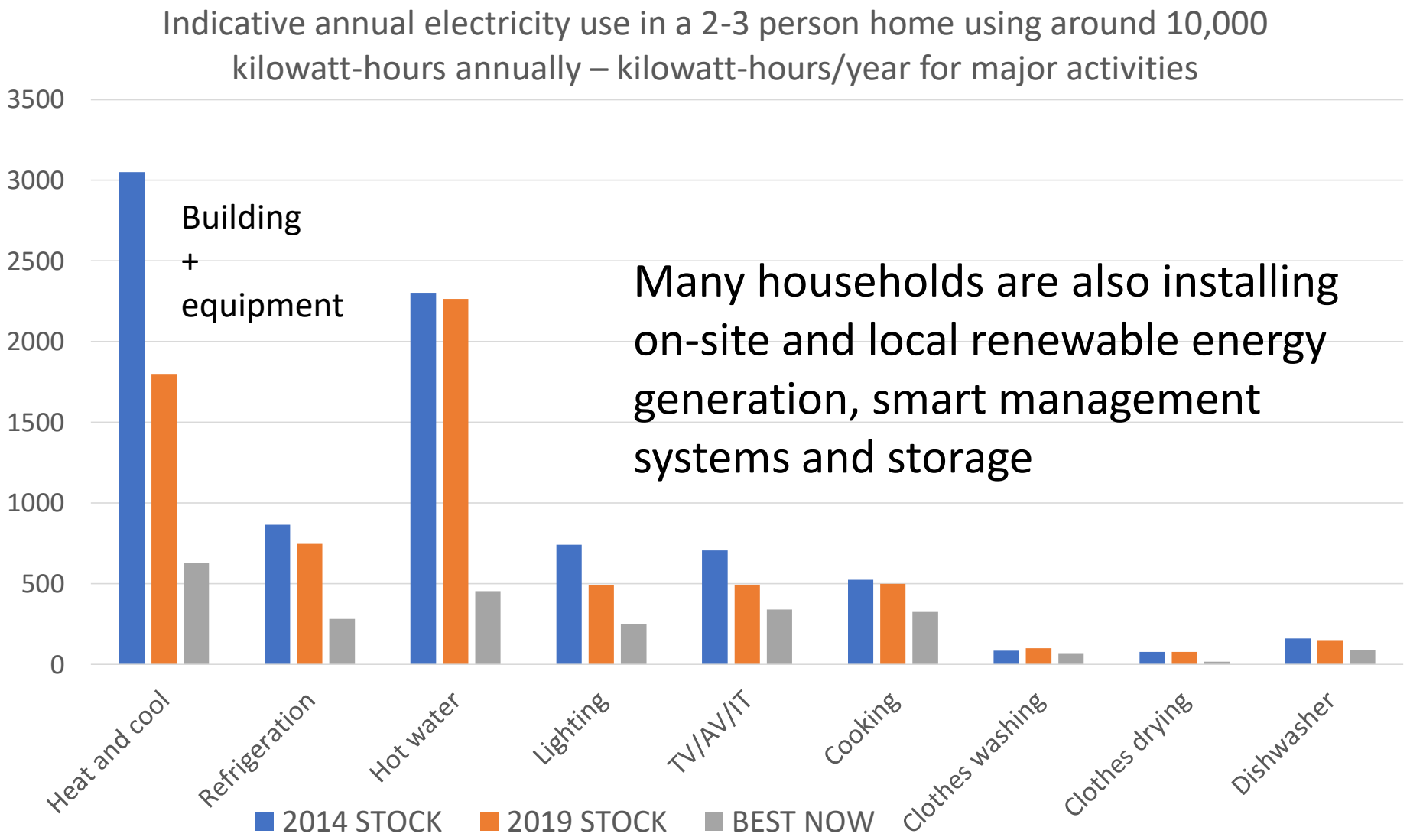
Labelled products include:
* TVs,
* fridges and freezers,
* dishwashers,
* clothes washers,
* clothes dryers
* Pool filter pumps
* airconditioners – new ‘climate zoned’ label being phased in

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)

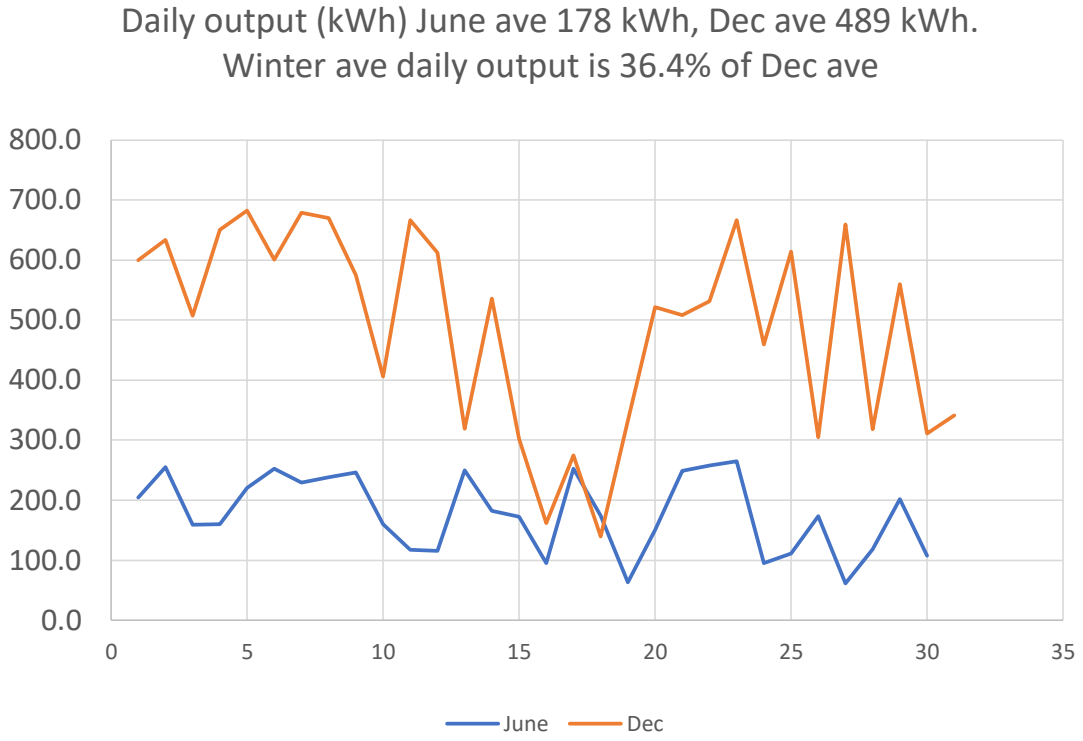
Priorities:

- 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



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, 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

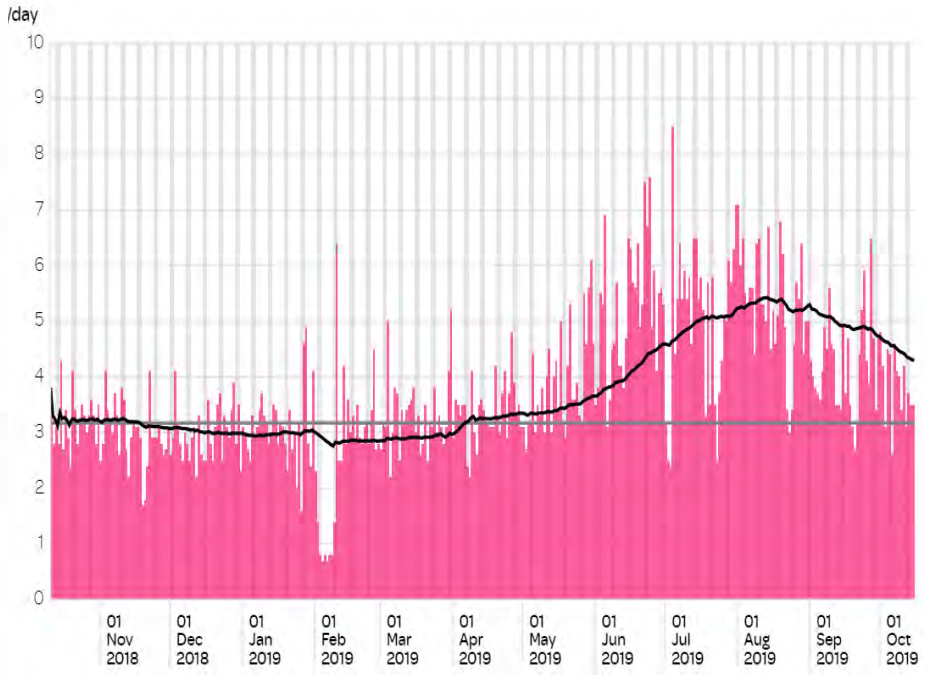


Energy efficiency and demand management can 'help' supply:

- Reduce energy consumption
- Reduce supply system losses
- Often reduce peak demand
- Reduce capacity of energy supply and storage required
- Reduce impacts of supply disruptions
- Reduce overall costs
- And more…… smaller capacity, often simpler and cheaper end use equipment

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.

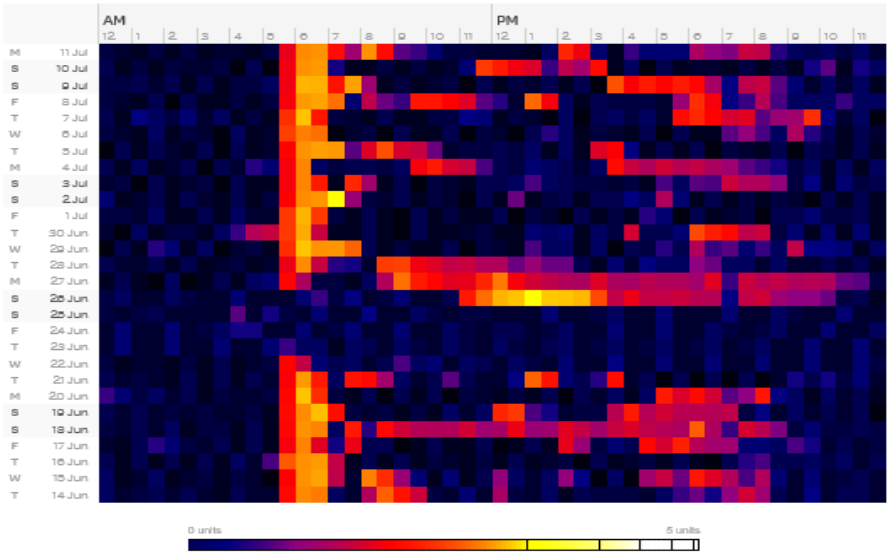
From https://www.agl.com.au/yourenergyinsights



The time of day you used the most power was usually
between 5:30 AM and 7:30 AM

The day you used the most power was
Sunday, 26 June 2016

Your peak usage was
between 7:00 AM and 7:30 AM on Saturday, 02 July 2016



Information empowers

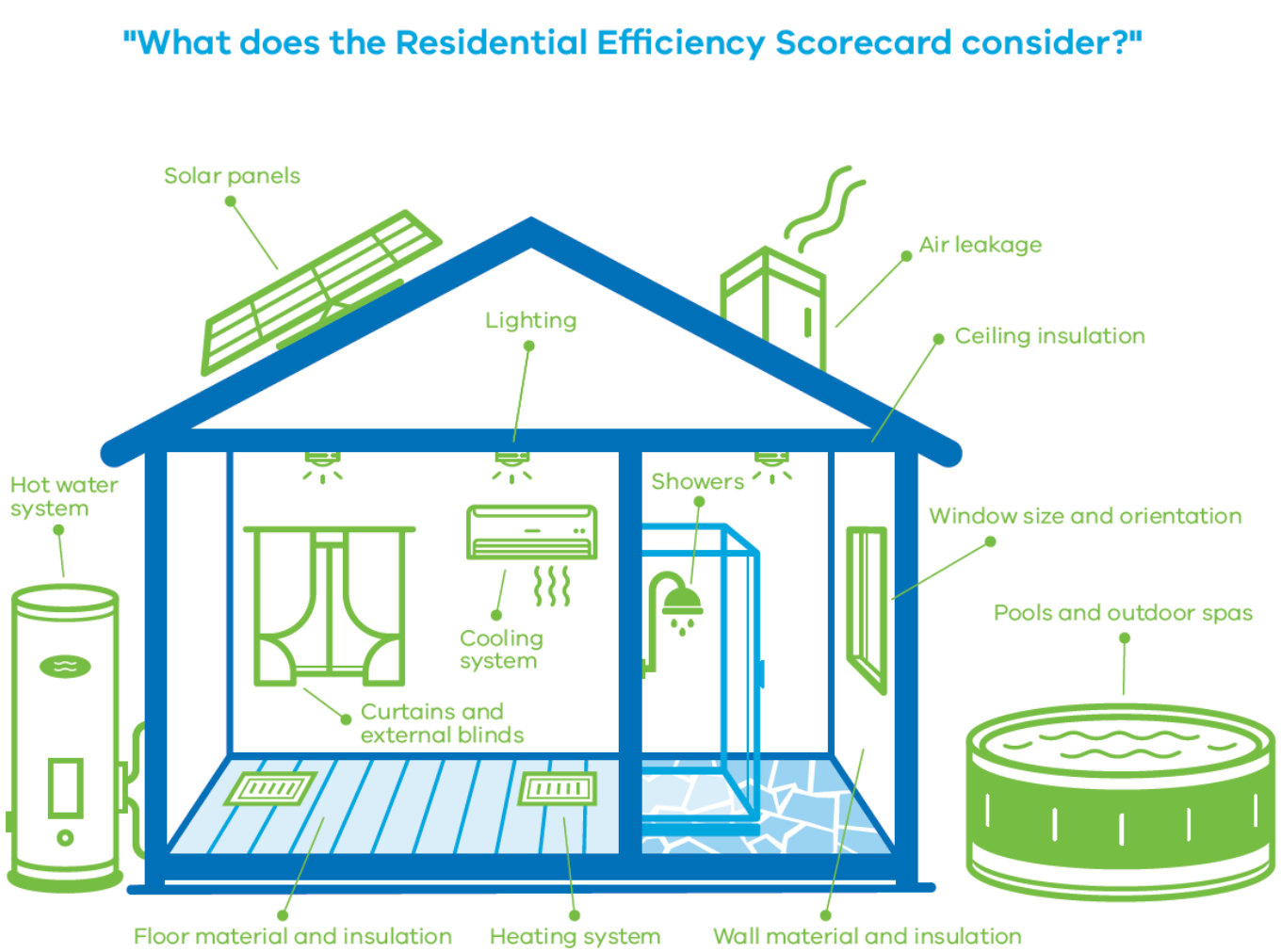
All Victorian homes now have ‘smart’ electricity meters that collect half-hourly usage data – available next day from retailer or network operator – real time data more useful, eg PowerPal, PV data.

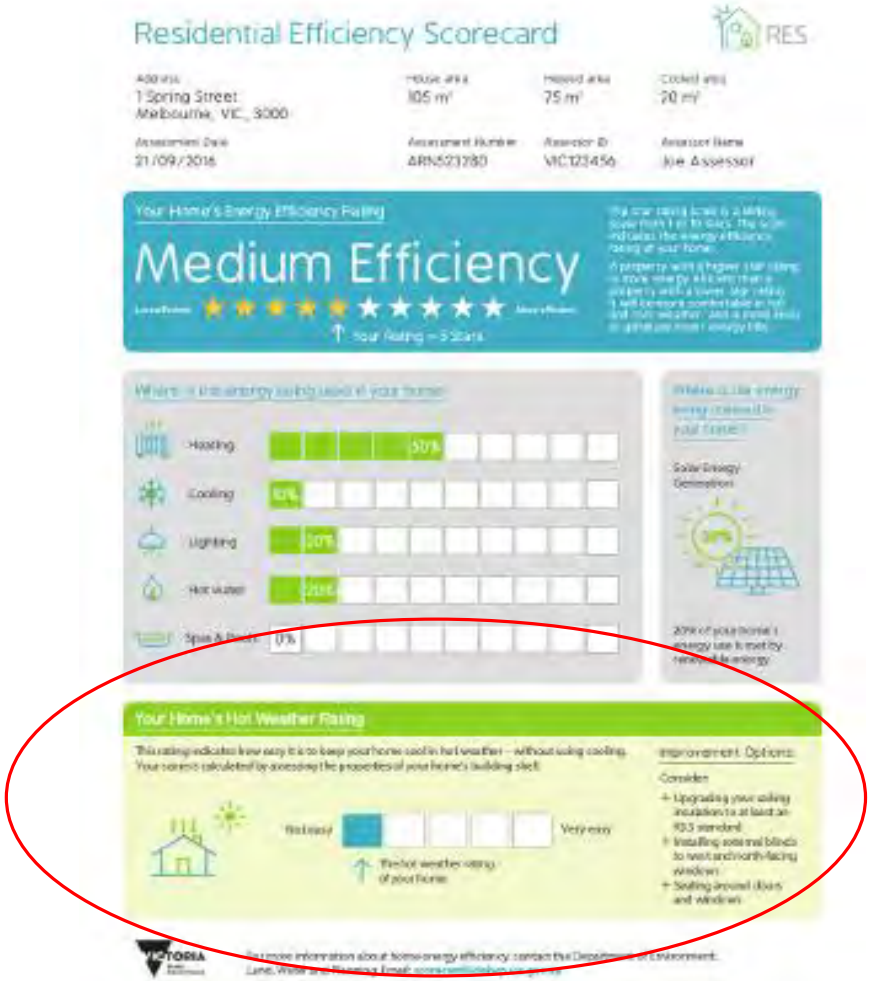
Most retailers and network operators offer tools to analyse usage. Many solar systems provide useful data. Energy advisers can interpret this if you or a friend can’t

For a time (eg a week) keep a diary of activities and match against usage

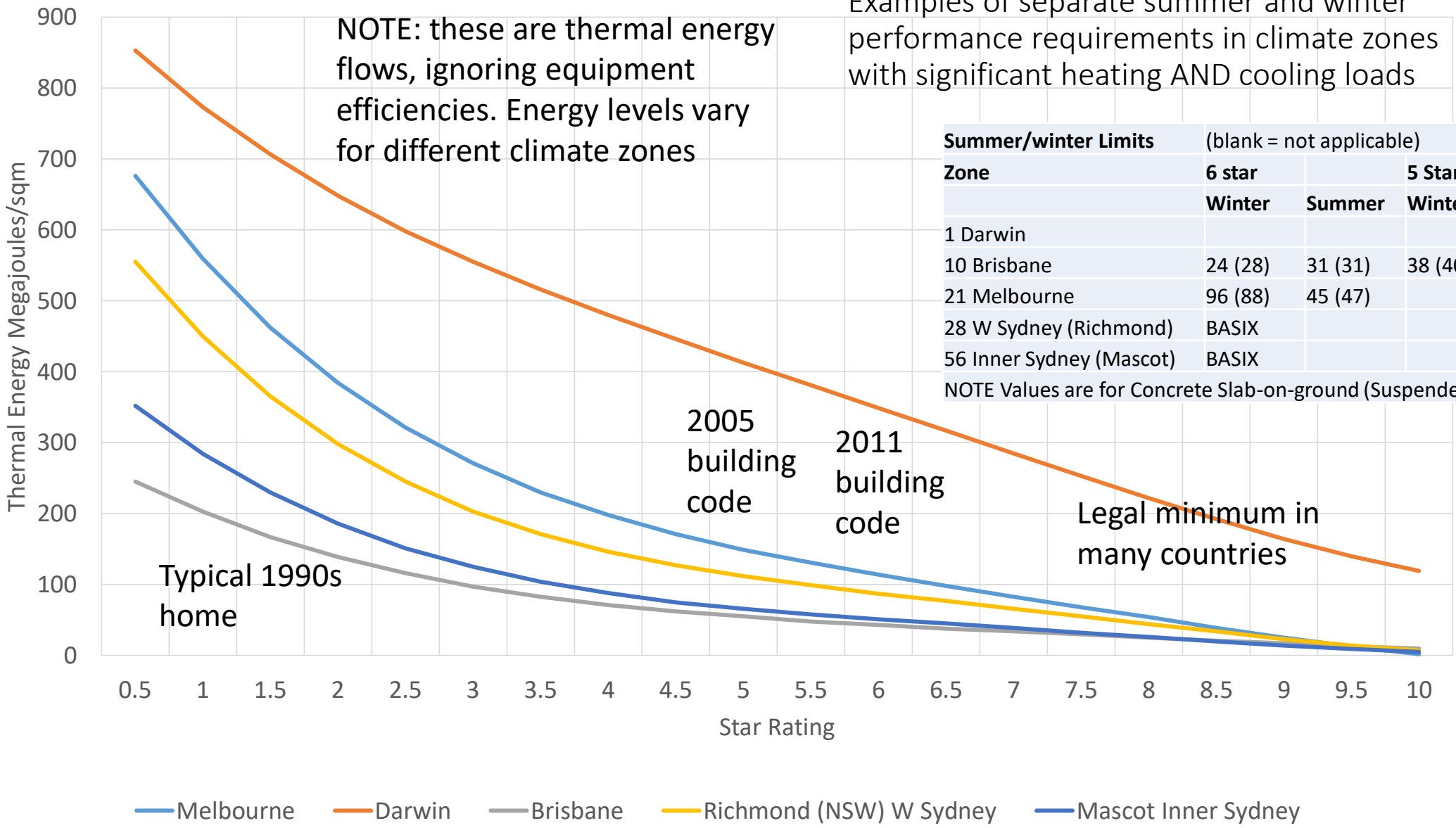
Increasing use of data analytics to provide personalised, activity-level insights, identify faults. Soon we will have adapters for gas and water meters to talk to the ‘cloud’ with real time data

Victorian Residential Efficiency Scorecard – focus on existing homes.
Voluntary but expected to be phased towards mandatory
https://www.victorianenergysaver.vic.gov.au/scorecard





Examples of NatHERS residential building star rating annual thermal energy (megajoules/square metre) from http://www.nathers.gov.au/files/publications/NatHERS%20Star%20bands.pdf

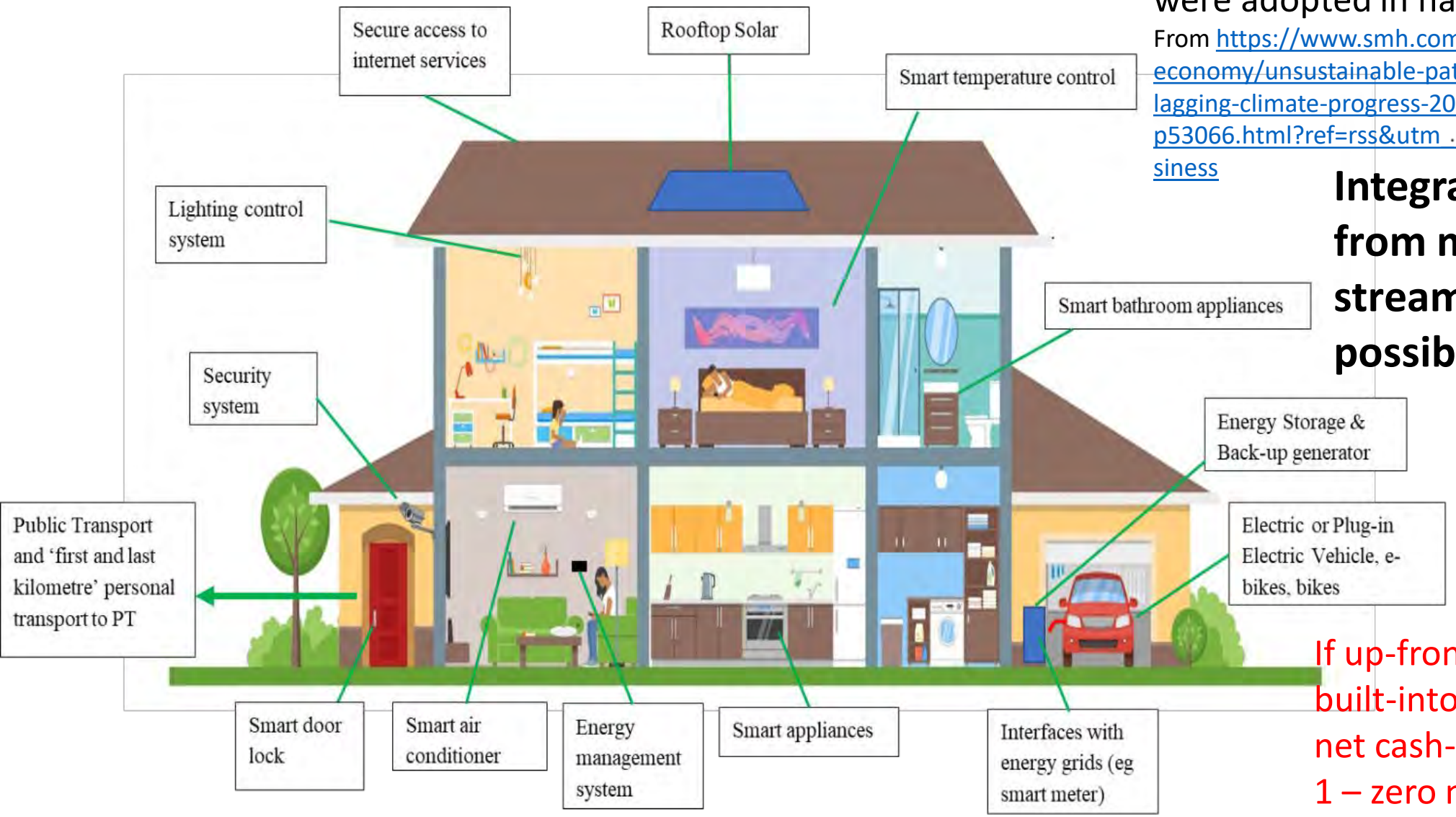


Examples of separate summer and winter performance requirements in climate zones with significant heating AND cooling loads

Summer/winter Limits	(blank = not applicable)			
Zone	**6 star**		**5 Star**	
	Winter	**Summer**	**Winter**	**Summer**
1 Darwin				
10 Brisbane	24 (28)	31 (31)	38 (40)	42 (37)
21 Melbourne	96 (88)	45 (47)		
28 W Sydney (Richmond)	BASIX			
56 Inner Sydney (Mascot)	BASIX			
NOTE Values are for Concrete Slab-on-ground (Suspended Floor)				

Future home? Smart, connected, efficient and renewable

(from Pears and Moore chapter in *Decarbonising the Built Environment* Newton P et al, 2019, Palgrave Macmillan)



Mr Tricoire [CEO of Schneider Electric] said digitally-enabled energy-measures could assist in driving a 50 per cent reduction of carbon dioxide emissions by 2040 if they were adopted in half of existing buildings.

From https://www.smh.com.au/business/the-economy/unsustainable-path-energy-leaders-warn-on-lagging-climate-progress-20191013-p53066.html?ref=rss&utm_medium=rss&utm_source=rss_business

Integrating information from multiple data streams opens up many possibilities!

If up-front incremental cost built-into mortgage, potentially net cash-flow positive from day 1 – zero net energy/fuel cost

THE END - DISCUSSION