Demand Response Capabilities for Selected Appliances

Public Consultation Sessions, August 2019

Craig Walker

On behalf of the E3 Committee

A joint initiative of Australian, State and Territory and New Zealand Governments.

Agenda

Speaker	Agenda Item/Topic	Timeframe
Craig Walker	Welcome and Background	13:30-13:40
Steven Humphries AEMO	Integrating Demand Response into the System	13:40-14:10
Dr George Wilkenfeld GWA	Consultation Paper Discussion – Demand Response Capabilities for Selected Appliances	14:10 – 15:00
James Simmonds	Q&A	15:00 – 15:50
Craig Walker	Wrap Up & Next Steps	15:50 – 16:00

Background / History

- A Consultation Regulation Impact Statement (RIS) on a similar proposal was published in 2013.
- 37 submissions were received from corporations, associations and government agencies.
- The proposal, at the time, received a generally positive response during public consultations.
- Feedback from this session was incorporated in a draft Decision RIS, which was developed in 2014.
- However, this draft Decision RIS was never finalised, nor submitted to the COAG Energy Council for decision.

2018 COAG Energy Council Decision

- In December 2018, the COAG Energy Council agreed that the 2013/14 work should be revisited, updated and reconsidered for regulation through the Greenhouse and Energy Minimum Standards (GEMS) process.
- South Australia proposed this work to the COAG Energy Council in December 2018.
- South Australia is Project Lead for this work on behalf of the Energy Equipment Efficiency (E3) Program.
- Particular interest in Demand Response (DR), and the opportunities that DR can provide for reducing customers' energy costs (amongst other things).

Work So Far in 2019

- Established an E3 Reference Group to input and steer this project whilst developing the Consultation Paper. Was agreed by the E3 New Zealand Representatives that New Zealand should be included within the scope of this work too.
- Entered into a contract with George Wilkenfeld & Associates, following a competitive tendering process.
- Agreed and recorded the scope, options and deliverables for this work – in conjunction with the E3 Reference Group.
- Updated the modelling and analysis of the 2013/14 work.
- Assessment and approval from the Office of Best Practice Regulation (OBPR) and the wider E3 Committee for the Consultation Paper to be published.

Other Relevant E3/GEMS Work Programs

- Any recommended demand response requirements will need to be integrated with other E3/GEMS work streams, eg
  - Determinations for Pool Pumps (different from controllers)
  - Determinations for Air Conditioners
  - Policy Roadmap for Water Heaters - led by New Zealand.

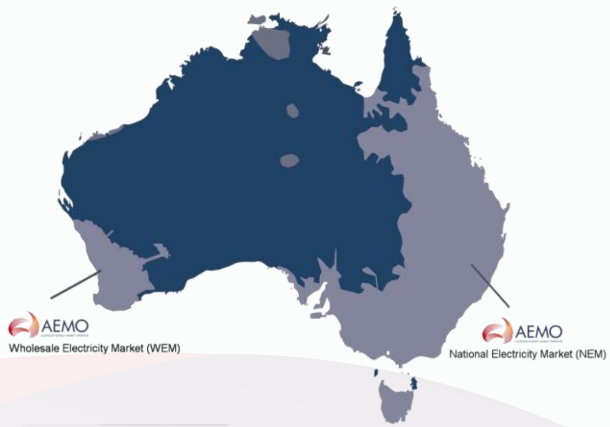
Smart Appliances RIS

Integrating Demand Response into the System

Steven Humphries
Demand Response Specialist, Emerging Markets and Services
AEMO

About AEMO

Emerging Markets and Services division explores new ways to embed new capabilities and technologies into Australia's energy system – especially Distributed Energy Resources (DER) - to affordable, secure and reliable energy supply.



DER – Distributed energy resources; can refer to distribution level resources which produce electricity or actively manage consumer generation; e.g. **PV solar systems, electric vehicles, batteries**, and **demand response such as hot water systems, pool pumps, smart appliances and air conditioning control**.

We operate Australia's National Electricity Market and power grid in Australia's eastern and south-eastern seaboard, and the Wholesale Electricity Market and power grid in south-west WA.

Both markets supply more than 220 terawatt hours of electricity each year.

We also operate retail and wholesale gas markets across south-eastern Australia and Victoria's gas pipeline grid.

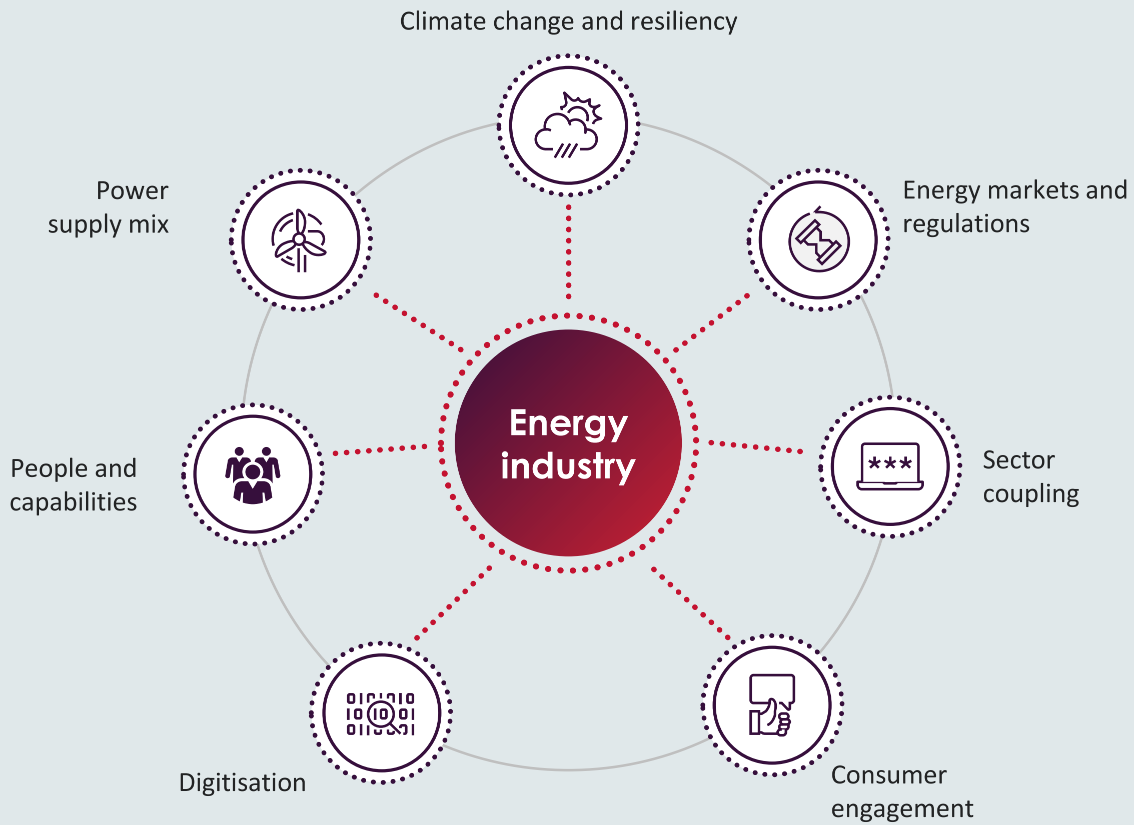
Collectively traded more than A$20 billion in the last financial year.

Ownership

40% Market participants

60% Governments of Australia

Our changing energy environment



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A decade of system operation, a decade of transformation in the NEM

	2009	2019
NEM Capacity	47.4 GW	55.5 GW
Number of generators	181 power stations (386 generating units)	300 power stations (493 generating units)
Registered participants	268	380
NEM Max Demand	35.5 GW	32.4 GW
Grid supplied electricity	208 TWh	196 TWh
VRE capacity	1.7 GW	5.5 GW
Solar PV systems	22,187	2,000,000
NEM customers	8.8 million	10.1 million

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AEMO's ISP – projecting significant change

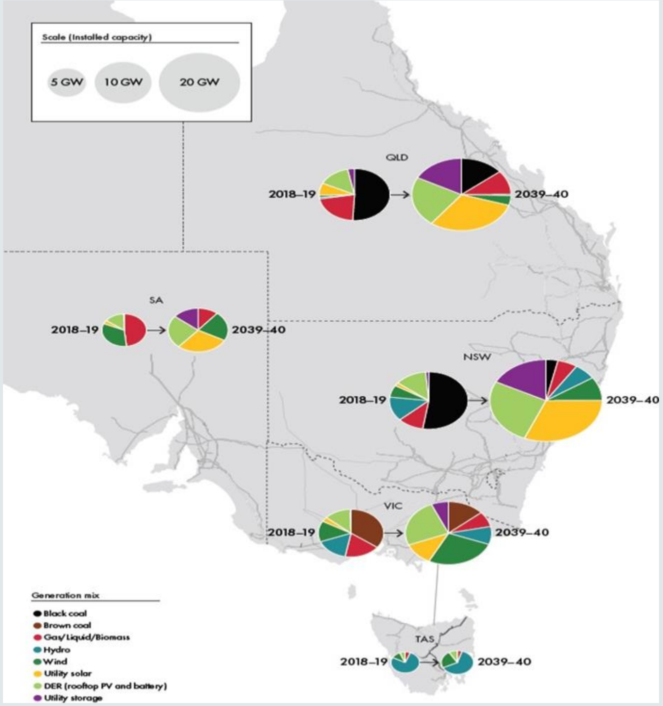
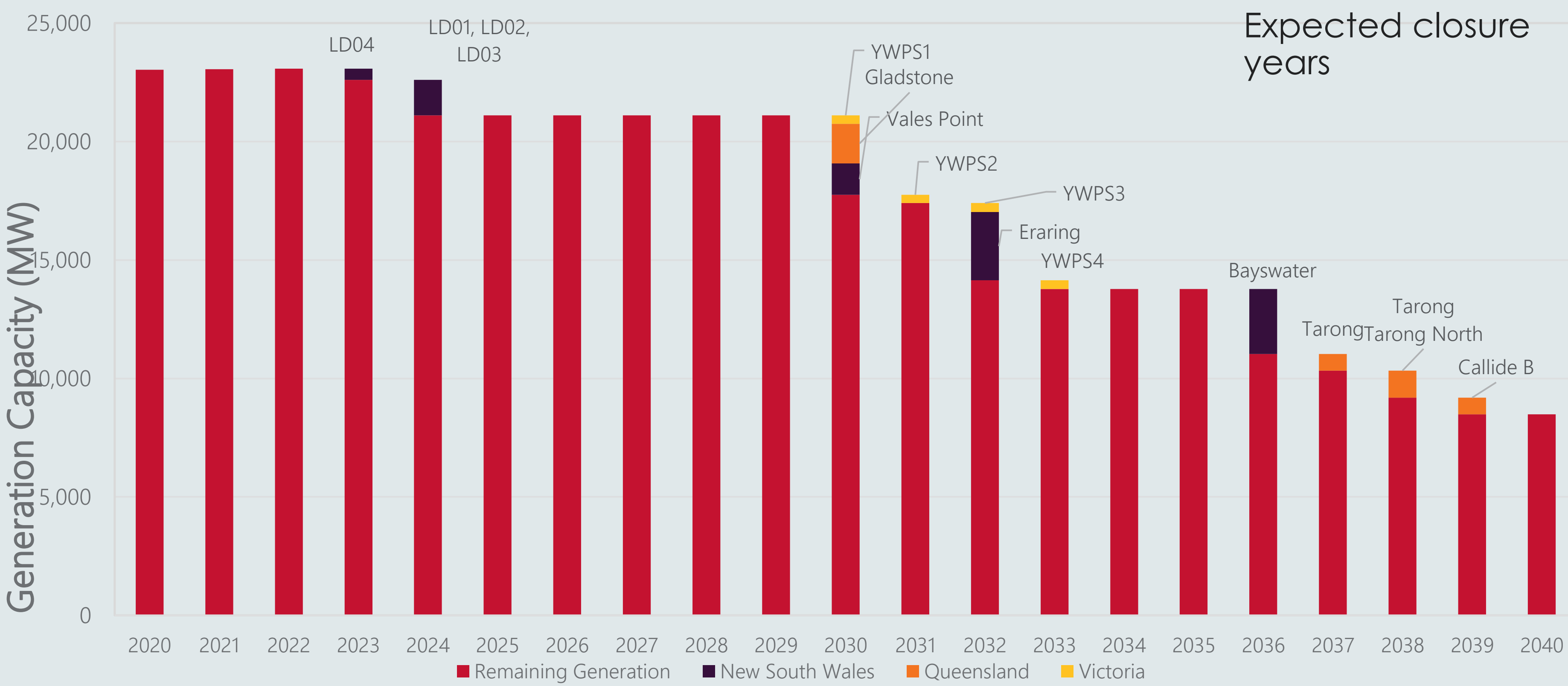


Figure 1 – AEMO ISP Projected change in generation resource mix (installed capacity) by NEM region over the 20-year plan horizon

Source: AEMO, ISP, 2018

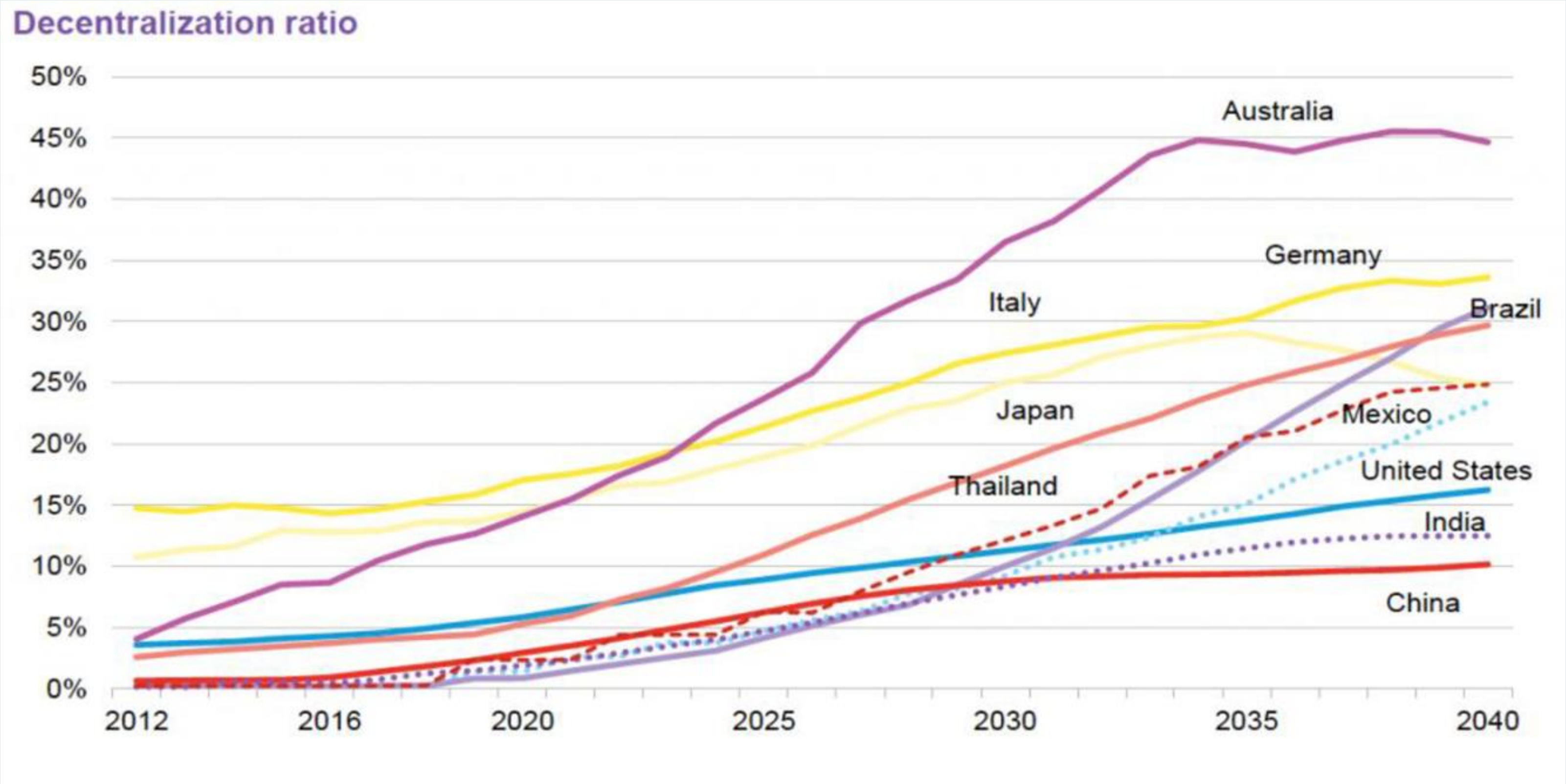
- By 2040 the NEM generation mix is to include:
  - Approximately 60GW of utility-scale variable renewable generation (solar and wind generation) and storage capacity
  - 27GW of distributed storage and rooftop PV capacity.
- Figure 1 highlights the generation resource mix by NEM region FY2018/19 and FY2039/40 under the neutral scenario.
- Note the significant role forecast for DER resources.

Existing generators have to be replaced



Source: AEMO 2018 ISP

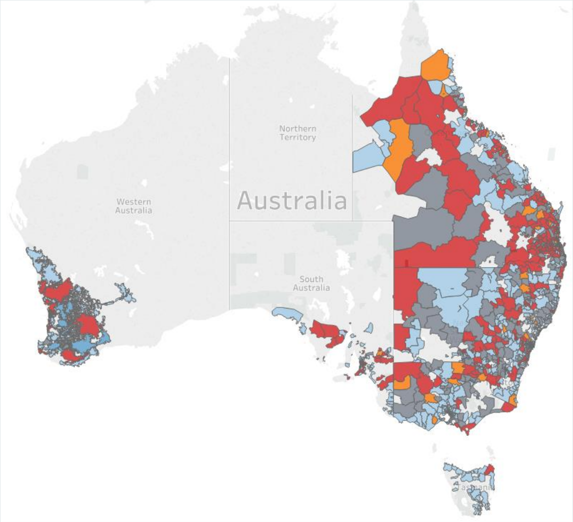
Decentralisation -Australia is leading the way



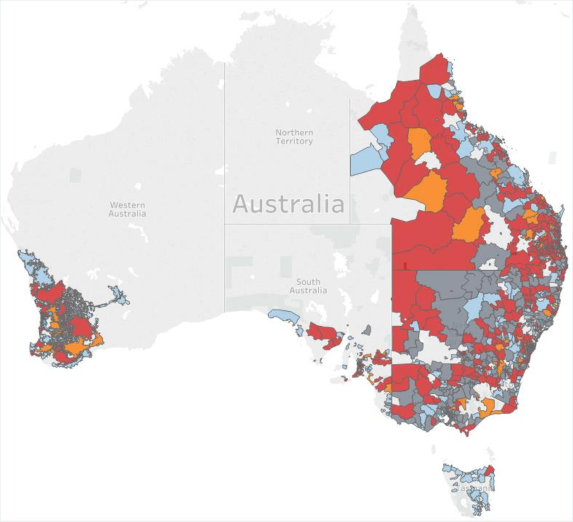
Source: Bloomberg New Energy Finance

Power Swings for the Networks

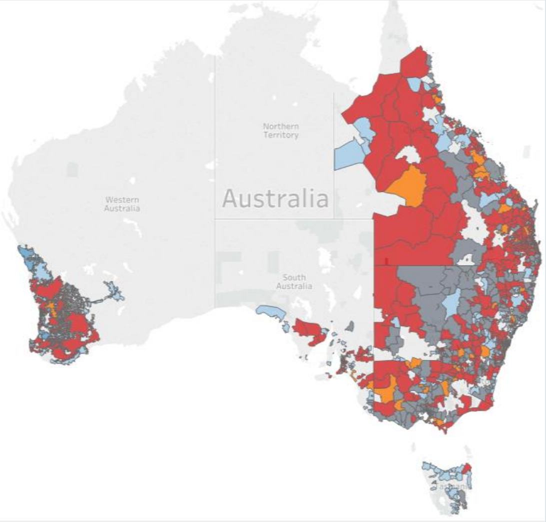
Reverse flows in across Australia's distribution networks



Slow DER scenario



Moderate DER scenario



Fast DER scenario

<=2025
<=2030
<=2040
<=2050
>2050

Source: Open Energy Networks – ENA/AEMO : Interim Report 2019

Power Swings for the System

Difference:

NSW (2020)
7886 MW

NSW (2036)
9772 MW

SA (2036)
2677 MW

Forecast summer maximum operational demand (sent out) by region, Central scenario (MW)

	New South Wales		Queensland		South Australia		Tasmania		Victoria	
	10% POE	50% POE	10% POE	50% POE	10% POE	50% POE	10% POE	50% POE	10% POE	50% POE
2019-20	14,293	13,291	9,643	9,355	3,193	2,950	1,431	1,370	9,967	8,837
2023-24	14,231	13,146	9,796	9,572	3,224	2,992	1,436	1,376	9,600	8,574
2028-29	14,368	13,169	9,987	9,799	3,224	2,994	1,416	1,355	9,589	8,504
2038-39	15,478	14,078	10,498	10,335	3,361	3,102	1,414	1,356	9,893	8,889

Forecast minimum operational demand (shoulder) by region, Central scenario (MW)

	New South Wales		Queensland		South Australia		Tasmania		Victoria	
	50% POE	90% POE	50% POE	90% POE	50% POE	90% POE	50% POE	90% POE	50% POE	90% POE
2020	5,405	5,213	4,150	3,913	568	511	885	834	3,047	2,803
2024	4,762	4,511	3,512	3,310	452	393	892	840	2,423	2,201
2029	4,609	4,347	3,240	3,021	472	414	874	823	2,276	2,044
2039	4,306	3,998	2,378	2,124	425	361	869	814	1,556	1,314

Central scenario forecast now projects 14,500 GWh of consumption from electric vehicles by 2036-37

Source: AEMO | 2019 Electricity Statement of Opportunities

Can DR assist the System ?

Understanding the impact of DER integration (of which DR is one) on power system reliability and security needs to occur recognising current levels of performance across these electricity service dimensions. Annually, the Reliability Panel of the AEMC prepares an Annual Market Performance Review, and we have used this methodology to highlight key trends on power system security, reliability and safety across key metrics, and then identified the linkage to DER operating and technical issues. The relevant measures from 2018 relating to security of supply are highlighted below https://www.aemc.gov.au/market-reviews-advice/annual-market-performance-review-2018

Security framework

AEMO and network operators manage power system as per technical standards

Power system defined to be in a secure operating state when it is in a satisfactory operating state (all equipment operating within safe loading levels and operational limits as per the NER) and will revert to satisfactory operating state following a single credible contingency event or protected event.

The AEMC's Reliability Panel identified the following measures:

Meeting frequency requirements Yes

Time spent outside of normal operating frequency band.

Under frequency load shedding Yes

UFLS schemes were activated.

Power system not operating in a secure operating state Yes

Power system operating not in a secure state.

Voltage limits Yes

Power system operating outside of secure voltage limits.

Network Constraints Yes

Power system operating limits set by network constraints.

System restart ancillary services Yes

Use of SRAS after black system event.

Number of Power System Directions Yes

AEMO directions to support power system security.

DER will play an important role in the NEM by 2030

Rooftop PV generation capacity

9.6 GW to **22.4 GW**

Embedded battery storage capacity

0.8 GW to **15.9 GW**

Electric vehicle electricity consumption

14.5 GWH to **7,710 GWH**

Virtual Power Plant aggregate load/storage capacity (Home Energy Management Systems)

53 MW to **9,100 MW**

Source: AEMO 2018 ISP

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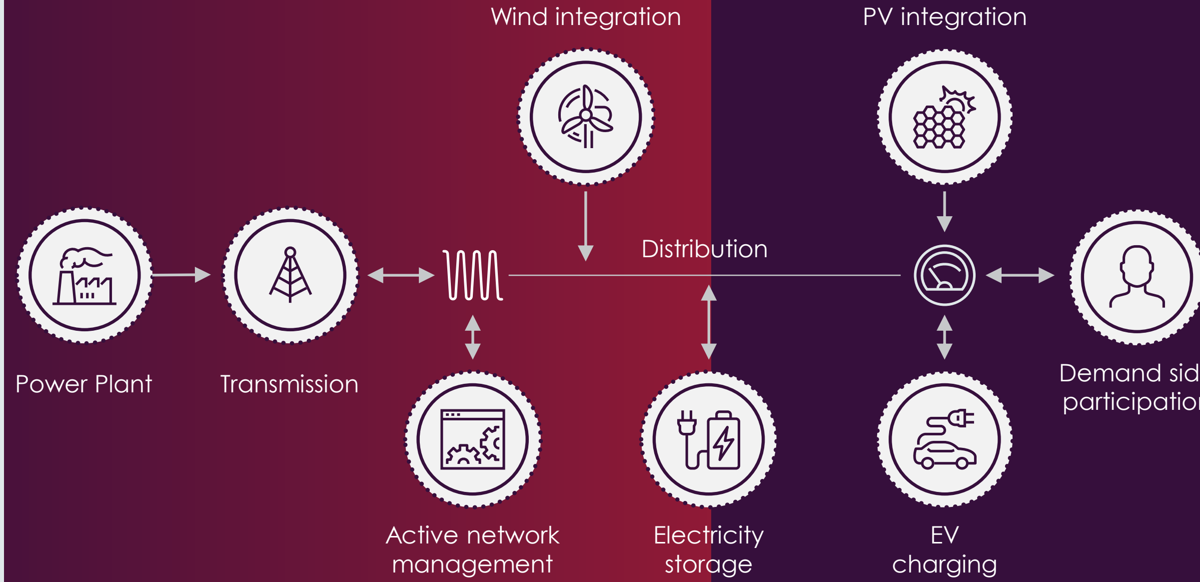
A two-way electricity system

- **AEMO's DER vision**
- Build a two-way electricity system
- Establish a 'marketplace' to trade 'standardised' services from consumers
- Enable open access

What we can see and operate in real time to optimise the market

What we can't see and will see as the system and market evolves

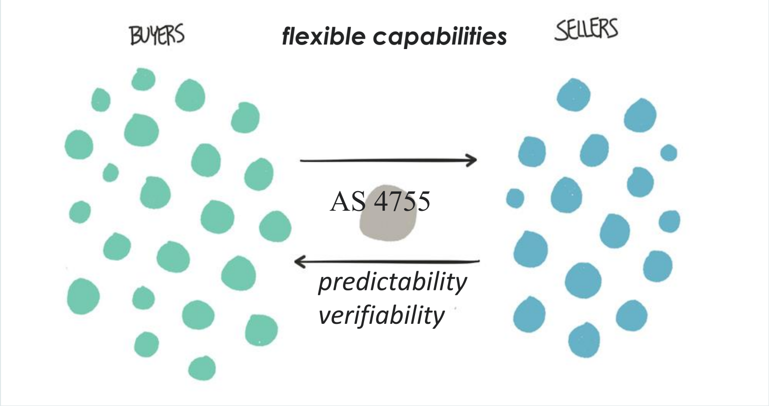


A two-sided market place for Services

It all starts with having standardised flexible capabilities -AS4755

Value to be provided to customers who invest in increasingly smart devices for air-conditioner, hot water, pools, electric vehicle charging or batteries

- Reduced peak demand and reduced wholesale energy cost of meeting peak demand
- Greater system resilience responding to challenges of weather dependent renewable energy
- Greater local network resilience especially as DER saturation increases
- Ability to provide Network or Flexibility services to offset network augmentation investment
- Load increases to manage minimum demand or peak solar generation



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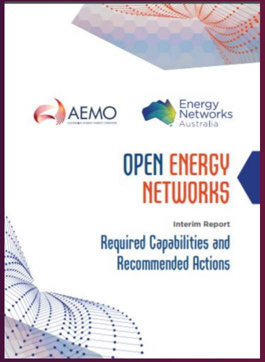
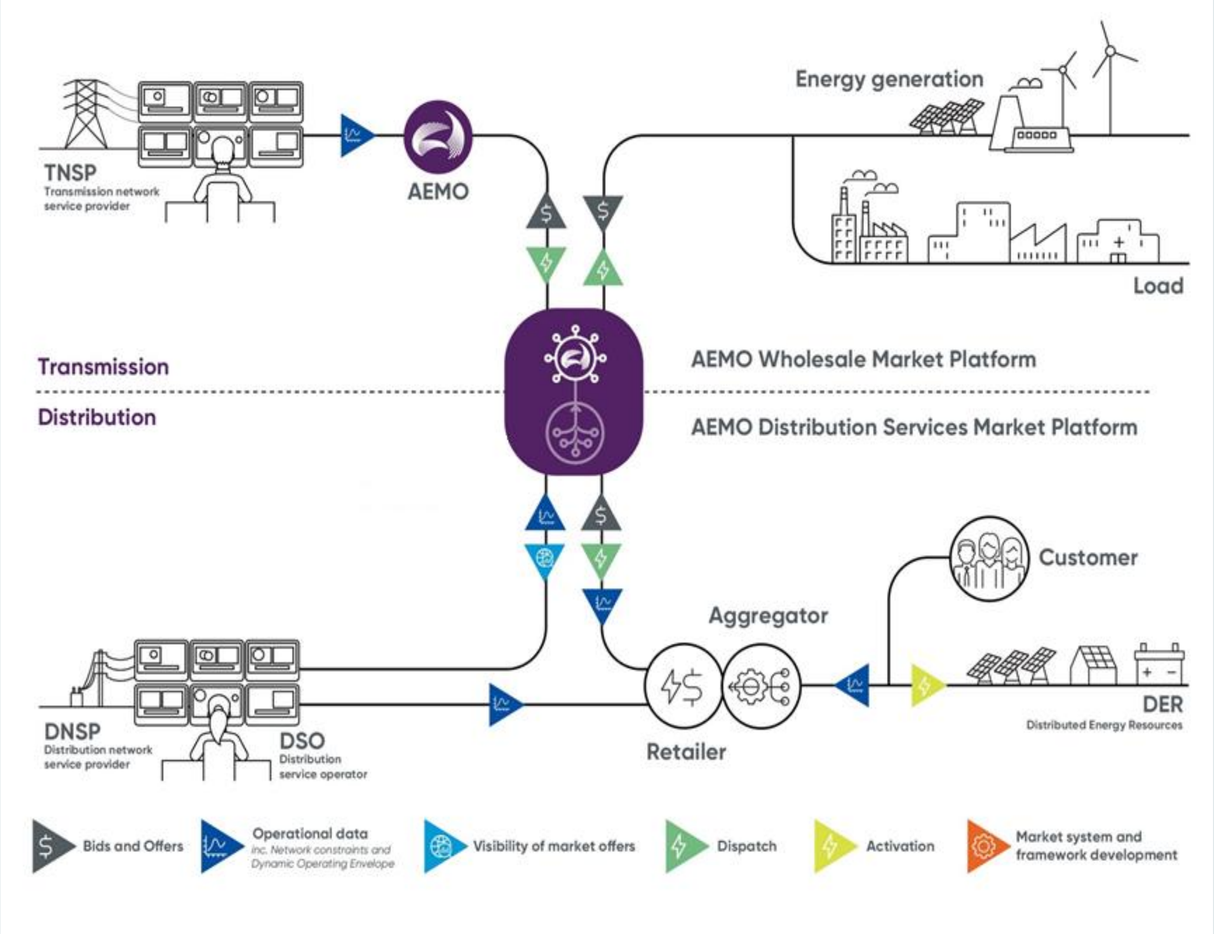
Open Energy Networks

Partnership with ENA to unlock flexibility markets





https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/DER-program/Open-Energy-Networks-joint-consultation-with-Energy-Networks-Australia

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More information

www.aemo.com.au

DER Program information
www.aemo.com.au/Electricity/National-Electricity-Market-NEM/DER-program

Email questions to: derprogram@aemo.com.au

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E3 Equipment Energy Efficiency

Demand Response Capabilities for Selected Appliances

Consultation Paper, August 2019

Dr George Wilkenfeld

On behalf of the E3 Committee

A joint initiative of Australian, State and Territory and New Zealand Governments.

This Session

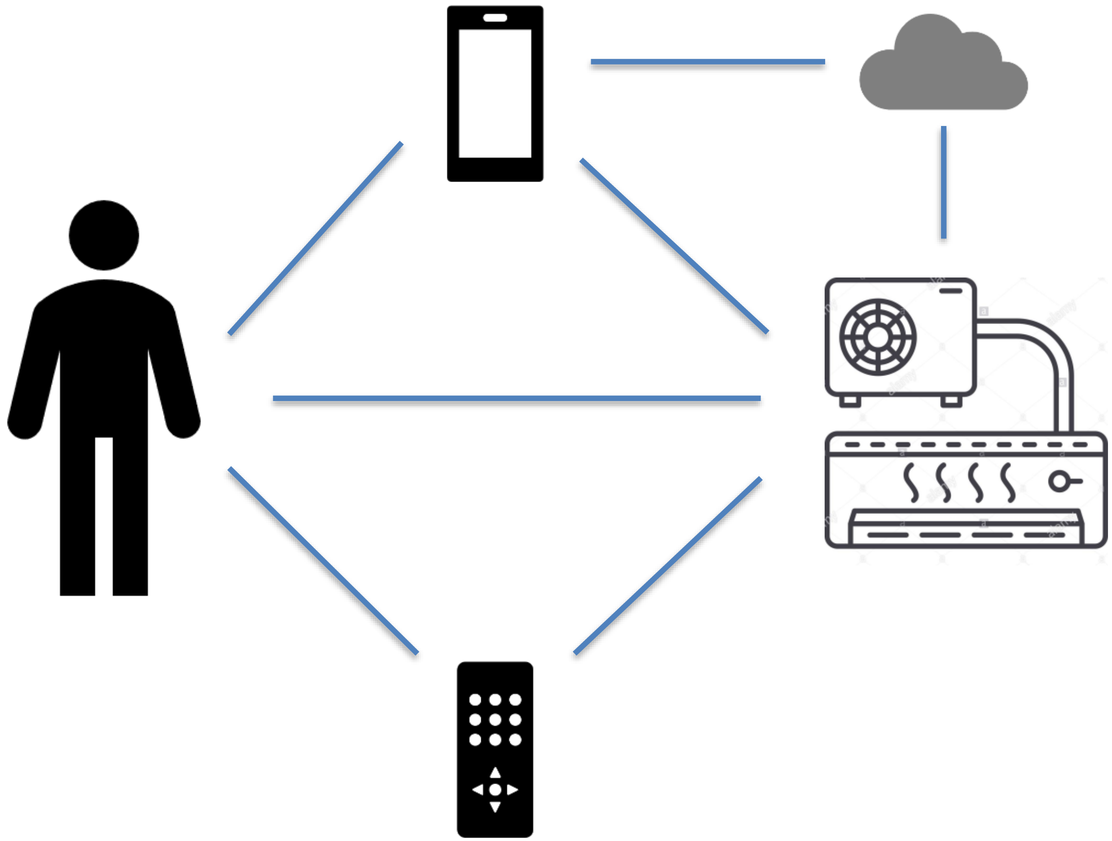
- Why this proposal now?
- Various types of DR and how they coexist
- The proposal: compliance with AS/NZS 4755
- Projected costs and benefits
- Relationship to international standards
- Consumer benefits and safeguards
- Implementation and timing

Why now?

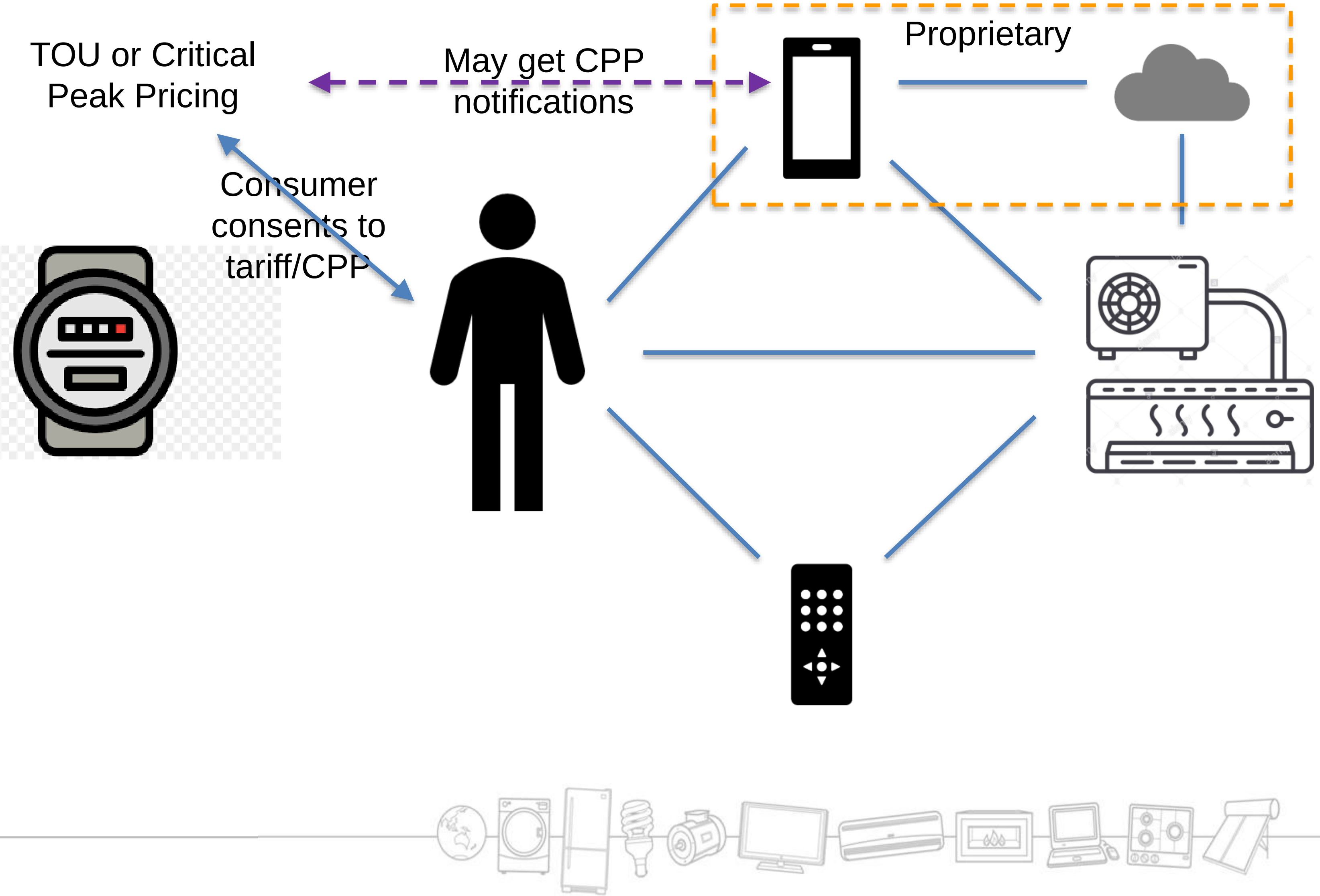
- COAG Energy Ministers requested review
- Local network constraints still a problem
- Wholesale generation costs still a problem
- With PV & wind, minimum demand a growing problem (see AEMO)
- DR identified as necessary but undeveloped
  - AEMO, ENA, CSIRO, AEMC, ACCC, Finkel
- AEMC rule changes moving toward small consumer engagement

Default air conditioner use

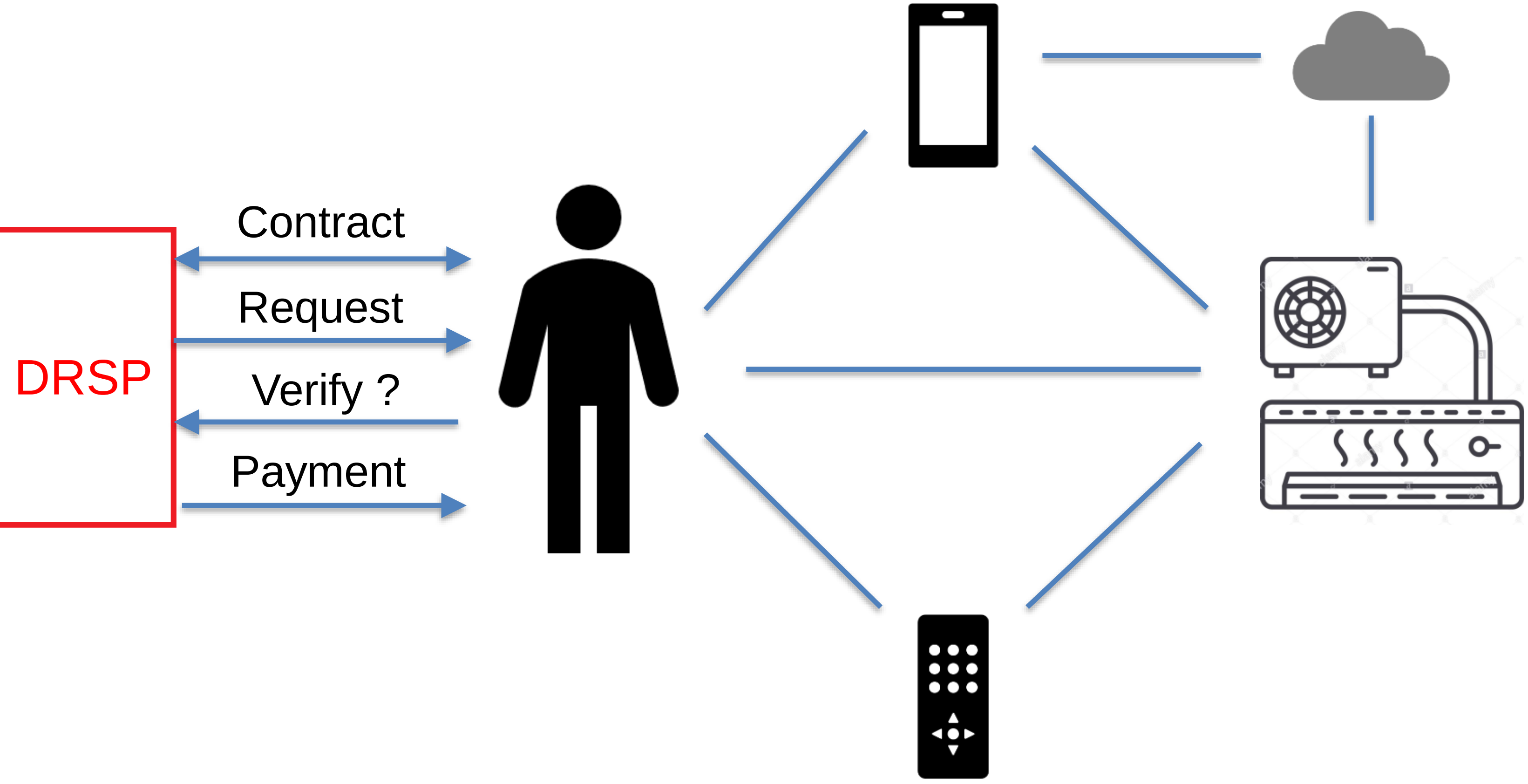
Unaware of price and/or on flat tariff



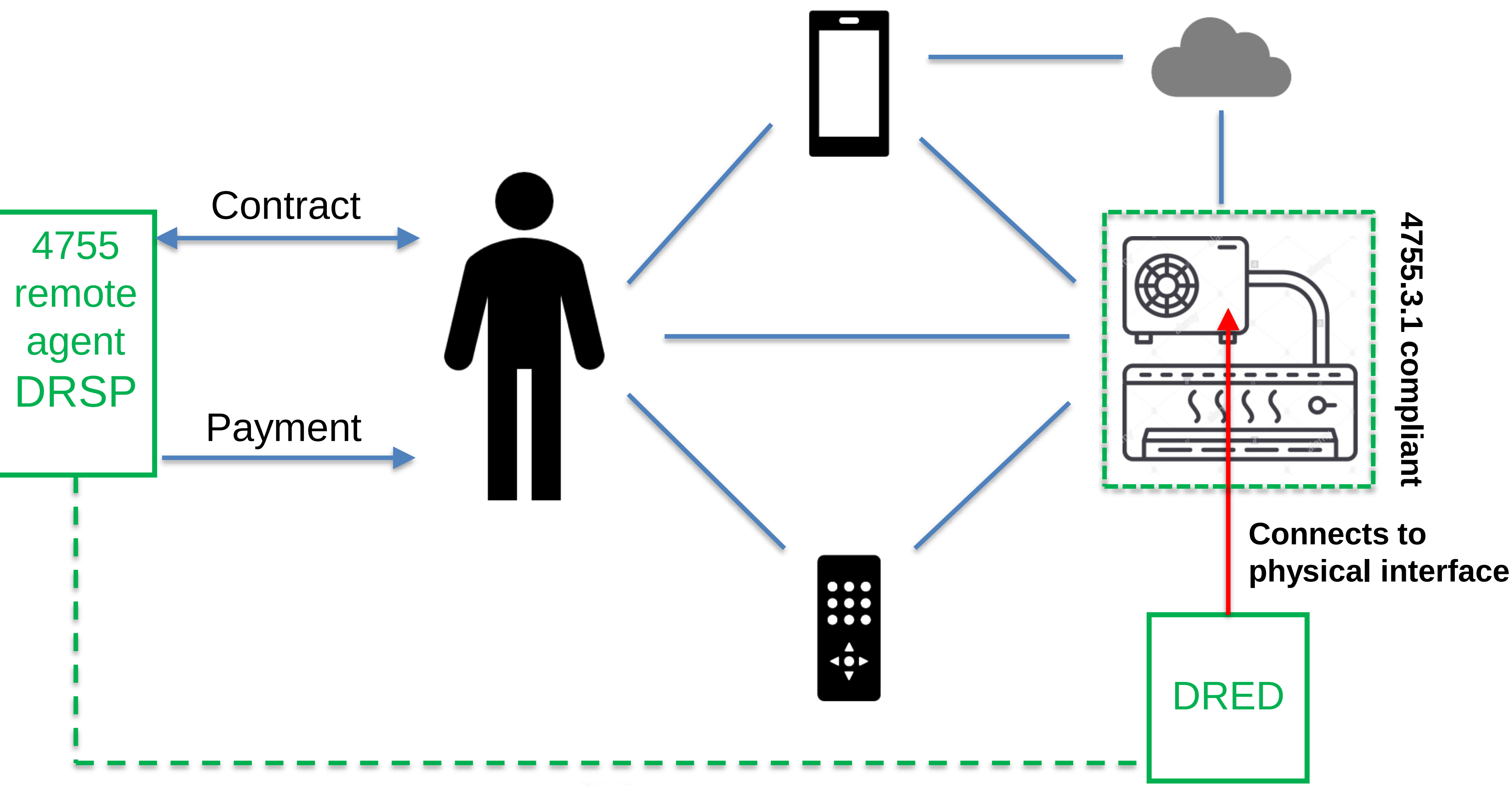
Price-driven demand response



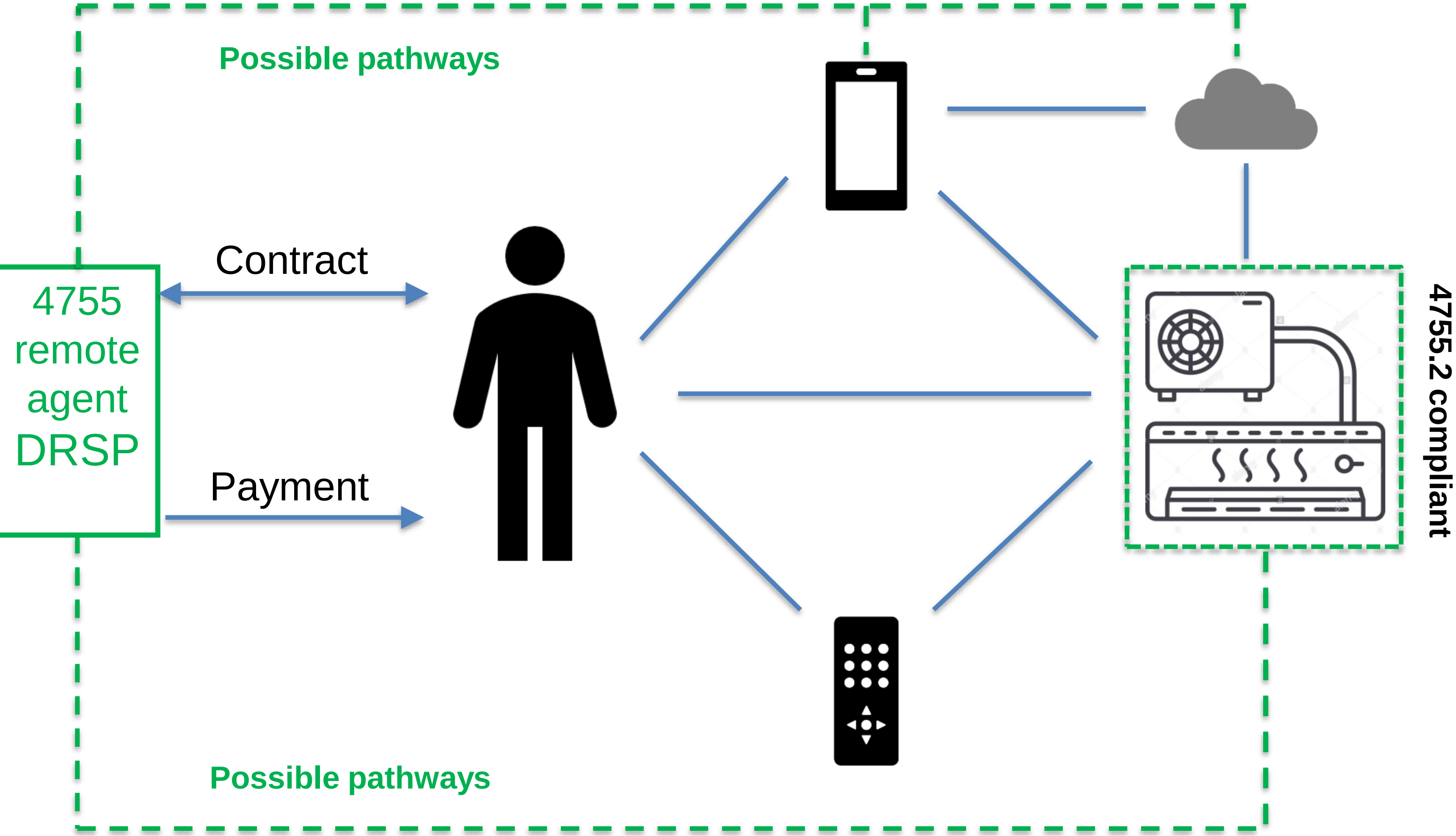
Behavioural demand response



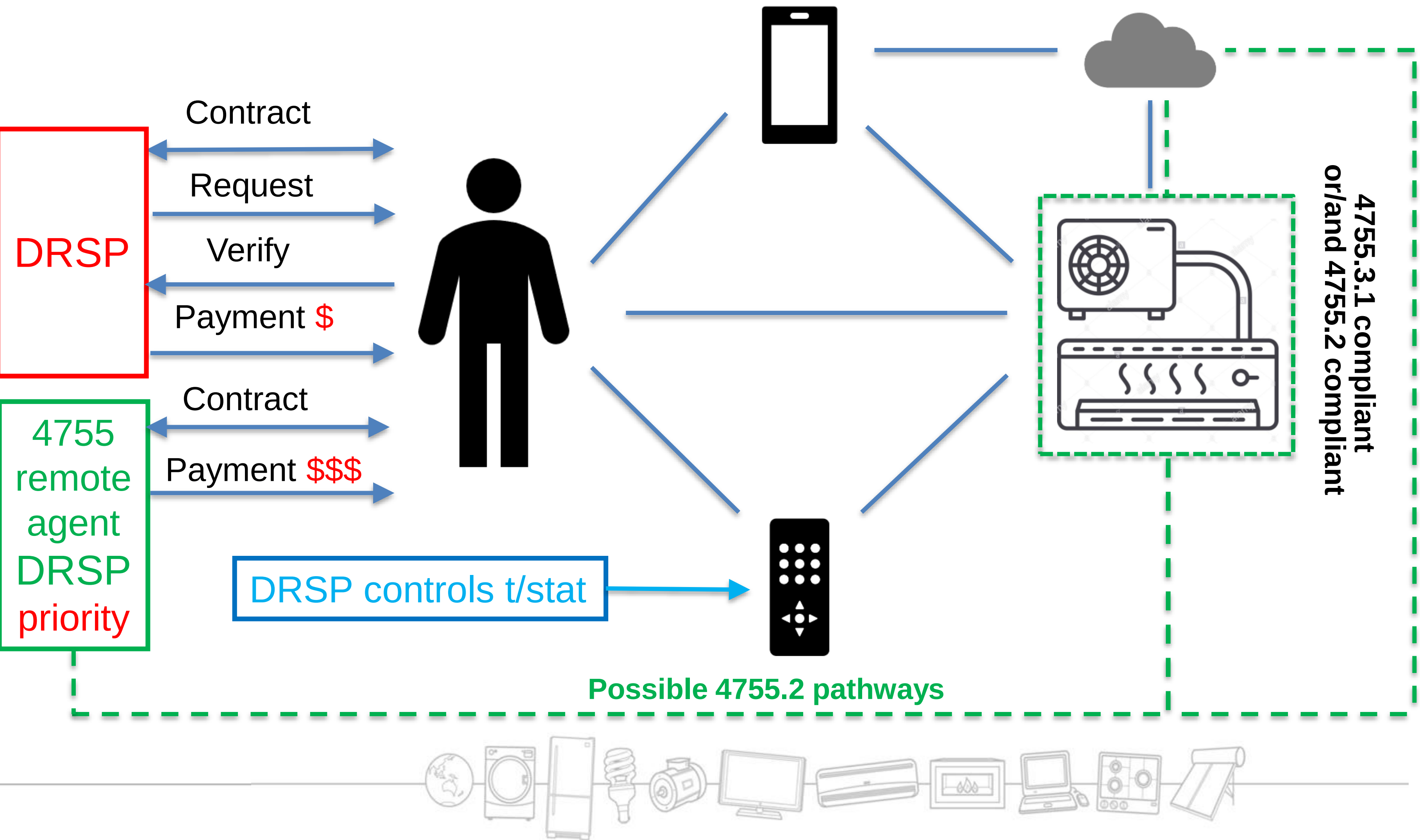
Demand response with AS/NZS 4755.1



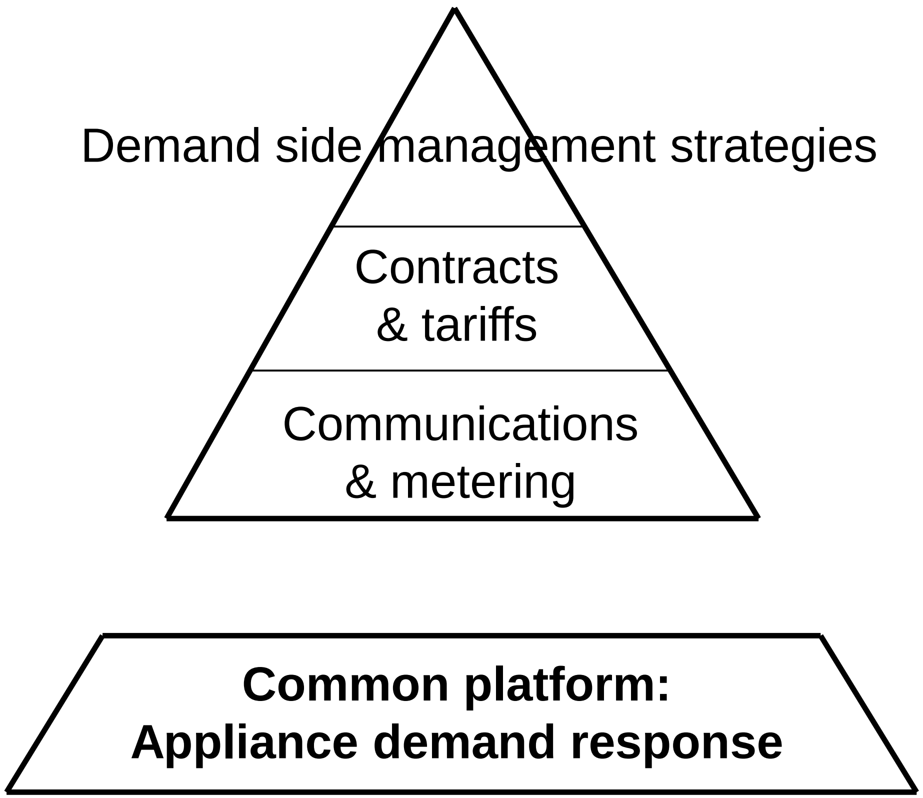
Demand response with AS/NZS 4755.2



Multiple DR pathways can coexist



Appliance DR is bedrock of residential sector demand side load management



Air Cond load management trials, 2005-12

State	Entity (type)	Location	Period	Participants
SA	ETSA Utilities (D)	Adelaide	2005-09	2,000
Qld	Ergon (D)	Townsville, Magnetic Is	2008-09	NA
Qld	Energex (D)	Brisbane	2008-10	3,500
WA	Western Power (D)	Nedlands, Perth	2008-11	Up to 2,200
NSW	Endeavour Energy (D)	Blacktown, Sydney	2008-12	2,500
SA	ETSA Utilities (D)	Adelaide	2010-12	1,000
WA	Western Power (D)	Perth	2011-12	380
Qld	Energex (D)	Brisbane	2011-12	200
ACT	ActewAGL (D)	Canberra	2011	NA

Trials involving AS/NZS 4755 products. Other trials involved breaking into the air conditioner controls.

ARENA-supported Res DR Trials, 2017-2020

States	Entity (type)	Notify/ behaviour	Direct load management	Comment
Vic, SA, NSW	EnergyAustralia (R)	✓	✓	AC, PP, Batt; Problems with load control device
Vic	United Energy (D)			Voltage reduction
Vic	Powershop (R)	✓	✓	Battery & PV
SA, Vic	Zen Ecosystems (A)	✓		
NSW	AGL (R)	✓	✓	AC, EV Too few AS/NZS 4755 compliant products among participants

Available AC DLC programs

State	Entity (type)	Program	Technology	Since	Participants
Qld	Energex (D) Ergon (D)	PeakSmart	AS/NZS 4755	2013	108,000 – pay on AC purchase
NSW	Endeavour (D)	CoolSaver	AS/NZS 4755	NA	NA – pay per summer + free AC service
Vic	Powercor (D)	Energy Partners	Sensibo (t/stat adjust)	NA	NA – pay per event

Conclusions – DLC programs

- DLC has proven effective in Australia
  - Up to 50% load reduction achievable & acceptable
- Over a decade experience with AS/NZS 4755
  - Most states, several utilities have trialled
  - Where programs did not proceed, other reasons
- No other comparable standard or technology has emerged (in Australia or elsewhere)
- Permits "behavioural" DR outside 4755 events
- Reduces risks to consumers of TOU/CPP

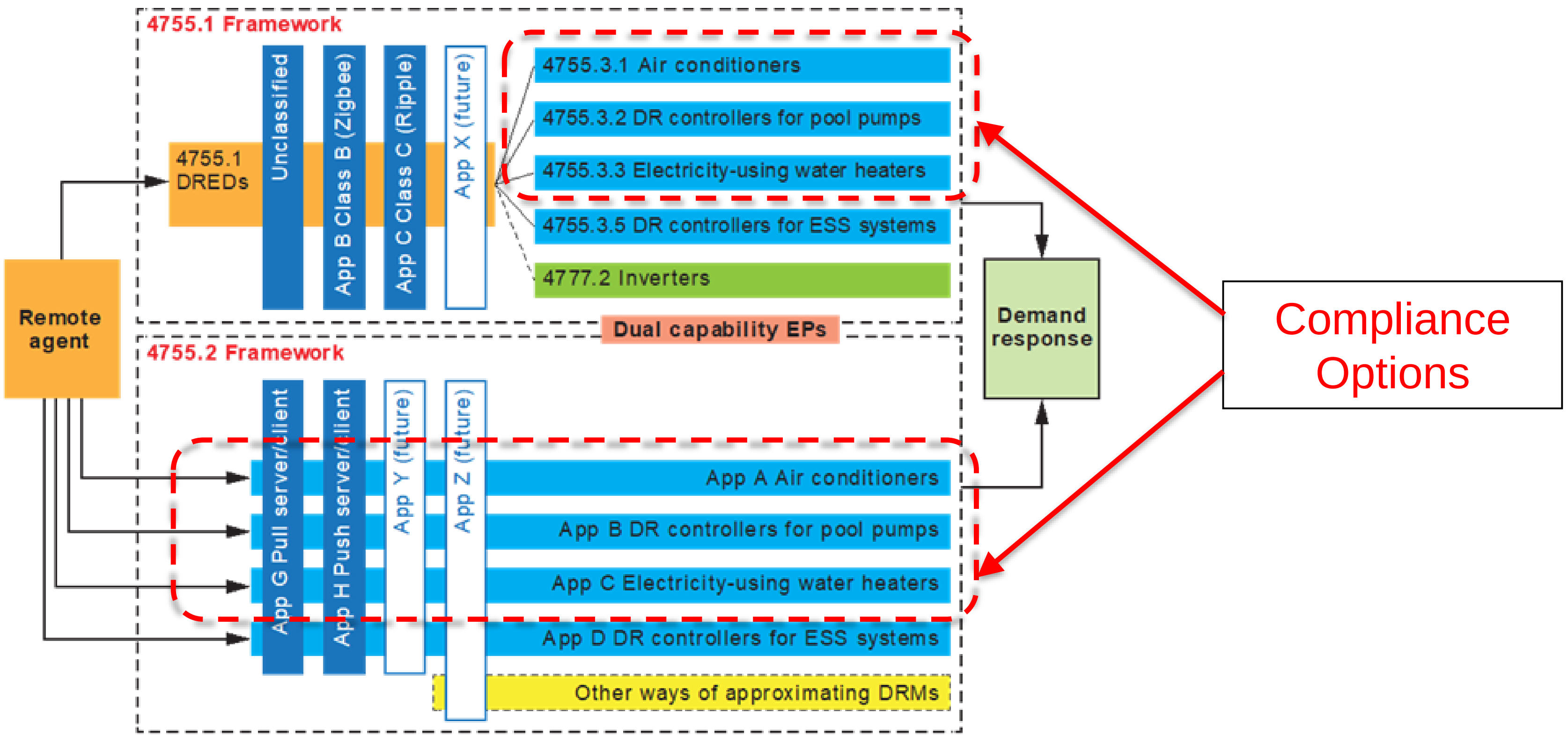
Options considered in Consultation Paper

1. Business as Usual
   – Voluntary compliance with AS/NZS 4755.3.1
     • About 33% of AC models, ?% of sales; no other products
   – Energy efficiency measures continue
2. Encourage voluntary adoption
   – Labelling DR capability and cash incentives
   – Labelling for DR has been tried and abandoned
   – Cash incentives work but COAG cannot dictate
     • If all products meet common standards, less $$ needed
3. Mandating compliance most effective option

The proposal

- Mandate compliance with relevant part of AS/NZS 4755 for 4 types of electrical products
  - Only affects *new* product sales, after target date
- Require all DRMs, not just DRM1
- Activation, contracts etc will be up to the market
- Intention is to create a common platform for DR
  - So consumers can change DRSPs without stranding their investment (and DRSPs can engage consumers at low cost)
- Value lies in greater economic efficiency of grid
  - How that value is shared is up to the market

Proposed AS/NZS 4755 compliance options

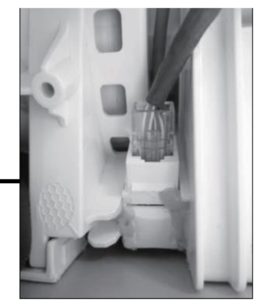


Origins of AS/NZS 4755

- Standards Committee EL-054 set up in 2005
  - Manufacturers, electricity utilities, govt, CSIRO, consumers
- AS4755:2007 *Framework for demand response capabilities and supporting technologies for electrical products* (superseded by AS/NZS 4755.1)
- Key to progress was separating comms from the appliance
  - AS/NZS 4755.3.1 (ACs) issued 2008, revised 2012, 2014
  - AS/NZS 4755.3.2 (PPCs) issued 2012, revised 2014
  - AS/NZS 4755.3.3 (WHs) issued 2014
  - AS/NZS 4755.3.5 (Electric energy storage) issued 2016
  - AS/NZS 4755.1 (DREDs) issued 2017
  - Draft of AS/NZS 4755.3.4 (EV chargers) not published
- AS 4755.2 at public comment stage – target early 2020

Air conditioners (Part 3.1/Part 2)

Part 3.1 Demand Response Enabling Device



Part 3.1 Connection point (RJ45 socket or screw terminal)

Note: Product shown as illustration of type only.
Does not indicate that this model complies with AS/NZS 4755

Pool pump controllers (Part 3.2/Part 2)

Note: Product shown as illustration of type only. Does not indicate that this model complies with AS/NZS 4755

Water heaters using electricity (Part 3.3/Part 2)

Note: Products shown as illustration of type only.
Does not indicate that these models comply with AS/NZS 4755

Electric vehicle charger/discharge controllers (DRAFT Part 3.4)

Note: Product shown as illustration of type only.
Does not indicate that this model complies with AS/NZS 4755

AS/NZS 4755 Demand Response Modes

Product	Standard Part (either option)	Minimum load/Off	Operation permitted at reduced load		Request Load on	No dis-charge to grid	Discharge to grid permitted at reduced rate		Request dis-charge to grid
			Limit to 50%	Limit to 75%			Limit to 50%	Limit to 75%	
Air Conditioner	3.1:2014 or Part 2	DRM 1	DRM 2	DRM 3	NA	NA	NA	NA	NA
Pool pump controller	3.2:2012 or Part 2	DRM 1	DRM 2	NA	DRM 4	NA	NA	NA	NA
Electric water heater	3.3:2014 or Part 2	DRM 1	DRM 2	DRM 3	DRM 4	NA	NA	NA	NA
EV Charge Controller	Draft 3.4 ??	DRM 1	DRM 2	DRM 3	DRM 4	DRM 5*	DRM 6	DRM 7	DRM 8

Mandatory

* DRM 0 also mandatory for models capable of discharge to grid

What the proposal is NOT

- It will *not* be mandatory for customers to participate
  - They can choose to, e.g. in order to avoid high-price periods or to gain cash incentives
- Proposal does *not* depend on smart metering
  - There are several alternative activation pathways
- Proposal does *not* depend on TOU Pricing
  - Trials so far have not used TOU; makes TOU less risky
- Proposal is *not* an energy efficiency measure
  - But will increase economic efficiency of electricity supply and lower bills, through less investment in poles & wires
  - Allows energy to be used/stored when renewables are high

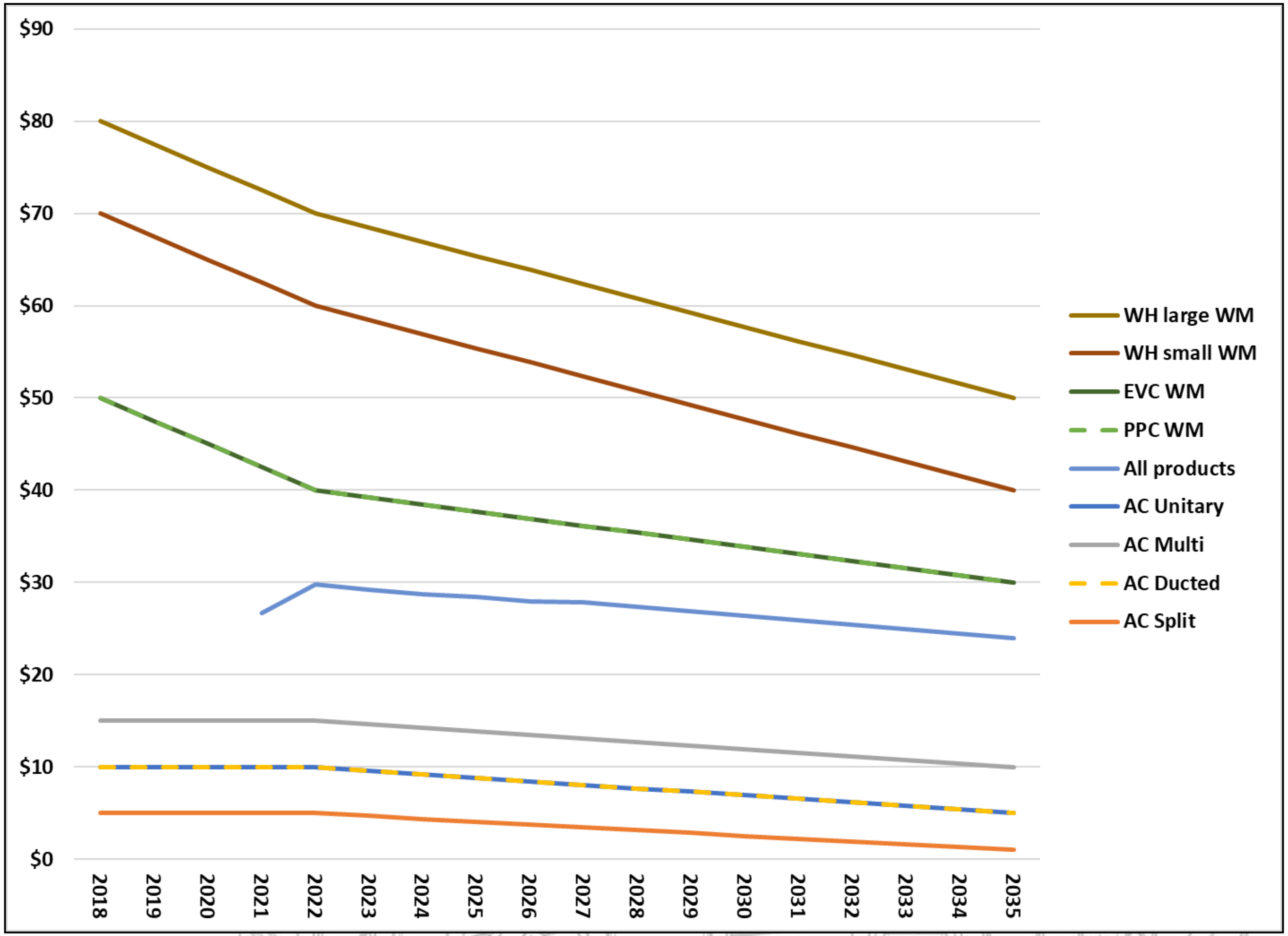
Estimated Costs

- Compliance adds about $30 per appliance sold
- Activation costs: Range $75 - $180
  - Incurred only once when appliance first activated
- Participation costs:$25/participant/year
- Constraint on energy services during DR events
  - e.g. room temperatures slightly higher
- Payments to consumers are transfers, not costs
  - But can be lower, so helps DRSPs business case
- DRSP monetizes its aggregated DR capability
  - Sells into wholesale DR, RERT, FCAS, to DNSPs

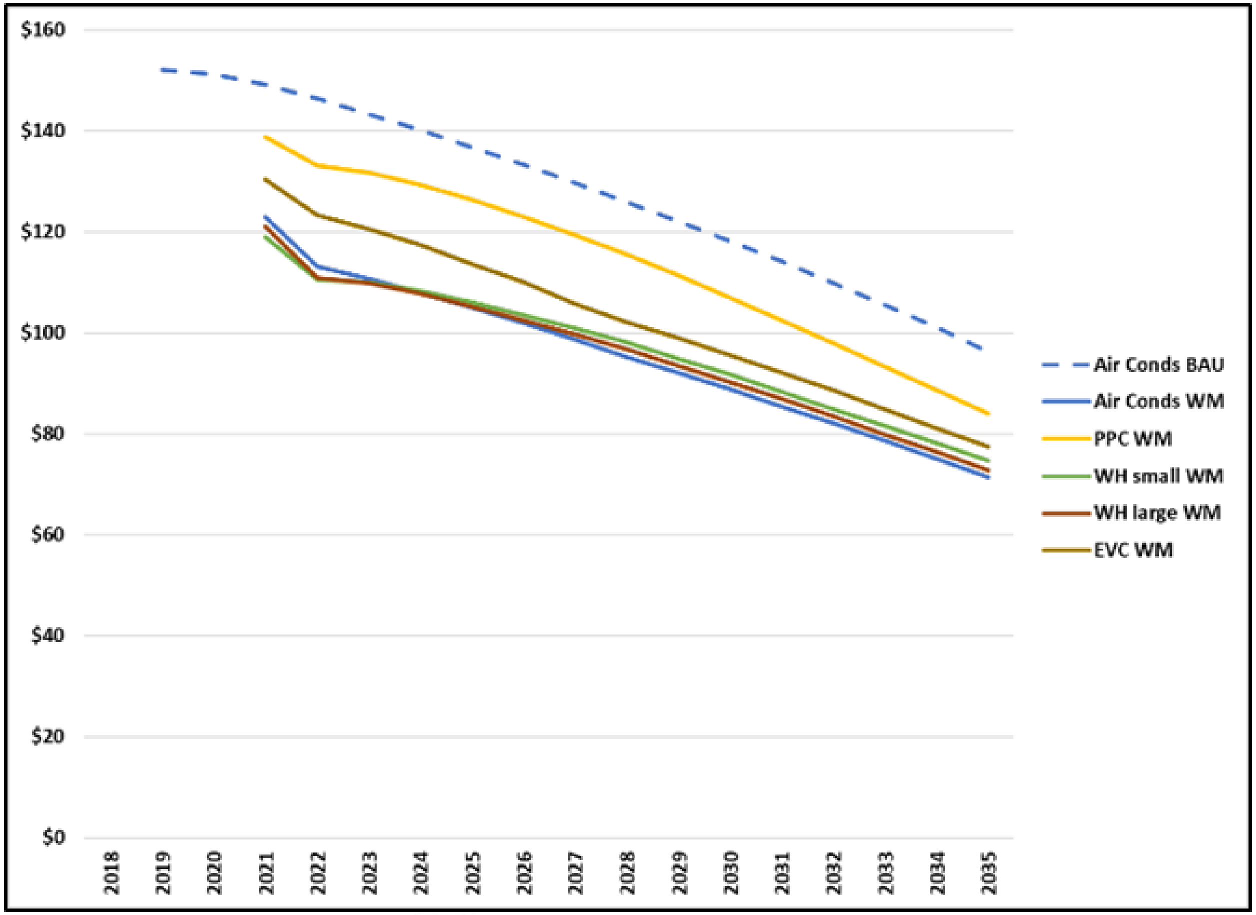
Estimated benefits

- Reduction in network peak demand
  - Grid-wide and local
  - Est. $ 200-3,600 per firm kVA (NEM av. $1,800)
- Reduced wholesale price to all consumers
- Emergency management (RERT)
- Shifting load into minimum demand events
- Grid support (supply, VARs) – not quantified
- PV of benefits – PV of costs = Net benefit

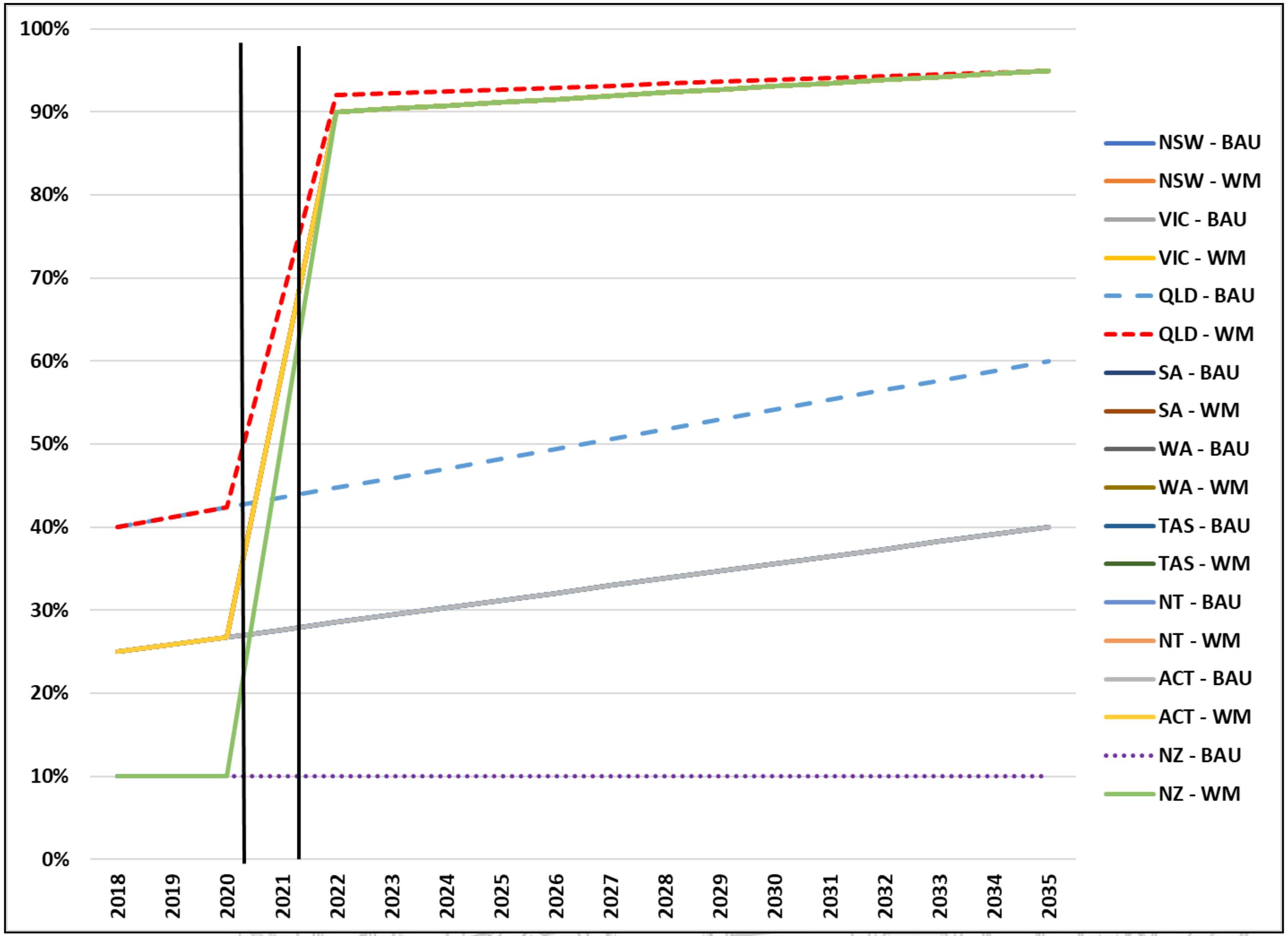
Increase in retail price



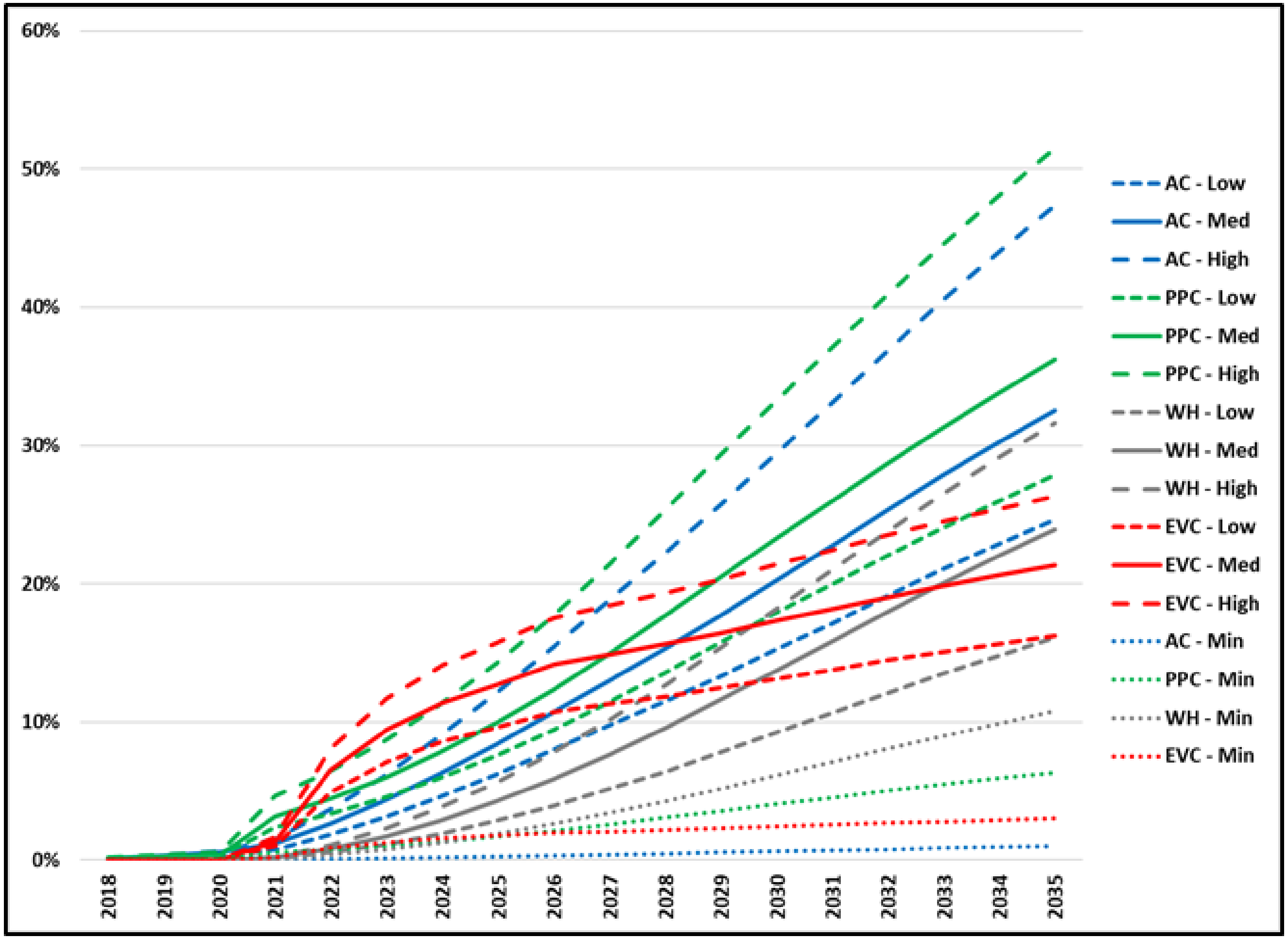
Activation costs



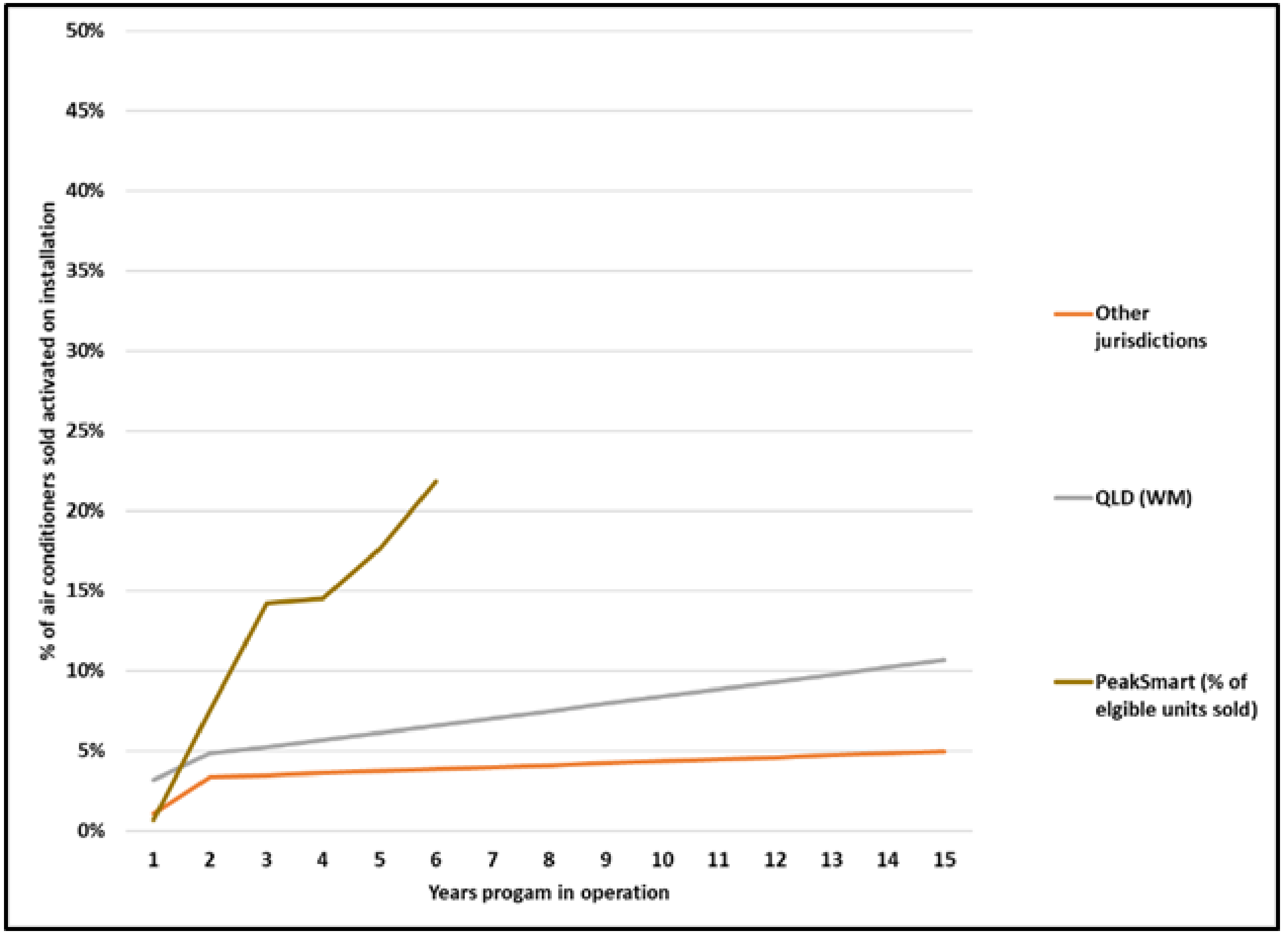
Compliance Rates, BAU/With Measures



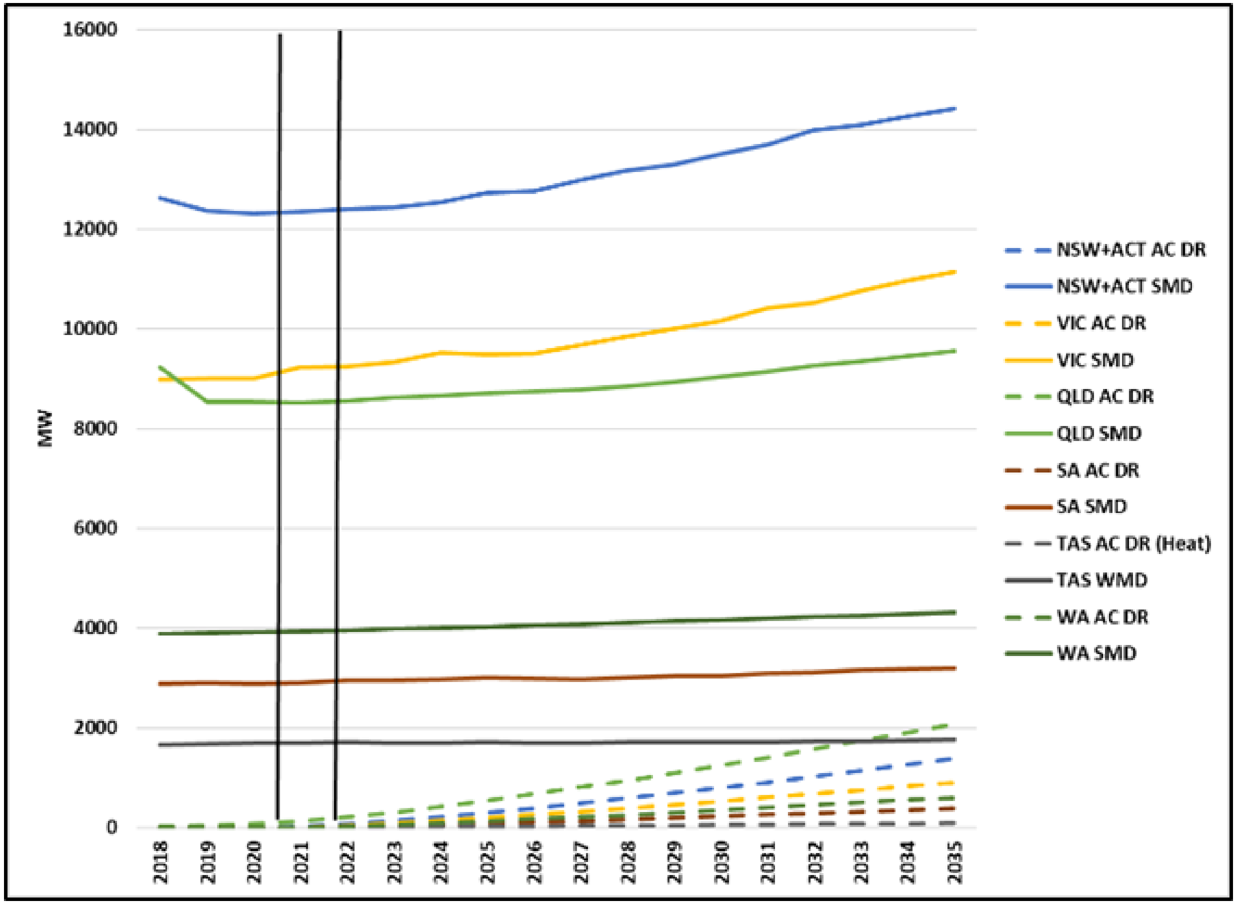
Activation rates (at-install + post-install)



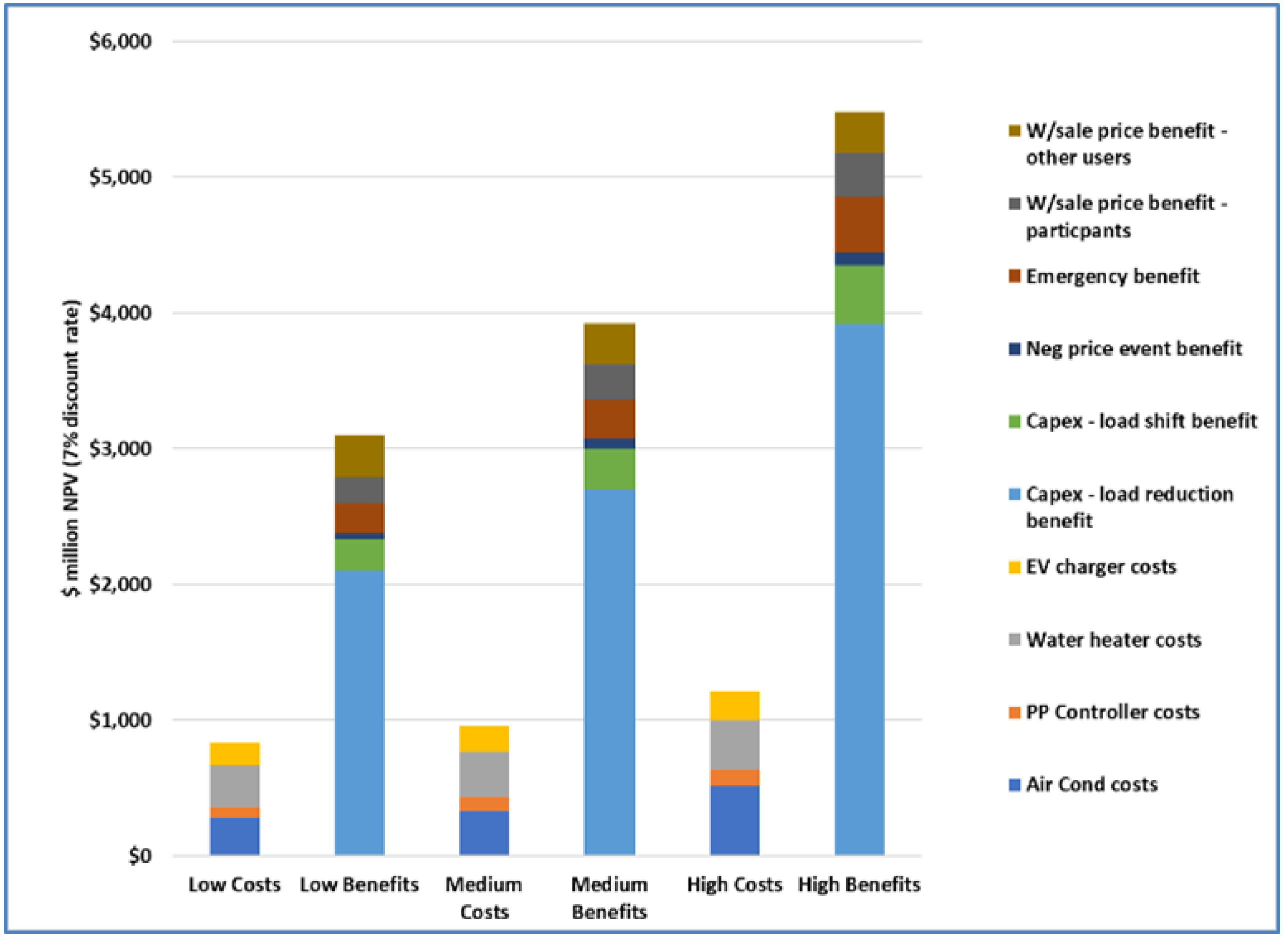
Actual at-install activations (Peaksmart)



Peak MW and controllable MW



NPV costs and benefits, Aust 2019-35



By appliance, Australia (Med Activ)

	Routine DLC Reduction available SMD 2035, MWe (a)	Costs $M NPV (b)	Benefits $M NPV (b)	Net Benefits $M NPV (b)	% net national benefits	B/C ratio	Without whole-sale price benefit	
							Net benefit	B/C ratio
Air Conds	2164	$335	$2,167	$1,832	61.8%	6.5	$1,511	5.5
PP Controllers	354	$94	$266	$172	5.8%	2.8	$160	2.7
Water heaters	467	$341	$642	$301	10.2%	1.9	$288	1.8
EV chargers	637	$191	$851	$660	22.2%	4.5	$446	3.3
All products	3621	$960	$3,926	$2,965	100.0%	4.1	$2,405	3.5

By appliance, New Zealand (Med Activ)

	Routine DLC Reduction available SMD 2035, MWe (a)	Costs $M NPV (b)	Benefits $M NPV (b)	Net Benefits $M NPV (b)	% net national benefits	B/C ratio
Air Conds	228	$43	$195	$152	72.2%	4.5
PP Controllers	NA	NA	NA	NA	NA	NA
Water heaters	139	$71	$146	$75	35.7%	2.1
EV chargers	12	$28	$12	-$17	-7.8%	0.4
All products	379	$142	$353	$211	100.0%	2.5

Benefits per household (mid-point)

- For Australia, NPV of $A 2,970 million is equivalent to net benefit of about $300 for each household
  – Net value after all costs
  – time-discounted and inflation-adjusted
  – Averaged over all HH: greater to participants
- For New Zealand, NPV of $NZ $210 million is equivalent to net benefit of about $115 for each household

Why mandate compliance?

- Addresses market failures:
  - Lack of energy price signals leads to over-investment in supply and networks – bills higher than necessary
  - Will make TOU tariffs more acceptable to consumers
  - ‘Positive externality’ – no stakeholder can gain enough of the value to risk introducing standard
- Non-mandatory options (e.g. labelling) not effective
  - Cost of retrofitting DR capability prohibitive
- Common platform reduces stranded investment risk
  - For manufacturers, DRSPs, consumers
  - Consumers not tied to one DRSP
- Benefits can also accrue to non-participants

Why AS/NZS 4755?

- Programmable communicating T/stats only suit ducted systems, thermally pre-conditioned spaces
  - ‘NEST’ type PCTs do not work with split unit ACs
- Compatibility with Japanese Echonet standard
  - Most 4755-compliant models also meet Echonet
- IEC DR standards at early stage (Aust was involved)
  - Europeans concentrating on DR for whitegoods
- 4755 responses can be verified at the appliance level
  - Independent of temp/thermal mass of conditioned space, etc
- 4755.2 designed to permit future interworking

Number of models certified to DR standards

Product category	US EPA Energy Star "connected" criteria	Australia/New Zealand Standard AS/NZS 4755	Japan Echonet Lite
Air conditioner – window-wall	✓7	✓0	✓
Air conditioner – split unit		✓990	✓26 families (a)
Air conditioner – central/ducted		✓113	✓
Electric resistance heating			✓
Pool pump controller		✓0	
Water heater – heat pump		✓0	✓11
Water heater – resistance		✓0	
Refrigerator & freezer	✓41		✓
Clothes washer & washer-dryer	✓0		✓
Clothes dryer	✓2		✓
Dishwasher	✓0		
Light fixtures	✓241		✓
Connected thermostat	✓47		✓
Energy battery storage system		✓5	✓46
Electric vehicle charger (EVSE)	✓0	✓(b)	✓1
Photovoltaic/battery inverter		✓(c)	✓**23**
Controller for other devices		✓0	✓**213**

Consumer benefits

All appliance owners can participate in DR market

- Via DNSPs and retailers now, via DRSPs if AEMC permits

Does not prevent other forms of DR participation

- Whether or not the 4755 capability is activated

Monetary benefits to participants

- If they do not see them as adequate, will not participate

Monetary benefits to non-participants as well

- Lower wholesale prices, higher value for PV owners, lower network charges than otherwise

Ultimate benefit is reduced risk of blackouts for all

No other options with similar benefits on offer

Consumer safeguards

- Activation of DR capability is a free choice
  - Informed consent will have to be given; vulnerable households advised not to participate (see contracts offered by Powercor, Energex etc – limited no. of events)
  - Projections assume only 32% takeup for ACs by 2035
- Consumers can withdraw from contracts
  - For Energex, only 0.2% of 108,000 have chosen to do so
  - Products can be deactivated (remotely, under 4755.2)
- Event overrides possible for PPCs, WHs, EVs
- Appliance must revert to normal operation in case of comms failure or conflicting commands

Timing and implementation

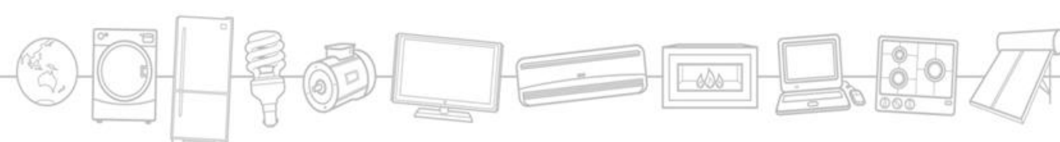
Now

Target for AS 4755.2

Target for 4755.3.4?

	2019	2020	2021	2022	2023
AC, WH		GEMS Determination >	Lead time	Compliance	
PPC, EV	GEMS Act amended		GEMS Determination >	Lead time	Comp

Some jurisdictions with imminent network issues requiring more controllable devices in the system may consider an earlier implementation using local regulation.



Possible additional products

Battery charge controllers
AS/NZS 4755.3.5

PV Inverters
AS/NZS 4777.2

Home Energy
Management Systems
No standard yet

THANK YOU – ANY QUESTIONS?

Q&A

- We invited questions to be submitted in advance of the public consultation sessions by 23 August 2019.
- We also welcome questions today as part of this session.
- Your questions will be recorded as part of the minutes for this session and will also feed into the analysis of responses once the consultation closes.

Timing and implementation

Now

Target for AS 4755.2

Target for 4755.3.4?

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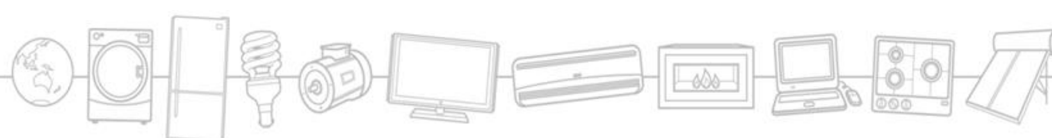

Next steps

- Written comments on Consultation Paper
  - by 16 September, please
  - To: smartappliances2019@sa.gov.au
- Questions on p43 of Consultation RIS
- E3 will consider responses
- E3 will prepare a Decision RIS
- Ministers will then consider and decide

THANK YOU – ANY QUESTIONS?