FINAL

Demand Response Capabilities for Selected Appliances – South Australia Specific Analysis

For SA Department of Energy and Mining

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GEORGE WILKENFELD AND ASSOCIATES Pty Ltd
ENERGY POLICY AND PLANNING CONSULTANTS
PO Box 460 Katoomba NSW 2780 Sydney Australia Tel (+61 2) 4782 1155
geosanna@ozemail.com.au

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Executive Summary

In November 2019, the Council of Australian Governments (COAG) Energy Council (EC) agreed on a timetable to introduce mandatory demand response standards for air conditioners, electric storage water heaters, swimming pool pump controllers and home chargers for electric vehicles. The cost and benefits of these measures were analysed in a Regulation Impact Statement (RIS) prepared by the E3 Committee: *'Smart' Demand Response Capabilities for Selected Appliances.*

There is some uncertainty regarding the timetable, both with regard to the ability of the *Greenhouse and Energy Management (GEMS) Act 2012*, to enforce the standards and the standards themselves, some of which are still in draft.

The implementation timetable agreed by COAG EC may be called the 'Base Case'. The present report was commissioned by the SA Department of Energy and Mining (DEM) to analyse the following matters:

- The impacts, costs and benefits of implementing the DR requirements in SA more rapidly than in the Base Case (Option 1);
- The impacts, costs and benefits of implementing more stringent requirements in SA than in the Base Case (Option 3); and
- A combination of the two (Option 2).

This report presents both a quantified analysis and a qualitative assessment of the risks.

All three options analysed in this study would accelerate the implementation in SA of the COAG EC decision on demand response standards for appliances, by regulating that products *supplied* after target dates would need to comply, not just products registered after those dates.

This distinction is likely to be most significant for electric storage water heaters, where the turnover of new models is slow, there are no models at present which comply with the DR standards and suppliers may choose to delay the introduction of complying models. For air conditioners there are over 1,100 complying models already, model turnover is high and the market is more competitive. Pool pump controllers and electric vehicle chargers are not yet covered by the *GEMS Act*, so there should be no significant lag between first registration and the time of supply.

Accelerating the implementation dates by two years for each product (Option 1) would increase the net benefits for SA by about $M 14-21 or 17-28% more than in Base Case. Applying more stringent requirements at the same time (Option 2) would also lead to greater benefits than the Base Case, but by a lesser margin than Option 1: $M 7-14, or 9-19% more.

Option 3 would follow the COAG EC target implementation dates, but would still accelerate the effects in SA by regulating that products supplied after those dates would need to comply. It would apply more stringent criteria, as in Option 2, and would also lead to slightly greater benefits than the Base Case: $M 1-8 or 1-10% more.

Option 3 would increase the retail price of products compared with the Base Case but should reduce activation costs because there would be time to redesign products so that separate demand response enabling devices (DREDs) would not be needed. This should lower costs for demand response service providers and encourage greater take-up by consumers. If it results in significantly higher activation rates, the increase in net benefit compared with the Base Case could range from $M 22-54 (37-72%).

These projections are sensitive to a number of assumptions and uncertainties:

- Activation rates: all compliant units incur a cost, but only those "activated" or connected to a demand response communications network deliver a benefit. The net benefit will depend on the activation rates achieved – whether medium, high or low. This will partly depend on whether the entry of demand response service providers to the market can be brought forward to the same extent as the availability of compliant products;
- The counter-factual Base Case: the more suppliers that take advantage of the "grandfathering" provision in the *GEMS Act* to delay the introduction of compliant products, the greater the impact of SA action;
- The specific cost to SA (apart from the technical costs of manufacturing and activating demand responsive products, which would be the same in all jurisdictions): the administrative costs of registration and check testing over the period when SA regulations differ from other jurisdictions, and the market price effects from fewer models and less competition in the SA market. If other jurisdictions adopt the same option and regulations as SA, administrative costs may be shared and the market price impacts on SA consumers reduced; and
- The value assigned to the capacity of water heating and pool pumping to store or use energy at times when on-site renewable electricity generation output exceeds the local load. The higher this value, the greater the benefit of each option.

The following table summarises the assessment of the market impacts and risks of the various options. If the SA government announces its intention to proceed with any of the three options, it is likely that some suppliers will be forced to increase prices or withdraw from the SA market until the national implementation timetable catches up.

	Option 1; faster implementation	Option 2; faster implementation; greater stringency	Option 3; current implementation schedule; greater stringency
Air conditioners	Model choice restricted for 2 years; some price increase; DRSPs need to work with DREDs	Models choice heavily restricted for 2 years; more price increase; some risk of non-supply	More time to introduce compliant products – low price impact and risk
Large ESWH	High risk of supplier withdrawal	High risk of supplier withdrawal	Moderate risk of supplier withdrawal
Small ESWH	High risk of supplier withdrawal if not exempt	High risk of supplier withdrawal if not exempt	Moderate risk of supplier withdrawal if not exempt
Pool pump controller	Moderate risk of supplier withdrawal	Moderate risk of supplier withdrawal	Low risk of supplier withdrawal
EV Charger	Low risk of supplier withdrawal	Low risk of supplier withdrawal	Low risk of supplier withdrawal

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Glossary

AC	Air conditioner
AS	Australian standard
AS/NZS	Australian and New Zealand (joint) standard
BAU	Business as usual
COAG	Council of Australian Governments
CRIS	RIS for Consultation
DEM	Department for Energy and Mining
DR	Demand response
DRED	Demand Response Enabling Device
DRIS	RIS for Decision (see References E3 2019a)
DRM	Demand response mode
DRSP	Demand response service provider
EC	Energy Council
ESWH	Electric storage water heater
EV	Electric vehicle
EVC	Electric vehicle charger
GEMS	Greenhouse and Energy Minimum Standards (Act)
GWA	George Wilkenfeld and Associates
HEMS	Home energy management system
LWH	Large (electric storage) water heater
MEPS	Minimum energy performance standards
PPC	Pool pump controller
RA	Remote agent
RIS	Regulation Impact Statement
SA	South Australia
SWH	Small (electric storage) water heater

1. Background

1.1 Mandatory demand response standards for appliances

In November 2019, the Council of Australian Governments (COAG) Energy Council (EC) accepted the following recommendations of the Regulation Impact Statement for Decision (DRIS) *'Smart' Demand Response Capabilities for Selected Appliances* (E3 2019a):

> 1. Ministers endorse the adoption of nationally applicable, public, non-proprietary standards for demand response for air conditioners (ACs), electric storage water heaters, pool pump controllers and electric vehicle (EV) chargers intended for residential use.
>
> **Air conditioners**
> 2. Air conditioners to comply with any of the following standards:
> - AS/NZS 4755.3.1:2014; or
> - AS 4755.2 (when published); or
> - The equivalent of the superseded AS/NZS 4755.3.1:2012 (for a limited period of 2 years from the Determination).
>
> 3. Compliance with three demand response modes (DRM1, DRM2, DRM3) to be required, for all AC types subject to MEPS (excluding portable air conditioners), up to a cooling capacity of 19kW inclusive, registered after 30 June 2023.
> 4. This option of complying with the equivalent of the superseded AS/NZS 4755.3.1:2012 to be no longer available for products registered after 30 June 2025.
> 5. A Determination to give effect to the above to be made by 1 July 2021.
>
> **Electric Storage Water Heaters (Resistive Heating)**
> 6. Electric Storage Water Heaters to comply with either of the following standards:
> - AS/NZS 4755.3.3:2014; or
> - AS 4755.2 (when published).
>
> 7. Compliance with demand response mode 1 (DRM1) to be required, for electric storage water heaters of 50 to 710 litres (inclusive) nominal capacity subject to MEPS (excluding heat exchange water heaters), registered after 1 July 2023. (Other DRMs are optional).
> 8. A Determination to give effect to the above to be made by 1 July 2021.
>
> **Devices controlling swimming pool pump-units**
> 9. Devices controlling swimming pool pump-units (as defined in AS/NZS 4755.3.2:2014) to comply with either of the following standards:
> - AS/NZS 4755.3.2:2014; or
> - AS 4755.2 (when published).
>
> 10. Compliance with demand response mode 1 (DRM1) to be required, for pool pump controllers supplied or offered for supply from 1 July 2024. (Other DRMs are optional).
> 11. Compliance with DRM1, DRM2 and DRM4 to be required for pool pump controllers supplied or offered for supply from 1 July 2026.
> 12. A Determination to give effect to the above to be made by 1 July 2022.
>
> **Electric Vehicle Charge/Discharge Controllers**
> 13. Controllers capable of managing the charging and/or discharging to the grid of EVs, that are intended for residential applications and capable of charging at SAE Level 2 or IEC Mode 3, to comply with any of the following standards:
> - AS/NZS 4755.3.4 (when published); or

- AS 4755.2 (when published); or
- an equivalent international standard, if an E3 technical working group determines by mid-2022 that there is one that provides equivalent capabilities to AS 4755.

14. Compliance with DRMs 0, 1,2,3,4,5 and 8 to be required (6 and 7 optional), or the equivalents in the other approved standard, for EV chargers supplied or offered for supply from 1 July 2026.
15. A Determination to give effect to the above to be made by 1 July 2024.

Additional recommendations

16. COAG Energy Council agrees to the establishment of an E3 Technical Working Group, with membership to be determined by the Senior Committee of Officials (SCO), to consider the matter of an equivalent international standard for EV charge/discharge controllers (in recommendation 13).
17. COAG Energy Council requests Standards Australia to:
    - Include an additional appendix in AS 4755.2 to cover EV chargers (based on draft AS/NZS 4755.3.4);
    - Expedite completion and publication of AS 4755.2; and
    - Expedite completion and publication of AS/NZS 4755.3.4; and
    - Prepare a new part of AS/NZS 4755 covering Home Energy Management Systems (HEMS) that are capable of providing demand response.
18. COAG Energy Council agrees to the investigation by E3 of the options, cost, benefits, advantages and disadvantages of requiring demand response capabilities meeting public, non-proprietary standards for:
    - Photovoltaic (PV) inverters within the scope of AS/NZS 4777.2; and
    - Controllers for grid-connected electrical energy storage systems (including residential scale batteries) within the scope of AS/NZS 4755.3.5.

Implementing the requirements through "determinations" implies the use of the Commonwealth's *Greenhouse and Energy Management (GEMS) Act 2012*, although the recommendations did not specify the GEMS Act because there is some uncertainty about whether the Act can make regulations for demand response (DR) capability for products not also covered for Minimum Energy Performance Standards (MEPS) or mandatory energy labelling. COAG EC therefore noted that amending the GEMS Act and the equivalent New Zealand legislation may be necessary (see Appendix 1).[1]

At present, the timetable for assessing the need for amendments to the GEMS Act, for amending the Act if necessary and for developing determinations is uncertain. There is also some uncertainty regarding the technical standards to be adopted. The editing of (draft) AS 4755.2 commenced at the end of April 2020, so the public comment and balloting stages are still to come. No progress has yet been made on developing or adopting standards for EVCs.

[1] The COAG EC Decision is at Appendix 1. The preceding description of the relevant standards is the Attachment A referred to in the COAG Decision (corrected for minor typographical errors identified after the meeting). The recommendations concerning pool pump controllers do not apply to New Zealand.

1.2 This report

The implementation timetable agreed by COAG EC may be called the 'Base Case'. The present report was commissioned by the SA Department of Energy and Mining (DEM) to analyse the following matters:

- The impacts, costs and benefits of implementing the DR requirements in SA more rapidly than in the Base Case;
- The impacts, costs and benefits of implementing more stringent requirements in SA than in the Base Case; and
- A combination of the two.

1.2.1 Terms of Reference

The DEM's Terms of Reference are:

Quantify, against the business as usual (BAU) scenario, the benefits and costs of the following options:

- Option one – Implement, in South Australia, the recommendations agreed by the Energy Council on 22 November 2019 earlier than the nationally agreed timeline.
- Option two – Option one, but also with higher performance requirements, including requiring a full range of DR modes, and permitting compliance via AS 4755.2 only.
- Option three – Implement according to the Energy Council schedule, but with higher performance requirements (as in Option two).

Quantify costs including (but not limited to):

- costs to product designers, manufacturers (local and overseas), retailers, and suppliers;
- costs to businesses with existing stock that may not meet the requirements;
- costs to consumers, including costs from reduced product availability and consumer choice;
- cost to the South Australian Government to administer a local requirement, including registration and compliance costs;
- costs of DR capable appliance connection(s) and activation(s); and
- costs of DR program participant servicing.

Quantify benefits, including (but not limited to):

- opportunities for better managing periods when export of rooftop solar PV exceeds minimum demand;
- reducing wholesale electricity prices; and
- improved electricity network reliability and security.

Utilise the cost benefit analysis (CBA) modelling methodology, assumptions, and input data from the *Demand Response Capabilities in Selected Appliances Decision Regulation Impact Statement*, amended where necessary for South Australia-specific implementation.

Identify for each product type and each option:

- the numbers of product models in the South Australian market that currently comply with the proposed performance requirements; and
- the numbers of product models in the South Australian market that would be removed under each option (if adopted).

Consult with industry to confirm product data inputs to the analysis. There should be no discussion with industry that might lead to questions about the timing of implementation. Where necessary, proceed on the basis of information from industry supplied in the CRIS.

Undertake a sensitivity analysis for each option assuming the following scenarios:

- at least one other jurisdiction of similar size to South Australia also implements either option one or option two; and
- at least one other jurisdiction larger than South Australia also implements either option one or option two.

The means for implementing these options are not considered. Even for the Base Case it may be necessary for SA to make special regulatory arrangements in the event that the national schedule slips, and such arrangements would certainly be necessary in the event that SA adopted an accelerated implementation and/or more stringent requirements. It is assumed that SA would be willing and able to make regulations so that only products complying with specified requirements would be legal to supply in SA from the nominated dates.

Registration vs Supply

The COAG EC decision relates to the dates after which the conditions for product registration will include compliance with AS/NZS 4755. Under S48(3) of the GEMS Act, products registered before that date will remain on the register for five years from the date of registration (unless deregistered voluntarily or for non-compliance). Therefore, it could take up to five years from the date of implementation before the last non-compliant model is removed from the register and so may no longer by supplied. An air conditioner or electric storage water heater registered on 30 June 2023, just before the COAG EC compliance target date of 1 July 2023, could remain on the market until 30 June 2028. The number of models likely to be in this situation will vary according to the market dynamics for each product (see next chapter).

Bringing forward the time of implementation in SA could be done in the following ways (both of which would require SA-specific regulation):

- Shortening the "overlap" so that air conditioners and water heaters registered under GEMS determinations prior to 1 July 2023 could remain on the SA market for less than the default 5 years (only up to 1 July 2025, for example); or

- Making compliance a condition of *supply* rather than registration. This could be enforced through the SA Electrical Products (Safety and Efficiency) Act.

The first approach would reduce uncertainties regarding the effects of registration timing (which some product suppliers may choose to exploit) whereas the second would avoid such uncertainties altogether. Given that SA-specific regulations would be needed for either approach, it would seem reasonable to maximise the benefits of such regulation by ensuring the times and conditions of supply, not merely registration.

1.2.2 Modelling approach

Scenarios are tested using variants of the cost-benefit model developed for the Decision RIS (E3 2019a).[2] The original modelling was already articulated by jurisdiction (states, territories and New Zealand), enabling the Base Case results for SA to be extracted. A second version of the model was generated, with the implementation dates for each

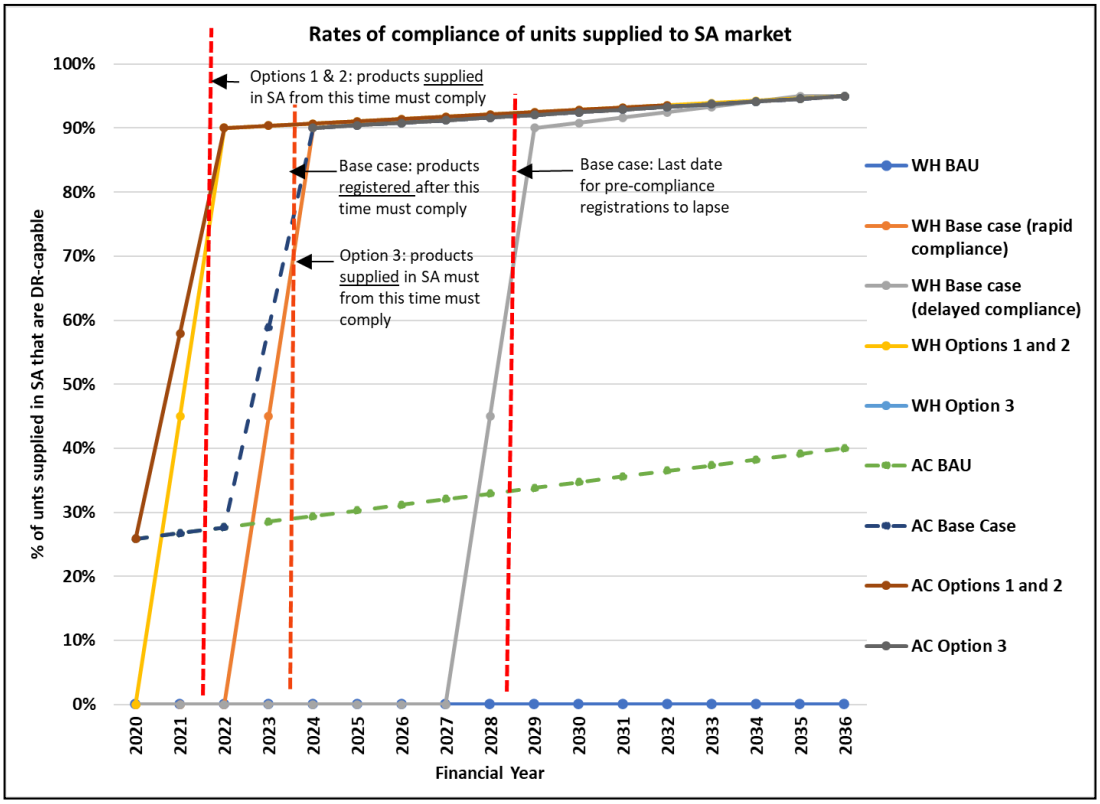
[2] The model comprises a set of nine linked spreadsheets.

product brought forward by two years compared with the Base Case. For example, in the Base Case, all air conditioners supplied from 1 July 2023 throughout Australia and New Zealand would have comply with AS/NZS 4755, but in Option 1, the compliance date in SA alone would be 1 July 2021. This is considered the earliest feasible compliance date for that product, and would depend on the SA government making an announcement of its intentions by the middle of 2020. A lead time of a year would be the absolute minimum notice that suppliers would need.

Given the uncertainty associated with registration timing, it was necessary to develop two Base Cases: one in which suppliers chose to comply with the COAG EC requirements rapidly, and one in which they were delayed as long as possible. The difference is illustrated in Figure 1. For air conditioners, where there are already many compliant models with a rising market share (even in the absence of new legislation), competitive pressures suggest that most suppliers will try to ensure compliance by the start of financial year (FY) 2023.

For water heaters, there are no compliant models. Some suppliers may choose to delay compliance with GEMS requirements as long as possible, by re-registering existing non-compliant models just before 1 July 2023. If so, compliant water heaters may not appear on the market before mid-2028. These two Base Case scenarios – "rapid" and "delayed" compliance – represent the extremes of the Base Case against which the impacts of SA regulations need to be assessed. Therefore, two sets of costs and benefits are presented: one set against the Rapid Base Case and one set against the Delayed Base Case. It is probable that actual cost and benefits will lie between these extremes.

Figure 1 Rates of product compliance under different scenarios



The suppliers of different products face different technical and market issues – as detailed in the next chapter – and their ability to respond to SA-specific requirements will vary. After discussion with DEM, it was decided to model the impact of bringing forward each implementation date by two years, rather than commencing them all on 1 July 2023, which would have meant an acceleration of two years for air conditioners and water heaters, but three years for pool pump controllers (PPC) and five years for EV Chargers (see Table 2). This reflected an assessment of the current familiarity of each industry with DR and its technical capability to respond. Retaining a staggered implementation also spreads the administrative burden on the SA Government.

Both the costs and benefits of policy measures accrue through time, usually at different rates, so scenarios are best compared on the basis of the net present value (NPV) of the cost and benefits. Throughout this report, NPVs are calculated using a discount rate of 7%, and analysed from the time perspective of mid 2020 (i.e. the start of FY 2021). The DRIS found that undertaking the analyses at higher and lower discount rates (10% and 3% respectively) had negligible impact on benefit/cost ratios because both capital costs and capital savings accrued at similar rates. Therefore, only the 7% discount rate is used throughout this report.

The combination of these factors in each option is summarised in Table 1, and the actual dates of implementation are in Table 2

Table 1 Scenarios Modelled

	COAG EC-agreed implementation timing	Implementation advanced 2 years
Registration regulated, COAG EC requirements	Base Case (Rapid) Base Case (Delayed)	
Supply regulated, COAG EC requirements		Option 1
Supply regulated, more stringent SA requirements	Option 3	Option 2

Table 2 Implementation target dates, various options

Product	Base Case & Option 3	First year of impact	Option 1 & 2	First year of impact
Air conditioner	1 July 2023	FY 2024	1 July 2021	FY 2022
Electric storage water heater	1 July 2023	FY 2024	1 July 2021	FY 2022
Pool pump controller	1 July 2024	FY 2025	1 July 2022	FY 2023
EV Charger	1 July 2026	FY 2027	1 July 2024	FY 2025

2. Key Issues

2.1 Supplier and Market responses

The DRIS estimates that the cost of products will increase due to the need for suppliers to design and manufacture new types of products that, in some cases, have not yet been introduced to the market. In the Base Case, suppliers will have the choice of complying with either AS/NZS 4755.3.X or AS 4755.2.[3] Both types must have control circuits that enable them to enter demand response modes (DRMs) on command from a Remote Agent (RA). The main difference is that AS/NZS 4755.3.X products need a physical interface that can connect to an external Demand Response Enabling Device (DRED), whereas those complying with AS 4755.2 must have a means of communication built in (e.g. wifi or 3G/4G/5G). It is expected that the latter will be more complex and hence more costly to manufacture. Conversely, they will not require a DRED, so the cost of activation (connection to an RA's communications network) will in many cases be low, especially if they connect via the consumer's pre-existing wifi network.

The DRIS assumed that the lead time for implementation would be long enough for an orderly redesign and introduction of compliant models. If suppliers are forced to introduce compliant models with a one year lead time (Options 1 and 2) rather than a three-to-eight year lead time, they will have to rely on technology already in production or that can be introduced quickly. The costs will probably be higher than in the Base Case and there will probably be fewer models and less consumer choice on the SA market, leading to market price impacts. If only non-DRED compliance options are permitted (as in Options 2 and 3), manufacturing cost impacts would be higher, but activation costs should be lower (see Table 3).

Table 3 Changes in estimated manufacturing, market and activation costs

	Cost of building in compliance with applicable DR standard				Average stock segregation and market price premium impacts			Activation cost at installation – Base & Opt 1(a)		Activation cost at installation – Options 2& 3(a)	
	Base	Opt 1	Opt 2	Opt 3	Opt 1	Opt 2	Opt 3	2019	2036	2019	2036
AC unitary	$20	$20	$60	$40	$20	$30	$10	$110	$55	$30	$27
AC split	$10	$10	$50	$30	$20	$30	$10	$110	$55	$30	$27
AC multi	$30	$30	$70	$50	$20	$30	$10	$110	$55	$30	$27
AC ducted	$20	$20	$60	$40	$20	$30	$10	$110	$55	$30	$27
PPC	$60	$60	$100	$80	$20	$30	$10	$140	$55	$30	$27
WH small	$60	$60	$100	$80	$20	$30	$10	$110	$55	$30	$27
WH large	$70	$70	$150	$120	$20	$30	$10	$110	$55	$30	$27
EVC	$40	$40	$40	$40	$20	$30	$-	$110	$55	$30	$27

(a) Activations costs post-installation are $50 higher in 2019, declining to $ 25 higher in 2036

An additional set of costs, not included in the DRIS modelling, would come from the fact that the SA market would be differentiated from the national market, either temporarily if SA implements the same measures but earlier, or permanently if SA

[3] AS/NZS 4744.3.X refers to all standards in Part 3 of AS/NZS 4755 – see References.

imposes more stringent requirements than apply elsewhere. This would impose additional costs such as:

- The cost of managing inventory and deliveries to separate SA-compliant stock from other stock. It is assumed that these costs would be recovered from SA consumers only, but some suppliers may choose to spread the cost over their total national sales, depending on their commercial strategies and competitive strengths in each State market; and

- There may be further costs to SA consumers if the shortened lead times force some suppliers to withdraw from the SA market temporarily. This would lead to a reduction in choice for SA consumers, and possibly impact on average prices if the withdrawn models or brands happen to be significantly cheaper (or dearer) then the ones which remain in the SA market. It is likely that any suppliers who withdraw for a time will re-enter the SA market later, once the DR requirements in other jurisdiction catch up and there is more time to develop new products.

These effects are included in the scenarios as a post-modelling adjustment (see Table 3). However, the values are speculative, because it was not possible to put the assumptions directly to industry. To address the uncertainty, the sensitivity of outcomes to a doubling of the price impact assumptions in Table 3 has been modelled (see Chapter 3).

It should be noted that there was no discussion with suppliers on these issues, in accordance with the provisions in the Terms of Reference that "there should be no discussion with industry that might lead to questions about the timing of implementation." Continuing contact with stakeholders in the forum of Standards Australia strongly suggests that industry support for the COAG EC outcomes is fragile and could easily fracture.[4] The following sections represent GWA's views on how each industry is likely to respond.

Air Conditioners

Since 2015, the Energex PeakSmart program has been offering incentives for customers to purchase and activate air conditioners that comply with AS/NZS 4755.3.1:2012. It maintains a list of eligible models, each of which it has been tested to a limited extent.[5] In April 2019, there were 1,113 models from 23 brands registered with PeakSmart

[4] In January 2020, the Australian Industry Group wrote to Standards Australia and the Commonwealth Department of Industry, Science, Energy and Resources stating:
"Ai Group and other industry bodies have been active contributors to Standards Australia's work on 4755. Our various member segments have not always agreed with the direction of 4755 but in the interest of progressing the development of [remote demand management] as a voluntary practice we have always been supportive. However, given the recommendations in the Decision RIS "Smart Demand Management Capabilities for Selected Appliances" to mandate 4755 we hold concerns that the relevant policy settings are lagging standards development and equipment suppliers are concerned that there are technical matters unresolved. We therefore recommend a pause in committee deliberations to remedy these concerns." Standards Australia has agreed to revisit these concerns with AiG once AS4755.2 is ready for public comment.

[5] https://www.energex.com.au/home/control-your-energy/positive-payback-program/positive-payback-for-business/air-conditioning-rewards/peaksmart-air-conditioner-models The testing verifies that the unit connects with a DRED correctly, changes operation in response to instructions from the DRED and enters DRM1 (compressor off) but does not verify whether the unit correctly complies with DRMs 2 and 3.

(Table 4). This is a significantly lower but more reliable number than the number indicating compliance on the GEMS register (Table 8).

With their non-DR-capable models included, the 23 PeakSmart brands account for 3,166 models, or 80% of the total registered. There are 49 brands without any DR-capable models registered with PeakSmart (see Appendix 4) but these account for only 20% of the models registered. While the model share is not the same as the sales share, the brands in Table 4 are the leading consumer brands, and probably account for an even larger share of the national market than 80%. The non-DR brands will not command a brand awareness premium, and so are likely to be cheaper on average (with exceptions such as Lennox, Carrier, York and APAC/Specialised Engineering, which focus on larger capacity models).

Table 4 Air conditioner models registered with PeakSmart, April 2019

	Inbuilt DR capability	With Extra part	Total DR capable	Inbuilt/ Total	Total reg Models(a)	DR-capable % of Tot models
Actron Air	0	135	135	0.0%	135	100.0%
Braemar	33	0	33	100.0%	93	35.5%
Daikin	0	167	167	0.0%	337	49.6%
Dimplex	3	0	3	100.0%	16	18.8%
Fujitsu	0	52	52	0.0%	130	40.0%
Gree	30	0	30	100.0%	207	14.5%
Haier	45	0	45	100.0%	66	68.2%
Hitachi	4	3	7	57.1%	91	7.7%
Kaden	3	0	3	100.0%	10	30.0%
Kelvinator	14	0	14	100.0%	70	20.0%
LG	0	25	25	0.0%	71	35.2%
MDV	48	0	48	100.0%	49	98.0%
Midea	12	0	12	100.0%	61	19.7%
Mitsubishi Electric	47	19	66	71.2%	366	18.0%
Mitsubishi Heavy Ind	109	0	109	100.0%	184	59.2%
Panasonic	249	3	252	98.8%	274	92.0%
Rinnai	7	0	7	100.0%	28	25.0%
Samsung Electronics	39	0	39	100.0%	44	88.6%
TCL	9	0	9	100.0%	637	1.4%
Teco	27	0	28	96.4%	43	65.1%
Temperzone	16	0	16	100.0%	101	15.8%
Toshiba	10	0	10	100.0%	192	5.2%
Westinghouse	3	0	3	100.0%	6	50.0%
Total	708	404	1113	63.6%	3166	34.7%

(a) On GEMS register, April 2019

Table 5 Total air conditioner models, April 2019

	Brands	Models with DR	Inbuilt DR	Extra Part DR	Non-DR models	Total reg Models (b)	Models per brand
Brands with DR models(a)	23	1113	708	404	2053	3166	138
Brands without DR models	49	0	0	0	795	795	16
Totals	72	1113	708	404	2848	3961	55

(a) From Table 4 (b) On GEMS register, April 2019

How then might the air conditioners respond to SA-specific requirements? The brands without any existing DR models are likely to withdraw from the SA market under Options 1 and 2, so driving up the average sales price of products compared with the Base Case, all else being equal. Some suppliers will eventually re-enter the market after the COAG EC rules take effect, since they will have the incentive of access to the entire national market as well as longer time to develop compliant models.

Among the major brands, there is no clear correlation between DR-capability and price. *Choice* magazine reported tests of 26 air conditioner models (all Table 4 brands) conducted between June 2019 and March 2020. It reported that 15 models were compliant with AS/NZS 4755 and 11 were not. The average capacity-normalised price of models with DR capability ($389/kW cooling output) was slightly *lower* than the models without ($409/kW).[6] Therefore, restricting sales to DR-capable models may not in itself drive up prices, but reduced market competition may do so.

Some 404 (36%) of the 1,113 DR-capable models in Table 4 require an extra component in the air conditioner. This did not inhibit their takeup: about 36% of PeakSmart activations involved an added component, 54% did not, and the other 11% are uncertain.[7] Daikin, for example, currently charges more than $100 for the extra component (a snap-in circuit card) but this may drop with sales volumes. The SA regulations could either prescribe that all parts necessary for DR must be supplied with every unit sold (so increasing the sale price) or leave it to the time of activation (so increasing the activation cost). As only a minority of products are expected to be activated at the start, the latter may be advisable.

Given the short lead time under Option 1, it is likely that only the PeakSmart-eligible models (meeting AS/NZS 4755.3.1:2012) would be available in SA for a year or so, after which new DR-capable models would start to appear on the GEMS register. Some of these – perhaps the majority – would comply with AS 4755.2 rather than AS/NZS 4755.3.1. If DRSPs start offering DR contracts in SA immediately, they will need to develop DRED-based communications systems that would not be stranded in a wireless environment.[8]

[6] Also, of the 11 models that Choice reported did not have DR capability (based on actual examination of the product), 7 models indicated DR capability on the GEMS registration CSV file. This underlines doubts about the accuracy of the GEMS register with regard to DR.

[7] Based on takeup data provided by Energex, personal communication, April 2019.

[8] One pathway would be to connect a DRED with the communications capabilities of an AS 4755.2 product to the physical interface of an AS/NZS 4755.3.X appliance. At the end of that appliance's service life it can be replaced by an AS 4755.2 appliance that communicates directly with the RA, and the DRED can be removed and redeployed to another AS/NZS 4755.3.X product.

Under Option 2, only AS 4755.2 air conditioners would be permitted from 1 July 2021. There are no such models on the market at present. It is feasible that extra components might be re-engineered in such a short lead time rather than the entire model, provided the supplier were technologically sophisticated (as indeed are the seven brands with "extra part" models listed in Table 4). The SA market alone may not be large enough to force the investment, but there would be first mover advantage for the national market. In the short term, however, the range of air conditioner models available in SA would be severely restricted – possibly to only a few hundred models - and average prices could rise by $80-100 (see Table 3).

In terms of product choice and price, Option 3 would give an outcome somewhere between Option 1 and Option 2, and may permit DRSPs to go straight to a DRED-less environment if enough 4755.2 models appear by July 2023.

Water Heaters

The dynamics of the electric storage water heater market with regard to DR capability are completely different from the air conditioner market. There are *no* ESWH models claiming compliance with AS/NZS 4755, and only one model that appears to have DR capabilities. While most air conditioners are imported, the majority of ESWHs are manufactured in Australia by Rheem (including Vulcan, Aquamax and Solahart brands), Dux (including Thermann brand) and Rinnai. These three companies, which also import units from China and Vietnam, account for nearly 88% of the national market between them (Table 6).

The commercial decisions of the three majors will decide what products are available on the SA market. Because of the prevalence of gas, solar and heat pump water heating in SA the DRIS estimated that the state accounted for only about 6.2% of national ESWH sales in 2019, projected to decline to 5.9% by 2036. By contrast, NSW and Queensland between them account for 66% of the national ESWH market.

There is a significant risk that suppliers will simply withhold all ESWH models from the SA market until they start to register compliant models to meet the COAG EC timetable. Figure 2 shows that most ESWH registrations will expire before 1 July 2023 (the solid red line). If suppliers choose to replace the expiring models with AS/NZS 4755 compliant ones, then a large number of nationally registered compliant models might become available by mid-2023, and even by mid-2021 (the dotted red line). Alternatively, suppliers could choose to renew the expiring registrations without redesign, and follow the strategy of delayed implementation illustrated in Figure 1.

In that case, there would be no compliant models available by mid-2021 as would be required under Options 1 and 2, and even by mid-2023 (Option 3) so suppliers would have to withdraw from the SA ESWH market for the time being. There would be little commercial cost to the majors from such a strategy, since they all make the full range of the gas, heat pump and solar water heaters which would have to fill in for unavailable ESWHs. However, it would be a major problem for replacing water heaters in apartments without gas connections, unless that market segment were exempt.

Option 3 carries less risk of WH suppliers withdrawing from the SA market. Some may be tempted to gain a first mover advantage in the national market by introducing

compliant models by 1 July 2023. However, there will probably be resistance to providing DRMs not required by the COAG EC decision, notably DRM4, which is the most valuable for SA policy objectives.

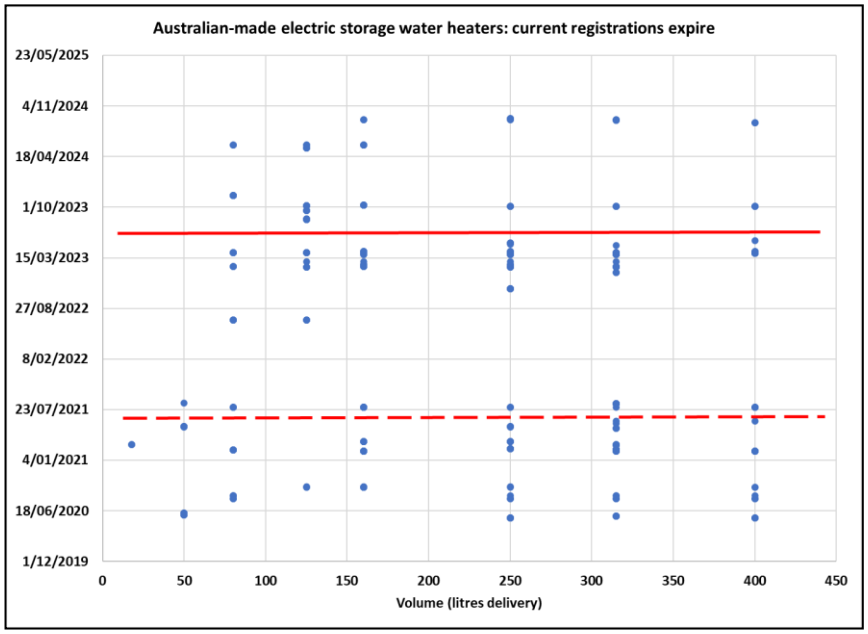
The company best placed to provide DRM4-capable models is Rheem, since it already has a model with these capabilities, although not certified to AS/NZS 4755 (see Appendix 3). Option 3 would require compliance to AS 4755.2; the necessary product development would be feasible with a three year lead time, but not a one year lead time. Therefore, Option 3 carries a lower risk of ESWHs becoming unavailable in SA.

Table 6 Electric Storage Water Heaters on GEMS Register, April 2020

Supplier	Made in Australia	Imported	Total Models	Market share 2014-2018(a)
Apricus	3	2	5	
Asti	-	5	5	
Atlantic	-	1	1	
CSR Bradford	-	28	28	
Dux	132	52	184	17%
Quantum	-	6	6	
Qudos (Wilson)	23	-	23	
Rheem	341	68	409	59%
Rinnai	69	118	187	10%
Robert Bosch	-	14	14	
Solar East	-	7	7	
Stiebel Eltron	-	3	3	
Total of above	568	304	872	88%
All minor brands	26	66	92	12%

(a) National ESWH market shares for From BIS Oxford Economics 2018

Figure 2 Electric storage water heaters registrations by volume and expiry date



Pool Pump Controllers

Pool pump controllers are not covered by any GEMS determination, so SA legislation would have to define the product in accordance with AS/NZS 4755 in order to regulate it.[9] There are no models compliant with AS/NZS 4755, but one Australian manufacturer (Pooled Energy) offers a product with capabilities similar to DRM1, DRM2 and DRM4. Some models imported from the US also have DR and wifi connection capabilities.

Given that suppliers would have to develop, certify and register products from scratch, there would be little advantage to them from a phased introduction (DRM1 only at first and other DRMs later). They may also prefer to go straight to a 4755.2 solution without offering 4755.3.2 products first. The issue is whether 1 July 2022 (Options 1 and 2) would give them enough lead time. They would have to meet Option 3 (registration by 1 July 2024) in any case if they are to meet the COAG EC timetable. Unlike ESWHs, there will be no possibility of registering non-compliant models in advance in order to delay effective implementation. From the suppliers' point of view, Option 3 would be very similar to the COAG EC decision, and so carries no additional risk for SA consumers.

If PPC suppliers did withdraw from the SA market for a period of time, it would have little commercial consequence for them, since SA has only 5% of the national swimming pool stock. It would however be a major problem for SA pool owners. While other water heater types could replace ESWHs if necessary, and conventional vehicles will remain as alternative for EVs for many decades, there is no ready substitute for a pool pump controller that integrates the management of pumping, sanitising and (in many cases) water heating.

EV Chargers

The projected rate of takeup of EVs in SA is highly uncertain. The mid-range of the SA sales projections is shown in
Table 7 summarises the preceding assessment of the market impacts and risks of the various options. If the SA government announces its intention to proceed with any of the three options, it is almost certain that some suppliers will claim they will be forced to increase prices or withdraw from the SA market until the national DR timetable catches up. Whether they do so would remain to be seen.
(Energeia 2018). These projections may well be optimistic in light of the COVID-19 impacts on the economy. Most of these EVs will be light passenger vehicles garaged at houses, the chargers for which will be required to have DR capabilities. As
Table 7 summarises the preceding assessment of the market impacts and risks of the various options. If the SA government announces its intention to proceed with any of the three options, it is almost certain that some suppliers will claim they will be forced to increase prices or withdraw from the SA market until the national DR timetable catches up. Whether they do so would remain to be seen.

[9] The definition in AS/NZS 4755 is: "pump-unit controller: device that is normally part of, or installed with, a pump-unit and regulates the supply of mains electricity to, or otherwise controls the operation or speed of, the pump-unit motor. Note 1: A pump-unit controller may also function as a sanitization controller or may control other pool equipment. Note 2: The assembly attaching the electricity supply cable to a single-speed pump-unit does not constitute a pump-unit controller for the purposes of this Standard."

shows, the size of the market will be small by mid-2026 (the COAG EC implementation date) and even smaller by mid-2024, the target date for Options 1 and 2.

The market dynamics resemble pool pump controllers, with regard to both market structure and technology. There are already several products with DR capabilities on the market in other countries, and these could be adapted for whichever DR standard is mandated in Australia. In fact, the extended lead time for compliance in the COAG EC decision is largely to give time to consider, adapt and if necessary, draft local standards, rather than for technology development. Suppliers have already indicated their preference for wireless approaches (of which AS 4755.2 is an example, although it does not at present cover EVCs). Therefore, there should be little risk to SA consumers in adopting any of Options 1, 2 or 3. In fact, it would place greater pressure on industry (and on other Australian jurisdictions) to resolve outstanding standards issues.

Summary of Market Size and Market Risks

Table 7 summarises the preceding assessment of the market impacts and risks of the various options. If the SA government announces its intention to proceed with any of the three options, it is almost certain that some suppliers will claim they will be forced to increase prices or withdraw from the SA market until the national DR timetable catches up. Whether they do so would remain to be seen.
illustrates the projected annual sales in SA of the relevant products, extracted from the DRIS. For products other than EVCs, the sales can be projected with reasonable confidence, based on existing stocks and population growth projections, because those markets are stable and/or near saturation so the great majority of sales will be to replace existing appliances when their service life ends. The EVC sales curve is largely speculative because the EV market is so undeveloped at present.

Figure 3 Projected annual sales of products covered by DR regulations, SA

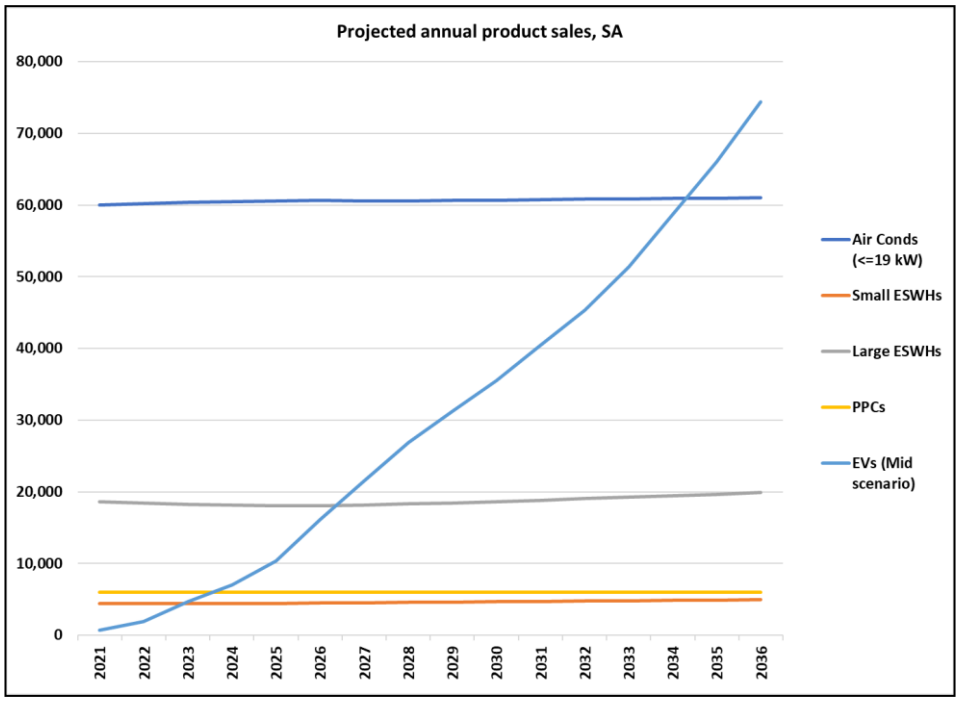


Table 7 Summary of market risk assessments

	Option 1; faster implementation	Option 2; faster implementation; greater stringency	Option 3; current implementation schedule; greater stringency
Air conditioners	Model choice restricted for 2 years; some price increase; DRSPs need to work with DREDs	Models choice heavily restricted for 2 years; more price increase; some risk of non-supply	More time to introduce compliant products – low price impact and risk
Large ESWH	High risk of supplier withdrawal	High risk of supplier withdrawal	Moderate risk of supplier withdrawal
Small ESWH	High risk of supplier withdrawal if not exempt	High risk of supplier withdrawal if not exempt	Moderate risk of supplier withdrawal if not exempt
Pool pump controller	Moderate risk of supplier withdrawal	Moderate risk of supplier withdrawal	Low risk of supplier withdrawal
EV Charger	Low risk of supplier withdrawal	Low risk of supplier withdrawal	Low risk of supplier withdrawal

Table 7 summarises the preceding assessment of the market impacts and risks of the various options. If the SA government announces its intention to proceed with any of the three options, it is almost certain that some suppliers will claim they will be forced to increase prices or withdraw from the SA market until the national DR timetable catches up. Whether they do so would remain to be seen.

2.2 Activation Rates

The DRIS modelling assumes that a significant proportion of products supplied from the date of implementation complies with the requirements, rising to 95% over a period of five years as the registration of non-complying products lapses and they are withdrawn from the market (experience with MEPS shows that compliance never reaches 100%). However, the number of products that deliver DR benefits depends on the rate of activation. The DRIS modelling projected low, medium and high activation rates for each product type. All three scenarios relied on the presence of DRSPs *from the time of implementation* who could offer DR contracts as soon as compliant products came on the market. The three-year lead time in the Base Case offered time to bed down regulatory initiatives such as the Australian Energy Market Commission (AEMC) Wholesale Market Demand Response Mechanism.[10]

If SA implements mandatory requirements in advance of the AEMC rule applying to small consumers, it would be necessary to ensure that there were sufficient drivers for DRSPs to offer SA consumers incentives to activate their DR-capable appliances. One option may be the expansion of the Retailer Energy Efficiency Scheme (REES) to reward DR. It has been assumed that whatever arrangements are put in place, they enable the activation trendlines for each product to be brought forward by the same number of years as the implementation date.

[10] The rule is scheduled to take effect on 1 July 2022. Under the draft rule, small customers would not be able to participate in the mechanism while the Commission undertakes a review of whether energy-specific consumer protections should be extended to demand response service providers (DRSPs). https://www.aemc.gov.au/news-centre/media-releases/wholesale-demand-response-mechanism-technical-working-group-4-discussion

2.3 Administrative Strategies and Costs

In addition to the cost imposed on suppliers by the segregation of the SA market, there would be a number of administrative costs deriving from the legislative framework, to ensure that suppliers, consumers and regulators are all clear about which models may be supplied and purchased in SA and can be confident that they do in fact comply.

To be effective, any SA regulations would have to:

- Define the products to which the regulation applies, by reference to a published standard or by spelling out a description;
- Nominate the date/s after which supplies of that product in SA must meet applicable DR standards;
- Prescribe the applicable DR standards (AS/NZS 4755.3.X, 4755.2 or either;
- Prescribe any DRMs required in addition to those specified in the standards; and
- Set out the requirements for the registration of products that meet the SA regulations.

For air conditioners, the conditions of registration in the GEMS determination in force until April 2020 required suppliers to answer questions about compliance with AS/NZS 4755.3.1 (without specifying the version: 2012 or 2014, but industry feedback is that no models comply with the 2014 version). Table 8 indicates the supplier responses up to April 2019. At first sight, this suggests that 1,532 models, or about half the number in the target capacity range (up to 19 kW cooling) complied, and about 93% of compliant models supported all three DRMs (see Table 8). However, it was subsequently found that the sequence of registration questions (the "script") was unclear and could have led to incorrect responses. In any case, there was no obligation on the GEMS Regulator to verify the statements, although presumably action could have been taken under the Consumer Protection Act in the event of deliberate misstatement.

The GEMS determination that took effect in April 2020 no longer requires applicants to answer questions about AS/NZS 4755 compliance. The GEMS regulator intends to retain the relevant questions in the (improved) registration script, but it would be up to suppliers whether to answer them or not, and the regulator would still have no power to verify claims of compliance. To meet the COAG EC timetable, a new determination would have to take effect by 1 July 2023 at the latest, so air conditioner models registered from that date would have to demonstrate compliance with one of the accepted DR standards in the same way they demonstrate compliance with MEPS: by submitting a test report. To give the industry adequate lead time, the determination should be published at least a year in advance (a recommendation accepted by COAG EC).

Table 8 Supplier responses to questions about compliance with AS/NZS 4755.3.1

% of models	Rated cooling output	Num-ber of mod-els	1. Has built-in DR capab-ility?	2. Label indic-ates DR?	4 Separ ate part?	5 Has DRM 1?	6 Has DRM 2?	7 DRM 3?	Has 1 DRM	Has 2 DRMs	Has 3 DRMs	Claim built-in *and* extra part
79%	<=19	3118	1532	1081	303	1583	1475	1478	105	3	1475	29
12%	19-39	484	75	6	111	84	59	59	25	0	59	1

9%	>39	340	63	0	94	63	33	33	30	0	33	0
100%	All	3942	1670	1087	508	1730	1567	1570	160	3	1567	30

Source: GWA analysis of GEMS register, April 2019. Question numbers indicated in registration script.

For ESWHs, which must also be registered under the GEMS Act, there has never been a requirement to declare whether a model complies with AS/NZS 4755.3.3. Pool pump controllers and EV chargers are not covered by any GEMS determinations.

For the time being, therefore, the SA regulator could not rely on the national GEMS register to reliably identify whether a model complies with one of the acceptable DR standards. SA would need to set up its own register, but it may not be necessary to start from scratch.

It would be reasonable for the SA regulator to declare that any models eligible under PeakSmart could be registered in SA without further testing, provided that:

- The supplier is prepared to made a declaration that the model complies with AS/NZS 4755.3.1:2012 or AS/NZS 4755.3.1:2014; and

- The supplier accepts that the SA regulator may randomly test a model supplied in SA and, if the unit is found to be non-compliant (after a series of follow-up tests, based on the GEMS rules) may deregister that product, so making it unlawful to supply in SA.

This would avoid the need for suppliers to test each model (at an estimated cost of about $2,500) but there would still be a registration fee in SA to recover administrative costs. A fee of $500 has been assumed for the present report. By comparison, the fee for registering an air conditioner model or family under GEMS is $790 (GWA 2018). It is also assumed that the SA Government would undertake a modest program of annual check tests in each year that the SA requirements diverge from national requirements.

Of course, air conditioner suppliers may wish to register models in SA that are *not* on the PeakSmart register, and should be able to do so if they submit a report of an AS/NZS 4755 test. Direct registration in SA, supported by a test report, would be the only option for suppliers of ESWHs, PPCs and EVCs.

Once registrations under a national determination become possible for a product, it would no longer be necessary for SA to maintain a separate register, even if it wanted to enforce more stringent requirements. For example, a national DR determination for electric storage water heaters could require suppliers to declare whether the model meets AS/NZS 47455.3.3:2014 or AS 4755.2, and which DRMs it supports apart from DRM1 (the only nationally mandated DRM). SA regulations could then declare that only those models which meet AS 4755.2 and have DRM4 as well would be lawful to supply in SA, but there would be no further need to register them separately. SA may still need is own check test program, however, if the national program is restricted to verifying compliance with the nationally mandated requirements only.

2.4 Spillover to other jurisdictions

If SA takes action in the ways analysed in this report, it may impact on other jurisdictions in the following ways:

a) Suppliers that introduce models to meet the SA requirements would probably offer those models in other jurisdictions as well, and this would bring forward and accelerate the scope for DR programs in those areas (assuming that local DRSPs were able to take advantage of those opportunities) without the need for regulation;

b) Other jurisdictions may follow SA's lead and introduce harmonised regulations. This would give suppliers the incentive to introduce more models that comply with the requirements, since the assured market would be larger;

c) If other jurisdictions introduce harmonised regulations, they could share with SA the cost of maintaining a register and conducting check testing.

It would be possible to model the projected benefits under (b) for other jurisdictions, but this information would only be salient if SA wished to persuade other governments to regulate for the same options as SA, and hence depart from the COAG EC consensus.

It was agreed with DEM that this analysis is not necessary at present. However, it is a relatively easy to test the effects of sharing the costs of (c) with other jurisdictions, and this has been done in Chapter 3.

3. Options

3.1 Base Case

The base case represents the costs and benefits if SA stays with the national DR standards implementation strategy and timetable. These are calculated in the same way as for the DRIS, but with the following changes:

- The electricity load reductions available from air conditioners are reduced from 40% to 35% of the power at rated capacity, to reflect the lack of models complying with AS/NZS 4755.3.1:2014, and the latest draft of AS 4755.2, which defines DRM2 as a reduction to 50% of power at rated capacity. An air conditioner would have to be operating at 85% load to achieve a 35% reduction under DRM2, or 35% to achieve a 35% reduction at DRM1 (see Figure 4).

- It was discovered that in the DRIS model the peak load avoided value for SA (set at $675/kVA after discussions with SA Power Networks) had not been carried through to the water heater spreadsheets, which were still linked to a previous, higher price assumption (the AC, PPC and EVC calculations were correct).

The revised Base Case is summarised in Table 9, Table 10, Table 11 for the Medium, Low and High Activation cases respectively. The effect of the above changes is to reduce the Net Benefit from $M 174 in the DRIS to $M 83 and the B/C ratio from 3.6 to 2.3 (about the same as for Tasmania, and higher than for NSW, ACT and NT). The projected MW reductions available in 2026 and 2036 also decline slightly.

Figure 4 Load reduction assumptions for air conditioners

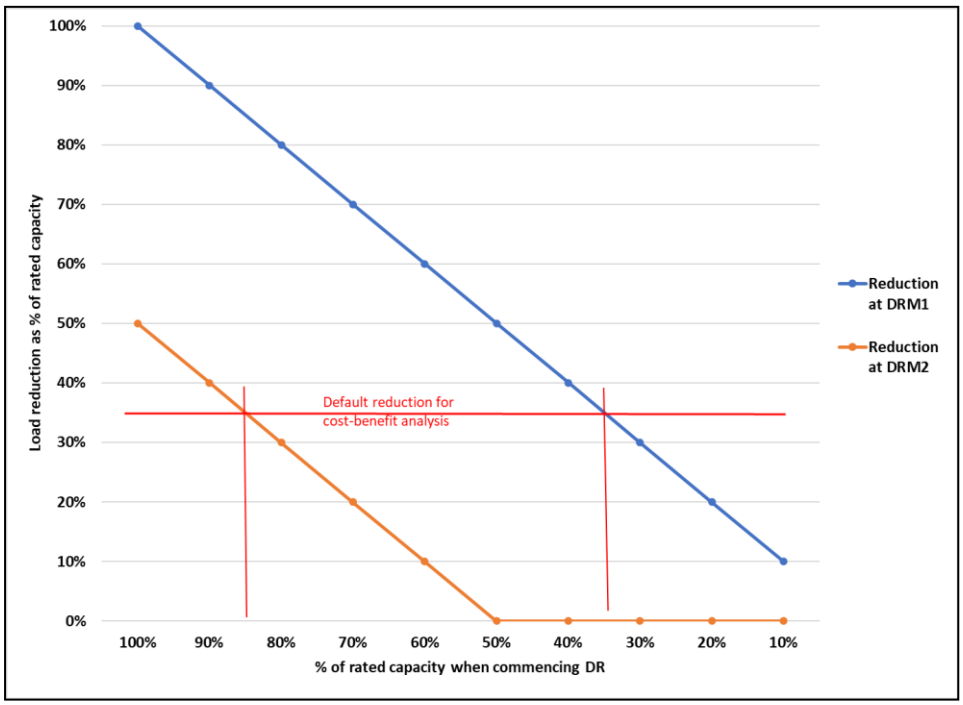


Table 9 Base Case - Medium Activation Rate (Rapid compliance)

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$70	$30	$40.4	2.4	58	345
PP Controllers	$11	$5	$6.8	2.5	2	16
Water heaters (Small)	$6.1	$2.5	$3.6	2.4	2(a)	21
Water heaters (Large)	$16.1	$11.6	$4.6	1.4		
EV chargers	$41	$14	$27.2	2.9	0	47
All products	$145	$62	$83	2.3	61	429
In DRIS (E3 2019a)	$ 242	$68	$174	3.6	83	455

(a) Note: MW reductions for small and large ESWHs are combined

Table 10 Base Case – Low Activation Rate (Rapid compliance)

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$57	$23	$33.7	2.45	44	261
PP Controllers	$9	$4	$4.7	2.18	1	12
Water heaters (Small)	$4.6	$2.3	$2.3	2.02	1(a)	15
Water heaters (Large)	$12.2	$10.6	$1.6	1.15		
EV chargers	$31	$13	$18.7	2.49	0	36
All products	$114	$53	$61	2.2	46	325

(a) Note: MW reductions for small and large ESWHs are combined

Table 11 Base Case – High Activation Rate (Rapid compliance)

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$96	$42	$53.6	2.27	86	508
PP Controllers	$16	$6	$10.8	2.91	3	23
Water heaters (Small)	$9.0	$2.9	$6.1	3.07	2(a)	30
Water heaters (Large)	$23.8	$13.5	$10.4	1.77		
EV chargers	$60	$17	$43.6	3.59	0	69
All products	$205	$81	$124	2.5	91	631

(a) Note: MW reductions for small and large ESWHs are combined

As discussed previously, given the expiry dates of existing models, there is a risk that water heater suppliers may re-register non-compliant models prior to 1 July 2023, after which only DR-compliant models could be registered under COAG EC timetable. In that case, the introduction of compliant water heaters could be delayed by up to 5 years (Figure 1). This would defer both the costs and benefits from ESWH DR, as shown in Table 12, Table 13 and Table 14, but would resulting in lower net benefits and lower MW reductions than in the rapid compliance Base Case. Therefore, the net benefits of SA-specific action would be correspondingly higher, by $M 7 (medium activation rate), $M 4 (low activation) and $M 12 (high activation) - compare Figure 9 with Figure 8.

Table 12 Base Case - Medium Activation Rate (Delayed compliance)

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$70	$30	$40.4	2.36	58	345
PP Controllers	$11	$5	$6.8	2.49	2	16
Water heaters (Small)	$1.8	$1.0	$0.8	1.77	0(a)	9
Water heaters (Large)	$5.5	$5.0	$0.5	1.09		
EV chargers	$41	$14	$27.2	2.94	0	47
All products	$130	$54	$76	2.4	60	418

(a) Note: MW reductions for small and large ESWHs are combined

Table 13 Base Case – Low Activation Rate (Delayed compliance)

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$57	$23	$33.7	2.45	44	261
PP Controllers	$9	$4	$4.7	2.18	1	12
Water heaters (Small)	$1.4	$1.0	$0.4	1.42	0(a)	7
Water heaters (Large)	$4.1	$4.7	-$0.6	0.88		
EV chargers	$31	$13	$18.7	2.49	0	36
All products	$102	$45	$57	2.3	45	317

(a) Note: MW reductions for small and large ESWHs are combined

Table 14 Base Case – High Activation Rate (Delayed compliance)

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$96	$42	$53.6	2.27	86	508
PP Controllers	$16	$6	$10.8	2.91	3	23
Water heaters (Small)	$2.7	$1.2	$1.6	2.35	0(a)	14
Water heaters (Large)	$8.1	$5.6	$2.5	1.45		
EV chargers	$60	$17	$43.6	3.59	0	69
All products	$183	$71	$112	2.6	89	614

(a) Note: MW reductions for small and large ESWHs are combined

3.2 Option One – Faster implementation in SA

The costs and benefits of Option 1 are summarised in Table 15, Table 16 and Table 17. These differ from the Base Case in that the streams of both costs and benefits commence earlier, increasing the NPV of both benefits and costs. These lead to higher net benefits than in the Rapid Base Cases (and higher still compared with the Delayed Base Case), even after an estimated $M 4.8 of SA-specific costs are included.

Table 15 Option 1 – Medium Activation Rate

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$95.2	$44.3	$50.9	2.1	110	449
PP Controllers	$15.8	$6.1	$9.7	2.6	4	19
Water heaters (Small)	$8.8	$3.4	$5.4	2.6	4(a)	27
Water heaters (Large)	$24.3	$16.2	$8.2	1.5		
EV chargers	$40.4	$12.7	$27.6	3.2	1	43
All products	$184.5	$82.7	$101.8	2.2	118	538
Reg & testing cost		$1.1				
Sales price premiums		$3.7				
After price premiums	$184.5	$87.5	$96.9	2.1		

(a) Note: MW reductions for small and large ESWHs are combined

Table 16 Option 1 – Low Activation Rate

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$76.0	$34.6	$41.3	2.2	83	340
PP Controllers	$10.4	$5.0	$5.4	2.1	2	14
Water heaters (Small)	$6.7	$3.1	$3.6	2.2	3(a)	20
Water heaters (Large)	$18.4	$14.6	$3.8	1.3		
EV chargers	$30.6	$11.3	$19.3	2.7	1	32
All products	$142.1	$68.6	$73.5	2.1	89	407
Reg & testing cost		$1.1				
Sales price premiums		$3.7				
After price premiums	$142	$73.4	$68.7	1.9		

(a) Note: MW reductions for small and large ESWHs are combined

Table 17 Option 1 – High Activation Rate

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$132.4	$63.1	$69.3	2.1	162	659
PP Controllers	$22.9	$7.6	$15.3	3.0	5	28
Water heaters (Small)	$13.1	$4.1	$9.0	3.2	5(a)	40
Water heaters (Large)	$35.8	$19.2	$16.6	1.9		
EV chargers	$59.1	$15.5	$43.6	3.8	1	62
All products	$263.3	$109.5	$153.8	2.4	174	788
Reg & testing cost		$1.1				
Sales price premiums		$3.7				
After price premiums	$263	$114.3	$149.0	2.3		

(a) Note: MW reductions for small and large ESWHs are combined

3.3 Option Two – More stringent requirements and faster implementation

The most significant changes from Option 1 are restricting compliance to AS 4755.2 for all products and requiring DRM4 for ESWHs and PPCs. As indicated in Table 3 this would impose additional costs on all product types but reduce activation costs. For large ESWHs and PPCs it would also bring additional benefits beyond mandating DRM1 only, because managing water heaters to maximise their heat storage capacity would be more convenient for DRSPs (see Appendix 3; it is assumed that DRM4 would not be required for small ESWHs, since their heat storage capacity is very low). Similarly, managing PPCs to turn on during periods of excess PV output would also be more convenient and therefore more likely to occur.

This is captured in the modelling by increasing the estimated average number of hours of load-on operation that these products will provide per annum (see Table 18). Air conditioners and EVCs are required to have the full range of DRMs in the Base Case, so there is no effect on those products.

Table 19, Table 20 and Table 21summarise the cost and benefits of Option 2. For air conditioners, PPCs and small ESWHs, the benefits (savings) are identical to Option1, but the costs are slightly higher. For large ESWHs both the benefits and costs are significantly higher than in Option 1, but the difference between them (the net benefit) is slightly lower. There would be no difference for EVCs, because Option 1 already requires the full range of DRMs. The SA registration costs are slightly lower than in Option 1 because there would be fewer models available on the market, but for the same reason the sales price premiums would be higher.

Table 18 Estimated hours per annum of load-on operation (DRM4)

	Base Case		Option 2, Option 3	
	2019	**2036**	**2019**	**2036**
Small water heater	30	60	60	110
Large water heater	90	150	120	250
Pool pump controller	60	110	90	150

Table 19 Option 2 – Medium Activation Rate

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$95.2	$44.9	$50.2	2.1	110	449
PP Controllers	$15.8	$6.4	$9.4	2.5	4	19
Water heaters (Small)	$8.8	$4.2	$4.6	2.1	4(a)	27
Water heaters (Large)	$29.7	$22.9	$6.7	1.3		
EV chargers	$40.4	$12.7	$27.6	3.2	1	43
All products	$189.8	$91.2	$98.6	2.1	118	538
Reg & testing cost		$0.9				
Sales price premiums		$7.8				
After price premiums	$189.8	$99.9	$89.9	1.9		

(a) Note: MW reductions for small and large ESWHs are combined

Table 20 Option 2 – Low Activation Rate

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$76.0	$37.1	$38.8	2.0	83	340
PP Controllers	$10.4	$5.5	$4.9	1.9	2	14
Water heaters (Small)	$6.7	$3.9	$2.7	1.7	3(a)	20
Water heaters (Large)	$22.5	$21.5	$1.0	1.0		
EV chargers	$30.6	$11.3	$19.3	2.7	1	32
All products	$146.1	$79.3	$66.8	1.8	89	407
Reg & testing cost		$0.9				
Sales price premiums		$7.8				
After price premiums	$146	$88.0	$58.1	1.7		

(a) Note: MW reductions for small and large ESWHs are combined

Table 21 Option 2 – High Activation Rate

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$132.4	$60.1	$72.3	2.2	162	659
PP Controllers	$22.9	$7.4	$15.5	3.1	5	28
Water heaters (Small)	$13.1	$4.9	$8.2	2.7	5(a)	40
Water heaters (Large)	$43.7	$25.8	$17.9	1.7		
EV chargers	$59.1	$15.5	$43.6	3.8	1	62
All products	$271.2	$113.7	$157.5	2.4	174	788
Reg & testing cost		$0.9				
Sales price premiums		$7.8				
After price premiums	$271	$122.4	$148.8	2.2		

(a) Note: MW reductions for small and large ESWHs are combined

3.4 Option Three – More stringent requirements, current schedule

Under Option 3 the implementation dates are the same as in the COAG EC decision (the Base Case) but the mode of implementation is different. The rules would apply to products *supplied* in SA after those dates, rather than to products registered nationally after those dates, so the impact is more immediate than in the Base Case. The higher stringency in Option 2 would also apply, but with two years longer lead time than Option 2 the cost impacts would be somewhat lower.

The outcomes are summarised in Table 22, Table 23 and Table 24. Compared with the Base Case, the costs are somewhat lower because the decline in activation costs for AS 4755.2 products outweigh the increase in product costs. There are no SA registration costs because the national registration systems would need to be in place by then, but there are still costs related to the segregation of the SA market.

Table 22 Option 3 – Medium Activation Rate

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$70.1	$27.4	$42.7	2.6	58	345
PP Controllers	$11.3	$4.2	$7.0	2.7	2	16
Water heaters (Small)	$6.5	$2.8	$3.7	2.3	2(a)	21
Water heaters (Large)	$19.6	$14.8	$4.8	1.3		
EV chargers	$41.2	$14.0	$27.2	2.9	0	47
All products	$148.7	$63.2	$85.5	2.4	61	429
Reg & testing cost		$0.0				
Sales price premiums		$2.3				
After price premiums	$148.7	$65.5	$83.2	2.3		

(a) Note: MW reductions for small and large ESWHs are combined

Table 23 Option 3 – Low Activation Rate

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$56.9	$22.3	$34.6	2.6	44	261
PP Controllers	$8.6	$3.8	$4.8	2.3	1	12
Water heaters (Small)	$4.9	$2.6	$2.3	1.9	1(a)	15
Water heaters (Large)	$14.8	$13.8	$0.9	1.1		
EV chargers	$31.3	$12.5	$18.7	2.5	0	36
All products	$116.5	$55.1	$61.4	2.1	46	325
Reg & testing cost		$0.0				
Sales price premiums		$2.3				
After price premiums	$116	$57.4	$59.1	2.0		

(a) Note: MW reductions for small and large ESWHs are combined

Table 24 Option 3 – High Activation Rate

	Total saving $M NPV	Increase in costs $M NPV	Net Savings $M NPV	Benefit/ Cost ratio	MW Reduction cf BAU 2026	MW Reduction Med 2036
Air Conds	$95.8	$37.3	$58.5	2.6	86	508
PP Controllers	$16.4	$5.0	$11.4	3.3	3	23
Water heaters (Small)	$9.7	$3.2	$6.5	3.0	2(a)	30
Water heaters (Large)	$28.9	$16.5	$12.4	1.8		
EV chargers	$60.4	$16.8	$43.6	3.6	0	69
All products	$211.2	$78.9	$132.3	2.7	91	631
Reg & testing cost		$0.0				
Sales price premiums		$2.3				
After price premiums	$211	$81.3	$130.0	2.6		

(a) Note: MW reductions for small and large ESWHs are combined

4. Findings and Conclusions

4.1 Comparison with Base Cases

Table 25 summarises the NPV of the net benefits (NPV of projected savings less NPV of projected costs over the period 2020-2036) for the Base Cases and three options. The data are presented by product and by the three activation scenarios used in the DRIS. The total net benefit is then reduced by the estimated SA-specific registration costs and market premiums for that option. There are no SA-specific costs for the Base Cases; the estimates are $M 4.8 for Option 1, $M 8.7 for Option 2 and $M 2.3 for Option 3.

The difference between the Rapid and Delayed Base Cases is due solely to assumptions about how quickly ESWH suppliers would respond to the COAG EC. If they responded quickly then the NPV (at a Medium activation rate) would be $M 3.6 for small ESWH and $M 4.6 for large ESWH. However, if suppliers delayed registering compliant models as long as possible, then benefits would not start to accrue until much later and the NPV (at a Medium activation rate) would fall to be $M 0.8 for small ESWH and $M 0.5 for large ESWH. In effect, there would be no assured benefit for ESWHs.

Table 25 Summary of Net Benefits – All Options

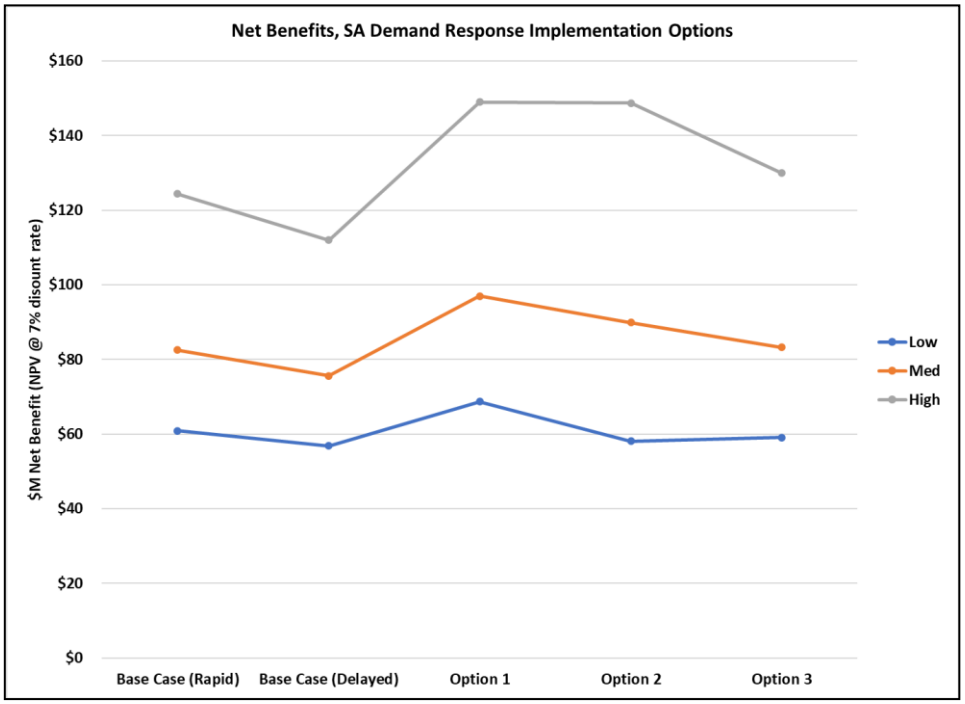
	AC $M	PPC $M	SWH $M	LWH $M	EVC $M	All $M	SA cost admin	SA cost market	After SA Costs
Base (Rapid) - Low	$33.7	$4.7	$2.3	$1.6	$18.7	$60.9	0	0	$60.9
Base (Rapid) -Med	$40.4	$6.8	$3.6	$4.6	$27.2	$82.5	0	0	$82.5
Base (Rapid) - High	$53.6	$10.8	$6.1	$10.4	$43.6	$124.4	0	0	$124.4
Base (Delayed) - Low	$33.7	$4.7	$0.4	-$0.6	$18.7	$56.8	0	0	$56.8
Base (Delayed) -Med	$40.4	$6.8	$0.8	$0.5	$27.2	$75.6	0	0	$75.6
Base (Delayed) - High	$53.6	$10.8	$1.6	$2.5	$43.6	$112.0	0	0	$112.0
Option 1 - Low	$41.3	$5.4	$3.6	$3.8	$19.3	$73.5	$1.1	$3.7	$68.7
Option 1 - Med	$50.9	$9.7	$5.4	$8.2	$27.6	$101.8	$1.1	$3.7	$96.9
Option 1 - High	$69.3	$15.3	$9.0	$16.6	$43.6	$153.8	$1.1	$3.7	$149.0
Option 2 - Low	$38.8	$4.9	$2.7	$1.0	$19.3	$66.8	$0.9	$7.8	$58.1
Option 2 - Med	$50.2	$9.4	$4.6	$6.7	$27.6	$98.6	$0.9	$7.8	$89.9
Option 2 - High	$72.3	$15.5	$8.2	$17.9	$43.6	$157.5	$0.9	$7.8	$148.8
Option 3 - Low	$34.6	$4.8	$2.3	$0.9	$18.7	$61.4	0	$2.3	$59.1
Option 3 - Med	$42.7	$7.0	$3.7	$4.8	$27.2	$85.5	0	$2.3	$83.2
Option 3 - High	$58.5	$11.4	$6.5	$12.4	$43.6	$132.3	0	$2.3	$130.0

Source: Table 9 to Table 24. All values $M NPV @7% discount rate for period 2020-2036

Table 7 summarises the preceding assessment of the market impacts and risks of the various options. If the SA government announces its intention to proceed with any of the three options, it is almost certain that some suppliers will claim they will be forced to increase prices or withdraw from the SA market until the national DR timetable catches up. Whether they do so would remain to be seen.
illustrates the sensitivity of outcomes to the activation rates. Under medium activation rates, Options 1 and 2 would have a higher net benefit than either base case. However, if

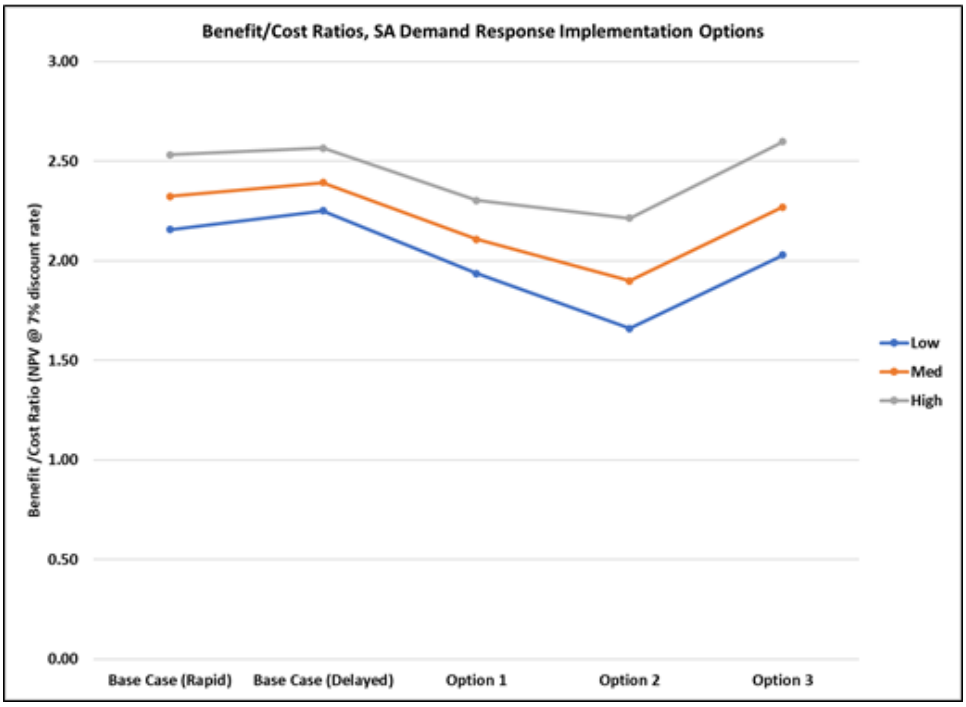
DRSPs were not able to offer activations as soon as compliant product start appearing, then the activation rates could drop to the point where SA consumers were no better off than in the base cases. Figure 6 illustrates benefit/cost ratios (NPV of projected savings *divided by* NPV of projected costs over the period 2020-2036) for the Base Cases and three options. While Options 1 and 2 have higher net $ benefits than the base cases, the B/C ratios are somewhat lower.

Figure 5 Net benefits: Base Cases and Options 1,2 and 3



Source: Table 25

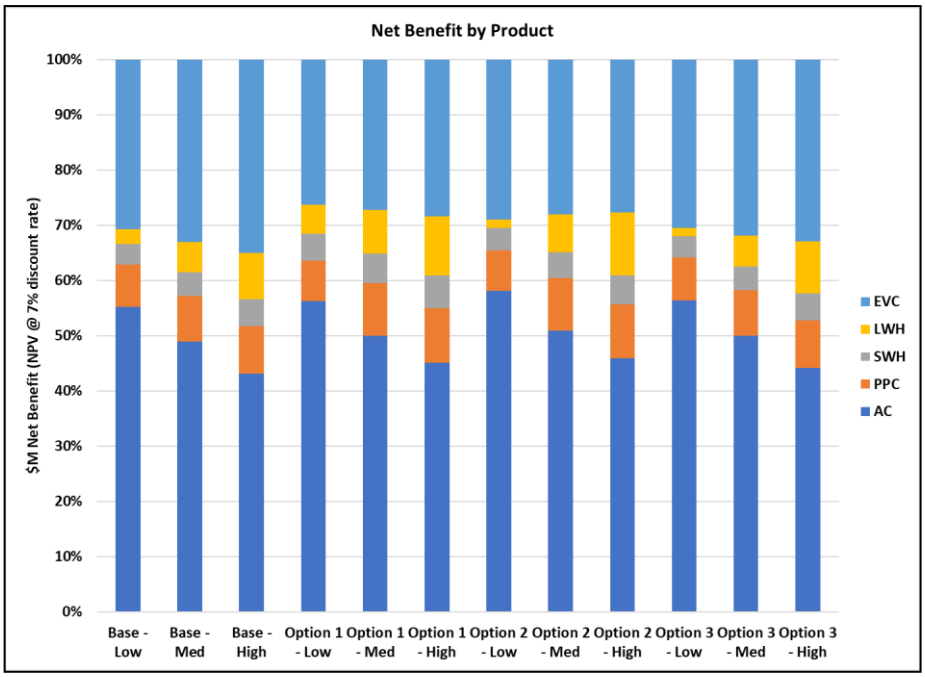
Figure 6 B/C ratios, Base Cases and Options 1,2 and 3



Source: Table 9 to Table 24.

Figure 7 illustrates the share of net benefit attributable to each product type under each option and activation scenario. In all cases ACs and EVCs account for the majority of benefits, followed by ESWHs (large and small combined) and then PPCs. The highest contribution of EWHS to total net befits is about 17% (Options 1 and 2, high activation rates).

Figure 7 Net Benefits by Product, Base Case (Rapid) and Options 1,2 and 3



Excludes SA-specific costs

Table 26 compares the net benefit of each option with to the two base cases, with the SA-specific costs included. At medium activation rates, Option 1 returns 17-28% higher benefits than the base case, Option 2 returns 9-10% higher benefits and Option 3 returns 1-10% higher benefits. At low activation rates, however, it is possible that the increase in SA-specific costs would match or exceed any increase. This is illustrated by the cases in Figure 8 and Figure 9 where the estimated SA-specific costs (shown below the X-axis) exceed the net benefits (the bars above the axis).

Clearly, the estimate net benefits are most sensitive to the assumption about WH supplier behaviour under the COAG EC Base Case.

Table 26 Increase in Net Benefits Compared with Base Cases, all options

	Compared with Rapid Base Case		Compared with Delayed Base Case	
Option 1 - Low	$7.8	13%	$11.8	21%
Option 1 - Med	$14.4	17%	$21.3	28%
Option 1 - High	$24.6	20%	$37.0	33%
Option 2 - Low	-$2.8	-5%	$1.2	2%
Option 2 - Med	$7.4	9%	$14.3	19%

Option 2 - High	$24.4	20%	$36.8	33%
Option 3 - Low	-$1.8	-3%	$2.2	4%
Option 3 - Med	$0.7	1%	$7.6	10%
Option 3 - High	$5.6	4%	$18.0	16%

Includes SA-Specific costs

Figure 8 Change from Base Case (Rapid): Benefits and SA-specific costs

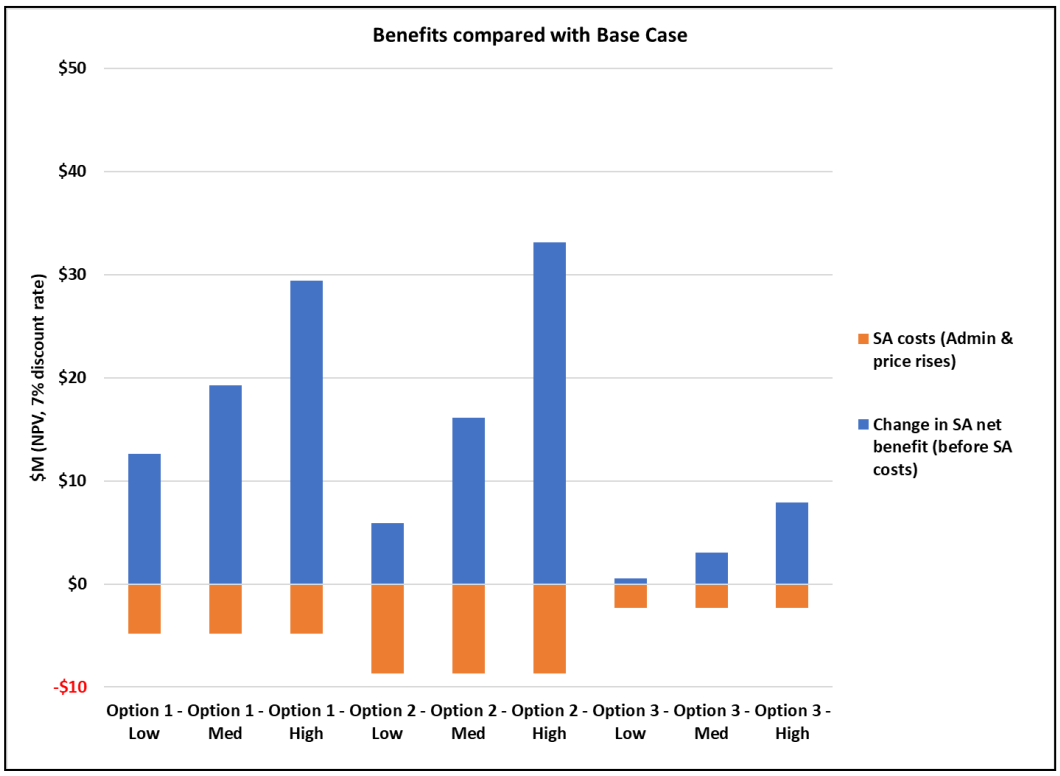
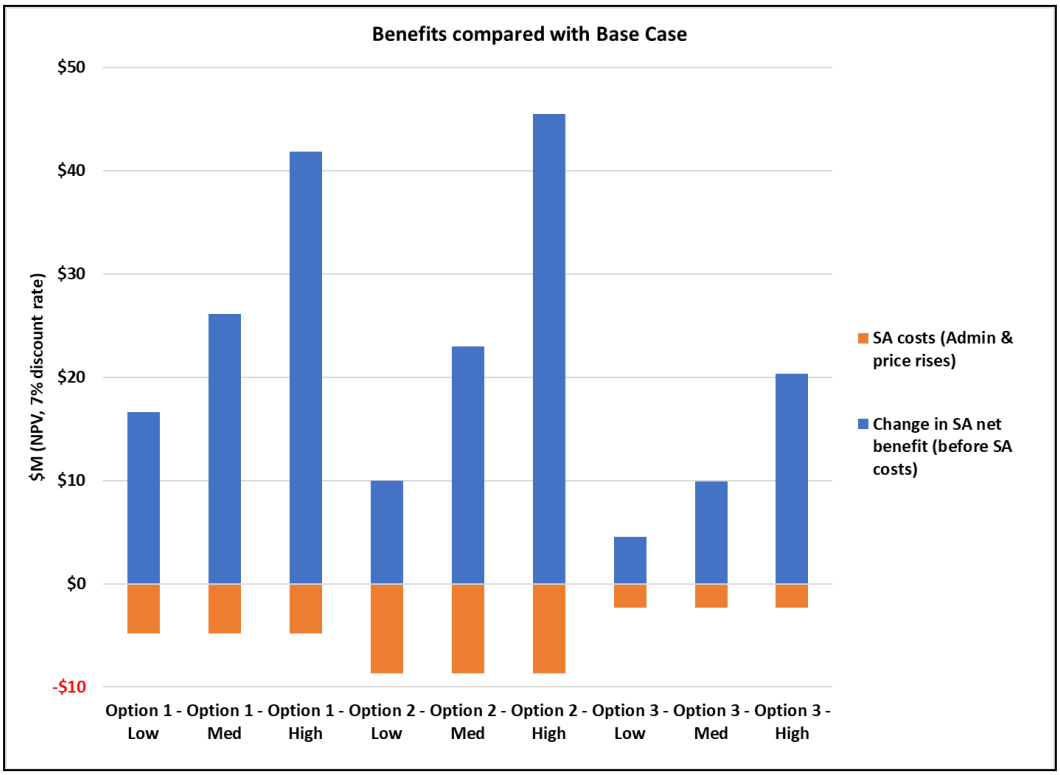


Figure 9 Change from Base Case (Delayed): Benefits and SA-specific costs



4.2 Sensitivity Tests

SA-Specific Costs

If other jurisdictions follow the same options and timing as SA, then it may be possible to share the costs of setting up and managing a common register of products. The purchase price premiums from recovering stock segregation costs could be spread more widely. The availability of a larger pool of consumers would be an incentive for suppliers who may otherwise have reduced their model offerings in the SA market, or at worst withdrawn entirely for a period, to introduce compliant models earlier. The increasing competition would reduce the market premiums that SA consumers would bear from the values in Table 3.

Table 27 shows the increase in net benefits in the event that SA "admin" (registration and testing) costs were equally shared with two other jurisdictions, and so reduced to one third of the values in Table 3. The effect on "market" premiums is less predictable, so it has been assumed that the values in Table 3 are halved. The net benefits of all options would increase to the values shown in Table 27 and Table 28.

Table 27 Increase in Net Benefits Compared with Base Cases, all options (lower SA-specific costs)

	Compared with Rapid Base Case		Compared with Delayed Base Case	
Option 1 - Low	$10.4	17%	$14.4	25%
Option 1 - Med	$17.0	21%	$23.9	32%

Option 1 - High	$27.2	22%	$39.6	35%
Option 2 - Low	$1.7	3%	$5.7	10%
Option 2 - Med	$11.9	14%	$18.8	25%
Option 2 - High	$28.9	23%	$41.3	37%
Option 3 - Low	-$0.7	-1%	$3.4	6%
Option 3 - Med	$1.9	2%	$8.7	12%
Option 3 - High	$6.8	5%	$19.2	17%

Al vales $M NPV. Includes SA-Specific costs

Table 28 Change in net benefits if SA-specific costs are reduced

	Compared with Rapid Base Case		Compared with Delayed Base Case	
Option 1 - Low	$2.6	4%	$2.6	5%
Option 1 - Med	$2.6	3%	$2.6	3%
Option 1 - High	$2.6	2%	$2.6	2%
Option 2 - Low	$4.5	7%	$4.5	8%
Option 2 - Med	$4.5	5%	$4.5	6%
Option 2 - High	$4.5	4%	$4.5	4%
Option 3 - Low	$1.2	2%	$1.2	2%
Option 3 - Med	$1.2	1%	$1.2	2%
Option 3 - High	$1.2	1%	$1.2	1%

All values $M NPV. Compares Table 30 with Table 26

Higher values for energy storage

One of the reasons for SA to consider taking action to implement DR requirements early is the value of distributed energy storage in its PV-intensive electricity network. In the DRIS, the value of energy shifted into minimum-load periods was set at $80/MWh (8c/kWh) on advice from AEMO. The effects of doubling the value (to 16c/kWh stored) and tripling it (to 24c/kWh stored) are illustrated in Figure 10 and Figure 11. This would significantly increase the value of all options at all activation rates.

Figure 10 Impact on Net benefits – higher storage values

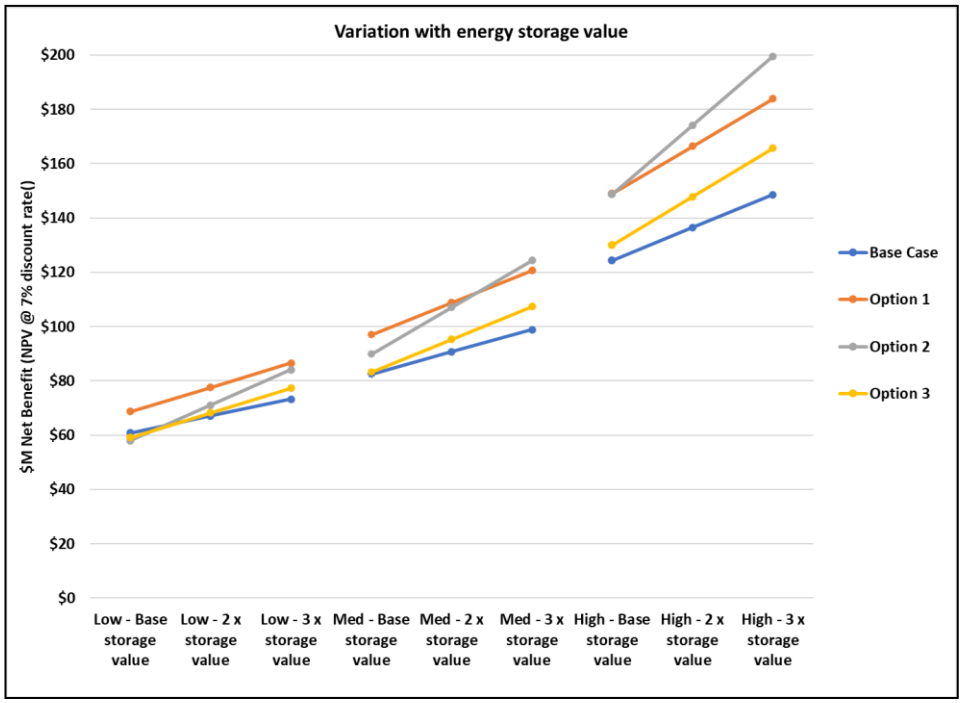
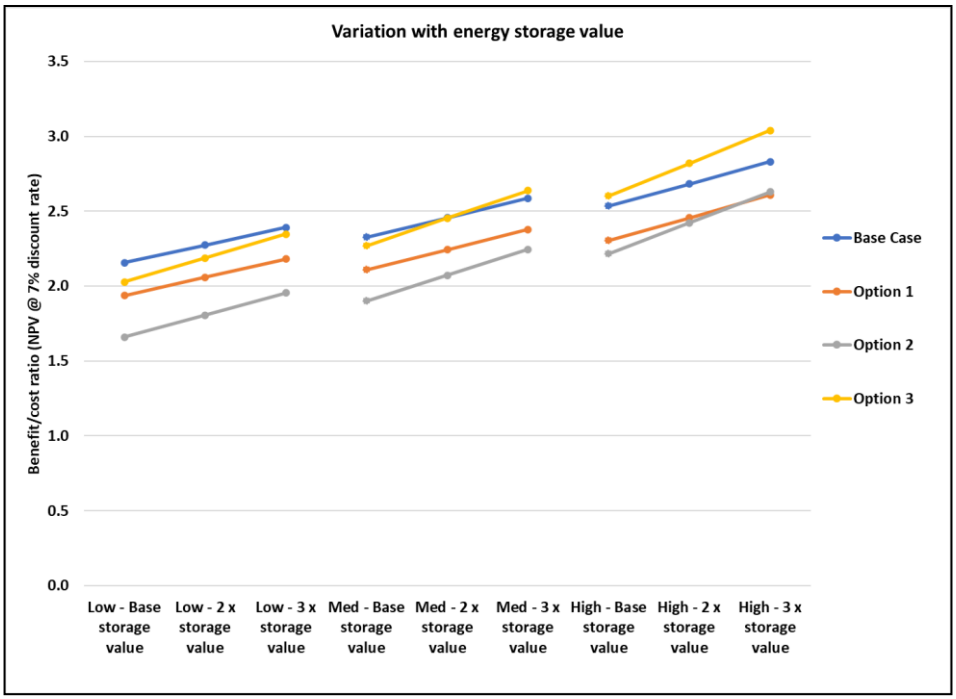


Figure 11 Impact on B/C ratios – higher storage values



Higher activation rates

All three options would result in higher product retail prices compared with the Base Case but Options 2 and 3 should have lower activation costs because separate demand response enabling devices (DREDs) would not be needed (Table 3). This should lower costs for demand response service providers and encourage greater take-up by consumers and higher activation rates than in the Base Case.

If there is an increase in activation rates, Option 2 and 3 could bring substantially higher benefits than the Base Case. (Option 1 would most likely be based on DRED

architecture, so there would be no advantage in activation costs). Table 29 illustrates the potential magnitude of these changes, compared with keeping activation rates constant across options.

While Option 2 shows higher increases in NPV, it is also riskier in that air conditioner and electric water heaters suppliers will find it very difficult to introduce products complying with AS 4755.2 with a lead time of only one year, and may have no choice but to withdraw from the SA market. Option 3 offers a much more realistic three year lead time. If it leads to higher activation rates than the Base Case, the increases in NPV could range from $M 22 to $M 54 (37% to 72%).

Table 29 Increase in Net Benefits if Activation Rates Increase Compared with Base Cases, Options 2 and 3

	Activation rates compared	cf Rapid Base Case		cf Delayed Base Case	
		$M	%	$M	%
Option 2	Med cf Low	$29	48%	$33	58%
Option 2	High cf Med	$66	80%	$73	97%
Option 3	Med cf Low	$22	37%	$26	46%
Option 3	High cf Med	$47	57%	$54	72%

All values $M NPV. Source: extracted from Table 25

4.3 Conclusions

All three options analysed in this study would accelerate the implementation in SA of the COAG EC decision on demand response standards for appliances, by regulating that products *supplied* after target dates would need to comply, not just products registered after those dates.

This distinction is likely to be most significant for ESWHs, where the turnover of new models is slow, there are no models at present which comply with the DR standards and suppliers may choose to delay the introduction of complying models. For air conditioners there are over 1,100 complying models already, model turnover is high and the market is more competitive. PPCs and EVCs are not yet covered by the GEMS Act, so there should be no significant lag between first registration and the time of supply

Accelerating the implementation dates by two years for each product (Option 1) would increase the net benefits for SA by about $M 14-21 or 17-28% more than in the Base Case (i.e. the COAG EC timetable). Applying more stringent requirements at the same time (Option 2) would also lead to greater benefits than the Base Case, but by a lesser margin than Option 1: $M 7-14, or 9-19% more.

Option 3 would follow the COAG EC target implementation dates, but would still accelerate the effects in SA and would apply more stringent criteria, as in Option 2. It would also lead to slightly greater benefits than the Base Case: $M 1-8 or 1-10% more. If it resulted in significantly higher activation rates, the increases in NPV could range from $M 22-54 (37-72% higher than the Base Case).

These projections are sensitive to a number of assumptions and uncertainties:

- Activation rates: all compliant units incur a cost, but only those "activated" or connected to a DR communications network deliver a benefit. The net benefit will depend on the activation rates achieved – whether medium, high or low. This will partly depend on whether the entry of DRSPs to the market can be brought forward to the same extent as the availability of compliant products;

- The counter-factual Base Case: the more suppliers that would otherwise take advantage of the "grandfathering" provision in the GEMS Act to delay the introduction of compliant products, the greater the impact of SA action;

- The specific cost to SA (apart from the technical costs of manufacturing and activating DR-compliant products, which would be the same in all jurisdictions): the administrative costs of registration and check testing over the period when SA regulations differ from other jurisdictions, and the market price effects from fewer models and less competition in the SA market. If other jurisdictions were to adopt the same option and regulations as SA, administrative costs may be shared and the market price impacts on SA consumers reduced; and

- The value assigned to the capacity of ESWHs and PPCs to store or use energy at times of when PV output would otherwise exceed load. The higher this value, the greater the value of each option.

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BIS Oxford Economics, July 2018

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E3 (2019a) *Regulation Impact Statement for Decision: 'Smart' Demand Response Capabilities for Selected Appliances,* Equipment Energy Efficiency Committee, October 2019

Energeia (2018) *Australian Electric Vehicle Market Study,* Prepared by ENERGEIA for ARENA and CEFC, FINAL May 2018

GWA (2018) *Greenhouse and Energy Minimum Standards (GEMS) Act: Product Registration Issues,* GWA for Department of Environment and Energy, April 2018

Appendix 1 COAG EC Decision

Decision at 22nd COAG Energy Council Meeting Perth, 22 November 2019:

1. **Agree** to introduce demand response (DR) capability requirements for air conditioners (ACs), electric storage water heaters (resistive), devices controlling swimming pool pump units (Australia only), and electric vehicle (EV) charger/discharger controllers recommended by the Decision RIS (DRIS) at **Attachment A** (Option 3 in the DRIS - Recommendations 1-15).
2. **Agree** to delegate endorsement of the legislative instruments to the Senior Committee of Officials (SCO).
3. **Note** that making legislative instruments to give effect to the new regulations recommended by the Decision RIS will be subject to legal advice and may require amendment to the *Greenhouse and Energy Minimum Standards (GEMS) Act 2012 Act* and New Zealand *Energy Efficiency (Energy Using Products) Regulations 2002*.
4. **Agree** that Energy Council requests Standards Australia and the SCO to update certain Australian Standards, evaluate potential International Standards, and investigate inclusion of DR requirements for additional products, as recommended by the Decision RIS at **Attachment A** (Option 3 in the DRIS - Recommendations 16-18).
5. **Note** the Office of Best Practice Regulation (OBPR) has advised that it considers the Decision RIS does not contain adequate analysis for an Energy Council decision.
6. **Note** that the New Zealand Ministry of Business, Innovation and Employment (MBIE) has advised the DRIS does not contain adequate New Zealand analysis for an Energy Council decision.
7. **Note** that officials will work with the OBPR to address their concerns in developing the proposed implementation legislative amendments identified in recommendation 3.

Appendix 2 Modelling assumptions: Options 1, 2 and 3

Option	Element	DRIS modelling assumptions ("BAU")	Revised modelling assumptions for SA
1	Air conditioners compliance (DRMs 1,2,3)	I July 2023	1 July 2021 (2 years early)
1	Electric storage water heaters compliance (DRM 1)	1 July 2023	1 July 2021 (2 years early)
1	Pool pump controller compliance (DRM 1; DRM 2,4 after 2 yr)	1 July 2024	1 July 2022 (2 years early)
1	EV charge controller compliance (DRMs 0, 1,2,3,4,5, 8 or equivalent in other standard)	1 July 2026	1 July 2024 (2 years early)
1	Activation rates on installation	High. Med, Low	Same rates, but buildup brought forward by same number of years as compliance (REES intends to introduce DR credits from 2021)
1	Activation rates post-installation	High, Med, Low	Same rates, but buildup brought forward by same number of years as compliance
1	Air conditioner impacts – DRM 2 reduced due to reversion to 2012 rules, but with prohibition on over-capacity operation during DR events	40% of rated capacity; revise to 35% (since it affects BAU case as well)	35% of rated capacity
1	Value of benefits		Retain current assumptions
1	Cost of air conditioners NOTE: Analysis of 26 models reported in Choice in June 2019, Nov 2019 and March 2020 indicates that average price of models with DR capability ($389/kW cooling output) is LOWER than models without ($409/kW). Also, of the 11 models that Choice reports do not have DR capability, 7 models indicate that they DO have DR capability on the registration CSV file.		Retain current assumptions for DR cost premium, but increase average sale price due to 1. lower-price non-compliant models withdrawn from SA for 2 yrs (but may be compensated by energy savings from higher EE). 2. Cost of stock segregation borne by SA sales for 2 yrs; $5 per unit sold.
1	Cost of other products		Retain current assumptions

Option	Element	DRIS modelling assumptions ("BAU")	Revised modelling assumptions for SA
1	Activation costs (undifferentiated between DRED and non-DRED options)		Retain assumptions in DRIS
1	Registration costs – air conditioners	No extra cost – assumed part of MEPS registration	No extra DR-capable models introduced; every current compliant model must be registered in SA @$500/model (accompanied by declaration but not test report if on PeakSmart register. Accompanied by test report @$2,500 for other models). Plus $40k for setting up register (all products). Revert to zero costs for models introduced after June 2023, with national registration
1	Registration costs – other products		All models to be registered on SA @$500/model, accompanied by test report @$2,500 per model.
1	Sensitivity to multi-state implementation		Share registration costs either 2 ways or 3 ways Stock segregation costs fall to $4/unit (2 states) or $3/unit (3 states)
2	Air conditioners compliance (DRMs 1,2,3); 4755.2 only	I July 2023	1 July 2021 (2 years early)
2	Electric storage water heaters compliance (DRM 1,2,4); 4755.2 only	1 July 2023	1 July 2021 (2 years early)
2	Pool pump controller compliance (DRM 1, 2,4)); 4755.2 only	1 July 2024	1 July 2022 (2 years early)
2	EV charge controller compliance (DRMs 0, 1,2,3,4,5, 8 or equivalent in other standard	1 July 2026	1 July 2024 (2 years early)
2	Activation rates on installation	High. Med, Low	Same rates, but buildup brought forward by same number of years as compliance
2	Activation rates post-installation	High, Med, Low	Same rates, but buildup brought

Option	Element	DRIS modelling assumptions ("BAU")	Revised modelling assumptions for SA
			forward by same number of years as compliance
2	Air conditioner impacts – DRM 2 reduced due to reversion to 2012 rules, but with prohibition on over-capacity operation during DR events	40% of rated capacity; revise to 35% (since it affects BAU case as well)	35% of rated capacity
2	Value of benefits		Retain current assumptions
2	Cost of air conditioners 4755.2 likely to allow manufacturers to comply using apps. Lower-price air conditioners do not offer this option, so likely to push average prices up.		Retain current assumptions for DR cost premium, but increase average sale price due to 1. lower-price non-compliant models withdrawn from SA for 2 yrs (but may be compensated by energy savings from higher EE). Greater impact than Option 1 – only products with app support on SA market. 2. Cost of stock segregation borne by SA sales for 2 yrs; $5 per unit sold.
2	Cost of water heaters; Higher tank manufacturing costs due to extra thermostat and thicker vitreous enamel for DRM4. If suppliers withdraw from SA market for 2 years. replacements in Cl1 dwellings would go to other types; exempt ESWH would need to be available for Cl2.	$80 (was deliberately generous)	$150 (industry submissions to DRIS said up to $200) Differentiate modelling by WH size, based on BIS Oxford Economics data. Assume LWH map to Class 1 dwellings and SWH to Class 2 dwellings.
2	Cost of pool pump controllers:	$50	$100
2	Cost of other EV charge controllers;	$50	Retain current assumptions Given standards uncertainties, not material)
2	Activation costs; non-DRED options only – cheaper than DRED	$120-140	$20-30 (no new hardware, but set-up costs to DRSP)
2	Registration costs – air conditioners all products	No extra cost – assumed part of MEPS registration	Every new compliant model must be registered in SA @$3,000/model

Option	Element	DRIS modelling assumptions ("BAU")	Revised modelling assumptions for SA
			(includes test to 4755.2). Plus $40k for setting up register (covers all products). Revert to zero costs when national registration due to start for each product .
2	Sensitivity to multi-state implementation		Share registration costs either 2 ways or 3 ways Stock segregation costs fall to $4/unit (2 states) or $3/unit (3 states)
3	Air conditioners compliance (DRMs 1,2,3); 4755.2 only	I July 2023	No change
3	Electric storage water heaters compliance (DRM 1,2,4); 4755.2 only	1 July June 2023	No change
3	Pool pump controller compliance (DRM 1,2,4); 4755.2 only	1 July 2024	No change
3	EV charge controller compliance (DRMs 0, 1,2,3,4,5, 8 or equivalent in other standard	1 July 2026	No change
3	Activation rates on installation	High. Med, Low	No change
3	Activation rates post-installation	High, Med, Low	No change
3	Air conditioner impacts – DRM 2 reduced due to reversion to 2012 rules, but with prohibition on over-capacity operation during DR events	40% of rated capacity; revise to 35% (since it affects BAU case as well)	35% of rated capacity
3	Value of benefits		Retain current assumptions
3	Cost of air conditioners More ways of meeting 4755.2 possible with longer lead times		Retain current assumptions for DR cost premium, but increase average sale price due to 1. lower-price (4755.1) compliant models not available in SA. Less initial impact than Option 1, but on-going. 2. Cost of stock segregation borne by SA sales; $5 per unit sold. Ongoing
3	Cost of water heaters; Higher tank manufacturing costs due to	$80 (was deliberately generous)	$120. Less than Option 2 because longer

Option	Element	DRIS modelling assumptions ("BAU")	Revised modelling assumptions for SA
	extra thermostat and thicker vitreous enamel for DRM4 If suppliers withdraw from SA market for 2 years replacements in Cl1 dwellings would go to other types; exempt ESWH would need to be available for Cl2.		lead time to develop. Differentiate modelling by sizes: Large in Cl1 dwellings, Small in Cl2.
3	Cost of pool pump controllers:	$50	$80. Less than Option 2 because longer lead time to develop
3	Cost of other EV charge controllers;	$50	Retain current assumptions
3	Activation costs; non-DRED options only – cheaper than DRED	$120-140	$20-30 (no new hardware, but set-up costs to DRSP)
3	Registration costs – air conditioners	No extra cost – assumed part of MEPS registration	No extra cost – assumed part of MEPS registration. SA Regs just indicate more restrictive criteria
3	Sensitivity to multi-state implementation		Stock segregation costs fall to $4/unit (2 states) or $3/unit (3 states)

Appendix 3 Energy Storage in Electric Water Heaters

AS/NZS 4755 is designed for commands to be sent from an authorised Remote Agent (RA) via a RA-managed demand response enabling device (DRED), but there is nothing to prevent the commands being issued by the user's own Home Energy Management System (HEMS) or solar controller, if it has the means to connect to the water heater.

Commands must include start and stop time for a demand response event, the DRM to be maintained during the event and a time randomisation instruction (with the option of "no randomisation required" which would be used if start time is "immediate").
If the WH complies with AS/NZS 4755.3.3 the connection must be via a physical interface. If the WH complies with AS 4755.2 the connection does not involve a physical interface, but does require that the WH has a means of communicating with the internet (via wifi, 4G/5G, powerline carrier etc).

The COAG decision means that WHs sold from July 2023 will have to have DRM1. The other DRMs defined in the standard (Table 30) will remain optional. DRM1 was primarily intended for load management. This appendix explores how DRM1 and DRM4 can be used as a means of thermal storage at times when excess solar energy is available.

Table 30 Water heater demand response modes, AS/NZS 4755

Operational instruction (OI)	Demand response mode (DRM)	Description of operation in this mode	Mandatory for conformance to AS 4755.2?
OI 1	DRM 1	No electric heating of water (whether by resistive heating element, heat pump or any other electrical device).	Yes
OI 2	DRM 2	(a) The water heater shall continue to be capable of heating water during the demand response event; and (b) When heating water, the energy consumed shall be between 40 % and 60 % of reference value.	No
OI 3	DRM 3	(a) The water heater shall continue to be capable of heating water during the demand response event; and (b) When heating water, the energy consumed shall be between 60 % and 80 % of reference value.	No
OI 4	DRM 4	The water heater initiates a period of higher storage mode operation, which continues until the DR event terminates or the required level of heat storage under this mode of operation is reached (whichever occurs first).	No

DRMs operate independently of the power supply to the WH. However, there are interactions:

- For WHs on controlled (OP) tariffs, applying DRM1 during power-on periods will prevent heating, but applying DRM1 during power-off periods will have no effect (in the longer term, all ESWHs could be continuously energised and DRM1 could replace OP tariffs as the prime main form of load-control).
- For WHs on continuous tariffs, applying DRM1 will interrupt and prevent heating until the DR event terminates.
- DRM4 will be effective whether the WH is on an OP or a continuous tariff.

DRM1 can be used for managing storage in the following ways, but only where there is a continuously energy element (in OP tanks, this would have to be a separate upper element):

- the external controller (the RA, the HEMS or the solar controller) stops heating before the water temperature reaches the upper t/stat set point (usually preset at 60ºC). The cutoff temperature should be 45-55ºC (lower for a larger tank with more heat storage – noting that the delivery temp should always exceed 40ºC). For a given tank, the lower the cutoff temperature the higher the storage capacity available, but the lower the current heat storage and the greater the risk of running out of hot water before solar energy is added. As the RA is remote from the WH, the exercise of DRM1 would need to be based on statistical data, and there would be a risk that some WHs will be cut off early (so running out of hot water) while others would be cut off too late (so leaving no room for further energy storage). The optimum control model would be a HEMS that monitors the tank temperature and is aware of the household's daily patterns of solar availability and energy use.
- the external controller releases DRM1 when there is sufficient excess solar output (i.e. the gain from the panels less other household demand is enough to trigger the elements. The average installed capacity of new PV installations in 2019 was 7.6kW[11], so a WH with a typical 3.6kW element could be in a position to store almost every day, even after other HH demands are satisfied. Heating would cease automatically once the upper thermostat temperature is reached.

DRM4 can be used for managing storage in any tank, irrespective of whether it is on an OP or a continuous tariff, or whether the temperature is at or below the normal upper setting, because the water heater defaults to a higher maximum setting (typically 75ºC).[12] Table 31 summarises the heat storage capacity of tanks of various sizes and at various starting temperatures, using either DRM1 or DRM4 control strategies and a combination of the two.

Case 1 would be typical of a 315 litre OP tank, where the storage temp drops during the day as hot water is drawn off. The DRM1 storage strategy (Case 2) is not applicable to OP, but DRM4 (Case 3) would be. This would give an average of 9.0 kWh and 2.5 hours of storage capacity per day. The kWh would only be of value to the consumer is the solar buyback price were lower than the OP tariff, but the 3.6 kW increase in load during over 2.5 hrs would be of value in managing minimum load events. How this value is signalled and returned to the consumer depends on the business model.

[11] Clean Energy Australia Report 2020, Clean Energy Council, April 2020 p71/86.
[12] The Solahart PowerStore "solar storage" water heater goes to 75ºC, using a heavier vitreous enamel coating to compensate for faster breakdown of the lining at higher temperatures.

Table 31 ESWH heat storage capacity scenarios

	Large tank				Small tank				Medium tank (or vol. above second element)			
	Not Managed (OP)	Managed with DRM1	Managed with DRM4	Managed with both	Not Managed	Managed with DRM1	Managed with DRM4	Managed with both	Not Managed	Managed with DRM1	Managed with DRM4	Managed with both
Case	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Volume (l)	310	310	310	310	50	50	50	50	160	160	160	160
Element (kW)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Cold temp (°C)	18	18	18	18	18	18	18	18	18	18	18	18
Upper t/stat (°C)	60	60	60	60	60	60	60	60	60	60	60	60
Standing temp (°C)	50	45	50	45	60	55	60	55	60	55	60	55
Temp rise (°C)	32	27	32	27	42	37	42	37	42	37	42	37
Energy stored (MJ)	41.5	35.0	41.5	35.0	10.6	7.8	8.8	7.8	28.1	24.8	28.1	24.8
Energy stored (kWh)	11.5	9.7	11.5	9.7	2.9	2.2	2.4	2.2	7.8	6.9	7.8	6.9
Max t/stat (°C)	60	60	75	75	60	60	75	75	60	60	75	75
Extra energy (kWh)	3.6	5.4	9.0	10.8	0.0	0.3	0.9	1.2	0.0	0.9	2.8	3.7
Heating time (hrs)	1.0	1.5	2.5	3.0	0.0	0.1	0.2	0.32	0.00	0.26	0.78	1.03
Max absorption hrs/yr	365	548	914	1096	0	29	88	118	0	94	283	377
% of year	4.2%	6.3%	10.4%	12.5%	0.0%	0.3%	1.0%	1.3%	0.0%	1.1%	3.2%	4.3%

ESWHs installed with PV, on continuous tariff and managed by a HEMS or solar controller, can be managed by DRM1 only (Case 2) or with *both* DRM1 and DRM4 (Case 4).

50 litre water heaters, suitable for apartments, are too small to qualify for OP tariffs. They have negligible heat storage capacity unless they have DRM4 (Cases 5 to 8). However, DRM1 is valuable for managing their peak load (an average of 0.5 kW during peak periods).

160 litre water heaters would be adequate for a large household if continuously energised (Cases 9 to 12). A similar heat storage capacity would be available from a large OP tank with dual elements, provided that the upper element were continuously energised (except when subject to DRM1) and there were about 150 litres above it.

The actual distribution of ESWH by volume and capacity in SA is uncertain. Table 32 shows the responses to three recent surveys of the SA stock by BIS Shrapnel (we do not have 2014 data). The responses are of low reliability, as evidenced by the fact that about half the respondents could not nominate the volume. Also, a large share of those who responded nominated a volume (200 litres) that is not in fact commercially available. However, the weighted average volume nominated was fairly steady at around 250 litres.

Table 32 ESWH volumes nominate by survey respondents, SA

Corresponding actual models	Nominated category	2018	2016	2012	Combined
50	50	2%	5%	1%	3%
80	100	5%	4%	14%	8%
160	150	12%	9%	16%	12%
	200	16%	20%	12%	16%
250	250	28%	27%	22%	26%
315	300	13%	15%	22%	17%
	350	9%	10%	7%	9%
400	400	15%	10%	7%	11%
		100%	100%	101%	100%
	Don’t know	45%	47%	57%	50%
	Responses n=	112	125	122	359
	Wtd Avg vol	257	248	236	247

Source: BIS Shrapnel surveys

Appendix 4 Air conditioner brands *without* DR capable models

No of Models	Brand
10	Advantage Air
s2	Aggreko
1	AirSmart
1	Airtemp
8	Akai
49	APAC
2	Astivita
3	ATD / Hisense
8	AUX
4	BD-BingDian
1	BEKO
36	Brivis
22	CAA
60	Carrier
5	Chigo
6	Clivet
1	Daewoo
28	Diamond
7	Domain
113	Dunnair
2	Elfa
3	Euromatic
4	Galaxy air
6	Goldair
9	Heller
2	IACS
4	ICE Solair Australia Pty Ltd
6	Ilec Appliances
3	Innova 2.0
3	Kogan
69	Lennox
10	Levante
21	Mammoth
4	MEC
11	Nexair
2	Norwegia
1	Olimpia Splendid
17	Pioneer International
2	Polaris Technologies
3	Proma
1	Qflow
5	Seiki
1	Solakool
5	Solano
86	Specialized Engineering
3	Stirling
2	Xpelair
70	York