LOAD FLEXIBILITY STUDY TECHNICAL SUMMARY

Australian Renewable Energy Agency

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Australian Government
Australian Renewable Energy Agency

ARENA

CONTENTS

1. GLOSSARY OF TERMS AND ABBREVIATIONS

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
BTM	Behind-the-meter
C&I	Commercial & industrial
DER	Distributed energy resources
DPV	Distributed Photovoltaic (rooftop solar)
ESB	Energy Security Board
EV	Electric vehicles
HVAC	Heating, ventilation and air-conditioning
ISP	AEMO's 2020 Integrated System Plan
NEM	National Electricity Market
NPV	Net present value
PLEXOS	Specialised energy market simulation software
SoW	State of the World
V2G	Vehicle-to-grid
VRE	Variable renewable energy

Image credit: BOC

2 STRATEGIC CONTEXT

OPTIMISING THE RENEWABLE ENERGY TRANSITION

Australia's transition to renewable and distributed energy is fundamentally changing how our electricity systems and markets operate. While renewable generation is helping to bring down electricity costs, significant investment in dispatchable generation and network infrastructure is required to balance variable generation output. Flexible demand can reduce new build requirements, thereby reducing the overall costs of the energy transition.

New distributed energy and digital technologies are rapidly increasing the scope for more flexible demand across the residential and commercial sectors. The electrification of transport and of key thermal processes will also enable significant new flexible load potential into the future.

The electricity market bodies are progressing a number of reforms in response to the increasing variability of supply, including enhancing frameworks for energy storage and demand-side participation in electricity markets.

SUPPORTING FLEXIBLE DEMAND

ARENA's 2021 Investment Plan has identified Demand Flexibility as a key focus area under our strategic priority to optimise the transition to renewable electricity. This Load Flexibility Study is the first step in implementing this strategy.

ARENA defines **'demand flexibility' as the capability to vary customer demand in response to generation, network, or market signals**. Demand flexibility can operate in real time and can be incorporated into long-term investment decisions.

Read more about the role of flexible demand in Australia's energy future: arena.gov.au/knowledge-bank/the-role-of-flexible-demand-in-australias-energy-future/

NERA'S LOAD FLEXIBILITY STUDY

ARENA commissioned NERA Economic Consulting and Energy Synapse to **model the potential value of flexible demand in the electricity transition.**

The Study provides important information about:

- how increased demand-side participation across major sectors of the Australian economy can contribute to the energy transition
- the potential contribution from different sources of demand-side flexibility and their role in offsetting the need for new-build large-scale generation assets
- the potential savings that could be achieved by enabling greater load flexibility through Australia's energy transition.

Insights from the Study can inform:

- long term system planning for resource adequacy
- long term transmission planning
- the cost-benefit analysis of potential market reforms that seek to enable greater demand side participation
- the relative priority that should be given to researching and demonstrating new technologies and commercial approaches to enable greater load flexibility.

A Study Reference Group was formed to guide the study's implementation, consisting of ARENA, AEMC, AEMO, AER and the ESB.

The industry context has evolved since the study commenced in 2021. While the results of the study remain relevant, readers are encouraged to consider how new information could impact their interpretation.

3 MODELLING APPROACH


Image credit: AusNet Services

MODELLING GENERATION AND STORAGE COST SAVINGS

The Load Flexibility Study adopts and extends conventional electricity market modelling approaches, such as those used for AEMO's ISP. These seek to estimate efficient market outcomes in terms of long-run generation and storage investment patterns and short-run dispatch profiles for electricity supply capacity based on a range of assumptions.


Image credit: Stock

MODELLING NETWORK COST SAVINGS

While more flexible demand results in substantial improvements in transmission system load factors, the Load Flexibility Study does not quantify consumer savings associated with this. Other studies have estimated that improved integration of demand side resources may contribute to avoided or deferred distribution and transmission network capital expenditure worth up to $11.3bn under the ISP 2020 Step Change scenario[1].

STEPS IN THE MODELLING APPROACH

1. **Techno-economic analysis**

   Energy Synapse undertook a techno-economic analysis of key sources of load flexibility to understand what could be feasible for different flexible demand technology categories under the right conditions. This includes technology costs, government incentives, network charges, wholesale electricity price and climate policy.

2. **States of the World**

   Five SoW were developed to explore the potential benefits associated with different load profiles and sets of enabled flexible demand resources. Each SoW is based on the previous state plus additional sources of demand flexibility.

3. **Modelling the benefits of system flexibility**

   PLEXOS was used to determine the efficient mix of new generation and storage investment required to ensure demand was met in each SoW.

4. **Market simulations**

   Market simulations were run through PLEXOS to create a dispatch profile over the modelling period. This determined the efficient mix of generation that is dispatched in each 30-minute trading interval.

5. **Interpretation of results**

   NERA then analysed and interpreted PLEXOS outcomes with regard to costs, emissions and transmission peak demand.

More information on modelling approach can be found in Sections 2 and 3 of NERA's Valuing Load Flexibility in the NEM report[2].

1 Baringa Partners, *Potential network benefits from more efficient DER integration*, June 2021, www.datocms-assets.com/32572/1629948077-baringaesbpublishable-reportconsolidatedfinal-reportv5-0.pdf.
2 NERA Economic Consulting, *Valuing Load Flexibility in the NEM*, February 2022, arena.gov.au/knowledge-bank/valuing-load-flexibility-in-the-nem.

3.1 MODELLING LIMITATIONS AND ASSUMPTIONS

MODELLING LIMITATIONS

Demand-side participation in electricity markets is famously complex to model, and PLEXOS and other power system optimisation software do not readily accommodate flexible demand in either investment or operational timeframes. PLEXOS treats the demand side of the market as a fixed input, while making supply-side decisions to minimise the cost of meeting demand.

As such, sources of demand flexibility (e.g. EVs, orchestrated DER, etc.) must be treated as supply-side resources when modelled in PLEXOS:

- **Load reduction is modelled as virtual generation.** For example, if a commercial customer sets their air conditioner to a higher temperature on a hot day, this would yield an absolute reduction in system demand over the course of a day. For load reducing sources of flexibility, this study assumes that they will respond when the wholesale price of electricity equals or exceeds their "trigger price" subject to any restrictions on their use.
- **Load shifting modelled as virtual storage.** For example, if a commercial customer pre-cools their building to avoid using the air conditioning system at a time of high load, then this would not decrease the total system demand over the day. These technologies act as virtual storage, because, like physical batteries, they do not (aside from losses) contribute to overall MWh consumption – they instead shift it to more economical periods. This study assumes they will respond when there is sufficient difference in the wholesale price of electricity between 'charge' and 'discharge' periods.

MODELLING ASSUMPTIONS

- Key input assumptions, like future **technology cost reductions**, were made at the time of modelling. However, in reality, the electricity market responds to changes as they actually occur and outcomes can depart substantially from prior estimates.
- Key assumptions were also made about **policy settings**. For example, the modelling assumes the same energy targets and emission reduction policies as the AEMO 2020 ISP Central Case. Changes in federal or state policies could result in substantially different outcomes.
- Electricity market modelling does not consider **electricity market externalities** (costs and benefits that are external to the electricity system). For example, in the case of electrification, while the cost of new electricity supply is included, savings in other fuel costs are not. Social and environmental costs and co-benefits are also not considered.
- The practicalities of the modelling task required **simplified participation rules** to be developed such as static 'trigger prices' for market participation and limited 'availability profiles' for some resources such as EVs.
- A range of assumptions and constraints were further applied to each source of flexibility, which are based on the Energy Synapse techno-economic analysis.

Note on market modelling: Unless specifically addressed, market modelling for the purposes of system planning or policy design will structurally underestimate the economic potential for dynamic demand-side participation. This is because demand is typically assumed to be inelastic and this must be compensated for by either additional generation or storage.

3.2 STATES OF THE WORLD

Informed by Energy Synapse's analysis, the Study Reference Group developed five States of the World (SoW) to model the potential value of load flexibility. This approach was chosen to differentiate the value of the main expected sources of load flexbility, rather than attempting to represent all potential outcomes.

SoW 1: Baseline Case

ISP Central Case set up with additional flexibility from enabling smart residential and commercial sources that are already electrified (e.g. heating and cooling, hot water systems and pool pumps), as per the Energy Synapse Base Case[3].

Low flexibility scenario	High flexibility scenario
Demand-side participation levels as assumed in the ISP Central Case	Additional residential & commercial demand flexibility

SoW 2: High EV Uptake

SoW 1: High flexibility scenario plus the additional demand from high EV uptake[3]. Additional flexibility from managed charging and V2G services.

Low flexibility scenario	High flexibility scenario
As above	SoW 1 High Flexibility scenario + Additional flexibility from EVs (deferred charging and V2G services)

SoW 3: Electrification

SoW 2: High flexibility scenario plus the electrification of residential, C&I sources and processes[3]. Additional flexibility from high electrification of residential and C&I sources (e.g. HVAC, metals and minerals production, and food and beverage industries).

Low flexibility scenario	High flexibility scenario
As above	As above + High electrification of residential and C&I sources

SoW 4: High DER Uptake

SoW 3: High flexibility scenario plus the faster uptake of DER sources[3]. Additional flexibility from high BTM PV and battery uptake, large-scale PV at ISP Step Change prices, and ISP Step Change renewable targets.

Low flexibility scenario	High flexibility scenario
As above	As above + high BTM PV and battery uptake + large-scale PV + ISP Step Change renewable targets

SoW 5: Hydrogen

SoW 4: High flexibility scenario plus the uptake of hydrogen electrolysers[3]. Load flexibility in SoW 5 was measured at two levels - 85% and 60% load factor.

Higher flexibility scenario (as above)	High flexibility scenario (as above)
+ electrolysers operating with an 85% load factor	+ electrolysers operating with a 60% load factor

3 As per the respective Energy Synapse scenarios. See Appendix B of NERA Economic Consulting, *Valuing Load Flexibility in the NEM*, February 2022, arena.gov.au/knowledge-bank/valuing-load-flexibility-in-the-nem.

4 SUMMARY OF RESULTS

Table 1

State of the World	NPV new-build cost savings (a)	NPV consumer cost savings (b)	Average annual emissions reduction (c)	Transmission load factor improvement (d)
SoW 1: Baseline case	$1 bn	$6 bn	0 Mt	0%
SoW 2: High EV uptake	$3 bn	$5 bn	0 Mt	1%
SoW 3: Electrification	$4 bn	$5 bn	0 Mt	2%
SoW 4: High DER uptake	$8 bn	$18 bn	3 Mt	6%

Table 1 summarises the savings estimated from the modelling. The column values represent the difference between flexibility scenarios of each SoW (i.e. the benefit of flexibility in each SoW).

Table 2

State of the World	NPV new-build cost saving per MWh (a)	NPV consumer cost savings per MWh (b)
SoW 1: Baseline case	$1	$6
SoW 2: High EV uptake	$1	$5
SoW 3: Electrification	$2	$5
SoW 4: High DER uptake	$4	$18

Table 2 summarises cost savings on a $/MWh basis.

INTERPRETING TABLES 1 AND 2

(a) Net present value new-build cost savings

The change in future capital and operating costs of the NEM (excludes sunk costs and those outside of the NEM (e.g. EV/DPV purchase costs, or other fuel cost savings).

(b) Net present value consumer cost savings

The costs saved by consumers including both new build cost savings, as well as 'inframarginal rent' that generators capture during peak pricing events. This is a better proxy for wholesale market prices.

(c) Average annual emissions reductions

The direct CO_2 emissions reduction from NEM-connected fossil fuel-based thermal generators. Note that these results do not include emissions outside the NEM (e.g. abatement associated with electrification of vehicles or industry).

(d) Transmission load factor improvement

The average transmission network load divided by the peak load (i.e. network utilisation).

IMPORTANT NOTES

- **SoW 4: High DER uptake** presents the most instructive scenario, given it most closely matches current investment trends in large-scale and distributed renewable energy resources. It also provides the best indication of the total potential value of flexible demand.
- Differences between NPV new-build and consumer cost savings represent a potential wealth transfer to consumers. High consumer cost savings generally means that the market is tight and load flexibility acts to reduce peak pricing.
- **SoW 5: Hydrogen** results are reported separately, as SoW 5 is not directly comparable as it incorporates some demand flexibility into its basecase.
- Pages 11-15 provide more detailed results for each SoW, including SoW 5.

4 KEY FINDINGS

1. LOAD FLEXIBILITY GREATLY REDUCES SYSTEM COSTS

The Load Flexibility Study estimates **$8-18 billion[4] in savings from demand flexibility** due to the reduced investment requirements for large-scale generation and storage capacity. This contributes to lower system costs and electricity prices for consumers. To unlock these savings, it is important that Australia addresses any inefficient barriers to demand-side participation.

2. THE VALUE OF LOAD FLEXIBILITY INCREASES AS MORE RENEWABLE ENERGY IS ADDED TO THE SYSTEM

The savings grow across the SoWs as more services are electrified and more variable renewable generation enters the power system. Load flexibility can help balance the market by taking advantage of intraday price spreads and by playing a role in mitigating occasional supply shortfalls. These benefits are proportional to the amount of variable renewable energy used.

3. LOAD FLEXIBILITY PUTS CONSUMERS IN CONTROL OF THEIR COSTS

In addition to reducing total system costs, load flexibility adds a new dimension to competition in electricity markets. Consumers with flexible demand resources can reduce their exposure to price spikes (scarcity pricing) and reduce the extent of generator 'super profits' that they would otherwise fund. This flows through to lower prices for all consumers.

4. LOAD FLEXIBILITY CAN MORE THAN OFFSET THE COSTS OF ELECTRIFICATION

While electrification of transport and industry will inevitably increase the total costs of the power system,[5] greater flexibility can offset this effect and result in lower prices ($/MWh basis) while electrifying.

4. LOAD FLEXIBILITY IMPROVES NETWORK UTILISATION AND EFFICIENCY

Load flexibility reduces the peak demand and peak generation flows at the transmission level, especially in high DER scenarios. An estimated peak load reduction of 6 GW in the SoW 4 scenario is material and warrants further consideration by transmission planners.

6. FLEXIBLE CHARGING OF EVs IS THE LARGEST DEMAND-SIDE RESOURCE

Flexible charging of EVs, whether through deferred charging or V2G services, was found to be the most utilised source of load flexibility. This is due to the very low marginal cost of delayed charging compared to other forms of load shifting or load curtailment. BTM batteries could also play a major role were they to be deployed at scale and responsive to wholesale market signals.

7. LOAD FLEXIBILITY GENERALLY FAVOURS WIND OVER SOLAR GENERATION

Adding more flexibility tends to favour wind over solar generation. An important exception is high flexibility hydrogen electrolysers (operating at 60% or lower load factors) that are able to take greater advantage of lower cost solar as they can operate less of the time.

8. GREATER LOAD FLEXIBILITY MODERATELY REDUCES EMISSIONS

The modelled emission reduction benefits were negligible in the first three SoWs, as flattening the load profile allowed continued utilisation of thermal generation. However, as more DER enters the system in SoW 4, flexible load technologies can take advantage of the inherent flexible supply conditions and reduce the utilisation of thermal generators, thereby reducing overall emissions.

4 Under SoW 4 *High* DER scenario.
5 Not accounting for fuel savings or other cost reductions outside of the power system associated with electrification.

4.1 SoW 1: BASELINE SCENARIO

SoW 1: Baseline Case
Based on the demand growth and generation cost projections included in the AEMO 2020 ISP Central Case.

Low flexibility scenario
Demand-side participation levels as assumed in the ISP Central Case

High flexibility scenario
Additional flexibility from existing residential & commercial demand response (e.g. heating & cooling, hot water systems, pool pumps)

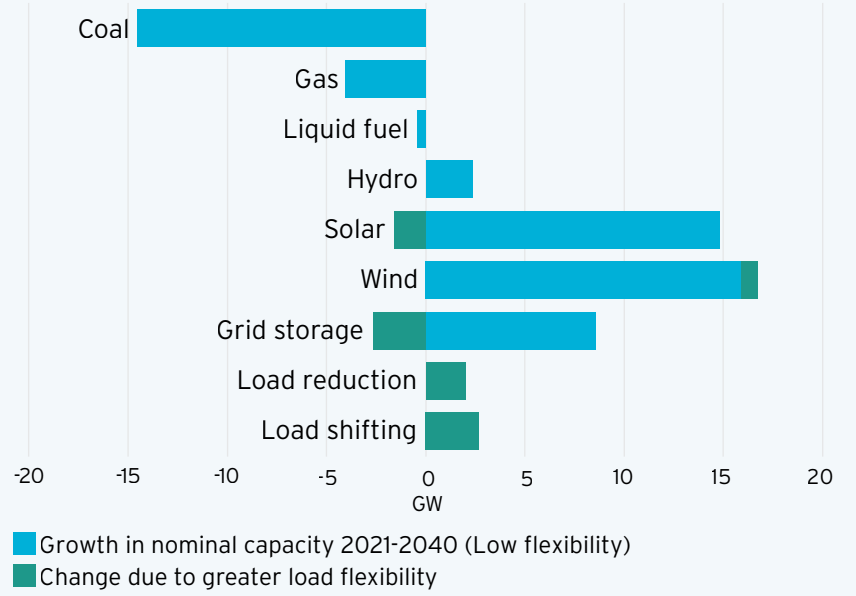
INTERPRETING THE RESULTS

- This scenario explores the benefits of making existing residential and commercial demand side resources more flexible. It is limited by assumptions as to what is feasible with current technology and commercial constraints.

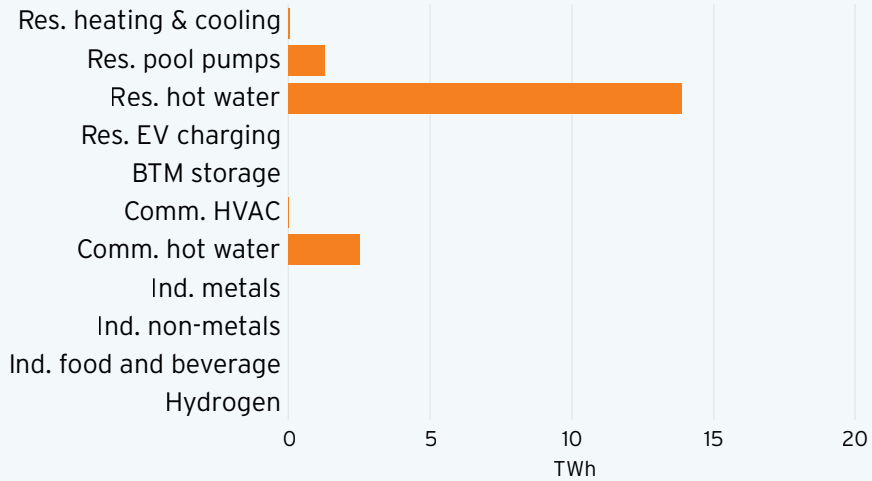
KEY FINDINGS

- Higher flexibility in SoW 1 delivers savings for consumers of between $1-6 billion. System cost savings result from reduced capital expenditure on grid-connected storage and large-scale solar. These savings are net of additional wind investment costs and incentive payments for demand side participation.
- Hot water systems are the most dispatched source of flexibility due to low marginal cost of supply, followed by residential pool pumps, and a smaller amount of flexibility coming from air-conditioners due to higher estimated trigger price[6].
- Emissions results are inconsistent across the modelling period and are not significantly lower under the high flexibility scenario.
- While NEM peak demand is consistently lower under the high flexibility scenario, this does not flow through to a substantially improved transmission load factor.

SoW 1 – Change in nominal capacity mix from 2021 to 2040



SoW 1 – Contribution from modelled load flexibility sources from 2021 to 2040



6 See Appendix B of NERA Economic Consulting, *Valuing Load Flexibility in the NEM*, February 2022, arena.gov.au/knowledge-bank/valuing-load-flexibility-in-the-nem.

4.2 SoW 2: HIGH EV UPTAKE

SoW 2: High EV Uptake
SoW 1 + the additional demand from high EV uptake.

Low flexibility scenario	High flexibility scenario
Baseline case Low Flexibility scenario	SoW 1 High Flexibility scenario + Additional flexibility from EVs (deferred charging and V2G services)

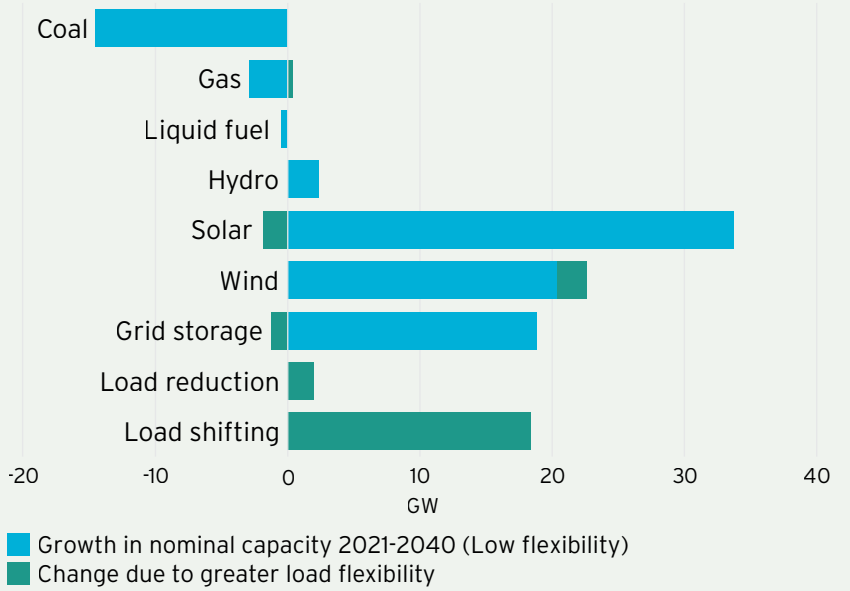
INTERPRETING THE RESULTS

- This scenario explores faster uptake of EVs than the 2020 ISP: EVs represent 80% of new vehicle sales by 2030 and 100% by 2040. 90% of EVs are assumed to be capable of managed charging by 2040 and 15% are capable of V2G.[7]
- Other savings and costs outside of the electricity system (e.g. EV purchase costs and fuel savings) are not included.

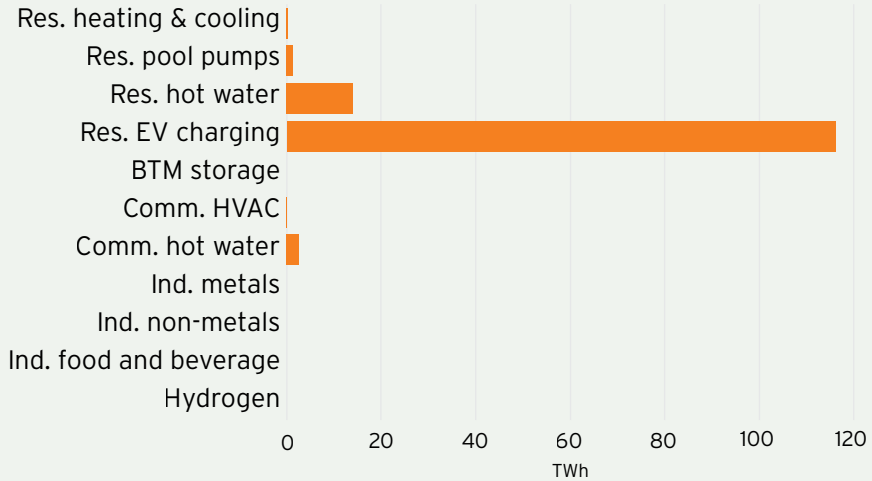
KEY FINDINGS

- A faster EV uptake substantially increases requirements for wind, solar and grid storage investment and, in the absence of flexibility, this places upward pressure on consumer electricity prices.[8]
- More flexible EV charging has a low marginal cost and delivers savings to consumers between $3-5 billion. These savings fully mitigate increases in electricity prices on a $/MWh basis.
- The model imposes a number of arbitrary constraints on EV charging flexibility including no ability to charge or discharge during the day. Relaxing these constraints would likely increased the savings results.
- Emissions savings are inconsistent across the modelling period and are not significantly lower under the high flexibility scenario.
- In the period 2035-40, EVs contribute about 15 GW to NEM peak demand (compared to SoW 1). More charging flexibility only moderately reduces peak demand and transmission load factor is improved by only around 1%.

SoW 2 – Change in nominal capacity mix from 2021 to 2040



SoW 2 – Contribution from modelled load flexibility sources from 2021 to 2040



7 See Appendix B of NERA Economic Consulting, *Valuing Load Flexibility in the NEM*, February 2022, arena.gov.au/knowledge-bank/valuing-load-flexibility-in-the-nem.

8 Not accounting for fuel savings or other cost reductions outside of the power system associated with electrification.

4.3 SoW 3: ELECTRIFICATION

SoW 3: Electrification
SoW 2 + the electrification of residential, C&I sources and processes.

Low flexibility scenario	High flexibility scenario
Baseline case Low Flexibility scenario	**SoW 2 High Flexibility scenario +** High electrification of residential and C&I flexible demand sources (e.g. HVAC, metals and minerals production, and food and beverage industries)

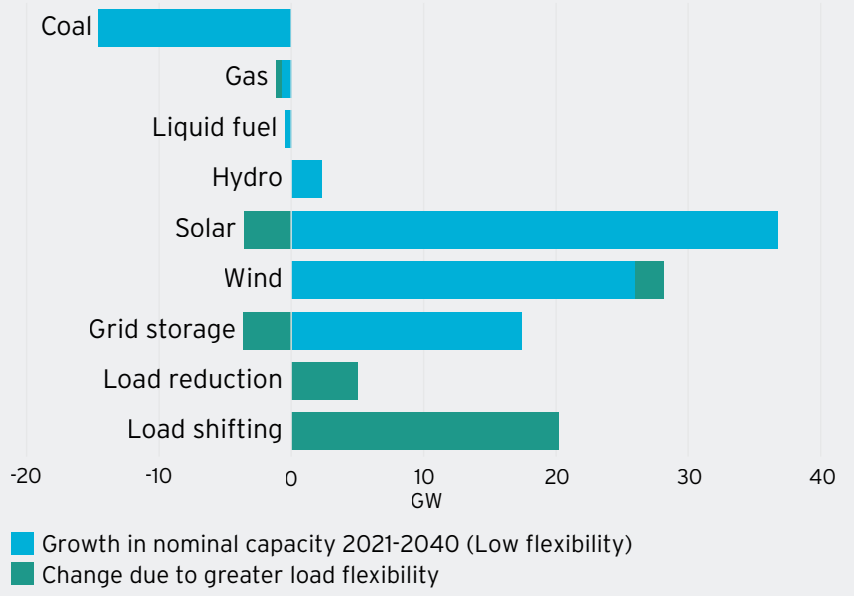
INTERPRETING THE RESULTS

- In the high flexibility scenario, it is assumed that 80% of industrial process heat (currently powered by natural gas) is electrified by 2040.[9]
- The analysis only accounts for costs and savings within the electricity system, and does not include savings associated fuel reduction (e.g. gas usage).

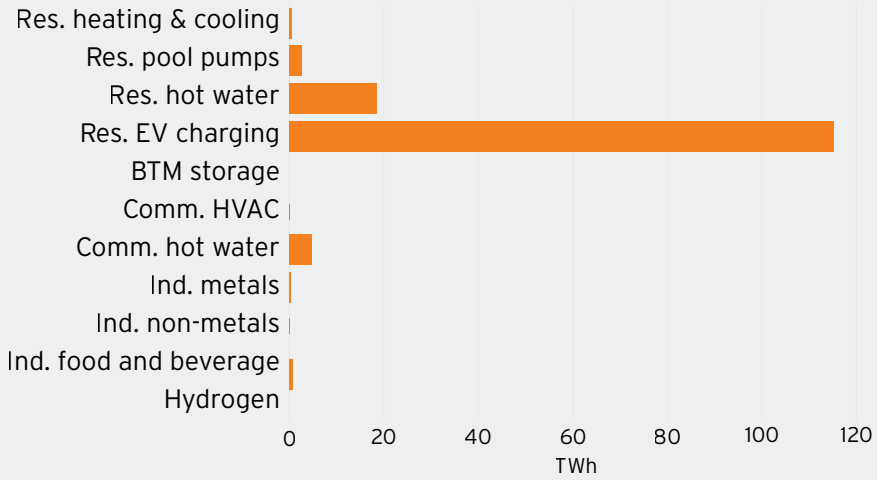
KEY FINDINGS

- Compared to SoW 2, the electrification is associated with increases in solar, wind and gas capacity investments and small reduction in energy storage.
- In this scenario, increased load flexibility increases wind investment while decreasing solar and storage requirements generating $4-5 billion savings to consumers. Flexibility also offsets any price increases associated with higher demand for electricity.
- Flexible EV charging continues to be the dominant source of load flexibility due to its relatively low marginal cost. While flexible industrial sources are enabled in the SoW 3 High Flexibility scenario, these technologies are very rarely dispatched due to their high trigger prices[9].
- This is the first SoW where demand flexibility replaces the need for new-build thermal generation to meet increased demand from electrified industrial processes. As a result, emissions marginally decrease.
- Flexibility reduces NEM peak demand by around 5 GW from 2035 to 2040 and transmission load factor is improved by around 2% overall.

SoW 3 – Change in nominal capacity mix from 2021 to 2040



SoW 3 – Contribution from modelled load flexibility sources from 2021 to 2040



9 See Appendix B of NERA Economic Consulting, *Valuing Load Flexibility in the NEM*, February 2022, arena.gov.au/knowledge-bank/valuing-load-flexibility-in-the-nem.

4.4 SoW 4: HIGH DER UPTAKE

SoW 4: High DER Uptake
SoW 3 + faster uptake of DER sources.

Low flexibility scenario	High flexibility scenario
Baseline case Low Flexibility scenario	**SoW 3 High Flexibility scenario +** High BTM PV and battery uptake **+** Large-scale PV **+** ISP Step Change renewable targets

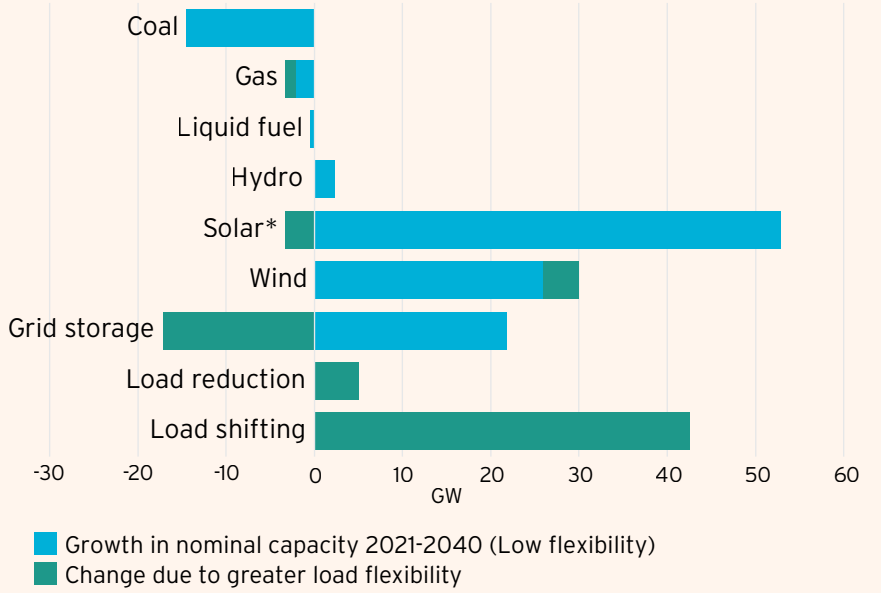
INTERPRETING THE RESULTS

- Faster uptake of VRE comes from high BTM PV uptake, cheaper options for large-scale PV (using ISP Step Change assumptions), more ambitious renewable policy target. Additionally, SoW 4 allows for BTM battery flexibility, with batteries assumed to have 2.5 hours of storage.[10]
- For ease of modelling, the contribution of additional behind-the-meter PV is captured by reducing electricity demand in daylight hours.

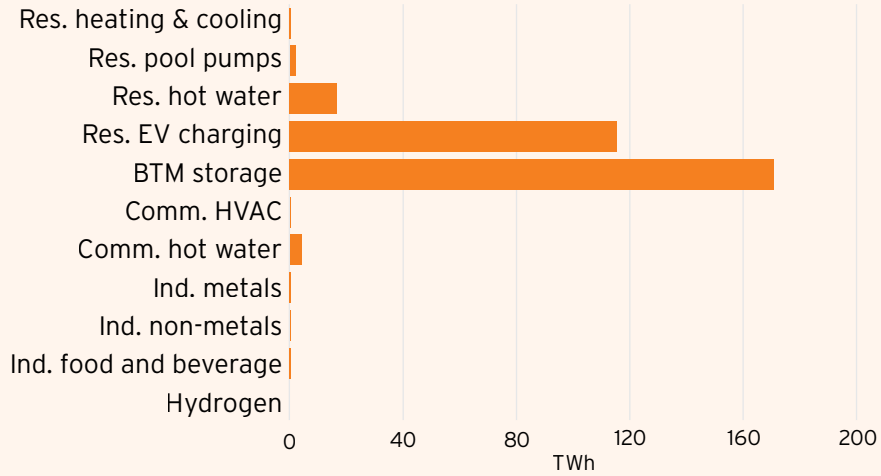
KEY FINDINGS

- The uptake of DER in the form of solar and BTM batteries directly offsets the need for large-scale solar and storage. In this study, these investments are funded by consumers and therefore result in lower system costs in both the low and high flex cases.
- High demand flexibility in SoW 4 results in savings of $8-18 billion. System costs are reduced in the form of reduced solar and grid storage requirements. In addition, consumers benefit from a large wealth transfer from generators by reducing the instance of peak price events (generator 'super profits').
- BTM storage and EVs constitute the highest single contribution to flexible capacity reflecting their low marginal cost. While not visible in these charts, industrial flexibility starts to grow rapidly towards the end of the modelling period.
- Emissions decrease on average by 3 Mt from 2035 to 2040, as the high flexibility scenario consistently deploys less coal generation.[11]
- Flexibility reduces NEM peak demand by around 8 GW from 2035 to 2040 and transmission load factor is improved by around 6% overall.

SoW 4 – Change in nominal capacity mix from 2021 to 2040



SoW 4 – Contribution from modelled load flexibility sources from 2021 to 2040



10 See Appendix B of NERA Economic Consulting, *Valuing Load Flexibility in the NEM*, February 2022, arena.gov.au/knowledge-bank/valuing-load-flexibility-in-the-nem.
11 In addition to emission reductions outside of the power system

4.5 SoW 5: HYDROGEN

SoW 5: Hydrogen
SoW 4 + the uptake of industry-scale hydrogen electrolysis.

SoW 4 Higher flexibility scenario	Higher flexibility scenario
+ H_2 electrolysers operating with 85% load factor.	+ H_2 electrolysers operating with 60% load factor.

INTERPRETING THE RESULTS

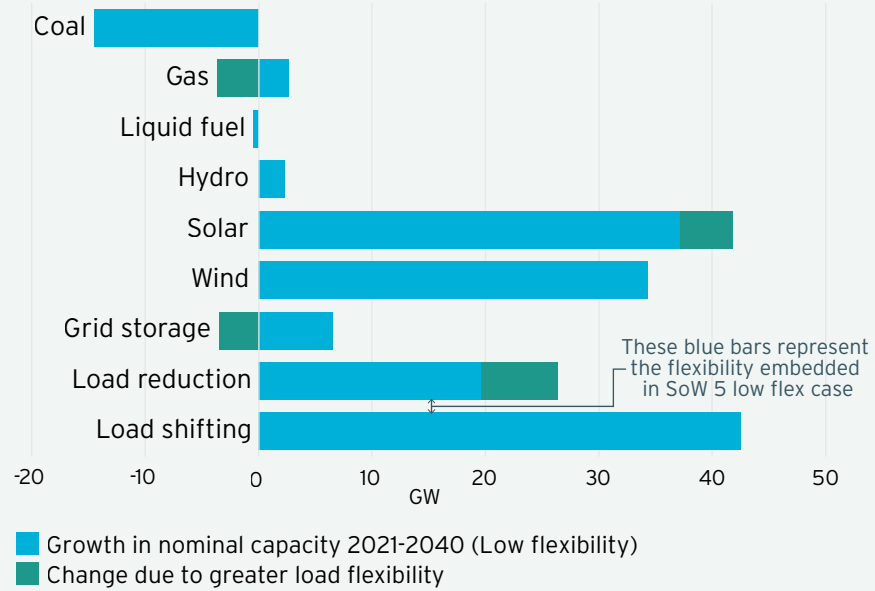
- Flexibility represents a reduction in the load factor of grid connected electrolysers from 85% to 60% while maintaining equivalent annual hydrogen production (i.e. the 60% case has more electrolyser capacity). In both the low and high flexibility cases, the electrolysers are operated to minimise electricity costs within the relevant load factor constraint.

KEY FINDINGS

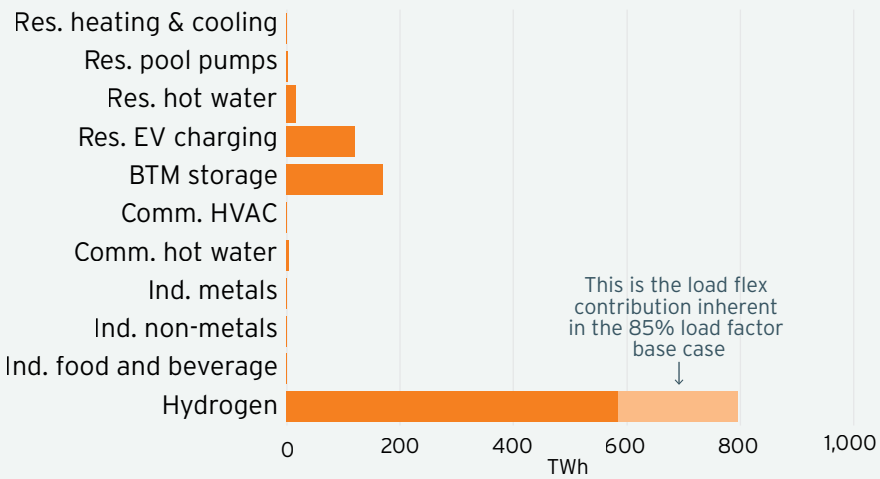
- SoW 5 has the highest new-build capacity relative to all previous SoWs just to meet the increased total demand from the hydrogen sector. However, this is not associated with price increases on a $/MWh basis.
- Reducing hydrogen production load factors from 85% to 60% reduces system costs by around $3 billion in the form of reduced storage and gas generation.[12] The relationship between load factor and cost is likely to be non-linear, with diminishing benefits associated with further load factor reductions.
- High-flexibility electrolysers pair well with solar generation. This is seen in the increase in solar generation not seen in other SoWs.
- Hydrogen production was not modelled to use only renewable electricity and consequently, total emissions in SoW 5 were substantially higher. Greater flexibility in hydrogen production reduced emissions by around 10 Mt per annum from 2035 to 2040.
- Moving from 85% to 60% load factor had no material effect of peak demand as peak reduction was inherent in the 85% load factor case.

12 In addition to the $9-17 billion savings inherent in the 85% load factor 'low-flex' case. Note that these savings estimates do not include the capital cost of increasing electrolyser capacity to enable a lower load factor.

SoW 5 – Change in nominal capacity mix from 2021 to 2040



SoW 5 – Contribution from modelled load flexibility sources from 2021 to 2040



5 NEXT STEPS

IMPORTANCE OF THE LOAD FLEXIBILITY STUDY

The Load Flexibility Study highlights the enormous potential that demand flexibility offers in reducing the costs of the energy transition. It is important to note that the study findings are shaped by a range of simplifying modelling assumptions, and therefore future technology and commercial innovations are likely to unlock opportunities in areas that are not covered in this study.

What is evident though, is that demand flexibility offers significant economic value in key areas such as water heating, EV charging and hydrogen production that it there is significant opportunity in its pursuit by consumers and industry, as well as through future market reforms.

ARENA'S STRATEGIC FOCUS

ARENA's focus is now on the next phase of technology research, development, deployment and commercialisation. ARENA is committing funds to supporting the following high-impact innovations:

- Demonstrate the technical and commercial viability of a range of novel flexible demand options, including managed charging of electric vehicles, flexible operation of hydrogen electrolysers, and other load shifting technologies in industrial, commercial and residential settings.
- Effectively integrate and orchestrate novel sources of flexible demand and supporting infrastructure and services, such as demand management systems, dynamic operating envelopes and virtual power plants.
- Support projects and knowledge sharing that will inform the regulatory framework on flexible demand, such as how it can best support the development of a more two-sided market.

DISTRIBUTED ENERGY INTEGRATION PROGRAM (DEIP)

- Energy market bodies, industry and consumer groups are collaborating to accelerate the integration of distributed energy resources in Australia's electricity systems. The Distributed Energy Integration Program provides a vehicle to explore reforms and technology and commercial innovations that can unlock greater levels of demand side participation through the energy transition.

FURTHER RESOURCES

- Read the NERA report *Valuing Load Flexibility in the NEM,* arena.gov.au/knowledge-bank/valuing-load-flexibility-in-the-nem
- See the NERA data annex, December 2021, arena.gov.au/knowledge-bank/valuing-load-flexibility-in-the-nem
- Read about the role of flexible demand in Australia's energy future arena.gov.au/knowledge-bank/the-role-of-flexible-demand-in-australias-energy-future/
- Read about ARENA's Investment Priorities arena.gov.au/about/publications/funding-investment-plan/
- For more information on the DEIP 2022 Work program, visit arena.gov.au/knowledge-bank/deip-ceo-forum-4-march-2022/

Further information is available at
arena.gov.au

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