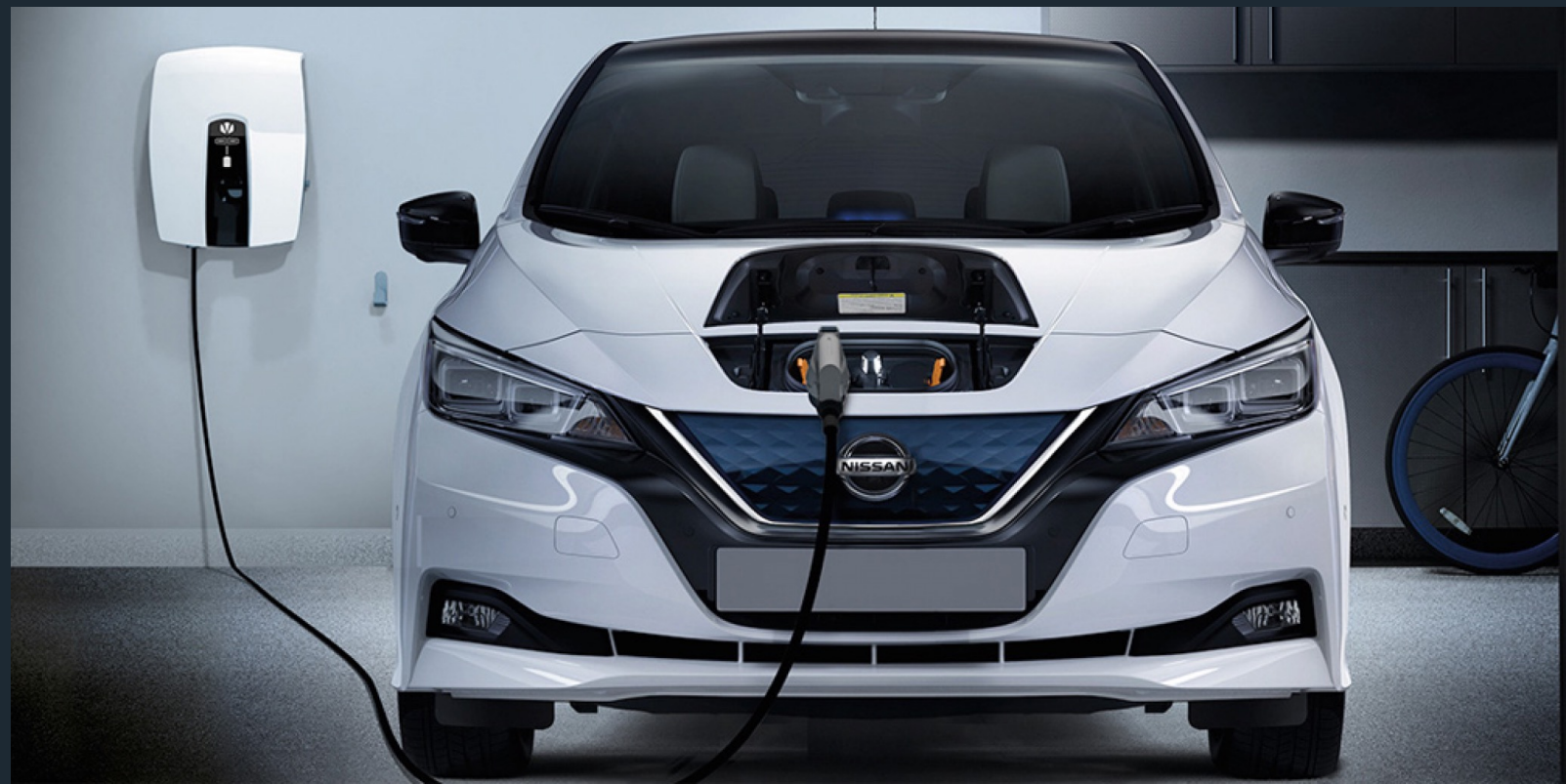
Institute for Energy Economics and Financial Analysis

Distributed storage will be the majority of storage

Batteries on wheels as vital instruments in a renewable symphony



Dr Gabrielle Kuiper

November 2023

The Energy Transition

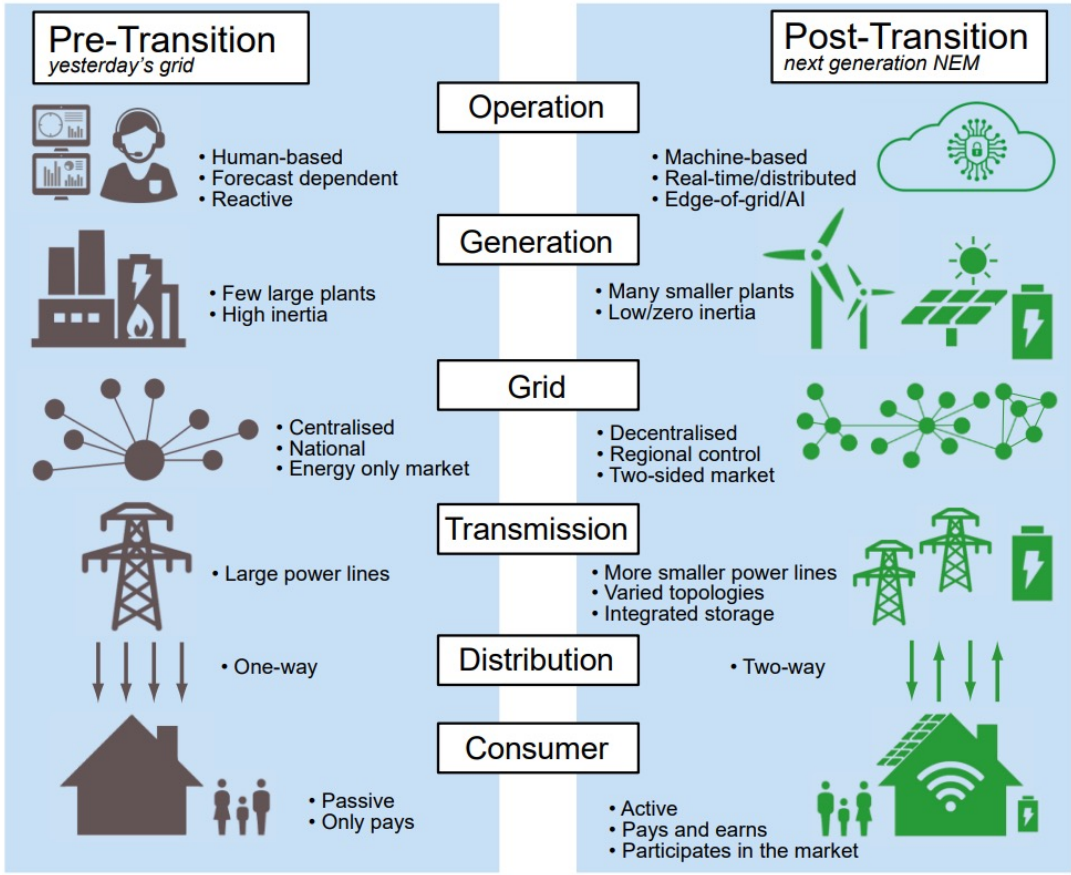
In the NEM so far:

- $25+ billion of household/business investment in Distributed Energy Resources (DER)
- 21.5GW rooftop solar (RTS)
- 14.3GW – 3+million household RTS systems
- 7.7GW – 400,000+ non-residential RTS systems, accelerating with large potential (28GW minimum for C&I)
- Over **180,000 household batteries**
- Over **100,000 EVs** (only a few with V2G)
- Demand response underutilised

Source: IEEFA

But the benefits of DER & opportunities of EVs are still underestimated

Levels of change

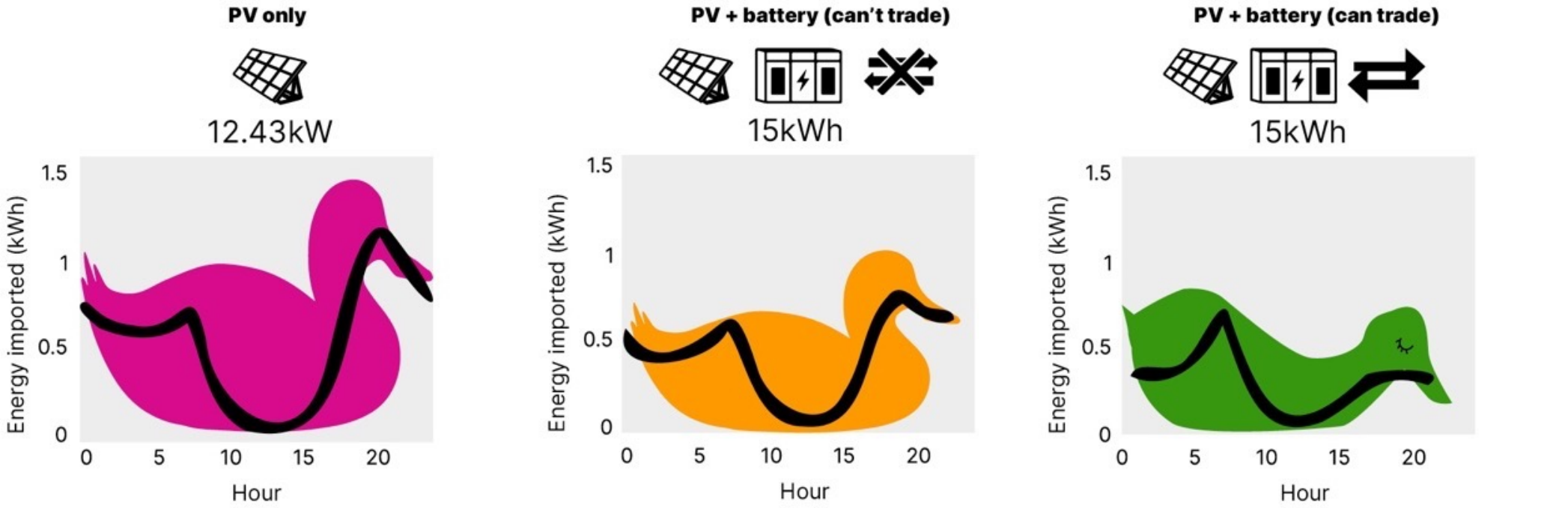


Source: IEEFA

Rooftop PV + batteries can put the duck to sleep

Import from wider grid

For the average household in the modelled suburb



Based on ITP Renewables modelling

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Rooftop PV + batteries puts the duck to sleep

Average Load

PV only

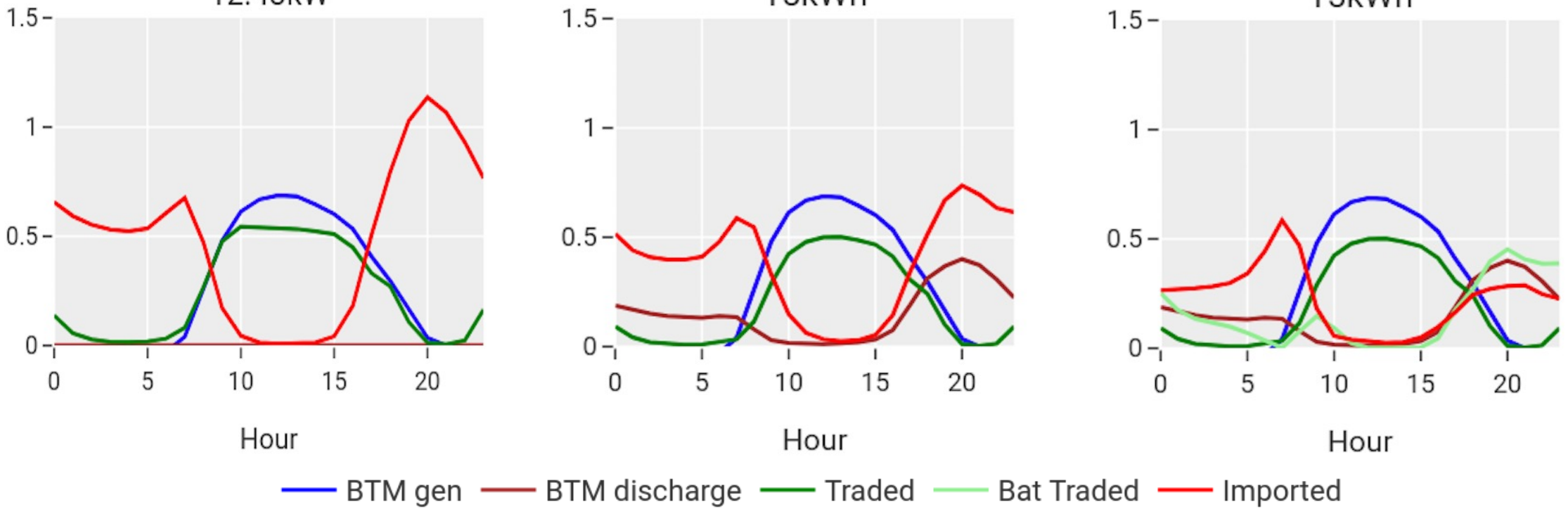
12.43kW

PV + battery (can't trade)

15kWh

PV + battery (can trade)

15kWh



Individual-scale V2L, V2H, V2G

- Current passenger car batteries: **110kW/40kWh** for a Nissan Leaf to **595kW/93kWh** for a Tesla model S
- The average vehicle currently travels 11,000km/year which equates to **7kWh/day** charging or **15-25% capacity** of a smallish 30-50kWh battery
- In turn, the average household uses 16kWh/day so a smallish battery could run a house for 2-3 days

Source: Race For 2030

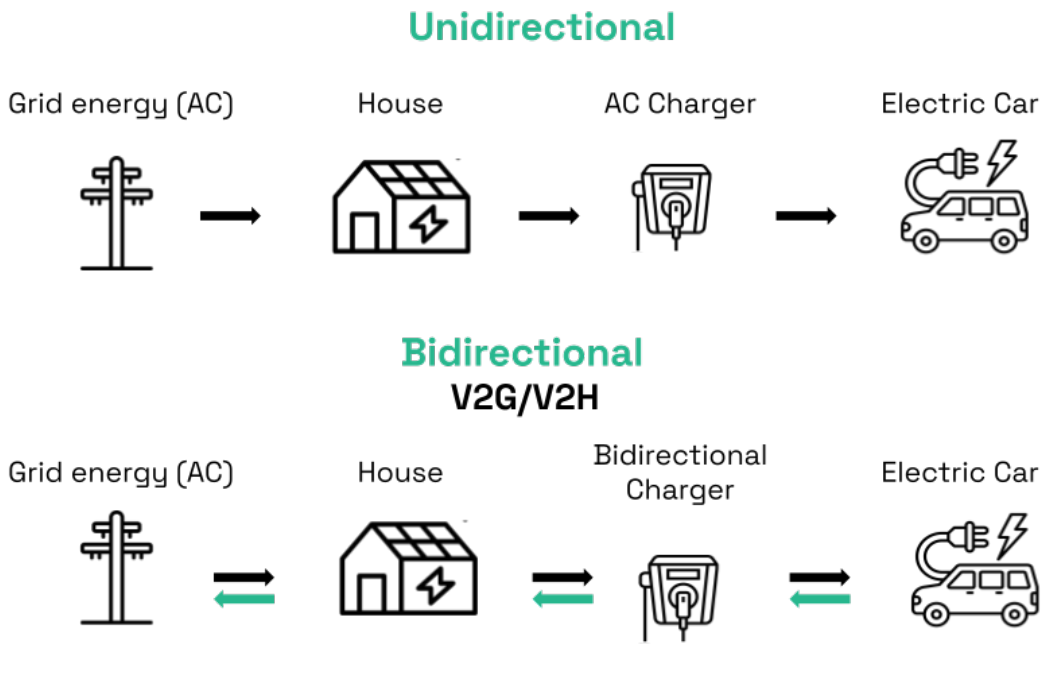


Figure 10 – Summary of EU homologated models with 'announced' or 'available' V2X capability (Source: ev-database.org, accessed 14/5/2023). 15+ bidirectional-ready EV models have been announced for the US market3. The Ford F-150 Lighting (North America only [4]) is an important early DC V2G/H product and it is case studied at Appendix B).

Automaker	DC V2G	AC V2G	V2L	Average V2G battery (kWh)	Average non-V2G battery (kWh)	Average V2G EV price premium
Audi	6	0	0	76.6	87.6	-38%
BYD	0	0	2	N/A	75.7	-
CUPRA	1	0	0	77.0	58.0	16%
Genesis	0	0	3	N/A	75.7	-
Hyundai	0	0	8	N/A	62.1	-
Kia	2	2	7	99.8	63.4	30%
Lucid	5	5	5	104.8	N/A	N/A
MG	0	0	8	N/A	57.9	-
Nissan	2	0	0	51.0	81.0	-62%
Polestar	2	2	4	107.0	81.5	56%
Skoda	6	0	0	77.0	56.0	34%
Volkswagen	10	0	0	77.0	56.1	27%
Volvo	2	2	2	107.0	74.7	100%
XPENG	0	0	6	N/A	85.2	-
All	**36**	**11**	**45**	**85.9**	**69.4**	**11%**

Source: enX for ARENA

The collective scale of batteries on wheels

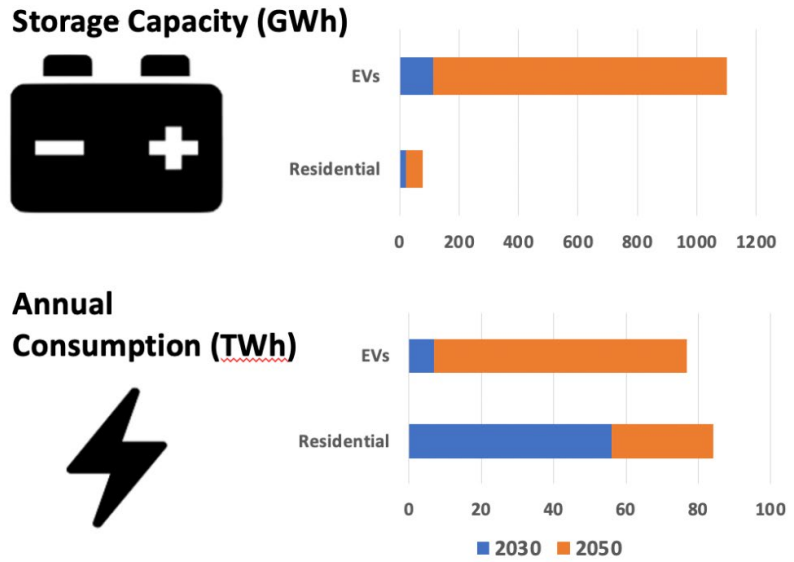
There are a wide variety of estimates of EV storage capacity and consumption:

- EV storage capacity estimates for 2050 range from 180GWh (CSIRO) to **2,340GWh (enX)** (cf 640GWh required)
- Simple case: **5 million EVs** discharging at 7kW is 35 GW - equivalent to peak demand in the NEM
- Race for 2030: If 80% of new sales of all vehicles are EVs by 2030
  → an EV fleet share of around 20-25% of all cars by 2030

  → **20 GWh per day** additional load

  → but if spread evenly over the day,
  only **3 - 4% increase in demand by 2030**

Source: Race For 2030, enX, CSIRO



Source: Race for Networks Project. Research Theme N1: Electric vehicles and the Grid Project. RACE for 2030. October 2021

V2G Revenue streams could be worthwhile

- **Roughly $600-1000/year for V2G** on current estimates
- Highly dependent on future market access and tariff design
- RACE for 2030 CRC: $879/year *median* revenue
- enX for ARENA: V2G from $1,560 (TAS) to over $6,000 in NSW and SA 10-year NPV cf smart charging
- ANU REVS V2G study: suggests up to $5,000 annually, where car mostly stationary

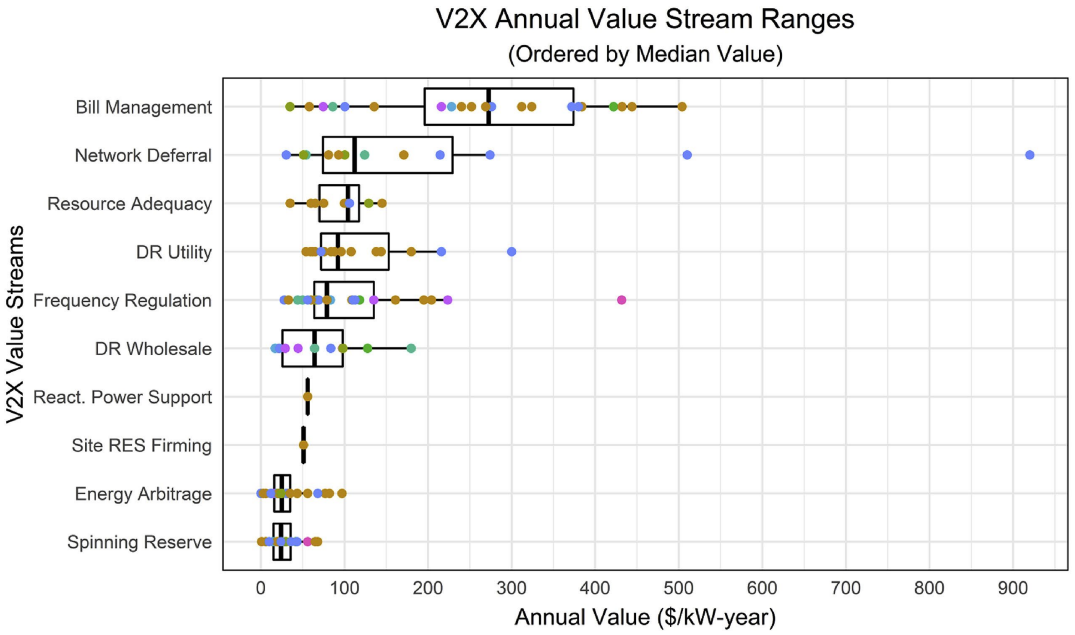


Figure 3: V2X annual value stream meta-analysis shows the overall economic potential of key V2X value streams in terms of annual revenue ($/kW-year), considering upper and lower limits and the median.[21]

Source: Race for 2030

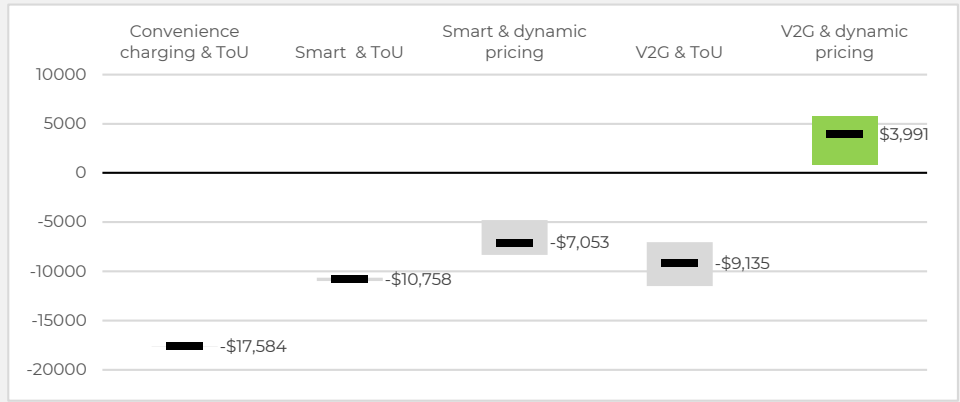


Figure 16

NSW – NPV of charging costs across user types (range across the 4 user types and average)

Average benefit of V2G relative to smart charging: $6,728

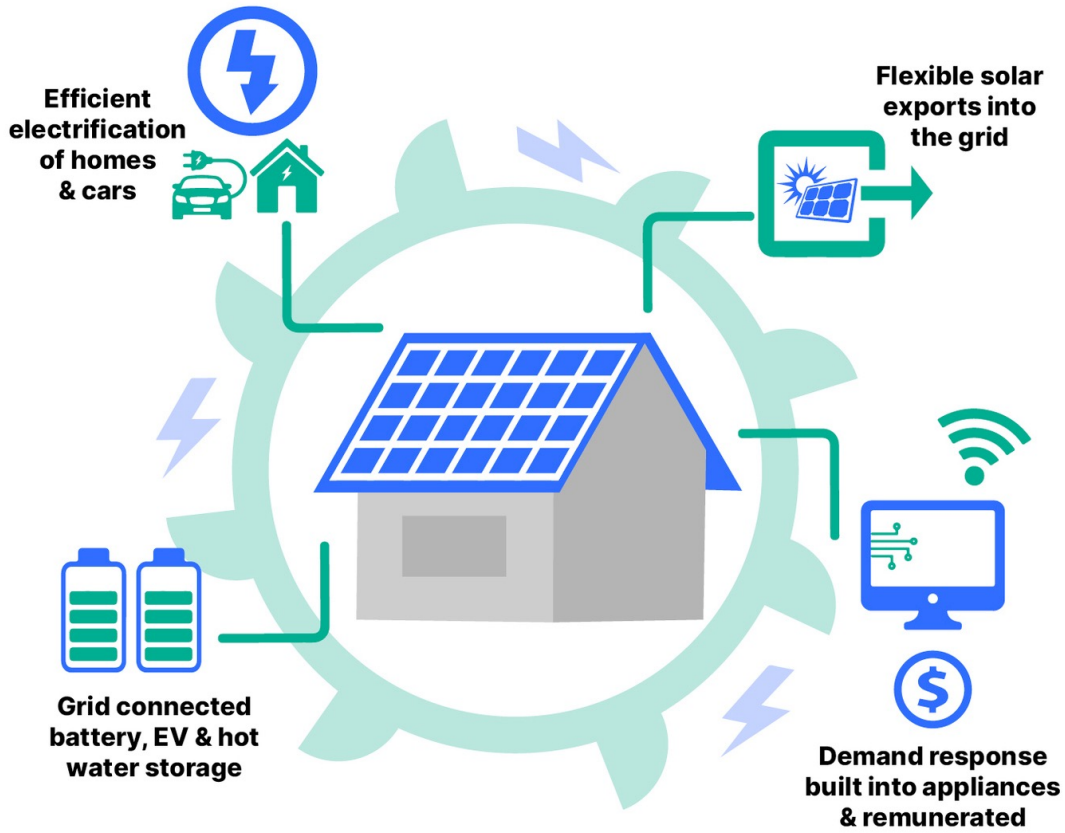
Source: enX used the Gridcog1 platform to model 24 different residential case study scenarios to determine the customer financial value of V2G relative to other charging modes – NPV over 10 years, solar households only, and vehicles assumed to be disconnected 6am-6pm weekdays and 9am-3pm weekends using 11.6kWh/day while driving. Also assumes 5kW static export constraint.

The resilience benefits need to be considered

https://newcastle.nsw.gov.au/about-us/news-and-updates/latest-news/solar-farm-powering-city-operations-and-revenue

https://www.australiantruckradio.com.au/city-of-newcastle-unveils-debut-electric-truck/

Optimising Distributed Energy Resources (DER) means enabling a sharing energy economy



Updates are required to **governance & regulation** to enable this:

- Dedicated body for the smart, timely development of technical DER authority standards
- Revised distribution network revenue regulation to enable DER to provide network services on a level playing field
- Review of energy market governance and its fitness for purpose for the energy transition

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1. Ensure appropriate technical standards are in place

RECOMMENDATION:

Create DER Technical Authority to set a vision for DER technical standards; develop a technical standards work program; monitor, review and set DER technical standards; consider issues related to compliance and enforcement of standards in their development; and providing advice on standards to other government and energy market bodies and undertake related reviews.

Dynamic operating envelopes: a necessary first step

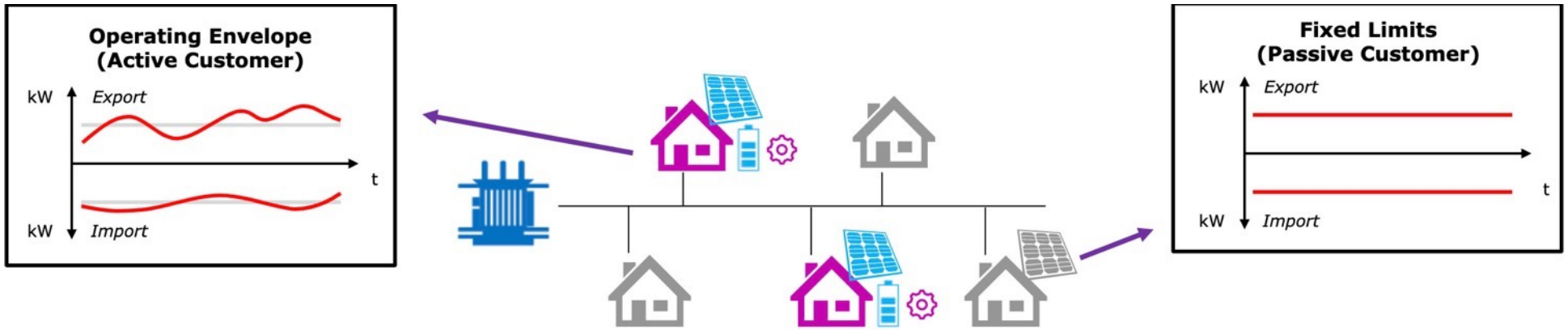
Set dynamically:
1-5-minute intervals,
24 hours in advance

Needs regulatory support:
including through consistency in APIs for information sharing – still a work in progress

Needs some funding:
but relatively small e.g. <1% revenue for SA Power Networks - $32m cf $3.9b 5-year revenue

Source: IEEFA

Allowing DER to play a greater role in energy markets and the grid



Source: Melbourne Energy Institute

2. Remove static constraints on existing solar

RECOMMENDATION:

Agree to **prioritise the implementation of flexible exports (dynamic operating envelopes)** across the NEM and the WEM by 2025

Agree to work collectively to **ensure distribution networks are being operated at voltages** which reduce consumer costs and improve consumer outcomes, especially rooftop solar exports and appliance longevity.

Flexible demand is as important as storage

Residential flexible demand:

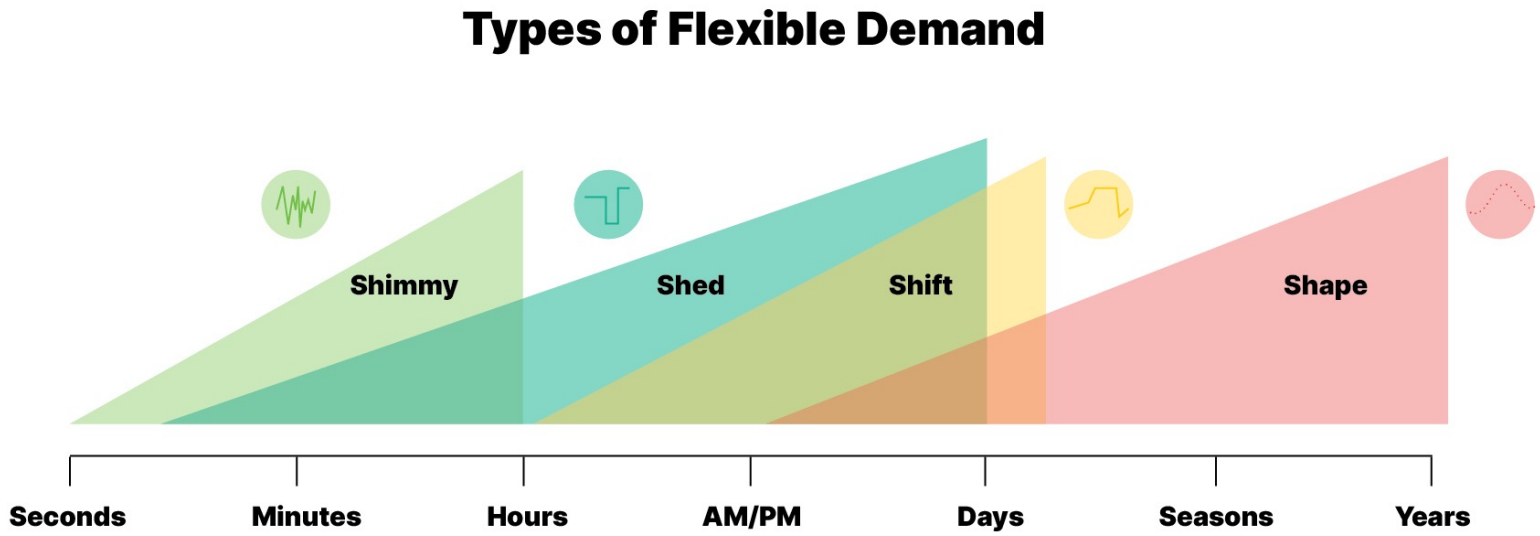
- 850MW Energy Queensland
- Size unknown Origin Spike

C&I flexible demand:

- 350MW EnelX
- 200MW Origin

Potential includes:

- 22GW electrified hot water
- 1.5GW existing industrial uses



		Wholesale Market & Grid Scale Renewable Support	Network Investment Savings	Contingency & Emergency Reserve	Distribution Network Support	Frequency Control Ancilary Services
Shift	Moving demand sporadically in response to an external signal	High	Medium High	Low	Medium Low	N/A
Shape	Moving demand routinely according to a standard long-term pattern	Medium High	Medium High	Low	Medium Low	N/A
Shed	Switching off equipment	Medium Low	High	High	Low	Medium Low (Lower only)
Shimmy	Moving demand over very short timescales in response to an external signal	N/A	N/A	N/A	High	High

Source: IEEFA

Source: IEEFA graphic based on Lawrence Berkley National Laboratory (LNBL) and Race For 2030 CRC

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4. Fast-track distributed storage

RECOMMENDATION:

Advocate to the Federal Treasurer that **Commonwealth's Small Business Energy Incentive run for three years**, until 20 June 2026.

Advocate to the Federal Government to **allow aggregated BTM storage (and, where possible, flexible demand) to participate in the Capacity Investment Scheme.**

Consider other ways to support BTM storage, including for reasons of resilience, and including through the SRES.

Agree that the new DER Technical Authority develop **an EV-grid integration workplan.**

5. Create a level-playing field in network services

RECOMMENDATION:

Commission a thorough, independent review of distribution network revenue regulation with the objective of ensure the regulation supports decarbonisation, the integration of DER and improved consumer outcomes, as well as economic efficiency.

Thank you!

IEEFA Guest Contributor

Dr Gabrielle Kuiper

View latest DER Report on the IEEFA website:

Growing the sharing energy economy

Institute for Energy Economics and Financial Analysis

www.ieefa.org