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The Benefits of Hyper-Utilisation of Consumer Energy Resources (CERs) Through a Virtual Energy Network (VEN)

ENERGY CONSUMERS AUSTRALIA

QUANTUM NRG

ReThink sustainability

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THE UNIVERSITY OF QUEENSLAND AUSTRALIA
CREATE CHANGE

Powertracer by enosi

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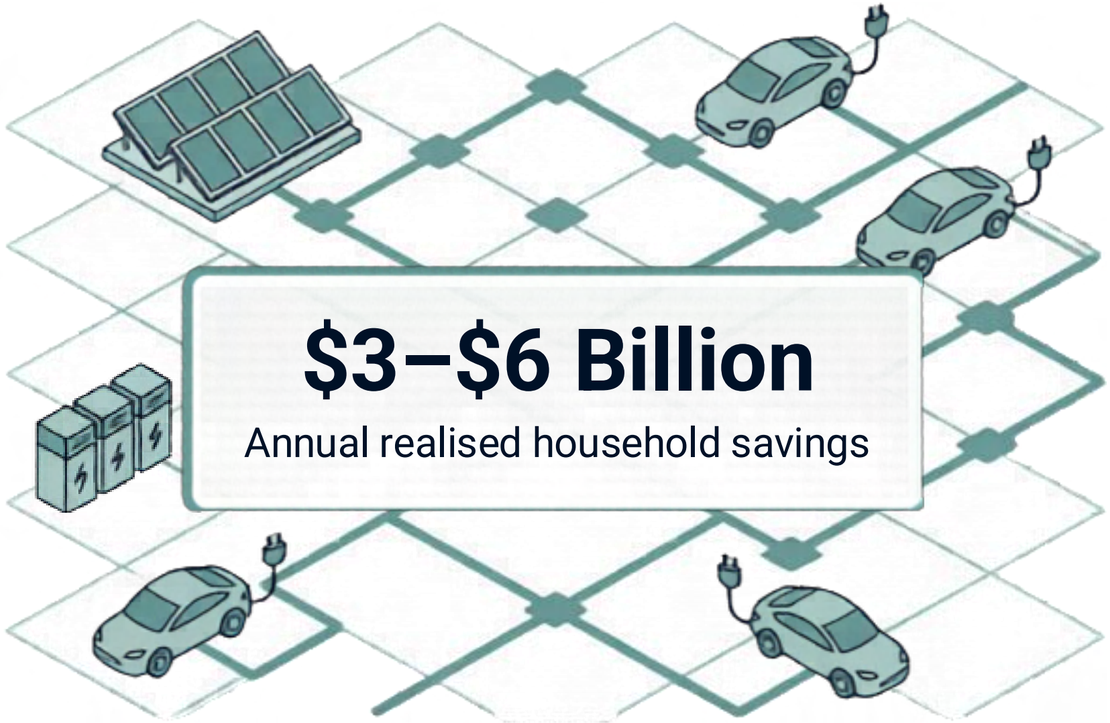
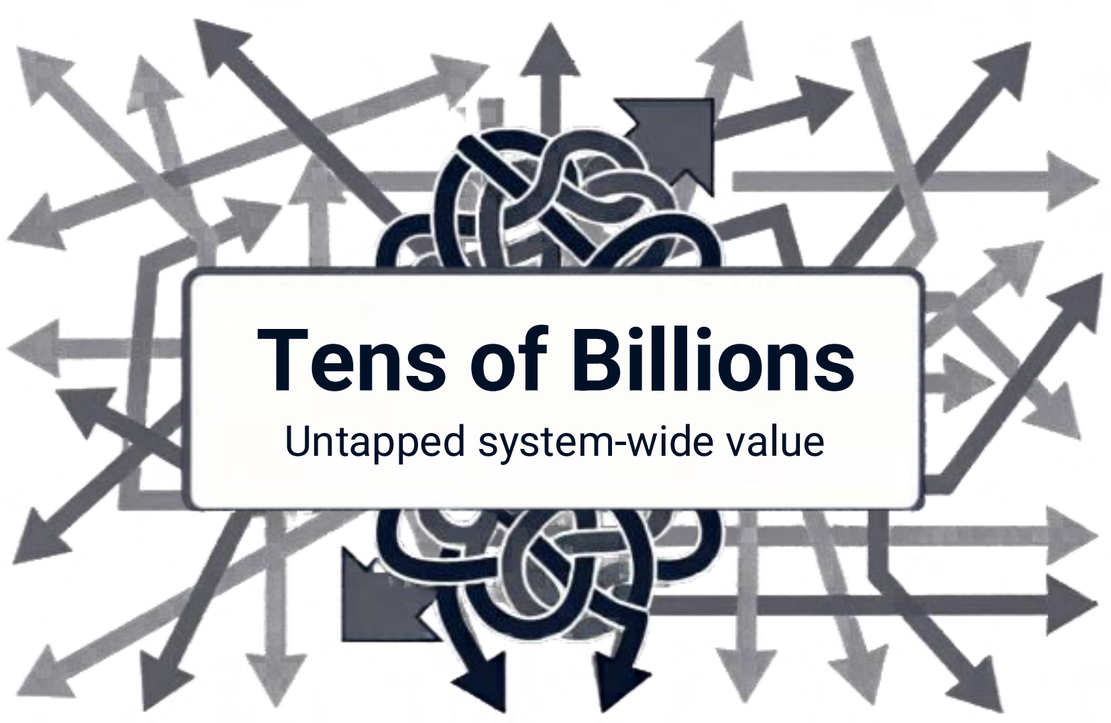
We have the technology.
We lack the coordination.

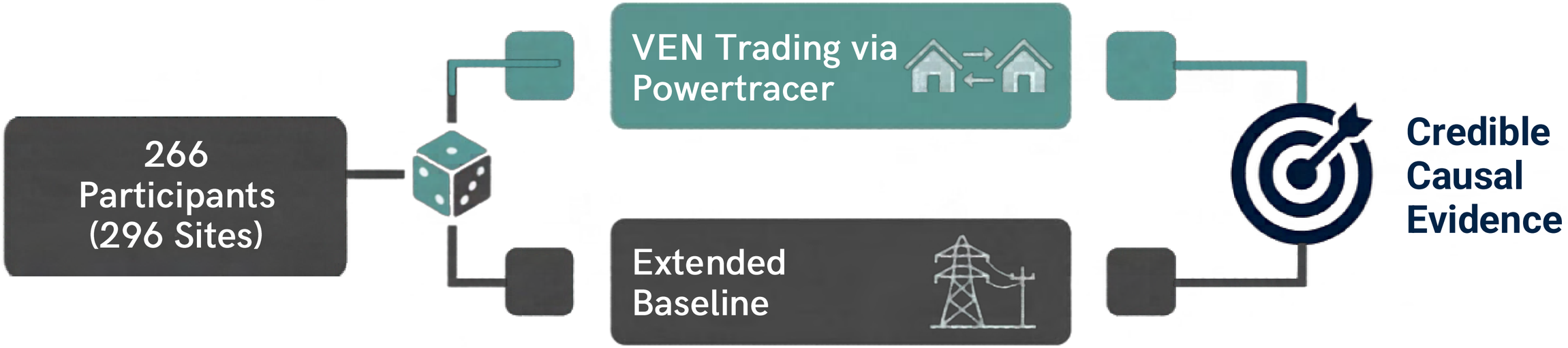


Insight Box
Australia's rapid uptake of rooftop solar (1 in 3 detached homes) creates a massive decentralised generation fleet embedded in the distribution network.



Insight Box
Uncoordinated individual optimisation may lead to network congestion, excessive exports, and wasted value. The missing piece is orchestration.

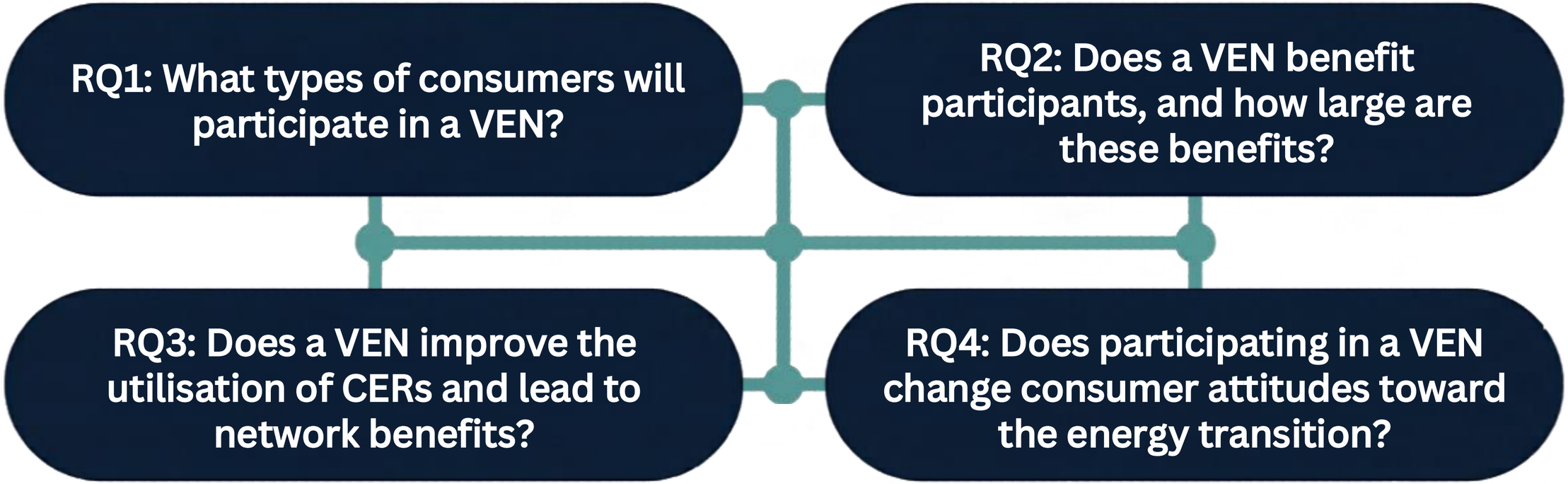
The Powertracer Trial: A Benchmark for Energy Research

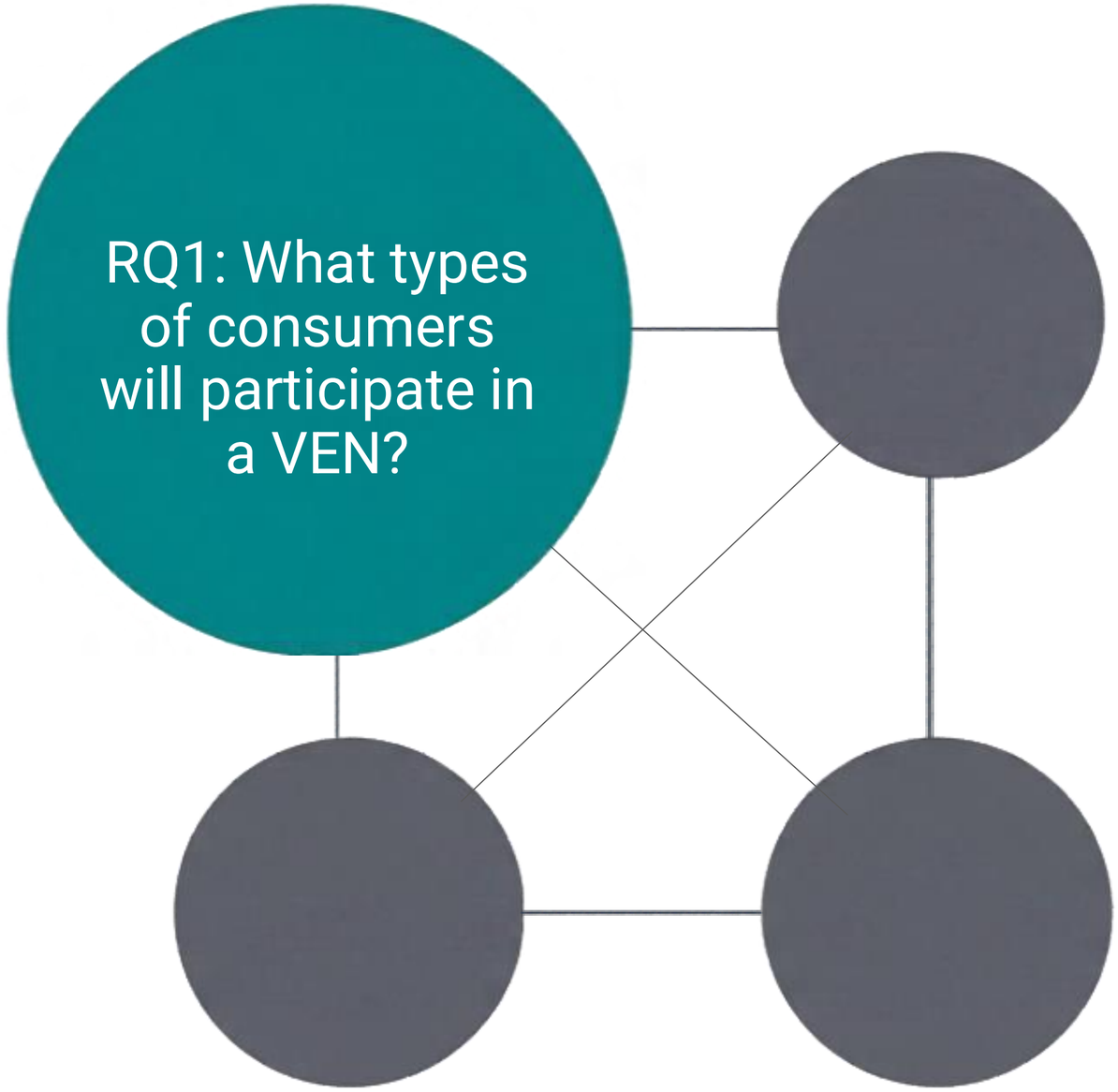


The Mechanism: A Virtual Energy Network (VEN) enabling peer-to-peer and community trading to align individual incentives with excess solar availability.

The Method: A phase-in Randomised Controlled Trial (RCT) spanning 6 cohorts, ensuring isolated, measurable impacts on energy use, prices, and consumer outcomes.

Four Questions for the Future of Energy Coordination

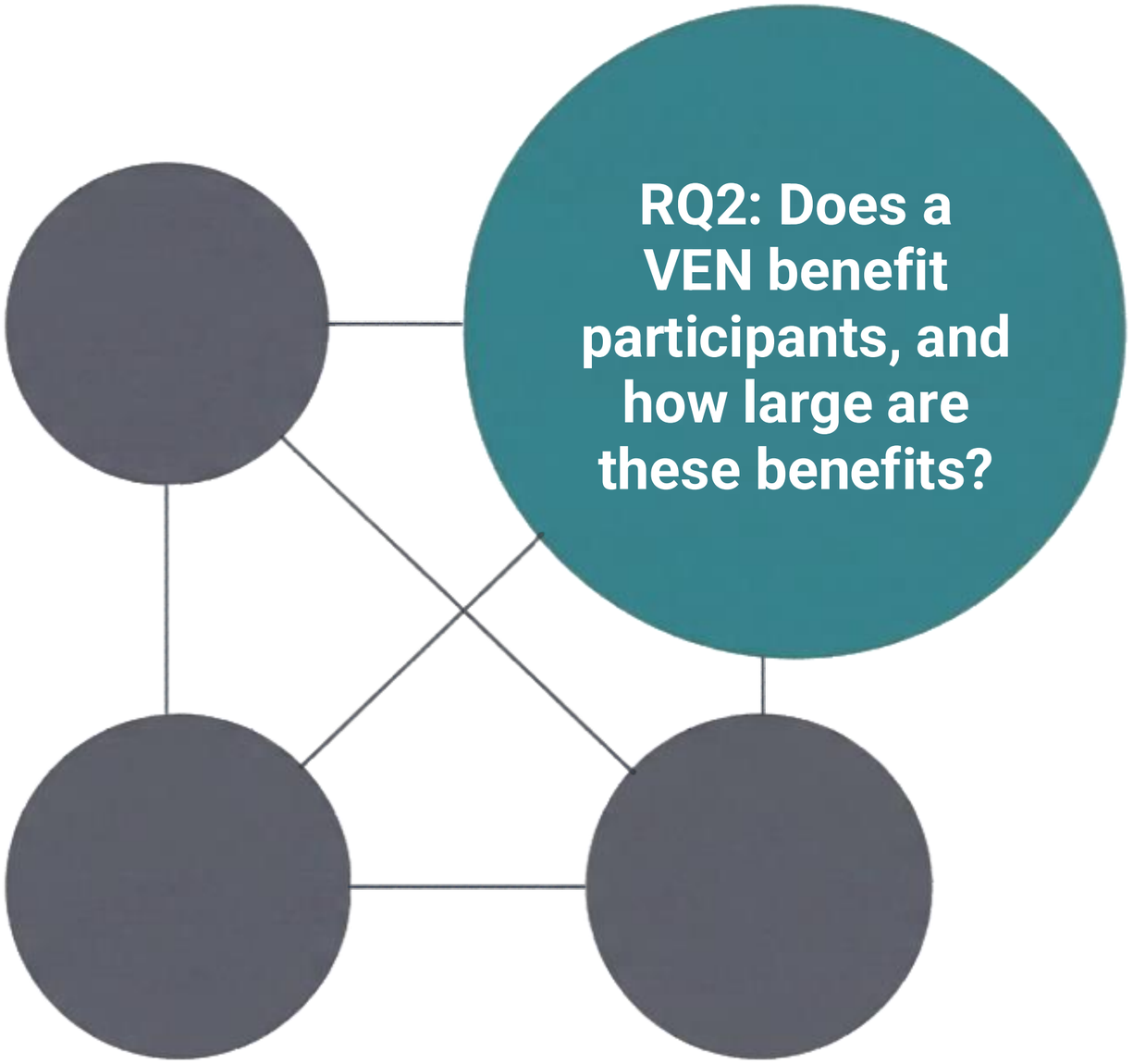



RQ1: What types of consumers will participate in a VEN?

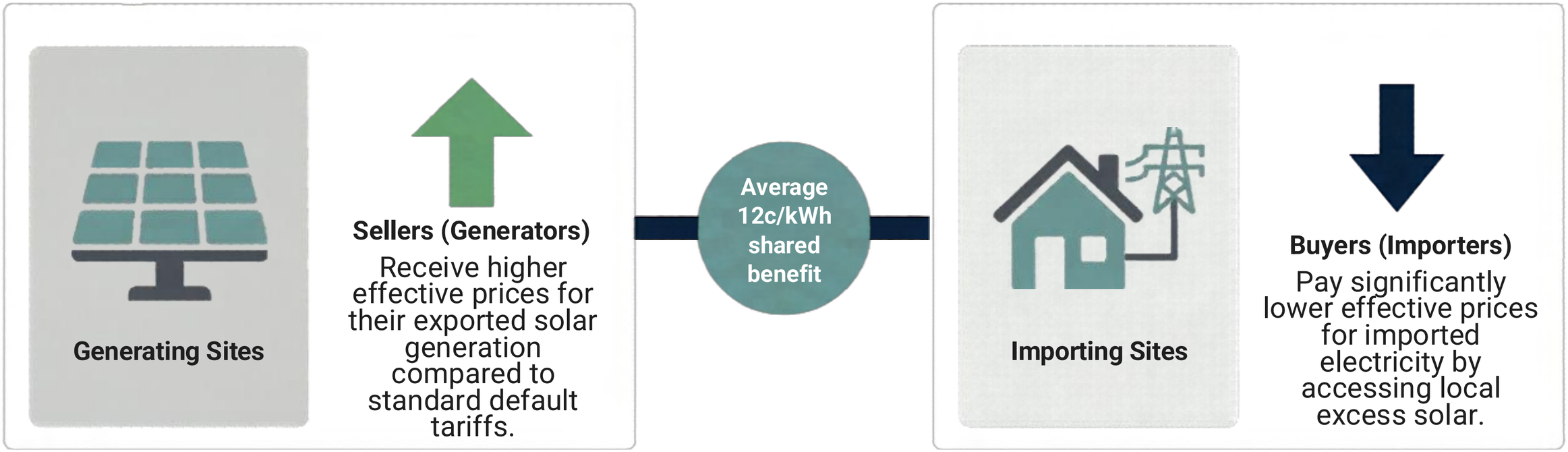
The Early Adopters: Highly Engaged and Resourced

	VEN Participant		Representative Sample
Rooftop Solar	**66%**		40%
Home Battery	**21%**		15%
EV Ownership	**23%**	10% (non solar)	12%
Homeowners	**92%**	79% (non solar)	63%
Average Income	**~$114k**	$118 (non solar)	~$98k

Current participants have the hardware and resources. To unlock system-wide value, future VENs must design recruitment pathways for less-resourced consumers to participate.


RQ2: Does a VEN benefit participants, and how large are these benefits?

Price-Mediated Coordination Works



The P2P pricing model established a 12c/kWh differential during peak solar hours, split equally, benefiting both sides of trades.

How Site Characteristics Shape VEN Benefits

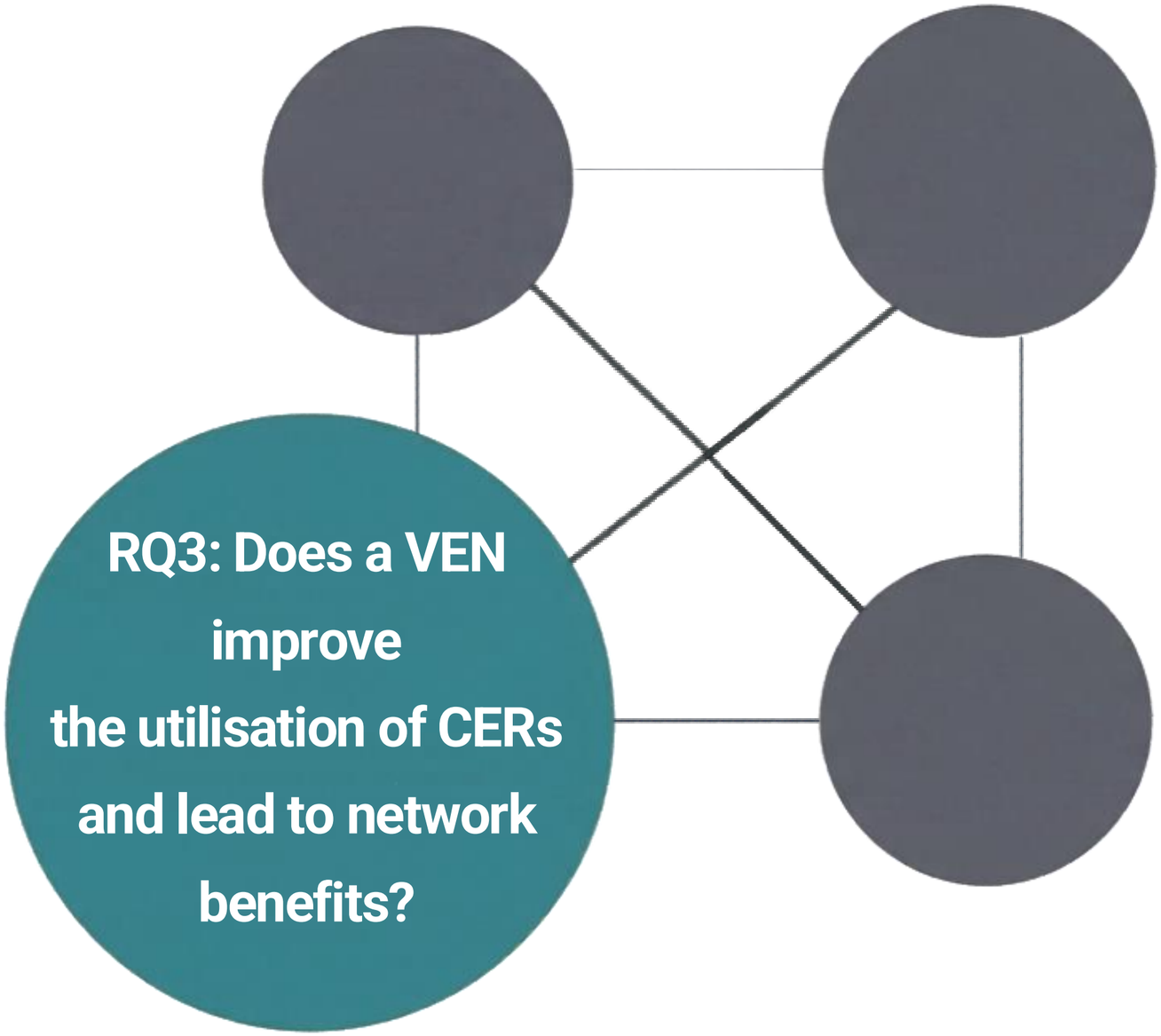
Small Users

The benefits are driven heavily by the Behaviour Effect. They shift appliance use (washing machines, dishwashers) to align with cheap, real-time solar availability.

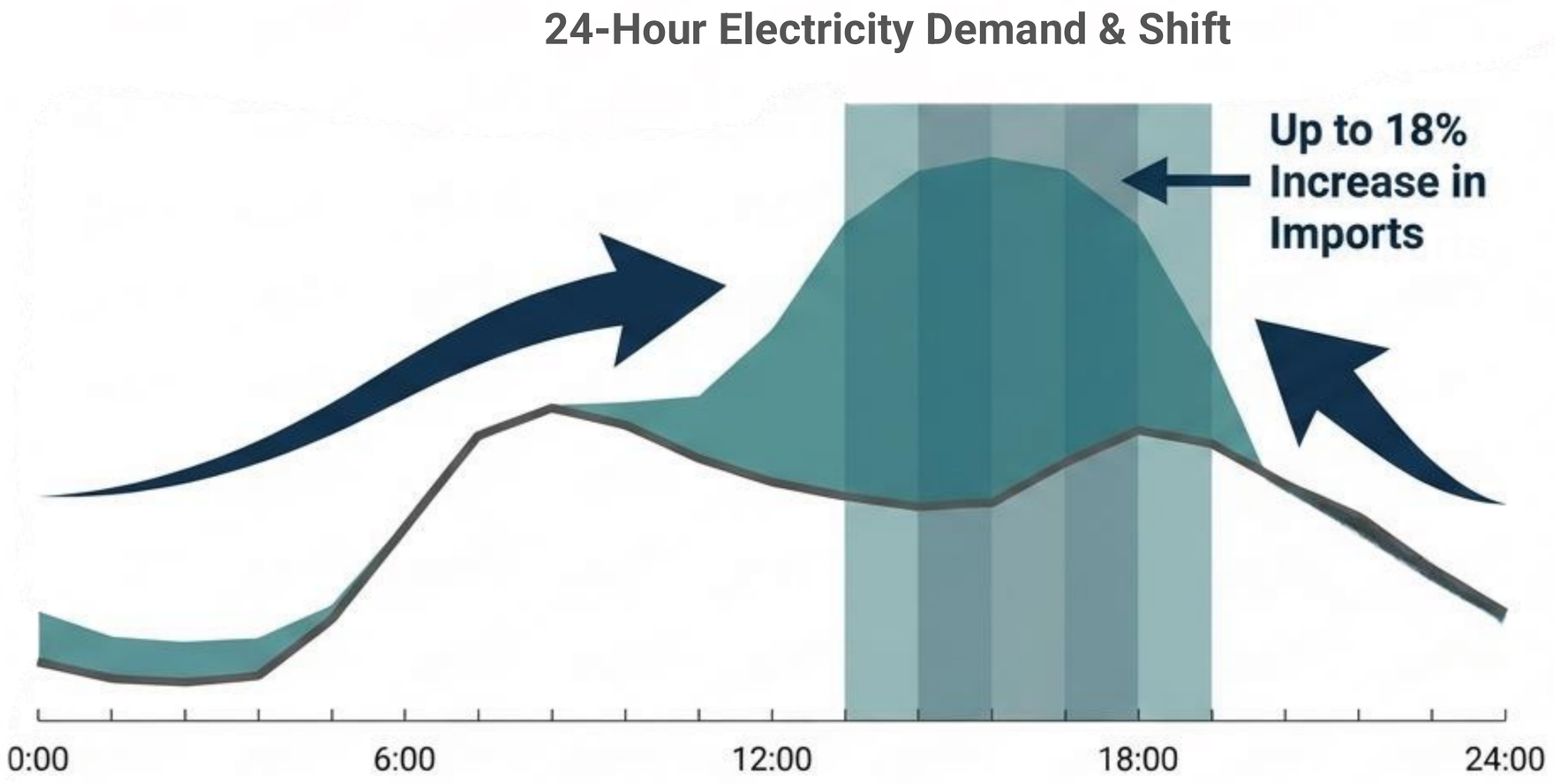
Large Users

The benefits are driven entirely by the Price Effect. They account for high volume and benefit inherently from the discounted rates, absorbing the financial benefit without significantly changing underlying habits.

Synthesis: Small users change behaviour; large users provide raw volume.


RQ3: Does a VEN improve the utilisation of CERs and lead to network benefits?

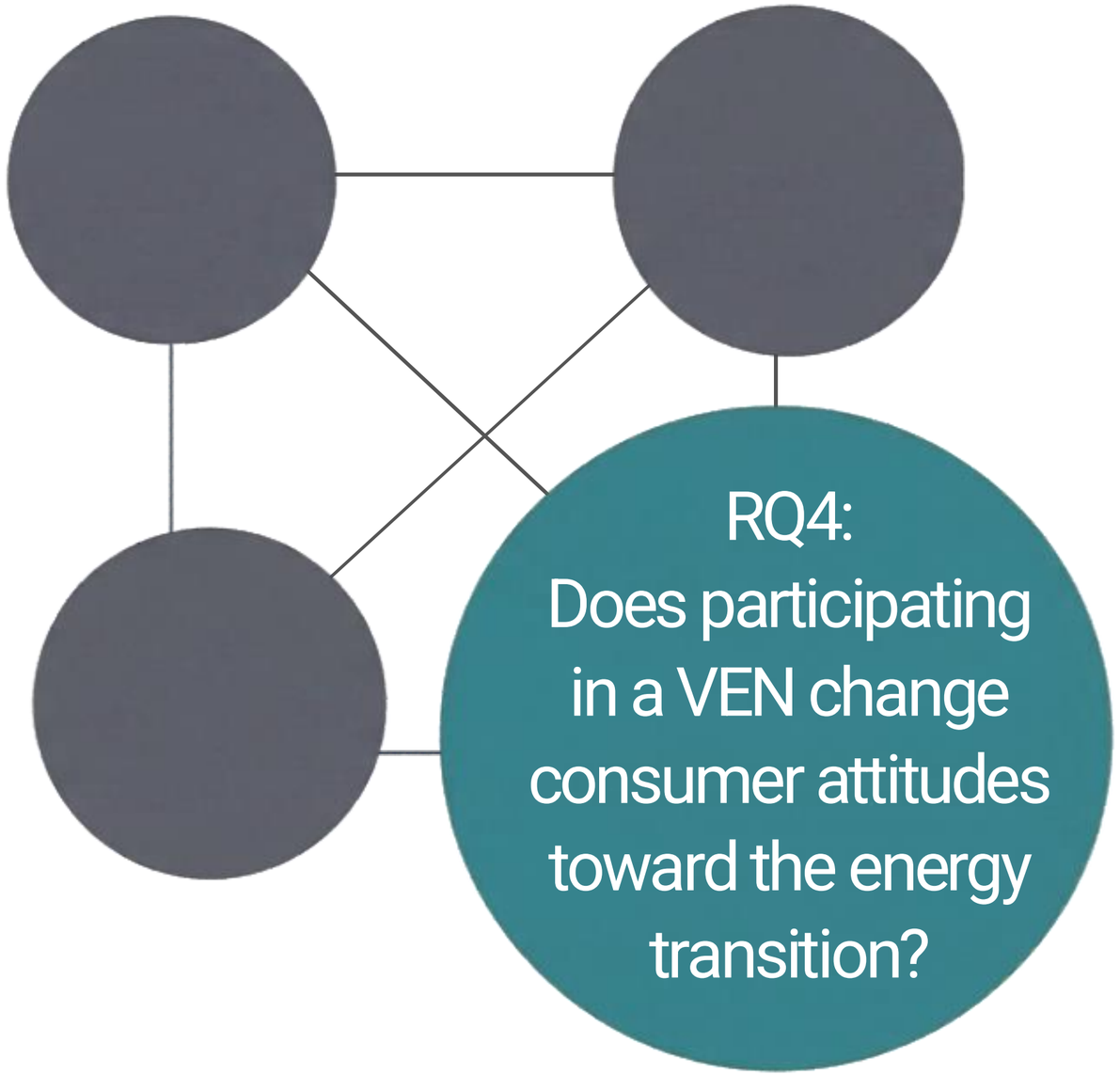
Creating the Solar Sponge



The Shift: Access to the VEN successfully increases electricity imports for non-generating participants by up to 18% during peak daylight hours.

The Drivers: Certain demographics show exceptionally high behavioural elasticity to soak up solar—specifically smaller sites, renters, EV owners, and homes with electric hot water.

Insight: Financial signals in a VEN actively and measurably shape load profiles, proving that decentralised households can act as coordinated, flexible demand.


RQ4:
Does participating in a VEN change consumer attitudes toward the energy transition?

The Fairness Dividend: Building Social Licence

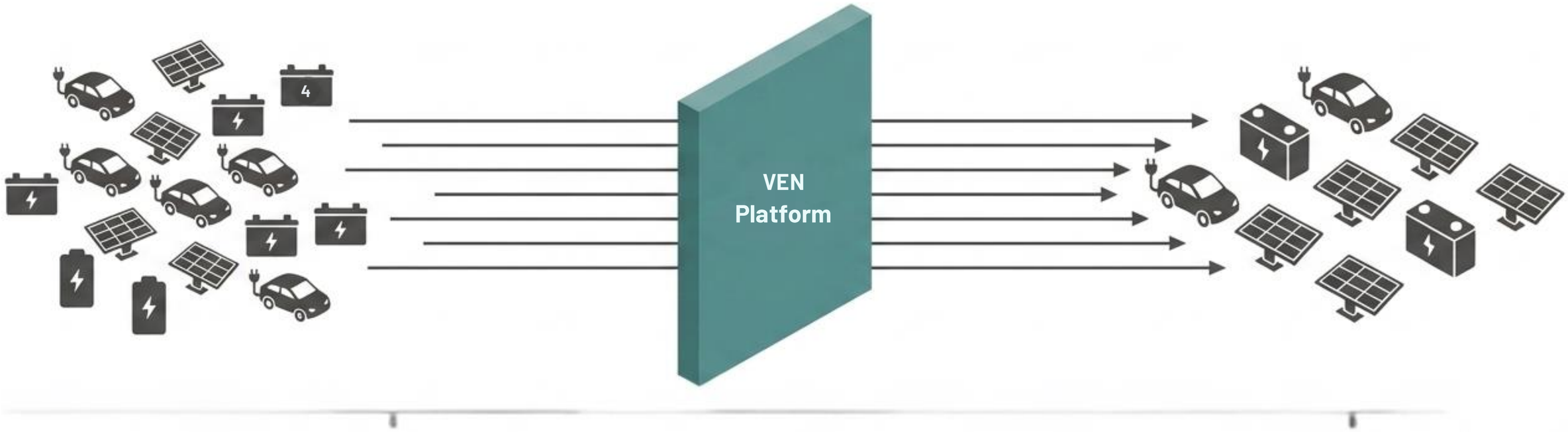
The Finding

Controlling for baseline attitudes, participation in the VEN resulted in a statistically significant increase in participants' confidence that the energy system is 'fair for households like you' (a 13% increase over the mean).

The Insight

Well-designed market mechanisms do more than balance the grid technically. By providing transparency and shared financial benefits, they actively manufacture the social trust required to sustain a decentralised energy transition.

Coordination > Technology



1. Who?

Engaged, highly-resourced early adopters.

2. Benefits?

Shared financial gains via price absorption and behavioral shifts.

3. Utilisation?

Successfully shifts load to solar-rich midday hours.

4. Attitudes?

Measurably improves perceptions of system fairness.

The Next Frontier: Evolving Virtual Energy Networks?

THE NEXT FRONTIER (FUTURE RESEARCH)

Network Constraint Integration

Incorporating local infrastructure conditions into price signals.

Granular Real-Time Signals

Providing participants with more timely visibility of resource availability and price signals.

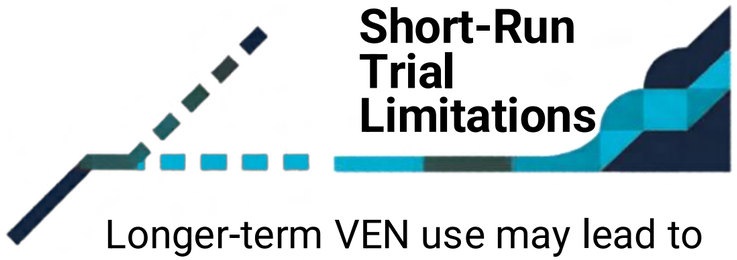
Targeted Peak-Reduction Incentives

Designing explicit market rewards to reduce consumption during critical evening peak periods.

VEN Trial: Limitations & Future Considerations

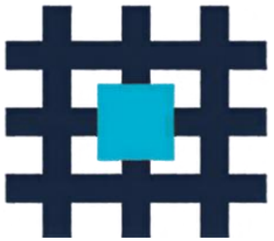
Understanding the constraints of duration and retail design for scaling the Virtual Energy Network model.

TEMPORAL & INVESTMENT CONSTRAINTS



Short-Run Trial Limitations

Longer-term VEN use may lead to increased CER investment, such as batteries, and/or electrification.



Static Infrastructure Assumptions

Current results do not capture structural changes in household energy hardware over time.

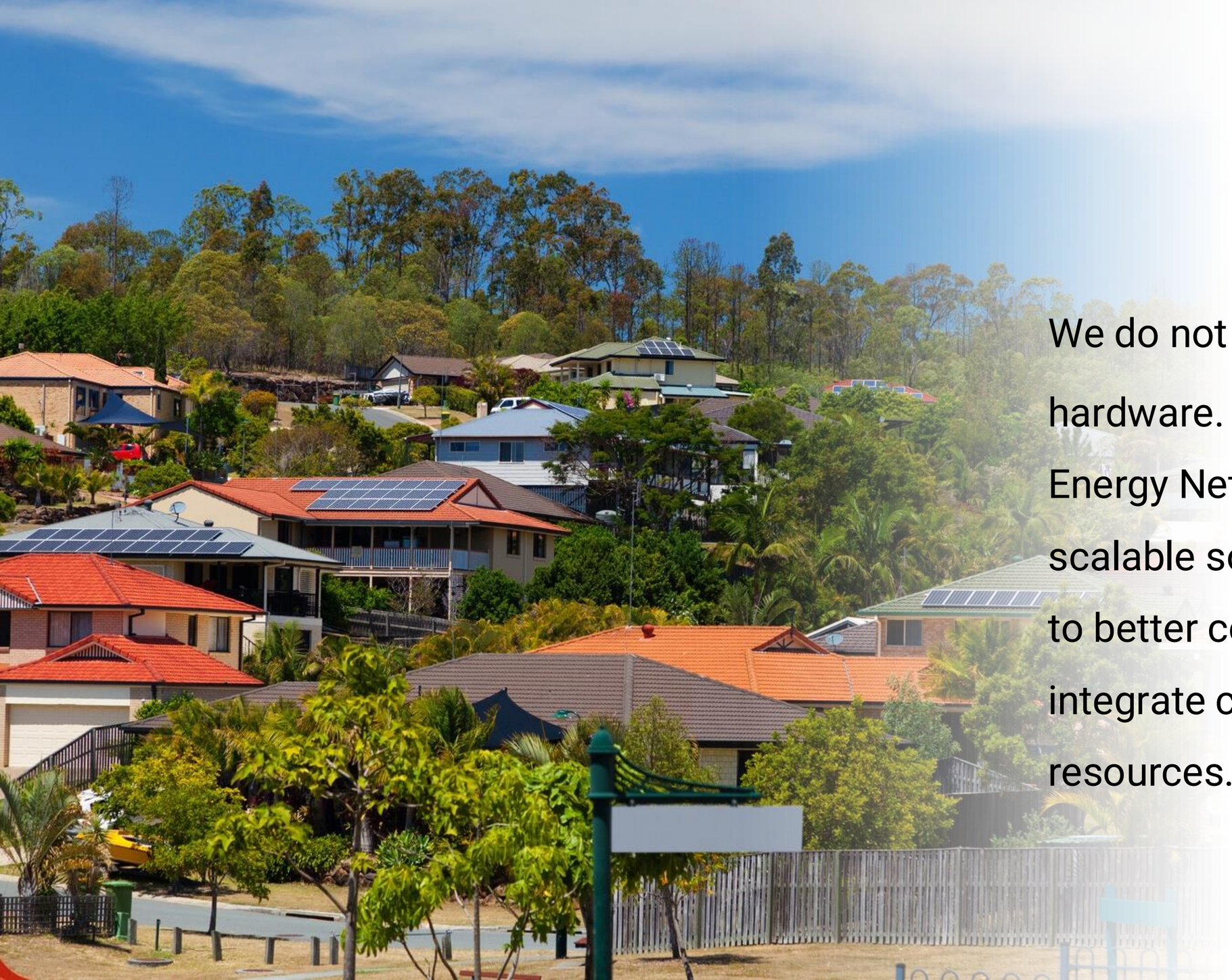
MARKET & BEHAVIOURAL VARIABLES

Alternative Retail Offerings

Behavioural responses and benefit distribution may vary significantly with different VEN retail structures.

Limited System Visibility

Absence of real-time signals and peak-reduction incentives may lead to increased evening consumption.



We do not need to wait for new hardware. Platforms like Virtual Energy Networks provide scalable software architecture to better coordinate and integrate consumer energy resources.

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With huge thanks to...

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