



ENERGY 2050

VISION FOR THE FUTURE ENERGY SYSTEM
South West Interconnected System



The future potential is clear. Australia can harness our abundance of renewable resources to deliver low cost, reliable and clean energy for all. The technology we need to achieve this is here, and there is every reason to believe continued rapid advancements in clean energy technology and scale will continue creating even more opportunities to deliver better energy for customers where and when they need it.

We are at a critical juncture where much of our current system that has served us well for over half a century needs to be replaced, independent of Government policy. This creates challenges and costs as well as opportunities. The choices we make now will determine how quickly, reliably and cheaply we can transition to a better energy future.

Energy2050 aims to define what a successful transition to net zero by 2050 looks like for Australian energy consumers, focusing on the core trilemma of reliability, affordability and sustainability.

This vision is broadly consistent with official projections out to 2050, but if these projections don't tell us everything about what is required to deliver the transition. If they are the "what", Energy2050 seeks to be the "how".

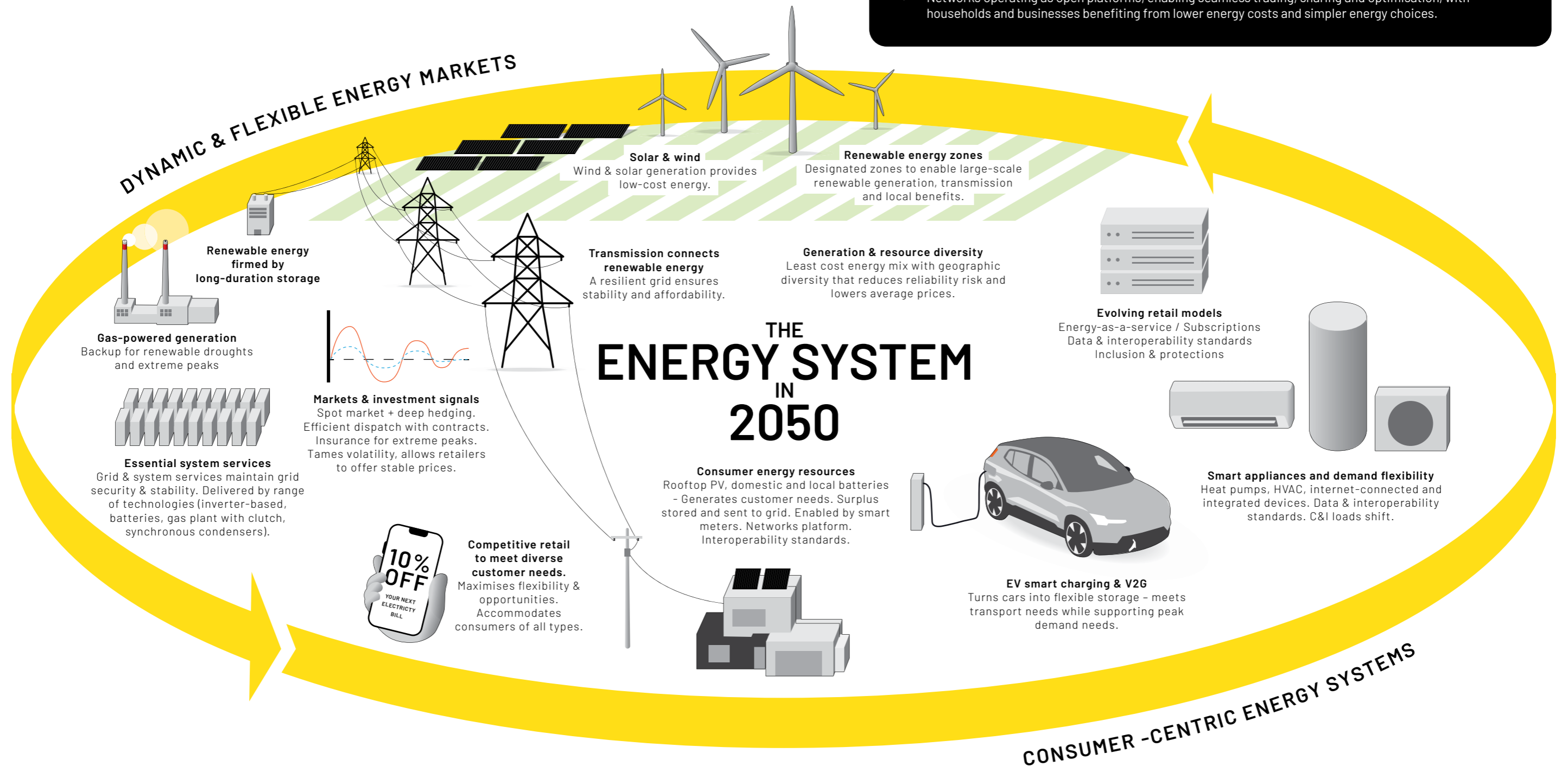
The AEC's vision for 2050 is deliberately intended to be a positive, aspirational "light on the hill". We recognise that makes it a challenging goal to achieve, but as with any such goals, the purpose is to drive action from today with a view to getting as close to these outcomes as possible, as a result of well informed, intentional policy design choices rather than by accident.

The Vision is for a decarbonised energy system based on two key pillars: dynamic and flexible energy markets and customer-centric energy systems. These work together to deliver energy system security, affordability and sustainability.

Energy2050 Vision

A 2050 energy system will be:

- Driven by dynamic and flexible wholesale and contract markets that efficiently reward generation, storage, firming, demand response and a broad range of essential system services to meet customer needs at lowest cost;
- A system with customers at the centre - from households to heavy industry - able to participate as much or as little as they choose, with frictionless engagement and trusted service providers acting on their behalf; and,
- Networks operating as open platforms, enabling seamless trading, sharing and optimisation, with households and businesses benefiting from lower energy costs and simpler energy choices.



The Priorities

The delivery of our Energy2050 vision will require a partnership between industry, governments, and policy makers, all working in concert to develop frameworks that will see a 2050 energy system that is secure, sustainable, and affordable. Energy2050 identifies seven priority areas of focus, each with a number of actions that will create and strengthen these frameworks, and assesses their impact on energy affordability:

Priority	Actions to Deliver	How this drives affordability
1	Establish and update a commonly accepted transmission plan One authoritative source to create and maintain a transmission plan. Charging and cost-recovery mechanisms for transmission investments should be clear and applied equally to all connecting projects.	More certainty about the roll-out of new transmission promotes investment and helps to keep wholesale prices down.
2	Make the grid connection process efficient and transparent Reform grid connection process to reduce delays and facilitate the connection of new generation.	More generation connecting to the grid will add supply and put downward pressure on wholesale prices.
3	Revenue certainty for generators Implement measures to address the missing money and shallow contracting market problems in the SWIS.	More generation connecting to the grid will add supply and put downward pressure on wholesale prices.
4	Improve coordination of the SWIS An overarching plan for the energy sector that identifies a central pathway, guiding policies and providing certainty to investors.	Encourages investment in the SWIS and increases generation supply. Prioritises reforms and reduces market fees.
5	Create opportunity for retail and behind-the-meter competition Support greater contestability and more innovation.	An increase in competition will drive better outcomes for consumers and the energy market.
6	Promote collaboration across CER participants Enable collaboration across CER participants so consumers can choose how deeply they engage.	Access to increased CER will bring sustained bill savings, reliability and trust.
7	Create more dynamic signals for consumers Establishing more dynamic ways to send signals to customers on when to consume or export power will maximise the advantages of CER.	Flexible solutions will improve outcomes for consumers.

What the system could look like in 2050

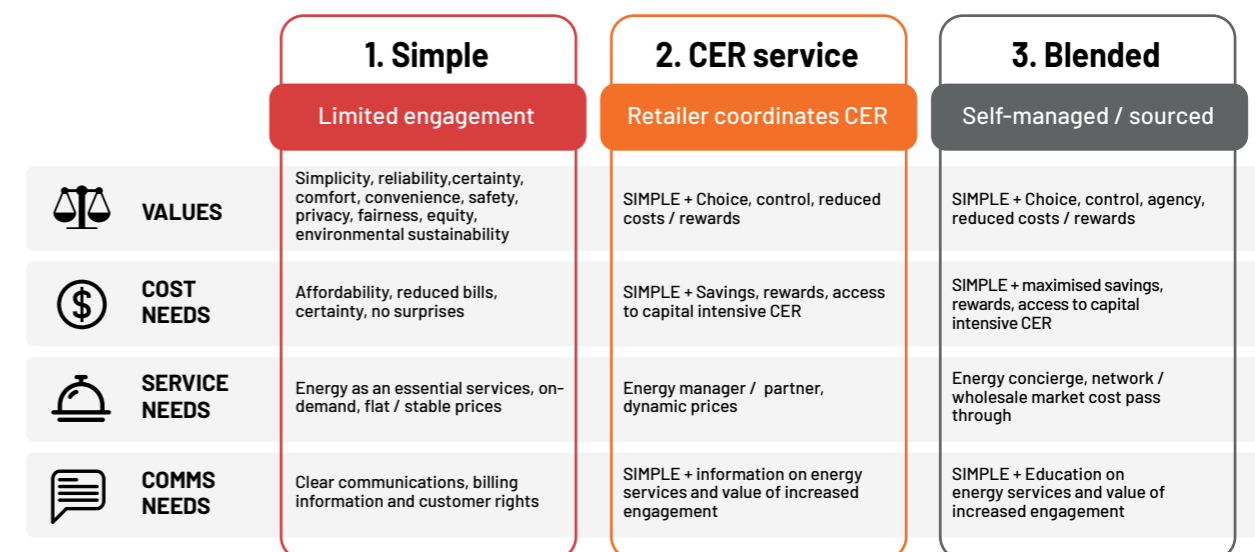
The likely physical configuration of the system and the inherent uncertainties are described in the table below.

System Element	Uncertainties
The amount of low-cost solar and wind generation will significantly increase. They will become more geographically dispersed across the SWIS relative to the historic system.	The contribution of wind and utility scale solar amongst the broader generation mix is unclear.
Transmission networks, existing and new, will connect renewable energy with consumers, bringing low-cost electrons to heavy industry, businesses and households.	The timing and location of new transmission build beyond 2030 is not known. There may be merit in seeking to locate new industry closer to generation.
Firming and shaping technologies will smooth out the variations in renewable supply.	The SWIS has limited scope for hydro, so it is likely to have a different mix of firming technologies. Batteries, and increasingly long-duration batteries, are expected to dominate, but other longer-duration storage technologies (such as compressed air) may become commercial by 2050.
Gas-powered generation will provide the necessary back up with critical power supply both for 'renewable droughts' or to meet peaks in consumer demand.	Gas may play a larger or smaller role than anticipated. If there is only a small role for gas, the gas network may struggle with the required flexibility.
Batteries, gas, and other network investments will deliver essential system security (ESS) services to maintain grid security and stability.	There is a need to make a switch from relying on spinning machines for ESS to relying mostly on inverters. How and when this occurs remains to be determined.
Rooftop solar and batteries will generate consumers' own electricity, store it for when they need it, and supply the excess back to the grid.	The scale of distributed resources is uncertain, as is how its owners will use it and whether they will allow their resources to be aggregated and orchestrated to optimise system needs or self-manage to meet their own needs. The timing and scale of any further competition in the retail and behind the meter markets is unknown.

Demand side deep dive

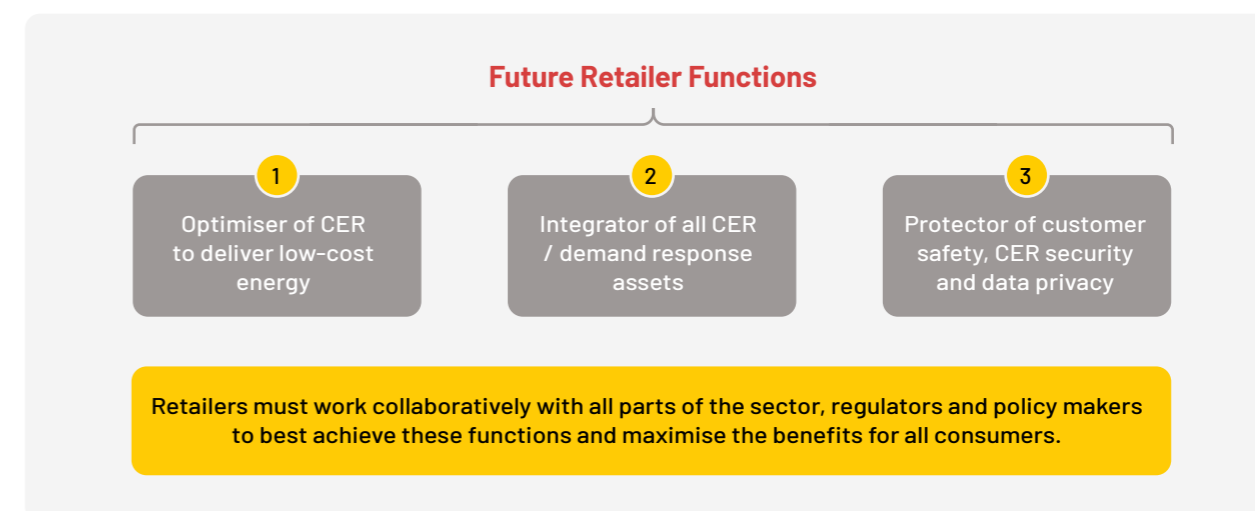
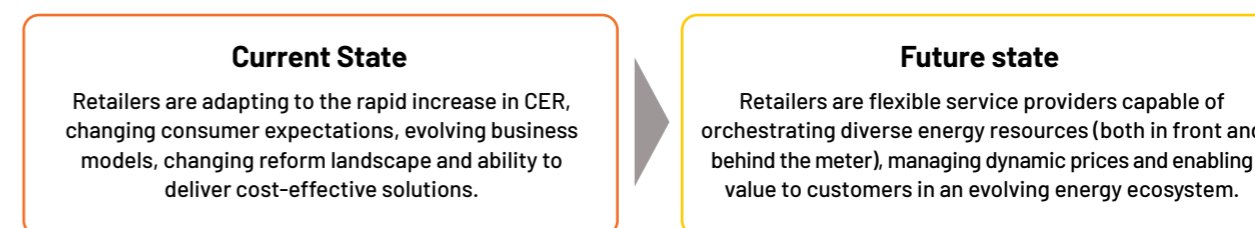
Customer-centric energy systems mean customers of all types and sizes can choose to participate as much as they want - from completely disengaged, passive consumers of grid electricity through to prosumers seeking to actively manage their consumption and produce energy.

For retailers understanding customers in this new energy system will be critical.



Realising the Future CER Vision

Retailer-led CER coordination will see retailers evolve their service offerings to get the most for customers. Retail orchestrated BESS with PV designed to give customer flexibility. Reduces cost to serve.



Dynamic and Flexible Energy Markets

Q. Can competition and market forces deliver the transition, or do governments need to step in?

A. Both play essential roles. Competition can deliver the cheapest mix of renewables and storage, just as it drove down solar costs, but markets work best when supported by clear government frameworks. No market can be expected to meet emissions targets without some mechanism to internalise these targets, for example. Stable investment signals, a robust transmission plan, and well-designed support schemes help attract the private capital needed. Competition in the supply of rooftop solar and batteries to homes and businesses has worked well for Australia, while the take-up has also been supported by government schemes and now Consumer Energy Resources are becoming an important part of the grid. Further competition in Consumer Energy Resources will drive benefits for consumers and support the grid during the transition. When markets and policy work together effectively, the transition becomes faster, cheaper, and more reliable for everyone.

Q. Is the current electricity market still fit for purpose as renewables dominate?

A. The WA State Government has done an excellent job of redesigning the market to support high renewable penetration and energy security within the South West Interconnected System. Further reforms will also be inevitable as the market continues to evolve. For instance, investors need greater financial certainty to build the backup capacity the grid requires.

Encouragingly, new mechanisms are being developed to address this. Getting state and federal policy settings aligned will be important to give businesses and investors the confidence to build what Australia needs.

Q. What do governments need to do to reach net zero by 2050?

A. Clear, consistent emissions targets, a robust transmission plan and a credible pathway for transitioning away from coal are fundamental. Aligning state and federal policies, creating stability for investors and streamlining approvals for new projects will help accelerate progress. Supporting regional communities through the transition is equally important. The goal is stable, long-term policy settings that give businesses and investors the certainty needed to commit to the significant infrastructure Australia needs to build.

Q. Why are fossil fuels still part of the energy mix on the path to net zero?

A. Renewables can't always generate power on demand, sometimes the wind drops or clouds roll in for days. Gas will be critical in the medium term to maintain reliability as it acts as a backup for these gaps,

keeping the lights on when solar and batteries fall short. In the longer term, gas is still expected to be needed in 2050, but in much smaller amounts and eventually using cleaner fuels like green hydrogen or biomethane. It's a bridge that helps manage a responsible and reliable transition.

Q. What happens when the sun isn't shining and the wind isn't blowing?

A. This is one of the central challenges of the transition. The answer lies in combining several solutions, batteries for short gaps, flexible gas plants for longer dry spells and peak demand periods, and smart demand management that shifts when we use power. No single technology solves this alone, but together they can keep electricity reliable and affordable even during extended periods of still, cloudy weather.

Q. Can Australia really afford the energy transition, or would it be cheaper to stick with the energy mix we already have?

A. We cannot stick with the energy mix we already have. We are at a critical juncture where much of our current system that has served us well for over half a century needs to be replaced, independent of Government policy. That requires significant new investment and large-scale upgrades.

The least cost, lowest impact pathway is an energy system dominated by renewables (wind and solar, including rooftop solar) and firmed with battery storage and gas. There is generally broad alignment across industry about this energy mix given these technologies are readily available and cost less to build and run than other technologies. There is every reason to believe continued rapid advancements in clean energy technology and scale will create even more opportunities to deliver better energy for customers where and when they need it.

Energy systems are always evolving. As we head to 2050 and beyond, new technologies may emerge to play a meaningful role too. This is one reason to ensure we have the right technology-agnostic market signals to encourage investment in emerging technologies as they become commercially viable.

Q. As Australia moves toward a low-emissions energy system, will gas still have a role in generation, our homes and businesses?

A. Gas will continue to have an important role as dispatchable plant and backup for renewables, both during renewable "droughts" and to meet peaks in demand.

There will be very little household and small business gas use as these customers progressively electrify their space heating, hot water and cooking needs. Industrial gas use will only decline slowly to 2050. This

reflects the fact that industrial users may find it harder to switch to lower emissions alternatives. Switch to lower emissions alternatives.

Consumer-centric Energy Markets

Q. Who is really driving Australia's energy transition?

A. It's genuinely a team effort. Everyday customers have played a remarkable role — Australians have installed more rooftop solar per capita than almost anywhere on Earth. They are also increasingly installing battery storage. Industry is now stepping up at the wholesale level, building large-scale renewables and storage. Government policy provides the essential framework that ties it all together. When all three work in concert, Australia is well placed to deliver an affordable, reliable clean energy future.

Q. As rooftop solar, household batteries and electric vehicles become more common, what role will they play in the future energy system and can households still make money from them?

A. These technologies are known as Consumer Energy Resources (CER) and allow consumers to generate and use their own power, reduce reliance on the grid and reduce costs. Retailers will evolve into system orchestrators, offering "total bill" solutions that integrate price and usage in real time, while shielding households and small businesses from complexity and risk. Consumers will be actively rewarded for flexibility through dynamic pricing and/or automated optimisation of their CER.

Key to CER providing more benefits in the SWIS is opening CER participation to a broader range of providers to improve the economics of household batteries, reduce customer energy bills, and enable distributed storage to play a greater role in meeting evening peak demand and supporting renewable integration.

Q. As Australia transitions to a renewable-dominated energy system, what will happen to household electricity bills?

A. While renewable energy is the lowest cost solution available currently, this may not translate into significantly lower prices over the medium to longer term. This is because when thermal plant, like coal generation exits the system, renewables backed by non-weather dependent sources (like gas and battery storage) will increasingly determine wholesale electricity prices. From year to year, wholesale price fluctuations will be common, largely driven by a more weather dependent renewable energy system, and particularly the availability of wind.

For households, by 2050, a large part of the transition will be the electrification of the home as gas is phased out. Electricity will more commonly be used

for space heating, hot water, cooking and transport. So, households will shift from potentially having three energy bills (gas, electricity and petrol) to one electricity bill.

Retailers will work with customers to coordinate their rooftop solar, battery and electric vehicles in a way that delivers the most bill savings and supports the efficient operation of the electricity system with customers. In this way, the system operates to share value between those who participate to those who are less engaged and need more support.

Q. What about households and businesses that don't have rooftop solar or batteries?

A. Coordinated Consumer Energy Resources like rooftop solar and batteries will help keep overall system costs lower. Virtual power plants, where electricity from different home installations is coordinated, for example, can see all households benefit from rooftop solar and home batteries. But it will still be important there are value-sharing mechanisms to ensure the benefits are distributed fairly, rather than concentrated among already advantaged households. Some households may choose not to opt in to coordination, and in that case, it's important that we work out how to send them the signals that align their CER use with the system's needs. Regulation in this environment should prioritise customer outcomes, fairness, service quality and consumer welfare, rather than focusing narrowly on controlling electricity prices.

Q. As coal power stations close over the coming years, what happens to the communities that rely on them?

A. Allowing communities to make a successful transition requires timely and proactive planning, comprehensive community and broader stakeholder engagement along with resourcing targeted to promote economic growth and diversification. The WA State Government has set the standard in this regard. They have provided clear, consistent communication on local benefits and project impacts, provided genuine support for workers, as well as tangible community benefits such as infrastructure and investment, and local participation in project planning and monitoring.

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