



Distributed Energy Transition Roadmap 2020-2025

Empowering South Australia

Nowhere in the world is the transition to a decarbonised electricity system being led by customers as it is in Australia. South Australia is at the forefront of this transition, with the highest uptake of rooftop solar per capita in the nation and with more than 60% of the state's energy needs met by renewables in 2020.

As South Australia's electricity distribution network operator, SA Power Networks' role is changing as the grid evolves into an increasingly distributed, two-way energy system. We are developing innovative solutions to help connect more solar and enable new technologies like battery storage and virtual power plants, while we also make sure we continue to provide a safe, reliable and affordable network for all South Australians.

We are passionate about empowering South Australia's distributed energy transition. We have developed this roadmap, in consultation with customer representatives and industry, to outline some of the initiatives we have underway in the next five years that will help us to enable this transition, including our plans to double the amount of solar that can connect to the SA electricity distribution network by 2025.

The changing energy landscape

South Australia is leading the world in integrating renewable and distributed energy resources (DER) like rooftop solar and home batteries into our electricity system. This is great news for our customers, the community and our economy.

In 2008, South Australians began to take up rooftop solar in increasing numbers, encouraged by government feed-in tariffs that paid a premium to feed surplus energy back into the grid. Now, just 12 years on, we have hundreds of thousands of small power stations dotted on the roofs of homes and businesses across the state, feeding a huge amount of energy

back into a network that was originally designed as a one-way system with the role of supplying homes and businesses with electricity generated by large, centralised power stations. In fact, rooftop solar is now SA's largest generator, and uptake continues to grow at a record-breaking pace (Figure 1).

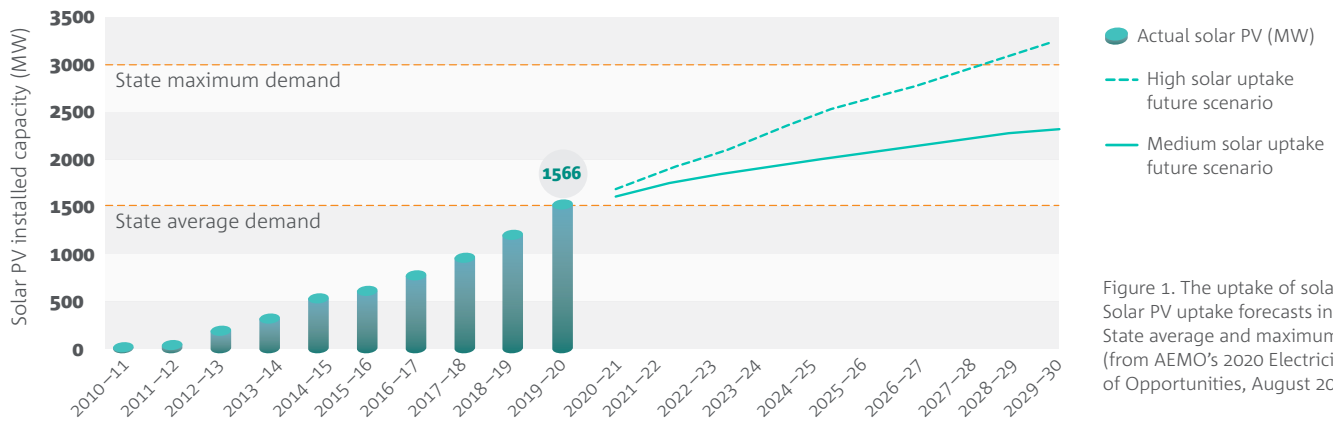


Figure 1. The uptake of solar in SA
Solar PV uptake forecasts in SA with the State average and maximum demand (from AEMO's 2020 Electricity Statement of Opportunities, August 2020.)

Adapting to a distributed energy future

Small distributed energy resources (DER) like rooftop solar, household batteries and virtual power plants (VPPs), present many benefits and opportunities for our customers and the energy system. However, as the number of renewables connected to the grid rapidly grows, the electricity system must adapt to operate in ways that weren't contemplated when it was originally designed. Large areas of our distribution network now regularly have energy flowing in reverse in the middle of the day as residential neighbourhoods generate more solar energy than they use, feeding this surplus energy back up into the network. This presents new technical challenges for us in maintaining the correct voltage levels and ensuring assets like transformers are not overloaded on mild, sunny days when reverse power flows are at their greatest.

At the state level, the Australian Energy Market Operator (AEMO) is also facing significant challenges keeping supply and demand in balance in South Australia. In 2020, for the first time ever, there were periods when solar generation produced enough electricity to power the whole state. No gigawatt-scale power system in the world has operated at these levels of solar before.

We are working closely with AEMO, the SA Government and the state's transmission network operator, Electranet, to help manage the system during periods of mild, sunny weather, when the large gas-fired generators that the system has historically relied upon to maintain stability are operating at historically low levels and excess solar energy is exported interstate.

The evolving role of the distribution network

As the state's energy mix transforms, our role is broadening. Instead of simply managing a passive network supplying electricity over the 'last mile' to customers, we will need to actively manage a dynamic, two-way electricity system that integrates hundreds of thousands of customers' smart resources. As an active 'distribution system operator' (DSO) we can help create more community value from the state's distribution network assets (Figure 2), enabling more solar to connect and integrating the smart batteries and VPPs that will play a vital role in balancing supply and demand in a future energy system dominated by renewables. With the transition to electric vehicles (EVs), our network will also become the state's primary source of energy for road transport.

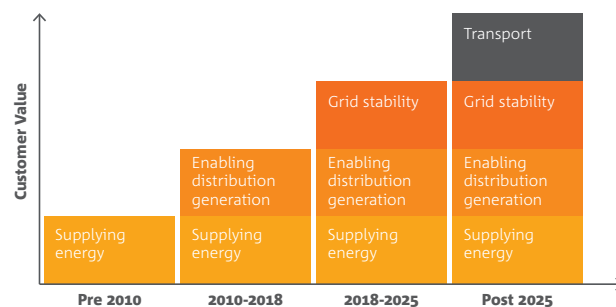


Figure 2. The changing role of the distribution network

Our ten-year vision

SA Power Networks' vision for the next decade is to help SA lead the world in the transition to a sustainable future powered by affordable and reliable clean energy.

Our vision is that, by 2030, all South Australians will share the benefits of the world's most advanced, decentralised and dynamic low-carbon energy system. Our goal is to enable this by providing Australia's most flexible, smart and integrated distribution network.

By 2030 our network will operate as a fully two-way energy platform, catering for a wide range of customer needs, from flexible connection arrangements for solar, batteries and smart appliances, to enabling customers to trade in the energy market or participate in microgrids or community energy schemes (Figure 3). Much of the energy consumed by homes and businesses will be generated locally within the distribution network and, during sunny periods, our whole network will often run in reverse, supplying customers' surplus solar energy to the state's large

industries and to be exported for use interstate.

Our network will also integrate thousands of smart EV charging stations in homes, car parks, shopping centres and service stations, supplying more than 2 gigawatt-hours of additional energy every day to fuel more than 350,000 electric vehicles.

By 2030 our customers will experience fewer outages and faster service restoration during extreme weather events. Our network will be more resilient than ever, enabled by advanced self-healing capabilities and the potential to 'island' remote areas using distributed energy.

Our Distributed Energy Transition roadmap sets out the actions we are taking in the next five years to progress towards this long-term vision for the network.

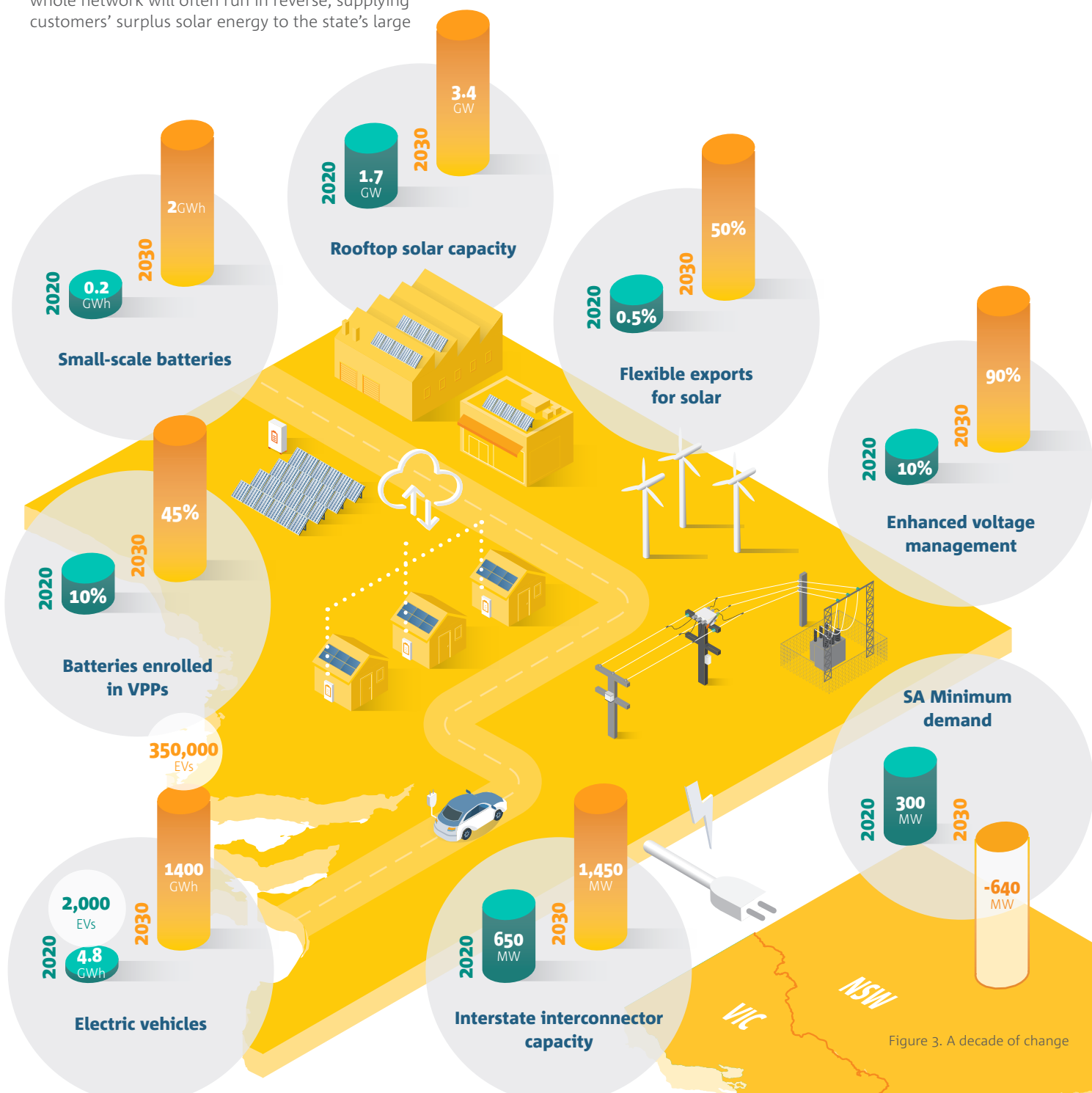


Figure 3. A decade of change

Our strategies for enabling more DER

Achieving South Australia's goal of achieving net-100% renewable electricity by 2030 will require changes to the way the electricity network is planned and operated. We are pursuing a range of strategies to integrate more DER with the network, while maintaining a safe, affordable and reliable grid for all South Australians.

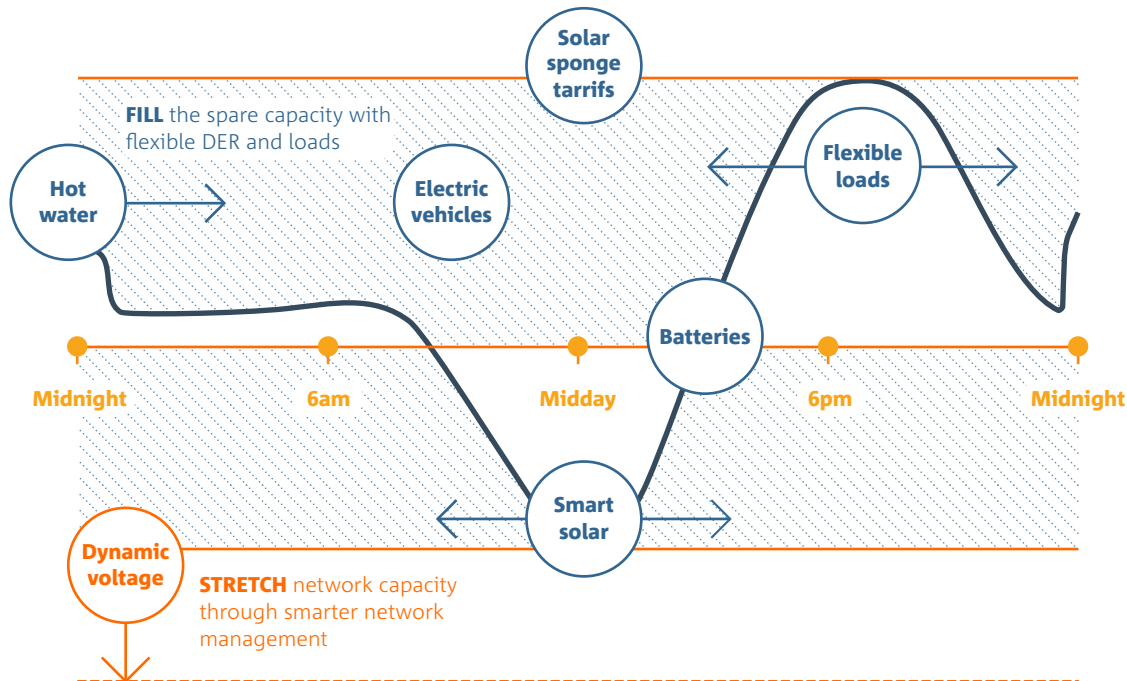


Figure 4. Strategies to integrate more DER

'Stretch and fill'

Over the next five years, our strategies are all about doing more with the network that we have. We call this 'stretch and fill'.

- We are working to **stretch** the export capacity and performance of our network assets with smarter systems, in particular more dynamic voltage management, as well as better monitoring and visibility. By being smarter about how we manage the network we can enable more solar to connect without costly upgrades to infrastructure, keeping prices down for all.
- As the network is sized for peak demand, it has lots of spare capacity outside of peak times. We are working to unlock this capacity and **fill** the troughs in asset utilisation by encouraging load shifting, through new tariffs and by actively integrating customers' smart DER through new systems and open interfaces. A key element of this strategy is the transition from fixed export limits for DER customers to smart, flexible connections.

Keeping the lights on

As solar continues to grow, we are working actively with AEMO and the SA Government to play our part to help make sure the grid remains stable, safe and reliable, even during emergencies such as extreme weather events. While the overall stability of the system is AEMO's responsibility, the transition to distributed energy means that we have an increasing role to play in helping AEMO to manage unexpected events that put the system at risk.

Positioning for 2030 and beyond

As well as managing the immediate challenges of integrating more DER with our network, the next five years are also about positioning for the longer-term. We are engaging actively with the national debate being led by the Energy Security Board (ESB) and the Australian Energy Market Commission (AEMC) around the future of the National Electricity Market (NEM). By sharing the lessons from South Australia we can help adapt the NEM to suit the 100%-renewable grid of the future.

Our key initiatives

Our Distributed Energy Transition roadmap outlines some of the key initiatives we are pursuing over the next 5 years, working closely with our customers and in partnership with other industry stakeholders.



Empowering our customers

Our goal is to ensure that all customers benefit from the distributed energy transition, not just those with their own DER. In 2020 we introduced new Time-of-Use tariffs with cheaper daytime network charges for all customers, and in the next five years we will pursue initiatives to help customers shift loads like hot water to the middle of the day to make the best use of low-cost energy, helping the network and saving customers money.

We are improving our online services to make it easier for customers to connect DER, and we are working to provide richer and more timely information to customers on the performance, hosting capacity and reliability of the network in

their area using channels that are easy to access.

We are taking a leading role in the national conversation around future network regulation, supporting reforms that will place clearer obligations on network operators to support DER, ensure network costs are shared fairly, and make it easier to reward customers who use their DER in ways that benefit the grid. We are also supporting reforms to give customers greater choice in how they connect to and use the network in future, including new energy services like VPPs, stand-alone power systems (SAPS), community energy schemes and peer-to-peer energy trading.



Enabling smart DER

Our goal is to double the amount of solar on our network by 2025, and we are working actively with the DER industry to enable smarter ways to integrate much higher levels of solar, batteries and other DER with the grid.

We are leading the nation in the transition from fixed export limits for DER customers to flexible connections, enabled by smart, internet-connected inverters using modern technical standards like IEEE2030.5. Smart inverters with flexible exports can feed more energy into the grid much more of the time, even in congested areas, and by building the systems we need to

support them we can unlock much greater value for DER customers.

Building on our award-winning innovation program and trials, we intend to be the first network in Australia to offer a flexible connection option as standard for all new solar customers, from 2022. We are working with industry to enable enhanced network access for other smart DER like batteries and smart loads, and working with VPP operators to help maximise the opportunity for customers' batteries to trade in energy markets without overloading the local network.

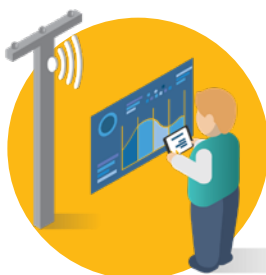


Supporting the uptake of electric vehicles

In 2020-2025 we will continue to support and promote the uptake of electric vehicles in SA. We will continue to actively support the state government, local councils and private businesses in efforts to roll out EV charging infrastructure connected to our network, and we are also supporting trials of new technologies such as smart charging and vehicle-to-grid. We will offer tariffs and flexibility services

that enable EV drivers and charging station operators to save money when they charge outside peak times.

As members of the EV Council we will continue to advocate for positive policy reforms to stimulate the Australian EV market, and we are leading by example by expanding the use of EVs in our own vehicle fleet.



Creating the future network

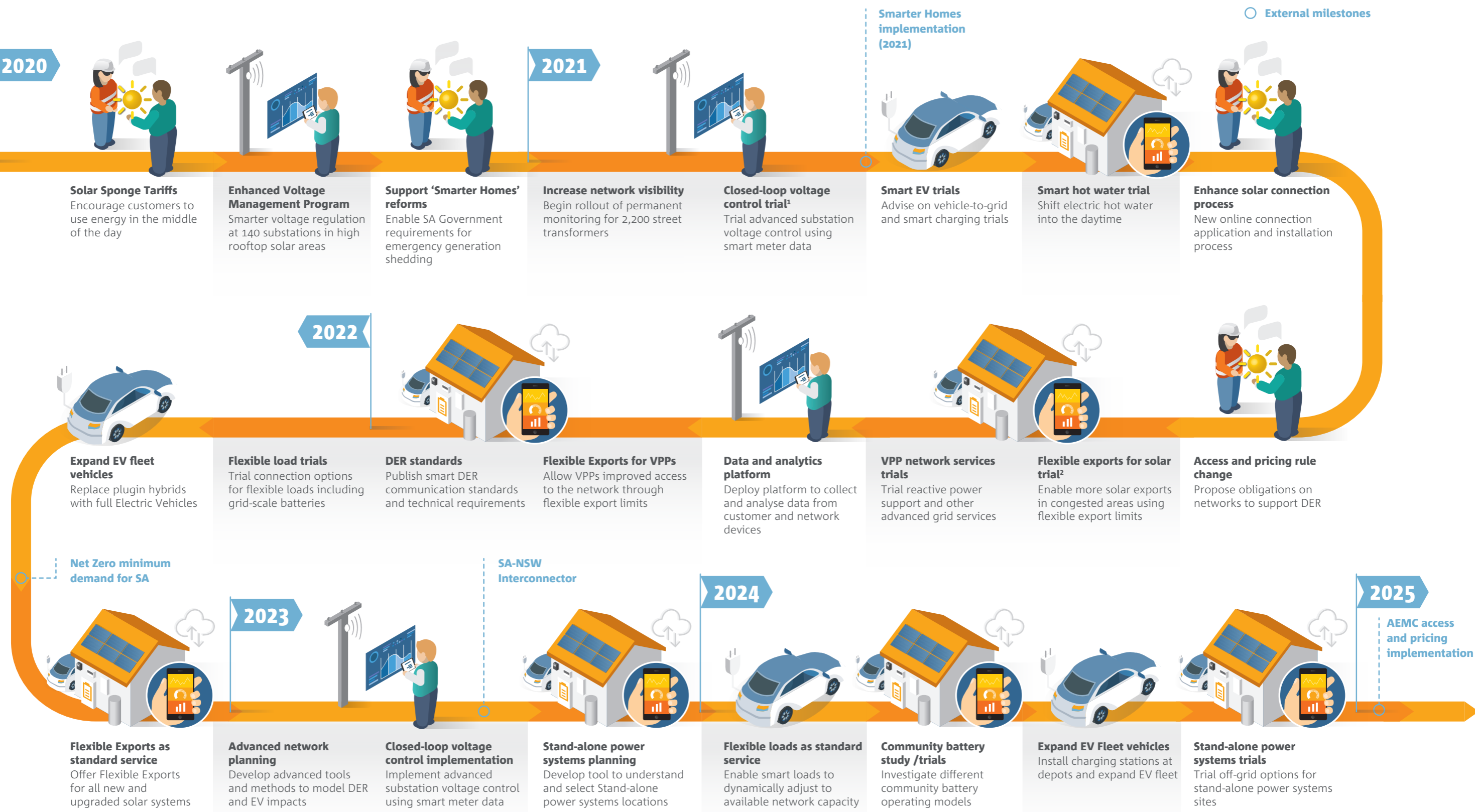
We are investing more than \$50 million in 2020-2025 in modernising our network and our planning and operational systems to adapt to a high-DER future. This includes rolling out enhanced voltage management capabilities to 140 major substations to address daytime voltage issues in high-solar areas and increase capacity, as well as other targeted upgrades to infrastructure.

We are also building systems that will enable us to analyse data from hundreds of thousands of smart DER connections to optimise the operation

of the network and unlock more value from our network assets.

We are improving our network planning and forecasting processes to accommodate future high-DER scenarios such as springtime reverse power flows and the impact of VPP operations and EV charging on our network, and we are working with the state government, AEMO and Electranet to improve our technical capabilities to help support the state's energy system during severe faults, extreme weather events or other abnormal conditions that could destabilise the system.

Our Distributed Energy Transition Roadmap 2020-2025



Footnotes
 1 This Project received funding from the South Australian Government under the Demand Management Trials Program
 2 This Project received funding from ARENA as part of ARENA's Advancing Renewables Program

Figure 5. The Distributed Energy Transition (DET) Roadmap for 2020-2025

Summary

As South Australia's world-leading transition to renewable energy continues, many believe that the state is on the brink of a new era of energy prosperity. In 2019, the average wholesale electricity price in SA fell below that in the eastern states for the first time since 2014, thanks to the high contribution of low-cost wind and solar, and prices continue to fall.

As the state's electricity distribution network operator, SA Power Networks has a key role in enabling this transition. Our challenge is to transform the physical 'poles and wires' network, and the systems and processes we use to manage it, to keep up with the pace of change over the next decade and beyond. Our goal is to do this in a way that delivers the greatest value to the community from the state's electricity network infrastructure, and ensures that all South Australians can share in the benefits, regardless of whether they have DER of their own.

This roadmap outlines some of the key initiatives we are undertaking over the next five years to meet the immediate challenges of doubling the amount of solar and other DER we can integrate with the network by 2025, and to establish the foundations for the continued journey to a net-100% renewable electricity state by 2030.

As we execute these plans over the next five years we will continue to work with our customers and stakeholders to refine and extend the roadmap, to map out the pathway beyond 2025 to achieve our 2030 vision.

Acknowledgement of Country

We acknowledge and respect the traditional owners and custodians whose ancestral lands we live and work upon, across all of SA Power Networks distribution network. We pay our respects to Elders past, present, and emerging.

We also acknowledge and respect the deep spiritual connection and the relationship that Aboriginal and Torres Strait Islander people have to Country. We pay our respects to the cultural authority of Aboriginal and Torres Strait Islander people and their nations in South Australia.

For more information visit:

Future Energy on www.sapowernetworks.com.au

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