



Supporting
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SA Power Networks Future Operating Model 2016-2031

2020-2025
Regulatory Proposal
May 2017



SA Power Networks Future Operating Model 2016–2031



Our Future Operating Model

Five years ago, SA Power Networks began a journey to explore what the future and our business would look like in 15 years. Our first Future Operating Model document created a rich picture of how we thought the world would change, and we used this insight to help explore the strategic choices we could make.

Five years on, we can see that we were definitely on the right track, except in one key respect - much of what we thought would take 15 years has come to pass in 5 years! The future is coming at us faster than we had imagined, and we need to be thinking and planning ahead for what this world of new technologies, changing community expectations, and innovative energy services and solutions will hold.

The SA Power Networks 2016-2031 Future Operating Model provides a renewed perspective on what the future world looks like for our customers and our network, and on how our work will change to meet the new challenges and opportunities. Once again, this vision will guide us into what will most certainly be a future with exciting possibilities - one that will be here before we know it.

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Section 1

Our Future World

What our world and the
electricity network could
look like in 2031



Imagine the World in 2031...

The world has changed dramatically over the last fifteen years, with many new technologies (eg Wi-Fi, smartphones and apps, drones) entering our lives, and many new household names emerging as significant new forces in our society (eg Facebook, YouTube, Uber). The pace of change is likely to continue over the next fifteen years. Already we can see major developments emerging such as 3D printing, driverless cars and the Internet of Things, that will reshape the way we live, work and play in equally dramatic ways.

You wake up one morning in 2031, and make your way to the kitchen to have breakfast. You remember that you were low on milk and out of cereal, but it doesn't matter because your smart fridge and pantry have ordered them for you, and a drone delivered them to your doorstep overnight.

You join your friends for a chat over breakfast, sitting around a single virtual table created by the immersive augmented reality system that you installed a year ago. Once breakfast is over, you change the immersive scenery, hop on your exercise bike and enjoy a twenty minute ride through the French countryside.

At 8.30am, your driverless car arrives to take you to work, and you sit back to watch your daily customised news report. Knowing that you are interested in sustainability, the reporterbot has chosen a short doco-vid on the history of renewable energy in South Australia as today's item. The stories of some of the early challenges of introducing renewable energy sources into the network, back in the mid 2010s, bring a smile to your face, and remind you of just how far things have come. It's hard to really recall what it was like before things like battery storage, electric vehicles and virtual power plants were a normal part of most people's experiences.

At lunchtime you call your mother back on the farm to see how her medical appointment went. Gone are the days when she had to make a 400km round trip even to see a GP. She spoke to a specialist in Sydney over the high speed video stream, and they were also able to patch in the head technician at Royal Adelaide Hospital to provide some reassurance about the robotic surgeon.

That evening you plan your upcoming driving holiday to Melbourne. You have splashed out and decided to hire the latest electric vehicle convertible, brand new out of the high-tech 3D printing facility. In this day and age, there is nothing like the feel of an electric vehicle for high performance, and so much cheaper to run than the petrol and diesel vehicles that some diehards still insist on driving. And now that electric vehicle charging stations are as common on the ground as petrol stations used to be, there's no limits on where and how far you can travel.

On your way to bed, you check in on the daily performance report from your integrated energy management system. Your current settings for when you use your appliances have reduced your bills by 25% from what you used to pay. It's been a pretty good day – even though it was cloudy in Adelaide, you got some credits from the solar panels integrated into the roof of your parents' farm, and you still have some electricity stored in your battery unit to tide you over until the sun decides to make a reappearance on the weekend.

The Customer of the Future

In 2031, our customers will have many new options for how they source, manage and use their electricity. Many customers will be very proactive and will invest in new technologies and explore the full range of options available. Others will continue to rely on the network, and will continue to expect reliable supply for the best possible price. The needs and expectations of our customers will be more diverse, and we will need to be more proactive in understanding the specific circumstances of individual customers and communities, and their particular types of electrical appliances and devices.

In 2031, many of our customers and communities will have ...

2 'Smart,' connected LED street lights - These can be monitored and controlled remotely, enabling lighting levels to be adjusted up or down at different times to reflect different activity and needs.

1 Rooftop Solar - Most South Australian homes and businesses will have solar PV, generating enough energy between them to power the whole state at times of low demand. New homes will increasingly be built with solar PV integrated directly into the roofing material.

3 HEMS - Many homes will have a Home Energy Management System as standard, to control battery storage, water heating, EV charging and smart appliances to make the best use of solar energy and minimise energy costs.

4 EV - Electric vehicles will be increasingly common, and owners will enjoy the convenience of charging at home or at public charging stations in most shopping centres, car parks and workplaces.

5 Battery storage - Battery storage will allow home owners to store surplus energy generated by their solar PV during the day to use in the home in the evening, as well as providing backup power in the event of a loss of supply from the grid.

What needs will our customers have?



Homeowners

With increased options for solar PV generation and more affordable battery storage options, many homeowners may be more self-sufficient for some of their electricity needs. They may want to share or sell electricity locally, and will certainly want to optimise their energy use and keep their costs down.



Developers

Developers building new housing subdivisions are already showing interest in installing micro-grids, linking all the houses in the community into an optimised local network of renewable electricity generation and storage. Most will still utilise a 'thin' connection to the main grid to support the local resources on cloudy days and to trade surplus energy on days when the community is generating more than it can use.



Electric vehicle owners

As electric vehicles become more prevalent, owners will want access to cheap prices and reliable connections for charging their vehicles. They will also want to have access to conveniently located and efficient charging stations that give them the freedom of movement that they need.



Businesses

Businesses will want to optimise their own energy usage through new technologies and management systems. Larger businesses will need integrated solutions that reduce costs and protect reliability across larger complexes of buildings and at multiple sites.



Remote communities

Renewable generation and storage provide good opportunities for more remote communities to be more self-sufficient in meeting their energy needs. In many cases, an 'off-grid' solution may be a more sensible option than a more expensive long-distance connection to the main grid.



Entrepreneurs

Entrepreneurial customers will see opportunities that they need help to realise – like cafe owners who want to install EV charging facilities for their customers, shopping centres that want to turn their carparks into Virtual Power Plants and app developers who want to make data available to consumers for a wide range of purposes.



Residents in microgrids and in remote communities

Residents in communities with micro-grids or in remote locations will want to monitor the performance of their systems and ensure they are producing optimal results. They will also need someone to maintain these systems and provide expert advice on opportunities to upgrade and reduce running costs as new technologies become available.



Councils and facility owners

Councils and facility owners will be looking for smart solutions that enable them to use electricity more effectively – such as smart lighting in public places and at major facilities which can be adjusted more flexibly at different times of day or night depending on usage times or attendance and the type of ambience they want to create. These might be integrated with other 'smart city' infrastructure such as car parking and EV charging.

The Network of the Future

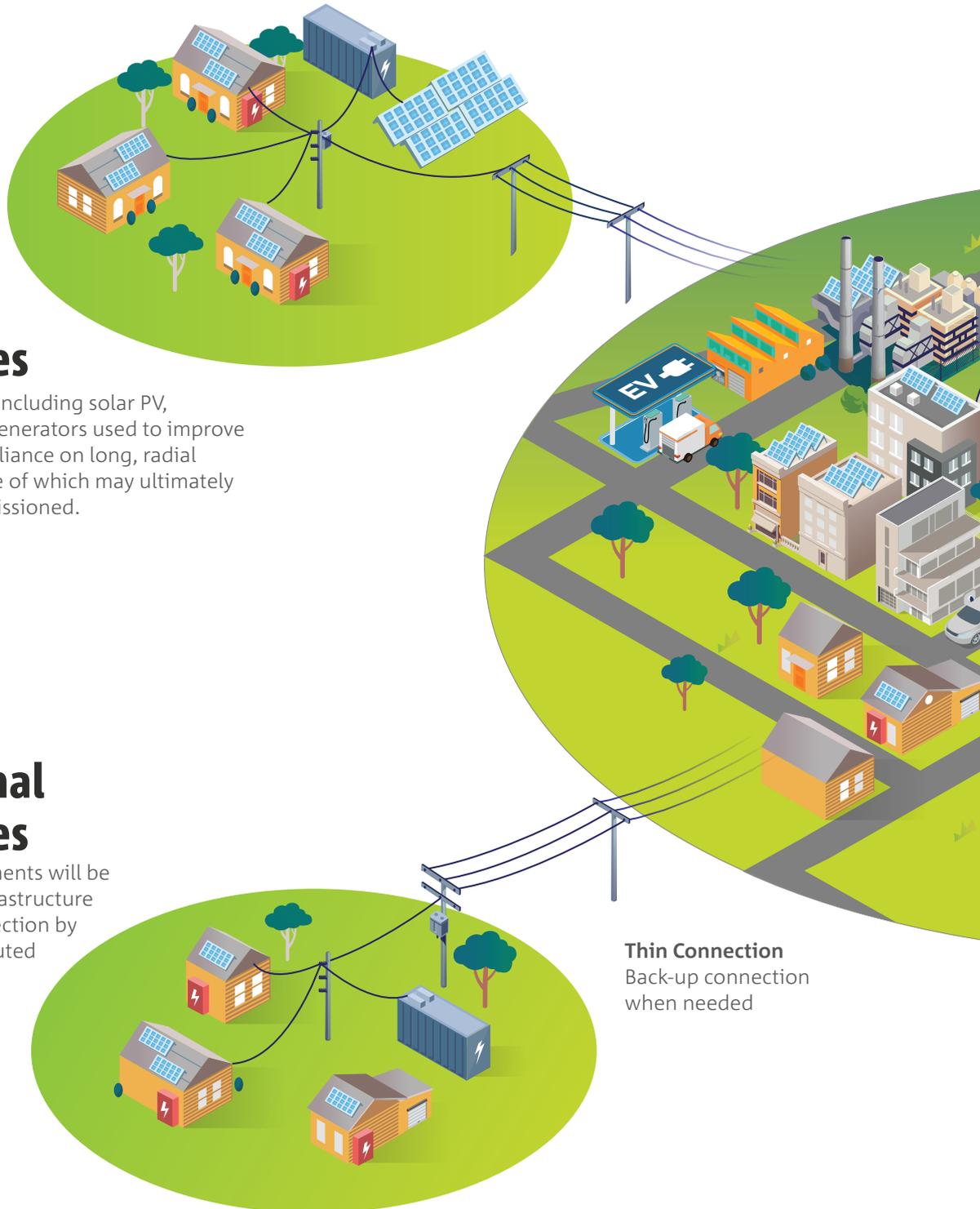
In 2031, the network will be much more diverse than today's largely one-size-fits-all network where SA Power Networks builds the substations, poles and wires to take electricity to wherever customers need it. There will be wider use of technologies for generating renewable energy and for storing electricity, both at the network level and at local homes, businesses and communities. This will create new challenges for maintaining a safe, secure and reliable distribution platform, but will also present new opportunities for reducing long-term costs and improving network utilisation and performance.

Remote Communities

Local energy resources including solar PV, batteries and back-up generators used to improve reliability and reduce reliance on long, radial distribution lines - some of which may ultimately be completely decommissioned.

New Regional Communities

New regional developments will be able to use existing infrastructure for their network connection by leveraging local distributed resources during peak demand periods.



Thin Connection
Back-up connection
when needed

New Network Technologies

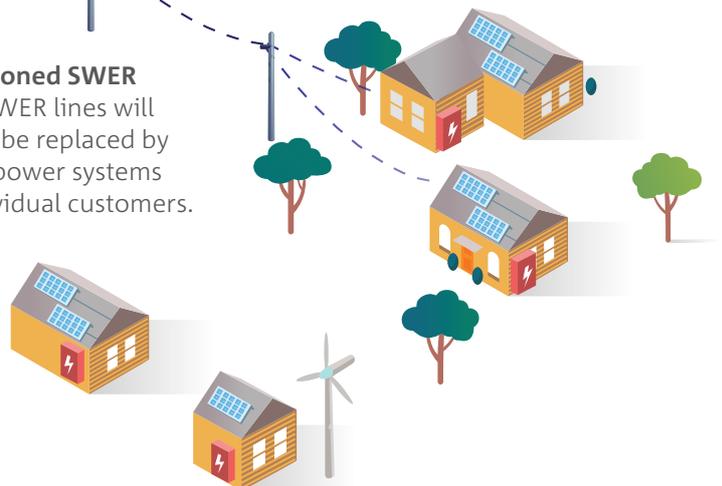
Diverse range of large scale renewable generation assets and battery storage units connected directly into the distribution network.



Standalone Customers

More widespread use of off-grid solutions for remote customers and communities.

Decommissioned SWER
Long rural SWER lines will increasingly be replaced by standalone power systems serving individual customers.



Metro Micro-Grid

Developers are increasingly expected to connect new subdivisions as micro-grids that are largely self-sufficient, but retain a thin network connection for back-up power and to enable excess energy to be traded with other customers.

Moving to an Interactive Network

In the future, the network is likely to be much more interactive. Not only will individual consumers, businesses and communities connect their own equipment for generating and storing electricity to the network, but there will be new opportunities to share or exchange electricity within local communities and across different properties in multiple locations. SA Power Networks will still have an important role as the operator of the distribution network, but with an increased focus not just on the physical poles and wires, but on setting up the management systems to enable an efficient, multi-dimensional exchange of electricity across the whole system.

Today's One-Way Distribution Network

The network today is a one-way distribution model with increasing use of renewable energy sources to generate electricity.

Customers and Other Participants

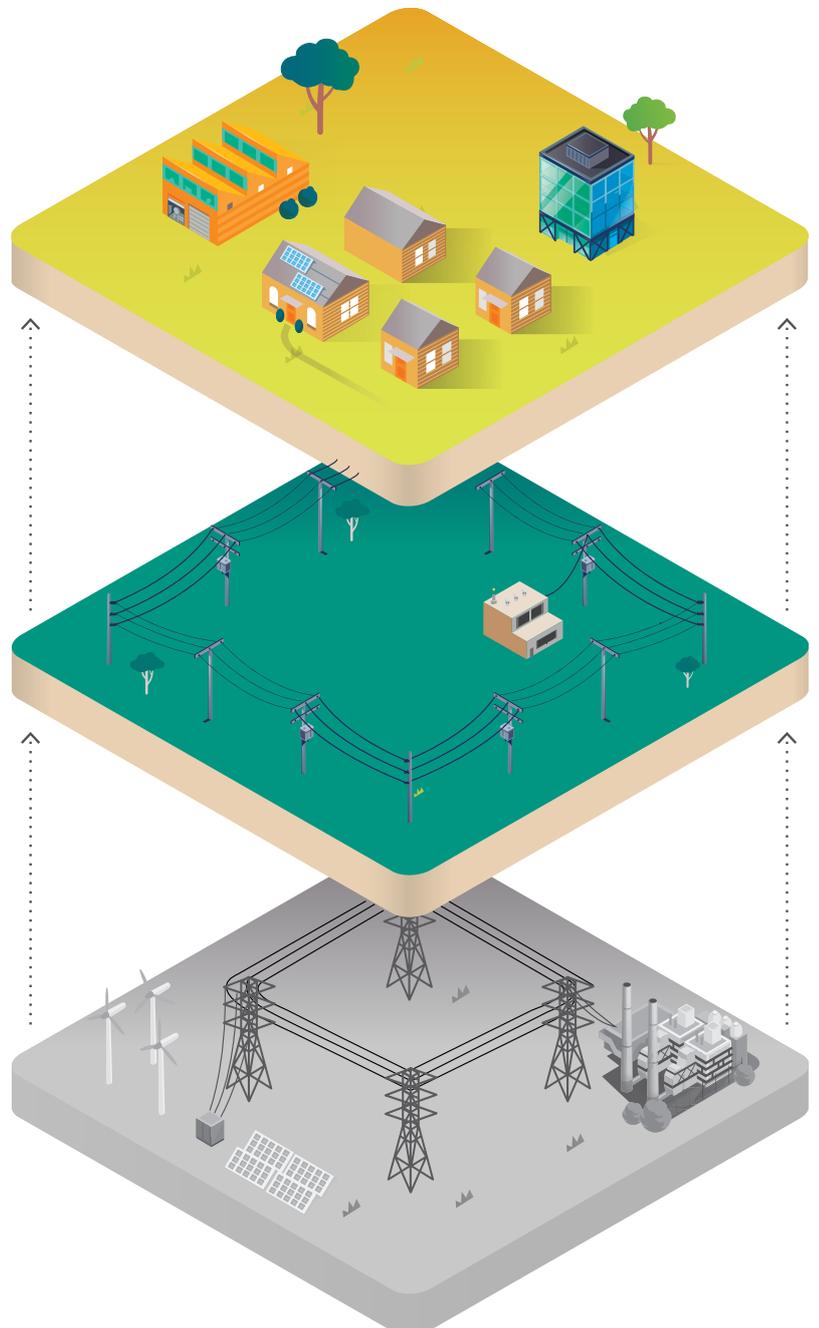
Most customers still rely primarily on the network for a basic connection and for reliable supply. 25% of customers have installed solar panels; battery storage technologies are just starting to appear in the market.

Distribution Network

SA Power Networks builds, operates and maintains the distribution network on behalf of the people of South Australia. The focus is on building the required physical assets to deliver safe and reliable supply to all members of the community, especially during periods of peak demand.

National Grid and Wholesale Market

High voltage transmission lines carry electricity around each state from large scale generators (traditionally from coal and gas-fired power stations, but increasingly from renewable sources as well). Energy is bought and sold at large scale in the National Electricity Market.



Future Multi-Dimensional Electricity System

There will be far more distributed energy generation and storage connected to the network and increasingly more two-way flows.

Customers and Other Participants

Many more homeowners, businesses and communities will have their own equipment to generate and store electricity. This will create increased demand for services to build, manage and maintain individual and community-based electricity assets.

Electricity Flows and Exchanges

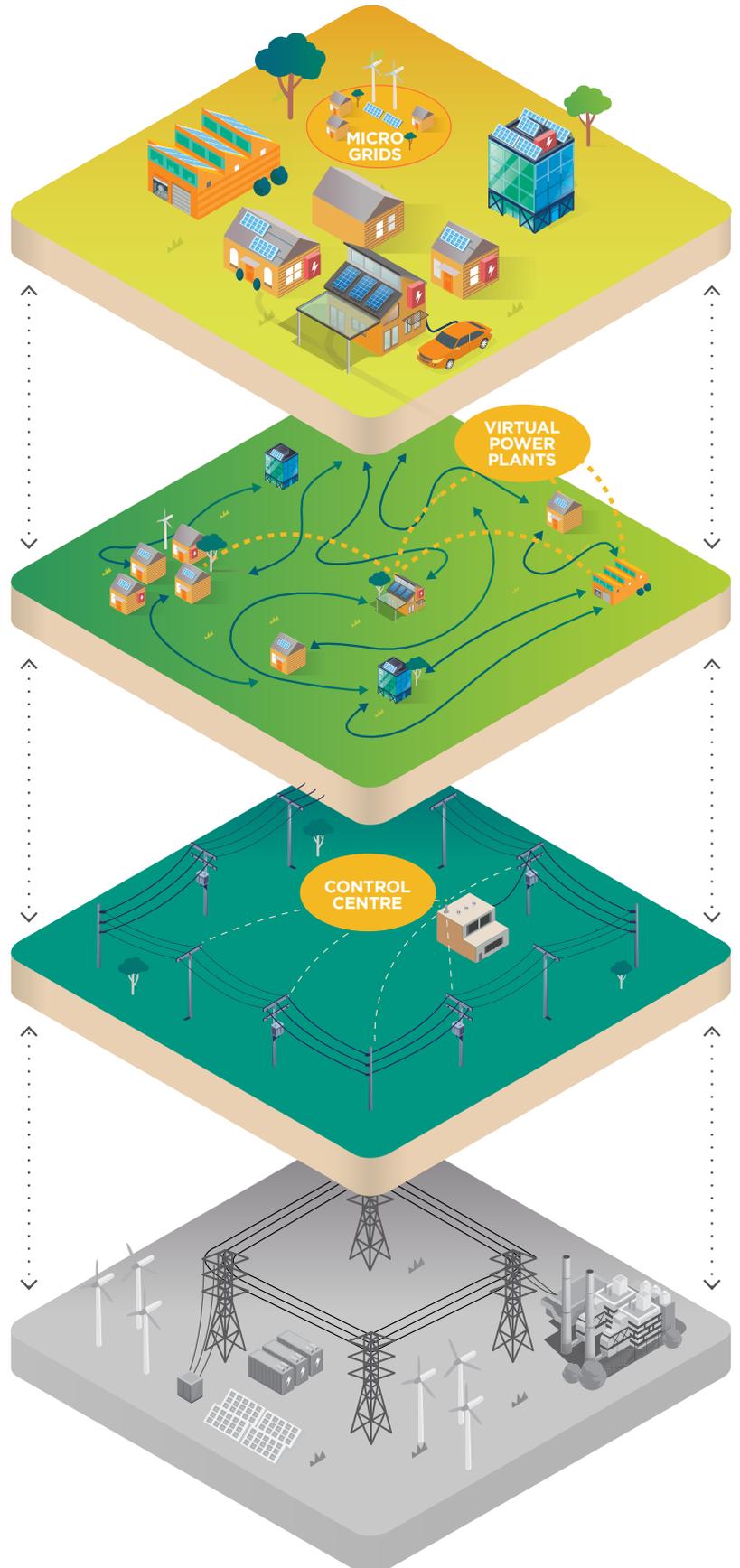
The future distribution network will involve many more active, multi-dimensional exchanges of electricity across the whole platform as customers share or sell their excess electricity. Aggregators will bring customers together to form virtual power plants, controlling their resources in return for discounted prices.

Distribution Network

SA Power Networks will be responsible for connecting and coordinating a broader range of physical assets, technologies and management systems into a stable and effective electricity distribution platform. There will also be new options to optimise the grid through better data, systems and approaches to managing assets.

National Grid and Wholesale Market

Older power stations using fossil fuels will continue to be phased out, to be replaced by newer large scale renewable generation assets. New interconnection lines between the states and improved management systems will be used to ensure reliability and maintain price stability in peak periods and in extreme weather.



The Future is Now

Although some aspects of this future world may seem far off, initiatives are already underway both overseas and here in Australia that are bringing the future into the here and now. With technologies rapidly evolving and becoming more affordable, and policies changing to allow new business models and ways of working, the future may be closer than we think.

The Changing Generation and Distribution Market

Initiatives to transform the supply and distribution of electricity

USA - New York State

New York's 'Reforming the Energy Vision' (REV) program is a whole-of-system approach to transforming their electricity market. The distributor role is being extended to include being a distribution platform provider and market operator. This means that they establish the rules for trading energy, monitor and maintain the flows of electricity, and manage the financial transactions between customers.

Netherlands

An 'Energy Agreement' (concluded by the government with employers, trade unions, environmental organisations and others) includes targets to increase the share of renewables, expansion of decentralised generation, electrification of transport and higher energy efficiency. They are also rolling out a smart distribution grid to facilitate these changes by 2020.

USA - California

Energy transformation here has focused on plans and targets for distributed resources and renewables. California has also become the first state in the US to allow aggregators to create virtual power plants with a load of 500 kW for dispatch into the wholesale market.

Australia - Perth

Utilising new wave energy technologies in Western Australia, Perth's Wave Energy project is the world's first commercial-scale wave energy array connected to the grid. The Garden Island Microgrid Project is an integrated microgrid with the ability to seamlessly switch between the microgrid and the WA electricity network. Both of these projects produce not only energy, but also desalinated water.

The Changing Retail and Consumer Market

Initiatives to provide more options and create more buying power for the consumer.

Netherlands - Distributed energy resources platform providers

Providers such as PowerPeers and Vandebron in the Netherlands allow consumers to share energy with each other, enabled by regulatory permission for them to act as retailers.

New consumer-side technology and retail services

In many markets across the globe (including some areas of Australia), smart meters are becoming more common and consumer-side technology is becoming more affordable, empowering consumers to become 'prosumers' and play a more active role in the generation and management of their energy. Retailers are having to adjust to remain relevant and offer new services to their customers.

Australia – Peer-to-peer trading

Power Ledger, a start-up in Perth, has also begun trials of consumer-to-consumer electricity trading using Blockchain technology.

Australia – New retail business model

The retail market is being disrupted by new aggregator business models, such as that of 'Mojo' in Australia. Customers no longer pay for energy based on their consumption, but instead get access to cheaper 'wholesale' prices for a flat subscription fee.

Section 2

Our Future Work

How SA Power
Networks could respond

The world has changed and we have too

The world keeps changing, and no one knows exactly what the future will hold. The electricity market continues to evolve as new technologies emerge, customer expectations shift and government policies are implemented in response to major social and environmental issues. As the operator of the distribution network, SA Power Networks needs to continue adapting to this changing context to maintain both its efficiency and its relevance – while also holding true to the vital things that people value, such as our engineering expertise and our commitment to safety and reliability.

Tipping point

In 2009, overall electricity demand unexpectedly peaked

2000s



New Technologies Entering the Mainstream

- Internet and Wi-Fi
- Solar panels
- Smart phones and tablets



The Electricity Marketplace

- Steady population growth
- Customers installing new appliances such as air-conditioning
- Demand for electricity growing every year



SA Power Networks' Focus

- Expanding the capacity of the network to meet rising peak demand from customers
- Replacing aging infrastructure
- Engineering capability extended to include stronger customer service focus

Tipping point

In 2016, Tesla makes battery storage systems more affordable and EVs trendy

2010s

2020s

- Large scale renewable energy projects (solar, wind, waves)
- Battery storage units
- Electric vehicles

- 3D printing
- Automated vehicles
- Smart machines / internet of things
- Robotics

- Price of electricity becomes a major issue for the community
- Greater focus on energy-efficient appliances and managing consumption
- Accelerating push towards renewable energy sources
- Growing concerns about climate change

- Widespread penetration of solar power, battery storage and electric vehicles
- Customers have many different options for where they source electricity
- Continued reduction in prices of relevant technologies
- More extreme weather events

- Optimising the way we build and maintain the network
- Connecting new distributed energy resources into the network
- Making information available to customers using multiple channels
- Recognising that customers need new services beyond electricity supply

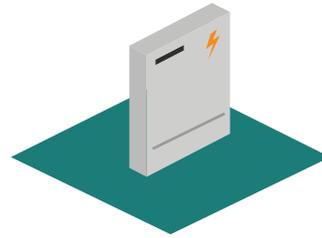
- Co-designing the network with multiple owners of electricity assets
- Building and operating the management systems to enable multi-dimensional flows
- Real-time data for field teams and customers
- New services and partnerships to meet much more diverse customer needs

How will our services change?

In the future, the network will be much more of a platform, with many individual consumers, businesses and communities connecting their equipment for generating and storing electricity to the network. The role of SA Power Networks will be to link these different assets, technologies and management systems together into a stable and reliable grid – one that enables an efficient, multi-dimensional exchange of electricity across the whole platform.

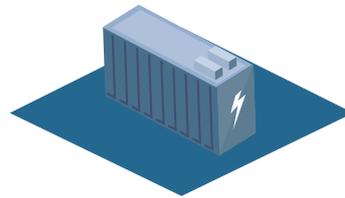
Examples of Potential New Offers for Customers

Residential customers



Advice on the best options for new technologies

Businesses and property owners

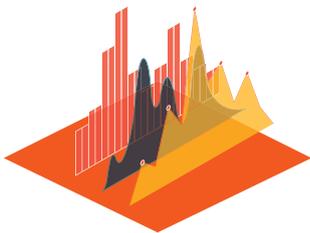


Purchase or long-term lease of generation and storage equipment to improve reliability and/or reduce cost

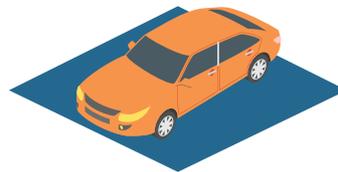
Communities



Solutions for going off the grid



Software and data to monitor and reduce consumption



Enhanced EV communications and charge/discharge control (at home)



Smart lighting options for property owners and public spaces



Installation and monitoring of EV charging facilities



Management of local community electricity infrastructure and usage (microgrids)



Co-design of non-network solutions to reduce the costs of augmenting the network

How will our people and capability be different?

As we move towards 2031, we will need to keep investing in the capabilities of our people and the processes they will use. We will need new skills to manage the wider range of energy services we will provide to customers, to understand the opportunities and impacts of operating a much more diverse network including many assets that we do not own or control, and to ensure that the needs of the whole community for electricity are being met at a price they can afford.

Key attributes of our people:



Mindful and vigilant about safety for all



Clear on the importance of their roles in creating great outcomes for customers and for the business



Quick to respond to issues and committed to effective communication



Proactive in looking for solutions and continuing to improve the way we do things



Alert to the competitive realities of the marketplace and committed to maintaining the reputation and high quality of SA Power Networks' work



Able to collaborate with many different people both inside and outside the business



Agile and adept at applying the latest technologies for the benefit of customers and employees

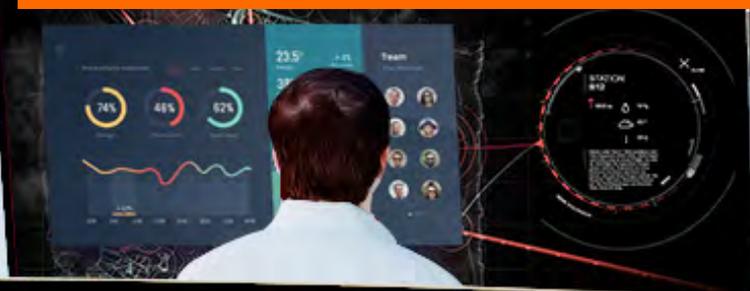


Commercially minded, with an eye for well-judged entrepreneurial opportunities



New Areas of Capability

- Model different scenarios for future electricity supply and consumption.
- Advise customers on new technologies and energy management options.
- Understand the emerging needs of customers and communities and other participants, and develop new services, solutions and partnerships with them.
- Monitor and manage multi-dimensional flows in both the High Voltage and Low Voltage network.
- Design software platforms to balance and manage local electricity flows.
- Integrate data across systems to create seamless experiences.
- Explore new business models, pricing options and commercial arrangements.
- Manage peer-to-peer trading.





How will we plan and manage the network and our assets?

As distributed energy resources become much more common, both at the network level and in local communities, homes and businesses, and demands on the network change, the way we plan and manage the network will also need to shift. New approaches will emerge as to how we plan for future demand, what assets we build, how long we expect those assets to last, and what systems we need to monitor flows of electricity in a multi-dimensional network. We will be working more closely with customers and other infrastructure owners to develop new options, share data and create integrated network solutions.

How we will plan and manage the network

- Make it easy for consumers to install their own distributed energy resources (DERs) and connect to the network.
- Increase the scope and sophistication of our planning processes to address more complex flows arising in a high DER network.
- Find new ways to meet demand without augmenting the network or replacing existing network assets (eg via non-network solutions).
- Change assumptions about the lifecycle of assets and what type of assets we will need to build.
- Monitor and manage the flows of electricity much more closely in both the HV and LV network.
- Improve network reliability and resilience while catering for a diverse range of renewable energy sources.
- Collect and share data to enable customers and owners of DER assets to get the best outcomes from their equipment.
- Transition to a network design and architecture that is more highly optimised for high-penetration DER.

How we will manage our assets

- Install sensors and use drones to enable remote monitoring of equipment.
- Upgrade the Asset Management System to cope with much higher volumes of data and generate new insights and efficiencies.
- Use real-time network and asset data to enable pro-active maintenance and more targeted inspections.
- Decommission assets if they are no longer needed.



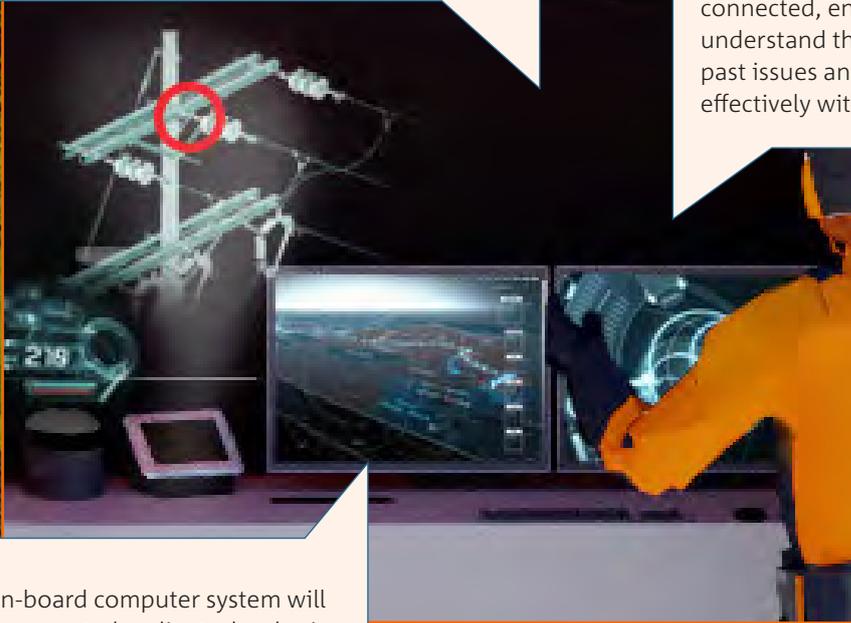
How will our field services team operate?

Our field services team will still be delivering many of its core services – restoring power after outages, conducting routine maintenance of powerlines, and managing vegetation. The main differences will be in the range of technologies used, the amount of information and the quality of communication with customers, and the seamlessness of the experience for both customers and technical teams.

1 In the future all work will be issued via a streamlined dispatch system direct to the vehicle on-board computer system, which will provide real-time data to enable crews to see what is happening on the network. By having access to all jobs on the system, crews will be able to prioritise the most urgent work first, respond resourcefully to new issues and find suitable jobs to fill in unexpected gaps in their schedules. This will also enable more accurate communications to customers about the timeframes for completing work.

2 Crews will have access to information on the history of the equipment and site, as well as which customers are connected, enabling them to understand the context, be aware of past issues and communicate more effectively with customers.

3 The on-board computer system will also use augmented reality technologies to overlay technical information onto the 'live' work site and equipment, and will be able to load a 3D model of the equipment to enable virtual risk assessments to occur and highlight known potential modes of failure.





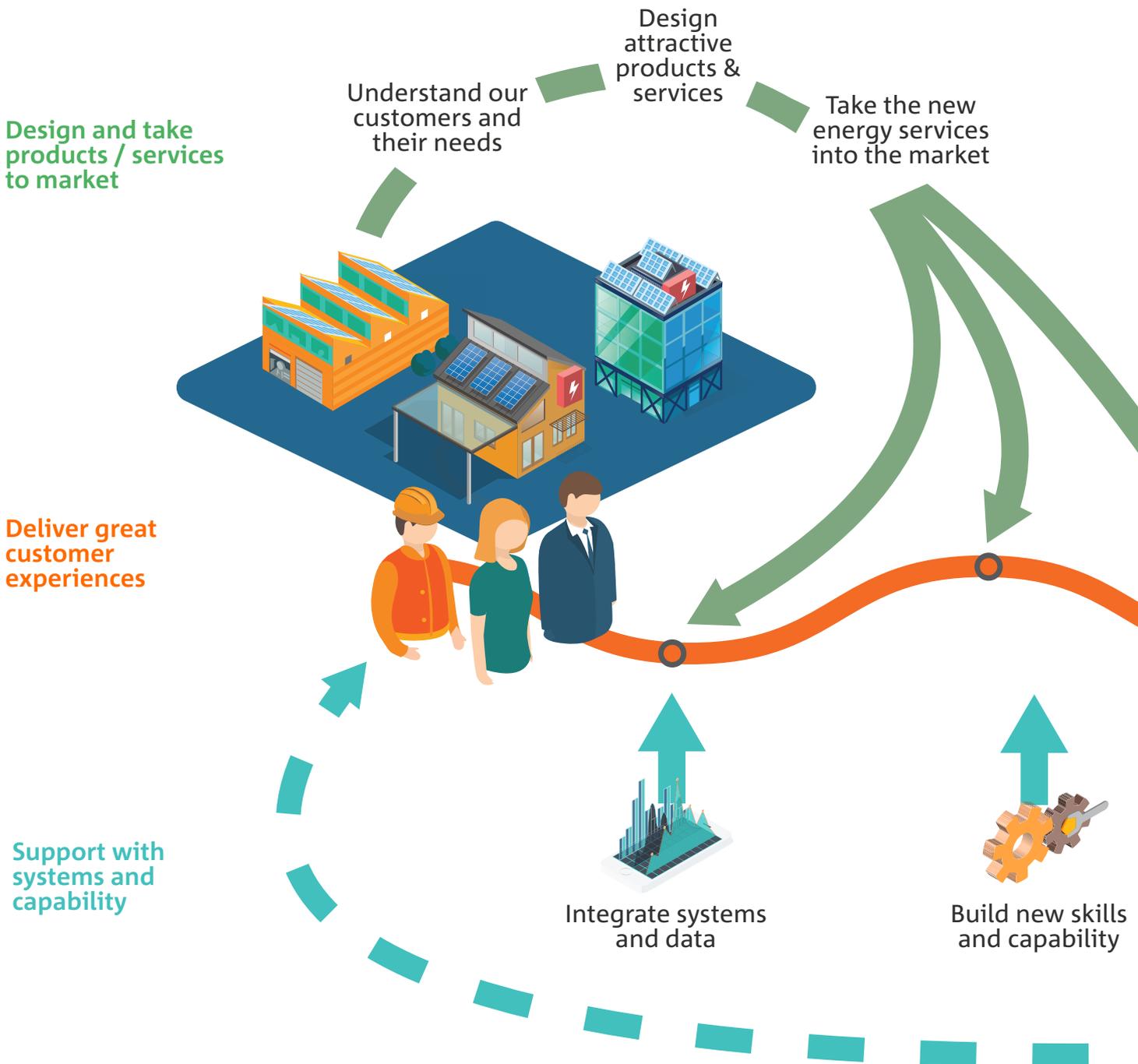
4 A small inspection drone will be carried by most vehicles, enabling a preliminary check of the network as they arrive at their task location, and aerial views to enable better understanding of the tasks they will be required to perform.

5 While the live line switching stick and hand tools will remain, new tools to interface with the increased information technology and communication side of assets will be introduced. Field teams will be able to interact with assets in the field, query them for faults or decline in asset life and operate in conjunction with the Advanced Distribution Management System.

6 A number of new manufacturing techniques and advances in science will alter materials in the future. Stronger and lighter materials will reduce manual handling of heavy weights. New surface treatments will be applied to clothing and work gloves, providing greater dexterity and touch feel for glove and barrier work. This will be accompanied by light overalls that are high visibility, flame retardant and with inbuilt electrical insulation, as well as wearable technologies to monitor field workers' health and well-being.

How will we develop and deliver new energy services?

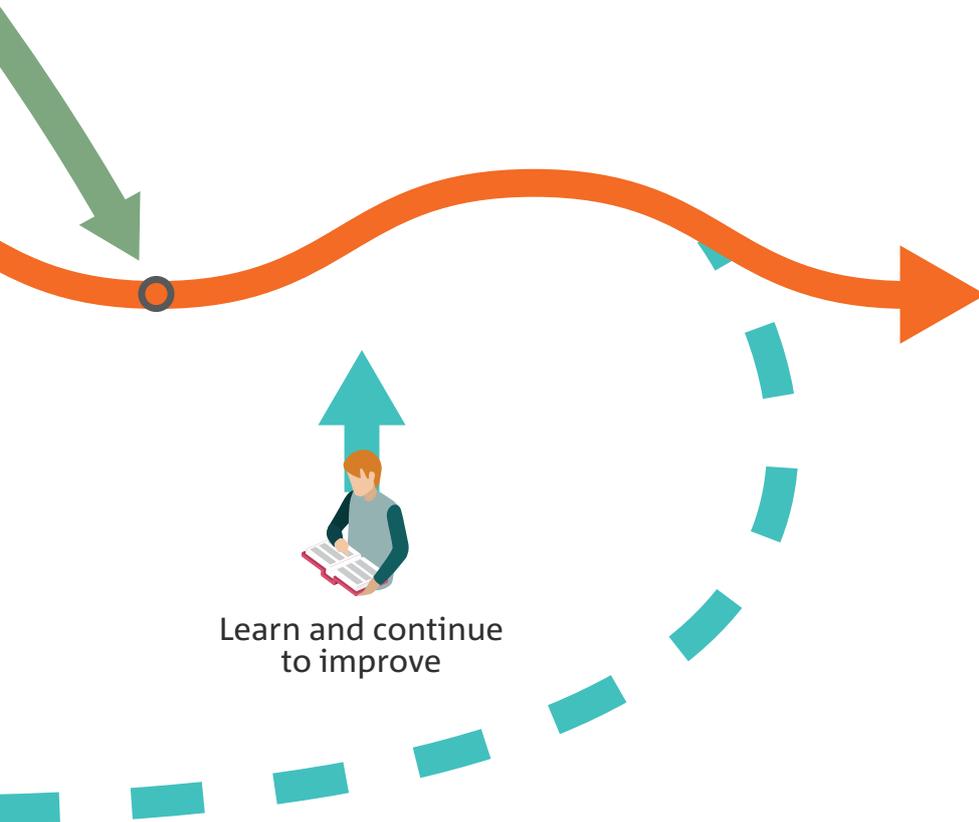
Today SA Power Networks provides its expertise and capability in constructing and maintaining large scale infrastructure as a service to a small number of other organisations. In the future, there will be many new opportunities to provide energy services to a much more diverse range of customers, outside of our traditional role of supplying electricity*. This will create a whole new range of considerations about how best we can meet these new customer needs, in a marketplace where we will be competing with many other service providers.



*To comply with new 'ring-fencing' requirements many of these services may be provided from separately branded affiliates of SA Power Networks.

What this will mean for us

- Continually refreshing our understanding about our customers and their changing needs.
- New capabilities to develop and deliver services that customers value, and creating great experiences for them.
- New approaches to how we market our services and engage with our customers.
- New support systems and better customer data to enable us to deliver new services efficiently and effectively.
- New partnerships and collaborations with manufacturers, suppliers, developers, local and state governments and communities.
- A new cultural focus not just on delivering a great service as we supply electricity to our customers, but on seeing new opportunities and responding in a timely and agile way.



Learn and continue
to improve

From Vision to Action

This high level vision for our future guides our strategic thinking regarding the future of our business. Our strategic response to this future is captured in our Strategic Plan.

The world keeps changing though, and our thinking and strategies need to change with it. We will keep monitoring what's happening in Australia and overseas, paying attention to changes in customer needs, new energy technologies, stakeholder expectations, industry best practice and competitive shifts in the marketplace. We will continue to re-evaluate our thinking as major disruptions and changes are identified and where appropriate update our Future Operating Model.

As an organisation we need to be ambidextrous - maintaining and improving the core of what we do and our high standards for safety, trust, and reliability, while also being agile enough to adapt and embrace new opportunities and create new value.

In 2031 we want to look back with pride on what we have achieved, with wonder at all the new things we are now doing, and with confidence that we will remain relevant to and valued by our customers and the community well into the future.



SA Power Networks has developed the 2031 Future Operating Model through a series of workshops attended by key stakeholders and subject matter experts from across the business. The workshops examined SA Power Networks' future customers, their needs, values and expectations, as well as the impact of those customers and emerging technologies on our network.

