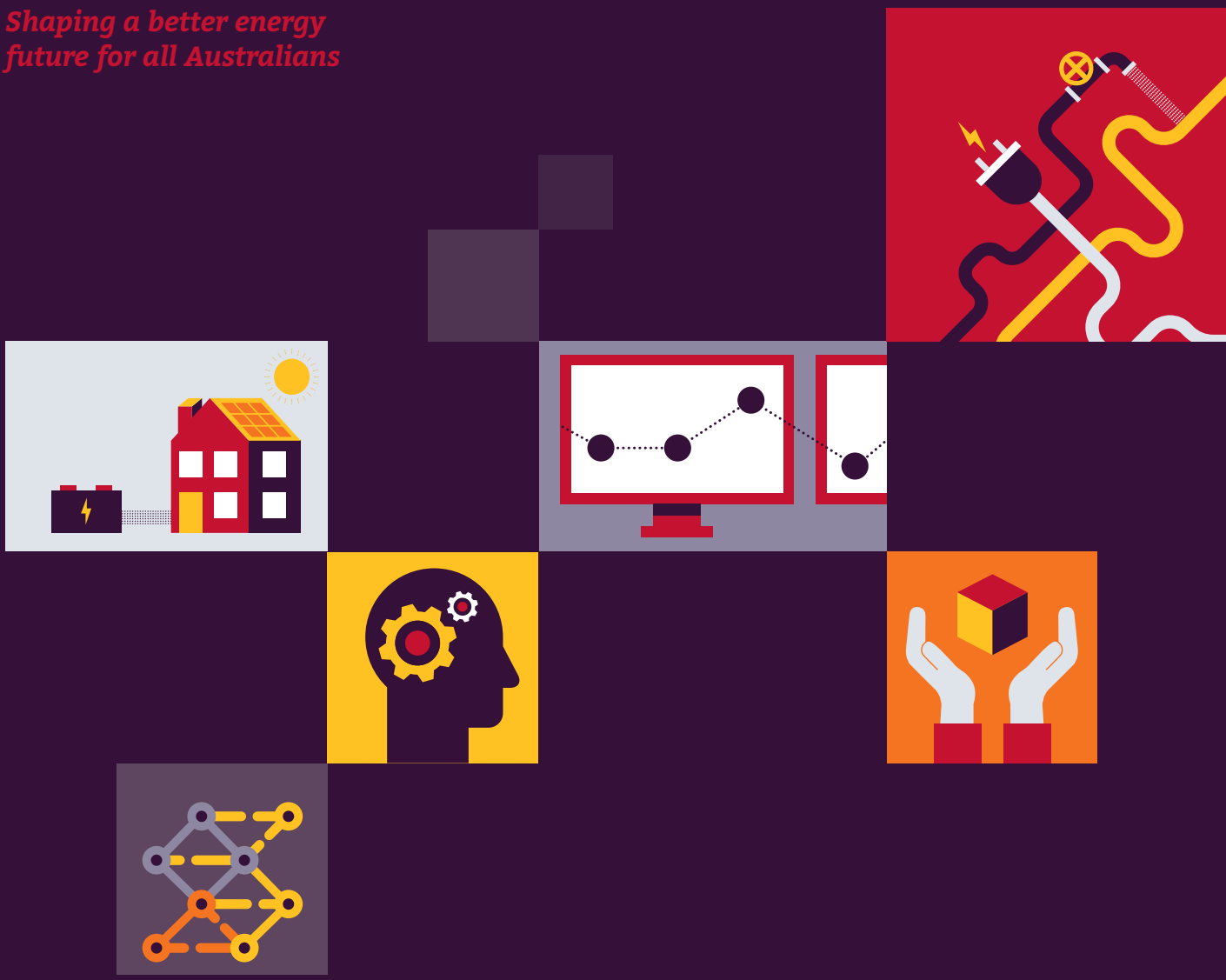
AEMO Corporate Plan 2020-23

Shaping a better energy future for all Australians



August 2019

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

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Message from the Chairman and Managing Director/CEO

AEMO is completing its first decade as the independent market and system operator for Australia's critical electricity and gas systems and markets. We are proud of how well our organisation has developed and supported the needs of the industry and the economy over the last decade, and would like to sincerely thank our staff, our members, and the stakeholders with whom we have worked for their vital contributions.

The energy industry in Australia is undergoing unprecedented, rapid and transformational change. Indeed, by many metrics, change is occurring faster in Australia than in almost all other developed economies, and in a physical and operating environment that poses greater technical and design challenges. Our experience over the last several years demonstrates that the challenges and opportunities within our industry are only increasing in scale.

AEMO is committed to leading and converting these challenges into sustained advantages for energy consumers. The forces of innovation that are changing the way energy is produced, delivered and consumed are also offering new ways to meet the essential requirements of affordable, secure and reliable energy that addresses community and environmental objectives.

Australia is leading the world in many ways, in the speed of adoption of variable renewable energy, distributed energy resources, and storage as core elements of the energy economy. AEMO is supporting this leadership through its pursuit of technical excellence, collaboration, and innovation that will produce best-in-class solutions to support Australian household and business consumers to realise the benefits of the energy industry transformation, today and into the future.

AEMO has always developed annual action, budget and risk management plans, but this Corporate Plan is the first time we have presented a unified three-year strategic plan. The annual planning and reporting cycles represent two key components of AEMO's commitment to transparency.

In this Corporate Plan for 2020–23, AEMO sets forward the opportunities, challenges and risks we are confronting, and our plans to address them consistent with the needs of the energy systems and consumers. We also specify our annual budget and expected performance outcomes.

Drew Clarke
Chairman

Audrey Zibelman
Managing Director/CEO

Executive summary

The Corporate Plan affirms AEMO's purpose and governance, outlines changes in the energy sector and their implications to our organisation, and details the action we are taking across our strategic pillars to deliver anticipated outcomes. It also summarises the financial outlook for the organisation and describes how we intend to manage the risks we face.

AEMO's purpose and governance

AEMO is the independent system and market operator and planner for the National Electricity Market (NEM), the WA Wholesale Electricity Market (WEM), wholesale and retail gas markets and supply hubs, and gas systems. We pursue the National Electricity, Gas and Energy Retail Objectives of 'promoting efficient investment in … operation and use of electricity and natural gas services for the long-term interests of consumers … with respect to price, quality, safety, reliability and security of supply'. Since AEMO was formed in 2009, we have considerably expanded our responsibilities for energy markets nationwide.

AEMO works closely with its members and a range of important energy industry stakeholders - in particular the Council of Australian Governments' (COAG) Energy Council and Energy Security Board (ESB), the Australian Energy Market Commission (AEMC), the Australian Energy Regulator (AER), and Western Australia's Public Utilities Office (PUO) and Economic Regulation Authority (ERA) - on issues of future system security. We also work in close partnership with major national agencies such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Australian Renewable Energy Agency (ARENA) and the Bureau of Meteorology (BOM).

The company is governed by a Board of Directors which is accountable to the members. Directors are appointed by the COAG Energy Council, and a majority of Directors, including the Chairman, are independent.

Changing energy environment

The disruptive changes associated with Australia's energy landscape are well known, and the industry must maintain energy affordability in light of challenges and opportunities. There are several developments that particularly impact our organisation:

Power supply mix: Rapid increases in both distributed energy resources (DER) and variable renewable energy (VRE) are forecast, coupled with the retirement of conventional plant. There are many new system management challenges in accommodating a high-share of VRE and DER (including battery storage), exacerbated by the reduced availability of ancillary services, which have historically been by-products from flexible and synchronous generation. Cost-effective resolutions to these challenges will require technical innovation, market and regulatory design changes, coordinated retirement planning of ageing capacity, and efficient long-term investments.

Sector coupling: Increasingly complex co-dependencies between multiple sectors such as gas, heating, electricity and transport (electric vehicles), water, and hydrogen will have a significant impact on how best to evolve a power system that meets Australia's future needs.

In particular, gas networks are being disrupted with economic and competition reforms, as well as price impacts from exports and supply tightening in some jurisdictions. These impact the capability of the gas network to deliver affordable gas for heating, industrial processing and power generation.

Energy markets and regulations: Regulatory frameworks and competitive energy markets were designed for a time when market and technological changes were more limited. The processes used to support changes are not able to respond with the speed necessary to allow the industry and markets to develop solutions to the complexity of new challenges. As a result, AEMO and market participants struggle to gain timely regulatory and market changes necessary to deliver value to energy users. The creation of new approaches to regulatory and market design is essential.

Climate change and resiliency: The energy systems are not designed, built or operated to accommodate the increased frequency, extremity and scale of climate-induced weather events, or the influence of weather on major sources of energy production. It requires a combination of integrated planning, improved asset design and management, and sophisticated disaster recovery to address vulnerabilities.

Consumer engagement: Energy markets have historically been wholesale and business-to-business in nature, but consumers now have more options to engage with their energy consumption, including owning distributed generation and storage. In parallel, the energy industry is at the forefront of a broader government policy initiative on Consumer Data Right (CDR) to empower consumers to make informed choices. We can expect consumers to become much more active participants in future markets through individual activity, automated, price-sensitive technology and innovative consumer facing businesses.

Digitalisation: The global explosion in data volumes, technologies such as artificial intelligence, and the characteristics of the energy industry mean the system will increasingly depend on digitalisation and data. A major strategic commitment to data and digital systems is a priority, utilising modern IT approaches, such as cloud computing and APIs, to offer capacity and performance at low cost. All this must be delivered securely under the threat from cyber-attack, and is of paramount importance for critical national infrastructure.

People and capabilities: The above challenges demand a broad range of technical competencies. To cope with continual change, AEMO employees must be skilled at multi-disciplinary capabilities in innovation, influencing and change management, drawing on modern organisational techniques such as agile design thinking and collaboration. Many of the skills AEMO requires are in very high demand. These challenges necessitate a focus on attracting and retaining key talent, while drawing on our strategic partners and collaboration with members to complement our knowledge base and capabilities.

Proactively converting challenges to opportunities

While AEMO's overall purpose remains unchanged, we and other energy industry participants must continuously assess how to maintain affordability and provide value to consumers in a rapidly changing environment.

AEMO's approach for the next three years will emphasise proactive change through **six strategic pillars**, which deliver benefits for consumers, system and market participants, and stakeholders.

1. Reliable and secure system operations
Maintaining reliable and secure systems is core to AEMO's purpose. The impact of increasing VRE and DER and the retirement of ageing infrastructure, present continuous improvement opportunities managed through an evolving portfolio of projects. These projects help manage power system frequency, voltage and system strength, gas system pressures and supply adequacy; they improve the near- and real-time forecasting of supply and demand balances, and develop sophisticated operational and computational tools to deal with the inherent complexities faster and better. AEMO will work with our institutional partners, including the ESB, the AEMC and the AER, and industry to ensure that these requirements are understood and the capabilities are developed to meet the emerging challenges in the NEM with similar actions progressed in the WA WEM. AEMO is also collaborating with CSIRO on the development of a 'digital twin' of Australia's power system, which is intended to be a powerful digital tool to inform complex future planning, system design and policy scenarios.

2. Future system design
Whole-of-system design and planning facilitates an orderly transition to a fit-for-purpose future system that provides individual market participants with the information necessary to assure timely and effective investment opportunities, which in turn can produce more efficient outcomes for consumers. A refined Integrated System Plan (ISP) and collaboration with relevant Western Australia energy institutions to develop the first WA Whole-of-System Plan (WoSP), will form an actionable blueprint for a technically robust, climate-resilient future system. This system will encompass fundamental changes in generation mix, a trend towards two-way energy flows in the network, optimisation of investments across the supply chain, and the emergence of new technologies and consumers as system participants with tailored products and services. The ISP and WA WoSP will form the heart of an iterative process of stakeholder engagement, consultation and acceptance.

3. Adaptive markets and regulations
Regulatory structures and market design must be aligned with current and developing technologies that can produce positive outcomes for consumers. In a system comprised of high volumes of VRE and DER, the design must at a minimum evolve to one that is truly bi-directional and efficiently pays for resource capability and flexibility that AEMO can rely on to ensure that the system remains in balance and is secure. In a rapidly changing technology environment, market trials become an essential vehicle to quickly learn and adapt to the regulatory and market incentives to facilitate the transition in a manner that can also supply continued consumer confidence and benefit. As the independent bulk power system and integrated market operator, AEMO has a particular purview on how the markets can evolve to support optimum outcomes to consumers. Entirely new market structures and technological approaches need to be trialled to support cost-effective VRE and DER integration, storage and ancillary services. We will work with market participants and consumer representatives, as well as policy and rule-making bodies to identify beneficial changes to current regulatory and market design for the near-term and future.

4. Consumer engagement and access
In the modern power system, decisions on how energy is supplied, delivered and consumed are shared among suppliers and consumers. To accomplish this, individual consumers must have sufficient and frictionless access to relevant data and decision tools. With a proliferation of energy choices (from retailers and other service providers) and the government's CDR policy, AEMO will upgrade to a digital platform that can simplify and facilitate consumers' access to their data necessary for the market to tailor supply and other services to their individual needs. AEMO will also continue work with Energy Networks Australia to promote the distribution and power system coordination and market design necessary for a two-way power system, including opportunities for new and traditional market participants to enhance value to consumers. Improved DER standards, and trials of DER markets will also be implemented to boost confidence to invest in sophisticated DER capabilities, improving the productivity and resilience of individual investments and the entire power system.

5. Digital and data
AEMO's digital platform will unlock new value for consumers, improve data access, choice and user experience, and enable flexibility and new services. It will exploit the explosion of data volumes and enable machine learning tools plus modern advances in IT infrastructure to overhaul legacy systems and create a scalable and easily accessible single-source-of-truth for data integrity. Security-by-design will underpin the platform including cyber security defences. This investment will reduce long-term operating costs for AEMO and the industry, improve service, reduce duplicated investment and lower entry barriers to enhance competition.

6. People, culture and capabilities
AEMO's key assets are our people and their knowledge. Through actions that focus on broadening our technical skills and evolving our culture and workplace environment to favour innovation, personal growth and collaboration, while continuing to raise the bar on diversity, we will keep AEMO a sought-after working environment that can continue to attract and retain the talented people we require to meet the complex challenges of the transforming industry.

Budget and fees

AEMO operates on a user-pays cost recovery basis and recovers all operating costs through fees paid by industry participants. Each year, AEMO prepares an annual budget outlining its fees and charges for each energy market it operates and the recovery of other services consistent with its legislative authority and for Western Australia as per the fees and charges approved by the ERA.

For the 2019–20 financial year, AEMO's operating budget, excluding depreciation, is $227 million and capital budget is $181 million. AEMO's fees and charges in the NEM will increase by around 12% consistent with AEMO's previous guidance, while the WA WEM fees will increase by 3% to reflect the ERA's final determination.

AEMO's other notable fee movements include an increase in the Declared Wholesale Gas Market (DWGM) of 3% and a general reduction across most Full Retail Contestability (FRC) Gas markets and a reduction in the Short Term Trading Market (STTM) fees. We expect these rates of change to remain consistent over the next three years.

AEMO's increases in both operating expense and capital requirements reflect increases in capabilities and technology requirements to respond to the needs of the transitioning system and markets, as well as increased scope, regulatory and reporting requirements. AEMO looks to moderate these impacts on our members through continuous actions to increase organisational efficiencies and steps to moderate the impact of cost changes on individual participants. These efforts are detailed in our published final budget and fees for 2019–20[1].

Performance

AEMO will continually measure performance to ensure that we meet expected outcomes. Over the three years of the Corporate Plan, we will have targeted outcomes to support the achievement of a secure, reliable and affordable power system. Key performance outcomes are detailed in the report and fall within the following key areas of focus:

- Assured real-time system performance.
- Industry-wide consensus on high-quality, actionable system blueprints.
- More adaptable regulatory environments and markets that facilitate technological, business model and service innovation that benefit consumers.
- More engaged consumers, with access to vastly improved consumer information and tools that support innovation, service quality and choice.
- Modern, cost-efficient digital platforms enabling value through ubiquitous access to data, new services, and reduced costs for industry.
- Motivated workforce with diverse skills and an innovative, collaborative culture and working practices.

In addition, we will continue to publish the information necessary to fulfil our regulatory obligations and inform our members. We are also undertaking broader stakeholder consultation to discover additional information of value to participants seeking to remain well-informed on system and market performance.

Risks

AEMO has a robust risk management approach aligned to the international standard for risk management: *AS ISO 31000: 2018 Risk management - Principles and Guidelines*. AEMO's plan addresses its principal operating and strategic risks.

The operating risks were identified as:

- Inability to maintain power and gas system security and reliability due to disruption in the energy ecosystem.
- A deliberate and directed cyber-attack compromises the confidentiality, integrity and/or availability of AEMO's IT and market systems.

AEMO's strategic risks were identified as:

- Ineffectively articulating and achieving necessary changes to manage industry transformation.
- Legacy technology that could compromise our ability to serve our members.
- Inability to capitalise on existing and future data to enable informed decision-making.
- Inability to adapt our workforce and culture to meet future needs and drive transformation.
- Members loss of confidence in AEMO's competency to deliver our functions as a systems and markets operator.

1 At **https://www.aemo.com.au/-/media/Files/About_AEMO/Energy_Market_Budget_and_Fees/2018/Final-AEMO-Consolidated-Budget-and-Fees-2018-19.pdf**

AEMO's purpose and governance

AEMO has prepared the Corporate Plan 2020-23 to inform stakeholders of its plans to shape a better energy future for all Australians within a rapidly changing energy landscape.

Through this Corporate Plan, AEMO will:

- *Affirm AEMO's purpose and governance.*
- *Outline changes in the energy sector and their implications for our organisation.*
- *Articulate its strategic pillars and priorities for the next three years.*
- *Explain the multi-faceted, interconnected programs of work to deliver this vision.*
- *Outline its plans for investment in its core assets – people and technology – to support this essential program of work.*

Independent system and markets operator and planner

Under AEMO's Constitution, our primary obligation is to perform the functions and exercise the powers conferred on us under the national electricity, gas and energy retail laws (NEL, NGL, NERL), which are directed to achieve the National Electricity, Gas and Energy Retail Objectives (NEO, NGO, NERO).

The NEO, NGO and NERO are:

> '…to promote efficient investment in, and efficient operation and use of, electricity and natural gas services for the long-term interests of consumers of electricity or natural gas with respect to:
>
> - Price, quality, safety, reliability and security of supply of electricity and natural gas.
> - The reliability, safety and security of the national electricity system.[2]'

In Western Australia, the *Electricity Industry Act 2004* (section 122) and the *Electricity Industry (Wholesale Electricity Market) Regulations 2004* provide for AEMO's role and responsibilities.

The market objectives for the WA WEM are similar, with the important distinction of having an explicit objective to reduce greenhouse gas emissions[3] through non-discriminatory market rules as well as the direct consideration of energy efficiency[4]. AEMO continues discussions with relevant stakeholders on options to extend our Western Australia power system responsibilities to also include the North West Interconnected System (NWIS).

AEMO is also responsible for planning and directing augmentation on the Victorian electricity transmission Declared Shared Network (DSN) and under the NGL, AEMO controls the security and operation of the Victorian Gas Declared Transmission System (DTS) and schedules the Victorian Declared Wholesale Gas Market (DWGM).

AEMO undertakes these legal responsibilities as an independent entity, owned jointly by government (60%) and industry (40%), which, through a transparent user-pays fee and charging regime, recovers the costs of providing these statutory and support services, such as energy infrastructure planning, forecasting and power and gas system operations, reliability and security advice and services to direct market participants and all other stakeholders.

AEMO was established by COAG on 1 July 2009 to manage the NEM and gas markets. COAG strengthened the national character of energy market governance by drawing together the responsibility for electricity and gas market functions, NEM system operations, operation of Victoria's gas transmission network, and national transmission planning.

The new entity was immediately tested by the failure of Bayswater Power Station on the day following our inauguration. Having successfully managed this incident, AEMO has taken on a progressively larger range of responsibilities including the operation of the Western Australian electricity system and markets, and several gas market functions including the WA Gas Bulletin Board and Gas Statement of Opportunities.

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2 The NEO, NGO and NERO are expressed separately in: the National Electricity Law, which is a Schedule to the *National Electricity (South Australia) Act 1996* (s 7); the National Gas Law, which is a Schedule to the *National Gas (South Australia) Act 2008* (s 23); and the National Energy Retail Law, which is a Schedule to the *National Energy Retail Law (South Australia) Act 2011* (s 13).

3 Section 122 (2) (c) of the *Electricity Industry Act 2004*: 'to avoid discrimination in that market against particular energy options and technologies, including sustainable energy options and technologies such as those that make use of renewable resources or that reduce overall greenhouse gas emissions.'

4 Section 122 (2) (e) of the *Electricity Industry Act 2004*: 'to encourage the taking of measures to manage the amount of electricity used and when it is used.'

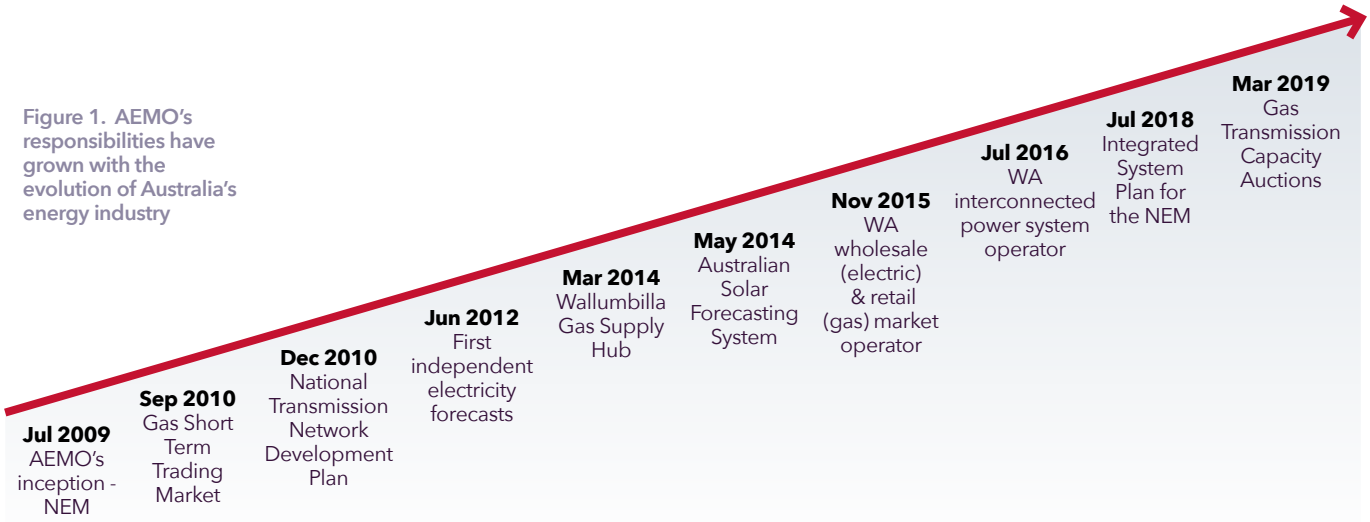


Figure 1. AEMO's responsibilities have grown with the evolution of Australia's energy industry

Over the last 10 years, AEMO has significantly expanded its role in informing system evolution through planning and forecasting activities, developing the first National Transmission Network Development Plan (NTNDP), the first independent electricity forecasts and the Australian Solar Forecasting System.

In 2015, AEMO took responsibility as the wholesale and retail market operator in Western Australia, integrating the functions of the pre-existing Independent Market Operator (IMO). Also in 2015, AEMO took responsibility for the WA Gas Bulletin Board and Gas Statement of Opportunities, which had been established for the Western Australian gas market through the IMO in 2013. Then on 1 July 2016, the power system operations function transferred from Western Power to AEMO, establishing AEMO as the independent power system operator for Western Australia.

In July 2018, AEMO published the inaugural Integrated System Plan (ISP) for the NEM, as recommended by the Finkel Review. The first ISP delivered a strategic infrastructure development plan, based on sound engineering and economics, to help facilitate an orderly energy system transition under a range of potential scenarios.

Members, stakeholders and industry partners

There are currently 380 market participants in the NEM and 80 in the WA WEM. As part of its function, AEMO hosts numerous forums to both inform and learn from members across all sectors of the industry about issues that are critical to efficient market operations and the performance of AEMO's functions.

In 2019–20, in conjunction with members, AEMO will undertake a review of its engagement practices, to improve forums and technology, and increase collaboration and information-sharing across the multiple dimensions of our activities.

Along with market participants, AEMO works with member organisations representing stakeholder interests and Commonwealth and state government departments and agencies that have responsibilities in this sector. Below is a list of the key government agencies with which AEMO engages on a regular basis:

- Council of Australian Governments (COAG) and the COAG Energy Council.
- COAG's Energy Security Board (ESB), which reports to the COAG Energy Council.
- Australian Energy Market Commission (AEMC), which makes the rules that govern energy markets.
- Australian Energy Regulator (AER), the national energy market regulator.
- Energy Consumers Australia (ECA), the independent, national voice for residential and small business energy consumers.
- Australian Competition and Consumer Commission (ACCC).
- Western Australia's Department of Treasury's Public Utilities Office (PUO), which provides services on energy matters for Western Australia.
- Economic Regulation Authority (ERA), Western Australia's independent economic regulator.
- State based energy regulators: Independent Pricing and Regulatory Commission (IPARC – ACT); Independent Pricing and Regulatory Tribunal (IPART – NSW); Essential Services Commission (ESC – VIC); Queensland Competition Authority (QCA); Essential Services Commission of South Australia (ESCOSA); and the Office of the Tasmanian Economic Regulator (OTTER).

Of particular importance is AEMO's position on the Energy Security Board (ESB), where we have the opportunity to work with independent and market-body board members, the secretariat of the ESB, and AEMC and AER personnel on detailed plans and programs to guide and drive adaptation of the future energy system to maintain energy affordability, reliability and security.

AEMO also maintains a series of partnerships across the energy industry in Australia and globally to gain access to new insights and provide leading perspectives on energy transformation. In particular, our strategic relationships and information-sharing with CSIRO, BOM, ARENA, the Clean Energy Regulator (CER) and the Clean Energy Finance Corporation (CEFC) help increase our understanding of the challenges and in developing solutions.

Corporate governance

AEMO is governed by a Board of Directors, which is accountable for the overall direction, management and corporate governance of the company. AEMO is committed to ensuring that a robust corporate governance framework is in place and to adopting better practices as informed by relevant industry bodies.

Members of the Board are appointed by the COAG Energy Council, following a selection process involving the Nomination Committee of the Board, the COAG Energy Council Appointments Selection Panel and AEMO's members (government and industry).

The Constitution requires the Chairman and a majority of Directors be independent of management and free of any real or perceived business or other relationships that could materially interfere with exercising unfettered and independent judgement.

The Board oversees AEMO's business affairs to meet the company's objectives and responsibilities under relevant law and regulatory regimes, and also monitors the performance and cost-effectiveness of AEMO's operations and systems.

Collectively, the members of the Board possess the core skills prescribed in AEMO's Constitution and provides a broad, diverse range of skills and experience necessary to face the challenges of an industry undergoing significant transformation.

Purpose and mission

In the development of the Corporate Plan 2020–23, AEMO reviewed its obligations in the rapidly changing world of energy and the environment. As an operationally focused organisation, we pride ourselves on understanding and finding solutions to the toughest technological challenges confronting the energy industry in a way that increases value to Australian energy consumers.

The rapid changes occurring in the Australian energy environment, the size of our energy grids, the changing supply availability and mix of our portfolio of gas and power resources and relative sparseness of our population, place AEMO in the unique position of having to solve technical challenges that our peers in other jurisdictions are just beginning to see or, due to population density and interconnected power systems, may never see.

However, we are optimistic that the rapid technological changes that are occurring in the Australian energy system, and the natural resources we have, can also become an advantage to consumers provided that there is a desire and willingness to pursue actions that achieve these benefits.

AEMO is equally convinced that due to the complex and novel forecasting, modelling and engineering challenges we are confronting, we cannot do this alone. Rather, to achieve our goal to be a best-in-class system planner and operator, we must simultaneously grow our internal capabilities and our ability to collaborate with our partners and industry participants. These stakeholders share our commitment to harnessing sector transformation to Australia's advantage, and thereby provide energy consumers with access to affordable, reliable and secure energy, which also meets the nation's emissions targets.

To be representative of this commitment, AEMO's statement of organisational purpose and mission reflect its desire to deliver value to the industry and consumers in this time of unprecedented industry challenge and change.

Statements of purpose and mission

Purpose: Shaping a better energy future for all Australians

Our mission is to:

- Pursue operational, technical and commercial understanding and excellence.
- Partner with others to explore, test and learn.
- Contribute to affordable, secure, reliable and sustainable energy for all Australians.

Changing energy system and operating environment

The disruptive changes associated with Australia's energy landscape are well known, and the industry must maintain affordability in light of these challenges and opportunities.

Changes in power supply mix

Over the next two decades, a significant proportion of Australia's existing generators will retire due to age and/or economic viability. When they retire, technological and cost changes show that they are likely to be replaced by a combination of renewable energy resources, storage and flexible gas plant.

In the NEM:

- Large-scale VRE sources are rapidly increasing and forecast to be 26–41% of energy and 22–35% of capacity by 2030.
- DER is forecast to increase to 10–14% of generation by 2030.
- In parallel, a progressive decommissioning (potentially at short notice) of some ageing infrastructure is forecast to see 8–11% of current capacity withdrawn between 2019 and 2030[5].

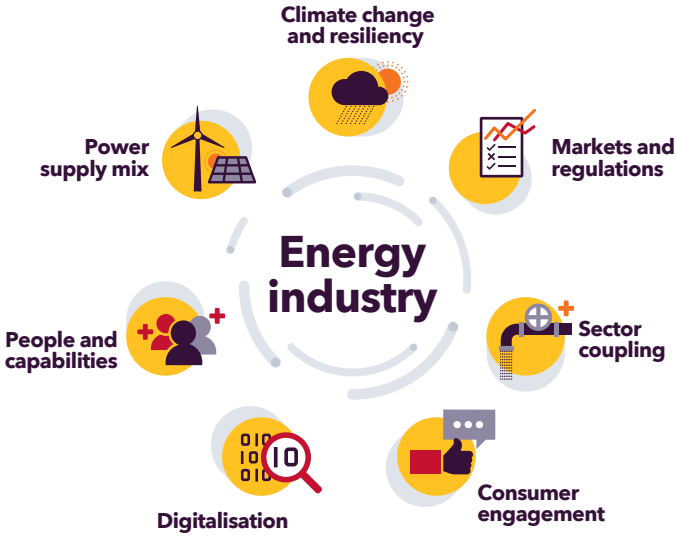
Similarly, in the WA WEM:

- Large-scale VRE is expected to account for 20–25% of capacity in the SWIS by 2020–21.
- Increasing DER penetration is expected to reduce operational consumption by around 20% by 2028–29.
- Instantaneous non-synchronous generation of 65% is forecast to occur by 2024.

This represents a shift of generation from large-scale and centrally controlled to more geographically dispersed patterns.

VRE and DER can provide economic as well as environmental benefits, due to their lack of fuel expense and otherwise low operating expense. At the same time, at high levels of penetration they present novel system management challenges that must be understood and addressed. For example, the growth in DER will shift and reduce minimum grid-delivered demand, which can result in lower costs but also result in difficulties in maintaining voltage levels. Voltage variability can in turn degrade power quality and adversely impact machines and home appliances.

Figure 2. Disruptive forces in the Australian energy industry



In the face of all these changes, the energy system must stimulate efficient long-term investments that renew infrastructure in strategic locations, optimise between prospective investment solutions, and facilitate careful decommissioning and replacement of retiring generation capacity and gas sources without major cost or reliability impacts.

Sector coupling

Increasingly complex co-dependencies between the gas, electricity and transport (electric vehicles) sectors will impact how we evolve energy systems that best meet Australia's future needs. Innovative modelling approaches and cross-industry partnerships will be required to enable tri-sector optimisation of gas, electricity and transport, such as forecasting gas supply and economics, electric vehicle uptake and charging behaviour, and the potential opportunity for hydrogen production, consumption (in transportation, or via gas distribution networks) and export.

In addition, gas networks are being disrupted with economic and competition reforms, as well as price impacts from exports and a tightening of gas supplies (in some jurisdictions). These disruptions also impact the capability of the gas network to deliver gas for power generation.

5 AEMO, 2018 Integrated System Plan, July 2018, Neutral and Fast Change scenarios. At **http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Integrated-System-Plan**

Energy markets and regulations

Australia's energy markets are trailing the pace of change in energy systems, lagging behind overseas jurisdictions, within a regulatory environment designed at a time when technological and business model changes were slower and less radical than we are witnessing and expect to continue.

Current markets are inadequate to deal with sophisticated emerging needs, such as two-way power flows from distributed generation and storage, and the potential for active network management and new essential system services that value system security and flexibility. They cater for wholesale market participants and traditional sources of supply, rather than the involvement of consumers and new entrants, such as fast-moving storage, and novel business models such as virtual power plants (VPPs).

The design of markets that better support technology and business model innovation, distributed power, and essential system and flexibility services from a wider range of participants is the subject of the ESB's work on market redesign for the near-term and into the mid-2020s. Market design is required to effectively manage costs and price volatility and support new investments. The Western Australian Government's Energy Transformation Strategy has a similar set of objectives for the WA WEM, with AEMO centrally placed to contribute thinking and learnings into both the NEM and WA WEM redevelopments.

Climate change and resiliency

Climate change is making weather more extreme and harder to forecast, and the current system is not designed, built, or operated to accommodate the extremity and scale of climate-induced weather events, or the influence of weather on major sources of energy production. The power system will need to prepare for increased frequency and scale of extreme weather events, making geographic and technical supply diversity much more desirable to mitigate risks of supply interruption. In addition, a multi-pronged strategy is required involving a combination of integrated planning, improved asset design and management, and disaster recovery to address vulnerabilities.

Consumer engagement

Consumers now have more options to engage with their energy consumption than ever before, and the Commonwealth CDR legislation will make authorised data access much easier for individuals and third parties, facilitating competition and the emergence of new energy products and services. Greater monetisation of DER, via options such as VPPs, is expected to deliver a more technically and economically efficient power system, with net benefits from enabling DER to respond to both market and network signals estimated by CSIRO in the order of $1–3 billion to 2030, and $15–20 billion between 2030 and 2050[6].

Digitalisation of the supply system – data requirements

A global explosion in volumes and types of data, and the emergence of technologies, such as artificial intelligence and cloud computing, mean a major strategic commitment to data and digital systems is now a priority for AEMO, as it is for most organisations, that typically rely on legacy systems that are high cost, inflexible, and increasingly incapable of meeting future needs.

The energy system, markets and their security and reliability will increasingly depend on digitalisation and data, to enable, for example, more than 1.8 trillion anticipated meter reads per annum. AEMO's unique position at the centre of a complex web of energy data offers an opportunity to unlock value to consumers by providing better data and tools that enable providers and consumers to achieve better outcomes and reduce costs industry-wide. It is paramount for critical national infrastructure, that all of this must be delivered securely, while combating the threat of a cyber-attack.

People and capabilities

The knowledge and capabilities of our employees are AEMO's greatest assets. The skills AEMO requires are in very high demand, posing challenges for recruitment and retention of often younger, more mobile individuals with high expectations in a highly competitive talent market. This requires AEMO to provide work opportunities and ways of working that are valued by those entering the work force and those with established careers, as a means to attract and retain employees. The organisation will also need to draw more on knowledge located outside the company, so strategic and meaningful partnering and relationship building are critical.

6 CSIRO, Review of cost-benefit analysis frameworks and results for DER integration, May 2019.

Converting technical challenges to market opportunities and consumer benefits

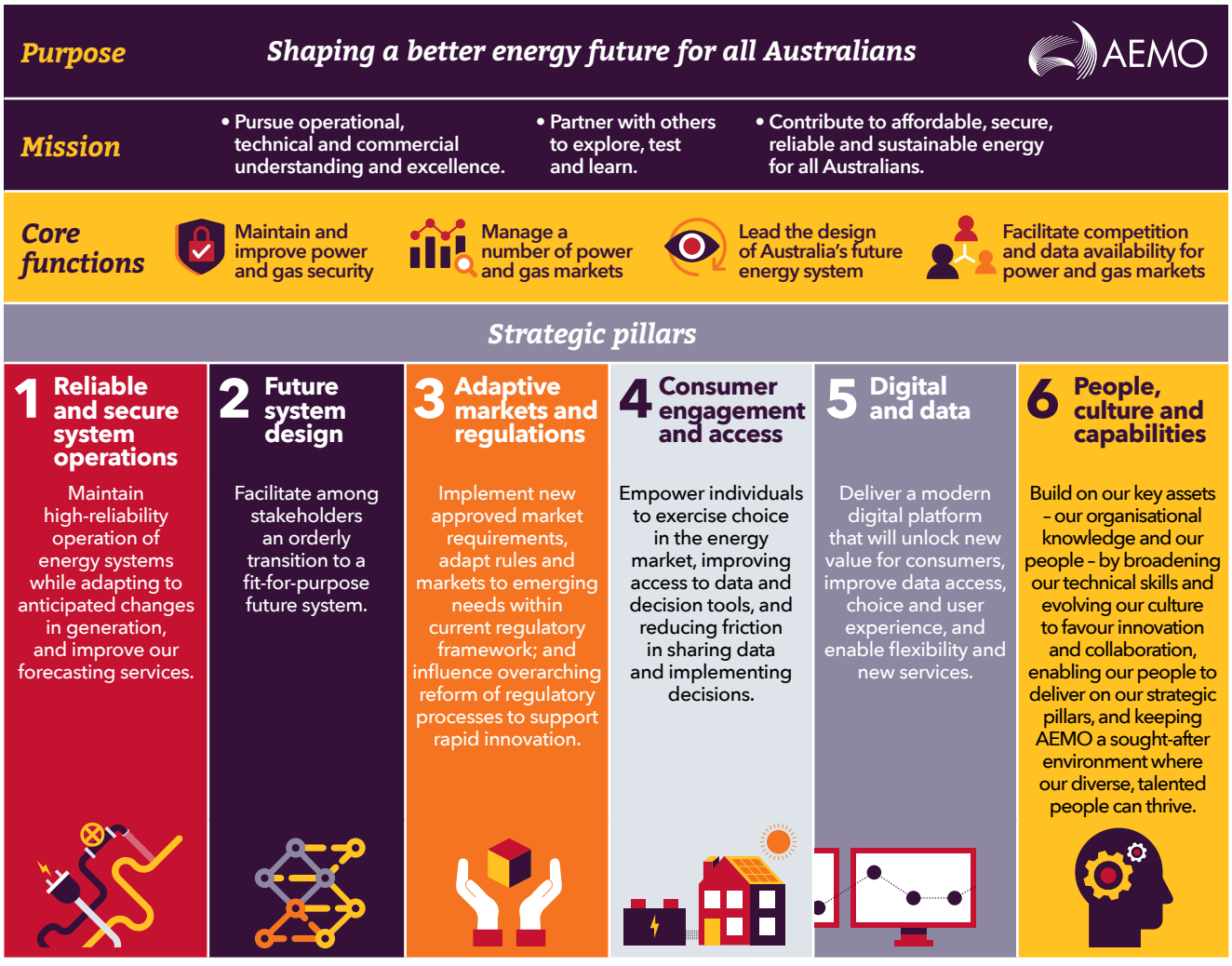
While AEMO's core purpose remains unchanged, our next 10 years must see AEMO and energy industry participants continuously assess how to maintain affordability and provide value to consumers in a rapidly changing environment.

AEMO's approach emphasises leadership and proactive change through **six strategic pillars** (see Figure 3).

The six pillars build on our core operational strengths, guide the effective adaptation of physical systems and markets, and facilitate meaningful consumer choice and the provision of comprehensive data and digital tools for complex decision making.

These pillars are underpinned by an organisation with deep and diverse technical expertise that values flexibility, learning, collaboration, and innovation, delivering benefits for consumers, system participants and stakeholders.

Figure 3. AEMO's strategic response to change – six strategic pillars



1. Reliable and secure system operations

Objectives

Reliable and secure system operations is the real-time, 24/7 heart of AEMO.

The objective of our Reliable and secure system operations pillar is to:

Maintain high-reliability operations of energy systems, while adapting to anticipated changes in generation, and improve our forecasting.

As part of the core operation for the power system in the NEM and WA WEM, AEMO must monitor system performance and has responsibility for managing system security, including the requirements for market and non-market essential system services, such as regulation balancing, frequency control, inertia and system strength, voltage management and system restart capabilities.

Forecasting and modelling of developing and potential changes in the system are critical to our ability to perform our work. We produce operational predictions of demand and supply and conduct planning for power and gas system operations, including providing information to market participants of likely risks to supply and assessing outages.

The prevalence of weather as a primary fuel source has driven AEMO to globally lead the use of data and tools to measure uncertainty and better incorporate renewable resources, such as wind and solar, into the system. Unlike in the past, challenges to the power system occur both in high demand and low demand circumstances. We will increasingly rely on simulation tools, advanced computing and knowledge of the system to learn how to manage uncontrollable but forecastable combinations of events.

AEMO is also responsible for ensuring reliable gas system operations in Victoria for the Victorian Gas Declared Transmission System (DTS).

The use of gas-fired generation in the NEM and WA WEM for reliability and security services requires that these critical real-time operating linkages with gas operations are understood and effectively managed.

Environment and opportunities

Impact of VRE, DER and ageing/retiring infrastructure

The transition to VRE and DER generation and the retirement of ageing capacity present both ongoing operational challenges and the potential for consumer benefits as the operating capabilities of these technologies improve and their costs decrease. An increasing share of VRE is leading us to better understand novel electrical phenomena and impacts on system control, and to overcome network constraints due to coincident generation. As these resources enter and ageing generation retires, the opportunity arises to create new approaches to the management of capacity for dispatch and new ancillary services for system security.

The complexity of DER integration has spurred a dedicated program of works to understand and resolve likely technical and operational issues. This program includes:

- Analysing DER behaviour during disturbances.
- The development of dynamic models for loads and DER.
- Impacts on emergency frequency control schemes and system restart.
- DER integration into current operational tools and processes.
- Working within Australian Standards and with industry bodies to set technical, operating, safety and cyber security standards for DER resources[7].

The changing nature of power systems also presents challenges and opportunities for the operation and planning of the gas systems. Increasing VRE and the retirement of coal-fired generators is resulting in periods of increased gas-fired power generation when VRE generation is low.

Conversely, higher levels of VRE generation are resulting in increased levels of VRE curtailment, creating incentives for increased energy storage, including the potential production of hydrogen. Meanwhile, increased gas prices and environmental initiatives to reduce methane emissions are also driving interest in supplying biomethane into gas distribution networks, creating new gas demand forecasting and retail metering challenges.

Collectively, these trends offer continuous improvement opportunities in frequency management, voltage management, and system strength and resilience.

7 AEMO's full suite of analysis on frequency management, voltage management, system strength and enabling DER can be found at **https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/DER-program**

Advancements in management of frequency, voltage and system strength

AEMO must be able to set and maintain frequency, which is controlled by the constant balancing of electricity supply and demand. Emergent challenges in frequency control require new approaches and incentives for the management of frequency that will be proposed to the AEMC.

Voltage management maintains voltages at different points in the network within acceptable ranges during normal operation, and enables recovery to acceptable levels following a disturbance. In particular, high voltages in the transmission network caused by reduced operational demand during periods of light load and displacement or retirement of synchronous power stations create a need to implement new longer-term management options.

System strength reflects the sensitivity of the power system to disturbances. Challenges include accurate prediction of system strength requirements given significant changes in generation mix and the power system, and a lack of careful investigation of outage conditions resulting in a further decline in system strength and potential generation instabilities. The design, settings and implementation of control and protection schemes can be adapted to remain suitable for the wide range of dynamic responses introduced into the power system over a relatively short time.

Increased sophistication of system analytics

Forecasting capability must match the increasing complexity of the energy system itself, for example, reliance on weather as a fuel source, electromagnetic transient models of a high-DER system response under normal, outage and extreme operating conditions, and reliability forecasts that will underpin the Retailer Reliability Obligation (RRO) in the NEM and the Reserve Capacity Target in the WA WEM. Improved forecasting techniques will also need to take advantage of an exponentially greater volume of data, for example, from IoT-connected devices, and exploit the emergence of new algorithms and machine learning approaches.

Priority actions

Frequency management

AEMO pursues continuous improvement through a major program of prioritised projects, coordinating short- and medium-term operational tasks with further needs emerging from AEMO's broader strategic initiatives, such as the DER program, the All-NEM study and the Western Australia Department of Treasury-led WoSP.

Current projects are focused on primary control, primary frequency management, and inertia. These include:

- A review of Market Ancillary Services Specifications (MASS).
- Trials of new technologies (including DER) for future frequency control ancillary services (FCAS).
- Short-term measures including amendments to the Frequency Operating Standard (FOS) for primary frequency issues within and outside the normal operating band.
- Improving the projection of inertia shortfalls.

Voltage management

Voltage management priorities are primarily DER-related. Projects are reviewing shortcomings in DER performance standards, developing dynamic models of DER behaviour during disturbances, compiling a registry of data on DER installations, and working with Distribution Network Service Providers (DNSPs) to implement solar feed-in management and to understand the operational complexities of transitioning to two-way networks.

System strength management

Efforts to manage system strength are focused on developing strength models, determining accurate operational limits for a secure operational envelope at minimum cost, and minimising the potential for adverse interactions between control schemes introduced to manage generation in weakening networks. We are also actively developing suitable control room tools for 24/7 management of systems.

Forecasting

We will uplift AEMO's operational forecasting performance, utilising machine learning and bottom-up forecasting, and incorporating the impact of aggregated, managed DER fleets, and weather impacts on wind and solar generation. AEMO is collaborating with CSIRO and the BOM on a 3-year project to make climate change data more accessible and useful for infrastructure decision-making on electricity and improved climate risk planning. We are also assuring forecasting quality control by re-establishing the Forecasting Advisory Group of industry specialists to steer continuous improvement.

To manage distributed sources of gas supply, including hydrogen and biomethane, AEMO will look to adapt gas demand forecasting systems and upgrade the gas retail metering systems to account for localised and regional changes in gas heating value. This will enhance the capability developed through the replacement of the Heating Value Allocation Model system.

The amount and complexity of data and information that AEMO must manage for secure system operations continues to grow exponentially. To manage in this increasingly complex environment, AEMO will pursue advancements in analytic tools, including artificial intelligence and machine learning, as well as modelling capabilities that support dynamic bi-directional system optimisation. Given the nature of our real-time operations, this development can best be pursued in a simulation environment that accurately portrays the current likely challenges to the electric and gas systems.

As part of the RRO, AEMO will produce a five year Reliability Forecast, which is contained within the ESOO. If there is a gap, versus the reliability standard, AEMO must request the AER to make a reliability instrument. This creates an obligation for retailers to enter financial contracts, which provides an incentive for investment in new resources.

AEMO has a joint action program with CSIRO to develop a true 'digital twin' simulator of the energy system. The 'digital twin' will be available for use for both improved operations and research by ourselves, CSIRO, government, academia and industry, and we believe will be world leading in the evolution of tools necessary to develop and manage future two-way, low-carbon power systems.

Outcomes

The key outcomes of the Reliable and secure system operations pillar for 2020–23 are:

- Performance against core operational KPIs maintained.
- Gain financing for the 'digital twin' simulator of the energy system.
- Forecasting accuracy improved.

2. Future system design

Objectives

As Australia's energy system undergoes its biggest transformation in arguably a century, AEMO must facilitate an orderly transition to an efficient future energy system, which is truly fit-for-purpose for an energy landscape fundamentally different from the one for which the current architecture was originally designed. The transition needs to balance multiple objectives of low cost and economic efficiency, system security and reliability, consumer choice, and government policy.

The objective of our Future system design pillar is to:

Facilitate among stakeholders an orderly transition to a fit-for-purpose future system.

Environment and opportunities

Facilitating such a complex transition presents a coordination challenge across technical and commercial issues and stakeholders. From a technical perspective, there is now an opportunity to optimise transition pathways for different scenarios[8]:

- Major increase in VRE generation sources, whose output is more difficult to forecast and inherently variable.
- A shift from centralised to distributed generation, creating greater complexity in local energy flows and distribution system management.
- Retirement of conventional generation capacity, requiring new approaches not just for energy supply but also for the provision of essential system services such as inertia, system strength and firming.
- A future where electricity, gas and transport sectors are coupled, recognising the co-dependencies between sectors.
- Optimisation of major investments across different parts of the supply chain (transmission, distribution, generation and storage, and consumer level resources) and their interoperability.
- New levels of sophistication and customisation of demand patterns arising from far greater engagement with consumers, and the emergence of new products and services to cater to their individual needs.
- Consequent explosion in the number of system participants – new consumers, with enhanced individual demands.
- Resilience to the risks of more extreme climate conditions.

8 AEMO (2018), *AEMO observations: Operational and market challenges to reliability and security in the NEM.*

Inevitably there is a range of different ways the overall system could evolve, hence there is benefit in taking an explicit scenario-based whole-of-system approach to the planning and design process to ensure the future energy system is least-cost and robust under a range of plausible outcomes.

Optimal outcomes are not necessarily those that would emerge from the current regulatory and market design structures. There is thus an important opportunity to facilitate effective cooperation, collaboration and coordination of actions between a large number of parties – regulatory agencies, market participants, governments and consumers – each of which have different roles, perspectives, objectives, incentives and constraints that must be balanced to achieve the optimal outcome for the Australian energy sector.

Actions

Develop Integrated System Plan (ISP) and WA Whole-of-System Plan (WoSP)

The core of AEMO's response to these challenges is the development of an Integrated System Plan (ISP) as an actionable blueprint for Australia's future energy system, which provides AEMO with the basis to meet its legal obligations, including the NTNDP.

The ISP will serve as a key communication and scenario planning tool to facilitate coordinated investment and policy decision-making among energy systems and markets stakeholders. The announcement by Western Australia's Minister for Energy[9] about leading the development of a Whole-of-System Plan (WoSP) for the SWIS and WA WEM by mid-2020 represents an equivalent process to the ISP, and AEMO expects to be integral to its development and ultimate implementation.

AEMO's inaugural ISP, published in 2018, delivered a strategic infrastructure development plan, based on accepted engineering and economics, designed to facilitate an orderly energy system transition under a range of scenarios. This is a system rather than merely a grid plan, to reflect that over time it will by necessity consider a wide spectrum of interconnected infrastructure and energy developments, including new gas field developments, transmission, generation, gas pipelines, sector coupling and DER.

The 2018 ISP is the first of many iterations, with updates in future years to address the changing nature of the power system and the need to continually innovate and evolve strategies in the future. Between now and 2022, AEMO will use the ISP to drive an on-going, iterative process of stakeholder engagement and consultation to facilitate efficient long-term regulatory and investment outcomes.

Similarly, an initial WA WoSP for Western Australia will be developed before mid-2020, led by the WA Government working closely with AEMO, Western Power and other stakeholders. An annual WA WoSP function will be implemented, utilising the learnings from the initial plan, which AEMO believes will likely focus on known emerging gaps, such as declining minimum demand, inertia and system strength.

Further refinements towards a fully integrated system plan will include research and development in the following areas (among others):

- Orchestration of distributed variable renewable energy generators.
- Enhancing resilience against unforeseen exits, fuel constraints, climate change and variability.
- Integrating across electricity, gas and transport.

The facilitation of new technologies, such as hydrogen, will also be a consideration of future ISPs and WA WoSPs. AEMO is supporting the National Hydrogen Strategy Taskforce, led by Australia's Chief Scientist, to develop a National Hydrogen Strategy during 2019, as well as the Standards Australia committee developing changes to the natural gas specifications to enable the blending of hydrogen into gas distribution networks.

Implement ISP major projects

AEMO is coordinating with the relevant Transmission Network Service Providers (TNSPs) and through the ESB to expedite the approval and delivery of the ISP Group 1 and Group 2 projects, in light of the planned retirement of the Liddell Power Station in 2023. The projects for early implementation are:

- Synchronous condensers in South Australia.
- Western Victoria Renewable Energy Zone initial works.
- Minor upgrades to the Victoria–New South Wales interconnector, and to the Queensland to New South Wales interconnector.
- Energy Connect RIT-T.

9 At **https://www.treasury.wa.gov.au/Energy-Transformation/Whole-of-System-Planning/**

AEMO will work with the relevant TNSPs and through the ESB to ensure these projects progress satisfactorily and are completed within the timeframes in the ISP. AEMO is also undertaking additional work and insights based on the 2018 ISP and enhancing the modelling and analysis of pumped hydro storage and coal-fired generator life expectancy.

Upon completion of the inaugural WA WoSP, AEMO expects that a similar approach and process will be designed and implemented for co-optimised generation and energy network investments within the SWIS for the WA WEM within the current Western Australia regulatory regime.

Implementation of the major projects recommended in the ISP will also address significant issues associated with the integration of large-scale VRE projects. Strategically improved network infrastructure can help to address rapidly declining marginal loss factors (MLF). It can also improve system strength, which can speed up extended connection processes and eliminate the need for costly system strength remediation schemes.

Orchestrate distributed variable renewable energy generators

Future ISPs and the inaugural WA WoSP must continue to take into account increasing consumer investment trends towards rooftop photovoltaics (PV), battery storage, demand-side participation, energy efficiency and other forms of DER. Improving DER cost information, constraint relief, and understanding consumer behaviours and their influencers are critical to successfully integrating DER into the future power system design.

These plans should include consideration of the role that aggregated DERs or VPPs could play. High penetration could enable consumer DER to contribute to system security or other services, supporting grid management and providing financial benefit to households. AEMO has commenced work to better utilise DER for the grid, i.e. the development of DER standards to enable DER systems to stay connected during disturbances, improving network security and enabling consumers to trade value with the grid. ENA has commenced work on a national regime for DER connections, and AEMO will work with them and others to evolve this framework.

AEMO is also working with CSIRO and ARENA through the GenCost project to better understand and establish potential for demand management as an alternative to electricity generation within the current power system and market design.

Enhance system resilience

The future power system will need to be resilient to factors such as extreme weather, failure of ageing infrastructure, cyber or physical attack, sudden closure of synchronous generation, and fuel disruptions. With increased concerns around the impacts these events have upon the power sector, AEMO is actively engaged in the process of developing frameworks for assessing how best to manage the risk of these new and emerging threats.

AEMO is working with market participants, the Australian Cyber Security Centre and the Critical Infrastructure Centre on a framework for cyber security resilience of the integrated grid. A similar standardised, cross-industry risk framework is being developed for resilience to extreme weather events and disasters. AEMO is collaborating with CSIRO and the BOM on a 3-year project to improve long-term climate risk planning.

Integrate across electricity, gas and transport

Increasingly complex dependencies between the gas, electricity, and transport (electric vehicles) sectors require innovative modelling approaches and cross-industry partnerships to design an optimal power system.

Building on existing modelling of gas/electricity co-dependencies, AEMO has commenced development of a roadmap to reliably and securely integrate electric vehicles (EVs) into the power system. The initial focus is on improving AEMO's forecasting of electric vehicle uptake and charging behaviour in the near-term, and identifying the research and analysis priorities over the longer term to enable tri-sector optimisation of gas, electricity and transport in future ISPs and potentially the WA WoSP, and eventually into power system management and operations. This includes the role of hydrogen production via electrolysis during periods of high VRE generation for storage and use as a transportation fuel and blending into gas distribution networks. Furthermore, as part of AEMO's Gas Statement of Opportunities (GSOO) work, AEMO will identify and assess potential options for increasing gas supply.

EV integration will be an important component of AEMO's DER strategies, and involve collaboration to determine regulatory changes, technical standards, information requirements, and operational and market needs. This will leverage work undertaken by Industry Victoria, the Electric Vehicle Council, Infrastructure Australia and others.

Outcomes

The key outcomes of the Future system design pillar for 2020–23 are:

- Consensus on high-quality blueprints through a continually evolving ISP.
- Group 1 and 2 ISP projects delivered.
- The inaugural WA WoSP developed.
- Decisions by stakeholders made in line with the blueprint.
- Stakeholders perceive AEMO as a valuable leader and facilitator within the energy industry.

3. Adaptive markets and regulations

Objectives

A major transformation in the complexity and operation of the energy system will create a matching opportunity for more rapid adaptation of the economic markets and regulatory frameworks that govern it.

Current market and regulatory mechanisms date from an era of relative simplicity and stability but face a future where they are no longer fit-for-purpose. Compared to overseas peers, Australian market design has not changed sufficiently, and regulatory requirements may be slowing needed investments, resulting in instability, intervention and higher prices for consumers.

The objective of our Adaptive markets and regulations pillar is to:

Implement new approved market requirements, adapt rules and markets to emerging needs within the current regulatory framework, and influence overarching reform of regulatory processes to support rapid innovation.

The Adaptive markets and regulations pillar is broken into three goals:

- Implement new approved market requirements.
- Facilitate required regulatory rule changes, and design and deliver market mechanisms for flexibility, essential services and DER.
- Support consumer benefit and timely reform to regulatory frameworks to support rapid change and greater adaptability of business models.

Environment and opportunities

Current market and regulatory structures are inadequate for future needs

Energy markets need to clearly value the services and system needs to promote the appropriate investment and operational outcomes. However, current market and regulatory structures are not adapted to complex emerging needs, for example, flexibility and essential system services (including planning and operating reserves). These will require more sophisticated and economically efficient future market options (such as for DER and consumers), which will show value more clearly and send better signals than the current design – principally a real-time spot energy market supported by private bilateral contracts.

The need for change has been recognised by market participants, the COAG Energy Council, ESB, AEMC, and AER, and participants in the WA Government's WEM Reform program.

For the NEM and WA WEM, we see options to:

- Provide sufficient incentives for flexible dispatchable resources.
- Provide essential services at fair value.
- Facilitate entry for demand-side response.
- Address resource diversity and underlying economics.
- Enhance long-term investment incentives.

Incentives for flexible dispatchable resources and demand-side response

There is scope to improve transparency, price formation and payment for flexibility and dispatchability, defining the requirements for non-energy ancillary services, including power system resilience, and on the economics of investment in long-lived power generation assets. There are also opportunities to establish complementary exchanges to the existing market design, such as use of unit commitment, intra-day, day ahead and capacity mechanisms, to supplement the existing market design to value resources.

The WA WEM faces similar concerns including negative pricing distorting market signals, more frequent system management interventions, and greater need for ancillary services that increase market cost.

Given the nature of our real-time operations, these developments can best be pursued in a simulation environment that accurately portrays the current and likely challenges that arise for the electric and gas systems.

Opportunities to streamline cumbersome governance structures

At a more general level, AEMO also sees opportunity for regulatory reform to significantly enhance the adaptability of existing governance structures (for example, for rule changes) and market constructs, allowing for easier modification and facilitating entry of new services and participants by supporting long-term investment incentives.

Priority actions

AEMO will engage collaboratively in a discussion of more fundamental reform of regulatory processes, contributing leadership and world-leading expertise on power systems and real-time operations. In addition, AEMO will specifically:

- Implement necessary policies, procedures, guidelines, operating procedures and system changes for Five-Minute Settlements (5MS) and Global Settlements into the current market design for operation by 1 July 2021.
- Make changes necessary to implement the Retailer Reliability Obligation and determine the allocation of costs under the Procurer of Last Resort mechanism, which allocates a portion of the cost of RERT to non-compliant liable entities.
- Work with regulators and stakeholders to adapt current regulatory rules and trial new market mechanisms, in particular for DER integration.
- Finalise AEMO's near-term technical work programs investigating services, resources and incentives to provide reliability, security, resilience, affordability, and real-time operations through the transformation.
- Implement the DER register, gathering data from our DER pilots, and learning through the joint project with ENA on Open Energy Networks.

Work with ESB and AEMC to evolve rules and market design

We are working within the ESB Work Program to identify improved immediate, intermediate and long-term rule, regulatory and procurement pathways, and on the post-2025 energy market design project.

A key priority is to reform the transmission access regime to provide clearer locational signals, more efficient congestion management and greater certainty regarding a generator's ability to access the market through the development of new hedging products.

AEMO is a central party to the AEMC's rule change processes, providing knowledge, data and expertise on system requirements with regard to security, resilience, and reliability.

Contribute expertise and leadership to regulatory reform process

AEMO will continue to work collaboratively with the WA Minister for Energy, the WA Treasury Department's Public Utilities Office, the ERA, Western Power and other stakeholders on evolving the present market design. A portfolio of short-term changes will be followed by new standards, regulations and market constructs developed to meet longer term requirements determined by the Western Australian Government's WA WEM Reform program. AEMO is also supporting the Western Australian Pilbara reforms to introduce light handed regulation and an Independent System Operator.

Table 1. AEMO's market and regulation priorities with AEMC Proposed Rule Change investigations

NEM and power system	• Implementation of 5-minute and Global Settlements • Requirement for operational reserves • Semi-scheduled to scheduled or firming rule change • Role of market information in unit commitment • Short-term forward products/exchange i.e. day ahead, and operating reserves • Registered participant category for bi-directional resource providers • Proposed WDR participant • Updating embedded networks regulatory frameworks • Access and transmission pricing reform
Retail competition	• NMI Standing Data Review • Customer switching
Gas markets	• Gas Capacity Trading and Day Ahead Auction (embedding) • DWGM improvements: Constrained pricing congestion management; Integrated Forward Market; Entry/exit AMDQ • Gas Bulletin Board: transparency uplift on availability and pricing across time horizons and logistic supply chains

The WA WEM reforms will be staged, with the reformed market going live in October 2022, and key changes including:

- Regulatory amendments for access under constraint, including connections and Reserve Capacity Mechanism.
- Market Registrations – particularly new/amended registration classes for new and emerging technologies.
- Security-constrained dispatch and market design for co-optimised energy and ancillary services.
- New market settlement and prudential arrangements to reflect market design changes.
- Improvements to forecasts, Projected Assessment of System Adequacy (PASA) and outage management.

Trial and enable markets to manage and optimise consumer DER

A key priority for AEMO over the next three years is to anticipate, enable, manage and optimise consumer level energy assets and services for DER – solar PV (passive DER), consumer level battery storage, and smart digital solutions for control of consumer demand. We will work to support the formation of two-way markets, enabling consumers to trade energy and other services of value with the grid, thereby facilitating optimisation at consumer sites, at the broader network level, and in aggregate via retailers or third parties.

AEMO sees substantive value to consumers, the broader power system and energy markets, and over the next three years is working with relevant industry stakeholders to:

- Gain visibility of DER resources[10].
- Understand the digital and communication technologies that will be needed to control DER resources[11].
- Play a critical role in developing industry standards for DER integration, operation and management.
- Pilot proof-of-concept solutions to integrate DER resources into Australia's energy and power system.

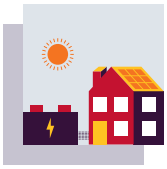
Outcomes

The key outcomes of the Adaptive markets and regulations pillar for 2020–23 are:

- Successful transition to 5-minute settlements (5MS) and Global Settlements for the NEM.
- Specified market rule changes identified, agreed and implemented.
- NEM 2025 and long-term future roadmap and foundational WA WEM Reform Program designed.
- DER products defined and exchanges trialled, providing visibility of assets and issues, and a market blueprint.
- Fuel security for generation strategy implemented.
- Ability to adapt DER visibility and metering capabilities enabled to manage the introduction of hydrogen and biomethane into gas networks.
- Reformed regulatory environment for more rapid adaptability.

10 For more on AEMO's activities on gaining visibility on DER resources please see **https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/DER-program/Virtual-Power-Plant-Demonstrations** and implementation of DER register.

11 At **https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/DER-program**



4. Consumer engagement and access

Objectives

Australia's energy system and markets have historically been the domain of industry-scale participants, with consumers accessing energy services via retailers. Energy consumers now have more options to engage with their energy consumption than ever before, and the proliferation of domestic solar generation and other distributed energy resources, combined with broader government policy on consumer choice, will make consumers critical and active participants in the future.

The objective of our Consumer engagement and access pillar is to:

Empower individuals to exercise choice in the energy market, eliminating barriers through easy access to their data and better tools to improve decision making, and reducing friction in sharing data with third parties and implementing decisions.

Environment and opportunities

Proliferation of energy choices

Consumers are making more choices with their energy consumption, considering options between retailers, investments in energy-efficient appliances, and DER in their homes. Their power to choose can be significantly enhanced by removing practical impediments to accessing and sharing relevant data, facilitating informed comparisons and decisions, and rapidly implementing decisions.

Introduction of the government's CDR policy

The energy industry is at the forefront of a broader government policy initiative to empower consumers to make informed choices. Following the pattern of fundamental reform in the financial services sector (including choice of fund, open banking), the energy industry will be next to implement CDR enabling consumer and accredited third-party access to data and information to facilitate better decision making. CDR has the potential to facilitate data liquidity and interoperability across multiple sectors of the economy.

Increased consumer ownership of generation, storage and energy efficiency assets and efficiency benefits of system integration

In parallel, consumers' investment in domestic energy infrastructure has expanded their range of energy options, but the opportunities to intelligently deploy them into the overall grid could be greatly enhanced. There are already more than 1.8 million solar systems installed[12], and the emerging battery, electric vehicle, energy efficiency and home automation markets have the potential for rapid parallel growth.

This represents a major contribution to overall system capacity, and the public benefits of effective incentives for consumer-grid integration could be significant. Moreover, options to manage costs through demand-response solutions or direct contracts with renewable generators open future avenues to sophisticated consumer choice.

Emergence of the 'prosumer'

These trends and reforms will result in energy services that can be individualised and optimised, and will fuel the emergence of 'prosumers', individuals actively engaged, themselves or through agents, in energy decisions, and able to participate in services that minimise overall system and market costs for the benefit of all consumers.

Priority actions

Consumers are considering options between retailers and investments in energy-efficient appliances, and with the affordability of domestic solar and batteries combined with government policy are rapidly deploying DER into their homes. The potential benefits to consumers and the wider grid from intelligent deployment of these assets are significant.

Improve public data on choices and outcomes and facilitate energy plan comparisons

Trust and data are the foundational enablers of consumer engagement, and AEMO's independent role in operating the grid, markets and in facilitating retail competition provides a unique platform to achieve this. Over the next three years, our priority tasks are therefore improving the accessibility and usability of consumer data and facilitating regulatory and market changes to boost consumer options and confidence.

We are partnering with the jurisdictional energy comparison services to deliver to consumers a comprehensive energy plan comparison based on 12 months of consumption data.

12 At **http://www.cleanenergyregulator.gov.au/**

We are also investing in systems for the delivery of richer public data sets, providing visibility of energy choices and transparency of outcomes in the market. For example, AEMO/CSIRO's National Energy Analytics Research (NEAR) program[13] pioneers the collection, integration and enhancement of energy sector information, available to researchers, the public and industry participants. It delivers a rich collection of interactive data products via the web, such as identifying key drivers of household energy consumption right through to the shifting need for heating and cooling across Australia. It will use the latest data science techniques to develop new datasets to solve emerging problems.

Upgrade digital platforms

In parallel, we are working with the ACCC, consumer groups and industry on the implementation of CDR in the energy sector. An upgraded digital platform will help facilitate efficient and cost-effective third-party access to individual energy data, as well as the delivery of other stakeholder information services, which will underpin choice and innovation in energy markets.

Influence regulatory changes to reduce switching times

To complement better information, AEMOs is working with the industry on regulatory changes in line with the ACCC retail enquiry review to reduce customer switching times between retailers to two days, so consumers can get better access to deals that suit their needs.

Update DER standards and engage in DER market trials

An updated set of Australian Standards for DER equipment and interoperability will boost consumer confidence that investments are fit-for-purpose to participate in the emerging markets, and AEMO and other stakeholders shall also have reasonable assurance with regard to quality, performance and cyber security.

We will also engage in trials to support the creation of an accessible and efficient two-way power system, enabling consumers to trade value with the grid and facilitating optimisation at consumer site and at broader network levels, via aggregation through retailers or third parties.

Outcomes

The key outcomes of the Consumer engagement and access pillar for 2020–23 are:

- A platform to help facilitate CDR and energy plan comparison is operational.
- NEAR and other rich public information sets available.
- Consumer switching of energy retailers within two business days enabled.
- Australian Standards updated for DER equipment and interoperability.
- Blueprints developed for a two-way power system with consumers as active participants.

13 For more information, see **https://near.csiro.au/assets/46008de4-56b8-64e4-aece-b7970f28e91a**

5. Digital and data

Objectives

Rapidly advancing needs for speed, capacity and flexibility of future data management are beyond the capability of AEMO's legacy systems.

The objective of our Digital and data pillar is to:

Deliver a modern digital platform that will unlock new value for consumers, improve data access, choice and user experience, and enable flexibility and new services.

Our digital program will deliver a modern digital platform that will provide a frictionless, secure and scalable digital experience that unlocks new value in the market for consumers and facilitates innovation for the benefit of members/participants, third parties and consumers.

The digital platform is a major investment for the benefit of AEMO's stakeholders. It will offer significant benefits across the industry, offering participants improved speed of market access, better data and insights, and will reduce their costs and investment needs, while also lowering barriers to entry to enhance competition.

Environment and opportunities

Explosion of computing power, data volume and machine learning tools

- Increasing data volumes: 5MS will create huge volumes of new data to collect, store, present and manage, for example, from our current 90 billion meter reads per year which is likely to jump to 1.8 trillion. Other technologies, such as Internet-of-Things (IoT) will also drive massive data volumes, and AEMO will ingest diversified external data sets to assist with reliability and forecasting systems.
- Increased computing power and emergence of sophisticated forecasting approaches and decision support/automated decisioning tools based on machine learning and artificial intelligence, for example, to managing complex distributed energy sources.
- Implementation of technologies like distributed ledger technology (blockchain), artificial intelligence and machine learning with the potential to impact the way markets are operated.

Heightened cyber security risks

- New system requirements, such as a consumer data platform to implement CDR, requiring flexible and agile platforms with appropriate security and data privacy.
- Ever more sophisticated threats of cyber-attack.

Greater stakeholder expectations for data and digital services

- Growing stakeholder expectations, for timely, intuitive access to data and new value-added services.

Legacy systems are inadequate for future needs

The high future performance levels required for greater data volumes and complexity are enabled by radical improvements in the way IT systems are designed, delivered and operated – such as cloud-based infrastructure, automated provisioning and configuration, standardised components, interoperability via APIs, and security-by-design – which supersede the technology of legacy systems.

The end-of-life uplift required for AEMO's systems presents an opportunity for significant improvements in both capability and efficiency, reduced delivery and maintenance costs (such as expensive licencing and support from duplication) and accelerating low cost adaptation, by focusing on new rather than old problems.

Hence, AEMO's challenge is to take advantage of the opportunity to ambitiously modernise our IT foundations and unlock the potential future technology capabilities that underpin AEMO's strategic pillars and deliver benefits to our stakeholders.

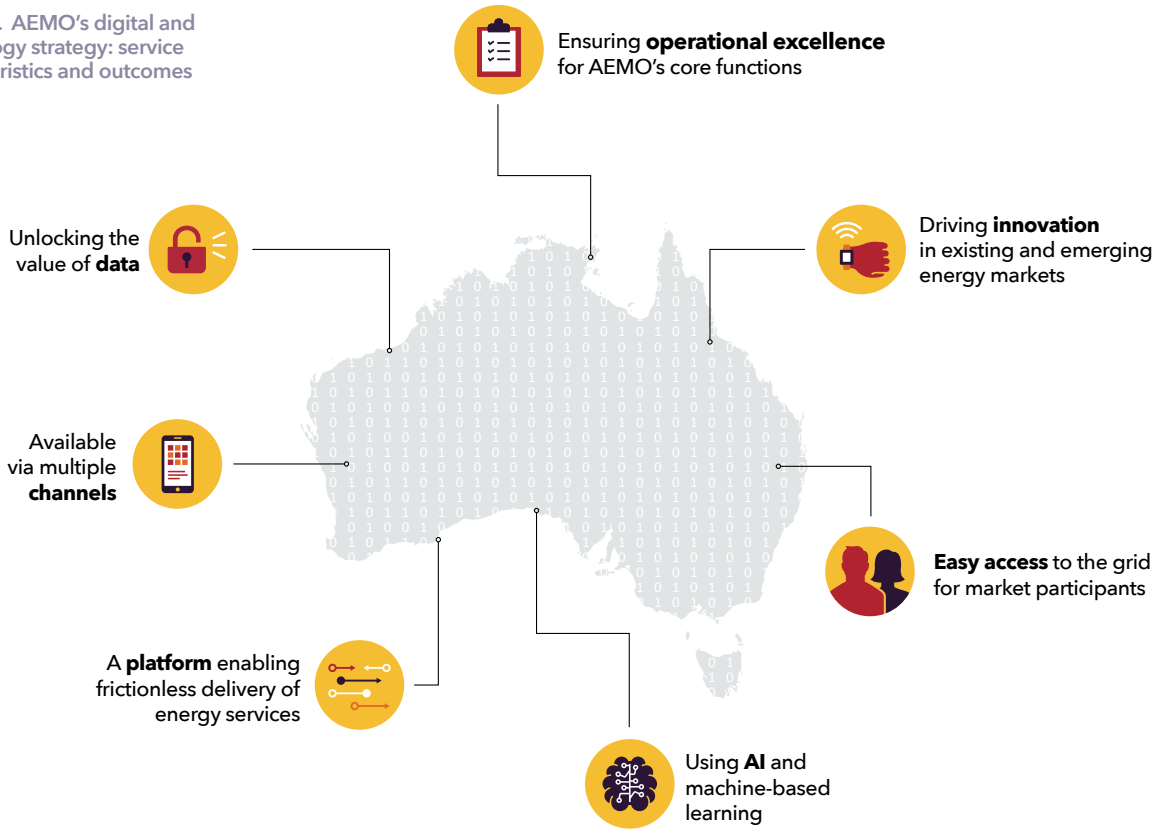
Priority actions

AEMO's digital strategy has been designed with our stakeholders at the centre, with careful consideration to their business needs. By placing them as the primary stakeholders and identifying critical interactions and services, the strategy aims to build a digital ecosystem that enables faster and more efficient interactions.

Provide a frictionless, secure and scalable digital experience for stakeholders

The core of the digital strategy is the delivery of a new platform and services that will provide a frictionless, secure and scalable digital experience for members, market participants, employees and consumers. It has been designed for today, whilst preparing for future needs. Figure 4 highlights AEMO's integrated digital and technology strategy.

Figure 4. AEMO's digital and technology strategy: service characteristics and outcomes



The platform will offer an improved scope and quality of services, greater reliability and assurance, and lower unit costs for AEMO and the industry.

Deliver a single-source-of-truth for data integrity

It will offer stakeholders a single-source-of-truth for data, replacing current fragmented information sources with one that is more comprehensive and far easier to access via web and mobile devices delivering a modern, intuitive and personalised end-user experience. It will enable the use of artificial intelligence and machine learning tools over this enhanced data set, a potential 'game changer' for timely, accurate and insightful forecasting using both historical data and predictive scenarios of the changing energy system, energy markets and environment. It will also provide an environment for piloting new services and testing emerging technologies to determine their value to the industry.

Better data and artificial intelligence tools will also enable greater visibility of the state of our market systems, assuring the availability and performance of our platforms and lowering the cost of system management with greater automation and stress testing.

Enable new services with rapid, low cost integration to others via APIs

AEMO's IT and operating costs will be substantially reduced as a result of a streamlined system and approach, and our partner organisations will be able to integrate their systems with AEMO rapidly, at lower cost. Recognising the significant costs for participants in implementing AEMC rule changes, AEMO's digital platform will use standard APIs to allow significant cost reductions for participants interfacing into AEMO. Collectively these features will improve service and significantly reduce the need for duplication of investment among stakeholders.

Ensure security-by-design underpins thorough cyber security defences

Underpinning our entire system is an uplift of AEMO's cyber security to improve the ability of AEMO and the industry to identify, protect, detect, respond to, and recover from cyber threats.

This starts with security-by-design so that AEMO's systems and processes are designed and operated with security in mind. This is reinforced by assurance testing and exercises, where AEMO is a recognised leader, and by security practices. We will enhance security awareness, training and a cyber safety culture within AEMO, and engage with the wider energy sector to be prepared, for and resilient to, foreseeable cyber threats.

AEMO is working with market participants, the Australian Cyber Security Centre, and the Critical Infrastructure Centre to lead the development and implementation of a framework to improve the grid's cyber security resilience.

Outcomes

The key outcomes of the Digital and data pillar for 2020–23 are:

- Cyber security capability enhanced.
- Greatly rationalised business applications portfolio.
- New DER platforms.
- A frictionless, secure and scalable digital ecosystem enabled for members, participants, employees and consumers.
- Reduction in participant costs to interface with energy markets, reductions in IT unit costs and improved speed of market access for existing and new participants.

6. People, culture and capabilities

Objectives

AEMO is a knowledge-based organisation which has always cultivated the best and brightest people who are highly regarded in the industry for their technical excellence, and who also have championed diversity and an approach that embraces the whole person, not just their technical skills.

The objective of our People, culture and capabilities pillar is to:

Build on our key assets – our organisational knowledge and our people – by broadening our technical skills and evolving our culture to favour innovation and collaboration, enabling our people to deliver on our strategic pillars, and keeping AEMO a sought-after environment where our diverse, talented people can thrive.

Environment and opportunities

Continual change and disruption at an unprecedented pace

In an environment where continual change and disruption are becoming the norm, our partners and stakeholders expect us to work in innovative ways, deploying strong strategic capabilities on complex problem solving requiring whole-of-system level thinking to create value for consumers. AEMO's people and our teams have the potential to work differently and smarter to meet these growing expectations for innovation and partnership.

Rapidly changing workforce and competitive employment market

As our rapidly changing workforce undergoes generational change, we have the opportunity for greater access to a range of new specialist skills, for example, machine learning, which are highly sought after in competitive employment markets.

Emergence of new technical capability

We can also build individual skills such as creativity, curiosity, resilience, and relationship building into organisational capabilities of collaboration and partnering, creating collaborative teams with a can-do attitude to problem solving that harness the collective capability of AEMO.

Increased demand for organisational agility

The experience of highly adaptive organisations emphasises the importance of four key characteristics: organisational agility, designing for the future while building for today, focusing on value creation, and embracing change.

Priority actions

We are deliberately evolving our people and our culture towards a future AEMO where we:

- Grow our people and invest in strategic capabilities.
- Develop exceptional enterprise leaders.
- Change our thinking, be agents of change.
- Realise the power of small high-performing teams.
- Make it easier to get things done.
- Strengthen impactful relationships.
- Remain value-driven and outcome-focused.

Uplift organisational capabilities and establish the people and organisational foundations

AEMO's future success will draw on our two key assets:

1. The organisation's deep technical capabilities – in engineering, mathematics, economics and technology.
2. Our outstanding people – intelligent, well qualified, experienced, passionate and energetic.

Under our People, culture and capabilities pillar, we will establish the people and organisational foundations that will make the best of these competencies. These will include training and opportunities to ensure our employees are provided with the work place environment and skill sets necessary to thrive in our culture. AEMO's culture is naturally inquisitive, enjoys technical challenges, focuses and values collaborative and individual contribution and problem solving, is prepared to take measured risk as an opportunity to learn, and embraces challenge and diverse ways of thinking as a means to arrive at better solutions for our members and consumers.

Continue to foster an inclusive workplace

Diversity and inclusion are part of AEMO's DNA, and we are raising the bar ever higher in representing and reflecting all the communities in Australia. Our vision is an inclusive workplace that is fair, equitable, respectful, safe and rewarding. We have a strong set of values and want to see diversity at the heart of what we do.

- Inclusion of all – Respecting and appreciating all facets of an individual e.g. culture, religion, geography, sexual orientation, disability, gender, caring responsibilities and other characteristics that make each person unique.
- Gender, culture background, flexibility – AEMO's Diversity and Inclusion strategy 2019–2022 has a specific focus on the areas of gender, cultural background and flexibility, which our people tell us are most important.
- Measure and adapt – We believe in data at AEMO. By measuring how our people feel and what we do, we will have an evidence-based approach to celebrate what we do well and know where to take improvement actions.

Create future energy leaders – the Zema Energy Studies Scholarship

AEMO recognises the importance of supporting Australian universities in the development of graduates with the passion and purpose of leading the future evolution of our energy system. With the support of the COAG Energy Council and in partnership with Monash University, AEMO is establishing a world-class scholarship to support outstanding PhD students in energy studies. Named in honour of Matt Zema, our founding CEO who epitomised the spirit of energy sector reform leadership, it will encourage an innovative, multi-disciplinary perspective and provide practical experience placements within AEMO and industry.

Outcomes

The key outcomes of the People, culture and capabilities pillar for 2020–23 are:

- Strategic capabilities: Strategic capabilities uplifted with new leadership and talent programs, to provide a workforce with the diverse skills mix required to drive improved outcomes for consumers.
- Organisational effectiveness: New systems, processes and organisational models implemented to optimise productivity and performance, and greatly improve the experience of working at AEMO.
- New ways of working: Small high-performing teams established with new working practices that drive collaboration and creativity, and transform AEMO's operating and execution culture to focus on flexibility and nimbleness.
- Culture and leadership: Advancement in culture and leadership across AEMO to enable proactive response to energy sector changes.
- Change and communications: Change and communication programs designed and delivered to reset organisational culture and enhance employee experience, making AEMO a great place to work and a magnet for talent.

Summary of current and expected performance and outcomes

To provide a better understanding of AEMO's Corporate Plan and how we will measure our progress, we have outlined:

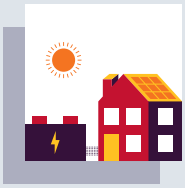
- The outcomes we will deliver for each of the six strategic pillars over the next 12 months.
- The corporate Key Performance Indicators (KPIs) that will ensure the continuation of our core functions.
- Our program of publications that will provide transparent and robust information on the energy systems.

The Corporate Plan expected outcomes

AEMO has determined a series of expected outcomes for each strategic pillar that will be delivered over the next 12 months, as outlined in Table 2.

Table 2. AEMO's expected outcomes for the next 12 months

Strategic pillars	1. Reliable and secure system operations	2. Future system design	3. Adaptive markets and regulations
Expected 12-month outcomes	• Secure progress of NEM rule changes for primary frequency control and voltage management • Implement reliability and emergency reserve trader (RERT) rule changes • Increase frequency and transparency of NEM MLF calculations and identify and pursue improvements with the AEMC • Review and consult on NEM transmission access and pricing options consistent with identified NEM MLF improvements • Develop coordinated program of work with the BOM and ARENA on improved accuracy of hourly weather and energy demand forecasts • Gain financing for the 'digital twin' simulator of the energy system • Develop demonstration program for real-time inertia monitoring • Engage in trials for the integration of virtual power plants into real-time market operations	• Ensure Group 1 projects are delivered according to the plan endorsed by the ESB's ISP Implementation Group • Publish actionable 2020 ISP • Progress coordinated WA WoSP • Complete first phase of Renewable Integration Study (RIS) and commence second phase to allow renewables to meet their full technical potential • Initiate studies of synthetic inertia and other novel solutions to address system strength issues and other technical constraints • Implement member supported account management program for new NEM connections	• Identify and submit rule changes necessary to support valuation of reliability and flexibility in the NEM, including, short-term forward market, scheduling and/or operating reserves, RRO Book Build • Identify and submit NEM rule change on the integration of storage into the wholesale and DER markets • Pursue WA WEM and constrained access reform • Support Pilbara reform, including establishment of Independent System Operators • Support 2025 market and regulatory design reform • WA WEM reform considering ancillary services, move to constrained grid, co-optimised dispatch of energy/ancillary services, registration/integration of storage



4. Consumer engagement and access

- Obtain NEM rule change for two-day customer switching
- Collaborate with NEM consumer groups, government agencies and distribution utilities on timely, standard and easily understood advisory on potential system outages
- Gain stakeholder agreement on key data services for and products to achieve DER integration at scale
- Implement CDR portal to facilitate consumer access to information in alignment with the ACCC's final decision
- In partnership with CSIRO, identify the consumer data sets from the NEAR program that can be used to improve consumer access to energy efficiency capabilities and programs
- Develop coordinated WA and NEM blueprints for seamless and efficient integration of DER into the wholesale markets and progress the development of the distributed market

5. Digital and data

- Commence implementation of 5MS program
- Achieve implementation milestones of digital platform and cyber security
- Commence delivery of new IT operating model including IT organisational restructure
- Contribute to the use of AI and machine-based learning for forecasting, the national simulator and control room operations

6. People, culture and capabilities

- Implement revised training, leadership, ways of working and recognition programs
- Develop programs to ensure diversity and inclusion across AEMO's individual and management structures and equal-pay initiatives
- Develop secondment programs with key partners and industry participants
- In coordination with Monash University, implement ZEMA scholarship program for the development of skills that support modern energy systems

AEMO's corporate annual KPIs

AEMO commits to annual corporate KPIs to ensure that the organisation continues to deliver its core functions (listed in Table 3). Importantly, AEMO considers that the intent of the outcomes by strategic pillar, along with the annual KPIs, provide the 'right' balance and focus for its day-to-day responsibilities, while ensuring that AEMO is accountable for its commitments in enabling Australia's future energy system.

Table 3. AEMO's annual corporate Key Performance Indicators

Corporate KPI	Target	Stretch target
No preventable load shedding occurs	0	N/A
Meet operational energy system security and reliability requirements	100%	N/A
No loss of system and/or market suspension due to preventable cyber incident impacting AEMO systems	0	0
Achieve all material legal and reporting obligations	90%	100%
Achieve annual budget	Actuals within +/-5%	Actuals within +/-3%
Achieve all material prudential supervision obligations	90%	100%
Execute the Corporate Plan	75%	90%
People, safety and engagement including:		
• Achieve WHSE scorecard	100%	100%
• Employee engagement	≥70%	≥80%

AEMO's program of publications

AEMO produces a range of reports each year to meet its statutory obligations. These provide substantive information to the energy industry and non-energy stakeholders. AEMO uses information and data from participants and stakeholders as well as undertaking a range of public consultations, to confirm data and make clear our assumptions and approaches applied in producing these essential public reports.

AEMO's forward-looking publications provide participants, stakeholders, and the public with greater understanding and transparency. AEMO also prepares reports associated with studies on specific subject areas and reviews of incidents and events.

Table 4 provides an overview of AEMO's current annual major publications program, and AEMO will work with members and stakeholders over the coming 12 months to identify additional performance information focused on how energy systems evolve, particularly where that information could be published on an ongoing basis on AEMO's public website.

In addition, AEMO will work with our members and stakeholders to identify the data, information and publications that will assist them in their businesses.

Table 4. AEMO's annual program of publications

Publication	Indicative timing
Gas Statement of Opportunities for east Australia Prepared annually forecasting annual gas consumption, maximum gas demand and the adequacy of eastern and south-eastern Australian gas markets to supply forecast demand for the next 20 years.	March
Victorian Gas Planning Report Prepared annually to forecast supply and demand, and pipeline capacity adequacy assessment for the Victorian Declared Transmission System for the next five years.	March
WA WEM Electricity Statement of Opportunities Prepared annually and provides forecasts and analysis of peak demand and energy use in the South West Integrated System for the next 10 years.	June
Victorian Annual Planning Report Prepared annually to provide information relating to electricity supply, demand, network capability and development for Victoria's electricity transmission declared shared network.	June
Integrated System Plan Prepared biennially to forecast a wide spectrum of interconnected infrastructure and energy development scenarios and plans including transmission, generation, gas pipelines, and distributed energy resources.	Biennial: Draft by December with Final by June
AEMO's Corporate Plan Prepared every three years, and updated annually, to present AEMO's strategy and forward plans to manage energy systems and markets.	July
NEM Electricity Statement of Opportunities Prepared annually to provide forecasts and analysis of technical and market data for the National Electricity Market for the next 10 years.	August
AEMO's Annual Report Prepared annually to present AEMO's organisational, operating and financial results for the most recent financial year.	November
Energy Adequacy Assessment Projection Prepared annually to quantify the impact of potential energy constraints on expected levels of unserved energy in the NEM for the next two years.	November
South Australian Electricity Report Prepared annually for the South Australian Minister for Energy and Mining about South Australia's electricity supply and demand.	November
Summer Readiness Report Prepared annually to provide information on AEMO's preparations for the forthcoming summer period and designed to minimise the risk of customer supply disruption in the NEM.	December
WA Gas Statement of Opportunities Prepared annually to provide forecasts of gas demand and supply for the West Australian gas industry, including overview of gas infrastructure and emerging issues, for the next 10 years.	December
AEMO's Quarterly Energy Dynamics Prepared quarterly to provide a summary of electricity and gas market dynamics, trends and outcomes for the previous quarter compared to historic quarters for Western Australian energy markets and NEM, and east coast gas markets.	Quarterly
Medium-term PASA Prepared weekly to provide information on peak load forecasts, total available generation capacity, demand-side management capacity, any identified capacity shortfall of ancillary services, transmission outages, any security problems, fuel supply and logistics, and any facility testing for each week for the next two years.	Weekly

Annual budget, fees, and levels of cost recovery

AEMO recovers the costs of delivering its legislative responsibilities, and on-request support and advice services through fees and charges.

Each year, AEMO prepares an annual budget outlining our fees and charges for each energy market we operate, and the user-pays recovery of other services consistent with our legislative authority and for Western Australia primarily as per the fees and charges approved by the ERA. AEMO undertakes regular consultations with participants and stakeholders on proposed fees as part of its annual budget process.

Operating costs

Excluding depreciation, operating costs are budgeted to increase in 2019–20 by $28 million compared to the 2018–19 budget. This increase comprises:

- An additional $18 million for compliance requirements and prudent initiatives.
  - Compliance requirements include integrated system planning uplift, increased cyber security requirements, the management of distributed energy resources, increased reporting and regulatory requirements and a more complex operating environment.
  - Prudent initiatives include investment in our systems through the digitalisation program, and the uplift of our organisational capability.
- An additional $10 million due to growth and committed costs, less targeted efficiency gains.
  - Includes recoverable costs increasing due to growth and cost pass-through, impacts including CPI and labour escalations, and additional costs as a result of increasing market and regulatory complexities.
  - Increases have been partially offset by targeted efficiencies in the 2019–20 budget totalling $7 million.

Capital program

The capital expenditure budget for 2019–20 is $181 million. The digital replacement program is the largest investment over the budget period. AEMO's current technology infrastructure was developed in an era where energy markets were stable and the use of data was predictable and limited.

Taking into account the exponentially faster rates of digital change and the technology required to enable significant initiatives including the 5MS program and WA market reform, AEMO conducted an assessment of its technology requirements and concluded that the prudent option is to replace the current ageing infrastructure. This investment will deliver a new platform and services that will reduce operating costs for AEMO and the industry and will provide services that support the transition to a new energy environment. AEMO's 10-year projections show lower overall Totex (combination of operating and capital costs) if the digital investment is made now, while not investing will incur a significant cost burden over time as AEMO's ageing infrastructure becomes costlier to maintain.

Fees and charges development

AEMO has a number of separate functions aligned with fees and charges associated with these services, of which operating the grids and markets in the NEM is the largest fee category by revenue collected (47% of total revenue). Each function has its own fees, which are set in accordance with published fee structures.

Fees are set on a cost recovery basis, and new initiatives and any under-recovery is funded via a debt facility. As projected in last year's budget process, the need for additional investment will result in the NEM fee increasing by 12% in 2019–20, with similar increases projected for the next three years. The fee is then expected to increase in line with inflation. The Declared Wholesale Gas Market (DWGM) fee is increasing by 3% as a result of lower consumption, and the majority of other gas fees are reducing or have minor increases.

There is a step increase in the National Transmission Planner fee to provide for the continued enhancement of the Integrated System Plan. AEMO is minimising the impact on participant fees by, firstly:

- Managing cost base to reduce current year costs by 6% compared to budget.
- Establishing strategic partnerships with CSIRO and the BOM to utilise expertise without needing to develop it or bring it in-house.
- Seeking funding from other sources including government and ARENA.

In addition to these immediate steps AEMO will also:

- Propose a long-term pricing approach in the NEM, where costs are recovered over a 10-year period rather than the current five-year period.
- Review the fees associated with each new development/service to ensure those costs are allocated to the beneficiaries (user-pays). For example, AEMO is proposing a consultation to seek views on whether 5MS should become a declared NEM project. If so, a further consultation would be conducted on how fees would be allocated.
- Commence an assessment of the fee allocation for our current services, taking into account the transformation of the industry. This will involve significant engagement with stakeholders throughout this process in the lead-up to the next fee determination.

Financial summary

Table 5 provides a financial summary of the budgeted profit and loss, and capital expenditure for 2019–20.

Table 5. AEMO's financial summary for FY2019–20

Profit and loss	**Budget 2019–20** ($m)
Revenue	217
Operating expenditure	258
Annual deficit	(41)
Capital expenditure	
Capital expenditure	181

For further information on AEMO's 2019–20 budget and fees, please go to ***https://www.aemo.com.au/About-AEMO/Energy-market-budget-and-fees***

Table 6. AEMO's fee summary for FY2019-20

Function	2019-20	2018-19	Change	Key drivers of fee changes
Electricity				
NEM ($/MWh)	0.50	0.44	↑ 12%	In line with projections provided last year to stakeholders.
FRC ($ per connection point per week)	0.02550	0.02476*	↑ 3%	From 2019-20 these costs will be recovered on a per customer supply point basis rather than a per MWh basis.
National Transmission Planner ($/MWh)	0.03040	0.02339	↑ 30%	Significant uplift of the integrated system plan.
VIC TNSP - TUOS fees ($'000)	594,555	462, 312	↑ 19%	Lower brought forward surplus, higher easement tax and inter-regional TUOS costs.
WA WEM fee ($/MWh)	0.861	0.833	↑ 3%	In line with additional activity in the WA WEM, including the ongoing System Management transition work.
Gas				
DWGM - Energy tariff ($/GJ withdrawn)	0.08713	0.08459	↑ 3%	Mainly driven by lower estimated consumption in 2019-20.
STTM - Activity fee ($/GJ withdrawn)	0.04258	0.05192	↓ -18%	Lower fee to return prior year surplus.
VIC FRC ($ per customer supply point per month)	0.06548	0.06893	↓ -5%	Lower fee to return prior year surplus.
QLD FRC ($ per customer supply point per month)	0.24482	0.22256	↑ 10%	Low dollar increase on a low base.
SA FRC ($ per customer supply point per month)	0.20839	0.21484	↓ -3%	Lower fee to return prior year surplus.
NSW and ACT FRC ($ per customer supply point per month)	0.15097	0.16410	↓ -8%	Reducing depreciation charges.
WA FRC ($ per customer supply point per month)	0.12811	0.13485	↓ -5%	Lower fee to return prior year surplus.

Function	2019-20	2018-19	Change	Key drivers of fee changes
Gas (continued)				
Gas Statement of Opportunities ($ per customer supply point per month)	0.03989	0.03799	↑ 5%	Continued uplift of the National Gas Forecasting Report.
Gas Supply Hub - Daily ($/GJ)	0.030	0.030	↔ 0%	
Gas Supply Hub - Weekly ($/GJ)	0.020	0.020	↔ 0%	
Gas Supply Hub - Monthly ($/GJ)	0.010	0.010	↔ 0%	
Capacity Trading Platform - Daily ($/GJ) **	0.044	0.043	↑ 3%	Capacity Trading Platform and Day-ahead Auction markets went live 1 March 2019. Fees set for 2018–19 to encourage activities in these markets. The 2019–20 fees set to increase to recover prior year deficit.
Capacity Trading Platform - Weekly ($/GJ) **	0.034	0.033	↑ 3%	
Capacity Trading Platform - Monthly ($/GJ) **	0.024	0.023	↑ 3%	
Day-ahead Auction (DAA) ($/GJ) **	0.034	0.033	↑ 3%	Refer to comment on CTP above.
Gas Bulletin Board - Producer ($/GJ)	0.00054	0.00050	↑ 7%	CPI increase plus recovery of prior year deficit.
Gas Bulletin Board - W/S gas market ($/GJ)	0.00268	0.00250	↑ 7%	CPI increase plus recovery of prior year deficit.
WA Gas Services Information ($'000)	1,708	1,520	↑ 12%	Minor increase in resources.
Other				
SA Planning ($'000)	1,000	1,000	↔ 0%	
Settlement Residue Auctions ($'000)	718	295	↑ 143%	Implementation of SRA Secondary Trading market coupled with required technology upgrade.

**Conversion of 2018–19 fee from $0.077 per MWh to $0.02476 per connection point per week.*
***The fee for Capacity Trading Platform and Day-ahead Auction includes a fee of $0.003 relating to Operational Transportation Service Code Panel.*

Risk statement

AEMO has a strong risk management culture at all levels within the organisation. The priority risks and mitigation actions identified below have been incorporated into the planning for each of AEMO's strategic pillars.

Our approach to risk management is aligned to the international standard for risk management: *AS ISO 31000: 2018 Risk management - Principles and Guidelines*. The risk management policy and framework clearly define our risk management objectives, structures, systems, tools and accountabilities for effective risk management.

Accountability for risk management and its implementation across AEMO sits with the Board. The AEMO Board has delegated this function to the Risk and Audit Committee, a sub-committee of the Board.

The Managing Director/CEO has clear accountability for the implementation of the risk policy and frameworks and is accountable to the Board for fostering a positive, transparent risk aware culture supported by the Executive Leadership Team (ELT) in integrating risk management into key operational decision making.

The Risk and Compliance team under the leadership of the Chief Governance Officer helps to maintain the risk management framework and support the business with appropriate guidance and tools (for example, risk matrix, risk tolerance statements) to identify, manage and report on our key risks.

Our risk management program is supported by a detailed program of internal audit, market and financial audits that provide assurance to management, the Board and our committees on the effectiveness of the internal control environment implemented to manage our key risks, both strategic and operational, including compliance risks.

Operational risks

Key risks	How we are managing our risks
Unable to maintain power and gas system security and reliability due to disruption in the energy ecosystem. The rapid change and disruption in the energy system is introducing increased levels of complexity within our power grids and challenging the maintenance of power and gas system security and supply reliability objectives.	We are focused on developing granular approaches to frequency, voltage management, system strength and re-start capabilities (for example, system strength and inertia guidelines, new generator technical requirements), pilot programs to test and integrate DER within our operational control. We continue to evolve our summer and winter readiness programs to better forecast and source the required supply (for example, long notice RERT).
A deliberate and directed cyber-attack compromises the confidentiality, integrity and/or availability of AEMO's IT and market systems. AEMO and market participants' systems are at risk of being compromised due to ineffectively managing the sustained threat from motivated individuals and groups, criminals, and nation states seeking to steal from, disrupt or destabilise organisations.	The Cyber Security Uplift program aims to deliver increasing IT and cyber security maturity and sustainable capability through partnering with vendors, TNSPs and government. AEMO is leading the development of greater capability across industry, and is tasked with developing the cyber security framework for the energy sector. We maintain continued engagement with key Commonwealth advisors and others (for example, NBN Cyber Security team).

Strategic risks

Key risks	How we are managing our risks
Ineffectively articulating and achieving necessary changes to manage industry transformation resulting in reputational damage. AEMO may not be able to effectively articulate and lead the transformation of the energy sector to drive the necessary changes, causing stakeholders to doubt our strategy and capability. This can have an adverse impact on our credibility and reputation of leading a successful transformation within the energy industry.	We continue to work with government, industry working groups and market bodies to influence change within the industry (for example, acceptance of the Integrated System Plan and the work in progress to implement this plan is a significant step towards transition). We are working with the ESB (and other regulatory bodies) to enhance future ISPs and working with WA stakeholders to develop the inaugural WoSP for the WA WEM. Also, we are trialling and piloting innovative ideas to help improve the security and reliability of energy supply in line with changing generation mix to validate the need for change and inform required rule changes.
Our legacy technology systems will compromise our ability to drive the transformation of the energy industry and execute our strategy. The changing nature of the energy system (for example, increasing volume of data, generation mix, decentralised energy trading, new entrants etc.) and our strategic pathways are going to significantly increase our technology requirements. This is a significant risk considering the predominant use of legacy systems within AEMO that will require significant investment in technology.	We are building new technology platforms, systems, solutions and capabilities with the right structures, governance and controls. This will significantly uplift our service delivery to members, participants, consumers and employees, facilitating innovation and value creation across the industry.
Inability to capitalise on existing and future data to enable better informed decision-making. While AEMO holds extensive data, it will require further data going forward to perform its functions in a changing environment. There is an opportunity to better manage our data to enable operational and strategic decision-making through the acquisition, storage, usage and dissemination of data down to the consumer level and leveraging big data analytics.	Our digital platform incorporates an explicit data stream which will provide both more comprehensive, reliable and accessible data for stakeholders, and advanced tools to facilitate its analysis. We are embedding an updated data governance model within our new technology build to better serve the information needs of our members, participants, consumers and AEMO.
Inability to adapt our workforce and culture to meet future needs and drive transformation. AEMO is embarking on a significant transformation program and strategy execution to deliver an affordable, secure and reliable energy system. This requires the right culture with an adaptive mindset, prepared with the required skills and capabilities to successfully transform and be future ready.	A transformation program has commenced to develop/acquire, maintain and improve strategic capabilities in digital, engineering excellence, stakeholder engagement and business acumen. We are introducing new ways of working to embed a collaborative, productive, agile and customer-centric culture.
Members lose confidence in AEMO's competency to deliver its function as a system and market operator. Stakeholders devalue and lose confidence in AEMO's competency to deliver reliable, secure and efficient long-term outcomes to energy consumers because of inefficient market outcomes and the limited transparency.	We continue to engage closely with government(s), industry working groups, the ESB and market bodies regarding key topics requiring alignment, and proactively obtain agreement from stakeholders on rule changes, through consultations, discussions and workshops. We are continually improving our influencing skills through our workforce and cultural adaption program.

We look forward to hearing your feedback

Please provide feedback to corporateplanfeedback@aemo.com.au.

For more information

For more information about AEMO and our Corporate Plan 2020–23, please visit the 'About AEMO' section of our website, www.aemo.com.au.

Australian Energy Market Operator Limited
www.aemo.com.au

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