

Our 20-year plan for the National Electricity Market

An overview of AEMO's 2020 Integrated System Plan (ISP)



Dear stakeholder,

The first Integrated System Plan (ISP) was prepared by AEMO and endorsed by the COAG Energy Council in 2018. It has since guided governments, industry and consumers on investments needed in the National Electricity Market (NEM) for an affordable, secure and reliable energy future, while meeting prescribed emissions trajectories, and triggered the processes for actionable ISP projects.

With the ISP to be updated every two years, AEMO is pleased to present the 2020 ISP, which responds to economic, policy, system and technology developments.

The ISP identifies investment choices and recommends essential actions to optimise consumer benefits, as Australia experiences what is acknowledged to be the world's fastest energy transition. That is, it aims to minimise costs and the risk of events that can adversely impact future power costs and consumer prices, while also maintaining the reliability and security of the power system.

Provided that transmission investments are timely and kept at an efficient level, the combined supply and network investments proposed in the ISP are expected to deliver \$11 billion in net benefits to the NEM. As regulated network investments typically have long lead times, the ISP provides clear signposts for decision making as the future unfolds.

In parallel with the ISP, the Energy Security Board (ESB) and market bodies are exploring essential reforms to attract investment and optimise bidding of supply and demand-based energy resources. Without reforms that can enable these market-based investments, the ISP benefits will not be realised in full.

The ISP serves its essential national purpose because it draws on constructive and critical input from all parties. AEMO consulted widely over the past 18 months in preparing this ISP, leading to important improvements from both the 2018 ISP and the Draft 2020 ISP, and we appreciate the considered input of all who participated.

We will continue to work hand-in-hand with the industry, government and consumers in making the energy system affordable, secure, reliable and sustainable.

Regards,



Audrey Zibelman
Chief Executive Officer
and Managing Director



ISP explained

The 2020 ISP is an actionable roadmap for eastern Australia's power system to optimise consumer benefits through a transition period of great complexity and uncertainty. It does so by drawing on extensive stakeholder engagement as well as internal and external industry and power system expertise.



P.2 Whole-of-system plan

A plan to maximise net market benefits and deliver low-cost, secure and reliable energy through a complex and comprehensive range of plausible energy futures. It identifies the optimal development path for the NEM, consisting of ISP projects and development opportunities, as well as necessary regulatory and market reforms.

P.3 Consultation and scenario modelling

AEMO developed the ISP using cost-benefit analysis, least-regret scenario modelling and detailed engineering analysis, covering five scenarios, four discrete market event sensitivities and two additional sensitivities with materially different inputs. The scenarios, sensitivities and assumptions have been developed in close consultation with a broad range of energy stakeholders.

P.4 Least-regret energy system

This analysis identified the least system cost investments needed for Australia's future energy system. These are distributed energy resources (DER), variable renewable energy (VRE), supporting dispatchable resources and power system services. Significant market and regulatory reforms will be needed to bring the right resources into the system in a timely fashion.

P.6 Projects to augment the transmission grid

The analysis identified targeted augmentations of the NEM transmission grid, and considered sets of investments that together with the non-grid developments could be considered candidate development paths for the ISP.

P.8 Optimal development path

A path needed for Australia's energy system, with decision signposts to deliver the affordability, security, reliability and emissions outcome for consumers throughout the energy transition.

P.10 Benefits

When implemented, these investments will create a modern and efficient energy system that is expected to deliver \$11 billion in net market benefits, and meets the system's reliability and security needs through its transition, while also satisfying existing competition, affordability and emission policies.

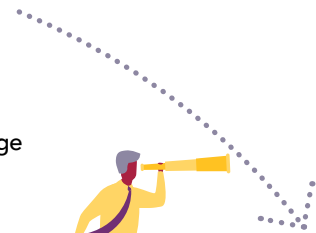
Whole-of-system plan

The ISP is a whole-of-system plan for the NEM that efficiently achieves power system needs in the long-term interests of consumers of electricity.



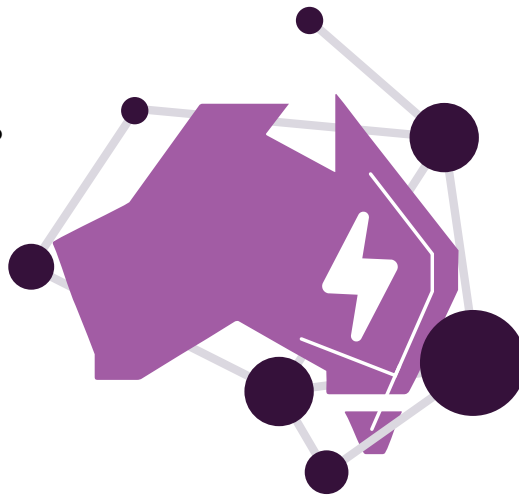
Its scope is the whole NEM power system

The ISP considers not only the capital and fuel costs of generation but also sector coupling and future energy resources, consumer-owned DER, virtual power plants (VPPs), large-scale generation, energy storage and power-system services.



Its planning horizon is over two decades, to 2040

As its planning horizon is at least 20 years, the ISP must provide a least-regret, dynamic, resilient and transparent roadmap for the NEM through Australia's energy transition, as well as increase system resilience to better deal with future challenges.



The ISP must be a transparent, dynamic roadmap

The ISP identifies the network and non-network energy resources the market needs to deliver in each possible scenario to meet consumer needs. It sets out the actionable and future ISP projects that allow the combination of energy resources to work optimally and efficiently together, along with recommended decision signposts to keep the power system resilient as economic, physical and policy environments change over time.



It recognises the risks to consumers of investments made in times of uncertainty

Change is certain in the economic, trade, security, policy and technology environments in which the NEM operates. Yet energy investments must be made, as Australian consumers rely on them for their economic and physical wellbeing. An optimal development path must therefore take into account consumer benefits, the essential nature of electricity as a service and prudent risk management.



Its guiding objective is to meet power system needs while optimising net market benefits

These system needs include enabling consumer affordability and maintaining system reliability and security while meeting government emissions and renewable energy policies. If these objectives are met at low long-term system cost, it will optimise net market benefits in the long-term interests of consumers.

Consultation and scenario modelling

For the 2020 ISP, AEMO has consulted extensively with industry, academia, government, developers and consumer representatives, culminating in our *Forecasting and Planning Scenarios, Inputs and Assumptions Report* in August 2019. AEMO updated multiple inputs and assumptions, drawing on feedback received on the Draft 2020 ISP and further analysis.



200+ stakeholders consulted



8 workshops held



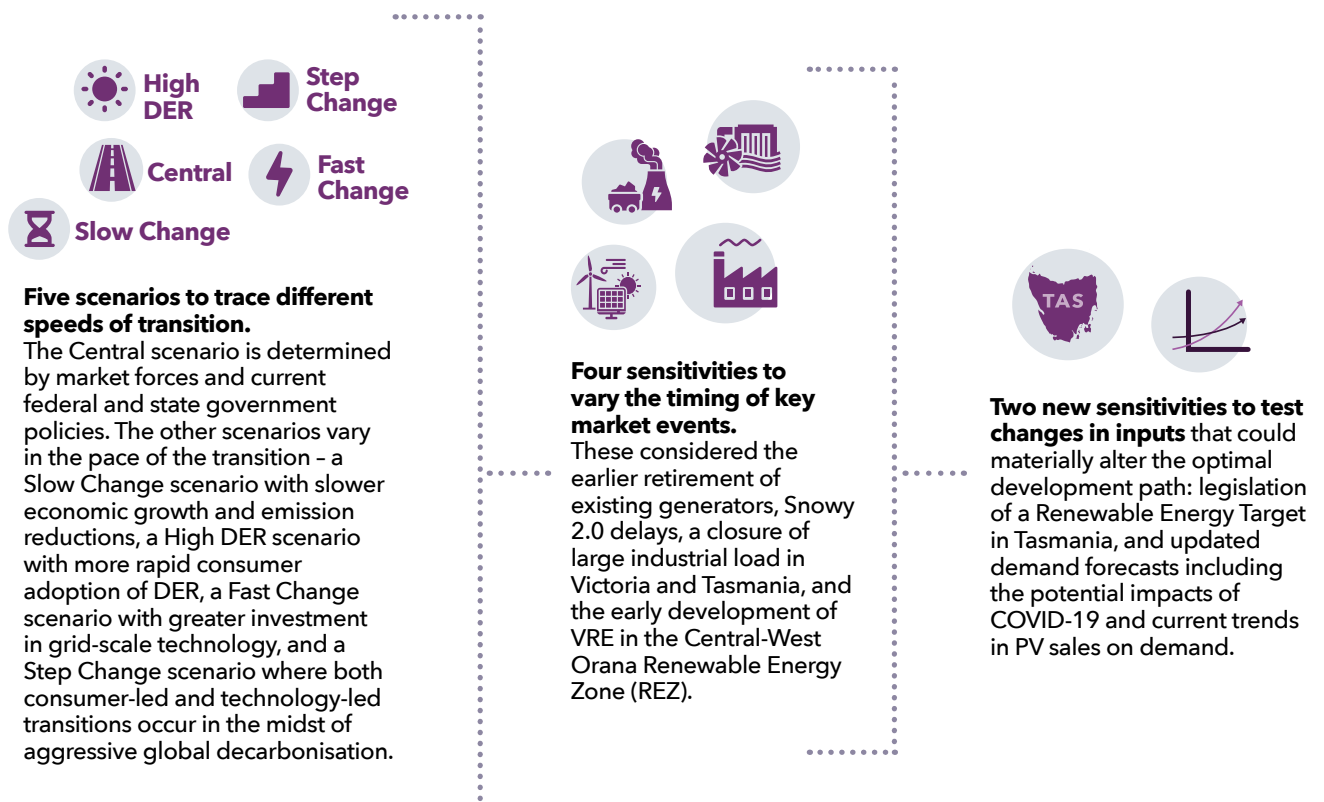
3 webinars hosted



85 written submissions provided

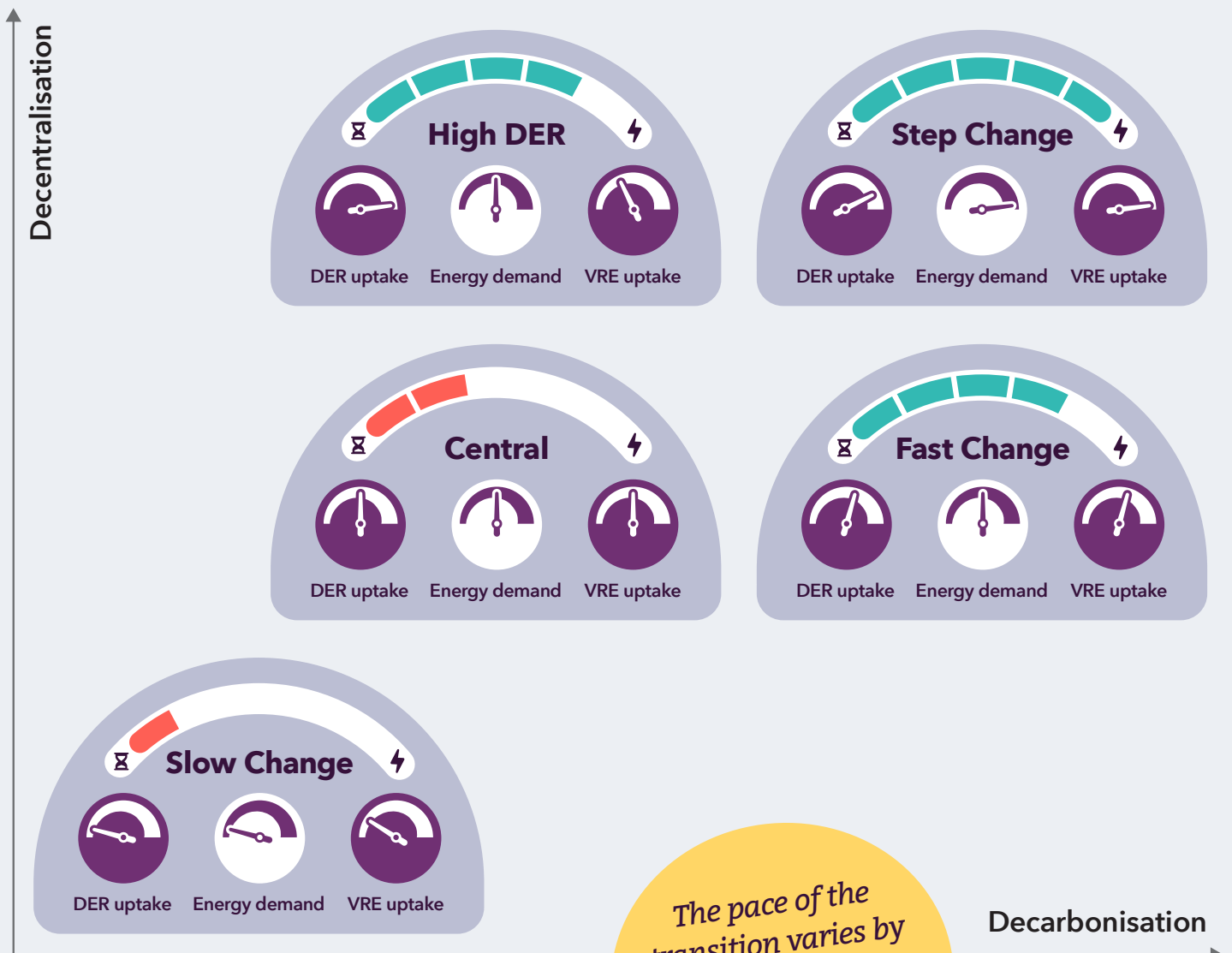
AEMO uses scenario modelling and cost-benefit analysis to determine the most efficient ways to meet power system needs through the energy transition and in the long-term interests of consumers. The approach aligns with the new ISP Rules and the intent of the Australian Energy Regulator’s proposed *Cost-Benefit Analysis Guidelines* for the ISP and regulatory investment tests.

The elements of the scenario modelling included:



Least-regret energy system

The ISP modelling confirms that the least-cost and least-regret transition of the NEM is from a system dominated by centralised coal-fired generation to a highly diverse portfolio of behind-the-meter and grid-scale renewable energy resources. These must be supported by dispatchable firming resources and enhanced grid and service capabilities, to ensure the power system remains physically secure.



The pace of the transition varies by scenario, although the trends are very consistent.



While the ISP Rules pave the way for actionable transmission projects through the RIT-T process, there is no similar regulatory mandate for other resources, such as generation and storage. Rather, the ISP offers a signal to inform the decisions of private developers. Market design is therefore crucial for both regulated and private investment to deliver the least-cost outcome for consumers.

ISP development opportunities across all scenarios to 2040



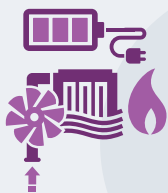
DER
+200%

Distributed energy resources expected to double or triple, providing 13 to 22 per cent of total underlying annual NEM energy consumption.



New VRE
26^{GW}

Variable renewable energy: more than 26 gigawatts (GW) of new VRE is needed to replace the 63 per cent of Australia's coal-fired generation set to retire.



New dispatchable resources
6-19^{GW}

6-19 GW of new dispatchable resources are needed to back up renewables, in the form of utility-scale pumped hydro or battery storage, demand response and distributed batteries participating as virtual power plants.



An augmented transmission grid
Strategically placed interconnectors and renewable energy zones (REZs), coupled with energy storage to add capacity and balance variable resources across the NEM.



Updated power system services

Needed to transform a system that has been dominated by traditional thermal generation with large spinning generators. Services span voltage control, system strength, frequency management, power system inertia and dispatchability.






Projects to augment the transmission grid

REZs are areas in the NEM where clusters of large-scale renewable energy can be developed to promote economies of scale in high-quality areas and capture geographic and technological diversity in renewable resources.



The optimal development path comprises projects to augment the transmission grid as well as the ISP development opportunities.

The ISP has four categories of transmission projects permitted to be developed by the transmission network service providers through the RIT-T process. They have been carefully selected from a large range of possible options to achieve power system needs through a complex energy sector transition.

Classification	Project	Indicative timing	2020
 Committed	Committed ISP projects. These are critical to address cost, security and reliability issues, and are underway and have already received their regulatory approval.	SA System Strength Remediation 2021-22	
		QNI Minor 2021-22	
		Western Victoria Transmission Network Project 2025-26	
 Actionable¹	Actionable ISP projects. These are also critical to address cost, security and reliability issues, and are either already progressing or are to commence immediately after the publication of the 2020 ISP10. These projects have not yet completed their regulatory approval process.	VNI Minor 2022-23	
		Project EnergyConnect 2024-25	
		HumeLink 2025-26	
		Central-West Orana REZ Transmission Link Mid-2020s	
		VNI West ² 2027-28	
		Marinus Link ² - Cable 1 2028-29 to 2031-32 - Cable 2 2031-32 to 2035-36	
 Preparatory Activities Required	Actionable ISP projects with decision rules. These projects are also critical to address cost, security and reliability issues. The decision rules for these projects can be assessed during the RIT-T process and will be confirmed by AEMO during an ISP feedback loop process with the TNSP once the decision rules eventuate.	QNI Medium & Large 2030s	
		Central to Southern QLD Early-2030s	
		Reinforcing Sydney, Newcastle and Wollongong Supply 2026-27 to 2032-33	
		Gladstone Grid Reinforcement 2030s	
		New England REZ Network Expansion ³ 2030s	
		North West NSW Network Expansion ⁴ 2030s	
 Future ISP Projects	Future ISP projects. These projects would reduce costs and enhance system resilience and optionality. They are not yet 'actionable' but are expected to be so in the future and are part of this ISP's optimal development path.	Far North QLD REZ 2030s	
		South East SA REZ 2030s	
		Mid North SA REZ 2030s	

1 Estimated practical completion including any subsequent testing - projects may be delivered earlier

2 Decision rules may affect timing

3 May be accelerated by government initiatives

4 Not shown on map. AEMO requires that preliminary engineering designs be completed by 30 June 2021

2040

Optimal development path

The NEM is constantly evolving and inevitably forecasts require assumptions to be made. A well-designed ISP is robust, so changes don't invalidate the optimal development path but rather signal a pre-determined change in direction. An integrated plan must also reflect the time it takes to design and construct major transmission and incorporate the ability and willingness of market participants to invest in resources that diminish the risk of uncertainty and delay.

The ISP recommends progressing actions on several fronts to mitigate the risks of insufficient or late investments. This recognises the inherent asymmetry between the significant costs of early investment in large transmission projects, and the even more significant costs and risks of not having adequate resources available when needed to deliver affordable and reliable electricity.

To avoid this risk, the optimal development path includes development of VNI West and Marinus Link as soon as possible, with decision rules that allow for adaptation if circumstances change. The changes noted are not expected to occur before the next (2022) ISP.

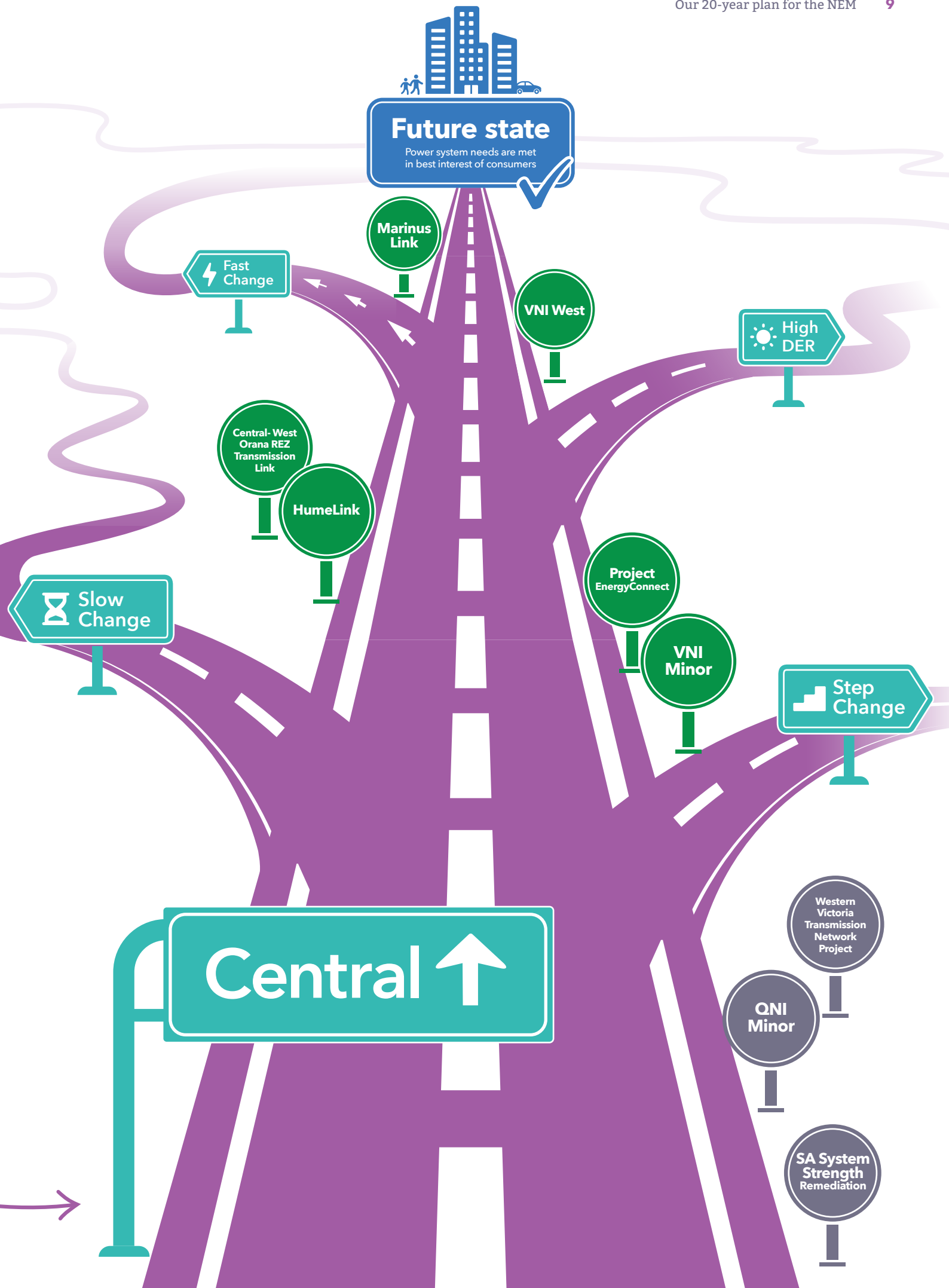
This dynamic roadmap is essential for the NEM to have both certainty and flexibility, and so meet the cost, security, reliability and emissions expectations of energy consumers through the energy transition.

Potential roadmap changes:

- **If the cost of proposed transmission investments exceed the benefits identified by the ISP**, then alternative developments should be pursued. In any case, every effort should be made to minimise the consumer-borne cost of these regulated assets.
- **If we find ourselves in the Slow Change scenario**, then AEMO will reassess the need to progress development of Marinus Link and VNI West.
- **If there is sufficient market-based dispatchable capacity in Victoria to maintain reliability in the event that brown coal-fired generation in Victoria is retired early or becomes increasingly unreliable**, then slow down delivery of VNI West. Similarly, if transmission project costs cannot be retained to an efficient level of \$2.6 billion, then the timing and scope of the investment should be reassessed.
- **If TRET is legislated, or we find ourselves in the Fast Change scenario, and there is successful resolution as to how the costs of the Marinus Link project will be recovered**, then Marinus Link's first cable should be completed by 2031-32.
- **If we find ourselves in the Step Change scenario and there is successful resolution as to how the costs of Marinus Link project will be recovered**, then accelerate completion of both Marinus Link cables as much as possible.
- **If the 2022 ISP confirms the value of Marinus Link's second cable**, then decision rules for this stage will be established at that time.



The optimal development path includes development of VNI West and Marinus Link as soon as possible.



Benefits

If fully implemented with the necessary market reforms, the ISP investments will create a modern and efficient energy system that meets the system's reliability and security needs through its transition, and meets existing competition, affordability and emission policies.



Assuming effective market design, **\$11 billion in net market benefits** would be available to consumers through reduced power bills.

By 2035 there may be periods in which nearly **90% of demand is met by renewable generation.**



With VNI West and Marinus Link, **regional Renewable Energy Targets** would be met in all scenarios that include these policies.



Australia's target of a **26% reduction** in 2005-level emissions by 2030 would be exceeded within the NEM (pro-rata share) under all scenarios.

Modelling confirms that with VNI West in place, the power system would

remain reliable

during a 1-in-10 year summer, meeting the COAG Energy Council's Interim Reliability Measure of 0.0006% expected unserved energy.



For more information

*For more information on the
2020 Integrated System Plan, please visit
www.aemo.com.au.*



