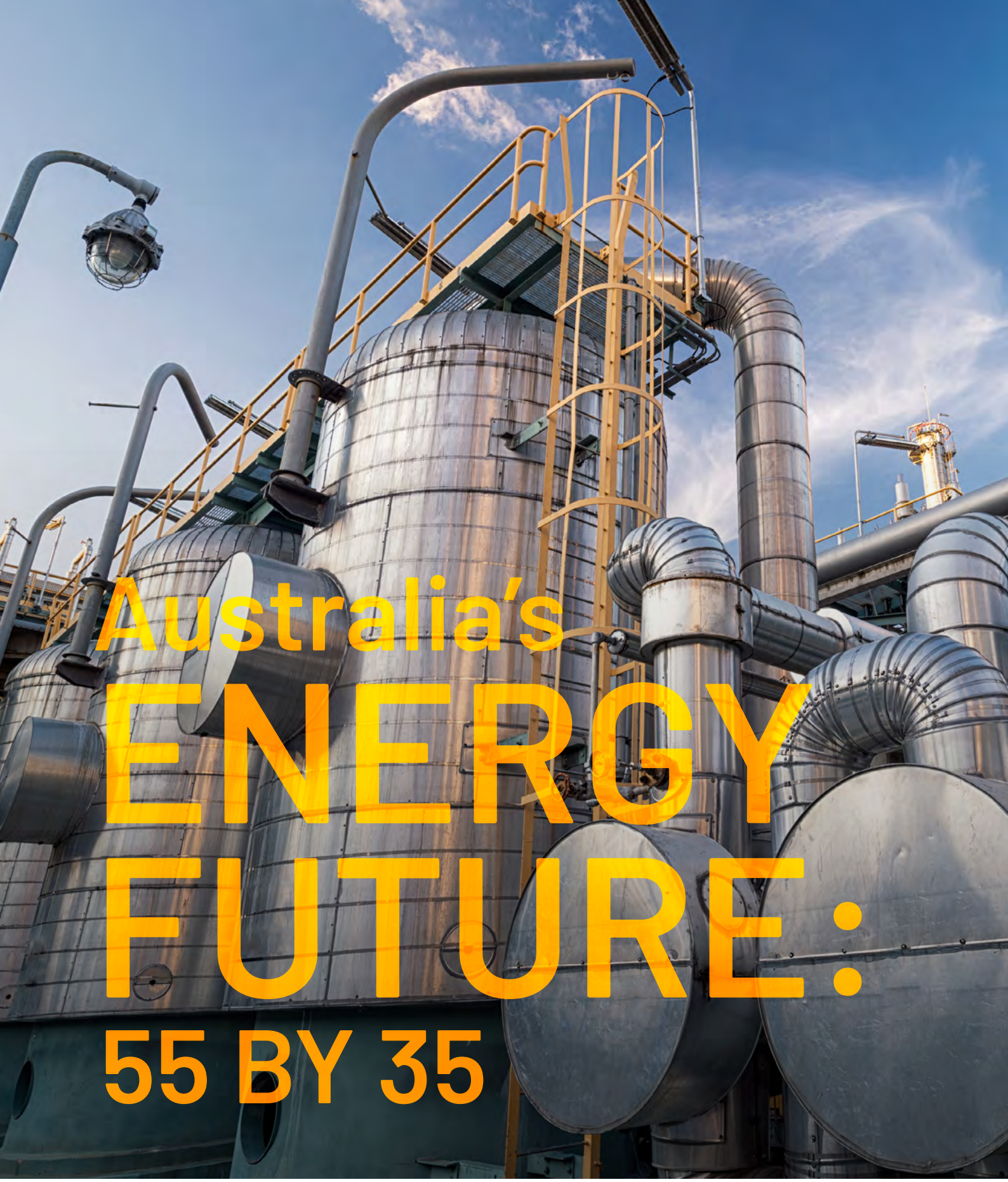

Australia's ENERGY FUTURE: 55 BY 35

Introductory Paper

AUSTRALIAN ENERGY COUNCIL

Executive Overview

The Australian Energy Council (AEC) published its Net Zero by 2050 policy in June 2020. That policy has since been adopted by Australia, and focus has turned to interim targets to set the economy on a realistic pathway to this ambition.

An interim target should be aspirational yet achievable, and consistent with the overall goal of net zero by 2050. An economy-wide target is more flexible and efficient than purely sectoral targets. With these factors in mind, the AEC has proposed an interim economy-wide target of 55% reduction from 2005 levels by 2035.

2035 is midway to 2050 and provides an opportunity for early decarbonisation to be shared beyond electricity into stationary energy and transport, sectors where large decarbonisation opportunities exist now through electrification. Even at the current electricity grid emissions intensity and assuming current electricity prices, many of these opportunities already have lower energy costs and result in lower emissions than the status quo. The progressive decarbonisation of the electricity sector will only further reduce emissions in these sectors. The prospect of indirect electrification via green hydrogen is also a potential route to decarbonisation, although this technology is less well-developed.

Electrification will increase electricity demand and the implications for the generation mix and networks require consideration. Additionally, decarbonisation is driving coal plant closures. As these plants are concentrated in a few regions of Australia, the consequences for those regions and their communities requires careful consideration.

In light of the above, the AEC is developing a series of papers examining the challenges and opportunities with decarbonisation. This is the first of these papers and the remainder of the series will cover the following topics:

- Decarbonisation of transport
- Electrification of buildings/industrial heat
- Zero emissions dispatchability
- Hydrogen - industry development and integration of hydrogen with electricity
- Regional transitions (where coal plants are closing)
- Implications for transmission investment
- Implications for distribution investment
- Final summary paper, drawing together the previous papers

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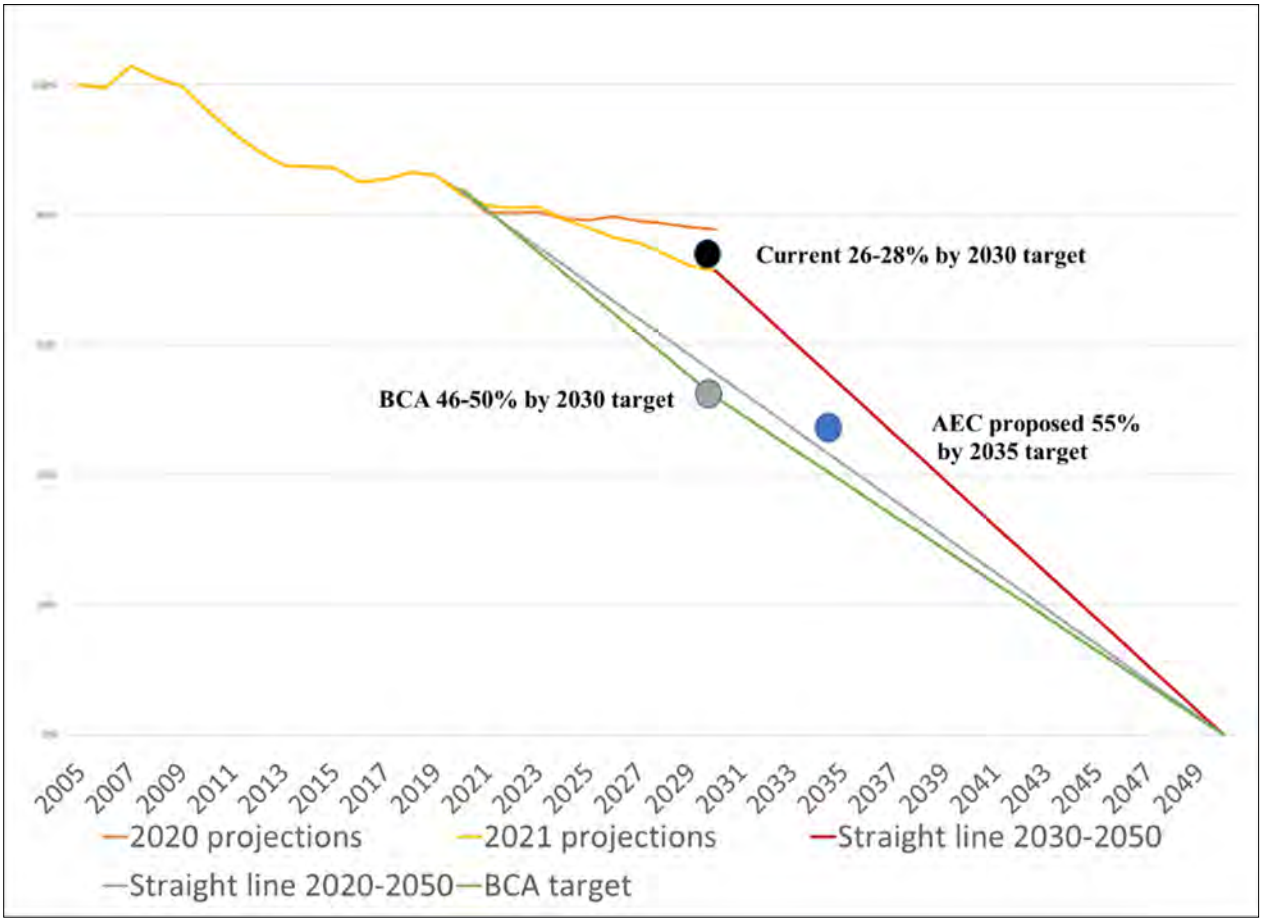
Introduction

The Australian Energy Council (AEC) published its Net Zero by 2050 policy in June 2020. That policy has since been adopted by Australia, and focus has turned to interim targets to set the economy on a realistic pathway to this ambition.

An interim target should be aspirational yet achievable, and consistent with the overall goal of net zero by 2050. An economy-wide target is more flexible and efficient than purely sectoral targets. With these factors in mind, the AEC has proposed an interim economy-wide target of 55% reduction from 2005 levels by 2035. This target is consistent with the current positions on 2030 targets of both major parties. It is similar to that proposed by other major industry groups such as the Business Council (BCA). 55% is marginally behind a straight line from 2021's emissions to Net Zero in 2050, but ahead of a straight line from the current 2030 projections.

2035 is midway to 2050 and provides an opportunity for early decarbonisation to be shared beyond electricity into stationary energy and transport, sectors where large decarbonisation opportunities exist now through electrification.

Figure 1 *Economy-wide trajectory paths*



Source: AEC analysis

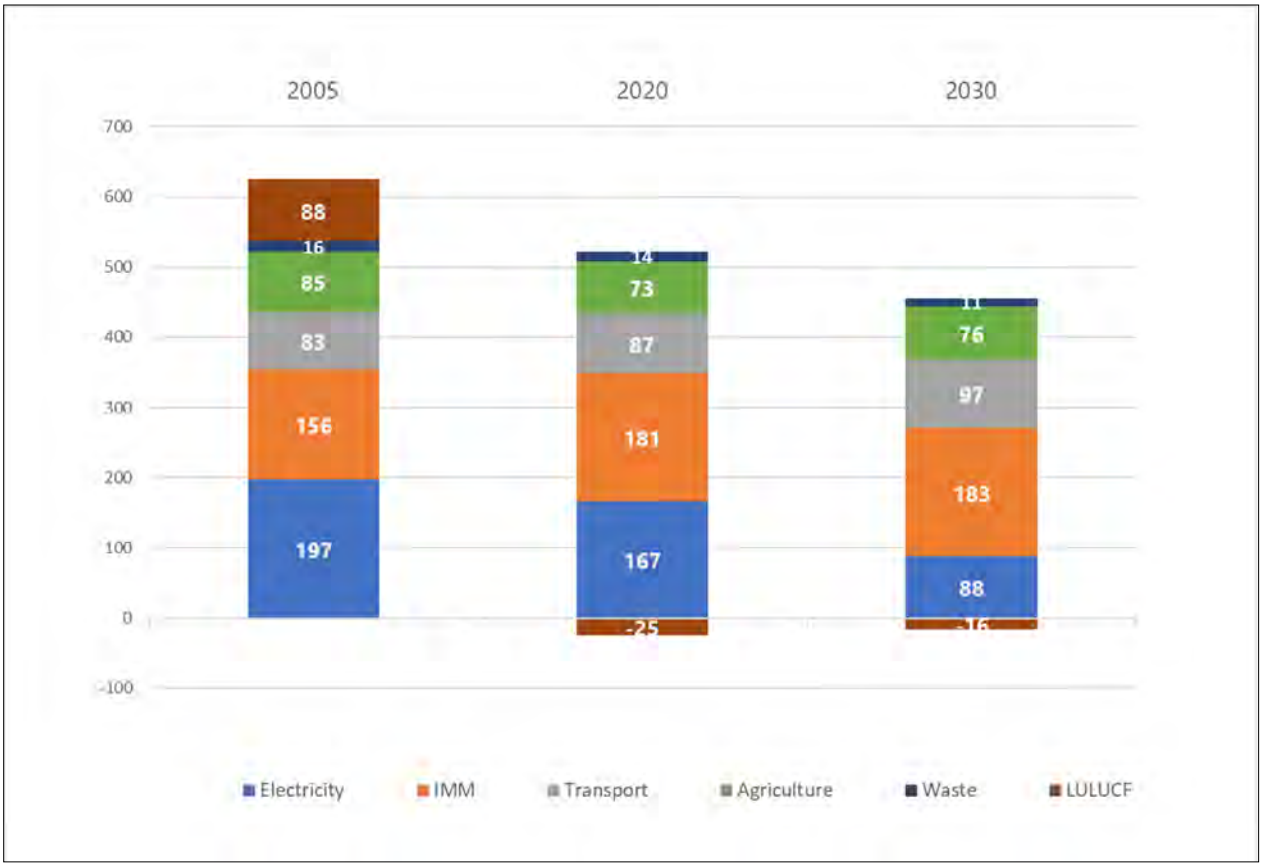
Sectoral opportunities

To date, Australia's emissions reductions have primarily come from two sectors of the economy. There has been a big shift in emissions from land use, land use change and forestry (LULUCF) so that it is now a net carbon sink. The opportunity for further emissions reduction (i.e., negative emissions) from this sector is limited. The electricity sector has also reduced its emissions over the period since 2015 due to renewables investment to replace old coal fired plant. Most other sectors have increased emissions, and Industry, mining and manufacturing (IMM)[1] has overtaken electricity as the largest sectoral source of emissions.

As Figure 2 shows, the Australian Government expects electricity to deliver the lion's share of emissions reduction over the next decade, while other sectors stay the same or even increase emissions. However, this expectation may be missing a range of other emission reduction opportunities that are at or close to cost-effectiveness. This is not to say that they are a substitute for further emissions reduction in the electricity sector. Rather, many of the opportunities are based on electrification of other energy uses, and so are complementary to electricity decarbonisation. If these opportunities are ignored now, the risk is that the task becomes harder later, when we have to make changes at a faster rate in order to meet our net zero targets.

Some sectors' activities are "hard to abate" with current technology (e.g., cement, and aviation) so action there may be for later decades. However, some activities could

Figure 2 *Change in Australian emisisons 2005-2020, 2030 projection, by sector, MtCO2e*



Sources: Australian greenhouse gas inventory, Australia's emissions projections 2021

1 The government uses different presentations of sectoral emissions. IMM includes the sectors identified as fugitives and stationary energy excluding electricity in other analyses.

be moving as fast as electricity right now, particularly light transport and stationary energy heating. For these activities, the thermodynamic advantages of electric vehicles and heat pumps alone remove most of their emissions, even before the electricity source itself is decarbonized. And electric power is already cheaper than combusting hydrocarbons for these applications. This means that the main barrier is the up-front costs of conversion to electric power. As this investment is typically cost-effective over its lifetime, it should be characterised as a financing challenge, and there are various ways to address financing challenges, with or without policy support.

Additionally, there is scope for trials of decarbonisation options in intermediate sectors such as trucks or steelmaking. In some cases, alternative fuels may be competitive with or superior to electrification. Hydrogen has the potential to be a highly versatile zero-carbon fuel, providing cost-effective solutions to the challenges of storing and transporting this volatile molecule are found. Australia, among many other countries, is making significant investments in the low carbon hydrogen sector, and addressing regulatory barriers to its production and use in several areas of the economy.

Green hydrogen is produced via electrolysis, so it's effectively indirect electrification. Either way, there is expected to be a significant ramp up in electricity demand as the economy decarbonizes. This has implications for the level and type of investment required in the electricity system, whether in generation, networks or by customers. While many parts of the system will see significant new investment, decarbonisation requires the closure of unabated coal plants (for example, those without carbon capture and storage). As these plants are concentrated in a few regions of Australia, the consequences for those regions and their communities requires careful consideration.

Papers in this series

In light of the above, the AEC is developing a series of papers examining the challenges and opportunities with decarbonisation. The list of topics is as follows:

- Decarbonisation of transport
- Electrification of buildings/industrial heat
- Zero emissions dispatchability
- Hydrogen - industry development and integration of hydrogen with electricity
- Regional transitions (where coal plants are closing)
- Implications for transmission investment
- Implications for distribution investment
- Final summary paper, drawing together the previous papers

The focus of each of the papers is set out below.

Decarbonisation of transport

A breakdown of Australia's transport sector emissions shows that light vehicles are the largest single contributor. In principle there are various options for reducing light vehicle emissions, but the one most likely to result in net zero emissions across the fleet is electrification. The report will show how electrification of transport can contribute to emissions reduction, noting that this occurs well before the electricity sector reaches zero emissions. The current emissions intensity for electric vehicles charged on Australia's electricity systems is already lower compared to internal combustion engine (ICE) drivetrains.

Larger vehicles – from trucks to planes - have some potential for electrification, but their larger size means that other options (e.g., hydrogen, biomass), may be competitive with electrification.

The impact of electrification of transport on the electricity system is dependent on uncertainties around characteristics of demand for EV charging (how fast, when, where). The report will outline potential challenges for sector and possible solutions to those challenges, noting that demand impact should be manageable with sensible policies.

It will consider potential barriers to take-up of EVs, noting that concerns around factors such as range and price do not reflect current EV offerings and that these are expected to improve further in any case.

Electrification of buildings and industrial heat

This report will explain how electrification of buildings and industrial heat processes can contribute to emissions reduction, and that this occurs well before the electricity sector reaches zero emissions.

There is existing analysis arguing that all-electric homes are already lower cost than gas homes in many cases, and that consequently remaining barriers are not purely cost-based.

It will outline the impact of electrification of buildings and industrial heat on the electricity sector. Aside from rate of uptake there is less uncertainty than in transport, i.e., the demand profiles arising from the switch to electric heat are fairly predictable. The report will examine the merit of concerns that widespread electrification of space heating would create winter peak demand pressures on the grid and, to the extent there is a real issue, how these may be mitigated.

It will consider an alternative scenario where a portion of the electrification of heat is indirect, i.e., via green hydrogen. This is especially likely where very high temperatures are required, so the report will include some analysis of temperature thresholds at which electrification is less likely to cost-effectively provide industrial heat. It will consider the technological frontier and the scope for economics of alternative industrial heat processes to improve, noting that some industrial processes may only be economic to convert later in the net zero journey.

Zero emissions dispatchability

This report will establish the need for some combination of long-duration energy storage (LDES) and net zero emissions gas generation to complement renewables and batteries. It will include an overview of available technologies, their characteristics and challenges. It will also review policy and market design options to ensure efficient deployment of the necessary levels of dispatchable capacity.

Hydrogen - industry development and integration of hydrogen with electricity

Major government support for green (and in some cases blue) hydrogen means it's plausibly a major future contributor to electricity demand. However, economic and technological constraints mean that this is more likely to be a post-2035 phenomenon.

The report will include a brief overview of progress towards a green hydrogen industry in Australia. It will outline scenarios of green hydrogen production for domestic use and export, and implications for electricity demand and volumes.

It will explore the potential role of green hydrogen in demand flexibility and how that might be limited by commercial considerations, such as the need for high utilisation of electrolyser to keep unit costs down or the need to fulfil supply contracts as well as the role of and challenges for hydrogen storage.

The report will also consider any policy implications for either the electricity sector or the hydrogen sector.

Regional transitions

It's important to recognise the significant regional impacts that the closure of coal-fired power stations and associated mines will have. This report will identify the key regions likely to be affected and provide an overview of existing and potential future sources of employment and economic development for these regions as well as transitional support policies/packages, such as retraining, small business support, and infrastructure improvements. It will consider options for brownfield developments at power station and mine sites, such as large batteries.

The report will review the historical impact of changes in employment in the sector, such as the period before and after the closure of the Hazelwood power station in Victoria's Latrobe Valley. It will also present a high-level review of international approaches to coal industry decline such as Germany and Spain.

Implications for transmission investment

AEMO's Independent System Plan (ISP) projects significant new transmission. This has implications for overall network costs, which retailers have to pass through to customers. Also, network investments are a partial substitute for generation. Meanwhile the WA Whole of System Plan (WoSP) anticipates relatively low levels of transmission investment in the SWIS.

The report will review the levels of transmission envisaged in these reports and the costs, under different scenarios.

It will examine social licence issues that may delay or increase the cost of major network investments.

It will include a review of the policy settings governing network investment decisions and whether there are ways to drive greater efficiencies, for example through greater levels of contestability. It will analyse network asset underutilisation risks and ways this could be mitigated.

It will examine alternatives to large-scale transmission investment, including through growing levels of economically efficient, congestion. The paper will contemplate the implications of this with respect to market design and private incentives.

Implications for distribution investment

The growth of distributed energy resources (DER) may require new types of distribution investment. As with transmission, this has implications for overall network costs, which retailers have to pass through to customers.

The report will contain high level estimates of distribution investment and examine alternatives/ways to minimise such investment. It will analyse network asset underutilisation risks and ways this could be mitigated.

It will briefly consider the boundary of network and competitive activities, and whether technological change could drive movement in that boundary.

Final summary paper, drawing together the previous papers

A final summary paper will bring together the key points of the preceding papers and provide some high level perspectives on overarching themes that are relevant across the papers.