CHAPTER 1: THE ENERGY FUTURE

1. The energy sector in Australia is undergoing transformation. This transformation needs to be guided by stable medium- to long-term government policies to encourage investment. Such policies should be based on evidence, not opinion or emotion.

There can be no doubt that the energy sector in Australia and elsewhere is changing dramatically. Although the major trends of this transformation are increasingly apparent, the extent and pace of change are not.[1] The trends include a decentralisation of electricity generation, the retirement of ageing coal plants, the development of new generation technologies, a focus on and preference for low-carbon energy sources, and changes in networks and the way in which the costs of these networks will be met.[2]

It remains unclear which energy options Australia will embrace.[3] The CSIRO's comprehensive Future Grid Forum Research Program, in analysis undertaken in 2013 and 2015, indicates that any of a range of possible scenarios for Australia's future electricity system remains plausible.[4] Any claim that there is certainty about future outcomes should be treated with caution.

The evidence suggests that the pace of changes to the energy sector will depend upon government policy, and will not be driven by technology and cost alone.[5] The transition pathway to low-carbon sources will be influenced by their relative costs and policy choices such as the incentives provided for new capacity to be installed.[6] The changes in transmission and distribution networks will be influenced by the extent of decentralised generation, ongoing reliance on networks to provide reliability of supply, and a desire for decentralised generators to sell surplus electricity.[7] It will also be influenced by the development of new pricing models to equitably fund networks among their users. All these matters will also be influenced by consumer behaviour in adopting new technologies for generation, storage and demand management.

Energy transformation will require substantial capital investment in both generation and networks.[8] Investment in generation has been affected by uncertainty about future policy,[9] recently demonstrated by the effect on investment from changes in 2012 to legislated subsidies in favour of renewables.[10] This is not to express a view about the desirability of those changes but to illustrate that investment is highly sensitive to policy uncertainty.

Given the complexity of the issues and cost of transformation, planning must be based on evidence.[11] That evidence should focus on a combination of cost, reliability and carbon intensity. This is discussed in greater detail in Chapter 4 Electricity generation. It is critical that long-term decision making should not rely solely on what is presently popular.

2. The opportunities for future South Australian participation in the global markets for uranium ore and other nuclear fuel cycle services are highly dependent on the policies and decisions of all nations to address climate change.

The Paris Agreement negotiated at the 2015 United Nations (UN) Climate Change Conference agrees to overall global reductions aimed at limiting any rise of the global average temperature to well below 2 degrees Celsius (°C) above pre-industrial levels. The Paris Agreement allows signatories to develop their own measures for reducing emissions and does not identify mechanisms for determining a country's share of reductions.[12]

This flexibility makes medium and long-term predictions about the actions needed to be taken to transition to low-carbon systems challenging. While the goal and general trends are known, neither the pace of change nor the transition pathway for any country can be identified with certainty.[13]

This is significant to the development of future energy generation technology, including nuclear energy and the industries that supply it.[14] The suitability of nuclear power for any country depends on the other power generation options available, as well as its political, economic and social circumstances. Many countries have already pursued nuclear power, some have committed to pursuing it, some are considering it, and others have decided against it or decided to abandon it.[15]

For this reason considerable caution must be exercised in making predictions about the future growth of nuclear power. There are firm global commitments to growth in installed nuclear capacity from current levels of about 380 gigawatts (GWe) to about 450 GWe by 2030.[16] However, firm predictions beyond 2030 are much more problematic.

Estimates by the International Energy Agency (IEA) based on emissions targets consistent with the Paris Agreement's 'well below 2 °C' target, show very substantial growth in nuclear generation.[17] That scenario is possible, as are scenarios with little or no growth. Ambitious projections of long-term nuclear industry growth have a history of not being realised. It is for that reason the Commission has not relied on such projections in its reasoning.

3. Significant additional global action will be required to achieve the 'well below 2 °C' target. The slower the abatement action taken now, the greater the action that will need to be taken later, and the greater its costs and impact on the economy.

Before the Paris conference, countries informed the UN of their stated intentions to reduce carbon emissions.[18] The intended nationally determined contributions reflected a range of commitments to reduce emissions of greenhouse gases, the most significant of which is carbon dioxide.[19]

Even if implemeted, modelling suggests that these commitments will only limit the increase in global temperature to about 2.7 °C.[20] That central estimate is within a fairly wide range of an increase up to 4 °C. Even assuming countries meet their commitments, the 'well below 2 °C' target will require significant further action.[21]

If one takes the approach of a total carbon budget reflecting the total permissible emissions into the atmosphere, it can be seen that the slower the abatement actions taken now, the faster the need for abatement in the future.[22] Modelling of emissions mitigation schemes to reduce global warming demonstrates that delaying emissions reductions from 2020 to 2032 would require more than a doubling of reduction rates to meet the same target.[23]

Moreover, analysis suggests that the speed of abatement will affect its ultimate cost.[24] Delayed abatement will, in the interim, increase risks of temperature increase, entrench a more emissions-intensive economy and defer cost reductions in low-emissions technology.[25] This will lead to higher eventual costs of abatement. Further, costs have been projected to increase at a rate disproportionate to the delay.[26]

4. It will be necessary to significantly transform Australia's energy sector to both reduce emissions and support pathways to decarbonise other economic sectors such as transport.

Australia has many options in reducing emissions from electricity generation. They include measures to improve efficiency and new technologies that manage demand.[27]

Given that electricity generation in Australia accounts for about one-third of national carbon emissions,[28] there is a need to transform the electricity generation sector to meet future carbon emission targets.

There is a widely held view, although it is not current policy in Australia, that to achieve the 'well below 2 °C' target it will be necessary to have an energy sector with zero net emissions by 2050.[29] Modelling suggests that it is unlikely that Australia could fully decarbonise its electricity sector by 2050 by relying on renewables alone. Combined cycle gas turbines will be required for system stability in the absence of other dispatchable generation. The importance of this timeframe is that such a transition is necessary to facilitate transformations in other sectors. For example, to switch fuel from carbon-intensive energy sources in industry and transport it is necessary to support a transition from carbon-based fuels to either electric- or hydrogen-fuelled vehicles, which is now incentivised in some countries.[30]

5. Nuclear power is presently, and will remain in the foreseeable future, a low-carbon energy generation technology.

Some energy generation technologies, particularly those that burn fossil fuels, generate substantial carbon emissions during their operation, while others such as solar photovoltaic (PV), concentrated solar thermal, wind and nuclear do not.[31] However, all energy generation technologies create emissions over their life cycle. These emissions are generated during plant construction (including in the extraction, manufacture and use of building materials such as steel, concrete and silicon), operation, maintenance and decommissioning.[32]

A large number of studies of life cycle emissions from electricity generation have been undertaken over several decades, with divergent results.

The National Renewable Energy Laboratory (NREL), the primary laboratory for renewable energy and energy efficiency research and development in the United States, undertook a peer-reviewed analysis and harmonisation of all earlier studies on carbon emissions from various electricity generation technologies. The significance of the harmonisation was that the assumptions and parameters of the various studies were assessed, allowing for their direct comparison.[33] The output of the analysis has been adopted by the Intergovernmental Panel on Climate Change (IPCC).

As shown in Figure 1.1, the median estimates under the NREL analysis ranked the emissions of nuclear (12 grams carbon dioxide equivalent per kilowatt hour (gCO_2-e/kWh) within the range of solar PV (18–50 gCO_2-e/kWh, depending on technology choice) and wind (12 gCO_2-e/kWh).

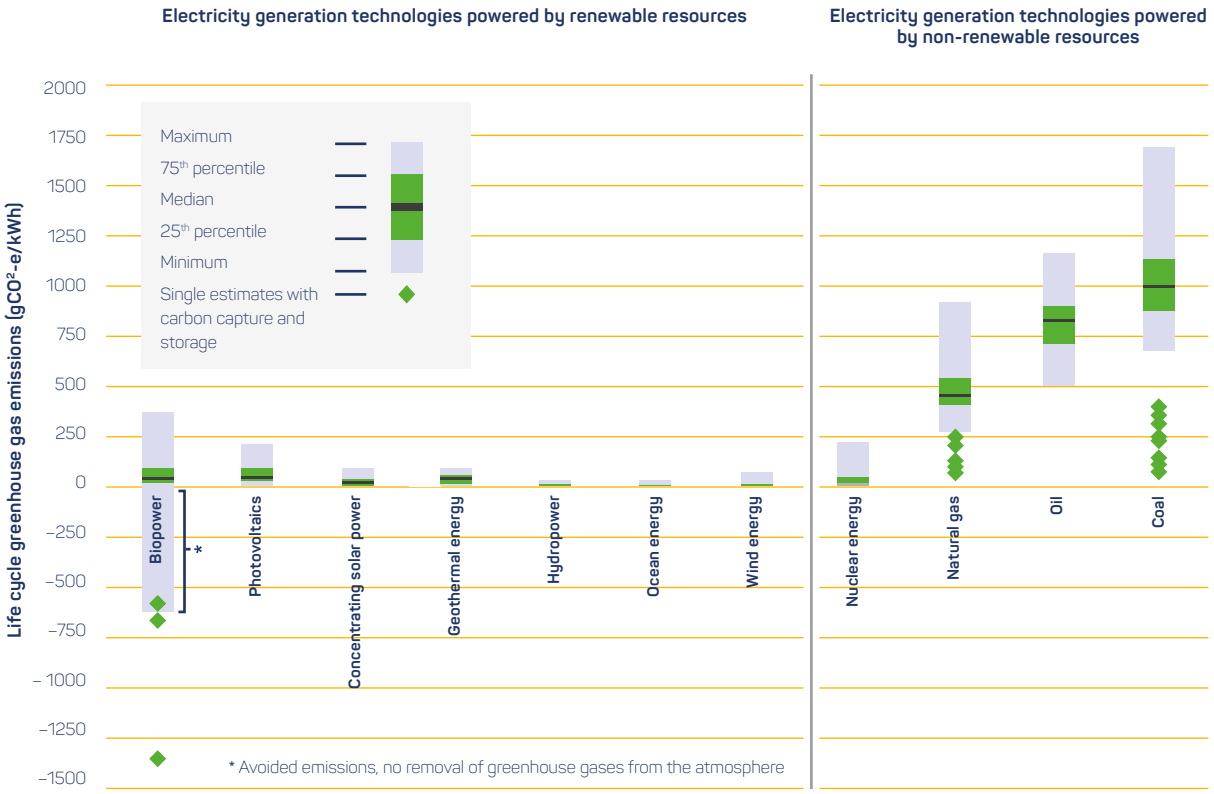

Figure 1.1: Life cycle greenhouse gas emissions for electricity generation technologies

Data sourced from National Renewable Energy Laboratory, 'Life cycle assessment harmonization results and findings', NREL.gov, last modified 21 July 2014, www.nrel.gov/analysis/sustain_lca_results.html

Note: gCO_2-e/kWh=grams carbon dioxide equivalent per kilowatt hour

That nuclear has emissions in the range of solar PV, wind, concentrated solar thermal and other renewables is supported by other significant contemporary studies.[34] In each case, those technologies are substantially less carbon-intensive than gas and significantly less again than coal. Across earlier studies the estimated emissions range for nuclear has varied considerably.[35] This variation arises from different methods for performing harmonisation over a large range of studies—some may be less complicated to perform, but result in less precision.[36] The NREL study is significant because of its comprehensive and detailed analysis.

The breakdown of carbon emissions for nuclear energy has been estimated to be approximately one-third for activities and services associated with manufacturing nuclear fuel, one-third for construction and decommissioning, and one-third for operation, storage and disposal of waste.[37] The life cycle carbon emissions for nuclear power have decreased marginally in recent years. This is due to increased energy efficiency, particularly the shift to centrifuge enrichment techniques from the more energy-intensive gaseous diffusion, and the higher proportion of low-carbon electricity used in nuclear conversion, enrichment and fuel fabrication.[38]

Nuclear will continue to be a low-carbon option for the foreseeable future. Studies have shown that even a substantial decline of ore grades to levels far lower than those currently mined in Canada or Australia (from either uranium-specific or polymetallic deposits) would have a minor effect on carbon emissions from nuclear power.[39] In any event, if uranium demand were to increase there is significant potential for the discovery of new deposits with economic grades. Were that to occur, the emissions intensity of mining uranium would not increase.[40]

6. In Australia, nuclear power cannot contribute to emissions reductions before 2030 because of the long lead time to make new capacity operational. It could contribute after that time, which may be important if more rapid action is required to be taken to reach a net zero emissions target from energy generation by 2050.

Following a lengthy period in which new reactors were not constructed in Europe and the United States, recent experience in those countries indicates that new nuclear capacity has taken substantially longer to construct than planned.[41] Construction of new reactors has at best, in countries outside Europe and the United States, been completed in about six years.[42] The fastest development of a new global nuclear program is in the United Arab Emirates; it took 10 years from the initial policy decision in 2008 to the planned start of operations in 2017. This program had the advantage of replicating nuclear plant designs already constructed and licensed in their country of origin.

When construction times are combined with the time it would take to develop a regulatory structure and implement policy,[43] the earliest likely date at which nuclear power could come into operation in Australia would be from 2030.[44] The Commission does not accept views that a nuclear power capability would take longer on the basis that a decade-long period of decision making and planning would be required.[45] Those timeframes reflect a business-as-usual approach and do not account for a targeted focus on achieving an outcome to address a recognised need.

In the event that fast and rapid action is required by Australia after 2030, nuclear power might play a useful role. This becomes particularly significant if the nation makes only modest progress in reducing emissions before 2030 and is required to commit to eliminating carbon emissions from electricity generation by 2050. In pursuing a policy of rapid decarbonisation, nuclear power might be a useful and significant contributor.

7. It would be wise to plan now for a contingency in which external pressure is applied to Australia to more rapidly decarbonise. Action taken now to settle policy for the delivery and operation of nuclear power would enable it to potentially contribute to reducing carbon emissions.

Australia's current emissions reduction targets, and any further contributions, both national and international, were the subject of discussion before the UN 2015 Climate Change Conference.

In the period leading up to the first progress review of the Paris Agreement in 2020, Australia's future commitments could again be the subject of discussion. That will occur in the context of other countries forming views about their fair share of abatement and the respective contribution of other nations to achieving the overall goal.

In that time, Australia may come under pressure to decarbonise more rapidly than it had planned. It is apparent from the Paris Agreement, with its associated national commitments, that the politics of climate change abatement remain fluid.

Australia's current commitments require it to reduce emissions to five per cent below 2000 levels by 2020, giving a target of 530 megatonnes carbon dioxide equivalent ($MtCO_2$-e).[46] Australia's emissions are projected to be 656 $MtCO_2$-e in 2019–20, requiring a further reduction of 126 $MtCO_2$-e to meet the target.[47] Firm commitments to further reductions have not yet been made.

Previous policy measures aimed at addressing carbon emissions have proven politically contentious. This has led to limited discussion and consideration of potential policy options. As scientific evidence on the impact of climate change mounts, perhaps it is time for a change in approach to facilitate a scientifically led debate. Long-term policy options need to be considered now if the nation is to avoid the disproportionate consequences of attempting to quickly reduce carbon emissions from electricity generation.

The Australian Government will formally review its current and future carbon abatement commitments in 2017.[48] This would be an ideal time for scientific rather than politically led discussions about future options.

The scope of the review has not been defined. In view of what is said elsewhere in this report, it will be important for such a review to contemplate not only Australia's current and short-term commitments, but also to prepare a strategy to meet longer-term goals, with sufficient flexibility to accommodate future developments.

8. While it is not clear whether nuclear power would be the best choice for Australia beyond 2030, it would be prudent for it not to be precluded as an option.

Australia should position itself to be able to take advantage of all the potential options in the event of a requirement for rapid emissions reduction.[49] It would be wise to facilitate a technology neutral policy for Australia's future electricity generation mix.

To make a range of technologies available, action is required now.

In the case of nuclear power, those actions include the:

- amendment of existing legislation
- setting of key policies that would send relevant signals for private sector investment
- development of an electricity market structure
- development of a new regulatory framework that addresses key principles of non-proliferation, safety and security in the use of nuclear energy.[50]

If such preparatory steps are deferred, nuclear power would continue to be precluded as an option—meaning that it would always be an option over the horizon.

Making nuclear power available as an option does not mean it would be the best choice for Australia in 2030. Other developments may well lessen the need for it. However, that should not be assumed. The present considerable optimism about the future cost of renewable generation and storage does not ensure certainty about these outcomes.[51] Nor should the development of nuclear be regarded as static. As nuclear projects are implemented in other countries, and as new systems are developed, particularly small modular reactors, the costs of nuclear may demonstrate that it should be part of a low-cost, low-carbon energy system in Australia.

NOTES

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