Energy Policy
INSTITUTE OF AUSTRALIA

Public Policy Paper
Paper 3/2021

ELECTRICITY GENERATION AND EMISSIONS REDUCTION IN AUSTRALIA: WE NEED A COHERENT POLICY TO FOSTER TECHNOLOGY DEVELOPMENT AND INVESTMENT

Stephen Anthony

Macroeconomics Advisory

August 2021

The Energy Policy Institute of Australia (EPIA) is Australia's only independent and apolitical energy policy body. EPIA focusses on high-level policy, governance and regulatory issues affecting the national interest, the economy as a whole, the environment and the community.

The Institute advocates that Australia must maintain a secure investment climate and be internationally competitive, whilst moving towards and contributing as much as it can to global efforts to build a low-carbon society.

The views expressed in this paper do not necessarily represent the official position of the Institute or any of its members.

For further information, please visit the Institute's website
http://energypolicyinstitute.com.au/

Key Points

- Science and public opinion is forcing governments around the world to commit to major reductions in emissions over the next several decades. This creates a problem for Australia: we lack a credible national policy for energy and lack a national technology-based energy plan to guide investment in electricity generation and emissions reduction.
- Current policy settings are a mixture of technological choices based on political expediency, defending existing rent seekers, opportunistic market intervention and poor to non-existent economic analysis.
- Current policy settings can be summed up as a complicated way of trying to make solar and wind work and result in fragmented oversight and planning.
- Much more attention needs to be paid to overall grid stability and the destablising impacts of asynchronous generation.
- A blind preferential approach may not deliver for Australia. Indeed it may also lead to huge fail as it embraces massive uncertainty. Either way, we need to thoroughly examining all of our options.
- Without a serious and properly analysed national policy based on technical realities as well as market needs, institutional investors will be reluctant to support the needed infrastructural investment.
- Underpinning national policy must be fundamental economic analysis of all technologies.
- A serious energy and emissions reduction policy should follow basic economic principles and use whatever technologies are best suited to solving the problem.
- It would be possible for government to substantially reduce costs by leveraging the large holdings of funds held in institutions and unlocking a stream of appropriately priced equity and debt funding.
- A single agency needs to be responsible for the broad sweep of progress towards targets and making revisions to market mechanisms and ensuring infrastructure requirements are met.

1. Emissions and the need for a credible policy

Science and public opinion is forcing governments around the world to commit to major reductions in emissions over the next several decades. These reductions are ambitious and are being promised under conditions of considerable economic and technological uncertainty. It is likely that the pressures to reform energy systems and make further cuts to emissions will increase over the short to medium term. In all this, Australia is coming to be seen as an outlier with weak policies and inadequate targets. Without action, it is also becoming likely that we will be subjected to economic sanctions.

It is noted that the Energy Security Board has delivered its three-volume advice on the redesign of the National Electricity Market. However, it has not been released to the public nor considered by governments at this time.

The purpose of this paper is to look at some of the issues around forming a national policy that would offer a credible pathway to emission reductions.

It is, of course, possible that Australia will choose not to reform our energy system in line with other major economies and stay with existing levels of political expediency and inefficiency.

The most obvious explanation for the lack of integration in national policy is that climate change has been used as a political weapon by all parties for decades. Initially climate science was denied or downplayed by major sectors of the population and political actors. This was followed by opposition to a carbon price, despite the fact that basic economic theory supports a price on externalities. Currently all major parties agree that emissions reduction is necessary but there is considerable disagreement about the rate of change needed, the technologies required and questions of cost.

In addition many of our policies are more a response to rent seeking by the solar and wind and fossil fuel lobbies than to an assessment of the national interests. Rent seeking is in the nature of politics, of course. But the opportunities to capitalise have been expanded due to the partisan nature of the energy debate and the lack of interest in finding bi-partisan compromise solutions.

In these circumstances, it is not a surprise to find that the economic analysis of emissions and energy policies has been thin. This is not the entire story as there are also issues around competence, discussed below. There are exceptions, but in too many cases, what passes for public analysis and debate does not extend beyond herd thinking. In the words of a famous physicist it is 'not even wrong.' In particular, there has been little attempt to think seriously about the trajectories that would maximise the welfare of the country as a whole. In addition standard mathematical principles of using the maximum available solution set have been abandoned for a biased technological approach.

Whatever the framework, it must be implemented at the international or at least national level. In the presence of externalities, problems of coordination and spillovers, it is economic folly to leave policy to the states or to 'the market.'

Without some level of certainty, it will be difficult to mobilise investment to the extent required to transform energy production and large sections of the economy.

In what follows we expand on these points. In section 2, we look at national policy and economic analysis. In section 3, we look at technology. Finally, in section 4, we look at mobilising institutional investment.

2. National policy and economic analysis

The task of decarbonising the Australian economy is enormous and will require a long-run sense of direction. Electricity is only part of the story. On the other hand, electricity is critical and is the main concern of this paper. It accounts for over 30 percent of our emissions. It will also be an input into reforms in many other sectors such as industry and transport.

The electricity grid in Eastern Australia runs for 5000 kilometres and is one of the longest in the world. Our population is relatively sparse and interconnections are relatively thin. This creates vulnerabilities. By contrast, Europe has an interconnected grid serving 400 million customers; the United States has four interconnected mainland grids serving 150 million customers. Texas is relatively isolated; events in February this year have shown the risks this presents.

Australia's electricity grid.
https://www.energynetworks.com.au/resources/fact-sheets/guide-to-australias-energy-networks/

The electricity system is not only critical to the economy but it is characterised by high levels of externalities that cannot be easily priced or dealt with unless there is a national policy. The need for a reliable electricity supply does not mean, of course, that government should direct every step. What national policy should be doing, however, is providing a framework for investors by setting goals and issuing guidelines about technological directions, demand profiles, investments requirement, Rate of Return targets, etc.. Issuing rational and enduring rules will attract investors, in particular, large institutional investors like Australian and overseas superannuation and pension funds. This may also require some innovative financial instruments as discussed below.

Ignoring the need for national coordination and long term directions and leaving generation decisions to sub-national governments, or to the market alone, must end badly. Decentralised decision making in these cases will almost always produce sub-optimal results.[1]

For example, when states' set individual renewable energy and emissions targets, they may be following a locally optimal pathway with a limited set of technologies. But there is little to indicate that these will somehow be integrated into a coherent whole. And there is little to indicate they will add to a collectively optimal policy.

If decisions are solely left to the market, without putting appropriate rules and infrastructure in place, considerations of short-term profits at a local level and in a limited time frame will always take the place of concerns for the system as a whole.

Certainly, it is possible to provide some coordination through the National Energy Market (NEM). On the other hand, without a clear direction and explicit procedures for dealing with large scale externalities that may not be captured in market prices or are outside the energy sector altogether, this cannot be efficient in an economic sense. In addition to the extent that renewable energy and emissions targets are set on a state basis, the NEM can only be reactive.

If we think of energy policy as an optimisation problem across a complicated system, what we should be doing is starting from the end and working back to get some idea of the best trajectory.[2]

An analysis of economic costs for the country as a whole needs to take into account trajectories of development, system-wide externalities, uncertainties, and so on.

It is not enough to rely on short-term levelised costs or energy cost estimates that ignore systems-wide implications and trajectories of development. These include grid-level costs, such as the costs of wires and poles and buffering, system level costs, including balancing and back up, land use costs, costs to industry, waste disposal costs and larger impacts on the economy as a whole (such as multipliers and capital diversion).

In more concrete terms, Australia has spent about A$50 billion on solar and wind to provide about 17-20 percent of our electricity or about 2-3 percent of our primary energy.[3] What happens if solar and wind are extended to say 20 percent of our primary energy? Is there an issue of crowding out investment from other areas? Alternatively, is growth stimulated?

---

[1] The point is that energy at the national level does not have the characteristics required for market decisions to produce an optimal outcome. In terms of economic theory, it is an n person game with n > 1, and any non-trivial equilibrium will almost never be on a Pareto frontier. For example, think of a two player prisoners' dilemma where each player has strategies of cooperate or defect. In this case the equilibrium is for both to defect even though there is a Pareto frontier with a greater payoff that is attainable. For the proof of the general case see Coram 2001, p.23 or contact the author.

[2] Some might say this sounds like central planning but nothing needs to be planned beyond indicating goals and creating a mechanism if you want a pseudo market.

[3] Total spending is probably higher but is difficult to estimate. For Bloomberg's figures see Peter Hannam, Sydney Morning Herald. 'Spending on large-scale renewable energy in Australia plunges.' Jan 16. 2020 https://www.smh.com.au/business/markets/spending-on-large-scale-renewable-energy-in-australia-plunges-20200116-p53s4g.html.

Is the extension of costs linear or non-linear? And so on.

There are high levels of uncertainty about the best technological pathways for a large scale energy transition. This means an economic analysis also needs to deal with hedging, options values along pathways, min-max values, opportunity cost and the like.

3. Technology

Australia seems to be drifting towards a policy of trying to produce electricity by relying on solar and wind while at the same time prohibiting nuclear and having no possibility of grid scale back up, unlike say Germany and California. This makes it unique amongst large industrial economies. This is certainly seems to be politically expedient. It raises a concern however that, like 'teacher's pets,' solar and wind are given favourable treatment and large scale changes are being made to accommodate them without serious analysis.[4] It has a chance of leaving us looking very foolish. The recurrent theme of 'doing it our way' might be good for a song. But it doesn't do much to inspire investor confidence.

Is this blind preferential approach a good way to bet the economy?

It is always possible that solar and wind will be facilitated by unexpected breakthroughs in batteries and hydrogen or that CCS may rapidly develop on a large scale and become a means of supplying inertia and back up. It is also possible that advanced nuclear may provide the best means to support and firm the grid.

It is even more likely that some of these possibilities will develop if Australia adopts a truly technologically neutral policy and attempts in a modest way to assist the development of potential options.

It is difficult to find any economically coherent reason for not searching for the lowest cost, long-term, technology mix that achieves the zero emission target.[5] It can only be seen as a self-inflicted wound that threatens to create serious problems in energy supply and retard the development of a high-technology workforce and export industry. In addition it is extremely risky to narrow options to the few and commit to trajectories before we have established what are the feasible technological alternatives. It also violates the basic principles of mathematical optimisation.

To deal with the consequences of increased use of variable sources, the NEM has developed pricing mechanisms intended to provide reliability. This is effectively a non-efficient pseudo market. Among the results are:

i. variable energy sources have increased as a percentage of total supply;
ii. total costs across the system have increased;
iii. there have been pressures on coal- and gas-fired power stations to close;

---

[4] Alex Coram and Stephen Anthony, Technological pathways for reducing emissions: uncertainty and options costs for the teacher's pets, Working model, Preliminary draft, Macroeconomics Advisory, 21 June 2021 https://macroeconomics.com.au/wp-content/uploads/2021/04/Technological_pathways_for_reducing_emissions_MEA_Preliminary_Draft.pdf

[5] By zero we mean as low as practicable.

iv. power system reliability has decreased; and
v. investment in other forms of generation have not been encouraged.

Despite the emphasis of the NEM on reliability, it has been necessary for the Australian Energy Market Operator to directly intervene and control generation to an increasing degree.

In its recent studies, the Energy Security Board has expressed concern about stability under existing arrangements as the percentage of solar and wind increases. It has suggested an urgent need for large scale investment in resources to increase reliability.

4. Investment

The investment needed to modernise the electricity system and provide energy for large scale penetration into transport and industry over the next 20 years could be in the order of $300 billion, although it is difficult to guess.[6] Where will the investment come from?

The disruptions to economies and government finances produced by the COVID-19 pandemic have made this question difficult to answer. Let us assume a reversion to some sort of business as usual in the investment and financial sectors

Most of the required capital could be sourced from institutional investors, both domestic and foreign. But, in the absence of a national policy framework and clear-cut mechanisms for dealing with uncertainty, it will be impossible to mobilise these. Why should investors carry the burden of uncertainty to improve collective welfare when governments are not prepared to accept any responsibility?[7] More likely, all sort of agents will seek to game arrangements instead - as we have repeatedly seen.

This problem is not confined to Australia. In 2016, the International Monetary Fund (IMF) identified the deepening global pool of surplus savings available for investment in energy infrastructure. It reported that institutional investors had far more funds available for deployment than corporate investors.[8] The IMF postulated that the "right" infrastructure investments could provide reliable, long-term returns to institutional investors.

A current source of uncertainty is interest rates and discount factors. Many of the levelised cost figures assume a rate of discount that heavily penalises high capital cost and long lived assets. At current rates most of these figures are misleading.

In financing very large scale energy investments, it is important that arrangements are

---

[6] As stated this is a guess. It would be possible to estimate figures but this would require some serious work. According to the Prime Minister, about $ 30 billion in new capacity has been funded since 2017 (https://www.pm.gov.au/media/investment-new-energy-technologies).This investment approximately provides about two to three per cent of primary energy without counting grid costs and other systems costs – or about seven per cent if you take Carnot efficiency into account.

[7] Robert Pritchard, *"Investing in Electricity Infrastructure in a Low-Carbon Era",* Public Policy Paper Number 7/2016, Energy Policy Institute of Australia, December 2016. http://energypolicyinstitute.com.au/images/7_Robert_Pritchard.pdf

[8] In 2016, institutional investors of all types held around US$100 trillion in assets under management (compared with the total market capitalisation in 2012 of US listed companies of US$18.7 trillion): Rabah Arezki et al, *"From Global Savings Glut to Financing Infrastructure: The Advent of Investment Platforms,"* IMF Working Paper WP/16/18, International Monetary Fund, February 2016. https://www.imf.org/external/pubs/ft/wp/2016/wp1618.pdf

designed in a way that addresses the problem, rather than just using an off the shelf solution. An example is the financing and building of the Oresund Bridge between Denmark and Sweden. This was accomplished by setting up a management authority jointly owned by the Danish and Swedish governments. Finance was raised on the domestic and international markets through a bond issue guaranteed by both countries. This gave the bonds a AAA credit rating and a low rate of return as safe investment. It also allowed the project to be built in a manner that maximised the welfare of the population. The underlying point is that you need sovereign guarantees for bond holders to be able to take risk exposure in the construction phase of projects.

An example of poorly thought-out methods of raising capital and inappropriate reliance on the market to properly price finance for large energy projects is the Hinkley Point C reactor in the UK. Its current build costs are about US$28 billion. Roughly half this is the cost of finance. This pain is basically self- inflicted. It is generated by the requirement that the developers carry most of the uncertainty and risk associated with the project without receiving any return for the welfare benefits. Alternatively, had government financed the project at say two per cent, the strike price for the electricity would have reduced to zero. At worst, the cost of electricity would have been about 5.6 cents kW/h or probably somewhat less than solar and wind.[9]

At the end of 2019, Australian superannuation funds held total assets of around $2.9 trillion.[10] A 2019 study by Industry Super Australia (ISA) added weight to the case for technology neutrality in energy policy.[11] The principal message from ISA's 2019 study was:

> *The lack of a genuine long-term technology-neutral energy policy is a major factor undermining fund investment. Industry superannuation funds stand ready to allocate capital towards the electricity sector but need to see governments put in place a comprehensive energy policy framework that deals with reliability, competitiveness and emissions reduction aspects. This is vital to provide the necessary certainty to investors.* [12]

There are a number of actions that might help provide certainty. Here are two.

i. Emissions could be priced and the choice of technologies left to the generators. We leave aside domestic political difficulties. It is possible that such a price might be imposed if other countries decide to place a border tax on carbon embodied in our exports. This possibility is often favoured by economists. It would be a step forward but it has some drawbacks:
   a. Even if a price were established the market response may be too slow to meet the rate of change required and individual profit maximising decisions may not lead to an integrated grid, as discussed above;

---

[9] van Dorp, J. 'The Hinkley Point C case: is nuclear energy expensive?' December 23. 2019. https://medium.com/generation-atomic/the-hinkley-point-c-case-is-nuclear-energy-expensive-f89b1aa05c27

[10] Association of Superannuation Funds of Australia, Superannuation Statistics, December 2019.

[11] ISA is a research and advocacy body for industry superannuation funds that manage the accumulating retirement savings of over five million members. These funds already hold over $40 billion in energy sector investments worldwide.

[12] Industry Super Australia, Modernising Electricity Sectors: A Guide to Long-Run Investment Decisions, Discussion Paper, June 2019, page 5. https://apo.org.au/node/244066

b. It might also be difficult to capture all energy and emissions-related externalities in a carbon price. Among these are uncertainties around technological trajectories, inappropriate discount rates and risk costings, flow on effects to the larger economy, technological capacity, waste disposal and so on.

ii. Emissions targets and generation requirements could be set by government and these could be left to the private sector to satisfy through a bidding process or the government could take more direct responsibility. It could ensure financing to raise low-cost capital in ways that would guarantee institutional investors a secure rate of return as in the example of the financing and building of the Oresund Bridge discussed above. Among the possibilities are:
    a. Financing through bond issues or other forms of innovative financial agreement. This would satisfy the requirement for institutions to hold a percentage of investments in secure assets. It would also provide the government with access to funds at a lower rates than private builds or public private partnerships.
    b. Establishing special funding bodies to provide finance for particular sorts of projects and bond issues guaranteed. Issues might be general as in some sort of Green Bond or tied to specific projects. .
    c. Taking direct responsibility beyond financing. This might mean choosing a project and sub-contracting and controlling the various stages of development. At the other extreme it might mean setting broad targets and financing on the basis of open market bids. These targets might be reducing emissions by x percent with a project that has a life span of y years under conditions a and b.

It is, of course, not necessary to restrict such funding arrangements to electricity. They could also be adapted for all lumpy infrastructure projects where technological progress is critical and uncertainty pervasive, such as in transport and industry.

It would also be possible to fund research and innovation in the same way, although it is important that this not be used as an excuse for lack of action. Technology not taxes should not mean 'do nothing and hope someone else will fix it.'

It is most likely that pure research would be undertaken in conjunction with larger research units or as a spinoff from experience. It might be possible, for example, to contribute to understanding large solar installations and grid stability. It might also be possible to help understand integrating emerging technologies such as micro reactors and intermittent energy.

Most fundamentally, any policy or plan must fix responsibility for determining and following through on outcomes with a single authority. A single agency should be charged with responsibility for broad progress towards targets and making revisions to market mechanisms and delivering on infrastructure requirements etc.

References

Arezki, R., Bolton, P., Peters, S., Samama, F., and Stiglitz, J., 'From Global Savings Glut to Financing Infrastructure: The Advent of Investment Platforms,' IMF Working Paper WP/16/18, International Monetary Fund, February 2016.

https://www.imf.org/external/pubs/ft/wp/2016/wp1618.pdf

Association of Superannuation Funds of Australia, Superannuation Statistics, December 2019. https://www.superannuation.asn.au/resources/superannuation-statistics

Coram, A. State, Anarchy and Collective Decisions. Some Applications of Game Theory to Political Economy. Palgrave Macmillan. Hampshire, 2001.

Coram. A and Anthony. S, Technological pathways for reducing emissions: uncertainty and options costs for the teacher's pets, Working model, Preliminary draft, Macroeconomics Advisory, 21 June 2021. https://macroeconomics.com.au/wp-content/uploads/2021/04/Technological_pathways_for_reducing_emissions_MEA_Preliminary_Draft.pdf

Hannam, P. 'Spending on large-scale renewable energy in Australia plunges.' Sydney Morning Herald. Jan 16. 2020. https://www.smh.com.au/business/markets/spending-on-large-scale-renewable-energy-in-australia-plunges-20200116-p53s4g.html.

Industry Super Australia, Modernising Electricity Sectors: A Guide to Long-Run Investment Decisions, Discussion Paper, June 2019. https://apo.org.au/node/244066

Morton, A. Scott Morrison's claim Australia's greenhouse gas emissions are falling does 'not stack up'. https://www.theguardian.com/environment/2021/may/24/scott-morrisons-claim-australias-greenhouse-gas-emissions-are-falling-does-not-stack-up

Prime Minister, Minister for Energy and Emissions Reduction, Media Release, 17 September 2020. https://www.pm.gov.au/media/investment-new-energy-technologies

Pritchard, B. Investing in Electricity Infrastructure in a Low-Carbon Era , Public Policy Paper Number 7/2016, Energy Policy Institute of Australia, December 2016 http://energypolicyinstitute.com.au/images/7_Robert_Pritchard.pdf

van Dorp, J. 'The Hinkley Point C case: is nuclear energy expensive?' December 23. 2019. https://medium.com/generation-atomic/the-hinkley-point-c-case-is-nuclear-energy-expensive-f89b1aa05c27

About the Author

Stephen Anthony is the Chief Economist at Macroeconomics and Adjunct Professor the Faculty of Business, Government and Law at the University of Canberra attached to the National Centre for Social and Economic Modelling (NATSEM). Stephen was invited in 2021 by the Energy Policy Institute of Australia to contribute an independent economic perspective to the decades-long debate in Australia over electricity industry reform.

Stephen's expertise and interest is finding the linkages between capital markets and macro economic trend, including business and liquidity cycles. He has a background in climate economics and discount rate issues stemming and a fascination with question related to uncertainty and longer-term fiscal pressures.

Over the past three decades Stephen has worked in the Federal Treasury and Department of Finance, the International Monetary Fund, and the private sector providing advice on macroeconomic policy, taxation reform, and budget analysis. Stephen was the lead economic analyst and advisor to the Australian Capital Territory's Taxation Review, and was Chief Economist at Industry Super Australia for almost six years.

Stephen is a member of the New South Wales Community Housing Industry Council (CHIC), the Victorian branch of China Australia Financial Markets Working Group (Victorian branch), and a foundation member of the Melbourne Economic Forum.

Stephen holds a first-class honours degree in economics from La Trobe University in Melbourne and Masters in Public Policy from Georgetown University in Washington DC and a PhD in Economics from La Trobe University.

Stephen may be contacted at stephen.anthony@macroeconomics.com.au or by phone on 0406 378 242.