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In the transformation of energy systems: what is holding Australia back?

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ABSTRACT

Australia has had a strong GDP growth rate, is endowed with a diversity of renewable energy resources yet has been unable to unshackle its dependency on fossil fuels. Our study identifies causes underlying Australia's underachievement in its transformation towards a renewable-energy economy. We apply a combined mixed-methods case-study and multi-criteria analysis to evaluate the greenhouse gas emissions and energy targets, policies and programs of four Australian Prime Ministers between 1996 and 2015. We identify four high-impact factors that contribute to Australia's underachievement. The Prime Minister's political stance on climate and energy is critical in setting the direction of government. The absence of target-driven policy frameworks results in less-effective policy outcomes. Orderly and cost-effective energy system transformation requires bipartisan, strategic long-term planning and substantial capital investment to provide policy certainty and stability that can induce new investment in renewable technologies and industries. Energy policy is primarily a political and ideological issue not one driven by underlying economic conditions. Going forward, Australia must achieve a bipartisan position on climate and energy policy at both federal and state levels. This will provide long-term certainty and stability to support investment in renewable energy and so doing achieve international emission reduction obligations.

1. Introduction

Australia is underperforming in greenhouse gas (GHG) reduction and energy systems decarbonisation among the developed nations. Despite its healthy gross domestic product (GDP) growth rate ranging 1.8% to 5% in the last two decades (World Bank, 2015) and rich endowment of diverse renewable-energy resource potential (BREE, 2014a), the contribution of fossil-fuelled electricity has remained stubbornly high at 85%, while renewable electricity (excluding hydro) stands at 7.5% (Australian Government, 2015d, p.21). The electricity sector by far is the largest source of GHG emissions in the national inventory accounting for 34% in 2014/15 and this rose an additional 3% in 2015 (Australian Government, 2015c, p.8–9). There remains an ongoing political disposition to financially subsidise the coal industry in-spite of inevitable longer-term social, economic and environmental impacts associated with climate change (Caldecott et al., 2013; Bullard, 2014). At the Paris Agreement of the Conference of the Parties (COP) 21 in 2015, Australia found its political position on energy caught between the tension of its entrenched support for the coal industry and an urge to keep pace with rapidly shifting international actions on climate change. Understanding the factors which inform, influence and drive energy policies in Australia remains deeply shrouded in complexity and have been simplified in public debates as ideological political positions.

The aim of this study is to identify the causes underlying Australia's underachievement in energy systems transformation and GHG emission reduction. Applying a combined mixed-methods case-study and multi-criteria analysis (MCA) evaluation framework to ex-post historical data, reports and studies, we investigate the political commitment, policy and enabling frameworks, monitoring and reporting systems of four Prime Ministers (PMs) in their term of government between 1996 and 2015.

Our study contributes to the crucial research field of climate change and energy systems transformation by providing insights to the underlying causalities to the underachievement of Australia's GHG emission reduction obligations and transition to a renewable energy (RE) economy. The findings from this study offer lessons for policy- and decision-makers as to the factors that may support or deter RE transition. Additionally, our MCA evaluation model can be applied to assess the effectiveness of other national governments as to their climate change mitigation action and RE transition policies.

The remainder of the paper is made up of the following sections. Section 2 provides a review of the complexity and cross-scale challenges in transforming the energy systems from the global political perspective and how these impact on the economic dimensions in Australia. Section 3 describes the development of the MCA involving

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the mixed-method approach and its ranking rule set. Section 4 presents the evaluation of the four PMs' performance under the MCA related to emission targets, climate mitigation planning, and funding and policy implementation. Section 5 discusses the findings and Section 6 concludes our study and identifies implications for the possible way forward for Australia.

2. Challenges and complexity in transforming energy systems

2.1. Global context

The 2015 United Nations Framework Convention on Climate Change (UNFCCC) COP21 in Paris represented a turning point in the geopolitical landscape to reduce global carbon emissions (UNFCCC, 2015a, 2015c). At the Paris meeting, 146 countries and the European Union, representing 86% of global GHG emissions reached an agreement to reduce emissions. 119 nations submitted their Intended Nationally Determined Contributions (INDC) that outlined their intended post-2020 climate actions under the new international agreement. The long-term goal of the Paris INDC Agreement was to limit the global average temperature rise to 2 °C as a minimum effort and then to 1.5°C by ratcheting up more global efforts to achieve net-zero emissions in the second half of this century (UNFCCC, 2015b). Despite comments that the combined achievements would be insufficient (Climate Action Tracker, 2015a), the commitments, nevertheless, represent a positive shift internationally and are in stark contrast to the lack of collective agreement, progress and political will expressed at previous UNFCCC meetings since 1995 (Helm, 2009).

Decarbonisation of the energy systems is the key to address the climate change challenge. The energy sector accounts for over two-thirds of the global GHG emissions and the power sector alone contributes more than 40% to the total energy-sector emissions (IEA, 2014b, 2015a, 2015b). Globally, fossil-fuelled electricity supplies two-thirds of the power demand which is projected to increase to over 70% in the period from 2013 to 2040 (IEA, 2015b). In spite of recent strong international commitments to transform energy systems, this projected increase highlights the complex interwoven social, economic, political and technological challenges that confront national and global energy systems. Globally, there are 1469 listed oil and gas companies which represent one of the world's largest asset classes worth nearly $5 trillion. A further 275 top coal firms are worth $233 billion as of the July 2014 stock market values. These assets are mostly owned by the world's largest investors and many governments are the major stakeholders (Bullard, 2014; IEA, 2014a). Politically, this represents an entrenched tension and arguably conflict of interest between the incumbent stakeholders to maximise a return on their capital for as long as possible thus avoiding or serving as an economic barrier to transition to a RE economy.

Economically, any investment in fossil-energy generation today will lock-in long-term future emission trajectories due to the heavy sunk-cost and long life-cycle of coal-fired power plants (IEA, 2014a). To ensure energy security, while transforming to a RE system, IEA (2014a) has projected $53 trillion in global investment capital by 2035 is required just to keep up with the energy supply and improve energy efficiency in order to get the world onto a 2 °C emissions trajectory. Additional projected investment would also be required for new renewable power plants ($11.3 trillion) and 75 million kilometres of transmission and distribution lines ($8.4 trillion) over the period 2015–2040 (IEA, 2015b).

Transforming the energy systems alone will not achieve the emission reduction target required to limit the global average temperature rise to below 2 °C (UNFCCC, 2015b). An additional $14 trillion would be needed to improve energy efficiency and productivity by 15% to 2035 (IEA, 2014a). Capping or reducing the energy end-use (demand) cannot be achieved without full understanding and acceptance by society as to the causal link between energy consumption and the anthropogenic impacts of climate change. This can be achieved through energy-efficiency regulations and standards. However, this requires a broader understanding and acceptance of the impacts of climate change and in turn long-term, multi-partisan commitments and a strategic alignment of government planning and policies (IEA, 2008, 2013).

As the energy resource endowment and socio-economic development profile of each country is unique, the mix of technology and policy choices to transition towards a RE economy will vary (IEA, 2008). The use of technologies and policies must be framed within the complex social, economic, political and environmental interactions. They must be able to support new long-term capital investment to boost RE technology development and deployment. They must also address the concurrent concern and resistance from the incumbent fossil-fuel industry. This can be achieved through an orderly phase-out of the ageing coal-fired and other fossil-fuel energy generation plants (Nelson et al., 2017). Policies also need to balance energy security and minimise social and economic disruption with appropriate transitioning speed and scale that enable the development of a low-carbon economy with consideration to the predicted pace of climate change impacts.

2.2. Energy systems and renewable energy characteristics

Investment in energy systems have traditionally been based on capital-intensive fossil-fuel power stations and many of these were state owned and regulated monopolies. This ownership, operation and regulation model minimised the capital risk for energy investors through guaranteed pricing for energy consumers (IEA, 2003). However, the flip-side has been an impenetrable barrier for new private energy players (Würtenberger et al., 2011). More recently, many governments have liberalised their power generation, transmission and distribution assets that are now corporatised or fully privatised assets. Paradoxically, these neoliberal changes have also occurred in parallel with the recognition of the need to support RE transformation through policies to promote more effective market competition, including grants and subsidies (IEA, 2003, 2008, 2014c).

While the method of electricity generation may be changing, the basic requirement of the electricity market continues to rely on a guarantee of supply from generators to meet variable demands. This requires generation to meet low base and high peak consumer demands (Clarke, 2009). Some types of fossil-fuelled power generation systems are able to ramp up or down their generation on demand with peak-loads delivered through excess network capacity (Jordan-Korte, 2011; Moser, 2011) which can be idled or underutilised for most of the time (Clarke, 2009). The intermittent ramping up and down of the peak-load capacity results in both increased GHG emissions and significantly reduced efficiency and lifespan of the coal-fired power plants (ESB National Grid, 2004; Pitt et al., 2005; Connolly et al., 2012). Unlike many fossil power-generation systems, most RE generation (except hydroelectric, geothermal, concentrated solar thermal and biomass) is intermittent. That means technologies such as solar PV and wind turbines are unable to produce electricity on-demand (Boyle, 2007). Presently, these RE systems can only serve both base and peak demands with adequate energy storage (Moser, 2011; Shaw, 2011; Budischak et al., 2013). However, many studies suggest that as RE technologies improve 100% renewable electricity supply scenarios in Australian is technically feasible (Elliston et al., 2012; AEMO, 2013; Diesendorf, 2016; Lenzen et al., 2016) and economically can be cost competitive to fossil-fuelled electricity (Elliston et al., 2013, 2014, 2016).

2.3. Enabling renewable energy policy framework

Ideally, RE transformation would be optimised if undertaken in tandem with a country's power generation investment cycle to replace