# Shifting gears to post carbon living: tracking the socio-technical transitions in renewable energy policy in Australia

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Renewable energy policy in Australia is part of the nation's approach to addressing de-carbonisation; the policy context also provides some means to meet the commitments of the Paris Agreement to maintain temperature below 2° C by 2030. The policy context in Australia has suffered from a series of conflicts, expansions and subsequent contractions that has resulted in policy stagnation in some areas and radical innovative approaches in others. This paper contributes to understanding these fluctuations and explains the transition pathways undertaken in both cases. The Australian political system incorporates a hybrid Westminster Parliamentary system with elements of the US style federalism that comprise a national level government, six State level governments and two Territory level governments. These political institutions add complicating factors in all attempts to implement effective and coherent renewable energy policy. Moreover, the policy area is framed by Australia's historical and cultural acceptance of natural resource exploitation, an emphasis on economic benefits and resource security for incumbent industry sources. This situation has resulted in a disparity between the national government's energy policy approach and respective State government approaches. This paper examines these policy contexts by reviewing government legislation, institutions and policy initiatives at the national level and in each respective State and Territory. The comparison between the various policy contexts identifies both conservative, incremental policy design features at the national level and innovative and transformative design approaches at some State based levels. The paper applies Cherp et al's framework for analysing low-carbon transitions based on the interplay of techno-economic, political and socio-technical processes (Cherp et al 2017). The paper draws on a range of Australian government energy statistics, the Renewable Energy Target initiative, departmental reviews of the Australian National Energy Market, stakeholder engagement submissions and academic books and articles. The paper makes three contributions to the study of socio-technical transitions in renewable energy: first, the paper extends the socio-technical transitions framework through linkages with Kingdon's multiple streams policy agenda setting literature, which provides a more nuanced analysis of public policy decision making, second, the paper demonstrates that transformative policy choices can function simultaneously in a multi-level system of government; and third, energy policy design must include clear links to emissions reduction and climate policies at a broad level.

Key words; socio-transitions, renewable energy, energy policy, governance, agenda setting, public policy

## Introduction

Energy is one of the world's primary policy problems. The production and generation of energy provides the basis for contemporary society across the developed and developing world. The capacity of energy to generate trade, and consequently, provide significant revenue for nation states is integral to the capitalist system. The manner in which fuel types are accessed, and protected, has caused global tensions that require international agreements and good will to ensure that most of the world's population has access to safe, secure and affordable energy. Recognizing that the dependence on oil and fossil fuels has caused ocean acidification and climate change has forced governments, science, technology and citizens to examine options that can enable a shift towards low carbon living. The capacity however, of nations to transition away from fossil fuel use raises many complex questions, and highlights the interconnected nature of the contemporary world. For, if one nation chose to maintain energy production using their domestic fossil fuel base then the surrounding nations equally share in the greenhouse gas emissions (GHG) through negative externalities.

Energy is inextricably linked to the environment. Energy consumption accounts for 60% of global greenhouse gas emissions (UN 2012). Energy is also inextricably linked to the economy not simply through the import and export of fuel types. Energy enables markets to function, mining and agriculture to continue, manufacturing to provide employment, transport and building construction – all aspects that we take for granted as part of everyday life. The International Energy Outlook (IEO) (2016) highlights that economic growth drives energy demand and that industry accounts for the largest share of delivered energy consumption. The IEO further estimates that world energy consumption will increase from 549 quadrillion Btu in 2012 to 629 quadrillion Btu in 2020 and then to 815 quadrillion Btu in 2040, a 48% increase (1.4%/year). Non-OECD Asia (including China and India) account for more than half of the increase, and further, that fossil fuels will continue to supply more than three-fourths of world energy use in 2040 (IEO 2016).

Renewable energy provides one way to address some of these concerns. The up-take of renewable energy is evident according to figures published by IEO (2016). Renewable energy is the world's fastest-growing energy source, increasing by 2.6%/year; nuclear energy grows by 2.3%/year, from 4% of the global total in 2012 to 6% in 2040. Renewable energy includes wind, solar, biomass, hydropower, tidal, geothermal and bio-sequestration (Australian Government, Department of Industry, Innovation and Science 2016). In a study undertaken by Wiseman, Edwards and Luckins (2013), many agencies and governments are exploring viable options to transition to renewable energy. These include: the European Commission, WWF, University research centres in the UK and Australia, and government agencies in Germany, United Kingdom, California, Korea, China, India, Australia and Denmark. While these strategies highlight different approaches to address issues, such as cost effectiveness (ibid: 84) economic growth (ibid .87) and the importance of transparent and powerful governance arrangements (ibid: 88), the authors note that there is little emphasis on what constitutes a socially just approach that can be translated into robust policy interventions (ibid. 87), interventions that links the national with the international. Importantly, Wiseman, Edwards and Luckins study highlights that key to the transition away from fossil fuels is to identify political, social and cultural change strategies that will assist with the transition process (ibid. 88).

The shift towards low carbon living provides significant challenges for most nations. Cherp et al (2017) argue that the ability for the state to develop transitional goals that cover energy is often constrained by institutional factors (ibid. 614). This institutional capacity, revolves around the interconnections between the political system (Ikenberry 1986), state-industry relations and interaction with the market economy (Cherp et al 2017: 614). In other words, if a nation state is endowed with large fossil fuel supplies, and has a long well established relation with the range of fossil fuel industries, attempting to change this relation is no doubt fraught with difficulties. Moreover, if the relation between the state and industry is one that includes subsides, tax incentives for investment, employment and some

form of royalty payment, any transition away from fossil fuel usage would require slow, conservative and incremental steps to ensure the social, economic and political fall-out is managed.

The work of sustainable socio-technical transitions provides one way to explore the interactions between these institutional practices. Linking the social with the technical emphasises the relationship between technology, politics, markets and society. As a framework to consider more sustainable outcomes, socio-technical strategies target the interaction between policy making, knowledge and technology, business and cultural discourse (Geels 2011: 25). One of the key attributes associated with this analytical framework, is its capacity to explore how new technologies interrupt dominant existing institutions. Moreover, by focusing on the links between socio-political world, the market economy and technology, the framework can provide possible scenarios to reconfigure the dominant system. Socio-technical transitions employ a multi-dimensional approach that identify a range of transition pathways – substitution pathways, transformation pathways, reconfigure pathways and de-alignment/re-alignment pathways (Geels et al 2016: 900), each emphasizing different aspects of the transitional process.

This paper takes the characteristics developed in the work of sustainable socio-technical transitions and applies them to the ongoing renewable energy policy context in Australia. Australia provides a good case study due to both its reliance on fossil fuels, and equally, the nation's abundance of renewable energy fuel types. Australia is a nation endowed with fossil fuel resources especially coal, but also natural gas and oil. Historically, Australia has relied on coal fired electricity, with abundant low cost coal resources, which account for at least three-quarters of the domestic electricity (Australian Government Geoscience 2017). Australia is also the world's largest exporter of coal worth over $AUS40 billion with still significant reserves untapped (ibid). Australia is also endowed with abundant renewable energy resources in terms of sun, wind and wave-tidal power. The Bureau of Resources and Energy (2012) has estimated that Australia is the sunniest country in the world (BREE 2012). This combination of

historical fossil fuel reliance and the increasing pressure to reduce GHG emissions through the development of renewable energy generation provides ample policy transitions ready for exploration.

Australia also has a complex political and policy system that incorporates a hybrid Westminster Parliamentary system with elements of the US style federalism. Australia as a national government, six State level governments and two Territory governments and a plethora of local governments. This combination of governments often results in opposing political parties holding power at Federal and State levels, and opposing political parties holding power in each of the respective states. This combination has significant implications in many policy contexts – such as education, health, environment, taxation, energy and so forth as the State governments have their own constitutions, and a separate structure of legislature, executive and judiciary (Parliament of Australia 2017), therefore each State can enact policy and legislation that can differ from the Australian Federal government. For the purpose of this paper, this has seen differing renewable energy targets across the nation; the most ambitious is for 50% in South Australia and Queensland; the Australian Capital Territory has instituted a 100% renewable generation by 2020; while other states have adopted a more conservative approach in line with the Federal government's policy framework of 20% by 2020 (CCA 2016: 19).

This paper contributes to scholarly research on socio-technical transitions and policy agenda setting frameworks with a specific focus on renewable energy in Australia. The primary research question is: *what is the scope and scale of the renewable energy policy transition in Australia?* In answering this question, the paper considers scope in terms of activity and movement; for scale, the paper targets the degree or steps in which movement may occur. Further, in responding to the question, the paper highlights areas of constraint that suggest an incremental/ conservative approach within the transition. Further, the paper also discusses 'policy windows' that provide transformative transitional strategies which suggest a 'radical' approach to renewable energy policy. By viewing these together the paper connects policy agenda setting frameworks with socio-technical transitions in a bid to build research in the area. To do so

the paper, is structured as follows: first, energy transitions and socio-technical transition literature is outlined, the section also includes key insights from the work of John Kindgon's (1995) multiple streams policy agenda setting framework. Second, the Australian renewable energy policy context is discussed with specific reference to transitional strategies. Third, Cherp et al's (2017) socio-technical transitions framework is used to examine a range of government policy initiatives and stakeholder engagement submissions. A detailed discussion of the above in provided in Section Four.

## Socio-technical transitions: systems, pathways, mechanisms and windows

Socio-technical transitions (STT) emphasize the importance of generating sustainable outcomes across a range of societal domains. One of the key features of the socio-technical transitions approach is that the framework emphasizes a multi-level perspective (MPL) (Geels 2004; 2011). As a framework for identifying innovative policy transitions, this model 'conceptualizes dynamic patterns in socio-technical transitions' (Geels 2004: 26). According to Geels (2011), transitions emerge as an effect of interactions between 'systems' that include actors, organisations, rules and institutions and 'technology'. The latter refers to the necessary elements that contribute to modern life, such as transport, IT, digital communications, artefacts and so forth (Geels 2004: 900). For the context of this paper with its focus on renewable energy policy, the socio-technical transitions approach provides a way to bring together multiple technologies in the renewable energy space with cultural and structural dynamics that provide the basis for transitional change.

The framework emphasizes the importance of socio-technical systems. As previously stated, systems include the characteristics that comprise modern society, recognizing the important role of technology. According to Geels (2004: 900), 'it makes sense to distinguish the production, distribution and use of technologies as sub-functions…ST-systems thus consist of artefacts, knowledge, capital, labour, and cultural meanin …Socio-technical systems do not function autonomously, but are the outcome of the

activities of human actors.' Taking this approach enables a way to identify the possible precursors to a transitional move, and subsequently, to examine the interaction between these conditions across a range of different sites and environments. Attempting to grasp the complexities involved in any transition requires both a backward look to identify preconditions, highlighting the effects of these precursors on contemporary knowledge, institutions and rules as well as providing possible ideas for the future.

The MLP, as a basis for understanding socio-technical transitions articulates three levels of investigation. Radical innovations or 'niches'; rules and practices that maintain stability – regimes; and the external landscape or socio-technical landscape (Geels 2011: 26-28). Accordingly, transitions therefore emerge from the interaction between the three levels, for example, niches can create pressure on existing knowledge and rules, which in turn, pressure the regime to change some aspect of its practices. Changes in the external environment can also create the possibility for innovations to occur which, in a sense, constitute the dynamics for a shift in the overall approach.

The emergence of new ideas, innovative technology and knowledge provides the possibility to reform or transform many aspects of human society. Turning these new 'configurations' into practical application that impacts how we live requires a combination of events at multiple levels. Any attempt to shift a collective position from one way of acting or understanding the world to a different position requires a transitional phase that, in a sense, unfolds over time and space. Transitions can be understood as both a form of moving away from something and a form of moving towards something else. Suffice to say that transitions involve a sense of uncertainty, possibilities and actions. An integral element in the transitional space is, according to Alfred Schutz's phenomenology of the everyday world, a sense of 'vacancy' in which what has previously been known as certain is thrown into doubt (Schutz 1967). It is the combination of doubt, 'vacancy' and possibility, which provide the basis for any form of transition.

Energy transitions follow the same logic. When considered in relation to Schutz's structure, doubt emerges in several ways. First through documented scientific evidence of the relationship between energy usage and global greenhouse gas emissions, thus pointing to the doubt around our current energy usage. Doubt is also evident in the non-sustainable use of energy through fossil fuels. Doubt further increases with innovative science and technological advances in renewable energies, which in turn raise questions regarding society's dependence of some forms of power. Doubt therefore expands in relation to the development of 'viable' possibilities. The notion of 'vacancy' is integral to the relationship between doubt and possibility, and it is an integral element in transitions to low carbon living. At one level, the transitional space is the 'vacancy', with doubt and possibilities intermingling such that there is no formal demarcation in the transition. It is due to these, at times, competing components that render transitions difficult to explore and understand. This is not to suggest that doubt, vacancy and possibilities exist as a zero sum game, whereby there is a specific number of possibilities and doubt factors that in a sense fill up the vacant space. Rather, as Schutz's (1967) work highlights, the interaction between these elements is porous, with the vacancy stretching in many directions bringing up multiple possibilities that can lead to change but may also not.

While there is little agreement as to how to define of an energy transition there are certain accepted principles. Sovacool identifies that an energy transition involves a change in an energy system, usually to a particular fuel source, a technology or device that converts energy into a service (2016:203). Transitions therefore suggest a temporal aspect, a knowledge component and an observable change in actions. Attempting to understand the nature of such transitions requires an exploration of each component and clear indicators that demonstrate the change. In the energy transition space, several scholars add to the way in which such transitions may be explained. According to Smil (citied in Sovacool 2016: 204), an 'energy transition refers to the time that elapses between the introduction of a new fuel or prime mover and its rise to 25% of national or global market share'. While others prefer to see energy transitions as a

'revolution' or disruptive event that transforms the social nature of energy use (Miller, Iles and Jones 2013).

The temporal nature of energy transitions raises many questions regarding the scope and scale of the 'vacancy' and the nature of possibilities that arise. In many instances energy transitions are long term with many examples taking decades from the 'idea' stage to 'implementation' and then on to market dominance (see Grubler 2012). Smil (in Sovacool 2016) notes that it is inconceivable to supplant the current fossil fuel based energy system with a reliable renewable system in a short time frame due to structural interconnections that would require a dismantling of a long-term dominant system. This is not to suggest that all energy transitions require many decades lead in time. Sovocool (2016: 209), highlights several marked energy shifts that occurred in reasonably quick fashion. The Swedish uptake of efficient lighting, which occurred over a nine-year period. In China, the introduction of energy efficient cook-stoves occurred over a 10 year period; further examples include the transition from oil and coal power to natural gas in the Netherlands, the shift from oil to nuclear power in France occurring over 15 years, and Denmark's transition from oil to wind energy which occurred in the 1970s and 1980s (Sovocool 2016 pp. 208-09).

This distinction between slow and more rapid transitions is relevant because it highlights the imperative of the policy context in which the rapid changes occurred. Historically, the slow changes, such as the introduction of steam engines and the widespread use of the internal combustion engine occurred over many decades (Sovacool 2016: 205). These changes emphasise cumbersome infrastructure, slow moving markets and very cautious government decision making. The more rapid and contemporary transitions however, point to the intersection between policy, technology and business – a relationship that is integral to contemporary capitalist society. These examples highlight the important role governments play in delivering successful and effective energy transitions. Importantly, this includes establishing and supporting an institutional setting that enables legitimate and stable decision making;

that governments implement effective policy tools that support new businesses through a range of subsidies and tax incentives, and that these are consistent over time; that governments mandate transparent regulations, and importantly, that governments are prepared to invest large sums to support this shift. While not to suggest that any such government intervention is straightforward, nor politically palatable for many nations in times of global austerity. Rather, it emphasises the importance of government policy in any shift that involves common pool resources for a collective policy issue.

Socio-technical systems comprise three interrelated levels that assist with explaining the emergence of innovative approaches to societal issues. Rules or 'regimes' provide the backbone to these technical systems. Rules are not simply the obvious rules that shape society, but comprise the cognitive, normative and informal routines that make up daily life. Rules therefore link actors and institutions around appropriate ways of being and acting, and importantly, these rules legitimise various forms of knowledge and expertise (Geels 2004; 2011). There is a duality to these regimes, one that is constitutive of the rules and at another level, it is through the rules that actors themselves are indeed configured (Geels 2004). Regimes are both singular and collective, with the former establishing the formal logic for a particular societal domain, for example medicine. The latter, the collective emerges through the intersection between regimes such that there is both a sense of stability and permeability. It is this combination therefore, that enables interruptions and innovations to occur.

Interruptions or cross fertilisation between regimes types provide the basis for learning and change. In the socio-technical system, 'niches' refer to the possibility to deviate from the rules of the existing regime (Geels 2004: 912). Niche ideas and actors play a primary role in stretching and reshaping the vacancy that is the transitional space. In some instances, niche ideas constitute a 'protected space' such as in research hubs, or through government subsidies in order to support and encourage the development of innovative solutions to problems (Geels 2011). In policy settings, niche ideas often require the advocacy of policy entrepreneurs to both protect and articulate the possible outcome of the innovative design. This

can occur in many policy contexts, renewable energy is only one area where this is necessary, equally, policy entrepreneurs are needed to address poverty, the treatment of Indigenous peoples, water, crime and drug addiction.

The final component of the socio-technical systems is the consideration of the external environment, referred to as socio-technical landscapes (Geels 2004). These include the political landscape, ideological perspectives, values and social mores, economic imperatives and international agreements (Geels 2011). Developments among any of these external conditions influence and in many instances impact, the nature, direction and feasibility of the socio-technical regime. For example, negative externalities may be bracketed by dominant groups within a particular regime, and path dependencies across various regimes often constrain the emergence of niche ideas and policy entrepreneurs.

The view that transitions emerge due to the dynamics between the three tiers is not to suggest there is a clear transition pathway. While early work on socio-technical transitions did not specifically consider the pathways that entrench change (Smith, Stirling and Birkhout 2005), but rather considered the single factors that prompted change (ibid). Geels and Schot (2007) articulate four transition pathways that may intermingle such that transitions may involve more than one pathway. The four transition pathways are as follows:

- Transformation path: this involves a modification in the direction of innovation activities in response to pressure from the external landscape.
- Reconfiguration path: this occurs when innovations are adopted to address more localised concerns which later influence the structure of the regime
- Technological substitution: this refers to a disruptive shock in the external environment that destabilises the existing regime

- De-alignment and re-alignment: this occurs when the external environment impacts and subsequently erodes an existing regime, this in turn can lead to multiple co-existing smaller innovations that may lead to a new regime (Geels and Shot 2007; Geels 2011; Foxon, Hammond, Pearson 2010)

While the above outline of socio-technical transitions provides a basic conceptual framework, the way in which the multi-level analysis is used as a research tool is constantly evolving (see Raven et al 2016 and Turnhein et al 2015). Cherp et al (2017) provide one such approach in their analysis that compares some of the energy transitions in Germany and Japan. This method articulates five mechanisms that help to advance the STT framework in two particular ways. First, the model provides distinct categories that clearly articulate the movement within the transition space. As a model for analysis, it provides a way to narrow the focus to more detailed instances and evidence; second, this model specifically emphasizes the role of the state in each specific context. While the conceptual framework of socio-technical transitions certainly includes the state in the external landscape, the emphasis is broad to account for a range of possibilities. For the purposes of this paper, the role of the state is primary to the development of the policy contexts across the Federal and State levels of government in Australia. The five mechanisms are as follows: 1. Balancing supply and demand, 2. the role of vested-interests and social movements; 3. material and institutional capacities, 4. political interests and coordination of STR; 5. reproduction and competition (Cherp et al 2017: 616). The paper will expand upon these mechanisms in Section Three.

The final part of this section explains the concept of 'transition windows'. Derived from the work of John Kingdon's 'multiple streams framework' (MSF) (Kingdon 1995). Transition windows provide a way to more specifically link the broad conceptual characteristics of socio-technical transitions to policy literature that addresses policy agenda setting. The main aim in bringing these two frameworks together is to situate the ideas regarding transitions more clearly in a policy context. One of the key insights from Kingdon's

MSF is that it provides a lens to explore how policy making is not always a rational problem solving exercise (Kingdon 1995). In other words, according to Kingdon (1995) there is little systematic connection between a problem and a solution, or put differently, policy decision making often attaches solutions that pre-exist a clear understanding of the nature of the problem. This not so rational process, accordingly, is part and parcel of policy agenda setting.

Before moving on to discuss the MSF it is necessary to explain that there is still current debate as to whether the MSF constitutes a policy theory, framework or heuristic device. While for some policy scholars, the MSF fits within the realms of theoretical framework (see Zahariadis 2007), for others, the conceptual approach is still developing along various lines, some of these include policy decision making, policy implementation and the policy cycle more generally (see Zohlnhöfer and Rüb 2016). There is certain agreement however that the MSF provides a robust lens to examine policy making in a range of political settings and under increasing levels of ambiguity (see for example, Howlett, McConnell and Perl 2016; Ackrill, Kay and Zahariadis 2013).

The conditions under which policy is made are becoming more complex with levels of integration between regional, national and international sphere. Most contemporary policy issues do not stop at national boundaries, nor is there one tried and tested way to address the complex and contestable nature of policy problems, nor for that matter can a solution in one situation be transferred to another jurisdiction. For example, how to address poverty reduction, increasing levels of displaced peoples, debt-crises and more and more calls for 'populist' politics; policy decision makers therefore are faced with complex, interwoven problems, increasing pressure to do something, temporal imperatives to act and in many instances shrinking monetary reserves. It is in this space that the MSF provides one way to pull apart the complexities and explore how policy solutions are indeed coupled with policy problems.

The MSF emphaises the role of policy entrepreneurs as key to the policy process. Policy entrepreneurs are 'advocates who are willing to invest their resources – time, energy, reputation, money – to promote a position in return for anticipated future gain in the form of material, purposive or solidary benefits' (Zahariadis 2007: 75). In part, the MSF emphasizes that the world of policy making is often replete with manipulation, bias and at times 'luck' (Kingdon 1995: 183). Importantly, the MSF does not assume that policy decision makers are rational, attempting to find the most effective solution to a policy problem. The framework also does not assume that the political power brokers aim to persuade their opponents on points of policy difference (Zahariadis 2007: 70). Rather, the MSF emphasizes that knowledge, information and technology are framed in ways that strategically privilege a particular meaning, context and interpretation of the issue and its preferred solution.

The MSF contains five elements, the first explained above is policy entrepreneurs. The remaining four include problems, policies, and politics, which are viewed as streams that are independent at times and at other times interconnect (Zahariahis 2007), and finally policy windows. The problem stream contains the conditions that society needs to be addressed. For Kingdon, problems are not self-evident' they need to be framed in ways that render the conditions as problematic (1995: 166). The problem stream contains both perceptions and interpretations of societal conditions that are seen as appropriate for government intervention. The policy stream, is the space for 'ideas' that compete for attention and approval in the decision making process. In this space, it is only some ideas that come to fruition dependent on feasibility and acceptability. The politics stream relies on three inter-related elements – pressure and lobby groups, administrative capacity and the national mood. Finally, policy windows provide the opportunity for the three streams to be joined at opportune moments (Kingdon 1995). These 'windows of opportunity' may be predictable, for example during budget preparations, or spontaneous due to unforeseen events, such crises or accidents (Kingdon 1995). Policy windows provide the basis for agenda setting in that the three streams need to be successfully coupled and a feasible solution with acceptance from high level policy

decision makers. These windows have a short timeframe, they are small and scarce and if missed, another change must be awaited (Kingdon 1995).

## Australian policy context: governance, policy and technology

The Australian energy sector is undergoing transformation that fits within the above outline of transitions away from a reliance on fossil fuels. The transitions can be seen in the use of new technology, the way in which consumers interact with energy systems, the changing face of energy infrastructure and the interaction between different types of energy generation. In a current energy system review in Australia, (Finkel Review 2016), the authors state that the energy system is transitioning from an alternate current (AC) energy system that utilizes a synchronous machines to generate AC energy to include numerous non-synchronous, variable renewable energy (VRE) sources which do not have the same stablising characteristics (Finkel Review 2016: 7). This Review, along with several others[1] provides an institutional 'breathing space' to gather information, to reflect upon current practices and processes and to consider possibilities to ensure the Australian energy system is secure, reliable and affordable into the future. This section outlines the current energy context, and covers shifts over the last 40 years in terms of governance and institutional practices, policy and political interventions and shifting views on technology. The section also highlights some key problem areas as identified in these government reviews.

As previously stated, Australia has a Federal system of government, with six State governments and two Territory governments. Up until the 1990s, the Australian electricity system had largely been vertical, that is a State or Territory government held a monopoly service with no integration between regions. States were responsible for their own operational capacity, and there was no competitive market for electricity, economic considerations were secondary (Australian Government 2002: 64). In the 1990s, the

[1] The Australian energy sector has been the subject of frequent and multiple reviews. The Finkel Review notes over 20 reviews have been or still are currently ongoing in the period 2014 – 2017. See Finkel Review Appendix C pp.59 – 71.

Hilmer National Competition Policy Review provided the impetus to reform the sector (Australian Government 1993). This resulted in the National Energy Market (NEM), which incorporated at that time four states and one territory the Australian Capital Territory (ACT). This changed to include a fifth state – Tasmania in 2005 (AEMC – www.AEMC.gov.au/Australian-Energy-markets-Overview ). Western Australia and the Northern Territory do not belong to the NEM. The Review led to the disaggregation of the system into supply chain elements, generation elements and retail elements which provided a competitive environment through the market.

One of the primary features of the Australian federal system of government is the Council of Australian Governments (COAG); this comprises of the Prime Minister, the Premiers of each State the Chief Ministers of the two Territories. COAG provides the forum to address intergovernmental matters (Summers and Lowe 2013). As part of on-going reviews of Australia's energy sector, COAG established the COAG Energy Council (COAG 2001) to steer the reform process across each jurisdiction (Australian Government, Vertigan Review, Issues Paper, 2015: 10). The Council has responsibility for developing policy leadership, facilitating the development of Australia's economic and competitive mineral and energy resources, building cooperation between the respective levels of government – Federal, State and Territories and promoting policies that ensure energy efficiency and productivity (COAG www.coagenergycouncil.gov.au).

Several other institutional reviews also provide relevant context to the current transitional nature of the Australian energy system. In 2002, COAG commissioned an independent review, titled "Towards a truly national and efficient energy market" (the Parer Review 2002). This review highlighted many deficiencies in the energy system, some of these still resonate in the current Finkel Review (see p.50). The Parer Review noted tensions around governance and regulatory arrangements, electricity market mechanisms and structure, electricity transmission reform, demand side participation and full market contestability and options to abate greenhouse gas emissions (ibid: 67). Moreover, the Report notes that

'energy market reform is far more complex than was initially anticipated (ibid: 69). The report highlights that there was significant uncertainty regarding the policy context, little strategic direction and insufficient regulatory stability (ibid: 70).

Still a further institutional review was undertaken in 2007 – also as a report commissioned by COAG. Energy Reform: the way forward for Australia, undertaken by the Energy Reform Implementation Group (Scales Review). This review, among other things, provided the impetus for the privatization of energy supply assets (2007:19), and recommended extended governance to include some oversight arrangements that aimed to address transparency, transmission planning and reporting procedures (Vertigan Review Issues paper: 2015: 13). The Parer Review coincided with amendments to legislation and the introduction of a range of Parliamentary Acts to ensure the changes to the energy sector across Australia had legitimacy. These include: *Trade Practices Amendment (Australian Energy Market Act (2004). The Australian Energy Market Commission Establishment Act 2004 (SA).* A further range of laws also underpin the energy sector – the National Electricity Sector 2005, the National Electricity Rules (2005), the National Gas Law and National Gas Rules (2008). Also, part of these regulatory frameworks are retail based laws – the National Energy Retail Law, and the National Energy Retail Rules (Vertigan Review, Issues Paper: 2015: 11).

It is important to mention that while these reviews are termed – National, as previously noted they do not include the state of Western Australia (WA) or the Northern Territory (NT). The latter, the Northern Territory is currently undergoing review, however the Territory will come under the National Electricity Rules in 2019. Western Australia is somewhat different, it is a geographically large State compared with the rest of Australia with a population of around 2.5 million, and 1.7 million living in the capital city, Perth. There are several smaller regional cities with around 10,000 to 40,000 population and many small towns with around 1,000 people. Western Australia also has around 100 remote indigenous settlements with several hundred people in each. These cities and towns are provided with electricity through the South

West Interconnected System (SWIS) and the North West Interconnected System (NWIS), and further 29 non-connected power systems (Anda, Brueckner, Haigh 2015). The WA electricity market is also under review, with a change of government in early 2017, the implementation of Recommendations is ongoing.

Governance is also an issue that is pertinent to policy transitions. In the Australian energy sector, governance arrangements have also undertaken shifts in step with the institutional changes noted above. The Australian energy sector has a particular governance structure that incorporates Federal and State levels of government, the policy making process and market based initiatives. Primarily, governance is provided through the roles of the COAG Energy Council, as previously explained. The other governance institutions are the Australian Energy Regulator (AER), the Australian Energy Market Commission (AEMC) and the Australian Energy Market Operator (AEMO). The former regulates the market, oversees the state and territory functions and laws. The main functions of the AER include setting network prices, monitoring wholesale electricity and gas suppliers, regulating retail energy markets in some states, providing transparent and energy market information. The AEMC covers the rules that pertain to the national electricity, gas and retail markets; it also undertakes reviews of the COAG energy council (Vertigan Review, Issues Paper, 2015: 25). The rules cover how companies function, and structure the competitive nature of the retail business. This Commission, in effect, manages requests for rule changes which can be submitted from any interested party, for example, energy suppliers or generators. Rule changes require a public consultation process with formal documentation and transparent decision making criteria (Vertigan Review, Issues Paper 2015: 25). The AEMO is a public company that facilitates the operation of markets and promoting reliable and efficient operation of energy systems and markets (Vertigan Review; Final Report 2015: 13).

In the Final Report of the Vertigan Review of Governance Arrangements of the Australian Energy Markets (2015), several issues regarding governance shortfalls were noted. The Review process covered six terms of reference with some 46 questions that covered institutional structures, division of mandate,

responsibilities and strategies to build relations between agencies. The Review received 53 submissions and raised a range of concerns in the Final Report. Notably, little evidence of transparency in decision making (ibid: 11); ambiguity and uncertainty in consumer engagement, no clear link between policy settings for climate change, reform process is very slow, and little commercial and operational certainty (ibid pp. 13-16). The COAG Energy council has responded to the recommendations, and the Council has developed an Implementation Plan that is ongoing from late 2016.

Two further bodies also comprise the governance structure in Australia's energy system. Energy Consumers Australia and the Clean Energy Regulator, the latter administers the national scheme to measure and manage greenhouse gas emissions and coordinate the Emissions Reduction Fund – this will be explained in the next section. The former, Energy Consumers Australia, provides a voice for energy consumers, residential and small business, and it provides a national advocacy platform (www.energyconsumersaustralia.com.au). For example, in their submission to the Finkel Review, the ECA supports the view that there is ongoing uncertainty regarding energy and emissions policy settings which has serious implications for their stakeholder base. (ECA 2017). The organization argues for a national, long term energy and emissions reduction framework that links demand side policy measures with supply (ibid: 15).

## Policy and politics

The realm of policy and subsequently politics is also relevant to grasping the transitional nature of the Australian energy network. The current policy context for considering energy policy and renewable energy policy more specifically come under three main initiatives: the Renewable Energy Target (RET), the Emissions Reduction fund – credit and purchasing mechanism (ERDCF), the emissions reduction fund – safeguard mechanism (ERDCM) (CCA 2016: 19). The RET aims to ensure at least 20% of electricity generation comes from renewable sources by 2020. This has created a market that supports investment

in new renewable energy generation. Within this model, there are two energy schemes – Large-scale renewable target (LRET) and Small-scale renewable scheme (SRES). There are fixed targets for the large-scale system – 33,000GWh of additional renewable electricity generation by 2020; the small system has not set targets. The ERFCP is a voluntary mechanism to purchase emissions reductions, and a regulatory safeguard aimed at ensuring emissions reductions purchased are not offset by emission growth (CCA: 20).

The Australian electricity sector is one of the key arms in contributing to global efforts to reduce emissions and limit warming to no more than 2 degrees by 2030 (Department of Environment and Energy 2016). Electricity generation contributes to around one third of Australia's emissions, in 2013-14 black coal was the largest single source of generation, contributing to 43 percent of total generation, natural gas was 22 percent, brown coal 19 percent and renewables 15 percent (CCA 2016: 15; DIEE 2015/16). Australia is committed to reducing its greenhouse emission by 26-28 percent below 2005 levels by 2030. In line with the ratification of the Paris Agreement, Australia has committed to the Intended Nationally Determined Contributions (INDC), which provides a quantifiable blueprint for action, and which all member nations have signed.

Before moving on to discuss the political nature of energy policy and renewables in Australia it is important to mention four recent triggering events in the energy space in Australia. These events highlight the complexities involved in the National Energy Market (NEM). Accordingly, the NEM is the longest geographical interconnected power system in the world – over 5000 kilometers and generates over 200 terawatt hours of electricity annually (Finkel Review 2016), and as previously stated, in incorporates the four eastern seaboard states – Queensland, New South Wales, Victoria and Tasmania, and the southern state of South Australia. The triggering events that coalesce around the energy space effected three of the five states more specifically. First, South Australia experienced volatile prices in their energy market; in Tasmania, there was a cable fault that required more than 200 megawatts of temporary diesel generation to protect Tasmania's energy supply. In September 2016, during an unprecedented weather

event, South Australia, experienced the first State blackout since the NEM began; and in March 2017, the Hazelwood power station in Victoria, the largest emission intensive coal fired power station closed due to a decision by the owners – Engie a French based company sooner than had been expected (Finkel Review 2016:9). This combination of 'triggering events' highlights the vulnerable nature and imperative of addressing the energy policy context in contemporary society.

The political dynamics that feed into this policy space have become increasingly competitive with opposing frames articulated by the major political parties in Australia. Questions of energy security, reliability, feasibility and affordability underpin the political debate around the transition to low carbon technologies and renewable energy. For example, immediately after the black-out event in South Australia, the Environment and Energy Minister, Mr Josh Frydenberg used the event to position the Liberal-Coalition Government 'as unapologetic for taking a responsible approach to energy security … energy security is non-negotiable, and that State governments that have adopted a more aggressive renewable energy target are indeed irresponsible' he stated (joshfrydenberg.com.au). Moreover, the opposition – the Australian Labor Party is 'touted as not taking energy security seriously – as demonstrating scant regard for energy security with their partly platform of 50% renewable energy by 2030' (joshfrydenberg.com.au). This narrative positions the debate around responsibility and irresponsibility, it suggests to the community there are significant fears regarding security of supply and further casts doubt on the capacity of renewable energy to produce stable power (Effendi and Courvisanos 2012, see also Finkel Review 2016 p.31).

A further political dynamic, and one that has permeated the Australian political landscape for over 10 years, is the lack of a coherent emissions policy. While Australia is a signatory to the Paris Agreement (COP21), the ongoing political debate around effective emissions policy has created the 'Typhoid Mary of Australian politics (Coorey 2017, 3 June: 47). This is due to the fact that several successive governments have tried to introduce a range of market based emissions schemes only to be removed from office, or

deposed as leader of their party (See Crowley 2013). The problem ostensibly is that supporting a tax on carbon emissions plays into the hands of the carbon lobby, and the fossil fuel industry, and the conservative arm of Australian politics, which together provide a powerful voice in the transition space. Therefore, any such shift towards pricing carbon has become fraught with difficulties and concerted media campaigns that support the status quo (Crowley 2013). A pricing mechanism was implemented by the Gillard Labor government in 2011. The Clean Energy Package provided a fixed price on carbon – $AUD23 per tonne for three years, and then a floor price to take over in July 2015, and the package instituted many of the governance arrangements and targets discussed above, such as the Climate Change Authority, the RET and the Clean Energy Finance Corporation. The pricing mechanism however, was repealed with the election of a Liberal-Coalition government in July 2014.

The current political situation is none the better, with little support from the current Liberal-National Coalition to consider market based policy instruments that place a tax on emissions (see Prime minister of Australia: February 2017). While industry and economics publicly call for the introduction of either an emissions trading scheme – one that places a tax on every tonne of carbon; or an emissions intensity scheme – one that allows a designated level of pollution and then imposes a tax on the emitters once the set level is reached. Rather, the current debate appears to take a more conservative 'business as usual' approach, one that is looking to transitions that include low carbon technology such as carbon capture and storage and low gas generation (CCA 2016).

## Discussion

As the aim of this paper is to explore the scope and scape of the transitions in energy policy in Australia this section brings together the key insights from the mechanisms developed by Cherp et al (2017), the pathway transitions developed by Geels (2011) with Kingdon's insights on policy agenda setting. Examining these transitions in the Australian context enables a discussion of the way in which politics

influences the emerging road ahead. Pertinent to this discussion is the difficulty associated with the collective nature of such transitions. In other words, energy, its production, generation and how it is consumed constitute a public good, a utility that is in the public interest that ensures the wellbeing of society. However, complicating this public good status is the fact that in Australia, energy is in most instances a private good, with production and generation of energy competing in a wholesale market that relies on a bidding system. This involves companies competing over how much they can deliver, (CCA 2016) and in some instances, the capacity delivered and the capacity they can make available (CCA 2016). The retail arm adds to the competitive nature of energy supply as retailers compete for customers. According to CCA (2016: 25), residential electricity prices have increased by around 70 percent in real terms from 2006 – 2013. The Finkel Review also points to the increase in electricity costs with a rise of around 10 per cent annually from 2009 – 2013 (2016: 41).

A further aspect to this discussion is the temporal nature of any transition. As previously discussed, transitions constitute a dynamic relation whereby dominant knowledge is thrown into question and possibilities emerge thus rendering the 'transitional space' or 'vacancy'. As Sovacool (2016) highlights, energy transitions are both slow and rapid and while these may appear as a linear process, it is also important to remember that time is also dimensional; time links the past to the present and future. The temporal is not simply the 'moment by moment' chronological time that is taken for granted (Schutz 1967), it is layered, and open; time functions on multiple levels that enables stretching and reshaping of the transitional space, and therefore allows for the capacity of multiple interpretations at any point in time.

The collective nature of energy and the temporal character of any transition are key considerations when exploring the Australian context in light of transitions mechanisms proposed by Cherp at al (2017). Accordingly, the first mechanism, 'secure demand and supply' (ibid: 616), which also emphasizes the importance of vulnerabilities around infrastructure has both a temporal and collective component.

Several issues can be noted in the Australian context: the age and inefficiency of the current coal fired power stations – half will be 40 in the next decade and some will be 60 years old (Australian Government Environment and communications – References Committee: The Senate 2017: 7-8), and nine coal fired power stations have closed since 2102 (Finkel Review: 25). This has serious implications for Australian energy context in that the nation generates 78% of electricity from coal fired stations which also generates 88 per cent of the nation's emissions (Australian Government: Environment and communications – References Committee. The Senate 2017). This situation points to the collective challenge and a temporal imperative for action.

However, while the mechanism proposed by Cherp et al (2017) focuses attention on the structural capacities and constraints in terms of electricity systems, the interaction between socio-technical components and policy decision making is not emphasised. As discussed above, the energy policy context in Australia is under review (see footnote 1) these play a primary role in the transition process. In this context, the MSF provides a lens to highlight some of the current constraints in the political debate. As the above example indicates, energy has been framed as a policy problem across three intersecting dynamics: reducing emissions to meet international agreements, technology/system integration and ensuring secure supply for all. While each of these components sit together to inform policy decisions, as identified in many reports, the politics of the situation have reframed the problem in terms of 'security of supply'. As noted above, the 'triggering events' enabled various policy entrepreneurs to more readily position the problem as one of expediency around supply thus bracketing the equal significance of the emissions reductions and the technology/system integration components. As the MSF emphaises manipulation, emotions and salami tactics alter the dynamics of choice by highlighting one dimension of the problem over others (Zahariadis 2007: 70). In effect, this reconfiguring of the problem as one that privileges security sets the policy agenda in ways that may benefit pre-existing incumbents and reinforce the status quo.

The second mechanism proposed by Cherp et al refers to identifying any vested-interests and their connection to socio-technical regimes and policy strategies. The socio-technical regimes in the Australian energy transition include a complex coordination between consumption, production generation, trade, governance, policy specific regimes and socio-cultural approach to energy utilisation. While each of these components has site specific rules, they also interact and thus continually configure and reconfigure the socio-technical energy space. A few examples of the 'rule in use' will make this point clear. For example, energy consumption is measured by 'measuring the total amount of energy used within the economy, this includes indigenous production, plus imports and minus export; measuring energy productivity, refers to the ratio of gross domestic product to energy consumption (AEU 2016: 6). These rules therefore tie energy in all its aspects to the 'wealth' of the nation. While this is not necessarily problematic, the rules demonstrate that it is difficult to consider energy without equally examining the push for economic growth. Another example of the rules in this space is how to understand energy production; this is defined as the total amount of primary energy produced in the economy, measured before consumption and transformation (AEU 2016:15). These specific rules legitimize this knowledge and expertise and further entrench energy within a complex system of meaning and interpretation.

While socio-technical transitions framework emphasize the link between regimes, and note there is interaction between policy goals and those with broad based vested interests, the framework is not as attentive to the manner in which vested interests intersect with policy ideas. For example, one of the key policy initiatives in the transition away from fossil fuels is the role of the Clean Energy Finance Corporation, introduced by the pervious Gillard, Labor Government in 2012. The CEFC is a statutory authority aimed to increase the flow of finance from brokering climate bonds and equity funds, into clean energy sector, through investment focused on renewable, energy efficiency and low emissions technology (www.cleanenergyfinancecorp.com.au). The policy idea in this example relates to the support for niche technologies that enable investment in renewable and low emissions technology. In the agency's latest

Annual Report, a record $AUS837 millions in new investment in 2015-6, which is a 73 per cent increase on the previous year supporting project worth $AUS2.5 billion (ibid). While certainly identified as a policy success in terms of developing and supporting projects that address emissions, the current policy idea is to stretch the remit of the Authority to include supporting investment into carbon capture and storage (CCS). CCS had previously been excluded from the CEFC as it did not meet the renewable energy criteria, and importantly, in the Australian context, the nation's current coal-fired power stations do not have the capacity for retro fitting this technology (Australian Government: the Senate 2017: 20). This would suggest that there is some support for maintaining the dominant role of the incumbent coal industry. This change is currently before Parliament (www.aph.gov.au/Parliamentary_Business/Bills_Legislation).

The third mechanism identified is the relationship between the state and incumbents and the importance of protecting niches technologies. This is certainly evident in the energy policy space through the introduction of the Renewable energy target (RET) and the Emissions Reduction Fund (ERD), the latter is part of the current Liberal-National coalition government's abatement strategy whereby in a reverse auction the government purchases abatement from a range of sectors (Finkel Review 2016). The Australian Renewable Energy Arena and the CEFC discussed above provide assistance into research of renewable energy technology. There is certainly strong evidence in support of niche activities with wind energy now one-third of renewable energy generation in Australia (Finkel Review 2016). According to the Climate Change Authority Report (2016), 15 per cent of energy generation was produced by renewables in 2013-14. Hydro contributed around 50 per cent, this was slightly reduced in the 2015-16 time frame due to less water available (AEU 2016 8); solar PV contributed 13 per cent – a ten-fold increase; other contributing technologies include bagasse and wood – five per cent; biogas four per cent and geothermal – less than one percent (CCA 2016 17).

The Clean Energy Regulator (2015: 68) also identifies that under the current scenario, Australia will not meet its commitment to reduce emissions by 26 – 28 percent below 2005 levels by 2030 if a business

as usual approach it taken. Australia's Large-scale renewable energy target requires around 6,000 megawatts of new renewable energy stations by 2020 to contribute to the reduction in emissions. From a policy perspective, there are tensions between emissions reduction policy and energy policy per se. According to recent reports by the Climate Change Authority (2016; 2017), report by Energy Networks Australia (2016), the current review of energy security – Finkel Review (2016) and a range of submissions to this review, there is little integration between energy and emissions reduction policies. While there is a range of possible policy options on offer, and some preferred options identified by several stakeholders, the current political embargo on introducing market based mechanism leaves the policy scenarios limited (see CCA 2016: 33).

Viewing this situation through the MSF politics lens highlights the cautious nature of the current political environment. The transition window in this space appears limited to 'technology pull policies', rather than a broader approach that encompasses a mix of policies that cover market, technology regulation and innovation (CCA 2016:31). This suggests that framing the problem in terms of security of supply over and above the reduction of emissions closes down a more broad based set of solutions. As the MSF highlights that a more effective solution for a policy problem is available, it does not equate to the implementation of such a policy mix.

The fourth mechanism that helps to explore the scope and scale of the transitions in Australia is the connection between socio-technical regimes and vested political interests. As the above scenario suggests there is always a political consideration to the choice of policy instruments. Certainly as the MSF highlights the choice of policy solution does not simply mean the most effective outcome to address the problematic nature of the issue. Rather, those who manage to frame the issue often controls the type of solution implemented. That the current Australian government has at this point ruled out the main market based tools – a cap and trade scheme or an emissions trading scheme appears to support the view that political

vested interests – that is not setting up a debate around increasing taxes – shape the current policy transition.

Cherp et al's (2017) fifth mechanism – the maturing of niches in low carbon technologies is nowhere near competing with the dominance of the coal sector in Australia. This is not to suggest that various jurisdictions across Australia are prepared to accept the status quo. For example, the Australian Capital Territory has a policy goal of 100 per cent renewable energy by 2020, South Australia had legislated for 50 per cent renewable generation by 2025; Queensland has proposed a 50 per cent goal by 2030 and Victoria has committed to 25 per cent by 2020 rising to 40 per cent by 2025 (CCA 2016: 19).

The energy transition space in Australia is complex and multi-dimensional, it necessarily includes large-scale shifts in all aspects of society. As Australia is endowed with large reserves of fossil fuels and a cultural history that is tied to mineral extraction, shifting this way of living presents many challenges – not the least political difficulties. The socio-technical transitions perspective has provided a systematic lens to consider the range of complexities in the current energy transition. Of the pathways identified by Geels and Shot (2007), perhaps the reconfiguration path best sums up the current malaise. The scope therefore of the current transition to low carbon energy is one that has some movement, albeit constrained by political and industry vested interests seen in the reticence to challenge the dominance of the coal industry in Australia. There is however an additional component to conceptualizing the scope of the transition as this appears to function at multiple levels across the various jurisdictions as seen in the different approaches from the various State governments. Therefore, the scale of the transition can be seen as gradual, which is not surprising given Australia's long-term commitment to fossil fuels.

## Conclusion

The above discussion highlights diverse innovations that are contributing to the overall energy transition in Australia. While there is evidence of innovative technological advances and a commitment by governments and business to work on ways to reconfigure this transition, there is also evidence of a

commitment to explore innovative policy and governance options as seen in the plethora of energy sector reviews over the last four to five years. As the purpose of this paper has been to explore the scope and scale of the transitions towards low carbon living in Australia, the STT framework has provided an effective lens to shed light on areas of expansion and constraint. Linking the specifics of the STT with Kingdon's multiple streams agenda setting framework, highlights that the transition window is slight with only an incremental step to move away from the over reliance on fossil fuel energy. There is certainly evidence of a willingness to engage in a range of policy scenarios, however balancing security of supply with a reduction in emissions is in a sort of 'readiness in waiting' (Schutz 1967).

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