



Regional Innovation Systems and Transformative Dynamics: Transitions in Coal Regions in Australia and Germany

Lars Coenen, Stephanie Campbell, and John Wiseman

Abstract

This chapter aims to better understand the implications of transformative change for regional innovation systems (RIS) research and policy by looking more closely into processes of structural change within coal regions against a context of transitions to a low-carbon future. Case studies of Germany's Ruhr and Australia's Latrobe Valley are used to demonstrate the challenges in implementing regional innovation policies under conditions of fundamental uncertainty. In the absence of regional innovation system structures and institutions, there is first and foremost a need for organisational and institutional innovation to arrive at working configurations of actors, networks and institutions that could act as proto- or 'pop-up' innovation systems. This chapter aims to shed some light on how to approach such processes. It argues that policymakers and researchers should explicitly acknowledge the experimental nature of RIS policy and conceptualize RIS policy development and implementation as a series of governance experiments.

Keywords

Low-carbon transition · Old industrial regions · Regional development · Regional innovation systems

1 Introduction

In recent decades, the regional innovation systems (RIS) approach has arguably offered one of the most influential and comprehensive frameworks with which to analyze the innovative capacity of regions (Asheim and Gertler 2005; Doloreux

L. Coenen (✉) · S. Campbell · J. Wiseman
Melbourne Sustainable Society Institute (MSSI), University of Melbourne, Melbourne, Australia
e-mail: lars.coenen@unimelb.edu.au

© Springer International Publishing AG 2018

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_10

199

2002). The approach has been developed in close interaction with the policy-making process, and widely used as a framework for the design, implementation and evaluation of innovation-based regional development policies in a variety of countries and regions. It provides an umbrella framework that synthesizes notions, ideas, insights and lessons from a range of studies and literatures that deal with innovation in a regional context (Doloreux 2002)—including (among others) various agglomeration theories on regional clusters and industrial districts, as well as institutional theory and, most recently, evolutionary economic geography (EEG).

Typically, RIS studies have been carried out by ‘mapping’ the core elements and mechanisms of a system along two dimensions (Cooke et al. 1998). Firstly, relevant firms and organizations in the RIS are identified, along with as their knowledge linkages and networks. In addition, important locational advantages (or the lack thereof) are analyzed to determine the role played by proximity within the innovation system (Boschma 2005). Secondly, an analysis is carried out of the governance system that underpins the coordination and decision-making processes for innovation. This identifies the role played by various institutions in the innovation system, as well as in the policy environment. It considers, among other things, the administrative, financial and legal framework, the role of the public sector, and specific regional cultural commonalities.

In part due to the evolutionary turn in economic geography, recent theoretical advancements in the RIS literature have addressed the criticism that the approach is primarily geared to providing static snapshots of a region’s innovation system. Insights and concepts borrowed from EEG (e.g. Boschma and Martin 2010) have enabled a deeper understanding of the inherently historically-shaped factors and conditions that influence regional development and RIS. Drawing on the evolutionary notion of path dependence, recent RIS research has identified different types of regional industrial development pathways conceptualized as path extension, path renewal and path creation (Isaksen 2014; Trippel et al. 2015; Coenen et al. 2017).

Nevertheless, Asheim et al. (2016) observe that much of the RIS literature has ignored transformative dynamics at the system level, and argue that a better understanding of the processes and mechanisms that drive transformative change remain a core issue for future research. Within the policy domain, the OECD (2015) observes that “by and large, most innovation policies aim to foster incremental change; fostering wider system change is a new challenge for innovation policy makers, especially as many of the actions will fall in areas outside the direct remit of research ministries or innovation agencies but where their input, coordination and implementation actions will remain critical” (p. 9). This challenge, in turn, requires so-called ‘system innovation policy’, understood as “a horizontal policy approach that mobilises technology, market mechanisms, regulations and social innovations to solve complex societal problems in a set of interacting or interdependent components that form a whole socio-technical system” (OECD 2015, p. 7).

Following RIS’ pragmatist rationale in embracing strategic problem-solving, Asheim et al. (2016) suggest extending the traditional market and system failures, to include transformational system failures as heuristics for identifying and analyzing transformative dynamics. Broadly, these failures relate to directionality,

demand articulation, reflexivity and policy coordination (Weber and Rohracher 2012). This new orientation paves the way for new and original research in RIS as it extends its perspective from a supply-side bias (Marques 2011) to include demand-side aspects (Martin 2016). Even more importantly, incorporation of such failure types hone in on the often understudied process and politics of (innovation) policymaking (Coenen et al. 2015a, b). However, relatively little empirical research has been conducted to date on such transformational system failures in a RIS context.

Studies on old industrial regions therefore provide a potentially useful empirical entry point into the theoretical discussion on RIS and transformative dynamics. Old industrial regions are typically specialized in mature technologies and industries experiencing decline, thus facing various types of lock-in (detailed below). Innovation activities in these regions often follow mature technological trajectories of an incremental character. Policy support is therefore needed to help transition old industrial regions into new pathways by means of disruptive path-breaking innovation and technological change (Coenen et al. 2015a, b). This has proven to be easier said than done. Even though regional actors (including policy-makers) are aware of the challenges to break out of the old industrial region ‘mould’, they are often struggling to find ways and practices to effectively do so. This is because the region and its industries are nested within a broader process of industrial transformation and institutional adaptation.

In this chapter, we focus on a particular kind of old industrial region facing transformative change, namely coal regions. Reducing greenhouse gas emissions at the speed and scale required to achieve the Paris Agreement goals will require rapid and fundamental transformation of current economic and social structures. The required transition away from reliance on coal and other fossil fuel-based energy sources towards renewable energy sources obviously has significant implications for those regions that are economically reliant on coal mining and specialized in coal-based energy and industry (Hudson 2005). Coal regions thus provide salient empirical case studies offering insights into transformative dynamics in RIS. Within this context, the aim of this chapter is to better understand the processes that drive transformative change in coal regions and to identify relevant RIS policy implications. To do so, the chapter draws on empirical analysis of two coal regions—namely Germany’s Ruhr and Australia’s Latrobe Valley. It should however be noted that the study has not been conducted in a systematically comparative way—this is partly because in the Ruhr the transition away from coal has largely taken place, while the one in Latrobe Valley has only recently begun.

In the remainder of the chapter we first outline the RIS framework (with a particular focus on RIS policy), followed by empirical case studies of the Ruhr and Latrobe Valley respectively. The next section will proceed with a discussion of the implications for RIS policy dealing with transformative change, before concluding the paper and providing suggestions for future research.

2 RIS and Systemic Innovation Policy

In the innovation systems literature that emerged during the early 1990s, the RIS approach has to date been most explicitly concerned with spatial dimensions of innovation and innovation-based regional development policies (Asheim and Gertler 2005; Asheim and Isaksen 2002; Braczyk et al. 1998; Cooke et al. 2004; Lundvall and Borrás 1997). This approach is based on the notion that regional competitiveness in a globalizing knowledge-based economy depends upon a region's ability to continuously and collectively recombine and exploit knowledge, including instances where innovations emerge when existing knowledge is reconfigured into new combinations in local contexts. According to Cooke et al. (2004), a RIS 'consists of interacting knowledge exploration and exploitation sub-systems linked to global, national and other RIS for commercialising new knowledge'. By emphasizing the interplay of knowledge exploration and exploitation, Cooke et al. (2004) stresses the centrality of interactions between industry and organisations involved in knowledge exploration, such as universities and research centres. Later developments within RIS literature have increasingly emphasised the importance of inter-industry dynamics and, correspondingly, how policy should support horizontal linkages (Cooke et al. 2007) based on the recognition that 'old' knowledge and technology from other sectors may be as important for innovation as 'new' knowledge and technology from within a sector or from academia (Asheim et al. 2011a).

The systemic perspective implies that RIS can be conceptualized in terms of (a) system components, (b) system linkages and (c) system boundaries (Asheim et al. 2011b). The system components refer to the private and public organisations involved in innovation processes, as well as to the institutions guiding their behaviour. System linkages refer to the relationships between the components which are part of a localized innovation network that allows for interactive learning to take place (Cooke 1998). The boundaries of the RIS draw attention to the demarcation, overlap and relationships between extra-regional actors, networks and institutions. For many years, industrial clusters have been very influential in the theoretical development of RIS, which also influenced the policy implications of RIS. Regarding policy, RIS has also drawn substantially from insights and lessons derived from a systems perspective on innovation, firstly pioneered within National Innovation Systems (NIS) but shortly after extended to RIS.

To a large extent, RIS follows the rationale for policy support in systemic approaches to innovation, which is to address system failures (Laranja et al. 2008). A system perspective on innovation goes beyond the neoclassical economic rationale that policy intervention is only legitimate and required in response to market failures resulting from sub-optimal resource allocation by firms. Rather, it builds on the notion that innovation processes are social learning processes that take place in a context of networks and institutions, and which can proactively influence the innovation capacity of firms, regions and nations. This implies that public intervention is legitimate and necessary not only if the complex interactions that take place among the different organisations and institutions involved in innovation

do not function effectively, but also even in the absence of failure to promote a dynamic, innovation-based competitiveness trajectory, or what is often referred to as a ‘high road strategy’ of competition. This perspective is also emphasised in the constructed regional advantage approach—an important policy concept derived from RIS theory and empirics (Asheim et al. 2011a, b). What is especially highlighted here is the role of a proactive public-private partnerships and the impact of the public sector and public policy support, by acknowledging to a greater extent the importance of institutional complementarities in knowledge economies. This approach represents an improved understanding of key regional development challenges, as well as a better anticipation and response by addressing system failures in regional innovation systems.

Various authors (e.g. Klein Woolthuis et al. 2005; Smith 1998; Weber and Rohrer 2012) have identified a number of structural system failures that inform and shape system-oriented public policy support for innovation. These include:

- *Capabilities’ failure*: The lack of appropriate competencies and resources at the firm and organisational level limiting and/or preventing the generation of, access to and exploitation of knowledge.
- *Infrastructural failure*: Lack of physical and knowledge infrastructure due to large scale, long time horizon of operation and ultimately too low return on investment for private investors.
- *Hard institutional failure*: Absence, excess or shortcomings of formal institutions such as laws, regulations and standards (in particular regarding IPR and investment).
- *Soft institutional failure*: Lack of informal institutions such as social norms and values, culture, entrepreneurial spirit, trust and risk-taking that impede collaboration for innovation.
- *Strong network failures*: Intensive cooperation in closely tied networks leading to myopia and a lack of infusion of new ideas.
- *Weak network failures*: Too limited interaction and knowledge exchange with other actors inhibiting the exploitation of complementary sources of knowledge and processes of interactive learning.

One of the main contributions of the RIS approach has been to specify what type of innovation support and policy best fit and are needed to address specific regional characteristics and challenges. There is no single permanent ‘best practice’ policy or mix of policy instruments available for every situation, as regions and nations are very different. Instruments and policy systems must therefore be context-specific and adapted to the particular needs and bottlenecks local firm and regional circumstances.

The systemic perspective in the RIS approach has been translated to an operational level by focusing on instrument mixes or ‘policy mixes’ (Flanagan et al. 2011) that combine different types of measures. This mix can be conceptualized in different ways. Borrás and Edquist (2013) suggest a classic mix of regulatory instruments, economic and financial instruments and soft instruments, following

the popular distinction between ‘sticks’, ‘carrots’ and ‘sermons’ of public policy instruments (Bemelmans-Videc et al. 2003). However, while a focus on instrument mixes has received considerable attention from policymakers in recent years, most innovation policy efforts are *de facto* limited to enhancing levels of public and/or private R&D expenditures (Borrás and Edquist 2013). Nauwelaers and Wintjes (2002) have arrived at a similar conclusion based on their review of regional innovation policies in Europe, where they find that most policies constitute resource-focused individual firm support in the form of R&D subsidies, rather than policy instruments selected in response to the actual problems identified in the innovation system. As such, it seems that considerable challenges remain to translate RIS theory to policy practice.

3 The Ruhr Valley

An illuminating example of a coal region that successfully transformed and diversified into a low-carbon development path can be found in Germany’s Ruhr region. The Ruhr Valley of northwestern Germany has been a centre of European coal (and steel) production since the mid-1800s. At their peak in 1956, the coal mines of the Ruhr produced 124 million tonnes of coal, employing almost half a million people (Hospers 2004). Due to the rise of oil as an alternative fuel to coal, cheap coal imports from countries such as the US and the increasing availability of less costly steel on the global market during the 1960s and 1970s, the Ruhr’s core industries—coal, steel and related industries—began to contract, and the region experienced sharp industrial decline and rising unemployment. By the 1990s, about two-thirds of the jobs in these industries no longer existed. At the same time, environmental conditions suffered severely as a result of the air and water pollution from the heavy industry, leading Willy Brandt (who would become one of West Germany’s most famous Chancellors) to declare that ‘the sky above the Ruhr must turn blue again’.

According to Hospers (2004), policy responses to the Ruhr’s challenges since the 1960s can be divided in two categories: re-industrialisation and neo-industrialisation. The former prevailed largely as an initial response during the 1960s and 1970s. This response unfolded against a degree of denial of change in the region and a belief that ‘the good days would return’. To improve competitiveness, core industry cooperation increased and led to several mergers between former competitors and closer linkages with customers and suppliers. Public policy support and investment was mainly directed to infrastructure—especially intraregional and interregional public transport systems and roads, yet also establishing new organisations of higher learning, universities and technical institutes where none has existed before. Despite these efforts to remain competitive, many mines and plants were still forced to close, albeit in a relatively controlled and coordinated manner through the provision of wage subsidies, compensation payments or early retirement (Stroud et al. 2014). Local government also tried to attract inward investment in large-scale *de-novo* industries such as micro-electronics, cars and chemicals. Partly due to the resistance

from vested industrial interests in the region, these government economic restructuring initiatives failed. As documented in Hospers (2004), the reaction of a famous industrial leader Gustav Krupp to the establishment of higher education in the Ruhr was telling: “What we need in the Ruhr are muscles, not brains” (p. 151).

In 1984, the State of North-Rhine Westphalia shifted its response towards neo-industrialisation via a more pro-active industrial policy and developed a program aimed at “sunrise technologies”, with a focus on environmental and renewable energy technology. Due to the massive amounts of energy resources needed and waste produced by the coal and steel plants, innovation in the field of energy efficiency, renewable resources, recycling and waste combustion was emphasised in the Ruhr relatively early compared to other regions in the world. This regional knowledge base, though for many years ‘hidden’ within the coal and steel industry, ultimately provided the resource base from which new industrial paths emerged. Moreover, state-led environmental protection policies supported the transformation of “the largest contributors to problems in the Ruhr district into problem solvers” (Kilper et al. 1996, p. 15). Today, the Ruhr has become one of the key centres for environmental industry, technology and research in Germany (Schepelmann et al. 2013). Local firms, universities, research institutes (e.g. the Soil Protection Centre and the Environmental and Packaging R&D Centre) and environmental agencies cooperate closely. Former mines and steel factories are currently used for tourist purposes (to preserve and exhibit ‘industrial culture’), with Zollverein, formerly one of Europe’s largest industrial coal complexes, now a UNESCO World Heritages Site and regional museum of the Ruhr area.

The state government has been central to the process of shaping these regeneration strategies, acting in partnership with municipalities, universities and private actors. The way that the neo-industrialisation approach towards structural change was organised departed significantly from previous approaches. The late 1980s and 1990s witnessed the beginning of new bottom-up development approaches, guided by regional planning and key State (Land) institutions, but designed and implemented by local groups. The renewal from within approach was organized in close dialogue with, and met with approval from, the local community.

An innovative approach was offered by the Emscher River International Building Exhibition (IBA)—with the official subtitle ‘Workshop for the Future of Old Industrial Regions’. From the early 1900s, the Emscher River had become a wastewater open sewer for local industry and households. It was considered the country’s most polluted river and in the 1980s, characterized by vacant factories, closed mines and abandoned docks, sinking ground, and heaps of mining residues and dams (Schepelmann et al. 2013). Established by the Ministry of Urban Development, Housing and Transport for the State of Northrhine-Westfalia, the IBA’s aim was “to be an answer to the complex economic, social and ecological problems of the Emscher sub-region and secondly, an attempt to give an internationally recognized example of state-led economic, social and ecological restructuring of old industrial areas” (Danielzyk and Wood 2006, p. 133). The initiative lasted from 1989 to 1999 and invited proposals from all sectors, including municipalities, companies, lobby groups and individuals, to address five themes for restructuring:

the renovation of the Emscher landscape into parkland, ecological regeneration of the Emscher River system, development of new work sites in derelict industrial sites, development of new housing forms and districts, and new uses for industrial buildings and monuments.

However, while the IBA is often associated with the restructuring of the Ruhr (Hospers 2004), it would be naïve to view its role as a silver bullet. As Shaw (2002) notes, it failed to deliver on a number of objectives. The first is direct job creation, with the pronounced focus of the IBA on supporting activities in culture, tourism and recreation failing to compensate for the job losses from traditional industries. The Emscher region remains well above national unemployment average. Shaw (2002) also highlights the failure to encourage environmentally sound products and production methods in the region, principally to a lack of investors. Both failures should, however, be viewed in terms of immediate direct outcomes of the program, as with respect to longer-term and indirect impacts the IBA has played a significant role for job creation and green industry build-up.

The approach implemented in the IBA initiative has informed the design, implementation and testing of institutional innovation for renewal. Over 10 years, 123 cooperative projects were implemented, varying from the setting up of technology centres to the renovation of apartments and the restoration of industrial monuments for tourist purposes. It is however this very role of providing a local and inclusive participation framework—combined with top-down quality control in contrast to previously more centralized policy and governance approaches—that constitutes the success of the IBA initiative in restructuring the Ruhr. First and foremost, the IBA provided an organizational form for dialogue and collaboration between stakeholders that lead to the inception of “regional development coalitions”, i.e. bottom-up, horizontally based co-operation between different actors in a local or regional setting based on a socially broad mobilization and participation of human agency (Asheim 2001). The establishment of such regional development coalitions has been an important foundation for the development of new industries in the Ruhr via related diversification processes.

4 The Latrobe Valley¹

Australia’s Latrobe Valley is located in the state of Victoria, approximately 150 km east of the state capital of Melbourne, in a region called Gippsland that is approximately the size of the Netherlands. The Latrobe Valley is situated on one of the world’s largest brown coal reserves, including 93% of Australia’s reserves (Geoscience Australia 2016). These lignite reserves are mined from three open-cut mines—Yallourn, Hazelwood and Loy Yang—and are used almost entirely for baseload electricity generation for domestic use, with the Latrobe Valley supplying more than 90% of Victoria’s electricity needs (Latrobe City Council 2016).

¹This section draws on Wiseman et al. (2017).

The Victorian government designated the region as a centre of electricity production in the 1920s, when it founded wholly state-owned power stations adjacent to the Valley's coal reserves. The combustion techniques, briquette technology and adjacent power station model employed in Germany to utilise lignite coal were studied and brought to the Valley (Heritage Council of Victoria 2008). The Victorian Government established a State Electricity Management Commission (SECV) whose mandate included managing Victorian electricity generation and supply, and developing its brown coal reserves (*Ibid.*) In the following decades, coal-fired electricity generation formed a central part of the SECV and state government's industrial and employment strategy in the Valley. As production and employment grew, subsidized housing, regulated wages, unionized workplaces and state-provided social infrastructure combined to create a prosperous region (Weller 2012). By 1981, mining and electricity generation in the Valley employed a largely male workforce of over 10,000 employees (Eklund 2017). In addition, ancillary industries had developed in the manufacturing and services sectors throughout the 1970s (Cameron and Gibson 2005). The region enjoyed periods of rapid economic growth and full employment, and the SECV was known for providing secure, reliable and often career-long jobs (Weller et al. 2011; Fairbrother and Testi 2002). During the 1980s and 1990s, however, Australia transitioned from a protectionist to open economy, with both Coalition and Labour governments at the state and national level consistently supporting economic rationalism or neoliberalism (Baer 2016).

In 1994, in line with a neoliberal agenda, the Victorian government announced that the SECV would be disaggregated and the coal mines and power stations privatised (Cameron and Gibson 2005). By the end of privatisation, approximately 8000 workers had lost their jobs and the Valley had become the most disadvantaged region in Victoria, with full-time employment in the region falling by 9% between 1994 and 2001 and a large increase in migration from the region occurring as job-seekers searched for alternative work (Tomaney and Somerville 2010; Giurco et al. 2011; Weller et al. 2011). Since privatisation, a series of government statements and plans have been developed, with the aim of re-positioning the Valley and decreasing the region's high dependence on the electricity and resources sectors.² However, despite some diversification (into the community services and retail sectors in particular), these initiatives have had limited success and the regional economy has remained dominated by the electricity generation sector, leaving it vulnerable to the anticipated power station closures (Weller et al. 2011). Cameron and Gibson (2005) note that the dominant economic development approach was to seek replacement by large-scale industries—including attempts to attract call centres, food processing, magnesium smelters and industry parks—to

²These include the Latrobe Valley Ministerial Taskforce, established by the Victorian Government in 2000; The Latrobe Economic Development Strategy 2004–2008; Latrobe 2021—The Vision for Latrobe Valley, by the Latrobe City Council; and The Latrobe Valley Industry and Employment Roadmap in 2012 by the Victorian Government.

locate in the region. The failure of such an approach is epitomised in the attempt to attract National Foods, which opened a dairy processing plant in the Valley in 1996–1997 and received approximately \$1.5 million in incentives from the Council, promising the creation of 700 new jobs and ultimately providing only 120—many of which were filled by inter-state transfer from other closures (*Ibid.*)

More recently, the need for regional industrial diversification and policies and plans that change the development pathway of the regional economy of this coal region has become highly acute with closure of the Hazelwood power plant. Prior to its closure in 2017, Hazelwood was one of the oldest coal-fired power stations in Australia, with its oldest units aged 52 years' old and its newest, 42 years (Colebatch 2017). Given its high emissions intensity, Hazelwood was known as “Australia’s dirtiest power station”, responsible for an estimated 16 million tonnes of pollution per year (Jotzo and Mazouz 2015). Several changes in re-branding and share ownership of Hazelwood Power Partnership have occurred since privatisation, with the majority owners since 2012 being French multinational Engie (formerly GDF Suez) holding a 72% share, and Japanese multinational Mitsui the remaining 28% (Engie 2017). On the 3rd November 2016, Engie announced that it had decided to close the power station permanently on the 31st March, 2017 (Engie 2016). This announcement provided only 5 months’ notice for workers and the community. Engie consistently emphasised that its decision was made on a commercial basis. It cited a difficult national energy market environment and the large costs required to ensure continued safe and viable operation (*Ibid.*)

On the 3rd November, the day of the closure announcement, the Federal Government announced a \$43 million package to be provided by the Commonwealth Government to assist workers affected by Hazelwood’s closure (Australian Department of Environment and Energy 2016). This included \$20 million to support local infrastructure, a \$3 million labour market structural adjustment package—including re-training, active job-seeking assistance and other support—and \$20 million as part of Regional Jobs and Investment Package, focused on local job creation, diversifying the regional economy and building a highly-skilled workforce via projects determined by community input.

The State Government promised an additional \$224 million of funding, bringing the Victorian Government’s support package to a value of \$266 million and making it the largest regional development project ever announced by a Victorian government (Baxendale 2016; ABC 2016). The \$224 million funding package was intended to create jobs in the region and encourage local business growth through the establishment of an Economic Growth Zone. The package consisted of two major components—a \$50 million Economic Growth Zone to encourage businesses to re-locate to the Valley via financial incentives such as stamp duty concessions and fee reimbursements and \$174 million for a Community Infrastructure & Investment Fund to finance local infrastructure projects such as road, rail, school upgrades, and the construction of health facilities (Andrews 2016; Gordon and Preiss 2016).

The Latrobe Valley experience provides an example of the negative consequences arising from the failure to adequately and proactively plan for

long-term shifts away from coal based industries and employment. Structural transformation and regional renewal processes had not been adequately considered before the announcement of Hazelwood's closure. One of the key aspects of the debate has been focused on energy security and affordability with both business and much of the mainstream media emphasizing the potential impact of Hazelwood's closure on household electricity prices and energy security.

Most policy options considered have been reactive and transactional rather than proactive and transformational. The proactive and inclusive conversations between all regional actors that should take place prior to 'the crisis hitting' have generally not occurred. In response, worker and community anxiety has been heightened and there has been significant resistance to the closure—with some politicians and business groups still raising the possibility of a last-minute intervention just days before the closure, further exacerbating uncertainty. The reactive and often acrimonious public debate created considerable fear and polarisation in some sections of the community. It also led to criticism of the Victorian government's role in bringing forward the Hazelwood closure, despite the fact that this was primarily a commercial decision made by a private, foreign-owned, multinational company.

5 Discussion: Implications for RIS Policy Facing Transformative Change

The challenges for coal regions are in many ways similar to those of old industrial regions. Like many old industrial regions, the development pathways of coal regions are locked-in through interconnected and co-evolving processes of path-dependency (Hassink 2010; Tödtling and Trippel 2005). Lock-in becomes problematic when path-dependency steers a region to deep specialization in long-established technologies and industries with little scope for further economic exploitation of knowledge while, often simultaneously, curtailing efforts by novel industries or technologies to emerge and develop.

Grabher (1993) highlights the multi-dimensionality of regional lock-in by distinguishing between three types of interrelated lock-in; functional, cognitive and political, noting that regional lock-in results from the interplay between these three types of lock-in. Functional lock-in refers to how overly strong and often hierarchical inter-firm networks in declining industries tend to block the development of alternative linkages and reorientations in the value chain. Cognitive lock-in refers to how a common world-view or mindset among actors reinforces 'group-think' and precludes the creativity and imagination necessary for the development of new ideas. Political lock-in is related to the existence of dense relationships between public and private sectors that aim at preserving traditional industrial structures, thus hampering alternative directions for industrial development (Grabher 1993; Underthun et al. 2014).

Hassink (2010, p. 455) has helped to further operationalize Grabher's categories by suggesting a set of economic-structural and political-institutional impact factors. Drawing on this framework, it is clear that both the Ruhr and the Latrobe Valley

display similar ‘old industrial region’ challenges. Moreover, our analysis shows that these challenges can be further specified into three characteristics of coal regions:

1. A marked industrial mono-structure centered around the coal industry, characterized by high capital-intensity, high entry and exit barriers, above average company size, oligopolistic market structure, and influential trade unions.
2. Dense actor-networks at the regional level, consisting of local, regional policymakers, captains of industry, regional trade unionists, and representatives of industry associations that are strongly focused on the coal industry and hence weakly on external relations.
3. National and supra-national institutions that strongly affect the policy conditions relevant to the leading industry (e.g. in industrial development and energy).

The above examples of the Ruhr and Latrobe Valley coal regions illustrate three interrelated challenges for the RIS approach and policies when addressing transformative change. The first concerns changing the direction of key regional development pathways. Due to lock-in, regional innovation and development strategies tend to be primarily based on path-extension driven by the core competences and vested interests of established actors (Isaksen 2014). This tendency for path-extension explains the delay (in the case of the Ruhr) or ambivalence (in the case of the Latrobe Valley) in recognising and responding to the crisis. Secondly, the two cases demonstrate coal regions suffering from weak regional capabilities in entrepreneurship, as not only is the regional industry characterized by a mono-structure based on the production chains of the leading (coal) industry, but there is little opportunity for new start-ups and entrants in the region. Moreover, there tends to be little entrepreneurship in the local research environment, educational facilities, and public administration, and marginal appetite for risk-taking, whether in the economic or political sphere. This results in ossified industrial and political institutions. Thirdly, the contested nature of coal mining and burning in light of climate change has amplified the risk of distrust and antagonism between different actors within the regional innovation system. The political nature of the low-carbon energy transition easily results in entrenched positions that make it difficult for the actors in the innovation system to collaborate, coordinate collective action or engage in reciprocal learning processes.

So, what are the policy implications of such challenges? What type of policy support does a coal region’s innovation system require? While much research on old industrial regions has led to a solid understanding of the troublesome conditions for innovation in such regions and its consequent challenges for renewal and revitalization, policy advice and analyses of initiatives that seek to facilitate such renewal are much less developed. Undoubtedly, this is a daunting task as ‘the capacity of a region to transform the whole regional innovation system turns out to be the decisive factor for renewal processes’ (Tripl and Otto 2009, p. 1231).

Indeed, in line with Trippel and Otto (2009), it can be argued that the challenges of directionality, entrepreneurship and trust address some of the essential underpinnings of the RIS approach. How to design systemic regional innovation strategies and policies if there is no viable innovation system to work with in the first place? This may call for a very different policy approach than the one that is usually advocated in RIS—to address the systemic problems of the innovation system (Tödtling and Trippel 2005; Coenen et al. 2017). Rather, an approach that aims to change institutions and involve new actors, rather than to reinforcing existing institutional arrangements and actor positions, is required. To this end, Frenken (2016) has argued for temporary or ‘pop-up’ innovation systems. Indeed, the Emscher IBA can be conceived as such a temporary innovation system that contributed to the development of more permanent innovation system structures in the region. Similarly, renewal of the Latrobe Valley is currently hampered due to a lack of effective innovation system governance structures and thus little absorptive and leverage capacity for the public policy investments made in the region in response to the coal crisis.

According to Frenken (2016), such temporary innovation systems can take many forms, including urban innovation programs, sectoral voluntary agreements, monitoring and labelling instruments, social enterprises, government task forces, citizen movements, online communities, and many others. What essentiality is at stake here is experimentation with a plurality of governance structures in a variety of technological, institutional and political contexts in which such “pop-up” innovation systems emerge. Through the notion of entrepreneurial discovery, the role of experimentation is also increasingly recognized in the European Union’s burgeoning smart specialization policy framework. Entrepreneurial discovery is more than ‘taking a technology to the market’ (Sotarauta and Pulkkinen 2011), as it involves linking knowledge and its societal use. Rather than a straightforward discovery, it is better understood as a trial-and-error process in which existing knowledge is used and combined, new knowledge is created, suitable routines are elaborated upon, market opportunities are screened and combinations of knowledge, routines, and markets are tested and continually adapted (Benner 2013).

Experimentation can thus be understood as an iterative construction process where networks of distributed actors jointly develop knowledge, create new market segments and user profiles, adapt regulations, lobby for subsidies, or define new technical standards—ultimately creating the conducive environment that helps a new product, process or indeed an entire industry to develop and mature (Garud and Karnøe 2003; Garud et al. 2010). This involves institutional entrepreneurship whereby actors break with the existing institutionalised rules and practices associated with the dominant institutional logics, and institutionalise the alternative rules, practices or logics that they are championing (Battilana 2006; Garud et al. 2007).

This focus on experiments and experimentation helps to explain some key features of contemporary regional innovation policies—notably the ways that they are delivered through projects understood as temporary inter-organizational arrangements. At first glance, the project-based organisation of many (if not most)

regional innovation policies may not align well with objectives for structural renewal of a regional economy. How can such relatively short-term and small-size arrangements leverage impact at a systemic and aggregate level? Surely policy reform may offer greater purchase in this respect? It would be naïve to assume that such policy-induced projects offer optimum conditions for firms and other stakeholders to engage in risky and unruly activities related to innovation. However, it would be more viable to conceive of the plethora of innovation projects that are planned, resourced and implemented through regional innovation policies as governance experiments.

In such governance experiments, innovation projects in real-life contexts are seen to be critical, by bringing together actors from a variety of environments in shared networking and learning activities. In these experiments, firms, research institutes, universities and governments search and explore the best possible combinations of innovations and their social and institutional embedding (Bulkeley and Castán Broto 2013). As such these innovation projects act as pop-up innovation systems that explore, examine, experiment, test and evaluate the feasibility of new technologies and institutional arrangements, whether they are workable solutions to given problems and can create sufficient demand.

6 Conclusions

By examining more closely the structural change processes of coal regions against a context of unfolding transitions to a low-carbon future, this chapter has aimed to better understand the implications of transformative change for RIS research and policy. The case studies of German's Ruhr and Australia's Latrobe Valley have demonstrated the challenges to implementing regional innovation policies under conditions of fundamental uncertainty—there is simply no substantial innovation system at the regional scale to begin with.

In the absence of such structures and institutions, there is first and foremost a need for organisational and institutional innovation to arrive at working configurations of actors, networks and institutions that could act as proto or pop-up innovation systems. These processes are by their nature experimental (Asheim et al. 2016). This chapter has tried to shed some light on how to approach such processes. It argues for explicitly acknowledging the experimental nature of RIS policy and for conceptualising RIS policy as governance experiments. While the concept of governance experiments is conceived in the debate on urban climate governance, it is probably fair to also apply the term to RIS policy. A closer reading of the Triple-Helix literature³, which has been very influential in the debate on RIS governance, also points to the creation of new institutional configurations and actor networks.

³Beyond straightforward university-business-government interactions.

Acknowledging the experimental nature of RIS policy can be difficult to legitimise, as governments may have their own stake in supporting existing institutional arrangements or be subject to strong lobby pressure by incumbent actors, and are generally reluctant to experiment with new rules and regulations (Bugge et al. 2017). With reference to the above cases, it seems also that regions may vary in their preconditions for and capabilities to carry out regional innovation policies as governance experiments.

Typically, a RIS in coordinated market economies (more typical of German regions or regions in the Nordic countries) is characterised by the positive effects of systemic relationships between the production structure and the knowledge infrastructure embedded in networking governance structures regionally and supporting regulatory and institutional frameworks on the national level. In contrast, a RIS in liberal market economies (found in the US, UK and other Anglo-American economies) lacks these strong systemic elements, and instead sources its dynamism from local venture capital, entrepreneurs, scientists, market demand and incubators. Such a system will, of course, be more flexible and adjustable and thus will not run the same risk of ending up in ‘lock-in’ situations as traditional RIS caught in path-dependency on old technological trajectories. On the other hand, RIS in liberal market economies do not seem to have the same long-term stability, slack capacity and systemic support for cross-sector collaboration and coordination, raising important questions about their long-term resilience in the face of potentially disruptive economic, social and environmental change.

In light of the large-scale adoption and mainstreaming of RIS policy in Europe under the banner of Smart Specialisation Strategies (Morgan 2017), there is an opportunity to study and compare how RIS are being constructed at an unprecedented scale and scope. Here, there is a need to better understand the design and practice of RIS policies as governance experiments in different contexts—for example, across coordinated and liberal market economies. An important area for future research will be to further unpack the notion of experimentation and the variety of ways it is being articulated (Ansell and Bartenberger 2016). RIS researchers are obviously very well-positioned to undertake this dual role of both designing and evaluating different institutional and governance arrangements to support regional innovation and transformation. In this task, Bjørn has been a highly inspiring role-model providing critical thought leadership and intellectual guidance.

Acknowledgments The authors gratefully acknowledge financial support provided by the project *Coal Transitions: Research and Dialogue on the Future of Coal* led by IDDRI (Paris) and Climate Strategies (London).

References

- Andrews, D. (2016, November 4). Economic growth zone to boost Latrobe Valley business – Media release.
- Ansell, C., & Bartenberger, M. (2016). Varieties of experimentalism. *Ecological Economics*, 130, 64–73.

- Asheim, B. T. (2001). Learning regions as development coalitions: Partnership as governance in European workfare states? *Concepts and transformation*, 6(1), 73–101.
- Asheim, B. T., & Gertler, M. (2005). The geography of innovation – Regional innovation systems. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford handbook of innovation*. Oxford: Oxford University Press.
- Asheim, B. T., & Isaksen, A. (2002). Regional innovation systems. The integration of local ‘sticky’ and global ‘ubiquitous’ knowledge. *Journal of Technology Transfer*, 27, 77–86.
- Asheim, B. T., Boschma, R., & Cooke, P. (2011a). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies*, 45, 893–904.
- Asheim, B. T., Lawton Smith, H., & Oughton, C. (2011b). Regional innovation systems: Theory, empirics and policy. *Special Issue of Regional Studies*, 45, 875–891.
- Asheim, B., Grillitsch, M., & Trippel, M. (2016). Regional innovation systems: Past – present – future. In R. Shearmur, C. Carrincazeaux, & D. Doloreux (Eds.), *Handbook of geographies of innovation* (pp. 45–46). Cheltenham: Edward Elgar.
- Australian Broadcasting Corporation. (2016, November 4). Hazelwood closure: Special economic zone to be established for Latrobe Valley. Accessed June 16, 2017, from <http://www.abc.net.au/news/2016-11-04/hazelwood-closure-prompts-economic-package-for-latrobe-valley/7994718>
- Australian Department of Environment and Energy. (2016, November 3). Media release: Government to support hazelwood workers. Accessed August 28, 2017, from <http://www.environment.gov.au/minister/frydenberg/media-releases/pubs/mr20161103.pdf>
- Baer, H. A. (2016). The nexus of the coal industry and the state in Australia: Historical dimensions and contemporary challenges. *Energy Policy*, 99, 194–202.
- Battilana, J. (2006). Agency and institutions: The enabling role of individuals’ social position. *Organization*, 13, 653–676. <https://doi.org/10.1177/1350508406067008>
- Baxendale, R. (2016, November 4). Hazelwood closure bad news for Victoria warns Josh Frydenberg. *The Australian*. Accessed 19 July, 2017, from <http://www.theaustralian.com.au/national-affairs/hazelwood-closure-bad-news-for-victoria-warns-josh-frydenberg/news-story/5ae3e0948f229894e71d28aa822f3a92>
- Bemelmans-Videc, M.-L., Rist, R. C., & Vedung, E. (2003). *Carrots, sticks and sermons: Policy instruments and their evaluation*. New Brunswick, NJ: Transaction Publishers.
- Benner, M. (2013). From smart specialisation to smart experimentation: Towards a new theoretical framework for EU regional policy. *SPACES online*, Vol. 11, Issue 2013-04. Toronto and Heidelberg: www.spaces-online.com
- Borrás, S., & Edquist, C. (2013). The choice of innovation policy instruments. *Technological Forecasting & Social Change*, 80, 1513–1522.
- Boschma, R. (2005). Proximity and innovation: A critical assessment. *Regional Studies*, 39, 61–74.
- Boschma, R., & Martin, R. (2010). *The handbook of evolutionary economic geography*. Cheltenham: Edward Elgar.
- Braczyk, H.-J., Cooke, P., & Heidenreich, M. (1998). *Regional innovation systems: The role of governances in a globalized world*. London: UCL Press.
- Bugge, M., Coenen, L., Marques, P., & Morgan, K. (2017). Governing system innovation: Assisted living experiments in the UK and Norway. *European Planning Studies*, 25, 1–19.
- Bulkeley, H., & Castán Broto, V. (2013). Government by experiment? Global cities and the governing of climate change. *Transactions of the Institute of British Geographers*, 38, 361–375. <https://doi.org/10.1111/j.1475-5661.2012.00535.x>
- Cameron, J., & Gibson, K. (2005). Alternative pathways to community and economic development: The Latrobe Valley community partnering project. *Geographical Research*, 43(3), 274–285.
- Coenen, L., Hansen, T., & Rekers, J. V. (2015a). Innovation policy for grand challenges. An economic geography perspective. *Geography Compass*, 9(9), 483–496.

- Coenen, L., Moodysson, J., & Martin, H. (2015b). Path renewal in old industrial regions: Possibilities and limitations for regional innovation policy. *Regional Studies*, 49, 850–865. <https://doi.org/10.1080/00343404.2014.979321>
- Coenen, L., Asheim, B., Bugge, M. M., & Herstad, S. J. (2017). Advancing regional innovation systems: What does evolutionary economic geography bring to the policy table?. *Environment and Planning C: Politics and Space*, 35(4), 600–620.
- Colebatch, T. (2017, March 28). Old coal, no new gas: How to generate an electricity crisis, National affairs. *Inside Story*.
- Cooke, P. (1998). Introduction: Origins of the concept. In H. J. Braczyk, P. Cooke, & M. Heidenreich (Eds.), *Regional innovation systems: The role of governance in a globalized world* (pp. 2–25). London: UCL Press.
- Cooke, P., Uranga, M. G., & Etzebarria, G. (1998). Regional systems of innovation: An evolutionary perspective. *Environment and Planning A*, 30, 1563–1584.
- Cooke, P., Heidenreich, M., & Braczyk, H.-J. (2004). *Regional innovation systems: The role of governance in a globalized world*. London: UCL Press.
- Cooke, P., Laurentis, C. D., Tödtling, F., et al. (2007). *Regional knowledge economies: Markets, clusters and innovation*. Cheltenham: Edward Elgar.
- Danielczyk, R., & Wood, G. (2006). Innovative strategies of political regionalization: The case of North Rhine-Westphalia. *European Planning Studies*, 12(2), 191–207. <https://doi.org/10.1080/0965431042000183932>
- Doloreux, D. (2002). What we should know about regional systems of innovation. *Technology in Society*, 24, 243–263.
- Eklund. (2017, March 30). Hazelwood power station: From modernist icon to greenhouse pariah. *The Conversation*. Accessed April 10, 2017, from <https://theconversation.com/hazelwood-power-station-from-modernist-icon-to-greenhouse-pariah-75217>
- Engie. (2016, November 3). Hazelwood to close in March 2017 – Media release. Accessed August 11, 2017, from <http://www.gdfsuezau.com/media/UploadedDocuments/News/Hazelwood%20Closure/Hazelwood%20closure%20-%20Media%20release.pdf>
- Engie. (2017). *History of Hazelwood*. Accessed August 11, 2017, from <http://www.gdfsuezau.com/media/UploadedDocuments/Hazelwood%20Closure/History/Hazelwood%20History%20Brochure.pdf>
- Fairbrother, P., & Testi, J. (2002). The advent of multinational ownership of the Victorian electricity generating plants: Questions for labour. In P. Fairbrother, M. Paddon, & J. Teicher (Eds.), *Privatisation, globalisation and labour: Studies from Australia*. Annandale, NSW: The Federation Press, as cited in Cameron & Gibson (2005).
- Flanagan, K., Uyarra, E., & Laranja, M. (2011). Reconceptualising the ‘policy mix’ for innovation. *Research Policy*, 40, 702–713.
- Frenken, K. (2016). *A complexity-theoretic perspective on innovation policy*. Innovation Studies Utrecht (ISU) Working Paper Series, 16(01), 1–17.
- Garud, R., & Karnøe, P. (2003). Bricolage versus breakthrough: Distributed and embedded agency in technology entrepreneurship. *Research Policy*, 32, 277–300.
- Garud, R., Hardy, C., & Maguire, S. (2007). Institutional entrepreneurship as embedded agency: An introduction to the special issue. *Organization Studies*, 28, 957–969. <https://doi.org/10.1177/0170840607078958>
- Garud, R., Kumaraswamy, A., & Karnøe, P. (2010). Path dependence or path creation. *Journal of Management Studies*, 47, 760–774. <https://doi.org/10.1111/j.1467-6486.2009.00914.x>
- Geoscience Australia. (2016). Coal – summary. Accessed August 28, 2017, from <http://www.ga.gov.au/aera/coal>
- Giurco, D., Cohen, B., Langham, E., & Warnken, M. (2011). Backcasting energy futures using industrial ecology. *Technological Forecasting & Social Change*, 78(2011), 797–818.
- Gordon, J., & Preiss, B. (2016, November 4). Latrobe Valley set to gain \$266 million rescue package. *The Age*. Accessed July 20, 2017, from <http://www.theage.com.au/victoria/latrobe-valley-set-to-gain-266-million-rescue-package-20161103-gshhqe.html>
- Grabher, G. (1993). The weakness of strong ties: The lock-in of regional development in the Ruhr area. In G. Grabher (Ed.), *The embedded firm* (pp. 255–277). London: Routledge.

- Hassink, R. (2010). Regional resilience: A promising concept to explain differences in regional economic adaptability? *Cambridge Journal of Regions Economy and Society*, 3, 45–58.
- Heritage Council of Victoria. (2008). *Mining heritage study in Victoria*, Prepared by Jack Vines. Melbourne: Heritage Council of Victoria.
- Hospers, G.-J. (2004). Restructuring Europe's rustbelt: The case of the German Ruhrgebiet. *Intereconomics*, 39(3), 147–156.
- Hudson, R. (2005). Rethinking change in old industrial regions: Reflecting on the experiences of North East England. *Environment and Planning A*, 37(4), 581–596.
- Isaksen, A. (2014). Industrial development in thin regions: Trapped in path extension? *Journal of Economic Geography*, 15(3), 585–600.
- Jotzo, F., & Mazouz, S. (2015). Brown coal exit: A market mechanism for regulated closure of highly emissions intensive power stations. *Economic Analysis and Policy*, 48, 71–81.
- Kilper, H., Lehner, F., Rehfeld, D., & Schmidt-Bleek, F. (1996). *Wegweiser in die Zukunft. Perspektiven und Konzepte für den Strukturwandel im Ruhrgebiet*. Essen: Klartext.
- Klein Woolthuis, R., Lankhuizen, M., & Gilsing, V. (2005). A system failure framework for innovation policy design. *Technovation*, 25, 609–619.
- Laranja, M., Uyarra, E., & Flanagan, K. (2008). Policies for science, technology and innovation: Translating rationales into regional policies in a multi-level setting. *Research Policy*, 37, 823–835.
- Latrobe City Council. (2016, December). *A strength-led transition*. Accessed July 26, 2017, from www.latrobe.vic.gov.au/.../A_Strength_Led_Transition_-_Latrobe_City_Council_2016_-_low_res.pdf
- Lundvall, B.-Å., & Borrás, S. (1997). *The globalising learning economy: Implications for innovation policy*. Brussels: DG XII, Commission of the European Union.
- Marques, P. (2011). Theories and policies of innovation: A critical review. *Geography Compass*, 5, 838–850.
- Martin, H. (2016). *Innovation for tackling grand challenges: Cleantech industry dynamics and regional context*. PhD thesis, Lund University, Sweden.
- Morgan, K. (2017). Nurturing novelty: Regional innovation policy in the age of smart specialisation. *Environment and Planning C: Politics and Space*, 35(4), 569–583.
- Nauwelaers, C., & Wintjes, R. (2002). Innovating SMEs and regions: The need for policy intelligence and interactive policies. *Technology Analysis and Strategic Management*, 14, 201–215. <https://doi.org/10.1080/09537320220133866>
- OECD. (2015). *System innovation: Synthesis report*. Paris: OECD Publishing.
- Schepelmann, P., Kemp, R., Klement, J., & Schneidewind, U. (2013). *The eco-restructuring of the ruhr area as an example of a managed transition*. Sustainability Transitions IST 2013 Conference, June 2013.
- Shaw, R. (2002). The International Building Exhibition (IBA) Emscher Park, Germany: A model for sustainable restructuring? *European Planning Studies*, 10(1), 77–97. <https://doi.org/10.1080/09654310120099272>
- Smith, K. (1998). What is 'basic science?' In E. Kallerud (Ed.), *Basic research in innovation and science policy* (pp. 79–96). Oslo: Norwegian Institute for Studies in Research and Higher Education, Report 9/98.
- Sotarauta, M., & Pulkkinen, R. (2011). Institutional entrepreneurship for knowledge regions: In search of a fresh set of questions for regional innovation studies. *Environment and Planning C*, 29, 96–112. <https://doi.org/10.1068/c1066r>
- Stroud, D., Fairbrother, P., Evans, C., & Blake, J. (2014). Skill development in the transition to a 'green economy': A 'varieties of capitalism' analysis. *The Economic and Labour Relations Review*, 25(1), 10–27.
- Tödtling, F., & Trippel, M. (2005). One size fits all? Towards a differentiated regional innovation policy approach. *Research Policy*, 34, 1203–1219.
- Tomaney, J., & Somerville, M. (2010). Climate change and regional identity in the Latrobe Valley, Victoria. *Australian Humanities Review*, 49, 29–47.

- Trippl, M., & Otto, A. (2009). How to turn the fate of old industrial areas: A comparison of cluster-based renewal processes in Styria and the Saarland. *Environment and Planning A*, 41, 1217–1233.
- Trippl, M., Asheim, B., & Miorner, J. (2015). Identification of regions with less developed research and innovation systems. CIRCLE Papers in Innovation Studies Paper no. 2015/1.
- Underthun, A., Hildrum, J., Svare, H., Finsrud, H., & Vareide, K. (2014). The restructuring of the old industrial region of Grenland in Norway: Between lock-in, adjustment, and renewal. *Norsk Geografisk Tidsskrift – Norwegian Journal of Geography*, 68, 121–132. <https://doi.org/10.1080/00291951.2014.894566>
- Weber, K. M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change – Combining insights from innovation systems and multi-level perspective in a comprehensive ‘failures’ framework. *Research Policy*, 41, 1037–1047.
- Weller, S. A. (2012). The regional dimensions of the ‘Transition to a low-carbon economy’: The case of Australia’s Latrobe valley. *Regional Studies*, 46(9), 1261–1272.
- Weller, S., Sheehan, P., & Tomaney, J. (2011, November). *The regional effects of pricing carbon emissions: An adjustment strategy for the Latrobe Valley*. Final Report to Regional Development Victoria. Centre for Strategic Economic Studies, Victoria University.
- Wiseman, J., Campbell, S., & Green, F. (2017). Prospects for a “just transition” away from coal-fired power generation in Australia: Learning from the closure of the Hazelwood Power Station, CCEP Working Paper 1708, November 2017. Crawford School of Public Policy, Australian National University.