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Transitioning beyond coal: Lessons from the structural renewal of Europe's old industrial regions

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Abstract

It is often assumed that a transition to a low-carbon future will have highly disruptive and potentially devastating effects on coal regions and their communities. However, evidence from the experience of industrial decline and attempted renewal in Europe's old industrial regions demonstrates that successful regional transition is—while not inevitable—indeed possible. Fundamental transformation of existing industrial, institutional, social and technological structures is not an easy nor straightforward process but fraught with the challenges of creative destruction: while new industrial activities and structures emerge, existing ones are broken down. Drawing on the literature of regional resilience and innovation, the paper offers lessons, insights and cautionary warnings from the experience of renewal initiatives in Europe's old industrial regions and illustrates the ways in which some of the seeds for a 'just' regional transitions to zero-carbon economies may, in fact, lie in a careful understanding of the potential to build on the specific historical context of the regions industrial development and capabilities.

Key words: coal transition, old industrial regions, regional development, regional innovation

JEL codes: O38 and R11

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The Coal Transitions Project

The *Australian Coal Transitions Project* is the Australian component of the international research project: *Coal Transitions: Research and Dialogue on the Future of Coal*. This collaborative project brings together researchers from six major coal producing nations (China, India, Germany, South Africa, Poland and Australia) to explore trajectories and policy options with the potential to facilitate well managed and equitable economic transitions away from coal.¹

The international Coal Transitions project is led by IDDRI (Paris) and Climate Strategies (London). The Australian component is led by the Australian National University's Crawford School of Public Policy, in collaboration with the University of Melbourne's Melbourne Sustainable Society Institute.²

¹ <https://coaltransitions.org/> The international Coal Transitions project is led by Climate Strategies <http://climatestrategies.org/> and The Institute for Sustainable Development and International Relations <http://www.iddri.org/>

² <https://ccep.crawford.anu.edu.au/ccep-research/coal-transition> ; <http://sustainable.unimelb.edu.au/coal-transitions>

International Coal Transition Research project
Working Paper

Transitioning beyond coal: Lessons from the structural renewal of Europe's old industrial regions

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1. Introduction

The challenges and opportunities of a zero-carbon transition for coal regions

Rapid and deep reductions in greenhouse gas emission are needed to implement the Paris Agreement and avoid dangerous climate change. This level of decarbonisation requires fundamental transformation of sociotechnical systems: the interlinked mix of technologies, infrastructures, organizations, markets, regulations, and user practices that together deliver societal functions (Geels et al., 2017). 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 reliant on coal mining and specialized in coal-based energy and industry.

It is often assumed that a transition to a low-carbon future will have highly disruptive and potentially devastating effects on coal regions and their communities. It is indeed a formidable challenge to conceive of economically and socially just low-carbon pathways for coal regions—their workers and communities.

However, evidence from the experience of industrial decline and attempted renewal in Europe's old industrial regions demonstrates that successful regional transition is—while not inevitable—indeed possible. Fundamental transformation of existing industrial, institutional, social and technological structures is not an easy nor straightforward process but fraught with the challenges of creative destruction: while new industrial activities and structures emerge, existing ones are broken down (Boschma and Lambooy, 1999). Studying these regions' experience can therefore provide relevant insights for addressing the challenge of achieving a just transition towards a zero-carbon future in coal regions—and suggest ways in which such a transition can be leveraged as an opportunity for positive economic, social and political transformation, i.e. just, zero-carbon transitions.

This paper is intended for policymakers concerned with the renewal and just transition of coal regions to zero-carbon future—including supranational institutions, and national, regional and local government authorities—as well as civil society organisations and other stakeholders interested in policy advocacy for a just transition.

Structural renewal in Europe's Old Industrial Regions: Implications for zero-carbon transitions

We begin by reviewing the research literature on the structural renewal of Europe's old industrial regions to address the question: *why, when faced with external transformative pressures, are some regional economies able to economically and socially renew themselves, whereas others remain locked in industrial decline?* This literature has engaged with the complex positive and negative aspects of creative destruction that regions experience when faced with industrial decline. As such, it provides us with a nuanced understanding of the interdependent, multi-faceted processes of regional structural renewal, in particularly those specialized in mature industries and technologies. Drawing on the literature of regional resilience and innovation, we distinguish between the short-term capacity of a region to absorb shocks (adjustment) and the long-term capacity of a region to develop new growth

paths (renewal) (Martin and Sunley, 2013). This includes a brief discussion of ways in which the constitutive elements of the regional innovation system (actors' interests and capabilities, networks and institutions) condition the ability of the old industrial region for adjustment or renewal, and particularly hone in on the question whether (and how) the presence of a regional innovation strategy has facilitated renewal. We then consider the lessons, insights and cautionary warnings from the experience of renewal initiatives in Europe's old industrial regions for coal regions currently facing transitions towards a zero-carbon future.

We will also seek to illustrate the ways in which some of the seeds for a 'just' regional transitions to zero-carbon economies may, in fact, lie in a careful understanding of the potential to build on the specific historical context of the regions industrial development and capabilities. Through processes of regional branching, communities can diversify into new areas of industrial development, drawing on the recombination of different but related knowledge, skills and competences found in their existing industries (Frenken et al., 2007). This is not, however, self-evident or given, as the very elements of the regional innovation system that led to historical economic success may ultimately become "stubborn obstacles to innovation" (Grabher, 1993, p.256).

We will therefore investigate what role different regional innovation strategies have played in mobilizing renewal and 'coordinated' transition of the regional economy – and on the work required to build social and political consensus to enable an appropriately long term time frame for a well-planned transition process to occur.

The remainder of the paper is structured as follows:

- *Section 2* provides a review of relevant concepts and evidence from the literature on regional resilience and innovation—in particular exploring the objective of regional renewal rather than adjustment—with a focus on the restructuring experience of European old industrial regions from the 1970s to 1990s.
- *Section 3* then draws out and summarises the critical lessons, insights and warnings from Europe's old industrial regions for regional coal transition strategies. In addition to generalizable lessons for policymakers, we discuss the extent to which some factors are specific to particular locations and historical circumstances—and will raise questions regarding the range of issues which might need to be considered in applying lessons from the EU context to non-EU and developing country contexts.

2. The renewal and resilience of Europe's Old Industrial Regions

Throughout the 1970s and 1980s, many Western regional economies began to experience. This decline occurred in response to several external transformative pressures, including globalisation and the resulting increased competition with low-cost labour countries and the relocation of industries as a result of a new global division of labour; technological advancements that resulted in the digitisation and automation of production processes and the crisis of Fordism; and privatisation of formerly publicly-owned industries in countries such as the United Kingdom (Baeten, Swyngedouw, and Albrechts 1999; Dicken 2003). Particularly Europe's old industrial regions (or rustbelt regions), such as the UK's Midlands, Germany's Ruhr area and the Lorraine in France were affected. These are regional economies based on large industrial agglomerations specialized in the production of either primary inputs for other sectors (such as coal, steel and chemicals), or mass consumer goods, such as cars (Boschma & Lambooy, 1999). These '*old industrial regions*' (OIRs) can more generally be defined as regions overspecialised in mature industries experiencing decline, leading to a loss of regional competitive advantage and innovation capacity (Tödting and Trippel, 2005). In response to these developments, a line of enquiry emerged within regional studies literature that has focused on the potential for, and challenges of, designing resilient regions. This literature asks the simple but particularly for OIRs compelling question, why are some regions capable of overcoming all sorts of shocks while are not?

Whether a region is 'resilient' refers to the distinction between the short-term capacity of a region to absorb shocks—that is, to *adjust*—and its long-term capacity to develop new growth paths—that is, to *renew* itself (Martin and Sunley 2015). To be resilient to changes in external factors, regions must develop new pathways of industrial development and innovation; however, the empirical literature examining regional case studies demonstrates that the capacity to develop such alternative pathways varies greatly between regions. This raises the question: *Why, when faced with external transformative pressures, are some regional economies able to economically and socially renew themselves, whereas others remain locked in decline?* The regional resilience literature has proposed and investigated several structural conditions and determinants of success to account for this variation. Given its focus on regional renewal, this literature provides relevant theory, concepts and empirical analysis that can usefully be applied to the contemporary challenge facing regions—as well as cities, communities and nations—of transitioning to a low-carbon economy.

Regional Innovation Systems

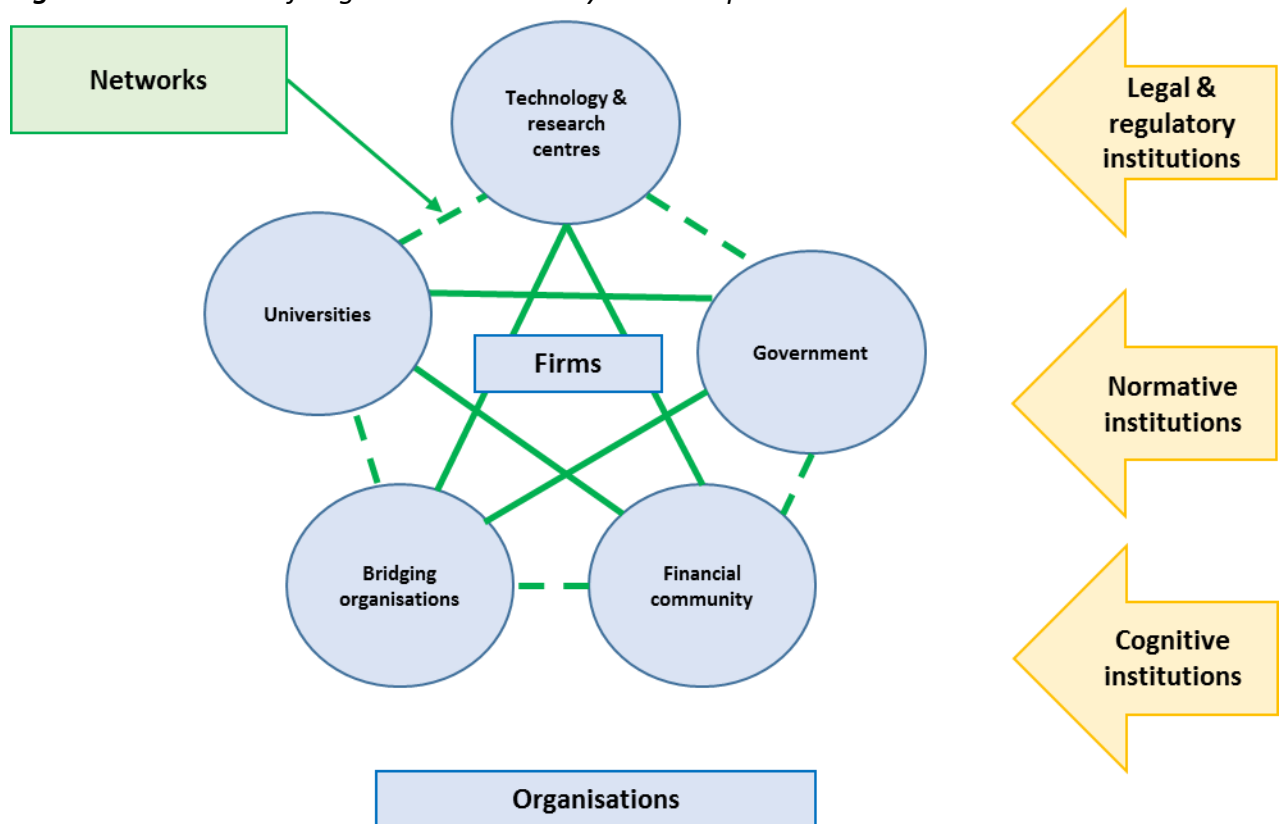
The concept of '*Regional Innovation Systems*' (RIS) emerged from scholarly inquiry into how to restructure the economies of 'rustbelt' areas experiencing industrial decline, through the application of the Innovation Systems approach (e.g. Freeman, 1987) to the study of regions and regional development (e.g. Cooke et al., 1997; Asheim and Coenen, 2005). A RIS is made up of three main components, as illustrated in Figure 1:

- the *organisations* involved in innovation processes: primarily industrial firms – including Small and Medium-sized Enterprises (SMEs), multinational companies, start-ups, and entrepreneurs; knowledge organisations—such as universities and research institutes; public sector organisation and governmental bodies—including regional

authorities and municipalities; NGOs—including unions, interest groups and innovation support organisations; and finance organisations—including chambers of commerce, and their interests and capabilities

- the *institutions*—including ‘hard’ institutions such as laws and regulations, and ‘soft’ institutions including ‘normative’ institutions such as accepted local practices and customs, and ‘cognitive’ institutions such as mainstream discourses and worldviews—that operate in the region; and
- the *networks*—with respect to chains of production, knowledge-sharing, and political relationships—that exist between these organisations and institutions (Asheim et al., 2011).

Figure 1: Schematic of Regional Innovation System components



Within this RIS framework, a region’s capacity for resilience is determined by these elements—its industrial composition, institutional structures, and the nature of its networks (Boschma 2015). The RIS approach has been widely used as a framework for the design, implementation and evaluation of regional innovation policy in a variety of countries and regions.⁵ The RIS approach has become particularly important for regional policy-making

⁵ Some scholars admit that the close relationship of the RIS approach with policy has not been unproblematic, as it may have led to ‘a tendency to collapse levels of abstraction into simple narratives to render them digestible for politicians and policy-makers’ (Morgan, 2004: 873). Nonetheless, the RIS approach lends itself well as a comprehensive umbrella framework that synthesizes notions, ideas, insights and lessons from a range of studies and literatures that deal with innovation in a regional context, including a.o. various agglomeration theories on regional clusters and industrial districts as well as institutional theory and most recently evolutionary economic geography (EEG). As an analytical focusing device, it has helped scholars and policymakers alike to formulate and implement innovation and regional development policy that is sensitive to the specific conditions found in a region.

through the rise of ‘Smart Specialisation’ as an *ex-ante* conditionality framework for European regions to access EU structural funds (Morgan 2017). Smart Specialisation refers to a process of priority-setting in research and innovation strategies in order to build “place-based” competitive advantages and help regions and countries develop an innovation-driven economic transformation agenda’ (Foray 2014; Grillitsch 2016). The concept of smart specialisation signals a new phase in the evolution of regional policy in Europe that has put innovation processes at the centre of regional development strategies. Well-known examples are the Regional Innovation Strategies (RIS), Regional Innovation & Technology Transfer Strategies (RITTS) and Regional Technology Plans (RTP)—initiatives that the European Union has funded in over 150 regions since the mid-1990s (Landabaso, Oughton, and Morgan 2001; OECD 2010). Several useful resources for policymakers have been created as a result of this work, with a selection included in Table 2 below.

Table 2: Resources on RIS and smart specialisation for regional policymakers

<ul style="list-style-type: none"> • EU Smart Specialisation Platform, http://s3platform.jrc.ec.europa.eu/ • European Commission (forthcoming) <i>Socio-economic transformation in coal transition regions</i> • Vezzani et al. (2017) <i>Smart Specialisation, seizing new industrial opportunities</i>, European Commission • Foray et al. (2012) <i>Guide to Research and Innovation Strategies for Smart Specialisations (RIS 3)</i>, European Commission • OECD/European Commission (2011) <i>Regions and Innovation Policy</i> • European Commission (2011) <i>Regional Policy for Smart Growth in Europe 2020</i> • OECD Innovation Policy Platform (2010) <i>Regional Innovation Strategies</i> • OECD <i>Reviews of Innovation Policy</i>, http://www.oecd.org/sti/inno/oecdreviewsofinnovationpolicy.htm

In contemporary applications of the RIS framework for smart specialisation strategies, a large portion of the literature is focused on the existing capabilities of a region and how these condition the range of new growth paths (i.e. new industries or areas of specialisation) that could feasibly develop (Coenen et al., 2017). This trend is based on new empirical insights that new but sustained economic activity that occurs in a region often tends to be related to previous activities—that is, the region is most likely to succeed in diversification through ‘regional branching’, based on ‘related variety’ of its existing capabilities (Neffke, Henning, and Boschma 2011; Rigby 2015). Regional development strategies aimed at diversification are thus more likely to succeed when based on a recombination of different but related knowledge, skills and competences found in existing industries in a region (Asheim et al., 2011; Boschma & Frenken, 2009; Frenken et al., 2007). Examples of such regional branching opportunities for coal regions are highlighted in Chapter 3.

More challenging is the ability to develop alternative growth paths that involve radical departures from previous areas of expertise—that is, unrelated diversification—through the recombination of technologies and knowledge previously not connected (Boschma et al., 2017). While such unrelated diversification would offer a long-term competitive advantage, such combinatorial knowledge dynamics face challenges in creating path-breaking innovation

due to high uncertainties and time horizons, particularly in terms of return on investment (Strambach and Klement 2012). One way to approach such a task is via trial-and-error. To inform the priority-setting process and identify strategic areas of intervention, regions often draw on RIS concepts and methods (Morgan 2017) combined with active and participatory stakeholder consultation and participation, to facilitate a process coined ‘entrepreneurial self-discovery’. Such an entrepreneurial self-discovery process links knowledge and its societal use through 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, 2014).

Regional Innovation Systems in Old Industrial Regions

The RIS framework allows for a differentiated policy approach for diverse types of regions, given that different barriers to renewal will require appropriately focused innovation approaches (Tödtling and Trippel 2005). Tödtling and Trippel (2005) note that policy approaches derived from successful cases of regional transitions may only have limited relevance for underperforming regions, and so identify three typical challenges for low-performing regions that map to the RIS components identified above:

- ‘Organisational thinness’: low clustering, and innovation capacity of, *organisations*—as seen in peripheral regions;
- ‘Lock in’: rigidity in inter-*organisation* networks, normative or cognitive *institutions*, or political *networks*—as seen in Old Industrial Regions (Grabher, 1993 – see below); or
- ‘Fragmentation’: insufficient *networks* between organisations—as is often the case in fragmented metropolitan regions.

They note that given the over-specialisation in mature industries and consequent industrial mono-structure common in OIRs, along with a homogenous worldview that is associated with such a dominance, lock-in will be the major innovation challenge facing OIRs. An inherent weakness of old industrial regions identified by Grabher (1993), is that the very elements of a region’s innovation system that enable its economic success—the extensive and specialized knowledge infrastructure, strong inter-firm linkages, industrial atmosphere and local political support for a given industry—may ultimately become obstacles to continued innovation and diversification into other industries and technologies over time. A region’s economic development can thus ultimately become rigidly specialised—that is, “*locked in’ by the very socioeconomic conditions that once made these regions ‘stand out against the rest’*” (*Ibid.*, p.256). Grabher (1993) identifies three types of such ‘lock-in’:

- *Functional lock-in*: 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*: how a common world view or mindset among actors reinforces ‘group-think’ and precludes creativity and imagination needed for the development of new ideas.

- *Political lock-in*: the existence of dense relationships between public and private sectors that aim at preserving traditional industrial structures that hamper alternative directions for industrial development.

One result of this tendency to lock-in in OIRs is that incremental and process innovation is far more likely to occur than radical, product innovation, given the mature stage of technological trajectories in OIRs and their economic mono-structures (Tödtling and Trippl 2005; Trippl and Otto 2009). Achieving radical innovation however, requires more than a push towards a new technological trajectory to break function lock-in, but also new knowledge-sharing and governance approaches that break cognitive and political lock-in.

Coenen et al. (2015) for example, analyse the experience of a policy designed to encourage renewal of the forestry industry in Northern Sweden, and find that the infusion of a ‘radical emergent technology’ into a mature and declining industry (in this case through the ‘Biorefinery of the Future’ program funded by the national innovation agency) was a *necessary but not sufficient* factor in achieving desired path renewal. The authors emphasise the need for not only a technology-focused ‘push’, but a parallel focus on experimentation processes with alternative firm strategies and business models, and coordination between regional innovation policy and other policy domains. This implies that subsidising Research & Development activities—a common tool to support innovation through public policy—may have limited effect, as there are few forestry firms in the region that would recognize and leverage value in the adoption of radically new technologies for their business. Instead, many forestry and related firms in the region needed to become more aware and learn about challenges, trends and opportunities for their sector and identify themselves what kind of support they needed to remain competitive and find new market opportunities (e.g. in relation to the circular bio-based economy). As such, the role of policy was primarily to act as a broker to facilitate a dialogue between firms, knowledge organisations and public sector organisations to articulate needs for innovation, as well as possible solutions. Once these priorities were known, public funds could be mobilised and allocated for far more targeted and bespoke innovation support.

The type of innovation support that will be most effective will of course vary by region based on the objective of support provision and its intended targets—Table 2 provides an indication of where different typical RIS policy tools might be most appropriate.

Table 2: Typology of public innovation support

Target level of support	Aim of innovation support	
	<i>Assign lacking resources to actors: Support the accomplishment of innovation ideas/reactive</i>	<i>Learning to innovate: Change organisational behaviour/ proactive</i>
<i>Single organisation oriented</i>	Type A: Innovation subsidies and loans, Risk capital	Type B: Business innovation centres, Loans for competence development, Mobility schemes
<i>(Regional) network oriented</i>	Type C: Subsidy for co-operative innovation	Type D: Cluster policies, Regional innovation strategies

Source: Adapted from (Nauwelaers and Wintjes 2002), as cited in (Coenen et al. 2017)

The political-economic context within which these attempts take place has a critical impact on the outcomes of such attempts to renew and diversify regions’ economies. While the

literature on OIRs is dominated by single case studies, Birch et al. (2010) provide a welcome exception in systematically comparing OIRs across Europe. They show that British OIRs perform better than their counterparts in France and Germany in terms of both GDP growth and service employment, while the latter perform better in retaining manufacturing employment. This result, the authors argue, reflects a contrast between the more interventionist industrial policies adopted in France and Germany, and the UK's laissez-faire, market-orientated approach—coupled with the emphasis on regional diversification and upgrading in the former cases, and transplantation through the attraction of inward investment in the latter. Another example is highlighted by Dawley et al. (2015), who compare the attempts by two peripheral UK OIRs (northeast England and Scotland) to leverage their traditional marine-related engineering capacity to diversify into offshore wind and renewable energy sectors. They find that the Scottish region has experienced more success in 'path creation' compared to northeast England's 'path extension', and argue that this is due to the difference in political-economic context—in particular the greater level of 'policy activism', the retention of local regional development institutions, and relatively greater political power and autonomy afforded by devolution in the Scottish context. Finally, Morgan (2017) emphasises the role of institutions, ideas held by the state and *policy* path dependence in the differential RIP repertoires implemented in Wales compared to Spain's Basque Country, which has experimented with more novel institutional approaches.

An example of how obstacles to regional restructuring were overcome can be seen in the transition of coal (and steel) industries in the Ruhr region in north-western Germany, highlighted in Box 1. This example illustrates that innovation-led regional restructuring is not a quick fix. Diversification of regional industry takes many years, if not decades. As the Ruhr illustrates, regional policy can have significant role in facilitating and steering this process. Particularly, policy support is needed to broker between the different organisations of the RIS to form networks and an institutional culture of interaction, collaboration and dialogue.

Box 1: *The restructuring of Germany's Ruhr Valley coal region (Coenen et al., forthcoming)*

A key example of a coal region that successfully transformed and diversified into a low-carbon development path can be found in the German Ruhr region. At its peak in 1956, the coal mines of the Ruhr produced 124 million tons of coal, employing almost half a million people. Due to the rise of oil as a fuel, cheap coal imports from countries such as the US as well as the increasing availability of less-expensive steel on the global market in the 1960s and 1970s, the Ruhr's core industries – coal, steel and related industry – began to contract and the region witnessed sharp industrial decline and rising unemployment. By the 1990s, about two-thirds of the coal, steel and related industry jobs were gone. At the same time, environmental conditions suffered severely from air and water pollution from the heavy industry which led 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'.

Policy responses since the 1960s can be divided in two categories: re-industrialisation and neo-industrialisation (Hospers, 2004). The former prevailed largely as an initial response in the 1960s and 1970s. Partly 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 which 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 all these efforts to remain competitive, many mines and plants were forced to close, albeit in relatively controlled and coordinated ways through the provision of wage subsidies, compensation payments or early retirement. 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 initiatives for economic restructuring 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 and indicative: “What we need in the Ruhr are muscles, not brains” (p. 151).

In 1984 the State of North-Rhine Westphalia changed its response towards neo-industrialisation through a more pro-active industrial policy and developed a programme 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 emphasized relatively early compared to other regions in the world. This regional knowledge base, though for many years ‘hidden’ within the coal and steel industry, provided the resource base from which new industrial paths emerged (i.e. regional branching based on related variety). Today, the Ruhr has become one of the key centers for environmental industry, technology and research in Germany. Local firms, universities, research institutes (e.g. the Soil Protection Centre and the Environmental and Packaging R&D Centre) and environmental agencies cooperate closely. Also, former mines and steel factories are currently used for tourist purposes (‘industrial culture’): having been one of Europe’s largest industrial coal complexes, Zollverein is now a UNESCO World Heritages Site Zollverein and the 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 the neo-industrialisation approach towards structural change was organized departed from the ways and approaches from the past. 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 in the local community. The Emscher River International Building Exhibition (IBA) heralded this new approach.

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 from mining and large heaps of mining residues and dams. The approach of the Emscher IBA – with the official subtitle ‘Workshop for the Future of Old Industrial Regions’ was innovative and new. Established by the Ministry of Urban Development, Housing and Transport for the State of Northrhine-Westfalia, its 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, 1993, p. 133). The initiative lasted from 1989 to 1999 and invited for proposals from all sectors of society, be it municipalities, companies, pressure groups, individuals and so on to address five themes for restructuring the area: the renovation of the Emscher landscape into parkland, ecological regeneration of the Emscher River system, development of new work locations in derelict industrial sites, development of new housing forms and urban district and, new uses for industrial buildings and industrial monuments.

The approach used to implement the IBA initiative has helped to design, implement and test both technological and institutional innovation for renewal. In 10 years 123 cooperative projects were implemented, varying from the setting up of technology centres (corresponding to abovementioned type B regional innovation support) to innovative and green renovation of apartments and the restoration of industrial monuments for tourists purposes (corresponding to abovementioned type C regional innovation support). It is however this very role of providing a local and inclusive participation framework combined with top-down quality control as an alternative to previously more centralized policy and governance approaches that constitutes the success of the IBA initiative in restructuring the Ruhr (corresponding to abovementioned type D regional innovation support). 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 built-up of new industries in the Ruhr through processes of related diversification.

3. Lessons for regional transitions to a zero-carbon future

This chapter aims to bring together some of the key insights from the literature on old industrial regions summarised above, and identify the ways in which its central insights can apply to coal regions. In particular, it must be emphasised that there is no ‘one size fits all’ approach to regional innovation policy (Tödting and Tripl 2005)—a lesson which applies to coal regions as much as any other region seeking to renew itself. Policymakers considering the structural renewal of coal regions must therefore assess which barriers to, and potential opportunities for, innovation apply to the region concerned. Any approach will likely require a mix of policies involving several complementary instruments and strategies given that—as with all aspects of the transition to a zero-carbon future—there is no ‘silver bullet’ solution. We can, however, identify some general insights from the historical experience of Europe’s OIRs—especially from the studies that have explicitly focused on diversification in OIRs whose economic base is coal mining—that are relevant to coal regions undergoing transitions to a zero-carbon future. Furthermore, the RIS approach provides a useful framework for considering policy responses for such regions.

Organisational interests and capabilities

Coal regions often face the economic-structural impact factors much alike those of Old Industrial Regions. They often feature an industrial mono-culture, are overly-specialised in declining, capital-intensive industry dominated by large (often multinational) companies and therefore high barriers to entry for entrepreneurs and start-ups. Much like OIRs, the economic structure of coal regions is characterised by overly strong clusters, with the fate of regions tied to the extractive industry cluster (Tripl and Otto 2009). Renewal and development strategies must therefore aim to steer regional industries away from becoming value extracting resource peripheries, through diversification into related and unrelated sectors and a focus on disputing functional lock-in. Every coal region will have different resources that provide the basis for regional branching and related diversification. However, the experience and analysis of coal mine closures in European old industrial regions to date suggests that the one of the following areas might offer a potential source of regional branching for a ‘typical’ coal mining region.

Tourism, natural beauty and infrastructure: Numerous examples exist of regions successfully leveraging their assets related to coal mining (particularly the physical space and infrastructure available) to offer contemporary tourist attractions—often in the form of sites for adventure sports and other outdoor activities, hosts of arts festivals and performances in former industrial infrastructure, or museums that honour the region’s history. For example, the Zasavje region in central Slovenia, which includes a number of previous coal mining towns, has focused on cultivating an image as a local tourist area—including establishing festivals that use former industrial buildings as performance venues; encouraging mountain biking, rafting and hiking through improved tourist routes, visitor information and the use of remediated sites (such as the Europark recreational area); and integrating new tourist avenues with existing industries, such as enhancing tourist offerings at local glass manufacturing sites (Harfst, 2015). An alternative example can be seen in the Austrian mine and steel region of Steirische Eisenstrass, which now holds an annual Erzberg- Rodeo motocross event with 50,000 attendees in the active open cast iron ore mining site—an event which is now the biggest of its kind in Europe and led to the encouragement of adventure

sports in the region—and an alternative music and arts festival, Rostfest, in the mining town of Eisenerz (*Ibid.*) The Lusatia region in eastern Germany has similarly filled former open-cast mines with water to create a “lakeland” (*Ibid.*) The opening of the Guggenheim Museum on a former industrial port site in Bilbao, situated in the heart of Spain’s Basque Country—an old industrial region that traditionally specialised in steel and shipbuilding, that has since sought to diversify into technology-intensive and services-related activities—provides another salient example of this strategy. In some instances, such diversification is building on the coal-mining history while in other instances such diversification may trajectories may take place alongside the phasing-out of coal-mining.

A related area for development in the tourism sector is the potential for museums designed to honour the heritage of coal regions, as has been implemented in the Steirische Eisenstrass region (Harfst, 2015). Similarly, former mines, power stations, steel factories are currently used to preserve and exhibit ‘industrial culture’ for tourists in the Ruhr Valley, where Zollverein (formerly one of Europe’s largest industrial coal complexes) is now a UNESCO World Heritage Site and regional museum (Coenen et al., n.d.). In Lusatia, a former conveyor bridge, wastewater treatment plant, and viewing tower have all been preserved as monuments of the region’s industrial heritage, and tours of the still operational open-cut mines are offered (Harfst, 2015).

Similarly, infrastructure related to coal-mining and power generation may be re-used and redeployed in different industrial context. An obvious opportunity lies in the renewable energy sector. For example, biomass and geothermal capabilities can be explored in regions with former open-cut coal mines, whereas power transmission and generation infrastructure used by coal-fired power stations could be relatively easily substituted by renewable energy sources.

Skills and expertise: Potential for related diversification within coal mining regions exists through the application of knowledge, skills, and competencies that are found in a typical mining regions—including manufacturing and engineering capabilities—to other sectors. Again, an obvious opportunity lies in the renewable energy sector. A lot of the worker’s knowledge in relation to installation, service and maintenance could potentially be readily redeployed. However, the objective must not be simply to attract an alternative industry or single large-scale employer, but to develop the endogenous capacity of regions to renew themselves (see Box 1). This implies not only seeking to apply a region’s existing skill base to new sectors, but making a concerted effort to both build up new skill bases via universities and technical colleges, and attract new skills will both be critical (Tödting and Trippel 2005). Examining skills development in deindustrialisation in Wales, Appalachia and the Ruhr Valley, Stroud et al. (2014) also suggest that that emergence of highly-skilled, good quality and well-paying jobs are more likely to occur in coordinated market economies such as Germany compared to the liberal market economies of United Kingdom and the United States.

Even though the natural endowments and available capabilities in energy technologies may offer comparative advantage for coal regions to diversify into renewable energy, these resources do not guarantee sustained competitive advantage unless localised value creation and capture processes are in place. There is otherwise a risk that resource-based industries are reduced to extractive resource-based enclaves with weak productive linkages to local

firms, foreign ownership of capital, and export of goods with low or no value-added—all of which lead to a vicious circle for local development, the so-called ‘regional resource curse’ that has been documented in high, middle and low-income countries regions alike (see for example, Freeman 2009; Iacono 2016; Xu et al. 2016). Resource-rich regional areas therefore often find themselves at the low-end in renewable energy value chains, as they primarily host basic natural resources and initial processing activities whose output is subsequently distributed beyond the initial rural resource system for further processing, value-added or use (Murphy and Smith, 2013).

Institutions

Of the institutions identified in Chapter 2, lock-in of cognitive and normative institutions will clearly be a critical factor in most coal regions, given the heated nature of the debate on climate change action. The scale and pace of transformation that many regions will experience in a low-carbon transition if the objectives of the Paris Agreement are to be met will be substantial and swift, in terms of changes to regions’ physical environments, the nature and availability of employment, and identity and community structures. Cognitive lock-in can therefore present a significant (arguably, one of the most significant) obstacle to zero-carbon transitions. In a study of state-led mine rehabilitation in East Germany, Harfsta and Wirtha (2011) highlight the need for regional capacity-building and the empowerment of affected municipalities to input into their own development agenda, presenting one avenue that may facilitate the establishment of new cognitive and normative frames.

Such lock-in may also present a source of division between regional actors with different world views and frames of interpretation. For example, analysis of Germany’s Lusatia lignite coal mining region by Morton and Müller (2016) find that the contestation over coal in Lusatia can be conceived as a contest between *‘competing visions of modernity; one bucolic, localized and post-industrial, in which the energy transition has become integrated into the fabric of rural life, and one urban, regional and industrial, in which the coal industry continues to sustain mass employment and prosperity for the “silent majority” and nourish a sense of pride and identity’* (p.11). The authors suggest that rather than additional policy recommendations aimed at solving a technocratic problem, what is required is greater understanding of the politics of coal regions and the motivations and narratives of the different actors involved—explored further in the discussion of political networks below.

Networks

A critical barrier to be overcome in coal regions is the political lock-in established through strong clusters of fossil fuel firms and associated vested interests. Baeten et al. (1999), assessing the failure of restructure attempts in the Belgian Limburg coal region following the contested closure of its remaining mines in 1992, highlight the role of political fragmentation, opposition politics and the formation of shifting interest-based coalitions that succeeded in blocking restructuring policies and acquiring significant financial resources based on their relative power. They caution against regional restructuring policies that do not consider regional power relations, their associated institutions, and what they term the ‘shifting power geometries’ (p.256) of alliances that are created and dissolved as the vested interests of

regional actors shift in response to changing circumstances. This idea of shifting coalitions is also highlighted in the assessment of the US experience by Hess (2014).

Baeten et al. (1999) attribute much of the failure to counter such powerful coalitions in the Limburg region to the absence of an overall restructuring strategy and lack of involvement of higher-level (in this case, Belgian and EU) public organisations that could support an integrated restructuring strategy able to overcome local party politics and short-term interests. This highlights an interesting tension, as the experience of coal regions in other countries (e.g. Italian regions) illustrates how national party politics can involve as much, if not more, short-term interests and inaction—demonstrating that the alignment of a given political actor to vested interests such as the fossil fuel industry is more relevant than the level of government per se, and that overcoming such incumbent interests is a primary step in ensuring coordination between all levels of government. Analysis of the vulnerability of OIRs in the low-carbon transition by Gonzalez-Eguino et al. (2012) similarly caution that industrial and climate policies must be well coordinated—and European and national bodies involved in such coordination—to ensure the mitigation of such adverse effects on regions.

Table 3 summaries the discussion above, distilling key considerations regarding barriers to renewal for policymakers in coal regions transitioning to a low-carbon future, and potential approaches to consider based on the answers.

Table 3: Summary of barriers to renewal and related considerations for policymakers in coal regions

Barriers to renewal	Policy strategy	Potential policy approaches
Functional lock-in into declining industries that tends to block the development of alternative linkages and reorientations in the value chain	<ul style="list-style-type: none"> • Renewal either through new industry build up or (related) diversification drawing on existing (coal-related) industry • Build up and attract new skills and competencies 	<ul style="list-style-type: none"> • Challenging to build up industry from scratch – need for anchor organisations that foster spillover effects (e.g. university, hospital) • Diversification that draws on skills of the coal workforce. • Redeployment of capabilities from the supporting industry from coal to other value chains. • On-the-job retraining of workforce • Mitigation of social costs without artificially extending the life-time of industries in decline
Cognitive lock-in that builds on a regional identity as a coal region	<ul style="list-style-type: none"> • Celebrate ‘small victories’ to transform ‘culture of defeat’ • Build up social capital (trust) • Empower and encourage entrepreneurship 	<ul style="list-style-type: none"> • Collaborative innovation projects that demonstrate that change / mindful deviation is possible • Collective envisioning of future development pathways with stakeholders in the region • Internalize entrepreneurial learning in teaching curricula

	<ul style="list-style-type: none"> • Political patience (no quick fix) 	<ul style="list-style-type: none"> • Identify and collaborate with entrepreneurs and start-ups in the region (incl. social entrepreneurs) • Allow for and anticipate failures in policy responses, give room for experimentation and focus on policy learning (capacity building) • Allow search for new regional identity
<p>Political lock-in because of dense relationships between public and private sectors that aim at preserving traditional industrial structures that hamper alternative directions for industrial development</p>	<ul style="list-style-type: none"> • Destabilize networks based on vested interests • Strength of weak ties 	<ul style="list-style-type: none"> • Allow for new voices in regional governance • Networking events that target and mobilize young population

We finish by identifying some unanswered questions for coal transitions raised by the OIR literature. Much relevant work on such questions has been undertaken in other disciplines, including political science, sociology and the broader transitions literature, pointing to the need for interdisciplinary consideration of complex transition processes such as transforming regional economies from dependence on coal-mining to a low-carbon future. However, further case-specific research, policy analysis and experimentation is needed. Of particular relevance are the power relations present in the regions in question, including identification of vested interests, coalitions of interest groups that are working together, and how these alliances might shift in response to different policy choices. As the Ruhr example illustrates, a vexing challenge for renewal of old industrial and coal regions is to create legitimacy and buy-in for transition from across a broad field of significant stakeholders and to avoid that renewal gets hampered by vested interests that have a stake in retaining status-quo. A second set of questions exist regarding the role of governance arrangements. Namely, identifying what levels of government are involved in regional coal transitions, whether others can (and should) be brought in, whether and how non-state actors (NGOs, social movements, community groups, private sector, entrepreneurs) can be engaged and what governance arrangements can ensure that such collaboration is in fact participatory and fruitful. Finally, it is important to remain cognisant of potential undesirable consequences that might result from economic and social transitions, and whether policies in related domains—for example, industrial or social policy—need to be coordinated to mitigate such effects.⁶

⁶ The authors are grateful for the comments of Oliver Sartor.

References

- Asheim, Bjørn T., and Lars Coenen. 2005. "Knowledge bases and regional innovation systems: Comparing Nordic clusters." *Research policy* 34, no. 8: 1173-1190.
- Asheim, Bjørn T., Ron Boschma, and Philip Cooke. 2011. "Constructing Regional Advantage: Platform Policies Based on Related Variety and Differentiated Knowledge Bases." *Regional Studies* 45(7):893–904.
- Baeten, Guy, Erik Swyngedouw, and Louis Albrechts. 1999. "Politics, Institutions and Regional Restructuring Processes: From Managed Growth to Planned Fragmentation in the Reconversion of Belgium's Last Coal Mining Region." *Regional Studies* 33(November):247–58.
- Boschma, Ron. 2015. "Towards an Evolutionary Perspective on Regional Resilience." *Regional Studies* 49(5):733–51.
- Boschma, Ron, Lars Coenen, Koen Frenken, and Bernhard Truffer. 2017. "Towards a Theory of Regional Diversification: Combining Insights from Evolutionary Economic Geography and Transition Studies." *Regional Studies* 51(1):31–45.
- Boschma, Ron and Jan Lambooy. 1999. "The Prospects of an Adjustment Policy Based on Collective Learning in Old Industrial Regions." *Source: GeoJournal* 49(4):391–99. Retrieved October 4, 2017 (<http://www.jstor.org/stable/41147439>).
- Coenen, Lars, Stephanie Campbell, John Wiseman. n.d. "Regional Innovation Systems and Transformative Dynamics: Transitions in Coal Regions in Australia and Germany." in *New Avenues for Regional Innovation Systems – Theoretical Advancements, Empirical Cases and Lessons for Policy*. Springer.
- Coenen, Lars, Bjørn Asheim, Markus M. Bugge, and Sverre J. Herstad. 2017. "Advancing Regional Innovation Systems: What Does Evolutionary Economic Geography Bring to the Policy Table?" *Politics and Space* 35(4):600–620.
- Coenen, Lars, Jerker Moodysson, and Hanna Martin. 2015. "Path Renewal in Old Industrial Regions: Possibilities and Limitations for Regional Innovation Policy." *Regional Studies*.
- Danielzyk, R. and Wood, G. 2006. "Innovative strategies of political regionalization: the case of North Rhine-Westphalia", *European Planning Studies*, 12:2, 191-207.
- Dawley, Stuart, Danny Mackinnon, Andrew Cumbers, and Andy Pike. 2015. "Policy Activism and Regional Path Creation: The Promotion of Offshore Wind in North East England and Scotland." *Cambridge Journal of Regions, Economy and Society* 8(2):257–72.
- Dicken, Peter. 2003. *Global Shift: Reshaping the Global Economic Map in the 21st Century*. 4th ed. London: Sage.

- Foray, Dominique. 2014. *Smart Specialisation: Opportunities and Challenges for Regional Innovation Policy*. Routledge.
- Freeman, Christopher. 1987. *Technology, Policy, and Economic Performance : Lessons from Japan*. Pinter Pub. London, New York.
- Freeman, Donald G. 2009. "The 'Resource Curse' and Regional US Development." *Applied Economics Letters* 16(5):527–30.
- González-Eguino, Mikel, Ibon Galarraga, and Alberto Ansuategi. 2012. "The Future of Old Industrial Regions in a Carbon-Constrained World." *Climate Policy* 12(2):164–86.
- Grabher, Gernot. 1993. "The Weakness of Strong Ties -- The Lock-in of Regional Development in the Ruhr Area." Pp. 255–77 in *The embedded firm: On the socioeconomics of industrial networks*. London and New York: Routledge.
- Grillitsch, Markus. 2016. "Institutions, Smart Specialisation Dynamics and Policy." *Environment and Planning C: Government and Policy* 34(1):22–37.
- Harfst, Jörn. 2015. "Utilizing the Past: Valorizing Post-Mining Potential in Central Europe." *Extractive Industries and Society* 2(2):217–24.
- Harfst, Jörn and Peter Wirtha. 2011. "Structural Change in Former Mining Regions: Problems, Potentials and Capacities in Multi-Level-Governance Systems." *Procedia - Social and Behavioral Sciences* 14:167–76. Retrieved (<http://dx.doi.org/10.1016/j.sbspro.2011.03.033>).
- Hess, David J. 2014. "Sustainability Transitions: A Political Coalition Perspective." *Research Policy*.
- Hospers, Gert-Jan. 2004. "Restructuring Europe's rustbelt: The case of the German Ruhrgebiet" *Intereconomics*, Vol. 39, Iss. 3, pp. 147-156.
- Iacono, Roberto. 2016. "No Blessing, No Curse? On the Benefits of Being a Resource-Rich Southern Region of Italy." *Research in Economics* 70(2):346–59. Retrieved (<http://dx.doi.org/10.1016/j.rie.2015.03.003>).
- Landabaso, Mikel, Christine Oughton, and Kevin Morgan. 2001. "Innovation Networks and Regional Policy in Europe." Pp. 243–73 in *Innovation Networks*. Heidelberg: Physica.
- Martin, Ron and Peter Sunley. 2015. "On the Notion of Regional Economic Resilience: Conceptualization and Explanation." *Journal of Economic Geography* 15(1):1–42.
- Morgan, Kevin. 2017. "Nurturing Novelty: Regional Innovation Policy in the Age of Smart Specialisation." *Environment and Planning C: Politics and Space* 35(4):569–83. Retrieved (<http://journals.sagepub.com/doi/10.1177/0263774X16645106>).

- Morton, Tom and Katja Müller. 2016. "Lusatia and the Coal Conundrum: The Lived Experience of the German Energiewende." *Energy Policy* 99:277–87.
- Nauwelaers, C. and R. Wintjes. 2002. "Innovating SMEs and Regions: The Need for Policy Intelligence and Interactive Policies." *Technology Analysis & Strategic Management* 14:201–215.
- Neffke, Frank, Martin Henning, and Ron Boschma. 2011. "How Do Regions Diversify over Time? Industry Relatedness and the Development of New Growth Paths in Regions." *Economic Geography* 87(3):237–65.
- OECD. 2010. *OECD Innovation Policy Platform Regional Innovation Strategies*. Retrieved (www.oecd.org/innovation/policyplatform).
- Rigby, D. L. 2015. "Technological Relatedness and Knowledge Space: Entry and Exit of US Cities from Patent Classes." *Regional Studies* 49(11):1922–37.
- Strambach, Simone and Benjamin Klement. 2012. "Cumulative and Combinatorial Micro-Dynamics of Knowledge: The Role of Space and Place in Knowledge Integration." *European Planning Studies* 20(11):1843–66.
- Stroud, Dean, Peter Fairbrother, Claire Evans, and Joanne Blake. 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.
- Tödting, Franz and Michaela Tripl. 2005. "One Size Fits All?: Towards a Differentiated Regional Innovation Policy Approach." *Research Policy*.
- Tripl, Michaela and Anne Otto. 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(5):1217–33. Retrieved October 4, 2017 (<http://journals.sagepub.com.ezp.lib.unimelb.edu.au/doi/pdf/10.1068/a4129>).
- Xu, Xiaoliang, Xuefen Xu, Qian Chen, and Ying Che. 2016. "The Research on Generalized Regional 'resource Curse' in China's New Normal Stage." *Resources Policy* 49:12–19. Retrieved (<http://dx.doi.org/10.1016/j.resourpol.2016.04.002>).