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Employment Effects of Historical Coal Decline

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Abstract of Thesis submitted by:

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The need to phase-out fossil fuel-based energy systems, particularly unabated coal-fired power plants for electricity generation and associated mining activities, has become an essential part of climate and energy policy agendas worldwide. In the management of exit from coal, the risks of employment and loss of substantial share of local economic activities are among immediate challenges that need to be addressed. Focusing on these emerging challenges, scholars have not systematically engaged in a retrospective analysis of previous industrial decline that can contain valuable lessons for the ongoing transition. The thesis systematically reviews the post-transitional literature based on three main categories according to intervention levels (regions and communities, companies, and individuals) and associated 11 sub-categories highlighting specific policy instruments to mitigate consequences for the affected groups. It conducts a systematic analysis of the employment effects of historical coal transition to deduce lessons from post-transitional literature to inform future research and policy in sustainability transition. The findings highlight that policymakers should focus on developing functioning institutions (i.e., higher education institutions, universities, research hubs) rather than public infrastructure to boost regional attractiveness for investors and nudge for job creation in the affected regions. Concerning companies, the findings emphasize the importance of government in sharing the liabilities with companies to ensure compliance with distributional justice, through reducing pension premiums and healthcare liabilities, and mine remediation and restoration costs. Regarding individuals, the findings suggest that governments should conduct an accurate statistical analysis of workers' age groups before closures, to identify the proportion of workers who might seek early retirement benefits and those who can be retrained for reemployment.

Keywords: regime destabilization, coal, coal mining, coal communities and workers, low-carbon energy transition, climate policy

Acknowledgements

During the unfolding days of pandemics, the class of 2020 faced numerous difficulties in writing process of the final thesis due to the shutdown of Central European University campuses and the library. I remember starting my day with typing “頑張って ください” (ganbatte kudasai) on top of a blank page which translates into “please do your best” and is a way to say “good luck” in Japanese. This simple phrase with such a unique meaning helped me keep going when I found it most challenging to proceed.

I would like to express my huge gratitude to my supervisor Professor Aleh Cherp, who closely assisted me through the process and helped me to overcome the challenges that came on my way during the writing journey. I would also like to thank Dr. Jessica Jewel of Chalmers University of Technology in Sweden for her assistance in formulating research design and sharing valuable knowledge in the initial stage of the research.

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1 Introduction:

Responding to the rapidly rising risks of climate change, a significant number of countries pledge to phase-out fossil fuel-based energy systems. The International Energy Agency (2019b) declares that in 2018, after 3 years of stagnation, there was a growth in global energy-related greenhouse gas (GHG) emissions ascribed to decelerating renewable diffusion and robust economic growth.

Among all types of fossil fuels, coal remains a predominant pollutant, accounting for more than 44% of global energy-related carbon dioxide emissions (Caldecott et al. 2017). The International Energy Agency (2019a) conducted a study to assess the proportion of various fossil fuel types impacting global temperature rise and concluded that carbon dioxide emitted only from coal combustion accounts for 0.3 degrees Celsius out of 1-degree Celsius increase in global average temperature compared to pre-industrial levels. The findings urge to eliminate unabated coal from the global energy systems to reach climate stabilization goals put forward in the Paris Agreement. Several national and state/provincial governments embrace ambitious targets for climate change mitigation and introduce policies that aim to reduce the use of coal. One of the most remarkable examples of such endeavors was established as the result of a coalition of Canadian and the UK governments who launched the Powering Past Coal Alliance (2018), to foster international cooperation on phasing-out coal-fired electricity generation by 2030 in OECD countries and by 2050 in all countries.

Transition of any kind involves eradication and abandonment of previously dominant sociotechnical systems. Plans related to phasing-out incumbent regimes impose disruption for local coal mining communities, resulting in so-called “structural breaks” in the global energy market that are characterized as abrupt changes impacting livelihoods of thousands and decline

in local economic performance (Caldecott et al. 2017). Reduction of coal use imposes a threat to the global coal market environment since such changes usually occur much faster than predicted by stakeholders managing structural changes and can be excessively troublesome causing regime destabilization (Leipprand & Flachsland 2018). In the management of exit from coal, the risks former workers face related to reemployment and loss of significant share of local economic activities are among the most immediate challenges that need to be addressed.

Modern literature on transition management often argues that these risks can be mitigated in a framework of "just transition" and tries to work out the best ways to achieve it. Scholars in different academic fields focus on various elements of "just transition" to identify and evaluate strategies that can minimize the impacts of climate policies on coal sector workers and advance understanding of regime destabilization (Pai et al. 2020). Nevertheless, scholars (Shove and Walker 2007; Turnheim and Geels 2012; Johnstone and Hielscher 2017) highlight that transition management literature often disregards the importance of the declining or disappearing systems and associated consequences for local communities and skilled workers, putting too much emphasis on theories of the technological innovation side of sustainable transition. Throughout the review of existing literature on sustainable transition, I have also identified a substantial gap in efforts to combine theoretical orientations towards the present and the future with lessons from historical industrial decline.

In view of these gaps in knowledge, my study pursues the following research questions:

1. What types of policies were effective in mitigating job losses correlated with historical coal decline in various contexts?

2. What lessons can be derived from previous industrial and mining sector decline to secure sustainable transition away from coal for workers, communities, and local economies that predominantly depend on coal?

The thesis aims to conduct a systematic analysis of the employment effects of historical coal transitions and deduce lessons from past for informing just low-carbon transitions. In order to achieve its aim, the thesis builds upon theories of economic regeneration, as well as regime destabilization theories, to better scrutinize transition management dynamics. Subsequently, the thesis aims to combine theoretical orientation with genuine lessons from history. To reach the predefined goal, the thesis seeks to pursue the following objectives:

1. To build up the literature review on seminal studies and economic theories that help to advance understanding of regime destabilization and codependent dynamics of job losses and job recovery.
2. Conduct a systematic review of post-transitional literature of the countries that have experienced a significant and persistent decline in coal production.
3. Link the analysis of the real-world practices and policies aimed at mitigation of consequences for communities and individuals in historical transitions, with the theoretical framing and deduce practical lessons to inform future policymakers and research in the area, particularly through CINTRAN—Carbon-intense Regions in Transition project (Coal Transitions 2020).

This paper takes an overarching retrospective approach using a systematic literature review method to examine the employment dynamics in the countries with a significant historical decline in coal production that had major impacts on local communities' livelihoods. The systematic review has been conducted through standardized and precise methods including the

following pillars: 1) question formulation with stakeholder engagement, 2) peer-reviewed protocol development (a detailed methodological plan of the review process), 3) comprehensive search for evidence, 4) careful eligibility screening of literature, 5) coding and data extraction, 6) critical appraisal of study validity, 7) synthesis (Berger-Tal et al. 2019, 3).

The research aims to identify solutions to secure a sustainable transition away from coal for workers, communities, and local economies that predominantly depend on coal. The review categorizes practices in 3 main sections based on the level of interventions: regions and communities, companies, and individuals. Each section is later divided into subsections based on the identified policies aiming to mitigate consequences of immense mine closure for groups mentioned above. Through conducting this review, I aim to assemble genuine lessons from historical coal decline to inform future policies and research in this area. In the discussion section, I aim to summarize the findings in light of the theoretical background built throughout the literature review.

The thesis is structured as follows. Chapter 2, I review the literature on seminal studies existing in regime destabilization, transition management, and economic theories that shape grounded understanding on dynamics of transition and correlated consequences. Chapter 3, I introduce systematic literature review method applied and the framework I have developed to conduct the research. Chapter 4, I present the results of post-transitional literature analysis in line with the established analytical framework. Chapter 5 further discusses findings in light with theoretical framing established in the literature review. Bearing in mind the predefined aim of the thesis, in Chapter 6, the conclusions, I present a set of policy recommendations based on historical best practices and lessons from former mining regions.

2 Literature review

The need to phase-out fossil fuel-based energy systems, particularly, unabated coal-fired power plants for electricity generation and associated mining activities has become a significant topic in climate and energy policy agendas worldwide (Kern and Rogge 2016, McCauley and Heffron 2018, Shove and Walker 2007). Due to the falling demand for thermal coal, many countries are planning to reduce coal production significantly, and some are already going through an exit from the coal economy. The main drive for such massive transition and active policy adjustments is the pressure to achieve the goals put forward in the Paris Agreement (Kern and Rogge 2016). Considering the time constraint, countries along the globe face challenges in tailoring policies that enable just transition for coal miners, their communities, and the local economy.

The literature review is subdivided into the following sections. The first section identifies the core elements of the destabilization of an incumbent socio-technical regime that come with the sustainability transition. Later, the review summarizes the just transition framework that has become a significant component of climate change mitigation discourse and further elaborates prerequisites to diminish the risks for coal workers and communities. This is followed by the review of seminal studies in labor economics and the institutional strategies that establish building blocks for better comprehension of job loss and recovery dynamics. The last section touch upon the importance of governance in job recovery for regions facing massive industrial decline.

2.1 Regime destabilization

Scholars have been explicitly focused on technological attributes of socio-technical transitions emerging in low-carbon transition debates, to unleash the full potential of radical innovation

technologies (Geels 2002; Genus and Coles 2008; Rosenbloom et al 2016). The burgeoning literature in the field of 'sustainability transition' has deployed the 'multilevel' model of innovation studies initially proposed by Rip and Kemps (1998), to describe how new niche-based technologies evolve from a protected environment into the dominant operating configurations that reform socio-technical regimes and landscapes. Academically, Shove and Walker (2007) highlight that current transition management literature holds on to an excessively optimistic attitude, built on an alluring amalgamation of complexities and predictions, neglecting the core element of the transition puzzle — a retrospective analysis of previous industrial decline. History holds critical and insightful hints to tailor policies for forthcoming energy transitions. Choosing historical cases allows for a full investigation of the destabilization process associated with energy transitions, from beginning to end means (Grubler 2012).

The destabilization of the incumbent regime and the decay of previously predominant socio-technical systems that come along with sustainability transition receive far less attention in transition management debates (Turnheim and Geels 2012). Turnheim and Geels (2012) define it as a neglected aspect of transition studies, referring to it as a flip side of the energy transition.

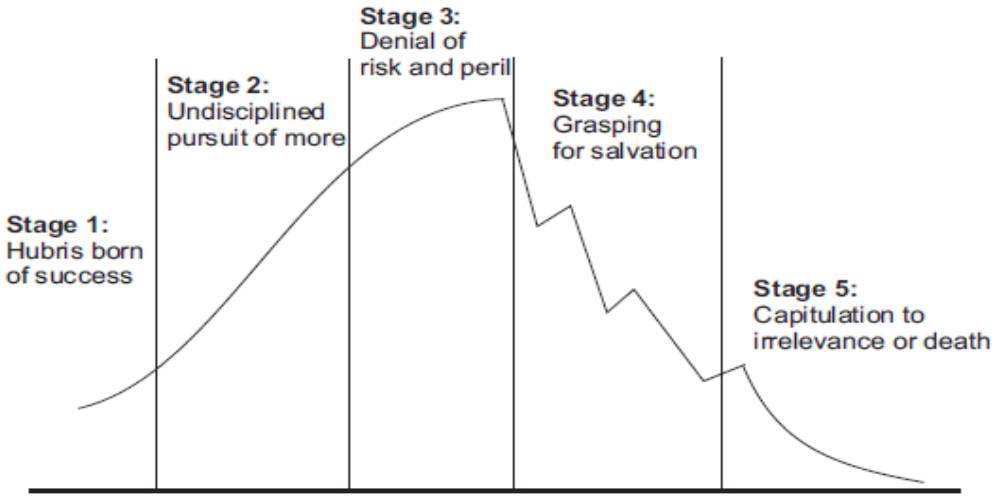
Paying more deliberate attention to the flip side of the energy transition, which is characterized as the destabilization of existing regimes and deindustrialization, can make a significant contribution to transition management literature (Johnstone and Hielscher 2017). In addition, it can help to accelerate the diffusion of niche-based renewable technologies by eliminating the bottleneck that deeply entrenched industries and systems impose on low-carbon transition (Turnheim and Geels 2012).

Stability of socio-technical systems and regimes can be explained as continuous reproduction of necessary elements in the recurring and cyclical matter (Markard et al. 2012). Destabilization, on the other hand, represents incapability of industry to maintain its competitiveness, performance weakening, and inability to reproduce core regime elements (Markard et al. 2012). This usually occurs when industry actors change the focus or direction by reorienting themselves to a new system, or when new entrants cause disruptions in the stable market environment (Turnheim and Geels 2012). With respect to stability, various academic disciplines highlight theories that help to explain regime reproduction from different aspects: a) evolutionary and industrial economics consider natural resources and labor force to be primary elements of the reproductive regime; b) neo-institutionalists argue for the importance of legitimacy and political support; c) managerial economists and sociologists assert that endogenous features such as confidence, commitment, and enactment are essential for regime's stability (Turnheim and Geels 2012). In the above mentioned first two categories, scholars consider both endogenous and exogenous elements to be prerequisites for sustaining stability in a market environment. However, in the case of managerial economics, destabilization is explained solely from a firm-oriented endogenous perspective. Collins (2009) views destabilization as a long-term process with multiple stages of decline derived from endogenous grounds (Figure 1).

Bearing in mind various aspects of destabilization, it can be concluded that growing external pressure and endogenous responses mediated by co-evolving dynamics of low-carbon transition undermine the performance of incumbent industries, causing a decline in financial resources to sustain the sector and delegitimization of socio-political environments (Turnheim and Geels 2012).

Scholars classify regime destabilization as a complex and multidimensional process involving multi-actor, multifactor and multilevel interactions (Geels 2002; Shove and Walker 2007; Turnheim and Geels 2012; Grubler 2012). The following subsections aim to analyze different pillars of the destabilization process rooted in socio-technical transition discourse to establish a solid understanding of mechanisms that derive transition.

Figure 1. Stages of industrial decline



Source: Collins 2009, 20

2.2 Emergent Transition and Purposive Transition

Throughout history, technological, economic, and political motives derived several major energy transitions around the globe, shifting from one type of fuel to another to keep the wheels of the economy turning to catch up with growing energy demand associated with robust economic growth. Moving from biomass to coal, introduction of steam engines, emerging electrification and internal combustion engines (ICE) can be encountered among major historical energy transitions (Smil 2004). While historically transitions have occurred predominantly due to economic, technological and political drives, currently environmental factors nudge to switch to low-carbon alternatives (Caldecott et al. 2017). Correspondingly, the

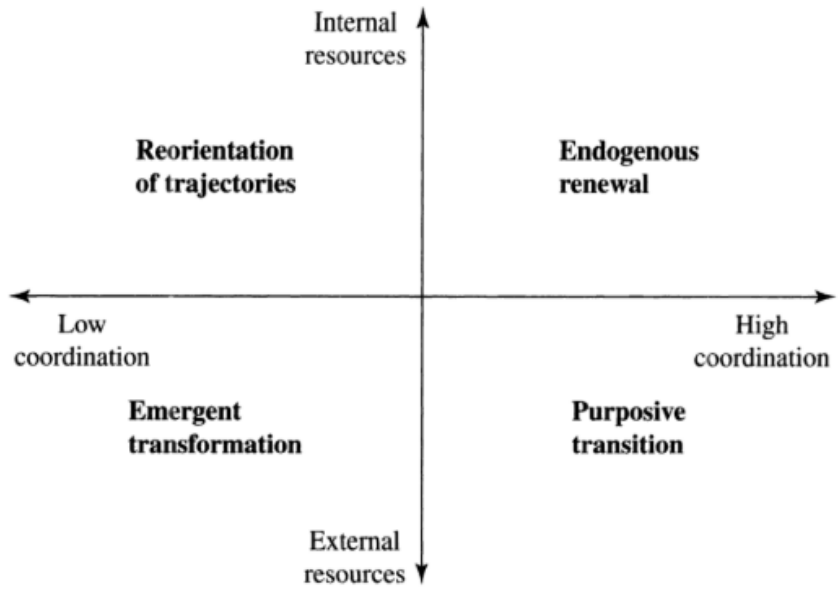
transition from one socio-technical regime to another can be best described as a long-term process influenced both by exogenous pressure and endogenous responses.

Relating to the nature of the transformation process should be a starting point in analyzing and advocating for particular transition management. Theoretical analysis establishes two dimensions to map transition context: coordination and resources (Berkhout et al. 2004). The first dimension seeks to define whether changes are envisioned at the regime level — requiring high coordination, or they are emerging outcomes of regime players' typical behaviors — requiring moderate or low coordination. The second dimension elucidates the degree of emerging pressure that can be responded to within the resources available inside of the regime and dependence on exogenous resources (Berkhout et al. 2004). This classification of actors and resources generates a fourfold trajectory of transition context (

Figure 2). Turnheim and Geels (2012) refer to low-carbon transition as a kind since the motive for such transformation is predominantly rooted in social norms and the tragedy of commons. Therefore, sustainable energy transition can be classified as 'purposive transitions', rational of which can be defined as "deliberately intended and pursued from outset to reflect an explicit set of societal expectations or interests" (Smith et al. 2005, 1502).

Berkhout and his colleagues (2004) highlight that while emergent transitions have self-governing nature, a purposive transition is the reflection of a much broader set of interests typically coming from outside of the regime.

Figure 2. Four transition context and transformation process



Source: Berkhout et al. 2004, 67

2.3 Effects of industrial decline on community livelihood

In an ideal policy environment, the transition should include both "creation of new and destabilizing the old" (Kivimaa and Kern 2016). However, the frameworks that scholars have identified in socio-technical transition literature do not provide a comprehensive analysis of the social consequences associated with regime destabilization. Research in socio-technical transition literature focuses on protecting a niche environment for low-carbon technologies or on technological decline associated with the destabilization process (Kivimaa and Kern 2016). Despite the literature highlighting social commitments to play a crucial role in regime stability, it gives far less attention to social attributes associated with industrial decline while applying frameworks to advance understanding of regime destabilization.

Turnheim and Geels (2012), using the triple embedded framework (TEF), describe motives and commitments of industry actors as regulated by an industry regime, which is 'a set of industry-specific institutions' enabling controlled behavior and action. Accordingly, the authors

categorize commitments as an essential lock-in mechanism. Turnheim and Geels (2012) categorize four main types of industrial commitments (Table 1).

Table 1. Different types of commitments

Types of commitments	**Theory relevance and definition**
Cultural-cognitive commitments	Cultural-cognitive institutions (mental maps, beliefs) focus the interpretations of actors, blinding them to developments outside their focus.
Mission and identity related commitments	Mission and identity refrains industry actors from changing their strategic and societal positioning (Dutton and Dukerich 1991).
Technological and regime commitments	Existing technical competencies creates resistance against technological discontinuities (Christensen 1997).
Institutional commitments	Industry actors are committed to industry-specific regulatory institutions through compliance mechanisms (Scott 1995).

Source: Turnheim and Geels 2012, 3

Johnstone and Hielscher (2017) suggest building on seminal theories such as Joseph Schumpeter's creative destruction and more recently evolving concept of regime destabilization (Turnheim and Geels 2012), to unleash the further potential of sustainability transition studies and propose policy recommendations that are favorable for impacted local communities and skilled workers.

Scholars in different disciplines are focusing on researching the consequences of industry decline on skilled workers and communities through developing strategies for "just transition" aiming to minimize the effects of climate policies on coal-dependent community livelihoods and workers (Pai et al. 2020).

Johnstone and Hielscher (2017) highlight the importance of merging studies of just transition strategies within the context of deindustrialization, to shine a light on often elusive social attributes (skilled workers, community livelihood) of socio-technical transition.

Considering the gaps in different pillars of transition studies, the following section aims to take a skeptical approach to investigate the implementation feasibility of just transition policies and seek to understand whether it can be improved if linked with existing fundamental knowledge in the field.

2.4 Just Transition framework

The International Labour Organization (2016) has proposed guidelines for "Just Transition Towards Environmentally Sustainable Economics and Societies for All" focusing on core elements of sustainable development framework, such as social justice, social protection, job creation, and poverty eradication. Furthermore, several non-governmental research institutions propose high-level summary documents for decision-makers based on a "just transition framework" to enable a smooth exit from the coal economy (Caldecott et al. 2017; Coal Transitions 2020).

The adjustments in the national energy policy agendas to exit from the coal economy come along with risks and challenges. In the management of exit from coal, the risks former workers face related to reemployment and loss of significant share of local economic activities are among the most immediate challenges that need to be addressed. These considerations resulted

in a growing need for formulating “just-transition” pathways to tackle the employment impacts for workers in the coal industry (Caldecott et al. 2017).

Any transition away from incumbent energy systems resulting in so-called “structural breaks” in the fossil-fuel industry and causing regime destabilization will have a significant impact on workers in these industries and their livelihoods (Pai et al. 2020). Anticipating the consequences of coal industry destabilization on workers and communities, scholars in different academic disciplines are focusing on developing sophisticated strategies for “just transition” aiming to minimize the effects of climate policies on communities. In burgeoning academic literature, scholars focus on various components of just transition; however, these components lack synthesized analysis and systematic cross-disciplinary studies (Pai et al. 2020).

The birth of just transition concept dates long before climate mitigation became the central concern of energy-related policy agenda, was first developed in the US in the 1970s when Tony Mazzocchi, a leader of Oil, Chemical and Atomic Workers’ Union sought to support environmental groups in their fight over safety and health concerns of the Shell company (McCauley and Heffron 2018). Back then, unionists recognized the severe damage industries caused to the environment, advocated for the action that acknowledged workers' health and safety concerns, and maintained the natural environment (McCauley and Heffron 2018). Since the mid-2000s, the concept has been broadly adopted in climate change discourse and is being developed by many scholars and policymakers within academia and outside (Pai et al. 2020).

2.5 Forms and elements of Just Transition

Job losses due to regime destabilization are not distinctive to the transition from the coal industry. The decline of industries has occurred previously due to a wide variety of triggers,

such as production relocation, fall of demand, overexploitation of resources, and technological developments. This section aims to elucidate precedents for a "just transition" for coal workers.

Two broad categories of justification have been made in defense of a need for just transition. The first is the ethical burden carried by governments to support affected communities, members of which had born health risks and dedicated themselves to the growth and prosperity of their county when fossil fuel was needed (Pai et al. 2020). This justification, however, is not limited to fossil fuel workers; it also implies for workers in other declining industries.

A second, a more practical argument has been put forward in climate change mitigation discourse, which envisions higher feasibility to reach climate targets if the affected members of associated industries experiencing decline are well accommodated (Pai et al. 2020). As mentioned previously, scholars in socio-technical transition studies have also identified that better planning for the decay of old regime is a key to unleash the full potential of low-carbon transition (Turnheim and Geels 2012; Grubler 2012; Kivimaa and Kern 2016; Johnstone and Hielscher 2017).

In the context of climate and energy studies, scholars have classified different forms of justice in four main categories (McCauley and Heffron 2018; McCauley et al. 2019; Pai et al. 2020):

- Distributional justice (D) concerning the equal distribution of consequences and advantages of climate and energy-related decisions.
- Procedural justice (P) emphasizes the importance of stakeholder participation in decision-making processes.
- Restorative justice (R1) aiming to restore damages for directly impacted individuals.

- Recognition justice (R2) involving the recognition of affected individuals and groups enduring consequences of climate and energy-related policy adjustments and regime destabilization.

Pai and his colleagues (2020) have presented a remarkable synthesis of existing literature in interdisciplinary transition studies and have identified a set of necessary elements for just transition. Table 2 summarizes 17 critical elements identified by the authors and ties them with the corresponding form of justice that has been elaborated above.

Table 2. Core elements of Just Transition classified according to justice form

Elements identified	**Justice forms**	**Description**
Long-term planning	R2	Long-term planning is necessary to identify most affected areas as the result of decarbonization.
The role of unions	P	Job losses in the coal industry might result in growing tension between unions and pro-environmentalists.
Community engagement	P	Continuous engagement with affected industrial stakeholders is necessary in low-carbon transitions in decision-making processes to ensure a benefit-sharing process.
Local jobs and diversified economies	D, R2	Local jobs should be created to develop economic diversification in impacted areas.

Elements identified	Justice forms	Description
Coal as an identity	R2	Cultural and geographical bonds of coal miners should be considered.
The gender gap in energy sector jobs	R1, R2	Historical injustice needs to be highlighted and recognized in order to eliminate gender gaps for future just transition.
Education/ research institutions	D	Education and research institutions should be recognized as a key tool in converting mining regions towards a knowledge economy.
Worker pensions	R2, D	Pension protection of affected workers should be advocated and guaranteed.
Just transition principles and the planning, legislative and regulatory	D, P, R2	Just transition strategies should be embedded in national federal and provincial environmental and labour legislations and regulations.
Job quality	R2	Well-paying, descent and secure jobs should be created as a prerequisite for a just transition.
Job guarantees and compensation	R1	Affected workers must be guaranteed to receive compensation that is an equivalent of their former salaries until re-employment.
Worker transition service	R2	Needs and interests of coal workers need to be addressed through training programs that can

Elements identified	Justice forms	Description
		help them to attain new skills and qualify them for working in other industries.
Local infrastructure development	R1, R2	Tax revenues of declining industry should be directed into funding local infrastructural development projects.
Local government revenue stream	R1, R2	Fiscal strategies can be developed to cope with revenue downstream associated with loss of economic activities in affected areas.
Communication of phase-out plans	P	Phase-out decisions need to be communicated with all stakeholders to ease the disruptiveness of forthcoming transformations.
Environmental remediation	R1	Funds should be directed to environmental remediation with a purpose to create remediation jobs in former coal workers.
Retraining workers	R2	Workers should be retrained to possess required skills in a new industry.

Source: Pai et al. 2020

Scholars in various academic disciplines such as labor economics, energy transition and climate policymaking, institutional economics have made crucial contributions to point out and explain necessary elements of just transition for coal workers and communities (Newell and Mulvaney 2013; ILO 2016; Tagliapietra 2017). Recent literature highlights that despite individual contributions, there is a lack of systematic attention to historical decline and seminal studies

that can derive a concise set of lessons for the future just transition (Pai et al. 2020). There is an urge to fill the gaps existing in emerging fields of just transition by conducting feasibility studies and systematic analysis to establish cohesive sets of guidelines and moving it forward from being social dialogue.

For instance, in the case of EU countries, there is a push for a rapid coal phase-out; however, the member states face delays due to a lack of guidelines for planning secure social welfare programs for coal miners who risk losing jobs (Tagliapietra 2017). Despite an already established fund of the European Globalization Adjustment Fund (EGF) to support coal mining regions, there is still a lack of tools to make better use of it (Tagliapietra 2017).

2.6 Job losses

Many scholars in labor economics and other related disciplines have put bold efforts to study the consequences of job losses. Holmes and Rahe (1967) classify job loss as a life event that happens as a result of the involuntary elimination of paid employment. Hanisch (1999) defines unemployment as an outcome of job loss and as a state of being not engaged in gainful activities. In these terms, unemployment is seen as a state, meanwhile job loss as an event resulting in unemployment unless the affected worker can obtain another job immediately (Hanisch 1999).

Jahoda's (1982) functional model establishes building blocks to comprehend economic and psychological consequences correlated with unemployment. The author states that unemployment deprives individuals of essential skills and needs that are typically obtained from being employed, such as time management skills, contact with people outside their family, a bigger vision and mission, and motivation for self-actualization, status, and identity. Jahoda (1982) predicts that leisure is not able to complement encountered skills and needs, and

therefore unemployment usually leads to destructive consequences both psychologically and economically.

2.7 Economic effects of job losses on individuals

The effects of job losses on individuals' livelihoods can be quite severe: their planned earning capacity, savings, and retirement plans are likely to get drastically affected, and it might take substantial amounts of time to get re-employed (Chan and Stevens 1999). In such circumstances according to dynamic models of retirement decisions, individuals in the mid or late-career phase need to decide whether they want to be economically active and seek re-employment or choose early retirement (Chan and Stevens 1999). Individuals facing involuntary job losses will undoubtedly face re-evaluation options for retirement decisions, comparing potential future earnings and retirement benefits. One of the most extensively studied areas within historic job losses and recovery tendencies highlights that labor displacement results in reduced earnings (Jacobson et al. 1993, Chan and Stevens 1999, Beatty et al. 2007). Findings of Louis Jacobson et al. (1993) show that a typical worker facing displacement experiences up to 25 percent of salary reduction that takes up to six years to stabilize back to its initial levels after a job loss. Job displacement associated with coal mine closures is no exception: Beatty and Fothergill (1996) examining labor-market adjustments in the UK coalfields during the period 1981-1991, have found that ex-miners have obtained new jobs at a lower pay-off rate compared to their wages in the coal industry. Consequently, lower wages result in a lack of attractiveness to find a new job; therefore, ex-miners usually prefer early retirement over the re-employment option (Caldecott et al. 2017). Such consequences experienced by individuals might result in a gradual weakening of the regional economy if accumulated.

2.8 Psychological effects of job losses on individuals

Economists studying behavioral models of the macroeconomy and social psychologists have established links between unemployment and negative emotional traits claiming that joblessness leads to diminishing productivity due to lower self-esteem, vanishing personal sense of worth, and unstable psychological well-being (Darity and Goldsmith 1996).

The mastermind of the theory of life-span development Erikson (1959) states that maturing sense of personal ego and self-esteem is conditional to eight consecutive stages. The author defines the fifth stage as an "industry stage," where an individual grows from 'adolescence into adulthood', which is realized upon obtaining professional identity. He describes a career as one of the prevailing conditions for the fulfilment of life goals for a "middle-age" individual. Consequently, the absence of success in a career pathway is expected to have severe impacts on a personal sense of worth and psychological well-being (Erikson 1959).

Darity and Goldsmith (1996) have established a macroeconomic model for the aggregate labor market that encounters the psychological state of individuals, which can be influenced by changing dynamics in the economy. They acknowledged that emotional anxiety as the result of job loss may lead to "discouragement", that would diminish willingness to find a job and would shift the labor supply curve backwards. This theoretical framing may help us to understand better why some workers prefer to stick to early retirement benefits rather than seeking reemployment. However, Goldsmith and Darity (1992) provide an example of an individual coping mechanism to preserve psychological health, defined as "trauma escape effect", which presumes that the affected individuals would actively seek for jobs and accept offers with a lower real wage. Scholars have also identified that affected individuals experiencing higher levels of distress had greater chances of getting reemployed in the following year due to excessive "trauma escape" behavior (Kessler et al. 1988; Darity and

Goldsmith 1992). Darity and Goldsmith (1996) highlight that the rise in unemployment harms severely emotional and motivational states of affected individuals, causing a breakdown in the psychological conditions of the labor force. These conditions can evolve due to following reasons (Darity and Goldsmith 1996):

- Unemployment shapes a striking and long-lasting impression.
- Reemployment in a lower-paying job can lead to dissatisfaction, which in return fails to enhance psychological conditions.
- Reemployment can lead to further disappointment as the result of developing feelings of insecurity due to depreciation of skills, loss of desire for seniority, and career growth.

2.9 The effects of job losses on local economy

Caldecott et al. (2017) highlight that coal transition studies have found that industrial destabilization and decline have long-term impacts on the local economy, resulting in a high dependency ratio between non-working and working population, low educational attendance, wage stagnation and environmental problems associated with site remediation. These tendencies correlate with the cumulative causation economic trajectory (Myrdal 1957) that some regions might have followed exiting from coal. This theory elaborates further consequences related to the decline of predominant industries such as coal in our case of analysis. According to this trajectory, the job losses in the coal industry could potentially evoke further job losses in other sectors of the local economy that are indirectly correlated to the decaying industry. Accordingly, local businesses that highly depend on consumer expenditures are among the most notable reasons for such causation (Beatty et al. 2007). Consequently, economic downfall can provoke out-migration of the population, which would in return result

in job losses in community services such as healthcare and education. The stakeholders would be discouraged to invest in local businesses due to falling market performance (Beatty et al. 2007).

Another approach rooted in neoclassical economics, so-called self-correcting view (Richardson and Townpoe 1978), takes a predominantly positive attitude and prescribes that in the long run, self-adjustments occur in aggregate demand and supply which eradicates imbalances in the local labor market. Richardson and Townpoe (1978) further explain that a decline in the predominant local industry would push down local wages; in turn, lower wages would increase investment attractiveness. As a result, the demand for labor would move up and restore market equilibrium. The part of the population that out-migrates to seek a job that fits their portfolio would further help to restore stability between labor supply and demand. There will undoubtedly be temporary imbalances in the local market; however, the rates of labor availability and price competitiveness would boost the long-term (Richardson 1978).

Theories cannot alone predict what happens after significant industrial destabilization. Beatty et al. (2007) highlight that historically in the real practice features of both approaches (self-correcting and cumulative causation) happened simultaneously in the same locality. Nevertheless, Beatty et al. (2007) state that no evidence can help us to foresee how the reality will turn around after exiting from coal; it is still a matter of an empirical question.

To better understand dynamics of recovery, the next section of the literature review aims to identify the institutional strategies and policies that can eliminate threats for incumbent firms and boost sustainable energy transition.

2.10 The role of government policies in job recovery

"Where industries are highly concentrated in one or a handful of regions, these impacts can have severe consequences for the local economy and the viability of communities. These regions will need pro-active assistance in creating alternative jobs and livelihoods, acquiring new skills, and weathering the transition to new industries" (Räthzel and Uzzell 2003, 147).

As it was mentioned previously, the governments carry an ethical obligation to accommodate those workers who have been affected due to sustainability transition and have served for the growth and prosperity of their country when fossil fuel was necessary to turn the wheels of engines (Pai et al. 2020).

Governments have an array of tools to deal with unemployment. In the case of sectoral declines, governments most often target the specific sectors through what in economics is called 'supply-side policies.' Supply-side policies are defined as government efforts to introduce policy adjustments and strategies that increase efficiency and boost economic productivity (Lindbeck and Snower 1990). This section aims to highlight the importance of supply-side policies to mitigate the risks related to the decline of incumbent systems. Among the supply-side policies, some are designed to avert unemployment. According to Burtless (2002), in the case where the economy operates close to its full capacity, unemployed workers facing severe challenges in the job-seeking process can be classified in the following two categories. Some who do not possess skills required in the market, whereas others who are skilled workers that have become victims of misfortune and dismissed from a job due to a decline in the industry, company, or profession (Burtless 2002).

The government can introduce mediating supply-side policies that can help to minimize the natural rate of unemployment through initiating retraining programs for the unemployed

population or boosting labor market flexibility (Lindbeck and Snower 1990). Lindbeck and Snower (1990) also highlight those supply-side policies can help unemployed people to attain new skills, which boosts their profile and enable them to participate in gainful activities.

Supply-side policies that help to prevent unemployment can be quite divergent. Some of them are designed to encourage unemployed workers to seek jobs by offering them generous incomes or benefits packages if they are willing to take the position that is currently available and competent with their sets of skills, or by boosting motives for job creation in the business community (Burtless 2002). Others aim to gradually decrease the amount of public transfer to make it unattractive to depend on such benefits in the long-term and nudge unemployed workers to seek jobs actively (Burtless 2002). The author further elaborates that the first approach comes at a specific cost for taxpayers as an increase in public expenditures is the result of increased tax payments directed to the federal budget. However, this approach is likely to boost the living standards of unemployed people and help them escape poverty. The second approach is usually less expensive, and it often removes weight from taxpayers; nevertheless, unemployed workers can suffer from the consequences of the reduction in transfer payments in the long term if they do not manage to get reemployed (Burtless 2002).

Burtless (2002) examines the effects of supply-side policies in alleviating unemployment and classifies these tools as the following:

- Restraining jobless population's willingness to stay unemployed by gradually decreasing the public transfer payments that initially aimed at providing basic support package;
- Boosting the attractiveness to get employed by increasing net income margins for unemployed workers willing to accept the jobs;

- Making efforts to enhance the human capital of unemployed to increase their employability;
- Offering training for jobless people to enable new sets of skills that are in high demand.

Nevertheless, typically economists take a significantly critical attitude when it comes to unemployment compensation and transfer payments, arguing that unplanned allocation of financial resources may have a reverse effect on the labor, causing unwillingness to participate in job hunting due to secure income level (Atkinson and Micklewright 1991). They highlight the following hypothetical issues correlated with unemployment benefit payments:

- benefit that is paid irrespective the reasons for becoming unemployed;
- flat-rate payments for an undefined period starting from the day of unemployment;
- payments disregarding an individual's efforts to seek for a job;
- no penalties in case of a denial to accept job offers;
- no predefined conditions concerning the amount of payments and historical employment records;
- eligibility regardless of the income level of other household members.

Therefore, in case of sustainability transition planning is predominantly necessary to ensure policies aimed at job loss mitigation does not only subsidize financial risks but also help to manage "structural breaks" characterized as abrupt changes impacting livelihoods of thousands and weakening of local economic performance (Caldecott et al. 2017).

2.11 Summary

The chapter started with a review of regime destabilization literature in the sustainability transition. Further, it highlighted unaddressed issues such as limited attention paid to social consequences that come with the decay of incumbent regimes. To advance understanding of transition management, I have referred to the literature that characterizes different levels of actor engagement and the nature of transition based on various triggers. Consequently, I have investigated current nature and requirements for the shift away from coal, covered in details in the Just Transition Framework section. Such massive transitions come with significant damages to the local economy and employment rates in affected regions that need to be considered while tailoring policies in transition management. I have merged seminal studies existing in neoclassic and behavioral economics and theories proposed by social psychologists to a form holistic view on different elements of transition.

3 Methodology and analytical framework

This paper takes a retrospective approach using a systematic literature review to examine unemployment related to the past decline of coal sector and policies to mitigate such unemployment. The research aims to identify solutions to secure sustainable transition away from coal for workers, communities, and local economies that predominantly depend on coal. Scholars in different disciplines have identified various theoretical and empirical features of industrial decline; however, due to the lack of synthesis of the existing literature, the findings remain quite scattered. Through conducting this review, I aim to assemble genuine lessons from historical coal decline to inform future policies and research, in this area.

3.1 Systematic Literature Review

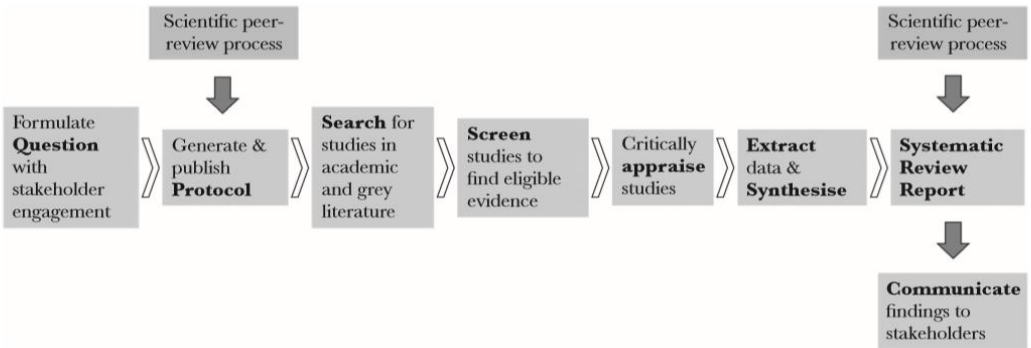
Traditional review methods and formal meta-analysis have been applied in the low-carbon transition literature to summarize evidence (Wiseman et al. 2013; Martínez 2017). However, these methods have been criticized by some scholars (Haddaway et al. 2015; Haddaway and Macura 2018) since such reviews usually include only highly cited peer-reviewed academic publications. Berger-Tal and his colleagues (2019) highlight that subjective decisions for inclusion criteria for studies can be highly vulnerable to bias at different stages of review; consequently, traditional reviews usually can be a subject of selection bias. On the contrary, a systematic literature review allows the inclusion of both peer-reviewed academic literature and organizational grey literature—it seeks to create a coherent and real-life based systematic map database (Haddaway et al. 2019).

As opposed to traditional reviews, systematic reviews also generally conducted through standardized and precise methods including the following pillars (Figure 3): 1) question formulation with stakeholder engagement, 2) peer-reviewed protocol development (a detailed

methodological plan of the review process), 3) comprehensive search for evidence, 4) careful eligibility screening of literature, 5) coding and data extraction, 6) critical appraisal of study validity, 7) synthesis, 8) reporting of findings in a peer-review, open-access publication, and 9) communication of results (Berger-Tal et al. 2019, p.3). Collaboration for Environmental Evidence (2018) defines systematic reviews and maps as diligent, straightforward and repeatable methods aimed for cataloging, collecting, and synthesizing all accessible and recorded findings on a topic of concern.

Systematic reviews were used broadly in the field of medicine in the 1990s and revolutionized evidence-based treatment (Berger-Tal et al. 2019). In the early 2000s, the field of environmental conservation and management adopted systematic reviews, which became an essential part of scientific evidence-based policymaking (Berger-Tal et al. 2019; Pai et al. 2020).

Figure 3. Systematic review process



Source: Berger-Tal et al. 2019, 2

Berger-Tal and his colleagues (2019) highlight the following four advantages of systematic reviews over traditional reviews:

Systematic reviews increase objectivity and transparency and try to minimize the bias at various stages of the review process.

By consolidating grey/organizational literature into the review, I attempt to add evidence-based findings to the pool, which is often disregarded in the traditional reviews. This helps to avoid any suspects regarding publication bias.

Structured investigation results in the inclusion of sources that are diverse in character or content and help to compare and interpret conflicting findings involving the same subject.

Stakeholder engagement allows to formulate a cohesive research question and provides support throughout the review process.

3.2 Question, scope and data gathering

The first step and the most essential principle in conducting a systematic literature review is to establish a question (Haddaway et al. 2019), I started the review with the following question that later became the basis of the inclusion criteria for my literature search: What types of policies were effective in mitigating job losses associated with a historical coal decline?

While there is no specific blueprint to administer a just transition, I have tried to assemble effective policies that have been tested in historical transition. The country selection was originally guided by Szabolcs Vágvölgyi's (2017) thesis (Table 3) where he identified countries and episodes of significant and persistent decline in coal production. However, as a result of extensive literature review in the initial phase of the research, I came across several more countries that experienced severe changes in local community livelihood and local economy after shutting down coalpits even though the scale of coal production decline was not recognized as significant at the national level.

Table 3. List of countries with significant and persistent decline in coal production

Country	1975-1984	1985-1994	1995-2004	2005-5014
Belgium	-23%	-93%	-69%*	-95%*
Czech Republic	6%	-32%	-10%	-28%
France	-28%	-46%	-91%	-51%*
Germany	1%	-44%	-26%*	-22%
Hungary	8%	-46%	-33%	-9%*
Japan	-23%	-63%	-100%	Ceased production
Poland	12%	-27%	-24%	-22%
Romania	52%	-24%	-20%	-23%
South Korea	14%	-69%	-42%	-38%*
Spain	93%	-20%	-36%	-74%
United Kingdom	-60%	-47%	-54%	-43%

Source: Szabolcs Vágvölgyi 2017, 47

* below 10% or 1300 ktoe threshold

I have determined the inclusion criteria (Table 4) to retrieve studies that contain findings necessary to answer the pre-defined research question. Applying various keywords and permutations, and using the following search engines, I have identified the list of the articles for the systematic literature review. The final review contains 35 articles (Table 5).

Web-based search engines

Search for academic and non-academic literature was performed in Google Scholar and Scopus, which is identified as a reliable source for retrieving grey literature (Haddaway et al. 2019).

Organizational websites

Initially, I used the most recent publications of Coal Transition Research Hub on coal-phase out and strategies for just-transition. In the later phase based on the web search engines, I came across the remarkable publication on lessons from the historical coal decline (Caldecott et al. 2017) of the Institute for Sustainable Development and International Relations (IDDRI) —the organization aiming to facilitate low-carbon transition. Consequently, I have included other relevant publications from the IDDRI website in the final review.

Bibliographic searches

In case I came along with the items that require further investigation while reviewing the articles, I commonly screened the reference list and included relevant studies to my database.

Table 4. Inclusion criteria for evaluating relevance of articles

Item	Details	Reason
Content	Policies to mitigate job losses correlated with a historical coal decline	The content aims to answer the question established in the initial stage of the systematic review

Language	English	Due to the limited language skills, I have reviewed publications and articles available in English.
Types of publications	Academic and organizational	Peer-reviewed academic articles and institutional publications that aim to facilitate low-carbon transition
Country selection	Countries which experienced decline in coal production	Search for the policy-related information for the list of the countries with significant and persistent decline in coal production (Szabolcs Vágvölgyi 2017) (see Table 3); Countries that experienced severe changes in local community livelihood despite the scale of decline was not recognized as significant
Period	Country specific	Period of decline vary among the countries chosen for review
Databases	Google Scholar, Scopus IDDRI, Coal Transitions	Past studies and most recent findings identified in institutional and academic sources

Due to time constraints and availability of studies in English, I did not manage to identify studies on all countries in Table 3, France, Belgium, Hungary, South Korea, Japan and Romania were omitted, the United Kingdom, Czech Republic, Germany, Poland, Spain, and were included in the final review. Furthermore, in the initial phase of the literature search, I came along with several other country-specific studies (the Netherlands and the United States) that contained valuable policy-related lessons from the historical decline in the coal industry. Table 5 presents a full list of the countries included in the systematic review.

Table 5. List of the countries and associated episodes of decline included in the review

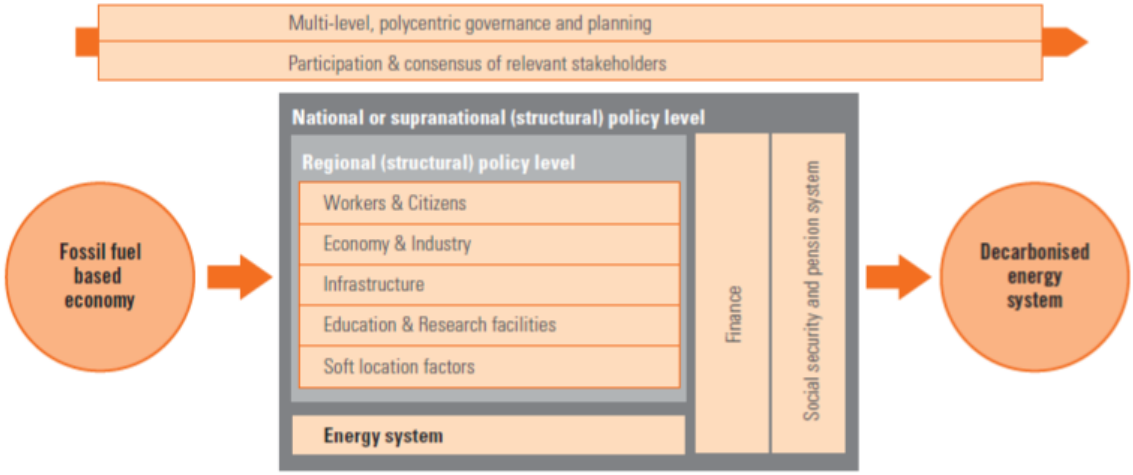
Country	**Period of decline**	**Regions**	**Sources**
United Kingdom	1980-1990 1990-2016	Multiple locations	(Beatty et al. 2007), (Fothergill 2017), (Hollywood 2002), (Murray et al. 2005), (Johnstone and Heilscher 2017), (White 2003)
Czech Republic	1990-2000 2000-2014	Multiple locations	(Caldecott et al. 2017), (Máca and Melichar 2016), (Rečková 2017), (IEA 2016), (Wirth et al. 2012)
Germany	1950-2018	Ruhr area, North Rhine-Westphalia, Saarland	(Oei et al. 2020), (Oei et al. 2019), (Campbell et al. 2017), (Agora Energiewende 2019), (Stognief et al. 2019), (Coal Transitions 2018)

Country	Period of decline	Regions	Sources
Poland	1990-1999	Upper Silesia, Małopolskie, Lubelski	(Wirth et al. 2012), (Szpor 2017), (Szpor et al. 2018), (Rzegocki 2020), (Caldecott et al. 2017)
United States	2008-2016	Appalachian and Powder River Basin	(Blondeel and Van de Graaf 2018), (Caldecott et al. 2017), (Kok 2017), (Sartor et al. 2018), (Yeo 2017), (Bottino 2018), (Louie and Joshua 2016)
Spain	1985-2008 2008-2015	Multiple locations	(Rio 2017), (Caldecott et al. 2017), (Rabanal 2009)
Netherlands	1965-1969 1970-1974	Limburg region	(Hölsgens 2016), (Gales and Hölsgeng 2017), (Caldecott et al. 2017), (Kasper and Etil 2012)

3.3 Analytical framework

Transition away from coal is a complex process involving multi-level interactions between stakeholders (Sartor 2018). Illustrating German Coal Transition (2018), Figure 4 highlights significant issues that need to be addressed while customizing policies and governance levels to diminish risks associated with the transition.

Figure 4. Multi-level governance of coal transition



Source: Sartor 2018, 33

General observations on the case studies validated the significance of multiple pillars indicated in Figure 4. These pillars were a starting point for a structure that I have developed for the systematic review where I divided observed policies into three main categories according to the levels of intervention: regions and communities, companies, and individuals. Each section of this chapter discusses one of these categories and is further divided into subsections highlighting specific policy instruments. Table 6 presents the structure followed in the results section combining the levels of intervention and policies targeted to mitigate consequences of industrial decline.

Table 6. Just transition policies at different levels of intervention.

Regions and communities	❑ Anticipation, communication and engagement ❑ Local infrastructure development ❑ Economic diversification and local job creation ❑ Community Projects
Companies	❑ Nationalization followed by organizational reconversion

	❑ Reducing mine remediation and restoration liabilities for companies ❑ Reducing or transferring pension premiums and healthcare liabilities
Individuals	❑ Retraining workers ❑ Early retirement ❑ Welfare allowances for voluntary redundancy ❑ Golden Handshake

3.4 Limitations

Studying historical coal decline is necessary since it holds insightful hints to tailor policies for the forthcoming transition. Grubler (2012) states that conducting retrospective analysis allows for a full investigation of the industrial decline process, from beginning to end means. Firstly, although real-life lessons can be derived from studying historical cases, they cannot be considered fully applicable to future transitions. Correspondingly, this thesis aims to carefully examine the dynamics of historical transition and deduce a set of practical lessons for the future; however, it is crucial to keep in mind that past policies are not necessarily a guide for the future.

Previous energy transitions took place mainly due to political, economic, and technological reasons; however, nowadays, countries worldwide are facing a need to switch from carbon-intense energy sources to sustainable alternatives due to environmental emergency (Sartor 2018). Therefore, following the pledges made in mitigating global climate change and providing just transition for fossil-fuel workers, policy adjustments might differ significantly from those that happened historically.

Second significant limitation is the number of studies available in English. To conduct more comprehensive policy analysis studies available in native languages in the area of interest should be merged into the review. Several researchers from IDDRI and Coal Transition Research Hub have published papers containing valuable country-specific information on different stages of the coal sector decline based on the resources available in the native languages (e.g., Rečková et al. 2017; Szpor 2017; Gales and Hölsgeng 2017; Rio 2017). Considering that history holds valuable lessons to prepare for the future transitions that are approaching soon for many countries globally, more emphasis should be brought in studying past transitions literature and conducting similar reviews.

The third limitation identified during the systematic analysis is more content-specific. To support qualitative analysis with quantitative figures, I initially planned to look closely into country-specific statistical data to determine the number of jobs lost in predefined periods of decline (Table 3), the timeframe of recovery, and the number of coal workers allocated with new jobs. However, later, I found out that due to "hidden unemployment" classified as shifting from active status to economic inactivity while receiving permanent sickness benefits and retiring abnormally early (Beatty et al. 2007), such numerical data is not a reliable indicator to merge into the analysis.

4 Results

Given the importance of coal for energy systems and for the low-carbon energy transitions, the literature is dominated by the discussion of tools and mechanisms that allow managed transition away from coal. The focus of this chapter is to bring together the main insights from the analysis of post-transitional national case studies and summarizes policies that can mitigate local economic consequences and unemployment resulting from transitions away from coal. This chapter starts with the identification of policies categorized according to Table 6 in the Analytical Framework proceeds with a summary of overarching observations concerning past transitions.

4.1 Cross-cutting observations

The scale of the affected labor force due to such transition is usually massive. For instance, in southern Poland, around 230,000 jobs were in 9 years lost due to mine closures starting from early 1990s (Szpor 2017). Similarly, in the Netherlands, approximately 75,000 jobs were gone in only a period of 10 years between 1965 and 1975 (Gales and Hölsgens 2017). In the UK, 90% of the coal jobs (both mining and other relevant jobs) in major coal mining regions (South Wales and North East England) were lost between the mid-1980s and 1990s due to pit closures (Beatty et al. 2007). Considering such massive scales, policies need to multi-dimensional and engaging both economic and social aspects discussed previously to mitigate adequately massive employee lay-offs.

Retrieved case studies indicate that countries failed to deliver sustainable outcomes due to discontinuity and disconnectedness of mitigation policies except for Dutch transitions. One of the most vivid examples of discontinuity has been witnessed in the UK transition.

According to documented labor-market accounting, it took around 20 years for the UK economy to recover from massive pit closure, suggesting that the number of jobs in the coal industry dropped by 225,000 from 1981 to 2008, following 180,000 new job creations in the affected areas by 2005 (Beatty et al. 2007). Although the number of jobs created seems impressive at first glance, it is necessary to highlight that the government started investing in the economic diversification of affected regions very late after actual mine closures, only in 1997 (Fothergill 2017). Therefore, failed to provide jobs for coal workers when needed since most of them were already supplied with other types of welfare benefits such as permanent sickness and early retirement (Beatty et al. 2007). It took around 20 years for the UK economy to recover from massive pit closure; however, some remote locations like Ayrshire, Northumberland, and South Wales still have higher unemployment rates than the national average (Beatty et al. 2007).

Commonly, coal production is highly geographically concentrated and located in remote areas, historically, economic recovery and job creation were not impressive in most case studies. The geographical concentration of mining activities, the extent of the local economy dependent on the coal industry compared to other activities in the region make a notable difference in economic regeneration capacity (Sartor 2018). Correspondingly, key findings from the case studies suggest that policies need to be tailored depending on local circumstances.

Table 7. Destination of ex-miners

Destination	**1965-1969**	**1970-1974**
Pension, old age or invalidity (%)	17	18
Bridge to pension (%)	13	22
Repatriation abroad (%)	12	3

Destination	**1965-1969**	**1970-1974**
Social workshops (%)	6	6
External employment (%)	41	35
Internal employment (chemical) (%)	10	7
Internal employment (other) (%)	0	8
Total exit (number)	**31585**	**18770**

Source: Gales and Hölsgens 2017, 7

The impact of transitions also depends on the characteristics of the labor force such as age and skill level. Successful policies take these distinctions into account. For example, in the Netherlands the policies to mitigate job losses were quite diverse and capable of allocating labor according to their preferences (Hölsgens 2016). According to deliberate planning on possible destinations for former coal miners in the Netherlands, the workers managed to get another job or left the work-force due to retirement and, for the most part, did not require any welfare allowances such as redundancy payments (Gales and Hölsgeng 2017) (Table 7).

4.2 Policies targeting Regions and Communities

Across the studies observed for the economic regeneration of regions and revitalization of community livelihoods, there was a lack of coherent vision and consistent strategies on the national scale. Therefore, this subsection tries to bring together different practices around the countries aiming at regional regeneration and community development through anticipation, communication of plans before mine closure, as well as applicable real-world policies on local infrastructure development, economic diversification, and community projects following industrial restructuring.

4.2.1 Anticipation, communication and engagement

Historical coal transitions have often resulted in a significant fall in employment in 10 years or even less. Allocating such an enormous scale of labor into jobs that match their skill sets and qualifications or into early retirement seems quite unrealistic in the short term, especially considering the following sets of conditions (Caldecott et al. 2017) in coal mining regions:

- Coal regions are often geographically concentrated and often constitute a considerable proportion of local economic activities.
- Geographical concentration in coal-producing areas results in developing a strong sense of cultural identity and community in relation to the predominant local industry.
- Coal miners usually suffer from skills scarcity often due to the absence of educational opportunities in most regions.

Considering the necessity to address all the challenges and complexities mentioned above, stakeholders are required to engage in anticipation and planning much earlier than the implementation of actual mine closures (Caldecott et al. 2017, Sartor 2018). Coal transitions usually come at a very high opportunity cost and significant risks for regions, companies, and individuals. Those risks are often interconnected in many ways. The strong interconnectedness between the stakeholders' interests suggests that communication and engagement are crucial steps in early risk mitigation and policy tailoring for transition strategies (Caldecott et al. 2017). The author highlights that the integration between stakeholders is a prerequisite to facilitate the transition away from coal.

The Dutch case is a vivid example of successful projections, timely communication, and setting up a commonly agreed action plan that fostered the transition. Constructive engagement between company management and the unions helped develop strong faith, and common

understanding early on, resulting in rigorous communication of transition strategies (Gales and Hölsgens 2017). The early engagement of workers and management in communication resulted in teaming up against the government in specific cases, putting forward workers' requirements (i.e., 'no closure without new employment') and allowed the voices of communities to be heard more strongly (Hölsgens 2016, Gales and Hölsgens 2017). Meanwhile, the policymakers had enough time to consider the requirements put forward by unions and communities and to customize policies that can accommodate labor (Gales and Hölsgens 2017). In the Dutch transition, the disappearance of the mature industry did not become a subject of conflict. On the contrary, the authors highlight that it was accepted and acknowledged by all stakeholders that coal was unprofitable and provided fundamentally unhealthy employment. In fact, in late 1964, a dominant labor union leader stated in his interview with a journalist: “I will hoist all flags when the last miner goes underground” (Gales and Hölsgens 2017, 5).

The case studies suggest that governments usually take up a high share of costs during the transition; therefore, engagement and communication in the early stages of the planning results in a successful allocation of financial resources. For instance, in the case of the US, ex-miners had to bear all the negative consequences of the transition independently and lost significant benefits such as health care and pension coverages when the companies went bankrupt (Kok 2017). Hence, engagement and early participation in decision-making are essential criteria for a successful transition.

4.2.2 Local infrastructure development

Among post-transition regeneration policies, those that enable infrastructure provision are of significant importance (Culter 1999). Sartor (2018) particularly highlights the importance of allocating financial resources to facilitate transport infrastructure development. Policymakers

are usually in favor of such policy instruments since it directly fosters short-term job creation, enhances connectivity and accessibility between affected areas and surrounding areas that are more developed (Sartor 2018). Additionally, post-mining regions need to be revitalized in terms of environmental responsibilities to establish recreation areas and restore natural habitats (Caldecott et al. 2017).

Among the countries that have been retrieved for the analysis, Spain distributes most of its funds to develop appealing infrastructure in post-mining regions to boost the regional competence (Rabanal 2009, Rio 2017, Caldecott 2017). In Spanish transition, in the Royal Decree 2020/1997 that came into force in February 1998, it was stated clearly that the government would cease the support for coal production, and instead will provide funds to encourage mining regions' reactivation and promote alternative economic development (Rio 2017). The motivation behind the 1998-2005 coal plan was to prepare for detrimental socioeconomic consequences of future mine closures (Rio 2017). The same source validates that 80% of reactivation funds were allocated into the provision of infrastructure. In Spain, investments in infrastructural development continued to be the central focus of the regeneration policies. Marco de Actuación 2013-2018 activity framework for ex-mining regions, included a more detailed description of the plan (Rio 2017):

- Dump recovery and restoration in the affected areas by coal mining activities.
- Improvement of electrification and related transformation equipment and construction of major gas, lightning, and hydro plants.
- Environmental remediation and forest recovery in affected areas including project such as wastewater treatments.
- Development and restoration of telecommunication and transportation lines.

- Creation of business hubs, including shared service and technological development centers.

The provision of an infrastructure indeed helped create short-term jobs; however, in Spain's case, such developments received criticism from local communities due to excessive emphasis on public infrastructure development (Rio 2017). In the interviews with ex-miners, one argues that “There aren’t opportunities here. Firms able to create employment have not been set up, but we have the best sidewalks and streetlights” (Rio 2017, 20). Another controversy statement has been put forward by the secretary-general of UGT (The Unión General de Trabajadores) in ex-mining regions in northern Spain: “the industrial estates in the mining areas are empty, the support funds have been used to build business such as petrol stations or garages that do not provide jobs.” (Rio 2017, 21). Moreover, author highlights that the labor unions reported complaints regarding incompliance of the government with a promised action plan on creation of industrial and business hubs.

In contrast to the Spanish case, the western German state of North-Rhine-Westphalia reflects a successful example of post-mining recovery due to infrastructure development that targeted affected community members, including ex-miners and their children (Oei et al. 2019). According to Stognief et al. (2019), along with improving transportation lines for better connectivity, the infrastructural provision plan's focus was concentrated in the following items:

- Focusing on strengthening other industries that have manifested a competitive advantage previously, such as chemical, aluminum, food, and automotive industries.
- Emphasis on improving soft location factors such as universities and research facilities encourage young people to stay in the area.

- Establishing networks between research hubs, universities, and companies to boost competitiveness and resilience in the area.

Building strong networks between universities, research institutions, and companies may create competitive and resilient structures (Stognief et al. 2019). Accordingly, Stognief et al. (2019) highlight that such efforts will nudge companies to stay in the region and lay a foundation for many start-ups.

Nowadays, the success of the Rhineland serves as a motivation for other regions in Germany that are going through a massive restructuring. For instance, with similar demographics and historical background, the Lusatia region tries to replicate Rhineland's path away from coal by mainly focusing on developing soft location factors, transportation infrastructure (Stognief et al. 2019).

4.2.3 Economic diversification and local job creation

There are several stumbling points that policymakers need to be aware of while planning for transition away from coal. Fothergill (2017) highlights that governments tend to ignore the geographical complexity and affected regions' capacity to create sustainable industries. For example, governments usually prioritize certain areas as "economic development zones," offering generous tax schemes for new investments (Fothergill 2017, Sartor 2018). Fothergill (2017) states that historical transitions demonstrate that such incentives alone are insufficient to deliver change and can only be effective if presented as part of a broader package. Sartor (2018) presents a wide variety of criteria that investors consider while making an investment decision. These include: 1) long-term economic prospects in the presented area; 2) cost-efficiency analysis given the capacity and accessibility in terms of logistics 3) the availability of skilled and qualified workers; 3) presence of higher education institutions, research hubs,

and innovation centers; 4) tax rates and incentives for businesses (Sartor 2018). To sum up, tax incentives alone are not attractive for industries to set up their new branches in the region. Instead, it requires a multi-level approach and governance to make the area more attractive to investors (Campbell 2017, Fothergill 2017, Sartor 2018).

Based on a historical analysis of transitioning European regions, Campbell et al. (2017) suggest the following strategies to achieve viable economic diversification:

- Related diversification— involves fostering industries that are related to existing activities in the local economy and do not depend on coal.
- Smart specialization— involves an in-depth assessment of skill sets of local labor, cultural and industrial background of the area to find a region's competitive advantage and establish new industries with high growth potential.
- Boosting local networks— involves maintaining and strengthening networks between existing industries, research hubs, local government, businesses, and companies to ensure support for growing entrepreneurial activities.

Despite a viable set of actions, there is a long-dated tendency of resistance towards diversification in communities where coal mining is a dominant industry (Sartor 2018). This resistance is due to "lock-in" to the incumbent industry which withstand the arrival of new industries to the area and neglects the consequences that might occur in the future (Sartor 2018). One example of such resistance has been witnessed in Germany, in the 1970s, in the Ruhr region, where striking companies and unions slowed the intended diversification (Oei et al. 2019). To avoid such resistance, policymakers must closely engage with local stakeholder networks, provide insights and coordination for incumbent industry actors, and integrate bottom-up comprehension with top-down monetary and regulative support (Sartor 2018). For

instance, in the 1980s, German policymakers managed to eliminate the “lock-in” effect in the Ruhr region by integrating more polycentric and inclusive governance combined with subsidies and support mechanisms (Oei et al. 2019). The author further states that in the 2010s, cities in the Ruhr region became significantly independent and facilitated new industries reflecting regional strength. Correspondingly, Dortmund has become a great example of success in the area, achieved to build a technology center specializing in microsystem technologies by strengthening networks between research institutions and companies (Oei et al. 2019).

4.2.4 Community projects

In the US, over the past couple of years, funding community projects have become a widely used policy instrument to help communities to participate in the local economic diversification process and job creation (Yeo 2017). This strategy embraces smart specialization (see Section 4.2.3) using regions' cultural and industrial heritage in diversifying the local economy. During President Obama's administration, the Appalachian Regional Commission (ARC) received financial aid under the Power Plus Plan targeting local projects that help create jobs in tourism, construction, solar, manufacturing, and healthcare business (Kok 2017). Author further states that communities located in Alabama, Tennessee, Pennsylvania, Ohio, Virginia and West Virginia profited the most from the initiative; receiving funds for projects targeting drug abuse and health problems, as well as support with strategic planning for small business activities planning to convert regions' competitive advantage into gainful activity.

For example, in Arizona, Navajo tribes brought the traditional wool back to the competitive market through developing partnerships and networks with wool merchandisers and organizing annual exhibitions (Yeo 2017). Additionally, the initiative of Sierra Club named Beyond Coal Campaign established strong bonds with public and private investors to foster the solar sector

in the Appalachian region, which helped to develop sites and supported a series of solar installation projects up to 200MW in old coal mining areas (Kok 2017). The federal funds supported several other sustainable energy and energy efficiency projects in the affected areas to preserve the regions' long-dated role as an energy provider (Kok 2017).

Similar attempts have been witnessed in the Dutch transition, where around12% of total unemployment that occurred due to mine closures from 1965 to 1975 were replaced with organized “social workshops” in agriculture, gardening and other low qualified jobs that employed from 300 to 3000 people (Gales and Hölsgeng 2017).

4.3 Policies targeting Companies

In response to the massive industrial decline, assuming well-built communication and negotiation of plans between companies and responsible state authorities before closure, governments usually own up for financial responsibilities such as decreasing or transferring pension premium payments, remediation and restoration costs, and healthcare liabilities for affected workers. In this subsection, I will introduce findings based on the national case studies where the state plans proactively to cover substantial costs for companies facing the threat of bankruptcy.

4.3.1 Nationalization followed by organizational reconversion

One of the most significant observations in the Dutch transition case was how Dutch State Mines, together with the government, acted preemptively to bear the risks correlated with the closure of the domestic collieries in the region of Limburg located in the south of the Netherlands (Hölsgens 2016, Gales and Hölsgeng 2017). Accordingly, the transition was a strategic plan managed by the government, aiming to reconvert the operations of the ceasing industry. To avoid significant risks, in the 1970s, The State Mines acquired private mines that

faced the threat of unprofitability, which otherwise would become a sacrifice of industrial misfortune (Gales and Hölsgeng 2017). As part of the pre-emptive plan, the state had alternative business options such as diversifying the coal industry by merging with promising chemical and natural gas industries. It was an intelligent approach that required a fundamental change of thinking to make the most of existing opportunities instead of being reactive to unfolding realities of transition (Caldecott 2017).

In the first place, the Dutch State Mines diversified their industrial base through getting involved in natural gas (Gales and Hölsgeng 2017). Correspondingly, the strategic shift was not due to the crisis, rather expected changes in the future of the energy systems and forecasts in fuel affordability.

Another remarkable attempt by the government was the early shift of the State Mines into the chemical industry (Gales and Hölsgeng 2017) when the old mining industrial base was fully converted into chemical plants. Between 1965 and 1969, almost half of the active labor (excluding those who retired) shifted to another job within the company's chemicals department (Gales and Hölsgeng 2017).

4.3.2 Reducing mine remediation and restoration liabilities for companies

According to Caldecott et al. 2017, governments can typically help mining companies to strengthen their balance sheet by decreasing or transferring part of site remediation and restoration costs. Among the retrieved case studies, The Czech government stands as a great example of generous financial support to ease the transition away from coal in terms of technical liabilities related to mine closures such as rehabilitation of environmentally damaged land and reclamation of affected areas (Rečková et al. 2017). Accordingly, financial resources allocated for remediation of environmental damages caused by mining were divided into two

broad categories: damages that appeared before the privatization of coal mines in 1994 and post-privatization obligation for companies to generate reserves for remediation and reclamation of areas affected by mining activities. In 2006, the Ministry of Finance in the Czech Republic claimed to use all reserves generated from privatization to finance the damages prior to privatization (Rečková et al. 2017). The authors highlight further categories of support scheme as the following:

- Providing support for mining companies and partly transferring remediation costs in Ústí nad Labem, Karlovy Vary, and Kladno Regions;
- Covering the expenses related to an ecological revitalization after the mine closures in the Moravian-Silesian Region;

However, during the post-privatization period, the companies were obliged to create reserves to cover remediation and reclamation costs and pay the royalty fees on minerals extraction (Rečková et al. 2017). Consequently, collected levies would further be transferred to the Regional Mining Authorities, where the accumulated income is equally distributed between state and municipal budgets. 50% of the revenues allocated to the state budget would then be designated to cover the cost related to site remediation and restoration in mining regions (Rečková et al. 2017).

Similar cases have been witnessed in other case studies as well, where the government owns up for remediation and restoration costs; however, it would usually be part of infrastructural provision plans that were investigated in Section 4.2.2. Yet in the Czech transition, companies would receive direct support from the government to deal with environmental liabilities.

4.3.3 Reducing or transferring pension premiums and healthcare liabilities

A significant issue neglected in the companies' historical transitions is their obligation to pay healthcare liabilities and pension premiums. If the transition plans are negotiated between stakeholders (companies and central government) in earlier stages of transition, the governments commonly assume responsibility for decreasing or transferring pension premiums and healthcare liabilities (Caldecott et al. 2017). In case of poor stakeholder engagement as in the US, when mining companies suffered from the misfortune of closures and went bankrupt, their workers lost access to vital benefit payments such as healthcare; and even senior employees were not provided with pension premiums despite the years of hard work and devotion (Kok 2017).

Historically, despite the pledges made by the government to support transitioning companies by transferring essential benefits and costs (i.e., Poland, Spain) obligations such as pension and healthcare liabilities were often underfunded (Szpor 2017, Rio 2017).

4.4 Policies targeting Individuals

Intelligent and deliberate transition management constitutes more pillars than just providing merits and supporting schemes for companies and communities; it also includes other kinds of practices that directly support individual prosperity. This section will present the main takeaways from historical transitions that directly contributed to workforce management. The section will summarize policies from historical transitions designated to individuals such as retraining workers at the danger age of 35 to 40, providing early retirement options for mature employees, allocating welfare allowances such as temporary redundancy payments until employees find new job opportunities.

Managing the risks associated with the disappearance of professional pride and status, personal identity traits inherited through possession of crucial responsibilities, and assuming a vital role in the company, the social networks within the community members are among the issues that need to be addressed (Caldecott et al. 2017). These factors are usually handled differently depending on the seniority level and age category of the affected workforce (Bottino 2018).

4.4.1 Retraining workers

According to Caldecott et al. 2017, various types of retraining opportunities and practices can be offered depending on different circumstances:

- Fulfilling new roles based on a short-term contract in case of the disappearance of key roles in the company to avoid redundancy payments before reemployment in the new industry;
- Providing internal mobility and rotation programs within the companies' different departments that help to develop operational and interpersonal skills;
- Providing "on-the-job" retraining opportunities when new businesses are acquired by the company to enable labor to transfer to the new industry;
- Training the workforce to obtain new skills that can be performed in other companies and sectors.

The authors further highlight that practices such as providing internal mobility and "on-the-job" retraining opportunities to mitigate the risks of the transition are usually possible in case of large companies and those that are nationalized by the government with robust financial health, however, smaller companies may struggle to provide such support schemes (Caldecott et al. 2017). For example, in the Netherlands, after the nationalization of the coal mining

companies, 21% of employees were retrained to obtain jobs in the acquired chemical industry between 1965 and 1975 (Gales and Hölsgeng 2017).

In most observed historical cases, retraining policies were ineffective, mainly due to mismatches between acquired skills from training and local demand for workers (Caldecott et al. 2017). For instance, in the UK transition, The Coalfields Regeneration Program started almost a decade after a significant industrial decline (White 2003). The author further explains that while there were some training opportunities available for affected workers the main emphasis was on educating the next generation. The intention was to motivate ex-miners' children to stay in school and persuade them to get higher educational degrees (White 2003). These programs, in fact, had a major contribution to the families of ex-miners helping the generation to deviate from mining identity and culture; however, it led to a migration of young labor force since there was a mismatch between skills acquired and local demand (White 2003). Consequently, investment did not pay off and did not contribute to revitalization of coalfields in the long-term and resulted in massive out-migration (White 2003).

Although most of the observed case studies highlight that training programs were ineffective in supporting large scales of affected labor, some positive observations need to be praised and scaled up for future transitions. Parallel to solar infrastructural developments in West Virginia, US, Coalfield Development Corporation launched by Brandon Dessison started an initiative providing traineeships to gain an associate degree and certification in solar installation and asbestos removal (Bottino 2018). Bottino (2018) further describes that the programs followed the 33-6-3 model, offering 33 hours of paid work, 6 hours of in-class training, and 3 hours of interpersonal skill development classes on a weekly basis. After completing two years of the traineeship, the company provided jobs for unemployed ex-miners in energy-efficient housing construction in the area (Bottino 2018).

Similar efforts in designing training programs for affected labor that match the local demand in West Virginia were put forward by dominant solar energy project developer and entrepreneur Dan Conant (Bottino 2018). The author further states that the primary motivation behind starting the initiative named Solar Holler was helping the transitioning communities and individuals to obtain sustainable jobs and remain in their home state in West Virginia rather than seeking opportunities away. With the mission statement "Repowering West Virginian homes, businesses, and non-profits with renewable energy", Solar Holler provides 2.5 years paid "on-the-job" training programs (Bottino 2018, p.19). In addition, Solar Holler acts jointly with Coalfield Development Corporation to hire workers that have attained competence to be employed in clean-energy jobs (Bottino 2018).

4.4.2 Early retirement

The case studies suggest that it is uncertain to what extent economic diversification in affected regions and availability of jobs in vicinities can help cover the job shortfalls due to industrial decline (Kasper 2012, Rio 2017, Gales and Hölsgeng 2017). Indeed, with support from the governments, it is possible to mitigate unemployment over time (i.e., US and UK case studies); however, in reality new employment opportunities often pay less than mining jobs, except for a small proportion of highly trained laborer (Kok 2017, Beatty et al. 2007). Consequently, due to a lack of attractiveness of available opportunities, older miners often seek early retirement or incapacity payments rather than re-entering the workforce, which puts a burden on regional economic welfare (Caldecott et al. 2017).

Furthermore, most of the case studies emphasize that poor transition management can result in the workforce retiring abnormally young, which imposes threats to social security funds and pension systems. A follow-up study of the 1990s transition period in Poland indicates that

approximately in five years, 30 to 40 percent of former coal employees in working-age were no longer part of the active labor force (Szpor et al. 2018). Similar trends have been witnessed in the Spanish transition, where the retirement age for ex-miners was unusually low at 44 in 2015 due to a lack of alternative employment opportunities (Caldecott et al. 2017). According to Rio (2017) estimates, such policy adjustment costs an extra 454 000 € per affected worker to the state than those who get reemployed in other industries. Caldecott et al. (2017) suggest that the costs imposed for the government usually extend beyond supporting individuals, considering other broader support schemes dedicated to regional revitalization and the creation of economic activities in affected areas. Therefore, the first and foremost essential criteria to establish new industries according to local labor force's competences to avoid consequences such as claims for early retirement and incapacity payments (Caldecott et al. 2017).

Social and psychological consequences related to early retirement are commonly disregarded in policies (Gales and Hölsgeng 2017, Szpor et al. 2018). These consequences may occur due to feelings of rejection and a lack of appraisal for those who dedicated their lives to the fossil fuel industry necessary to sustain national economies (Caldecott et al. 2017). The suggestion is to allocate generous funds to deal with possible post-retirement social consequences (Gales and Hölsgeng 2017). In the Dutch and Polish transition case, these topics were the central focus of transition debates; however, due to lack of financial means in the later phase, they received far less attention from policymakers (Gales and Hölsgeng 2017, Szpor 2017). For example, in Poland, in 1993-1994, transition planning offered a program to mitigate social risks correlated with deteriorating industrial decline and laid the grounds for policy instruments to secure social protection for early retiring labor in mining regions (Szpor 2017). According to Szpor 2017, the labor force with the remaining three years until retirement and high seniority level could benefit from early-retirement options that amounted to 50% of their former salaries; they could

choose between options to be paid on a monthly basis or receive upfront lump-sum payments. In addition to that, ex-miners would also be provided with annual benefits and privilege payments, recognizing their contribution to the national economy in periods when needed (Szpor 2017).

Later, in 1998, within the initiative called Miners' Social Package, existing allowances were further strengthened by increasing the pensions up to 75% of their previous wages (Szpor 2017). According to statistical data, the research concludes that between 1990 and 2005, around 67 000 miners benefited from the Miners' Social Package for early retirement (Szpor 2017).

Similarly, in Spain, 1998-2005 coal plan, reduction in productive capacity, and associated labor layoff were accompanied by support schemes for affected laborers offering early retirement options and redundancy payments that recognized seniority levels (Rio 2017). Accordingly, to the policy that came into force in February 1998, those who had at least ten years of seniority in the mining companies could receive up to 70% of their gross salary (Rio 2017).

Despite in most cases, early retirement packages failed to address social and psychological risks imposed on employees; it was a necessary policy intervention, especially in cases where the local economy could not allocate affected labor with new jobs (Beatty et al. 2007, Rio 2017, Szpor 2017).

4.4.3 Welfare allowances for voluntary redundancy

Redundancy payments usually have been paid either for following 12 months (in some cases more, however with gradual decline) (Kok 2017, Stognief et al. 2019) or as a one-time lump-sum payment (Beatty et al. 2007, Fothergill 2017, Szpor 2017, Rečková 2017) upon mine closures. According to Caldecott et al. 2017, there were usually paid to employees that have served more than determined minimum period in the company, and they were distributed in the

following ways: 1) direct payments by state-owned mining companies; 2) through fund distribution from the government to non-state-owned enterprises; 3) in some cases by private companies with strong financial health. Most of the historical cases retrieved for study indicate that redundancy payments alone are ineffective and need to be combined with other support types, such as retraining programs, to increase reemployment chances for affected workers.

There is evidence that workers who received shorter and lower redundancy benefits combined with other support schemes (i.e., paid retraining and relocation) tend to get reemployed compared to those who received more significant financial support (Caldecott et al. 2017). Beatty et al. 2007 state that more extended periods of redundancy payments discouraged workers from seeking jobs in the case of the UK, resulting in shifting into a permanent sickness support scheme. In the British transition, employees were provided with several options such as redundancy payments and other welfare benefits, career advice and training, and for more senior workers the opportunity to retire early (Fothergill 2017). In the UK, the funds provided to the Coal Industry Social Welfare Organization by the government constituted lump-sum redundancy payment equivalent to 6 to 12 months of employee wage, combined with career advice and training for ex-miners (Fothergill 2017). Notwithstanding the efforts and generous social contributions, the UK transition failed to deliver positive outcomes (Beatty et al. 2007). Accordingly, in the UK transition, in the planning phase, the central focus of the debates was on social benefit packages and, for the most part, ignored the need for economic regeneration. While major closures occurred in the early and mid-1980s, it was only the 1990s, to be more precise in 1997 when the government started investing in the economic regeneration of affected regions (Beatty et al. 2007).

Contrary, in the US, federal funds allocated 75 million USD in the regeneration of Appalachian, distributed equally between welfare benefits and economic recovery, creating new

opportunities that enabled miners to get employed after receiving redundancy payments (Kok 2017).

To sum up, redundancy payments are sufficient for workers who have several years left until eligibility for early retirement (Rečková 2017) or combined with other social benefits and economic regeneration programs for transitioning regions (Kok 2017). Otherwise, it may lead to detrimental social consequences, such as loss of personal and professional identity and deterioration of self-esteem (Caldecott et al. 2017). To ensure just transition for ex-mining communities, all the categories mentioned above need to be considered while tailoring future transitions policies.

4.4.4 Golden Handshake

In the Polish transition case, there was a unique supporting scheme for ex-miners that intended to recognize seniority named "Golden Handshake," providing welfare benefits for those who dedicated their life-time and sacrificed their health to provide unsustainable fuels such as coal necessary to the economic growth of the country (Szpor et al. 2018). These support schemes consisted of two options. Based on personal preferences, ex-miners could either choose honorable handshake receiving generous single lump-sum payments based on seniority level (minimum five years) in case of unconditional leave; or smaller amount of payment combined with funded retraining opportunities (Szpor 2017). Suggested support schemes that provided opportunity to choose preferable option based on personal preferences appealed to be a just policy tool, however, it failed to deliver positive outcomes (Szpor et al. 2018). Among the options provided, a considerable proportion of miners chose to stick to a one-time payment, ignoring future consequences and a need to plan for further re-employment (Szpor 2017). According to follow up studies on the analysis of miners' social and psychological state, it

turned out that those who received single payment in the long term were seriously worse off (Caldecott et al. 2017, Szpor 2017). Most of them turned to seek permanent sickness benefits and remain economically inactive (Szpor 2017).

There was a substantial trade-off between the pace of employment reduction that came with generous financial contributions and the inability of such mechanisms to provide positive outcomes in the long term (Szpor 2017). Accordingly, although the "Golden Handshake" helped reduce the number of active miners in the short term, it imposed threats to the local economy's long-term sustainability. Attractiveness to single lump-sum payments and honorable recognition, raised a question in the academic and political sphere, on how to design policy instruments that recognize seniority without undermining the potential and motivation to seek job replacement (Caldecott et al. 2017). As stated previously, in the case of redundancy payments, usually more significant financial contributions increase reluctance and demotivate miners from staying economically active (Caldecott et al. 2017).

Many other scholars highlighted that despite generosity, the “golden handshakes” had misleading attractiveness that proved to be an ineffective policy instrument (Wirth et al. 2012, Rzegocki 2020)

5 Discussions

The results section's primary focus was to assemble the main observations from the analysis of post-transitional literature and outline policies that have been put in place in the national agenda to facilitate local economic regeneration and tackle massive unemployment that occurred due to destabilization in the coal sector. The policies observed in the post-transition studies fall into three main categories and 11 sub-categories defined in the Analytical Framework (Table 6). The three main categories correspond to the levels of intervention: regions and communities, companies, individuals, and sub-categories indicate types of policies within each category. This chapter interprets the Results in light of theoretical framing established in the literature review section.

5.1 Regions and Communities

A large cluster of observed policies was directed at affected regions and communities. These included anticipation, communication and engagement; local infrastructural provision; economic diversification and job creation, and community projects.

The success of policies directed at regions and communities depend on regional recovery capacity which falls into two theoretical pathways identified in the literature review: **cumulative causation** and **self-correcting view** (Beatty et al. 2007, Richardson and Townpoe 1978). **Cumulative causation** stands for local economic downfall due to decaying dominant industry accompanied with high rates of out-migration, declining consumer expenditures, and associated tax revenues, exhaustion of community services (i.e., healthcare and education) (Beatty et al. 2007). Such inclination tends to result in falling market performance and eradicates areas' attractiveness towards new investments. Similar outcomes have been witnessed in post-transitional literature analysis, specifically in the UK (Ayrshire,

Northumberland, South Wales) due to limited planning, communication and management of stakeholder engagement before major shutdowns (Beatty et al. 2007).

On the other hand, the Dutch transition has become a successful example of a recovery process (Gales and Hölsgens 2017). It aligns with the attributes of **self-correcting view** in the neoclassical economics and neo-institutionalists approach that claims the necessity of legitimacy and political support (Turnheim and Geels 2012). The efforts put forward by Dutch transition were also a blueprint for Procedural and Recognition Justice, which involves early admission and negotiation of consequences for individuals and communities that come with regime destabilization (Pai et al. 2020).

Self-correcting view in economics takes an outstandingly positive approach to predict the turn of events after a significant local industrial decline (Richardson and Townpoe 1978). According to this view, the decay of the dominant industry pushes down minimum wage levels in the area. In return, lower wages boost the attractiveness of the region for investors; due to new industries settling in the region demand for labor increases. Richardson and Townpoe (1978) explain that employees that out-migrate help to restore the balance between labor demand and labor supply. In the Netherlands, policymakers could foresee opportunities highlighted in self-correcting theory and to make the best out of the turn of events engaged early in anticipating possible outcomes and negotiating with key stakeholders (Hölsgens 2016).

Richardson (1978) affirms that short-term imbalances are unavoidable; however, price competitiveness is the key to economic recovery in the long-term. As discussed throughout the literature review, to facilitate the recovery process prescribed in the self-correcting view, there is a need for a state to act as a mediator by assisting with policies that can help to mitigate risks related to the destabilization of the system (Lindbeck and Snower 1990). The government

intervention in the free-market through introducing supply-side policies assists and eases the economic recovery process (Burtless 2002). Similarly, in the Netherlands, despite accurate planning there was a resistance of the communities in the initial phase of the shut-down, however, coordination and farsighted approach of the policymakers made the destabilization of the binding regime a collective process (Gales and Hölsgens 2017).

Concerning local infrastructural provision, Germany and Spain were among the countries which directed a vast proportion of economic regeneration budget in this specific category (Rio 2017, Oei et al. 2019). However, the striking difference between the countries was the type of infrastructure developed in affected areas. Germany took more strategic measures by bringing universities and research institutions in the Rhineland and Ruhr regions (Stognief et al. 2019, Oei et al. 2019). By boosting networks between local enterprises and higher education institutions, it laid grounds for growing numbers of start-ups in the area (Stognief et al. 2019).

Instead, transition management in Spain focused excessively on improving public infrastructure, hoping to boost regional attractiveness for the investors, yet it failed to deliver positive outcomes in the long run (Rio 2017). Ex-miners had massive complaints regarding the situations arguing that renovated sidewalks and street lights were unable to attract new industries in affected areas resulting in high unemployment rates after mine closures (Rio 2017).

With respect to economic diversification and job creation, Germany, Netherlands, and the US are most remarkable cases. Although their pathways and strategies significantly diverged, they showed exceptional experiences in diversifying the economies. These efforts were in line with the requirements of Restorative Justice for just transition, aiming to restore damages for directly impacted workers (Pai et al. 2020).

In the 1980s, in the Ruhr region of Germany due to polycentric and inclusive governance of transition, policymakers managed to mitigate the "lock-in" effect and established new industries that reflected regional strengths (Oei et al. 2019). For instance, in the case of Dortmund, as the result of well-built networks between established research institutions and companies, the city has become a technology hub specialized in the field of microsystem technologies (Oei et al. 2019).

In the Netherlands, due to farsighted policymaking, the government acted proactively by nationalizing coal mines facing the threat of decline, and later merged with the chemicals and natural gas industries (Gales and Hölsgeng 2017). As a result, between 1965 and 1969, half of the active labor shifted to a new job within the chemicals department (Gales and Hölsgeng 2017).

In the USA, the active support of the government on community projects during Obama's presidency, 75 million USD that were allocated into economic regeneration gave rise to the solar sector in the Appalachian regions through several initiatives actively retraining ex-miner and providing job opportunities in the sustainable energy sector (Kok 2017).

The main findings directed at strengthening regional and community performance discussed throughout the section indicate notable features of just transition and lessons for future policymakers. **Table 8** summarizes country-specific examples reviewed in this section in line with economic and justice framing.

Table 8. Economic and justice framing of region-directed policies.

Types of policies	Country-specific examples	Economic framing	Justice framing
Anticipation, communication and engagement	UK	Cumulative causation	Recognition and Procedural justice
	Netherlands	Self-correcting	
Local infrastructure development	Spain	Cumulative causation	Restorative and Recognition justice
	Germany	Self-correcting	
Economic diversification and job creation	Germany, Netherlands, US	Self-correcting	Distributional and Recognition justice
Community projects	US, Netherlands	Self-correcting	Recognition and Procedural justice

5.2 Companies

Reducing or transferring mine remediation and restoration costs, pension premiums, and healthcare liabilities for the companies were the main elements retrieved from post-transitional literature.

Reducing and transferring pension premium payments and healthcare liabilities for the companies by the state provides security for coal workers if the mining company suffers from massive production reduction and goes bankrupt (Kok 2017). In most observed cases, this issue was excluded from transition debates, and in cases (i.e., Poland, Spain) where the government initially pledged to cover pension and healthcare liabilities later failed to provide funds upon actual closures (Szpor 2017, Rio 2017).

Czech government allocated generous financial support to tackle technical liabilities related to the rehabilitation of environmentally damaged land and the reclamation of mining areas

(Rečková et al. 2017). The damages that occurred before privatization (1994) were covered entirely by the government from the reserve generated from the privatization; however, in post-privatization, the costs were partially supported by the reserve generated from levies and the royalty fees on minerals extraction (Rečková et al. 2017).

Table 9. Justice framing of company-directed policies.

Types of policies	**Country-specific examples**	**Justice framing**
Mine remediation and restoration	Czech Republic	Restorative justice
Pension premiums, and healthcare liabilities	Poland, Spain	Restorative, Recognition and Distributional justice

The absence of transferring substantial costs for threatened companies in the transition management and non-compliance in cases of Poland and Spain violated the principles of Distributional Justice where the consequences of climate policy adjustments should be equally distributed between stakeholders (Pai et al. 2020) (Table 9).

5.3 Individuals

In the view of individuals, investigated policies covered a broad spectrum, including analysis of retraining workers, early retirement, voluntary redundancy benefits, and other benefit packages depending on the seniority of the employees. The government's obligation to support individuals and groups affected from the consequences of energy-related policy adjustments falls into the Recognitional, Restorative and Distributional Justice category (Pai et al., 2020). Table 10 provides a summary of successful policies aimed at mitigating consequences for individuals in light of justice framing discussed in the literature review chapter.

Retraining labors through providing different options and support schemes depending on local circumstances and other available industries, has been broadly discussed in the results section. The significant observation is that the provided training should enable laborers to get employed either after the termination of the contract or by the end of redundancy benefits. For instance, in the UK, there was an apparent mismatch between retraining opportunities and the availability of jobs matching new skills attained by the ex-miner (White 2003). That is partially due to the fact that The Coalfields Regeneration Program started only ten years after the massive coalpit closures (White 2003). Hence, investments directed in retraining affected workers did not pay-off since most of them choose to stick to permanent sickness benefits after the redundancy or out-migrate from the regions in search of new jobs (White 2003).

However, in the US, their ambition to preserve energy-related identity in the Appalachians by bringing the solar industry into the region was assisted with funds to retrain former miners into more sustainable jobs (Bottino 2018). Similarly, in the Netherlands, through proactive labor management "on-the-job" training programs enabled 21% of miners to shift to the chemicals industry between 1965 and 1975 (Gales and Hölsgeng 2017). Due to deliberate planning, policymakers in the Netherlands managed to provide a secure transition for workers, resulting in no requirements for funding large scale redundancy payments (Gales and Hölsgeng 2017) (Table 7). The lesson learned from historical case studies is that investing in retraining should come together with regional economic diversification to secure reemployment for former coal workers.

In most of the countries analyzed throughout the review, the retirement age was abnormally young. That was mainly due to weak economic diversification and lack of job opportunities in the affected areas (Kasper 2012, Rio 2017). In Spain, for instance, former workers from the

coal sectors could retire at 44, which put stress on the pension system, costing an extra 454 000 € per individual to the state (Rio 2017).

Table 10. Justice framing of individual-directed policies.

Types of policies	**Country-specific examples**	**Justice framing**
Retraining workers	USA, Netherlands	Distributional and Recognition justice
Early Retirement	All countries	Distributional and Recognition justice
Redundancy Benefits	All countries except for the Netherlands	Restorative justice
Golden Handshake	Poland	Recognition justice

Another significant issue often avoided in the transition studies was detrimental physiological effects for unemployed workers receiving redundancy benefits at danger age (35-45) or retiring early (Gales and Hölsgeng 2017, Caldecott et al. 2017). According to the mastermind of behavioral economics who established the theory of life-span development (Erikson 1959) highlights that the sense of maturing ego has eight stages, the fifth which is classified as an "industry stage", realized when an individual acquires a professional identity. Due to a massive decline in coal production and associated employment, individuals can often experience a diminishing sense of worth and deterioration of psychological well-being (Erikson 1959).

Concerning the welfare allowances for voluntary redundancy, the findings indicate that those who receive relatively low redundancy benefits combined with other types of support (i.e., paid retraining and relocation) often tend to seek for reemployment more compared to those who receive more generous financial support (Caldecott et al. 2017).

6 Conclusions

This thesis aimed to derive lessons from past transitions to the ongoing low-carbon transition based on the systematic review of post-transitional policies in countries that have experienced a massive historical decline in the coal sector. To achieve this aim, in the literature review, I first started with an assessment of seminal studies grounded in transition management literature. Findings indicate that current transition management research is excessively focused on the deployment of innovative technologies and models, and pays far less attention to the decay of dominant socio-technical regimes and associated risks for communities and workers (Grubler 2012, Rosenbloom et al. 2016). I have merged theories established in neoclassical, behavioral, and institutional economics to scrutinize better the effects of industrial decline on the local economy, communities and workers; and the role of institutional governance in transition management, to develop a holistic view on different elements of transition. I have also defined preconditions for designing just frameworks for communities and workers during future sustainability transitions. Despite burgeoning academic literature and political efforts to develop just transition framework aiming to minimize detrimental outcomes of climate policies on communities, modern literature either highlights a lack of synthesis of cross-disciplinary findings (Pai et al. 2020) or deficiency of historical post-transitional analysis (Caldecott et al. 2017).

I have applied a systematic literature review method to derive lessons from past coal transitions. To avoid bias, I systematically selected studies in line with their relevance to countries with significant coal decline identified in a previous study. Based on the analytical framework I developed for the analysis of observed post-transitional literature, I classified findings into three main sections according to intervention levels (regions and communities, companies, and individuals) and associated 11 sub-sections highlighting specific policy instruments to mitigate

consequences for those affected groups. In the discussion section, I shed light on my findings by linking them with the theoretical framing assisted throughout the literature review.

It is necessary to highlight that the nature of historical transitions diverges significantly from the current one. Historically, major energy transitions have occurred due to technological, economic, and political motives falling into the emergent transition category, followed by low coordination (Berkhout et al. 2004) (Section 2.2, Figure 2). However, as Grubler (2012) highlights, history holds critical and insightful hints that can be exceptionally helpful in customizing policies for upcoming transitions and avoid possible errors.

On the contrary, the current low-carbon transition happens solely due to global environmental pressure, aiming to reduce energy-related carbon dioxide and greenhouse gas emissions. The latter imposes an ethical burden on the governments to actively participate and involve in high coordination to mitigate consequences for communities and workers who have sacrificed their health conditions to provide fossil fuels that were necessary to sustain the country's economy (Pai et al. 2020).

6.1 Lessons from post-transitional studies and policy recommendations

The lessons derived from post-transitional studies can be grouped according to the three analytical categories: **regions and communities, companies, individuals.**

With respect to policies focused on **Regions and Communities**, I have identified that due to complexities and enormous scales of coal transition anticipation of possible scenarios, and communication of plans with key stakeholders in the early stages is a clue to successful transition management. It ensures better preparedness and helps to bring actors in a common

stance. As historical cases validate, this also provides guidelines on fund allocation and prioritization of further development plans in line with local circumstances.

Local infrastructural provision is effective when it establishes grounds for economic diversification and job creation. There should be balance between funds allocated for public infrastructure development and functioning institutions (i.e., higher education institutions, universities, research hubs) to boost regional attractiveness for investors.

Economic diversification can be enhanced through soft policies and alternatives that require strategic thinking rather than excessive financial means. For instance, introducing the types of educational institutions mentioned above and building up strong networks between them and entrepreneurs/investors can establish foundations for many start-ups and community projects in the affected areas.

With respect to **Companies,** considering the ethical burden that comes with sustainability transition, the governments should proactively be involved in sharing liabilities imposed on companies that face threats of declining financial performance and even bankruptcy in most cases. Reducing or transferring pension premiums and healthcare liabilities, as well as mine remediation and restoration costs for companies, should be prioritized in policy agendas aimed at mitigating the consequences of transition. Historically, some of the country-specific post-transitional literature recognized obligations mentioned above; however, there was significant disobedience in most cases. Considering the ethical burden, the governments need to comply with their pledges to support companies to ensure Distributional justice and enable just transition.

With respect to **Individuals**, I have identified that planning prior to closure plays a crucial role in easing the transition for affected workers. Governments should conduct an accurate

statistical analysis of workers belonging to different age groups prior to significant closures. These will help identify and anticipate the proportion of workers who might seek early retirement benefits and those who can be retrained for reemployment.

As studies have proven, generous and long-term redundancy benefits are often ineffective in the long run. It creates an issue of excessive reassurance and demotivates affected labor from looking for a new job. Instead, it results in seeking other types of welfare allowances, such as permanent sickness. Welfare allowances (i.e., redundancy payments) should be combined with different kinds of retraining opportunities to initiate motives to stay economically active in the long-run. Additionally, governments should take responsibility for ensuring that newly trained skills are in demand in the affected regions.

6.2 Future research recommendations

While conducting this research, I had a chance to educate myself on a broad spectrum of aspects of coal transition. The most surprising part for me was the immense amount of financial means required to allocate individuals, and to support communities as well as companies facing risks due to sustainability transition to ensure just transition for all affected groups. The first question that appeared to me was: Why did governments choose not to investigate and invest in further potential and research of carbon capture technologies to boost their diffusion from a niche into a competitive environment since the social costs imposed for just transition are equally significant? Hereby, I have decided to search for possible answers on this issue if, in the future, I choose to pursue doctoral studies.

In view of the complexity and emergency of the issue I call fellow researchers to focus on questions mentioned below and to contribute to the research in this area. Considering puzzles that came along the way, I would advise future research to focus on the following questions:

> How to ensure ambitious policy-making that promotes and invests in decisions which have long-term effectiveness instead of providing solutions that are functional only in the short-run?
>
> Are there any real-world examples of policy intervention that help mitigate psychological risks for employees falling into the "danger age" category?
>
> What are the ways to unleash the full potential of affected areas from massive mine closures by closely examining other skill sets and cultural heritage of communities and building up new industries (such as leisure and recreation) that bring new branding for the regions?

Decreasing the use of coal is an inevitable and urgent issue that needs to be addressed pre-emptively. As historical cases validate, consequences of such transition on community livelihoods and individuals are usually more severe than predicted prior to implementation. Considering the enormous scales and pace of decline, I would like to call the attention of research on the low-carbon transition to focus on the complexity and severity of the issue. I highly advise future research to focus on the synthesis of cross-disciplinary findings and historical post-transitional analysis to ensure policymakers are rigorously informed on the multi-dimensions of the process.

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