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Bachelor Thesis

Coal Identities and Climate Beliefs:

How Historical Economic Dependence Shapes Contemporary Attitudes in Europe

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Abstract

This thesis investigates whether historical dependence on coal, interpreted as a “coal identity”, influences present-day climate skepticism across European regions. Building on theories of economic identity, it explores how cultural legacies rooted in coal mining shape beliefs about the causes of climate change. Using harmonized data from the European Social Survey (ESS) and historical coal employment records at the NUTS-1 level, the analysis combines regional exposure measures with individual attitudes toward climate change attribution.

The results reveal a robust positive relationship between regional coal identity and climate skepticism: individuals in historically coal-dependent regions are significantly more likely to attribute climate change primarily to natural rather than human causes. This effect persists after controlling socio-economic and regional indicators, and remains stable across robustness checks. These findings suggest that the social and cultural imprints of coal extend across generations and continue to influence environmental worldviews.

Overall, the results highlight that fossil-fuel-based identities can shape perceptions of human responsibility for climate change long after the industry’s decline. Recognizing and addressing these identity-based dynamics is essential for designing climate communication and transition policies that are both effective and socially just.

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List of Aids

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Gemini	Literature and Data Search
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Cursor	Data Cleaning, Statistical Analysis
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Scribbr	Citations

1 Introduction

Climate change represents one of the most pressing global challenges of the twenty-first century. Despite an overwhelming scientific consensus that it is primarily caused by human activity, public disagreement persists. Across Europe, a substantial share of citizens continues to attribute climate change partly or entirely to natural processes. This gap between scientific evidence and public belief has important implications for the political feasibility of climate action. Understanding why climate skepticism persists remains a key question for both researchers and policymakers.

While existing research has identified political ideology, values, and trust in science as central drivers of climate attitudes (Hornsey et al., 2016; Poortinga et al., 2019), less attention has been paid to the historical and cultural roots of skepticism. Many European regions were long dependent on coal mining, which shaped not only local economies but also collective identities and social structures. Even decades after mine closures, these legacies remain visible in regional culture, heritage, and self-understanding. Yet it is still unclear whether such enduring "coal identities" influence how people interpret and respond to climate change today.

This thesis addresses this gap by investigating whether regions that were historically dependent on coal, and therefore developed distinct coal identities, exhibit greater climate skepticism. In doing so, it draws inspiration from recent work by Dewitte (2024), who shows that fossil fuel exposure created enduring "oil identities" in the United States that continue to shape attitudes toward climate change. Extending this logic to Europe's coal context, this study explores whether similar identity-based legacies can help explain regional variation in climate beliefs across the continent.

The analysis builds on Akerlof and Kranton (1997) theory of economics and identity, which argues that individuals derive part of their self-concept from their social and economic environment. When particular industries dominate local life, economic dependence can become intertwined with identity and belonging. Coal regions epitomize this process. Mining not only provided employment but also symbolized dignity, solidarity, and national progress. Over time, these meanings became institutionalized as coal identities, regional attachments that persist even after economic dependence has faded. Such identities may shape climate attitudes by eliciting defensive reactions when the energy transition is framed as a moral judgment on fossil fuels. In this view, skepticism becomes a form of identity protection rather than ignorance.

To empirically test this mechanism, the thesis combines historical data on coal employment with contemporary survey data from the European Social Survey (ESS, Round 11). From the full ESS sample, five European countries were selected for analysis based on their substantial coal histories and availability of coal employment data: Germany, the United Kingdom, Belgium, Spain, and Poland. Regional coal identity is proxied by historical coal employment per 10,000 inhabitants, capturing the social density of coal dependence during the post-war peak of industrialization. A logistic regression model estimates the relationship between regional coal identity and individual climate attitudes, controlling for socio-economic factors such as education, income, ideology, age, and gender, gdp per capita as well as country fixed effects. Two robustness checks further test intergenerational persistence and the influence of outlier regions.

The results show that regional coal identity is a robust predictor of climate skepticism. Individuals living in coal-intensive regions are significantly more likely to attribute climate change to natural rather than human causes. This suggests that residents of former coal regions reinterpret the causes of climate change in ways that protect their collective self-image. The effect persists among younger generations and remains stable when excluding the largest coal regions, indicating that the identity-based legacy of coal extends beyond direct employment experience.

By linking historical economic structures to contemporary attitudes, this study makes three contributions. First, it introduces an identity-based perspective to the study of climate skepticism, showing that environmental beliefs can reflect long-term cultural legacies rather than only short-term political or informational factors. Second, it provides the first quantitative evidence for coal identity effects across multiple European countries. Third, it offers insights into why some regions resist climate policy more strongly than others, emphasizing that the energy transition is not only a technical or economic process but also a social and cultural one.

The remainder of this thesis is structured as follows. Chapter 2 reviews the literature on climate attitudes, highlighting the key individual and contextual determinants of climate skepticism. Chapter 3 provides a historical overview of Europe's coal regions. Chapter 4 outlines the theoretical background on economic identities and the formation of coal identities. Chapter 5 and 6 describe the data and empirical strategy, followed by the empirical results in Chapter 7. Chapter 8 discusses these findings and their implications for policy and future research, and Chapter 9 concludes.

2 Climate Attitudes

2.1 Scientific Consensus on Climate Change

In the last three decades, scientists have accumulated a compelling body of evidence demonstrating that the drastic global warming observed since the 1950s can almost entirely be attributed to human activities such as greenhouse gas emissions, deforestation, and industrial processes, rather than to natural climate cycles. Already in 1992, the Intergovernmental Panel on Climate Change (IPCC) concluded that the emission of greenhouse gases "will enhance the greenhouse effect" (IPCC, 1992, p. 64), ultimately increasing Earth's surface temperature. By 2013, the IPCC had gathered additional evidence allowing them to state that human activities were "extremely likely" to be the dominant cause of observed climate change (IPCC, 2013, p. 15). Finally, in 2021, the IPCC concluded unequivocally that there is no doubt climate change is primarily human-made (IPCC, 2021, p. 1).

Despite this overwhelming scientific consensus, climate skepticism remains surprisingly widespread. According to the latest European Social Survey (European Social Survey European Research Infrastructure, 2025), an average of 53.3% of Europeans doubt that climate change is primarily human-driven, instead attributing it to natural processes or equally to human and natural causes. The extent of skepticism varies considerably across Europe, ranging from 38.6% in Sweden to 76.3% in Norway, with most countries falling between 45% and 60% (European Social Survey European Research Infrastructure, 2025) .

2.2 Determinants of Climate Skepticism

Understanding the persistence of climate skepticism has become an important research agenda. A growing body of literature shows that political orientation, values, and worldviews are far stronger predictors of climate attitudes than socio-demographics such as age, gender, or education. Large-scale meta-analyses confirm that individuals with conservative or right-leaning political views, free-market ideologies, or hierarchical and individualistic worldviews are systematically more skeptical, whereas environmental values and trust in science correlate strongly with acceptance of anthropogenic climate change

(Hornsey et al., 2016, pp. 4–9). Cross-European evidence further demonstrates that skepticism is more pronounced among men, older people, and those with lower education or self-enhancement values, though the strength of these effects varies regionally (Poortinga et al., 2019, pp. 11–17). In the United States, this politicization has been especially pronounced: McCright et al. (2016, pp. 2–8) argue that skepticism is best understood through an "anti-reflexivity" framework, whereby climate denial is rooted in defending the industrial capitalist system against environmental critique, reinforced by partisan polarization and conservative countermovements.

Other studies stress that experience alone is insufficient to reduce skepticism. Whitmarsh (2008, pp. 357–367), for instance, shows that flood victims in the UK were no more likely than others to believe in or worry about climate change, since they interpreted flooding as a local management issue rather than evidence of global warming. By contrast, individuals reporting health impacts from air pollution showed significantly greater concern and pro-environmental engagement, suggesting that tangible experiences only influence climate perceptions when they are conceptually linked to broader environmental problems. Longitudinal evidence also demonstrates that macro-level shocks shape skepticism: economic downturns, elite political cues, and media controversies such as "Climategate" have reinforced doubt, particularly in Anglophone countries, whereas concern has risen steadily in parts of Latin America, Africa, and Southern Europe (Capstick et al., 2014, pp. 38–53).

While individual- and national-level drivers have been extensively studied, research at the subnational scale remains rare. Mewes et al. (2024, pp. 3–7) demonstrate that climate skepticism in Germany is not randomly distributed but systematically shaped by local contexts such as the urban–rural divide, regional prosperity, the legacy of green political culture, and the East–West divide. Similarly, Lübke (2021, pp. 158–163), using ESS Round 8 data, shows that both climate change denial and skepticism vary considerably across European regions, being more common in rural, less prosperous, and fossil fuel–dependent areas. Dewitte (2024, pp. 20–27) adds a longer-term perspective by demonstrating how historical fossil fuel extraction in the United States created enduring "oil identities," which persist across generations and continue to reduce concern of climate change even after extraction has ceased.

Taken together, these studies highlight that climate skepticism is shaped by a combination of individual values and ideologies, contextual and regional legacies, and historical identities. This suggests that skepticism is not merely a matter of ignorance or informa-

tion deficit but is deeply embedded in social, political, and cultural structures. In this light, coal-dependent regions may also have developed strong “coal identities,” similar to the oil identities described by Dewitte (2024, pp. 20–27), which could help explain persistent patterns of climate skepticism in Europe. To better understand the European coal context, the next chapter will give a brief geneses of coal across Europe.

3 History of Coal across Europe

3.1 Post-1950 European Context

By the mid-20th century, coal was the backbone of Europe's industrial economy and energy supply. In the immediate postwar years, coal output rebounded and even appeared to reach new heights. Coal's strategic importance was underscored by the founding of the European Coal and Steel Community (ECSC) in 1951, the predecessor of the European Union (EU), to jointly manage resources and rebuild economies. Yet this boom was short-lived. From about 1958–1959, European coal demand sharply declined as cheap oil and natural gas entered the market. Mines began closing across Western Europe, heralding a structural decline of the coal industry. Governments intervened with subsidies and national plans to avoid massive unemployment, but the trend was irreversible. (Lagrou et al., 2006, pp. 610–615)

Western European countries undertook managed contractions of their coal sectors. Unprofitable pits were shut, production was consolidated in more efficient mines, and workforces were slashed. This process meant the disappearance of an enormous occupational class of coal miners with a distinct working-class culture and solidarity. In contrast, Eastern Europe saw a very different trajectory: coal output continued to rise well into the 1970s under socialist regimes, as governments in Poland, Czechoslovakia, and the GDR relied heavily on domestic coal to power state-led industrialization. While the West was grappling with closures, Eastern mining regions expanded, making coal both an economic cornerstone and a symbol of socialist progress. (Lagrou et al., 2006, pp. 610–615)

3.2 Germany

Coal was the backbone of Germany's industrialization. The Ruhr Valley emerged in the 19th century as one of the world's densest industrial hubs, where coal powered steel, chemicals, and heavy industry, as well as rail and electricity. The Saarland was another key coal basin, its political fate contested between France and Germany after both World Wars. In the East, vast lignite (brown coal) deposits in Lusatia, Saxony, and Brandenburg supplied most of the GDR's electricity, making East Germany one of the most coal-dependent states in Europe. By the 1950s, hundreds of thousands of miners worked in

West German hard coal. The 1958 “coal crisis” marked the start of decline as oil gained ground. Over the next decades, subsidies and mergers slowed contraction, but employment fell steadily. The last hard coal mine closed in 2018. (Oei et al., 2019, pp. 367–374)

In contrast, lignite still plays a relevant role in German energy today, accounting for 15% of total energy production in 2024 (Statistisches Bundesamt, 2024). However, the German administration enacted the Coal Phase-out Act, which plans to end energy production from lignite by 2038, with some stakeholders pushing for an even earlier phase-out (Bundesregierung, n.d.).

3.3 United Kingdom

Coal was the foundation of Britain’s industrial revolution. From the late 18th century onwards, seams in South Wales, Yorkshire, Lancashire, Durham, and Scotland supplied the steam engines, railways, and steelworks that made Britain the “workshop of the world.” By the early 20th century, Britain was the world’s leading producer, mining nearly 300 million tons annually and employing more than one million miners. Coal defined landscapes of pit villages and collieries, shaped a strong working-class culture, and gave miners a powerful voice in politics through their unions and the Labour Party. (Turnheim & Geels, 2012, pp. 38–44)

After 1945, coal was nationalized and remained Britain’s strategic fuel, still covering the vast majority of energy needs. But from the late 1950s onwards, oil, natural gas, and nuclear power steadily displaced coal. Productivity lagged, pits closed, and employment shrank. The social cost was immense: entire regions built around coal entered a long period of economic decline. The conflict reached its height in the 1984–85 miners’ strike, a bitter confrontation that ended with an accelerated phase-out of the industry. (Brauers et al., 2020, pp. 241–244; Turnheim & Geels, 2012, pp. 38–44)

Recently, in September 2024, another milestone was reached when the last coal power plant closed, marking a new coal-free era for the UK (Department for Business, Energy & Industrial Strategy, 2021)

3.4 Belgium

Coal underpinned Belgium's early industrialization. The Sillon industriel, stretching through Hainaut and Liège, became the heart of Wallonia's steel and glass industries. In the early 20th century, Belgium was one of Europe's top coal producers, and mining towns developed strong working-class cultures. After 1945, coal demand remained high, and the labor shortage was filled by Italian migrant workers, later joined by Greeks and Spaniards. The 1956 Marcinelle disaster, in which 262 miners died exposed the human cost of coal and marked a turning point. By the 1960s, Belgian coal became uncompetitive, and closures accelerated. Wallonia's last mine closed in 1984, and the final Belgian pit (in Limburg, Flanders) in 1992. The collapse left Wallonia with high unemployment and economic decline, but coal heritage sites today preserve the memory of this era. (Valisena & Armiero, 2017, pp. 88–107)

3.5 Poland

Poland presents a contrasting narrative – a coal powerhouse that maintained high production well into the late 20th century. Sitting atop vast coal reserves (hard coal in Upper Silesia and Zaglebie, plus lignite in other regions), Poland treated coal as the lifeblood of its economy, especially after 1945. Under the communist government, coal mining was aggressively expanded and modernized to fuel Poland's push for heavy industrialization. Output soared from about 78 million tons in 1950 to a peak of 172 million tons by 1975, making Poland the second-largest coal producer in Europe (after the USSR) during the Cold War. Mining employment numbered in the hundreds of thousands, and coal became ingrained in the national identity – Silesian mining communities in particular enjoyed prestige as the country's industrial vanguard. (Brauers & Oei, 2020, pp. 1–9; Szpor et al., 2018, pp. 1–8)

The transition away from coal in Poland began in earnest after 1989, when the fall of communism and shift to a market economy exposed the inefficiencies of the mining sector. Unprofitable mines could no longer be propped up indefinitely, and severe air pollution from coal raised environmental alarm. Over the past 30+ years, Poland's hard coal mining has undergone a dramatic contraction. Hard coal production has dropped 63% since 1990 (from 147 million tons in 1990 to just 54 million tons by 2020) and employment in coal mining plummeted by about 80% (from roughly 390,000 jobs to 80,000).

The government introduced social packages (such as generous severance pay and pre-retirement leave for miners) to ease the transition. Nevertheless, the persistence of coal in Poland's energy mix has been notable: even in the late 1990s, Poland still mined over 130 million tons annually, and as of 2020 it remains heavily coal-dependent for electricity. This has made Poland something of an outlier in Europe's decarbonization efforts, often resisting EU climate mandates in order to protect its coal sector and the jobs tied to it.(Brauers & Oei, 2020, pp. 1–9; Szpor et al., 2018, pp. 1–8)

3.6 Spain

Spain's coal story is centered in a few key regions – notably Asturias and León in the north, and parts of Aragón (Teruel) and Castilla-La Mancha – which for ages were known as the country's mining heartlands. Coal mining in Spain dates back to the 19th century, and by the mid-20th century it was an important sector, though never as large as in Britain or Germany. After 1950, under General Franco's autarkic regime, Spain actually expanded certain mining operations to reduce reliance on imported fuel. (Bolet et al., 2023, pp. 1347–1349; López et al., 2023, pp. 3–7)

Economically, from the late 1970s onward, Spanish coal struggled to compete with cheap oil, and later with imported coal. Successive governments (both Socialist and conservative) kept the mines on life support through heavy subsidies, recognizing the lack of alternative jobs in the mining valleys. By the 1990s, the EU's state aid rules pushed Spain to begin phasing down these subsidies and close the most unprofitable pits. In 2018, Spain made international headlines with a landmark Just Transition agreement: the Socialist government signed a deal with labor unions and mining companies to shutter all remaining coal mines by the end of that year, in exchange for a €250 million package of early retirements, retraining, and investment in alternative economic development in the mining regions. The final chapter of Spanish coal is unfolding now: the last Spanish coal mine closed in late 2019, and the remaining coal power plants are rapidly shutting down. (Bolet et al., 2023, pp. 1347–1349; López et al., 2023, pp. 3–7)

3.7 Summary

Europe's coal industry since 1950 presents a complex pattern of industrial rise and fall, government intervention, labor conflict, and eventual transformation. Coal once served as the economic backbone across these nations. Several factors drove coal's decline: technological advances leading to oil and gas adoption, energy market globalization, increasing labor costs and safety requirements, and more recently, the urgent need to reduce carbon emissions. This trajectory reflects Europe's broader post-industrial evolution. Beyond its economic significance, coal came to define the people and places that depended on it. The following chapter explores how this dependence fostered enduring economic identities, and how these "coal identities" continue to influence collective attitudes toward change today.

4 Theoretical Framework: Economic and Coal Identities

4.1 Theory of Economic Identity

Akerlof and Kranton (1997) seminal paper on economics and identity introduced the idea that economic behavior cannot be understood solely through material incentives. Individuals also derive utility from affirming their identity, their sense of self in relation to social categories and prescribed roles. Conforming to these roles enhances self-image, while deviation produces anxiety and social sanctions. Importantly, identity can reshape preferences, create externalities from others' actions, and be deliberately reinforced or manipulated by institutions. This framework has since been applied to contexts such as gender segregation in labor markets, persistent poverty, and household divisions of labor.

Later research has extended this logic beyond individuals to communities and regions. When a single industry dominates local economic life, people's sense of place and belonging often becomes tied to that sector (Romanelli & Khessina, 2005, pp. 349–352). Gusman and Sandry (2022, pp. 6–10) similarly argues that territorial identities are frequently rooted in a region's economic base and, in turn, shape how communities understand development and change. Together, these perspectives highlight that identity and economic dependence co-evolve.

Coal regions epitomize this dynamic. Beyond its role as an energy source, coal created entire occupational classes, reshaped landscapes, and anchored local notions of dignity, solidarity, and progress. Over time, this dependence fostered coal identities, regional attachments in which mining was not merely an occupation but a core element of collective belonging and historical pride.

4.2 Formation of Coal Identities

Coal infrastructures have long had the capacity to generate symbolic meanings and cultural attributes that facilitate the rapid construction of institutionalised identities. The very landscapes of mining (pits, shafts, slag heaps, and company towns) function as minescapes that feed collective imaginaries of prosperity and give those who labor in them symbolic and material power (Sanz-Hernández, 2020, p. 2). Della Bosca and Gillespie (2018, p. 736) similarly highlight how the concept of the minescape captures the ways in which

extraction processes become deeply intertwined with local identity, making coal appear as the foundation of regional development and security.

At the level of everyday experience, coal work created strong occupational and class identities. The demanding and dangerous character of mining forged bonds of solidarity among workers. As (Sanz-Hernández, 2020, p. 8) observes, occupational identity "has a personal character based on individual experience," while class identity is "collective, extended and strengthened by the community identity of the town, region and entire territory influenced by coal." Thus, miners came to see themselves not only as individuals employed in a difficult trade, but as part of a proud working class whose collective contribution powered industrial modernity.

The economic structure of coal regions reinforced these cultural and class-based attachments. With few alternatives available, mining communities often displayed minimal production diversification, creating a high degree of economic reliance on coal (Sanz-Hernández, 2020, p. 8). This dependence, in turn, became the "main meaning source" in legitimising identities: to be from a coal region was to be dependent on coal and to defend its centrality in community life (Sanz-Hernández, 2020, p. 8).

Coal also became culturally framed as a sacrifice for family, community, and nation. In Central Appalachia, Lewin (2017, pp. 59–61) shows how miners understood their labor as an honorable service, sustaining households, fueling the community, and contributing to national prosperity. This theme of sacrifice is echoed across coal regions globally, where mining was often narrated as a vocation of endurance and pride.

Together, these dynamics show that coal identities were not incidental by-products of industrialization. They were actively shaped through infrastructures, occupational bonds, cultural narratives, and economic dependence, forming durable regional identities that continue to resonate long after the mines themselves have closed.

4.3 Intergenerational Persistence of Coal Identities

While coal has lost its material centrality in most European economies over the past two to three decades (with the notable exception of some Easter European countries) the identities forged around coal mining have proven remarkably persistent. Even in regions where mines closed long ago, coal continues to shape community life, memory, and po-

litical culture.

This persistence is evident in two complementary mechanisms. Bottom-up, communities preserve their coal heritage through symbols, rituals, and institutions. Former mining towns often maintain museums, festivals, and football clubs (e.g. Schalke 04 and VFL Bochum in the Ruhr area) linked to coal, transforming an occupational identity into a broader regional heritage (Rezende, 2024, pp. 16–17). As Sanz-Hernández (2020, p. 5) notes, identification with coal continues even after employment ties vanish, while heritage preservation ensures that communities "do not break with their mining past" (Sanz-Hernández, 2020, p. 2). In Germany's Ruhr, this transformation from a working-class identity into a heritage-based regional identity illustrates how material infrastructures and cultural practices sustain collective memory.

Top-down, industries and states have actively worked to maintain coal identities. Bell and York (2010, pp. 111-113) describe how West Virginia's coal industry invested in "economic identity maintenance," using sponsorships (e.g., the Friends of Coal Bowl), patriotic imagery, and school programs to sustain coal as a cultural symbol (pp. 138–139). Similarly, in Poland, political elites, state-owned firms, and media narratives have tied coal to patriotism, independence, and resistance against foreign interference, constructing coal as a national identity marker (Brauers & Oei, 2020, pp. 5–7).

The endurance of such identities can also be understood through the intergenerational cultural transmission model of Bisin and Verdier (2011). Values are passed vertically from parents to children (pp. 65–66). At the same time, schools, peers, and media transmit coal-related values obliquely and horizontally, reinforcing occupational pride and regional solidarity beyond the family sphere (pp. 65–66). Importantly, political attitudes are also shown to transmit across generations (p. 63), meaning that coal identity not only persists but continues to influence how subsequent cohorts interpret policy debates. Economic identities tied to fossil fuels therefore do not vanish with mine closures. Instead, they adapt and persist across time, shaping both cultural memory and political orientations.

4.4 Coal Identities and Climate Skepticism

The persistence of coal identities has important implications for climate attitudes. Previous studies show that these identities are associated with higher levels of climate skep-

ticism. Abreu and Jones (2021, p. 5) demonstrate that residents of former coalfield communities in the UK were significantly more sceptical of the scientific consensus on climate change, as measured by agreement with the statement that the "environmental crisis is exaggerated." Similarly, Dewitte (2024, pp. 20–27) shows that in the United States, historical exposure to oil created lasting "oil identities," which strongly predict climate skepticism even decades after production declined. Together, these findings suggest that fossil fuel–based identities, whether tied to coal or oil, can shape political attitudes towards climate change long after the industries themselves lose economic significance.

The literature identifies several mechanisms through which coal identities foster climate skepticism. Sanz-Hernández (2020, p. 2) shows coal communities develop resistance identities when facing imposed energy transitions. Spanish miners viewed closures as a betrayal (p. 2), disrupting occupational and territorial identities (p. 5). Despite solidarity-based reactive meaning sources emerging (p. 8), policies like early retirement packages left many feeling like "losers" (p. 9). Resistance to climate policy is thus deeply tied to cultural identity and perceived injustice.

In Australia, Della Bosca and Gillespie (2018, p. 736) demonstrate that coal communities have strong place attachment, interpreting changes as threats to identity. When transition activists demonise coal communities, it's perceived as a personal attack, reinforcing rather than weakening coal attachment (p. 739). This shows how climate discourse may inadvertently deepen skepticism in coal regions.

Although these studies provide valuable insights into the mechanisms linking coal identity and climate skepticism, the empirical evidence remains limited and largely context-specific. Most existing research relies on qualitative case studies from individual regions such as Appalachia, Spain, or Australia, with only a few quantitative studies like Abreu and Jones (2021) from coal communities in the UK.

This scarcity of systematic evidence highlights the need for further research. In the next chapters, the focus shifts to the empirical framework. The subsequent section introduces the data sources and variable construction, followed by an analysis that tests whether coal identities can account for regional differences in climate skepticism across Europe.

5 Data & Descriptive Statistics

5.1 Country Coverage and Regional Level of Analysis

The following analysis focuses on five European countries with historically significant coal industries: the United Kingdom, Spain, Belgium, Poland, and Germany. The country selection followed three criteria: (i) a relevant coal history, (ii) coverage in the European Social Survey (ESS) on climate attitudes, and (iii) availability of regional coal employment data. Although Czechia and Serbia met criteria (i) and (ii), they were excluded from the analysis as coal employment data wasn't available in the required format (iii).

All countries are analyzed on the NUTS-1 level, the highest tier of the European Union's Nomenclature of Territorial Units for Statistics. NUTS-1 divides each country into a small number of large regions (see Table 1), which ensures both historical data compatibility and sufficient survey sample sizes.

Table 1: Number of NUTS-1 regions per country

Country	**# NUTS 1 Regions**
Germany	16
United Kingdom	12
Poland	7
Spain	7
Belgium	3

5.2 Climate Attitudes and Control Variables

The climate attitude data are taken from the European Social Survey (ESS). For all five analyzed countries the 11th Edition was used (European Social Survey European Research Infrastructure, 2025). The central variable is ccnthum, which asks whether climate change is caused by natural processes, human activity, or both.

The possible answers are:

1. *I don't think climate change is happening (1.3%)*
2. *Entirely by natural processes (2.7%)*

3. *Mainly by natural processes (7.4%)*
4. *About equally by natural processes and human activity (43.2%)*
5. *Mainly by human activity (36.5%)*
6. *Entirely by human activity (8.9%)*

In line with previous research (Lübke, 2021), this study distinguishes between climate denial and climate skepticism to capture different forms of disbelief in anthropogenic climate change. Climate denial (response = 1) refers to respondents who reject that climate change is occurring at all. This represents an extreme and relatively rare position that stands in direct contradiction to established scientific evidence. Climate skepticism, by contrast, captures respondents who acknowledge that climate change exists but attribute it primarily or equally to natural causes rather than human activity (responses = 2–4).

This operationalization follows the idea that disbelief is not binary but exists along a continuum, from complete denial to more moderate doubt about causation. Climate skepticism thus reflects a subtler form of opposition, where individuals distance themselves from the anthropogenic framing of climate change without rejecting environmental change per se. This distinction is crucial in the European context, where outright denial is rare, yet skepticism toward human responsibility remains widespread and politically consequential.

Given that the scientific consensus had already been firmly established decades before the first survey waves, namely, that the observed climate change since 1950 is overwhelmingly human-induced (see Chapter 2), responses 1–4 all deviate from this consensus, while only responses 5 and 6 (“mainly” or “entirely human activity”) align with it. Accordingly, the binary variable for climate skepticism equals 1 for responses 2–4 and 0 otherwise.

For descriptive purposes, both denial and skepticism are reported below. However, due to the very small number of respondents expressing complete denial, this category is excluded from the regression analysis.

In addition to the climate change variable, ESS also provides a range of individual-level controls (years of education, income, political ideology, age, gender, etc.) that are included in the empirical analysis.

Table 2 shows climate skepticism and denial percentages by country. Poland stands out with the highest level of climate skepticism at 63.2%, significantly above the other analyzed countries which cluster around 45-49%. In contrast, climate denial remains rare across all countries, with percentages consistently below 1%.

Table 2: Climate skepticism and denial by country

Country	Total N in Sample	Skeptic %	Denier %
Belgium	1337	48.7%	0.3%
Germany	1788	45.1%	0.1%
United Kingdom	994	50.4%	0.1%
Spain	1428	46.5%	0.9%
Poland	939	63.2%	0.4%

Regional variation in climate attitudes is substantial. The three regions with highest skepticism are all in Poland, where South Macroregion leads at 69.3% (Table 3). For climate denial, Spanish regions dominate the top positions, with Canarias showing the highest percentage at 2.0% (Table 4). The within-country regional variation (Table 5) is most pronounced in Belgium, where climate skepticism has a standard deviation of 6.6% across regions, while Germany, Poland and the UK show moderate variation (5.4-5.6%). Spain has the most uniform skepticism levels across regions (3.4% standard deviation) despite having the highest regional denial rates.

Table 3: Regions with highest climate skepticism rates

Region	Country	Skeptic %
Central Macroregion	Poland	67.5%
North-West Macroregion	Poland	67.0%
South Macroregion	Poland	67.2%

Table 4: Regions with highest climate denial rates

Region	Country	Denial %
Canarias	Spain	2.7%
North Macroregion	Poland	1.7%
Este	Spain	1.4%

5.3 Proxy for Coal Identity

Regional coal identity is proxied by coal employment at its post-1950 peak per 10,000 inhabitants. This measure effectively captures the relative economic and social signifi-

Table 5: Regional variation in climate attitudes within countries

Country	Skeptic Std. Dev	Denial Std. Dev
Belgium	6.5%	0.26%
Germany	5.2%	0.11%
Spain	3.3%	0.96%
United Kingdom	4.9%	0.27%
Poland	4.6%	0.63%

cance of coal mining in each region's history. Unlike measures such as decades of extraction activity (used in Dewitte's 2024 study on oil identities), employment figures better represent the social embeddedness of coal in local communities. High regional coal employment typically coincided with the formation of distinct coal cultures, social institutions, and collective identities that often persisted beyond industry decline. The employment metric also accounts for the intensity of coal's presence in a region, not just its duration.

The 1950 cut-off was chosen for reasons of general data availability, and because most European coal regions had reached their historical peak or were close to it after that year. The subsequent decline was driven largely by the growing availability of oil and natural gas, which began to replace coal as the dominant energy source throughout the 1960s and 1970s (Lagrou et al., 2006, pp. 610–615). For consistency and due to data availability, this study uses 1950 or 1951 as the reference years for coal employment in Germany, the United Kingdom, Belgium, and Spain, as these years closely capture the peak period across Western Europe. Poland, in contrast, experienced a later peak and remained coal-dependent much longer (Szpor et al., 2018, pp. 1–8); therefore, 2005 is used as the earliest harmonized data point available. Additionally, the former GDR NUTS 1 regions of Germany and Northern Ireland had to be excluded as no historic data for coal employment was available.

The following table summarizes the peak years of coal employment for each country in the post-1950 period and the reference years used in my analysis:

Table 6: Peak coal employment years by country

Country	Post-1950 Peak	Reference Year Used
Germany	1950s	1951
United Kingdom	1950s	1951
Poland	1989	2005
Spain	1950s	1950
Belgium	1950s	1950

5.4 Coal Employment Statistics

The analysis reveals significant variation in regional coal employment both in absolute terms and relative to population size. In absolute terms, North Rhine-Westphalia (Germany) stood out with nearly 500,000 people directly employed in coal mining at its peak. This was followed by the UK regions of North East and Yorkshire and the Humber, both with approximately 150,000 coal miners.

When examining coal employment relative to population (per 10,000 inhabitants), which better captures the social density of coal culture, the UK's North East region leads with 717 coal workers per 10,000 inhabitants. Germany's Saarland follows closely with 705 per 10,000, and Wales ranks third with 490 per 10,000 inhabitants (see Table 7).

Table 7: Regions with highest coal employment per 10,000 inhabitants

Region	**Country**	**Coal Employment per 10k**
North East	United Kingdom	717
Saarland	Germany	705
Wales	United Kingdom	490
East Midlands	United Kingdom	421
North Rhine-Westphalia	Germany	374
Wallonia	Belgium	338
Yorkshire and the Humber	United Kingdom	308
Scotland	United Kingdom	176
South Macroregion	Poland	155
Noroeste	Spain	145

5.5 Data Sources Coal Employment & GDP per Capita

Coal employment data was compiled from a variety of sources:

- Historical census data (Office for National Statistics, 1951)
- Statistical yearbooks (Statistics Belgium, 1950),
- Specialized mining statistics (Consejo de Minería, 1952)
- Articles & Historical studies (Hibner, 2016; Kaelble & Hohls, 1987; Phillips, 2017; Żuk, 2010)

For population denominators, census records and statistical yearbooks were complemented with Eurostat NUTS-level datasets where available (Eurostat, 2025b; House of Commons, 1951; Instituto Nacional de Estadística, 1951; Office for National Statistics, 1951; Statistics Belgium, 1950; Statistisches Bundesamt, 1952). Regional GDP per capita was mainly drawn from Eurostat (NUTS-1), except in the UK where national statistics had to be used (Eurostat, 2025a; Office for National Statistics, 2025).

A key challenge was mapping historical administrative data to contemporary NUTS-1 boundaries. For this, country-specific concordances and mapping datasets were employed, ensuring comparability across regions and over time (Eurostat, 2024; Office for National Statistics, 2017).

5.6 Data Limitations

The data come with several limitations. First, coal employment data could only be harmonized at the NUTS-1 level, which masks variation within regions. Second, the historical employment peak differs in timing across countries, with Poland in particular relying on much later data (2005 while the peak was in the 1980s). Third, the employment measures themselves are not fully standardized across sources and countries, as national statistical offices and historical archives differ in how they define and record coal-related employment. This limits the precision of direct cross-country comparisons. Nonetheless, the data are consistent in capturing the relative regional importance of coal and therefore fulfill their main purpose as a proxy for coal identity. Finally, the ESS sample size is limited at the subnational level, which reduces statistical power in some regions. For this analysis, appropriate survey weights have been applied.

6 Empirical Strategy

To test whether regional coal identities predicts climate skepticism, I estimate a logistic regression model linking individual climate attitudes to my proxy for regional coal identity. The dependent variable is a binary indicator for *climate skepticism*, constructed from the ESS item ccnthum (see chapter 5). It equals 1 if respondents attribute climate change primarily or equally to natural causes, and 0 if they attribute it mainly or entirely to human activity.

Descriptive statistics for climate denial are presented in the data section (see chapter 5) but excluded from the analysis due to the small number of observations, which prevents meaningful inference.

Given the binary outcome, all models are estimated using logistic regressions with clustered standard errors at the regional level.

6.1 Key Independent Variable

The central explanatory variable is our proxy for coal identity:

$$\text{Coal Identity}_r = \ln\left(\frac{\text{Coal Employment}_r}{\text{Population}_r} \times 10,000 + 1\right) \tag{1}$$

The logarithmic transformation addresses the highly skewed distribution of coal employment across regions and ensures that estimates are not disproportionately driven by coal-intensive areas. The addition of +1 serves a technical purpose: several regions recorded zero coal employment, and taking the logarithm of zero is undefined. By adding one, I can retain these regions in the sample while still applying the log transformation. This way, regions without coal employment enter the regression with a coal identity value of zero after transformation, preserving comparability.

6.2 Control Variables

To mitigate omitted-variable bias, I include a set of individual- and regional-level controls consistently highlighted in the literature as determinants of climate attitudes:

- **Age**.
- **Gender**.
- **Political Ideology**: Left–Right self-placement (0–10).
- **Years of Education**.
- **Income**: Self-reported income scale (1–10).
- **GDP per Capita** (NUTS 1 level).
- **Country Fixed Effects**: to account for unobserved heterogeneity in national contexts such as institutions, media landscapes, or policy frameworks.

6.3 Model Specification

Formally, the baseline model can be expressed as:

$$P(Y_{i,r,c} = 1) = \text{logit}^{-1}\left(\alpha + \beta\,\text{Coal Identity}_r + \gamma X_{i,r,c} + \delta_c + \varepsilon_{i,r,c}\right), \tag{2}$$

where $Y_{i,r,c}$ denotes the binary climate skepticism outcome for individual i in region r and country c; Coal Identity$_r$ is coal employment per 10,000 inhabitants; $X_{i,r,c}$ is the vector of individual and regional controls; δ_c are country fixed effects; and $\varepsilon_{i,r,c}$ is the error term.

The parameter of interest is β, which captures the effect of historical coal exposure on the likelihood of expressing climate skepticism.

7 Results & Robustness

This section presents the empirical findings on the relationship between coal identity and climate skepticism. Table 8 reports the main regression results, while Table 9 summarizes the robustness checks.

Table 8: Comprehensive Analysis: Climate Skepticism

Variable	OR	SE	p-value
Log Coal per 10k	1.048	0.012	< 0.001***
Age	1.011	0.001	< 0.001***
Political Ideology	1.206	0.010	< 0.001***
Female	1.126	0.040	< 0.001***
Education	0.952	0.004	< 0.001***
Income	0.960	0.007	< 0.001***
Log GDP per capita	1.090	0.112	0.401
Constant	0.164	0.186	0.110
Dummy DE	1.083	0.086	0.320
Dummy ES	1.166	0.120	0.137
Dummy GB	1.162	0.098	0.074
Dummy PL	2.108	0.297	< 0.001***
N	6,486		

Table 9: Robustness Analysis: Climate Skepticism

Analysis	OR	SE	p-value	N
Regular	1.048	0.012	< 0.001***	6,486
Intergenerational	1.070	0.021	< 0.001***	1,563
Exclude 3 Biggest Coal Regions	1.059	0.013	< 0.001***	6,387

7.1 Main Findings

Across all specifications, the results confirm that regional coal identity is a significant and robust predictor of climate skepticism. The proxy variable—log coal employment per 10,000 inhabitants—shows a strong positive association: individuals in coal-intensive regions are more likely to attribute climate change primarily to natural rather than human causes (OR = 1.048, $p < 0.001$). This relationship remains stable across robustness checks and persists even when controlling for demographic, socioeconomic, and ideological factors.

The findings suggest that the historical importance of coal continues to shape regional belief systems today. Coal legacies appear to foster narratives that downplay human responsibility for climate change, consistent with the notion of identity-protective cognition.

7.2 Controls

The control variables behave largely as expected and are consistent with previous research. Political ideology emerges as the strongest predictor: individuals with right-leaning political orientations are significantly more likely to exhibit climate skepticism (OR = 1.206, $p < 0.001$). Education and income both reduce skepticism, reflecting the role of socioeconomic status and knowledge in fostering acceptance of scientific consensus. Age increases the likelihood of skepticism, suggesting generational differences in climate perceptions, while female respondents are slightly less skeptical than male respondents. Regional GDP per capita, once country fixed effects are included, is statistically insignificant—indicating that cross-country differences, rather than within-country variation, drive GDP effects.

7.3 Magnitudes

Beyond statistical significance, the effect size of coal identity is also economically meaningful. Moving from a region with very low historical coal employment (e.g., Hamburg, with around 4 coal jobs per 10,000 inhabitants) to a highly coal-dependent region such as North Rhine–Westphalia (approximately 374 per 10,000) corresponds to an increase of about 4.5 log units in coal employment. Given the estimated coefficient of 0.048, this raises the log-odds of being climate-skeptical by 0.218, which translates into approximately 24% higher odds of skepticism.

For comparison, a one-step shift to the right on the political ideology scale (0–10) produces an effect about four times larger. Education works in the opposite direction, with each additional year of schooling reducing skepticism by approximately 0.049 log-odds. Thus, moving from a low- to a high-coal region corresponds roughly to four and a half fewer years of education in its effect on climate skepticism. Hence, while ideology remains the dominant driver, the influence of coal identity is comparable in magnitude to core socioeconomic determinants such as education and income.

7.4 Robustness

To test the stability of the findings, two robustness checks were conducted (Table 9).

Intergenerational Persistence: Restricting the sample to respondents born after the major decline of the coal industry in each country[1], meaning those who did not directly experience coal's economic centrality, yields a similar positive and significant effect (OR = 1.070, $p < 0.001$). This indicates that the influence of coal identity persists even among generations without personal economic dependence on the industry, pointing toward cultural or intergenerational transmission mechanisms.

Excluding Major Coal Regions: Re-estimating the model without three outlier regions (North East, Saarland, and Yorkshire and the Humber) produces nearly identical results (OR = 1.059, $p < 0.001$). Hence, the observed pattern is not driven by a small number of extreme cases but reflects a broader structural relationship across regions.

7.5 Summary

Taken together, the results provide consistent evidence that coal identity has a lasting impact on how people perceive climate change. The effect persists across generations, remains robust to the exclusion of outliers, and is comparable in magnitude to key individual-level predictors such as education and income. These findings support the hypothesis that the social and cultural legacy of coal continues to shape environmental attitudes in Europe today

[1]The post-decline period is defined approximately as after 2000 in Germany and Spain, and after 1990 in the United Kingdom and Belgium. These cut-offs are based on the literature identifying the main phase of deindustrialization and coal industry contraction in each country rather than exact employment data. Poland is excluded from this restriction, as coal mining has remained a major economic sector well into the 2000s.

8 Discussion

8.1 Interpretation

As hypothesized, stronger coal identities predict higher climate skepticism. This supports the idea that climate attitudes are shaped not only by knowledge or ideology but also by regional identity legacies. Coal was historically tied to industrial pride and community purpose; as the sector declined, this collective self-image faced erosion. The portrayal of coal as the main culprit of climate change has therefore provoked identity-protective responses, individuals defend their community's moral worth by questioning human responsibility for climate change.

Many residents of former coal regions also feel socially and economically abandoned by the transition, reinforcing defensive narratives. Although the decline of coal was primarily economic rather than environmental in origin, the recent framing of the energy transition as a moral and environmental necessity can make this loss feel stigmatized. As a result, skepticism functions as a psychological buffer: it allows individuals to maintain a positive sense of identity while rejecting blame.

While this study excluded the climate denial category from estimation due to its small sample size, preliminary regressions indicate a negative relationship between coal identity and outright denial. This suggests that people in coal regions rarely reject the existence of climate change altogether. Instead, they reinterpret it, acknowledging climate change but attributing it to natural variability. Future research with larger and more balanced samples should further explore this pattern.

8.2 Connection to the Literature

The findings align closely with prior research on economic identities and climate attitudes. Dewitte (2024) documents how oil-dependent regions in the United States display higher skepticism and lower policy support for climate action. Likewise, Abreu and Jones (2021) show that inhabitants of former UK coal regions tend to believe that the severity of climate change is exaggerated. Both studies point toward identity protection as a key mechanism: when livelihoods and pride were historically tied to fossil fuels, accepting anthropogenic climate change implies moral responsibility and social loss.

This thesis extends these insights to a multi-country European context, providing evidence that such identity effects persist even decades after the coal industry's decline. The results reinforce the view that economic structures can leave cultural imprints that shape political and environmental beliefs long after their economic relevance has faded.

8.3 Implications for Policy and Practice

These results highlight that climate skepticism in post-coal regions is not merely a product of misinformation or ideology but also of collective identity. Effective policy design must therefore integrate social and psychological dimensions of transition.

First, communication strategies should acknowledge coal's historical contribution to national development rather than portraying the industry's decline as a moral failure. Recognizing the dignity and achievements of coal workers can reduce defensiveness and foster openness to new narratives of progress.

Second, just transition policies must go beyond economic compensation to address symbolic and identity-related needs. For many miners, coal work was not merely a source of income but a system relevant contribution to national prosperity, an occupation associated with sacrifice, endurance, and pride in powering the nation. Programs that offer meaningful reemployment opportunities in the energy, infrastructure, or manufacturing sectors, especially those requiring similar technical skills, can therefore help preserve this sense of purpose and continuity. The renewable energy industry, for example, provides a natural bridge that allows former coal communities to maintain their identity as essential energy providers within a new, sustainable framework.

Finally, understanding identity dynamics is crucial for future transitions in other high-carbon sectors. Automotive and steel workers may experience similar pressures as decarbonization proceeds. Addressing identity early can prevent alienation and resistance.

8.4 Limitations

Several limitations must be acknowledged. First, the analysis covers only five European countries and omits key cases like the Czech Republic, which limits generalizability. Second, the number of respondents classified as climate deniers was too small for robust in-

ference. Third, the coal identity measure captures only direct employment in the industry, omitting indirect economic dependencies such as supplier networks. Finally, the analysis is limited to NUTS-1 regions; finer spatial granularity could capture stronger localized identity effects.

8.5 Future Research

Future research could investigate whether the influence of coal identities on climate attitudes differs between regions where economic dependence on coal has largely passed and those where it remains central to local livelihoods. Comparing post-transition economies such as Germany, the United Kingdom, Belgium and Spain with still coal-dependent countries like China, India, Australia, or the United States could reveal how ongoing economic relevance shapes the relationship between identity and climate beliefs.

Additionally, the relationship between coal identity and climate denial deserves closer investigation with larger samples. As mentioned before, preliminary analyses indicated a negative association between coal identity and outright climate denial. Future research should examine whether this relationship remains robust in larger datasets and explore why stronger coal identities might correspond to lower levels of denial.

Lastly, extending this approach to other emission-heavy sectors undergoing structural change, such as automotive or steel manufacturing, would reveal whether similar mechanisms operate beyond coal or fossil-fuels. These insights would be valuable for designing socially just and psychologically informed transition policies.

9 Conclusion

This thesis examined whether historical dependence on coal, interpreted as a persistent “coal identity”, shapes contemporary climate attitudes in Europe. Using subnational data and individual survey responses, the analysis revealed a strong and consistent relationship between regional coal identity and the tendency to attribute climate change to natural rather than human causes.

The findings suggest that individuals in coal regions do not reject climate change itself but reinterpret its origins in ways that protect community pride and moral integrity. This supports the view that climate skepticism can serve as an identity-protective belief system rather than a simple knowledge deficit. Moreover, the persistence of this effect among younger cohorts demonstrates that fossil fuel identities can outlast the industries that created them.

For policymakers, the results underline the importance of addressing identity alongside economics in the energy transition. Successful decarbonization requires narratives and policies that respect local histories, foster dignity, and offer meaningful pathways for participation in a low-carbon future.

While limited in geographic and data scope, this study contributes to a growing understanding of how economic identities shape environmental attitudes. Recognizing that climate skepticism is partly rooted in cultural legacies rather than ignorance or ideology alone is essential for building socially fair and politically durable climate strategies.

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- that all parts of the thesis produced with the help of aids have been declared;
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