

**Clearing the Air:  
An QCA Analysis of Compliance with the  
2008 EU Ambient Air Quality Directive**

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## **Abstract**

The European Union has long flaunted itself as a leader in environmental policies, ranging from reducing its greenhouse gas emissions to promoting the use of renewable energy sources. To ensure the success of such ambitious policies, the compliance of all member states with the EU's directives is essential. However, despite their obligation, some countries fail to do so. Why do differences exist in compliance when it comes to environmental policies that appear to be so central to the Union's agenda? This thesis examines that gap by using the case of the 2008 EU Ambient Air Quality Directive as an example of a long-standing 'green' directive. This research will explore why several EU member states did not comply with this directive, using several possible explanations identified by scholars over the years. Rather than identifying a single cause, it will explore potential combinations of factors, by conducting a qualitative comparative analysis. The findings show that the combination of low regional authority with either high financial capacities or efficient or 'green' prior policy choices is most likely to cause compliance. This thesis has implications for understanding EU coherence and the struggles with implementing environmental policies at large.

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This MSc thesis is dedicated to my parents.

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# 1 Introduction

Humanity is facing one of her biggest crises yet, as temperatures are rising, ice caps are melting, and natural disasters such as floodings or wildfires are escalating. Every passing year more and more people, animals, and even entire ecosystems are endangered. The disastrous impact that a rise of only half a degree Celsius will have on our planet is unimaginable (Sommer, 2021). Amidst this global catastrophe, the European Union (EU) has emerged as a 'global leader' striving to combat climate change. With ambitious directives ranging from reducing greenhouse gas emissions to promoting the use of 'green' vehicles, it has been at the forefront of the worldwide battle (Siddi, 2023; European Commission, n.d.). Drawing its powers from a diverse assembly of countries, the EU's effectiveness hinges on the implementation and transposition of its directives by the member states. Efficient compliance ensures the uniform application of EU directives across all these countries, which is particularly important for Europe's green transition.

In practice, however, compliance with the EU's directives does not always occur. Some states take longer to put them into effect or fail to comply altogether – occasionally even necessitating legal action by the European Commission. These instances of non-compliance raise concerns about the effectiveness of the EU's green transition, as it depends on each state's active participation. Moreover, it highlights the urgency of understanding what causes such differences in compliance. Although the literature on compliance is extensive, there has yet to be reached a consensus on the main causes. Some scholars emphasize the significance of political actors, that might hinder a swift implementation process (Mastenbroek, 2005; Börzel et al., 2007). Others point to obstacles arising from financial constraints or administrative weaknesses, arguing that sometimes states are unable to comply despite wanting to (Tallberg, 2002; Zhelyazkova et al., 2023). Given this lack of agreement, it is imperative not only to identify which factors are truly significant but also to understand how they may interact and influence each other. Could it be that, rather than searching for a single main factor, the factors are interconnected? Certain factors alone may not suffice to cause compliance, as they likely exert mutual influence rather than act in isolation.

This thesis will examine a notable instance of an EU environmental directive where several member states failed to comply: the 2008 EU Ambient Air Quality Directive. Initially created in the early 2000s, this directive underwent a significant revision in 2008 to set

ambitious standards aimed at reducing pollutants in the air (such as nitrogen dioxide, particulate matter, and ozone) (EU Monitor, n.d.). Moreover, it mandated each member state to develop a tailored action plan to meet the standards, as well as required them to track their process and provide yearly revisions. However, by 2018 – when the European Commission proposed to further amplify the directive’s scope - not all member states had succeeded in complying with the directive. Despite several warnings by the European Commission, several countries still fell short in meeting the air quality standards and were as a result brought to court (European Commission, 2018; Brozowski, 2018). Interestingly, the non-complying countries appear vastly different, lacking a common geographical, financial, or political status. The differences in compliance provide a valuable opportunity to gain a broader understanding of what exactly drives compliance with EU’s green directives. This research thus seeks to answer the following question:

*What factors accounted for the differences in compliance with the 2008 EU Ambient Air Quality Directive amongst member states in 2018?*

This research’s empirical relevance is demonstrated by its contribution to the ongoing discourse on compliance with the EU, which as mentioned, is still inconclusive. Rather than aiming to identify a new primary factor, it will explore the interrelationships between the main factors pointed out by scholars. To do so, it will conduct a qualitative comparative analysis (QCA) which allows for the identification of such combinations of conditions. Second, its societal relevance is established as it is essential for EU policymakers to understand what factors – or rather, combination of factors – may hinder compliance when creating their environmental strategies. In their race against climate change, it is imperative to develop directives that are feasible for each member state. Air pollution is the ‘single largest environmental health risk in Europe’, even causing premature deaths (EEA, 2023). The EU cannot afford any non-compliance with their directives aimed at addressing such issues, and thus must comprehend what causes its members to do so.

The structure of this research is as follows: first, a literature review will provide an overview of the past and present debates regarding compliance with the EU and its causes. Second, a theoretical framework will illustrate the main factors that this research analyses. Next, the methodology will outline the method of QCA and detail the operationalization of the factors. This is followed by an analysis, where the results of the QCA are presented and evaluated.

Lastly, a discussion and conclusion will interpret the findings and discuss limitations and recommendations for future research.

## 2 Literature review

This chapter will provide an overview of the academic discourse surrounding compliance with EU directives, focusing on factors identified by scholars as main conditions for achieving compliance.

### 2.1 Europeanization

The European Union (EU) is one of the most intricate and complex institutions in modern history, wielding authority over its member states yet simultaneously drawing its power and legitimacy from them. Ever since its establishment, scholars have tried to comprehend the dynamics that underlie the process by which member states adopt and align their policies with those of the EU. This process, known as *Europeanization*, is commonly understood as

“the i. construction, ii. diffusion and iii. institutionalization of formal and informal rules, procedures, policy paradigms, styles, “ways of doing things” and shared beliefs and norms which are first defined and consolidated in the making of EU decisions and then incorporated in the logic of domestic discourse, identities, political structures, and public policies” (Graziano & Vink, 2013, p. 37).

Europeanization involves top-down processes, driven by EU directives and policies, as well as bottom-up processes as domestic actors also shape the implementation of said directives to align with their own interests (Graziano & Vink, 2013). With the Europeanization processes, however, a significant challenge arises: what happens if member states do not implement the EU laws as intended, or even not at all? The so-called *implementation gap* refers to the disparity between the adaptation of EU policies at the supranational level and their implementation at the national level (Knill & Lenschow, 1998). The gap becomes apparent through several indicators, such as delays, inadequate enforcement, or incomplete transposition<sup>1</sup> (Zhelyazkova et al., 2023). For decades, scholars have been engaged in uncovering the factors behind this implementation

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<sup>1</sup> Transposition refers to the “process of incorporating EU directives into the national laws of EU member states” (EUR-Lex, n.d.).

gap, aiming to understand why countries sometimes fail to comply with their obligation to implement the EU's directives. Are there specific conditions that affect the ease or difficulty of complying with EU legislation?

## 2.2 Goodness of fit

Scholars initially explained the implementation gap by pointing to the differences between the regulatory structures of the EU and those of its member states. These differences influence whether member states comply with EU legislation (Knill & Lenschow, 1998). Such structures include existing national traditions, legal systems, and state identity (Brendler & Thomann, 2023). This hypothesis, known as the *goodness of fit*, encompasses the idea that member states only successfully implement EU law when there is an 'institutional fit' between the two, as well as a match between ideologies, interests, and traditions (Falkner et al, 2007; Brendler & Thomann, 2023). As stated by Knill and Lenschow (1998, p. 603),

“[i]mplementation problems are likely to arise if the implementation requirements imply the change of deeply and/or widely institutionalized regulatory patterns.”

Subsequently, the distinction was made between two types of misfits, namely between a policy misfit and an institutional misfit. On the one hand, a *policy misfit* relates to the policy content, indicating that compliance is more likely when national policy contents align with that of the EU (Mastenbroek, 2005). An *institutional misfit*, on the other hand, suggests that compatibility between the institutions and regulatory styles of the EU and its member states ensures a smoother implementation process and thus increases the likelihood of compliance (Brendler & Thomann, 2023). When one of these misfits is present, adaptational pressure emerges that compels states to conform (Graziano & Vink, 2013). This pressure is always bound to the historical and institutional context of the member state (Knill & Lenschow, 1998). Moreover, the goodness of fit hypothesis assumes that member states often act as ‘guardians of the status quo’, and thus choose to not comply when their values, preferences and structures do not align with those of the EU (Falkner et al., 2004). However, the idea that states have an ever-present desire to maintain their status quo has been criticized by later scholars who argue that states are dynamic actors that are shaped by changing circumstances and strategic considerations (Treib, 2003; Mastenbroek, 2005; Mastenbroek & Kaeding, 2006). Moreover, Brendler and Thomann (2023) found that an institutional misfit does not necessarily result in non-compliance, but rather can stimulate countries to engage in so-called ‘customization’ strategies: the changing

and interpretation of EU policies. They therefore contend that the goodness of fit hypothesis does not account for every instance of non-compliance. Thus, it is more often the case that scholars have disproven this theory, given its lack of explanatory competency. This lack of fit has forced scholars to explore other explanations for compliance with the EU that go beyond a mere ‘fit’.

### 2.3 Political culture and autonomy

Haverland (2000), drawing from his case studies of the implementation of the EU Packaging Waste Directive, concluded that instead of a goodness of fit, *institutional veto points* have a significant impact on the quality and timing of EU implementation. Institutional veto points refer to

“all stages in the decision-making process on which agreement is legally required for a policy change” (Haverland, 2000, p. 3).

He found that the country with the largest institutional misfit, the United Kingdom (UK), showed a greater degree of timely and efficient adaptation than Germany, which had no misfit. Conclusively, the presence of veto players in Germany may have increased the risk of non-compliance (Haverland 2000; Mastebroek 2005). Alternatively, other scholars have found that veto players alone cannot reliably predict compliance or find no association between the number of veto players and compliance at all (Toshkov, 2007). Falkner et al (2007, p. 403) even insist that veto players sometimes “simply do not play a crucial role in transposition”.

Nonetheless, scholars often link compliance to political actors within a state’s government (Mastebroek, 2005), by for instance highlighting the individual party preferences. Treib (2003, p. 24) argues that the active support of a political party for an EU directive often leads to a “swift and correct adaption even if the required changes are considerable”. Others argue that left-wing governments show a higher level of compliance with EU legislation than right-wing ones (Toshkov, 2012). In general, scholars find that politicization affects the degree to which a country is willing to implement EU policies (Zhelyazkova et al., 2023). This includes, among others, the presence of populist leaders, the number of political parties, and the support and ideologies of ministries and parties (Pollex & Ruffing, 2024; Lampinen & Uusikya, 1998). All these actors can hinder the ability of the national government to comply as they impede its autonomy in decision-making processes (Börzel et al., 2007).

## 2.4 East vs West

With the enlargement of the EU in 2004, and the accession of Bulgaria and Romania in 2007, a comprehensive understanding of compliance with EU legislation became even more pressing (Falkner & Treib, 2008). The influx of new cultures and political structures – many of which carried remnants of communism – sparked concerns about potential negative consequences for the functioning of the EU (Toshkov, 2012). Scholars adhering to the goodness of fit theory feared that the misfits would be too large, especially given the added influence of international institutions such as the World Bank that might pressure countries to adopt their regulations (Toshkov, 2012). In fact, any process of Europeanization might harm their still-developing economies. Furthermore, Schimmelfennig, Engert and Knobel (2003) contended that the supposed weaknesses of the new members' civil societies may limit their ability to identify instances of non-compliance, further increasing the risk. Even small factors such as misinterpreting language during the implementation process or unclear treaty language may cause unwilling non-compliance (Tallberg, 2002). Lastly, many scholars pointed to – and still point to – the weaknesses of a country's administrative system as a key determinant of non-compliance, emphasizing the significance of not only administrative capacities in coordinating and managing but also of abundant financial resources (Börzel et al, 2007). Despite this, Toshkov (2012) finds that these concerns were mostly unfounded for the new member states as all complied relatively well, regardless of the alleged misfits and weaknesses.

## 2.5 Worlds of compliance

Many scholars agree that an 'one-size-fits-all' explanation is insufficient as each state is affected differently by their circumstances. For example, political actors play a significant role, and so too does the administrative system and government autonomy. Falkner, Treib and Hartlapp (2007; 2008) differentiate the states into three 'worlds of compliance' based on these elements. For example, they group several Nordic states together which allegedly show a greater commitment to complying with the EU due to their pre-existing norms and robust administrative systems. Several West-European countries on the other hand, fall under a different 'world' due to their politicians that often prioritize domestic interests (Conant, 2012; Falkner et al., 2007). After the EU's enlargement, Falkner and Treib (2008) added a fourth world to take the new member states into account, considering the alleged capacity limitation of the administration of Eastern-European states.

Although the worlds of compliance provide a framework for understanding the phenomenon, it has faced criticism for reinforcing cultural stereotypes by grouping the member states (Conant, 2012). Such considerations in many cases do little more than recreate stereotypes about East-West divisions and other existing cultural pre-conceived notions. Others, such as Thomson, Torrenvlied and Arregui (2007) or Toshkov (2007) find that there is no empirical evidence that proves there is a clear distinguishment between the four worlds, as the differences between the four are only marginally significant. Furthermore, although Falkner et al (2007) believe their work disproves the goodness of fit hypothesis, Thomson (2009; Graziano & Vink, 2013) re-analyzed their dataset to show the level of misfit does in fact, affect compliance. Most scholars accept that administrative capacities, or cultural and historical circumstances, play an essential role in the successful implementation of EU legislation. They do not, however, necessarily adhere to Falkner's 'worlds of compliance' (Zhelyazkova et al., 2023; Toshkov, 2007; 2012).

## **2.6 Green transition**

Lastly, it is argued that compliance with EU directives also depends on the specific nature of the directive. Environmental policies, in particular, are considered to be easier to implement when the countries are already advancing in their green transition. Fatima et al (2024, p. 13085/6) assert that the lower a state's carbon level, the better and less challenging their "transition towards cleaner energy sources" is. Moreover, they content that investments in green technologies also facilitate this process.

Concludingly, whilst the academic literature on compliance is extensive, scholars have yet to identify a single primary factor as there continues to be a lack of coherence among their research. It is thus more effective to focus on the relationships between multiple factors, as presumably, no single factor alone determines compliance. Rather, the factors may collectively play a significant role, potentially working together in sets to affect compliance outcomes.

## **3 Theoretical framework**

The following chapter will provide an overview of the factors of compliance that will be analyzed. It will also elaborate on certain factors that will not be used, and why.

### 3.1 Factors of compliance

The factors influencing compliance that are identified through the literature are as followed (see *table 1*).

**Table 1**

*List of factors of compliance*

i.	Government autonomy
ii.	Administrative capacities
iii.	Financial capacities
iv.	Prior policy choices
v.	Goodness of fit
vi.	Worlds of compliance

#### *i. Government autonomy*

The ability of a member state to oppose the implementation of EU directives can significantly determine compliance. As highlighted in the literature, many scholars agree that a greater number of veto players (eg. political parties or politicians) decreases the likelihood of compliance (Haverland, 2000; Toshkov, 2012; Lampinen & Uusikya, 1998). Börzel et al (2007, p. 8) refer to this as *government autonomy*, denoting that the ‘‘domestic institutional structure [of a member state] influences the degree of a state’s capacity to act and its autonomy to make decisions’’. Further, the level of regional authority in a country also influences government autonomy as it illustrates the ability of regional governments to either facilitate or hinder the implementation and execution process and thus decrease national autonomy (Mendez & Bachtler, 2024). Concludingly, the higher a government’s autonomy, the higher the likelihood of compliance.

#### *ii. Administrative capacities*

When national governments lack efficient administrative capabilities, they may face obstacles in compliance (Tallberg, 2002; Mendez & Bachtler, 2017; Börzel et al., 2007). These capabilities include, for instance, the management and organization of policy, coordination amongst personnel, as well as transparency and accountability measures. The presence of such elements may affect compliance with the EU’s directives.

iii. *Financial capacities*

The financial capacity of a country may also influence compliance. Given that EU directives can be quite costly, variations in budget availability and financial capability to implement policy among member states can lead to differences in the degree of compliance (Zhelyazkova et al., 2023; Nicolaidis & Oberg, 2006). If a member state has certain financial burdens, it might be face greater challenges during the implementation process.

iv. *Prior policy choices*

Lastly, the ability of a member state to comply with EU directives can be affected by its prior policy choices. These decisions pertain to governmental policies aimed at a green transition, such as reducing greenhouse gas emissions or investing in sustainable technologies to increase the share of renewable energy sources. Countries that have already made such commitments are better positioned to implement new green EU directives (Fatima et al., 2024). Certainly, factors such as favorable natural conditions or historical contexts also shape the circumstances under which the policy choices were made. Conclusively, countries starting from a less advantageous position in their green transition may be less likely to comply with the EU Ambient Air Quality Directive as they might face greater challenges and require more time.

### 3.2 Omitted factors

The following two factors are identified by some scholar as influential in determining compliance, yet they will not be analyzed in this research for several reasons, as explained below.

v. *Goodness of fit*

The goodness of fit hypothesis is one of the first theories about compliance, asserting that an institutional or a policy fit between the EU and its member state can increase the likelihood of compliance (Radaelli, 2003; Knill & Lenschow, 1998). This factor, however, will not be utilized for the following reasons. First, the existing scholarly literature questions its validity, as numerous scholars over the years have disproven the goodness of fit hypothesis by introducing contradictory theories (eg. Falkner et al., 2007) or by outright refuting it (eg. Toshkov, 2007). Mastenbroek and Kaeding (2006, p. 336), who provided a critical assessment of the goodness of fit, concluded that the hypothesis is neither ‘‘a sufficient [condition] for non-compliance [...] nor a necessary condition’’. More importantly however, the institutional fit is difficult to measure due to the complex nature of institutions which are undoubtedly influenced

by context-specific factors. The policy fit, although less complicated, proves also challenging due to a lack of accessible information on national policies - particularly those from 2008 – compounded by language barriers. Concludingly, for the purpose of efficiency and reliability, this research will not use either fit as a factor for compliance. It is, nevertheless, important to recognize that a policy and institution fit – despite its controversial nature – might still have influenced compliance with the directive of this research.

vi. *Worlds of compliance*

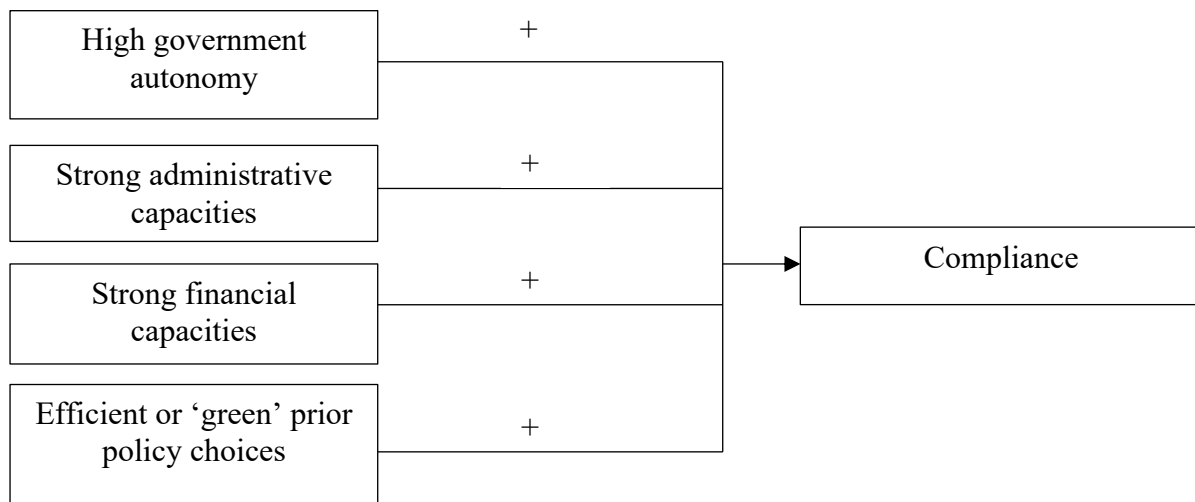
Falkner's words of compliance theory suggest that a country's compliance with the EU's directives depends on what 'world' they belong in. It is therefore categorized based on countries that share similar cultural, institutional, and historical circumstances. However, the theory's reliance on cultural predisposition limits its credibility. Moreover, it would not provide any answers to which factors in particular influenced compliance, as it groups diverse elements such as administrative or financial capabilities, or culture, in only four 'worlds'. Given that the countries that did and did not comply do not share a singular cultural, institutional, or historical context – and do, therefore, not fall under the same 'world' – the theory fails to provide substantial insights into compliance. Consequently, this factor will not be analyzed.

### 3.3 Conceptual framework

To sum up, four factors have been highlighted that will be analyzed as they may have led to compliance with the EU 2008 Ambient Air Quality Directive in 2018. The following propositions can thus be drawn:

- i. A high level of government autonomy increases the likelihood of compliance.
- ii. Strong administrative capacities increase the likelihood of compliance.
- iii. Strong financial capacities increase the likelihood of compliance.
- iv. Efficient or 'green' prior policy choices increase the likelihood of compliance.

See *figure 1* for the conceptual framework.

**Figure 1***Conceptual framework*

## 4 Methodology

The following chapter will elaborate on the justification behind the qualitative comparative analysis method, the operationalization of the concepts, the data collection process, and the reliability and validity of the research.

### 4.1 Justification

The QCA method is relatively new, as it was developed in 1987 by Charles Ragin to “bridge the gap” between qualitative and quantitative research methods in social sciences (Grofman & Schneider, 2009). It is grounded in configurational analysis, as it aims to understand complex causal relationships by examining the interplay of multiple factors. For the remainder of this research, the complex causal relationships will be referred to as *causal conditions*. QCA uses Boolean logic to establish a relationship between causal conditions and certain outcomes. Therefore, it enables researchers to generalize findings and compare cases without losing the complexity of the individual cases. QCA allows for the analysis of cases that are too small for quantitative methods such as linear regression analysis, yet too large for case studies (Rihoux & Ragin, 2009; Roig-Tierno et al., 2017). Specifically, the QCA method is based on the concepts of *necessity* and *sufficiency*. A condition is necessary when the outcome is not possible without and is sufficient when the condition alone will bring about the outcome (Cooper & Glaesser 2016).

#### 4.1.1 Relevancy

The QCA method provides an effective means to analyze why certain EU member states did, and others did not comply with the 2008 EU Ambient Air Quality directive in 2018, as it allows for an in-depth understanding of each country's situation whilst also revealing broader patterns of compliance within the EU. The factors of compliance are likely to be in a complex relationship with one another given their intertwined nature. In QCA research, this is referred to as *equifinality*, that different combinations of conditions can produce the same result. For instance, non-compliance with the ambient air directive might be in part the result of financial capacities while regional authority may also play a role. Given that QCA assumes complex causality – namely that conditions are rarely ever sufficient or necessary on their own – this method is an excellent fit for this research question (Schneider & Wagemann, 2006, p. 752).

#### 4.1.2 Fuzzy-set

The QCA method generally uses a *fuzzy set* (fsQCA) or a *crisp set* (csQCA) to detect causality. A crisp set categorizes conditions based on a dichotomy: ascribing either the value [1] (for full membership) or [0] (for full non-membership) (Roig-Tierno et al., 2017). This research will utilize the fuzzy set however, which allows for greater flexibility as it assigns membership values on a continuum from [0] to [1], thus allowing partial membership (Ragin, 2008). Hence, it shows the variety in the degree to which a factor influences the outcome and is better suited to address the complexities of this research. Fuzzy sets allow for an analysis that captures the inherent ambiguity of the world. The values [1] and [0] are not used, as these scores would ‘correspond to positive and negative infinity’ (Ragin, 2008, p. 88), and are instead replaced with [0.95] and [0.05] respectively. Ragin (2008) makes the distinction between a continuous fuzzy-set and a 3-value, 4-value, and 6-value fuzzy-set. This research will employ the 6-value set (as seen in *table 2*) which sets four ‘intermediate’ levels between ‘full membership’ and ‘full non-membership’. As argued by Ragin (2008, p. 31), this set is useful when researchers have ‘a substantial amount of information about cases, but the evidence is not systematic or strictly comparable from case to case’. This is particularly relevant in this research as there is much information about EU compliance as well as the various factors under analysis but much of the information cannot be compared in a one-to-one manner as the type of data and availability of such data varies from case to case.

**Table 2***6-Value fuzzy set*

<b>Score</b>	<b>Degree of membership</b>
[0.95]	<i>Full membership</i>
[0.8]	<i>Mostly 'in' but not fully out</i>
[0.6]	<i>More 'in' than 'out'</i>
[0.4]	<i>More 'out' than 'in'</i>
[0.2]	<i>Mostly 'out' but not fully in</i>
[0.05]	<i>Full none-membership</i>

#### **4.2 Case selection**

The ambient air directive (EU Directive 2008/50/EC) offers an excellent example of where several member states failed to comply but did not strictly fall within one particular geographic space of the EU (i.e., East vs West). Further, it is noteworthy not only because these countries failed to effectively implement the EU directive but did so repeatedly as the European Commission took legal actions against them for 'non-compliance' (European Commission, 2018; Brozowski, 2018). Additionally, the directive provides a valuable opportunity to explore the challenges of environmental governance within the EU. The directive addresses major global health concerns – as the air quality impacts both the environment and public wellbeing – and thus an understanding of compliance with such environmental directives is crucial for shaping future policies, especially those that are more challenging to implement. The 2008 directive – which was revised to become more ambitious in 2022 - exemplifies how environmental regulations tend to become rigorous over time. This underscores the importance of comprehending factors of compliance for future environmental policies. Concludingly, the directive represents a compelling case for analysis due to its environmental relevance and its additionally complex dynamics surrounding compliance and relative publicity surrounding how some member states did not comply. This research will consider all 28 EU member states.

### 4.3 Operationalization

This section will outline how each causal condition is measured, and how the data was collected. Moreover, it will show the calibration in the 6-value fuzzy-set.

#### *Outcome Y: compliance with the EU Directive 2008/50/EC (COMP)*

The outcome of this research is compliance with the 2008 EU Ambient Air Quality Directive. Member states are ‘non-compliant’ when their failure to comply with the directive has been publicly acknowledged by the European Commission and met with legal actions in 2018. This is therefore scored [0]. This threshold is picked when the European Commission initiates legal proceedings after several warnings that are disregarded and thus illustrates clearly when a country did not comply. Whilst some member states may have also faced challenges in complying with the directive, if they were not brought to court by the European Commission in 2018, they are not classified as ‘non-compliance’ and thus score [1]. For efficiency, the outcome is scored on a binary scale rather than on a continuum<sup>2</sup>. The seven countries that did not comply are France, Germany, Italy, Romania, Hungary, Poland, and the United Kingdom (European Commission, 2018; Brozowski, 2018).

#### *Causal condition X(i): high level of government autonomy (RAI) & (GOV)*

The first condition concerns the level of autonomy that a government has. The higher this level is, the less resistance a government experiences from veto players or regional authorities. Hence, the higher the government autonomy level, the more likely compliance is. This condition will be measured using two separate indicators.

First, as stated by Mendez and Bachtler (2024, p. 694) there is a ‘‘greater opportunity for regional governments to block compliance’’ in countries that delegate authority to regional or local governments. Thus, one can assume that the lower the level of regional authority, the higher the likelihood of compliance. The level of regional authority will be operationalized using the regional autonomy index (RAI), following the research of Marks, Hooghe and Schakel (2008). The RAI measures the ‘‘formal authority of intermediate or regional government combining measures of self-rule and shared rule’’ (Mendez & Bachtler, 2024, 694).

- i. *Self-rule* refers to the ability of a regional government to exercise authority over those living in its region. It is measured by exploring five dimensions, being i.

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<sup>2</sup> This includes the use of [0] and [1], instead of [0.05] and [0.95]. All the causal conditions will have [0.05] and [0.95] values.

Institutional depth, ii. Policy scope, iii. Fiscal autonomy, iv. Borrowing autonomy, and v. Representation (Hooghe et al., 2016).

- ii. *Shared rule* refers to the ability of a regional government to exercise authority in the entire country. It is measured by five other dimensions, being i. Law making, ii. Executive control, iii. Fiscal control, iv. Borrowing control, and v. Constitutional reform (Hooghe et al., 2016).

Each country has been measured per dimension on a scale of 0-4, and the sum of both the self-rule and shared rule is a value between 0 and 40. A lower value indicates a lower level of regional authority. All 28 numbers are ranked and categorized based on their closeness, considering the few extremes in the data. This means that all countries with similar values will fall under the same fuzzy score. See *table 3* for the calibration.

**Table 3**

*Calibration RAI-set*

<b>Level of regional authority in 2018</b>	<b>Score</b>	<b>Value</b>
<i>Between 0 and 5,9</i>	[0.95]	Highest level of government autonomy
<i>Between 6 and 11,9</i>	[0.8]	Very high level of government autonomy
<i>Between 12 and 20,9</i>	[0.6]	High level of government autonomy
<i>Between 21 and 26,9</i>	[0.4]	Moderate level of government autonomy
<i>Between 27 and 32,9</i>	[0.2]	Low level of government autonomy
<i>Between 33 and 40</i>	[0.05]	Very low level of government autonomy

*Note:* The data for this set was abstracted from Hooghe, L., Marks, G., Schakel, A. H., Chapman-Osterkat, S., Niedzwiecki, S., & Shair-Rosenfield, S. (2021). *Regional authority index (RAI) v.3* [Data set]. European University Institute.

Second, the nature of the executive government (GOV) can influence the implementation process as the more political parties that need to agree, the lower government autonomy is and thus the more difficult compliance becomes. According to Pollitt and Bouckaert (2017), there are typically four different types of executive governments:

- i. *Single party (or: minimal winning/bare majority)*: one party holds more than 50% of the legislative seats.
- ii. *Minimal winning coalition*: two or more parties hold more than 50% of the legislative seats.
- iii. *Minority cabinet*: the party/parties composing the executive hold less than 50% of the legislative seats.
- iv. *Oversized executive (or: grand coalition)*: additional parties are included in the executive.

Presumably, the lower the number of executive parties, the higher the likelihood of compliance. The member states have been divided into the four types, depending on their executive government. Given that there are only four types, the two most extreme scores of [0.95] and [0.05] will not be included in this indicator.<sup>3</sup> Evidently, no two governments are truly alike and thus this categorization is a simplification. However, this approach is adopted for reasons of efficiency. See *table 4* for the calibration.

**Table 4**

*Calibration GOV-set*

<b>Type of executive government</b>	<b>Score</b>	<b>Value</b>
<i>Single party</i>	[0.8]	Very high level of government autonomy
<i>Minimal winning coalition</i>	[0.6]	High level of government autonomy
<i>Minority cabinet</i>	[0.4]	Low of government autonomy
<i>Oversized executive</i>	[0.2]	Very low level of government autonomy

*Note*: The data for this set was abstracted from European Commission. (N.d.). *Eurydice – Organization and Governance*. <https://eurydice.eacea.ec.europa.eu/chapter-topics/organisation-and-governance>

*Causal condition X(ii): strong administrative capacities (ADM)*

<sup>3</sup> As even single-party governments can oppose EU directives, and even a grand coalition can unanimously agree, the most extreme values are not relevant to use.

Any weaknesses of the administrative system may also impede a state's ability to comply. The European Commission assesses the administrative capacities of the member states through five dimensions (Thijs, Hammerschmid & Palaric, 2018):

- i. *Transparency and accountability*: Both factors lower the potential of corruption and help to hold officials accountable leading to increased administrative capacity.
- ii. *Civil service systems and Human Resource management (HRM)*: Both factors lead to heightened rates of a skilled workforce and more standardization within the workforce.
- iii. *Digitalization and service delivery*: These factors can affect administrative quality and accessibility.
- iv. *Organization and management*: Both factors optimize government performance.
- v. *Policy making, coordination and implementation*: These factors ensure correct implementation and communication throughout the policy process.

As the European Commission weighs each dimension equally, this research will do so too. The European Commission ranked each state across all dimensions on a scale from 1 to 5, 1 indicating good performance and 5 indicating poor performance. All rankings are summed up and calibrated in accordance with *table 5*. Given that there are no extremes in the data, unlike for instance RAI, the scores are ranked from lowest to highest (5-25) and equally divided.

**Table 5**

*Calibration ADM-set*

<b>Administrative performance in 2018</b>	<b>Score</b>	<b>Value</b>
<i>Between 5 and 7</i>	[0.95]	Strongest administrative capacities (ADM)
<i>Between 8 and 10</i>	[0.8]	Very strong ADM
<i>Between 11 and 14</i>	[0.6]	Strong ADM
<i>Between 15 and 17</i>	[0.4]	Moderate ADM
<i>Between 18 and 21</i>	[0.2]	Weak ADM
<i>Between 22 and 25</i>	[0.05]	Very weak ADM

*Note*: The data for this set was sourced from Thijs, N., Hammerschmid, G., & Palaric, E. (2018). *A comparative overview of public administration characteristics and performance in EU28*. European Commission. Their assessment is based on data from the World Bank, UN, Eurostat, OECD, amongst other institutions.

*Causal condition X(iii): strong financial capacities (GDP) & (DEF)*

The third condition regards the financial constraints that countries may face while implementing and complying with the EU directive. A lack of finances can impede a member state's ability to comply effectively. Two indicators will be used to measure this condition.

First, although there are many ways to measure a country's financial status, it is generally agreed that GDP growth is one of the most reliable indicators (Callen, n.d.; World Bank, n.d.). GDP growth measures the increase or decrease in the value of all goods and services produced by an economy over a certain period. Given that the directive was put into effect in 2008, this research will measure the GDP growth (GDP) over the period from 2008 to 2018. Unlike only measuring the growth over a year, this approach will illustrate the overall economic growth up until the moment of non-compliance, providing a more structural understanding of a country's financial stability as it also accounts for potentially distorting fluctuations. Given that there are no extremes in the data, the percentages are ranked and equally categorized. See *table 6* for the calibration.

**Table 6***Calibration GDP-set*

<b>Overall GDP growth (in %)</b>	<b>Score</b>	<b>Value</b>
<b>between 2008 -2018</b>		
<i>Between 41% and 100%</i>	[0.95]	Strongest financial capacities (FIN)
<i>Between 21% and 40%</i>	[0.8]	Very strong FIN
<i>Between 1% and 20%</i>	[0.6]	Strong FIN
<i>Between 0% and- 20%</i>	[0.4]	Weak FIN
<i>Between -21% and- 40%</i>	[0.2]	Very weak FIN
<i>Between -41% and -100%</i>	[0.05]	Weakest FIN

*Note:* The data for this set was sourced from The World Bank. (N.d.) *GDP (current US\$)* [Data set].

<https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2018&locations=SE&start=2008>

Furthermore, the government surplus/debt (DEF) provides significant insights into the financial capabilities of a country, as it reflects its ability to manage its finances and its fiscal room for the implementation of policies (Dippelsman et al., 2017). It is expressed as a percentage of the total GDP of the country, as this provides a more accurate view by accounting for the size of the economy. Hence, it allows for a better comparison between countries. Given the extremes in the data, the data was ranked, categorized according to the closeness of related countries, and linked to a corresponding score. See *table 7* for the calibration.

**Table 7***Calibration DEF-set*

<b>Government surplus/deficit (in % of GDP) in 2018</b>	<b>Score</b>	<b>Value</b>
<i>2,5% or higher</i>	[0.95]	Strongest financial capacities (FIN)
<i>Between 1,1% and 2,5%</i>	[0.8]	Very strong FIN
<i>Between 0 and 1%</i>	[0.6]	Strong FIN
<i>Between 0 and -1%</i>	[0.4]	Weak FIN
<i>Between -1,1% and -2,5%</i>	[0.2]	Very weak FIN
<i>-2,6% or lower</i>	[0.05]	Weakest FIN

*Note:* The data for this set is sourced from Eurostat. (2023, October 23). *Government deficit/surplus, debt and associated data* [Data set].

[https://ec.europa.eu/eurostat/databrowser/view/gov\\_10dd\\_edpt1\\_\\_custom\\_10979983/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/gov_10dd_edpt1__custom_10979983/default/table?lang=en)

Another way to assess the financial capabilities – particularity regarding this directive - is the share of the budget allocated to environmental matters. However, this indicator can be misleading because countries with already well-preserved natural environment will likely spend a smaller percentage of their total budget on this. Therefore, this indicator will not be included.

*Causal condition X(iv): efficient or ‘green’ prior policy choices (REN) & (GAS)*

The last condition that might influence compliance is the presence of prior policy choices that could place countries at a more favorable starting position when implementing the directive. For example, a member state’s pre-existing dependence on non-renewable energy sources might place it at a disadvantage compared to others as it would need to exert

significantly greater effort to meet the same standards. Pertaining to the 2008 EU Ambient Air Quality Directive, a country is at an advantage when they have already undertaken efforts toward its green transition, which increases its likelihood of compliance.

One indicator to measure this is the share of renewable energy in the gross final energy consumption (REN). This reflects the dependence of countries on non-renewable energy sources. Countries with a high share of renewable energy are in a more advantageous position to meet the directive's requirements, as they rely less on polluting fossil fuels and have likely also invested in sustainable initiatives (Fatima et al., 2024). Thus, the higher the share of renewable energy in 2008, the higher the likelihood of compliance. The scores were ranked and ordered based on their close relationships given the presence of a few extremes in the data. See *table 8* for the calibration.

**Table 8**

*Calibration REN-set*

<b>Share of renewable energy (in %) in 2008</b>	<b>Score</b>	<b>Value</b>
<i>Between 43% and 50%</i>	[0.95]	Highest advantage
<i>Between 36% and 42,9%</i>	[0.8]	Very high advantage
<i>Between 26% and 35,9%</i>	[0.6]	High advantage
<i>Between 16% and 25,9%</i>	[0.4]	Moderate advantage
<i>Between 6% and 15,9%</i>	[0.2]	Low advantage
<i>Between 0% and 5,9%</i>	[0.05]	Lowest advantage

*Note:* The data for this set was abstracted from Eurostat. (2024, April 05). *Share of renewable energy in gross final energy consumption by sector* [Data set].

[https://ec.europa.eu/eurostat/databrowser/view/sdg\\_07\\_40/default/table?lang=en&category=t\\_nrg.t\\_nrg\\_sdg\\_07](https://ec.europa.eu/eurostat/databrowser/view/sdg_07_40/default/table?lang=en&category=t_nrg.t_nrg_sdg_07)

Moreover, the level of greenhouse gas emissions in the atmosphere (GAS) also provides an assessment of the quality of the air. This measure can reveal whether countries had an initial advantage at the beginning of the directive in 2008. A lower level of greenhouse gas emissions in 2008 may increase the likelihood of compliance. The data ranges from 1 to 30 tones per capita. Given the few extremes in the data, it was calibrated by dividing the data in groups of those closely related. The calibration is shown in *table 9*.

**Table 9***Calibration GAS-set*

<b>Net greenhouse gas emissions (in tonnes/capita) in 2008</b>	<b>Score</b>	<b>Value</b>
<i>Between 0 and 4,9</i>	[0.95]	Highest advantage
<i>Between 5 and 7,9</i>	[0.8]	Very high advantage
<i>Between 8 and 9,9</i>	[0.6]	High advantage
<i>Between 10 and 14,9</i>	[0.4]	Moderate advantage
<i>Between 15 and 20,9</i>	[0.2]	Low advantage
<i>Between 21 and 30</i>	[0.05]	Lowest advantage

*Note:* The data for this set was sourced from Eurostat. (2024, May 21). *Net greenhouse gas emissions* [Data set].

[https://ec.europa.eu/eurostat/databrowser/view/sdg\\_13\\_10/default/table?lang=en&category=t\\_env.t\\_env\\_air](https://ec.europa.eu/eurostat/databrowser/view/sdg_13_10/default/table?lang=en&category=t_env.t_env_air)

There are certainly other indicators to measure this condition. Consequently, even if the results do not show a strong connection between these two indicators and the outcome, a relationship might still exist.

#### **4.4 Reliability and validity**

This research has employed several methods to ensure its validity. Internal validity refers to the extent to which the results accurately reflect the causal relationship between the dependent and independent variable (Creswell & Creswell, 2017). This is ensured by the careful selection and operationalization of factors based on information sourced from globally recognized sources. Moreover, the fsQCA's systematic, step-by-step approach allows for an accurate identification of causal relationships. External validity relates to the generalizability of the results (Creswell & Creswell, 2017). As this research encompasses all 28 EU member states, its findings are broadly generalizable across the EU. It is important to note, however, that this research pertains specifically to compliance with the EU's environmental directives. The results may therefore not directly apply to, for instance, trade or immigration-related legislation. Furthermore, the reliability of this research is ensured through the transparency of the operationalization and calibration process, which allows future researchers to replicate it.

The fsQCA method produces consistent results due to its standardized program. Lastly, the sources of data are made available.

There are, however, a few limitations that must be addressed too. First, two potential factors of compliance were not included in the analysis due to a lack of explanatory power and difficulty in measuring. Nonetheless, it must be acknowledged that these factors may still have contributed to the outcome. Secondly, the QCA method depends upon the subjective operationalization and calibration of the conditions, which introduces potential researcher bias as there are no standardized calibration formats or thresholds. Although the process of calibration has been made as transparent as possible, there remains the possibility of bias in how thresholds are set and how concepts are operationalized.

## 5 Analysis

This chapter will provide the results of the fsQCA. First, it will show an overview of the calibrated scores. Second, it will analyze potential necessary conditions. Afterwards, a truth table is made to test the results for sufficiency. It will then give a counterfactual analysis, through which core and periphery conditions are established. Lastly, it will test the robustness of the results.

### 5.1 Calibrated data

Following the calibration process, the raw data was assigned a fuzzy score. For a full overview of all the data and its corresponding fuzzy score per set, see the Appendices. *Table 10* shows an overview of all the fuzzy scores, which afterwards were imported into the fsQCA software for further analysis.

**Table 10**

*Full overview of all calibrated scores*

Member state	RAI	GOV	ADM	GDP	DEF	REN	GAS	COMP
Austria	[0.4]	[0.2]	[0.6]	[0.6]	[0.6]	[0.6]	[0.6]	[1]
Belgium	[0.05]	[0.2]	[0.6]	[0.6]	[0.3]	[0.05]	[0.4]	[1]
Bulgaria	[0.95]	[0.6]	[0.05]	[0.8]	[0.8]	[0.2]	[0.8]	[1]
Croatia	[0.8]	[0.6]	[0.05]	[0.4]	[0.4]	[0.4]	[0.8]	[1]
Cyprus	[0.95]	[0.8]	[0.05]	[0.4]	[0.05]	[0.05]	[0.4]	[1]

Czechia	[0.6]	[0.6]	[0.2]	[0.6]	[0.6]	[0.2]	[0.4]	[1]
Denmark	[0.8]	[0.4]	[0.95]	[0.6]	[0.6]	[0.4]	[0.4]	[1]
Estonia	[0.4]	[0.8]	[0.6]	[0.8]	[0.4]	[0.4]	[0.4]	[1]
Finland	[0.8]	[0.4]	[0.95]	[0.4]	[0.4]	[0.6]	[0.6]	[1]
France	[0.4]	[0.6]	[0.6]	[0.4]	[0.2]	[0.2]	[0.8]	[0]
Germany	[0.05]	[0.6]	[0.6]	[0.6]	[0.8]	[0.2]	[0.4]	[0]
Greece	[0.8]	[0.8]	[0.05]	[0.2]	[0.6]	[0.2]	[0.4]	[1]
Hungary	[0.8]	[0.8]	[0.05]	[0.6]	[0.2]	[0.2]	[0.8]	[0]
Ireland	[0.8]	[0.8]	[0.6]	[0.8]	[0.6]	[0.05]	[0.2]	[1]
Italy	[0.4]	[0.6]	[0.2]	[0.4]	[0.2]	[0.2]	[0.6]	[0]
Latvia	[0.95]	[0.6]	[0.6]	[0.4]	[0.4]	[0.6]	[0.95]	[1]
Lithuania	[0.95]	[0.6]	[0.6]	[0.6]	[0.6]	[0.4]	[0.8]	[1]
Luxembourg	[0.95]	[0.8]	[0.6]	[0.8]	[0.95]	[0.05]	[0.05]	[1]
Malta	[0.95]	[0.8]	[0.6]	[0.95]	[0.8]	[0.05]	[0.6]	[1]
The Netherlands	[0.6]	[0.6]	[0.8]	[0.4]	[0.8]	[0.05]	[0.4]	[1]
Poland	[0.8]	[0.8]	[0.4]	[0.6]	[0.4]	[0.2]	[0.6]	[0]
Portugal	[0.8]	[0.6]	[0.4]	[0.4]	[0.4]	[0.4]	[0.8]	[1]
Romania	[0.8]	[0.6]	[0.05]	[0.6]	[0.05]	[0.4]	[0.8]	[0]
Slovakia	[0.8]	[0.6]	[0.05]	[0.6]	[0.4]	[0.2]	[0.6]	[1]
Slovenia	[0.95]	[0.6]	[0.2]	[0.4]	[0.6]	[0.4]	[0.8]	[1]
Spain	[0.05]	[0.4]	[0.4]	[0.4]	[0.05]	[0.2]	[0.6]	[1]
Sweden	[0.6]	[0.4]	[0.95]	[0.6]	[0.6]	[0.95]	[0.95]	[1]
United Kingdom	[0.8]	[0.4]	[0.8]	[0.4]	[0.2]	[0.05]	[0.6]	[0]

## 5.2 Necessary conditions

Before looking at the causal complex relationships, first it must be determined whether any individual condition is necessary for the outcome to occur. Subsequently, the consistency<sup>4</sup> and coverage<sup>5</sup> scores can be used to test which conditions may be necessary. A condition is *necessary* when the outcome cannot exist without it (Cooper & Glaesser, 2016). A causal condition is necessary when its consistency score is higher than 0.9, and its coverage score is not lower than 0.5 (Ragin, 2008). All calibrated data was put into the fsQCA program and tested

<sup>4</sup> The *consistency score* indicates the degree to which the condition is necessary for the outcome.

<sup>5</sup> The *coverage score* indicates the degree to which the condition explains all cases of the outcome.

for its consistency and coverage scores. As causality is asymmetric, both the presence and the absence of the outcome ought to be analyzed (Schneider & Wagemann, 2012). The conditions that are necessary for the positive outcome to occur, may be different than those necessary for a negative outcome (Robinson, 2019). Hence, *table 11* presents the consistency and coverage scores for both the presence and absence<sup>6</sup> of each condition, as well as for both the positive outcome (compliance) and the negative outcome (non-compliance).

**Table 11**

*Consistency and coverage scores of each causal condition*

<b>Causal condition</b>	<b>COMP</b>		<b>~ COMP</b>	
	Consistency	Coverage	Consistency	Coverage
<i>RAI</i>	0.738	0.777	0.636	0.223
<i>~RAI</i>	0.262	0.683	0.364	0.317
<i>GOV</i>	0.571	0.732	0.629	0.268
<i>~GOV</i>	0.428	0.776	0.371	0.224
<i>ADM</i>	0.471	0.786	0.386	0.214
<i>~ADM</i>	0.529	0.721	0.614	0.279
<i>GDP</i>	0.560	0.765	0.514	0.235
<i>~GDP</i>	0.440	0.731	0.486	0.269
<i>DEF</i>	0.526	0.844	0.293	0.156
<i>~DEF</i>	0.474	0.668	0.793	0.332
<i>REN</i>	0.307	0.816	0.207	0.184
<i>~REN</i>	0.693	0.724	0.793	0.276
<i>GAS</i>	0.569	0.722	0.647	0.278
<i>~GAS</i>	0.431	0.790	0.343	0.210

As shown in *table 11*, although some of the coverage scores fall below 0.5<sup>7</sup>, none of the consistency scores rise above 0.9 either. Therefore, none of the conditions can be considered necessary. This is not uncommon in empirical research as necessary conditions are rarely encountered (Schneider & Wagemann, 2006), nor is it surprising as this research expects to find

<sup>6</sup> (~) indicates ‘the absence of’.

<sup>7</sup> Notably, only those with the COMP outcome - as opposed to ~COMP - have coverage scores of >0.5.

causal complex relationships rather than the necessity of one single condition. Nonetheless, it can be expected that RAI will be highly present in the compliance cases, as it has the highest consistency score for outcome COMP.

### 5.3 Sufficient conditions

The next step is to test the conditions for sufficiency. A *sufficient* condition may bring about the outcome without any of the other conditions present (Cooper & Glaesser 2016). Therefore, all the fuzzy scores from the seven sets were submitted in the fsQCA software and converted into a truth table (see *table 12*). Similar to the necessity-analysis, due to asymmetric causality both the positive and negative outcomes will be analyzed.

#### 5.3.1 Truth table: positive outcome Y (COMP)

To create a truth table, first a *consistency cut-off* must be established. The consistency indicates the degree to which the data shows a consistent relationship between the causal conditions and the outcome (Ragin, 2008). To determine which combinations pass the “fuzzy set-theoretic consistency” (Ragin, 2008, p. 135) a certain cut-off value must be ascribed. Generally, this value is 0.8, as scores below indicate the existence of inconsistency (Fiss, 2011). This research therefore sets the value at 0.8. Secondly, a *frequency threshold* must be decided upon. The frequency indicates how many cases are explained by a combination of conditions (or: paths). Thus, a certain threshold must be established to ensure that only meaningful configurations are included in the analysis (Pappas & Woodside, 2021). This research sets the threshold at 1. After the thresholds are decided upon, a truth table is created<sup>8</sup> (see *table 12*).

**Table 12**

*Truth-table for outcome COMP*

RAI	GOV	ADM	GDP	DEF	REN	GAS	COMP	Cases (N)	Raw consistency <sup>9</sup>
1	0	1	0	0	1	1	1	1	0.838
1	0	1	1	1	1	1	1	1	0.838
1	1	1	0	0	1	1	1	1	0.824
1	1	0	1	1	0	1	1	1	0.805

<sup>8</sup> Additionally, PRI (proportional reduction in inconsistency) was applied to further filter the truth table rows.

<sup>9</sup> All scores are rounded down to three decimal digits.

1	0	1	1	1	0	0	1	1	0.802
1	1	1	1	1	0	1	1	2	0.802
1	1	1	1	1	0	0	0	2	0.795
1	1	0	0	1	0	1	0	1	0.787
1	1	0	1	1	0	0	0	1	0.778
1	1	0	0	1	0	0	0	1	0.745
0	0	1	1	0	0	0	0	1	0.744
1	1	1	0	1	0	0	0	1	0.742
0	0	1	1	1	1	1	0	1	0.729
1	1	1	1	0	0	0	0	1	0.722
1	0	1	0	0	0	1	0	1	0.716
1	1	0	0	0	0	0	0	1	0.708
1	1	0	0	0	0	1	0	3	0.686
1	1	1	0	0	0	1	0	1	0.667
0	0	0	0	0	0	1	0	1	0.664
1	1	0	1	0	0	1	0	4	0.650
0	1	1	1	1	0	0	0	1	0.620

Each horizontal row in the truth table represents a possible path. The total of paths is  $2^k$ ,  $k$  being the number of causal conditions (Pappas & Woodside, 2021). Given that there are seven conditions, there are a total of  $2^7 = 128$  paths. The truth table allows for the identification of explicit connections between combinations of causal conditions and outcomes (Ragin, 2008). As the frequency threshold was set at 1, only 21 paths are relevant and included in the truth table, as opposed to the total possible paths of 128 (referred to as ‘logical remainders’<sup>10</sup> (Ragin, 2008)).

### 5.3.2 Counterfactual analysis

After the truth table is created, its results can be simplified using Boolean algebra (Fiss, 2011). This will show which conditions are *core* causes and which are *peripheral* causes. The former relates to causal conditions for which the evidence points to a strong causal relationship with the outcome, whereas the latter indicates less evidence and thus a weaker relationship (Fiss,

<sup>10</sup> *Logical remainders* are ‘‘configurations for which no case possesses a membership score above 0.5, or which have been judged to contain too few cases in relation to the total number of cases (Thiem & Dusa, 2013, p. 73). Logical remainders still provide valuable information about important combinations of conditions.

2011). To determine whether a factor can be considered a core condition, the Boolean algebra provides *solutions*: referring to the instance when a combination of paths is supported by a high number of cases. fsQCA provides three types of solutions, i. a complex solution, ii. an intermediate solution, and iii. a parsimonious solution.

- i. *Complex solutions* only present paths that are present in the data, excluding logical remainders. It does not consider the theoretical bases that might be influential. Hence, its universality is not high, and thus this solution is not recommended.
- ii. A *parsimonious solution* is a simplification of all paths (including logical remainders) yet does not evaluate their plausibility.
- iii. An *intermediate solution* falls in between the other two, as it both incorporates logical remainders yet uses theory to produce the paths. Therefore, it is recommended as the best solution for substantive interpretation (Ragin, 2008).

A core condition would be found in both the parsimonious and the intermediate solution. A periphery condition can only be found in the intermediate solution. The results from the parsimonious solution show four possible paths, all of which are also found in the intermediate solutions, thus encompassing core conditions. The four paths found can be simplified to the following formula (see *figure 2*):

**Figure 2**

*Pathway of core conditions outcome COMP*

$$\text{RAI} \cdot \left\{ \begin{array}{l} \text{GDP} \cdot \text{GAS} \cdot \text{DEF} \\ \text{REN} \\ \sim \text{GOV} \cdot \left\{ \begin{array}{l} \text{GDP} \\ \text{DEF}^{11} \end{array} \right. \end{array} \right. \rightarrow Y$$

*Table 13* shows a visual representation<sup>1213</sup> of the results from the intermediate solution. Each column shows the influence of the conditions on one of the six paths that were provided.

<sup>11</sup> (·) means ‘and’, (~) means ‘the absence of’, and (+) means ‘or’.

<sup>12</sup> This type of visualization was created by Fiss (2008) and will thus be adopted.

<sup>13</sup> Black dots (·) indicate the presence of the condition, circles with an ‘x’ (⊗) indicate the absence. Large circles are core conditions (●, ⊗), small circles are periphery conditions (·; ⊗). A blank space relates to the condition’s irrelevancy (its presence or absence does not alter the outcome).

**Table 13***Configuration table for outcome COMP*

<b>Factor</b>	<b>Configuration</b>	<b>i.</b>	<b>ii.</b>	<b>iii.</b>	<b>iv.</b>
<b>1</b>	RAI	•	.	•	•
	GOV		.	⊗	⊗
<b>2</b>	ADM	.		.	.
<b>3</b>	GDP	⊗	.	•	•
	DEF	⊗	.	•	•
<b>4</b>	REN	•	⊗	⊗	•
	GAS	.	⊗	⊗	•
<i>Raw coverage<sup>14</sup></i>		<i>0.207</i>	<i>0.307</i>	<i>0.183</i>	<i>0.198</i>
<i>Unique coverage<sup>15</sup></i>		<i>0.019</i>	<i>0.124</i>	<i>0.017</i>	<i>0.010</i>
<i>Consistency</i>		<i>0.845</i>	<i>0.832</i>	<i>0.802</i>	<i>0.838</i>
<i>Cases</i>		<i>2</i>	<i>3</i>	<i>1</i>	<i>1</i>
<i>Countries</i>		<i>FI, LV</i>	<i>BG, LT,</i>	<i>DK</i>	<i>SE</i>
			<i>MT</i>		
<i>Solution coverage<sup>16</sup></i>	<i>0.388</i>				
<i>Solution consistency<sup>17</sup></i>	<i>0.862</i>				

### 5.3.3 Significant pathways

First of all, the solution consistency score shows that the overall consistency is remarkably high. The solution coverage score indicates that about 40 percent of the cases in the outcome can be explained by the complete solution. The intermediate results provide the following important paths.

<sup>14</sup> *Raw coverage* shows the extent to which each path explains the outcome.

<sup>15</sup> *Unique coverage* shows the proportion of cases that can be explained exclusively by the path.

<sup>16</sup> *Solution coverage* shows the proportion of cases in the outcome that can be explained by the complete solution.

<sup>17</sup> *Solution consistency* shows the combined consistency of all paths. Both the solution coverage and consistency scores meet the standards for them to be representative and informative (Ragin, 2008).

**Paths I - II:** The first two pathways show both the highest raw and unique coverage scores, with path II scoring a raw coverage as high as 0.307. The paths combined also cover the largest number of cases: a total of five different countries. As clear from *table 13*, the core condition of RAI is present in both paths. Interestingly, when the third factor is present entirely (*strong financial capacities*) – thus both GDP and DEF – the fourth factor (*efficient prior policy choices*) is completely absent – both REN and GAS – and this is also true in reverse. Due to Boolean minimization<sup>18</sup>, these conditions can be seen as ‘substitutable’ for the combination of path 1 and 2 and can thus be removed from *figure 3*. The second factor (*strong administrative capacities*) is only present in one of the two pathways.

### Figure 3

*Positive pathways I and II*

$$\text{RAI} \cdot \left\{ \begin{array}{l} \text{GOV} \\ \text{ADM} \end{array} \right. \rightarrow Y$$

**Paths III - IV:** Paths 3 and 4 show relatively low coverage scores, although the consistency scores remain high. Again, the core condition RAI is present, yet its counterpart GOV is fully absent. Both the second factor (*strong administrative capacities*) and the third factor (*strong financial capacities*) are entirely present. However, in one pathway the fourth factor (*efficient prior policy choices*) is present too, yet in the other pathway it is fully absent. Therefore, due to Boolean minimization, it can be seen as insignificant for the outcome of the two pathways combined (as seen in *figure 4*).

### Figure 4

*Positive pathways III and IV*

$$\text{RAI} \cdot \sim \text{GOV} \cdot \text{ADM} \cdot \text{GDP} \cdot \text{DEF} \rightarrow Y$$

<sup>18</sup> If the same conditions appear but both present and absent, they cancel each other out and thus can be removed from the formula.

Nevertheless, it is important to note that although the overall unique coverage scores appear to be very low, this does not take away from the validity of the pathways. In fact, it illustrates “substantial overlap” between the paths which means that there is a main path with some variants, due to substitutable conditions (Rubinson et al., 2019). The results will be further interpreted chapter 6 (*discussion*).

#### 5.3.4 Truth table: negative outcome $Y (\sim COMP)$

The truth table for the absence of the outcome of compliance can be found in appendix H. Again, the frequency threshold is set at 1. The consistency cut-off, however, cannot be 0.8 as it needs to be lower than the highest raw consistency score. In this case, that score is 0.380, which means that the cut-off is set at 0.3<sup>19</sup>. The raw consistency scores are significantly lower than those of the truth table for outcome COMP. This implies that the results from this truth table are less representative.

#### 5.3.5 Counterfactual analysis

The results from the parsimonious solution put forward 5 possible sets of core conditions, which can be minimized to the following formulas (see *figure 5*):

### Figure 5

*Pathways of core conditions outcome  $\sim COMP$*

$$\begin{array}{l} \sim RAI \cdot \left\{ \begin{array}{l} GOV \\ DEF \cdot \left\{ \begin{array}{l} \sim GAS \\ \sim REN \end{array} \right. \end{array} \right. \rightarrow \sim Y \\ \\ \sim DEF \cdot GAS \cdot \left\{ \begin{array}{l} \sim ADM \\ GOV \end{array} \right. \rightarrow \sim Y \end{array}$$

The results from the intermediate solution can be found in *table 14*.

<sup>19</sup> It must be noted that this consistency cut-off is very low, which reduces the reliability of the subsequent truth table results.

**Table 14***Configuration table for outcome ~ COMP*

<b>Factor</b>	<b>Configuration</b>	<b>i.</b>	<b>ii.</b>	<b>iii.</b>	<b>iv.</b>
<b>1</b>	RAI	.	.	⊗	⊗
	GOV	•	•	⊗	•
<b>2</b>	ADM		⊗	⊗	.
<b>3</b>	GDP	⊗		⊗	.
	DEF	⊗	⊗	⊗	•
<b>4</b>	REN	⊗	⊗	⊗	⊗
	GAS	•	•	.	⊗
	<i>Raw coverage</i>	<i>0.407</i>	<i>0.464</i>	<i>0.257</i>	<i>0.214</i>
	<i>Unique coverage</i>	<i>0.057</i>	<i>0.114</i>	<i>0.000</i>	<i>0.057</i>
	<i>Consistency</i>	<i>0.328</i>	<i>0.355</i>	<i>0.336</i>	<i>0.380</i>
	<i>Cases</i>	<i>4</i>	<i>7</i>	<i>1</i>	<i>1</i>
	<i>Countries</i>	<i>HR, FR, IT, PT</i>	<i>HU, HR, IT, PL, PT, RO, SK</i>	<i>ES</i>	<i>DE</i>
	<i>Solution coverage</i>	<i>0.600</i>			
	<i>Solution consistency</i>	<i>0.353</i>			

### 5.3.6 Significant pathways

Evidently, the solution consistency score is much lower than that of the positive outcome results. The solution coverage score, on the other hand, is higher. This implies that whilst a great portion of cases can be explained by the solution, the conditions are barely necessary for the outcome.

**Path I – II:** The first two paths show the highest raw coverage scores and cover the largest number of cases: a total of 8 different countries. The first factor (*high level of government autonomy*) is fully present, with GOV even being a core condition. Furthermore, the third factor

(*strong financial capacities*) is almost fully absent, with DEF as a core condition. Interestingly, the fourth factor (*prior policy choices*) shows mixed results, as REN is fully absent, yet GAS is fully present and a core condition. See *figure 6* for the minimized formula.

### Figure 6

*Negative pathways I and II*

$$\text{RAI} \cdot \text{GOV} \cdot \sim \text{DEF} \cdot \sim \text{REN} \cdot \text{GAS} \cdot \left\{ \begin{array}{l} \sim \text{GDP} \\ \sim \text{ADM} \end{array} \right. \rightarrow \sim \text{Y}$$

**Path III – IV:** The last two paths are more interesting, as they have higher constancy scores yet relative lower raw and unique coverage scores than the first two paths. Both RAI and REN are absent, yet whilst in path 3 only GAS is present and the other conditions are all absent, path 4 is the complete opposite. Moreover, path 4 shows many core conditions, such as the full absence of the fourth factor (*efficient prior policy choices*). Due to Boolean minimization, the following formula emerges (see *figure 7*).

### Figure 7

*Negative pathways III and IV*

$$\sim \text{RAI} \cdot \sim \text{REN} \rightarrow \sim \text{Y}$$

## 5.4 Robustness test

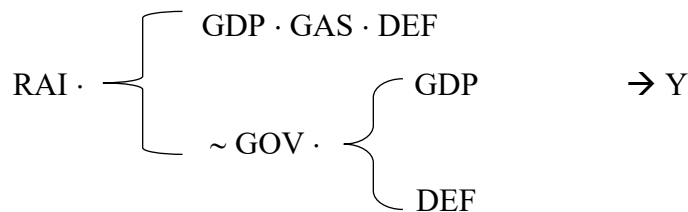
Before the fsQCA results can be interpreted, their robustness must be tested. The sufficient conditions are robust if the consistency and coverage remain approximately the same when the data is changed (Schneider & Wagemann, 2012). There are a few methods to assess this, two of which will be used: changing one of the conditions and changing the frequency threshold.

#### 5.4.1 Eliminating the REN-set

First, by eliminating one of the conditions, it can be determined whether the results remain consistent (Skaaning, 2011). As highlighted in 5.3.3 (*Significant pathways*), condition REN appears to be interesting as it half of the time it is present, and half of the time it is absent. Together with RAI it also forms a core condition for the positive outcome. If the results from dropping REN significant changes the solution, or consistency and coverage scores, the robustness of the results is questionable. After eliminating REN from the analysis, and re-running fsQCA, the following core conditions are found (see *figure 8*):

**Figure 8**

*Pathway of core conditions outcome COMP without REN*



As expected, the only difference is that REN is gone from the core conditions, as no other conditions were dropped in the process. The solution coverage and consistency results of the intermediate solution, as shown in *table 15*, only changed slightly. This confirms the robustness of the results, as not only did the scores hardly change, but the core conditions that were present also remained the same.

**Table 15**

*Coverage and consistency scores for results including and excluding REN-set*

	Including REN	Excluding REN
<i>Solution coverage</i>	0.388	0.369
<i>Solution consistency</i>	0.862	0.856

#### 5.4.2 Changing the frequency threshold

The robustness can also be tested by increasing the frequency threshold (Skaaning, 2011). Originally, it was set at 1, which is the standard. By raising this to 2, only four rows remain in the truth table. As seen in *table 16*, both coverage and consistency scores of the intermediate solution decrease. The coverage score in particular, declines with about 40%. This

is not unsurprising, as only solutions that led to two or more cases were included. No other significant differences were found by increasing the frequency threshold.

**Table 16**

*Coverage and consistency scores for results with different frequency thresholds*

	N=1	N=2
<i>Solution coverage</i>	0.388	0.221
<i>Solution consistency</i>	0.862	0.802

## 6 Discussion

Now that the results have been established, they can be interpreted to discern the causal conditions that influenced the differences in compliance. The following chapter will discuss the main findings of the fsQCA and potential alternative explanations.

### 6.1 Main findings

The fsQCA results show that multiple causal conditions can lead to the same outcome. The intermediate solution identified four pathways for the positive outcome of compliance, encompassing both core and periphery conditions. The level of *regional authority* consistently influences the positive outcome, as it is the most frequent core condition and shows the highest consistency score. Conversely, the second indicator of government autonomy – the *type of executive government* – did not have the same significant impact. Further, *financial capacity* played a decisive role in several cases yet was of little importance in other cases. It is important to note that 2008 marked the beginning of Europe’s Great Recession, and subsequently the Sovereign Debt Crisis, which affected many member states (Szczepanski, 2019). In Finland and Latvia, their relatively weak financial status - characterized by stagnant growth and poor export performance - did not prevent compliance (Brede et al., 2017). Instead, the findings demonstrated that their high level of government autonomy, combined with existing ‘green’ policy choices facilitated compliance. Alternatively, Bulgaria, Lithuania and Malta did not have efficient prior policy choices yet still managed to comply due to their relatively strong economy and high government autonomy. Interestingly, Bulgaria entered the 2008-2018 period with a large current account deficit, yet – unlike Latvia – managed to stabilize its economy through their government’s intensive focus on balancing the budget (Bakker & Klingen, 2012). Similar stories unfolded in Lithuania and Malta, as both countries showed impressive efforts to keep

their economies afloat after 2008 (Bakker & Klingen, 2012). Consequently, the findings suggest that compliance is more likely when the country is either in a robust financial position or well-advanced in its green transition, as long as this is combined with a high level of government autonomy that allows for the unopposed implementation of the EU directive. The centralization of authority in the countries mentioned may have enabled a swift and efficient implementation process.

These findings match up with the theoretical context, as many scholars agree that the level of autonomy in decision-making processes is essential (Börzel et al., 2007; Mastenbroek, 2005). However, according to the results, the type of executive government was not as relevant. This does not imply that the number of political parties with decision-making powers is irrelevant for compliance, as there are many other ways to measure this factor. Scholars have pointed to, for instance, the presence of populist leaders or institutional veto points as conditions that may exert influence (Pollex & Ruffing, 2024; Haverland, 2000). Furthermore, the possession of financial resources to implement the often-costly directives is also highlighted as crucial (Zhelyazkova et al., 2023; Nicolaidis & Oberg, 2006). The fact that efficient prior policy choices are less significant – except when financial capacities are weaker – is somewhat surprising. One might expect that compliance with the EU’s environmental directives would be greatly influenced by the initial dependence on renewable energy sources or greenhouse gas emissions. However, these two conditions are only relevant when financial capacities are weak, and only in combination with low regional authority. Certainly, there are other indicators that can measure a country’s prior ‘green’ progress other than the two used in this research, that might also influence compliance. Lastly, although the literature identified administrative capacities as an influential condition, the findings show that it was of minor importance.

Four different pathways emerged in the negative outcome solution. First, financial capacities played a pivotal role, emerging as core conditions and with a relatively high (in the case of government deficit/surplus) consistency score. The share of renewable energy sources was influential as well. France, Italy, and the UK – all countries that failed to comply – shared common traits of economic struggles and a relatively high dependence on non-renewable energy sources. France for instance, faced challenges that were illustrated by the Gillet Jaunes protests in 2018, which emphasized the conflict between the government’s plans for a more sustainable (yet costly) future and public discontent over their financial issues (Cigainero, 2018). Italy faced economic hardships such as stagnant growth and high debt following the 2008 crisis,

which was exacerbated by its political instability in 2018 as a hung government and a rise of Euroscepticism further complicated the situation (Seth, 2022). On the other side, Germany had a more stable economy yet according to the findings failed to comply due to its disadvantageous position in its green transition combined with high regional authority. It must be noted that Germany implemented an ‘ambitious strategy’ to green its energy, known as the *Energiewende* in 2011, incited after the Fukuyama disaster (Ferreira, 2017), thus reducing its initial disadvantage by the year. Lastly, the presence of regional authority affected a few cases of non-compliance, thus matching with the conclusions drawn from the positive outcome cases.

## 6.2 Alternative explanations

It is important to understand the context-specific circumstances within each country that may also have influenced these outcomes. For instance, both France and Italy experienced political instability with public dissatisfaction, stemming – amongst others – from precarious governments (Cigainero, 2018; Seth, 2022). Similarly, the UK faced political turmoil during the lead-up to Brexit in 2018. This instability may have diverted governmental focus away from their green transition, prioritizing immediate societal issues over (EU-bound) environmental commitments. It is, nevertheless, important to denote that such periods of political and societal turmoil are not unique to the non-complying countries alone. Each country is affected differently by its circumstances, depending on its culture, history, public discourse, amongst others. Future researchers will benefit from conducting more in-depth case studies that explore the specific dynamics of each country to determine whether they truly align with the findings of this research.

## 7 Conclusion

This research aimed to understand what factors accounted for the differences in compliance among member states with the 2008 EU Ambient Air Directive in 2018. It has conducted a fuzzy-set qualitative comparative analysis to do so, as to find causal complex relationships between the conditions. Four different conditions, encompassing a total of seven indicators, were analyzed: i. low level of autonomy in decision-making processes, ii. strong administrative capacities, iii. strong financial capacities, iv. efficient prior policy choices. The fsQCA analysis showed that in cases of compliance, the combination of high government autonomy with either strong financial capacities or efficient prior policy choices appears to be

the most significant causal condition. In cases of non-compliance, the combination of weak financial capacities with inefficient prior policy choices seems to be most influential.

Several limitations to this research must be discussed. First, the QCA method allows for potential bias as the operationalization and calibration of the conditions depend on the interpretation of the researcher. Moreover, the selection of the conditions – although all drawn from existing scholarly literature – is also subject to bias due to data availability and feasibility. As mentioned before, goodness of fit and the words of compliance were not included in the analysis for this reason. Therefore, there might be other factors relevant to (non-)compliance that were not operationalized or used as indicators. Second, the findings of QCA research are less generalizable than those of true quantitative studies as they are specific to the cases and conditions. This thesis aimed to understand patterns of compliance with an EU environmental directive, thus limiting the generalizability of the pathways to sustainability-related EU directives. Third, the coverage scores of the non-compliance pathways were significantly lower than those of the compliance cases, lowering the reliability and generalizability of these findings as this indicates that many instances were not explained by the pathways found (Robinson, 2019).

Lastly, a few recommendations can be drawn for future researchers. First, they should incorporate the two omitted factors into this analysis to test whether they influence the results. They can also test the robustness and significance of the findings by picking different indicators (e.g., institutional veto points or the presence of populist leaders) or by changing the calibration thresholds. Second, they should conduct in-depth case studies across the member states to validate whether the pathways remain accurate for compliance with the ambient air directive. Lastly, they could increase the generalizability of the findings by replicating the research using different or additional environmental EU directives.

This research has not only contributed to an empirical understanding of compliance with EU environmental directives, but also offers valuable insights for EU policymakers. The factors influencing compliance are not as straightforward as one might believe, but rather interconnected and complex. Countries with high levels of regional authority will likely have a harder time complying with the directives, especially when also facing financial constraints. EU policymakers could propose more tailored environmental strategies that consider the differences in capacities between countries, regions, and communities. Through

communication with regional stakeholders (e.g., local authorities, parties, citizens) such strategies can be created in way that their needs and limits are respected. Regions with larger, industrial cities will face more opposition in implementing clean air policies and might benefit from longer implementation periods or greater financial support. Besides larger fundings, the EU could also consider investing in 'green' educational campaigns or rewarding sustainable, innovative projects to stimulate public participation and thus compliance. Only when understanding the unique needs of each country and catering to this, compliance may occur more frequently, thus allowing the EU to be the green leader they have set out to be.

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## Appendices

### Appendix A: Data set of causal condition X(i) – RAI

Member state	Level of regional authority in 2018	Score
Austria	23	[0.4]
Belgium	33,88	[0.05]
Bulgaria	2	[0.95]
Croatia	9,55	[0.8]
Cyprus	1	[0.95]
Czechia	12,32	[0.6]
Denmark	7,34	[0.8]
Estonia	0	[0.4]
Finland	7,09	[0.8]
France	21,85	[0.4]
Germany	37,67	[0.05]
Greece	9	[0.8]
Hungary	8,13	[0.8]
Ireland	11	[0.8]
Italy	25,82	[0.4]
Latvia	4	[0.95]
Lithuania	2	[0.95]
Luxembourg	0	[0.95]
Malta	0	[0.95]

The Netherlands	17,5	[0.6]
Poland	11,32	[0.8]
Portugal	9,51	[0.8]
Romania	10,09	[0.8]
Slovakia	8,84	[0.8]
Slovenia	3,23	[0.95]
Spain	35,67	[0.05]
Sweden	12	[0.6]
United Kingdom	9,59	[0.8]

### Appendix B: Data set of causal condition X(i) – GOV

Member state	Type of executive government	Score
Austria	4	[0.2]
Belgium	4	[0.2]
Bulgaria	2	[0.6]
Croatia	2	[0.6]
Cyprus	1	[0.8]
Czechia	2	[0.6]
Denmark	3	[0.4]
Estonia	1	[0.8]
Finland	4	[0.4]
France	2	[0.6]
Germany	2	[0.6]
Greece	1	[0.8]
Hungary	1	[0.8]
Ireland	1	[0.8]
Italy	2	[0.6]
Latvia	2	[0.6]
Lithuania	2	[0.6]
Luxembourg	1	[0.8]
Malta	1	[0.8]

The Netherlands	2	[0.6]
Poland	1	[0.8]
Portugal	2	[0.6]
Romania	2	[0.6]
Slovakia	2	[0.6]
Slovenia	2	[0.6]
Spain	3	[0.4]
Sweden	3	[0.4]
United Kingdom	3	[0.4]

### Appendix C: Data set of causal condition X(ii) – ADM

<b>Member state</b>	<b>Administrative performance in 2018</b>	<b>Score</b>
Austria	11	[0.6]
Belgium	12	[0.6]
Bulgaria	23	[0.05]
Croatia	23	[0.05]
Cyprus	23	[0.05]
Czechia	18	[0.2]
Denmark	5	[0.95]
Estonia	10	[0.6]
Finland	5	[0.95]
France	12	[0.6]
Germany	13	[0.6]
Greece	24	[0.05]
Hungary	22	[0.05]
Ireland	11	[0.6]
Italy	20	[0.2]
Latvia	13	[0.6]
Lithuania	13	[0.6]
Luxembourg	12	[0.6]
Malta	14	[0.6]

The Netherlands	8	[0.8]
Poland	15	[0.4]
Portugal	16	[0.4]
Romania	24	[0.05]
Slovakia	22	[0.05]
Slovenia	19	[0.2]
Spain	15	[0.4]
Sweden	6	[0.95]
United Kingdom	8	[0.8]

#### Appendix D: Data set of causal condition X(iii) – GDP

Member state	Overall GDP growth (in %) between 2008-2018	Score
Austria	5%	[0.6]
Belgium	5%	[0.6]
Bulgaria	22%	[0.8]
Croatia	-10%	[0.4]
Cyprus	-8%	[0.4]
Czechia	5%	[0.6]
Denmark	1%	[0.6]
Estonia	26%	[0.8]
Finland	-4%	[0.4]
France	-5%	[0.4]
Germany	6%	[0.6]
Greece	-40%	[0.2]
Hungary	1%	[0.6]
Ireland	40%	[0.8]
Italy	-13%	[0.4]
Latvia	-4%	[0.4]
Lithuania	12%	[0.6]
Luxembourg	21%	[0.8]
Malta	96%	[0.95]

The Netherlands	-4%	[0.4]
Poland	10%	[0.6]
Portugal	-8%	[0.4]
Romania	14%	[0.6]
Slovakia	5%	[0.6]
Slovenia	-3%	[0.4]
Spain	-13%	[0.4]
Sweden	7%	[0.6]
United Kingdom	-2%	[0.4]

#### Appendix E: Data set of causal condition X(iii) – DEF

<b>Member state</b>	<b>Government surplus/deficit (in %) in 2018</b>	<b>Score</b>
Austria	0,2%	[0.6]
Belgium	-0,9%	[0.3]
Bulgaria	1,7%	[0.8]
Croatia	0%	[0.4]
Cyprus	-3,6%	[0.05]
Czechia	0,9%	[0.6]
Denmark	0,8%	[0.6]
Estonia	-0,6%	[0.4]
Finland	-0,9%	[0.4]
France	-2,3%	[0.2]
Germany	1,9%	[0.8]
Greece	0,9%	[0.6]
Hungary	-2,1%	[0.2]
Ireland	0,1%	[0.6]
Italy	-2,2%	[0.2]
Latvia	-0,7%	[0.4]
Lithuania	0,5%	[0.6]
Luxembourg	3%	[0.95]

Malta	2%	[0.8]
The Netherlands	1,5%	[0.8]
Poland	-0,2%	[0.4]
Portugal	-0,3%	[0.4]
Romania	-2,8%	[0.05]
Slovakia	-1%	[0.4]
Slovenia	0,7%	[0.6]
Spain	-2,6%	[0.05]
Sweden	1%	[0.6]
United Kingdom	-1,5%	[0.2]

#### Appendix F: Data set of causal condition X(iv) – REN

<b>Member state</b>	<b>Share of renewable energy (in % of gross final energy consumption) in 2008</b>	<b>Score</b>
Austria	28.788 %	[0.6]
Belgium	3.611 %	[0.05]
Bulgaria	10.345 %	[0.2]
Croatia	21.986 %	[0.4]
Cyprus	5.131 %	[0.05]
Czechia	8.674 %	[0.2]
Denmark	18.543 %	[0.4]
Estonia	18.811 %	[0.4]
Finland	31.071 %	[0.6]
France	11.188 %	[0.2]
Germany	10.072 %	[0.2]
Greece	8.183 %	[0.2]
Hungary	8.564 %	[0.2]
Ireland	3.979 %	[0.05]
Italy	11.492 %	[0.2]
Latvia	29.811 %	[0.6]
Lithuania	17.824 %	[0.4]

Luxembourg	2.809 %	[0.05]
Malta	0.195 %	[0.05]
The Netherlands	3.596 %	[0.05]
Poland	7.686 %	[0.2]
Portugal	22.929 %	[0.4]
Romania	20.204 %	[0.4]
Slovakia	7.723 %	[0.2]
Slovenia	18.646 %	[0.4]
Spain	10.744 %	[0.2]
Sweden	43.922 %	[0.95]
United Kingdom	2.700 %	[0.05]

#### Appendix G: Data set of causal condition X(iv) – GAS

<b>Member state</b>	<b>Net greenhouse gas emissions (in tonnes/capita) in 2008</b>	<b>Score</b>
Austria	9,3	[0.6]
Belgium	13,3	[0.4]
Bulgaria	7,2	[0.8]
Croatia	5,9	[0.8]
Cyprus	13,5	[0.4]
Czechia	13,6	[0.4]
Denmark	13,5	[0.4]
Estonia	10,9	[0.4]
Finland	9,6	[0.6]
France	7,7	[0.8]
Germany	12,0	[0.4]
Greece	11,9	[0.4]
Hungary	6,6	[0.8]
Ireland	17,0	[0.2]
Italy	9,3	[0.6]
Latvia	2,4	[0.95]

Lithuania	5,5	[0.8]
Luxembourg	26,7	[0.05]
Malta	8,2	[0.6]
The Netherlands	13,7	[0.4]
Poland	9,8	[0.6]
Portugal	6,6	[0.8]
Romania	5,8	[0.8]
Slovakia	8,1	[0.6]
Slovenia	7,2	[0.8]
Spain	8,2	[0.6]
Sweden	1,1	[0.95]
United Kingdom	8,7	[0.6]

#### Appendix H: Truth table for outcome ~ COMP

RAI	GOV	ADM	GDP	DEF	REN	GAS	~COMP	Cases (N)	Raw consistency
0	1	1	1	1	0	0	1	1	0.380
1	1	0	1	0	0	1	1	4	0.350
0	0	0	0	0	0	1	1	1	0.336
1	1	1	0	0	0	1	1	1	0.333
1	1	0	0	0	0	1	1	3	0.314
1	1	0	0	0	0	1	0	1	0.292
1	0	1	0	0	0	1	0	1	0.278
0	0	1	1	1	1	1	0	1	0.271
0	0	1	1	0	0	0	0	1	0.256
1	1	0	0	1	0	1	0	1	0.255
1	1	0	1	1	0	0	0	1	0.222
1	1	0	0	1	0	1	0	1	0.213
1	1	1	1	1	0	0	0	2	0.205
1	1	1	1	1	0	1	0	2	0.198
1	0	1	1	1	0	0	0	1	0.198
1	1	0	1	1	0	1	0	1	0.195

1	1	1	0	0	1	1	0	<i>I</i>	0.176
1	0	1	0	0	1	1	0	<i>I</i>	0.162
1	0	1	1	1	1	1	0	<i>I</i>	0.162