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Exploring Subnational Climate Target Adoption in the Paris Agreement Era: The Case of US States

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Abstract

States play a pivotal role in multilevel climate governance in the United States (US) federal system, particularly as federal climate policy fluctuates under changing national leadership. Nearly half of US states have adopted greenhouse gas (GHG) emissions reduction targets during the Paris Agreement era (2016-present). However, the factors driving state adoption of GHG targets during this period remains understudied. This thesis employs fuzzy-set qualitative comparative analysis (fsQCA) to examine how key institutions, interests, and ideas interact to influence state GHG target adoption. The findings indicate that political-institutional factors – specifically party control and membership in the United States Climate Alliance (USCA) – are sufficient to explain state GHG target adoption during this period. Favorable public opinion emerges as likely a necessary condition for state GHG target adoption. Economic interests (dependency on fossil fuel production and state wealth) and public opinion are revealed as insufficient to explain adoption on their own. These results underscore the non-deterministic nature of GHG target adoption and pronounced partisan polarization shaping subnational climate governance in the US. This study demonstrates the utility of fsQCA in state climate policy research, offering causal nuance that complements traditional covariational approaches. Understanding what drives state-level climate action is particularly timely, given highly inconsistent national leadership on climate governance. The findings also provide valuable insights for future comparative research on multilevel climate governance in federations.

1. Introduction

The bottom-up approach of the Paris Agreement on climate change relies on the international community to collectively reduce net emissions of greenhouse gases (GHGs) to limit warming to no more than 2°C (or, preferably, 1.5°C) above pre-industrial levels. This framework requires parties – signatories to the international convention – to submit their own, self-imposed "Nationally Determined Contributions" (NDCs) to tackling climate change. NDCs often include quantified pledges to reduce emissions of climate-warming GHGs ("GHG targets"). Yet, together, current NDCs are not sufficient to reach the global temperature limits set in Paris (Intergovernmental Panel On Climate Change 2022).

The inadequacy of international and national climate policies has led to growing interest in multilevel climate governance, which emphasizes the roles of subnational actors in advancing climate action (Jänicke 2017; Marquardt 2017; Zhang et al. 2017). In federal systems, subnational "constituent units" such as states, provinces, cantons, and Länder hold formal, independent legal authority that allows them to adopt and implement their own climate policies. These policies can complement national commitments or compensate for federal inaction (Fenna, Jodoin, and Setzer 2023a).

The United States of America (US) – the largest historical emitter of GHGs – has played a powerful role in both advancing international cooperation on climate change and preventing progress. Recently, under President Barack Obama (2009-2017), the US helped negotiate the watershed Paris Agreement on climate change in 2015 and submitted an Intended NDC (INDC) of reducing annual GHG emissions to 26 to 28 percent below 2005 levels in 2025 (United Nations Framework Convention on Climate Change 2017). The election of President Donald Trump the following year led to the country's withdrawal from the Paris Agreement. This threw American commitment to international cooperation on climate change into doubt in the critical first years following the agreement. The US did not submit an NDC under President Trump. The first official US NDC was submitted under President Joe Biden in April 2021. It represents a pledge to reduce annual GHG emissions to 50 to 52 percent below 2005 levels in 2030 (United Nations Framework Convention on Climate Change 2025). In December 2024, the US submitted its so-called "NDC 3.0," adopting a target to reduce net GHG emissions by 61 to 66 percent below 2005 levels in 2035. Yet the reelection of President Trump to serve a second term (2025-2029) has once again cast doubt over

US national commitments to climate change, with a likely second US withdrawal from the Paris Agreement and abandonment of its NDC (Reuters 2024).

The US exemplifies the tensions and opportunities inherent to multilevel climate governance in federations. US states have played a key role in compensating for inconsistent leadership at the national level (Rabe and Smith 2023). Leading states have adopted climate and clean energy policies across a wide range of instruments and economic sectors (Bergquist and Warshaw 2023). Almost half have adopted their own state GHG targets, supporting national efforts to reduce emissions (Bromley-Trujillo and Holman 2020). Yet these efforts remain uneven: while some states lead on climate action, others have not taken comprehensive measures to address GHG emissions, with some actively obstructing federal and subnational initiatives (Basseches et al. 2022; Pappas 2024). Understanding the factors driving state-level GHG target adoption takes on special importance now, as subnational commitments may become the primary safeguard for US contributions to the Paris Agreement.

Despite widespread recognition of the important role subnational units play in advancing climate mitigation efforts in federations, factors leading to the adoption of subnational GHG targets since the Paris Agreement remains understudied. The thesis uses fuzzy-set qualitative comparative analysis (fsQCA) to examine why US states adopted GHG targets between 2016-2024. Drawing on theories of institutions, interests, and ideas, I assess the role of key factors, including partisan control of state government, governors' membership in an interstate climate organization, public opinion, dependence on fossil fuel production, and wealth. My research question is:

Which combinations of institutions, interests, and ideas best explain why US states have or have not adopted GHG targets during the Paris Agreement era (2016-present)?

The thesis proceeds as follows. The next chapter (*Background*) provides additional context on a few key topics. The first subsection provides background on multilevel climate governance in federations, with a focus on federal constituent units (e.g. states). This is followed by a brief discussion of GHG targets as the climate policy output of interest before turning to the role of subnational GHG targets in federal contexts. The final subsection reviews the US case, painting the history of US state climate policy in broad strokes. This is guided by Rabe's (2011) two-dimensional typology describing different periods of the US state-to-federal climate policy relationship. The purpose of this section is to place multilevel climate governance and GHG targets in the US into historical context. The third chapter (*Theory*) first reviews a rich literature on climate policy adoption, identifying key institutions, interests, and ideas that are likely to impact state GHG target adoption. I then set hypotheses regarding how certain state institutions, interests, and ideas may combine to provide pathways leading to states' GHG target adoption in the Paris Agreement era. The fourth chapter (*Data and methods*) begins with a description of cases assessed in this study. I then provide a primer on fsQCA as a relatively nascent methodology with distinct logical foundations that are well-suited to this research. I then explain the operationalization of fsQCA in this thesis. The sixth chapter (*Results*) describes the key results from the fsQCA. The penultimate chapter (*Discussion*) provides an analysis of the fsQCA results considering existing literature, highlights exceptional cases, and notes some limitations. Finally, the last chapter (*Conclusion*) summarizes the findings, contribution and relevance of the thesis before suggesting avenues for future research.

2. Background

2.1. Multilevel climate governance in federations

This thesis explores the adoption of GHG targets within a federal context. In federations, constitutionally distinct levels of government act with some autonomy from each other and accountability to their respective electorates (Anderson 2008). Bakvis and Brown (2010, 484) describe federations as existing "to divide power and to promote diversity" in governance. To this end, authority is divided both vertically (between central and subnational governments) and horizontally (between *constituent units*) (Fenna, Jodoin, and Setzer 2023b).

A growing literature on multilevel climate governance under federalism highlights the dynamic role that the constituent units – such as states, provinces, cantons, and Länder – play in complementing, compensating for, or conflicting with national climate policy initiatives (or lack thereof) (Fenna, Jodoin, and Setzer 2023a). They may serve as laboratories for policy innovation and adoption (Jörgensen, Jogesh, and Mishra 2015), foster policy diffusion among peers (Bromley-Trujillo et al. 2016; Rabe 2009), and participate in "polycentric" governance across scales (Byrne, Taminiau, and Nyangon 2022; Dorsch and Flachsland 2017; Fisher and Leifeld 2019; Ostrom 2010). Subnational governments are often responsible for implementing national or regional climate policies (Puppim De Oliveira 2009). However, their approaches to climate policy can diverge significantly. A lack of vertical and horizontal coordination can cause inter-jurisdictional challenges by shifting pollution or compliance costs, or jeopardize climate progress (Harrison 2013). Identifying the factors driving these divergent approaches remains a critical area of research (Fenna, Jodoin, and Setzer 2023a; Glasgow, Zhao, and Rai 2021; Karapin 2016).

While constituent units play important roles in climate governance in federal contexts, the effect of federalism on climate policy is ambivalent and highly context-dependent (Balthasar, Schreurs, and Varone 2020). Federalism often acts as a "double-edged sword" that can both cut through climate policy delay and against climate policy progress under different conditions (Karapin 2020). On the one hand, federalism can foster locally responsive measures, policy experimentation and inter-jurisdictional learning, and a "fail-safe" degree of redundancy; on the other, it can lead to challenges such as uncoordinated policies, blame-shifting, and collective action problems (Fenna, Jodoin, and Setzer 2023a, 4).

As with constituent units in other federations, states play a key role in the story of multilevel climate governance in the US (Rabe and Smith 2023). This is enabled by their broad jurisdiction over activities that are primary sources of GHG emissions, such as energy production, distribution and use, land and waste management, and industrial activity (Karapin 2020; Rabe 2011). Yet, as in other federal contexts, the fifty US states exhibit substantial variation in their approaches to climate change, with some leading on GHG reduction initiatives and others opposing climate regulations altogether (Alexander 2020). This thesis seeks to uncover why some states adopt GHG targets while others do not, focusing on the Paris Agreement era.

2.2. GHG targets

This research centers on a critical climate mitigation policy output: quantified GHG emissions reduction targets (hereafter "GHG targets"). Policy outputs, observed directly in statutory legislation, executive orders, or administrative regulations, are adopted as a result of political decisions and are distinct from policy outcomes (Jörgens and Knill 2023). While most policy outputs (e.g. GHG targets) aim to achieve an outcome (a certain level of GHG emissions), doing so depends on numerous external factors beyond policymakers' immediate control.

GHG targets have long been central to climate governance. They allocate responsibility for reducing emissions and directly address the root cause of climate change – rising atmospheric

GHG concentrations (Bodansky and Rajamani 2018). Such targets provide benchmarks for evaluating progress and identifying policy gaps (Iacobuta et al. 2018). While historically GHG targets have not always been met, their adoption plays an important role in legitimating and providing accountability for other climate governance approaches (Haarstad 2020). Initially established at the international level, GHG targets are now widespread in both the private and public sector at multiple levels of governance (Bang et al. 2007; Cale and Reams 2013; Glasgow, Zhao, and Rai 2021; Krabbe et al. 2015; Krause 2011; Pablo-Romero, Pozo-Barajas, and Sánchez-Braza 2015; Scott, Peeters, and Gössling 2010).

GHG targets can vary in scope or coverage of GHGs. Some are economy-wide, while others are sector-specific (e.g. focusing solely on the electricity sector) (Ross, Rich, and Ge 2016). Further, while some may target only carbon dioxide (CO_2) – the largest overall contributor to climate change – many encompass all direct GHGs: methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3) (National Atmospheric Emissions Inventory 2025). All state GHG targets assessed in this research are economy-wide and cover all GHGs.

The Paris Agreement's bottom-up approach allows countries to design GHG reduction targets suited to their specific contexts, fostering diverse approaches that vary in ambition and credibility (Schaub et al. 2022; Victor, Lumkowsky, and Dannenberg 2022). Ambitiousness reflects the magnitude of GHG reductions a target seeks (Peterson et al. 2023). Credibility reflects whether a jurisdiction's policy mix and plans align with its stated GHG target, and whether it is legally binding (Rogelj et al. 2023). Climate policy outputs can also be evaluated by their stringency, density, intensity, or sectoral coverage (Knill, Schulze, and Tosun 2012; Schaffrin, Sewerin, and Seubert 2015; Schaub et al. 2022). Thus, while the Paris Agreement framework assumes that countries will commit to reduce GHG emissions, it leaves considerable flexibility regarding the extent of reductions and how they are achieved (Stankovic, Hovi, and Skodvin 2023).

Although this research thus does not systematically analyze additional dimensions of state GHG targets in the US such as ambition or credibility, it draws on a rich climate policy adoption literature spanning these topics. Doing so is essential for developing my hypotheses for how state institutions, interests, and ideas contribute to GHG target (non) adoption. Understanding the drivers of state GHG target adoption provides valuable insights into the broader international climate policy landscape – and vice versa – while offering opportunities for future comparative research.

2.3. Subnational GHG targets in federations

In contrast to official parties to the Paris Agreement, subnational governments – such as US states or other constituent units in federations – are not bound to adopt GHG targets by international conventions. Many of these subnational entities have nonetheless adopted such targets. While adoption is far from universal, understanding their unique role in multilevel climate governance under federalism helps contextualize their importance.

Subnational GHG targets in federations can serve as a "fail-safe" mechanism that bolsters emissions reduction efforts regardless of the national policy direction (Fenna, Jodoin, and Setzer 2023, 4). The concept of *compensatory federalism* (Derthik 2010; Thompson 2001) helps frame this dynamic in the context of NDCs, wherein subnational policies can partially fill governance gaps left by federal inaction (Fenna 2023; Jordaan et al. 2019). This compensatory role is especially pronounced during federal policy rollbacks such as the shift from President Obama to President Trump in the US. This dynamic also applies in other federal contexts, such as Brazil's high-profile fluctuations between Presidents Lula da Silva and Jair Bolsonaro and an upcoming shift in national climate leadership in Canada as Prime Minister Justin Trudeau steps down. While subnational GHG targets contribute to multilevel climate governance under any conditions, their importance is magnified during periods of federal inaction or instability (Fenna, Jodoin, and Setzer 2023a).

Constituent units in federations have adopted GHG targets in several national contexts. For example, nearly all Australian states have voluntarily adopted their own GHG targets, where federalism has proven to be a "facilitating rather than a hindering factor" in a country with one of the highest levels of per capita GHG emissions (Fenna 2023a, 15). In Germany, an early pioneer in climate policy, eight of sixteen German Länder adopted GHG targets before most were superseded by federal targets updated in 2021 (Eckersley et al. 2023). Here, federalism has enhanced multilevel cooperation overall, despite pronounced differences between the approaches of Länder with distinct energy and industrial interests (Weidner and Mez 2008). Nine of ten large and geographically diverse provinces in Canada have adopted GHG targets (Center for Climate and Energy Solutions 2025). Harrison (2023) identifies a trend toward federal unilateralism during the Paris Agreement era which has started to complicate the story of Canadian federalism as an unmitigated obstacle to climate action. This diversity represents a puzzle for explaining which factors drive divergent subnational GHG target adoption behavior in federations.

Due to the complexity of subnational climate governance, there is not firm consensus on which conditions ultimately lead subnational entities to adopt GHG targets or not. Yet there is broad agreement – based in rigorous theoretical development and empirical research – on how certain factors may drive divergent climate policy adoption behavior in general. Different approaches can be due to jurisdictional factors including governance and institutions, media environment and public opinion, economic and political interests, and advocacy coalitions (Basseches et al. 2022). It can also reflect coalitional behavior with peer jurisdictions nationally, or within transnational networks (Michaelowa and Michaelowa 2017; Song et al. 2022). An essential branch of existing climate governance scholarship highlights the overlapping influence of structural factors such as material endowments, political systems and control, and ideas, values, and beliefs systems (Dubash et al. 2022). This literature, reviewed in more detail in the *Theory* section, provides key insights into factors influencing GHG target adoption in US states that are assessed in this thesis.

2.4. Background on the US case

Within the US, some states have implemented ambitious, economy-wide GHG targets, while others have abstained altogether. US state GHG targets are established through either statutory legislation or gubernatorial executive orders (Center for Climate and Energy Solutions 2025).[1] Twenty-four US states have adopted current GHG targets, with some variations in ambition and structure (Ibid.). US state GHG targets are set as a percentage reduction from a base year (e.g. 2005) by a target year (e.g. 2030). This aligns with the approach of the US NDC and allows for a specific quantification of the targeted level of emissions, normally reported in megatons of carbon dioxide equivalent ($MtCO_2e$). Some short-term state targets directly align with the US NDC goal of a 50-52 percent reduction below 2005 levels by 2030, while others differ in base years, target

[1] Gubernatorial (or governor-enacted) executive orders are authorized in most state constitutions or statutory legislation. Executive orders issued by state governors have the force of law, and do not require legislative or judicial intervention; while they can be overridden by either branch, this is rare in practice (Cockerham and Crew 2017). They may be used to establish new programs, modify the administration of the executive branch or state operations, and increase government attention and energy on an issue (Gakh, Vernick, and Rutkow 2013).

years, and reduction percentages. Long-term goals, such as achieving net-zero emissions by 2050, are also common.

This section provides an overview of the history of state climate policy in the US, focusing on the interplay between state and federal GHG targets (or their absence) over time. This is because, while all federations share the feature of having "states within states" providing for an additional level of government actors and opportunities for policy diversity, the evolution of multilevel governance within each federation depends on myriad contextual factors (Fenna 2023, 328). An understanding of the policy dynamics that have evolved between the central government and constituent units is therefore fundamental.

2.4.1. An historical typology of the US state-to-federal climate policy relationship

An early academic observer of the critical role of US states in climate governance, Rabe (2011) developed a simple two-dimensional typology for describing the evolving relationship between state and federal climate policies. This typology evaluates state and federal government activity on climate change policy as either low or high. Importantly, it assumes that such "activity" is meant to mitigate climate change, therefore making a positive contribution to addressing the problem. I will use this framework to situate the brief history provided here. Table 1 shows an adapted depiction of his typology. The horizontal dimension qualifies the level of involvement of the federal government in climate policy, from low to high. The vertical axis indicates the level of involvement of state governments.

Table 1: Typology of multilevel climate governance dynamic in the US federal system, 1975-2025

State domination Low federal, high state 1998-2007, 2017-2021	**Contested federalism** High federal, high state 2008-2017, 2021-2025
Symbolic policy Low federal, low state 1975-1997	**Federal domination** High federal, low state None

Table 1: Typology of multilevel climate governance dynamic in the US federal system, 1975-2025. Adapted and updated from Rabe (2011).

2.4.2. The symbolic policy period (1975-1997)

The first, so-called *symbolic policy* period witnessed the consolidation of scientific understanding of the global climate problem and the beginnings of international policy cooperation on the issue. During this period, climate change transformed from mainly a "scientific issue" to a "policy issue" (Bodansky 2001). As national governments convened in international fora, the predominant view was that any solution to the climate problem would be achieved through international cooperation of sovereign nations (Rabe 2008). The adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 established a formal climate regime, emphasizing a top-down approach that culminated in the 1997 Kyoto Protocol (Bodansky 2001). However, in the leadup to the UNFCCC, President George H.W. Bush emphasized his position (shared by many US federal policymakers through the 1990s) that the US would oppose any climate treaty requiring the country to reduce its GHG emissions (Harris 2009). President Bill Clinton ultimately submitted a voluntary target to the UNFCCC of reducing GHG emissions to 1990 levels by 2000, which was not met (Royden 2002).

While federal and state leaders began to formulate modest policies at this time, Rabe (2011, 499) argues that none that were ultimately adopted should be considered "a serious policy initiative." One example of a policy that might have met this qualifier was President Clinton's proposed BTU tax to reduce emissions and raise government revenue, which failed amid congressional opposition in 1993 (Royden 2002). States experimented with mostly small-scale renewable energy and voluntary air pollution reduction programs (Rabe 2011). Overall, during this symbolic policy period, federal and state governments largely deferred to international negotiations, resulting in low domestic policy development.

2.4.3. The first period of state domination (1997-2009)

State domination of US climate politics emerged during the second presidential term of Bill Clinton (1997-2001) and continued through the presidency of George W. Bush (2001-2009). This era began with the adoption of the 1997 Kyoto Protocol at the international level, which sought to bind developed countries listed in Annex I of the UNFCCC (including the US) to collectively reduce their average annual GHG emissions between 2008 and 2012 to 5.2 percent below 1990 levels (Bodansky 2001). While the US participated in negotiations and signed the agreement in 1998, it never ratified the protocol nor adopted such a binding GHG target (Pataki et al. 2008).[2]

[2] Why? In the US, treaties setting new international legal obligations require ratification in the US senate given its power of "advice and consent." The "Byrd-Hagel" resolution (S.Res. 98, 105th Congress) in the US senate reflected strong opposition to ratifying an agreement that set GHG requirements for some (Annex I countries) but not other (developing) country parties. It passed in an overwhelming 95-0 vote in a senate body of 100. Given this signal, President Clinton never submitted the treaty for Senate ratification. Regardless of the reasons motivating it, this obstinance solidified the US' status as a climate laggard on the international stage during this period.

After assuming office in 2001, President Bush withdrew the US from participating in the Kyoto Protocol process (Cohen and Egelston 2003).

President Bush signaled early on that he was unwilling to regulate carbon dioxide emissions, overstating a lack of scientific certainty on causes of and solutions to climate change (Rosencranz 2002). He announced an "emissions intensity" approach to climate policy, which was criticized for an inability to secure net GHG emissions reductions (Blanchard and Perkaus 2004). Overall, the Bush administration weakened domestic environmental laws and regulations, deferring in large part to industry (Harris 2009).

The "first wave" of state GHG target adoption occurred during this period as the federal government failed to enact binding GHG targets (Glasgow, Zhao, and Rai 2021). At the time, a group of states responded to lack of federal-level commitment to GHG "targets and timetables" by taking a bottom-up approach (Rabe 2004). A bipartisan group of New England Governors, in collaboration with Eastern Canadian Premiers, issued Resolution 25-9 in 2000 and a subsequent Climate Change Action Plan in 2001, thus beginning the period of *state domination* of US climate policymaking (Littell, Westerman, and Burson 2008). Participating jurisdictions pledged to collectively reduce GHG emissions to 1990 levels by 2010 and 10 percent below 1990 levels by 2020. While the effort began with a collective GHG reduction pledge, many states adopted GHG targets that reflected this collective target.[3] As will be detailed later in this thesis, this closely resembles the dynamic of GHG target adoption exemplified by members of the US Climate Alliance. In assessing the drivers of this behavior using event history analysis, Glasgow, Zhao, and Rai (2021) find evidence that Democratic party control of state legislatures and the absence of GHG emissions intensive industries contributed to state GHG target adoption.

It is during this period that states also began to adopt innovative climate policy instruments and take a leadership role in reducing GHGs. One of the most powerful instruments, adopted by roughly two dozen states during this period, is the renewable portfolio standard (RPS). RPS policies require a certain percentage of electricity generation to be derived from renewable sources, encouraging a shift away from fossil fuels (Matisoff 2008). A cap-and-trade program for the power

[3] Maine was first state to adopt an explicit, quantified GHG reduction target into statutory law in 2003 (National Conference of State Legislatures 2024). The state's Public Law 237, known as the Maine Climate Change Act, adopted a goal of reducing GHG emissions to 1990 levels by 2010, 10 percent below 1990 levels by 2020, and suggesting that further reductions may be needed (38 MRSA, §576) (Littell, Westerman, and Burson 2008).

sector, the Regional Greenhouse Gas Initiative (RGGI), was also adopted by a coalition of ten states in Northeast in 2009 to reduce CO_2 emissions (Yan 2021). States also increasingly took responsibility for reducing GHG emissions in their jurisdiction. By 2009, over a dozen states had adopted economy-wide GHG targets. Table A.4 in the Appendix presents these state GHG targets.[4]

2.4.4. The first period of contested federalism (2009-2017)

The third period of US climate policy began in 2009 and continued through the two presidential terms of Barack Obama (2009-2017). It was characterized by *contested federalism*, termed as such because the President's policymaking approach was at cross-purposes with a coalition of states contesting his authority to regulate GHGs in their jurisdictions. Attempts from the Obama administration to take executive actions on climate change mitigation were supported by some states and vigorously opposed by others (Rabe 2011).

The US was more cooperative on the international stage during this period. President Obama ultimately played a key role in negotiating the watershed Paris Agreement under the UNFCCC and joined the convention on behalf of the US in the later years of his presidency. The Paris Agreement struck on December 12, 2015, established the 2°C and 1.5°C global temperature goals and a requirement for parties to submit increasingly ambitious NDCs every five years (Rogelj et al. 2017). President Obama submitted the US Intended NDC on March 31, 2015, pledging efforts to reduce GHGs 26 to 28 percent below 2005 levels by 2025. During the emergent Paris Agreement era, many states would eventually start to mirror their own GHG targets after this INDC.

Domestically, the Obama administration attempted to expand executive action on climate change as legislation to address the issue failed in Congress. His administration adopted more stringent vehicle emissions standards and sought to regulate GHG emissions from power plants through its Clean Power Plan (Tollefson 2009).[5] While supported by many states, the Clean Power Plan was strongly opposed by a group of states whose attorneys general eventually sued the Obama administration over the rules, largely along party lines (Besco 2018). The American Clean Energy and Security Act (also known as the "Waxman-Markey" bill) – congressional legislation to

[4] Of these, Arizona and Florida do not currently maintain state specific GHG targets
[5] These efforts had been enabled by the landmark 2007 Supreme Court case *Massachusetts v. EPA* which ruled that the federal government had such responsibilities to regulate climate pollution, including carbon dioxide emissions.

establish a national cap-and-trade program for GHG emissions – was also defeated in 2010 (Stavins 2022).[6]

States continued their policy experimentation during this period as the federal government's role expanded. However, the Supreme Court ruling in *Massachusetts v. EPA (2007)* – that the federal Environmental Protection Agency should regulate carbon dioxide as an air pollutant under the 1990 Clean Air Act amendments – led many to believe that the federal government might now take the lead on reducing GHGs (Rabe 2011). Thus, while there were high levels of both state and federal climate policymaking activity, leading states were more prone to collaborate with and respond to more active federal leadership than take pioneering steps on their own. During the first period of contested federalism, only a handful of states adopted new GHG targets (shown in Table A.5 in the Appendix).

2.4.5. The second period of state domination in the Paris Agreement era (2017-2021)

The presidential election of Donald Trump a year after the Paris Agreement was signed ushered in second period of *state domination* of climate policy. Since the Trump presidency, the role of states has grown more pronounced than ever (Bromley-Trujillo and Holman 2020). Scientific assessments became more sophisticated in demonstrating the urgency of the problem as climate-fueled disasters spread across the world; large-scale climate demonstrations worldwide led to a marked rise in the political salience of climate change.

At the international level, President Trump withdrew the US from the Paris Agreement, reneging on the country's INDC and refusing to commit the US to GHG emission reductions. His "America First" approach was rooted in a tradition of US isolationism and an opposition to multilateralism – he viewed international climate agreements as unfairly disadvantaging the US economy (Jotzo, Depledge, and Winkler 2018). This striking policy reversal prompted a backlash internationally and domestically, including the creation of the "We Are Still In" coalition of (public and private) subnational entities in the US; it also ultimately led, in June 2017, to the formation of the United States Climate Alliance (USCA) comprised of state and territorial governors collectively committed to global temperature targets (Dubash et al. 2022).

[6] Recent scholarship has shown evidence that the fossil fuel industry coordinated lobbying, campaign expenditures, and contrarian witnesses reflecting an overrepresentation of scientists known to deny the scientific consensus at congressional hearings on the bill (Nanko and Coan 2024).

Domestically, President Trump worked to reverse or weaken climate policies put in place by the preceding Obama Administration (De Pryck and Gemenne 2017). His deregulatory agenda included rollbacks to the Clean Power Plan and vehicle emissions standards, as well as methane regulations and energy efficiency standards. His administration also promoted new oil and gas leasing by shrinking national parks (Bomberg 2021). Overall, federal climate policy reflected the President's opposition to limiting climate change (Jotzo, Depledge, and Winkler 2018).

State climate policymaking activity rose once again during the Trump presidency. Bromley-Trujillo and Holman (2020) document states' increasingly sophisticated use of regulatory and market-based approaches to climate mitigation and adaptation. Many members of the USCA took on the role of climate policy leaders (sometimes exercising influence internationally) during this period (Dubash et al. 2022). This alliance has institutionalized interstate cooperation on climate change, regardless of the federal administration's efforts.[7] This increased state activity ushered in a "second wave" of state GHG target adoption coinciding with the Paris Agreement era (Glasgow, Zhao, and Rai 2021), which is analyzed in this thesis. A diverse group of over 20 states adopted GHG targets, as shown in Table A.6 in the Appendix.

2.4.6. The second period of contested federalism and the first US NDC (2021-2025)

The election of President Joe Biden ushered in another pendulum swing in the US state-federal climate policy relationship. This period witnessed a reemergence of *contested federalism* with high state and federal climate policy activity, reminiscent of the state-to-federal dynamic during the Obama years.

President Biden recommitted the US to the Paris Agreement early in his presidency. The first official US NDC was submitted on Earth Day (April 22), 2021. It reflected the country's commitment to achieve between 50 and 52 percent reductions in net greenhouse gas emissions from 2005 levels by 2030. Biden recommitted to cooperation on the international stage, seeking to establish the US as a climate leader amid high levels of partisan polarization in the capital. Most recently, during the "lame duck" period after the November 2024 election, President Biden

[7] The USCA has persisted during the presidency of Joe Biden despite the current President's recommitment to the Paris Agreement. The alliance's capacity to compensate for federal government inaction on and antagonism toward climate policymaking will be tested again throughout President-elect Trump's second term from 2025-2029.

submitted the US NDC "3.0," committing the country to 61 to 66 percent reductions from 2005 levels by 2035 (United Nations Framework Convention on Climate Change 2025).

This period was ultimately one of substantial US federal level climate policymaking. Biden took unilateral executive actions to regulate emissions from power plants and vehicles that built upon the path set by his Democratic predecessor, Barack Obama. These were again resisted by oppositional states, while being integrated into the policy efforts of subnational climate policy leaders (Wang and Mei 2024). President Biden signed into law the Infrastructure Investment and Jobs Act (IIJA) (also known as the Bipartisan Infrastructure Law) on November 15, 2021, and a budget reconciliation measure known as the Inflation Reduction Act (IRA) on August 16, 2022 (Murray and Monast 2024). These made unprecedented investments in clean energy and GHG reduction measures across the country.

During this period, many states continued to engage in active GHG regulation strategies. Leading states adopted statewide cap and trade regulations, GHG targets, renewable portfolio standards, and zero or low-emissions vehicle standards (Pappas 2024). Byrne, Taminiau, and Nyangon (2022) identify this as a continuation of a wave of state-led policymaking to prevent national US climate policy "destruction" that began as the Paris Agreement era started to emerge. States continued to adopt and update GHG reduction targets, with several designed to mirror the US NDC for 2030 and a goal of reaching net zero emissions by 2050. These eight instances of GHG target adoption are shown in Table A.7 in the Appendix.

2.4.7. Where to, now?

The meandering path of multilevel governance in the US federal system justifies close attention to why some states have adopted GHG targets in the Paris Agreement era, and why others have not. The predominant approach of international climate policy since the Paris Agreement is distinct for its bottom-up approach, voluntarism, and flexible coordination. It also overlaps closely with the "Trump era" of US politics, which has led states to renew their commitments to climate leadership as warnings from scientists – and impacts on the ground – become increasingly dire (Bomberg 2017). Now, the country is likely headed for another period of state domination of climate policymaking in the final years it has to achieve its NDC target for 2030. The purpose of this thesis is to understand why states have adopted GHG targets during the current Paris Agreement era of international, multilevel climate governance.

3. Theory and hypotheses

3.1. The role of institutions, interests, and ideas in driving GHG target adoption

As we have seen, climate change mitigation has increasingly become a focus of subnational governance in the US, where many states have adopted their own GHG targets. Structural factors that shape climate governance include material endowments, political systems and control, and ideas, values, and belief systems (Dubash et al. 2022). These concepts fit nicely into the "3Is framework" of institutions, interests, and ideas often used by scholars to categorize and assess causal influences on climate governance choices (Baker 2023; Lamb and Minx 2020; Wagner and Lima 2024).

In this section, I review literature identifying factors that may influence state adoption of GHG targets. I focus on key institutions, interests, and ideas that influence GHG target (non) adoption. I then introduce hypotheses that emphasize the causal complexity and asymmetry inherent in climate policy adoption behavior. Specifically, hypotheses identify ways in which institutional, interest-based, and ideational conditions may combine to be sufficient or necessary to lead to state GHG target adoption.

Institutions

Institutions are arrangements that structure political interactions and social relationships (Frieden, Lake, and Schultz 2022; Hall 2009). They include formal political structures and organizations that promote shared rules and norms. Those with power to shape institutions play a key role in influencing political behavior. Party control and shared membership in an institution dedicated to state climate policy reflect important political-institutional drivers of GHG target adoption.

Party control

Party control of legislative institutions represents a key influence on whether states adopt GHG targets, as parties reflect different value systems and agendas. Knill et al. (2010) find that party matters across countries: as national parties incorporate environmental priorities into their platforms, policy adoption increased. Scholars have often found that "left-leaning" parties may be more prone to adopt climate policies (Garmann 2014; Neumayer 2003; Tobin 2017). This tendency may stem from these parties' greater propensity to support interventionist policies that are required to sharply reduce GHG emissions (Schulze 2021).

Tsebelis (1995) notes that partisanship reflected in legislative bodies plays an important role as "partisan veto players" can influence agenda-setting and policy adoption behavior. This effect is pronounced as partisan polarization on climate change seems to have intensified in certain contexts, particularly Anglophone countries and Western Europe (Caldwell, Cohen, and Vivyan 2024). US policymaking elites exhibit particularly high levels of polarization (Brulle, Carmichael, and Jenkins 2012), where there is now a stark divide between the Democratic party, which has increasingly prioritized climate action, and the Republican party, which has often embraced climate denial and delay (Basseches et al. 2022).

State-level analyses in the US confirm that Democratic partisanship is strongly associated with higher levels of climate policy adoption (Bromley-Trujillo and Poe 2020; Trachtman 2020). Glasgow, Zhao, and Rai (2021) find Democratic control of the legislature to be a statistically significant predictor of GHG target adoption during the "first wave" of state domination in the early 2000s. Moreover, the predictive power of partisanship on climate policy outputs seems to have grown over time, driven by increasing polarization since the 2016 presidential election of Donald Trump (Bromley-Trujillo and Holman 2020; Dunlap, McCright, and Yarosh 2016; McCright and Dunlap 2011).

This thesis accordingly acknowledges that party control of a majority of state legislative institutions exerts great influence on whether states adopt GHG targets, both in terms of policy priorities and institutional structure. Deep partisan polarization surrounding climate change identified in recent state climate policy literature serves to increase the influence of party control on climate policy adoption. Specifically, Democratic control of state legislative institutions has likely driven GHG target adoption in the post-Paris Agreement era of US climate politics. I expect majority Democratic party control of state legislative institutions to contribute to state adoption of GHG targets.

USCA Membership

Shared participation in inter-jurisdictional institutions fosters policy adoption by promoting policy learning and imitation (Berry and Berry 2007). Holzinger and Knill (2005) find that these organizations play a vital role in facilitating such interactions. At the international level, Spilker (2012) finds that countries' memberships in intergovernmental organizations are associated with reduced GHG emissions. Tews, Busch, and Jörgens (2003) highlight how international platforms promote the transnational spread of environmental policies by setting agendas and fostering imitation. Kammerer and Namhata (2018) find climate policy adoption behavior to be significantly influenced by countries' shared cooperative activities, which may increase social pressure on policymakers. This dynamic also exists within subnational networks. Hakelberg (2014) identifies participation in transnational municipal networks as a strong predictor of local climate policy adoption.

Shared membership in organizations like the United States Climate Alliance (USCA) provide state policymakers with institutionalized opportunities for peers to learn from and emulate each other's climate policies, including GHG targets. The USCA was founded in June 2017 by the governors of California, New York, and Washington in response to President Donald Trump's attempted withdrawal from the Paris Agreement. The mission of the USCA today is to reduce "collective net greenhouse gas emissions at least 26-28% by 2025, 50-52% by 2030, and 61-66% by 2035, all below 2005 levels, and collectively achieving overall net-zero GHG emissions as soon as practicable, and no later than 2050," (U.S. Climate Alliance 2025). This makes the USCA an example of compensatory federalism directed at achieving the US NDC. It now includes the governors of 24 states and territories. Governors' membership in the USCA should encourage state GHG target adoption by fostering institutionalized climate policy collaboration and accountability among members. I expect state gubernatorial membership in the USCA to contribute to state adoption of GHG targets.

Ideas

Public opinion

Ideas reflect individual and group values, and include public perceptions of climate change, ideology, and public opinion (Wagner and Lima 2024). Democratic theory of electoral politics – where responding to the policy preferences of the public is considered a central concern (Wlezien and Soroka 2009) – provides reason to believe high levels of public concern about global warming increases the likelihood of climate policy adoption. In representative democracies like the US, elected policymakers are accountable to constituencies whose policy preferences should influence policy outputs. Public opinion thus likely plays an important role in motivating political leaders to adopt climate policies.

There is evidence for the impact of public opinion on climate policy adoption. Anderson et al. (2017) link public environmental priorities to renewable energy policy outputs across European countries. At the other end of the multilevel governance spectrum, public support has been found to be the strongest determinant of climate policy adoption in cities (Yeganeh, McCoy, and Schenk 2020). Yet, public preferences for specific and potentially costly climate policy instruments, such as carbon taxes or other regulations, is less clearly linked to concern about the problem generally (Fairbrother 2022). GHG targets, as one of many potential climate policy outputs, may represent a more direct response to public concerns about global warming per se while relegating the discussion of immediate trade-offs to debates over specific policy instruments.

State-level studies also provide evidence that public opinion plays a role in subnational climate policy adoption. Matisoff (2008) found public concern about climate change to be a strong predictor of state climate policy adoption, a finding later corroborated by Bromley-Trujillo and Holman (2020). Recent research has emphasized the interplay between public concern about global warming and issue salience (Bromley-Trujillo and Poe 2020; Schwörer 2024). In other words, the likelihood of policy adoption depends not only on general concern but also whether its top-of-mind for voters and political elites. I expect majority state-level public support for more state policy action on global warming to contribute to state adoption of GHG targets.

Interests

Interests reflect preferences and power of actors (Shearer et al. 2016) and can include different distributions of costs and benefits of policy choices in society (Hughes and Urpelainen 2015). State dependence on fossil fuels and wealth represent interests that likely influence state GHG target adoption behavior.

Fossil fuel dependence

State dependence on fossil fuel production represents a powerful interest-based condition affecting GHG target adoption. High levels of state dependence on fossil fuel production may represent a conflict of interests: mitigating climate change could come at a higher cost for states that extract and supply fossil fuel resources. While it could theoretically motivate states to adopt GHG targets to reduce pervasive GHG emissions in their state (Glasgow, Zhao, and Rai 2021), fossil fuel dependence is normally considered to be a potent obstacle to climate policy adoption (Matisoff 2008). States abundant in these resources benefit from local energy production and distribution while exports to other jurisdictions generate economic growth. They therefore face economic and political challenges in transitioning away from these industries, including resistance from vested interests and fiscal pressures. Indeed, meeting the Paris Agreement global temperature goals necessitates a transition away from an energy system dominated by fossil fuels (Roemer and Haggerty 2022). Lamb and Minx (2020) note that climate policy may pose an existential threat to fossil fuel interests.

Dependence on fossil fuel resources has been shown to constrain climate policy adoption. In extending the concept of the "resource curse," Tadadjeu, Njangang, and Woldemichael (2023) find evidence that – while countries receiving substantial oil rents may in theory support funding streams that could be directed toward climate policies – their very dependence on these resources represents a major obstacle in practice. Combining fossil fuel exports, subsidies, and share of electricity generation, Baker (2023) finds that fossil fuel dependency is a powerful obstacle to climate policy harmonization and ambition. Lamb and Minx (2020) also find fossil fuel extraction to inhibit climate policy adoption. Ide (2020) provides evidence that dependence on fossil fuels for energy generation is a strong predictor of insufficient climate policies.

This effect is borne out in research on US state climate policies. In the US, burning fossil fuels accounts for roughly 74 percent of total GHG emissions and 93 percent of total anthropogenic CO_2 emissions (U.S. Energy Information Administration 2025). Yet fossil fuels are unevenly distributed geographically, with 21 states dominating fossil fuel production (Raimi et al. 2023). Assessing the first wave of state adoption of GHG targets in the early 2000s, Glasgow, Zhao, and Rai (2021) find coal production to reduce the likelihood that states adopt a GHG target. Karapin (2016) finds that fossil fuel production per state GDP significantly influences the strength of states' climate policy mix, on net. Stokes (2020) highlights that fossil fuel interests are represented in advocacy coalitions operating across in US states that are highly effective in resisting the swift transition away from polluting energy sources. An organized countermovement of industry interest groups, think tanks, and political coalitions aligned with the fossil fuel industry has emerged as a potent obstacle to climate action in the US and elsewhere over the past several decades, further accentuating this dynamic in fossil fuel dependent states (Brulle 2021).

Recent work by Raimi et al. (2023) to assess states' fiscal dependence on fossil fuel resources identifies 21 states that in 2019, together with federal and tribal lands, accounted for 99.8, 99.5, and 97.3 percent of US oil, natural gas, and coal production, respectively. This dichotomous qualitative distinction distinguishes states that are directly dependent on fossil fuel production in their jurisdiction. I expect state dependence on fossil fuel production to contribute to state non-adoption of GHG targets.

Wealth

Financial capacity may enhance public and policymaker interest in climate mitigation. Post-materialist theory suggests that as societies become wealthier, they are more likely to prioritize environmental issues over immediate material needs (Karapin 2016). Relatedly, the "environmental Kuznets curve" hypothesis suggests that pollution levels initially rise with industrialization but eventually decline as nations transition to advanced economies with cleaner technologies and higher environmental awareness (Mania 2020). Further, jurisdictions with greater wealth are often deemed to have a higher moral responsibility to address climate change (Anderson, Bernauer, and Balietti 2017). Klebl and Jetten (2023) find that perceptions of national wealth can enhance public support for climate action by fostering a sense of moral obligation to mitigate a global problem.

While these concepts are most often applied at the international level, they may also hold for subnational units within the US, where states exhibit divergent levels of wealth amid the country's high overall level of economic development. The US is the largest historical polluter of climate-warming GHGs and a wealthy country. Particularly wealthy states within the US may therefore be the subnational entities best suited to adopting GHG targets, globally. Following this line of reasoning, scholars focusing on US state environmental policy regularly assess the impact of relative levels of state wealth or income on policy outputs (Zhang et al. 2024). Matisoff (2008) suggests that wealthier states are better able to experiment with and invest in mitigation measures that lead to benefits accruing over time.

There is empirical support for the link between relative wealth and climate policy internationally and at the subnational level. Tobin (2017) finds evidence that relative wealth is a contributory condition for higher climate policy ambition among developed countries. Bromley-Trujillo et al. (2016) identify per capita income as a statistically significant predictor of various state climate policies, including GHG reduction targets. Further, Chandler (2009) finds state wealth and government ideology to be the most powerful predictors of renewable portfolio standard adoption. Zhang et al. (2024) find state income to be positively associated with state climate policy adoption. Berry, Laird, and Stefes (2015) find that states with a more liberal and wealthier public to be more likely to adopt renewable energy policies.

State wealth may thus shape the political, moral, and economic calculus around GHG target adoption. Less wealthy states are more likely to resist ambitious targets due to the perceived cost of transition compared to their peers. Wealthier states may perceive less risk from economic disruption, making them more interested in and able to adopt climate policy innovations needed to meet GHG targets. They are likely better equipped to adopt GHG targets if the political will is present to do so. Further, wealthier states may exhibit more post-materialist tendencies in an already wealthy country and be willing to do their "fair share" to combat global climate change. I expect relative state wealth to contribute to state adoption of GHG targets.

3.2. Hypotheses

Through my review of the literature on why governments adopt GHG targets and related public policies, I have identified five conditions that are likely to influence state GHG target adoption. The influence of *institutions* is captured by party control of legislative institutions and membership in a prominent inter-jurisdictional climate organization. The influence of *ideas* is captured by public opinion on state climate change policy. The influence of *interests* is captured by state dependence on fossil fuel production and wealth.

Each condition is likely to contribute to GHG target adoption in a certain way, *ceteris paribus*. Yet climate policy adoption behavior is characterized by complex and asymmetric causality, where interdependent factors interact. The theoretical development above thus forms the basis for five hypotheses implicating such causality. The hypotheses are explicitly based on set theoretic relationships between conditions and the outcome of interest that are sometimes left underspecified in social science research (Ragin 2008). Specifically, the hypotheses consider which combinations of conditions (hereafter: “configurations” or causal “recipes”) represent ideal-typical archetypes driving states to (not) adopt GHG targets, which minimal configurations are likely sufficient to lead states to (not) adopt GHG targets, and which conditions may be necessary for states to adopt GHG targets.

3.2.1. Hypotheses for “archetypal” configurations

Archetypal configurations represent ideal-typical causal recipes that should altogether promote or inhibit state adoption of GHG targets (*TARGET*). I propose two opposing archetypes and associated hypotheses below, which serve as useful bases for cross-case comparison. The first two hypotheses suppose that archetypal configurations should always lead either to state adoption or non-adoption of GHG targets.

Archetype 1: States most likely to adopt GHG targets (*TARGET*)

The first archetype represents a state that is theoretically most likely to adopt a GHG target. This state:

1. Has a governor who is a member of the USCA (*USCA*)
2. Exhibits majority Democratic party control of legislative institutions (*PARTY*)
3. Has majority public support for more gubernatorial action on global warming (*PUBLIC*)
4. Is relatively wealthy (*WEALTH*)
5. Is not a significant fossil fuel producer (*~FOSSIL*)

This configuration is denoted using Boolean algebraic notation as:

PARTY USCA*PUBLIC*~FOSSIL* WEALTH*[8]

The first hypothesis is expressed in words and using Boolean notation as:

H1: States that satisfy all elements of the first archetypal configuration should always adopt GHG targets.

H1: PARTY USCA*PUBLIC*~FOSSIL* WEALTH ⇒ TARGET*

The exact inverse of this is the second archetypal configuration, presented below.

[8] * denotes “and,” + denotes “or,” and ~ denotes “not” (or set negation).

Archetype 2: states most likely to *not* adopt GHG targets (~*TARGET*)

The second archetypal configuration represents a state that is theoretically most likely to *not* adopt a GHG target. This state:

1. Has a governor that is not a member of the USCA (~*USCA*)
2. Exhibits majority Republican control of legislative institutions (~*PARTY*)
3. Has only minority public support for more gubernatorial action on global warming (~*PUBLIC*)
4. Is not relatively wealthy (~*WEALTH*)
5. Is a significant fossil fuel producer (*FOSSIL*)

The second hypothesis is:

H2: *States that satisfy all elements of the second archetypal configuration should never adopt GHG targets.*

H2: ~PARTY~USCA*~PUBLIC*FOSSIL*~WEALTH ⇒ ~TARGET*

3.2.2. Hypotheses for sufficient conditions

While the causal conditions and archetypal configurations reflect the (combined) directional influence that individual conditions are expected to have on the likelihood of GHG target adoption, a more nuanced and asymmetric theoretical approach is justified. Not all states will fit neatly into archetypal configurations or satisfy every condition that theoretically contributes to a specific outcome.

Even non-archetypal configurations, while not completely aligned in either direction, may still prove sufficient to produce the outcome of GHG target (non) adoption. This thesis seeks to identify which non-archetypal configurations are sufficient to explain the adoption or non-adoption of GHG targets. Accordingly, I propose two hypotheses that posit specific, limited configuration of institutions, interests, and ideas as sufficient to lead to state (non) adoption of GHG targets.

Political-institutional factors – including institutions such as USCA membership and party control – play a particularly prominent role in shaping climate policy adoption in US states. USCA membership signals a state governor's explicit commitment to aligning state climate policy with the US NDC under the Paris Agreement. Yet the degree to which this collective commitment translates into concrete state-level GHG targets varies. Democratic majority control of legislative institutions may enhance the likelihood of turning this collective commitment into state-level GHG targets.

Despite the significant influence of institutional conditions, overcoming policy inertia in representative democracies often requires majority public support. Moreover, favorable configurations of institutions and ideas may need to be facilitated by another contributory condition – lack of fossil fuel dependency or high levels of relative wealth – to lead to GHG target adoption. Building on this reasoning, the third hypothesis is:

H3: The combination of USCA membership, majority Democratic party control of legislative institutions, and majority public support is sufficient to lead states to adopt GHG targets if another contributory interest-based condition – lack of fossil fuel dependency or relatively high levels of wealth – is present.

*H3: PARTY*USCA*PUBLIC*(~FOSSIL+WEALTH) ⇒ TARGET*

Conversely, the pronounced role of political-institutional factors and partisan veto points identified in the literature provides cause to suspect an asymmetric relationship. Specifically, institutional conditions aligned against GHG target adoption may prove sufficient on their own to prevent GHG target adoption. I hypothesize that governors' non-membership in the USCA and Republican party control is sufficient to explain GHG target non-adoption. The fourth hypothesis is:

H4: The combination of USCA non-membership and majority Republican party control of legislative institutions is sufficient *to lead states not to adopt GHG targets.*

H4: ~PARTY~USCA ⇒ ~TARGET*

By emphasizing the primacy of political-institutional factors and ideas, I argue that the interests assessed here are insufficient on their own to explain GHG target adoption. In other words, interests are non-deterministic amid more powerful conditions. These interests and ideas should nonetheless support GHG target adoption if other core conditions are met.

3.2.3. Hypothesis for necessary conditions

The first four hypotheses consider which causal recipes consistently lead to state GHG target (non) adoption. The final hypothesis considers which, if any, conditions are necessary to produce the outcome. Necessary conditions are (virtually) always present when an outcome occurs (Ragin 2008). Majority public support is likely required to generate the political will needed to adopt a GHG target but may be insufficient on its own. I hypothesize that states adopt GHG targets only if there is majority public support (*PUBLIC*). The fifth hypothesis is:

H5: Public support is a necessary condition *for GHG target adoption.*

H5: PUBLIC ← TARGET

In testing some determinants of GHG targets, I exclude others. However, I do not argue that other factors are irrelevant. Instead, I follow Potoski and Woods' (2002) suggestion that distinct environmental policies (e.g. state GHG targets) may have distinct sets of empirical determinants. Rather than deriving a perfectly specified model which considers all potentially impactful variables, I seek to derive parsimonious explanation for whether a certain set of factors reliably explains state GHG target adoption behavior.

I elaborate more causally complex hypothesis than traditionally employed in covariational reasoning. This is in part a response to the longstanding critique that US state environmental policy research has been characterized by "the too-often repeated testing of bivariate hypotheses, such as the effects of problem severity, state wealth, partisanship, and institutional capacity on state environmental policy outputs" (Lester 1994, p. 696). Revisiting this critique almost three decades later, Woods (2021) notes that similar predictor variables are still routinely analyzed in isolation, calling for greater attention to the conditions under which factors or combinations of factors drive policy adoption. He specifically suggests that "more work is necessary to understand the conditions under which particular predictors… would be expected to be more or less important" (Ibid., 357). By adopting fsQCA to test more explicitly configurational hypotheses, I seek to respond to this critique.

4. Data and methods

States have been central to climate mitigation efforts in the US, where national policies have been conspicuously inadequate. But only about half of states have adopted their own GHG targets in the Paris Agreement era. The purpose of this research is to find an explanation for this divergence. In this chapter, I first provide a summary of cases analyzed in this research. I then provide a primer on fuzzy-set Qualitative Comparative Analysis (fsQCA) as a relatively nascent methodological approach which is well-suited to this research. I then explain how fsQCA is operationalized through data calibration then by separate analyses of necessity and sufficiency.

4.1. Case selection: US state GHG targets

Every US state represents a case in the analysis. Table A.1 in the Appendix summarizes basic information on each state's GHG target (or lack thereof) used as the outcome in this thesis. Importantly, all US states that currently maintain an economy-wide GHG target adopted a target during the period examined here. I exclude non-state territories as they are categorically distinct from states in terms of their rights and authority under the federal construct. These include American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, Puerto Rico, the US Virgin Islands, and Washington, D.C. They are not the *constituent units* of federations described by Fenna et al. (2023a) in their seminal book on climate governance under federalism. Including non-state territories could complicate international comparison.

4.2. Fuzzy-set qualitative comparative analysis (fsQCA)

I employ fuzzy-set qualitative comparative analysis (fsQCA) to explore how institutions, interests, and ideas combine to influence state (non) adoption of GHG targets. QCA approaches are increasingly popular in social scientific research for their ability to disentangle complex causal relationships between multiple conditions (independent variables) and an outcome (dependent variable) of interest (Rihoux and Ragin 2009). Proponents of QCA suggest that it balances the key benefits of quantitative and qualitative methods, respectively: generalizability and complexity (Ragin 1987). Specifically, QCA leverages formalized procedures grounded in Boolean logic and set theory to assess which causal recipes may be sufficient or necessary for an outcome to occur (Rihoux and Ragin 2009; Schneider and Wagemann 2012). This is highly compatible with the hypotheses developed above.

QCA involves taking a logical approach that is distinct from covariational reasoning and is particularly well-suited to answering the research question and hypotheses posed in this thesis. A central feature of this is *multiple conjectural causation*, which holds that (1) outcomes are normally influenced by a combination of causally relevant, interdependent conditions, rather than isolated, independent conditions (2) a condition, depending on the context, may have divergent effects on the outcome (known as *multifinality*) and (3) it is possible for more than one distinct combination of conditions to lead to the same outcome (known as *equifinality*) (Fischer and Maggetti 2017). Berg-Schlosser et al. (2009, 8) emphasize that this way of reasoning "runs completely against key assumptions on which mainstream statistical techniques rest" such as *additivity,* whereby "a given factor is assumed to have the same incremental effect on the outcome across all cases, regardless of the values of other causally relevant conditions."

QCA entails a systematic comparison across cases that preserves holistic accounts of each case. In this way, QCA is "case-centric" by design, helping to identify interesting cases for further study while avoiding "netting away" exceptional cases (Schneider and Wagemann 2012). Because of its case-centric orientation, I use fsQCA as an intermediate test of my hypotheses before qualitatively evaluating within- and between-case variation in more depth.

4.3. Data collection and calibration

I first collect data on conditions that should contribute to the presence or absence of the outcome. For this thesis, my outcome of interest is dichotomous: did a state adopt a GHG target (*TARGET*) or not (*~TARGET*)? The causal conditions that should lead to the outcome represent institutions, interests, and ideas that may contribute to state GHG target adoption. Raw data for each case is presented in Table A.2. in the Appendix. Each condition, the outcome, data sources, and calibrated values are summarized in Table 2, and described in more detail below.

Once raw data is collected, the outcome and conditions must be qualitatively calibrated based on theoretical knowledge and/or the structure of the data (Schneider and Wagemann 2012). This form of standardization requires iteration between theoretical insights that drive how a given condition is defined and represented by available data (Ragin 2008). Cases' set membership in each condition as well as the outcome is calibrated along a scale ranging from 0 to 1, where 0 represents full non-membership in a set, and 1 represents full membership. The "cross-over point" (or value where membership is maximally ambiguous) is 0.5 (Ibid.). In contrast to traditional "crisp set" QCA, fuzzy set calibration is more granular, offering degrees of set membership. Calibration can be accomplished using either categorical levels of membership (most common are dichotomous, 4-value or 6-value sets) or using a continuous scale. I use a mix of approaches depending on the nature of the variable. Each case (US state) has a calibrated set membership score for each condition and outcome.

Table 2: FsQCA conditions and outcome

Role in QCA	**Variable Name**	**Description**	**Source**	**Values**
Outcome	TARGET	Did the state adopt an economy wide GHG reduction target in the Paris Agreement era, between 2016-2024?	State-specific primary documents, reflected in Table A.1 in the Appendix	0, 1
Institutions	PARTY	What percentage of legislative and executive branches of state government consist of majorities for the Democratic party, at the time the GHG target was adopted? If a target was not adopted, what percentage is reflected in the latest complete legislative session?	Archives from official state website for executive and legislative branches	0, 0.33, 0.67, 1
	USCA	Was the state a member of the US Climate Alliance at the time the target was (not) adopted?	United States Climate Alliance website; media reports	0, 1
Ideas	PUBLIC	What percentage of citizens are estimated to respond "more" or "much more" when asked: "Do you think your governor should do more or less to address global warming"?	Yale Program on Climate Change Communication (2023)	0-1
Interests	FOSSIL	Is the state a major fossil fuel producer?	Resources for the Future (RFF) report: "The Fiscal Implications of the U.S. Transition Away from Fossil Fuels" (Raimi et al 2023)	0, 1
	WEALTH	State GDP (SDP) per capita.	US Bureau of Economic Analysis (BEA) state GDP estimates; US Census Bureau population estimates	0-1

Table 2: FsQCA conditions, outcome, data sources, and calibrated values

Outcome (*TARGET*) calibration

The outcome (*TARGET*) is calibrated as a crisp-set, dichotomous outcome. I collect this data using state-specific primary documents reflected in Table A.1 in the Appendix and refer to other official documentation confirming the existence of state GHG targets. States with a score of 1 adopted a GHG target since the Paris Agreement was signed in December 2015. This includes all states with an active GHG target, and one (Louisiana) with a target that is no longer active. States with a score of 0 have not adopted a target since the Paris Agreement was signed and do not have an active GHG target.

Party control (*PARTY*) calibration

The *PARTY* condition measures the percentage of relevant legislative institutions in which the Democratic party has majority control. For states that adopted GHG targets, set membership scores are based on the legislative session in which the target was adopted. For states that did not adopt GHG targets, it is based on the latest complete legislative session. I manually compile this data on party control using official state websites of the executive branch (governor) and legislature (house and senate) of each state.

All state executive branches are led by a governor. Almost every state has a bicameral legislature, with upper (senate) and lower (house) chambers. There are therefore normally three legislatively relevant bodies, and consequently four possible set membership scores: 1, 0.67, 0.33, and 0. A state has a score of 1 if Democrats held a majority in all chambers of the legislature and governorship. A score of 0.67 reflects Democratic control of either the entire legislature, or one of two legislative chambers and the governorship.[9] A score of 0.33 reflects Democratic control of only one of the two legislative chambers or the governorship. Finally, states have fuzzy set scores of 0 if Republicans controlled all chambers of the legislature and the governorship.

United States Climate Alliance (*USCA*) calibration

The *USCA* condition reflects whether a state's governor was a member of the USCA at the time of (non) adoption, using binary values. I collect data on USCA membership using the website and media reports of new memberships (as well as departures). A state that adopted a GHG target has a membership score of 0 in *USCA* if the governor was not a member of the USCA when it adopted its GHG target. In contrast, such a state has a score of 1 if the governor was a member of the USCA when it adopted its GHG target. States that did not adopt a GHG target have a score of 0 if their governor is not currently a member of the USCA, and a score of 1 if their governor is currently a member.

Public opinion (*PUBLIC*) calibration

The *PUBLIC* condition is based on the percentage of the state population who think their governor should be doing "more" or "much more" to address global warming. Estimates are taken from data retrieved by request from the Yale Program on Climate Change Communication's Climate Opinion Maps 2023 Project (Yale Program on Climate Change Communication 2023). For each

[9] Nebraska (NE) is the only state with a unicameral legislature. In such an exceptional case, divided government would be reflected with a calibrated score "in favor" of the legislature, so that Democratic control of the legislature with Republican governor would be scored 0.67. No procedural adjustment is necessary, however, because Republicans control both the governorship and the legislature in Nebraska.

state, I use the average estimated value from 2015 until the year that a state adopted its GHG target, if applicable. For states with no target, I use the average value from 2015 through 2023.

I use continuous calibration since percentages are continuous by nature. The threshold for full membership is set at 54 percent, which is the rounded mean of all cases and reflects a solid majority opinion. I follow Baker (2023) in setting the crossover threshold at 51 percent. The threshold for full non-membership is set at 50 percent. This means that states in which only a minority of citizens believe their governor should do more to address global warming are fully out of the set.

Fossil fuel dependency (*FOSSIL*) calibration

The *FOSSIL* condition represents states that are considered major fossil fuel producers. I use Resources for the Future's list of 21 states which were responsible for the bulk of US oil, natural gas, and coal production from 2015 to 2020 as a dichotomous variable defining major fossil fuel producing states (Raimi et al. 2023). States with a score of 1 are thought to have exceptionally high levels of political and economic dependence on fossil fuel resources, whereas states with a score of 0 are not.

Wealth (*WEALTH*) calibration

The *WEALTH* condition reflects gross state product (GSP) per capita. I calculate this using the US Bureau of Economic Analysis (BEA) data on states' GSP and the US Census Bureau's population estimates. For states that adopted a GHG target, I use the average value from 2015 until the year in which the target was adopted. For states that did not adopt a target, I use the average value from 2015-2023. GSP per capita should better capture a state's overall comparative economic capacity (Matisoff 2008) than measures used elsewhere such as median income (see for example Glasgow, Zhao, and Rai 2021) because of its inherent implication of statewide economic activity.

As with public opinion, I employ continuous calibration for the state wealth indicator. North Dakota, Delaware, Massachusetts, and New York have exceptionally high GSP per capita at over $80,000; the next highest are Alaska and Connecticut (at $76,802 and $75,459 respectively). I use $75,000 as the threshold for full membership in the set of wealthy states. The rounded mean value of all states, to the nearest thousand – $60,000 – is used as the crossover threshold. Mississippi has a notably lower GSP per capita (at $40,595) than other states. The next lowest is West Virginia, at $45,549. I use $46,000 as the threshold for full non-membership.

The result of the entire calibration procedure is presented in Table A.3 in the Appendix, and in map form in Figure 1. The raw state GDP and public opinion data, as well as the outcome of my manual coding procedure for the other conditions, is included in Table A.2 in the Appendix.

Figure 1: Calibrated case values for conditions and outcome

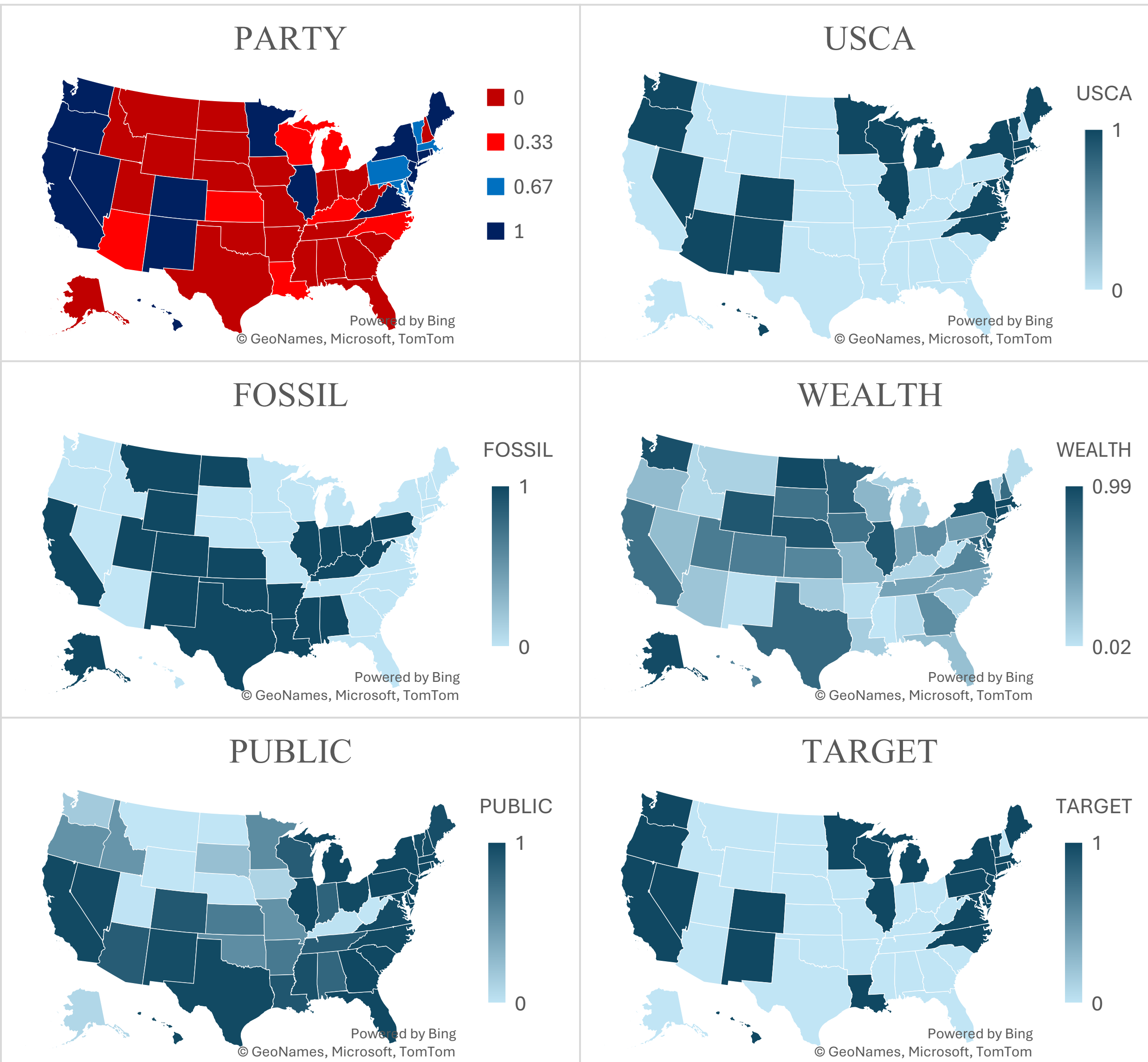

Figure 1: Calibrated case values for conditions and outcome

4.4. Analyzing necessity and sufficiency with fsQCA

Once scores are calibrated, I conduct fsQCA analysis using the fs/QCA software (version 4.1) developed by Ragin and Davey (2023). I use the accompanying manual to guide my analysis (Ragin 2017). The first step in fsQCA is to assess whether there are any conditions that are necessary to produce the outcome (*TARGET*) or non-outcome (~*TARGET*), respectively. For conditions to be considered necessary, they must be present in (virtually) all instances of an outcome (Braunschweiger and Ingold 2023). Analysis of necessity involves a simple assessment of the degree of set overlap between each condition and the (non) outcome. The second step is to assess whether any configurations are sufficient to explain the (non) outcome. Sufficient configurations (virtually) always lead to the outcome. The goal of sufficiency analysis is to find the shortest logical expression of configurations (or the *solution*) sufficient to produce the (non) outcome (Ragin 2008).

In the language of set theory, necessary conditions are therefore *supersets* of the outcome, whereas sufficient configurations are *subsets* of the outcome. A simple depiction of the logic of necessity and sufficiency in fsQCA is presented in Figure 2 and Figure 3 below.

Figure 2: Necessity

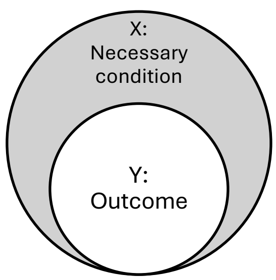

Figure 2: X ← Y: X is a necessary condition for Y
X ≥ Y: X is a superset of Y

Figure 3: Sufficiency

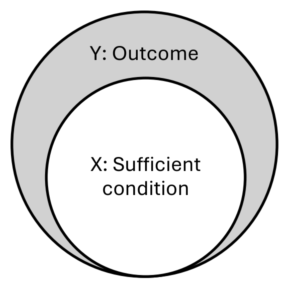

Figure 3: X→Y: X is a sufficient condition for Y
X ≤ Y: X is a subset of Y

QCA illuminates asymmetric causal effects: conditions and/or configurations that lead to the presence of an outcome may not symmetrically explain its absence (Ragin 2008). This is why analyses for the presence (*TARGET*) and absence (*~TARGET*) of the outcome is conducted separately.

5. Results

5.1. Analysis of necessity

I first assess whether any conditions may be considered necessary for the outcome (*TARGET*) or non-outcome (*~TARGET*) to occur. The results from the two separate analyses of necessity are presented together in Table 3.

Table 3: Analysis of necessity

	Outcome: TARGET			**Outcome: ~TARGET**		
Condition	Consistency	Coverage	Relevance (RoN)	Consistency	Coverage	Relevance (RoN)
PARTY	0.83*	0.95**	0.97**	0.04	0.05	0.59
~PARTY	0.17	0.14	0.46	0.96**	0.86*	0.84*
USCA	0.89*	0.94**	0.95**	0.05	0.06	0.56
~USCA	0.11	0.10	0.48	0.95**	0.90**	0.89*
PUBLIC	0.91**	0.61	0.51	0.53	0.39	0.40
~PUBLIC	0.09	0.15	0.74	0.47	0.85	0.94
FOSSIL	0.25	0.29	0.66	0.58	0.71	0.83
~FOSSIL	0.75	0.62	0.66	0.42	0.38	0.54
WEALTH	0.57	0.54	0.68	0.45	0.46	0.65
~WEALTH	0.43	0.42	0.64	0.55	0.58	0.71

Table 3: Consistency scores above the necessity threshold of 0.9 are indicated with two asterisks (**), and those between a threshold of 0.8 and 0.9 with one asterisk (*). High coverage and relevance of necessity (RoN) scores are marked similarly if a condition meets the consistency threshold for necessity.

Consistency scores in the analysis of necessity indicate the degree to which the outcome is a subset of the condition (Schneider and Wagemann 2012). High consistency scores indicate necessary conditions. The consistency threshold for necessity, which is rarely reached in social sciences, is normally set to 0.9 (Tobin 2017). *Coverage* reflects the degree to which an instance of the condition is associated with the outcome, quantifying its empirical relevance (Rihoux and Ragin 2009). High coverage scores indicate significant set overlap between a condition and the outcome. Generally, coverage should only be analyzed if consistency thresholds are met (Ragin 2008). Relevance of necessity (RoN) is another measure of fit introduced by Scheider and Wagemann (2012), which quantifies the degree to which necessary conditions are trivial or relevant (Cooper and Glaesser 2016).[10] Thus, while consistency is a direct indicator of whether a configuration is

[10] The formula for calculating RoN is $SUM(1-X_i) / SUM(1-MIN(X_i, Y_i))$, where X_i is case i's set membership in condition X, and Y_i is its set membership in the outcome Y.

necessary for an outcome to occur, coverage and RoN are ways of measuring the condition's empirical importance in explaining the outcome.

5.1.1. Necessary conditions for *TARGET*

In cases where states adopted GHG targets (*TARGET*), the consistency threshold for necessity was reached by *PUBLIC* with a consistency score of 0.91. High levels of public support for further gubernatorial action on global warming therefore may be considered a necessary condition for states to adopt GHG targets. However, the low coverage and relevance scores for *PUBLIC* (0.61, 0.51) show that there are also many instances in which there is majority public support for governors to take more action on global warming, but states did not adopt GHG targets.

USCA membership (*USCA*) and Democratic control of a majority of legislative institutions (*PARTY*) were close to reaching the necessity threshold at 0.89 and 0.83, respectively. *USCA* had high coverage and RoN scores (0.90 and 0.95). *PARTY* also had high coverage and RoN scores (0.95 and 0.97). The high coverage and RoN scores indicate empirical relevance. The two conditions nearly reach the threshold for being considered non-trivial necessary conditions.

5.1.2. Necessary conditions for *~TARGET*

In cases of the non-outcome (*~TARGET*), Republican party control of a majority of legislative institutions (*~PARTY*) and a governor's non-membership in the USCA (*~USCA*) reached the consistency threshold for necessity at 0.96 and 0.95, respectively. Both conditions have relatively high coverage (0.86 and 0.90) and RoN scores (0.84 and 0.89), indicating empirical relevance. These scores indicate that Republican control of at least two legislative institutions and governors' non-membership in the USCA are necessary conditions for states to *not* adopt GHG targets.

5.2. Analysis of sufficiency

I next identify configurations which are sufficient to consistently produce the outcome and non-outcome, respectively. Analysis of sufficiency proceeds through logical minimization, beginning with the construction of a "truth table" (Ragin 2008). Truth tables reflect every potential combination of conditions and outcomes, with a row for each. Thus, the number of truth table rows is 2^c, where c represents the number of conditions used for analysis.[11]

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[11] Practitioners often suggest that the number of possible configurations should roughly approximate the number of cases under scrutiny (Scheider and Wagemann 2012).

The truth table includes all 50 cases (US states) and 32 possible configurations of conditions. Each observed case is sorted into the row reflecting the case's set membership across all conditions.[12] Each row thus represents a unique configuration. Because truth tables reflect every *possible* configuration, they regularly include so-called "logical remainders" – configurations that are not observed in any of the empirical cases, reflecting limited diversity among cases (Ibid.).

A few intermediate steps are taken to simplify the truth table. The first is to remove configurations for which there are no (or very few) empirical cases. I set this frequency cutoff at N=1. I therefore do not exclude any empirically observed cases out-of-hand. The second step is to set a consistency threshold for including rows in the logical minimization process. While 0.75 is considered a minimum reasonable consistency threshold (Tobin 2017), setting it based on noticeable gaps in consistency may be best justified (Ragin 2008). I follow the latter approach and set my threshold for the presence of the outcome at 0.93 and absence at 0.82. Rows with consistency scores at or above these thresholds are used to find solutions via logical minimization. Those below the thresholds are not.

The truth table analyses for the outcome (*TARGET*) and non-outcome (*~TARGET*) are conducted separately. Table 4 presents the simplified truth table for *TARGET*, and Table 5 presents the simplified truth table for *~TARGET*. These are sorted in descending order by the frequency with which each configuration was observed (**N**). Of the 32 theoretically possible configurations, 15 were observed empirically. The 17 logical remainders are excluded from the tables below. Cases included in the analysis of sufficiency are shown with a value of 1 in the *TARGET* and *~TARGET* column in Table 4 and Table 5, respectively. Two cases represent logical contradictions, whereby configurations are subsets of both the outcome and non-outcome. These cases – Arizona (AZ) and Louisiana (LA) – are marked with asterisks in the truth tables and are discussed in more detail later.

[12] This is based on whether the calibrated set membership score is above or below the "crossover threshold," which is defined as a score of 0.5.

Table 4: Simplified truth table for the presence of the outcome (*TARGET*)

STATE	PARTY	USCA	PUBLIC	FOSSIL	WEALTH	N	TARGET	Consistency
NY, DE, HI, MN, NJ, MA, CT, VA, MD	1	1	1	0	1	9	1	0.98
MS, AR, OK, IN, AL, LA*	0	0	1	1	0	6	0	0.18
NV, RI, VT, OR, ME	1	1	1	0	0	5	1	0.95
ID, FL, MS, SC, TN	0	0	1	0	0	5	0	0.00
AZ*, WI, NC, MI	0	1	1	0	0	4	1	0.79
AK, ND, UT, WY	0	0	0	1	1	4	0	0.02
MT, KY, WV	0	0	0	1	0	3	0	0.20
IA, NE, SD	0	0	0	0	1	3	0	0.00
TX, KS, OH	0	0	1	1	1	3	0	0.13
GA, NH	0	0	1	0	1	2	0	0.00
CO, IL	1	1	1	1	1	2	1	1.00
WA	1	1	0	0	1	1	1	0.93
PA	1	0	1	1	0	1	0	0.77
NM	1	1	1	1	0	1	1	1.00
CA	1	0	1	1	1	1	0	0.77

Table 4: Simplified truth table for TARGET. Logical contradictions are marked with an asterisk (*).

Table 5: Simplified truth table for the absence of the outcome (*~TARGET*)

STATE	PARTY	USCA	PUBLIC	FOSSIL	WEALTH	N	~TARGET	Consistency
NY, DE, HI, MN, NJ, MA, CT, VA, MD	1	1	1	0	1	9	0	0.02
MS, AR, OK, IN, AL, LA*	0	0	1	1	0	6	1	0.82
NV, RI, VT, OR, ME	1	1	1	0	0	5	0	0.05
ID, FL, MS, SC, TN	0	0	1	0	0	5	1	1.00
AZ*, WI, NC, MI	0	1	1	0	0	4	0	0.21
AK, ND, UT, WY	0	0	0	1	1	4	1	0.98
MT, KY, WV	0	0	0	1	0	3	1	0.98
IA, NE, SD	0	0	0	0	1	3	1	1.00
TX, KS, OH	0	0	1	1	1	3	1	0.87
GA, NH	0	0	1	0	1	2	1	1.00
CO, IL	1	1	1	1	1	2	0	0.00
WA	1	1	0	0	1	1	0	0.70
PA	1	0	1	1	0	1	0	0.23
NM	1	1	1	1	0	1	0	0.00
CA	1	0	1	1	1	1	0	0.23

Table 5: Simplified truth table for ~TARGET. Logical contradictions are marked with an asterisk (*).

Consistency scores in the analysis of sufficiency indicate the degree to which the configuration is a subset of the outcome. High scores indicate that the outcome is (virtually) always present when the configuration is present (Cooper and Glaesser 2016). Logical contradictions reduce the consistency score in the analysis of sufficiency.

5.2.1. Solutions for sufficient configurations in QCA

I use the simplified truth table to derive *solution* terms. Solutions are attained through a minimization process that applies the principles of Boolean algebra to exclude logically redundant conditions (Ragin 2008). There are three possible solution types: *complex, parsimonious,* and *intermediate.* These differ in how they handle counterfactuals. Counterfactual analysis is essential for addressing limited diversity, as some logically possible configurations ("logical remainders," of which there were 17) remain unobserved (Ibid.). This analysis involves comparing observed empirical cases to imagined counterfactual cases and assessing their plausibility (Hicks, Misra, and Ng 1995).

Solution types exist along a continuum from most complex to least. At one end, *complex* solutions are the strictest in their treatment of counterfactuals. They exclude counterfactual cases from contributing to solution terms. At the other end, *parsimonious* solutions treat counterfactuals as "don't care" combinations, allowing them to take any outcome value that supports a simpler solution (Ragin 2008, 156). *Intermediate* solutions fall between these extremes and require specifying the directional influence a condition is expected to have on the outcome. Thus, the three solution types differ in the degree to which there must be empirical evidence – as well as theoretical cause to believe – that a particular condition contributes to a solution. Consequently, parsimonious solution terms are supersets of intermediate solutions, which are in turn supersets of the most complex solutions. A simple depiction of this nested relationship is provided in Figure 4 below.

Figure 4: Subset/superset relationships between solution types

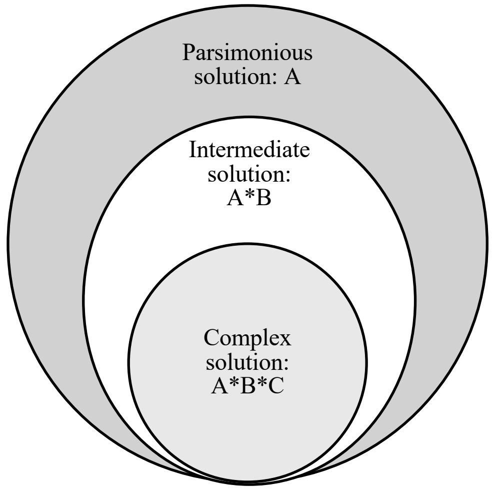

Figure 4: Subset/superset relationships between solution types

Intermediate solutions require substantive and theoretical knowledge to form the basis of directional expectations – whether a particular condition should contribute to the presence or absence of the outcome. As described in the *Theory* chapter and reflected in the archetypal hypotheses, set membership in all conditions except for *FOSSIL* should, *ceteris paribus*, contribute to the outcome *TARGET*, and vice versa. These directional expectations are used to derive *intermediate* solution terms.

I present parsimonious and intermediate solutions below, using the notation developed by Ragin and Fiss (2008) (Fiss 2011). Parsimonious solutions are generally considered the most robust and are often the only solutions described in fsQCA results (Braunschweiger and Ingold 2023; Tobin 2017). Dușa (2019) notes that intermediate solutions are best able to accommodate both sufficiency and parsimony at once. They may also provide deeper insight into different ways in which conditions combine to produce the outcome, beyond the parsimonious solution. These intermediate solutions allow counterfactual reasoning to guide the minimization process if the *direction* of a given condition's influence within a counterfactual case conforms to theoretical expectations (Ragin 2008). I therefore present any unique intermediate solutions.

5.2.2 Parsimonious solutions for *TARGET* and *~TARGET*

Figure 5 depicts the parsimonious solutions for the outcome (*TARGET*) and non-outcome (*~TARGET*) using "Fiss charts" (Rubinson 2019). Filled and crossed circles indicate the presence and absence of conditions that are part of the solution, while empty cells denote conditions that are not part of the solution.

Figure 5: Parsimonious solutions for both the outcome (*TARGET*) and non-outcome (*~TARGET*)

Parsimonious Solutions		
	TARGET	**~TARGET**
PARTY	●	⊗
PUBLIC		
WEALTH		
FOSSIL		
USCA	●	⊗
Cases	CO, CT, DE, HI, IL, MA, MD, ME, MN, NJ, NM, NV, NY, OR, RI, VA, VT, WA	AL, AK, AR, FL, GA, IA, ID, IN, KS, KY, MO, MS, MT, ND, NE, NH, OH, OK, SC, SD, TN, TX, UT, WV, WY
Consistency	0.98	0.97
Raw Coverage	0.76	0.88
Unique Coverage	0.76	0.88

Figure 5: Parsimonious solutions for both the outcome (TARGET) and non-outcome (~TARGET)

The parsimonious solutions indicate that USCA membership and party control are sufficient in both directions. The configuration with set membership in *USCA* and *PARTY* is sufficient for a state to adopt a GHG target (0.98 consistency, 0.76 coverage), whereas its inverse (*~USCA* and *~PARTY*) is sufficient for a state *not* to adopt a GHG target (0.96 consistency, 0.92 coverage). High coverage scores indicate that the solutions are empirically relevant. The parsimonious solutions indicate that the combination of Democratic control of legislative institutions and gubernatorial membership in the USCA are sufficient to produce GHG target adoption. Conversely, gubernatorial non-membership in the USCA and majority Republican control of legislative institutions are sufficient to explain non-adoption.

5.2.3. Intermediate solutions for *TARGET*

For the presence of the outcome (*TARGET*), there are two intermediate solutions, as presented in Figure 6 below. "Core" conditions are denoted with larger circles and are components of the parsimonious solution; "contributory" conditions are represented by smaller circles and are not part of the parsimonious solution (Rubinson 2019). Notably, the sole intermediate solution for the non-outcome (*~TARGET*) was identical to the parsimonious solution. It is therefore not presented again.

Figure 6: Intermediate solutions for the outcome (*TARGET*)

Intermediate Solutions		
Conditions	**TARGET**	
PARTY	⬤	⬤
PUBLIC	•	
WEALTH		•
FOSSIL		⊗
USCA	⬤	⬤
Cases	CO, CT, DE, HI, IL, MA, MD, ME, MN, NJ, NM, NV, NY, OR, RI, VA, VT	CT, DE, HI, MA, MD, MN, NJ, NY, VA, WA
Consistency	0.98	0.99
Raw Coverage	0.68	0.40
Unique Coverage	0.33	0.04

Figure 6: Intermediate solutions for the outcome (TARGET)

The first intermediate solution (*USCA*PARTY*PUBLIC*) includes conditions representing institutions and ideas. The configuration of membership in the USCA, Democratic control of a majority of legislative institutions, and majority public support for more gubernatorial action on global warming was sufficient, regardless of wealth and fossil fuel dependence. The consistency score is high (0.98), though the coverage score is middling (0.68).

The second intermediate solution (*USCA*~FOSSIL*PARTY*WEALTH*) indicates that aligned institutions and interests are also sufficient for producing the outcome. States that were USCA members, had a majority of legislative institutions held by Democrats, were relatively wealthy, and were not significant fossil fuel producers adopt GHG reduction targets. Consistency is high (0.99), but coverage is low (0.40).

5.3. Exceptional cases

Finally, I follow Schneider and Wagemann's (2012) recommendation by identifying cases that are left unexplained by the parsimonious solutions. It is important to evaluate unexplained cases, as fsQCA is a fundamentally qualitative and case-centric approach (Braunschweiger and Ingold 2023).

The linear diagram in Figure 7 provides a depiction of set overlap for each condition and the outcome as recommended by Rubinson (2019). Each row represents a state – binary set membership in the outcome and each condition can be read horizontally. Likewise, set membership in the outcome and each condition is reflected by the presence or absence of symbols along the vertical axis. This is useful for quickly identifying patterns and reviewing unexplained cases.

Figure 7: Linear diagram of cases' binary set membership

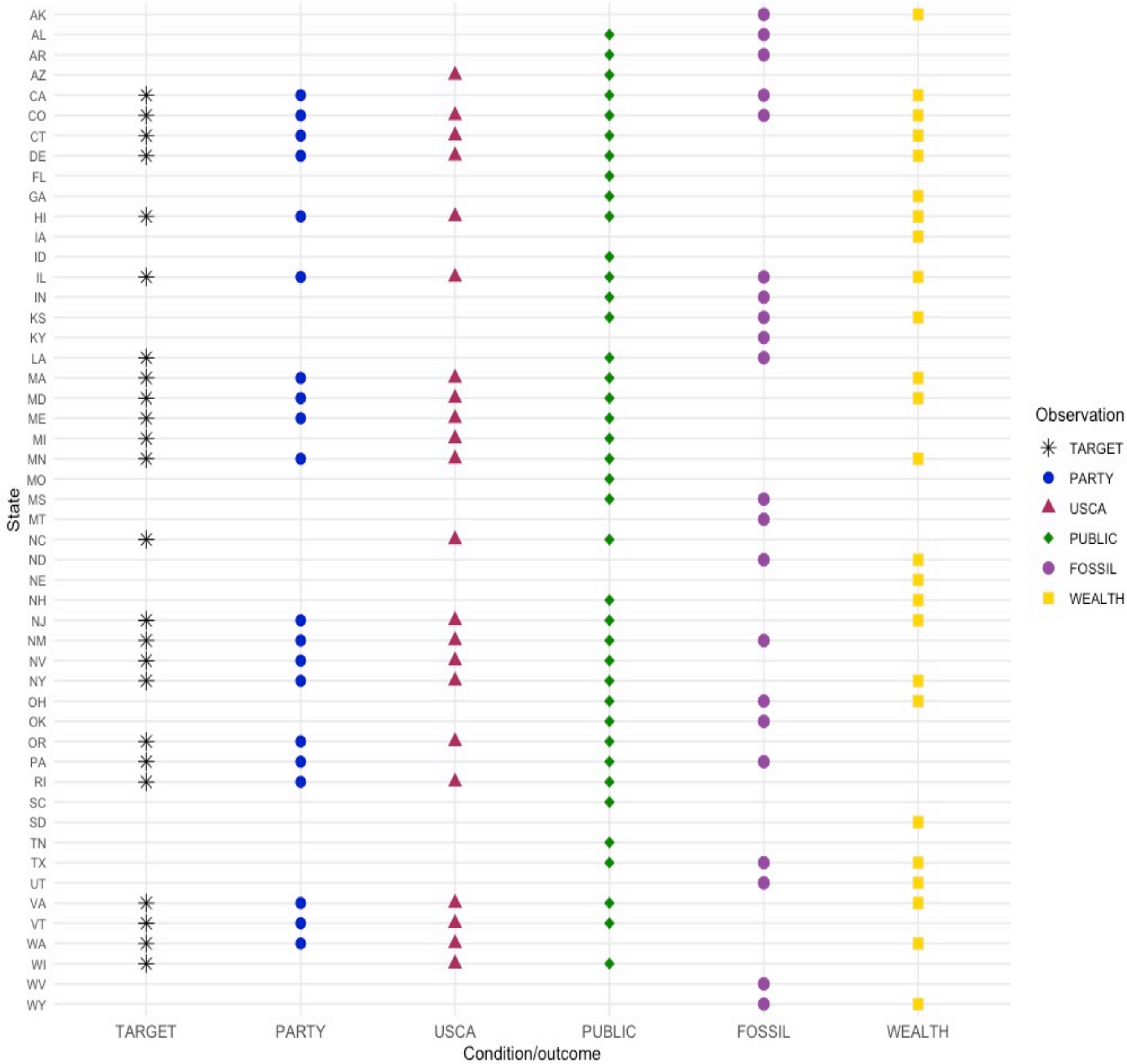

Figure 7: Linear diagram of cases' binary set membership

Table 6 summarizes the cases left unexplained by each parsimonious solution, which were identified using the linear diagram above. The parsimonious solution (*USCA*PARTY*) for states that adopted GHG targets (*TARGET*) leave seven of 24 cases unexplained. For states that did not adopt GHG targets, the parsimonious solution (*~USCA*~PARTY*) leaves only one of 26. Two of these unexplained cases, Arizona (AZ) and Louisiana (LA), represent logical contradictions in the truth table, and are discussed separately in the next chapter.

Table 6: Cases left unexplained by parsimonious solutions

Outcome	**Solution pathway**	**Unexplained cases**
TARGET	PARTY*USCA	CA, LA, MI, NC, PA, WI, WA
~TARGET	~PARTY*~USCA	AZ

Table 6: Cases left unexplained by parsimonious solutions

6. Discussion

6.1. Hypotheses confirmed?

6.1.1. Archetypal configurations and hypotheses

Two archetypal configurations were hypothesized to consistently lead to *TARGET* or *~TARGET,* respectively:

*H1: PARTY*USCA*PUBLIC*~FOSSIL*WEALTH ⇒ TARGET ⇒ TARGET*

H2: ~PARTY~USCA*~PUBLIC*FOSSIL*~WEALTH ⇒ TARGET ⇒ ~TARGET*

These are both confirmed. This is unsurprising, as these represent altogether aligned configurations in each direction. The first configuration – capturing states with USCA membership, Democratic legislative control, public support, wealth, and lack of major fossil fuel production – was perfectly matched by nine states (CT, DE, HI, MA, MD, MN, NJ, NY, VA), all of which adopted targets. The second configuration – the exact inverse – was represented by three states (MT, KY, WV), none of which adopted targets. The higher frequency for the first archetypal configuration is emblematic of a tendency for states that adopted targets to have multiple contributory conditions coexisting at once.

6.1.2. Non-archetypal sufficiency hypotheses

Two causal recipes were hypothesized to be sufficient to lead to *TARGET* or *~TARGET*, respectively.

The third hypothesis proposed that *PARTY, USCA, PUBLIC* must align with one other interest to produce *TARGET*:

H3: The combination of USCA membership, majority Democratic party control of legislative institutions, and majority public support is sufficient to lead states to adopt GHG targets if another contributory interest-based condition – lack of fossil fuel dependency or wealth – is present.

*H3: PARTY*USCA*PUBLIC*(~FOSSIL+WEALTH) ⇒ TARGET*

H3 is not confirmed by the parsimonious solution, which presents a simpler expression:

*USCA*PARTY ⇒ TARGET*

Only *USCA* and *PARTY* are core conditions. Their set coincidence is enough to reliably predict GHG target adoption.

My fourth hypothesis proposed that the combination of *~PARTY* and *~USCA* would be sufficient to lead to *~TARGET:*

H4: The combination of USCA non-membership and majority Republican party control of legislative institutions is sufficient *to lead states not to adopt GHG targets.*

H4: ~PARTY~USCA ⇒ ~TARGET*

H4 is directly confirmed by the parsimonious solution for *~TARGET*.

The parsimonious solutions indicate that the two political-institutional conditions alone are sufficient to produce the outcome or non-outcome. The consistency scores (0.98 for *TARGET* and 0.97 for *~TARGET*) underscore their predictive power.

However, the parsimonious solutions warrant cautious interpretation as they draw on limited empirical observations. In other words, there are very few cases that directly test whether these political-institutional conditions, alone, drive target (non) adoption. Contributory conditions such as wealth, public support, or lack of fossil fuel production often co-occur with USCA membership and Democratic control. Thus, while the findings from the fsQCA are powerful and suggest high explanatory power of both partisanship and membership in the USCA, it is worth understanding the limits of this solution implicated by “don’t care” counterfactual reasoning used to derive parsimonious solutions.

The parsimonious solution for *TARGET* was not directly tested, empirically. There are no instances in which a state was a member of the USCA with majority Democratic control of legislative institutions, but did *not* have one other condition that should theoretically favor GHG target adoption. New Mexico is the most direct test of the sufficiency of the parsimonious solution, with a configuration that reads:

*PARTY*USCA*PUBLIC*FOSSIL*~WEALTH*

Democratic party control, USCA membership, and public support seem to combine for GHG target adoption in New Mexico even though it is not wealthy and is a fossil fuel producer. This case seems to further undermine *H3* insofar as the hypothesis supposed that these three conditions would require another contributory interest-based condition to lead to GHG target adoption.

States that adopted GHG targets, other than New Mexico, exhibit set membership in at least two other idea- or interest-based contributory conditions (beyond core institutional conditions in the parsimonious solution). This limited diversity limits the empirical grounding of the parsimonious solution for *TARGET*. It is also one reason to assess the intermediate solutions, which provide support for the directionality of the hypotheses and idea that USCA membership and partisan control combine with at least one contributory condition for a state to adopt a GHG target in practice. Without direct empirical observations, the conclusion that states meeting the conditions in the parsimonious solution *would have* adopted GHG targets in the absence of other contributory conditions should be made with caution.

In contrast, the parsimonious solution for *~TARGET* is supported directly by the cases of Georgia (GA) and New Hampshire (NH). These states, despite favorable public opinion and economic conditions, lacked the political-institutional prerequisites for GHG target adoption. *But for* their institutional set memberships they might have been expected to adopt their own GHG target. These cases highlight the decisive role these political institutional factors play in influencing GHG target non-adoption and merit further study.

6.1.3. Public opinion as a necessary condition

The hypothesis that states would only adopt GHG targets if there was majority public support for gubernatorial action on global warming seems to be confirmed. The fifth hypothesis was:

H5: PUBLIC ← TARGET

Yet, while *PUBLIC* reached the consistency threshold for necessity, its low coverage reflects the fact that most states in this analysis had majority public support. Among the 11 states lacking majority support, 10 did not adopt a target. Even among the states that *did not* adopt a target, more had majority support for further gubernatorial action than not. These results support the idea that lack of majority public support for more gubernatorial action on global warming would lead states *not* to adopt GHG targets, but public support alone is not enough to lead states to adopt targets. This reflects the asymmetric nature of the condition. This pattern regarding public opinion suggests that factors other than lack of statewide public support are decisive in driving state adoption of GHG targets, though it might reasonably be considered a necessary condition based on the high consistency score and the high degree of set overlap between ~*PUBLIC* and ~*TARGET*.

The one state providing a foil to public opinion as a necessary condition was Washington. This case provides cause for a nuanced understanding of public opinion as driver and response to state leadership. Washington's Governor, Jay Inslee, was one of three founding member states of the USCA. In fact, Governor Inslee ran for the US presidency in 2019 on a platform dedicated to climate change, suggesting that it should be the president's "Job 1" (Kelly 2019). Perhaps public opinion has responded to this gubernatorial leadership – not opposing gubernatorial action but rather recognizing their governor has done (and perhaps continues to do) "enough" (or "too much"). Public opinion might be seen both as a driver of climate policy and a response to past policymaking. Nonetheless, there is still majority public support for further action in other climate leading states, including those which have adopted GHG targets. Regardless, Washington stands out as an interesting case for further study. The state is considered by some observers to be a key climate leader (Pailthorp 2024) while only receiving limited attention from scholars on US state climate policy (Kearl and Vogel 2023; Rice 2010; Rizzo 2024).[13]

6.2. Reflections on institutions, interests, and ideas

The findings emphasize the role of political institutions and ideas over economic or interest-based explanations for GHG target adoption. Democratic party control, USCA membership, and public opinion emerge as prominent factors, while states' status as major fossil fuel producers is a notable

[13] Rice (2010) evaluates the city of Seattle's climate mitigation efforts, Kearl and Vogel (2023) draws lessons on climate *adaptation* in Washington state, and Rizzo (2024) focuses on the compatibility environmental justice principles and the state's cap-and-trade policy.

but not insurmountable obstacle. Wealth appears to play a more ambiguous role. Below, I discuss the implications of the results regarding the role institutions, interests, and ideas play in driving state GHG target adoption, connecting it to the existing climate policy adoption literature.

Institutions

Party **(PARTY)**

The results confirm the extreme partisan polarization of climate mitigation policymaking identified in recent scholarship (see, for example: Basseches et al. 2022). Majority Democratic party control of legislative institutions nears non-triviality as a necessary condition and features prominently in the parsimonious solution for the outcome. Majority Republican control is a necessary and core condition in the parsimonious solution for the non-outcome, reflecting the party's unity in opposing GHG governance. These findings build on research identifying partisanship as a fundamental driver of climate policy adoption in the US and an identified growth in partisanship over time (Bromley-Trujillo and Poe 2020; Brulle, Carmichael, and Jenkins 2012; Dunlap, McCright, and Yarosh 2016; McCright and Dunlap 2011; Trachtman 2020).

The findings at the US state level also align with literature at the international level suggesting that left-leaning parties may be more apt to adopt climate policies (Garmann 2014; Neumayer 2003; Tobin 2017; Schulze 2021). It supports work finding that partisan polarization on climate change seems to have intensified in several national contexts (Caldwell, Cohen, and Vivyan 2024).

Twenty years ago, a leading scholar on US state climate and energy policy remarked on the issue's bipartisan nature (see Rabe 2004). Decades before, Lester (1980) – despite finding evidence that Democratic-led states were more likely to adopt environmental policies overall – found that partisanship was considered "relatively unimportant" in its effect on policy. This bipartisanship seems to have waned to a striking degree in recent years.

USCA membership **(USCA)**

Membership in the USCA is also considered a non-trivial necessary and core sufficient condition for GHG target adoption, with non-membership as a necessary and core condition explaining non-adoption. States that adopted targets in the Paris Agreement era typically saw their governor join the USCA first, highlighting the role of inter-jurisdictional institutions in promoting similar policy adoption behavior. Such networks facilitate learning, agenda setting, and collective action, consistent with theories of policy emulation (Berry and Berry 2007; Holzinger and Knill 2005; Kammerer and Namhata 2018). Institutions like the USCA promote the spread of environmental policies by setting agendas and supporting collective action (Tews, Busch, and Jörgens 2003). The findings specifically support a literature identifying these dynamics within *sub*national policy networks (Hakelberg 2014). Shared memberships in organizations like the USCA provide states with opportunities to learn from and emulate each other's climate policies, including state-specific GHG targets.

Ideas

Public opinion **(PUBLIC)**

Public opinion favoring more gubernatorial action on global warming is a necessary but insufficient condition for GHG target adoption. Yet coverage is low. The results reflect public opinion's asymmetric influence: while necessary, public opinion alone does not guarantee target adoption, especially in Republican-led and non-USCA member states. This could also reflect a bias toward inertia in climate policymaking, where adopting targets is often more challenging than maintaining existing policies despite public support.

These findings align with previous work demonstrating public opinion's role in driving state climate policy (Matisoff 2008; Bromley-Trujillo and Holman 2020) and its broader influence at international and municipal levels (Anderson, Böhmelt, and Ward 2017; Yeganeh, McCoy, and Schenk 2020). GHG targets, as one of many potential climate policy outputs, may be relatively easier to adopt than complex policy instruments while responding to public opinion on climate change directly.

This analysis uniquely evaluates support for gubernatorial climate action. Overall, the findings invite a nuanced theoretical understanding of the impact of public opinion on climate policy. This is supported by methods such as fsQCA, which enable asymmetric treatment of explanatory conditions.

Interests

Only my second intermediate solution for the presence of the outcome (*TARGET*) implicated fossil fuel production and relative. The second intermediate solution suggests that state wealth (WEALTH) and lack of dependence on fossil fuel production (*~FOSSIL*) are contributory conditions that combine with core political-institutional factors to enable GHG target adoption. Neither were found to be necessary conditions for states to adopt GHG targets, though lack of fossil fuel production (*~FOSSIL*) was closer to being a non-trivial necessary condition for GHG target adoption (*TARGET*) than wealth. It had a substantially higher consistency score for necessity (0.75 for *~FOSSIL* compared to 0.57 for *WEALTH*). I reflect on these two interest-based explanations for state GHG target adoption in turn.

***Fossil fuels* (FOSSIL)**

While fossil fuel dependency does not meet the consistency threshold for necessity, my findings provide support for the idea that state dependence on fossil fuel production influences GHG target adoption. The directional expectation finds support in the analysis of necessity for *TARGET* and the second intermediate solution. These findings support the idea that fossil fuel dependency may reduce the likelihood of state GHG target adoption, but not prevent it (Glasgow, Zhao, and Rai 2021; Karapin 2016). These findings are also consistent with international level scholarship (Baker 2023; Lamb and Minx 2020; Ide 2020). The fact that five major fossil fuel producing states adopted targets suggests that entrenched interests can be overcome under favorable conditions (Brulle 2021; Stokes 2020). This raises the question of how state lawmakers in these jurisdictions approach local fossil fuel production amid GHG targets, and how it might be reframed in certain contexts to generate and maintain political will.

***Wealth* (WEALTH)**

Relative state wealth does not emerge as a significant driver of GHG target adoption. Several of the states classified as wealthy did not adopt GHG targets, and many of the less wealthy did. These results add nuance to findings that relative state wealth in the US is a significant predictor of climate and clean energy policies (Berry, Laird, and Stefes 2015; Bromley-Trujillo et al. 2016; Chandler 2009; Tobin 2017; Zhang et al. 2024). It also challenges simple post-materialist explanations to subnational GHG target adoption behavior (Karapin 2016).

Wealth may act as a contributory condition when paired with favorable political motivations but does not seem to independently drive GHG target adoption. Why does relative wealth play no role in the parsimonious solutions? Tellingly, Matisoff (2008) finds that "*as institutions become more liberal* and as wealth increases, states are likely to implement more climate change mitigation programs" (p. 538, emphasis mine). Thus, economic resources supporting GHG target adoption may only be activated under the right political-institutional conditions. The effect of relative wealth *within* a wealthy country may also be considerably less pronounced than across countries, where wealth may represent a more fundamental barrier to policymaking capacity than at the US state level.

While the findings indicate an ambiguous relationship between relative state wealth and GHG target adoption, they not directly contradict findings that wealthier jurisdictions are better able to experiment with and invest in mitigation measures. Perhaps the adoption of GHG targets as such may be more straightforward and less costly compared to more complicated policy instruments that are used to meet these targets. These instruments include renewable portfolio standards, cap and trade schemes, or investments in clean energy technologies implicated in some of the research cited above. It is worth asking whether achieving targets with a suite of (potentially) complex and expensive policy instruments is more dependent on state economic capacity than adopting GHG targets themselves. This distinction could be further elucidated in future research.

6.3. Unexplained cases

Seven states that adopted GHG targets were left unexplained by the parsimonious solution. These are California (CA), Louisiana (LA), Michigan (MI), North Carolina (NC), Pennsylvania (PA), Wisconsin (WI), and Washington (WA).

California and Pennsylvania adopted a GHG target despite not first being a member of the USCA. However, California was a founding member of the USCA and adopted the target assessed here a year before. While this timing indicates that California's GHG target adoption was not influenced by its eventual USCA membership, the state's role as a convener of this interstate climate institution aligns with its reputation as a climate leader (see, for example: Karapin 2016, 2017; Mazmanian, Jurewitz, and Nelson 2020). Pennsylvania adopted a GHG target in January 2019, only months before the state's then-governor Tom Wolf joined the USCA at the end of April 2019. The announcement that the state was joining the USCA coincided with the day the state released its 2019 climate action plan, which was designed to meet its GHG target. This coordinated timing suggests a politically strategic decision by Governor Wolf to bolster the state's climate commitments: joining the USCA coalition with a plan to back it up. Among the 21 major fossil fuel-producing states, California and Pennsylvania join Colorado (CO), Illinois (IL), and New Mexico (NM) in adopting GHG targets during this period. These states, as a group, likely merit further analysis.

Three unexplained cases represent states that adopted GHG targets under Republican-controlled legislatures. All three were adopted via executive order by Democratic governors who were members of the USCA at the time. These include Michigan, North Carolina, and Wisconsin. These gubernatorial actions confound the expectation that partisan control of a *majority* of legislative institutions would likely be decisive. However, Democratic governors in Kansas (KS) and Kentucky (KY), states with similarly Republican-controlled legislatures, did not adopt GHG targets. Unlike in Michigan, North Carolina, and Wisconsin, the governors of Kansas and Kentucky were not USCA members, suggesting the coalition's role as a catalyst for and reflection of gubernatorial action in these cases. Further, these three states are not major fossil fuel producers, whereas Kansas and Kentucky are. In fact, Kentucky reflects an archetypal configuration for the non-outcome, with low levels of wealth and only minority public support for further gubernatorial action on global warming. In contrast, Kansas is classified as wealthy and exhibits majority public support for more gubernatorial action on global warming. Finally, Michigan, North Carolina, and Wisconsin are all considered non-wealthy states. This pattern highlights the potential influence of USCA membership and fossil fuel dependence in shaping state GHG target adoption in such edge cases.

Louisiana is another exceptional case which represents a logical contradiction in the truth table. Louisiana's then-governor, John Bel Edwards, adopted a GHG target via executive order in 2020 despite Republican control of the legislature and his initial non-membership in the USCA. The state is a fossil fuel producer and is not among the wealthy states, though public opinion favors further gubernatorial action on global warming. In August of 2020, Governor John Bel Edwards established a climate task force to meet a target of reducing net GHG emissions by 40-50 percent from 2005 levels by 2030. He later joined the USCA in May of 2021 (U.S. Climate Alliance 2021). One potential reason that Louisiana is an exceptional case is that it was hit in 2005 by the costliest hurricane in American history – Hurricane Katrina – the strength of which was exacerbated by climate change (Diaz et al. 2020). It sits among regional peers that did not adopt GHG targets, which may help explain the governor's late accession to the USCA. Nonetheless, the governor was term limited and did not run for reelection in 2023. His Republican successor, Jeff Landry, withdrew from the USCA, has labeled climate change a "hoax," and filled key environmental posts with fossil fuel industry leaders (Jones 2024). The future of the state's GHG target is thus uncertain under the new administration and amid a clear reversal of course on climate policy.

The only unexplained case for the non-outcome (~*TARGET*) was Arizona (AZ), which was also a logical contradiction. Arizona is the newest member of the USCA, having joined in July of 2023 (U.S. Climate Alliance 2023). Despite majority public support for climate action, Arizona's political environment, dominated Republican legislative control since 1992, likely discourages state-specific GHG target adoption. The state's governor, Katie Hobbs, was elected in 2022 after fourteen years of Republican control of the legislature and governorship – Democrats held the governorship from 2002-2008 but have not controlled either chamber of the legislature since 1992, when they held the senate. In an environment dominated by an opposing party that is skeptical of climate change mitigation policy as such, adopting a state-specific GHG target might be considered a political liability. From an interest perspective, Arizona is not a significant fossil fuel producer but is also not in the set of wealthier states. One might expect Arizona to be the next most likely state to adopt its own GHG target, especially if Democrats maintain the governorship and take control of at least one chamber of the legislature.

The results of fsQCA and subsequent analysis suggest some promising cases for deeper study. Washington state confounded expectations regarding public opinion. What is unique about climate policy and politics there, and how does public support for further gubernatorial action respond as states adopt new policies? Fossil fuel dependence failed to obstruct GHG target adoption in California, Colorado, Illinois, New Mexico, and Pennsylvania. What has encouraged these states' policy leaders to adopt GHG targets despite their status as fossil fuel producers? The answer offered by this research is that Democratic control and USCA membership were decisive. But are there other underlying similarities among these geographically sparse states, for instance in terms of how policymakers or interest groups frame and achieve climate action? Further analysis could shed light on the unique climate politics and policy in Georgia and New Hampshire, where climate policy-relevant interests and ideas seem to favor adoption amid institutional obstacles. Despite some exceptions, qualitative, case-study based scholarship on state climate and energy policy and politics in the US regularly focuses on high-profile leading states like California and New York, or prominent laggards such as Texas. Future research might take the results from this thesis as a starting point for studying states that seem to confound theoretical expectations more deeply.

6.4. Limitations

Despite the insights provided in this research, it was subject to limitations. First, despite the strengths noted above, fsQCA has been criticized for sensitivity to calibration decisions and a need to justify why it is preferable to statistical approaches (Tobin 2017). I have sought to calibrate conditions in as straightforward and transparent a way as possible. Further, while I believe it well-justified in the case of this research, I do not suggest that fsQCA is preferable to other approaches. It should be considered as part of a pluralistic suite of methodologies that accentuate different aspects of the relationship between cause and effect. Indeed, without the insights from prior literature narrowing the potential conditions providing parsimonious explanations from dozens to relatively few, conducting QCA in a theoretically and empirically grounded manner would have been impossible. In the case of this research, relaxing temporal determinism and employing configurational reasoning has enabled a clear and parsimonious conclusion on the key drivers of GHG target adoption.

Relatedly, my use of fsQCA considered a distinct period of time – “the Paris Agreement era” from 2016-present – de-emphasizing the role of time or past policymaking in driving GHG target adoption. This departure from quantitative methods that emphasize temporal sequencing or deeper case study approaches was meant to strike a balance between qualitative and quantitative rigor. While traditional methods have yielded significant insights, they often treat causal factors as independent variables and assess their average net effects on likelihood of adoption. This may de-emphasize parsimony as well as the interplay and asymmetry of conditional impacts driving state-level policy adoption.

Further, many potentially influential factors were not tested here. By assessing structural factors like state institutions, interests, and ideas, I have set aside other influential meso- and micro-level factors. These include, for example, organized policy combat between advocacy coalitions and the role of policy entrepreneurs (Karapin 2016; Kingdon 1997; Sabatier 1988; Stokes 2020). These are clearly critically important to holistic explanations of state climate policy adoption and likely influence the ultimate role of macro-level conditions I assess in this research. There are also other structural factors that conceivably influence GHG target adoption, which are often multicollinear with conditions assessed here, such as states' education or GHG emissions levels (Karapin 2016). By attempting to derive a parsimonious solution to explain state GHG target adoption across all 50 US states, I sacrifice a degree of detail that could be highlighted in future research. Doing so has illuminated the primacy of political-institutional variables – particularly partisanship and interstate institutions – in driving GHG target adoption in US states.

7. Conclusion

This thesis aimed to identify the combinations of institutions, interests, and ideas that have driven US states to adopt GHG targets in the Paris Agreement era. Using fsQCA, I found that partisan control and gubernatorial membership in a key interstate climate institution provide a parsimonious explanation for state GHG target adoption or non-adoption. These findings underscore the highly partisan nature of recent US state climate policymaking and highlight the pivotal role of inter-jurisdictional fora in promoting climate action. While favorable public opinion on gubernatorial action to address global warming may be necessary for GHG target adoption, it is not sufficient in isolation.

This research adds nuance to current understanding of the role that factors measuring climate policy-relevant interests and ideas – namely fossil fuel dependency, wealth, and public opinion – play in the context of polarized climate policy environments. The results suggest that interest-based factors assessed here that have previously been found to be statistically significant predictors of climate policy adoption may be better thought of as contributory conditions rather than co-equal independent explanatory variables, in the presence of more powerful causal explanations. They also show that the influence of interests is non-deterministic: a diverse group of states has adopted GHG targets under aligned political-institutional conditions.

Methodologically, this thesis represents a novel application of fsQCA to US state climate policy. By moving beyond traditional covariational methods, it addresses longstanding critiques of US environmental policy research, which has often relied on isolated testing of bivariate hypotheses. FsQCA provides a framework for exploring the complex and contingent dynamics underpinning the adoption of GHG targets (and other climate policy outputs), enabling more nuanced assessments of the conditions under which various predictors interact.

The findings implicate a vast literature explaining and evaluating climate policy outputs across multiple levels of governance, particularly regarding the combined role of institutions, interests, and ideas in driving climate policy adoption. It advances the literature on multilevel climate governance, particularly within federations where constituent units hold significant authority to address climate change. Empirically, it provides insights into subnational climate governance in the US, the world's most polluting federation, and identifies pathways to state-level GHG target adoption. These findings can inform analyses of similar policy adoption in other federations, offering a baseline for comparison and extending the scope of research to other contexts.

Future research could also build on this foundation by exploring the evolution of state GHG target adoption in other periods, particularly during the earlier period of state domination in the early 2000s or potential future waves of state climate policy adoption. Comparative studies across federations with varying levels of partisan polarization could further deepen understanding of the interplay between political control and GHG governance. Additionally, incorporating measures of target ambitiousness and credibility, as well as other qualitative methods such as interviews or discourse analysis, could provide a more holistic view of the factors driving policy adoption and implementation at multiple levels.

The contributions of this thesis are timely because, while the US federal government just updated its NDC by adding a GHG target for 2035, the country is likely to abandon a national GHG target and its commitment to the Paris Agreement altogether in 2025. While countries are expected to "ratchet up" their national climate ambition, it is all but certain that the US federal government will scale down its GHG governance. The US may therefore be on the verge of a third period of *state domination* of climate policy, with a new benchmark (US NDC 3.0) from which to model state GHG targets in the next decade. The findings here provide insights to subnational policymakers or constituencies aiming to foster compensatory federalism.

As we have seen, compensatory federalism is particularly important during periods of national policy retrenchment. State lawmakers and their voters may rightly focus their attention on subnational GHG reduction efforts. The state GHG targets assessed in this thesis may be considered to represent the state-level remnants of a nationwide US GHG target. They represent a "fail safe" redundancy that may allow US states to go some way to "filling the void" of federal inaction to meet the US NDC through a new period of state led climate policy in the US. This thesis has highlighted the conditions that facilitate state leadership on GHG reductions. Understanding what enables states to take GHG reduction efforts remains essential for researchers interested in subnational climate governance as the global community continues to struggle to avert climate catastrophe.

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9. Appendix

Table A.1: State GHG targets adopted during the Paris Agreement era

Year	State	Source	GHG Reduction Targets
2016	California	SB 32	40% below 1990 levels by 2030
2018	Connecticut	SB 7; Public Act No. 18-82	45% below 2001 levels by 2030
			80% below 2001 levels by 2050
2019	Colorado	HB 19-1261	26% below 2005 by 2025

			50% below 2005 by 2030
2019	Illinois	EO 06-19	26% below 2005 levels by 2025
			50% below 2005 levels by 2030
2019	Maine	S.P. 550 – L.D. 1679	45% below 1990 levels by 2030
			80% below 1990 levels by 2050
2019	Michigan	ED 2019-12	26-28% below 2005 levels by 2025
			50-52% below 2005 levels by 2030
2019	Nevada	SB254	28% below 2005 levels by 2025
			45% below 2005 levels by 2030
			Net zero by 2050
2019	New Mexico	EO 2019-003	45% below 2005 levels by 2030
2019	New York	S 6599	40% below 1990 levels by 2030
			85% below 1990 levels by 2050
			Net zero by 2050
2019	Pennsylvania	EO 2019-1	26% below 2005 levels by 2025
			80% below 2005 levels by 2050
2019	Wisconsin	EO 38	26-28% below 2005 levels by 2025
2020	Louisiana	EO JBE-2020-18	26-28% below 2005 levels by 2025
			40-50% below 2005 levels by 2030
			Net zero by 2050
2020	Oregon	EO 20-04	45% below 1990 levels by 2035
			80% below 1990 levels by 2050
2020	Vermont	Act 153	26% below 2005 levels by 2025
			40% below 1990 levels by 2030
			80% below 1990 levels by 2050
2020	Virginia	SB 94	Net zero by 2045
2020	Washington	HB 2311; Ch 79, Laws of 2020	45% below 1990 levels by 2030
			70% below 1990 levels by 2040
			95% below 1990 levels by 2050
			Net zero by 2050
2021	Massachusetts	S.9	50% below 1990 levels by 2030
			75% below 1990 levels by 2040
			85% below 1990 levels by 2050
			Net zero by 2050
2021	Rhode Island	2021 Act on Climate	45% below 1990 levels by 2030
			80% below 1990 levels by 2040
			Net zero by 2050
2021	New Jersey	EO 274	50% below 2006 levels by 2030
2022	Hawaii	Act 238 (HB 1800 CD2)	50% below 2005 levels by 2030
2022	Maryland	SB 528	60% below 2006 levels by 2030

2022	North Carolina	EO 246		50% below 2005 levels by 2030
				Net zero by 2050
				75% below 2005 levels by 2040
				90% below 2005 levels by 2045
				Net zero by 2050
2023	Delaware	HB 99		50% below 2005 levels by 2030
				Net zero by 2050
2023	Minnesota	HF 2310		50% below 2005 levels by 2030
				Net zero by 2050

Table A.1: State GHG targets adopted during the Paris Agreement era

Table A.2: Raw data for causal conditions

State	Code	SDP/capita	USCA	FOSSIL	PUBLIC	PARTY	Date Range
Alabama	**AL**	$ 48,474	0	1	52%	0.00	2015-2023
Alaska	**AK**	$ 76,802	0	1	50%	0.00	2015-2023
Arizona	**AZ**	$ 53,912	1	0	53%	0.33	2015-2023
Arkansas	**AR**	$ 46,231	0	1	52%	0.00	2015-2023
California	**CA**	$ 64,976	0	1	56%	1.00	2015-2016
Colorado	**CO**	$ 63,215	1	1	53%	1.00	2015-2019
Connecticut	**CT**	$ 75,459	1	0	59%	1.00	2015-2018
Delaware	**DE**	$ 80,183	1	0	58%	1.00	2015-2023
Florida	**FL**	$ 54,719	0	0	59%	0.00	2015-2023
Georgia	**GA**	$ 61,120	0	0	58%	0.00	2015-2023
Hawaii	**HI**	$ 62,563	1	0	56%	1.00	2015-2022
Idaho	**ID**	$ 48,531	0	0	51%	0.00	2015-2023
Illinois	**IL**	$ 71,018	1	1	59%	1.00	2015-2023
Indiana	**IN**	$ 58,794	0	1	53%	0.00	2015-2023
Iowa	**IA**	$ 64,900	0	0	50%	0.00	2015-2023
Kansas	**KS**	$ 62,315	0	1	52%	0.33	2015-2023
Kentucky	**KY**	$ 50,144	0	1	50%	0.33	2015-2023
Louisiana	**LA**	$ 51,880	0	1	53%	0.33	2015-2020
Maine	**ME**	$ 47,677	1	0	54%	1.00	2015-2019
Maryland	**MD**	$ 68,390	1	0	60%	0.67	2015-2022
Massachusetts	**MA**	$ 81,354	1	0	59%	0.67	2015-2021
Michigan	**MI**	$ 51,280	1	0	57%	0.33	2015-2020
Minnesota	**MN**	$ 69,145	1	0	51%	1.00	2015-2023
Mississippi	**MS**	$ 40,595	0	1	54%	0.00	2015-2023
Missouri	**MO**	$ 55,945	0	0	51%	0.00	2015-2023
Montana	**MT**	$ 51,075	0	1	48%	0.00	2015-2023

Nebraska	**NE**	$ 71,572	0	0	50%	0.00	2015-2023
Nevada	**NV**	$ 55,121	1	0	55%	1.00	2015-2019
New Hampshire	**NH**	$ 66,094	0	0	55%	0.00	2015-2023
New Jersey	**NJ**	$ 68,615	1	0	62%	1.00	2015-2021
New Mexico	**NM**	$ 45,609	1	1	54%	1.00	2015-2019
New York	**NY**	$ 83,629	1	0	61%	1.00	2015-2019
North Carolina	**NC**	$ 56,858	1	0	56%	0.33	2015-2022
North Dakota	**ND**	$ 80,006	0	1	46%	0.00	2015-2023
Ohio	**OH**	$ 60,927	0	1	56%	0.00	2015-2023
Oklahoma	**OK**	$ 52,609	0	1	51%	0.00	2015-2023
Oregon	**OR**	$ 55,321	1	0	51%	1.00	2015-2020
Pennsylvania	**PA**	$ 59,222	0	1	57%	0.67	2015-2019
Rhode Island	**RI**	$ 56,817	1	0	57%	1.00	2015-2021
South Carolina	**SC**	$ 49,372	0	0	57%	0.00	2015-2023
South Dakota	**SD**	$ 65,080	0	0	51%	0.00	2015-2023
Tennessee	**TN**	$ 58,656	0	0	53%	0.00	2015-2023
Texas	**TX**	$ 66,592	0	1	56%	0.00	2015-2023
Utah	**UT**	$ 63,515	0	1	49%	0.00	2015-2023
Vermont	**VT**	$ 52,640	1	0	55%	0.67	2015-2020
Virginia	**VA**	$ 62,149	1	0	55%	1.00	2015-2020
Washington	**WA**	$ 73,424	1	0	50%	1.00	2015-2020
West Virginia	**WV**	$ 45,549	0	1	48%	0.00	2015-2023
Wisconsin	**WI**	$ 56,233	1	0	53%	0.33	2015-2019
Wyoming	**WY**	$ 70,780	0	1	45%	0.00	2015-2023

Table A.2: Raw data for causal conditions

Table A.3: Calibrated case values for conditions and outcome

State	**Code**	**USCA**	**FOSSIL**	**PARTY**	**WEALTH**	**PUBLIC**	**TARGET**
Alabama	AL	0	1	0	0.08	0.81	0
Alaska	AK	0	1	0	0.97	0.09	0
Arizona	AZ	1	0	0.67	0.22	0.87	0
Arkansas	AR	0	1	0	0.05	0.69	0
California	CA	0	1	1	0.73	0.99	1
Colorado	CO	1	1	1	0.66	0.9	1
Connecticut	CT	1	0	1	0.96	1	1
Delaware	DE	1	0	1	0.98	1	1
Florida	FL	0	0	0	0.25	1	0
Georgia	GA	0	0	0	0.56	1	0
Hawaii	HI	1	0	1	0.63	0.99	1
Idaho	ID	0	0	0	0.09	0.51	0
Illinois	IL	1	1	1	0.9	1	1

Indiana	IN	0	1	0	0.44	0.83	0
Iowa	IA	0	0	0	0.73	0.11	0
Kansas	KS	0	1	0.33	0.61	0.67	0
Kentucky	KY	0	1	0.33	0.12	0.02	0
Louisiana	LA	0	1	0.33	0.16	0.91	1
Maine	ME	1	0	1	0.07	0.96	1
Maryland	MD	1	0	0.67	0.84	1	1
Massachusetts	MA	1	0	0.67	0.99	1	1
Michigan	MI	1	0	0.33	0.14	1	1
Minnesota	MN	1	0	1	0.86	0.57	1
Mississippi	MS	0	1	0	0.02	0.95	0
Missouri	MO	0	0	0	0.3	0.53	0
Montana	MT	0	1	0	0.14	0	0
Nebraska	NE	0	0	0	0.91	0.01	0
Nevada	NV	0	0	1	0.27	0.98	1
New Hampshire	NH	0	0	0	0.77	0.97	0
New Jersey	NJ	1	0	1	0.85	1	1
New Mexico	NM	1	1	1	0.05	0.97	1
New York	NY	1	0	1	0.99	1	1
North Carolina	NC	1	0	0.33	0.34	0.99	1
North Dakota	ND	0	1	0	0.98	0	0
Ohio	OH	0	1	0	0.55	0.99	0
Oklahoma	OK	0	1	0	0.18	0.56	0
Oregon	OR	1	0	1	0.28	0.53	1
Pennsylvania	PA	0	1	0.67	0.46	1	1
Rhode Island	RI	1	0	1	0.34	1	1
South Carolina	SC	0	0	0	0.1	1	0
South Dakota	SD	0	0	0	0.73	0.24	0
Tennessee	TN	0	0	0	0.43	0.87	0
Texas	TX	0	1	0	0.79	0.99	0
Utah	UT	0	1	0	0.67	0.01	0
Vermont	VT	1	0	0.33	0.18	0.97	1
Virginia	VA	1	0	1	0.61	0.98	1
Washington	WA	1	0	1	0.94	0.17	1
West Virginia	WV	0	1	0	0.05	0	0
Wisconsin	WI	1	0	0.33	0.31	0.87	1
Wyoming	WY	0	1	0	0.9	0	0

Table A.2: Calibrated case values for conditions and outcome

Table A.4: State GHG targets adopted during the first period of state domination

Year	State	Basis	GHG Limit
2003	Maine	Me. Stat. Ann. tit. 38 § 575	1990 levels by 2010 10% below 1990 levels by 2020 75-85% below 2003 levels, long term
2005	Vermont	Vt. Stat. Ann. tit. 10, § 578; Vt. Stat. Ann. tit. 10, § 582	25% below 1990 levels by 2012 50% below 1990 levels by 2028 75% below 1990 levels, long term
2005	New Mexico	EO 05-033	2000 levels by 2012 10% below 2000 levels by 2020 75% below 2000 levels by 2050
2005-2006	California	EO S-3-05 Cal. Health & Safety Code § 38530	2000 levels by 2010 1990 levels by 2020 80% below 1990 levels by 2050
2006	Arizona	EO 2006-13	2000 levels by 2020 50% below 2000 levels by 2040
2007	Minnesota	Minn. Stat. § 216H.01 et seq.	15% below 2005 levels by 2015 30% below 2005 levels by 2025 80% below 2005 levels by 2050
2007	New Jersey	N.J. Rev. Stat. § 26:2C-37 et seq. EO 54	1990 levels by 2020 80% below 2006 levels by 2050
2007	Oregon	Or. Rev. Stat. § 468A.260	10% below 1990 levels by 2020 75% below 1990 levels by 2050
2007	Florida	EO 07-127	2000 levels by 2017 1990 levels by 2025 80% below 1990 levels by 2050
2007	Illinois	EO 2006-11	1990 levels by 2020 60% below 1990 levels by 2050
2007-2008	Washington	EO 07-02 Wash. Rev. Code § 70.235.020	1990 levels by 2020 25% below 1990 levels by 2035 50% below 1990 levels by 2050
2008	Massachusetts	Mass. Gen. Laws Ann. ch. 21N et seq	1990 levels by 2010 10-25% below 1990 levels by 2020 75-85% below 1990 levels, long term
2008	Connecticut	Conn. Gen. Stat. § 22a-200a	10% below 1990 levels by 2020 45% below 2001 levels by 2030 80% below 2001 levels by 2050
2009	Maryland	Greenhouse Gas Reduction Act of 2009	25% below 2006 levels by 2020 90% below 2006 levels by 2050
2009	Michigan	EO 2009-4	20% below 2005 levels by 2020 80% below 2005 levels by 2050

Table A.4: State GHG targets adopted during the first period of state domination.

Table A.5: State GHG targets adopted during the first period of contested federalism

Year	State	Basis	GHG Limit
2014	Rhode Island	Resilient Rhode Island Act of 2014	10% below 1990 levels by 2020 45% below 1990 levels by 2035 80% below 1990 levels by 2050
2016	California	SB 32	40% below 1990 levels by 2030
2016	Maryland	S.B. 323	25% below 2006 levels by 2020 40% below 2006 levels by 2030

Table A.5: State GHG targets adopted during the first period of contested federalism: the second half of 2009 through the first half of 2017.

Table A.6: State GHG targets adopted during the second period of state domination

Year	State	Basis	GHG Limit
2018	Connecticut	SB 7; Public Act No. 18-82	45% below 2001 levels by 2030 80% below 2001 levels by 2050
2018	Hawaii	Act 15 (House Bill 2182)	Net zero emissions by 2045
2018	North Carolina	EO 80	40% below 2005 levels by 2025
2019	Colorado	HB 19-1261	26% below 2005 by 2025 50% below 2005 by 2030
2019	Illinois	EO 06-19	26% below 2005 levels by 2025 50% below 2005 levels by 2030
2019	Maine	S.P. 550 – L.D. 1679 EO 2019-0	45% below 1990 levels by 2030 80% below 1990 levels by 2050 Net zero by 2045
2019	Michigan	ED 2019-12	26-28% below 2005 levels by 2025 50-52% below 2005 levels by 2030
2019	Nevada	SB254	28% below 2005 levels by 2025 45% below 2005 levels by 2030 Net zero by 2050
2019	New Jersey	PL 2019 c.197	80% below 2006 levels by 2050
2019	New Mexico	EO 2019-003	45% below 2005 levels by 2030
2019	New York	S 6599	40% below 1990 levels by 2030 85% below 1990 levels by 2050 Net zero by 2050
2019	Pennsylvania	EO 2019-1	26% below 2005 levels by 2025 80% below 2005 levels by 2050
2019	Wisconsin	EO 38	26-28% below 2005 levels by 2025
2020	Louisiana	EO JBE-2020-18	26-28% below 2005 levels by 2025 40-50% below 2005 levels by 2030 Net zero by 2050
2020	Michigan	ED 2020-10	Net zero by 2050
2020	Oregon	EO 20-04	45% below 1990 levels by 2035 80% below 1990 levels by 2050
2020	Vermont	Act 153	26% below 2005 levels by 2025 40% below 1990 levels by 2030 80% below 1990 levels by 2050
2020	Virginia	SB 94	Net zero by 2045
2020	Washington	HB 2311; Ch 79, Laws of 2020	1990 levels by 2020 45% below 1990 levels by 2030 70% below 1990 levels by 2040 95% below 1990 levels by 2050 Net zero by 2050
2021	Massachusetts	S.9	50% below 1990 levels by 2030 75% below 1990 levels by 2040 85% below 1990 levels by 2050 Net zero by 2050
2021	Rhode Island	2021 Act on Climate	45% below 1990 levels by 2030 80% below 1990 levels by 2040 Net zero by 2050

Table A.6: State GHG targets adopted during the second period of state domination: the second half of 2017 through the first half of 2021

Table A.7: State GHG target adoption during the second period of *contested federalism*

Year	State	Basis	GHG Limit
2021	New Jersey	EO 274	50% below 2006 levels by 2030
2022	California	AB 1279	85% below 1990, net zero and net negative thereafter by 2045
2022	Hawaii	Act 238 (HB 1800 CD2)	50% below 2005 levels by 2030
2022	Maryland	SB 528	60% below 2006 levels by 2030
2022	North Carolina	EO 246	50% below 2005 levels by 2030 Net zero by 2050
2023	Colorado	SB 23-016	65% below 2005 levels by 2035 75% below 2005 levels by 2040 90% below 2005 levels by 2045 Net zero by 2050
2023	Delaware	HB 99	50% below 2005 levels by 2030 Net zero by 2050
2023	Minnesota	HF 2310	50% below 2005 levels by 2030 Net zero by 2050

Table A.7: State GHG target adoption during the second period of contested federalism: the second half of 2021 until now.

10. Declaration of Consent

Declaration of consent

on the basis of Article 30 of the RSL Phil.-nat. 18

Name/First Name: Wu, Sebastian

Registration Number: 23-120-405

Study program: MSc. Climate Sciences, with Special Qualification in Social Sciences

Bachelor ☐ Master ☒ Dissertation ☐

Title of the thesis: Exploring Subnational Climate Target Adoption in the Paris Agreement Era: The Case of US States

Supervisor: Prof. Dr. Karin Ingold

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