Uneven Roads: State-level variations in consumer benefits and regulations for purchasing and operating EVs

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ABSTRACT

Issues of climate change and the environment have been politically divisive in the United States. Some states have adopted more climate-friendly policies than others. One such policy is promoting the use of electric vehicles (EVs) through offering consumer-based incentives. Consumer benefits and regulations for purchasing and operating EVs play a significant role in encouraging individuals to transition to the use of EVs. Yet, why do some states offer more incentives than others? While a primary justification is the environmental benefit EVs afford in terms of reduced carbon emissions and, consequently, improved quality of life, other political and economic factors also affect decision-making calculus of state governments. The study finds that addressing environmental decay, whether a state has a unified government, and interstate competition in attracting businesses predict the extent to which states pursue consumer benefits and regulations for purchasing and operating EVs.

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1. Introduction

There has been a concerted global push to reduce carbon emissions, a movement led by the signing and ratification of several multinational agreements, including the Paris Agreement (2016), the Kyoto Protocol, and the United Nations Framework Convention on Climate Change (1992). These agreements, a testament to the commitment of global leaders over the years, frame the climate change measures instituted by individual countries. In addition to these international efforts, each country has implemented climate change policies tailored to its own specific circumstances. Furthermore, the carbon reduction effort is sector-specific, so these existing efforts have been attuned to these nuances.

The transportation sector has attracted significant attention due to its urgent carbon emissions problem. In 2021, it was the largest contributor to carbon emissions, accounting for 28 percent of the total in the United States (US EPA, 2021). This stark reality underscores the pressing need for immediate and practical solutions to curb emissions in this sector. Electric vehicles (EVs) have emerged as a promising solution to the transportation sector's challenge of reducing carbon emissions. Despite challenges, such as higher initial acquisition costs and inadequate charging infrastructure, the potential of EVs to substantially impact carbon emissions is a hopeful prospect for the future (Bonges III & Lusk, 2016; Coffman et al., 2017a; Wee et al., 2018). Prior research investigated consumer benefits and regulations related to purchasing EVs to understand how government-provided consumer incentives drive the purchase of new electric vehicles, the factors influencing when adoption occurs, and how effective those incentives are (Coffman et al., 2017a; Jin et al., 2014; Sierzchula, 2014; Wee et al., 2018).

However, some essential determinants remain understudied. With much focus on the effectiveness of incentives, existing literature has not explored the factors that may account for

the variation in the availability of incentives to citizens depending on the state in which they reside. This study, therefore, examines why some states offer more consumer benefits and regulations for purchasing and operating electric vehicles (EVs) than others, proposing three sets of factors: environmental, political, and economic. We hypothesize that as environmental quality declines due to increasing carbon emissions or as the problem becomes more urgent, state governments will offer more consumer benefits and regulations for purchasing and operating electric vehicles (EVs). This expectation aligns with the extant literature on problem severity as a determinant of government activity (e.g., Kalesnikaite & Neshkova, 2021; Mullin & Rubado, 2017).

Interstate competition to attract EV production firms also plays a role in states offering consumer benefits and regulations for purchasing and operating EVs. Electric vehicles (EVs) necessitate significant infrastructure investment in the form of charging stations, and as demand for EVs rises, automakers are establishing new manufacturing facilities. This has led to fierce economic competition between states, each vying for these new investments to create jobs and boost their economies (Genschel & Seelkopf, 2015; Gillette, 1997; Kahan & Kamar, 2002; Weber & Friedrich, 1929). Further, we know that states are subject to market forces and seek to attract businesses and wealthy residents to discourage needy populations from relocating to their states (Choi & Neshkova, 2019; Peterson, 1995; Rom et al., 1998). Thus, an economic rationale exists for offering consumer benefits and regulations at the state level.

Finally, the political ideology of the state elected officials is expected to predict the extent to which states offer EV consumer benefits, given that climate change and the environment have been politically polarized issues in the U.S., with Democratic Presidents being more pro-

environment compared to their Republican counterparts (*LCV National Environmental Scorecard*, 2023).

Using data from the Environmental Protection Agency (EPA) and the US Department of Energy's Alternative Fuels Data Center, this analysis measures the extent of consumer benefits and regulations for purchasing and operating EVs that a state offers. The study utilized state-level data from 2015 to 2023 and found that as environmental quality declines, consumer-accessible incentives and regulations for purchasing and operating electric vehicles (EVs) increase at the state level. Additionally, states with business attraction rankings tend to offer more consumer-accessible incentives. However, these incentives are less financially oriented compared to those in states with higher economic rankings. Finally, we found that states controlled by a unified government have more effective and a wider variety of consumer-accessible incentives than those controlled by a divided government.

This study contributes to existing knowledge by exploring how environmental, political, and economic contexts predict the availability of state-level EV incentives and gives insight into how these perspectives may influence the principle of incentivizing solutions to politically polarized global problems with local impact. Using three measures, namely, a count of incentives, a weighted index based on existing literature to assess the effectiveness of incentives, and a measure of the variation (types) of incentives offered by states, this research explores EV incentives with a multifaceted and comprehensive approach. Further, the urgency of the growing carbon emissions problem is underscored by the fact that the occurrence and intensity of natural disasters have increased fivefold since the 1980s, an increase attributed to the worsening climate position (CRED, 2015; Thomas, 2017). As the debate on climate change evolves, understanding the motivations for effective public policy development and implementation will be crucial to

bridging the divide and reaching a consensus on these matters. This paper contributes to this theorization by examining how economic and political considerations influence state governments' responses in these politically polarized policy areas, as well as their reactions to the severity of local problems.

2. Theoretical Framework

Electric Vehicles as a Public Policy Dilemma

The theory informing this study is that incentives are necessary to drive the adoption of electric vehicles (EVs) due to the challenges and anxieties associated with adopting this emerging technology. Second, incentives arise from both federal and state legislation, and this legislative process unfolds differently in states depending on their political makeup (trifecta vs. divided government), the severity of the problem being addressed, and the economic benefits associated with transitioning from gasoline to electric vehicles (EVs).

One of the most significant appeals of EVs over their gas counterparts is their environmental friendliness. In 2021, the transportation sector was the most significant contributor to greenhouse gas (GHG) carbon emissions at 28%, with 'light duty' vehicles (passenger cars with a gross vehicle weight rating of less than 8500 pounds) accounting for 58% of that total in the U.S. (US EPA, 2021). However, the potential of EVs to reduce carbon emissions and improve air quality in many areas across the US offers a hopeful prospect. The improved air quality is linked to better health outcomes and an enhanced quality of life (US EPA, 2021). Therefore, since EVs are a potential solution to the severe environmental quality problem through reduced carbon emissions, it is crucial to examine whether state governments are

utilizing consumer benefits and regulations to encourage the purchase and operation of EVs and address this issue.

The federal and state governments have played a crucial role in promoting and regulating the use of EVs in the transportation sector. Wee et al. (2018) are among the first to empirically examine how effectively the federal and state governments' broad policy objective of stimulating the sales of new electric vehicles (EVs) is facilitated by the various policy instruments implemented by these governments. The existing literature suggests that both financial and non-financial benefits are associated with EV policy and legislation. Financial consumer benefits can be categorized into two types: capital (e.g., upfront subsidies and tax rebates) and operational (e.g., reduced vehicle licensing fees and time-of-use electricity rates) (Jin et al., 2014; Nie et al., 2016; Whitehead et al., 2019). Non-financial incentives, such as access to high-occupancy vehicle lanes and other preferred access benefits, including parking, are notable benefits (Bento et al., 2024; Coffman et al., 2017). However, several challenges make the straightforward transition to EVs more difficult than desired.

Challenges to EV Adoption

A relevant question in seeking to understand whether states are using consumer benefits and regulations for the purchasing and operation of EVs as a tool to lower carbon emissions and, therefore, improve quality of life, or for some other political or economic motivation, is why a need exists to stimulate the sale of EVs in the first place. Several studies conclude that the availability of charging infrastructure is the most significant factor in driving or hindering the adoption of electric vehicles (Coffman et al., 2017a; Jin et al., 2014; Lu et al., 2022; Nie et al., 2016; Wee et al., 2018). Electric vehicles have a finite mileage due to the use of batteries; the possibility of running out of battery charge is a vital consideration for consumers (Lu et al.,

2022; Wee et al., 2018; Whitehead et al., 2019). Therefore, consumers in states with high vehicle miles traveled (VMT) tend to have a lower inclination toward using electric vehicles (EVs) (Whitehead et al., 2019). The lack of charging ports, combined with the limited mileage of battery electric vehicles, has given rise to a phenomenon known as 'range anxiety.' Range anxiety is characterized as uncertainty about the availability and compatibility of charging stations (Bonges III & Lusk, 2016; Coffman et al., 2017a). The literature proposes various solutions to alleviate range anxiety, including policy reform related to designated parking for electric vehicles (EVs) and increased investment in EV infrastructure, such as charging stations.

Literature also underscores personal income as a significant factor influencing citizens' willingness to purchase electric vehicles, given the higher upfront cost of EVs compared to their gas counterparts (Coffman et al., 2017; Jin et al., 2014; Wee et al., 2018). In 2021, an electric vehicle cost eleven thousand (USD) more than a comparable gas vehicle (Murillo, 2021).

Consumer benefits and regulations for purchasing and operating electric vehicles are designed to mitigate the associated costs. As personal income rises, the availability of these incentives is anticipated to decrease, reflecting the changing dynamics of EV adoption.

Consumer Benefits and Regulations for Purchasing and Operating EVs

Given the above challenges pertaining to EVs, governments offer consumer-based benefits and regulations to encourage citizens to purchase EVS. The passage of the American Recovery and Reinvestment Act (ARRA) in 2009 provided the first significant financial incentive offered by the federal government for the purchase of electric vehicles (EVs); the ARRA offered up to $ 7,500 in financial credit to consumers purchasing new electric vehicles (H.R.1 - 111th Congress, 2009). Since then, states have followed suit by offering additional

incentives (Jin et al., 2014; Wee et al., 2018). For this paper, the term ‘consumer benefits and regulations for purchasing and operating EVs’ will be used to refer to incentives or regulations that promote the adoption of EVs in the form of financial or non-financial recompense to purchase or operate EVs (Coffman et al., 2017; Diamond, 2009; Jin et al., 2014; Sierzchula et al., 2014; Wee et al., 2018). This broader conceptualization includes explicit mention of regulations.

Previous studies on hybrid electric vehicles (HEVs) have found that both financial and non-financial incentives are significant in driving the sales of HEVs (Diamond, 2009; Whitehead et al., 2019). The most effective financial incentives are capital and operational. Capital incentives include upfront subsidies and tax rebates, while operational incentives concern time-of-use rates, electricity rates, and reduced vehicle licensing fees (Jin et al., 2014; Lu et al., 2022; Wee et al., 2018). Non-financial incentives such as High Occupancy Vehicle (HOV) lane access and other preferred access incentives (e.g., parking) are notable incentives for customers willing to pay a premium to avoid congestion through the use of HOV lane access (Bento et al., 2024; Coffman et al., 2017). One study has found that upfront payouts/subsidies were more effective than tax credits or rebate financial incentives. Wee et al. (2018) utilized functional sub-categories to disentangle financial incentives into ‘capital financial incentives,’ which consist of upfront or post-credit taxation schemes, from ‘operating financial incentives,’ which include exclusive discounts on vehicle registration or time-of-use electricity rates. However, some states have implemented disincentives, such as EV registration fees, which aim to offset the revenue losses from gas taxes (Coffman et al., 2017; Wee et al., 2018).

The term ‘incentives’ in some instances in the existing literature has excluded state and federal regulations as a distinct element in naming the tools of government to promote the

adoption of EVs (Jin et al., 2014; Sierzchula et al., 2014; Wee et al., 2018). This paper will examine the intersection of incentives, consumer benefits, and regulations for purchasing and operating electric vehicles (EVs). The 'public good' principle aptly justifies the government's intervention in providing incentives for the purchase and operation of electric vehicles (EVs). Public goods are non-rival, one individual's consumption does not reduce the consumption of another, and are non-excludable in that individuals cannot be restricted from access (Weimer & Vining, 2017). Private firms, therefore, are not interested in providing public goods, as they cannot maximize sustainable profits (Lewinsohn-Zamirt, 1998). The environment is the most encompassing public good; therefore, solutions geared toward preserving the environment fall squarely within the government's purview (Boettke, 2018; Lewinsohn-Zamir, 1998; Weimer & Vining, 2017).

While the debate is ongoing concerning the extent to which EVs should be considered public goods (Frazin, 2024; Turner, 2018), there is enough consensus to suggest that at least the barriers to access for an average citizen to own an EV should be tempered (e.g., the passing of the American Recovery Reinvestment Act in 2009). Additionally, the behavioral public choice theory posits that public decision-makers are prone to the same psychological biases that private decision-makers in the marketplace may exhibit. Proponents of this theory suggest that an element ignored mainly in behavioral economics is the paradox surrounding the role of policymakers. The paradox revolves around the idea that policymakers must have independent and impartial judgments, yet be influenced by their behaviors (Lewinsohn-Zamirt, 1998; Viscusi, 2015).

Given the implications of behavioral public choice theory coupled with the principle of the public good, this study assumes that policymakers are attuned to the public's concerns about

climate change and the environment. It underscores the need for them to collaborate and provide consumer benefits and regulations that promote the ease of purchasing and operating EVs. The theory suggests further that elected officials, as consumers themselves, are catering to the needs of consumers by offering EV incentives. Therefore, the relevant question is whether this context prompts policymakers to take collective action and collaborate on addressing climate change and reducing carbon emissions or whether they will remain divided along party lines.

Problem Severity and the Environmental Context

Existing scholarship, however, does not thoroughly investigate the reasons for the differences in the number of consumer-based benefits and regulations offered by states and the possible ideological motivations that drive states to adopt consumer benefits and regulations for purchasing and operating electric vehicles. Scholars have examined local government policy choices and how they address specific issues. They have found that, concerning social inclusion and climate change, the proximity of the policy issue (local, regional, or global) plays a crucial role in how local governments respond and enact policy. Policy responses to local issues are enhanced when the problem is severe. When issues are global, political ideologies influence policy directives most, and when issues are regional, the policy response is influenced most by the stance of neighboring competing states (Hughes et al., 2018; R. M. Krause, 2011).

Mullin and Rubado (2017) characterize climate change as a global problem that manifests its effects most visibly on a local scale. The nature and severity of its impacts vary across communities, a fact attributable to regional risk patterns and the condition of a community's built infrastructure. The local experience of global problems, such as climate change, underscores the need for robust local policy responses. Therefore, while climate change is a global problem, its effects, including poor environmental quality, are locally experienced through water shortages

(such as droughts), floods, and extreme heat events. We know that the severity of the problem influences the policy response of state and local governments. Issues related to climate change and the environment are complex due to the lack of a clear definition and the technical nature of the subject, with no universal solution (Calvin et al., 2023; Egan & Mullin, 2017; Head & Alford, 2015).

As established above, the more severe a problem, the greater the urgency for local and state officials to act. At the same time, given the severity of the problem, cross-party and organizational collaboration is necessary to achieve effective policy implementation. Prior research has established the need for cross-party and cross-organizational collaboration to effectively address severe problems, including environmental quality issues. The transaction costs of addressing severe problems make implementing such solutions challenging and potentially elusive (Head & Alford, 2015; Kalesnikaite & Neshkova, 2021; R. M. Krause, 2011). Since EVs, however, are promoted as tools to solve the carbon emissions problem, the first hypothesis postulates that:

> *H_1: States with poorer environmental quality will have more consumer benefits and regulations for purchasing and operating electric vehicles.*

Furthermore, this study suggests that the policy agenda setting related to consumer benefits and regulations for purchasing and operating electric vehicles may extend beyond the problem severity rationale of improving air quality by reducing carbon emissions and enhancing the quality of life. This paper argues that state governance structures, through political sorting on issues of climate change and the environment, will influence the extent to which states offer consumer benefits and regulations for purchasing and operating EVs.

The Political Context

Environmental quality is classified as a global problem; therefore, as scholarship suggests, political ideology influences the policy responses of state and local governments (Hughes et al., 2018; Mullin & Rubado, 2017). The laws of supply and demand for food and other scarce resources, contentions around the 'invisible hand,' rent-seeking, the distribution of incentives, and the price of labor have formed the foundations of the theory of the political economy (Boettke, 2018; Hildreth et al., 2021; Horn, 1995). Making political decisions undoubtedly has economic consequences, and therefore, the dynamics of the policy-making process are complicated by these nuances. The policy-making process in the United States is cyclical and complex, involving extensive consensus-building and negotiation to pass legislation.

First, a policy must align with an agenda, which must then be sponsored by a legislator who lobbies for support from their fellow lawmakers. The policy agenda is fueled by the elected party's mandate, as well as the influence of lobbyists and interest groups, which explains to some extent why some policies are more concentrated in specific groupings and others are more generalized. Arnold (1990) explored the reasons Congress adopts the policies that it does and posited that the interaction of lobby groups, elected legislators, coalition leaders (legislators form coalitions on policy issues in Congress), and engaged citizens (who ultimately have the power to recall their representatives as they do through the election cycle) are the main determinants of congressional policy.

Therefore, policy development and application depend on lawmakers' political ideologies, the interest groups that support them, and the salience and complexity of the policy matter (Arnold, 1990; Mackie, 2023). However, the interactions between legislators, coalition leaders, and citizens in the political landscape shift in response to the salience and complexity of

policy issues. Issues related to the environment and climate change are considered high in salience and complexity (Arnold, 1990; Mackie, 2023). Elected officials generally approach issues of high salience and complexity from a distance due to the high level of citizen involvement and the uncertainty surrounding policy implementation. These issues are generally left to the high-level bureaucrats. Of further relevance to the political context, there is a growing polarization on issues of climate change and the environment. This polarization is attributed to 'political sorting.'

Political sorting aligns party affinity and political philosophy (Dunlap et al., 2016; Egan & Mullin, 2017; Mackie, 2023). The elite members in both political parties identify with the interests that most closely align with their business needs, and, in turn, business interests are reflected in the political parties that adopt the ideology supporting their cause. An existing study finds that states are more likely to act on climate change when headed by democratic leadership (Kalesnikaite & Neshkova, 2021; Zahran et al., 2008). The League of Conservation Voters (LCV) is an environmental watchdog group that tracks the voting records of members of the US House of Representatives and the US Senate on various categories related to climate change and environmental preservation, including clean energy, wildlife conservation, and public spending on environmental programs. Data from the LCV indicate that from 1972 to 2016, the difference in scores between Democratic and Republican elected representatives in the House and Senate increased from 20 points to over 80 points (LCV National Environmental Scorecard, 2023; Dunlap et al., 2016; Mackie, 2023). Thus, the second hypothesis posits that:

> *H_2: States with Democratic party leadership will offer more consumer benefits and regulations for purchasing and operating electric vehicles.*

Furthermore, this study proposes that, in addition to environmental problem-solving and political sorting theories, economic motivation through interstate competition may predict why states offer more consumer benefits for purchasing and operating electric vehicles (EVs) than others.

The Economic Rationale

Given the political polarization in the United States regarding climate change and the environment, promoting the economic benefits of shifting toward electric vehicle (EV) mobility can serve as common ground that facilitates cooperation across the aisle. This paper argues that the extent to which states offer consumer benefits and regulations for purchasing and operating electric vehicles is motivated by the economic business principles of supply and demand and firm profit maximization. States that can be categorized as less supportive of climate change and environmental policy may still find interest in using consumer benefits and regulations for purchasing and operating electric vehicles. States may utilize them not because of an environmental rationale, but rather the economic rationale of attracting major EV production players and federal financing, such as that afforded through federal funding (e.g., the American Recovery and Reinvestment Act, or ARRA).

New investments, whether through federal funding or private firms, will trigger a multiplier effect, thereby creating new jobs. (Flammang, 1979; North, 1955; Weber & Friedrich, 1929). The ARRA of 2009 allocated over USD 2.5 billion in funding, including grant and loan support for electric vehicle manufacturing, EV charging infrastructure, and EV batteries (American Recovery and Reinvestment Act, 2009). Between 2009 and 2021, federal funding for the development and manufacturing of electric vehicles (EVs), including charging stations, totaled $3.3 billion across 16 programs (Burget, 2022). States are actively competing to attract firms to establish manufacturing plants and operational headquarters within their respective

borders. We know that states also seek to attract businesses and wealthy residents while discouraging low-income populations from relocating to their states (Choi & Neshkova, 2019; Peterson, 1995; Rom et al., 1998). States compete by offering state tax incentives, rebates, or credits to firms, as well as land, technical assistance, and workforce development initiatives (Enrich, 1996; Gonzales et al., 2019).

Gonzales et al. (2019) studied the effectiveness of business attraction programs across states. They found that the states with the most effective business attraction programs are strategic and deliberate in their methodology. States employ measurable goals and bolster targeted sectors informed by comprehensive research while investing in staff and systems to monitor their comparative advantage. This indicates that states that successfully attract firms to their respective locales do so because they perceive the economic benefits that will result from their investment. Alfred Weber's firm location theory aptly justifies the motivations of states with anti-environmental elected officials or ideologies to adopt consumer benefits and regulations for purchasing and operating electric vehicles as part of a package that attracts new funding to their state economies. Weber's characterization of the firm location and economic growth problem centered around transportation and the movement of raw materials to productive sites. As the central focus of the firm location theory, Weber posits that firms prioritize incurring the least transportation costs to maximize profit (Weber & Friedrich, 1929).

North (1955) extended the firm location theory by building a model that emphasized not only the attraction of firms to an area based on minimizing transportation costs but also the incentivizing of firms in their chosen locations to transform them into net exporters of goods or services to realize economic growth for the regions in which they are located (North, 1955). Therefore, this study argues that as states seek to compete and establish a comparative

advantage, as Ricardo (1895) outlined, each state will position itself favorably to access these new investments, with environmental benefits essentially an afterthought.

In addition, the era of competitive states follows the 'Keynesian Welfare National States' (Genschel & Seelkopf, 2015). The Keynesian Welfare State, emerging after World War II, adhered to the economic theories of John Maynard Keynes. He challenged traditional economics regarding the "invisible hand" and "self-correcting economies" by emphasizing aggregate demand (total spending in the economy) as a key factor influencing output, inflation, and employment. While the Keynesian state had a demand-side macroeconomic policy focus and a justification for state intervention in the economy, the era of the competitive state had a more microeconomic efficiency focus, with a free-market supply-side approach rather than a demand-side focus. The supply-side microeconomic focus of the competition state era supports private sector-driven economic growth through favorable taxation, free market competition, reduction in welfare entitlements, and an increase in subsidized training and employment (Genschel & Seelkopf, 2015; Gillette, 1997). Prior research, however, suggests that supply-side incentives can lead to increased demand in a "feedback loop" (Gopalan et al., 2014; Tan, 2019). The feedback occurs through two main mechanisms: first, by providing incentives for political actors, and second, by providing those actors with information that encourages a particular action (Arnold, 1990; Pierson, 1993). Given the known challenges related to the acquisition of EVs outlined above, this paper argues that states offering sufficient supply-side incentives to firms will strategically provide demand-side consumer benefits and regulations for purchasing EVs, thereby sustaining the EV market and maximizing their initial investment in supply-side incentives.

For this study, the incentive offered to political actors in a democracy like the U.S. is presumed to be the political gain from successfully attracting firms to their states, which creates jobs for constituents and provides consumer benefits to their electorate, thereby supporting reelection campaigns. The third hypothesis, therefore, investigates whether states will increase the offering of consumer benefits and regulations for purchasing and operating EVs alongside the supply-side incentives that attract firms to states.

> *H_3: States with more attractive economic policies for doing business will offer more consumer benefits and regulations for purchasing EVs.*

3. Data and Methods

Sample

The empirical analysis utilizes data from 50 states over an 8-year period, from 2015 to 2023. The panel dataset is well-balanced, comprising 450 state-year observations. States were selected as the unit of analysis due to the significant variation in their political, economic, and environmental contexts. Additionally, available state-level data is more detailed than city and county data concerning incentives offered at that level. Furthermore, the abundance of state-level studies lends itself well to effective study comparison, allowing for the extraction of best practices (Coffman et al., 2017; Diamond, 2009; Jin et al., 2014; Wee et al., 2018; Whitehead et al., 2019). Therefore, contributing to the existing literature in this area will enhance the understanding of the factors that influence state-level decision-making, enabling the generalization of findings with greater confidence. This makes the study relevant and impactful for EV policymakers and stakeholders.

Dependent Variable – Consumer-Based Benefits and Regulations for Purchasing and Operating EVs/Incentives

This study uses three measures to assess the extent to which states offer incentives for electric vehicles (EVs). First, it employs a cumulative count of the incentives offered by states each year (M = 8.60, SD = 9.72). Second, it classifies incentives based on the approach of Wee et al. (2018) and Bento et al. (2024), which focus on financial and non-financial incentives. Financial incentives are divided into two categories: capital incentives (e.g., upfront tax breaks and tax rebates) and operating incentives (e.g., reduced vehicle licensing fees and time-of-use charging discounts). Non-financial incentives are preferred access incentives, such as using high occupancy vehicle lanes (HOV) and designated or free parking for EVs. A total of ten categories of incentives were used; this variable, therefore, captures the number of different types (out of the ten categories) that each state offers in a particular year (M = 2.97, SD = 2.04). Finally, a weighted index was developed based on existing research, measuring the incentives offered by each state in terms of their effectiveness in encouraging EV adoption (M = 0.71, SD = 0.81). The weighting structure of the index used in this study assigns incentives related to charging station buildout a weighting of 40%, financial incentives a weighting of 50%, and non-financial incentives a weighting of 10%. (see Appendix 1 for details on index creation and weight justification). The list of consumer benefits and regulations for purchasing and operating EVs was obtained from the US Department of Energy's Alternative Fuel Data Center.

Main Explanatory Variables

The main explanatory variables used in this paper measure states' environmental, economic, and political contexts. Air quality, measured in terms of carbon emissions in metric tons of Carbon dioxide per capita, serves as a proxy for the severity of environmental problems

in each state and, therefore, as a measure of environmental quality. The Environmental Quality Index (EQI), developed by the Environmental Protection Agency (EPA), is used to assess the overall quality of the environment across several key indicators, including air quality, water quality, and climate change mitigation (US EPA, 2021). A significant variable in assessing environmental quality is air quality. Carbon emissions are a popular proxy for air quality (Tamayao, 2014; Thomakos & Alexopoulos, 2016; US EPA, 2021). Tamayo (2014) finds that carbon emissions account for the most significant portion of environmental quality indices and serve as the best-isolated proxy of environmental quality. Thomakos and Alexepolous (2016) find that Carbon intensity has the most significant explanatory power for environmental quality rankings and consistently produces the predicted negative sign in its relationship to environmental quality.

To measure the economic context, interstate economic competitiveness metrics are used, which, in other words, refer to the extent to which states position themselves by offering supply-side incentives to attract firms to locate and do business in their states. The CNBC "Top States for Doing Business" ranking is used. CNBC has been ranking states annually on ten categories of competitiveness, which are established in prior research (Gillette, 1997; Proehl, 2024) as key factors firms consider when making site selection decisions. These categories include workforce, which measures the availability and price of skilled labor; quality of life, which includes the price of housing and essential utilities; infrastructure, which measures the effectiveness of a state transportation system in moving high volumes efficiently; and the state economy, which includes considerations for GDP, taxation, and the availability of credit (Gillette, 1997; Kahan & Kamar, 2002; Proehl, 2024; Weber & Friedrich, 1929).

The form of state government control, such as trifectas or divided government, is used to measure the political dimension. Two dichotomous variables are created to represent Republican trifectas and divided government, with the reference group being Democratic trifectas, to examine the impact of the form of state government control on the extent to which states offer consumer benefits and regulations for purchasing and operating electric vehicles (EVs). This study argues that trifecta states reflect the positions of their respective political parties, as indicated by the LCV scores at the national level. This argument hinges on the concept of political sorting (Bernstein et al., 2022; Dunlap et al., 2016; Kim & Urpelainen, 2017), divided governments are less sorted.

Control Variables

Control variables, including population density, oil refinery, electricity price, vehicle miles traveled, and levels of education, are used to account for alternative explanations that may affect the extent to which states offer consumer benefits and regulations for purchasing and operating electric vehicles (EVs). Population density is measured by dividing each state's population by its square kilometers. States with larger populations may have more incentives due to their population size and the natural pressures that can be applied as policymakers cater to a larger population and meet increased demand.

The Oil Refinery variable, a binary variable indicating states with oil refineries within their boundaries, is used in this study as a proxy for measuring a state's likely social and economic culture toward the use of alternative energy solutions. The assumption here is that states with oil refineries located within their borders will have a more resistant culture towards alternative energy solutions, such as electric vehicles, as this is likely to have a negative impact on the oil refinery industry. This negative impact stems from the potential for lower fuel

consumption, which will directly affect the profit margins of oil companies and, consequently, have a detrimental effect on the state's economic output. Additionally, existing studies suggest that oil refineries engage in significant lobbying efforts, which often exert influence on the political class at both the federal and state levels (Golden, 1998; Hall et al., 2024; Yackee & Yackee, 2006). These lobbying efforts will make it more difficult for alternative energy legislation to be passed within a state.

The electricity price, measured in cents per kilowatt-hour, serves as an indicator variable to demonstrate how the cost of electricity may deter EV adoption. This can affect the number of EV incentives offered in two ways. First, existing studies indicate that high electric prices may deter consumers from using electric vehicles (Caperello & Kurani, 2012; Coffman et al., 2017). This cost barrier may lead state governments to offer more consumer benefits and regulations that ease this cost barrier; this would be the case for states that are more politically and culturally inclined to support the EV transition for environmental reasons, or second, it may lead to states not attempting to overcome this cost barrier at all. Notable states with oil refineries tend to have lower electricity prices as the transportation cost of oil is less in these states.

The Vehicle Miles Travelled variable serves as a proxy for range anxiety. One obstacle to the adoption of electric vehicles (EVs) is consumers' concern about the limited distance they can travel, given their limited battery capacity. This variable measures the per capita vehicle miles traveled by the state in thousands of miles. The expectation is that states with higher vehicle miles traveled would have more incentives to address this consumer concern.

Finally, the education variable measures the percentage of the population in each state that holds at least a bachelor's degree. This variable serves as a proxy for two salient considerations in the electric vehicle adoption literature: personal income and public opinion on

climate change incentive policies. First, regarding personal income, existing literature suggests that education levels are correlated with personal income levels (Tamborini et al., 2015; Torpey, 2018). EVs are more expensive than their gas counterparts (Carley et al., 2019; Coffman et al., 2017; Wee et al., 2018). Financial incentives are therefore offered to consumers to balance this cost disparity. It is expected that states with higher levels of education (and therefore higher personal incomes) will have fewer financial incentives and may focus on more non-financial incentives, such as increasing the number of charging stations. Second, regarding public sentiment, existing research indicates that education levels are also correlated with a more positive attitude toward climate change policy initiatives (Ballew et al., 2020; P. Kumar et al., 2023). This study, therefore, uses education as a proxy for public sentiment toward climate change, expecting that higher public sentiment will be positively correlated with the extent to which states offer consumer benefits and regulations for purchasing and operating electric vehicles (EVs).

The control variables are state-specific and time-varying. According to the literature, these variables can influence the number of consumer benefits and regulations a state offers for purchasing and operating EVs.

Estimation Strategy and Model Specifications

For the analysis in this study, two sets of models are estimated. The dependent variable developed as a weighted EV index to measure the effectiveness of incentives toward adoption employs a pooled ordinary least squares (OLS) estimation. The Index was logged to account for skewness in distribution and to facilitate ease of interpretation of the results. Negative binomial regression models are used when the additive measures of EV incentives are utilized as dependent variables. A negative binomial regression model was favored to the Poisson

distribution because the additive models' variance and mean showed significant signs of over- or under-dispersion.

Both models are used within a panel data framework. This framework covers 50 states and 450 observations from 2015 to 2023. Pooled OLS estimation is suitable because we aim to analyze the political, economic, and environmental traits of states that may influence the overall provision of consumer-based EV incentives, with the index also being a continuous variable. The estimation will also control error clustering by using cluster-robust standard errors. In addition, to distinguish between financial and non-financial incentives offered by states, a Logit binomial generalized linear model was utilized to predict the likelihood that an incentive offered by states would be financial or non-financial.

A two-way fixed-effect model was also conducted as a robustness check to account for within-unit effects. The fixed effects model enables baseline estimation for each unit, accounting for all non-varying characteristics among states regarding units and for potential time-related impacts that would have equally influenced all states. This helps determine whether initial baseline differences in each state influence the results from the pooled model. Although the significance results differ, as expected due to the reduced degrees of freedom in the fixed effect estimation, the overall direction of the key independent variables remains consistent. This enhances the validity of the findings from the pooled OLS model.

The general model Specification is as follows:

$$\textbf{Incentives} = \beta_0 + \beta_1 \textbf{CarbonEmmissions} + \beta_2 \textbf{RepublicanTrifecta} + \beta_3 \textbf{DividedGovernment} + \beta_4 \textbf{EconomicRanking} + \beta_5 \textbf{VMT} + \beta_6 \textbf{Populationdensity} + \beta_7 \textbf{Educ} + \beta_8 \textbf{ElectricPrice} + \beta_9 \textbf{Oil Refinery}$$

Table 1. Variable Descriptions and Operationalization

Variable	Description	Data Source	
Incentive Index	An index created by the researcher to quantify incentives by effectiveness using a weighted index	Department of Energy (USDOE)	Dependent Variable
Incentive Types	Count of the number of different types of incentives offered by each state	Department of Energy (USDOE)	Dependent Variable
Incentives Count	Count the number of incentives in a state	Department of Energy (USDOE)	Dependent Variable
Carbon Emissions Per Capita	Kilograms of energy-related carbon dioxide per person (10kg)	Environmental Protection Agency (EPA)	Main explanatory variable (Hypothesis 1)
Democratic Trifecta	A binary variable that equals 1 if a state is a democratic trifecta and 0 otherwise	ballotpedia.org	Main explanatory variable (Hypothesis 2)
Republican Trifecta	A binary variable that equals 1 if a state is a republican trifecta and 0 otherwise	ballotpedia.org	Main explanatory variable (Hypothesis 2)
Divided Government	A binary variable that equals 1 if the governor's party does not control at least one of the chambers and 0 otherwise	ballotpedia.org	Main explanatory variable (Hypothesis 2)
Economic Ranking	A binary variable that equals 1 if a state ranks in the top half for doing business and 0 otherwise	CNBC	Main explanatory Variable (Hypothesis 3)
Population Density	State Population Density in persons per square Km	Census.gov	Control Variable
Oil Refinery	A binary variable that equals 1 if a State has an oil refinery located within its boundaries	Department of Energy (USDOE)	Control Variable
Electricity Price	Average retail electricity price in cents per KWH	Department of Energy (USDOE)	Control Variable
Vehicle Miles Travelled	Average Vehicle miles traveled per person, delineated in thousands of miles	US Department of Transportation (USDOT)	Control Variable
Education	Percent of population with bachelor's degrees	Census.gov	Control Variable

4. Results

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Incentive Index	450	0.71	0.81	0	7.05
Incentive Types	450	2.97	2.04	0	10
Incentive Count	450	8.60	9.72	0	93
Environmental Quality	450	1.01	1.05	0.05	681.02
Republican Trifecta	450	.46	.49	0	1
Divided Government	450	.31	.46	0	1
Economic Ranking	450	25.45	14.44	1	50
Population Density	450	77.75	102.00	0.481	484.32
Oil Refinery	450	0.64	0.48	0	1
Electric price	450	14.21	4.785	9.09	43.03
Vehicle Miles Travelled	450	5.65	1.13	2.36	9.69
Education	450	32.55	5.59	19.60	47.80

Table 3. Results for Hypotheses 1-3

	Model (1) Incentive Index	Model (2) Incentive Types	Model (3) Incentive Count
Environmental Quality	.240***	.109***	.247***
	(.036)	(.029)	(.05)
Republican Trifecta	-.285**	-.111	-.045
	(.124)	(.074)	(.111)
Divided Government	-.399***	-.581***	-.706***
	(.112)	(.063)	(.089)
Economic Ranking	.002	.005**	.012***
	(.004)	(.003)	(.003)
Population Density	-.002***	-.001***	-.002***
	(.001)	(.0003)	(.0003)
Oil Refinery	.063	-.089*	.016
	(.09)	(.051)	(.076)
Electricity Price	-.021*	.001	-.006
	(.012)	(.005)	(.01)
Vehicle Miles Travelled	-.025	-.023	-.115***
	(.037)	(.027)	(.037)
Education	.084***	.078***	.143***
	(.012)	(.007)	(.01)
Constant	-2.853***	-1.291***	-2.169***
	(.52)	(.328)	(.484)
/alpha (ln)		-16.326***	-1.062***
		(.214)	(.109)
Observations	450	450	450
R^2	0.24		
Pseudo R^2		.12	.11

*Robust standard errors are in parentheses *** p<.01, ** p<.05, * p<.1*

This study examines why certain states offer more incentives/consumer-oriented benefits, as well as regulations, for purchasing and operating electric vehicles (EVs) than others. It suggests that environmental, economic, and political factors influence the variation in EV incentives offered by different states.

Environmental

Table 3 presents the results of estimations predicting the effect of environmental quality, as measured by kilograms of carbon emissions per person, on the extent to which states offer consumer benefits and regulations for purchasing and operating electric vehicles. Specifically, based on the literature on problem severity, it was hypothesized that states with poorer environmental quality would offer more incentives in a policy effort to reduce carbon emissions from the transportation sector.

The results across the three models, displayed in Table 3 above, indicate that the primary independent variable, carbon emissions, was positive and highly significant. In other words, a 10 kg increase in energy-related carbon emissions per person (resulting in environmental quality decline) increases the number, types, and magnitude of consumer benefits and regulations associated with purchasing and operating electric vehicles. More specifically, the results indicate that when carbon emissions increase by 10 kg per person, the magnitude of the incentives offered increases by 0.24 units. In the case of the types and number of incentives offered, a similar result was found. When carbon emissions increased by 10kg per person, the types of incentives offered increased by 11.5%, and the total number of incentives offered increased by 28%. Table 4 provides more nuanced information regarding the types of incentives offered, indicating a 3% decrease in the odds that any given additional incentive is financial for each additional unit of environmental quality decline. This finding supports the hypothesis that states with poorer

environmental quality tend to have more consumer benefits and regulations for purchasing and operating electric vehicles, and also indicates that the incentives offered are more often non-financial in nature.

Political

The political variables of interest used in this model were Republican Trifecta and Divided Government. The coefficient for the Republican Trifectas was negative across the three models. However, only model 1 showed a statistical significance. Regarding the magnitude of incentives, the results show that Republican trifectas had 0.29 less effective incentives than Democratic trifectas. Similarly, Divided governments had 0.40 less effective incentives than Democratic governments.

Regarding types of incentives, the results show that Republican trifectas had approximately 10.5% fewer types of incentives than Democratic trifectas, although this difference was not statistically significant. Divided governments had approximately 44% fewer incentive types than Democratic trifectas, with a high level of statistical significance ($p < 0.001$). Table 4 provides further details on the nature of the types of incentives, showing that if a state has a republican trifecta, there are 87% higher odds that any given incentive is financial. For divided governments, this scenario translates to 3.4 times higher odds that an incentive is financial.

Finally, regarding the total number of incentives, Republican trifectas had 4.4% fewer than Democratic trifectas, and divided governments had approximately 51% fewer than Democratic trifectas. These findings support our second hypothesis.

Economic

The economic ranking of states in terms of doing business was significant, as reflected in Table 3, particularly in relation to the types and total number of incentives. Results indicate that a one-unit decline in a state's economic ranking predicts a 0.5% increase in the variety of incentives (types) offered. For example, a state that declines 10 places on the economic ranking would have 5% more types of incentives than it previously had at a higher ranking. Furthermore, regarding the total amount of incentives offered, a state that moves 10 places down the ranking will have 12% more incentives cumulatively than states with higher economic rankings. Notably, however, Table 4 shows that as the economic ranking declines, the odds that an incentive is financial decrease by approximately 27% for each unit of decline in economic ranking. This finding partially supports our third hypothesis.

Control Variables

Education, used as a proxy variable for personal income and public sentiment in support of climate change policies, had a positive and significant effect across all three measures of the dependent variable. This indicates that as levels of education increased, the magnitude of effectiveness, types of incentives, and the overall count of incentives offered by states increased. More specifically, concerning the magnitude of incentives, each additional percentage point in the population with a bachelor's degree predicts a 0.084 increase in the magnitude of incentives, an 8.1% increase in the types of incentives (or 0.81 actual types), and a 15.4% increase in the cumulative count of incentives. Concerning the types of incentives as displayed in Table 4, each unit of increase in the percentage of the population with a bachelor's degree decreases the odds that an incentive is financial by approximately 19%.

Population density had a consistent negative and significant sign across all three measures of the dependent variable. This finding is not as expected, as it indicates that as population density increases, the magnitude, types, and count of incentives offered by states decline. More specifically, a 100-person increase in population density per square kilometer predicts a 0.2-unit decline in the magnitude of the incentive index.

Similarly, regarding the different types and total number of incentives offered, a 100-person increase in population density would be associated with reductions of 9.5% and 18.1% in the respective categories. Table 4 further indicates that a 100-person increase per square kilometer in the population will lead to a 35% increase in the odds that an incentive is financial, as opposed to nonfinancial.

The electricity price was negative and significant ($p < 0.1$) across the incentive magnitude variable (model 1). This result indicates that as the electricity price increases by an additional cent, the magnitude of incentives decreases by 0.021 units.

The oil refinery variable was positive and marginally significant ($p < 0.1$) in the model with the incentive types variable (model 2). States with oil refineries have 8.5% or .85 fewer types of incentives than states without oil refineries.

The Vehicle miles traveled variable was only significant in the model concerning the cumulative count of incentives, where it had a negative coefficient. This indicated that as vehicle miles travelled increased, states had 3.7% fewer incentives. The negative coefficient was consistent for the other dependent variable measures but was not statistically significant.

Table 4. Financial Incentives Ratio - Binomial Generalized Linear Model – Logit

Financial Incentives Ratio	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Environmental Quality	-.003	.001	-2.18	.029	-.005	0	**
Republican Trifecta	.624	.364	1.72	.086	-.089	1.337	*
Divided Government	1.236	.308	4.01	0	.632	1.84	***
Economic Ranking	-.031	.011	-2.73	.006	-.053	-.009	***
Population Density	.003	.001	2.39	.017	.001	.006	**
Oil Refinery	.522	.26	2.01	.044	.013	1.031	**
Electric Price	-.006	.031	-0.18	.856	-.066	.054	
Vehicle Miles Travelled	.13	.119	1.10	.273	-.103	.364	
Education	-.206	.034	-6.06	0	-.272	-.139	***
Constant	4.802	1.577	3.05	.002	1.712	7.892	***

Mean dependent var	0.642	SD dependent var	0.276
Number of obs	413	Chi-square	114.507
Prob > chi2	0.000	Akaike crit. (AIC)	469.122

*** p<.01, ** p<.05, * p<.1

5. Discussion

Scholars have explored the use of electric vehicle incentives and their effectiveness in promoting the adoption and sale of electric vehicles at the state level. Prior research indicates that financial incentives, especially upfront payouts and subsidies, are the most effective consumer financial incentives (Coffman et al., 2017; R. Krause et al., 2013; Wee et al., 2018). The need for incentives arises from electric vehicles (EVs) being more expensive than their gasoline counterparts (Carley et al., 2019). Additionally, scholars widely agree that the availability of charging infrastructure is the most significant barrier to EV adoption, primarily due to the concept of 'range anxiety' resulting from limited battery capacity and inadequate charging infrastructure (Coffman et al., 2017; R. R. Kumar & Alok, 2020; Langbroek et al., 2016; Mekky & Collins, 2024; Narassimhan & Johnson, 2018; Pamidimukkala et al., 2024; Rezvani et al., 2015)This study addresses a gap in the existing literature, examining why some states provide more consumer benefits and regulations for purchasing and operating electric

vehicles (EVs) than others. It investigated the incentive policies available to citizens at the state level from three perspectives: environmental, political, and economic.

Environmental Impact on the Extent of Incentives

Data from 50 states over eight years, from 2015 to 2023, indicates a negative relationship between a state's environmental quality and the extent to which states offer consumer benefits and regulations for purchasing and operating electric vehicles (EVs). In other words, as state environmental quality declines, the number, types, and magnitude of consumer benefits and regulations for purchasing and operating electric vehicles (EVs) increase. These results support the first hypothesis of this study. This finding is consistent with the literature on problem severity, which posits that state and local governments are more likely to address local problems that are considered a serious potential threat to local livelihoods and quality of life (Egan & Mullin, 2017; Kalesnikaite & Neshkova, 2021; Mullin & Rubado, 2017). Notably, this study found that states with poorer environmental quality tend to place a greater emphasis on non-financial incentives compared to financial incentives. These non-financial incentives include the installation of charging stations and the implementation of preferred parking regulations. The magnitude or effectiveness-weighted average will be higher for these states if charging station infrastructure is considered the most effective independent factor driving EV adoption.

Political Impact on the Extent of Incentives

This study found that the more pro-environmental a state government is, the greater the extent to which states offer consumer benefits for purchasing and operating electric vehicles (EVs). This finding supports our second hypothesis and is consistent with the literature on political sorting. The literature on political sorting suggests that state elected officials will mirror their party's national ideologies on climate change, a global issue with local consequences (Egan

& Mullin, 2017; Mullin & Rubado, 2017). This finding indicates that democratic states offer more consumer benefits and regulations for purchasing and operating electric vehicles (EVs) in terms of magnitude, type, and number. This is evidence that the national political divide on climate change policy issues extends to the state level, influencing local policies and actions. Additionally, political control by Republican trifectas is associated with a higher likelihood that an incentive will be structured as financial compared to Democratic trifectas. Yet the magnitude or weighted effectiveness index of incentives is lower for Republican trifectas and divided governments, although the likelihood of incentives being financial in these political settings is higher. This appears to be a paradox, as the literature states that financial incentives are more effective than non-financial incentives in driving EV adoption. However, this apparent anomaly can be attributed to the weighting structure of the index used in this study, where incentives related to charging station buildout were assigned a weight of 40%. In comparison, financial incentives received a weight of 50%, and non-financial incentives received a weight of 10%.

Republican and divided governments are more likely to offer financial incentives, suggesting a high effectiveness of their EV adoption index. However, the results show that the indices were lower for Republican trifectas and divided governments compared to Democratic trifectas. This may be because the other important part of the index, charging stations, is significantly low, indicating an underinvestment in charging infrastructure and thus a lower overall index. This implies that charging station expansion is less of a priority in Republican trifectas and divided governments compared to Democratic trifectas. What may explain this? First, the pro-environment stance of Democratic governments is a key factor. States with a unitary government that lean pro-environment suggest their citizens are more aligned with pro-environment policies and, therefore, need less financial incentive to adopt EVs than less pro-

environment Republican trifectas. Second, a unitary government allows for easier funding allocation and policy coordination; thus, taking advantage of federal funding, such as that provided through the IIJA, the IRA, and other EV-related programs, is more seamless in Democratic trifectas than in Republican or divided governments. Existing studies indicate that in a divided government scenario, political fragmentation complicates policymaking and implementation (Curry & Lee, 2019; Edwards III et al., 1997; Harbridge-Yong et al., 2023; Waterman, 2009).

Economic Impact on the Extent of Incentives

The third hypothesis examines the economic rationale behind offering consumer benefits and regulations for purchasing and operating electric vehicles (EVs), utilizing the "supply-to-demand side" feedback loop hypothesis (Gopalan et al., 2014; Tan, 2019). The findings of this study support this hypothesis, albeit not in the expected direction. As the Doing Business economic ranking of states declines, states offer a greater variety of incentives, along with an increased total number of incentives overall. Results also indicated that the additional incentives offered are more likely to be non-financial in nature than financial.

The competition state theory partially explains the discrepancy between the study's results and the expected outcomes. It emphasizes that incentives are more frequently offered on the supply side than on the demand side in the era of competitive states, unlike the reverse in the Keynesian or welfare state (Genschel & Seelkopf, 2015). Therefore, the fact that demand-side incentivization, such as consumer benefits and regulations for purchasing and operating electric vehicles, is more common in states that are less competitive at attracting firms can be explained by suggesting that the feedback loop is reversed in these less attractive states for doing business. Alternatively, it could be that these states are trying to compete with fewer financial incentives

and more non-financial incentives to stay competitive with states that have more financial resources to invest in supply-side incentivization.

States that are less attractive for doing business may use demand-side incentives to boost their competitiveness in the traditional Keynesian sense, as they cannot compete effectively on the supply side. The fact that these increases in incentives are non-financial aligns logically with the fact that these states are spending less on incentives generally and may be using non-financial incentives to boost their competitive advantage. This finding underscores the need for further research on the incentive feedback loop theory, which was developed and tested in this paper.

Control variables

The covariates used in the study also provided valuable insights. Education, measured as the percentage of the state population holding a bachelor's degree, served as a proxy for both personal income and public sentiment in support of climate change policies and was positively correlated with the number, magnitude, and types of incentives offered. The types of incentives, however, offered were not financial. This aligns with our expectation that higher levels of education are linked with a lower predicted proportion of financial incentives. This supports the expectation that more educated populations, potentially accompanied by higher incomes and greater support for climate change policies, may not require as heavy a reliance on financial inducements for EV adoption.

Furthermore, Theory suggests that more densely populated areas have a higher proportion of electric vehicles, likely because charging stations are more concentrated in urban, densely populated areas (Wee et al., 2018)—incentives we had expected to be higher in these areas as a result. However, the findings suggest that these areas not only have fewer incentives but also

fewer types and magnitudes of incentives. This may be explained by the fact that there is a natural affinity towards EV adoption, especially since charging stations are more likely to be available in more densely populated areas. Consequently, the incentives are more focused on areas that are less densely populated, which need that boost.

The presence of oil refineries in states is associated with a higher emphasis on financial incentives. This may be due to a targeted economic strategy that focuses on these states. The appeal to EV adoption is more likely to be directed at citizens in these states, given the expected cultural barriers and lobbying efforts in states with active oil refineries and their known impact on local and state economies.

6. Conclusion

This paper examines why some states have a higher number of electric vehicles than others and proposes three sets of factors that predict this trend: environmental, political, and economic. Key findings indicate that declining environmental quality is associated with an increased offering of incentives. Democratic trifectas offer a larger number and greater variety of EV incentives and are generally more effective at providing them compared to Republican trifectas and divided governments. Furthermore, states with lower economic rankings for doing business tend to have more and a broader range of incentives than those with higher rankings. However, these incentives are often less focused on financial benefits.

The implications of these findings are significant. First, the study provides evidence that incentives for reducing carbon emissions are being used in areas more heavily impacted by carbon emissions as a possible response to the severity of the issue. This enhances the existing research on local policy responses to serious local problems. Additionally, the study presents

suggestive evidence of political sorting from the national to the state levels. This finding underscores the importance for policymakers to recognize this sort of political alignment, which may (or may not) lead to more informed decisions on climate change policy, but it certainly promotes transparency among policymakers and bureaucrats. Third, from an economic perspective, policymakers and practitioners can identify important factors to consider regarding the EV industry and the adoption of EVs. The use of non-financial incentives as a means to promote EV adoption in states that rank lower in terms of their Doing Business Index is worth further exploration.

The findings of this study pave the way for several avenues of future research. First, we examined why states offer more EV incentives than others and found that the need for environmental quality improvement influences this phenomenon. Therefore, future research should delve into the mechanics of the problem severity theorization explored in this paper, specifically concerning electric vehicles (EVs), to identify the specific elements of the theory that uniquely inform policy-making actions related to EV adoption. Second, to further explore the collaboration theory regarding forms of state government control. This paper found that democratic trifectas react more strongly than any other state governance to worsening environmental quality by offering more consumer benefits and regulations for purchasing and operating EVs. This conclusion supports the political sorting theorization, which posits that state governments will adopt the policy positions of their parties at the national level. However, it would be helpful to investigate in future studies whether this political sorting results from the high transaction costs associated with the collaboration necessary to solve severe problems. In other words, is there a willingness on the part of political players that is upended by the

difficulties in finding effective partnerships and opportunities for consensus (Head & Alford, 2015; Kalesnikaite & Neshkova, 2021)?

Ultimately, future research should explore how the incentive feedback loop is implemented. Are there demand-to-supply or supply-to-demand feedback loops, and under what conditions do either scenario manifest itself? Future qualitative research could provide valuable insights into these findings and inform policy decisions. This study has several limitations. The period under study, 2015-2023, included the COVID-19 pandemic, which could have redirected, delayed, or deferred policy priorities. Furthermore, additional controls could have been added to the model to enhance the model fit, such as the number of registered environmental interest groups, which would serve as a proxy for the level of lobbying to state governments. Finally, while a pooled OLS regression and negative binomial regression with cluster-robust errors and controls provide a general overview of the factors that may predict our outcome, the policy prioritization decision is one of those unobserved factors that may skew the findings. These limitations should be taken into account when interpreting the results of this study.

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8. Appendix 1

Table 5. Weighted Index Justification of the Dependent Variable

Category	Incentive Type	Description	Weight
Financial Incentives *(Total Weight: 0.5)*			
GNT	**Up-front Payouts/Subsidies**	**Immediate discounts are applied at the point of vehicle purchase**	**0.20**
TAX	**Income Tax Credits**	**Tax credits realized after vehicle purchase**	**0.05**
EXEM	**Sales Tax Exemptions**	**Exemptions from sales tax on EV purchases**	**0.10**
RBATE	**Tax Rebates**	**Tax rebates received after purchase**	**0.05**
TOU or use LOANS	**TOU Electricity Usage**	**Discounts given for specific Charging at home**	**0.10**
Non-Financial Incentives *(Total Weight: 0.10)*			
OTHER	**Preferred Access to HOV Lanes**	**Access to high-occupancy vehicle lanes for EV drivers**	**0.05**
RTC	**Specialized Parking for EVs**	**Reserved or priority parking spots for electric vehicles**	**0.05**
Infrastructure *(Total Weight: 0.40)*			
BUILD	**Charging Infrastructure Availability**	**Availability and accessibility of charging stations**	**0.40**
Total			**1.00**

Justification of the Revised Weights

1. Financial Incentives (Total Weight: 0.5)

Financial incentives collectively account for 50% of the total weight, reflecting their established impact on reducing the cost barrier to EV adoption, as cited in existing literature.

- Up-front Payouts/Subsidies (0.20)
    - Justification: Highlighted as the most effective incentive, immediate discounts at the point of purchase have a powerful influence on consumer decisions.
    - Impact: Directly lowers the initial purchase price, making EVs more competitive with conventional vehicles.
    - Supporting Studies:
        - *Coffman et al. (2017) found that* immediate subsidies significantly increase adoption rates.
        - *Wee et al. (2018) demonstrated a stronger consumer response to upfront* incentives.
- Income Tax Credits (0.05)
    - Justification: Provides financial relief, but the benefit is delayed until tax returns are filed.
    - Impact: Less immediate effect on the purchase decision compared to up-front incentives.
- Sales Tax Exemptions (0.10)
    - Justification: Reduces the overall cost by eliminating sales tax, but the savings are a smaller percentage of the vehicle price.
    - Impact: Modest influence on affordability at the point of sale.
- Tax Rebates (0.05)
    - Justification: Similar to tax credits, rebates are received post-purchase, delaying the benefit.
    - Impact: Less impactful on the initial decision-making process.
- TOU or use LOANS (0.10)
    - Justification: TOU Electricity Usage Discounts are given for specific Charging at home. Considered an upfront operational payment. Loans featured in this catalog and EV users may be eligible for solar panel installation loans.
    - Impact: Modest influence on affordability at the operational stage.

2. Non-Financial Incentives (Total Weight: 0.10)

Non-financial incentives account for 10% of the total weight, acknowledging their role in enhancing the appeal of EVs without significantly affecting the purchase price.

- Preferred Access to HOV Lanes (0.05)
    - Justification: Offers time-saving benefits for commuters, particularly in congested areas.
    - Impact: Adds convenience but is a secondary consideration for most buyers.
- Specialized Parking for EVs (0.05)
    - Justification: Provides parking convenience and sometimes charging opportunities.
    - Impact: Enhances the ownership experience but has limited influence on purchasing decisions.

3. Infrastructure (Weight: 0.40)

Charging infrastructure availability is assigned a weight of 0.40, reflecting its critical role in supporting EV use.

- Justification: The presence of widespread and accessible charging stations addresses range anxiety and practical usability.
- Impact: Essential for daily operation, significantly influencing the viability of owning an EV.
- Supporting Studies:
    - *Sierzchula et al. (2014) identified* infrastructure as a key driver of adoption.
    - *Li et al. (2017) demonstrated a* strong correlation between charging availability and market growth.
    - Coffman et al., 2017 - *demonstrated a* strong correlation between charging availability and market growth.

      Wee et al. (2018) *demonstrated a* strong correlation between charging availability and market growth.

Appendix 2

Table 6: Pairwise correlations

Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Environmental Quality	1.000								
(2) Republican Trifecta	0.128	1.000							
(3) Divided Government	-0.072	-0.620	1.000						
(4) Economic Ranking	-0.271	-0.121	0.023	1.000					
(5) Population Density	-0.001	-0.354	0.051	-0.023	1.000				
(6) Oil Refinery	0.289	0.082	-0.070	0.129	-0.196	1.000			
(7) Electricity Price	-0.117	-0.446	0.090	0.277	0.411	-0.112	1.000		
(8) Vehicle Miles Travelled	0.037	0.323	-0.115	-0.144	-0.116	0.084	-0.382	1.000	
(9) Education	-0.093	-0.532	0.221	-0.333	0.501	-0.289	0.450	-0.255	1.000
VIF 1.84									

Appendix 3 –

Table 7: Two-way fixed effect Model

	Model (1) Incentive Index	**Model (2) Incentive Types**	**Model (3) Incentive Count**
Environmental Quality	-1.711**	.64*	.148
	(.849)	(.358)	(.307)
Republican Trifecta	-.412	-.124	-.218
	(.424)	(.192)	(.151)
Divided Government	-.173	-.129	-.122
	(.245)	(.104)	(.101)
Economic Ranking	.001	-.003	.001
	(.006)	(.004)	(.003)
Population Density	.022	.027***	.021**
	(.027)	(.009)	(.008)
Electricity Price	-.015	.017	.025**
	(.031)	(.017)	(.01)
Vehicle Miles Travelled	-.042	-.017	-.001
	(.065)	(.061)	(.058)
Education	.152**	-.012	.026
	(.059)	(.032)	(.026)
_cons	-4.468*	-1.663	-2.333
	(2.385)	(1.608)	(1.473)
/lnalpha		-20.862	-21.99
		(0)	(0)
Observations	450	450	450
Pseudo R^2	.z	.284	.394

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*