

# Defeating cap-and-trade: How the fossil fuel industry and climate change counter movement obstruct U.S. Climate Change Legislation

Mirjam O. Nanko<sup>\*</sup>, Travis G. Coan

Centre for Climate Communication and Data Science, University of Exeter, Clayden Building, Streatham Rise, Exeter EX4 4PE, United Kingdom

## ARTICLE INFO

### Keywords:

climate change  
contrarianism  
denialism  
US Congress  
lobbying  
campaign contributions

## ABSTRACT

This study investigates the role of climate change contrarians in the defeat of the American Clean Energy and Security Act in 2010, a pivotal moment in U.S. climate policy that marked the end of extensive efforts to enact cap-and-trade climate legislation in the United States. Our research objectives are twofold: firstly, to determine the extent to which climate contrarians gained access to testify at congressional hearings in the years leading up to the bill's ultimate defeat; and secondly, to examine the potential influence of fossil fuel industry (FFI) funds in facilitating this access. We compile a comprehensive new dataset encompassing all witnesses testifying at cap-and-trade and climate science hearings from 2003 to 2010. This information is cross-referenced with other pertinent data concerning interest groups, lobbying activities, and Congress. Our findings reveal a significant correlation between FFI lobbying expenditures and campaign contributions and the presence of contrarian witnesses at these hearings, suggesting a coordinated effort by the FFI to obstruct climate legislation. We find that contrarians were able to obtain disproportionate access to central hearings in key committees with jurisdiction over cap-and-trade bills, increasing their potential to obstruct legislation. Moreover, our analysis exposes a concerning over-representation of scientists known to deny the scientific consensus at these hearings, undermining the scientific consensus on climate change and perpetuating doubt about the urgency of climate action.

## 1. Introduction

The passage of the American Clean Energy and Security Act on June 26, 2009, marked a significant milestone for U.S. climate policy. The bill, which aimed to establish an economy-wide cap-and-trade system for greenhouse gases, was passed by a vote of 219 to 212 in the House of Representatives (Congress.gov, 2009). This was the first time that any U.S. congressional chamber had passed mandatory climate legislation and the first meaningful American climate change policy within reach since the U.S. failed to ratify the Kyoto Protocol in 1997 (McCright and Dunlap, 2003). The passage of the bill in the House, which is often referred to as the Waxman-Markey bill after its sponsors Representatives Henry Waxman and Edward Markey, was called a historic action by President Obama, who hoped this would be the moment when America finally decided to confront its energy challenge and reclaim its climate future (Obama, 2009).

To become a law, however, the bill also needed to pass in the U.S. Senate – a chamber known to be a bastion for Members of Congress (MoCs) opposed to climate change legislation. Since the 1990s, many

Republicans have taken an increasingly firm stand against climate legislation (Dunlap et al., 2016), and in 2007, a poll indicated that only 13% of the surveyed Republicans thought it had “been proven beyond a reasonable doubt that the Earth is warming because of man-made problems”, as opposed to 95% of the surveyed Democrats (Cohen and Bell, 2007). More importantly, passing legislation in the Senate often requires broad bipartisan support to obtain the three-fifths super-majority required to overcome a filibuster (Binder and Smith, 1997).

Despite the Senate's past reluctance to pass climate legislation, three factors made passage of the Waxman-Markey bill appear within reach: the public mood, organised support for the bill, and the balance of political power. Public support for regulating carbon dioxide emissions was as high as 77% and spanned the political spectrum, with 91% of Democratic, 63% of Independent, and 64% of Republican voters supporting legislation (Leiserowitz et al., 2010, Q172). Furthermore, 65% of respondents stated that the U.S. should reduce greenhouse gas emissions regardless of what other countries did and 69% stated this should be done even at moderate economic costs (Leiserowitz et al., 2010, Q169/Q170). Support also came from several key stakeholders in

<sup>\*</sup> Corresponding author.

E-mail address: [m.o.nanko@exeter.ac.uk](mailto:m.o.nanko@exeter.ac.uk) (M.O. Nanko).

<https://doi.org/10.1016/j.gloenvcha.2024.102919>

Received 22 January 2024; Received in revised form 23 July 2024; Accepted 27 August 2024

Available online 13 September 2024

0959-3780/© 2024 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

the policy debate, ranging from businesses – including several energy providers and oil and gas companies – to environmental groups, unions, NGOs, and local governments, as well as the *U.S. Climate Action Partnership* (USCAP), a coalition of big industrial corporations and environmental organisations in favour of cap-and-trade climate legislation (Altman, 2009).

In addition to strong support in the public and among key organisations, the balance of political power had recently shifted from the Republican to the Democratic party. In 2007, the Democrats gained control of both chambers of Congress for the first time in twelve years. In 2009, the Democrats not only strengthened their control of both chambers but also gained control of the White House. With 59 Senate seats, the Democratic caucus fell one seat short of the three-fifths supermajority to overcome a filibuster. Yet numerous bipartisan attempts at passing climate legislation in the Senate in the years preceding Waxman-Markey (Table A.1) suggested at least some Republican allies and thus created optimism for the bill's successful passage.

With all these factors aligned – strong public support, organised industry support, Democratic majorities in both congressional chambers and control of the Presidency, and a recent history of bipartisan attempts to pass climate legislation – a policy window opened (Kingdon, 2014) and comprehensive U.S. climate action seemed realisable. Yet one year after the bill passed the House, all hopes of its passage evaporated. Citing a lack of majority support, Senate Majority Leader Harry Reid (D) announced on July 22, 2010, that the Senate would abandon the pursuit of legislation aimed at reducing greenhouse gas (GHG) emissions (Hulse and Herszenhorn, 2010). Why, with so many factors aligning in favour of legislation, was it impossible to mobilise even a single Republican vote in support of the bill?

While there are several factors influencing the inability to enact climate legislation, research suggests that an organised and well-funded climate change counter-movement (CCCM) has played a crucial role in preventing meaningful U.S. climate action (Björnberg et al., 2017; Boussalis and Coan, 2016; Brulle, 2013; Brulle et al., 2021; Dunlap and McCright, 2011; Dunlap and McCright, 2015; Farrell, 2016a; Jacques et al., 2008; McCright and Dunlap, 2000; McCright and Dunlap, 2003; Oreskes and Conway, 2010). For instance, McCright and Dunlap (2003) document how the CCCM mobilised to “defeat Kyoto” in the 1990s: faced with the first prospect of binding greenhouse gas emission limits, industry allies and the CCCM actively campaigned against the threat and effectively framed climate change as non-problematic during their extensive, and arguably disproportionate, presentation of climate change skeptic views at congressional hearings on the subject. It stands to reason that the fossil fuel industry (FFI) and the CCCM would try to employ a similar strategy when faced with the threat of cap-and-trade legislation: obstruct any passage of a bill by saturating the debate with discourses of climate delay and contrarian claims (Coan et al., 2021; Lamb et al., 2020) to cast doubt on the veracity of climate science and the feasibility of climate policy.

This article explores the extent to which this obstruction was employed to “defeat cap-and-trade” by focusing on two core questions. First, did climate change contrarians gain access to testify at congressional hearings in the years leading up to the defeat of the Waxman-Markey bill? Second, do FFI campaign and lobbying expenditures correlate with increased access for these contrarian witnesses? Before attempting to answer these questions, the chapter will take a closer look at the background of the FFI and the CCCM, and discuss why we are looking at congressional testimonies to measure the CCCM's influence on the congressional climate debate.

### 1.1. The fossil fuel industry and the climate change counter movement

As climate change made its way onto the agenda in the 1980s, the threat of political action triggered the mobilisation of an organised campaign against climate change policy (Dunlap and McCright, 2015). The FFI, specifically Exxon, which had previously been a pioneer in

carbon dioxide research and climate modelling, changed their strategy from confirming the consensus to undermining it (Banerjee et al., 2015; Rich, 2019; Supran et al., 2023). Seeing its entire business model at stake, Exxon revised its public position on the greenhouse effect and put forward three key strategic points, to emphasise “the uncertainty in scientific conclusions”, to urge “a balanced scientific approach”, and to resist “the overstatement and sensationalization of potential greenhouse effect [sic]” (Carlson, 1988). These arguments have been repeated in countless variations ever since (Cook, 2023). Against this backdrop, an organised movement to derail climate legislation was born, employing techniques that had already proven successful in the tobacco industry: to cast doubt on the scientific consensus and to use all means necessary to prevent action, including the creation of counter-narratives, the misrepresentation of scientific findings, the dissemination of disinformation, and even attacking individual scientists (Oreskes and Conway, 2010). With the rise of global environmentalism (Dunlap and McCright, 2011) in the 1990s and ahead of the ratification of the first international treaty to combat climate change with binding targets, the Kyoto Protocol, the CCCM escalated its activities to cast doubt on climate science and challenge the need for climate policies. As outlined in McCright and Dunlap (2003), when confronted with this threat, the CCCM mobilised contrarian scientists, conservative think tanks, foundations, and trade associations to prevent the U.S. from signing the treaty by flooding the media and congressional hearings on the issue with contrarian voices. In the end, U.S. ratification of the treaty was preemptively hindered by a resolution passed in the Senate, the Byrd–Hagel Resolution (Congress.gov, 1997).

Research suggests that the CCCM constructs the non-problematicity (Freudenburg, 2000; McCright and Dunlap, 2003) of human-made climate change by spreading five key climate disbeliefs: “it's not happening”, “it's not us”, “it's not bad”, “solutions won't work”, and, “climate science/scientists are unreliable” (Coan et al., 2021). Over time the arguments have become more sophisticated, trying to justify inaction with discourses of climate delay that “focus attention on the negative social effects of climate policies and raise doubt that mitigation is possible” (Lamb et al., 2020) rather than denying climate change outright. The CCCM is highly reactive to external events (Boussalis and Coan, 2016) and intimately linked to carbon-intensive industries and conservative political elites (Brulle, 2013). In the 1990s, these ties were conspicuous and corporations openly challenged climate science alongside the other CCCM actors: Many big companies publicly opposed the regulation of GHG emissions, for example as members of the Global Climate Coalition (Kolk and Levy, 2003; Newell, 2000), a lobbying group arguing “that most, if not all, of the observed warming is part of a natural warming trend which began approximately 400 years ago” (Global Climate Coalition, 1996).

### 1.2. From outright denial to hidden opposition

Around the turn of the century, however, the overwhelming scientific consensus (Oreskes, 2004) made climate change denial less and less politically acceptable. While there were still outspoken opponents to climate change legislation, such as the contrarian *American Coalition for Clean Coal Electricity* (DeSmog, 2022a), many companies, including many important members of the FFI, began distancing themselves from outright climate change denialism and shifted their efforts. This materialised in two opposing ways. First, by the support of climate change legislation conducive to a transition favourable to the respective industry (“pro-legislation”), and, second, by the divergence of the increasing CCCM funding through obscure pipelines.

A corporate pro-trading coalition began backing market-based carbon pricing legislation (as opposed to command-and-control policies) (Meckling, 2011), attempting to minimise compliance costs by shaping the legislation (Downie, 2017). This resulted in initiatives such as the *Chicago Climate Exchange* (CCX), a voluntary, private greenhouse gas trading scheme (Chicago Climate Exchange, 2002), and advocacy

coalitions between environmental NGOs and big corporations such as the *Partnership for Climate Action* and the more successful *U.S. Climate Action Partnership* (USCAP), calling for a mandatory, economy-wide, market-based policy framework on climate change (USCAP, 2007b). In their *Call for Action*, USCAP went as far as proposing specific reduction targets (USCAP, 2007a). However, some USCAP members were simultaneously involved in contrarian organisations, suggesting that greenwashing may have been an alternative motivation to join the coalition<sup>1</sup>.

Contrary to these pro-trading endeavours, were efforts to obscure the ties between the industry and the CCCM, which are evident from shifts in the flow of funding of the CCCM: Leading up to the defeat of the Waxman-Markey bill, CCCM funding rose steadily, however, this money was increasingly funnelled through Donors Trust (from less than 5% in 2003 to almost 25% in 2009 and 2010), a donor-advised fund pursuing the donor's intent while hiding their identity (Brulle, 2013). At the same time, traditional funders such as Exxon and Koch Industries significantly reduced their CCCM funding over just a few years (ibid.).

The FFI's efforts to conceal their CCCM funding along with a potential financial interest in obstructing or weakening cap-and-trade legislation, might suggest a strategy of publicly endorsing climate change legislation while simultaneously facilitating contrarian voices to oppose it. Therefore, we aim to test if we find a positive correlation between the FFI's exertion of congressional influence and the access provided to contrarian witnesses for testifying at congressional hearings.

### 1.3. The puzzle: fossil fuel money, contrarians and the congressional debate

In their most direct attempt at influencing the congressional cap-and-trade debate, the FFI drastically increased their lobbying expenditures and campaign contributions ahead of the Waxman-Markey bill, both in absolute and relative terms (see Section 3.3 for more details). Assessing the impact of these funds on advancing the FFI's interests is inherently difficult in a system as complex as the U.S. Congress, not least because many aspects of the legislative process occur behind closed doors. Scientific research has identified testifying at congressional committee hearings as one important avenue of influencing the legislative process. It is one of the most widely employed lobbying techniques, providing lobbyists with a stage to argue their case and gain access to key legislators (Schlozman and Tierney, 1986). The intimate committee setting is an essential point of entry for shaping policy and plays an important role in determining the success or failure of lobbying efforts (Evans, 1996; Wolpe, 1990). More importantly, the committee stage is also a prime opportunity to bury legislation: only a small fraction of the bills that get referred to a committee ever get considered through hearings, markup, and get reported back to the parent chamber for a floor vote (Heitshusen, 2020). Evans (1996) finds that "lobbying committee staff was associated with group success", and Hall and Wayman (1990) find that campaign contributions buy committee members' time with the "intended effect [...] to mobilize bias in congressional committee decision making". We suggest that interest group money, furthermore, buys access to testify at committee hearings, thus generating bias in the congressional debate. Failure to ratify the Kyoto Protocol was preceded

<sup>1</sup> Initially, several USCAP members were simultaneously members of the contrarian *American Coalition for Clean Coal Electricity* (DeSmog, 2022a). Furthermore, many were members or on the Board of Directors or Executive Committee of three well-known CCCM advocacy groups, the American Petroleum Institute, the National Association of Manufacturers, and the U.S. Chamber of Commerce (Table A.2), casting doubt on the sincerity of their pro-legislative stance. Due to a perceived conflict of interest, several of the USCAP members from the energy sector distanced themselves from ACCCE in 2009 (DeMelle, 2009). However, in 2010, five of the thirteen FFI USCAP members were still members of at least one of the four CCCM advocacy groups mentioned above.

by a notable rise in testimonies by industry allies and "climate change skeptic scientists" (McCright and Dunlap, 2000) and this analysis aims to investigate if there is a similar pattern ahead of the defeat of the Waxman-Markey bill, including potential links to FFI money. While there have been investigations into climate change lobbying (Kim et al., 2016; Delmas et al., 2016; Ard et al., 2017; Brulle, 2018) and climate change contrarianism in presidential and floor speeches (Farrell, 2016a; Guber et al., 2020) for the period under investigation, there has not yet been an analysis of CCCM influence on the crucial committee stage.

Specifically, we investigate the extent to which known climate-change contrarian witnesses were able to testify at congressional hearings on cap-and-trade legislation and climate-change science from 2003 to 2010. Additionally, we explore if these contrarians were able to obtain disproportionate access to central hearings, if scientists known to deny the scientific consensus were over-represented, and if FFI money appears to buy access for contrarian witnesses.

Under the assumption that contrarians strive to testify at hearings held by key committees with jurisdiction over one of the cap-and-trade bills (Table A.1), where their potential influence on the legislation is highest, we test if contrarians are successful in obtaining this access and have disproportionate representation in these committees compared to all others.

H1: The mean proportion of contrarian witnesses is higher at cap-and-trade hearings in key committees compared to all other committees.

Next, we evaluate whether climate change denialist views were disproportionately represented in comparison to mainstream scientific views. Denialist witnesses are those who have publicly rejected the established scientific consensus on climate change, in contrast to contrarian witnesses, who encompass individuals actively working against climate policy (Howarth and Sharman, 2017). The precise level of denialist testimonies constituting over-representation is open to debate. Numerous studies of the peer-reviewed scientific literature have shown that roughly 97% of climate researchers endorse the scientific consensus on anthropogenic global warming (Oreskes, 2004; Doran and Zimmerman, 2009; Cook et al., 2013; Anderegg et al., 2010), although Doran and Zimmerman (2009) suggest that the level of agreement drops to roughly 82% when considering all Earth scientists (i.e., those both with and without expertise in climate science). As such, a suitable estimate for over-representation is that testimonies by witnesses that are known to have made claims in the four categories "it's not happening", "it's not us", "it's not bad", and, "climate science/scientists are unreliable" (Coan et al., 2021) should not exceed 3% of all scientific testimonies, while a threshold of 18% offers a conservative test of our expectations. We hypothesise that denialists exceed these numbers and are thus over-represented at congressional cap-and-trade hearings.

H2: The mean proportion of denialist testimonies out of all scientific testimonies at cap-and-trade hearings exceeds 3% (18%), indicating over-representation compared to the scientific consensus.

Finally, we hypothesise that contrarian witnesses are more likely to gain access to these hearings through funding from the FFI.<sup>2</sup> To disentangle the effect of FFI expenditures from other effects, we consider various control variables, namely committee type, congressional majority status, the specific committee hosting the hearing, and the half-

<sup>2</sup> We are only focusing on pre-categorised FFI funding in this analysis while ignoring CCCM funding, which has no existing category in the OpenSecrets classification system (see Section 2.1.3). CCCM advocacy groups with close ties to the FFI are included in this FFI funding category, for example, the American Petroleum Institute. On the other hand, funding from conservative foundations and think tanks that also form part of the CCCM is not included. However, a review of the money expended by these donors indicates that the amounts are comparatively negligible.

year term during which the hearing took place.

H3: FFI expenditures, both in the form of lobbying expenditures (H3a) and campaign contributions (H3b), positively correlate with the mean proportion of contrarian witnesses at cap-and-trade hearings.

A known problem when investigating interest group influence on the legislative process is the lack of transparency. While federal lobbying must be registered and lobbying expenditures above a certain threshold reported, specific communications between lobbyists and MoCs are not required to be disclosed (Straus, 2015). The witness invitation process is similarly opaque. Committee members from the majority party will usually coordinate witness invitations with members of the minority party to ensure that all relevant points of view are heard (Davis, 2015; Heitshusen, 2017). Yet, who proposes to invite who remains undisclosed. Thus, even campaign contributions, that can be traced from the donor to a specific MoC, cannot directly be linked to witness invitations. The available data limit our analysis to the hearing level and prohibit individual-level causal inference (Fig. 1). Nevertheless, an analysis at the aggregate level provides detailed insight into the congressional debate on climate change legislation by disclosing who was granted access to contribute their views and can reveal aggregate-level links between FFI funding and contrarian witnesses. Specifically, we can analyse if mean FFI lobbying at the time of the hearing and mean campaign contributions received by the MoCs on the committee holding the hearing positively correlate with the proportion of contrarian witnesses that are invited to testify at cap-and-trade hearings.

## 2. Material and methods

The following sections summarise the data and methods used in the study at hand.

### 2.1. Data

Data from multiple sources were combined for this analysis. The following sections describe which data was used and how it was handled for this analysis.

#### 2.1.1. Congressional hearings

We obtained 12090 congressional hearings held from the 108<sup>th</sup> and the 111<sup>th</sup> Congress (2003–2010) by scraping the govinfo database (U.S. Government Publishing Office, 2022). To narrow down the data to the relevant hearings on climate change or cap-and-trade legislation, we established three criteria. To be included a hearing had to:

- A) mention either the term *climate change* or *global warming*,
- B) contain a climate-focus keyword (Table A.3) in the title – or –
- contain more than ten cap-and-trade keywords (Table A.3) in the text,
- C) have at least one witness giving testimony.

We conducted a thorough evaluation of the relevance of the 255 hearings that ensued, excluding those only tangentially touching upon carbon emissions cap-and-trade policies or climate science. This process led to a final selection of 117 hearings.

#### 2.1.2. Witnesses

Committees invite expert witnesses to testify at their hearings. We identified 855 witnesses at the 117 hearings by extracting their names and affiliations from the transcripts. These witnesses were categorised

using the *Open Secrets* coding system for federal lobbying, which includes 13 sectors and 134 subordinate industries (Center for Responsive Politics, 2022c). We extended this system with three new categories: “Individuals”, “International/Intergovernmental”, and “Nuclear Energy”. Around 42% of witnesses were automatically classified by matching their affiliations with the relevant industry’s list of lobbying clients. The remaining witnesses were classified manually. The classified witnesses were aggregated into eight categories (Fig. 2):

- (1) *Alternative Energy*, includes producers of renewable energy like solar, wind, and geothermal power, as well as renewable fuels and nuclear energy (Clarke et al., 2022).
- (2) *Business & Services*, encompasses consulting, legal, financial, insurance, and real estate firms, along with the service industry and business associations.
- (3) *Carbon-Intensive Industry*, represents agribusiness, manufacturing, transportation, construction, and mining.
- (4) *Fossil Fuel Industry (FFI)*, covers electric utilities, the oil and gas industry, and coal mining.
- (5) *Non-Profit Organisations*, includes workers’ unions, think tanks, civil society groups, and other non-profit organisations.
- (6) *Scientists*, comprises university and government researchers, including organisations like NOAA, National Laboratories, and NASA.
- (7) *Government Officials*, encompasses civil servants, public officials, administrators, city and state officials, tribal governments, as well as their councils, committees, commissions, and associations, and elected MoCs when testifying as a witness.
- (8) *Other*, includes individuals, international or intergovernmental representatives, and religious organisations.

Additionally, we identified *climate change contrarians* by cross-referencing the witnesses with lists of known contrarians and CCCM organisations (DeSmog, 2022b), along with a compilation of contrarian organisations by Farrell (2016b). Finally, we manually pinpointed contrarian witnesses who are *climate change denialists*, individuals who have publicly contested the well-established consensus on anthropogenic climate change.

#### 2.1.3. Committee members, campaign contributions and lobbying

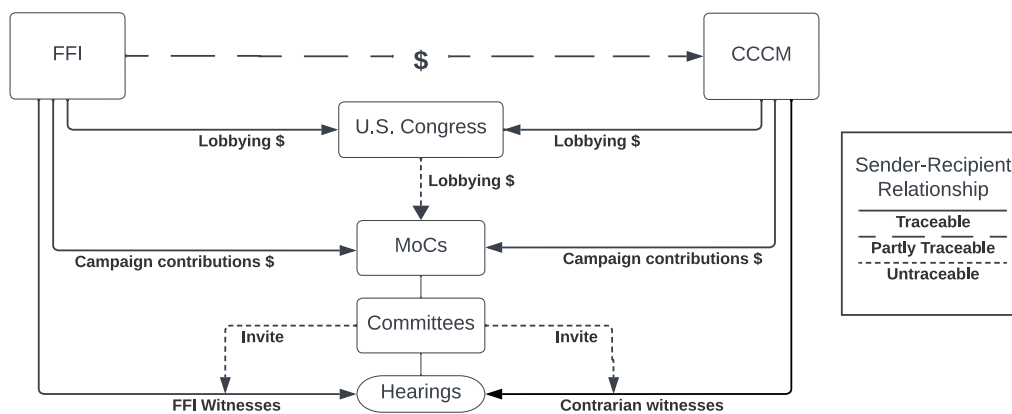
For each hearing, we collected data about the committee holding the hearing. We identified the serving MoCs using the *Congressional Assignment Data* files (Stewart and Woon, 2017) and complemented this information with OpenSecrets identifiers (unitedstates, 2022) for committee members, matched campaign contributions, including those from the FFI, within the relevant two-year congressional term (Center for Responsive Politics, 2022a), and included congressional lobbying expenditures for the corresponding term, covering both total expenditures and those specific to the FFI (Center for Responsive Politics, 2022d). The FFI funds were subset using sixteen OpenSecrets codes specific to this industry (Table A.4).

#### 2.1.4. Variables

The unit of analysis for the models in this study is the hearings. The dependent variable is the proportion of *contrarian witnesses*. The independent (IV), control (CV), and cluster (CLV) variables (descriptive statistics in Table A.5) are operationalised as follows:

- (1) *FFI campaign contributions (in \$1 M)*: FFI campaign contributions, in million dollars, received by all committee members during the two-year congressional term of the hearing. We utilise contributions spanning the entire term as a proxy for the ongoing





**Fig. 1.** The various ways of the FFI and the CCCM to influence Congress and the congressional debate. As indicated, not all important links are directly traceable. As such, it is unclear which MoCs were lobbied and which MoCs invited whom to testify at the congressional hearings.

collaboration between industry donors and committee members, capturing the potential influence associated with the promise of future donations (IV).

- (2) *FFI lobbying (in \$1 M)*: Fossil fuel industry lobbying expenditures, in million dollars, during the half-year term of the hearing (IV).<sup>3</sup>
- (3) *Committee type*: Committees with jurisdiction over any of the cap-and-trade bills in the sample (Table A.1) are categorised as key committees (IV for H1 and CV for H3).
- (4) *Majority*: The party with majority status in both congressional chambers (CV) at the time of the hearing.
- (5) *Committee*: The committee holding the hearing (CLV).
- (6) *Time*: The half-year term when the hearing was held (CLV).

## 2.2. Model specification

The proportion of contrarian witnesses is a binomial response variable, representing the number of successes (contrarian witnesses) in a sequence of trials (witness invitations to the respective hearing) (Agresti, 2019). Accordingly, we model it with a generalised linear model (GLM) with binomial link function. Model fit is assessed with the squared Pearson correlation  $r^2$  of the empirical correlation between the observed and predicted outcomes (Mittlböck and Schemper, 1996). Due to the clustered nature of the data (hearings nested in committees/hearings nested in time), the independence assumption may be violated. Seeing that the contextual effects are not of interest here, the level two

<sup>3</sup> We did not subset lobbying expenditures by specific issues mentioned in the lobbying report. While other research on climate lobbying has done so (Kim et al., 2016; Delmas et al., 2016; Brulle, 2018), our focus here is solely on lobbying by the FFI. It's reasonable to assume that the majority of FFI lobbying efforts are related to energy and environmental issues. Data limitations also played a role; around 30% of FFI lobbying reports lacked specific issue descriptions, with an uneven distribution over time (91%, 54%, 13%, and 7% of reports had missing issue data in the 108<sup>th</sup>, 109<sup>th</sup>, 110<sup>th</sup>, and 111<sup>th</sup> Congress, respectively). Excluding these contributions would introduce a systematic bias into the analysis. Additionally, relying solely on a keyword search for cap-and-trade might miss reports with vague issue descriptions, such as "Represented the client on various energy and environmental issues.". Examining lobbying expenses rather than the number of filed reports reveals that the bulk of the funding was allocated to lobbying activities associated with cap-and-trade bills. To be precise, 87% of the expenses reported in only 50% of the 8300 lobbying reports could be linked to cap-and-trade issues. Ultimately, it is assumed that all contacts between FFI lobbyists and MoCs strengthen their relationship, regardless of the specific issue discussed, thus increasing the chances of placing a witness representing the FFI's interest at hearings. It's important to note that subsetting the data by issue did not significantly alter the model's conclusions. The code used for this analysis is available for replication and further exploration.

clusters are considered noise that needs to be parcelled out (Huang, 2016). This is achieved by estimating two additional types of models, first GLMs with HCO cluster robust standard errors (sandwich estimators) (Zeileis, 2006; Zeileis et al., 2020; Zorn, 2006) and second GLMs using generalised estimating equations (GEE) (Hanley, 2003; Hardin and Hilbe, 2013; Zorn, 2006). According to (Zorn, 2006) "the differences between GEE and more traditional GLM models with robust variance estimates appear to be less important, at least for inference, than are choices about the unit on which observations are grouped". With that in mind, we explored two potential clustering variables: the 18 committees as well as within time (15 half-year terms, as no relevant hearings were held in term two of 2004). Additionally, we estimated robust standard errors with multi-way clustering (within committees and time). Lastly, we further assessed the robustness of our findings by estimating models with a weighted version of the *FFI campaign contributions*, giving additional weight to committee members from the majority party and with seniority status (Stewart and Woon, 2017, see codebook for senior party member variable definition). Since all models yield consistent results for the main effects and most control variables, we only present the unweighted base model with classic and multi-way cluster robust standard errors in the results section. The other models can be found in the appendix (A.10). Testing has confirmed that the base model with robust standard errors satisfies all relevant assumptions.

## 3. Results

The climate change debate in Congress clearly reflects the political power dynamics (Fig. 3). Between 2003 and 2006 when both Congress and the presidency were under Republican control, the debate simmered along without any sharp peaks of activity. However, following the transition of congressional power from Republican to Democratic hands in 2007, the debate gained considerable momentum and maintained this heightened level of activity throughout the subsequent congressional cycle when Barack Obama won the presidency. This surge in the congressional debate is evident through a substantial increase in climate change and cap-and-trade policy hearings. While only 17 such hearings were held in the four years from 2003 to 2006, this number rose to 100 in the following four years. Two distinct peaks of activity emerge: one aligning with the first months of the Democratic Congress in early 2007 and coinciding with the release of the Fourth IPCC Assessment Report (IPCC, 2007), and a second peak in 2009, surrounding the introduction of ACES and the 2009 United Nations Climate Change Conference (UNFCCC, 2022). Similar to the increase in hearings, there was a noticeable uptick in the number of proposed cap-and-trade bills during the Democratic-controlled Congresses. This rise in legislative proposals was particularly pronounced immediately following the shift in congressional power in 2007 and reflects the optimism towards passing

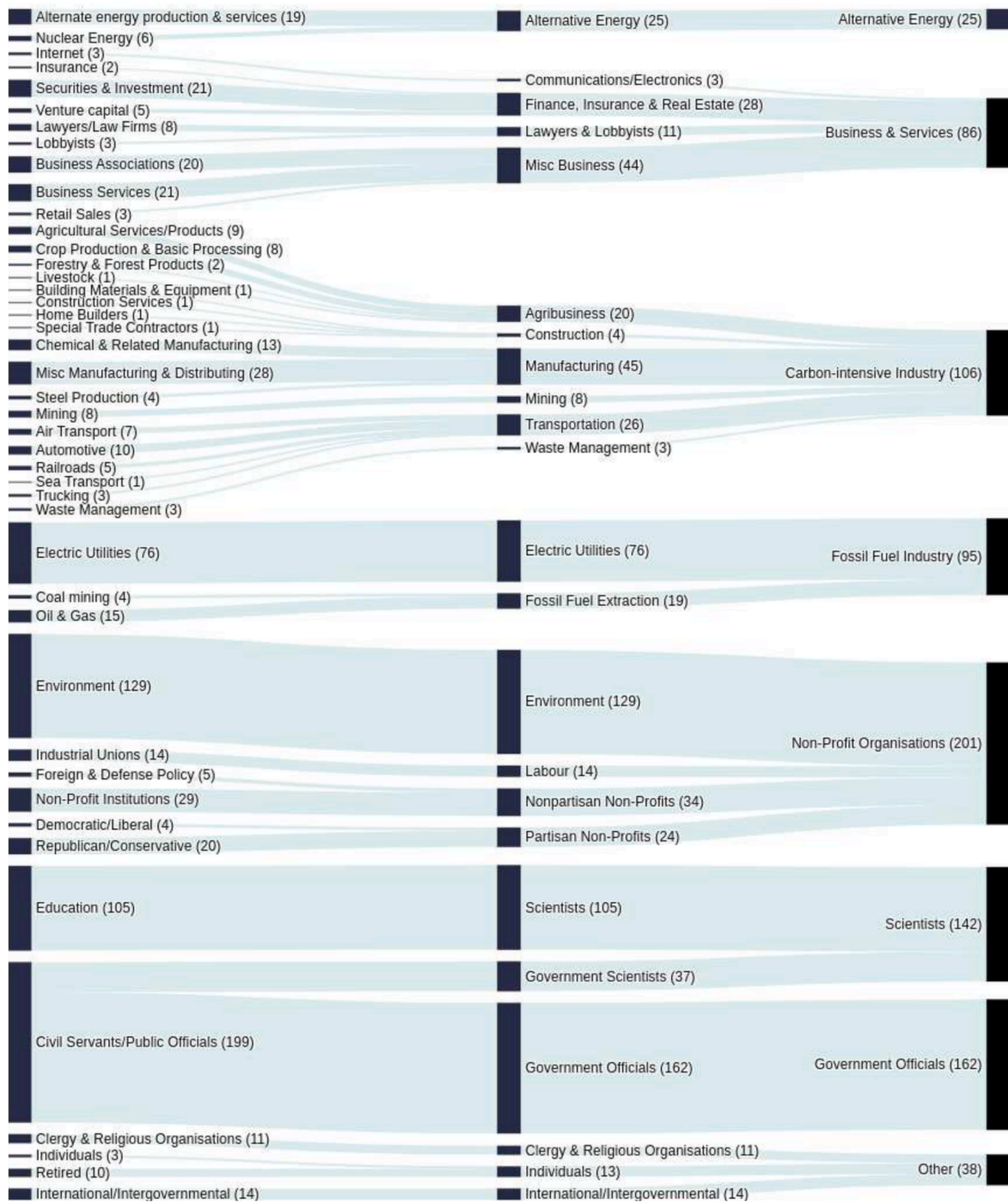


Fig. 2. Witness overview: Step-wise witness aggregation from the *Open Secrets* industry affiliations (left) to subcategories (middle) and categories (right) with witness counts in brackets.

climate legislation during that period.

### 3.1. Witnesses at cap-and-trade hearings

The surge in hearings after 2007 entailed a pronounced increase in experts testifying at hearings during the 110<sup>th</sup> and 111<sup>th</sup> Congress. Yet, the distribution across the eight witness categories remained surprisingly stable (Fig. 4). Business, service and industry witnesses

consistently made up between 31% and 40% and thus, taken together, constituted the largest group of witnesses. Notably, with 8%, alternative energy witnesses only accounted for a small fraction of these industry witnesses. Non-profit organisation witnesses, predominantly from environmental groups, constituted between 17% to 26% of witnesses. This proportion was highest during the 111<sup>th</sup> Congress, when the Waxman-Markey bill was being debated, primarily driven by a rise in contrarian witnesses from non-partisan and partisan non-profits.

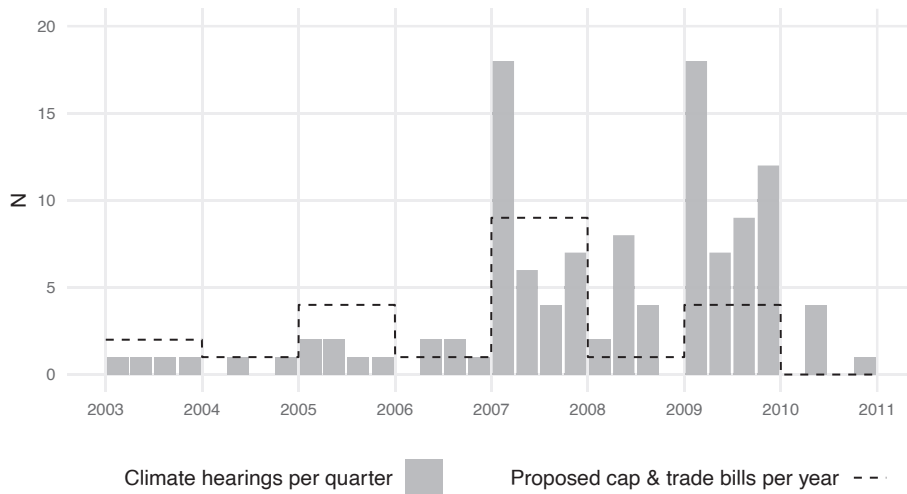


Fig. 3. Quarterly number of climate change and cap-and-trade policy-related hearings from 2003 to 2010 (grey bars) and yearly number of cap-and-trade policy bills proposed in the U.S. Congress.

Scientists made up between 13% to 28% of witnesses, roughly a quarter of which came from federal research agencies such as the National Oceanic and Atmospheric Administration. The remaining witnesses were mostly government officials, with only very few witnesses falling into the *Other* category.

3.2. Contrarian witnesses

A total of 91 contrarian witnesses were identified, more than 10% of all witnesses heard. Around 45% of these were industry witnesses from the *Business & Services* (N = 16), *Carbon-intensive* (N = 12) and *Fossil Fuel* (N = 11) industries. The large majority of these contrarian industry witnesses were associated with business and trade associations and other industry advocacy groups, e.g. the American Council for Capital Formation, the Industrial Energy Consumers of America, or Edison Electric Institute (Table A.6). Another 26% of the contrarian witnesses represented conservative *Non-Profit Organisations* (in descending order: American Enterprise Institute, Competitive Enterprise Institute, Heritage Foundation, Cato Institute, Science and Public Policy Institute,

Business & Media Institute, Copenhagen Consensus Center, FreedomWorks, National Black Chamber of Commerce). Lastly, 20% of contrarian witnesses were contrarian *Scientists* employed at Universities (and one non-profit research foundation) while the remaining 8% were other known contrarians not affiliated with any specific advocacy group. Importantly, these contrarian witnesses did not replace the FFI testimonies, as only twelve of the contrarian witnesses directly represented FFI organisations, while the remaining 79 contrarian witnesses were affiliated with other CCCM organisations.

The mean proportion of contrarians at hearings in key committees (M = 14.4%, SD = 17.6) with jurisdiction over any of the proposed cap-and-trade bills was significantly higher compared to hearings in other committees (M = 5.9%, SD = 10.8), supporting H1 and indicating that contrarians may get disproportionate access to key hearings (Welch one-tailed two-sample t-test:  $t(113.96) = 3.21, p < .001$ ).

Approximately half of the contrarians were climate change denialists who had at some point publicly challenged the scientific consensus on climate change. Despite the marginal nature of denialist views, there were 45 denialist testimonies compared to 123 from conventional

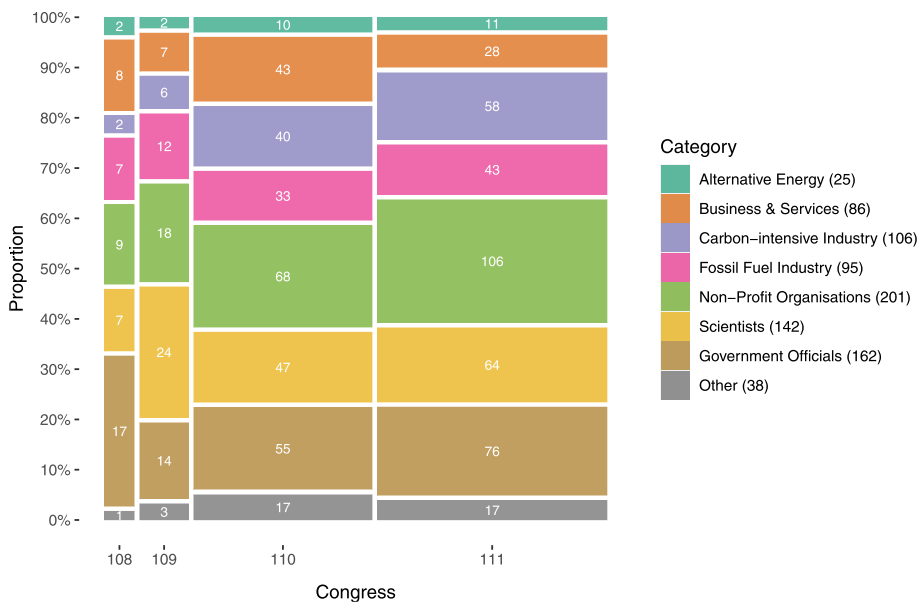


Fig. 4. Proportion of testimonies per witness category for each of the four two-year congressional cycles from 2003 to 2010 (N = 855 witnesses). Absolute numbers inside of each mosaic tile and category totals in legend. Categories in the plot follow the same order from top to bottom as in the legend.

scientists (Fig. 5), meaning that for every three scientific testimonies, at least one denialist testimony was heard.

The mean proportion of denialist testimonies ( $M = 27.7\%$ ,  $SD = 36.7$ ) out of all scientific testimonies was significantly higher than the proportion of scientists who hold denialist views within the scientific community, both compared to the more conservative threshold of 18% for Earth scientists questioning that climate change is caused by humans (One-tailed one-sample t-test:  $t(66) = 2.15, p < .02$ ), let alone the 3% of experts in climate science (One-tailed one-sample t-test:  $t(66) = 5.50, p < .001$ ). This supports H2 that denialist views are over-represented at cap-and-trade hearings. At hearings in key committees, the over-representation was even more pronounced ( $M = 35.8\%$ ,  $SD = 39.0$ , One-tailed one-sample t-test compared to 18%:  $t(43) = 3.02, p < .002$ ; compared to 3%:  $t(43) = 5.58, p < .001$ ).

### 3.3. FFI funding over time

The energy and natural resources sector is the fifth largest lobbying sector in the U.S. (Center for Responsive Politics, 2022e), spending hundreds of millions of dollars on lobbying the U.S. Congress and financing the election campaigns of (prospective) MoCs every year. In the period from 2003 to 2010, FFI lobbying expenditures amounted to \$1.85 billion, corresponding to approximately 8% of all money spent on congressional lobbying. The heightened efforts to pass climate legislation after 2007 are reflected in a marked increase in FFI lobbying (Fig. 6, top).

After relatively constant FFI lobbying expenditures of around 7% of total expenditures from 2003 to 2007, they increased to around 10% in 2008 and remained at that level up to and including 2010. Notably, more than a quarter of these lobbying expenditures were made by only five companies: Exxon Mobil, PG&E Corporation, Southern Co, Edison Electric Institute and Chevron Corporation (Table A.7). Moreover, the major contributors comprise FFI industry heavyweights, with all five investor-owned entities responsible for the highest levels of historical CO2 and methane emissions up to 2010 (Heede, 2014, Supplementary material) heavily involved in federal lobbying during that period.

The same trend is observable for FFI campaign contributions to MoCs running for reelection (Fig. 6, bottom). While the annual contributions oscillate with higher contributions in election years, the overall trend is positive. Around 56% of the \$114 K FFI contributions were made to MoCs on committees holding at least one cap-and-trade-related hearing. They received significantly higher mean FFI campaign contributions ( $M = 68499$ ,  $SD = 98871$ ) than other MoCs ( $M = 40463$ ,  $SD = 65346$ ; Welch Two-Sample t-test:  $t(1509.7) = 7.5, p < .001$ ), indicating a careful allocation of FFI funds.

Narrowing the analysis down the committee members at the hearings in this sample reveals that the FFI spent significantly higher sums on

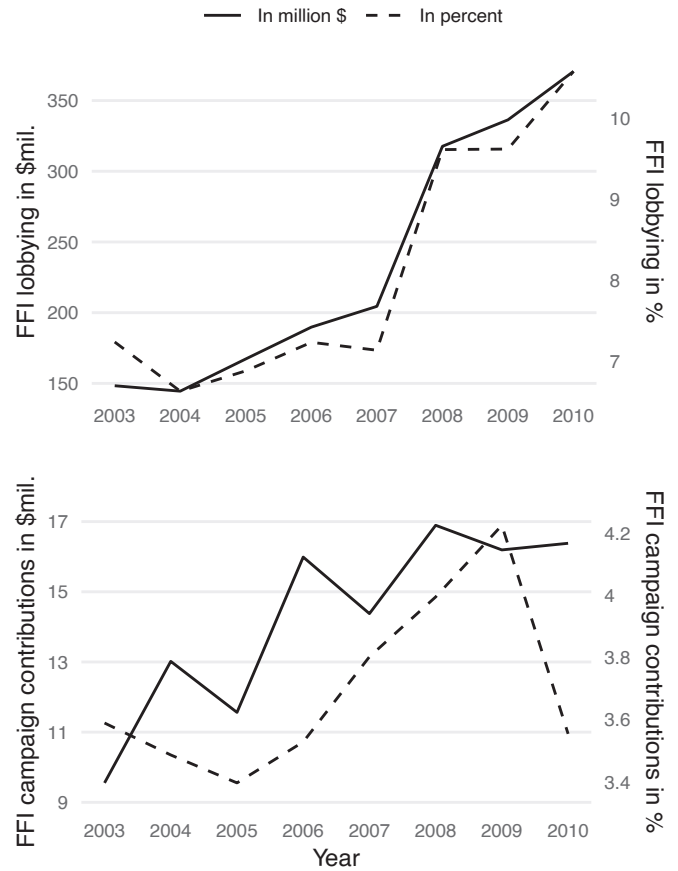


Fig. 6. Top: Yearly fossil fuel industry (FFI) congressional lobbying over time in million \$ (solid line, left axis) and in per cent of the total congressional lobbying expenditures that year (dashed line, right axis). Bottom: Yearly FFI campaign contributions to MoCs running for reelection in million \$ (solid line, left axis) and in per cent of the total campaign contributions to these MoCs in the same year (dashed line, right axis).

supporting Republican committee members ( $M = \$1.59$  M,  $SD = 0.91$ ) compared to Democratic ones ( $M = \$1.25$  M,  $SD = 0.91$ ; Welch Two-Sample t-test:  $t(232) = 3, p < .01$ ). The same holds for supporting committee members on key committees ( $M = \$3.27$  M,  $SD = 1.86$ ) compared to the ones on the other committees ( $M = \$2.05$  M,  $SD = 1.16$ ; Welch Two-Sample t-test:  $t(113) = 4, p < .001$ ).

The largest campaign contributions to MoCs on cap-and-trade related hearings were made by PACs, with the following top 5 contributors: National Rural Electric Cooperative, Koch Industries, Exelon,

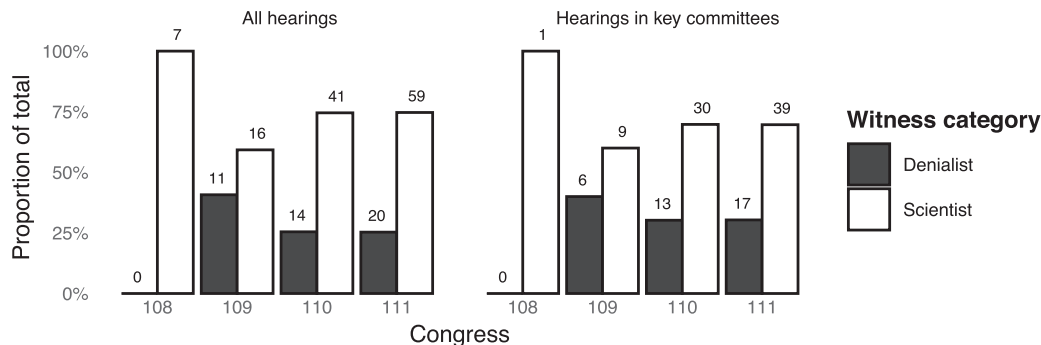


Fig. 5. Denialist and conventional scientist testimonies by congressional term for all hearings ( $N = 107$ ; left) and for hearings in key committees ( $N = 77$ ; right), i.e. committees with jurisdiction over one of the cap-and-trade bills. The bars show the percentage of the total denialist and scientist testimonies in each congress, with the absolute number of testimonies at the top of each bar.



ExxonMobil, and Florida Power & Light Co. (Table A.8). These findings show that the FFI industry swiftly reacted to the potential threat of a meaningful climate bill by increasing their lobbying activities as well as their re-election campaign funding of MoCs, especially targeting MoCs on the committees with jurisdiction over the very legislation.

### 3.4. Does FFI funding correlate with access?

Our models find a significant relationship between FFI funds and access for contrarian witnesses to testify at congressional cap-and-trade hearings (Table 1, RSE), supporting H3. We find a significant positive association between FFI lobbying expenditures and the proportion of contrarian witnesses across all our models, in clear support of H3a. The picture is, however, more varied for the FFI campaign contributions. While there is clear evidence of a significant positive effect of campaign contributions in the House (Model 2), this effect is only significant at the 10% level in the Senate (Model 3), indicating mixed support of H3b. However, a model for the Senate where campaign contributions were weighted by committee member majority status and seniority finds a significant positive effect on the proportion of contrarians testifying at Senate hearings (Table A.9), indicating that contributing to campaigns of powerful committee members may be a particularly successful strategy in the Senate. Furthermore, the model predicts a significantly higher proportion of witnesses when there is a Republican majority in Congress. Similarly, we find a significantly higher proportion of contrarians at hearings held by key committees with jurisdiction over climate legislation compared to other committees in the Senate, while the same does not hold for the House, providing more nuanced support for H1.<sup>4</sup>

Note that the cluster robust standard errors are noticeably smaller than the naïve standard errors. This phenomenon occurs when there is negative within-cluster correlation, for example “when individuals compare [sic] for a scarce (and fixed) set of resources, the speaking time of one individual is at the expense of another individual (i.e. ‘one’s pain is the other’s gain’)” (Nielsen et al., 2021). In our model, interest groups are competing for a limited number of spaces to testify at hearings. This competition is exacerbated by the aim to represent a range of opinions, making it less likely that similar witnesses will be called multiple times by the same committee or within the same half-year term. Another explanation could be that advocacy groups temporarily reduce their efforts to get a specific witness to testify after a successful invitation. The fact that naïve standard errors are markedly different from the cluster robust ones confirms that the former are biased due to the cluster non-independence. Consequently, only the robust standard errors should be interpreted.

While all independent and control variables in the model for the entire Congress (Model 1) are significant, their effect sizes vary considerably.<sup>5</sup> The model predicts the largest effect for the congressional majority status, indicating a 19.5% rise in the proportion of contrarian witnesses in a Republican-led Congress compared to a Democratic-led one, holding all else constant. Following closely is the effect of FFI lobbying expenditures, with a predicted increase of 17.4% when varying the lobbying expenditures from the minimum to the maximum. The committee type ranks third in terms of effect size with a predicted increase in contrarian witnesses of around 9.3% in key compared to other committees. Lastly, the smallest effect is predicted for the FFI campaign contributions with an increase of only 5.8% when varying the campaign

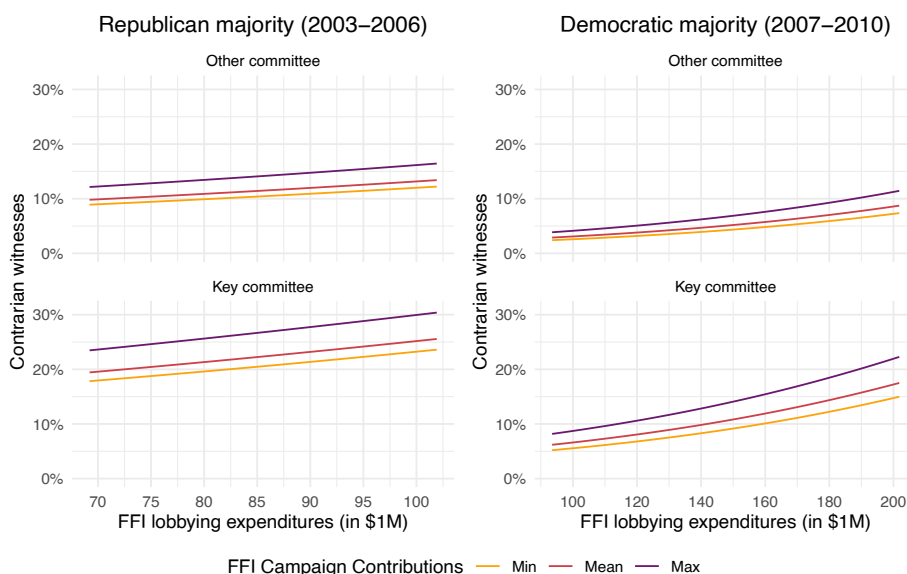
<sup>4</sup> Model 1 re-estimated excluding campaign contributions and lobbying expenditures by USCAP members stayed virtually the same (Table A.10).

<sup>5</sup> The effect sizes were measured as the difference in the predicted proportions of contrarian witnesses, calculated as marginal means (Lüdecke, 2018) when varying the variable of interest from the minimum to the maximum observed value or by category while holding all other variables constant at the mean.

**Table 1** Logistic regression models estimating the log-odds of the proportion of climate change contrarian witnesses at cap-and-trade related hearings from 2003 to 2010. Additionally to the naïve standard errors (SE), multiway cluster robust standard errors (RSE) clustered within committees and half-year terms are presented. Model 1 is estimated on cap-and-trade hearings held in either congressional chamber, while Model 2 is limited to the House of Representatives and Model 3 to the Senate.

	Model 1: Congress				Model 2: House				Model 3: Senate					
	$\hat{\beta}$	SE	z	RSE	$\hat{\beta}$	SE	z	RSE	$\hat{\beta}$	SE	z	RSE	z	
FFI campaign contributions (in \$1 M)	0.08	0.06	1.40	0.03	0.16	0.09	1.73	†	0.04	0.68	0.42	1.61	0.40	1.69
FFI lobbying (in \$1 M)	0.01	0.00	2.44	*	0.01	0.01	1.99	*	0.00	0.01	0.01	1.38	0.00	3.68
Committee type: Key committee	0.80	0.31	2.59	**	-0.12	0.57	-0.20	0.30	0.30	1.87	0.69	2.71	**	0.61
Majority: Republican	1.63	0.41	3.95	***	2.15	0.59	3.63	***	0.01	1.46	0.60	2.42	*	0.33
Intercept	-4.77	0.74	-6.44	***	-4.54	1.04	-4.34	***	0.14	-6.51	1.77	-3.68	***	-4.22
Null deviance	144.18 (df = 116)				71.50 (df = 57)				70.95 (df = 58)					
Residual deviance	121.38 (df = 112)				54.54 (df = 53)				57.41 (df = 54)					
Pearson $\chi^2$	.252				.326				.278					
N	117				58				59					

Signif. codes: \*\*\*p < .001, \*\*p < .01, \*p < .05, †p < .1



**Fig. 7.** Model 1 predicted proportions of contrarian witnesses (conditional effects) for the congresses with a Republican majority (left) versus Democratic majority (right), depending on fossil fuel industry (FFI) lobbying, FFI campaign contributions, and committee-type. To avoid extrapolation, FFI lobbying and campaign contributions were confined to the respective values observed during each majority phase. Therefore, FFI lobbying is presented on different scales. Similarly, the minimum, mean, and maximum campaign contributions represent the respective values observed in each phase (Republican majority: \$0.84 K, \$2.1 K, \$4.96 K; Democratic majority: \$0.75 K, \$2.96 K, \$6.54 K).

contributions from the minimum to the maximum. Fig. 7 illustrates the predicted proportion of contrarian witnesses for different combinations of the independent and control variables.

#### 4. Discussion and conclusion

Taken together, these results are akin to a puzzle that gradually reveals an image but is still missing a good part of its pieces – lost in the black box of congressional policy-making. From 2003 to 2010, cap-and-trade legislation took centre-stage in the congressional debate, backed by a multitude of stakeholders and further supported by a Democratic majority in both congressional chambers. Simultaneously, the organisations standing to lose the most from binding emissions limits dramatically intensified their attempts to influence Congress, increasing both their campaign contributions and lobbying expenditures. The campaign contributions reveal that the money reaches exactly the right people, as MoCs on committees holding these hearings receive comparatively much higher contributions from the FFI than other MoCs, especially on the key committees. While this evidence is consistent with the finding that lobbying efforts will be carefully targeted, this finding must be interpreted with caution, as lobbying expenditures cannot be traced to individual MoCs – the first missing piece. We also find that these contrarian and denialist witnesses have an especially high presence in the key committees with jurisdiction over one or more of the cap-and-trade bills proposed at the time, indicating that the CCCM manages to get their people exactly into the right places to maximally obstruct climate legislation. Importantly, these witnesses cannot simply invite themselves but rather get granted access by committee members, at least some of whom received a meaningful proportion of their campaign contributions from the FFI (up to 35%). Yet again, seeing that it is not public who exactly invited these witnesses, we cannot directly link these invitations to the FFI funds – the second missing piece. More generally, in line with an extensive literature on interest groups and lobbying transparency (see, for example, Holman and Luneburg, 2012), these results speak to the ways in which a lack of transparency in legislative processes undermines efforts to support meaningful action on climate change by making it difficult – if not impossible – to assess interest group influence and hold legislators accountable.

We are thus left with only a birds-eye view and yet our general

findings paint a clear picture: the more money the FFI spends on congressional lobbying activities, the more climate change contrarians get to testify at hearings debating climate legislation. We need to tread carefully here to avoid committing an ecological fallacy. The available aggregate data does not allow us to infer that FFI money directly bought access for contrarian witnesses at the individual level. There is no way to know if the interest groups spending money on lobbying are spending this money to lobby the specific MoCs that end up inviting the contrarian witnesses. It is useful, however, to consider exactly what an ecological fallacy in this case would imply: namely that MoCs are unaffected by FFI lobbying or even less likely to invite contrarian witnesses the more they get lobbied by the FFI. It could even be the case that only MoCs that were not at all lobbied by the FFI invited contrarian witnesses. However, this notion seems to lack common sense, not least because it would be unreasonable for the FFI actors to continue investing their money and time if they did not achieve any results with their actions.

In any case, we can conclude that on average the more money the FFI spent on lobbying activities, the more contrarian witnesses were granted access to hearings on cap-and-trade and we argue that this played an important role in blocking the passage of any cap-and-trade legislation. Throughout the entire eight-year period contrarians were able to testify and made up around 10% of all testimonies. In addition, we find a distinct over-representation of denialist voices, with one denialist testimony being heard for every three scientific testimonies. At hearings in key committees, this over-representation was even higher, with one denialist testimony being heard for every two scientific testimonies, far exceeding the proportion of denialist views in the peer-reviewed literature. Akin to the false balance bias in the news media (Boykoff and Boykoff, 2004), this constitutes an information bias making a scientific debate beyond dispute appear contested and creating uncertainty around the veracity and severity of climate change. Yet it is not only science denialists that constitute the problem, as more subtle tactics employed by other contrarians such as proclaiming that climate solutions will not work (Coan et al., 2021) or reiterating other discourses of climate delay (Lamb et al., 2020) may be equally (if not more) detrimental to climate legislation. Consistent with previous scholarship (McCright and Dunlap, 2003; Brulle, 2018), we find that contrarian witnesses originate from a range of business and non-business interests,

suggesting that contrarian voices are not only over-represented in the scientific discourse but also over-represented among actors in key positions of power across a range politically influential sectors. Further, considering the competitive advantage of defenders of the status quo in Congress (Baumgartner et al., 2009), it is essential to acknowledge that one in ten voices potentially dismissing the need for climate legislation is a considerable force in the ongoing struggle for attention and prioritisation in Congress. To gain further insight into the debate, the next step is to analyse the contrarian testimonies in-depth and assess how widely contrarian claims are spread throughout the entirety of testimonies.

We acknowledge that a multitude of factors will have contributed to the defeat of the Waxman-Markey bill, for example, the fact that the Democrats never truly appear to have championed cap-and-trade in their floor speeches at the time, while the Republicans vigorously argued against it (Guber et al., 2020). Yet, we believe that the continuous and targeted presence of contrarian and denialist voices at congressional hearings on cap-and-trade legislation is a testament to the efforts of the FFI to obstruct binding emission targets and that these efforts likely played a decisive role in hindering the legislation. To date, the defeat of cap-and-trade has been effective and lasting. Few cap-and-trade bills were introduced after 2010 (Price on Carbon, 2020), none of which gained much traction. FFI lobbying expenditures declined since peaking in 2010 (Center for Responsive Politics, 2022f), suggesting that there was no threatening legislation to oppose, and business continued as usual. Still, no federal binding emissions limits have been introduced, and while coal production has approximately halved since 2010, natural gas production has seen a 55% increase and crude oil production more than doubled (EIA, 2022a; EIA, 2022c; EIA, 2022b). While the U.S. has re-joined the Paris Agreement under President Biden in 2021, and committed to Nationally Determined Contribution targets for 2030 that are deemed “almost sufficient”, there remains sizeable gap in climate action in the US, which means that the policies currently in place do not suffice to meet the proclaimed domestic target (Climate Action Tracker, 2023). As the price of inaction rises with every passing day, meaningful action is more pressing than ever.

#### CRedit author statement

**Mirjam O. Nanko:** Conceptualization, Methodology, Investigation, Data Curation, Formal analysis, Validation, Writing - Original Draft, Writing - Review & Editing, Visualization, Project administration, Funding acquisition. **Travis G. Coan:** Conceptualization, Writing - Review & Editing, Supervision, Funding acquisition.

#### Funding sources

This work was supported by the Economic and Social Research Council in the UK via grant ES/P000630/1 awarded for the South West Doctoral Training Partnership (SWDTP). This funding is gratefully acknowledged.

#### Licence

For the purpose of open access, the authors have applied a Creative Commons Attribution (CC BY) licence to any Author Accepted Manuscript version arising from this submission.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Data availability

The data and code for replicating this analysis are available under <https://github.com/MirjamOdile/defeating-cap-and-trade>.

#### Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.gloenvcha.2024.102919>.

#### References

- Agresti, A., 2019. An Introduction to Categorical Data Analysis. Wiley series in probability and statistics. Third ed., John Wiley & Sons, Hoboken, NJ.
- Altman, P., 2009. Broad and diverse support for Waxman-Markey's American Clean Energy and Security Act. NRDC Expert Blog. Available at: <https://www.nrdc.org/experts/pete-altman/broad-and-diverse-support-waxman-markeys-american-clean-energy-and-security-act> [Accessed on October 17, 2022].
- Anderegg, W.R.L., Prall, J.W., Harold, J., Schneider, S.H., 2010. Expert credibility in climate change. *Proc. Nat. Acad. Sci.* 107, 12107–12109. <https://doi.org/10.1073/pnas.1003187107>.
- Ard, K., Garcia, N., Kelly, P., 2017. Another avenue of action: an examination of climate change countermovement industries' use of PAC donations and their relationship to Congressional voting over time. *Environmental Politics* 26, 1107–1131. <https://doi.org/10.1080/09644016.2017.1366291>.
- Banerjee, N., Song, L., Hasemyer, D., 2015. Exxon Believed Deep Dive Into Climate Research Would Protect Its Business. *Inside Climate News*. Available at: <http://insideclimatenews.org/news/16092015/exxon-believed-deep-dive-into-climate-research-would-protect-its-business> [Accessed on July 13, 2022].
- Baumgartner, F.R., Berry, J.M., Hojnacki, M., Leech, B.L., Kimball, D.C., 2009. *Lobbying and Policy Change: Who Wins, Who Loses, and Why*. University of Chicago Press, Chicago, London.
- Binder, S.A., Smith, S.S., 1997. *Politics or Principle?: Filibustering in the United States Senate*. Brookings Institution Press, Washington, D.C.
- Björnberg, K.E., Karlsson, M., Gilek, M., Hansson, S.O., 2017. Climate and environmental science denial: A review of the scientific literature published in 1990–2015. *Journal of Cleaner Production* 167, 229–241. <https://doi.org/10.1016/j.jclepro.2017.08.066>.
- Boussalis, C., Coan, T.G., 2016. Text-mining the signals of climate change doubt. *Global Environ. Change* 36, 89–100. <https://doi.org/10.1016/j.gloenvcha.2015.12.001>.
- Boykoff, M.T., Boykoff, J.M., 2004. Balance as bias: global warming and the US prestige press. *Global Environmental Change* 14 (2), 125–136. <https://doi.org/10.1016/j.gloenvcha.2003.10.001>.
- Burle, R.J., 2013. Institutionalizing delay: foundation funding and the creation of U.S. climate change counter-movement organizations. *Climatic Change* 122, 681–694. <https://doi.org/10.1007/s10584-013-1018-7>.
- Burle, R.J., 2018. The climate lobby: a sectoral analysis of lobbying spending on climate change in the USA, 2000 to 2016. *Climatic Change* 149, 289–303. <https://doi.org/10.1007/s10584-018-2241-z>.
- Burle, R.J., Hall, G., Loy, L., Schell-Smith, K., 2021. Obstructing action: foundation funding and US climate change counter-movement organizations. *Climatic Change* 166, 17. <https://doi.org/10.1007/s10584-021-03117-w>.
- Carlson, J., 1988. The Greenhouse Effect. [Exxon Memo]. Climate Files. Available at: <http://www.climatefiles.com/exxonmobil/566/> [Accessed on October 17, 2022].
- Center for Responsive Politics, 2022a. Campaign Finance Data. Available at: <https://www.opensecrets.org/open-data/bulk-data> [Accessed on July 13, 2022].
- Center for Responsive Politics, 2022b. CRP Categories. Available at: [https://www.opensecrets.org/downloads/crp/CRP\\_Categories.txt](https://www.opensecrets.org/downloads/crp/CRP_Categories.txt) [Accessed on November 28, 2022].
- Center for Responsive Politics, 2022c. Interest Group List. Available at: <https://www.opensecrets.org/industries/slist.php> [Accessed on July 13, 2022].
- Center for Responsive Politics, 2022d. Lobbying Data. Available at: <https://www.opensecrets.org/open-data/bulk-data> [Accessed on July 13, 2022].
- Center for Responsive Politics, 2022e. Ranked Sectors. Available at: <https://www.opensecrets.org/federal-lobbying/ranked-sectors?cycle=a> [Accessed on November 28, 2022].
- Center for Responsive Politics, 2022f. Sector Profile: Energy & Natural Resources. Available at: <https://www.opensecrets.org/federal-lobbying/sectors/summary?cycle=2022&id=E> [Accessed on November 26, 2022].
- Chicago Climate Exchange, 2002. About CCX. Available at: <https://web.archive.org/web/20020414191739/http://www.chicagoclimatex.com/html/about.html> [Accessed on October 6, 2022].
- Clarke, L., Wei, Y.M., Navarro, A., Garg, A., Hahmann, A., Khennas, S., Azevedo, I., Löschel, A., Singh, A., Steg, L., Strbac, G., Wada, K., Ameli, H., de La Beaumelle, N., Bistline, J., Byers, E., Calvin, K., Chawla, K., Cui, Y., Davis, S., DeAngelo, J., Dhar, S., Edge, J., Germeshausen, R., Hejazi, M., Jeffery, L., Iyer, G., Koivisto, M., McCollum, D., Muratori, M., Nemet, G., Patange, O., Santillan Vera, M., Singh, U., Sovacool, B., Stankeviciute, L., Ueckerdt, F., Uvo, C., van Soest, H., Veldstra, J., 2022. Energy systems, in: P.R. Shukla, J. Skea, R. Slade, A. Al Khouridajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley (Eds.), *Climate Change 2022: Mitigation of Climate Change*.



- Working Group III Contribution to the IPCC Sixth Assessment Report, Cambridge University Press, United Kingdom. pp. 613–746. <https://doi.org/10.1017/9781009157926.008>.
- Climate Action Tracker, 2023. USA: Policies & action. Available at: <https://climateactiontracker.org/countries/usa/policies-action/> [Accessed on November 6, 2023].
- Coan, T.G., Boussalis, C., Cook, J., Nanko, M.O., 2021. Computer-assisted classification of contrarian claims about climate change. *Scientific Reports* 11, 22320. <https://doi.org/10.1038/s41598-021-01714-4>.
- Cohen, R.E., Bell, P., 2007. Congressional Insiders Poll. *National Journal*. Available at: [https://web.archive.org/web/20070207105143/https://syndication.nationaljournal.com/images/203Insiderspoll\\_NJlogo.pdf](https://web.archive.org/web/20070207105143/https://syndication.nationaljournal.com/images/203Insiderspoll_NJlogo.pdf) [Accessed on November 6, 2023].
- Congress.gov, 1997. S.Res. 98 - A resolution expressing the sense of the Senate regarding the conditions for the United States becoming a signatory to any international agreement on greenhouse gas emissions under the United Nations Framework Convention on Climate Change. Available at: <https://www.congress.gov/bill/105th-congress/senate-resolution/98> [Accessed on October 18, 2022].
- Congress.gov, 2009. American Clean Energy and Security Act of 2009. Available at: <https://www.congress.gov/bill/111th-congress/house-bill/2454> [Accessed on August 22, 2019].
- Cook, J., 2023. Arguments from Global Warming Skeptics and what the science really says. *Skeptical Science*. Available at: <https://skepticalscience.com/argument.php> [Accessed on November 6, 2023].
- Cook, J., Nuccitelli, D., Green, S.A., Richardson, M., Winkler, B., Painting, R., Way, R., Jacobs, P., Skuce, A., 2013. Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environ. Res. Lett.* 8, 024024. <https://doi.org/10.1088/1748-9326/8/2/024024>.
- Davis, C.M., 2015. House Committee Hearings: Arranging Witnesses. CRS Report 98–304. Congressional Research Service.
- Delmas, M., Lim, J., Nairn-Birch, N., 2016. Corporate environmental performance and lobbying. *Acad. Manage. Discov.* 2 (2), 175–197. <https://doi.org/10.5465/amd.2014.0065>.
- DeMelle, B., 2009. Is Controversial Coal Lobby Front Group ACCCE On The Verge of Implosion? DeSmog. Available at: <https://www.desmog.com/2009/09/02/controversial-coal-lobby-front-group-accce-verge-implosion/> [Accessed on November 26, 2022].
- DeSmog, 2018a. American Petroleum Institute's members year over year. Data Set. Available at: [https://www.desmog.com/wp-content/uploads/files/API%20Members%20-%202018\\_0.xlsx](https://www.desmog.com/wp-content/uploads/files/API%20Members%20-%202018_0.xlsx) [Accessed on November 26, 2022].
- DeSmog, 2018b. National Association of Manufacturers' Board Members, by individual and company. Data Set. Available at: <https://www.desmog.com/wp-content/uploads/files/NAM%20People%20-%2020Pub.xlsx> [Accessed on November 26, 2022].
- DeSmog, 2022a. American Coalition for Clean Coal Electricity. Climate Disinformation Database. Available at: <https://www.desmog.com/american-coalition-clean-coal-electricity/> [Accessed on November 26, 2022].
- DeSmog, 2022b. Climate Disinformation Research Database. Available at: <https://www.desmogblog.com/global-warming-denier-database> [Accessed on May 20, 2021].
- Doran, P.T., Zimmerman, M.K., 2009. Examining the scientific consensus on climate change. *Eos, Trans. Am. Geophys. Union* 90 (3), 22–23. <https://doi.org/10.1029/2009EO030002>.
- Downie, C., 2017. Fighting for King Coal's crown: business actors in the US Coal and Utility Industries. *Global Environ. Polit.* 17 (1), 21–39. [https://doi.org/10.1162/GLEP\\_a\\_00388](https://doi.org/10.1162/GLEP_a_00388).
- Dunlap, R.E., McCright, A.M., 2011. Organized Climate Change Denial. In: Dryzek, J.S., Norgaard, R.B., Schlosberg, D. (Eds.), *Oxford handbook of climate change and society*. Oxford University Press, Oxford, UK; New York, pp. 144–160.
- Dunlap, R.E., McCright, A.M., 2015. Challenging Climate Change: The Denial Counter-movement, in: Dunlap, R.E., Brulle, R.J. (Eds.), *Climate change and society: sociological perspectives*, Oxford University Press, New York, NY. pp. 300–332. <https://doi.org/10.1093/acprof:oso/9780199356102.003.0010>.
- Dunlap, R.E., McCright, A.M., Yarosh, J.H., 2016. The Political Divide on Climate Change: Partisan Polarization Widens in the U.S. Environment: Science and Policy for Sustainable Development 58(5), 4–23. <https://doi.org/10.1080/00139157.2016.1208995>.
- EIA, 2022a. Aggregate coal mine production. U.S. Energy Information Administration Independent Statistics and Analysis. Available at: <https://www.eia.gov/coal/data/browser/> [Accessed on November 26, 2022].
- EIA, 2022b. U.S. Field Production of Crude Oil. U.S. Energy Information Administration Independent Statistics and Analysis. Available at: <https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=mcrfpus1&f=a> [Accessed on November 26, 2022].
- EIA, 2022c. U.S. Natural Gas Gross Withdrawals. U.S. Energy Information Administration Independent Statistics and Analysis. Available at: <https://www.eia.gov/dnav/ng/hist/n9010us2a.htm> [Accessed on November 26, 2022].
- Evans, D., 1996. Before the roll call: interest group lobbying and public policy outcomes in house committees. *Political Research Quarterly* 49 (2), 287–304. <https://doi.org/10.2307/448875>.
- Farrell, J., 2016a. Network structure and influence of the climate change counter-movement. *Nature Climate Change* 6, 370–374. <https://doi.org/10.1038/nclimate2875>.
- Farrell, J., 2016b. Network structure and influence of the climate change counter-movement. Supplementary Information. Available at: [https://static-content.springer.com/esm/art%3A10.1038%2Fncclimate2875/MediaObjects/41558\\_2016\\_BFNclimate2875\\_MOESM351\\_ESM.pdf](https://static-content.springer.com/esm/art%3A10.1038%2Fncclimate2875/MediaObjects/41558_2016_BFNclimate2875_MOESM351_ESM.pdf) [Accessed on September 10, 2024].
- Freudenberg, W.R., 2000. Social constructions and social constrictions: Toward analyzing the social construction of 'the naturalized' as well as 'the natural', in: Spaargaren, G., Mol, A., Buttel, F. (Eds.), *Environment and Global Modernity*, SAGE Publications Ltd, London. pp. 103–120. <https://doi.org/10.4135/9781446220139>.
- Global Climate Coalition, 1996. Global Climate Coalition - An overview. Available at: <https://www.documentcloud.org/documents/5453339-1996-GCC-Overview-and-Reports.html> [Accessed on October 24, 2022].
- Guber, D.L., Bohr, J., Dunlap, R.E., 2020. 'Time to Wake Up': Climate change advocacy in a polarized Congress, 1996–2015. *Environmental Politics* 30 (4), 1–21. <https://doi.org/10.1080/09644016.2020.1786333>.
- Hall, R.L., Wayman, F.W., 1990. Buying time: moneyed interests and the mobilization of bias in congressional committees. *American Political Science Review* 84 (3), 797–820. <https://doi.org/10.2307/1962767>.
- Hanley, J.A., 2003. Statistical Analysis of Correlated Data Using Generalized Estimating Equations: An Orientation. *Am. J. Epidemiol.* 157 (4), 364–375. <https://doi.org/10.1093/aje/kwf215>.
- Hardin, J.W., Hille, J.M., 2013. *Generalized estimating equations*, Second ed. CRC Press, Boca Raton, FL.
- Heede, R., 2014. Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers, 1854–2010. *Climatic Change* 122, 229–241. <https://doi.org/10.1007/s10584-013-0986-y>.
- Heitshusen, V., 2017. Senate Committee Hearings: Arranging Witnesses. CRS Report 98–336. Congressional Research Service.
- Heitshusen, V., 2020. Introduction to the Legislative Process in the U.S. Congress. CRS Report R42843. Congressional Research Service.
- Holman, C., Luneburg, W., 2012. Lobbying and transparency: A comparative analysis of regulatory reform. *Interest Groups & Advocacy* 1, 75–104. <https://doi.org/10.1057/iga.2012.4>.
- Howarth, C., Sharman, A., 2017. Influence of Labeling and Incivility on Climate Change Communication, in: *Oxford Research Encyclopedia of Climate Science*, Oxford University Press. pp. 175–196. <https://doi.org/10.1093/acrefore/9780190228620.013.382>.
- Huang, F.L., 2016. Alternatives to Multilevel Modeling for the Analysis of Clustered Data. *J. Exp. Educ.* 84 (1), 175–196. <https://doi.org/10.1080/00220973.2014.952397>.
- Hulse, C., Herszenhorn, D.M., 2010. Democrats Call Off Climate Bill Effort. *The New York Times*. Available at: <https://www.nytimes.com/2010/07/23/us/politics/23cong.html> [Accessed on October 11, 2022].
- IPCC, 2007. Climate change 2007: the physical science basis: contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.
- Jacques, P.J., Dunlap, R.E., Freeman, M., 2008. The organisation of denial: Conservative think tanks and environmental scepticism. *Environmental Politics* 17 (3), 349–385. <https://doi.org/10.1080/09644010802055576>.
- Kim, S.E., Urpelainen, J., Yang, J., 2016. Electric utilities and American climate policy: lobbying by expected winners and losers. *Journal of Public Policy* 36 (2), 251–275. <https://doi.org/10.1017/S0143814X15000033>.
- Kingdon, J.W., 2014. *Agendas, alternatives, and public policies*. Pearson New International Edition, 2nd ed. Pearson, Harlow.
- Kolk, A., Levy, D., 2003. Multinationals and global climate change: issues for the automotive and oil industries, in: Lundan, S.M. (Ed.), *Multinationals, Environment and Global Competition* (Research in Global Strategic Management, Vol. 9), Emerald Group Publishing Limited, Leeds. pp. 171–193. [https://doi.org/10.1016/S1064-4857\(03\)09008-9](https://doi.org/10.1016/S1064-4857(03)09008-9).
- Lamb, W.F., Mattioli, G., Levi, S., Roberts, J.T., Capstick, S., Creutzig, F., Minx, J.C., Müller-Hansen, F., Culhane, T., Steinberger, J.K., et al., 2020. Discourses of climate delay. *Global Sustainability*. Cambridge University Press 3, e17. <https://doi.org/10.1017/sus.2020.13>.
- Leiserowitz, A., Maibach, E., Roser-Renouf, C., Smith, N., 2010. Climate Change in the American Mind: Public Support for Climate & Energy Policies in June 2010. Yale University and George Mason University, New Haven, CT: Yale Project on Climate Change Communication. Available at: [https://climatecommunication.yale.edu/wp-content/uploads/2016/02/2010\\_06\\_Public-Support-for-Climate-Energy-Policies.pdf](https://climatecommunication.yale.edu/wp-content/uploads/2016/02/2010_06_Public-Support-for-Climate-Energy-Policies.pdf) [Accessed on December 12, 2023].
- Lüdtke, D., 2018. ggeffects: Tidy data frames of marginal effects from regression models. *J. Open Source Software* 3, 772. <https://doi.org/10.21105/joss.00772>.
- McCright, A.M., Dunlap, R.E., 2000. Challenging Global Warming as a Social Problem: An Analysis of the Conservative Movement's Counter-Claims. *Soc. Probl.* 47 (4), 499–522. <https://doi.org/10.2307/3097132>.
- McCright, A.M., Dunlap, R.E., 2003. Defeating Kyoto: The Conservative Movement's Impact on U.S. Climate Change Policy. *Social Problems* 50(3), 348–373. <https://doi.org/10.1525/sp.2003.50.3.348>.
- Meckling, J., 2011. *Carbon Coalitions: Business, Climate Politics, and the Rise of Emissions Trading*. The MIT Press. <https://doi.org/10.7551/mitpress/9078.001.0001>.
- Mittlbock, M., Schemper, M., 1996. Explained Variation for Logistic Regression. *Statistics in Medicine* 15, 1987–1997. [https://doi.org/10.1002/\(SICI\)1097-0258\(19961015\)15:19<1987::AID-SIM318>3.0.CO;2-9](https://doi.org/10.1002/(SICI)1097-0258(19961015)15:19<1987::AID-SIM318>3.0.CO;2-9).
- Newell, P., 2000. *Climate for Change: Non-State Actors and the Global Politics of the Greenhouse*. 1 ed., Cambridge University Press, Cambridge. <https://doi.org/10.1017/CBO9780511529436>.
- Nielsen, N.M., Smink, W.A.C., Fox, J.P., 2021. Small and negative correlations among clustered observations: limitations of the linear mixed effects model. *Behaviormetrika* 48, 51–77. <https://doi.org/10.1007/s41237-020-00130-8>.
- Obama, B., 2009. President Obama on the Passage of the Clean Energy and Security Act. Available at: <https://obamawhitehouse.archives.gov/video/President-Obama-on-the-Passage-of-the-Clean-Energy-and-Security-Act> [Accessed on December 09, 2018].
- Oreskes, N., 2004. The Scientific Consensus on Climate Change. *Science* 306. <https://doi.org/10.1126/science.1103618>, 1686–1686.



- Oreskes, N., Conway, E.M., 2010. Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming. 1st U.S. ed., Bloomsbury Press, New York.
- Price on Carbon, 2020. Know the Legislation. Available at: <https://priceoncarbon.org/business-society/history-of-federal-legislation-2/> [Accessed on November 26, 2022].
- Rich, N., 2019. *Losing Earth: The Decade We Could Have Stopped Climate Change*. Pan Macmillan, London.
- Schlozman, K.L., Tierney, J.T., 1986. *Organized interests and American democracy*. Harper & Row, New York.
- Stewart III, C., Woon, J., 2017. Congressional Committee Assignments, 103rd to 114th Congresses, 1993–2017: [House of Representatives & Senate, 2003–2010]. Data Set. Available at: [http://web.mit.edu/17.251/www/data\\_page.html](http://web.mit.edu/17.251/www/data_page.html) [Accessed on July 12, 2022].
- Straus, J.R., 2015. The Lobbying Disclosure Act at 20: Analysis and Issues for Congress. CRS Report R44292. Congressional Research Service.
- Supran, G., Rahmstorf, S., Oreskes, N., 2023. Assessing ExxonMobil's global warming projections. *Science* 379, eabk0063. <https://doi.org/10.1126/science.abk0063>.
- UNFCCC, 2022. Copenhagen Climate Change Conference - December 2009. Available at: <https://unfccc.int/conference/copenhagen-climate-change-conference-december-2009> [Accessed on December 12, 2023].
- unitedstates, 2022. congress-legislators. GitHub repository. Available at: <https://github.com/unitedstates/congress-legislators/> [Accessed on July 12, 2022].
- U.S. Chamber of Commerce, 2006. Board of Directors. Available at: <https://web.archive.org/web/20060213012046/http://www.uschamber.com/about/board/all.htm> [Accessed on November 26, 2022].
- U.S. Chamber of Commerce, 2007. Board of Directors. Available at: <https://web.archive.org/web/20070208024448/http://www.uschamber.com/about/board/all.htm> [Accessed on November 26, 2022].
- U.S. Chamber of Commerce, 2008. Board of Directors. Available at: <https://web.archive.org/web/20080214232239/http://www.uschamber.com/about/board/all.htm> [Accessed on November 26, 2022].
- U.S. Chamber of Commerce, 2009. Board of Directors. Available at: <https://web.archive.org/web/20090218113936/http://www.uschamber.com/about/board/all.htm> [Accessed on November 26, 2022].
- U.S. Chamber of Commerce, 2010. Board of Directors. Available at: <https://web.archive.org/web/20100706050615/http://www.uschamber.com/about/board/all.htm> [Accessed on November 26, 2022].
- U.S. Government Publishing Office, 2022. Congressional Hearings. Available at: <https://www.govinfo.gov/app/collection/chrh> [Accessed on May 12, 2022].
- USCAP, 2007a. A Call for Action. Available at: <https://web.archive.org/web/20070203061819/http://www.us-cap.org/ClimateReport.pdf> [Accessed on October 6, 2022].
- USCAP, 2007b. Major businesses and environmental leaders unite to call for swift action on global climate change. Available at: <https://web.archive.org/web/20070203061819/http://www.us-cap.org/media/release.pdf> [Accessed on October 6, 2022].
- Wolpe, B.C., 1990. *Lobbying Congress: how the system works*. Congressional Quarterly, Washington, D.C.
- Zeileis, A., 2006. Object-Oriented Computation of Sandwich Estimators. *J. Stat. Softw.* 16 (9), 1–16. <https://doi.org/10.18637/jss.v016.i09>.
- Zeileis, A., Köll, S., Graham, N., 2020. Various versatile variances: an object-oriented implementation of clustered covariances in R. *J. Stat. Softw.* 95 (1), 1–36. <https://doi.org/10.18637/jss.v095.i01>.
- Zorn, C., 2006. Comparing GEE and robust standard errors for conditionally dependent data. *Polit. Res. Quart.* 59 (3), 329–341. <https://doi.org/10.1177/106591290605900301>.