Grand Challenges and Local Beliefs: How Belief in Climate Change Relates to Greenhouse Gas Emissions in U.S. Manufacturing Facilities

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ABSTRACT

There is significant variance in the degree to which people accept the evidence that human activity is causing climate change, yet we do not know how much such disparity in beliefs influences corporate behavior. We investigate using the Greenhouse Gas Reporting Program (GHGRP) from 2010-15 and survey data on climate beliefs. We find effects both for the facility's county and that of its headquarters. Moreover, the effects are substantial: a facility located in a county at the 90th percentile of climate change concern would emit 19% less than one located in a county at the 10th percentile. Meanwhile, a facility with its headquarters in a location in the 90th percentile of concern would emit 12% less than one with headquarters in the 10th percentile.

Keywords: Greenhouse gas emissions; Climate beliefs; Corporate Structure, Environmental Strategy, Community Norms

Running Title: Climate Beliefs and Greenhouse Gas Emissions

INTRODUCTION

There is increasing concern among academics and practitioners that climate change threatens social and economic systems. Although there are multiple sources of the greenhouse gases (GHGs) that cause climate change, industrial activity from various industries is a key contributor. Thus, it is important to develop a better understanding of what factors influence emission changes at industrial facilities. Yet to date the strategy literature has not engaged significantly with climate change issues, and relatively few studies have examined how firms address this challenge (Delmas, Nairn-Birch, and Lim, 2015; Hiatt et al., 2015; Lewis, Walls, and Dowell, 2014; Reid and Toffel, 2009a). This lack of attention to how corporations engage with climate change is unfortunate both because it is important to understand what factors might induce firms to reduce GHG emissions, and because examining these emissions can shed light on fundamental issues regarding firms' attention to social and environmental issues and the way that firm structure affects this relationship.

In this paper, we provide the first study of the relationship between the characteristics of the communities in which a firm operates and the firm's GHG emissions. In doing so, we contribute both to the literature on corporate environmental performance and to organization theory research on the relationship between corporate actions and the communities in which they operate (Marquis, Glynn, and Davis, 2007). Much of the research in this area has considered the effect of community characteristics at the firm's headquarters on corporate action (Gupta, Briscoe, and Hambrick, 2017; Marquis, Toffel, and Zhou, 2016). This focus is understandable, as the firm's headquarters exerts a significant influence over the practices of dispersed units (Berchicci, Dowell, & King, 2017) and local conditions at the headquarters have important effects on the firm's practices. Yet many firms' operations are geographically dispersed, and their operating units are exposed to disparate community norms, which are potentially associated with different behaviors on the part of the units. We ask two questions with respect to these norms. First, do facilities located in areas of greater climate change concern reduce emissions to a greater degree than other facilities? Second, are there effects both at the facility's own community and from its headquarters, and if so, do these effects complement or substitute for one another?

We build on prior research that has examined knowledge transfer within organizations (Banaszak-Holl, Mitchell, Baum, and Berta, 2006; O'dell and Grayson, 1998; Szulanski, 1996), especially within multi-unit firms. Prior research has documented that facilities can differ widely in performance within the same corporation (Maksimovic and Phillips, 2008). Generally, researchers attribute this within-firm variance to the difficulty of transferring knowledge between organizational units (Szulanski, 1996; Doshi, Dowell, and Toffel, 2013). As we argue in this paper, however, this disparity is exacerbated due to differences in the social environment in which facilities are located, so that facilities in areas where social issues are higher priority attend more closely to such issues. Thus, even if firms work to reduce frictions that impede knowledge transfer, performance differences may persist.

In the next section of the paper, we briefly outline the issues in anthropogenic climate change and the corporate contribution to this issue. We then develop hypotheses that link community conditions and firm-level structure to facility GHG emissions. We test these hypotheses using facility-level data from the US Environmental Protection Agency (EPA) Greenhouse Gas Reporting Program (GHGRP) from 2010-2015. We conclude with a discussion of the results and their implications for research on strategic management and for managers and policy makers.

Greenhouse Gases, Climate Change, and Regulation

Although it is beyond the scope of this article to review the extensive literature in the natural sciences on greenhouse gases and climate change, the conclusions from this literature are important in setting the context for the hypotheses we develop and the measures that we use. Among climate scientists, there is consensus that the Earth's climate is changing, and that human activity is a significant contributor to this change (IPCC, 2014; Oreskes, 2004). Burning fossil fuels is a significant contributor to climate change (IPCC, 2014), as combustion of hydrocarbon fuels releases carbon dioxide and other greenhouse gases into the atmosphere, and these gases trap heat from escaping into space. The Intergovernmental Panel on Climate Change (IPCC) estimates that nearly half of GHG emissions stem from either electric utilities or industrial sources (IPCC, 2014), and the EPA estimates a similar proportion of emissions come from these sources in the United States (US EPA, 2017b).

Recognizing that anthropogenic climate change has unknown, but potentially catastrophic economic and social consequences, regulators, non-governmental organizations (NGOs), investors, and other stakeholders have begun to put pressure on firms to reduce GHG emissions. For example, some states have used regulatory action such as adopting a Renewable Portfolio Standard (RPS) to incentivize less carbon-intensive electricity production (Lyon and Yin, 2010), and others have imposed caps on aggregate emissions (Chen, Liu, and Hobbs, 2011; Murray and Maniloff, 2015). Investors have pressured public firms to disclose their carbon emissions and construct plans for reducing those emissions, through investor groups and NGOs such as CDP (formerly Carbon Disclosure Project) (Kim and Lyon, 2011; Lewis et al., 2014; Reid and Toffel, 2009b). Activists have also attempted to delegitimize investment in major GHG emitting companies, such as oil and gas producers (Hiatt et al., 2015), leading some major investment funds to pledge to reduce or divest their holdings in these stocks (McKibben, 2017).

To date, there are no limits set on GHG emissions at the federal level in the United States (Delmas et al., 2015), although the US Department of Energy historically encouraged firms to voluntarily undertake and disclose emissions reductions efforts (Kim and Lyon, 2015). There is, however, a national mandatory disclosure program for GHG emissions. The Greenhouse Gas Reporting Program (GHGRP) was established by the EPA in 2009 with facilities first reporting their 2010 emissions. The GHGRP requires all facilities in the United States that emit over 25,000 metric tons of CO2-equivalent gases per year to report annually on their emissions.[1] Among the GHGRP's key objectives is to provide more consistent and accurate data so that policymakers and other stakeholders will have better information to guide their actions (WRI, 2015).

The GHGRP covers what are known as "Scope 1" emissions, which are those directly created by a given facility, most frequently from burning of fossil fuels to power operations. It does not cover "Scope 2" emissions from purchased electricity or "Scope 3" emissions indirectly created from activities like employee travel or customer actions. Scope 1 emissions from industrial activities are, however, a significant source of greenhouse gases, both in the United States and globally (US EPA, 2017b).

[1] The term CO2-equivalent refers to weighting other emissions (e.g., methane) to create the equivalent climate change impact as CO2 would have. For example, methane, which is the second most prevalent GHG after CO2, receives a weight of 25 in the EPA data, indicating that a pound of methane is equivalent to 25 pounds of CO2.

Facilities can reduce their Scope 1 emissions in a variety of ways. The most common methods include substituting lower-carbon fuels in production processes, investing in energy efficiency initiatives, and electrifying processes that previously used fossil fuels. For example, the distiller Brown-Forman has reduced its emissions by substituting biomass for fossil fuels in the distillery process and installing more efficient heating systems in facilities (Peterson, 2015).

Corporate and Facility Environmental Performance

Research in strategy, as well as in finance and economics, has long recognized that performance levels can differ substantially within units of the same firm (O'Dell & Grayson, 1998; Szulanski, 2003). This heterogeneity can persist over time, and is often attributed to barriers in knowledge transfer (Chew, Clark, & Bresnahan, 1990; O'Dell & Grayson, 1998; Szulanski, 1996). For example, Szulanski (1996) outlines barriers on the part of both sending and receiving units, and finds that elements of both the information itself and of the relationship between the sender and receiver influence the likelihood that the knowledge is successfully transferred. Facilities within the same firm can exhibit significantly different levels of performance, both in terms of overall efficiency (Maksimovic and Philips, 2008) and on specific performance measures such as toxic releases (Berchicci et al., 2017). Thus, although firms exert (imperfect) influence over their own facilities' production (Berchicci et al., 2017) and facilitate knowledge transfer (Argote and Miron-Spektor, 2011), barriers remain and other factors influence facilities, including, we argue, local norms.

Prior research suggests that local factors influence firms' environmental stances (Delmas & Montes-Sancho, 2010; Dowell & Muthulingam, 2017). Yet, as we detail in this paper, GHGs represent a significantly different environmental issue than those that have been the focus of prior studies. In particular, the impact of GHGs is more dispersed both geographically and temporally than the toxic chemicals that have been widely studied (Doshi et al., 2013; King and Lenox, 2000). As a result, pressure from local interests to mitigate emissions in order to achieve better air quality or higher property values should be muted in our setting. Rather, we expect that climate emissions changes at the facility level will be influenced by beliefs regarding climate change. Thus, in studying how community beliefs on climate science and climate crisis urgency influence GHG emissions this study can provide insights into how local norms relate to issues that have widespread effects well beyond the community (Dowell & Muthulingam, 2017; Sine & Lee, 2009).

Prior research indicates that both individuals and firms behave differently in regions that have strong environmental norms than in areas where such norms are weaker. For example, in areas with stronger environmental norms, there is greater entry into 'green' industries (Meek, Pacheco, & York, 2010; Sine & Lee, 2009), and existing firms are more likely to undertake environmentally-friendly actions (Delmas & Montes-Sancho, 2010; Dowell & Muthulingam, 2017). While research has yet to identify the exact mechanisms by which norms influence firms' behaviors, a plausible process is that the managers and employees of firms that are in areas of stronger environmental norms have internalized these norms, and are thus more likely to take actions that are consistent with them. There is considerable evidence that consumers in regions with stronger environmental norms exhibit 'conspicuous conservation,' demonstrating a willingness to spend more on visible environmentally-friendly purchases (Bollinger and Gillingham, 2012; Kahn, 2007; Sexton and Sexton, 2014). It is reasonable to expect that these behaviors can also be manifested in managers' actions in such areas, so that managers in locations with stronger environmental norms pay greater attention to opportunities to improve environmental performance (Cordano & Frieze, 2000; Dowell & Muthulingam, 2017). Thus, while at times these norms are manifested through the direct action of, for example, environmental NGOs that can exert pressures on firms (Sine and Lee, 2009), it is also the case that strong norms in an area create a lens through which people interpret information and choose courses of action (March & Simon, 1993; Weber, Kopelman, & Messick, 2004).

Greenhouse gas emissions represent an ideal situation for examining the degree to which local beliefs influence firms' actions. First, unlike the pollutants that have been the focus of much prior research (Pargal and Wheeler, 1996; Toffel and Marshall, 2004), GHGs do not have a significant effect on local environmental outcomes and typically pose no immediate local threats of mortality or morbidity. Thus, local pressure on managers to reduce GHG emissions should not reflect a fear of direct health outcomes or decreased property values as a result of local emissions, as is the case for toxic chemical emissions (Currie, Davis, Greenstone, and Walker, 2015). Rather, the degree of belief in climate change is likely to influence the degree to which managers of local facilities feel personally motivated or socially pressured to search for ways to reduce GHG emissions.

Second, local beliefs are likely to significantly influence GHG emissions because there has emerged a high degree of disagreement within the United States over whether GHGs represent a significant problem. The degree to which various chemicals cause harm to humans and ecosystems has, of course, been debated previously. However, many researchers have noted that the role GHGs play in climate change is more controversial than other pollutants (Hoffman, 2011, 2015; Marshall and Toffel, 2005). This disparity, then, will be reflected in the degree to which facilities search for, and implement, ways to reduce GHG emissions. Facilities located in areas where belief in climate change is stronger are likely to have both greater local pressures to consider GHG emission levels, and to have employees and managers who have internalized concerns about climate change.

Recent evidence suggests that concern over climate change influences individuals' behaviors. Baldauf, Garlappi, and Yannelis (Baldauf, Garlappi, & Yannelis, 2020) find that climate-change vulnerability influences property values to a significantly greater degree in communities with higher climate change concerns. They posit that people who hold greater concern over climate change account for the risks of property damage from climate-related events and therefore demonstrate lower willingness to pay for vulnerable real estate. While the Baldauf et al. (2020) paper investigates the influence of belief on individual actions, we suggest that these beliefs also matter for managers' decisions, as managers are influenced by community norms and pressures (Delmas & Toffel, 2004). We expect that in areas where people have higher levels of belief in climate change and climate urgency, managers are more likely to pay attention to climate-related issues and facility emissions.

In sum, we expect that facilities located in communities with greater belief in climate change will have lower emissions:

H1: The greater the concern with climate change in the community where a facility operates, the greater the facility's reduction in GHG emissions over time.

In addition to the influence from their local communities, facilities also are often part of larger corporations, and environmental performance at the plant level is influenced by broader corporate policies and routines (Delmas and Toffel, 2004). Prior research on organizations and the natural environment has demonstrated that firms have significantly different environmental strategies (Bansal & Roth, 2000; Sharma, 2000), and that ownership effects matter for facility performance (Berchicci et al., 2017). With regard to GHGs, in recent years there has been a growing awareness of the need to curtail GHG emissions and growing pressure on firms from customers, NGOs, government, and investors to more actively manage GHG emissions. Firms that are located in areas where the concern over climate change is greater may have a greater expectation that carbon regulation is forthcoming (Howard-Grenville, Nash, and Coglianese, 2008). They may also find that taking action to limit GHG emissions improves morale and lowers wage demands among employees (Burbano, 2016). Moreover, managers of firms headquartered in such areas may also have internalized these beliefs, as managers are often actively engaged in community activities (Lewis et al., 2014; Marquis et al., 2007).

For all of these reasons, a facility's GHG emissions may differ depending upon whether or not its parent company is located in an area of high climate change concern. For example, picture two industrial facilities in the same community. The first is owned by a firm that is headquartered in an area where local belief in the need to fight climate change is minimal. The second is headquartered where the local belief in the need to fight climate change is significantly higher. We expect that the latter facility will exhibit lower emissions, ceteris paribus, as the norms that are prevalent at the facility's headquarters will exhibit some influence over the behavior at the facility itself.

H2: The greater the concern with climate change in a facility's headquarters' community, the greater the facility's reduction in GHG emissions.

Our arguments thus far suggest that facilities are influenced both by norms in their own communities and by those in their headquarters' communities. The impacts of these influences on facility behavior, however, are not likely to be independent of each other. Instead, we expect that the *relative* strength of climate concern at the local and headquarters levels plays a role in the degree to which facilities change their emissions. The question we consider is how might the relative levels of concern at the facility and at headquarters be related to improvement? The answer, we believe, lies in understanding that improving performance on a given social or environmental dimension often involves both development and deployment of knowledge (Berchicci et al., 2017; Hart, 1995) and often requires new procedures and equipment (Dowell and Muthulingam, 2017).

In light of these considerations, successful improvement depends upon characteristics of both the source and recipient of the knowledge (Szulanski, 1996). When the knowledge source has greater commitment to a given practice, it will invest more effort in accomplishing the transfer. Likewise, when the knowledge is highly valued by the recipient, it will have greater motivation to act on the knowledge. This dynamic is likely especially powerful when it comes to information that has social or environmental dimensions, such as greenhouse gas emissions. Such issues are value-laden and can be in conflict with other key organizational goals (Palmer et al., 1995), so the degree to which both the source and recipient agree on the necessity of engaging with the information is likely to have a significant impact on how successfully relevant information is transferred.

To date, much of the research on how companies manage transfer of socially responsible practices has been carried out within the international business literature. For example, as firms face greater societal pressures in their home country, they may respond by transferring irresponsible practices to subsidiary units, with the host country's local institutional conditions influencing the likelihood of such a transfer (Surroca, Tribó, & Zahra, 2013). Similarly, when it comes to cross-border transfer of corporate responsibility initiatives, both the competency of the unit initiating the transfer and the degree of engagement at the receiving unit are associated with successful transfers (Barnett & Lee, 2012). In addition, evidence suggests that host country institutional environments can lead subsidiaries to implement more responsible practices (Marquis et al., 2016). Such studies suggest that environments at headquarters and local facilities have not just the independent (additive) effects we predict in H1 and H2, but that they might interact in more complex ways.

In particular, we consider how the influence on managerial practice of climate change concern in the facility's community might depend upon not only the absolute level of that concern, but also the level relative to that of its headquarters. We consider two situations. First, when the headquarters is in a community with low climate change concern, it is likely to place less emphasis on climate change. Thus, for any of its facilities that are in locations with strong concerns and that are motivated to reduce emissions, the 'buy-in' from headquarters is relatively low, reducing the support the facility can receive and dampening any potential knowledge transfer from headquarters (Doshi et al., 2013). Since one of the key ways in which corporate headquarters adds value is by transferring knowledge (Feldman, 2020), facilities owned by firms headquartered in low climate-change concerned areas will be disadvantaged in terms of their abilities to enact greenhouse gas reductions. Thus, even facilities in communities with higher levels of climate concern than headquarters may have difficulty translating motivation into action.

In contrast, when an issue is highly salient to headquarters, executives are more motivated to attend to it and transfer any knowledge relating to it to the firms' units. When the parent firm is more concerned about environmental performance, it is more likely to monitor its facilities' environmental outcomes; thus, part of the heterogeneity in environmental performance across facilities is likely to stem from differing levels of emphasis that firms place on this issue (Bansal and Roth, 2000; Sharma, 2000). Indeed, when a facility is sold from a firm that exhibits poor environmental performance to one that is a better performer, that facility tends to improve (Berchicci et al., 2017). For example, a firm that is concerned with climate change can enact policies that foster emissions improvements, including internal carbon prices (Akhurst, Morgheim, & Lewis, 2003; Gillingham, Carattini, & Esty, 2017) and formal and informal incentives relating to improvement. Thus, if headquarters demonstrates concern with and attention to a particular issue, this will tend to prevent "backsliding" on the issue at facilities located in areas of low concern. Moreover, if a facility is in a community with even higher concern than headquarters, it will be able to translate its motivation into action because the concern at headquarters can amplify the facility's own strong motivation and ability to improve on that dimension.

We expect, therefore, that the degree of concern at the headquarters' community both mutes the effect of lesser concern in the facility's community and amplifies the effect of greater concern in the facility's community:

H3: The greater the concern with climate change in a facility's headquarters' community, the more that an even higher level of climate change concern in the facility's community is associated with reduction in GHG emissions.

DATA AND METHODS

Greenhouse Gas Reporting Program Data

Our dependent variable is the level of GHG emissions from a given facility in a given year. These emissions are reported as the metric tons of CO_2-equivalent (CO_2e) emissions that the facility released through its operations over the course of the year. We use the natural log of the emissions as the dependent variable in order to reduce the skewness of the data. We also winsorize the variable at the 1% level in order to reduce the influence of outliers.

Our source for these data is the US EPA's Greenhouse Gas Reporting Program (GHGRP) from the program's inception in 2010 through 2015. This program requires industrial facilities in the United States that are classified as 'large emitters' (those emitting over 25,000 metric tons of CO_2-equivalent greenhouse gases per year[2]) to report on their emissions. The EPA estimates that the GHGRP data covers over 85% of industrial GHG emissions (US EPA, 2017a). The EPA establishes the allowable methodologies for calculating emissions; although some facilities have continuous emission monitoring, others calculate emissions based upon standard formulae for the emissions produced by a given amount of fuel or other input (US EPA, 2017b).

The GHGRP data consist of 41,997 observations of 7,830 facilities over the six years of our sample. However, as we discuss in more detail below, certain steps we take to make the analysis more robust end up reducing our sample size. First, because we believe it is crucial to control for facility output, we match the GHGRP to the EPA's Toxics Release Inventory in order to obtain a measure of facility output. Second, because we do not want to be misled by outliers, we restrict our analysis to counties with at least 25 respondents on the survey of climate change concerns described below. Our final sample comprises 4,046 observations of 809 facilities primarily from four major industrial sectors: primary manufacturing (48%), utilities (19%), secondary manufacturing (24%), and food and textiles (7%). Appendix I details the change in the sample from the data availability and restrictions that we impose.

Independent Variables

[2] To put this in perspective, the EPA estimates that a typical passenger vehicle emits about 4.7 metric tons of CO_2 per year. Thus, each facility in this database emits the equivalent of over 5,000 passenger vehicles in CO_2 per year.

Our first two hypotheses posit that there is a relationship between facility emissions and the degree of concern over climate change in the facility's (H1) and headquarters' (H2) communities. To measure this degree of local belief, we use data from the Cooperative Congressional Election Study (CCES) administered by Harvard University. We use data from the 2010 CCES so that our measure of climate change belief predates the first GHGRP data release. While the CCES is principally a survey of respondents' political views, the 2010 version also includes a question about respondents' concern over climate change, and critically, whether action should be taken to mitigate anthropogenic climate change.[3] That is, it is not simply a measure of whether respondents believe that the climate is changing, but also whether they feel that humans bear some responsibility for this effect and should take action to mitigate it. Higher values on this response indicate greater skepticism regarding climate change and no urgency for action, while lower values indicate both a belief in climate change and a belief in the urgency of action on the problem. For example, a value of 1 indicates "Global climate change has been established as a serious problem, and immediate action is necessary." and 5 is "Global climate change is not occurring; this is not a real issue."

The 2010 wave of the CCES survey includes over 50,000 respondents across the United States. Data from the CCES survey have been used to examine relationships between climate change belief and extreme weather events (Konisky, Hughes, and Kaylor, 2016) and between climate change attitudes and religious beliefs (Arbuckle and Konisky, 2015). Moreover, Howe et al. (2015) show that the data from the CCES survey correspond closely to an alternate measure of climate concern.[4]

[3] Unfortunately, the CCES did not regularly ask this question in the same format, so we use the time-invariant measure from just prior to the GHGRP release.
[4] Howe et al. (2015) create a multilevel regression and post-stratification (MRP) model of the Yale-George Mason climate survey and create estimates of county-level belief in Climate Change from these data, which would seem to

Since the climate change concern variable is ordinal, taking the simple average of the responses raises interpretation questions. We therefore measure climate change concern by the proportion of the respondents in a given county who answer 1 or 2 on the survey, as these values indicate the highest concern with climate change. For H2, we use parent company address information listed by the EPA in the GHGRP data for each facility to match the level of climate concern at the headquarters (HQ) level. When a facility has multiple owners, we match to the majority owner. For those facilities owned by 50/50 joint ventures, we use the first parent listed; we have replicated the analysis using the second parent and results were unchanged. Although some facilities are foreign-owned, as discussed in the following section on controls, they will still list a US-based parent company, which is used for this level of analysis. We then measure the degree of climate change concern of the county in which the facility's headquarters is located using the same method described above.

For H3, we predict that greater concern over emissions at the headquarters community will mute the effect of a lower level of concern at one of the firm's facilities and amplify the effect of a higher level of concern in a facility's community. This reflects both the headquarters' ability to prevent "backsliding" at the facility level, and to support facility leadership that goes above and beyond expectations. We assess this with a spline variable "Facility Greater Concern" which takes on a value of 0 if the level of concern in the facility county is less than or equal to that at its headquarters, and otherwise is equal to (Facility Concern – Headquarters Concern). We then split the sample at the median level of headquarters concern (0.57). This allows us to assess whether the effect of increased concern at the facility is stronger as its community's level

make these data highly applicable for our purposes. However, in estimating the MRP, they include a measure of local emissions as a predictor of climate belief. Thus, their measure of climate belief might be endogenous to the very outcome we predict, and we therefore employ the CCES data.

of concern increases beyond that of its headquarters, and whether this effect is amplified by the strength of concern at the headquarters. We compare the coefficient on the spline variable in the low HQ concern regression against that on the high HQ concern regression; support for H3 is indicated by a larger (more negative) coefficient in the high HQ concern subsample.

Control Variables

We utilize a fixed-effects panel regression model, so we can only include time-varying control variables. The facility fixed effect will control for all unobserved and time-invariant factors, such as founding date of the facility, unchanging state effects, and fixed industry characteristics. The most important time-varying factor to control for is facility output, since output changes will influence emissions. Unfortunately, it is hard to find reliable data on facility output, especially for private firms. As mentioned above, our solution to this problem is to match the GHGRP data with the EPA Toxics Release Inventory (TRI) data, which has been used for many environmental performance studies (King and Lenox 2001; Freudenburg, 2005; Doshi et al. 2013). The TRI data include a measure of the "Production Ratio," which is the ratio of the facility's output in year t over its output in year t-1 (Berchicci et al. 2017). Facilities report the production ratio for each product line; since we do not have an accurate measure of the scales of each product line, we take the simple average of these to approximate the overall changes in production from t-1 to t.

In addition, we include a clock variable defined as Year – 2010. This variable serves two purposes. First, it controls for any overall trends in emissions over time. Second, we interact the clock with the climate change concern variables in order to identify the effects at the facility and headquarters counties. While this approach is necessitated by the fixed-effects model (i.e., we cannot identify the time-invariant climate change concern effects with a FE model), it also has the benefit of allowing us to assess the difference in trends between facilities according to the level of concern in their counties.

We include three additional control variables. First, we include the count of sibling facilities that a given facility has, both to control for the possibility that firms shift production between facilities and for an admittedly crude approximation of firm size. Given the large number of privately-held firms in our sample, it is difficult to control for size in a more accurate manner. Second, we include time-varying counts of energy policies at the state and county level. We captured these policies by searching the Database of State Incentives for Renewables and Efficiency (DSIRE) and coding both state and local policies over our observation period.

Model

As mentioned above, we use a fixed-effects panel regression model. We have repeated observations of the same facility over time, which means that our observations are not independent and the standard error of our estimates could be incorrectly specified. We therefore use the Huber-White correction to cluster standard errors at the facility level.

We consider two potential sources of endogeneity and, we believe, have mitigated these sources. The first is that the release of GHGRP could itself influence belief in climate change in a given community. That is, if there were reports that a facility in a community emitted large quantities of GHG, residents could become more attuned to climate issues. (As discussed in footnote 7 above, this is why we do not use the Yale-George Mason survey data.) We mitigate this concern by measuring the belief in climate change in 2010 and holding it constant through the panel. Since the CCES survey took place before the GHGRP data were released, the GHGRP results could not affect survey responses.

Second, it is possible that firms choose to locate facilities where residents are less concerned with climate change. This would be a form of the pollution haven hypothesis (Dowell, Hart, & Yeung, 2000). However, our analysis mitigates this concern. We are able to assess the effect of the facility's community's concern over climate change, while controlling for the concern at the HQ community. Thus, we can partial out the firm's concerns over climate change which presumably would be the driver for this endogenous location choice.

Finally, it is important to emphasize that our focus is not on assessing the effect of the GHGRP itself, which would necessitate some controls for pre-GHGRP emission trends as an identification strategy (Doshi et al. 2013). That is, we do not claim that facilities reduce emissions more in regions of high climate change concern because the mandatory disclosure enacted through the GHGRP brought attention to emissions. Instead, we are focused upon the degree to which norms in a community influence emissions, and therefore the pre-trend emissions are less important. In fact, to the extent that facilities in high climate-change concern areas had already enacted improvements prior to the release of the GHGRP, that would work against our finding effects over our observation period.

RESULTS

Table 1 presents descriptive statistics and Table 2 presents correlations between variables. The average facility emits 11.99 ln(emissions), which translates to 163,734 pounds of CO_2 equivalent emissions in a year. Table 1 also shows that on average, 52% of respondents in facilities' counties consider climate change to be a serious problem (answering 1 or 2 on the

CCES survey) and that headquarters tend to be in locations with greater belief in climate change (57% responding that it is a serious issue). The correlation table shows that both facility- and headquarters-level climate change beliefs are associated with lower emissions, but with the panel data structure this correlation is very preliminary, since it cannot account for how the emissions change over time at individual facilities.

Insert Table 1 about here

Insert Table 2 about here

In Table 3 we present the results of our fixed-effects regression of the natural log of emissions on the independent and control variables. Model 1 contains only the control variables, which show that emissions rise with facility output and that controlling for the other factors, emissions decline over time, while neither state nor local energy policies are associated with significant emission changes. In Model 2, we include the interaction of climate change concern and the clock variable for both the facility's county and that of its headquarters. We find that both have a negative and significant effect on emissions, providing support for both H1 and H2. These results show that the headquarters effect has a coefficient of -0.103, (p-value = 0.051), while the effect of climate change concern at the facility's county has a coefficient of -0.110, (p-value = 0.048). These effects are large in practical terms. By the end of our panel, a facility that had experienced median growth and was located in a county where 69% of residents (90^{th} percentile of concern) expressed concern over climate change would emit 19.2% fewer greenhouse gases than one located in a county where only 33% of residents (10th percentile) expressed such concerns. For headquarters, the effect of going from the 90th to 10th percentile is a 12.6% reduction in emissions by the end of the sample period.[5]

Insert Table 3 about here

In H3, we predict that the effect of the facility's community's level of concern will be stronger when the facility's headquarters is also in an area of high concern. In Models 4 and 5 we include the spline variable as described above and split our sample according to facilities whose headquarters are in counties with low or high levels of climate change concern, relative to the median level (57% concerned). This separation allows us to assess the relative effect of concern at the facility and the headquarters level without employing a triple-interaction approach, which is particularly difficult with three continuous variables as for H3. The coefficient for the facilities whose headquarters are in counties with high climate change concern is -0.890 (p-value = 0.093) and for counties with low climate change concern it is a much smaller and statistically insignificant -0.053 (p-value = 0.483). The difference between these is large and statistically significant (t-test for the difference is 1.57, p-value of .058). In Figure 1, we plot the emissions for the final year of the panel, separated by low and high concern at the headquarters. The graph shows that as the concerns at the facility level exceed that of its headquarters, the emissions decrease much more rapidly for those facilities whose headquarters also are in high-

[5] We calculate this using the coefficients in Model 2, holding all other variables at their medians. For the 10th percentile of facility-county concerns, the median facility would emit 175,046 pounds of CO2-equivalent, while at the 90th percentile it would emit 146,797 pounds. Similarly, for the HQ effect, the median facility headquartered by a firm in the 10th percentile would emit 170,579 pounds, while one with its HQ in the 90th percentile would emit 151,525 pounds.

concern communities, indicating that there is a complementary effect. For facilities whose headquarters are in low-concern communities, however, concern at the facility level has little impact. For completeness, we include in Models 6 and 7 a similar spline variable that captures the effect of climate concern at headquarters when it exceeds concern at the facility level. The coefficient for the headquarters effect when facilities are in counties with high climate change concern is -0.0363 (p-value = 0.708) and for counties with low climate change concern it is -0.161 (p-value = 0.070). The difference between these, however, is not significant (t-score 0.952, p-value=.344).

Insert Figure 1 about here

Robustness Tests and Identifying Mechanisms

Our results thus far provide evidence that facilities' emissions fall more rapidly both when they are located in areas with strong climate change concern, as well as when their headquarters are in such areas; moreover, these effects reinforce each other, as the effect of strong local concerns is greater for facilities whose headquarters are in counties with higher levels of concern. We suggested above that the most likely explanation for these effects is that the managers and employees in these areas have internalized concerns for climate change and are, at the margin, more likely to take actions that reduce GHG emissions. Moreover, when concern at both the facility and headquarters is high, knowledge transfer across the firm is more effective, amplifying the effects of the individual levels separately. We have undertaken further tests that provide greater insights into these mechanisms, as well as test the robustness of our results.

Does the measure of climate change concern capture other factors?

Although we have used results from a large-scale national survey that directly assesses climate change concerns, it is possible that other, related, factors are influencing emissions. For example, our measure of climate change concern could be a proxy for demographic factors that are known to relate to environmental justice issues (Shapiro, 2005) and may drive facility emissions patterns. Alternatively, communities with more concern about climate change could be home to more environmental NGOs and pressure from these NGOs might induce emission reductions. (We test this possibility using a random effects specification in Table 6.)

With respect to the demographic variables, in Table 4 we replicate the analysis presented in Table 3, but interact the clock variable with measures of county income (Model 1), percentage of residents with college degrees, (Model 2), percentage of African-American residents (Model 3), the proportion of Evangelical Christians in the county (Model 4), and the proportion of donations made to Republican candidates in the county (Model 5). The choice of income, education and minority resident measures reflects prior research on the topic of environmental injustice (see, e.g. Shapiro, 2005), while the Evangelical and Republican measures reflect both academic work (Carr, Patterson, Yung, and Spencer, 2012; Dunlap and McCright, 2008) and popular perception that conservative Christians and Republicans are more skeptical regarding the seriousness and causes of climate change. Although we find that both rates of Evangelicalism and support for Republican candidates are positively associated with emissions over the observation period when we do not control for climate concern directly (we omit those regressions from the table to conserve on space), Table 4 shows that those factors are insignificant once we control for the direct measures of climate change concern. In other words, our measure captures more than simply these demographic factors.

Insert Table 4 about here

How does our sample affect our results?

In order to control for changes in output, we merged the GHGRP data with the TRI data. Further, we excluded counties for which the CCES survey has fewer than 25 respondents, as the estimate for climate change concern may be imprecise when there are few observations in a county. Together, these restrictions reduced our sample size as we detail in Appendix I. Thus, we cannot be certain that our results generalize to the entire population of emitters. In Table 5 we show the results for the full sample of facilities (i.e., those in which there are any respondents on the CCES survey) and for the sample in which there are sufficient respondents in the facility's county but which are not matched to the TRI. The results show that in the full sample, where we are not confident in the climate change concern measure because many of the counties have very few CCES respondents and thus may have poor estimates of the county concern, we do not find an association between concern and emissions, but even without controlling for output we do see an effect for the facility's county's level of concern in Model 2 (but not for the headquarters' county).

Insert Table 5 about here

To assess the difference between the full sample of GHGRP facilities and our final sample, we examined the change in emissions for the two samples (available from authors). A t-test reveals no significant difference in the emissions changes between the full and reduced sample. There is, however, a significant difference in the degree of climate change concern in counties where the CCES coverage is thin, compared to those with more observations. Further analysis of this variable shows that when there are few observations in a county, there are more extreme estimates of the degree of climate change concern, which is consistent with our expectations and our reasons for excluding those counties from the original analysis. Overall, while we cannot conclusively state that our restricted sample is representative of the entire population of facilities, this further analysis supports our decisions to restrict the sample.

How sensitive are the results to the empirical specification we use?

Finally, although we believe that our use of the fixed-effects model with errors clustered at the facility level is a stringent approach, we are not able to include any time-invariant controls in the analysis. We therefore estimate a Random Effects model, again clustering the standard errors at the facility level, and present these results in Table 6. We include industry (two digit NAICS) fixed effects and state fixed effects. We control for the demographic variables that we use in Table 4 (income, education level, percentage of African-American residents, percentage of donations to Republican candidates, and the proportion of Evangelical Christians).

We also control for firms' commitment to reduce GHG by incorporating an indicator variable for a company's participation in the EPA Climate Leaders program. This program was launched in 2002, and ran through 2010, when the EPA began to phase it out, partly due to the impending introduction of the GHGRP (Roos, 2010). EPA Climate Leader companies pledged to measure and address GHG emissions, and share information about progress among themselves and with the EPA. Over 200 companies joined the program before it ended; we use the list of participants as of 2010. The variable takes on a value of 1 for facilities owned by companies participating in the EPA Climate Leaders program, and 0 otherwise. In addition, in order to address the concern that counties with high climate change concern might have larger numbers of environmental NGO members, who are driving emissions reduction, we include the number of Sierra Club members per capita within 50 miles of a given facility.[6] Finally, we include the count of state and county energy policies, as we did in the fixed-effects models in Table 3.

Insert Table 6 about here

In Model 1, which contains only the control variables, we find that facilities located in areas with a higher proportion of Evangelical Christians, along with those with higher proportions of Republican donations and those in higher-income counties, exhibit higher emissions. Facilities in counties with higher education levels have lower emissions. The remainder of the controls are generally in the expected direction, though the p-values are generally indicative of low statistical significance. The remaining Models 2-6 replicate the models in Table 3 and the patterns are very consistent with those obtained in the fixed-effects analysis.

Because we could not include the EPA Climate Leader variable in the fixed-effect regressions, it is worth pointing out that Climate Leaders reduce emissions on average at a

[6] We obtained the number of Sierra Club members in a given chapter from the Sierra Club and then linked each chapter to a given county and measured the distance from each facility to the geographic center of each county.

significantly more rapid rate than non-Leaders, as shown in Models 1 and 2. When we split the sample according to the level of climate concern at headquarters, we do not find a significant effect for Climate Leaders. However, when we split the sample based on climate concern at the facility level, we find that Climate Leaders make significantly greater progress at facilities in areas with low concern than do non-Leaders (Model 5), but do not perform significantly better than non-Leaders at facilities in areas with high concern (Model 6). This reinforces the general thrust of H3, which posits that there are important interactions between behavior at headquarters and the impact of local beliefs at the facility level. In this case we see that leadership from headquarters seems to make more of a difference for facilities in areas with low climate concern, which might otherwise face less pressure for improvement.

Throughout the regressions in Table 6, we find no evidence that GHG reductions are due to the presence of environmental group members around a facility. This supports our theory that local norms operate directly to reduce facility-level emissions, rather than simply being mediated through membership in environmental activist groups. In additional analysis, we interacted the number of Sierra Club members with the clock variable and found no significant results, nor did that affect the coefficients on our climate change concern variables.

We also performed additional robustness tests, including assessing the effects of skepticism rather than concern and the effect of deleting major sectors included in the data. These results, which confirm our hypotheses, are detailed in the attached Appendix II.

DISCUSSION

We offer the first analysis of GHG emissions from industrial facilities in the United States, and our results indicate that emissions are affected both by norms in the facility's community and by those at its headquarters. Moreover, the effect is substantial: by the end of our sample period, a facility in an area where only 33% of residents express climate concerns would emit 19% more greenhouse gases than a facility in an area where 69% of residents express concern and the corresponding effect for facilities' headquarters is 12.5%. Additionally, though it was not the focus of our analysis, we find that our measure of climate change concern has greater explanatory power than the demographic proxy variables that have been used in prior research (see, e.g. Shapiro, 2005). This supports our expectation that because GHG emissions do not create local risks to human health, socioeconomic variables that are associated with environmental injustice related to toxics are less associated with emissions related to climate change effects, which are more diffuse both in time and in geography. However, as discussed above, local attitudes about climate change---at both the facility level and the headquarters level--- do have significant effects on GHG emissions levels and variation over time.

In addition, we find that concerns at the headquarters level amplify those in the facility's own county. For facilities that are owned by firms located in high-concern communities, the more that the facility's own community's concerns exceeds that of its headquarters, the greater the decline in emissions. For facilities whose headquarters are in low-concern counties, however, increasing local concerns have only modest effects. We attribute this to the greater congruence between headquarters attention to climate issues and local acceptance of those issues; many of the changes that result in reduced emissions require both support from headquarters (e.g. capital investment) and interest from local management. When both are present, the effect is much stronger than if only one exists.

Our results have implications for both strategic management and public policy. From a strategy perspective, it appears that in the absence of binding federal regulation, local norms permeate operational decisions – facilities operate differently depending upon the expectations of the people around them. There is also a firm-level effect, as facilities owned by firms located where there is greater climate change concern emit fewer GHGs. Conversely, we also find that emissions reduction is weaker when facilities or their headquarters are located in areas with greater climate change skepticism. These results have interesting implications for nonmarket strategy: industry trade associations seeking to create climate skepticism can achieve their goals much more cost-effectively by targeting the areas in which corporate headquarters are located than by targeting each facility location individually.

Our results complement and extend prior research in strategy and economics that has examined how units of the same company can exhibit markedly different performance (Maksimovic and Phillips, 2008). Strategic management research has long acknowledged, for example, that it can be difficult to transfer knowledge among units within the same firm (Szulanski, 1996), in part because of different priorities and expectations between the sender and receiver of the knowledge. Here, we find that another source of friction may be the different beliefs and norms in the regions in which the units of a firm operate. This finding speaks to the call for more research on how public attitudes shape the enactment of public policy and corporate strategy (Millner & Ollivier, 2016). It is especially noteworthy that we find evidence for a complementarity between the level of concern at the facility's county and that of its headquarters. This is consistent with the idea that information transfers more readily when the sender and receiver are both motivated to accomplish the transfer (Szulanski, 1996).

From a public policy perspective, our findings illustrate that many facilities make GHG improvements that go beyond what is required by law, and that norms may provide the impetus to do so. This is not to say that local attitudes are sufficiently strong drivers to replace public policy. Instead, firms in localities with stronger beliefs about the urgency of addressing climate change are likely to be more open to policy initiatives, and facilities in such areas may have reduced emissions in anticipation that more stringent regulations are forthcoming (Delmas and Montes-Sancho, 2010). However, overall our results suggest that when policy progress at the federal level is blocked, progress can still be made by educating people about climate science at the state and/or local level, which may in turn eventually percolate up to the federal level. Of course, education creates change only over a period of years or even decades, and many scientists argue that the window for avoiding the worst effects of climate change will close within just a few years (Figueres et al., 2017). Nevertheless, climate education is important. Recent studies have shown how some large corporations covertly funded a public campaign to sow doubt about the state of climate science and distrust of climate scientists (Oreskes and Conway, 2011). Moreover, public views about climate change appear to depend heavily on political leanings (Dunlap, McCright, and Yarosh, 2016). Our findings show that doubt creation strategies are likely to work through multiple channels. Theoretical work has shown how doubt creation can influence public policy (Chiroleu-Assouline & Lyon, 2020), thereby reducing regulatory pressures on firms. Our results suggest that doubt creation can also affect businesses by changing local beliefs, which also serves to reduce pressures on firms to take action.

As the first paper to study how GHG emissions from a broad spectrum of industrial facilities---not just electric generating units---respond to local factors, our study naturally has a number of limitations. To begin with, climate concern as captured by the CCES is a single indicator, and it would be worthwhile to study a broader range of indicators to ensure that our findings are robust. In addition, we are currently using a simple average of the survey results within a county, but it may also be of interest to explore how heterogeneity of beliefs within a given community affects GHG emissions performance. It would also be very interesting to explore heterogeneity across industries in more detail.

CONCLUSION

Understanding how firms react to beliefs and norms in the communities in which they operate requires paying attention to corporate structure and considering how both the local conditions at operating units and the conditions at headquarters might separately and jointly influence behavior. Viewing operating facilities as atomistic entities understates the influence of the corporation in which they are embedded. However, viewing corporations as monolithic is equally flawed, as it fails to account for the heterogeneity in performance among the corporation's units. Importantly, as we show in this paper, a substantial amount of that heterogeneity is associated with the difference in norms in areas where the units operate.

In future work it would be very interesting to probe more deeply into the mechanisms through which local attitudes on climate change influence corporate behavior. Is local "shaming" of managers important? Do local beliefs shape corporate expectations about future policy? Do managers simply internalize local beliefs, or do they perhaps instead work to create those local beliefs? All of these questions, and more, are worthy of exploration as management and strategy scholars address this grand challenge.

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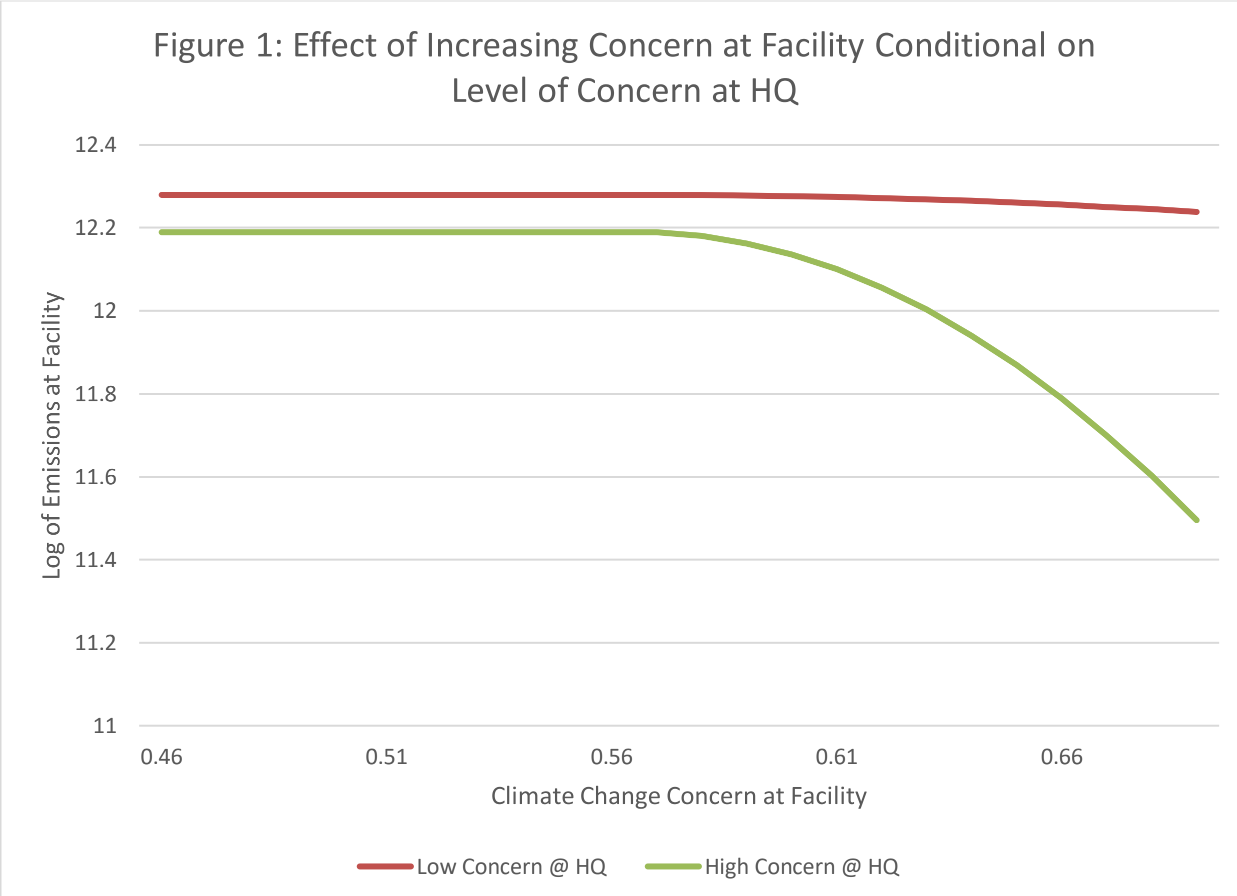

Figure 1: Effect of Increasing Concern at Facility Conditional on Level of Concern at HQ
12.4
12.2
12
11.8
11.6
11.4
11.2
11
Log of Emissions at Facility
0.46
0.51
0.56
0.61
0.66
Climate Change Concern at Facility
Low Concern @ HQ
High Concern @ HQ

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Log of Facility Emissions	11.99	1.83	6.16	15.91
Facility County Climate Change Concern	.52	.11	.21	.85
HQ County Climate Change Concern	0.57	.10	.210	.85
Increase in Facility Output	1.08	.55	.01	9.57
Clock (Year – 2010)	2.51	1.69	0	5
Count of State-level Energy Policies	48.24	22.33	0	124
Count of County-level Energy Policies	.25	.71	0	4
Log of Median Income in Facility County	10.87	.19	10.44	11.51
Percentage of College Graduates in Facility County	27.46	7.61	12.90	59
Evangelical Christians in Facility County/1000 residents	162.31	102.20	4.92	505.23
African American Pop (%) in Facility County	14.68	12.83	.50	69.10
Republican Party Donation % in Facility County	56.25	18.59	10.30	100
Number of Corporate Siblings	10.65	15.70	1	259
Firm is EPA Climate Leader	.14	.35	0	1
Sierra Club Members Within 50 miles of Facility (Scaled by Pop)	156.25	366.18	0	2863.88

N=4,046

Table 2: Pearson Correlation Coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Log of Facility Emissions	1.000															
Facility County Climate Change Concern	-0.096	1.000														
HQ County Climate Change Concern	-0.083	0.143	1.000													
Facility Concern Greater	-0.031	0.521	-0.455	1.000												
HQ Concern Greater	0.007	-0.658	0.565	-0.464	1.000											
Increase in Facility Output	-0.020	-0.024	-0.009	-0.007	0.013	1.000										
Clock (Year – 2010)	-0.031	0.001	-0.002	-0.001	-0.003	-0.095	1.000									
Count of State-level Energy Policies	-0.056	0.089	-0.012	0.082	-0.063	-0.029	0.131	1.000								
Count of County-level Energy Policies	-0.045	0.191	-0.003	0.151	-0.128	-0.029	0.068	0.276	1.000							
Log of Median Income in Facility County	0.039	0.101	0.071	0.040	-0.019	-0.030	0.001	0.210	0.096	1.000						
Percent College Graduates in Facility County	-0.046	0.384	0.104	0.219	-0.195	-0.036	-0.004	0.063	0.131	0.668	1.000					
Percent Evangelical Christians in Facility County	0.072	-0.357	-0.093	-0.180	0.198	0.032	0.002	-0.229	-0.046	-0.352	-0.221	1.000				
Percent African American Pop (%) in Facility County	0.007	0.147	0.003	0.080	-0.113	0.030	0.001	-0.294	-0.029	-0.420	-0.060	0.495	1.000			
Percent Republican Party Donation in Facility County	0.077	-0.455	-0.083	-0.248	0.276	0.008	-0.006	-0.196	-0.177	-0.195	-0.244	0.354	-0.033	1.000		
Number of Corporate Siblings	0.251	0.022	0.025	-0.022	-0.011	-0.035	0.034	-0.033	0.019	0.041	0.021	-0.004	0.056	-0.017	1.000	
Firm is EPA Climate Leader	-0.113	0.073	0.156	-0.033	0.054	0.012	-0.001	-0.001	0.007	-0.002	0.064	-0.052	0.045	-0.066	-0.011	1.000
Sierra Club Members Within 50 miles of Facility (Scaled by Pop)	0.032	0.169	0.052	0.098	-0.079	-0.007	0.013	0.171	0.120	0.292	0.204	-0.195	-0.055	-0.198	0.025	0.058

Table 3: Fixed-Effects Regressions of GHG Emissions at US Facilities, 2010-15

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample, Controls	Full Sample, H1/H2	Only Low Concern @HQ	Only High Concern @HQ	Only Low Concern @Facility	Only High Concern @Facility
Increase in Facility Output	0.0702 (0.000)	0.071 (0.000)	0.036 (0.043)	0.108 (0.000)	0.042 (0.053)	0.103 (0.000)
Clock	-0.0213 (0.022)	0.093 (0.008)	0.026 (0.533)	0.144 (0.119)	0.103 (0.052)	0.159 (0.074)
Count of State-level Energy Policies	0.00372 (0.447)	0.005 (0.271)	0.003 (0.471)	0.007 (0.413)	0.003 (0.625)	0.009 (0.208)
Count of County-level Energy Policies	-0.0383 (0.175)	-0.030 (0.270)	-0.025 (0.434)	-0.077 (0.127)	-0.014 (0.579)	-0.039 (0.360)
Number of Corporate Siblings	-0.002 (0.241)	-0.002 (0.255)	0.002 (0.287)	-0.006 (0.012)	-0.001 (0.539)	-0.005 (0.164)
Clock X Facility County Climate Change Concern		-0.110 (0.048)			-0.217 (0.034)	-0.323 (0.039)
Clock X HQ County Climate Change Concern		-0.103 (0.029)	-0.068 (0.408)	-0.254 (0.067)		
Clock X Facility Concern Greater			-0.053 (0.483)	-0.890 (0.093)		
Clock X HQ Concern Greater					-0.161 (0.070)	-0.0363 (0.708)
Constant	11.90 (0.000)	11.82 (0.000)	12.03 (0.000)	11.66 (0.000)	12.00 (0.000)	11.59 (0.000)
Observations	4046	4046	2013	2033	2061	1985

P-Values in Parentheses
Fixed Effect at Facility Level, Standard Errors Clustered at Facility Level

Table 4: Fixed-Effects Regressions of Demographic Characteristics and Climate Change

	(1)	(2)	(3)	(4)	(5)
Increase in Facility Output	0.071 (0.000)	0.071 (0.000)	0.071 (0.000)	0.071 (0.000)	0.071 (0.000)
Clock	0.340 (0.170)	0.100 (0.007)	0.058 (0.175)	0.093 (0.008)	0.100 (0.022)
Count of State-level Energy Policies	0.006 (0.212)	0.005 (0.266)	0.007 (0.162)	0.005 (0.263)	0.005 (0.299)
Count of County-level Energy Policies	-0.031 (0.258)	-0.030 (0.280)	-0.034 (0.216)	-0.030 (0.270)	-0.031 (0.256)
Number of Corporate Siblings	-0.002 (0.277)	-0.002 (0.268)	-0.002 (0.246)	-0.002 (0.256)	-0.002 (0.256)
Clock X Log of Median Income in Facility County	-0.023 (0.303)				
Clock X College Graduate Percentage in Facility County		-0.001 (0.453)			
Clock X Evangelicals Percentage in Facility County			0.001 (0.127)		
Clock X African American Population Percentage in Facility County				0.000 (0.980)	
Clock # Republican Donations Percentage in Facility County					-0.000 (0.786)
Clock X Facility Concern	-0.108 (0.052)	-0.097 (0.079)	-0.082 (0.168)	-0.110 (0.043)	-0.115 (0.036)
Clock X HQ Concern	-0.101 (0.033)	-0.102 (0.033)	-0.099 (0.039)	-0.103 (0.028)	-0.104 (0.029)
Constant	11.785 (0.000)	11.820 (0.000)	11.761 (0.000)	11.823 (0.000)	11.832 (0.000)
Observations	4046	4046	4046	4046	4046

P-Values in Parentheses
Fixed Effects at Facility Level, Standard Errors Clustered at Facility Level

Table 5: Fixed-Effects Regressions of GHG Emissions at US Facilities, 2010-15, Expanded Samples

	(1)	(2)
	All Facilities	All Facilities in Counties with >25 Observations on Survey
Clock	-0.048 (0.001)	0.016 (0.636)
Count of State-level Energy Policies	0.008 (0.001)	0.014 (0.000)
Count of County-level Energy Policies	-0.012 (0.617)	-0.001 (0.969)
Number of Corporate Siblings	-0.000 (0.286)	-0.001 (0.073)
Clock X Facility County Climate Change Concern	-0.009 (0.535)	-0.121 (0.021)
Clock X HQ County Climate Change Concern	0.014 (0.505)	-0.025 (0.554)
Constant	11.176 (0.000)	10.901 (0.000)
Observations	27575	10285

P-Values in Parentheses
Fixed Effects at Facility Level, Standard Errors Clustered at Facility Level

Table 6: Random-Effects Regressions of Greenhouse Gas Emissions at US Facilities, 2010-15

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample, Controls	Full Sample, H1/H2	Only Low Concern @HQ	Only High Concern @HQ	Only Low Concern @Facility	Only High Concern @Facility
Increase in Facility Output	0.067 (0.000)	0.068 (0.000)	0.034 (0.053)	0.103 (0.001)	0.039 (0.066)	0.101 (0.000)
Clock	-0.021 (0.024)	0.088 (0.016)	0.029 (0.497)	0.134 (0.168)	0.108 (0.061)	0.140 (0.116)
Count of State-level Energy Policies	0.003 (0.483)	0.005 (0.311)	0.003 (0.486)	0.006 (0.477)	0.003 (0.608)	0.007 (0.348)
Count of County-level Energy Policies	-0.046 (0.105)	-0.037 (0.175)	-0.028 (0.381)	-0.087 (0.076)	-0.019 (0.476)	-0.034 (0.422)
Log of Median Income in Facility County	1.154 (0.015)	1.041 (0.033)	0.890 (0.212)	0.496 (0.441)	1.522 (0.039)	1.004 (0.153)
College Graduate Percentage in Facility County	-0.016 (0.146)	-0.011 (0.328)	-0.007 (0.686)	-0.003 (0.815)	-0.019 (0.326)	-0.016 (0.299)
Evangelicals Percentage in Facility County	-0.005 (0.676)	-0.007 (0.531)	0.013 (0.375)	-0.029 (0.062)	-0.028 (0.106)	0.004 (0.827)
African American Pop (%) in Facility County	0.001 (0.841)	0.004 (0.593)	0.002 (0.828)	0.003 (0.787)	0.003 (0.852)	-0.012 (0.199)
Republican % Political Donations in Facility County	0.001 (0.733)	0.000 (0.981)	-0.003 (0.578)	0.004 (0.431)	0.004 (0.528)	-0.004 (0.484)
Number of Corporate Siblings	-0.001 (0.490)	-0.001 (0.545)	0.002 (0.272)	-0.003 (0.172)	-0.000 (0.854)	-0.003 (0.348)
Firm is EPA Climate Leader	-0.164 (0.021)	-0.149 (0.036)	-0.161 (0.203)	-0.159 (0.113)	-0.160 (0.042)	-0.069 (0.507)
Sierra Club Members Within 50 miles of Facility (Scaled by Pop)	0.000 (0.446)	0.000 (0.395)	0.000 (0.166)	0.000 (0.789)	0.000 (0.090)	0.000 (0.861)
Facility Concern		-0.589 (0.360)	0.018 (0.983)	-0.919 (0.313)	-2.961 (0.007)	-0.058 (0.967)
Clock X Facility Concern		-0.105 (0.058)			-0.225 (0.042)	-0.285 (0.065)
HQ Concern		-0.170 (0.580)	0.844 (0.128)	-0.011 (0.986)	-0.029 (0.940)	-0.251 (0.534)
Clock X HQ Concern		-0.098 (0.060)	-0.073 (0.387)	-0.238 (0.101)		
Clock X Facility Greater Concern			-0.057 (0.453)	-0.855 (0.095)		
Clock X HQ Greater Concern					-0.174 (0.077)	-0.009 (0.926)
Constant	-0.809 (0.874)	0.726 (0.891)	1.205 (0.875)	6.597 (0.346)	-2.764 (0.729)	1.374 (0.860)
Observations	4046	4046	2013	2033	2061	1985

P-Values in Parentheses
All Models Include Industry and State Fixed Effects, Standard Errors Clustered at Facility Level

Appendix I: Sample Changes from Data Restrictions

	All GHGRP Data	Facilities Not Co-Located with HQ	Facilities Not Co-Located and Any Data on Climate Change Concern Survey	Facilities Not Co-Located and >25 Observations on Climate Change Concern Survey	Facilities Not Co-Located and >25 Observations on Climate Change Concern Survey and TRI Matched
Number of Observations	41,997	30,102	27,575	10,285	4,046
Mining	0.143	0.168	0.147	0.060	0.004
Utility	0.226	9.229	0.233	0.282	0.183
Food and Beverage	0.051	0.060	0.062	0.048	0.081
Primary Manufacturing	0.209	0.231	0.241	0.252	0.508
Other Manufacturing	0.067	0.065	0.070	0.106	0.219
Transportation	0.081	0.107	0.099	0.063	0.000
Solid Waste	0.186	0.127	0.135	0.178	0.004

Appendix II: Measuring Skepticism Instead of Concern and Examining Industry Effects

Our primary analysis considers the relationship between climate change concern and emission changes. Here, we consider the role of climate skepticism. There has been much discussion of the way in which organized interests in the U.S. funded by the fossil fuel industry have worked to create doubt about climate science (Oreskes and Conway, 2011; Chiroleu-Assouline and Lyon, 2020). If these efforts are successful in mobilizing public opinion, then it is possible that climate skepticism is a more powerful force than climate concern. To explore this possibility, in columns 1 and 2 we present fixed-effects regressions replicating the analysis in Models 1 and 2 in Table 3, but examining the effect of low beliefs in climate change (climate skepticism) at the facility and headquarters counties. We encoded the proportion of respondents in a county that answered 4 ("Concern about global climate change is exaggerated. No action is necessary.") or 5 ("Global climate change is not occurring; this is not a real issue."). The results are similar to those in Table 3, but in the opposite direction. We find that both facility and HQ skepticism are associated with increases in emissions over our panel.

Finally, we explore the possibility that the effects we find are driven by a subset of industries. In Columns 2-5 we re-run the analysis from Table 3, excluding one sector at a time. The results indicate that our two most-represented industries (primary manufacturing and utilities) are driving the results, as excluding either of these industries weakens the effect of climate change concern. Excluding either other manufacturing (Model 3) or food and beverage (Model 4) has much less impact on the results. Overall, the results from Models 2-5 suggest that the impact of local norms may differ by sector.

Table A1: Effect of Skepticism on Emissions and Robustness to Industry Deletions

	(1) Skepticism	(2) Omitting Primary Manufacturing	(3) Omitting Other Manufacturing	(4) Omitting Food and Textiles	(5) Omitting Utilities
Increase in Facility Output	0.070	0.116	0.076	0.073	0.033
	(0.000)	(0.001)	(0.000)	(0.000)	(0.015)
Clock	-0.085	0.060	0.116	0.091	0.069
	(0.002)	(0.250)	(0.001)	(0.020)	(0.082)
Count of State-level Energy Policies	0.005	0.000	0.002	0.005	0.009
	(0.330)	(0.967)	(0.672)	(0.320)	(0.038)
Count of County-level Energy Policies	-0.034	-0.047	-0.012	-0.035	-0.053
	(0.213)	(0.515)	(0.672)	(0.236)	(0.044)
Number of Corporate Siblings	-0.002	-0.003	-0.002	-0.002	0.003
	(0.247)	(0.173)	(0.290)	(0.263)	(0.177)
Clock X Facility Skepticism	0.123				
	(0.074)				
Clock X HQ Skepticism	0.113				
	(0.045)				
Clock X Facility Concern		-0.025	-0.169	-0.099	-0.091
		(0.757)	(0.014)	(0.086)	(0.120)
Clock X HQ Concern		-0.124	-0.090	-0.110	-0.073
		(0.087)	(0.034)	(0.052)	(0.165)
Constant	11.852	12.058	12.213	11.930	11.229
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	4046	1992	3158	3719	3305

P-Values in Parentheses
Fixed Effect at Facility Level
Standard Errors Clustered at Facility Level