



Economic framing dominates climate policy reporting: a fifty-state analysis

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Abstract

This paper analyzes the framing of the leading state-level climate change mitigation policy in the USA, renewable portfolio standards, in top newspapers from all fifty states. From a corpus of 1522 state newspaper articles which mention renewable portfolio standards, our analysis uses structural topic modeling to identify common frames by region, time period, and state partisanship. Interviews with activists in Michigan and Nevada who were involved in framing renewable portfolio standard legislation provides additional context as to how social movement organizations (SMOs) make framing choices. We find that in newspaper reporting economic frames about business development and utility costs strongly predominate over other frames about emissions and public health. Despite some evidence that a public health frame is effective at increasing support for climate mitigation policies and its being advanced by activists, the frame is almost nonexistent in newspaper coverage.

Keywords Climate change policy · Renewable portfolio standards · Framing · Media coverage · United States · State-level

1 Introduction

The scientific community identified climate change as a life-threatening issue over 30 years ago, but they and environmental campaigners have so far failed to mobilize society to take adequate action. In the hopes of mobilizing the public and policymakers, advocates and lobbyists are constantly changing the way they talk about an issue and crafting their language to their political contexts (e.g., Schuldt et al 2011; Villar and Krosnick 2011; Feinberg and Willer 2013; Schuldt and Roh 2014). Most studies of “framing” climate change have focused at the national level, where climate policy has been in gridlock for decades, but evidence suggests that state-level climate action may be both more likely and more effective (Collier and Löfstedt 1997; Lindseth 2004; Rabe 2008; Rayner 2010; van Asselt and Zelli 2014; Rabe 2011; Hultquist et al. 2017; Hand and Williams 2019).

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We explore the framing of a particularly successful climate change mitigation policy which has been raised in all fifty state legislatures, and passed in more than half: renewable portfolio standards (Stokes and Breetz 2018; National Conference of State Legislators n.d.). Renewable portfolio standards (RPSs) are arguably the foremost climate policy in the USA, associated with about “half of all growth in US renewable electricity generation and capacity since 2000” (Barbose 2018, p. 3). They require that some set percentage of the electricity utilities sell comes from renewable sources by a certain date (Bromley-Trujillo et al 2016). Targets, timelines, and definitions vary across states, but the basic structure of the legislation is the same nationwide (Stokes and Breetz 2018; National Conference of State Legislators n.d.). This consistency in legislation provides a unique opportunity to compare policy framing by states, which vary in terms of majority party in power, by region, and to examine shifts in how the benefits of renewable energy have been framed over time.

Our main research questions are: *Which frames are being used to discuss state-level renewable energy targets? How do frames in newspaper reporting differ in conservative or liberal states and in different regions? How have frames changed over time?*

To explore these questions, we systematically collected the text from up to fifty articles with RPS-related keywords from the most popular daily newspaper by circulation in each US state. This yielded 1522 articles mentioning renewable portfolio standards. To analyze the frames in these texts, we conducted topic modeling (LDA) using MALLET software. Rather than individually reading through each text in a dataset to identify frames (known as “hand-coding”), topic modeling uses computer software to identify “topics,” i.e., clusters of words that often appear in the same texts. We chose to focus our analysis on four main frames: a frame about utility costs, a frame about business development/jobs, a frame about climate change/reducing emissions, and a frame about pollution/public health. Our central finding is that in spite of their disputed ability to motivate people, economic frames about business development and utility costs were predominant in reporting about RPSs at the state level, across types of states, and rather consistently over time.

We also conducted exploratory interviews with NGO advocates regarding RPS legislation in states where legislative battles were taking place (Michigan and Nevada), to learn what frames they used and how they made choices about how to frame.

Before turning to the findings, we briefly review how the framing literature has been applied to the issue of climate change, and describe the dataset we built and the topic modeling methods we applied to that data. We then describe our results, which strongly support recent findings that economic framings of climate action dominate in America. We conclude by putting forward a modest research agenda to better understand why this might be, and what framings might be more effective.

1.1 Framing, climate change, and renewable energy

Framing involves highlighting some aspects of an issue instead of others (Myers et al. 2012). Different frames tell different stories about the issue (Snow 2004); they identify problems, ascribe causality, assign blame, and often suggest what should be done to address the problem (Snow and Benford 1988; Entman 1993; Trumbo 1996; Benford and Snow 2000; Snow et al 2018). Successful frames are argued to be specific and targeted, empirically supported, internally consistent, deployed by credible sources, in line with their audience’s experiences and existing worldviews, and emphasizing issues

which are central to their audience's lives (Price and Tewksbury 1997; Benford and Snow 2000; Druckman 2001; Nisbet 2009a; Elzen et al. 2011; Lupia 2013; Ketelaars 2016; Snow et al. 2018).

Frames are not all-powerful (Scheufele 1999; Druckman 2001), but framing does impact people's views, both generally and in the context of climate change (Price and Tewksbury 1997; Kinder 1998; Druckman 2001; Carmichael and Brulle 2017). Political context and ideology can significantly affect the impact of frames related to climate change (Schuldt et al. 2011; Villar and Krosnick 2011; Feinberg and Willer 2013; Schuldt and Roh 2014; Zhou 2016; Carmichael et al. 2017). Framing may also directly influence legislators (Hess et al. 2016), and given that legislators are at least somewhat responsive to their constituencies (Miler 2016; Tromborg and Schwindt-Bayer 2019), framing's impact on citizen views suggests it may affect policy outcomes. Frames can also have an impact on elite views, which have been shown to drive climate policy (Carmichael and Brulle 2017).

Studies focusing on framing and renewable portfolio standards (RPSs) provide key insights for this study. A 2007 paper evaluating RPS case studies in 5 states found that advocates of renewable portfolio standards often emphasize the economic development impacts of renewable energy rather than the climate mitigation impacts (Rabe 2007b). Hess et al. (2016) used quantitative and qualitative methods to study how renewable energy and energy efficiency legislative proposals were framed in conservative US states, finding that tax reductions and incentives were the most successful. The only experimental research on RPS framing found that a frame about RPSs increasing utility bills led to a dramatic reduction in support for RPS legislation, while a frame about RPSs creating jobs increased support (Stokes and Warshaw 2017). This research also found that air pollution and partisanship frames increased support for legislation, but three frames emphasizing climate change had null effects. These studies represent some of the only work on RPS framing, and given that RPSs are one of the leading forms of state-level climate change mitigation policy, the limited work on this issue is an important research gap.

Other experimental work about climate change in general find that a public health frame prompts more pro-mitigation feelings than environmental and national security frames, including for respondents who are doubtful or dismissive of climate change (Maibach et al. 2010; Myers et al. 2012). Similarly, a wide array of actors consistently emphasize non-climate-related "co-benefits" when explaining their climate-related actions, rather than justifying those actions solely based on the need to mitigate climate change (Betsill 2001; Lindseth 2004; Vasi 2006; Rabe 2007a; Boudet 2011). These co-benefits (i.e., frames) primarily focus on economic impacts such as energy savings, economic development, creating jobs/attracting businesses and workers, as well as air pollution, urban livability/transportation, non-climate-related environmental benefits, and energy independence/security (Betsill 2000; Lindseth 2004; Vasi 2006; Rabe 2007a, 2008; Wood et al. 2014; Karapın 2018). However, this research does not quantitatively evaluate which co-benefits are cited most often.

Other research has identified commonly used frames in popular discourses about climate change, all of which seem to create significant barriers to action on climate change (Hajer and Versteeg 2005; Ereaut and Segnit 2006; Stoknes 2014; Wetts 2020a). Unlike the practical, issue-specific frames used to evaluate climate mitigation policies, these frames are primarily focused on how concerned to be about climate change, who should mitigate it, and whether its economic impacts will be higher costs or job creation (Ereaut and Segnit 2006; Nisbet 2009b; Stoknes 2014; Caniglia et al. 2015; see also Brulle and Norgaard 2019). However, most of this work uses hand-coding (limiting the size of data sets) and/or interviews and process tracing rather than quantitative evaluation. Furthermore, this work

focuses on climate change in general, rather than climate change mitigation policies such as renewable portfolio standards.

Benford and Snow pioneered studies of how social movements use frames and adjust to changing contexts by abandoning unsuccessful frames and creating or borrowing new ones (Ellingson 1995; Benford and Snow 2000; Cress and Snow 2000). If social movement organizations (SMOs) are powerful early in a cycle of protest, they can create dominant “master frames” (Snow and Benford 1988, p. 212) which transform how people understand issues (Snow 2004). This literature focuses on complex “collective action frames” which mobilize and attract supporters and “neutralize or demobilize adversaries” (Snow et al. 2018, p. 395).

Wetts (2020a) systematically reviews framings by environmental SMOs in the USA and finds they have largely adopted neoliberal and elite framings, which she associates with the failure of the movement to move national climate policy. However, there has been little analysis of when and how environmental SMOs adopt frames from elsewhere, and when and how they push their preferred frames into broader public discourse.¹

This paper evaluates frame prominence using a larger dataset than other work (e.g., Ereaut and Segnit 2006) and using structural topic modeling rather than hand-coding; the only comparable paper in terms of dataset and methodology is Wetts (2020a), which has a different focus (SMO press releases rather than newspaper articles about RPSs). Furthermore, the existing literature fails to analyze changes in framing over time (Caniglia et al. 2015) despite the fact that changes in political and social context may influence which frames are mobilized and which are resonant (Ellingson 1995; Brulle and Benford 2012), a research gap which this paper seeks to address. Additionally, despite wide partisan differences between US states in terms of views on climate change and government intervention (e.g., Pew Research Center 2019), and despite the fact that most tangible action on climate has been at the state level, there has been limited focus on framing across states, and the work that has been done generally includes only a few states (e.g., Rabe 2007b) or samples by region (Hess et al. 2016). By taking a state-by-state approach that includes all 50 states, this paper addresses these research gaps. This paper also focuses on a specific policy (RPSs) rather than climate change in general, unlike much of the literature. Finally, the qualitative section of this paper adds to the existing literature on SMO framing of environmental issues, and is able to conduct some preliminary analyses of how SMO frames compare to newspaper frames in the same areas.

2 Methods

2.1 Frames

We chose to focus our study on four main categories of frames: frames about business development, frames about utility costs, frames about climate change/reducing emissions, and frames about pollution/public health. These frames have a relatively narrow scope (focused on the specific impacts of a specific policy) and thus differ from frames about

¹ One exception is Reber and Berger (2005), who found that frames used by the Sierra Club “appeared about three times more often [in newspaper articles] than [those] of competing political actors” (193). However, this paper’s dataset was composed of newspaper articles mentioning the Sierra Club, potentially biasing the results.

climate change in general, which tend to focus on more complex and theoretical issues such as how about concerned one should be about climate change and how best to mitigate it (Ereaut and Segnit 2006; Nisbet 2009b; Stoknes 2014; Caniglia et al. 2015). We chose to focus on frames related to specific policy impacts, rather than more theoretical frames, for a few reasons.

First, as we discuss in greater depth below, the topic modeling software that we used for this research struggles to capture tone, making it difficult to evaluate complex and theoretical frames. By contrast, topic modeling software can more effectively capture frames focusing on policy impacts, because they use specific and distinct words depending on the frame (e.g., “jobs” and “companies” for a business development frame or “rates” and “utility” for a utility costs frame).

Second and more importantly, we were more interested in analyzing frames related to policy impacts. Climate change is not mitigated through a general belief that it matters but through specific policies which reduce carbon emissions, those specific policies have impacts beyond reducing carbon emissions, and lawmakers and citizens consider all of a proposed law’s impacts when evaluating it. This means that the fate of climate mitigation depends to a significant extent on factors not related to climate change at all, such as the economic or health impacts of climate mitigation legislation. We believe that evaluating these impacts is crucially important to understanding how climate mitigation occurs (or does not); so in this paper, we chose to analyze frames relating to the specific policy outcomes of a specific climate change mitigation policy. The four frames we focused on (business development, utility costs, climate change/reducing emissions, and pollution/public health) are comprehensive of the main impacts of RPSs and many other climate change mitigation policies. Additionally, they appear in the literature on framing of climate mitigation policies (Rabe 2007b, 2008; Maibach et al. 2010; Myers et al. 2012; Karapin 2018).²

Finally, the four frames we chose to focus on are all used in the only experimental study of RPS framing (Stokes and Warshaw 2017). Analyzing them in this paper allows us to evaluate how often newspaper articles use the frames which are experimentally successful in driving pro-RPS attitudes, with implications for the success (or lack thereof) of climate mitigation legislation in the USA.

2.2 Data sources

From the most popular daily newspaper by circulation in each US state,³ we captured the text of articles which included keywords related to renewable portfolio standards.⁴ For a

² If our topic modeling had identified a frame about another impact of RPSs (for example, a frame about the national security benefits of shifting away from foreign oil as an energy source) we would have noted that in the paper and integrated it into our analyses. No such frames appeared at any meaningful level beyond the four frames that we chose to focus on.

³ The source for the top daily newspaper by circulation was media analysis company Agility PR. The top newspaper for Wisconsin and Minnesota (the Star Tribune) was the same, leaving us with 49 newspapers. We gathered articles using the Newsstream and Access World News databases and newspaper websites.

⁴ The full search string used was: “renewable portfolio standard,” “renewable portfolio standards,” “renewable energy portfolio standard,” “renewable energy portfolio standards,” “renewable energy standard,” “renewable energy standards,” “renewable alternative portfolio standard,” “renewable alternative portfolio standards,” “alternative energy portfolio standard,” and “alternative energy portfolio standards.” In most cases articles were available from the 1990s or earlier, though in a few states only articles from more recent years were available.

full list of the newspapers used for each state, see Table 1. We removed duplicate articles and visual media.⁵

2.3 Analysis categories

We first identified frames across our full dataset ($n = 2328$ articles, average 47.5 articles per newspaper). However, given the large disparity in number of articles captured per newspaper, we sought to reduce the disproportionate impact of a few states by capping the dataset at 50 articles per state. Articles to include in the capped dataset were selected randomly. Our final dataset, therefore, was 1522 articles mentioning renewable portfolio standards spanning the years 1997–2019, for an average of 31.1 articles per newspaper.

For regional analyses, we divided our dataset into common regional divisions—the West,⁶ Southwest,⁷ South,⁸ Midwest,⁹ and Northeast.¹⁰ We next divided our data into time periods. To ensure that we had a sufficiently-large sample size in each period, we decided upon 5-year time period increments and worked backwards from 2019, when the research was conducted. The number of papers declined dramatically over time, so in order to maintain a sufficient sample size, we combined all articles prior to 2004 into one category. Thus, the time period categories were 2015–2019 ($n = 457$ articles), 2010–2014 ($n = 597$ articles), 2005–2009 ($n = 392$ articles), and 1997–2004 ($n = 76$ articles). Finally, we analyzed the data by partisanship, measured by how each state voted in the five most recent presidential elections at the time of writing (2000, 2004, 2008, 2012, 2016).¹¹ We recognize that state partisanship may not correspond with the partisan lean of state newspapers, but we were unable to find a metric of state newspaper partisanship for all of the newspapers in our sample and across the entire time period of our sample, so we used overall state partisanship as a proxy. We also recognize that votes in the five most recent presidential elections is only one potential proxy for overall partisan identification and that others might produce different results; we chose to use votes in presidential elections because it is a simple and consistent proxy.

⁵ Some newspapers publish all letters to the editor as one article. To avoid allowing unrelated letters to the editor to skew our results, we kept only letters to the editor that referenced RPSs.

⁶ Washington, Oregon, California, Nevada, Montana, Idaho, Wyoming, Hawaii, Alaska; $n = 291$ articles.

⁷ Oklahoma, Texas, New Mexico, Colorado, Arizona, Utah; $n = 246$ articles.

⁸ West Virginia, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, Louisiana; $n = 161$ articles.

⁹ Ohio, Michigan, Indiana, Wisconsin, Illinois, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas; $n = 398$ articles.

¹⁰ Maine, Vermont, New Hampshire, Massachusetts, New York, Rhode Island, Connecticut, Pennsylvania, New Jersey, Maryland, Delaware; $n = 426$ articles.

¹¹ Conservative states category: Alabama, Alaska, Arizona, Arkansas, Florida, Georgia, Idaho, Indiana, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Montana, Nebraska, North Carolina, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, West Virginia, and Wyoming (26 states, $n = 615$ articles). Liberal states category: California, Colorado, Connecticut, Delaware, Hawaii, Illinois, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Hampshire, New Jersey, New Mexico, New York, Oregon, Pennsylvania, Rhode Island, Vermont, Virginia, Washington, and Wisconsin (24 states, $n = 907$ articles).

2.4 Topic modeling

We used a computer-based text analysis method called structural topic modeling (STM) to identify frames, operationalized as clusters of related words rather than a single phrase like “climate change.”¹² Rather than individually reading through each text in a dataset to identify frames (known as “hand-coding”), STM computer software takes as its input an entire corpus of texts. From this corpus, the software identifies and returns a list of “topics”: clusters of words that often appear in the same texts. The software also evaluates the prominence of each topic based on which topics are most likely to occur in any given article. Topic prominence is operationalized by the software as a “weight” variable assigned to each topic; higher weights indicate that a topic is more prominent in the data.

Once the topic modeling software has generated its list of word clusters, researchers eliminate incoherent or irrelevant word clusters and label the remaining word clusters as frames (Mohr and Bogdanov 2013). Because frame labeling is subjective, this work must be done by hand.

Topic modeling mirrors common language patterns, and it reduces the potential for bias and increases reliability when analyzing large datasets, compared to hand-coding (DiMaggio et al 2013; Mohr and Bogdanov 2013; Roberts et al 2014). However, because text analysis software looks for words which appear together consistently, it is good at identifying issues that are being discussed but is not able to evaluate subtler differences regarding *how* those issues are discussed. This means that researchers cannot easily distinguish between pro-RPS, anti-RPS, and more mixed frames—for example, a pro-RPS business development frame (e.g., “increased renewable energy production will support the local solar industry”) would likely not be differentiated from an anti-RPS business development frame (e.g., “RPSs will hurt local coal mining and lead to job losses”). We chose to use topic modeling despite these limitations because it allowed us to analyze a much larger dataset than would have been possible using hand-coding.¹³

The topic modeling software we used requires researchers to decide how many word clusters to have the software generate. In line with Wetts (2020a), we looked for a size that produced word clusters which were comprehensive of relevant frames, minimized irrelevant or extraneous frames, and did not repeat or splinter frames. We found that generating 20, 30, and 40 word clusters best accomplished this goal; so for each set of articles that we analyzed, we ran the topic modeling software three times to produce 20, 30, and 40 word clusters respectively. We then combined the word clusters from all three of these run-throughs for each analysis. From these full lists of word clusters, we removed clusters which were unclear, incoherent, unrelated to RPSs, or a blend of two unrelated frames. Because our goal was to examine frames with broad applicability, we also removed word clusters with more than ~3 state-specific words, though we kept regional clusters. After these removals, we were left with a series of word clusters which we had to label as frames.

Labeling word clusters as frames is a subjective process. Each word cluster contains 20 words, and even word clusters which obviously represent the same frame generally have at least a few different words between them. We needed to ensure that word clusters which

¹² In line with the work of Wetts (2020a), Stoknes (2014), and Feinberg and Willer (2013).

¹³ We used the MALLET topic modeling software, as it has been used to conduct similar framing analyses (e.g., Wetts 2020a). For all analyses, we used the optimize-interval MALLET command, allowing the software to use hyperparameter optimization “to better fit the data by allowing some topics to be more prominent than others” (“Topic Modeling” n.d.).

Table 1 Newspapers from which articles were gathered, with the number of articles noted; asterisks indicate that the dataset was capped at 50 articles per state

State	Newspaper	Number of articles identified
Alabama	The Birmingham News	8
Alaska	Alaska Dispatch News	2
Arizona	The Arizona Republic	178*
Arkansas	Southwest Times Record	4
California	Los Angeles Times	51*
Colorado	The Denver Post	266*
Connecticut	Hartford Courant	19
Delaware	Wilmington News Journal	75*
Florida	Tampa Bay Times	46
Georgia	Atlanta Journal-Constitution	17
Hawaii	Midweek Oahu	1
Idaho	Idaho Statesman	13
Illinois	The Chicago Tribune	33
Indiana	The Indianapolis Star	14
Iowa	Des Moines Register	40
Kansas	The Wichita Eagle	92*
Kentucky	The Courier-Journal	8
Louisiana	Baton Rouge Advocate	8
Maine	Portland Press Herald	39
Maryland	Baltimore Sun	72*
Massachusetts	The Boston Globe	41
Michigan	The Detroit Free Press	107*
Minnesota	Star Tribune	81*
Mississippi	The Clarion-Ledger	1
Missouri	St. Louis Post-Dispatch	66*
Montana	Billings Gazette	48
Nebraska	Omaha World-Herald	21
Nevada	Las Vegas Sun	82*
New Hampshire	New Hampshire Union Leader	108*
New Jersey	The Star-Ledger	17
New Mexico	Albuquerque Journal	98*
New York	Wall Street Journal	67*
North Carolina	The Charlotte Observer	28
North Dakota	The Forum	8
Ohio	The Plain Dealer	128*
Oklahoma	The Oklahoman	22
Oregon	The Oregonian	73*
Pennsylvania	The Philadelphia Inquirer/Philadelphia Daily News	54*
Rhode Island	The Providence Journal	58*
South Carolina	The Post and Courier	6
South Dakota	Argus Leader	32
Tennessee	Knoxville News Sentinel	13

Table 1 (continued)

State	Newspaper	Number of articles identified
Texas	Houston Chronicle	46
Utah	Deseret News	28
Vermont	Seven Days	10
Virginia	The Virginian-Pilot	17
Washington	Seattle Times	40
West Virginia	The Herald-Dispatch	5
Wisconsin	Star Tribune (same as for Minnesota)	81*
Wyoming	Casper Star-Tribune	37

we assigned the same label were actually similar. To accomplish this, we first assigned preliminary frame labels to each word cluster based on reading the words in the clusters. We next synthesized the words that appeared most frequently in word clusters with the same name, creating archetypes representing each frame. We then reevaluated each word cluster, comparing them to these archetypal frames, and assigned a frame label to a word cluster if the majority of the words in that cluster matched words in the archetypal frame. Examples are listed in Table 2. A list of all of the frames we identified in one topic model, with corresponding word clusters, can be found in Supplementary Material 1. A full list of all the frames we identified in each analysis category (e.g., Northwestern states, conservative states, etc.) can be found in Supplementary Material 2.

We labeled a word cluster with a frame label if at least half of its words matched the words in the archetypal frame. This meant that there were minor differences in words between different variants of the same frame. As a result, we were also able to compare different variants of the same frame, examining how their words differed from the archetypal frame to make preliminary conclusions about how the same general frame might differ slightly in different regions, partisanship categories, and time periods.

For our analysis, we examined four main categories of frames: those related to business development, those related to utility costs, those related to climate change, and those related to pollution/public health. In a few instances, to increase sample size, we combined business development frames, utility costs frames, and other smaller economic frames into one larger umbrella category. We also did minor analysis on a few additional frames, such as frames about government intervention.

2.5 Qualitative research

For the exploratory qualitative interviews, we chose Michigan and Nevada based on their recent policy fights related to legislation to increase RPS requirements and their different political and regional contexts. Ann conducted a total of ten exploratory semi-structured interviews with members of social movement organizations (SMOs) involved in efforts to strengthen RPS legislation. Interview subjects were identified primarily by searching for activists quoted in newspaper articles about the relevant policy fight, and then using the snowball method (gathering suggestions from interviewees). Interviewee titles at the time of the policy fights in question included Executive Director, Deputy Director, Director

of External Affairs, Program Director, Policy Director, Campaign Manager, Coordinator, Managing Partner.

We queried subjects on which frames they had used in their organizing work, which frames they had considered using, how they made decisions about how to frame, how coalitions they were a part of approached the issue of framing, the success of different frames, and changes in framing over time (for a full interview protocol, see Supplementary Material 3). Interviews were recorded and notes were taken during interviews; we synthesized and analyzed notes to determine commonalities within and between the states.

3 Findings

This paper analyzes the framing of renewable portfolio standards (RPSs), arguably the most important state-level climate change mitigation policy in the USA. From the most popular newspaper by circulation in each US state, we collected articles which mentioned RPSs, and then evaluated the prominence of four key frames (business development, utility costs, climate change/reducing emissions, and pollution/public health) nationally, by region, by partisanship, and by time period.

We found that economic frames such as business development and utility costs frames strongly predominate over other frames in newspaper coverage, and that a public health frame is almost nonexistent. We found no meaningful changes over time in the prevalence of any frame, and found few to no differences across regions and partisanship categories. That is, framings of why renewable energy should be adopted are heavily economic, and are utilized fairly uniformly across a wide range of states and time periods.

Economic frames about business development and utility costs dominated the overall dataset. For each topic model it generates, topic modeling software provides a “weight” measure, which represents how prominent the topic is. We compared the average frame weights for all the frames of each type across every analysis category (e.g., Southern states, conservative states, etc.).¹⁴ We found that frame weight was significantly affected by frame type ($p < 0.0005$, Welch’s ANOVA, $n = 120$). The average weight of the business development frames was statistically significantly larger than the average weights of the pollution/public health frames ($p < 0.0005$) and climate change/reducing emissions frames ($p < 0.0005$). The average weight of the utility costs frames was statistically significantly larger than the average weights of the pollution/public health frames ($p = 0.001$) and climate change/reducing emissions frames ($p < 0.0005$) (Fig. 1).¹⁶

¹⁴ Unless otherwise noted, data were normally distributed ($p > 0.05$ on the Shapiro–Wilk test of normality). To determine whether variances were homogeneous ($p > 0.05$ on Levene’s test of equality of variances), Levene’s test based on mean was used for normally-distributed data and Levene’s test based on median was used for skewed data (as suggested by “1.3.5.10. Levene Test for Equality of Variances” [n.d.]). When variances were homogeneous, a standard one-way ANOVA and Tukey post-hoc testing or an independent samples t-test (as appropriate) were used. When variances were not homogeneous, a Welch’s ANOVA and Games-Howell post-hoc testing or a Welch t-test (as appropriate) were used.

¹⁵ We also analyzed the weights of the frames in only the main dataset. We did not find significant differences between the weights of the economic, business development, utility costs, and climate change/reducing emissions frames (a public health frame did not appear), likely due to the extremely small number of unique frames ($n = 12$).

¹⁶ Data in the climate change/reducing emissions and utility costs frame categories were not normally distributed, and there was no measure of the distribution of the data in the pollution/public health frame category because there were only 2 data points in the sample. We repeated each of these tests with outliers

Table 2 Archetypal frames for four of the main frames analyzed in this paper

Frame label	Archetypal frame
Business development	Energy jobs renewable clean state economic economy industry growth development investment create future efficiency policy support green manufacturing companies business
Utility costs	Power customers cost energy costs electricity utilities utility electric rates year million pay rate commission public price market consumers bills
Climate change/reducing emissions	Climate emissions carbon change gas greenhouse environmental reduce pollution global coal clean air warming states dioxide plants natural cap-and-trade environment
Pollution/public health	Clean energy renewable pollution air change environment state water federal sources health conservation carbon public protection dirty reduce emissions future

Economic frames also dominated in a number of more specific analyses. In order to maintain sample size, we combined the utility costs and business development frames, along with a few other small economic frames, to compare across regions and partisanship categories. We found that the weights of this combined category of economic frames were not statistically significantly higher in any particular region ($p=0.870$, standard ANOVA, $n=35$).¹⁷ Differences by partisanship category narrowly failed to reach the level of statistical significance ($p=0.056$, Welch t test, $n=17$; frame weights were higher, indicating more prominence, in liberal states).¹⁸ These findings show that economic frames were dominant in all regions and in both partisanship categories.

However, we recognize that there may have been differences in tone among articles using the same frame; for example, a business development frame can be used in a pro-RPS or anti-RPS manner. To begin to address this issue, we compared different versions of the business development frame in different regions and partisanship categories by examining the words in different variants of the frame. We found that versions of the business development frame in the conservative states category included more words relating to the environment than versions in the liberal states category. Variants of the business development frame in the South and Midwest, regions which tend to be conservative (Saad 2018), were both relatively similar to the archetypal frame.¹⁹

The average weight of the climate change/reducing emissions frames was significantly higher in the liberal states category than the average weight of those frames in the conservative states category ($p=0.003$, independent samples t test, $n=7$). Climate change/reducing emissions frames were also

Footnote 16 (continued)

removed, and found nearly identical results. We also analyzed the number of frames which appeared, and found similar results to this analysis.

¹⁷ Removing one outlier and retesting returned the same result ($p=0.521$, standard ANOVA).

¹⁸ The weight of economic frames initially appeared to be statistically significantly higher in the liberal states category than in the conservative states category ($p=0.021$, Welch t -test). However, excluding one highly-weighted blended frame from the liberal states category (a blend of RPS definition & utility costs), eliminated the difference.

¹⁹ However, we were not able to evaluate specific articles which used the business development frame (structural topic modeling software does not assign frames to individual articles), meaning that we likely missed some nuances in how the business development frame was used in different categories.

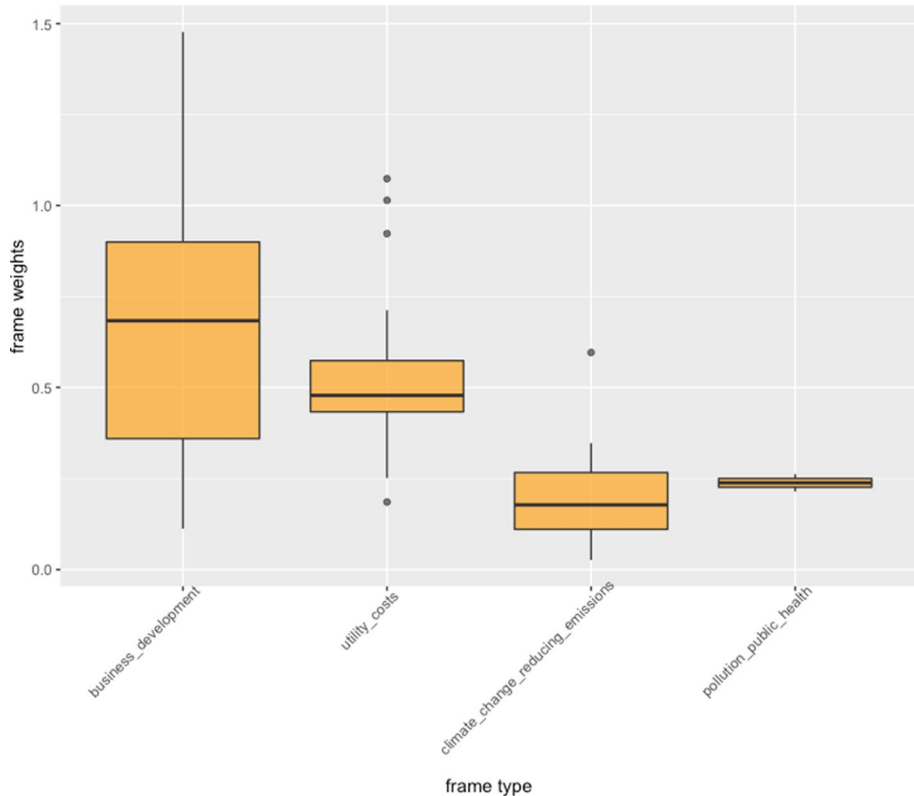


Fig. 1 boxplot illustrating frame weights for the four main frames analyzed in this paper; the box represents the interquartile range, whiskers represent minimum/maximum, and dots represent outliers. Graphic created using R

significantly more prominent in the Northeast relative to other regions²⁰, there were no other significant differences in average frame weights between regions. Individual analysis of different versions of the climate change/reducing emissions frame found that variants in the Northeast states category were more focused on action than those in other regions (using words like “efficiency,” “plan,” “action,” “goals,” and “initiative”). Climate change-related frame variants in the Southern and (to a lesser extent) Southwestern states categories had somewhat more of a focus on federal action. And variants of the climate change/reducing emissions frame in the liberal states category were slightly more focused on action than those in the conservative states category.²¹

²⁰ The average weight of climate change/reducing emissions frames significantly differed by region ($p=0.007$, standard ANOVA, $n=17$). The average weight of climate change/reducing emissions frames in the Northeast was significantly larger than the average weight of climate change/reducing emissions frames in the Midwest ($p=0.015$), the South ($p=0.008$), the Southwest ($p=0.019$), and the West ($p=0.022$). The data in the Northeast states category were not normally distributed in either of these tests. Removing an outlier and retesting returned nearly identical results.

²¹ Again, though, we were not able to evaluate specific articles using these frames and therefore likely missed some nuance. Furthermore, we recognize limitations in our partisanship analysis. First, we used vote in the 2000–2016 presidential elections as our proxy of state partisanship, but we recognize that partisanship is a complex characteristic and that other metrics of partisanship might return different results. We also recognize that state partisanship may not correspond with the partisan lean of state newspapers. More work using different measures of partisanship, and/or integrating measures of newspaper partisanship, would be a valuable addition to our work here and the literature as a whole.

We next analyzed changes over time. In order to maintain sample size, we again combined the utility costs and business development frames, along with a few other small economic frames. The average weight of these economic frames narrowly failed to reach statistical significance between time period categories ($p=0.077$, standard ANOVA, $n=25$).²² The average weight of climate change/reducing emissions frames over time period categories also failed to reach statistical significance ($p=0.415$, Welch's ANOVA, $n=17$).²³ A pollution/public health frame did not appear in any of the time period categories. Next, we individually analyzed the wording of frame variants, and our analysis suggests that there has been at most a slight increase in focus on national/international action in climate change/reducing emissions frames after 2005. Comparing variants of the business development frame, we found that in the 2010–2014 and 2015–2019 time periods, business development frames used more words related to government and national/federal action than in 2004–2009 or in the archetypal frame. Furthermore, there were many fewer singly-occurring frames in these time periods. This suggests that business-related frames have become increasingly consistent over time and begun to focus more intently on federal action at the same time that major legislation was being introduced in Congress, though more detailed analysis would help to confirm this finding.

Finally, we analyzed frames related to government intervention in liberal and conservative states. Partisanship category of states did not have a statistically significant effect on the average weight of frames related to government ($p=0.614$, Welch t test, $n=42$)²⁴ or government intervention ($p=0.164$, Welch t test, $n=17$).²⁵ Furthermore, none of the frames in either partisanship category included any words which might indicate either favorability or unfavorability toward government intervention (such as “support,” “oppose,” “good,” “bad,” etc.), and there were no favorability differences in either the climate change/reducing emissions or the business development frame variants between partisanship categories. Lastly, our data did not include any frames which we could identify as collective action frames (frames including words relating to action, groups, conflict, and/or adversaries).

The overall picture was of a dominance of economic frames about business development and utility costs and an absence of frames about pollution/public health, with only limited variation in what frames were being reported in the most popular state-level newspapers in each US state.

4 Case studies

To understand how social movement organizations (SMOs) make framing choices, we conducted exploratory interviews with ten activists in Michigan and Nevada who were heavily involved in framing renewable portfolio standards legislation in the state. These interviews

²² The weights of economic frames rose steadily over time, indicating greater prominence, until the final time period category (2015–2019), in which economic frames were slightly lower-weighted than in the 2010–2014 category.

²³ In the 1997–2004 category, the sample size ($n=2$) was too small to allow for normality analysis.

²⁴ The data were not normally distributed in either category. A retest after removing an outlier found the same result. Another retest, after removing low-weighted frames so that each category had the same number of frames (to ensure that a few low-weighted, minor frames were not skewing the data) also found the same result.

²⁵ Data were not normally distributed in either partisanship category. Removing two outliers and retesting found the same result.

suggested that SMOs used frames which they believed resonated with the general public, but a closer analysis of newspaper coverage in these two states show they were unable to push their preferred frames into local reporting.

Michigan's original RPS, established in 2008, required 10% renewable energy by 2015 ("Renewable Energy Standard" 2018). In 2012, a ballot measure raising the RPS to 25% lost, with 62.3% of votes in opposition (Ferber 2012). In 2016, legislation raised the RPS to 15% by 2021 ("Renewable Energy Standard" 2018). Michigan has been a Republican trifecta state (both the state House and Senate controlled by Republicans, and a Republican governor) since 2011, before the failed ballot measure, and remained a trifecta until 2019, well after the RPS legislative increase ("Michigan State Senate" 2020b n.d.).

Nevada's RPS was originally established in 1997 and was subsequently increased more than once ("Energy Portfolio Standard" 2018). In 2017, legislation raising the RPS to 40% by 2030 was vetoed by the governor (Walton 2017). In 2018, an activist coalition brought to the ballot a constitutional amendment to enshrine a 50% by 2030 RPS into the state constitution, which passed with 59% of votes in favor ("Nevada question 6, renewable energy standards initiative (2018)" n.d.).²⁶ In 2019, legislation to raise the RPS to 50% by 2030 passed unanimously through the state legislature (Morehouse 2019; "Renewable Portfolio Standard" n.d.2020d). In 2019, when the policy fight occurred, Nevada was a Democratic trifecta state ("Nevada State Senate" n.d.2020c). The policy fight regarding this legislation was the focus of our interviews, though activists made it clear that the 2018 ballot measure campaign was inextricably linked to the 2019 legislative effort and that their discussion of frames applied to both.

In Michigan, our interviewees suggested that a cost frame (that renewables are a lower-cost energy source compared to fossil fuels) seemed to be the most commonly used frame in the 2016 policy fight, due to its quantifiability and perceived salience. A public health frame focusing on air pollution seemed to be the second most prominent frame, possibly the primary frame used with the public, due to its salience across the political spectrum and for communities of color facing environmental racism. The public health frame emphasized cost (e.g., the cost of healthcare related to pollution from coal plants) rather than environmental justice; according to one activist, this was to appeal to Republican lawmakers. A climate change frame was seen as unsuccessful, due to politicization and a lack of salience, and was not used prominently. Two activists stated that arguments about the RPS creating jobs were hard for environmental organizations to credibly make. One activist discussed frames about free-market ideology, but these frames were ultimately connected to lower energy costs (as the result of free-market competition).

In Nevada, the frames that interviewees most commonly reported using were those centered around public health (primarily focused on clean air) and job creation/economic impacts. Economic frames were believed to be especially salient for rural communities, business coalitions, and conservatives, while public health frames reportedly appealed to lower-income communities and communities of color because of the direct impacts of health harms and the visibility of poor air quality. As in Michigan, the public health frame was linked to economic considerations, such as the healthcare costs and workforce impacts of pollution-induced illness. A frame related to energy

²⁶ Constitutional amendments in Nevada must be approved twice to take effect; the measure passed again in 2020.

costs seemed to be the third most prominent frame, though less prominent, while a climate change frame was deemphasized.

In both states, some interviewees suggested that climate change is becoming a more salient issue, suggesting that climate change frames may become more prominent in the future.

Both states' coalitions' framing and messaging choices were deliberate, coordinated, and consistent. The coalitions brought in outside support to help develop/coordinate a communications strategy and to create materials for coalition members. They used public health professionals as spokespeople to increase the credibility of the public health frame. And they extensively researched frame success via repeated polling and focus group work (in both states), relationship mapping of the legislature (in Michigan), and online panels and ad tests (in Nevada). This research was crucial: in Michigan, the success of research-identified frames helped resolve disagreements among coalition members about which frames to use, while the Nevada coalition decided which ads to run based on testing. However, the coalitions also targeted their framing to different audiences, both among the public and among lawmakers, striking a balance between coordination and flexibility. Though one activist noted that the success of the Michigan policy campaign was partially attributable to an unrelated deregulation battle, framing was still important, as it allowed many Republicans to accept the legislation and helped overcome divisions among Democrats.

To complement these qualitative data, after conducting interviews, we also conducted structural topic modeling analyses of the articles in our dataset from Michigan and Nevada, using the same software and procedure discussed above. Two Michigan interviewees stated that the pro-RPS coalition began working in 2013, so we analyzed articles from the years 2013–2016 ($n = 23$). In Nevada, we sought to capture frames used in the 2018 ballot measure campaign but avoid frames from the unsuccessful 2017 policy fight, so we analyzed articles from 2018–2019 ($n = 22$).

In both states, the frames we uncovered in newspaper articles were quite different from the frames the coalitions reported deploying. In Michigan, the ranking of newspaper frames by weight was exactly the opposite of what activists listed as their ordering of frames: first a frame which mentioned market choice, then frames about business development, and then environment frames. Though some environmental frames mentioned pollution, public health frames did not appear, nor did a clearly-identifiable energy/utility costs frame. Newspaper frames from Nevada also sharply contrasted with activist frames: a business development frame strongly predominated, distantly followed by a climate change/reducing emissions frame and a utility costs frame; a pollution and/or public health frame did not appear.²⁷

5 Discussion

One of the clearest findings of this fifty-state study of leading newspaper reporting on renewable portfolio standards (RPSs) is the strong prevalence of economic frames in the articles we analyzed.²⁸ Structural topic modeling found that a business development frame,

²⁷ Analysis of all newspaper articles in our dataset from these states, regardless of time period ($n = 107$ Michigan, $n = 82$ Nevada), similarly found sharply different frames from those which activists reported using.

²⁸ A limitation of our research is that we were only able to analyze newspaper articles from one paper per state, and some papers had relatively few articles. Additional analysis with a larger number of articles and a broader sample of papers would add to the literature in this area.

utility costs frame, and general economic frame blending both predominated over other frames. Indeed, the economic frames were so dominant in the over 1500 articles we analyzed that there were no observable differences in their prominence between different partisanship categories or in different regions of the country, nor in different time periods since 1997. Furthermore, there was significant overlap between business development frames and frames defining RPSs. This suggests that business development frames are present in articles which introduce/define RPSs, indicating their dominance from the very start of RPS framing.

Our exploratory interviews and state-level structural topic modeling of newspaper articles in two states also support this finding: a cost frame was the most prominent in Michigan and a jobs frame was one of the two most common frames in Nevada. Furthermore, public health frames in both states were linked to economic considerations (e.g., reducing healthcare costs) rather than presented as issues of environmental justice.

Our findings are consistent with previous research suggesting that climate change is often framed in economic terms in the U.S. (e.g., O'Connor et al 2002; Kahn and Kotchen 2011; Scruggs and Benegal 2012; Carmichael and Brulle 2017; Carmichael et al 2017), and that the co-benefits used to justify climate mitigation policies mention economic upsides more often than those related to public health or the environment (e.g., Bettisill 2000; Rabe 2007b; Karapin 2018). Furthermore, though political ideology has been seen to interact strongly with framing (e.g., Schuldt et al 2011; Villar and Krosnick 2011; Schuldt and Roh 2014), it was not enough to affect the frame prevalence of economics in this analysis: conservative states were not measurably different than liberal ones. Climate change/reducing emissions frames were, however, significantly more prominent in liberal states relative to conservative states, a finding which coheres with earlier research showing that liberals emphasize climate change more than conservatives do (Meyer 2020). Climate change/reducing emissions frames were also significantly more prominent in the Northwest than in any other region.

Our case studies also suggested that a climate change frame is seen as generally unsuccessful, and was less emphasized by SMO activists during the study period. However, activists in both Michigan and Nevada stated that popular perceptions about climate change have been changing rapidly in recent years, and polling supports this (Meyer 2020)—so while this finding was not reflected in our quantitative analysis, climate change frames appear to be rising in prevalence.

Some studies suggest that a public health frame can be very successful with the general public (Maibach et al. 2010; Myers et al 2012; Stokes and Warshaw 2017). Our exploratory interviews in Michigan and Nevada strongly support this finding: in both states, the public health frame was one of the two frames most commonly used by activists. However, this frame was almost nonexistent in our quantitative data of articles in leading state newspapers. A pollution/public health frame appeared only twice across all analyses, compared to 40 occurrences of business development frames, 31 occurrences of utility costs frames, and 47 occurrences of climate change/reducing emissions frames.²⁹ This suggests that newspaper reporters in our sample do not reliably transmit the frames advanced by SMO activists, a finding that is supported by our analysis of newspaper articles in our case study states. (For example, Nevadan activists stated that public health was one of their primary frames,

²⁹ Though the average weight of the pollution/public health frames across all categories was not significantly different from that of the climate change/reducing emissions frames, the differences in number of frames very strongly indicate the lower prominence of the pollution/public health frame.

but we did not find a single instance of a public health frame in Nevada.) However, the public health toll of the fires and heat waves in summer 2021, which have been connected to climate change by many observers, may make a public health framing of climate change more salient. More work examining post-2021 public health frames could evaluate this.

Results from our case study states generally indicate a strong disjunction between the frames present in the newspapers we analyzed and those used by activists. This contrasts with earlier work suggesting that environmental SMOs are able to push their preferred frames into newspaper discourse (Reber and Berger 2005), but may cohere with more-recent work which suggests that large institutions, especially businesses, are most successful at having their positions quoted in major national newspapers (Wetts 2020b). The bottom line is that while climate activists work hard to frame the push for renewable energy in ways that will resonate with the public and with policymakers, the main frames advanced by reporters emphasize economic reasons for supporting or resisting renewable energy targets. This informs the national-level research showing that economic arguments have become hegemonic in the USA (Wetts 2020a), and suggests the need for significant research on the agenda-setting role of newspaper reporters and reasons for this economic bias; a crucial area for research is the dominance of business interests in newsrooms and the legislative corridors of power. The rise of social media also raises the question of how and when activists attempt to speak directly to their audiences, and whether this is driven in part by journalists not transmitting their preferred agendas and frames.

After decades of insufficient success in mobilizing state legislators and governors in enacting ambitious climate laws, our exploratory interviews in Michigan and Nevada strongly indicated that environmental SMOs and activists often adopt frames from outside their organizations. In both states, activists identified and used what were perceived to be the most successful frames, regardless of whether they cohered with an SMO's priorities or values. Salience and resonance are key aspects of successful framing (see Snow and Benford 1988; Benford and Snow 2000), but SMOs may have less power to shift discourses in the public sphere than this literature indicates, at least in the current political moment.

The time period under study coincides with a period of relatively limited action to mitigate climate change in the USA (see Rabe 2008; Hultquist et al. 2017), suggesting that the dominant (economic) frames used during this time may have been less-than-successful at motivating action. This aligns with Wetts' (2020a) finding at the national level that environmentalists adopted neoliberal language when discussing climate change, without success (see also Skocpol and Hertel-Fernandez 2016). Experimental evidence shows that economic frames are powerful in the short term (e.g., Stokes and Warshaw 2017), but other evidence suggests that extrinsic motivators like economic impacts may reduce intrinsic motivation to mitigate climate change in the long-term (see Markowitz and Shariff 2012).

Another clear finding of this research was that the frames we identified did not always match the frames identified or theorized by other research. For example, we did not uncover any of the less tangible frames—focusing on how concerned to be about climate change and who should be taking steps to mitigate it—that others have identified (see Ereaud and Segnit 2006; Nisbet 2009b; Stoknes 2014; Caniglia et al. 2015), a finding which coheres with survey research regarding how lawmakers frame climate mitigation policies (Vasi 2006). However, since these frames tend to be more complex and nuanced in the wording which they use, it is also possible that such frames do exist and were simply unidentified by our topic modeling software.

We also found a strong distinction between utility costs and business development frames. Despite the fact that both frames focus on economic impacts of RPSs, not a single frame identified in our quantitative analysis blended words related to both business

development and utility costs, and activists clearly differentiated between these frames. Both frames were significantly more prominent than any other frame analyzed, indicating their importance. However, though both frames are addressed in the literature, very little work examines both at the same time.³⁰ Furthermore, relatively little of the existing literature focuses on a utility costs frame, despite the prominence of this frame in our data and in the research which does study it (Stokes and Warshaw 2017). Similarly, though most of the empirical work about RPS framing has used a frame of job creation/destruction, the jobs-related frame we identified was in fact a broader business development frame which mentioned jobs but did not exclusively focus on them. Additional research is needed to evaluate common frames, so that future experimental and theoretical work can accurately mirror frames as they actually appear in discourse.³¹

Additionally, more work comparing specific articles would also be useful to help determine nuances of tone and (un)favorability toward RPSs that the structural topic modeling software was unable to evaluate.

A final limitation of this research is that we were only able to evaluate two case study states, and we interviewed only five activists in each state. More qualitative research evaluating the framing of state-level policies is needed, especially since most prior work has occurred on a national level. The two states we examined successfully increased their RPSs. Research focused on states which had unsuccessful RPS policy fights—such as Arizona, where a 2018 ballot measure to raise the state’s RPS to 50% by 2030 failed dramatically (Trabish 2018)—would help uncover the mechanisms connecting SMO frames, newspaper frames, public perception, policymaker outlooks, and legislative efforts and outcomes. Because of the US’s federalist structure, the stakes of state-level climate change policy are high. The role of effective framing of why states should act merits much more attention.

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Data availability We are completing another article using these data, after which we will make the data available.

Code availability Data analysis used software package MALLETT, which is Open Source Software released under the Common Public License.

Declarations

Additional declarations for articles in life science journals that report the results of studies involving humans and/or animals N/A.

³⁰ Stokes and Warshaw (2017) and Rabe (2007b) are exceptions.

³¹ Research is also needed to identify potential new frames—for example, the winter 2021 blackouts in Texas raised issues of reliability and resilience of an electricity grid heavily dependent upon natural gas-fired power plants, so a diversification/resilience framing may arise.

Ethics approval

We received exemption from Brown University's Institutional Review Board because the interviewees were judged to be key informants, not human subjects, since the respondents were not talking about themselves or other individuals.

Consent to participate N/A.

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