



Original research article

Moral foundations of energy transitions in the United States: A cross-sector discourse analysis

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ABSTRACT

Morality, people's evaluative judgments of right and wrong, can help explain and motivate their policy support and actions. Given the critical need to overcome ideological differences and facilitate stakeholder buy-in for energy transitions, we explore variations in moral values within and across three key stakeholders in the U.S.: the government, energy companies, and the mass media. Specifically, we leverage insights from the Moral Foundations Theory and employ computational text analysis to examine a vast dataset comprising national congressional proceedings, firm Securities and Exchange Commission (SEC) filings, and newspaper articles from selected news outlets over the last decade. Our results show a growing focus on energy transitions in recent years, underscoring its increasing importance on the public policy agenda. Notably, our analysis reveals a significant disparity in moral framing between newspapers and SEC filings: while newspapers tend to emphasize binding moral foundations and convey a negative tone, SEC filings are more inclined to employ individualizing moral foundations and express a relatively positive sentiment. This disparity highlights the potential tension between the general public's moral concerns and the priorities of energy companies amidst the ongoing energy transition, providing important implications for policy design and the pursuit of a just transition.

1. Introduction

Mounting scientific evidence has been pointing to the urgency of transitioning from a global economy heavily reliant on fossil fuels to one powered by cleaner, low- to zero-carbon energy sources [1]. Initially, research and policy on energy transitions focused on establishing the technical and economic feasibility of low-emission sources. Now, the landscape has evolved, with the focus shifting to sustaining the integration of low-emission sources into power systems via complex and intertwined technological, social, and institutional changes. This involves, for instance, intricate interactions between established and emerging business models and technologies, intensified economic and policy uncertainties for stakeholders such as utility companies and industrial associations, and significant challenges for the overall functioning and performance of the energy sector [2]. An important factor adding to the intricacy of energy transitions is the (re)alignment of values and policy preferences within and beyond the domains of energy production, distribution, and consumption, given the critical importance of stakeholder buy-in in energy transitions. One effective approach to understanding this complexity is to analyze the discursive strategies

and framing employed by different stakeholders, as these reflect their underlying values and policy preferences with regard to energy transitions [3,4].

A growing line of research has examined stakeholder values and discourse in the context of energy transitions, focusing on important topics such as how stakeholder values shape discursive strategies when advocating for emerging energy options [5] and how these values influence the market behavior of energy companies [6]. A related yet understudied area about stakeholder values and discourse in energy transitions is moral framing, which refers to how issues and/or positions are presented through the lens of moral values and principles, reflecting how people judge what is “right” or “wrong” when evaluating intentions, decisions, and actions [7]. There is compelling evidence to suggest that variation in moral framing could help us better understand stakeholder values and discourse in energy transitions. First, research on environmental psychology and politics has revealed the moral roots of environmental attitudes, indicating that moral values can help account for the varied and polarized views on environmental issues and that reframing environmental discourse in varying moral terms (e.g., preserving purity) could bridge the gap between environmental liberals and

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conservatives [8]. Second, and perhaps more importantly, moral values have been shown to play a crucial role in shaping individuals' support for environmental policies [9] and their political participation [10]. This highlights the potential of moral values to not only drive attitudinal changes but also to cultivate behavioral changes and greater civil engagement in energy transitions.

To better understand the stakeholder values and discourse in energy transitions, the current study focuses on morality and examines the distribution and variations of different moral values within and across the discourse of three different sectors—the government, energy companies, and mass media—in the U.S. In doing so, we draw on the Moral Foundations Theory (MFT; [11])—a well-established positive framework of morality—to guide our research. MFT, developed primarily by Jonathan Haidt and Jesse Graham, was designed to examine the moral reasoning behind people's attitudes and behaviors across cultures [12,13]. Together with Moral Foundation Dictionary (MFD) and Moral Foundation Questionnaire (MFQ), MFT has been extensively used to explore individuals' moral psychology (i.e., the relation between morality and attitudes toward various issues, including political [14], social and cultural [15], as well as environmental issues [12]) and to analyze moral judgments within a wide range of texts. These texts include sermons, tweets, speeches by U.S. politicians, newspaper articles, organizational press releases, and Voter Guide statements across various issues such as religion [16], general politics [17,18], scientific research [19], and climate change [20]. Building on MFT's demonstrated versatility, our goal is to use this framework to address two primary research questions: (1) How do government agencies, energy companies, and mass media in the United States differ in their use of moral foundations when discussing energy transitions? and (2) what implications do these differences have for policymaking?

Empirically, our study collects data from diverse sources, including national congressional proceedings, corporate Securities and Exchange Commission (SEC) filings, and articles from select news outlets over the past 10 years. To better capture moral rhetoric dynamics in our data, informed by the literature (see e.g., [10,21]), we conduct a theory-driven computational text analysis, guided by the principles of MFT. Specifically, we utilize a dictionary-based approach facilitated by the extended Moral Foundations Dictionary (eMFD), a robust tool designed for extracting moral content from textual data [22]. Our findings highlight a growing focus on energy transitions in recent years, underscoring its increasing importance on the public policy agenda. Notably, our analysis reveals a significant disparity in moral framing between newspapers and SEC filings. Newspapers tend to emphasize binding moral foundations and often adopt a negative tone, highlighting the importance of collective action and community protection. In contrast, SEC filings lean toward individualizing moral foundations and convey a relatively positive sentiment, suggesting a preference for minimal regulatory intervention and market-based approaches. Such a contrast underscores the potential tension between the general public's moral concerns and the perspectives of energy companies amidst the ongoing energy transition.

Our study contributes to the literature in three important ways. First, it broadens the scope of energy transition research by examining moral framing at the organizational level across government, energy companies, and mass media in the United States—an approach that highlights institutional actors' evaluative judgments and expands on prior work focused on individual or community perspectives. Second, by comparing these three sectors within a single analytical framework, our study provides valuable insights into how their rhetorical strategies converge or diverge, laying the groundwork for future investigation into the relationships between stakeholders' moral framing preferences and policy positions. Finally, our paper offers a methodological contribution by applying MFT and its associated computational text-analysis tools to large-scale textual data, providing a framework for future research aimed at deepening our understanding of the complex moral dimensions in energy transitions.

2. Moral foundations of energy transitions

Energy justice is a crosscutting social science research agenda that integrates principles of justice into energy policy, production, systems, consumption, activism, security, and climate change [21]. Foundational principles of energy justice often can find roots in moral philosophy [23], and accordingly, a substantial body of research focus has been devoted to studying the moral and equity dimensions of energy systems and transitions (see e.g., [24,25]). Commonly discussed values in the context of energy transitions include energy affordability and poverty, energy security, energy pollution, environmental sustainability, and more broadly energy ethics and justice [26,27]. Importantly, moral claims often do not refer to objectively existing, universally applicable ethical truths; rather, they are rooted in our shared humanity and the meanings we ascribe to life [28]. This perspective has led to extensive research examining individuals' perceptions of ethics and justice concerning energy systems and transitions. Factors such as perceived procedural and distributive justice, as well as recognition justice (i.e., diversity, inclusion, and the rights of the least well-off) [21,29], and potentially interactional fairness (e.g., interpersonal justice and information transparency) [30], play a significant role in shaping people's sense of legitimacy and justice in energy transitions. Furthermore, research has looked into community perceptions and acceptance of transition pathways, further highlighting the importance of bottom-up efforts and local buy-in for successful energy transitions [31].

In addition to examining individual and community-level perceptions of ethics and justice in energy systems and transitions, there is a growing—though still limited—body of research that explores organizational-level dynamics. For instance, drawing on interviews with organizational representatives, Fuller and McCauley [32] illustrate how activism and advocacy organizations strategically frame their interpretations of energy justice and how these frames are shaped by broader societal forces. Similarly, by analyzing visioning documents from community-based organizations, Elmallah et al. [33] propose a “frontline-centered” approach to energy justice, emphasizing key principles such as addressing the root causes and legacies of inequality, shifting power imbalances in existing energy governance structures, and creating new, cooperative, and participatory systems of energy governance and ownership. Along this line, research has also examined dynamics within government agencies, yielding insights into the feasibility of integrating energy justice principles into national and local efforts [34], how governments prioritize energy justice concerns [35], and the varying degrees to which national energy transition plans address different dimensions of energy justice across countries in the Global South [36]. Furthermore, while scholars have underscored the importance of firms/businesses in advancing energy ethics and justice [37,38], empirical research on their perspectives remains scarce. This gap highlights the need for a more comprehensive analysis of organizational perspectives, encompassing the energy companies as well as other types of organizations such as government and civil-society entities.

In addition to commonly discussed values—such as energy affordability and poverty, environmental sustainability, and energy ethics and justice—that have informed research on the moral and equity dimensions of energy systems and transitions, scholars have increasingly drawn on specific theoretical frameworks, including Schwartz's value theory [39] and MFT [40]. Here, Schwartz's value theory offers a systematic framework for understanding and analyzing how values drive human behavior and inform societal norms. Centering on personal values, it recognizes both the universal and culture-specific dimensions of values and organizes these values into a structured construct based on their underlying motivations and interrelationships [41,42]. As for MFT, as indicated previously, it is a prominent psychological framework that aims to explain the intuitive bases of human morality [11]. There is a growing body of research that applies MFT to studying energy and environmental issues at both individual and organizational levels (see e.g., [7,43]). Central to MFT is the idea that morality can be understood

through a finite set of “moral foundations,” which capture distinct moral profiles while accommodating both cultural and individual differences [44]. In its original form, MFT identifies five core moral foundations: care/harm, fairness/cheating, loyalty/betrayal, authority/subversion, and sanctity/degradation. These foundations serve as the building blocks of moral systems, described as “interlocking sets of values, virtues, norms, practices, identities, institutions, technologies, and evolved psychological mechanisms that work together to suppress or regulate self-interest and make cooperative societies possible” [45, p. 270].

Specifically, each foundation highlights a different dimension of right and wrong and is framed as a pair of opposing concepts (virtue/vice). Since virtue and vice words target the same moral foundation from opposite directions, they belong to the same underlying structure. Here, virtue words represent prescriptive moral concerns—what one should do—while vice words represent prohibitive moral concerns—what one should not do [20]. Specifically, the care/harm foundation centers on kindness, sympathy, and protecting the innocent from suffering, emphasizing the promotion of well-being and opposition to violence. The fairness/cheating foundation focuses on justice, cooperation, and rejecting discrimination, condemning unfair practices or inequitable distributions of resources. Because they emphasize the rights, welfare, and interests of individuals, both care/harm and fairness/cheating are conceptualized as individualizing foundations. By contrast, the loyalty/betrayal foundation involves group belonging and solidarity (including patriotism) and condemns actions that contravene group interests. The authority/subversion foundation relates to hierarchy, obedience to social structures, respect for tradition, and aversion to disorder. Finally, the sanctity/degradation foundation revolves around both physical and spiritual purity, opposing indulgent or degrading behaviors. Because they center on collective duties, adherence to group norms, and self-control, loyalty/betrayal, authority/subversion, and sanctity/degradation are categorized as binding foundations [12,16].

Given the increasing scholarly interest in uncovering the moral origins of attitudes and framing around energy transitions, researchers have progressively adopted MFT as an analytical framework in pertinent research. For example, at the individual level, [46] examine the influence of moral framing on support for renewable energy initiatives—in this case, an offshore wind farm project in Turkey—using a survey experiment with two framing conditions informed by MFT. Their findings indicate that left-leaning individuals exposed to an individualizing frame are more likely to support offshore wind farms compared to those exposed to binding or control conditions. At the institutional level, [47] innovate the concept of the “moral entrepreneur” to describe deliberate efforts to alter entrenched moral norms and to facilitate systematic transitions. Their research suggests that moral entrepreneurs can instigate landscape-level change by gradually decoupling established rules and practices from their underlying moral foundations through macro-systemic discourse. In a comparative context, [20] apply MFT to assess moral foundations in the discourse on climate change and energy transitions across newspapers in the United States, the United Kingdom, and China. Their study suggests that while newspapers across all three countries predominantly rely on the care/harm foundation and exhibit a similar preference for the sanctity/degradation foundation, Chinese media tend to emphasize the loyalty/betrayal and authority/subversion foundations, whereas U.S. and U.K. media more frequently invoke the fairness/cheating foundation. Despite these advances, our literature review indicates that research employing MFT to examine organizational perspectives—particularly studies incorporating the views of energy companies, government, and civil society—remains underexplored, warranting further investigation.

3. Data and methods

The literature acknowledges variations in discourses regarding energy transitions among stakeholders from different sectors (e.g., political parties, civil societies, and the energy industry; [48]). Building on

this, our investigation explores the discourses of three key stakeholders in the U.S.: the government [49,50], energy companies [51], and mass media [52,53]. In doing so, we draw on insights from MFT and employ computational text analysis to examine a vast dataset, using the U.S. congressional hearings and committee reports, nationwide newspapers, and SEC filings. Our sample period spans from January 2009 to August 2022, covering the Obama Administration (2009–2017), the Trump Administration (2017–2021), and the beginning of the Biden Administration (2021–2022). Global importance to energy transition makes the U.S. become the focus of our study. As one of the largest global emitters of carbon and a major player in energy production and consumption, the U.S. wields significant influence over global energy transitions [54,55].

The timeframe we selected covers major energy transition milestones both worldwide and in the U.S. One of the notable examples is the 2009 Copenhagen Climate Conference, which positioned climate and environmental issues as central concerns in global politics and stimulated actions from social organizations, environmental groups, and the public. In the U.S., with the inauguration of President Barack Obama, who made addressing climate change and promoting sustainable energy central to his campaign platform, the American Recovery and Reinvestment Act of 2009 was considered the most significant investment in clean energy in U.S. history.

Academia's focus on energy transition also began to gain traction around 2010, marked by the publication of several influential and foundational articles. For instance, scholars reviewed past energy transitions—specifically the shift from wood/organic fuels to fossil fuels—and summarized key patterns and lessons learned from previous transitions, such as price incentives, policy support, and technological advancements (see e.g., [56–58]). These studies also provided valuable insights into the implications of these historical experiences for the ongoing energy transition from fossil fuels to sustainable energy.

In terms of search terms, informed by [59], we use “Energy transition,” “Energy system change,” “Energy transformation,” “Energy structure change,” and “Energy mix change.” Employing these search terms within [congress.gov](https://www.congress.gov) and utilizing the “Word Variants” feature, we first created a dataset encompassing 102 Congressional Records and 34 Committee Reports from the 111th to the 117th sessions of the U.S. Congress. As noted in previous studies, congressional hearings serve as pivotal forums that facilitate direct discourse and debate among a wide range of stakeholders [49,50]. These stakeholders, including government officials, interest groups, and businesses, articulate their perspectives through the policymaking process, thereby attracting attention and gaining support from diverse political constituencies.

Next, drawing from the work of [52], we accessed four major U.S. national newspapers—The Wall Street Journal (WSJ), USA Today, The New York Times (NYT), and The Washington Post—via the Factiva database. News media plays a crucial role in public discourse and policymaking, reflecting and shaping public opinion on critical issues by bridging expert analysis with layperson perspectives, including energy transition. These selected newspapers have a large national readership, consistently ranking among the top five in the U.S. Additionally, these publications are routinely monitored by policymakers for insights into public sentiment [20,52]. Our search collected 1336 news articles from four newspapers.

As for corporate perspectives, we focus on SEC filings within the energy and utilities sector. Mandated by the U.S. SEC, these filings serve as vital disclosures for investors and regulators, ensuring transparency and facilitating informed decision-making [60,61]. Unlike communications tailored to specific interest groups, SEC filings are directed at a broader audience, similar to press releases, enabling the assessment of companies' general rhetorical strategies in shaping public perceptions [62]. Widely utilized to gauge corporate stances on environmental, social, and governance (ESG) issues [63], as well as renewable energy [64] and climate change [51], SEC filings—particularly 10-K reports—offer valuable insights into companies' attitudes and commitments. Given the energy industry's pivotal role and the increasing pressure to contribute

to environmental sustainability through energy transition [64], we anticipate a heightened emphasis on this topic within SEC filings from energy and utility companies. Leveraging the Lexis-Nexis database, our search yielded a total of 3385 SEC filings.

Upon collecting the data, we processed it using eMFD. The data processing pipeline for eMFD scoring contains several steps. First, we downloaded and extracted text from the original files, converting them into TXT files. When the files were ready, we proceeded to pre-process. Following common practices in the field [65], our pre-processing steps included: (1) Converting text to lowercase; (2) Removing punctuation; (3) Eliminating numerical characters; (4) Filtering out stopwords (please refer to supplementary materials for examples); (5) Excluding specific terms like “factiva” and “page” (for newspapers), and “sec edgar filings combined” and “end of document” (for SEC filings). For SEC filings, the generic stopwords “should” and “shouldn't” were not removed due to their high likelihood of affecting model scoring. Lastly, we utilized the eMFDscore Python library to extract a diverse array of moral information metrics.

We applied the Bag-of-Words (BoW) algorithm within the eMFD-score framework to score our pre-processed TXT files [22]. Since its inception, eMFDscore has been applied across diverse contexts to analyze moral foundations, including newspapers [66], social media texts [67,68], and movie scripts [69]. The associated dictionary, the Extended Moral Foundations Dictionary (eMFD), is compiled from crowd-sourced annotations and comprises 3270 unique words, expanding upon the original MFD by 324 terms. In contrast to traditional MFD, which contains two lists of words (virtues and vices) for each moral foundation, eMFD gives 10 continuous values for each word. Five values indicate the possibilities that a word belongs to a given foundation, and five corresponding values of the sentiment (virtue or vice) of the word when it refers to a certain foundation.

To compute the foundation probabilities of individual words, the developers of eMFD employ a large number of annotators to identify content pertinent to each moral foundation within massive news articles. The process begins with annotators highlighting content associated with specific foundations. After removing stopwords among the highlighted content, a vocabulary for each foundation is constructed. For example, for annotators who are in charge of annotating sanctity/degradation foundation, assuming that they have seen the word “clean” 100 times during annotation and they annotate 25 of them are related to sanctity/degradation foundation. The sanctity/degradation foundation probability for “clean” is $25/100 = 0.25$. Consequently, each word in eMFD is linked to five moral foundation probabilities, ranging from 0 to 1. For moral sentiment scores, eMFD differs from previous MFDs by utilizing the Valence Aware Dictionary and sEntiment Reasoner (VADER) to calculate sentiment scores for words within each moral foundation [70]. This approach yields five continuous variables, ranging from -1 (most negative) to 1 (most positive). For example, the sanctity/degradation sentiment score for “clean” is 0.41, meaning that when the word “clean” is associated with the sanctity/degradation foundation, the overall sentiment of the context in which it appears is 0.41. In sum, leveraging coders from diverse social and cultural backgrounds, eMFD aligns with real-world moral judgments, which are often rapid and spontaneous. Compared to conventional expert-curated dictionaries, crowd-sourced moral foundation dictionaries offer greater impartiality, intuitiveness, and extensiveness [22].

When scoring the files, each word within the document is compared against the eMFD dictionary for scoring. When a word match is detected, the algorithm retrieves and records the corresponding five foundation probabilities and five foundation sentiment scores, thus generating a 10-item vector for each word. Following the scoring process for the entire document, these vectors are averaged to yield a single 10-item vector representing the document as a whole. This excludes the impact of document length on the results. Additionally, we scrutinized the output and excluded filings that lacked main texts and bibliography files, which were generated during the downloading process. We then calculated the

individualizing foundation probability by averaging the care/harm probability and fairness/cheating probability. Similarly, the binding foundation probability was computed by averaging the authority/subversion probability, loyalty/betrayal probability, and sanctity/degradation probability. In total, our final dataset encompasses 136 government files, 1268 newspaper articles (551 from The Wall Street Journal, 393 from The New York Times, 281 from The Washington Post, and 43 from USA Today), and 2353 SEC filings.

Importantly, while our methodology is well-suited for our analysis, before presenting our results, we would like to acknowledge several potential limitations in our empirical strategy. First, although MFT has proven valuable in studying moral psychology and framing, it faces several challenges. For example, Iyer et al. [71] argue that the current five-foundation model may be insufficient, suggesting that additional dimensions, such as “liberty,” are needed to capture libertarian moral sensibilities. Second, while our analysis of organizational-level documents provides a broad range of insights, it is important to recognize that these entities often pursue specific interests, necessitating caution when interpreting our findings. For example, we selected newspapers as a representative proxy for mass media. However, as new media platforms emerge, newspaper readership has become increasingly limited (see e.g., [72,73]). Moreover, the political leanings of news outlets may introduce bias into media coverage. According to the AllSides Media Bias Chart, the four newspapers we selected tend to lean left or center [74]. Additionally, as previously noted, the eMFD was previously applied for analyzing news articles, social media posts, and movie scripts. This poses potential limitations when applied to government documents or SEC filings, which typically employ more formal and structured language, making it challenging for the eMFD to accurately assess their moral framing.

4. Results

We first examine the time trend of focus on energy transition in the period selected by counting the number of documents quarterly. As shown in Fig. 1, the period after 2020 saw a sharp increase in the number of documents related to energy transition, though there had been a steady rise before that. The analysis of the time trend in document frequency supports the rationale for our chosen timeframe, as the sharp increase in attention to energy transition has occurred primarily in the past five years. Before this period, the level of attention remained relatively low for a considerable amount of time. Therefore, the selected timeframe in this study effectively captures the trends and characteristics of the growing focus on energy transition.

4.1. Distribution of moral foundations on energy transitions across the government, energy companies and newspapers

We first compare the moral discourses across the three types of discourse to identify the prevailing moral dynamics around U.S. energy transitions. Figs. 2 and 3 summarize our insights into the moral foundations across different stakeholders, emphasizing the importance of considering diverse perspectives in relevant discourse. Here, moral probability indicates the association between a text and specific moral foundations, while moral sentiment reflects the extent to which a text employs positive (virtue) or negative (vice) terms associated with specific moral foundations. The points and error bars in the plot represent the mean value and 95 % confidence interval of each indicator. As shown in Fig. 2, in the four of five basic foundation probabilities except fairness/cheating foundation, newspaper coverage generally employs the most morality discourse while SEC filings employ the least. In contrast, government documents use moral discourse moderately. In the fairness/cheating foundation, SEC filings unusually highlight it, reflecting businesses' focus on and/or preference for the principles of equality, justice, rights, and autonomy. We attribute this primarily to the contextual nuances inherent in the fairness/cheating foundation.

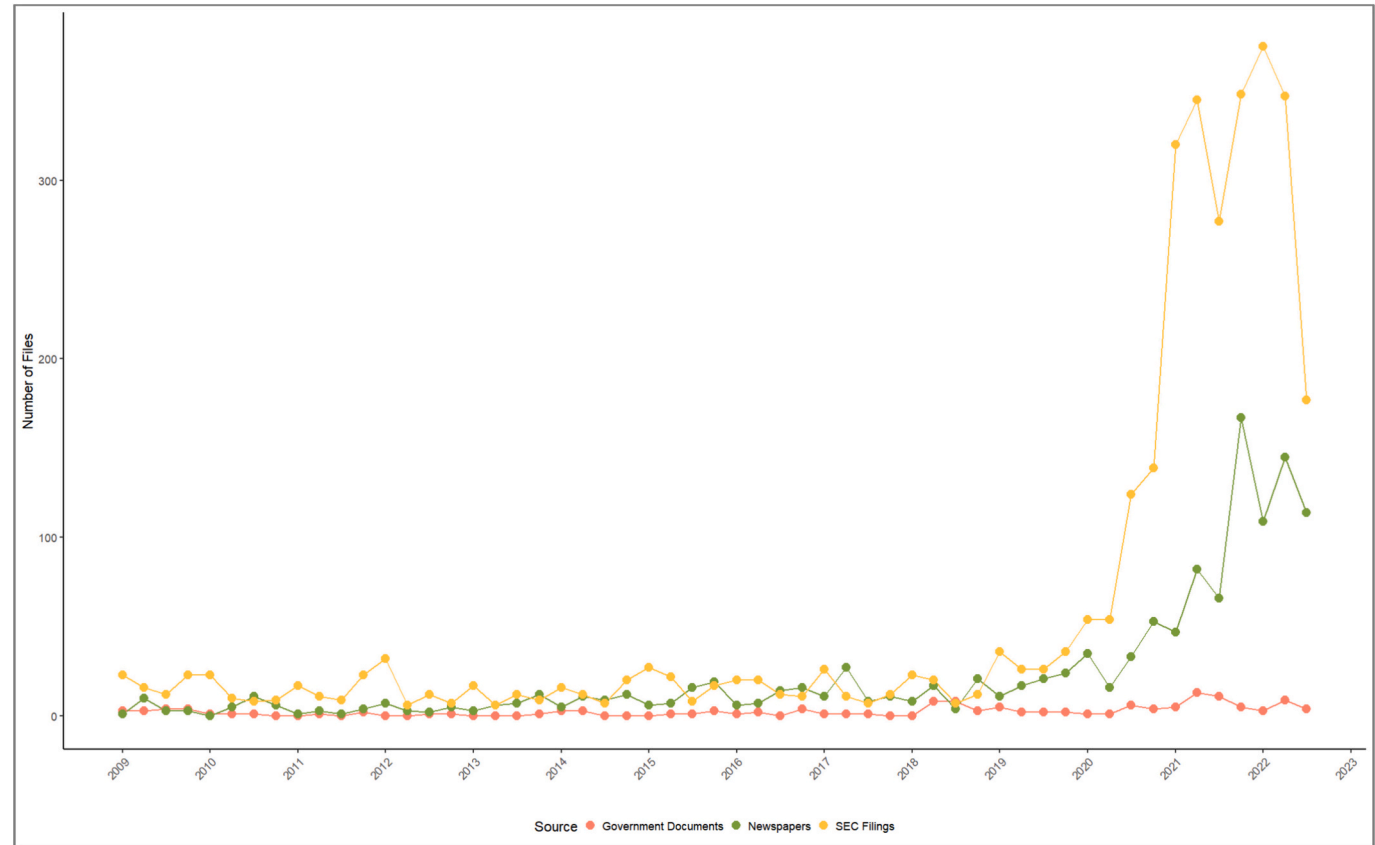


Fig. 1. Quarterly number of energy transition files.

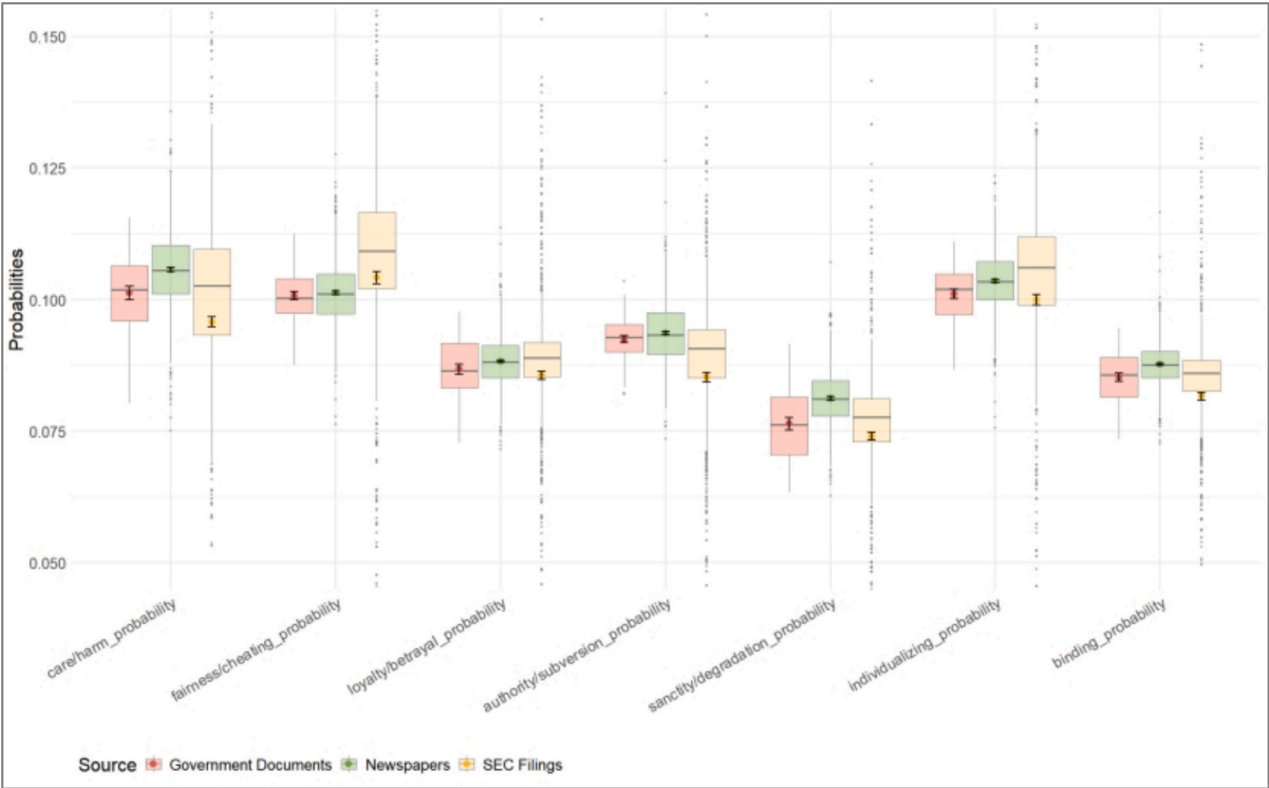


Fig. 2. Variations of moral foundation probabilities across types of discourse (2009–2022).

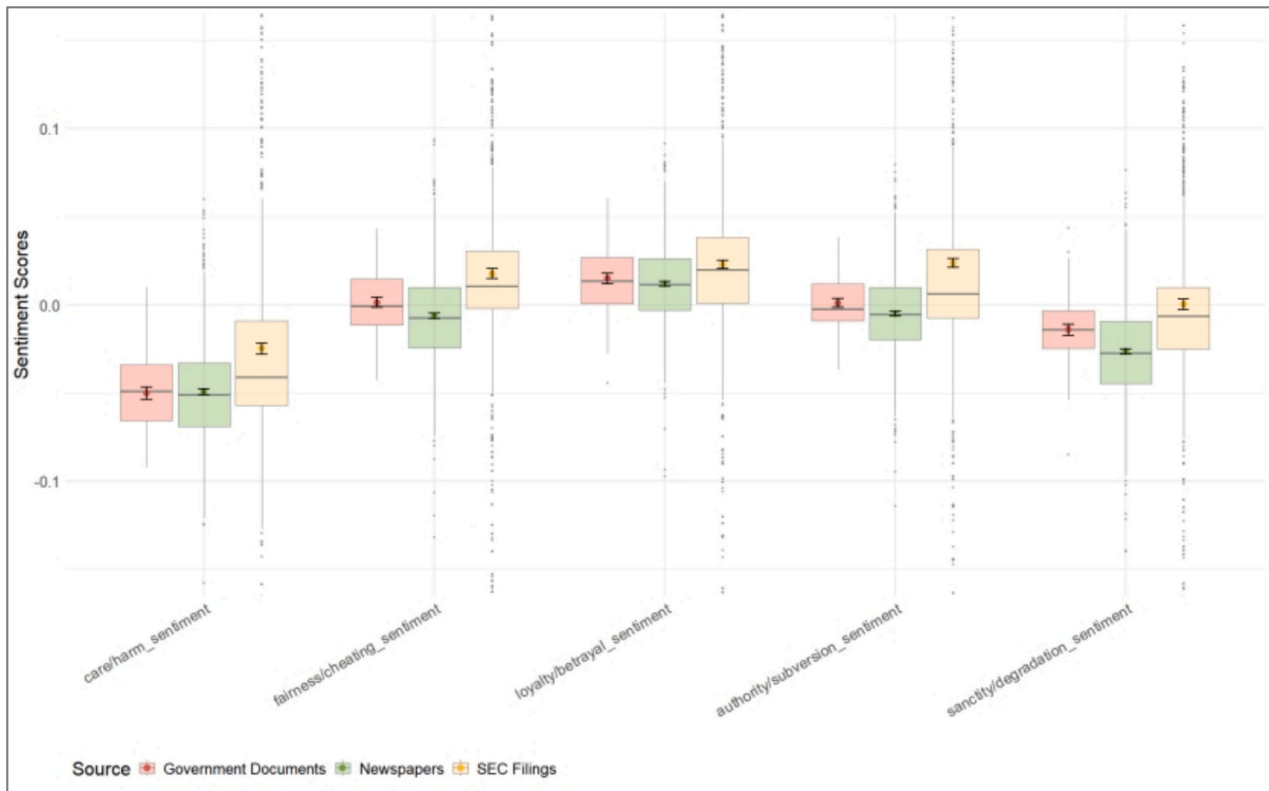


Fig. 3. Variations of moral sentiments across types of discourse (2009–2022).

Although the energy sector has traditionally been seen as resistant to sustainable and just energy transitions, there is growing awareness within the industry of environmental concerns [75,76]. Companies are increasingly dedicating efforts to public communication strategies that highlight their performance in these areas [77,78]. For example, companies may argue that the burden of the energy transition should not be disproportionately placed on them. From this perspective, fairness could be framed in terms of equitable responsibility-sharing, where energy companies might assert that the costs of the transition should be more evenly distributed across all sectors, including consumers, policymakers, and other stakeholders [79]. Furthermore, energy companies might highlight that traditional energy sources are more affordable for consumers and provide a more reliable, autonomous energy supply, while the transition to renewable energy may introduce uncertainties and potential shortfalls that could fail to meet public demand, this could ultimately impact public utilities and overall welfare [80]. The results of individualizing and binding foundation probabilities fit our finding mentioned above, as newspaper articles use the most individualizing and binding foundations while SEC filings use the least.

As for moral sentiments shown in Fig. 3, all three types of discourse—congressional hearings, newspapers, and SEC filings—emphasize harm (vices in care/harm foundation) and loyalty (virtue in loyalty/betrayal foundation). Specifically, newspapers generally adopt the most negative sentiments (lower sentiment scores) and government documents adopt slightly more positive sentiments. Conversely, SEC filings exhibit a distinctly positive moral sentiment, avoiding negative themes like cheating, subversion, and degradation. These observations are consistent with the typical rhetorical strategies of these stakeholders: newspapers often use critical and/or controversial narratives, while firms aim to present themselves in a favorable light (see e.g., [77,78,81]).

4.2. Distribution of moral foundations on energy transitions across the Obama, Trump, and Biden administrations (2009–2022)

We then delve into the variations in moral foundations across the three presidencies within our sampled timeframe (i.e., the Obama, Trump, and Biden Presidencies, 2009–2022), focusing on differences in government documents (i.e., congressional hearings and committee reports) generated during each presidential term (see Figs. 4 & 5). This analysis aims to detect potential differences in policy preferences and rhetorical strategies across different administrations. Despite previous research indicating disparities in moral foundations between liberals and conservatives—especially regarding the emphasis on the two individualizing foundations [82]—our results reveal a surprising degree of consistency in moral foundation probabilities across documents from different presidencies as shown in Fig. 4. Though documents from the Trump Administration tend to exhibit the lowest levels of moral discourse across most foundations, this difference is not statistically significant. This is likely due to the long-term, slow-paced nature of energy transitions [83], along with the path dependency and incrementalism that typically characterize transition processes in environmental and sustainability-related sectors [84].

Additionally, as shown in Fig. 5, the sentiments associated with moral foundations exhibit only modest variation across the three presidencies. However, discourse from the Trump Administration generally displays a more negative tone regarding the care/harm foundation than that of the Obama Administration, a statistically significant difference. While no other statistically significant differences were identified—likely due to the relatively small number of documents—Obama Administration documents tend to express the most positive sentiments across most foundations, whereas those from the Trump Administration reflect the most negative sentiments. Notably, in both Figs. 3 and 5, the care/harm foundation consistently registers lower sentiment scores than other foundations. This pattern could be explained by the “negativity bias” identified in environmental psychology and communications

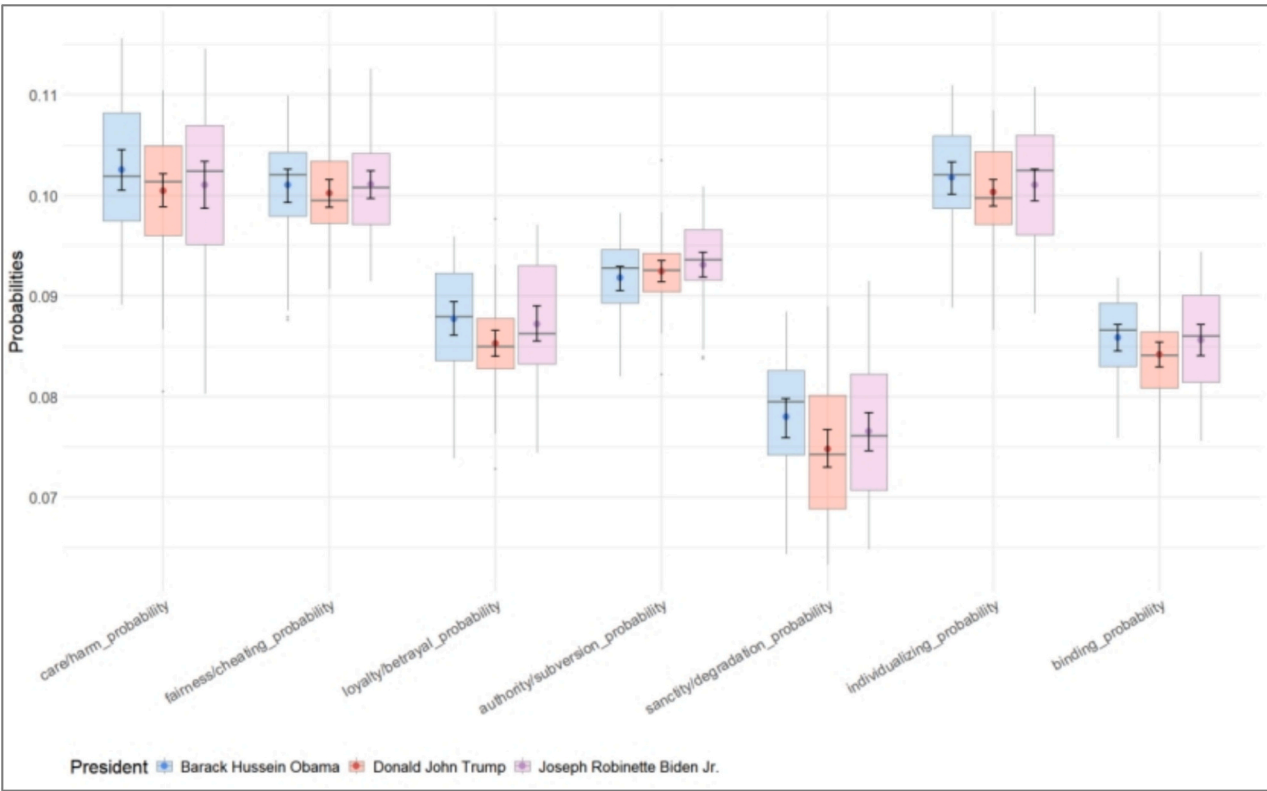


Fig. 4. Variations of moral foundation probabilities across the Obama, Trump, and Biden administrations (2009–2022).

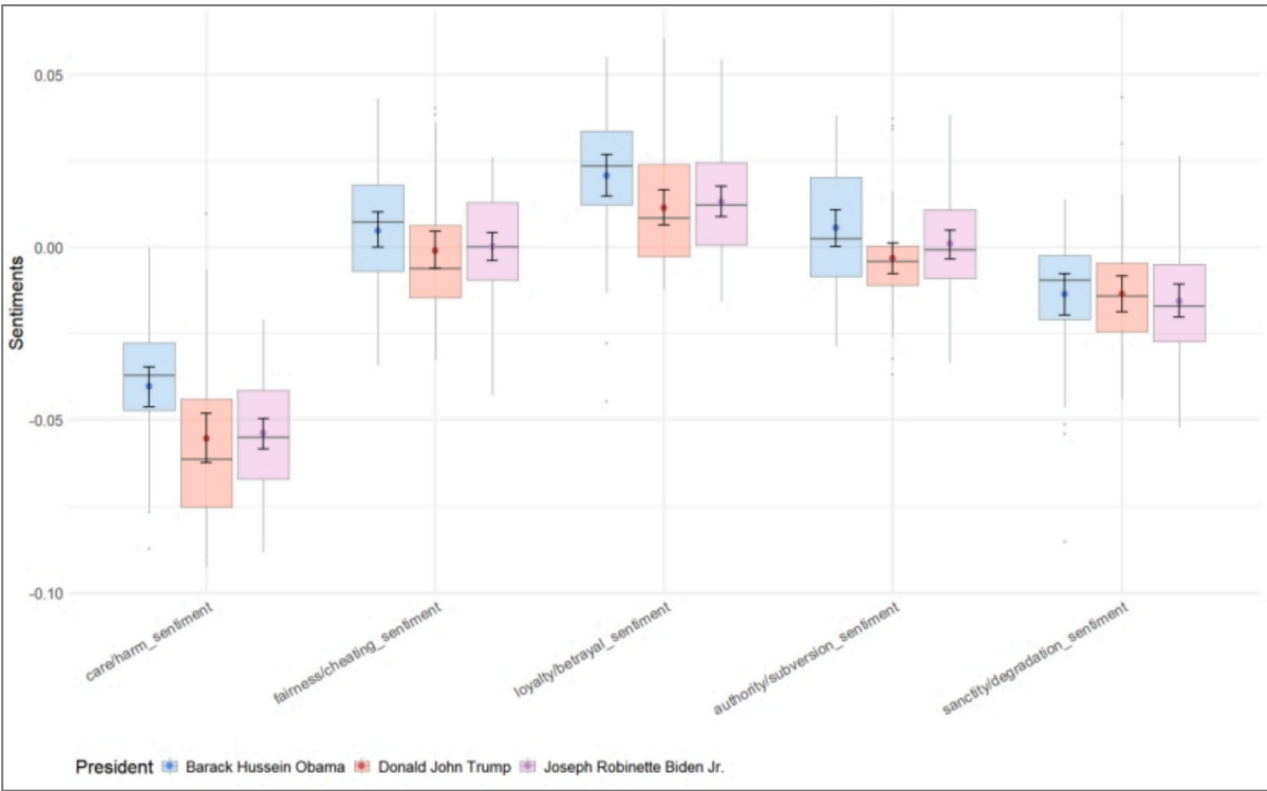


Fig. 5. Variations of moral sentiments across the Obama, Trump, and Biden administrations (2009–2022)

research [85,86], which suggests that negatively framed messages are often more effective than positively framed ones in motivating pro-environmental behaviors and eliciting public support. Because the care/harm foundation centers on promoting well-being and opposing violence, stakeholders may have emphasized its negative dimensions when shaping their discourse. In terms of sanctity/degradation sentiment, the three presidencies exhibit a high degree of similarity. This observation suggests that the policy preferences of political leaders, such as anti-establishment stances and climate change skepticism, may influence or be reflected in the moral tone of energy policy narratives.

4.3. Temporal dynamics of moral foundations on energy transitions in the U.S.

We now focus on the temporal dynamics of moral discourse in energy transitions at a more granular level, exploring patterns of fluctuation and divergence in moral foundations using quarterly data. In terms of moral foundation probability in Fig. 6, our findings indicate an overall increasing emphasis on the authority/subversion and loyalty/betrayal foundations across the three types of discourse (though fluctuation exists). These foundations reflect the importance of respecting authority and maintaining societal order, as well as loyalty to communities, such as one's family or country, respectively. The increasing attention to these foundations signifies that, in the context of our analysis, key stakeholders from the three sectors are becoming more aware of the need for coordination, cohesion, and regulatory compliance in the energy transition process. Moreover, such a trend also highlights the potential conflicts that may challenge established rules on energy transitions and governance.

For both the care/harm and sanctity/degradation moral foundations, we observe similar patterns across the analyzed documents. Newspapers show an overall higher usage of these two foundations compared to government documents and SEC filings, and sometimes the difference is statistically significant, as indicated by the non-overlapping confidence

intervals. However, in terms of trends, government documents, and SEC filings appear to be converging toward the levels observed in newspapers. By the end of our data collection period, the differences among the three document types are no longer statistically significant. This convergence is particularly evident in SEC filings, where a steeper upward trend is observed. These trends suggest that the emphasis on alleviating others' suffering (care/harm) and protecting purity from pollution or degradation (sanctity/degradation) is becoming a common rhetorical ground among key stakeholders in the energy transition discourse.

The most pronounced divergence occurs in the fairness/cheating foundation, where SEC filings consistently show significantly higher usage compared to other forms of discourse throughout the sampled period. This is expected, as the fairness/cheating foundation emphasizes equality, justice, rights, and autonomy. This finding aligns with previous research on energy company reports and communications. For instance, energy companies tend to express environmental friendliness publicly (e.g., through potential greenwashing practices) and demonstrate compliance with relevant regulations, presenting themselves as responsible corporate entities [78,87,88]. At the same time, these companies emphasize that fossil fuel consumption is driven by rising consumer demand, rejecting the notion that they should bear sole responsibility for climate change. From this perspective, fairness is framed in terms of equitable responsibility-sharing, with energy companies arguing that the costs of transitioning to sustainable energy should be more evenly distributed across all sectors, including consumers, policymakers, and other stakeholders [79]. Additionally, energy companies often stress that traditional energy sources offer a more reliable and autonomous energy supply, while the transition to renewable energy could introduce uncertainties and potential deficits that might fail to meet public demand, ultimately affecting public utility and welfare [80].

We then explore the dynamics in moral sentiment scores across foundations in Fig. 7. In doing so, we observe overall downward trends

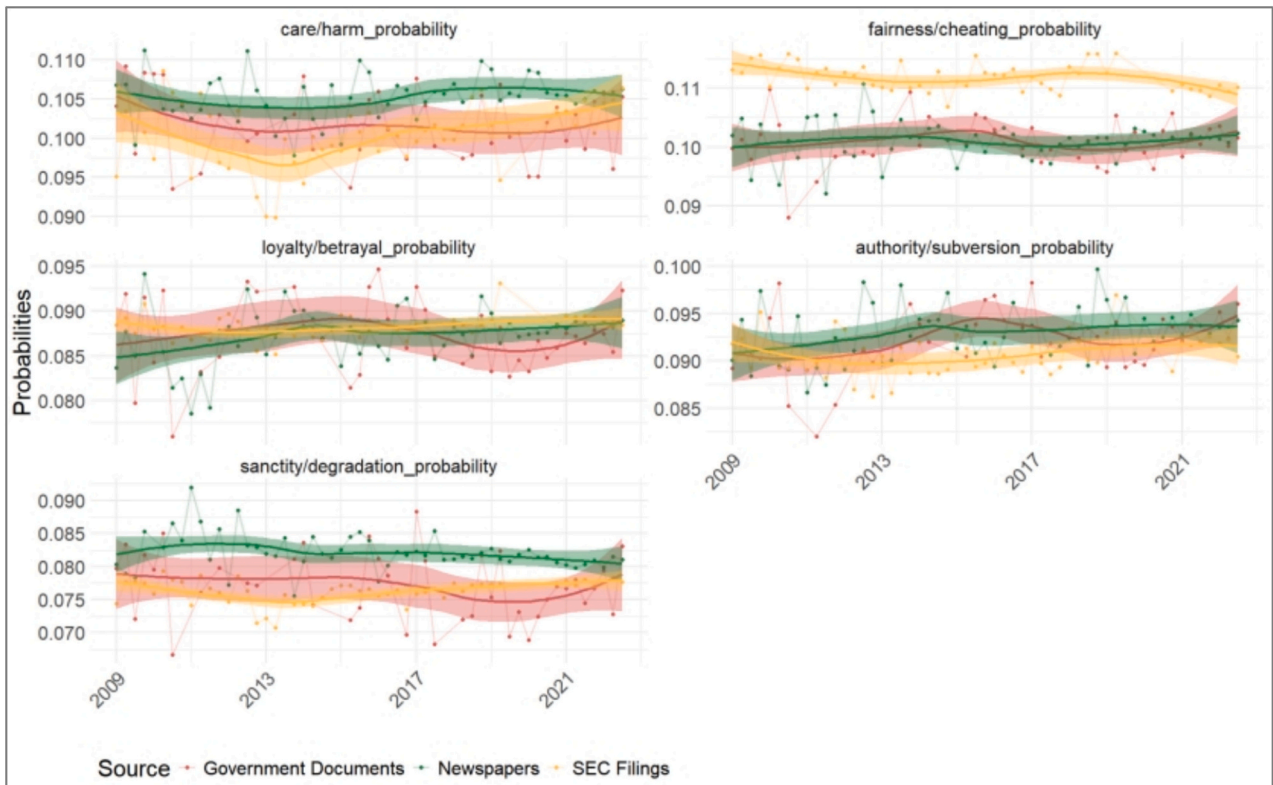


Fig. 6. Quarterly variation of moral foundation probabilities.

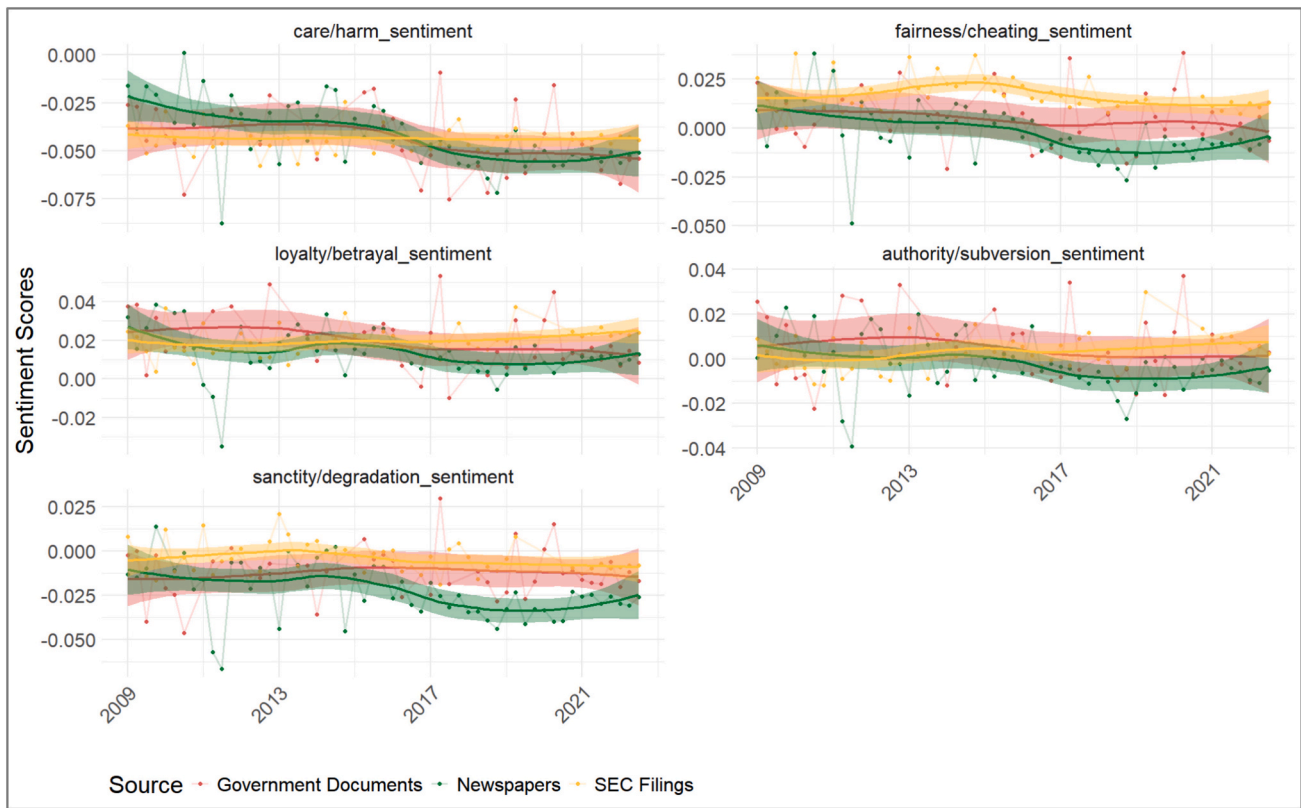


Fig. 7. Quarterly variation of moral sentiment scores.

in the moral sentiment of newspapers across most foundations, suggesting a heightened emphasis on environmental harm, challenges in environmental cooperation, and other negative externalities of energy and environmental issues. The sentiments of government documents also presented a downward trend in most foundations but in a milder way. In contrast, the moral sentiment of SEC filings shows upward trends in the authority/subversion and loyalty/betrayal foundations, while remaining relatively stable in others. In particular, the Trump Administration (2017–2021) witnessed a relatively negative moral sentiment in newspapers across all dimensions, significantly lower than SEC filings and even government documents in some dimensions. Notably, the main divergences in moral sentiment are found in the fairness/cheating and sanctity/degradation foundations, with SEC filings exhibiting the most positive sentiment, newspapers the most negative, and government documents falling in between. This disparity is likely due to the formal and less emotive language used in government documents, while newspapers increasingly adopt emotive discourse to capture public attention on energy transition issues, and SEC filings aim to portray companies in a favorable light negative impact of human activities.

In summary, the divergences between SEC filings and the other two sources of discourses in moral sentiment scores highlight the distinct rhetorical strategies adopted by different sectors in the U.S. on the topic of energy transitions.

5. Conclusion and discussions

To better understand the moral and equity dimensions of energy transitions in the U.S., our study focuses on moral framing and examines the distribution and variations of different moral values within and across the discourse of three key sectors—the government, energy companies, and mass media. Leveraging insights from MFT and employing a comprehensive dataset comprising government documents, firm SEC filings, and newspaper articles from selected news outlets over

the past decade, our computational text analyses reveal several key findings. First, there is a growing focus on energy transition in the examined documents in recent years, suggesting its increasing importance on the policy agenda and the broader public discourse. Second, our analysis uncovers a significant disparity in moral framing between newspapers and SEC filings: newspapers tend to emphasize binding moral foundations and often convey a negative tone, whereas SEC filings are more inclined to employ individualizing moral foundations and express a relatively positive sentiment. According to MFT, individualizing moral foundations emphasize the protection of individuals, their rights, and their welfare. Conversely, binding foundations prioritize the protection of the group or institution and aim to prevent selfishness by binding individuals into specific roles or duties [89]. In this case, the disparity in moral framing between newspapers and SEC filings is indicative of the two sectors' policy preferences, highlighting the potential tension between the general public's moral concerns and the perspectives of energy companies on energy transition.

Along these lines, our study makes several key contributions. First, by examining the moral dynamics of organizational-level discourse across multiple sectors in the United States, our work breaks new ground in understanding how various stakeholders frame energy transitions. Previous research has predominantly focused on individual or community-level perspectives (see e.g., [21,29–31]), and our approach expands this lens to illuminate moral framing at the institutional level. This extension is crucial because moral values shape stakeholders' evaluative judgments of right and wrong, which in turn can help explain and/or predict these important organizations' rhetorical strategies and policy preferences. Given the critical importance of buy-in from all relevant stakeholders, our findings offer timely insights into the moral underpinnings of energy transition strategies. Specifically, they highlight how different sectors—government, energy companies, and media—may align or diverge in their discursive stances, with implications for policy design and communication.

Second, and relatedly, our focus on the government, energy

companies, and mass media complement previous research that has examined these actors in isolation (see e.g., [21,29–31]). By comparing the rhetorical strategies and policy preferences of these three sectors within a single analytical framework, our study offers valuable insights into the complex discursive dynamics around energy transitions. That said, while we have attempted to link variations in moral framing and discourse dynamics to the policy stances of different sectors, our analysis remains largely descriptive. Future research should therefore investigate the correlational or causal relationships between these discourses and the diversity of their underlying moral values. For instance, by incorporating data that more explicitly reflects stakeholders' policy preferences—such as congressional voting records—researchers could develop a more nuanced understanding of how policymakers' moral foundations influence their positions on energy transitions.

Third, our use of MFT and associated computational text-analysis tools can guide future research on moral values in a wide range of textual data and topical areas. As for the three types of discourse examined in this study, we encourage further investigation, given the wealth of information contained in these sources. Importantly, while our application of MFT and its computational tools is both innovative and well-suited to our analysis, it may also introduce certain biases. For example, whether morality can be strictly divided into five foundations [10] or if additional foundations exist [43] remains an open question that could refine this work. In line with established literature, we focused on the broader, well-recognized categories of individualizing and binding foundations to interpret our results. Even so, we recommend that future research explore alternative methods of operationalizing moral values to build on these findings. Relatedly, because our study focuses on the United States—and specifically on discourse related to energy transitions within government, energy companies, and mass media—questions of generalizability may arise. Discursive strategies and moral intuitions may differ across contexts. Therefore, additional research in comparative or alternative settings would provide further insights into the complexity of moral values in energy transitions.

Our study also raises two practical considerations. First, newspapers emphasize binding moral foundations and care/harm foundation, whereas SEC filings only focus on fairness/cheating foundation. This contrast likely reflects differing sectoral preferences regarding institutional solutions for energy transitions in the United States. Newspapers' emphasis on binding foundations and care/harm foundation suggests a public preference for collective action and community protection, while companies' emphasis on fairness/cheating foundation likely indicates a preference for minimal intervention and market-based approaches. For policymakers, recognizing these distinct moral stances is essential, as both sectors play pivotal roles in shaping energy transitions. Radical policy changes that disregard these differing perspectives may face resistance, reducing their effectiveness [90]. For instance, given that the newspapers in our sample tend to emphasize binding issues, we suggest policymakers consider encouraging or mandating structured public consultations for major energy transition initiatives since media coverage is a key component of public discourse and can influence public opinions and attitudes. (see e.g., [53,91,92]) Incorporating the public's binding moral values—such as community-level impacts—can facilitate greater trust, legitimacy, and buy-in [93]. Meanwhile, the positive tone used by energy companies may reassure investors but fail to address communal concerns. Governments and regulatory bodies could therefore consider expanding business reporting requirements to include not only individual-level impacts (e.g., workforce well-being) but also community-level considerations [94]. Guidelines on disclosing these binding concerns—such as local environmental justice—can help align corporate communication with broader public moral priorities.

Second, the newspapers' gradual negativity on the care/harm foundation highlights concerns within the mass media and the public about the potential lack of protection for individuals during energy transitions in the U.S. Existing research suggests that energy transitions may drive

up short- and medium-term costs due to the need to invest in new infrastructure and technology. Additionally, workers in conventional energy sectors could face job losses and economic hardships [1]. Consequently, when designing policies, it is crucial to adopt inclusive measures that incorporate protective mechanisms—such as subsidies or legal reforms [95]—to mitigate these potential injustices and enhance community resilience. One practical approach involves creating collaborative platforms for representatives from various sectors to regularly exchange information on energy transitions [33,96]. Such dialogue can help stakeholders recognize differing justice concerns, and policymakers, advocacy groups, and businesses can tailor outreach and strategic communications more effectively.

CRediT authorship contribution statement

Yuhao Ba: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Haoyi Tan:** Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation.

Declaration of competing interest

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

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.erss.2025.104090>.

Data availability

Data will be made available on request.

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