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Review

The energy trilemma COP-out: accessibility is under-reported in international English-language media coverage of United Nations Climate Change Conferences

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A B S T R A C T

Media coverage plays a crucial role in shaping public understanding of energy challenges and climate policy; robustly monitoring the way that energy challenges are depicted in news media is therefore important for understanding progress on meeting climate change goals. This study employs corpus linguistics methodology to analyze global media representations of the energy trilemma - the balance between accessibility, security, and environmental sustainability - in coverage of UN Climate Change Conferences (COP21-COP27, 2015–2022). Analysis of 18,578 news articles (11.6 million words) from 12 countries reveals significant cross-national variation in trilemma coverage. Using a novel quantitative measure validated against human ratings, we found that sustainability dominated media discourse compared to security and accessibility. This ranking was observed in each nation, though there was also variation between countries and over time in the extent of coverage of each aspect of the trilemma. Notably, media coverage patterns diverged from objective energy policy indicators. The study highlights the advantages of such corpus linguistic analysis of news articles over both traditional qualitative analyses of language and quantitative, decontextualized language-analysis tools.

1. Introduction

Effective communication of energy issues through the media plays a pivotal role in enhancing public understanding, mobilizing support, and fostering engagement in initiatives aimed at mitigating climate change [1]. Mayer & Parks map out the connections between media coverage, perception, public acceptance, and energy policy [2]. News coverage frame events and issues in different ways [3–7]. These framings can affect the public perception of energy issues [8–10], and so affect public opinions and attitudes towards these issues [11–15]. Importantly, public attitudes can create pressure to enact change via changes to policy [16–19] or consumer behavior [20]. Various studies have tracked media framing of energy issues within individual countries, with a particular focus on the UK [21–24], Canada [3,11,25], Germany [13,26–28], and Western Europe [5,29,30]. However, there is currently a limited understanding of how media framing varies at an international level [2,31].

One important nexus of science, politics and media coverage is the UN Climate Change Conference of the Parties (COP) which aims to bring national leaders and institutions together to tackle the challenges of climate change. Indeed, COP conferences have been described as 'the main drivers of media attention to climate change around the world', a result of the number, status and diversity of stakeholders at such events [32]. COP conferences have led to notable changes in international policies: the Paris Agreement, for instance, emerged out of COP21 and created an international treaty to address climate change. However, political commitment to the agreement has wavered [33,34], and climate-justice related topics, such as compensation for loss and damage associated with climate change for vulnerable developing countries, can lose momentum as a result of COP negotiations [35]. Ultimately, a political mandate from citizens may be required to hold politicians to account, but this may only happen if citizens are accurately informed about the proceedings of COP via balanced news coverage; hence the need for understanding how different national media may represent discussions and policies at events like COP [36]. In reality, news that seeks to popularize climate issues can lead to increased politicization of the topic [37], and despite even well-intentioned messaging (which cannot be assumed), public engagement with mitigating climate issues may veer between hopelessness and skepticism [38,39]. Wessler et al. [32] argue that systematic analysis of media representations at the

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national level related to COP conferences, for instance the actions following the Paris Agreement, is required. This study builds on previous linguistically-informed studies of media representations of COP (e.g. [32,35,40–42]), by proposing a linguistic methodology for systematically analyzing media representations of COP at the national level.

Energy is a central issue at COP, with difficult decisions being made around the "Energy Trilemma". This is a model that encapsulates three crucial challenges of our global energy system and its many subsystems: accessibility (or affordability), security, and environmental sustainability (Glasgow Science Centre). Researchers and policymakers assert that adopting a holistic approach to ameliorating energy conditions involves a careful balance in order to promote just and reliable energy supply. The three aspects of the Energy Trilemma ought not operate in opposition to each other, or in isolation; rather, decision makers are expected to devise policies, technologies, and resources that function with all "arms" of the Trilemma in mind [50]. In reality, there may be contextually dynamic political tensions between the different elements, as had been highlighted by political energy-related responses to the Ukraine war [42], or more broadly relating to the relationship between specific national governments and fossil-fuel production [43]. Furthermore, while there has been research on media reporting of specific aspects of the trilemma [37,38,44] there are a lack of studies examining the trilemma as a coherent model in news media. This gap is significant because the media plays a crucial role in shaping public understanding of energy issues. By focusing predominantly on security or sustainability, media coverage can skew public perception and potentially influence policy decisions, such as the public's willingness to accept renewable energy projects that may initially increase costs but ensure long-term sustainability. This study will therefore examine the extent to which the trilemma is reported in news media both in its entirety and in terms of its distinct aspects, within the context of reporting on COP conferences. The implications of these findings will be discussed in the final section of the paper.

The Energy Trilemma considers issues such as access to secure energy, the daily realities of disadvantaged populations, and broader infrastructural questions around energy transmission, peak consumption hours, market supply and demand, and the stability of political institutions [45]. Further, proponents of the Trilemma take into account environmental impact and sustainability: they posit that energy actions to alleviate current energy burdens among populations and render energy distribution reliable must not compromise the well-being of future generations and their quality of lives [46].

Despite a lot of research and policy work on the trilemma [45,47–52], we could find no research on how the concept is discussed in the media. While it would be simplistic to suggest a deterministic relationship between media coverage and changes to public attitudes and behavior, there is evidence that, in relation to climate change, the former can influence the latter [53]. For instance analyze the effect that certain types of online media communication about COP21 had on the adoption of climate-supporting behaviors. More broadly, the concept of reverse-agenda setting [54], whereby an issue introduced by the media is actively engaged with by the public to such an extent that the media (and potentially the government), in turn, has to respond, has been applied to developing patterns of behavior related to climate change and environmental concerns (e.g. [55]).

And while one of the main aims of the current paper is methodological, through demonstrating how the types of questions listed in the next paragraph can be robustly addressed, the analysis of the linguistic content of news articles reveals important patterns regarding the debate about the energy trilemma in the context of COP conferences. Understanding how climate change news is represented in different national media can help shed light on the environmental concerns such media are prioritizing or downplaying.

This paper thus attempts to answer the following interconnected questions: how does a selection of international news media report on a complex climate issue, that of the energy trilemma at COP conferences? And, how does the media in specific countries report on the same issue, and are any differences quantifiable? These are important questions when seeking to address complex global challenges like climate change and energy, because such knowledge can help scientists target their communications to both policy makers and the media. However, answering these questions is difficult because of complex relationships between various domains, and climate scientists and engineers may have insufficient evidence to answer them. As part of a wider project to understand the interrelation between science, politics and the media in the context of climate change policy, this study aims to provide empirical, replicable findings about how aspects of the energy trilemma are reported. To accomplish this, we demonstrate that a novel, linguistically-informed methodology can benefit communication-related studies of climate change. Our methodology also allows for the quantitative findings to be interpreted in context, thus allowing for inferences about the emergence of certain patterns and their potential implications.

Section 2 discusses key concepts in the analysis of media discourse, with a focus on the notion of representation, and explains the value of using a corpus linguistics approach for the type of data analysis conducted in this paper. Section 3 introduces the methods for collecting the news articles and measuring the amount of discussion of each part of the energy trilemma. Section 4 analyses the data to provide insights about the representation of the energy trilemma across countries. We show how the emphasis on the three dimensions of the energy trilemma is distributed across countries and how it has changed from COP21 to COP27. Further, we trace the trajectories of this change over time and compare how the degree of focus varies before, during and after the conference. Next, we analyze the distribution of the discussion across articles, finding that most articles discuss at least two aspects of the trilemma. Finally, we demonstrate further applications of the corpus by performing a short qualitative study comparing the framing of COP between Bangladesh and the US. Section 5 discusses the implications and limitations of our findings.

2. News media and representation

Before outlining our methodology in Section 3, it is important to briefly explore the concept of news representation, and its relevance for understanding the reporting of news in media discourse in general, and specifically in relation to news concerning climate change. Put simply, any discourse such as news reporting is not a straightforward reflection of reality. The creation of news inevitably involves selecting, discarding and framing events, actors and positions [4,6,7], in other words representing them. Representation, according to Hall, 'is a very different notion to reflection. It implies the active work of selecting and presenting, of structuring and shaping' [56]. All news reporting therefore involves active choice in terms of what is and is not represented, and how it is represented. Early work in discourse analysis of newspapers by [57] demonstrated how different social actors and events are represented differently in newspaper headlines and articles, depending on the political orientations of the papers concerned [58]. Specific lexical and syntactic choices construct different versions of the same event, with the actors bearing differing degrees of responsibility and agency.

While representation highlights the inevitable bias in news reporting, this is not to imply that the producers of news are being deliberately dishonest. Rather, representation is an inherent feature of all discourse, one that may be particularly apparent in news reporting. As Baker et al. [59] in a corpus-linguistic study of media discourse argue:

> As it is never possible to present a completely impartial, accurate and full account of an event, instead the media offer *representations* of events (…) newspapers function as more than mere mirrors of reality. Instead, they have the role of constructing ideologically motivated versions of reality which are aimed at persuading people that certain phenomena are good or bad.

Two points from this quotation merit further consideration, that discourse is ideological, and that it is persuasive. From a critical discourse analysis perspective, all discourse is inherently ideological because it involves choices which reflect certain values, and ideology can be understood as a collection of values, practices and beliefs shared among groups [57]. If something appears to align with your values, the more likely you are to be persuaded by it, an insight which has particular relevance for influencing people's orientations concerning climate change [60]. The effective framing and power of misinformation and disinformation relating to climate change is well documented (see [61] for a review), and yet the persuasive potential of discourse can also be seen as beneficial to society at large. In the context of climate communications [62], argues that language not only represents reality, but can also play a transformational role in society: 'Knowledge from linguistic and textual studies contributes to an improved knowledge base for societal and political actions to be undertaken in order to avoid dangerous consequences of climate change'. Our study contributes to this knowledge base by shedding light on the ways that a complex issue such as the energy trilemma is represented in various national media, as well as demonstrating how such representations can be analyzed.

2.1. Corpus linguistics as a tool for exploring cross-national news discourse

This study draws on the field of Corpus Linguistics, a collection of tools and methods for analyzing large collections of language use in context [63,64]. Corpus Linguistics has the relevant breadth of methods to allow such a study. More quantitative methods such as topic modelling struggle to account for context and its relationship with meaning, partly through employing a 'very naive' model of what a text is [65,66]. On the other hand, purely qualitative methods such as discourse analysis struggle to process and analyze large amounts of data [64]. Corpus Linguistics sits in the "Goldilocks Zone" between these two extremes, able to identify quantitative trends across large datasets while also illustrating why those trends matter by drilling down into the data with more qualitative analysis. This study expands on previous corpus-linguistic studies of environmental issues (e.g. [37,44,67–69]) through: analyzing a hitherto unexamined topic, that of media reporting of the energy trilemma in COP conferences; originally extending the methodology through triangulation with other methods, including comparing quantified results from the corpus analysis with human ratings, and iteratively adjusting the search parameters to boost validity; collaborating as a highly interdisciplinary team to ensure the research is linguistically robust, but most importantly informationally relevant to a scientific audience. By examining how terms related to the energy trilemma are used across different national media, we can gain insight into how these concepts are prioritized or marginalized in public discourse. This can, in turn, influence political agendas and public understanding of the trade-offs inherent in energy policy [17,19].

Various practical tools help gain a more nuanced understanding of the main topics, concerns and positions represented in these different national news media. For example, critical differences between texts from different countries can be extracted using what is termed a 'keyword search': locating words that occur with a significantly higher frequency compared to some norm, typically through comparison with a larger reference corpus [70]. Tests of significance (the log likelihood test [71]) and effect size (log ratio) can be used to calculate the statistical significance of words in texts, as is the case here. Such statistically significant keywords can then be examined from a qualitative perspective in their contexts of use, and the practical, real-world implications of the specified linguistic choices explored. That is, we can infer the situated meanings, their underlying evaluative force (e.g. whether it co-occurs, or 'collocates' with negative meanings), and consider whose interests are served by these choices and the implications for society. A premise of such linguistic analysis is the notion of choice: language is a system of 'meaning potential' [72], in that there are usually several grammatical and lexical ways the same idea can be linguistically expressed. The actual choice made can reflect and reinforce certain social practices and ideologies [73].

3. Material and methods

To demonstrate the value of a corpus linguistic approach to energy communication, we examine international media coverage of COP conferences. We obtained relevant data and processed them into a systematic corpus, developed a way to measure the discussion of the issue within that data, and verified that the measures were valid and robust. This involved developing a list of relevant common words and phrases, termed 'salient terms' that relate to each challenge of the trilemma (see Section 3.2 below). Finally, we analyzed the variation and interpreted the patterns using quantitative and qualitative tools (see Fig. 1).

3.1. Data

News articles were collected according to a balanced and representative sampling frame, following best practice in corpus linguistics [74,75]. The target population was all English-language news articles mentioning COP conferences from COP21 (November 2015, when the Paris Agreement was reached) to COP27 (November 2022). Nexis Advance (2022) was chosen as the data gathering platform, since it provides access to millions of articles from thousands of news organisations, providing a wide sampling frame. The news archive was used to obtain English language news articles mentioning COP conferences from COP21 to COP27.

The majority of results came from 12 regions with prominent English-language news media (Australia, Bangladesh, Canada, China, Hong Kong, India, Ireland, Nigeria, South Africa, UAE, UK, and USA), so these became the focus of the study. Although English is not the majority language in each region, they all have prominent English-medium news coverage and collecting data in a common language allowed comparisons between regions for this study.

The final sample was obtained by randomly selecting up to 500 articles for each country, ensuring that the corpus was reasonably balanced between countries. The sample is not intended to be representative of all regions, nor comprehensive of international coverage. However, it serves as an adequate sample for testing the quantitative methodology and for analyzing variation within the sample. Duplicate articles were identified and removed. Texts were tokenized into words using the R package *quanteda* [76]. Further data processing identified the date of publication of each article, and grouped the articles into those published before, during and after each conference. The final data sample included a total of over 11.6 million words from 18,578 articles. The data sets and replication code for this study are available in a Github repository (https://github.com/seannyD/COP_Corpus).

3.2. Estimating discussion scores

A novel measure was developed to assess the extent of discussion of each aspect of the energy trilemma in our data. Simple methods such as searching for technical phrases are not reliable, since they are not often used in news coverage. For example, the phrase "energy trilemma" only appears 16 times in 11 million words. Therefore, we searched for a curated list of common words and phrases that relate to each challenge of the trilemma, what we will call "salient terms" (see supporting information, SI). These terms were identified via an iterative process with two steps. The first step was to identify terms and their morphological variants from the academic literature [45,47–51] and teaching resources (Glasgow Science Centre, 2021; Our Future Energy, 2022). The second step checked the internal validity by manually verifying that these terms appeared in relation to the energy trilemma in our corpus. In addition, collocations of "sustainability", "security" and "accessibility" were obtained to identify more salient terms. The third step obtained further

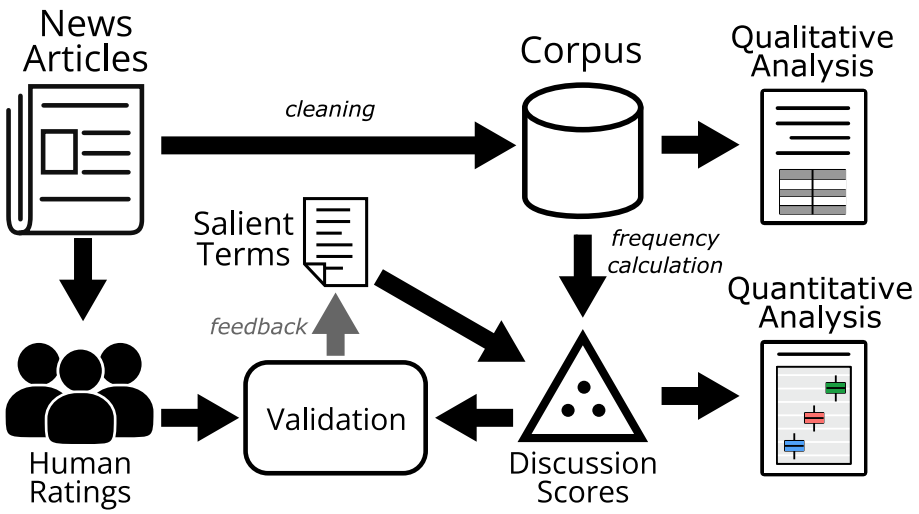

Fig. 1. Process flow for calculating discussion scores.

salient terms from the human judgements (see below). The final set of salient terms included 71 terms for sustainability (e.g. "green", "emissions", "renewables"), 40 terms for security (e.g. "risk", "reliability", "blackouts"), and 52 terms for accessibility (e.g. "affordability", "energy justice", "electricity bill", see Table 1 for all terms). These terms are not necessarily diagnostic of discussion of the energy trilemma in every context but are intended to be applied to news articles about COP conferences.

The discussion scores were calculated as follows. For a given set of news articles with a total of W words, the frequency f of each salient term was obtained. For a given component with N salient terms and a frequency for each term $f_1 \ldots f_N$, the sum of the relative frequencies (f_i/W) was calculated. Since different components have different numbers of salient terms, this is also normalized by the number of salient terms that were searched for (Eq. (1)):

$$F = \frac{1}{N} \sum_{i=1}^{N} \frac{f_i}{W} \tag{1}$$

This frequency was calculated for terms related to sustainability (F_{sus}), security (F_{sec}) and accessibility (F_{acc}). The discussion score of a component D was then calculated as the relative proportion of the normalized frequencies (Eqs. (2)–(4)):

$$D_{sus} = \frac{F_{sus}}{F_{sus} + F_{sec} + F_{acc}} \tag{2}$$

$$D_{sec} = \frac{F_{sec}}{F_{sus} + F_{sec} + F_{acc}} \tag{3}$$

$$D_{acc} = \frac{F_{acc}}{F_{sus} + F_{sec} + F_{acc}} \tag{4}$$

This score represents the relative proportion of discussion about sustainability, security and accessibility in a given set of news articles. These scores were calculated for articles related to each conference in each country. The overall change over time for a component was calculated as the sum of the differences between each pair of adjacent time points.

The discussion scores were paired with the corresponding World Energy Council's Energy Trilemma Index for each year and country (World Energy Council, 2023). This index is a numerical score which reflects each country's performance on dealing with the three components of the trilemma, according to independent analysis by the World Energy Council based on 31 objective indicators. The ranking of each country was also compared to the Energy Justice Metric [46], which measures the balance between the components of the energy trilemma.

Table 1
Salient terms that indicate the discussion of each aspect of the energy trilemma.

Accessibility	Ability to pay, able to pay, affordability, affordable, basic need, basic needs, budget, cheap, consumed, consumer, consumers, consuming, consumption, cooling, cost effective, cost-effective, development, economic class, economical, efficiency, electricity bill, electricity bills, energy bill, energy bills, energy burden, energy cost, energy efficiency, energy justice, energy poverty, energy prices, energy-efficiency, equity, fuel poverty, fuel-poverty, gas bill, gender, household, household cooling problems, household heating, household heating problems, households, inability to pay, inequalities, inequality, inequity, insurance, low cost, low income household, low income households, low-cost, low-income household, low-income households, lower class, lower-class, middle class, middle-class, minorities, personal finance, personal finances, race, reduced costs, reduces costs, reducing costs, social economic class, thermal comfort, transportation bills, transportation poverty, unable to pay, underrepresented, underserved communities, unequal, upper class, upper-class, utility bill, utility bills, women, working class, working-class
Security	adequacy, aging infrastructure, agreement, black-out, black-outs, blackout, blackouts, certainty, conflicts, consistency, consistent, corrupted, corruption, disaster, disasters, energy crises, energy crisis, energy demand, geo-political, geo-politics, geopolitics, industries, industry, intermittency, intermittent, nationalization, nationalizing, nationalization, nationalizing, neoliberalism, nuclear, peak hours, petro-politics, petropolitics, poor infrastructure, power cut, power cuts, power outage, power outages, reliability, reliable, resilience, resilient, secure, security, stability, war, wars
Sustainability	alternative, alternatives, bio-mass, biomass, c02, carbon capture, carbon neutral, carbon neutrality, carbon reduction, carbon-neutral, carbon-neutrality, CCS, CCU, centralized, centralized, clean energy, clean-energy, coal, decarbonisation, decarbonise, decarbonization, decarbonize, decentralized, decentralized, e-vehicles, eco-system, eco-systems, ecosystem, ecosystems, electric vehicles, electrical vehicles, emission, emissions, emits, emitted, emitting, energy storage, energy-storage, environmental health, EV, EVs, frack, fracked, fracking, geo-thermal, geothermal, green, greenhouse, hydrogen, low-carbon, natural gas, natural-gas, net zero, net-zero, nuclear, o-zone, ocean energy, ozone, Paris agreement, photovoltaic, photovoltaics, pollutant, polluted, polluting, pollution, PV, PVs, re-knowable, renewable energy, renewables, sea levels, sequester, sequestering, sequestration, solar, solar panel, solar panels, subsidies, subsidize, subsidizing, subsidize, subsidizing, subsidy, sustainability, sustainable, tidal, transition, transitioning, transitions, wind, zero carbon, zero-carbon

To test if the scores differed between phases (before, during, and after the conference), a mixed effects model was used, predicting sustainability score by phase, year, and a random effect for country. Significance was determined by comparison with a null model that did not include phase (see SI).

The distribution of discussion scores across articles was also analyzed. In principle, it could be that most articles focus on a single aspect, or always discuss all three (in different frequencies). The number of articles discussing each possible combination of components was obtained. To place these empirical results into perspective, random baselines were estimated for the expected number of articles with each combination of components. Word distributions are notoriously skewed and clustered [71], limiting the applicability of standard statistical tests. Therefore, these baselines were estimated using random permutation: for each article, all the Accessibility words from that article were swapped with all the accessibility words from a randomly chosen article. Then, the combination of component overlaps was re-calculated. This maintains the same overall frequency of each key term and the same number of articles, and maintains the clustering of discussion of particular topics within an article, but breaks the dependence between components (e.g. whether security is discussed is no longer dependent on whether sustainability is discussed). This permutation was conducted 1000 times to create a distribution of expected frequencies for each combination of trilemma component.

3.3. Validation

The automated measure was validated with a human judgement experiment. 12 fluent English speakers in the UK were trained on the basics of the energy trilemma, using standard teaching resources on the topic (Glasgow Science Centre, 2021; Our Future Energy, 2022). Participants were not told what the salient terms were. Each participant was asked to read 40 articles from the corpus. Eighty percent of these were unique to the given participant in order to cover a range of articles, and 20 % were identical across participants and used to test the agreement between human raters. For each article, they rated the extent to which it discussed each of the three aspects of the energy trilemma, scoring each aspect independently from 0 to 10. One participant was excluded because they reported difficulties seeing the data in the correct format (see SI).

An alternative measure of frequency was tested, which took into consideration the frequency of each salient term in typical news articles (extended SiBol corpus [77],). However, this measure correlated poorly with human judgements, so was not used. To improve the *D* score, articles with human ratings that were poorly predicted by the automatic methods were identified and compared to articles that were accurately predicted. Additional salient terms were identified and fed back into the final salient term list.

4. Results

4.1. Validation analysis

The automatic discussion scores agreed well with human ratings. Ratings for the three discussion scores were correlated with each other, so the validation analysis focuses on the measures of sustainability, which was the most frequent topic and exhibited the most variation. The agreement between human raters was "fair" (intra-class correlation coefficient = 0.57 [0.33,0.86], $F(7,80) = 15.8$, $p < 0.001$, see [78]), with an average correlation of $\tau = 0.55$, sd = 0.27. A mixed effects model including a random intercept for each participant, found a significant positive correlation between human and automated judgements (pseudo marginal $R^2 = 0.65$, $z = 28.43$, $p < 0.001$). The correlation between human and automated judgements is within 0.36 standard deviations of the correlation between human judgements (see SI for full results).

However, the discussion scores did not simply reflect objective progress on energy issues. While the discussion scores for sustainability were correlated with the World Energy Council's Energy Trilemma Index ($r = 0.48$, $p < 0.0001$), there was no significant correlation between the two measures for security ($p = 0.22$), and the measures for accessibility were negatively correlated ($r = -0.48$, $p < 0.001$). Similarly, our analysis found that the ranking of countries was the same as the Energy Justice Metric [46] for sustainability and security, but not for accessibility. This implies that the amount of reporting about each aspect of the energy trilemma is not simply a reflection of reporting on objective progress on infrastructure or policy, suggesting that the media discussions scores provide important additional information about the perception of energy issues. A more contextually nuanced analysis of our data is conducted in the following two sections, allowing us to better understand this finding.

4.2. Variation in discussion of the energy trilemma

The discussion of each component has a consistent ranking across regions. Overall, news articles discussed sustainability the most (mean D_{sus} across countries = 53 %, sd = 4.9), followed by security (mean D_{sec} = 32 %, sd = 3.5), and discussed accessibility least (mean D_{acc} = 15 %, sd = 3.1). Across regions, sustainability was discussed significantly more than security ($t = 11.8$, $p < 0.001$) and security was discussed significantly more than accessibility ($t = 12.9$, $p < 0.001$). This ranking is evident for every region (Fig. 2).

The emphasis on each component varies between regions (Fig. 3A). For example, articles from Hong Kong discussed sustainability most (61 %), articles from the USA discussed security most (38 %) and articles from Nigeria discussed accessibility most (21 %).

The emphasis on each component also changes over time (Fig. 3B). For most regions, the discussion of sustainability has increased and the discussion of security has decreased, while for others the opposite pattern holds (Hong Kong, Canada, Australia). Overall, there was a significant increase in discussion of sustainability during COP 26 (GAM EDF = 5.5, F = 9.3, $p < 0.001$), at the expense of the two other topics (Fig. 4).

Finally, the distribution of reporting is relatively evenly spread out before, during and after the conference (Fig. 5). However, there is a small increase in media discussion of sustainability during the conferences, compared to before or after (increase of 0.035, $t = 2.8$, log likelihood difference = 4.71, $\chi^2(2) = 9.43$, $p = 0.009$).

Individual articles tended not to discuss just one aspect of the trilemma. 49 % of all articles mention at least one salient term from all three components, which is higher than expected by the baseline simulation (Fig. 6). Accessibility is less likely to be discussed than the other two components both in articles focusing on a single component (accessibility 2 %, security 4 %, sustainability 9 %), and in articles focusing on just two components (accessibility and security 2 %,

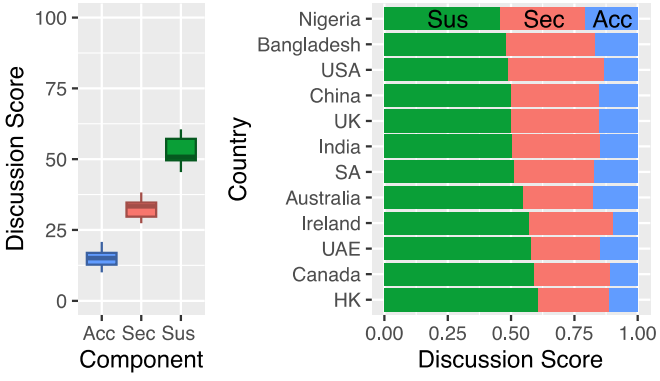

Fig. 2. Average discussion scores for each component (left) and for each country (right). Acc = accessibility, Sec = security, Sus = sustainability.

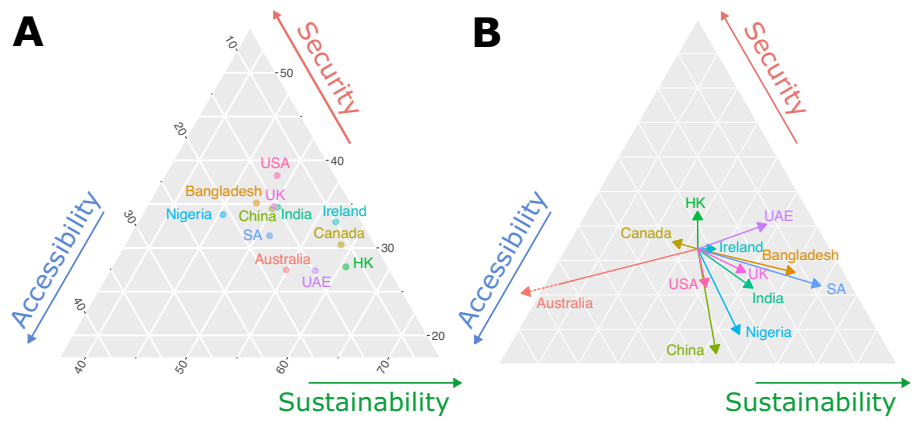

Fig. 3. A: Ternary graph showing the absolute proportions of discussion of the three subjects of the Energy Trilemma for various countries (SA: South Africa, UAE: United Arab Emirates, UK: United Kingdom, USA: United States of America, HK: Hong Kong). B: The relative change over time for each country. Vectors represent the average change across conferences from COP21 to COP27.

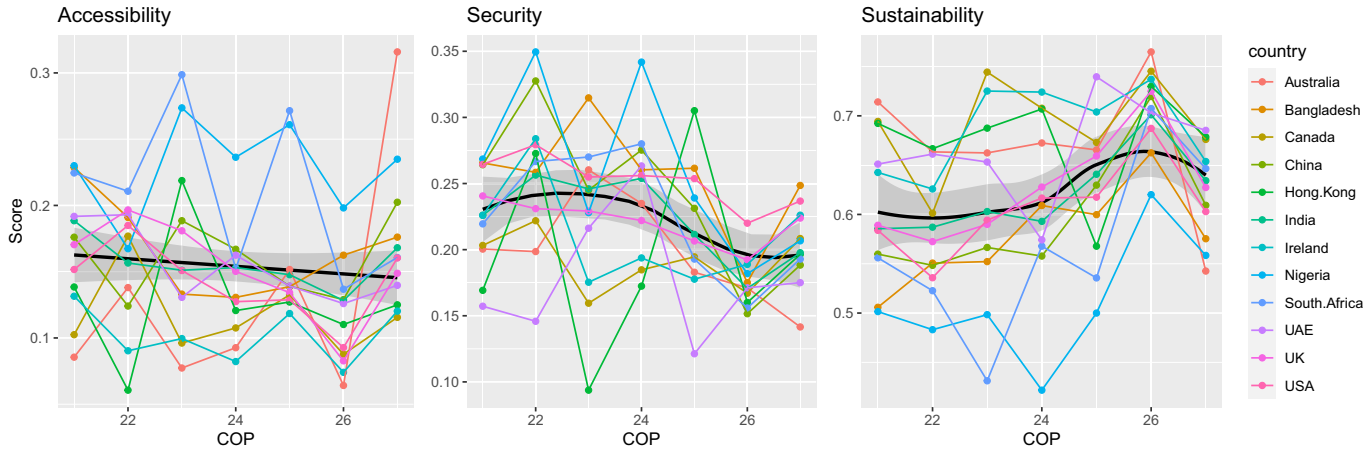

Fig. 4. The change over time for each component and each country. The black lines show LOESS trend lines.

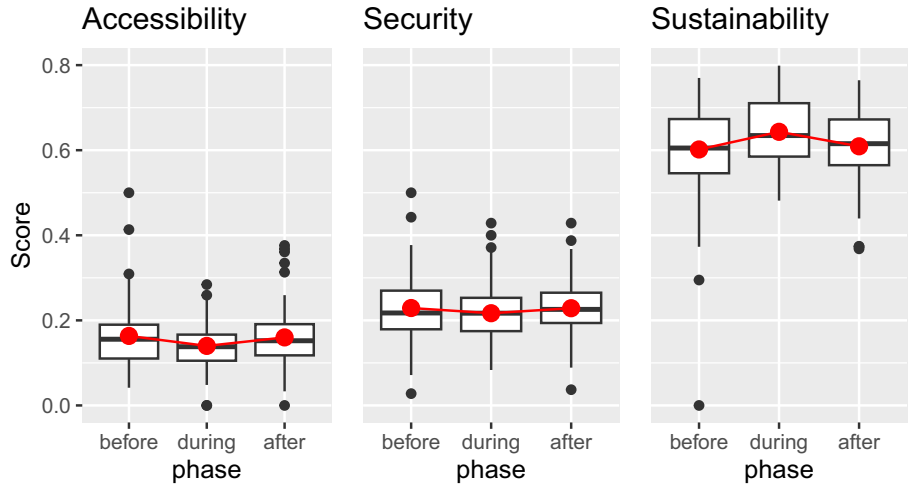

Fig. 5. Comparison of component scores (*D*) based on media coverage published before, during and after each conference.

accessibility and sustainability 9 %, security and sustainability 25 %). Furthermore, articles that combine discussion of accessibility with one other component are less frequent than the baseline, suggesting that accessibility is treated as a secondary concern in media representations compared to security and sustainability.

4.3. Discourse emerging from media coverage

In the introduction, we ask whether there are regional differences in the media coverage of COP and the energy trilemma, and how relevant findings might be interpreted in context. The quantitative discussion

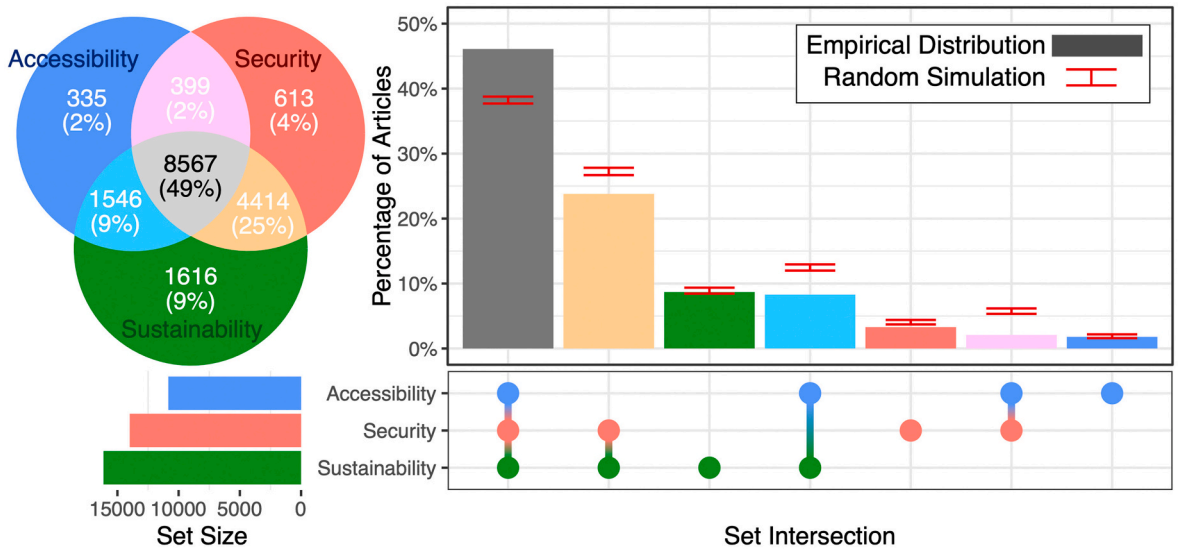

Fig. 6. The proportion of articles that mention different combinations of the energy trilemma. Top left: Venn diagram of the proportions. Top Right: 'Upset' plot showing the empirical percentage of articles in each intersection (grey bars) and the range of expected percentages from a random permutation simulation (red bars). Bottom left: overall set size for each component (number of articles mentioning each component). Bottom right: Set intersection diagram to identify each column in the upset plot. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

scores of the energy trilemma above demonstrate that there are differences between regions. However, interpreting the differences requires a more detailed analysis of the texts. One of the main aims of this paper is to demonstrate that corpus linguistics methodologies can provide a bridge between quantitative measures of large bodies of text and meaningful qualitative analysis of context.

In order to demonstrate how this challenge can be partly addressed, and therefore enable more informed inferences to be made, we compare the data from two countries, Bangladesh and the US. These two are chosen for a variety of reasons. For instance, an analysis of the frequency of mentions of COP summits in web news articles by country shows that Bangladesh has the highest number of mentions per million words of online news text (1.27 per million), compared to the US with the lowest (0.13). Table 2 shows the figures per country, and Fig. 7 provides a visual representation. These results provide suggestive evidence for the degree of attention paid to COP conferences in the national media.

Another reason for comparing Bangladesh and the US is the different level of risk posed by climate change. For instance Bangladesh is widely seen as one of the most affected countries (Iberdrola, 2023), and one with the greatest risk of flooding (World Bank, 2023). The US, in contrast, is relatively less threatened according to available indices, and more able to respond to threats through its far greater GDP and wealth (whereas the mean income in the US is over $70,000 p.a [79], it is around $3500 in Bangladesh, Bangladesh Bureau of Statistics, 2022). Furthermore, the US is far more responsible for climate change through its historical and current carbon footprint than Bangladesh ([80,81], see discussion of media discourse on this topic in [82]). Therefore, one might expect news articles from each country to focus on different aspects of the trilemma.

Table 2
Frequency of mentions of COP summits in web news articles by country.

Country	Raw frequency	Frequency per million words
Bangladesh	105	1.27
New Zealand	414	0.81
Tanzania	26	0.79
Ghana	104	0.66
Jamaica	27	0.53
Kenya	126	0.52
Sri Lanka	58	0.52
Singapore	268	0.51
Philippines	193	0.47
Hong Kong	32	0.46
India	598	0.43
Nigeria	274	0.4
Great Britain	450	0.28
Pakistan	89	0.26
Canada	378	0.24
Australia	220	0.22
South Africa	156	0.22
Ireland	208	0.21
Malaysia	59	0.17
United States	672	0.13

Table 3 shows each country's top ten key nouns that appear significantly more frequently in news articles about COP compared to a reference corpus (the 14.7 billion-word News on the Web corpus [83],). While some of the keywords are repeated across both lists ('climate', 'emission', 'warming', 'summit'), there are several differences. Most strikingly, the top keyword for US articles is not directly related to the environment ('coronavirus'). The top three keywords on the Bangladesh list arguably highlight the particular concerns of that nation, being globally one of the most affected by climate change. The environmental reality in Bangladesh already requires mitigation, reflected in mitigations' top collocate, 'adaptation'.

A closer reading of the language around 'mitigation' reveals that it involves finance, for instance 'Bangladesh has adopted a 37bn-dollar program for mitigation of climate change damages along the country's coastal areas'. We can also see the co-occurrence of the top three keywords in the way Bangladesh media positively frames its national response: 'despite being a climate-vulnerable country, Bangladesh is a global pioneer on adaptation and mitigation initiatives and resilience'. To properly consider whose interests are served by such a positive representation (e.g. Bangladesh as a 'global pioneer' despite its vulnerability), further analysis of the local political context and relevant linguistic political statements is required.

In contrast, the top three keywords from the Bangladesh corpus do not appear at all on the complete US keyword list, which contains 292 words, perhaps reflecting that for much of the US media, these are not yet pressing concerns, or the news media is not willing to represent the situation as such. Furthermore, while the word 'cyclone' is a top keyword for Bangladesh (perhaps reflecting the fact the country is globally most at risk of flooding), 'cyclone' and related terms ('storms', 'hurricanes', 'floods') do not appear at all in the complete US keyword

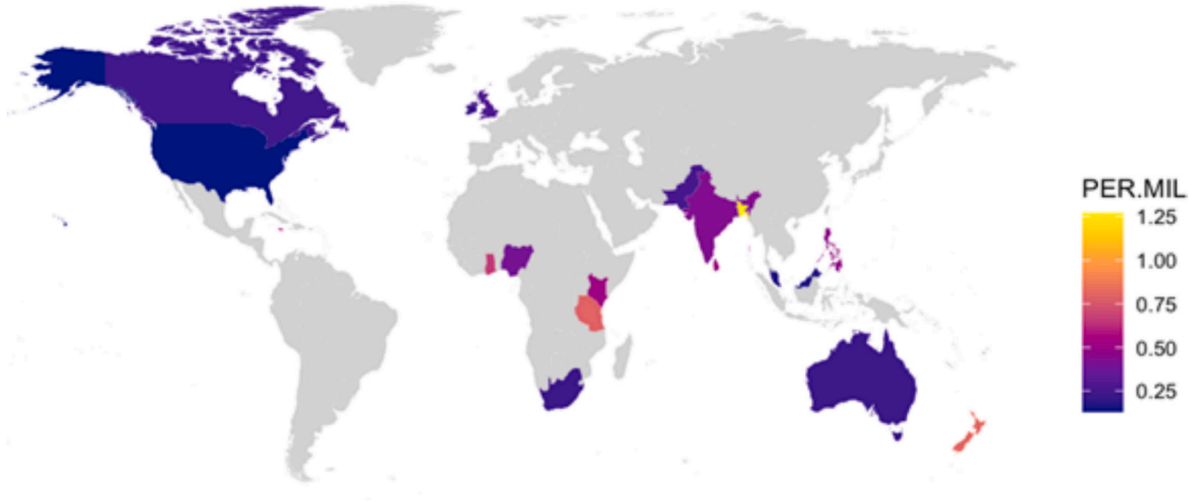

Fig. 7. Relative frequency of mentions of COP summits in English language news media from different countries.

Table 3
The top 10 key nouns in the US Cop26 and Bangladesh Cop26 corpora.

Rank	US Cop 26 Key nouns	Bangladesh Cop 26 Key nouns
1	Coronavirus	Mitigation
2	Emitter	Resilience
3	Climate	Adaptation
4	Emission	Climate
5	Greenhouse	Cyclone
6	Warming	Emission
7	Summit	Warming
8	Carbon	Pledge
9	Envoy	Summit
10	Biodiversity	Greenhouse

list. Clearly, despite both countries suffering extreme weather events (EPA, 2022), Bangladeshi news articles link them to COP26 to a greater extent than news articles from the US.

Even words that appear on both key lists are not used in the same contexts. For instance, although 'climate' appears alongside mentions of intergovernmental attempts to address climate change for both countries, in the US corpus it is also used in the context of the reality of climate change being questioned, for instance 'Just as members of Congress still need persuading on climate matters, so do the U.S. bishops'. In the Bangladesh corpus, 'climate' is framed in categorical, urgent terms, for example 'Climate change is a survival battle', or 'six million Bangladeshis have already become climate displaced'. Such findings raise further questions about why such differences in representation occur, and triangulating with different data sources (such as corpora of political and commercial language) can develop analyzes that can raise cross-cultural awareness and guide policy.

5. Discussion

Our analysis of COP and the energy trilemma found that the focus of media coverage varies systematically. First, we found that, although policymakers and academics encourage the view that the three components of the energy trilemma should be equally important, they are not discussed equally in the media. Topics related to sustainability are discussed more than the other two components put together. Moreover, the discussion in the media does not always reflect measures of infrastructure and policy such as the WEC Energy Trilemma Index. The least discussed element of the trilemma was accessibility. Finding ways to improve public communication about accessibility is important since it affects individual citizens directly in the short-term [84–86], and is becoming a major issue in energy transition [87]. In other words, we argue that our analysis suggests that there is more work to be done with regards to the public communication of the trilemma.

There was also variation between countries, exhibiting a trade-off between discussing sustainability and security, and across time, responding to specific events and country contexts. Understanding this variation is a key challenge to aligning priorities between different countries. Furthermore, the variations between countries, and the possible reasons for them, can lead to greater cross-cultural understanding. The discussion of the differences between the US and Bangladesh, for instance, may lead to greater awareness of the environmental and political challenges faced in different parts of the world.

That we find differences in reporting at the national level, is, in some ways, unsurprising. We analyze national newspapers, and news tends to be context-specific. The discursive news values approach [88], a linguistic framework demonstrating how repeated news values (such as negativity or eliteness) are represented through media discourse, helps explain this phenomenon. Proximity is one such news value, which accounts for the tendency for the news to be represented in a way that highlights geographical or cultural closeness to the target audience. But while the finding that there are differences in reporting at the national level is in some ways unremarkable, it is not without implications. Addressing climate change at the national level may be necessary but is far from sufficient; in other words, for the aims of COP to be realized (such as net zero), trans-national cooperation is required. But the differences in representation of the energy trilemma indicated above, for instance the differences between the US and Bangladesh, reporting by the nation with the highest C02 emissions (see also [67]), must give pause for thought.

According to [32], who survey the differing framings and narratives around COP conferences, national reporting is rather similar despite diverging national media cultures; these transnational frames typically focus on "problems and victims, on demands for change, on the actual negotiations, or on clean energy as the larger policy context". Our study diverges from this in two ways: firstly, we find variety at the national level of representations of the energy trilemma, and secondly that our analysis is more content-driven – by focussing on the energy trilemma. We examine how this scientific model, which is not part of public parlance, is represented (or not) in national media. And while the energy trilemma is a scientific model, it is also more than a theoretical abstraction. The components of the trilemma can also be seen as a combination of representations, or frames, with real-word impacts:

> "[T]hey are frames or ways of selectively constructing the climate-energy policy problem. In other words, that problem can be seen

through the lens of environmental sustainability, with carbon emissions at the centre of that. It can be viewed from the perspective of affordability for consumers. And it can be seen from a security frame, where domestic supplies are not easily threatened by exogenous forces."

[42]

That the different components can be represented in different ways according to the orientations of the national media and the political powers in each nation (for instance, in terms of degrees of engagement with mitigation and adaptation) is an important but perhaps unsurprising finding of our analysis. But the role of linguistic representations in addressing, or not addressing climate change, is, we argue, perhaps not sufficiently appreciated – hence the value of such studies of the energy trilemma. In the context of Germany, for instance [27], demonstrate how discourses around energy security and affordability have undermined a transition to cleaner energy, and have enabled the continued use of coal as part of Germany's energy mix. We argue that studies like this demonstrate how a scientific model like the energy trilemma, through selected representation, can be exploited to undermine the very justification of the model itself.

This project was partly motivated by a desire to demonstrate our methodology. We argue that refining these methods requires an interdisciplinary team. In the case of this study, without the interactions between a group of quantitatively-minded linguists, engineers with expertise in energy, and a sociologist with expertise in environmental sociology and pro-environmental behavior, neither the development of the methodology, the creation of a worthwhile research question, or the awareness of what is an original and significant from multi-disciplinary perspectives could have been achieved. Put simply, engineers do not know what they do not know about analyzing communication, and linguists do not know what the pressing issues for scientists are concerning communication and energy.

There are several limitations in the current study that could be addressed in future research. First, the study only analyzed news media in one language, subsequently limiting the representation of international coverage. Secondly, a broader approach to energy issues is possible, for example expanding to other conceptualisations of the trilemma including the importance of innovation [89] or local context [43]. Finally, while the use of salient terms in this study was validated by human judgements, the application of more powerful automatic tools for analyzing context could be applied, for example Large Language Models [90,91].

6. Conclusions

Without sufficient public understanding, the support and engagement for any research-informed public policy around climate change will wither. In terms of how politicians and scientists may achieve their aims of boosting understanding and engagement, it is often with and through the media that they need to communicate. In turn, the media itself will represent these communications through specific national, political and ideological lenses. Systematic methods are required to understand these relationships between international leaders' statements, news coverage, and citizen responses.

Our novel methodology provides valid, replicable findings which represent a step towards understanding these relationships by characterising the amount of discussion of each aspect of the energy trilemma. Automated linguistic analyzes of news articles provide several advantages over more traditional indexes of the energy trilemma based on manual evaluation of policy [92]. First, they can be applied consistently across countries with little bias from researchers. Secondly, they can be estimated automatically and rapidly to gauge ongoing changes in the media. Finally, they appear to differ from measures based on infrastructure and policy, providing a new window into how ordinary citizens are informed about the trilemma. However, not all automated tools for language analysis are equal when it comes to understanding meaning in context, and therefore an additional step involving qualitative discourse analysis is needed to ensure a plausible interpretation of the results. The approach we have outlined here, we argue, thus allows for analysis that has validity but also enables framing of meaning, through representation, to be understood.

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Data availability

The data sets and replication code for this study are available in a Github repository (https://github.com/seannyD/COP_Corpus).

References

[1] B. Cozen, D. Endres, T.R. Peterson, C. Horton, J.T. Barnett, Energy communication: theory and praxis towards a sustainable energy future, Environ. Commun. 12 (3) (2017) 289–294, https://doi.org/10.1080/17524032.2017.1398176.
[2] A. Mayer, P. Parks, Media and partisanship in energy transition: towards a new synthesis, Energy Res. Soc. Sci. 108 (2024).
[3] S. Ganowski, I.H. Rowlands, Read all about it! Comparing media discourse on energy storage in Canada and the United Kingdom in a transition era, Energy Res. Soc. Sci. 70 (2020).
[4] J. Smith, Dangerous news: media decision making about climate change risk, Risk Anal. 25 (2005).
[5] E. ter Mors, E. van Leeuwen, C. Boomsma, R. Meier, Media coverage of carbon capture and storage: an analysis of established and emerging themes in Dutch national newspapers, Energies 16 (4) (2023).
[6] B. Nerlich, R. Jaspal, UK media representations of carbon capture and storage: actors, frames and metaphors, Metaphor Soc. World 3 (1) (2013).
[7] D.A. Scheufele, Framing as a theory of media effects, J. Commun. 49 (1) (1999).
[8] T.M. Skjolsvold, Curb your enthusiasm: on media communication of bioenergy and the role of the news media in technology diffusion, Environ. Commun. 6 (4) (2012).
[9] A. Carvalho, J. Burgess, Cultural circuits of climate change in U.K. broadsheet newspapers, 1985-2003, Risk Anal. 25 (2005).
[10] J.B. Corbett, J.L. Durfee, Testing public (un)certainty of science: media representations of global warming, Sci. Commun. 26 (2) (2004).
[11] D. Peters, J. Axsen, A. Mallett, The role of environmental framing in socio-political acceptance of smart grid: the case of British Columbia, Canada, Renew. Sust. Energ. Rev. 82 (2018).
[12] W.A. Gamson, A. Modigliani, Media discourse and public opinion on nuclear power: a constructionist approach, Am. J. Sociol. 95 (1) (1989).
[13] J. Schreiber, A. Scherrer, H.L. Breetz, Driving discussion: media framing of electric, hydrogen, and conventional vehicles in German newspapers and Twitter, Energy Res. Soc. Sci. 103 (2023).
[14] M.A. Cacciatore, D.A. Scheufele, A.R. Binder, B.R. Shaw, Public attitudes toward biofuels: effects of knowledge, political partisanship, and media use, Polit. Life Sci. 31 (1–2) (2012).
[15] M. Wædegaard, S. Hvemon, M.J. Pedersen, Can media influence public support for carbon capture and storage? Comparing the impacts of frames in Denmark, Energy Res. Soc. Sci. 110 (2024).
[16] M. Hajer, W. Versteeg, A decade of discourse analysis of environmental politics: achievements, challenges, perspectives, J. Environ. Policy Plan. 7 (2005).
[17] L. Feldman, P.S. Hart, Climate change as a polarizing cue: framing effects on public support for low-carbon energy policies, Glob. Environ. Chang. 51 (2018).
[18] D. Ockwell, L. Whitmarsh, S. O'Neill, Reorienting climate change communication for effective mitigation: forcing people to be green or fostering grass-roots engagement? Sci. Commun. 30 (3) (2009).
[19] P. Bergquist, D.M. Konisky, J. Kotcher, Energy policy and public opinion: patterns, trends and future directions, Prog. Energy 2 (3) (2020).
[20] M. Wahlund, J. Palm, The role of energy democracy and energy citizenship for participatory energy transitions: a comprehensive review, Energy Res. Soc. Sci. 87 (2022).
[21] K. Isoaho, J. Markard, The politics of technology decline: discursive struggles over coal phase-out in the UK, Rev. Policy Res. 37 (3) (2020).
[22] L. Williams, B.K. Sovacool, The discursive politics of 'fracking': frames, storylines, and the anticipatory contestation of shale gas development in the United Kingdom, Glob. Environ. Chang. 58 (2019).
[23] C.L. Donnison, K. Trdlicova, A. Mohr, G. Taylor, A net-zero storyline for success? News media analysis of the social legitimacy of bioenergy with carbon capture and storage in the United Kingdom, Energy Res. Soc. Sci. 102 (2023).
[24] H. Doulton, K. Brown, Ten years to prevent catastrophe?. Discourses of climate change and international development in the UK press, Glob. Environ. Chang. 19 (2) (2009).

[25] N. Dusyk, J. Axsen, K. Dullemond, Who cares about climate change? The mass media and socio-political acceptance of Canada's oil sands and Northern Gateway Pipeline, Energy Res. Soc. Sci. 37 (2018).
[26] J. Dehler-Holland, K. Schumacher, W. Fichtner, Topic modeling uncovers shifts in media framing of the German Renewable Energy Act, Patterns 2 (1) (2021).
[27] P. Buschmann, A. Oels, The overlooked role of discourse in breaking carbon lock-in: the case of the German energy transition, WIREs Clim. Change 10 (3) (2019).
[28] J. Markard, A. Rinscheid, L. Widdel, Analyzing transitions through the lens of discourse networks: coal phase-out in Germany, Environ. Innov. Soc. Transit. 40 (2021).
[29] L.F. Hirt, Technocratic, techno-economic, and reactive: how media and parliamentary discourses on solar PV in Switzerland have formed over five decades and are shaping the future, Energy Res. Soc. Sci. 108 (2024).
[30] S. Vikström, E. Mervaala, H.L. Kangas, J. Lyytimäki, Framing climate futures: the media representations of climate and energy policies in Finnish broadcasting company news, J. Integr. Environ. Sci. 20 (1) (2023).
[31] M. Rochyadi-Reetz, D. Arlt, J. Wolling, M. Bräuer, Explaining the media's framing of renewable energies: an international comparison, Front. Environ. Sci. 7 (2019).
[32] H. Wessler, J. Lück, A. Wozniak, Communication, negotiation, and influence at international climate change meetings and summits, in: Oxford Research Encyclopedia of Climate Science, Oxford University Press, 2017.
[33] N.K. Arora, I. Mishra, COP26: more challenges than achievements, Environ. Sustain. (Singapore) 4 (4) (2021).
[34] A. Wiltshire, D. Bernie, L. Gohar, J. Lowe, C. Mathison, C. Smith, Post COP26: does the 1.5°C climate target remain alive? Weather 77 (12) (2022).
[35] E. Calliari, Loss and damage: a critical discourse analysis of Parties' positions in climate change negotiations, J. Risk Res. 21 (6) (2016).
[36] A. Schmidt, A. Ivanova, M.S. Schäfer, Media attention for climate change around the world: a comparative analysis of newspaper coverage in 27 countries, Glob. Environ. Chang. 23 (5) (2013).
[37] C. Huan, Politicized or popularized? News values and news voices in China's and Australia's media discourse of climate change, Crit. Discourse Stud. 21 (2) (2023).
[38] M.T. Boykoff, J.M. Boykoff, Climate change and journalistic norms: a case-study of US mass-media coverage, Geoforum 38 (6) (2007).
[39] K. Nairn, Learning from young people engaged in climate activism: the potential of collectivizing despair and hope, Young 27 (5) (2019).
[40] J. Broadbent, J. Sonnett, I. Botetzagias, M. Carson, A. Carvalho, Y.J. Chien, et al., Conflicting climate change frames in a global field of media discourse, Socius 2 (2016).
[41] A. Wozniak, H. Wessler, C.H. Chan, J. Lück, The event-centered nature of global public spheres: the UN climate change conferences, Fridays for future, and the (limited) transnationalization of media debates, Int. J. Commun. 15 (2021).
[42] C.J. Hilson, Masterplots of demand and supply and the energy trilemma: delaying the transition, in: Law, Narrative and Masterplot, Routledge, 2025.
[43] L.L.B. Lazaro, R.S. Soares, The energy quadrilemma challenges-insights from the decentralized energy transition in Brazil, Energy Res. Soc. Sci. 113 (2024).
[44] R. Willis, Taming the climate? Corpus analysis of politicians' speech on climate change, Environ. Polit. 26 (2) (2017).
[45] J. Oliver, B. Sovacool, The energy trilemma and the smart grid: implications beyond the United States, Asia Pac. Policy Stud. 4 (1) (2017).
[46] R.J. Heffron, D. McCauley, B.K. Sovacool, Resolving society's energy trilemma through the Energy Justice Metric, Energy Policy 87 (2015).
[47] N. Gunningham, Managing the energy trilemma: the case of Indonesia, Energy Policy 54 (2013).
[48] P. Šprajc, M. Bjegović, B. Vasić, Energy security in decision making and governance - methodological analysis of energy trilemma index, Renew. Sust. Energ. Rev. 114 (2019).
[49] O. Weiss, G. Pareschi, G. Georges, K. Boulouchos, The Swiss energy transition: policies to address the Energy Trilemma, Energy Policy 148 (2021).
[50] L. Marti, R. Puertas, Sustainable energy development analysis: Energy Trilemma, Sustain. Technol. Entrep. 1 (1) (2022).
[51] D. Gent, J. Tomei, Electricity in Central America: paradigms, reforms and the energy trilemma, Prog. Dev. Stud. 17 (2) (2017).
[52] H. Liu, I. Khan, A. Zakari, M. Alharthi, Roles of trilemma in the world energy sector and transition towards sustainable energy: a study of economic growth and the environment, Energy Policy 170 (2022).
[53] M. Fernandez, L.S.G. Piccolo, D. Maynard, M. Wippoo, C. Meili, H. Alani, Talking climate change via social media: communication, engagement and behaviour, in: WebSci 2016 - Proceedings of the 2016 ACM Web Science Conference, 2016.
[54] M. McCombs, S. Valenzuela, Setting the Agenda: Mass Media and Public Opinion, 3rd ed., John Wiley & Sons, 2020.
[55] Z. Xu, D.J. Atkin, Framing climate change in the 5th estate: comparing online advocacy and denial webpages and their engagement, Electron. News 16 (2) (2022).
[56] S. Hall, New ethnicities, in: A. Rattans, J. Donald (Eds.), Race, Culture and Difference, Sage, London, 1982.
[57] R. Fowler, Language in the News: Discourse and Ideology in the Press, Routledge, 2013.
[58] A. Carvalho, Ideological cultures and media discourses on scientific knowledge: re-reading news on climate change, Public Underst. Sci. 16 (2) (2007).
[59] P. Baker, C. Gabrielatos, T. McEnery, Discourse Analysis and Media Attitudes: The Representation of Islam in the British Press, Cambridge University Press, 2013.
[60] G. Smart, M. Falconer, 5. Genre, uptake, and the recontextualization of climate change science by 'denialist' cultural communities, in: Genre in the Climate Debate, De Gruyter, 2021.
[61] R.E. Dunlap, R.J. Brulle, Sources and amplifiers of climate change denial, in: Research Handbook on Communicating Climate Change: Elgar Handbooks in Energy, the Environment and Climate Change, 2020.
[62] K. Fløttum, Linguistic analysis in climate change communication, in: Oxford Research Encyclopedia of Climate Science, Oxford University Press, 2016.
[63] J. Sinclair, Trust the Text: Language, Corpus and Discourse, Routledge, 2004.
[64] T. McEnery, A. Hardie, Corpus Linguistics, Cambridge University Press, 2011.
[65] G. Brookes, T. McEnery, The utility of topic modelling for discourse studies: a critical evaluation, Discourse Stud. 21 (1) (2018).
[66] R. Grundmann, Using large text news archives for the analysis of climate change discourse: some methodological observations, J. Risk Res. 25 (3) (2021).
[67] R. Grundmann, M. Scott, Disputed climate science in the media: do countries matter? Public Underst. Sci. 23 (2) (2012).
[68] M. Gillings, C. Dayrell, Climate change in the UK press: examining discourse fluctuation over time, Appl. Linguis. 45 (1) (2023).
[69] C. Cunningham, C. Foxcroft, H. Sauntson, The divergent discourses of activists and politicians in the climate change debate: an ecolinguistic corpus analysis, Eur. Bus. Rev. 26 (3) (2022).
[70] P. Baker, Using Corpora in Discourse Analysis, Bloomsbury, 2023.
[71] P. Rayson, D. Berridge, B. Francis, Extending the Cochran rule for the comparison of word frequencies between corpora, in: JADT 2004: 7es Journées internationales d'Analyse statistique des Données Textuelles, 2004.
[72] M.A.K. Halliday, C.M.I.M. Matthiessen, M. Halliday, C. Matthiessen, An Introduction to Functional Grammar, Routledge, 2014.
[73] N. Fairclough, Critical Discourse Analysis the Critical Study of Language, second edition, Routledge, 2013.
[74] D. Biber, Representativeness in corpus design, Lit. Linguist. Comput. 8 (4) (1993).
[75] T. McEnery, G. Brookes, Building a written corpus: what are the basics?, in: The Routledge Handbook of Corpus Linguistics, Second edition, Routledge, 2022.
[76] K. Benoit, K. Watanabe, H. Wang, P. Nulty, A. Obeng, S. Müller, et al., quanteda: an R package for the quantitative analysis of textual data, J. Open Source Softw. 3 (30) (2018).
[77] A. Partington, Modern diachronic corpus-assisted discourse studies (MD-CADS) on UK newspapers: an overview of the project, Corpora 5 (2) (2010).
[78] D.V. Cicchetti, Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology, Psychol. Assess. 6 (4) (1994).
[79] E.A. Shrider, M. Kollar, F. Chen, J. Semega, Income and poverty in the United States: 2020. US Census Bureau, current population reports, Available from: https://www.census.gov/library/publications/2021/demo/p60-273.html, 2021 (Internet).
[80] M. den Elzen, J. Fuglestvedt, N. Höhne, C. Trudinger, J. Lowe, B. Matthews, et al., Analysing countries' contribution to climate change: scientific and policy-related choices, Environ. Sci. Pol. 8 (6) (2005).
[81] J. Hickel, Quantifying national responsibility for climate breakdown: an equality-based attribution approach for carbon dioxide emissions in excess of the planetary boundary, Lancet Planet. Health 4 (9) (2020).
[82] R. Murali, A. Kuwar, H. Nagendra, Who's responsible for climate change? Untangling threads of media discussions in India, Nigeria, Australia, and the USA, Clim. Chang. 164 (3–4) (2021).
[83] M. Davies, The Coronavirus Corpus Design, construction, and use, Int. J. Corpus Linguist. 26 (4) (2021).
[84] A. Amin, Y. Liu, J. Yu, A.A. Chandio, S.F. Rasool, J. Luo, et al., How does energy poverty affect economic development? A panel data analysis of South Asian countries, Environ. Sci. Pollut. Res. 27 (25) (2020).
[85] Y. Li, X. Ning, Z. Wang, J. Cheng, F. Li, Y. Hao, Would energy poverty affect the wellbeing of senior citizens? Evidence from China, Ecol. Econ. 200 (2022).
[86] A.O. Acheampong, M.O. Erdiaw-Kwasie, M. Abunyewah, Does energy accessibility improve human development? Evidence from energy-poor regions, Energy Econ. 96 (2021).
[87] S. Carley, D.M. Konisky, The justice and equity implications of the clean energy transition, Nat. Energy 5 (8) (2020).
[88] M. Bednarek, H. Caple, News Discourse, A&C Black, 2012.
[89] S. Rayner, M. Caine, The Hartwell Approach to Climate Policy, Routledge, 2014.
[90] O.H. Kwon, K. Vu, N. Bhargava, M.I. Radaideh, J. Cooper, V. Joynt, et al., Sentiment analysis of the United States public support of nuclear power on social media using large language models, Renew. Sust. Energ. Rev. 200 (2024).
[91] J. Song, Y. Yuan, K. Chang, B. Xu, J. Xuan, W. Pang, Exploring public attention in the circular economy through topic modelling with twin hyperparameter optimisation, Energy AI 18 (2024).
[92] R.J. Heffron, D. McCauley, G.Z. de Rubens, Balancing the energy trilemma through the Energy Justice Metric, Appl. Energy 229 (2018).

Online refs

[web] EPA. https://www.epa.gov/climate-indicators/weather-climate, 2022.
[web] Glasgow Science Centre, The energy trilemma. https://www.glasgowsciencecentre.org/our-blog/the-energy-trilemma, 2021.
[web] Our Future Energy, Energy trilemma resource. https://ourfuture.energy/teacher-zone/energy-trilemma-resource/, 2022.
[web] Nexis Advance, Online: https://advance.lexis.com, 2022.

[journal] World Energy Council, Energy trilemma index, Online: https://trilemma.worldenergy.org/, 2023.
[web] Iberdrola. https://www.iberdrola.com/sustainability/top-countries-most-affected-by-climate-change, 2023.
[web] World Bank. https://climateknowledgeportal.worldbank.org/country/bangladesh/vulnerability, 2023.