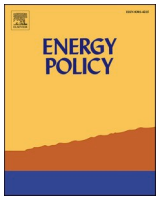
Energy Policy 202 (2025) 114592

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol



A computational analysis of the media coverage of the European Parliament's 'green' Designation on sustainable energy and climate change

Ileana Zeler [a,*], Joan Ramon Rodriguez-Amat [b], Riasat Muhammad Amir [a]

[a] Departament of Advertising, Public Relations and Audiovisual Communication Autonomous University of Barcelona Edifici I - Carrer de la Vinya Campus de la UAB, 08193, Barcelona, Spain
[b] School of Journalism, Media and Communication University of Sheffield Western Bank, Sheffield Sheffield, S10 2TN, United Kingdom

ARTICLE INFO

Keywords:
Nuclear energy
Sustainability
Energy policy
European union
News media
Topic modelling

ABSTRACT

Energy is pivotal to the sustainable development agenda for 2030. In this context, nuclear energy emerges as a potential solution for renewable energy development and carbon dioxide mitigation. However, the Russian invasion of Ukraine in 2022 exacerbated global energy concerns, leading to a surge in fuel prices and an economic slowdown, prompting the European Parliament to designate nuclear energy investments as "green." Despite the potential of nuclear energy in advancing sustainability goals, public perception, influenced by historical negative narratives and media coverage, remains a challenge. This article examines the impact of the European Parliament's decision on the news flow and coverage about sustainability, climate change, and nuclear energy in the global media. By analysing seven months of global news coverage, a total of 7822 news stories in English were selected. Through descriptive analysis and unsupervised topic modelling Latent Dirichlet Allocation (LDA) machine learning techniques, this study explores trends in news content and coverage, shedding light on the intersection of energy policies, and media coverage.

1. Introduction

Energy is at the heart of the sustainable development agenda for 2030 (IEA, 2018), and so are the efforts to ensure energy is reliable, clean, and affordable (Ho and Kristiansen, 2019) and capable to substitute fossil fuels while keeping up with the related environmental and energy security concerns (Kanwal et al., 2022). Nuclear energy emerges in this context as an option for the development of renewable energy and carbon dioxide isolation for fossil fuels to preserve the global environment (Matsui et al., 2008).

Sustainable development is on the agenda of many countries, but the Russian invasion of Ukraine in February 2022 drove up fuel prices worldwide (Ben Hassen and El Bilali, 2022), increasing prices and hitting household fuel bills: including heating, cooling, cooking, and mobility (Guan et al., 2023). The global energy shortage further compounded the global economic slowdown already triggered by the COVID-19 pandemic in 2021 (Aktar et al., 2021). In response to the energetic crisis, the European Commission approved the Complementary Climate Delegated Act (February 2nd, 2022) that was voted by the European Parliament on July 6, 2022 (for the timeline detail, please, check Fig. 1, below). The Act declared nuclear energy investments as "green" shifting direction in and, an important step forward for the European Union (EU)'s energy transition and security.

Debates around "sustainability" and nuclear power present challenges (Muhammad Amir and Zeler, 2024a). Research has shown patterns underscoring the connection between sustainable energy and sustainable investments (Arslan et al., 2021; Ji et al., 2021). However, public opinion has historically held a negative perception of nuclear energy (Ho and Kristiansen, 2019), initially fuelled by media coverage spotlighting protests against nuclear facilities. This negative perception has persisted, shifting towards more negative reporting (Harney, 1991). Recent research analysing newspaper articles coverage in Russia, China, the Netherlands, the United Kingdom (UK), and other European countries have identified cycles of news publication concerning nuclear energy risks and environmental issues (Du and Han, 2019; Ho and Kristiansen, 2019; Mercado-Sáez et al., 2019; Vossen, 2020). Nevertheless, the public debates including (and combining) nuclear energy, green energy and sustainable investment are very scarce in the public sphere (Muhammad-Amir and Zeler, 2024b).

This article asks whether and to what extent the European Act altered the news flow and coverage about sustainability, climate change, and nuclear energy in the media globally. To do so, we collected seven

* Corresponding author.
E-mail addresses: ileana.zeler@uab.cat (I. Zeler), mon.rodriguez@sheffield.ac.uk (J.R. Rodriguez-Amat).

https://doi.org/10.1016/j.enpol.2025.114592
Received 21 October 2024; Received in revised form 28 February 2025; Accepted 4 March 2025
Available online 23 March 2025

Date	Event
February 2, 2022	The European Commission has approved a Complementary Climate Delegated Act under certain conditions, which includes specific nuclear and gas energy activities in the EU taxonomy under strict conditions.
March 9, 2022	Formally adopted in all EU official languages.
March 10, 2022	Transmitted to the European Parliament and the Council for their scrutiny.
July 6, 2022	The European Parliament voted for the inclusion of specific nuclear and gas energy activities, under certain conditions, in the list of environmentally sustainable economic activities covered by the EU Taxonomy. It was then transmitted to the co-legislators for the scrutiny period.
July 11, 2022	Scrutiny period ended by the co-legislators
July 15, 2022	The Complementary Climate Delegated Act has been published in the Official Journal.
January 1, 2023	The Complementary Climate Delegated Act entered into force and applied.

Fig. 1. Timeframe for the Complementary climate Delegated Act.

months of news stories (June 1st to Dec 31st, 2022) on the news database Lexis Nexis, adding to a total of 7822 stories in English. The initial descriptive analysis of the metadata led to the analysis, using topic modelling technique of Latent Dirichlet Allocation (LDA) of the 1600 stories published in the UK & Northern Ireland. That helped organise and classify the main contents of the news.

This article starts with a review of the literature on sustainability (2.1) and on related European energy policy process (2.2). After that, section 2.3 explores the features of media coverage, and how news framing informs public perception on climate change or nuclear energy, which is the focus of section 2.4. Section 2.5 brings the case of this research forward and contextualises the chronology and relevance of the European approval of the Complementary Climate Delegated Act. Section 2.6 briefly describes how computational methods and topic modelling can help approach the news coverage of the Complementary Climate Delegated Act and inform the research question (section 3) and methodology of this paper (section 4). The findings section (5) is then structured along three lines: first the description of the corpus of news and sources (5.1); then the specific analysis of the coverage in the UK (5.2); and the topic modelling along time and outlets to provide a broad view and the features of the coverage of nuclear energy and sustainability news among which, the European Complementary Climate Delegated Act Agreement (5.2). Sections 6 and 7 correspond to the discussion and conclusions.

2. Literature review

2.1. Sustainability and risk society

Beck's concept of risk society addresses uncertainties in modernity and fears stemming from globalisation's impact on society (Jarvis, 2007), where climate and environmental changes (Apanovich et al., 2020; Briska and Rungule, 2010), technological, and economic factors give rise to concerns as among which nuclear power, global warming, or environmental degradation (Boyd et al., 1993; Kabu, 2016). Risk escalates with human decisions, now managed by government agencies and corporations (Kabu, 2016). The substantial industrialization's social and environmental costs (Kabu, 2016; Roper, 2012) have led to an awareness shift towards sustainable consumption (McDonagh, 1998), that aligns with the global sustainable climate agenda (Apanovich et al., 2020).

As much as there is some consensus on global climate sustainability its interpretation varies among stakeholders, including industries like oil, gas, shipping, mining, and tourism, and environmental NGOs (Sidorova et al., 2017) which complicates and challenges its scientific operationalisation and validity (Salas-Zapata and Ortiz-Muñoz, 2019).

The concept of sustainability traces back to Carlowitz's 1713 work on sustainable forest management (Spindler, 2013). This concept links to contemporary approaches to sustainable development. The notion seeks productive harmony between humans and nature for the benefit of present and future generations (Gruen et al., 2008), as was already

emphasised in the 1972 report 'The Limits of Growth' (Romeiro, 2012).

However, in business practices, the idea of sustainability as productive harmony can mask contradictions, between competing perspectives (Kong et al., 2002) such as the opposition between economic growth and sustainable development. Furthermore, "weak sustainability" argues for the substitutability of natural capital, while "strong sustainability" contends that such substitution is impossible (Salas-Zapata and Ortiz-Muñoz, 2019). Distinguishing weak from strong sustainability is pivotal in crafting policies for energy, global warming, and forest management to combat climate change and address the energy crisis (Singh, 2021); and yet, these tensions lead to sectoral disparities and ideological tensions (Barbosa et al., 2014; Stål and Ali, 2022) that contribute to conflicting discourses and actions, reflecting the concept's manipulation for political and economic interests (Sachs, 2012). Because both political and environmental discourses commonly employ the term sustainability. Tracking public uses and representations of sustainability this study explores the political alignments and strategic discourses associated with it.

2.2. Sustainability policies in todays' European context: focus on energy

To achieve comprehensive sustainable development, policies must address environmental, social, and economic risks, including climate change, social inequality, poverty, biodiversity loss, overpopulation, and resource scarcity (Sachs, 2012). The 17 Sustainable Development Goals (SDGs), established in 2012 and adopted in 2015 (UN, 2022), provide a global framework for these challenges, aiming to transform the world towards shared prosperity and sustainability by 2030.

Energy conservation and efficiency are vital for sustainable economic growth and long-term development (Zakari et al., 2022). The energy sector must be reliable, clean, and affordable, necessitating investments in renewable electricity, nuclear power, and fossil fuels with carbon capture and storage (McCollum et al., 2018). Energy policy significantly impacts global economic development, intersecting with economic, foreign, and national security policies (Filho and Voudouris, 2013).

Regulatory frameworks for sustainable finance in Europe face challenges in mobilising private capital towards sustainable investments, despite efforts to enhance transparency regarding environmental, social and governance (ESG) factors (Brühl, 2022). As discussed in the next section, EU taxonomy (Regulation (EU) 2020/852 of the European Parliament and of the Council of June 18, 2020, 2020) classifies environmentally sustainable economic activities, providing clarity to investors and mitigating the risk of greenwashing. However, specific criteria for green activities are still under development.

In the meantime, half of EU member states rely on nuclear energy, considering it a clean, affordable, and efficient energy source (Christoforidis et al., 2021; El-Emam et al., 2020; Ghazali et al., 2020). Despite the Fukushima disaster, nuclear energy remains a key low-carbon electricity source, crucial for reducing CO_2 emissions and achieving sustainable growth (Bandyopadhyay and Rej, 2021; Hassan et al., 2020; Yue et al., 2022); this makes the discussion about the social perception of nuclear energy very relevant (section 2.4). However, before entering that space, it is worth revisiting the literature that explains the relevance of media coverage to understand the public perception of nuclear energy.

2.3. Media representations of sustainability policies in the public debates

The principle behind the analysis of media coverage is that media outlets define social events by giving them cultural meanings that reproduce and establish views of the world (see McQuail and Deuze, 2020). In this context, a lot of research has been dedicated to analysing news -as a stable media genre in comparison to other kinds of media contents (De Vreese, 2005)- and how information is presented or "framed".

Framing research classically builds on Goffman's concept (Goffman, 1974), who explains how framing manages the self-public identity and shapes how people are perceived in society, whether as heroes, victims, or villains, based on how they perform in front of the media "stage; " and the work by Entman (1993) for whom "frames define problems, diagnose causes, make moral judgements and suggest remedies'' (McQuail and Deuze, 2020, p. 416). Altheide (1997) contributed to the discussion suggesting that "frames focus on what will be discussed, how it will be discussed, and above all, how it will not be discussed" (p. 651). Framing thus involves presenting information within a specific context to influence its interpretation, this is, highlighting some elements while marginalizing others, and even impacting public opinion (Nelson et al., 1997).

The framing approach to news content analysis aligns with works on public agenda setting (Boykoff et al., 2009; McCombs et al., 2017), that consider that the media priorities impact on the perception of the audience setting the audience's priority agenda too. As much as these approaches have suffered of conceptual reductionism and deplorable methodological shoehorning in the last decade, the notion of frames as news contents and assuming that the news coverage presents realities under particular prisms is still fertile research starting point.

High public interest debates on the media, such as energy issues could shape public perceptions and drive positive change (Homar and Cverlbar, 2021). Media discourse insistence on the environment, economic and political benefits of biomass energy helped grow its social value (Liu and Liu, 2022). There is some previous research on media coverage (Barkemeyer et al., 2018) and on social media interactions (Oliveira et al., 2023) around climate change (Bulian et al., 2023). They have succeeded at using machine learning processes and large language models to analyse media activity, similarly to this case; but specific work on sustainability policy discourse (Mulderrig et al., 2019) is less frequent. This article, thus, breaks ground by exploring the coverage of news on nuclear and sustainable energy, assuming that the analysis of news on sustainability might help highlight public issues that could shape public opinion (Anderson, 2015; Rochyadi-Reetz et al., 2019), raise social awareness (Fischer, 2016) or even prompt further government social policy action (Sen, 2011).

2.4. Nuclear energy and disasters: public perceptions

Media coverage plays a pivotal role in framing the fluctuating social perception of nuclear energy (see Durdovic et al., 2024 or Ho et al., 2019, among others). Still media coverage happens in historical moments or in technological contexts that shape that perception too; and following Entman's concept of framing distinct frames are influenced by structural conditions (Rochyadi-Reetz et al., 2019). For instance, whereas in the early years of post-World War II, nuclear energy symbolised scientific progress and geopolitical power, closely linked to its weaponized use and to the growth of the United States (US) world power (Boscarino, 2019). However, such enthusiasm soon activated concerns linked to its safety (see Hellman, 2011): the Cuban Missile Crisis in 1962, the Three Mile Island accident in 1979 (Boscarino, 2019), Chernobyl in 1986 or Fukushima in 2011, among others, kept public attitudes in check in relation to nuclear safety and regulatory frameworks (Perko et al., 2014). And in the case of Fukushima Daiichi, the quick sharing information through internet strongly influenced public opinions (Huang et al., 2018) and encouraged a shift toward renewable energy sources, in Japan and around the world (Kim et al., 2013) and around the world (Prati and Zani, 2013) in differentiated ideological patterns (Bian et al., 2021).

Research on the coverage of nuclear energy shows for example that while Chinese media largely support nuclear energy, local sources may portray it as risky (Du and Han, 2019). In the US, initial positive framing shifts after accidents (Slovic, 2000); and in the case of the European media the safety dominant narrative was altered after Fukushima, emphasising issues like safety and the environmental aspects of nuclear

energy (Zeh and Odén, 2014). Italian media highlighted health risks following Chernobyl (Cantone et al., 2007). Irish media argued that nuclear energy is sustainable, given climate urgency (Devitt et al., 2019). All these framing differences reflect contextual and cultural influences (Almaghlouth, 2022); or cultural values (Bauer et al., 2018) rather than the nature of the energy source. According Slovic (2000), risk perception is heavily influenced by factors such as dread, trust in authorities, and media portrayal, all of which were exacerbated by these disasters. At the shorter distance, many oppose nuclear projects near their homes, a response known as the "not-in-my-backyard" (NIMBY) phenomenon (Gerrar and Gerrardt, 1994); to which governments and industry leads have offered transparency and community engagement (Renn, 2008); as fundamental for energy transition in long-lasting sustainability plans (Jenkins et al., 2016).

2.5. The EU Complementary climate Delegated Act. European Green Deal

The global response to the energy crisis (IEA, 2023), that caused oil and gas prices to surge to their highest levels in nearly a decade linked to the Russian invasion of Ukraine (Tank, 2022) prompted many countries to reconsider their energy supplies (Khatib, 2012), particularly European nations reliant on Russian energy (Ruhnau et al., 2022) to seek energy diversification, and to cut the dependence on Russian fuels (Tollefson, 2022).

Disruptions in the energy market, worsen cost-of-living crises, and increase food and energy poverty, which can lead to social unrest (Ben Hassen and El Bilali, 2022). It is essential for stakeholders involved in the 2030 Agenda for Sustainable Development to uphold their commitments to the Paris Agreement while addressing the immediate energy crisis (UNCTAD, 2022). The long-term challenge sets stage for a green transition, like the energy efficiency improvements seen after the 1970s oil crisis (Vaughan, 2022).

The EU taxonomy is a framework created as part of the EU's goal to achieve climate neutrality by 2050, in line with the objectives of the European Green Deal. Its aims include to reduce "greenwashing," enhance transparency, and guide the EU's transition to a low-carbon, resilient economy by aligning financial flows with sustainable development goals (Svälas, 2023). Indeed, the Taxonomy, driven and implemented by the EU Commission, helps guide the green transition by establishing scientifically rigorous criteria that define and classify environmentally sustainable economic activities ensuring a common language for stakeholders, including investors, companies, and policymakers (Lucarelli et al., 2020). The taxonomy aligns investments with the six environmental objectives (Linden and Jade, 2022): climate change mitigation; climate change adaptation; sustainable use and protection of water and marine resources; transition to a circular economy; pollution prevention and control; and protection and restoration of biodiversity and ecosystems (European Parliament and the Council, 2020).

The Climate Delegated Act: Adopted in June 2021 (European Union, 2021) and the Complementary Climate Delegated Act approved by the EU Commission on February 2, 2022 (European Union, 2022; see Fig. 1) are secondary legislation used to define technical criteria for the Taxonomy. The former (European Union, 2021) sets the criteria for economic activities that support climate change mitigation and adaptation, prioritizing those aligned with the EU's climate neutrality goals. It covers sectors such as renewable energy, energy efficiency, and low-carbon technologies but it does not address nuclear and gas. Whereas the complimentary Act (European Union, 2022) expands the taxonomy to include transitional activities like natural gas and nuclear energy, which are considered sustainable under specific conditions as 'transitional' economic activities under the EU taxonomy (Spinaci, 2022). On July 6, 2022 (Fig. 1), the European Parliament -which, as the democratically elected body of the EU, exercises scrutiny over the Commission's proposals-approved, after discussion, classifying natural gas and nuclear power as "green" energy sources. This inclusion led to controversy, the EU Commission backed the approval with supporters arguing for the necessity of transitional solutions (Muhammad-Amir and Zeler, 2024b); but environmental advocates (CNN, 2022) and other critics claimed that it undermines the taxonomy's credibility. Despite the contentious scenario the Council of Europe who had the authority to veto proposals put forward by the EU Commission but in this case, it decided not to use such power. On July 15, 2022, the Complementary Climate Delegated Act was published in the Official Journal of the EU (Fig. 1) amending the existing EU Taxonomy Climate Delegated Act (Dillon Euctace, 2022).

After the approval, natural gas can now be considered a sustainable investment if it cannot be replaced by renewables, and nuclear power is classified as 'green' if it includes plans for managing radioactive waste. This new scenario potentially opens financial avenues for nuclear and gas project development enabling them to receive significant state subsidies and private investments (European Union, 2022).

3. Research questions

The central question this article tries to give answer to is:

How has the adoption of the Complementary Climate Delegated Act by the European Commission altered the international coverage of news on nuclear energy and sustainability?

This question is operationalised along these three sub-research questions that structure the findings section.

RQ1: What is the frequency and distribution of news covering nuclear energy and sustainability at global scale according to Lexis-Nexis?

RQ2: Do the UK & Northern Ireland media coverage of nuclear energy and sustainability news change in relation to the publication of the EU agreement?

RQ3: What are the main topics discussed in the UK & Northern Ireland news articles regarding nuclear energy and sustainability? Is there a variation coinciding with the Complementary Climate Delegated Act publication?

4. Methodology

4.1. Data collection

The news articles were retreived from Lexis-Nexis database using its own search and retrieval system aiming at all news articles extending the diverse range of outlets in multiple languages (Lexis-Nexis, n.d.). The search involved combining keyword groups including "nuclear energy" and the recent EU green energy declaration, encompassing terms such as "Nuclear Energy", "Taxonomy", "EU Commission", and "green energy" in English. The time frame was from June 1st, 2022, to December 31st, 2022, covering both pre- and post-act phases of the Complementary Climate Delegated Act on 6th July and offering a comprehensive coverage and trend identification over time. The collection comprised 7822 articles from newspapers that were downloaded in two stages: first identifying the news and collecting their metadata in a data frame (.xlsx format) and then using the headlines and links to download the full texts of the news, which were later matched with the headlines data frame using a Python text recognition feature.

Lexis-Nexis allows access to full articles and pertinent data including publication date, type, length, and more. While powerful, it lacks the sophisticated search capabilities of some academic databases, potentially resulting in missed articles (Barry and Greenhalgh, 2019). Therefore, one should consider these limitations when interpreting the results. However, the richness of the service allows to obtain a volume of news which serves for a more comprehensive analysis of the event's media representation while also offering a valuable perspective on the issues discussed around the main event following a clear temporal and geographical distribution.

Country	N	%
Mexico	2389	30.5
United Kingdom & Northern Ireland	1600	20.5
Canada	292	3.7
Germany	206	2.6
Russian Federation	191	2.4
Iran	141	1.8
China	123	1.6
Australia	119	1.5
Ireland	108	1.4
South Africa	99	1.3
India	93	1.2
Ukraine	87	1.1

Fig. 2. Number of news items by country (Top 12).

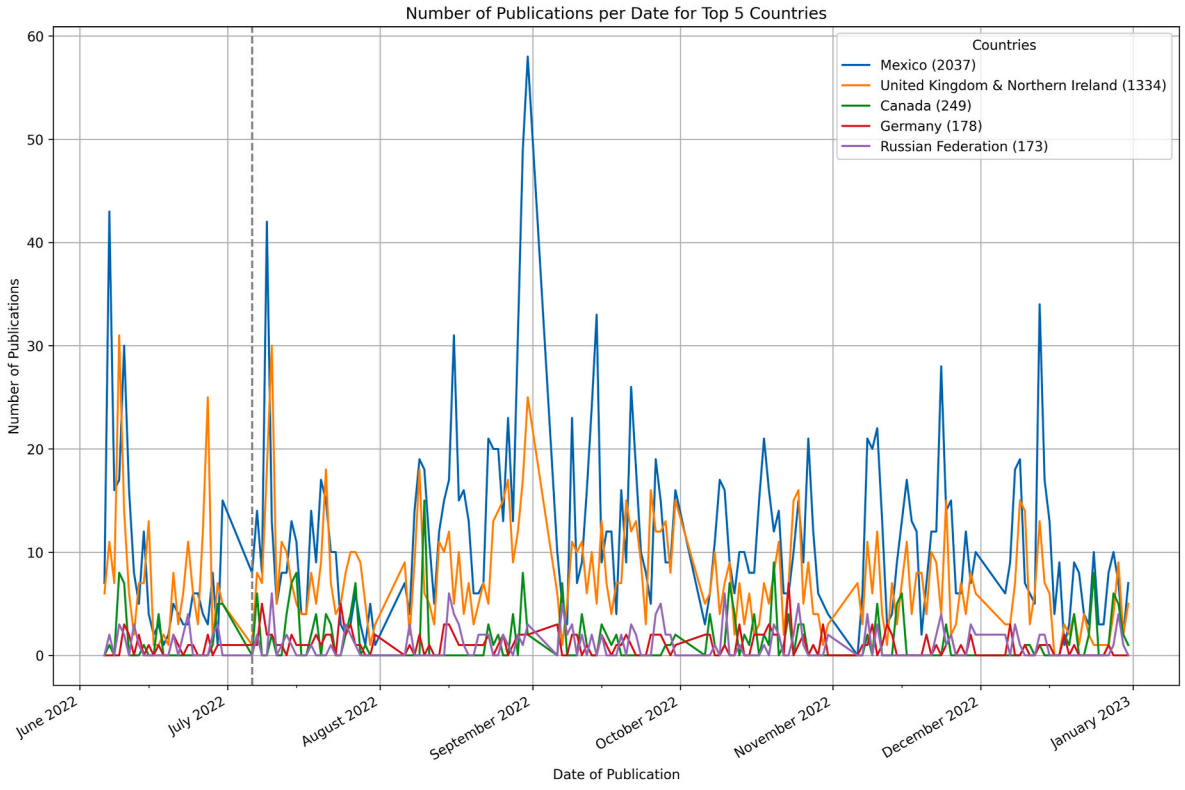


Fig. 3. Number of news by date of publication by top countries. the vertical grey line indicates the 6th of July the date of the Complementary Climate Delegated Act approval (the discrepancy with the total number of news items per country -see Fig 2- is because this chart shows news dated after June 2022; whereas Fig 2 includes news in the search published earlier.

Top countries	Outlets by country		News by country	
	(N)	(%)	(N)	(%)
Mexico	2	1.2	2389	51.1
United Kingdom & Northern Ireland	94	58.4	1600	34.2
Canada	53	32.9	292	6.2
Germany	6	3.7	206	4.4
Russian Federation	6	3.7	191	4.1
Total	161	100	4678	100

Fig. 4. Outlets and news articles by top 7 countries.

This sample was analysed using the open source Gensim library to apply unsupervised machine learning tools enriched with Dirichlet Process Mixtures (DPMs) in a process called Latent Dirichlet Allocation (LDA) topic modelling (Blei, 2012).

4.2. Data analysis

In particular, the analysis comprises three stages. The first stage (RQ1) consists of an Exploratory Data Analysis with a descriptive purpose of the complete sample (7822 news articles); and digging deeper in the countries with the highest news, to identify publication frequency, article extension, and their sources. For the second stage (RQ2), the attention centres on the news from the UK and Northern Ireland. That second-stage analysis (a sample of 1600 articles) includes the exploration of the contents using topic modelling a Natural Language technique based on Bayesian statistics. Topic modelling relies on unsupervised machine learning to identify clusters of similar words in a body of text (Grimmer et al., 2022). Such a form of unsupervised analysis of the large body of text (Van Atteveldt et al., 2022) works with a keyword clustering technique (k-) that helps identify topic sets that correspond to the main themes of the news content in the media discussions as emerging topics. The development and fitting of the LDA topic modelling (Blei, 2012) is done in Python and using packages such as NLTK and Gensim with their dictionaries and lemmatisation processes before the model offers an. html visualisation of the word clusters (Fig. 3), that helps identify topics or themes. The modules are then linked back to the main data frame of news articles to identify each topic with each story and revisit the distribution of topics over time. The analysis of the distribution of the emergency topics through newspapers and along the timeline helps also understand the features of the coverage of the events in the English-speaking countries, for RQ3. The LDA topic modelling identified 5 differentiated topics and helped re-label the news articles with their dominant topic.

LDA topic modelling technique has proven useful for media framing analysis and its popularity has gained traction recently (Verbytska, 2024; Ylä-Anttila et al., 2022) due to its ability to manage large volumes of text and capturing latent thematic structures. Techniques like LDA offer a scalable and systematic method for identifying frames in media content (Bowen and Min, 2023) and it has been used to identify thematic patterns in news articles, revealing underlying frames (DiMaggio et al., 2013) while reducing human effort, and improving reproducibility. Guo et al. (2016) used topic modelling to identify key themes in the analysis of US newspaper coverage of immigration. Atteneder and Rodriguez-Amat (2024) used LDA modelling to combine it with Critical Discourse Analysis on blogs; while (Jacobi et al., 2016) found how scientific uncertainty and economic costs dominate the media narrative on climate change coverage. Despite its consistent popularity no research has previously used LDA on nuclear energy coverage, yet. This article uses LDA to identify the emerging topics.

5. Findings

Findings are presented in the three sections responding to the three sub-research questions. The first section is the exploratory and descriptive data analysis of the sample of news published in around a hundred countries. The second section focuses on news published in the UK & Northern Ireland as the country that appears with the highest number of outlets. Results of the emerging LDA topic modelling analysis are shared. The third section shows the topic distribution along time and across news outlets.

5.1. Frequency and distribution of news covering nuclear energy and sustainability

The number of news published across countries insists on the geographic extension of media coverage of the topic of nuclear and sustainability news: more than 90 countries, with a high overall mean of 70.3 news per country however, the standard deviation (301.7) speaks to a wide dispersion; meaning that most of the news are concentrated on a small number of countries (Fig. 2). Only 10% of countries produced more than 100 news items, while 55.6% produced less than 10 news, and 33.3% produced only 1–2 news each. This variation does not speak as much of the relevance of the topic as it does about the limitations of Lexis-Nexis (Madrid-Morales et al., 2023).

There are significant differences on the top tier too: Mexico and the UK & Northern Ireland (including England, Wales, and Scotland) accounting for around 60% of the total sample (Fig. 2). The remaining countries produced in seven months, less than 5% of it. Canada performed third best, far from the top two. Germany and Russian Federation also produced just under 400 news combined. The remaining countries produced less than 2% of the total volume of news. Based on these results, it is worth diving deeper into the publication dates and outlets to obtain a more nuanced understanding of how those news appeared across the top countries (i.e., Mexico, the UK & Northern Ireland, Canada, Germany, Russian Federation); and further onto the limitations both of the search and database itself.

The publication frequency by top countries (Fig. 3) shows some significant peaks over the seven months of data. They appear before and after the Parliamentary approval of the Complementary Climate Delegated Act on July 6, 2022. Throughout the period June to December

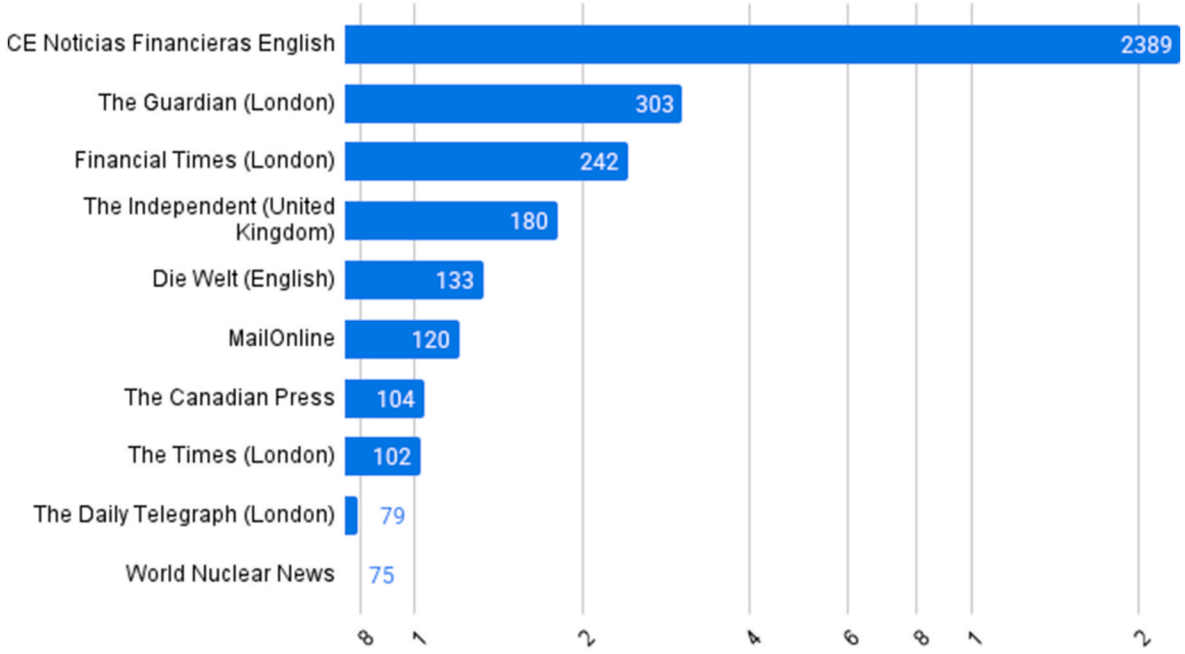


Fig. 5. Outlets with the highest number of news articles.

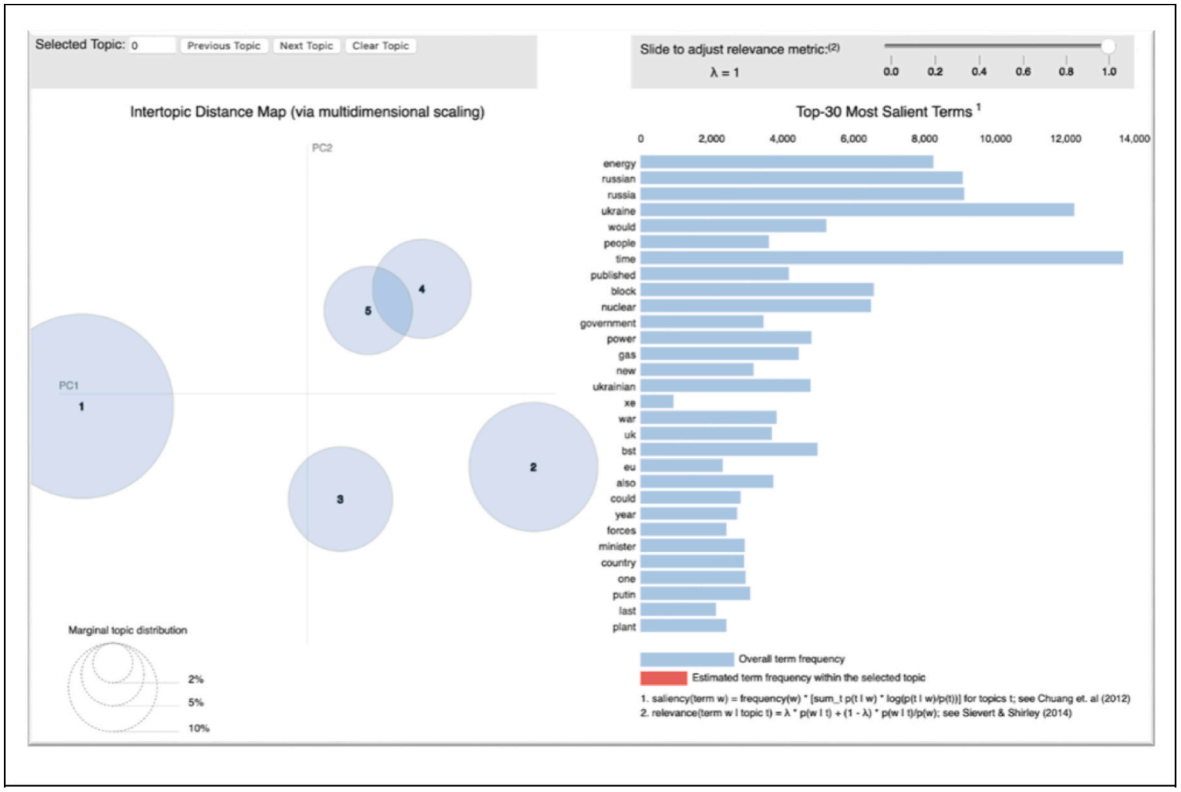


Fig. 6. Image of the relative distance between the five topics on a double axis for the case of news-stories.

2022, the peaks with higher number of publications from Mexico and the United Kingdom seem to coincide. Around June 1st-8th, the UK and Mexico covered discussions related to energy and climate challenges amid the Russia-Ukraine conflict (see examples in Annex A.1. Nw10, Nw11, Nw12, Nw13). During that month, Canadian outlets focused on the Russia-Ukraine war while news published in English in the Russian Federation highlighted the conflict impact on international politics (Annex A.1. Nw3, Nw45, Nw46). The UK peak around June 17–25, 2022, also pointed at the energy crisis due to war (Annex A.1. Nw14). Iran's nuclear deal appeared in the UK and Mexico news in June 26- July 3, 2022, (Annex A.1. Nw15, Nw16). Moreover, Canada, the UK, and Mexico referred to nuclear energy in the transition towards a sustainable future throughout June 2022 (Annex A.1. Nw1, Nw2, Nw4, Nw5), while news published in the Russian Federation mostly insisted on Russia's

Topic Id	Topic Trend	Keywords	Example headlines	Proportion
T-N1	Energy crisis	time, ukraine, russia, russian, block, energy, nuclear, bst, ukrainian, power, published, would, gas, us, war, uk, also, president, people, new, one, government, updated, minister, putin, country, kyiv, military, could, plant	Nw19; Nw20; Nw21; Nw22 (Annex A.1.)	0,67

Fig. 7. Topic "energy crisis".

Topic Id	Topic Trend	Keywords	Example headlines	Proportion
T-N2	European Union	ukraine, energy, time, would, russian, nuclear, russia, gas, block, power, putin, government, also, ukrainian, country, uk, people, year, war, could, us, published, minister, one, new, president, last, eu, world	Nw23; Nw24; Nw25 (Annex A.1.)	0,14

Fig. 8. Topic "European Union.

Topic Id	Topic Trend	Keywords	Example headlines	Proportion
T-N3	Russia-Ukraine war	time, ukraine, russia, russian, energy, block, nuclear, bst, would, war, power, people, ukrainian, published, also, gas, government, minister, new, us, uk, eu, putin, one, year, time updated, could, president, last, country	Nw26; Nw27; Nw28; Nw29 (Annex A.1.)	0,09

Fig. 9. Topic "Russia-Ukraine".

Topic Id	Topic Trend	Keywords	Example headlines	Proportion
T-N4	Energy policy	energy, ukraine, russian, time, russia, nuclear, power, block, ukrainian, bst, government, uk, would, gas, war, also, people, published, new, could, one, xe, eu, country, minister, plant, us, president, putin, year	Nw30; Nw31; Nw32 (Annex A.1.)	0,08

Fig. 10. "energy policy".

international relations (Annex A.1. Nw9). After the approval of the Complementary Climate Delegated Act, two major Mexican and Canadian news peak in August 2022, Mexico news referred to the global energy crisis to the European electricity crisis and the involvement of the nuclear power plants in the Russia-Ukraine war (Annex A.1. Nw17, Nw18, Nw6) late December 2022 the news covered nuclear investments in Europe, nuclear security, and new technologies based on fusion energy, particularly in Canada (Annex A.1. Nw7).

Topic Id	Topic Trend	Keywords	Example headlines	Proportion
T-N5	Putin government	russian, energy, russia, ukraine, time, block, published, nuclear, ukrainian, gas, would, new, uk, people, power, government, bst, also, forces, could, country, president, year, one, war, minister, us, updated, putin, plant	Nw33; Nw34; Nw35 (Annex A.1.)	0,03

Fig. 11. "Putin government".

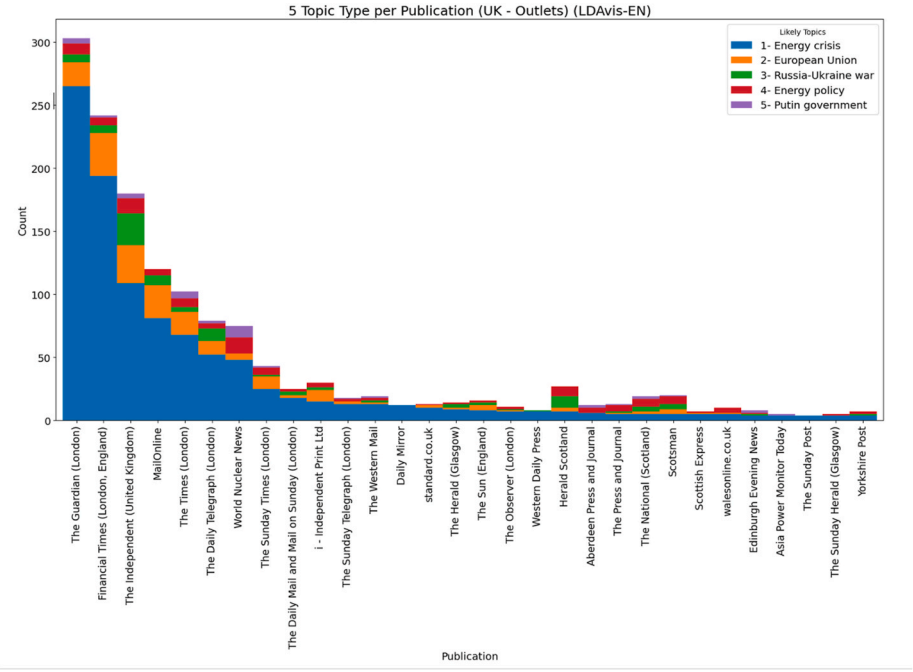


Fig. 12. Topic distribution per newspapers, organised by frequency of articles on the "energy crisis".

The analysis of outlets and news by the top countries (Fig. 4), shows the concentration and diversity of the ratio between the number of news and the number of outlets per country, providing a view on the degree of frequency of the media coverage. Findings reveals significant differences between countries. More than 50% of news found are generated in Mexico, but all are concentrated in only two newspapers. The UK & Northern Ireland lean more towards newspapers proportionally to the volume of news by outlets (17 news articles per outlet on average). Canada has the second-highest number of outlets represented (32.9%); however, the production of news articles is low, averaging around 5-6 articles per outlet. Germany and the Russian Federation showed a small number of outlets represented (6 each one), but the concentration of news articles per outlet is high: 31.8 in the Russian Federation and 34.3 in Germany.

The specific analysis of 161 outlets in the top countries (Fig. 4) help identify the top outlets in the sample (Fig. 5). There is a notable concentration of stories in certain outlets and countries. For instance, the Latin American Spanish and Portugal focused Mexican online financial and business newspaper *CE Noticias Financieras English*. Instead, other countries show higher diversity of available outlets covering the topic. The UK and Northern Ireland is a prime example of diversity with five internationally recognised newspapers providing a high number of stories: *The Guardian* (303), *Financial Times* (242), *The Independent* (180), *MailOnline* (120), *The Times* (102), and *The Daily Telegraph* (79). Also, there is a notable volume of articles published in UK from the nuclear sector, such as *World Nuclear News* (75). Results also showed the presence of internationally recognised newspapers such as the German *Die Welt* (133).

5.2. Topic analysis of news articles in the UK & North Ireland

The second analysis phase on topic modelling helps identify the topics emerging from the news published in the UK & Northern Ireland (1600 articles). The LDA model applied using the Gensim Python library with a metric of $\lambda = 1$ relevance, and five topics (Fig. 6) in the news stories: "energy crisis" (T-N1), "European Union" (T-N2), "Russia-Ukraine war" (T-N3), "energy policy" (T-N4) and "Putin government" (T-N5). While Fig. 6 shows the relative distribution of the topics, the text below describes each topic; the main words, and the number of articles fitting each topic.

Topic (T-N1) "energy crisis" includes articles linking the Russia-Ukraine conflict and its impact on energy supply in different countries. It also involves countries and governments responses to the crisis and implemented energy-saving measures. Keywords include Russia,

1- Energy Crisis	2- European Union	3- Russia - Ukraine War	4- Energy Policy	5- Putin Government
The Guardian (London)	Financial Times (London)	Independent (UK)	World Nuclear News	World Nuclear News
Financial Times (London)	Independent (UK)	Daily Telegraph (London)	Independent (UK)	The Times (London)
Independent (UK)	Mail Online	Herald Scotland	The Guardian (London)	Independent (UK)
Mail Online	The Guardian (London)	Mail Online	Herald Scotland	The Guardian (London)
The Times (London	The Times (London)	The Guardian (London)	The Times (London)	Aberdeen Press
Daily Telegraph (London)	Daily Telegraph (London)	Financial Times (London)	Scotsman	The National (Scotland)
World Nuclear News	The Sunday Times (London)	Scotsman	Financial Times (London)	Daily Telegraph (London)
The Sunday Times (London)	i-Independent Print	The Times (London)	The Sunday Times (London)	Financial Times (London)
Daily Mail (London)	World Nuclear News	The National (Scotland)	The National (Scotland)	Edinburgh Evening News

Fig. 13. Outlets with more news for each of the topics.

block, energy, nuclear, plant, published, updated, Ukraine, war, US, UK, president, government, minister, Putin, country, Kyiv, military (Fig. 7).

Topic (T-N2) "European Union" news refer to the impact of the Russian-Ukraine conflict on the European economy and its dependence on Russian gas supply. Some terms are Ukraine, energy, would, Russian, block, nuclear, Russia, gas, power, Putin, government, also, Ukrainian, country, UK, people (Fig. 8).

Topic (T-N3) "Russia-Ukraine" reports on the latest political and military activity not from all nations involved, keywords include time, Ukraine, Russia, Russian, energy, war, power, people, Ukrainian, government, minister, US, UK, EU, Putin, one, year, last, time-updated, could (Fig. 9).

The "energy policy" (T-N4) discusses new technologies and energy sources such as nuclear energy and efforts to reduce greenhouse gas emissions, which could have significant implications for the energy industry and the global economy (Fig. 10).

The "Putin government" topic (T-N5) includes news about the sanctions to Russia in response to the Russia-Ukraine armed conflict. The relationship between Russia, Ukraine, and some of the world's major powers are also discussed (Fig. 11).

5.3. *Discussions on nuclear energy and sustainability in the UK & North Ireland*

To start answering to RQ3, the topics were assigned to the news articles, to identify patterns between the outlets and the topic preference. The coverage of the "energy crisis" (T-N1) appears prominently across the newspapers; still, Fig. 12 shows that the presence of discussion about the European Union (orange) or the Russian-Ukraine war (green) are consistently present in the newspapers (Fig. 5) throughout. Similarly to the discussions about Putin's government, that in lower amounts still appears regularly across newspapers.

Not all newspapers cover the news on sustainable nuclear energy in the same way: exploring the newspapers priorities in relation to the amount of news per topic Fig. 13 shows that "energy crisis" is clearly present in The Guardian, The Financial Times, and The Independent;

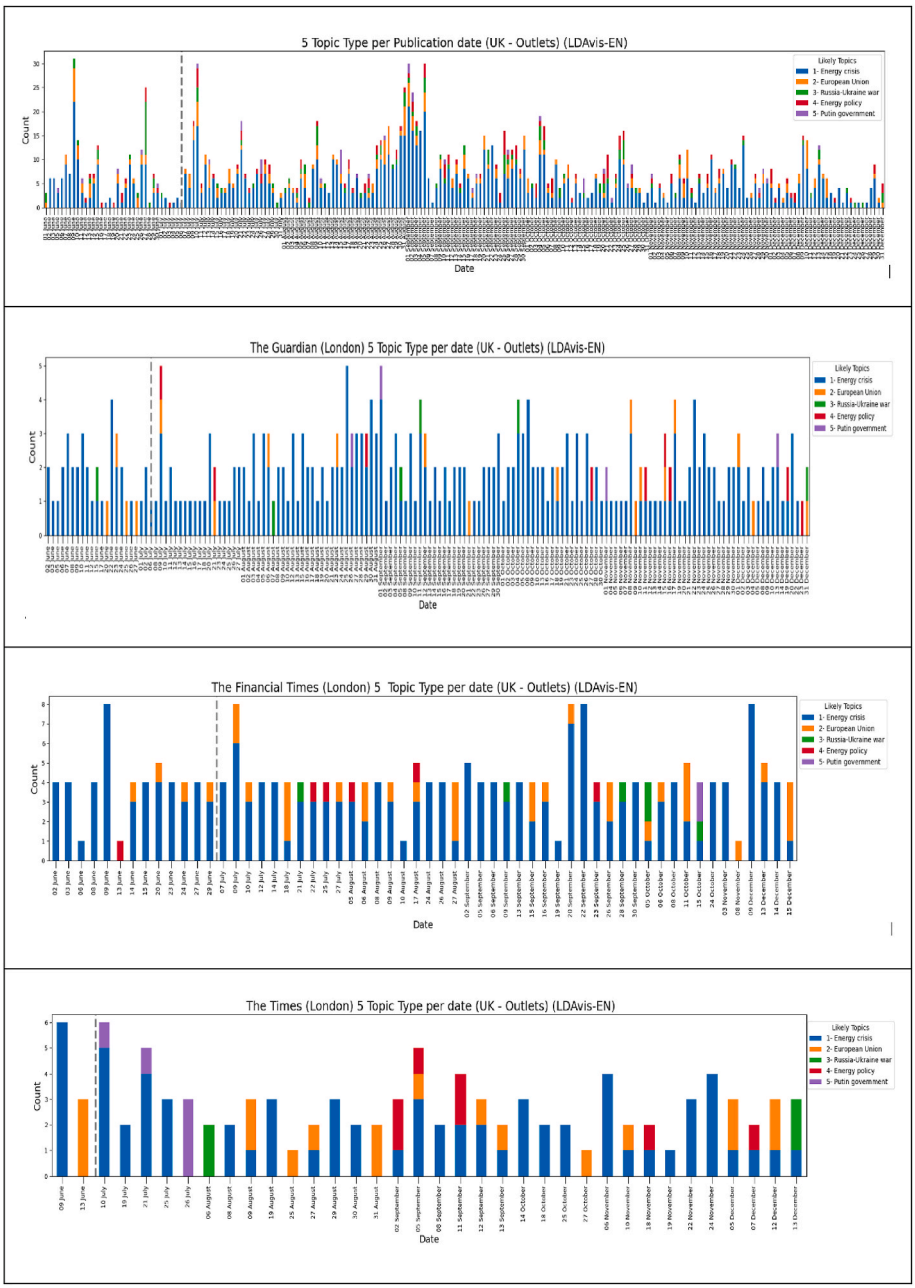


Fig. 14. Top. Stories per topic between June and December 2022. Below. three charts show the news published per topic in The Guardian, The Financial Times and The Times in the same period.

while “energy policy” (TN-4) is clearly owned by the specialised publication "World Nuclear News". These differences suggest that a deeper analysis might help track how these differences in news coverage and newspapers priorities align with political or editorial leanings.

The next step is to identify the timeline of the different topics across all newspapers (Fig. 14). The examples below (Fig. 14) show in three figures The Guardian, The Financial Times, and The Times show some differences worth considering. In principle, the prominence of news on the energy crisis is clear throughout the three timelines; but there is a difference in the other topics emerging.

For instance, by mid-June, the Financial Times published a piece about Japan and its effort for sustainable energy (Annex A.1. Nw36); this was classified as energy policy (in red); while The Times published a piece on French candidate Melenchon talking about ending French reliance on nuclear power (Annex A.1. Nw43) which was identified as European Union (in orange). The Guardian published a series of articles (second half of June): on the 15th about the Russia-Ukraine war (Annex A.1. Nw37); on the 20th on the French elections (Annex A.1. Nw38); and on the 23rd on California nuclear plant (Annex A.1. Nw39); and on the 25th another story about Iran and US resuming talks (Annex A.1. Nw40); on the 27th on the UK Glastonbury Festival (Annex A.1. Nw41) the news in this series are all classified as European Union (in orange).

Still, none of these detailed analyses show a change between before and after the Complementary Climate Delegated Act approval (on July 6th). Only The Financial Times published a piece on the July 7th (Annex A.1. Nw42); and The World Nuclear News published a specific piece on the approval of the on July 6th (Annex A.1. Nw44); Instead, between the 3rd and 10th of July, the Guardian did not publish a single piece on the topic; neither did The Times or The Independent.

6. Discussion

European Parliament's decision on sustainable investment as outlined in the Complementary Climate Delegated Act adopted the July 6, 2022 signifies an important change in the approach to nuclear energy, after a long history of criticism and dramatic accidents. The importance of such a turn in the regulatory framing of one of the world's referential environmental policy and energy consumption led to believe that it would impact across the media with ripples extending all over the world.

Media has historically played a central role in shaping public perception and understanding of nuclear energy: they have not always been supportive of nuclear energy (Bisconti, 2018; Bizzozero et al., 2004; Cantone et al., 2007; Zeh and Odén, 2014); but the Complementary Climate Delegated Act holds global interest as many countries re-evaluate their energy plans, and the media has the potential to shape public opinion by promoting sustainable nuclear energy as part of the agenda (Bisconti, 2018; Kristiansen, 2017; Tessenyi, 2021). Still this research shows that this was not the case. Instead, emerging pressing issues and the Ukraine-Russian war took most of the wind off the sails of this newsworthy event that happened rather isolated within the summer oasis.

This study collected the news carrying the words "Nuclear Energy," "Taxonomy," "EU Commission," and "green energy" over seven months (June–December 2022). That search produced 7822 stories. Even if the collection provided news from around 90 countries (RQ1), the lack of diversity of sources led to focus the analysis on the news published in the UK and North Ireland. News stories were classified using an unsupervised machine learning clustering model (LDA topic modelling) that provided five topics: Energy Crisis; European Union; Russia-Ukraine War; Energy Policy; Putin Government (RQ2). These five topics were also unevenly distributed across the different newspapers, and across the timeline (RQ3); but the European Parliament's decision on the Complementary Climate Delegated Act was not regarded as a primary topic on the agenda of many UK media outlets or in most countries.

There are many reasons that could help explain such a lack of global attention to this important change in the regulation of nuclear energy, and this is certainly an invitation for further research; but the hypothesis of the timing might be a key one: the perfect storm of the Russian invasion of Ukraine threatening the political stability in the East of Europe and its impact on the European energy prices, and the summer oasis of the news where politicians and journalists are on holidays, might have contributed to the lack of coverage of such an important event. Furthermore, the news production processes are less friendly to policy changes than they are to military conflict: war sells more than law. Still, these are all hypotheses that will require further research. Fact, for now, is that the analysis of this extensive coverage shows a clear prominence of the Ukraine-Russian war, and no variation in the provision of nuclear related stories mentioning energy or sustainability, before and after the approval, by the European Parliament, of the Complementary Climate Delegated Act.

Despite the undisturbed continuity in the news production dynamics, the exploration shows that there are some interesting take outs. Newspapers stories showed their insistence on Ukraine and conflict with very little space for energy policy and sustainability. This issue emerges just underneath the clear prominence of the topics that invite for further the research at least in two directions: first, building on the contents and consider incorporating other news databases and digital platforms to compare results and analyse time-trends. Understanding how different digital platforms, including social media, set their agenda and shape public opinion is crucial. Furthermore, delving into the discourses of stakeholders would help provide a deeper understanding of the controversies surrounding the topics to identify differences in the wording and connections with editorial lines, political interests or ideologies linked to them. The second direction the research opens for further research is methodological: to what extent a single round of LDA topic modelling approach might throw artefactual findings that require afterwards to be complemented with a deeper and more systematic interpretive analysis to align with (Atteneder and Rodriguez-Amat, 2024; Lindgren, 2020). This could advocate for a richer hybrid stance that dares growing a combination of computational science and deeper sociological theory.

CRediT authorship contribution statement

Ileana Zeler: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Joan Ramon Rodriguez-Amat:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Riasat Muhammad Amir:** Writing – review & editing, Writing – original draft, Visualization, Investigation, Formal analysis.

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.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.enpol.2025.114592.

Data availability

Data will be made available on request.

References

Aktar, M.A., Alam, M.M., Al-Amin, A.Q., 2021. Global economic crisis, energy use, CO2 emissions, and policy roadmap amid COVID-19. Sustain. Prod. Consum. 26 (April), 770–781. https://doi.org/10.1016/j.spc.2020.12.029.

Almaghlouth, S., 2022. Environmental sustainability in the online media discourses of Saudi Arabia: a corpus-based study of keyness, intertextuality, and interdiscursivity. PLoS One 17 (11 November), 1–18. https://doi.org/10.1371/journal.pone.0277253.

Altheide, D.L., 1997. The news media, the problem frame, and the production of fear. Sociol. Q. 38 (4), 647–668. https://doi.org/10.1111/j.1533-8525.1997.tb00758.x.

Anderson, A., 2015. Reflections on environmental communication and the challenges of a new research agenda. Environmental Communication 9 (3), 379–383. https://doi.org/10.1080/17524032.2015.1044063.

Apanovich, M., Barabanov, O., Cheremisin, P., Maslova, E., Reinhardt, R., Savorskaya, E., 2020. Climate policy in a global risk society (Issue December). https://valdaiclub.com/files/32499/.

Arslan, A., Haapanen, L., Hurmelinna-Laukkanen, P., Tarba, S.Y., Alon, I., 2021. Climate change, consumer lifestyles and legitimation strategies of sustainability-oriented firms. Eur. Manag. J. 39 (6), 720–730. https://doi.org/10.1016/j.emj.2021.03.005.

Atteneder, H., Rodriguez-Amat, J.R., 2024. Ideologies in Geospatial Futurism: a computational and critical discourse inquiry into the Arcgis and ESRI-blogs. Media Commun. 12. https://doi.org/10.17645/mac.8193.

Bandyopadhyay, A., Rej, S., 2021. Can nuclear energy fuel an environmentally sustainable economic growth? Revisiting the EKC hypothesis for India. Environ. Sci. Pollut. Control Ser. 28 (44), 63065–63086. https://doi.org/10.1007/s11356-021-15220-7.

Barbosa, G.S., Drach, P.R., Corbella, O.D., 2014. A conceptual review of the terms sustainable development and sustainability. Int. J. Soc. Sci. 3 (2), 1–15. http://www.iises.net/a-conceptual-review-of-the-terms-sustainable-development-and.html.

Barry, E., Greenhalgh, T., 2019. General practice in UK newspapers: an empirical analysis of over 400 articles. Br. J. Gen. Pract. 69 (679), E146–E153. https://doi.org/10.3399/bjgp19X700757.

Bauer, M.W., Gylstorff, S., Madsen, E.B., Mejlgaard, N., 2018. The Fukushima Accident and Public Perceptions About Nuclear Power Around the Globe–A Challenge & Response Model. Environ. Commun. 13 (4), 505–526. https://doi.org/10.1080/17524032.2018.1462225.

Ben Hassen, T., El Bilali, H., 2022. Impacts of the Russia-Ukraine war on global food security: towards more sustainable and resilient food systems? Foods 11 (15), 1–17. https://doi.org/10.3390/foods11152301.

Bian, Q., Han, Z., Veuthey, J., Ma, B., 2021. Risk perceptions of nuclear energy, climate change, and earthquake: how are they correlated and differentiated by ideologies? Climate Risk Management 32 (July 2020). https://doi.org/10.1016/j.crm.2021.100297.

Bisconti, A.S., 2018. Changing public attitudes toward nuclear energy. Prog. Nucl. Energy 102 (December), 103–113. https://doi.org/10.1016/j.pnucene.2017.07.002.

Bizzozero, I., Lucchelli, F., Prigione, A., Saetti, M.C., Spinnler, H., 2004. "What do you remember about Chernobyl?" A new test of memory for media-mediated events. Neurol. Sci. 25 (4), 205–215. https://doi.org/10.1007/s10072-004-0323-3.
Blei, D.M., 2012. Probabilistic topic models. Commun. ACM 55 (4), 77–84. https://doi.org/10.1145/2133806.2133826.
Boscarino, J.E., 2019. From Three Mile Island to Fukushima: the impact of analogy on attitudes toward nuclear power. Policy Sci. 52 (1), 21–42. https://doi.org/10.1007/s11077-018-9333-5.
Bowen, S., Min, Y., 2023. Analyzing ESG news articles and research papers through LDA (latent Dirichlet Allocation). Asia-Pacific Journal of Convergent Research Interchange 9 (8), 73–85. https://doi.org/10.47116/apjcri.2023.08.07.
Boyd, W., Beck, U., Shrader-Frechette, K.S., 1993. Risk society: towards a new modernity. Econ. Geogr. 69 (Issue 4). https://doi.org/10.2307/143601.
Boykoff, M., Goodman, M., Curtis, I., 2009. Cultural Politics of climate change: interactions in Everyday spaces. In: The Politics of Climate Change, vol. 11. https://doi.org/10.4324/9780203819234-14.
Briska, I., Rungule, R., 2010. Risk society in Latvia: Characteristics of environmental aspects. Eur. Integr. Stud. 4, 22–30.
Brühl, V., 2022. Green financial products in the EU — a critical review of the Status Quo. Intereconomics 57 (4), 252–259. https://doi.org/10.1007/s10272-022-1057-2.
Bulian, J., Schäfer, M.S., Amini, A., Lam, H., Ciaramita, M., Gaiarin, B., Huebscher, M.C., Buck, C., Mede, N., Leippold, M., Strauss, N., 2023. Assessing large language models on climate information. The Twelfth International Conference on Learning Representations, October. https://doi.org/10.48550/arXiv.2310.02932.
Cantone, M.C., Sturloni, G., Brunelli, G., 2007. Comment on "The role played by stakeholders in the public debate that brought Italy out of the club of nuclear energy producers.". Health Phys. 94 (5), 484–485. https://doi.org/10.1097/01.HP.0000308505.88168.f5.
Christoforidis, T., Katrakilidis, C., Karakotsios, A., Dimitriadis, D., 2021. The dynamic links between nuclear energy and sustainable economic growth. Do institutions matter? Prog. Nucl. Energy 139 (September 2020), 1–13. https://doi.org/10.1016/j.pnucene.2021.103866.
CNN, 2022. European Parliament says natural gas projects can be considered 'green' for investments. https://edition.cnn.com/2022/07/06/world/eu-votes-natural-gas-nuclear-green-sustainable-climate/index.html.
De Vreese, C., 2005. News framing: theory and typology. Inf. Des. J. 13, 51–62. https://doi.org/10.1075/idjdd.13.1.06vre, 1993.
Devitt, C., Brereton, F., Mooney, S., Conway, D., O'Neill, E., 2019. Nuclear frames in the Irish media: implications for conversations on nuclear power generation in the age of climate change. Prog. Nucl. Energy 110 (August 2017), 260–273. https://doi.org/10.1016/j.pnucene.2018.09.024.
Dillon Euctace, 2022. Publication of EU taxonomy climate complementary Delegated act in the Official journal : implications for funds (Issue July 2022). https://s3.amazonaws.com/a.storyblok.com/f/220868/8b38f7be0d/eu-taxonomy-climate-complementary-delegated-act-published-in-official-journal-july-2022.pdf.
DiMaggio, P., Nag, M., Blei, D., 2013. Exploiting affinities between topic modeling and the sociological perspective on culture: Application to newspaper coverage of U.S. government arts funding. Poetics 41 (6), 570–606. https://doi.org/10.1016/j.poetic.2013.08.004.
Du, Q., Han, Z., 2019. The framing of nuclear energy in Chinese media discourse: a comparison between national and local newspapers. J. Clean. Prod. 245, 1–10. https://doi.org/10.1016/j.jclepro.2019.118695.
Durdovic, M., Turcanu, C., Sala, R., Geysmans, R., López-Asensio, S., Gonçalves, L., 2024. The outlooks of nuclear energy in society: Unraveling public attitudes in the context of climate and energy security challenges. Prog. Nucl. Energy 174 (June). https://doi.org/10.1016/j.pnucene.2024.105286.
El-Emam, R.S., Ozcan, H., Zamfirescu, C., 2020. Updates on promising thermochemical cycles for clean hydrogen production using nuclear energy. J. Clean. Prod. 262, 121424. https://doi.org/10.1016/j.jclepro.2020.121424.
Entman, R.M., 1993. Framing: toward Clarification of a Fractured Paradigm. J. Commun. 43 (4), 51–58. https://doi.org/10.1111/j.1460-2466.1993.tb01304.x.
European Union, 2021. Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021 supplementing Regulation (EU) 2020/852 by establishing the technical screening criteria for climate change mitigation and adaptation. Official Journal European Union L 442, 1–349 (C/2021/2800). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R2139.
European Union, 2022. *Commission Delegated Regulation (EU) 2022/1214 of 9 March 2022 amending Delegated Regulation (EU) 2021/2139 as regards economic activities in certain energy sectors and Delegated Regulation (EU) 2021/2178 as regards specific public disclosures for those* economic activities. Official Journal of the European Union, Official Journal of the European Union, L 188, 1–45 (C/2022/631). http://data.europa.eu/eli/reg_del/2022/1214/oj.
European Parliament and the Council, 2020. Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 (Text with EEA relevance). Official Journal of the European Union 63 (2). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32020R085.
Filho, W.L., Voudouris, V., 2013. Energy security as a Subset of national security. Global Energy Policy and Security 8 (330), 11–25. https://doi.org/10.1007/978-1-4471-5286-6_2.
Fischer, D., 2016. Sustainability science. In: Sustainability Science. Springer, pp. 139–148. https://doi.org/10.1007/978-94-017-7242-6.
Gerrar, M.B., Gerrardt, M.B., 1994. The victims of NIMBY. Fordham Urban Law J. 21 (3), 495. https://ir.lawnet.fordham.edu/uljAvailableat. https://ir.lawnet.fordham.edu/ulj/vol21/iss3/4.
Ghazali, F., Ansari, A.H., Mustafa, M., Zulhafiz, W.M., 2020. Legal perspectives on nuclear energy and sustainable development in Malaysia. Journal of Nusantara Studies 5 (1), 169–188. https://doi.org/10.24200/jonus.vol5iss1pp169-188.
Goffman, E., 1974. *Frame analysis: An essay on the organization of experience*. Northeastern UP. https://psycnet.apa.org/record/1975-09476-000.
Grimmer, J., Roberts, M., Stewart, B., 2022. Text as Data: A New Framework for Machine Learning and the Social Sciences. Princeton University Press.
Gruen, R.L., Elliott, J.H., Nolan, M.L., Lawton, P.D., Parkhill, A., McLaren, C.J., Lavis, J. N., 2008. Sustainability science: an integrated approach for health-programme planning. Lancet 372 (9649), 1579–1589. https://doi.org/10.1016/S0140-6736(08)61659-1.
Guan, Y., Yan, J., Shan, Y., Zhou, Y., Hang, Y., Li, R., Liu, Y., Liu, B., Nie, Q., Bruckner, B., Feng, K., Hubacek, K., 2023. Burden of the global energy price crisis on households. Nat. Energy. https://doi.org/10.1038/s41560-023-01209-8.
Guo, L., Vargo, C.J., Pan, Z., Ding, W., Ishwar, P., 2016. Big social data Analytics in journalism and mass communication. Journal. Mass Commun. Q. 93 (2), 332–359. https://doi.org/10.1177/1077699016639231.
Harney, P.L., 1991. Newspaper coverage of anti-nuclear protests: 1979 vs . 1986 [San Jose State University]. https://doi.org/10.31979/etd.7qq9-f3ke.
Hassan, S.T., Danish, Salah-Ud-Din, khan, Awais Baloch, M., Tarar, Z.H., 2020. Is nuclear energy a better alternative for mitigating CO2 emissions in BRICS countries? An empirical analysis. Nucl. Eng. Technol. 52 (12), 2969–2974. https://doi.org/10.1016/j.net.2020.05.016.
Hellman, M.E., 2011. How risky is nuclear optimism? Bull. At. Sci. 67 (2), 47–56. https://doi.org/10.1177/0096340211399873.
Ho, S.S., Kristiansen, S., 2019. Environmental debates over nuclear energy: media, communication, and the public. Environmental Communication 13 (4), 431–439. https://doi.org/10.1080/17524032.2019.1603018.
Ho, S.S., Leong, A.D., Looi, J., Chuah, A.S.F., 2019. Online, offline, or word-of-mouth? Complementary media usage patterns and credibility perceptions of nuclear energy information in Southeast Asia. Energy Res. Social Sci. 48 (April 2018), 46–56. https://doi.org/10.1016/j.erss.2018.09.012.
Homar, R., Cverlbar, L., 2021. The effects of framing on environmental decisions: a systematic literature review. Ecol. Econ. 183 (January). https://doi.org/10.1016/j.ecolecon.2021.106950.
Huang, L., He, R., Yang, Q., Chen, J., Zhou, Y., Hammitt, J.K., Lu, X., Bi, J., Liu, Y., 2018. The changing risk perception towards nuclear power in China after the Fukushima nuclear accident in Japan. Energy Policy 120 (May), 294–301. https://doi.org/10.1016/j.enpol.2018.05.007.
IEA, 2018. World energy Outlook 2018. https://doi.org/10.1787/weo-2018-2-en.
IEA, 2023. Global Energy Crisis. International Energy Agency. https://www.iea.org/topics/global-energy-crisis.
Jacobi, C., Van Atteveldt, W., Welbers, K., 2016. Quantitative analysis of large amounts of journalistic texts using topic modelling. Digital Journalism 4 (1), 89–106. https://doi.org/10.1080/21670811.2015.1093271.
Jarvis, D.S.L., 2007. Risk, globalisation and the state: a critical appraisal of Ulrich Beck and the world risk society thesis. Glob. Soc. 21 (1), 23–46. https://doi.org/10.1080/13600820601116468.
Jenkins, K., McCauley, D., Heffron, R., Stephan, H., Rehner, R., 2016. Energy justice: a conceptual review. Energy Res. Social Sci. 11, 174–182. https://doi.org/10.1016/j.erss.2015.10.004.
Ji, X., Chen, X., Mirza, N., Umar, M., 2021. Sustainable energy goals and investment premium: Evidence from renewable and conventional equity mutual funds in the Euro zone. Resour. Policy 74, 1–9. https://doi.org/10.1016/j.resourpol.2021.102387.
Kabu, E., 2016. Risk society and sustainability of business practices in Indonesia. IMPACT: International Journal of Research in Business Management 4 (4), 101–108. https://oaji.net/articles/2016/490-1465203894.pdf.
Kanwal, S., Mehran, M.T., Hassan, M., Anwar, M., Naqvi, S.R., Khoja, A.H., 2022. An integrated future approach for the energy security of Pakistan: Replacement of fossil fuels with syngas for better environment and socio-economic development. Renew. Sustain. Energy Rev. 156. https://doi.org/10.1016/j.rser.2021.111978.
Khatib, H., 2012. IEA world energy Outlook 2011 — a comment. https://doi.org/10.1016/j.enpol.2012.06.007.
Kim, Y., Kim, M., Kim, W., 2013. Effect of the Fukushima nuclear disaster on global public acceptance of nuclear energy. Energy Policy 61, 822–828. https://doi.org/10.1016/j.enpol.2013.06.107.
Kong, N., Salzmann, O., Steger, U., Ionescu-Somers, A., 2002. Moving business/industry towards sustainable consumption: the role of NGOs. Eur. Manag. J. 20 (2), 109–127. https://doi.org/10.1016/S0263-2373(02)00022-1.
Kristiansen, S., 2017. Characteristics of the mass media's coverage of nuclear energy and its risk: a literature review. Sociology Compass 11 (7), 1–10. https://doi.org/10.1111/soc4.12490.
Lexis-Nexis. *All products*. Nexis Uni®. Retrieved. https://internationalsales.lexisnexis.com/products/nexis-uni#cfform. (Accessed 15 May 2023).
Linden, V. Der, Jade, J., 2022. Environmental Sustainable Project Portfolio Management Master Thesis Environmental Sustainable Project Portfolio Management. Eindhoven University of Technology. https://pure.tue.nl/ws/portalfiles/portal/208713608/Master_Thesis_Jade_van_der_Linden.pdf.
Lindgren, S., 2020. Data Theory: Interpretive Sociology and Computational Methods. Polity.
Liu, X., Liu, Z., 2022. Exploring the impact of media discourse on social perceptions towards biomass energy utilization in China. Energy Strategy Rev. 42 (May), 1–10. https://doi.org/10.1016/j.esr.2022.100896.

Lucarelli, C., Mazzoli, C., Rancan, M., Severini, S., 2020. Classification of sustainable activities: EU taxonomy and scientific literature. Sustainability 12 (16). https://doi.org/10.3390/su12166460.
Madrid-Morales, D., Rodríguez-Amat, J., Lindner, P., 2023. A Computational Mapping of Online News Deserts on African News Websites. Media Commun. 11 (3), 330–342. https://doi.org/10.17645/mac.v11i3.6857.
Matsui, K., Ujita, H., Tashimo, M., 2008. Role of nuclear energy in environment, economy and energy issues of the 21st century green House gas emission Constraint effects. Prog. Nucl. Energy 50 (2–6), 97–102. https://doi.org/10.1016/j.pnucene.2007.10.010.
McCollum, D.L., Zhou, W., Bertram, C., De Boer, H.S., Bosetti, V., Busch, S., Després, J., Drouet, L., Emmerling, J., Fay, M., Fricko, O., Fujimori, S., Gidden, M., Harmsen, M., Huppmann, D., Iyer, G., Krey, V., Kriegler, E., Nicolas, C., et al., 2018. Energy investment needs for fulfilling the Paris agreement and achieving the sustainable development goals. Nat. Energy 3 (7), 589–599. https://doi.org/10.1038/s41560-018-0179-z.
McCombs, M.E., Shaw, D.L., Weaver, D.H., 2017. New directions in agenda-setting theory and research. In: Advances in Foundational Mass Communication Theories, first ed. Routledge, pp. 131–152.
McDonagh, P., 1998. Towards a theory of Sustainable Communication in Risk Society: Relating issues of sustainability to marketing communications. J. Market. Manag. 14 (6), 591–622. https://doi.org/10.1362/026725798784867699.
McQuail, D., Deuze, M., 2020. McQuail's Media and Mass Communication Theory, seventh ed. SAGE Publications Ltd.
Mercado-Sáez, M.T., Marco-Crespo, E., Álvarez-Villa, À., 2019. Exploring news frames, sources and editorial lines on newspaper coverage of nuclear energy in Spain. Environmental Communication 13 (4), 546–559. https://doi.org/10.1080/17524032.2018.1435558.
Muhammad Amir, R., Zeler, I., 2024a. Discourses on the sustainability of nuclear energy: a semi-systematic literature review of scientific production. Discover Sustainability 5, 503. https://doi.org/10.1007/s43621-024-00596-6.
Muhammad-Amir, R., Zeler, I., 2024b. Nuclear Energy as a Sustainable Source? Examining Media Discourses Surrounding the EU-Complementary Delegated Act. Commun. Soc. 37 (4), 179–195. https://doi.org/10.15581/003.37.4.179-195.
Mulderrig, J., Montessori, N.M., Farrelly, M., 2019. Introducing critical policy discourse analysis. Critical Policy Discourse Analysis 1–22. https://doi.org/10.4337/9781788974967.00006.
Nelson, T.E., Oxley, Z.M., Clawson, R.A., 1997. Toward a Psychology of framing effects. Thomas E. Nelson, Zoe M. Oxley, Rosalee A. Clawson 19 (3), 221–246. https://www.jstor.org/stable/586517?origin=JSTOR-pdf.
Oliveira, E., Rodriguez-Amat, J.R., Ruiz-Mora, I., Zeler, I., 2023. The Fluid and Disruptive shape of activism: strategic communication in #fridaysforfuture. Int. J. Strat. Commun. 17 (4), 301–324. https://doi.org/10.1080/1553118X.2023.2204299.
Perko, T., Thijssen, P., Turcanu, C., Van Gorp, B., 2014. Insights into the reception and acceptance of risk messages: nuclear emergency communication. J. Risk Res. 17 (9), 1207–1232. https://doi.org/10.1080/13669877.2013.875933.
Prati, G., Zani, B., 2013. The effect of the Fukushima nuclear accident on risk perception, antinuclear behavioral intentions, attitude, trust, environmental beliefs, and values. Environ. Behav. 45 (6), 782–798.
Renn, O., 2008. Risk Governance Coping with Uncertainty in a Complex World, first ed. Routledge. https://doi.org/10.4324/9781849772440.
Rochyadi-Reetz, M., Arlt, D., Wolling, J., Bräuer, M., 2019. Explaining the media's framing of renewable Energies: an international comparison. Front. Environ. Sci. 7 (August), 1–12. https://doi.org/10.3389/fenvs.2019.00119.
Romeiro, A.R., 2012. Sustainable development: an ecological economics perspective AdemAr ribeiro romeiro. Estud. Avançados 26 (74), 65–92. https://doi.org/10.1590/S0103-40142012000100006.
Roper, J., 2012. Environmental risk, sustainability discourses, and public relations. Public Relat. Inq. 1 (1), 69–87. https://doi.org/10.1177/2046147x11422147.
Ruhnau, O., Stiewe, C., Muessel, J., Hirth, L., 2022. Gas demand in times of crisis. The response of German households and industry to the 2021/22 energy crisis 9. http://hdl.handle.net/10419/261082.
Sachs, J.D., 2012. From millennium development goals to sustainable development goals. In: The Lancet, vol. 379. Elsevier B.V, pp. 2206–2211. https://doi.org/10.1016/S0140-6736(12)60685-0, 9832.
Salas-Zapata, W.A., Ortiz-Muñoz, S.M., 2019. Analysis of meanings of the concept of sustainability. Sustain. Dev. 27 (1), 153–161. https://doi.org/10.1002/sd.1885.
Sen, A., 2011. Peace and Democratic Society Edited by Amartya Sen. Open Book Publishers. https://doi.org/10.11647/OBP.0014.
Sidorova, L., Ferguson, J., Vallikivi, L., 2017. Signs of Non-recognition: Colonized Linguistic Landscapes and Indigenous peoples in Chersky, Northeastern Siberia. In: Gail Fondahl, G.N.W. (Ed.), Northern Sustainabilities: Understanding and Addressing Change in the Circumpolar World, first ed. Springer, Cham, pp. 135–149. https://doi.org/10.1007/978-3-319-46150-2.
Singh, S., 2021. Energy crisis and global climate change. In: Singh, P., Singh, S., Kumar, G., Baweja, P. (Eds.), Energy: Crises, Challenges and Solutions. Wiley-Blackwell. https://doi.org/10.51461/pb.75.14.
Slovic, P., 2000. Perception of risk. https://doi.org/10.1017/CBO9781316422250.040.
Spinaci, S., 2022. EU Taxonomy: Delegated Acts on Climate, and Nuclear and Gas. https://www.europarl.europa.eu/thinktank/en/home.
Spindler, E.A., 2013. The history of sustainability the Origins and effects of a popular concept. In: Jenkins, I., Schröder, R. (Eds.), Sustainability in Tourism: A Multidisciplinary Approach, first ed., vol. 2. Springer, Fachmedien Wiesbaden, pp. 9–31. https://doi.org/10.1007/978-3-8349-7043-5.
Stål, A., Ali, D.H., 2022. Do different industries define sustainability differently ? A comparative analysis of the Swedish Retail and it sectors [University of Gävle]. https://www.diva-portal.org/smash/get/diva2:1673525/FULLTEXT01.pdf.
Svälas, M., 2023. The EU taxonomy Gold standard or Institutionalised greenwashing? March. http://www.duo.uio.no/.
Tank, A., 2022. Economic impact of Russia -Ukraine war. International Journal of Innovative Research in Science, Engineering and Technology 11 (4), 3345–3350. https://doi.org/10.15680/IJIRSET.2022.1104025.
Tessenyi, E., 2021. The Changing Attitudes around Nuclear Energy in Japan: a comparative case study (Issue September) [Imperial College London]. https://doi.org/10.25560/94681.
Tollefson, J., 2022. What the war in Ukraine MEANS for energy, climate and food. Nature 604, 232–233. https://doi.org/10.1038/244187a0.
UN, 2022. The Sustainable Development Goals Report 2022. United Nations publication issued by the Department of Economic and Social Affairs. https://unstats.un.org/sdgs/report/2022/%0A. https://www.un-ilibrary.org/content/books/9789210018098%0A. https://www.un-ilibrary.org/content/books/9789210478878.
UNCTAD, 2022. Global impact of war in Ukraine : energy crisis. In: UN Global Crisis Response Group on Food, Energy and Finance. Issue 3. https://unctad.org/publication/global-impact-war-ukraine-energy-crisis.
Van Atteveldt, W., Trilling, D., Calderón, C.A., 2022. Computational Analysis of Communication. Wiley Blackwell. https://cssbook.net/.
Vaughan, A., 2022. The first global energy crisis. New Scientist 253 (3379), 18–21. https://doi.org/10.1016/s0262-4079(22)00513-9.
Verbytska, A., 2024. Topic modelling as a method for framing analysis of news coverage of the Russia-Ukraine war in 2022–2023. Lang. Commun. 99, 174–193. https://doi.org/10.1016/j.langcom.2024.10.004.
Vossen, M., 2020. Nuclear energy in the context of climate change: a frame analysis of the Dutch Print media. Journal. Stud. 21 (10), 1439–1458. https://doi.org/10.1080/1461670X.2020.1760730.
Ylä-Anttila, T., Eranti, V., Kukkonen, A., 2022. Topic modeling for frame analysis: a study of media debates on climate change in India and USA. Global Media Commun. 18 (1), 91–112. https://doi.org/10.1177/17427665211023984.
Yue, X., Peng, M.Y.P., Anser, M.K., Nassani, A.A., Haffar, M., Zaman, K., 2022. The role of carbon taxes, clean fuels, and renewable energy in promoting sustainable development: how green is nuclear energy? Renew. Energy 193 (June), 167–178. https://doi.org/10.1016/j.renene.2022.05.017.
Zakari, A., Khan, I., Tan, D., Alvarado, R., Dagar, V., 2022. Energy efficiency and sustainable development goals (SDGs). Energy 239, 1–11. https://doi.org/10.1016/j.energy.2021.122365.
Zeh, R., Odén, T., 2014. Energieträger in der Berichterstattung: die Nachwehen von Fukushima in Schweden und Deutschland. In: Wolling, J., Arlt, D. (Eds.), Fukushima und die Folgen. Medienberichterstattung, Öffentliche Meinung und Politische Konsequenzen. Univ.-Verl. Ilmenau, pp. 211–232. https://nbn-resolving.org/urn:nbn:de:0168-ssoar-49415-7.