

YouTube debates on nuclear energy as ‘green’: mapping actors, interactions, and arguments

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Abstract. This study investigates how the European Commission’s decision to classify nuclear energy as ‘green’ is represented and discussed on YouTube. It aims to identify the actors involved, examine their interactions and positions, and explore the key themes and arguments they use. The study employed a combination of content analysis to classify the actors and their positions, network analysis to identify their interactions, and thematic and discourse analysis to explore the themes and arguments presented on 92 YouTube videos. Findings reveal seven main actors and three secondary actors. Certain secondary actors have strong connections to the main ones, while others do not. Professionals, organisations, and news media were the most active actors. The actors expressed a range of positions (positive, negative, and neutral) toward nuclear energy, leading to a variety of interactions based on these perspectives. The discourse across the videos was dominated by nine major themes. Positive arguments focused on the advantages of nuclear power and shortcomings of alternatives, whereas negative arguments promoted renewables and emphasised the risks of nuclear energy. Neutral positions acknowledged both benefits and drawbacks. This study calls for stronger collaboration between journalists, scientists, and academic institutions to create credible and constructive narratives that accurately reflect the complexities of nuclear energy and its role in the energy transition.

Keywords. Sustainability, nuclear energy, green energy, EU taxonomy, YouTube.

^{ES} Debates en YouTube sobre la energía nuclear como ‘verde’: mapeo de actores, interacciones y argumentos

Resumen. Este estudio investiga cómo la decisión de la Comisión Europea de clasificar la energía nuclear como ‘verde’ es representada y discutida en YouTube. El objetivo es identificar a los actores implicados, examinar sus interacciones y posiciones, y explorar los temas y argumentos clave que utilizan. El estudio empleó una combinación de análisis de contenido para clasificar a los actores y sus posiciones, análisis de redes para identificar sus interacciones, y análisis temático y del discurso para explorar los temas y argumentos presentados en 92 vídeos de YouTube. Los resultados revelan que hay siete actores principales y tres secundarios. Algunos actores secundarios tienen fuertes conexiones con los principales, mientras que otros no. Los profesionales, las organizaciones y los medios de comunicación fueron los actores más activos. Los actores expresaron una variedad de posiciones (positivas, negativas y neutrales) hacia la energía nuclear, lo que dio lugar a una variedad de interacciones basadas en estas perspectivas. El discurso en los vídeos estuvo dominado por nueve temas principales. Los argumentos positivos se centraron en las ventajas de la energía nuclear y las deficiencias de las alternativas, mientras que los argumentos negativos promovieron las energías renovables y enfatizaron los riesgos de la energía nuclear. Las posiciones neutrales reconocieron tanto los beneficios como los inconvenientes. Este estudio llama a una mayor colaboración entre los periodistas, científicos e instituciones académicas para crear narrativas creíbles y constructivas que reflejen de manera precisa las complejidades de la energía nuclear y su papel en la transición energética.

Palabras clave. Cortometrajes narrativos palestinos, estudiantes de periodismo, educación mediática, identidad cultural, percepción cinematográfica.

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1. Introduction

Energy is a critical determinant in the development of any nation and is central to the sustainable development agenda for 2030, as highlighted by the International Energy Agency (IEA, 2018). Achieving sustainable development necessitates reliable, clean, and affordable energy (Ho & Kristiansen, 2019). However, recent events, such as the COVID-19 pandemic and the Russian invasion of Ukraine, have raised energy security concerns, driving up fuel costs and household bills globally (Aktar *et al.*, 2021; Ben Hassen & El Bilali, 2022). The crisis challenges the EU's commitment to a sustainable, low-carbon future raises doubts about sustainable development and transitions across EU member states (Sasmoko *et al.*, 2023).

To overcome the crisis, in July 2022, the European Commission classified nuclear energy as 'green,' allowing it to receive investment funding and advance the EU's energy transition (European Commission, 2022a). This approach ensures that member states diversify their energy sources, aligning with the objectives of the 2030 climate and energy framework. The EU decision has produced mixed reactions among different actors because in the existing literature the concept of sustainability and sustainable development is somehow polarised (Muhammad Amir & Zeler, 2024b). Although nuclear energy generates a low impact on the environment (Paraschiv & Mohamad, 2020), concerns persist regarding the safety of nuclear plants, public health, and societal acceptance of nuclear energy (Smolinski *et al.*, 2024).

In this context, social media platforms play a crucial role in shaping public opinion, particularly YouTube, that significantly influences public opinion through audiovisual content (Al-Marouf *et al.*, 2021). This social network is a top platform for sharing videos and engaging in live discussions (Giertz *et al.*, 2022). Its wide accessibility empowers individuals, organisations and institutions to engage in important conversations, including those on nuclear energy and environmental sustainability (Zimmermann *et al.*, 2022). Consequently, YouTube content creators are becoming increasingly influential in shaping discussions about political and cultural issues (Lewis, 2020), including energy policy.

While YouTube's accessibility makes it a relevant platform for discussions on nuclear energy and sustainability, some research has primarily focused on renewable energy research by using platforms like Twitter/X (e.g., Mastroeni *et al.*, 2023; Sconfienza & Durand, 2023; Vyas *et al.*, 2023), leaving an insight in understanding how content creators on YouTube contribute to these discussions. Although previous studies have addressed similar topics within the context of news media (Zeler *et al.*, 2025). Hence, debates surrounding nuclear energy and sustainability on YouTube remain underexplored.

This research aims to identify the key actors featured in 92 YouTube videos discussing the European Commission's designation of nuclear energy as 'green', analyse their positions and interactions, and explore the most prominent themes and arguments they use to convey their viewpoint. By examining these dynamics, this study provides insights

into how YouTube content creators contribute to the debates of sustainability policies, amplifying certain voices and steering discourse in different directions. These insights are crucial for guiding energy policies that are more attuned to public perception and emerging debates on digital platforms.

2. Theoretical background

2.1. Sustainability and nuclear energy: a polarised debate

Sustainability is broadly defined as the ability to maintain or endure over time, specifically describing something 'bearable' and 'capable of being continued at a certain level' over time (Gruen *et al.*, 2008, p.1579). In this context, the energy sector has been identified as a key area, given that energy production and consumption are directly linked to greenhouse gas emissions and other environmental impacts (Wang & Azam, 2024).

Nuclear energy is a controversial topic in sustainability debates, with different scholars, policymakers, and industries holding varying interpretations and priorities. Nuclear energy has been stigmatised for decades due to its military origins and the negative effects of radiation (Baron & Herzog, 2020). This perception has been further exacerbated by major global nuclear accidents, its association with nuclear weapons, and how it is portrayed in popular culture (US Dept of Energy, 2020). Nonetheless, several studies emphasised the substantial contribution that nuclear energy can make towards sustainability transitions, which has led to divided public opinion on the issue (Ho & Kristiansen, 2019).

In a more recent study involving 27 European countries, perceived benefit accounted for the greatest variation in nuclear energy acceptance, followed by perceived risk and trust among citizens in individual level (Wang & Kim, 2018). Acceptance is contextually influenced by several factors, including the proportion of energy derived from nuclear sources, environmental concerns, and ideological positions.

The political debate on sustainable nuclear energy remains mixed. While some politicians advocated for phasing out nuclear energy due to safety concerns, particularly after incidents such as Chernobyl or Fukushima (Bizzozero *et al.*, 2004; Hartwig & Tkach-Kawasaki, 2020), others argued that nuclear power is a low-carbon and safe energy source, comparable to wind and hydropower (Sánchez Nicolás, 2022).

Among scientific experts, opinions also vary. Diaz-Maurin & Kovacic (2015) argued that assessing the sustainability of nuclear fission is challenging, especially due to issues surrounding long-term waste management and uranium depletion. On the other hand, Duffey (2005) emphasised that nuclear energy produces zero greenhouse gas emissions, highlighting its potential to foster a sustainable, safe, and secure energy future. Scholars like Adamantiades and Kessides (2009) took a more balanced approach, recognising the benefits of nuclear energy in reducing greenhouse gas emissions while also acknowledging 'significant issues' such as safety, waste disposal, and the risk of nuclear proliferation, which contribute to the scepticism

among the public and decision-makers. Conversely, Verbruggen (2008) rejected nuclear power as a sustainable resource, viewing it a rival to renewable energy source. However, more recent literature noted the potential of nuclear energy to contribute to the achievement of sustainable development goals (Lizikova, 2020).

2.2. Sustainability policies in the EU context: focus on nuclear energy

The EU's sustainability policies aim for climate neutrality by 2050, promoting renewable energy and reducing emissions through the European Green Deal (Eckert & Kovalevska, 2021). Russia's invasion of Ukraine has triggered an energy crisis by causing a surge in oil and gas prices (Yagi & Managi, 2023). The dependence on Russian supplies prompted the European countries and other nations to seek energy diversification and reduce reliance on Russian of these imports (Tollefson, 2022). Against this backdrop, REPowerEU Plan launched in 2022 aims to accelerate the EU's transition to clean energy, reducing dependence on Russian fossil fuels and enhancing energy security (Dinu, 2023). This situation has also underscored the importance of endeavours to fulfil the obligations of the Paris Agreement while tackling pressing issues (UNCTAD, 2022). In light of these growing demands for reliable, sustainable energy solutions, nuclear energy emerged as a low-carbon energy source.

Approximately half of the EU members stated that they rely on nuclear energy, considering it a clean, affordable, and efficient energy source (El-Emam *et al.*, 2020; Ghazali *et al.*, 2020). However, the EU is divided on the role of nuclear energy in the future energy mix. While some member states, such as France, advocated for nuclear power as an essential tool in meeting the EU's ambitious climate targets, including carbon neutrality by 2050 (IEA, 2021), others argued for a stronger focus on renewable energy and energy efficiency. Countries like Germany, which experienced heightened anti-nuclear sentiment following the Fukushima disaster in 2011, have committed to phasing out nuclear energy altogether (Hartwig & Tkach-Kawasaki, 2020).

Recently, politicians in several countries, such as Austria, Denmark, Germany, Luxembourg and Spain, expressed disapproval of including nuclear power in the EU's green finance scheme (Elsner, 2024). Debates over classifying nuclear energy as 'sustainable' under the EU taxonomy have sparked strong opposition, highlighting a polarised discussion.

2.3. The role of YouTube in shaping energy and sustainability discourse

Social media plays a key role in shaping public debates on sustainability policies, acting as arenas of discursive confrontation where meanings and legitimacies are negotiated (Lovari & Valentini, 2020). Among these digital platforms, YouTube presents a paradigmatic example due to its multimodal (video) and algorithmic nature, which amplifies both its educational potential and the risks of polarisation. The research suggested the double-edged role of YouTube, showing how it can both inform and misinform the users about complex scientific matters

as the nuclear energy (Vraga & Bode, 2018), where emotional and sensationalist content frequently competes in visibility with more rigorous analysis (Cui & Chu, 2021), creating a discursive ecosystem where authority and truthfulness are constantly disputed. Expert-led channels can enhance social awareness and contribute to informed policy decisions (Looi, 2019).

This ecosystem is populated by diverse content creators—including environmental activists and critics of sustainability—, whose interactions and argumentative strategies shape public understanding. Most of the actors disseminating information on YouTube focus on the risks of nuclear energy, citing Fukushima and Chernobyl, along with concerns about radioactive waste and high infrastructure costs (Cui & Chu, 2021). On the contrary, nuclear energy advocates argue it is essential for addressing climate change due to its efficiency and low carbon emissions (Looi, 2019). This contrasting narratives between risk and solutions, as well as fear and technological urgency, establish the core of the debate on the digital platform.

The influence of these actors can be increased by their credibility and the expertise they convey, which is a critic feature of YouTube that makes it equally accessible for different sources. Studies demonstrated that experts or individuals perceived as knowledgeable on technical subjects can significantly influence users attitudes on science and technology-related issues, including nuclear energy (Koswatta *et al.*, 2022). Nevertheless, YouTube's open-access nature allows content from less credible sources or those presenting biased viewpoints to gain wide attention, further contributing to polarised and fragmented users perceptions (Munger & Phillips, 2022). Therefore, the spread of misinformation—such as the amplification of risks—and the efforts of scientific dissemination are interconnected critical aspects of the broader matter of narrative legitimacy.

This dynamic positions YouTube as a critical discursive landscape for the public redefinition of nuclear energy. The social media platform is not a mere location where viewpoints are found, but also a relational space where the visibility, perceived authority and argumentative frames interact and compete, giving rise to a complex and often contradictory landscape for public perception.

2.4. The case: the European Commission's declaration on nuclear energy as 'green'

The adoption of the Complementary Climate Delegated Act (EU-CDA) on July 6, 2022, which declared nuclear energy investments as 'green' (European Commission, 2022b), marks a significant development in the discourse surrounding sustainable energy within the European context. This reclassification is key for assessing its year-long impact on YouTube. Nuclear energy, initially excluded from the EU-CDA, was later granted transitional status after a safety review (European Commission, 2022b). This reclassification has catalysed extensive debates regarding safety, environmental impact, and proliferation risks associated with nuclear energy.

Historically, nuclear energy has led to debates about safety, health, and societal concerns (Hamer *et al.*, 2021). Issues such as the contribution of radioactive emissions and nuclear waste to pollution, as well as the potential link between proximity to nuclear plants and increased cancer risks (Russo *et al.*, 2022), add complexity to the public discourse and complicate the global landscape (Miller, 2017). Nevertheless, experts suggest that nuclear energy can be a viable and safe option for electricity generation with proper safety measures (World Nuclear Association, 2022).

3. Objectives and methodology

This study maps the key actors in 92 YouTube videos on the EU's decision to classify nuclear energy as 'green', outlines their stances and interactions, and identifies the main themes they promote. It shows how actors shape sustainability debates and public opinion, offering insights to better align energy policy with online discourse. In light of this case (2.4), the following research questions (RQ) are developed to address the general objective of this study:

RQ1: Who are the actors participating in the debate regarding the European Commission's classification of nuclear energy as 'green' on YouTube videos?

RQ2: What interactions emerge between main and secondary actors?

RQ3: What are the actors' positions regarding the European Commission's classification of nuclear energy as 'green' on YouTube?

RQ4: What themes and arguments do the actors present that reflect their respective positions on nuclear energy as 'green' on YouTube videos?

3.1. Data collection

To gather the sample videos for this study, the YouTube Data Tools application was employed. The application enables researchers to automate the data scraping process through the YouTube API, based on given criteria (Omena & Currie, 2022). This suite comprises a straightforward tool designed for extracting data from the YouTube platform via the YouTube API v3 (Sui *et al.*, 2022). The YouTube Data Tools encompass six distinct data collection modules: channel info, channel list, channel network, video list, video network, and video comments (Jurg, 2024).

The video selection process began with the video list module, which generated a compilation of video information and statistics from one of four sources: videos uploaded to a specified channel, videos within a playlist, videos retrieved via a particular search query, or videos specified by a list of IDs. In this study, four sets of keyword lists were employed for the search queries. The following keyword groups yielded the corresponding number of search results:

Search query 1: Nuclear energy, sustainability, green, Europe, Taxonomy = 490 results

Search query 2: EU parliament, taxonomy, nuclear energy, green label, debate = 111 results

Search query 3: Nuclear Energy Europe EU Taxonomy European Commission = 491 results

It is noteworthy that during the searches, specific customisations were applied to publication date and the number of iterations, allowing for a maximum of 10 iterations per query. This restriction resulted in a maximum of 500 results from each search. It indicates that some crucial videos may be out of reach. Consequently, it is essential to acknowledge that some potentially significant videos might have been excluded, and these limitations should be considered when interpreting the findings. To mitigate this limitation, a manual review of the top results was conducted to ensure the sample's relevance and diversity, helping control for potential biases in the selection process.

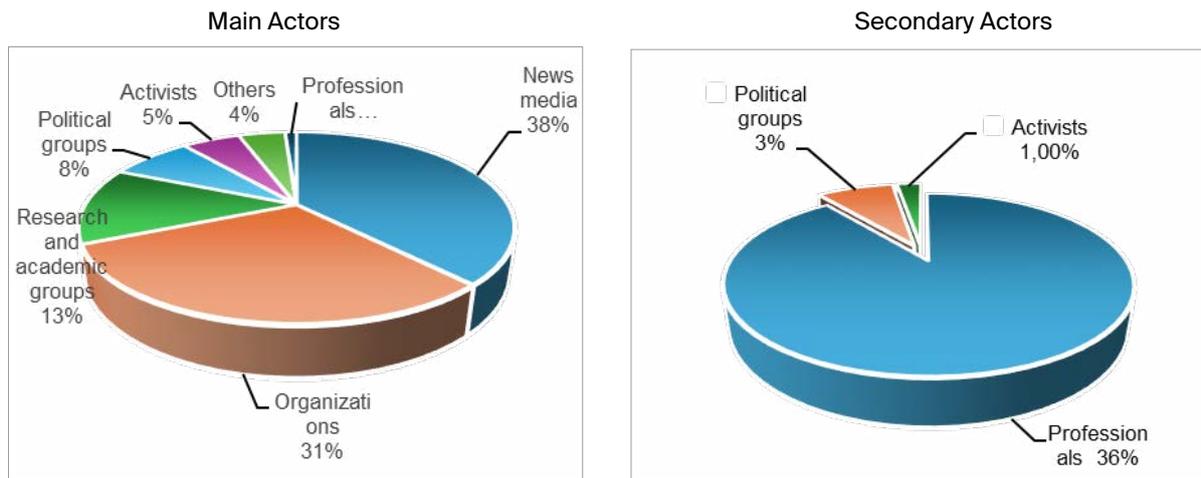
The videos were subsequently sorted based on their relevance to the respective search query. The combined results of Search Queries 1, 2, and 3 yielded a total of 1,092 videos. However, 408 were identified as duplicates, leading for a refined count of 684 valid results. The critical next step involved sample finalisation, focusing on aligning video titles with the main event. Ultimately, 92 sample videos were selected for the analysis (Figure 1). The final selection of the samples was conducted manually, based on the titles of videos relevant to the main event. This allows for a more personalised and context-aware approach.

The publication timeframe for these videos was established from February 1 to December 31, 2022. This period was chosen because the draft of the EU-CDA was made public in February 2022 (European Commission, 2022a). The selected timeframe ensures that the collected videos capture the initial reactions and ongoing discussions surrounding the act. Videos published before February 2022 were excluded because they do not reflect the immediate public response to the draft's release, while those after December 2022 were also omitted to maintain a focused analysis. This approach provides a clearer understanding of how the subject evolved in the months following the announcement, ensuring the sample is relevant and directly connected to the draft's impact on public discourse. The search for videos was conducted on September 19, 2024.

3.2. Data analysis

This study employed a mixed-methods approach that combined content analysis, network analysis and discourse analysis. Content analysis, a method for examining text and visuals to identify patterns and underlying meanings (Krippendorff, 2019), was used to classify actors and their positions. Network analysis was applied to explore the connection between primary and secondary actors, drawing on actor-network theory, a socio-anthropology approach to technology pioneered by Latour (1992) and Callon (1986). Discourse analysis, a method for examining language, communication, and social context within text, speech, or multimedia content, was also employed to uncover the underlying power dynamics, ideologies, and cultural narratives embedded in communication (Davies & Elder, 2008). This technique allowed a deeper examination of the main themes and arguments presented by actors, reflecting their respective positions.

Figure 1. Portion of main and secondary groups of actors in YouTube videos.



Source: authors.

4. Results

The results are presented in based to the RQs developed.

4.1. Identification of actors

Regarding the RQ1, the study identified seven main groups of actors: news media, organisations, research and academic groups, political groups, activists, professionals, and others. In addition, three of these groups of actors also act as secondary actors: professionals, political groups and activists.

As shown in Figure 1, the main actors responsible for setting the predominant framework for discussion regarding the European Commission’s declaration that classifies nuclear energy as ‘green’ on YouTube include news media, organisations, and academic and research groups, who together account for 82% of the content disseminated. Among these actors, news media published the highest number of videos, totalling 35 (38%). This category includes news channels, newspapers, independent journalists, news agencies, and radio stations, with Euronews, a television news channel, producing the most videos (4%). Organisations including governmental and regulatory bodies, non-governmental organisations (NGOs), think tanks, policy institutions, investor organisations, youth and community groups, and other non-profit organisations also contributed significantly, with 28 videos (31%). Notably, both the Bellona Foundation and Europe Calling, as NGOs, each produced 4% of videos, the highest number among organisations. Furthermore, research and academic groups, which encompass research and training centres, higher educational institutions, and individual researchers and academics, published 12 videos (13%), surpassing political groups composed of political parties and politicians, which contributed five videos (5%), social, environmental and political activists with 5 videos, and professionals –such as engineers, scientists, lawyers, economists– with only one video.

The study further identified professionals, political groups, and activists as secondary actors in the videos (Figure 1). Most news media and organisations invited these secondary actors to participate in discussions on the topic. A diverse array of

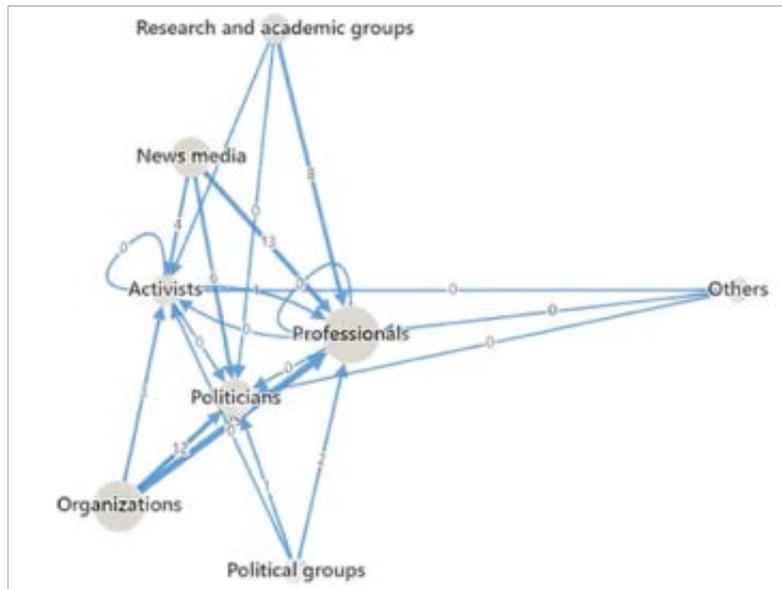
professionals contributed to the videos, totalling 33 (36%), including professionals in legal and governance, corporate, energy and environmental issues, financial and investment specialists, sustainable development advisers, and economists. Political groups such as politicians and political parties were identified in 3 videos, and activist groups, mainly composed of environmental activists, were identified in one video. Additionally, several videos showcased collaborations among multiple secondary actors; for instance, professionals and political groups worked together in six of the ten videos featuring both. DiEM25 emerged as the most active channel representing this collaboration. In five videos, all three types of secondary actors’ professionals, political groups, and activists participated, with these videos primarily disseminated by news media outlets such as Sky news and *The New York Times* (see examples in Appendix ID-VD1 and VD17). Out of the total of 92 videos, 42.4% exhibited a lack of participation from secondary actors.

4.2. Interactions between main and secondary actors

In terms of interactions between actors (RQ2), findings showed that main actors –such as news media, organisations, and research and academic groups– mainly established connections with professionals and politicians, who acted as secondary actors (Figure 2). The most significant interactions were observed between organisations and professionals (25), followed by notable connections between news media and professionals (13). In both cases, professionals were quite active in contributing to discussions in which they participated, particularly in panel discussions and interviews where they were more frequently invited. Professionals also showed significant interactions with research and academic groups (8).

Other notable connections include those between organisations and politicians (12) and between news media and politicians (6). By contrast, activists demonstrated a significant low level of interactions. This limited engagement was generated between activists with news media (4) and organisations (3), revealing the peripheral role of activists in the core exchanges that shape the debate on the issue.

Figure 2. Network between main and secondary actors.



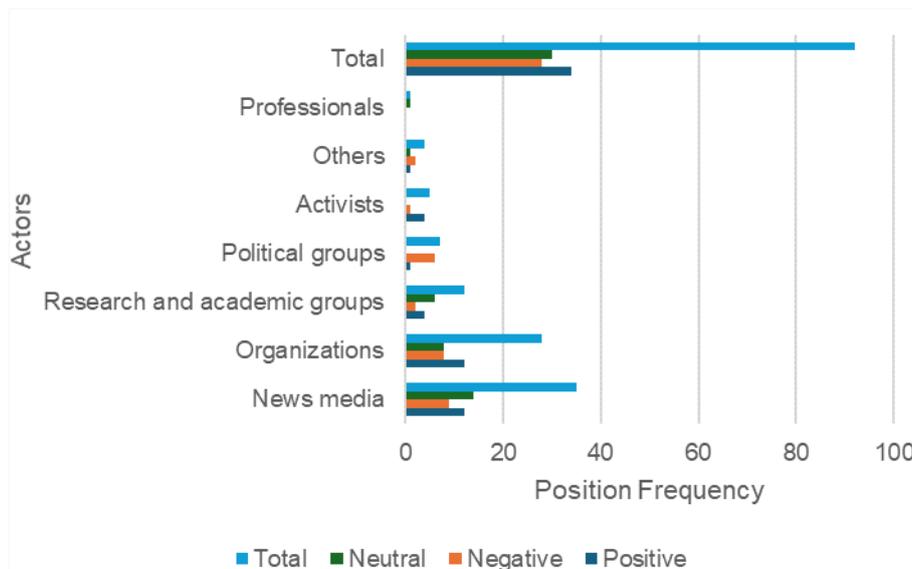
Source: authors.

4.3. Actors' positions

The analysis of the actors' positions (RQ3) revealed three stances among the actors involved in the

debate: support (positive), opposition (negative) and neutral (balanced) stance (Figure 3).

Figure 3: Position of main actors.



Source: authors.

Positive Position: Research and academic groups supported nuclear energy for its scientific potential in achieving decarbonisation goals. Many professionals highlighted its reliability and low-carbon benefits, while regulatory organisations emphasised long-term climate targets and energy security. News media in general portrayed nuclear energy positively, showcasing its role in a sustainable energy mix.

Negative Position: Political groups and activists expressed concerns about environmental risks and safety issues related to nuclear power. Some NGOs and a minority of professionals opposed it due to fears about nuclear waste management and potential accidents.

Neutral Position: Some news media and organisations took a neutral position during discussions on nuclear energy, which aims to present balanced views. Many professionals reflected caution, recognising both the benefits and risks associated with nuclear power.

It is important to note that different groups of actors showed varied positions depending on the context. For instance, in some videos, certain organisations expressed positive views (see Appendix ID-VD60), while in others, different organisations held negative or neutral stances (Appendix ID-VD72). As a result, there is no definitive assumption that any specific type of actor consistently maintained a particular position. Instead, the overall assumption

reflects the majority stance observed across the various cases involving each group of actors.

4.4. Themes and arguments by different actors' positions

The analysis of themes and arguments presented by actors (RQ4) reflected their respective positions on nuclear energy as 'green' on YouTube videos. The analysis showed nine specific topics predominantly addressed by key actors: decarbonization, energy security, greenwashing, high reliability of nuclear, low-cost electricity, reliability of solar and wind as source of energy, safety, sustainable taxonomy, and waste management.

4.4.1. Supporting position

Under the supporting position, narratives were drawn from a diverse range of actors, highlighting the positive aspects of nuclear energy.

Decarbonisation: In a video titled "SPECIAL REPORT: Going Nuclear—The Clean Energy Debate" (Appendix ID-VD1), the main actor, "Sky News Australia", acknowledged nuclear as a clean energy source by the following statement:

Nuclear is no longer a dirty word. Increasingly, European nations are embracing it as an emissions-free option, and here in Australia, the question now is whether we are faced with soaring electricity prices and supply problems. Why not seriously think about going nuclear well? (0:11')

The argument remarked the crucial role of nuclear power for reducing carbon emissions and combating climate change. Nuclear power plants offer a cleaner alternative to fossil fuels by not producing carbon emissions during electricity generation. This means they can provide a large-scale, reliable energy source without contributing to the greenhouse gas emissions that drive global warming.

Low-cost electricity: As can be seen in video titled "Nuclear Power and Secure Energy Transitions" (Appendix ID-VD15), the main actor IEA spokesperson, Faith Bairol, presented a study in which nuclear power was identified as a cost-effective solution. He said,

Lifetime extension of existing nuclear power plants emerged as a key option to reduce emissions, and it also proved to be a cost-effective option. So, it was more of an appeal to especially advanced economies where the several nuclear power plants came to a critical age. (2:10')

This argument is a strong support for the claim that nuclear energy offers low-cost electricity and enhances energy security by providing stable operational costs.

Energy security: The video titled "Is nuclear energy a threat for the Kremlin policy?" (Appendix ID-VD76), the main actor New direction', a representant of political group funded by European Parliament said:

Nuclear technology is becoming more efficient, especially with advancements in small

modular reactors (SMRs). These compact and mobile reactors have the potential to fill gaps in our energy grid and improve overall energy distribution. (3:30')

The argument acknowledges the importance of nuclear energy to ensure energy security.

High reliability of nuclear energy: Regarding this topic, *The Economist*, a British news media, claimed the following statement about the reliability of nuclear energy in a video titled "Nuclear power: the clean, green energy dream?":

If you look at the British grid, it has got lots and lots of wind on it, and it has got gas, and its got nuclear, and the supply lines from winds are crazy, they go up and down and up and down all the time, but the supply line from nuclear is just like a calm, serene flat line in comparison. (Appendix ID_VD2; 1:05')

This argument supports nuclear reliability, making it a cornerstone of stable and continuous electricity generation. Unlike weather-dependent renewable sources like wind and solar, nuclear power plants operate consistently, ensuring a steady electricity supply.

Reliability of solar and wind: "Planet Proof", an environmental activist group, showed concerns in a video titled "Why Nuclear Energy Can Save The World" (Appendix ID-VD22). According to the activist group,

Solar only generates energy when it is sunny, and wind only generates energy when it is windy, even though battery technology is rapidly improving. Some energy experts doubt whether we can cheaply and effectively create a completely reliable energy grid using only variable renewable sources. (8:13')

This argument agrees that solar and wind energy can be unreliable due to their dependence on weather conditions. Their output fluctuates, making it challenging to rely solely on these sources without adequate storage solutions or backup systems.

Waste management: In this regard, NewsNation, a US news media, showed their concern in a video titled "Nuclear energy the way to combat climate change?" by saying: "Nuclear power? say no; it's far too dangerous. There are better alternatives available" (Appendix ID-VD16, 0:29'). But a secondary actor, the professor and environmental activist Dr. Michael Shellenberger, opposed this claim. He said:

From an environmentalist's perspective, the ideal approach is to store the waste at the site of production, minimizing the need to transport it elsewhere. This method ensures that the waste is managed in a contained and controlled environment, aligning with sustainable energy practices. (2:52')

The argument supports the idea that nuclear waste management is a manageable problem. Advances in technology and engineering have provided effective solutions for safely handling and storing nuclear waste (Subba Rao *et al.*, 2021). Ongoing research into waste recycling and reduction techniques continues to improve safety and efficiency.

Safety: In the video titled “Why Greenpeace Co-Founder Left to Pursue Nuclear Energy” (Appendix ID-VD7), NewsNation, as a main actor, articulated concerns regarding the future of energy policy in the United States, stating:

The European Union is turning to nuclear energy as a green solution in its quest for sustainability. While nuclear power contributes nearly 19% of electricity generation in the U.S., fossil fuels still dominate at around 60%. Advocates are pushing for nuclear energy as a key solution to America’s energy challenges. (0:34’)

The argument supports the idea that nuclear technology advancements and strict safety protocols have significantly lowered the likelihood of incidents. Lessons from past incidents led to more stringent regulations and ongoing safety improvements.

Sustainable taxonomy and greenwashing: In the video titled “EU taxonomy: Delegated acts on climate, and nuclear and gas” (Appendix ID-VD18), the European Parliamentary Research Service, the in-house research department and think tank of the European Parliament, shared their supports on the transition of nuclear energy in the sustainable taxonomy in their policy podcast by saying: “new classification system to guide public and private investments towards sustainable economic activities and innovative technologies that will help Europe move towards a carbon neutral economy by 2050”. (0:39’)

The argument supports the idea that by establishing clear criteria, sustainable taxonomy helps prevent greenwashing the misleading representation of activities as eco-friendly and provides a reliable guide for investors, companies, and policymakers.

4.4.2. Opposing position

Under the opposing position, narratives are drawn from different actors, emphasising traits that represent the negative aspects of nuclear energy.

Safety: DIEM25, a political group, always opposed nuclear energy and they invited secondary actors to talk about the negative side of this energy source. For instance, in a video titled “Basav Sen: Stop greenwashing gas/nuclear and get behind a transition to renewable energy” (Appendix ID-VD89), the Climate Policy Director at the Institute for Policy Studies in the United States, Basav Sen, stated: “Nuclear energy is another dirty, dangerous, false solution. The production and processing of uranium is extremely toxic”. (0:32’)

His argument supported the idea that nuclear energy has several disadvantages, including hazardous radioactive waste, high initial costs, catastrophic accidents, environmental impact of uranium mining, risks of nuclear proliferation, challenges of decommissioning old plants, thermal pollution, and limited fuel supply, making it less favourable compared to other renewable sources.

Reliability of solar and wind as source of energy: The news website *Prospector News* invited Scott Melbye –President of the Uranium Producers of America and Executive Vice President of Uranium Energy Corp– to share his views on the reliability of solar and wind energy compared to nuclear power. As the main actor and host, *Prospector News*

maintained a neutral position by asking “What government is actually thinking as far as energy policy going forward now?” (1:18’), in a video titled “The Green Revolution will be Powered by Nuclear Energy” (Appendix ID-VD66), As a secondary actor in his response, Melbye stated:

The viability of these plants (nuclear) has improved dramatically over the decades [...] it’s hard to improve on what has already been a safe industry. If we look at the sober facts of injuries or deaths from nuclear energy compared to all other forms of energy, we’re comparable to wind and solar, and perhaps the safest industry over the last 50 years given all the trillions of megawatts produced over that time. (6:35’)

This argument indeed supports the reliability of solar and wind as source of energy over nuclear.

Greenwashing: Many activists identified the inclusion of nuclear in EU taxonomy is greenwashing. The Left in the European Parliament activist group clarifies their position in a video titled “Taxonomy? STOP THE GREENWASHING!”. According to them,

Gas and nuclear power should not be classified as green energy in the context of the climate crisis. This mislabelling constitutes greenwashing and undermines efforts to achieve the Paris Agreement’s goals. Accepting this classification will direct more funding to these energy sources, which is misguided, especially in light of the war in Ukraine. Both fossil fuels and nuclear energy increase our dependence on undemocratic countries, harming the environment. (7:02’)

This argument clearly indicated labelling nuclear as “green” is nothing but greenwashing.

Low-cost electricity: INRAG is an NGO that invited journalists to talk about the EU’s e-taxonomy regulation in a video titled “Meet the Press: The experts view on key nuclear issues”. (VD72). As a main actor, INRAG held a neutral position by organising the discussion. As a secondary actor, one of the journalists –Paul Dorfma– opposed the concept of low-cost electricity generated by nuclear energy. He said:

Nuclear energy is simply too slow and expensive. What we have here are questions of sustainability—can it deliver on its promises? The real issue is whether nuclear energy can be sustainable in the context of climate concerns. The truth is that nuclear power is inflexible and costly; it cannot easily adjust to the fluctuations in demand. (45:39’)

This argument denies nuclear’s ability to produce low-cost electricity, which is aligned with previous research findings.

Sustainable taxonomy: *The New York Times*, a leading news US based newspaper, invited Sandrine Dixson-Declève Co-President, Club of Rome, and Luisa Neubauer, climate justice activist and author, to participate in a discussion on the Europe’s energy transition. As a main actor, *The New York Times* held a neutral position by moderating the event in a video titled “Europe’s Energy Transition: What does This

Look Like Amid Russia's War in Ukraine'? (Appendix ID-VD17). As a secondary actor, Sandrine opposed the concept of new EU taxonomy where nuclear is included. She said:

The sustainable finance platform and its taxonomy were designed to evaluate what qualifies as green and what is considered brown. We clearly indicated that, from both an environmental standpoint and a greenhouse gas emissions perspective, we cannot permit gas to be included. Additionally, for political reasons, we cannot allow nuclear energy to be classified as green either. (17:04')

This argument clearly opposes the idea of including gas and nuclear energy in EU taxonomy.

Waste management: Tobias Pauley, a climate activist shows his concern about nuclear waste management in a debate organised by IAEA who is the main actor and supports nuclear energy. The title of the video is "Youth Debate: Nuclear Energy Climate Friend or Foe"? (Appendix ID-VD12). According to him,

How can we declare nuclear waste as something dangerous for the future, so that people can recognise it? One idea is to use a recognisable image, like "The Scream", to convey the danger associated with nuclear waste. This approach aims to effectively communicate that nuclear waste poses a significant threat. (14:26)

The argument clearly expresses the danger of nuclear waste.

4.4.3. Neutral position

Under this position, narratives are drawn from voices from various actors. The discourses emphasise traits that represent the neutral aspects of nuclear energy.

Sustainable Taxonomy: In one of the video titled "The Taxonomy CDA misalignment with the path to net-zero and REPowerEU, and the CEE perspective" (Appendix ID-VD74), the main actor, news channel 247TV held a neutral position regarding the inclusion of nuclear in EU taxonomy. 247TV stated:

The European Union has approved rules labelling investments in gas and nuclear power plants as climate-friendly [...]. The European Parliament voted to classify investments in gas and nuclear energy as sustainable under the EU's green financing taxonomy. [...]. However, the decision has faced criticism from environmental groups and some EU lawmakers, who argue that it greenwashes fossil fuel and nuclear energy investments [...]. Supporters of the proposal argue that excluding gas and nuclear energy [...] would lead to higher energy prices and make the transition away from coal more difficult. (0:42)

The discussions highlight characteristics that depict both positive and negative aspects of nuclear energy sources in a balanced manner. Instead of taking a side, the actor portrays the overall scenario from a neutral standpoint.

Reliability of solar and wind as source of energy: Environmental activist Planet Proof argued that the reliability of wind and solar energy can be increased, making them viable alternatives to nuclear energy. In a video titled "Why Nuclear Energy Can Save The World" (Appendix ID-VD22), they said that "solar only generates energy when it's sunny and wind only generates energy when it's windy, but battery technology is rapidly improving that could solve the issue" (8:13). Although the actor shows his support towards nuclear energy throughout the video, at the same time the actor also supports the positive aspects of renewables from a neutral point of view.

5. Discussion and conclusions

The analysis identified seven main groups of actors and three secondary groups (RQ1). The findings reveal that while a few dominant actors—notably news media and NGOs—exert considerable control over the narrative, secondary actors provide valuable, albeit less prominent, alternative perspectives. Specifically, the dominant actors set the agenda by framing nuclear energy predominantly as a low-carbon solution, with comparatively limited emphasis on its associated risks. This aligns with theories of media framing (Entman, 1993) and agenda-setting (McCombs & Shaw, 1972), which argue that the media's selection and emphasis of issues influence public perception. Secondary actors, including activists and professionals (though contributing less content) introduce expertise and alternative viewpoints that add depth to the debate. These actors, who often possess specific policy knowledge or technical expertise, can challenge the narratives advanced by dominant groups and offer alternative, more critical perspectives. This supports earlier research suggesting that expert voices are crucial in shaping public engagement, yet their marginalisation may prevent a more nuanced discussion (Adamantiades & Kessides, 2009). The collaboration between main and secondary actors, as seen in this study, demonstrates the importance of integrating a diversity of viewpoints to foster a well-rounded conversation on energy policy.

Regarding the RQ2, the study suggested that main actors—such as news media, organisations, and research and academic groups—predominantly established connections with professionals and politicians, who acted as secondary actors. Within the network, professionals emerged as the most active and well-connected participants. This prominent role is closely linked to their frequent invitations to panel discussions and interviews, formats that structurally position them as key interlocutors and amplify their centrality within the discursive ecosystem (Von Soest, 2023).

The study also showed that discussions about nuclear energy mostly highlight its potential to reduce carbon emissions while often downplaying risks. This reflects a broader trend in policy debates, particularly on digital platforms, where complex issues are simplified into polarised viewpoints. In this regard, the findings identified three positions on nuclear energy (RQ3)—positive, negative, and neutral—contributing to a fragmented debate that sometimes overlooks critical issues like safety, waste disposal, and long-term sustainability (Kovacic, 2015).

Social media platforms intensify polarised framing by promoting certain narratives and marginalising others (Kreiss & McGregor, 2024). This dynamic was confirmed in this study where key actors focused on nine main themes in response to RQ4, illustrating how selective narratives shape public discourse. This effect of YouTube goes beyond just spreading content and has a real impact on public opinion and policy. According to Yin (2024), social media shapes public opinion and policy by often prioritising sensational content over substantive or nuanced discussion. This underscores the need for strategic content creation to communicate accurate information. The expertise of nuclear scientists, climate experts, and academic institutions is essential, as they provide evidence-based insights that counter misinformation and help the society critically assess nuclear energy's role in a sustainable future.

In conclusion, this study explores how different groups –notably news media, organisations, professionals, research and academic groups, politicians, and activists– shape the conversation about nuclear energy and its classification as 'green' source of energy on YouTube. It showed that when these actors work together, they can create more complete and meaningful discussions about any particular issue. The positions of these actors on nuclear energy are deeply polarized, reflecting varying interests and concerns.

By analysing discourses, the research highlights that even though nuclear energy comes with safety risks; it has important benefits such as reducing carbon emissions, providing reliable power, and supporting energy security. Because of this, the study argues for a balanced energy policy that includes a mix of energy sources, not just one solution. This kind of approach would help the world move toward a cleaner future in a way that is not only good for the environment but also stable for the economy and global politics. When we look at both the strengths and weaknesses of all energy options, we can make smarter, more balanced decisions.

However, the study presents several limitations. Firstly, since only the first 500 YouTube search results were included, some relevant videos might have been excluded. Secondly, the analysis relied primarily on video titles, which could have led to the

omission of valuable content that did not include specific keywords. Thirdly, the absence of formal reliability tests for the assignment of positions and topics to actors, which may have introduced inconsistencies in the categorisation of actors and the identification of their views on nuclear energy. Lastly, the study focused on a particular time frame, meaning that it may not fully capture earlier or more recent discussions on the topic.

For future research, it would be helpful to go beyond just the content and look at how people react to it by analysing viewer comments, likes, shares, and other engagement. This could show how these conversations shape public opinions and behaviours. It would also be useful to study other platforms like X (formerly Twitter), Facebook, or LinkedIn to see how they influence energy discussions. Looking at how the conversation changes over time especially after big global events could also give deeper insights. For example, future studies could look at how people talked about nuclear energy after the COP28 Agreement in 2023, which called for a global move away from fossil fuels.

Overall, the study makes a significant contribution to the field of responsible social media communication. By analysing how nuclear energy is portrayed on YouTube, it offers valuable guidance for developing balanced, accurate, and impactful communication strategies. The study underscores the importance of journalistic integrity in presenting complex issues, highlighting the need for careful, nuanced reporting. These insights are especially relevant for content creators, journalists, communicators, and policymakers who aim to encourage informed public discourse in an era increasingly influenced by misinformation and political polarisation. The research calls for stronger collaboration between media professionals, scientists, and academic institutions to create credible and constructive narratives that accurately reflect the complexities of nuclear energy and its role in the energy transition.

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7. Authors' contribution

Conceptualisation	Ideas: formulation or evolution of overarching research goals and aims.	Author 1
Data curation	Management activities to annotate (produce metadata), scrub data and maintain research data (including software code, where it is necessary for interpreting the data itself) for initial use and later re-use.	Authors 1 and 2
Formal analysis	Application of statistical, mathematical, computational, or other formal techniques to analyse or synthesise study data.	Authors 1 and 2
Funding acquisition	Acquisition of the financial support for the project leading to this publication.	Authors 1 and 2
Investigation	Conducting the research and investigation process, specifically performing the experiments, or data/evidence collection.	Authors 1 and 2
Methodology	Development or design of methodology; creation of models.	Authors 1 and 2
Project administration	Management and coordination responsibility for the research activity planning and execution.	Authors 1 and 2
Resources	Provision of study materials, reagents, materials, patients, laboratory samples, animals, instrumentation, computing resources, or other analysis tools.	Authors 1 and 2

Software	Programming, software development; designing computer programs; implementation of the computer code and supporting algorithms; testing of existing code components.	Authors 1 and 2
Supervision	Oversight and leadership responsibility for research activity planning and execution, including mentorship external to the core team.	Author 2
Validation	Verification, whether as a part of the activity or separate, of the overall replication/reproducibility of results/experiments and other research outputs.	Authors 1 and 2
Visualization	Preparation, creation and/or presentation of the published work, specifically visualisation/data presentation.	Authors 1 and 2
Writing / original draft	Preparation, creation and/or presentation of the published work, specifically writing the initial draft (including substantive translation).	Authors 1 and 2
Writing / review & editing	Preparation, creation and/or presentation of the published work by those from the original research group, specifically critical review, commentary or revision –including pre or post-publication stages.	Authors 1 and 2

8. Statement on the use of artificial intelligence

Artificial intelligence has not been used throughout the research.

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Appendix

https://docs.google.com/spreadsheets/d/17pY6Tv-yPhluXqg7Fsc-_hDXgbQiPxif6y8EZj3ObNI/edit?usp=sharing