

Article

Assessing Views towards Energy Sources with Social Media Data: The Case of Nuclear Energy in the UAE

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Abstract: Insights from the analysis of views towards energy sources are of paramount importance for the setting of successful energy policies, especially in instances where the public might be reluctant towards certain projects' implementations. This work presents an analysis of social media comments data given in response to posts around the connection to the grid of a nuclear plant reactor in the United Arab Emirates (UAE). We assessed comments on Facebook posts of local and international media, as well those written in response to a post of a social media influencer. We extracted the main themes and performed sentiment analysis. The results indicate the presence of mixed views towards nuclear energy when focusing on comments on international media's posts as well as on the social media influencer's post considered, whilst they were very positive when assessing comments to local media. All in all, nuclear waste and previous nuclear accidents appear to be as the top of the mind; at the same time, solar energy is often suggested in the comments as a viable energy source for the UAE. Implications for the communication of nuclear energy developments in social media are discussed.

Keywords: climate change; nuclear energy; renewable energy; social media



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1. Introduction

It is urgent and imperative to implement effective energy policies to curb climate change [1]. This appears of particular importance among countries in the Middle East due to already high average temperatures and elevated water scarcity risks [2]. Such policies can be defined as 'low carbon' as they share the goal of reducing emissions of CO₂. These include investments in nuclear energy, renewable energy, fuel efficiency regulations, and carbon taxes [3]. At the same time, it is key to obtain public support for low-carbon initiatives to ensure their rapid, sustainable, and successful uptake. In this regard, nuclear energy appears to be, usually, a rather contentious energy source. This is due to a number of risks: the possibility of accidents, the production and potential release of radioactive waste disposal, the risk of nuclear proliferation, uncertainties about construction time, expensive capital costs, geopolitical risks, and decommissioning challenges [4]. These might lead to radical opposition or skepticism towards its implementation, despite the presence, on the other hand, of the potential benefits of energy source diversification and lower emission of greenhouse gases (GHGs) as opposed to other energy sources, ultimately leading to greater social costs associated with nuclear energy [5].

Whilst traditionally views on nuclear energy and more energy sources were, and are, investigated by means of quantitative surveys, including stated preferences studies [6–8], environmental psychology surveys aimed at assessing the role of various constructs [9,10], and qualitative approaches, such as focus groups [11], there is a great availability of social media data. For instance, public comments on posts in Facebook, Instagram, or comments on videos on YouTube can provide an in-depth view of the public's opinion. Whilst this does not allow practitioners to directly investigate the determinants of views in a traditional fashion, it allows assessment of the sentiments and emerging topics. By analyzing

comments on particular posts, it is then possible to unveil more effective communication strategies. In turn, this contributes to more impactful energy policies.

In this study, we assess debates around nuclear energy focusing on the case of the United Arab Emirates, which recently announced, on the first week of August 2020, successful completion of the development of their first nuclear reactor [12]. We identified posts in Facebook that have received substantial attention in terms of views and comments. We characterized and described the salient features of the conversations around nuclear energy and provide recommendations in terms of communication. This appears an area where scant research has been conducted, especially with regards to the Middle East. Furthermore, this paper intends to present an approach to the investigation of views towards energy sources that can complement more traditional investigations, and can be extended to the analysis of views towards more energy sources for a holistic assessment of energy strategies.

2. Materials and Methods

2.1. The Posts Considered

We considered Facebook posts related to the UAE's nuclear plants announcement made from local and international media, as well as a social media influencer, as shown in Table 1.

Table 1. List of Facebook posts considered for analysis.

Link	Published Date	Type	Comments *	Likes *	Page	Influencer/Local/Intern.
https://www.facebook.com/watch/?v=234409694277575	3 August	Video post	12234	441 K	Nas Daily	Influencer
https://www.facebook.com/thenational.ae/posts/3251236508232562	1 August	Article post	132	3.4 K	The National	Local
https://www.facebook.com/GulfNews.UAE/posts/3469937436405823	2 August	Article post	83	2.4 K	Gulf News	Local
https://www.facebook.com/bbcnews/posts/10158039238937217	2 August	Article post	947	6.5 K	BBC news	International
https://www.facebook.com/cnninternational/posts/10158619263889641	1 August	Article post	181	1 K	CNN International	International

* At the time of data download (14 August 2020).

In order to select relevant posts, in August 2020, we searched, within Facebook, the following key words: “Nuclear Energy UAE” and “Nuclear plant UAE”. We focused on Facebook as it seems to currently still be the top social media platform used amongst the general population [13]. We also found a relevant post from the Facebook page of the Khaleej Times and ENEC (Emirates Nuclear Energy Corporation), but this was not included in the study due to a very limited number of comments.

It is important to note that out of the five posts considered, one contained a video, whereas the remaining four contained a link to an article. The video posted by Nas Daily, a social media influencer with 20 million followers on Facebook as of August 2021, is titled ‘World’s Cleanest Electricity’, clearly placing the emphasis on nuclear energy being clean in terms of atmospheric emissions. No other post in Facebook related to nuclear energy in the UAE, at that time, had generated a greater number of comments. The post was also accompanied by the following text:

I can't believe they let me film in a nuclear power plant!

But I'm so happy they did!

So I can finally show you (and see for myself) the work being done to get rid of oil.

It's hard to imagine 4 years ago, Nas Daily was just a Facebook page with no followers, and now here we are at nuclear power plant....in the middle of the desert. After my visit to Barakah Nuclear Power Plant and Noor Abu Dhabi solar plant, I'm a lot more excited for the future. I hope you are too!

PS: I'm aware a lot of people are scared of nuclear and are against it. I decided to go with my convictions and still make this video. At the end of the day, science doesn't lie and neither does the data—nuclear is very safe.

Besides the concept of a clean energy source, the text accompanying the post appears to highlight the relative safety of this energy source. The video indeed remarks on these points, presenting nuclear power in a rather positive fashion, as it is mentioned during the video that *'nuclear is 100% safe'*.

The post from The National is titled *'The Barakah nuclear power plant in Abu Dhabi reaches a major milestone with one of the reactors now switched on'*. It emphasizes that the UAE appears to be the first Arab country to produce nuclear energy. Moreover, it highlights that this is the outcome of a long-term vision. It also remarks on the pride in the achievement of this important milestone. The content of the Gulf News post is very similar, which leads to the article titled *'UAE becomes first Arab country to create nuclear energy with operations starting at Barakah plant'*. The page of the National on Facebook has over 800,000 likes, whereas the page of Gulf News stands at 3.3 million likes.

The post by BBC news, whose page has 53 million likes on Facebook, instead reads as follows: The oil-rich country has said it wants to adopt more sustainable energy sources, but Qatar has called the plant a "threat to regional peace". It hints to geopolitical tension around this move, citing Dr Paul Dorfman from the Nuclear Consulting Group to substantiate this point. This aspect is somewhat mirrored by the post of CNN as well, which mentions that '[...] some experts have questioned the need for the nuclear plant given the country's potential to develop solar energy and the tensions surrounding nuclear plant in the Middle East'. The page of CNN on Facebook has over 18.8 million likes.

2.2. Data Analysis

We exported the comments from the selected posts and analyzed them with the following software: Dataiku [14] and QDA Miner [15]. With the latter, we proceeded to analyze words and phrases in context, in order to extract main themes, in the correspondence of words, or combinations of words, stated most frequently by the users. In addition, we performed a cluster analysis of key phrases. With Dataiku, we instead performed sentiment analysis of comments. Our work combines qualitative and quantitative analysis. Whilst the comments we analyzed are public, we removed the names of the individuals who commented from the files that were used for analysis. The final sample size considered for analysis consisted of 6574 comments for the Nas daily post, 678 for the BBC post, 112 for the CNN post, 100 for the National post, and 70 for the Gulf news post.

2.2.1. Extraction of Common Themes

We firstly analyzed the comments extracted with the aim to look for statements underpinning certain views or opinions. This part of the analysis drew on discourse analysis [16]. Previous research has employed this technique to better understand social dynamics of energy views [17], to assess environmental values linked to wind energy [18], in the context of the water-energy-food nexus [19], etc., yet research in the area of views towards nuclear energy with a focus on the Middle East is scant. In this work, we refer to the term 'themes' rather than discourses as we did not aim to analyze the structure of the text accounting for linguistic and sociolinguistic contexts [20]. It is important to notice that we did not assess from where respondents were commenting or their socio-demographic characteristics.

In terms of analysis, we looked at words' frequencies, and sentences written around the most common words in the comments (function 'word in context' in QDA Miner). Furthermore, as far as the Nas Daily data is concerned, given the volume of comments obtained, we explored relationships between key words, applying hierarchical cluster analysis [21] and displaying results by means of proximity plots. Hierarchical cluster analysis was applied using the association strength as the agglomeration order, and single word clusters were removed.

2.2.2. Sentiment Analysis

The sentiment analysis applied to the comments provided a predicted sentiment associated with the comments, i.e., positive, negative, or neutral. In this work, we labelled positive comments as comments that clearly displayed a positive view towards nuclear energy in the UAE or agreement with the positive content about nuclear energy in the UAE, for instance *'Congratulations UAE for the achievement'*, *'Amazing'*, *'Proud to be a resident'*. Instead, we denoted negative comments as comments that clearly displayed a negative opinion towards nuclear energy in the UAE or disagreement with the content being posted in the case of Nas Daily, such as *'100% safe? Clean energy? Not sure'*, *'And what do we do with the nuclear waste? Where does it go?'*, *'Cleanest and safest energy is wind and solar'*. All other cases, including comments not strictly related to the post, were labelled as neutral. Sentiment analysis draws on natural language processing, which, in simple terms, can be reduced to a machine learning classification task [22]. Prior to running the analysis, we proceeded to clean the text by normalizing it, removing stopwords and applying stemming. When the text was normalized, characters were converted to the same case (i.e., all lower capital) and punctuation and special characters were dropped. With regards to stopwords, these are common words in the comments that do not actually bear important information for the success of the sentiment analysis, for instance, words, such as *'is'*, *'a'*, *'the'*. We also removed comments that only contained names, where someone else was being tagged to see the video, as well as comments identified as spam. The stemming procedure led to data reduction, reducing words to their stems. This, for instance, avoided the same words in singular and plural form being considered different. To attribute whether a comment was positive, negative, or neutral, we used the plug in *'sentiment analysis'* available from Dataiku [23,24], and subsequently revised the comments, adjusting for inappropriate classification. We reviewed the output of the sentiment analysis to ensure incorrect sentiment attribution was minimized, such as in cases of sarcasm by individuals hardly identifiable by the algorithm. Examples of sentiment analysis in the relevant literature can be found in [25], where sentiment analysis was applied to Twitter data to unveil views towards climate change and energy issues.

3. Results

This section first presents the results regarding the extraction of themes and then moves to the findings of the sentiment analysis. We present the results of the former analysis beginning with the focus on the comments given to the *'Nas daily'* post, then moving to the international media posts (CNN and BBC), and finally assessing the comments given to the local media posts (Gulf News and The National). We jointly analyzed the comments from CNN and BBC so as to represent themes emerging from comments on posts from international media. Finally, we jointly analyzed the comments on The National and the Gulf News posts, both belonging to local media.

3.1. Analysis Applied to *'Nas Daily'* Comments Data

From the analysis of the comments, it appears that a number of individuals disagreed with the rather positive presentation of nuclear energy given in the video. In some instances, it seems to have obtained emotional responses from individuals who, according to their views, remarked that nuclear is not clean nor it is the solution to climate change. The arguments against its cleanliness are that renewable energies are cleaner, that nuclear waste is produced, and the risk of accidents that stems from memories of past accidents, such as in Chernobyl and Fukushima. The first theme we highlight is *'Nuclear is not clean and it is not the solution'*, and we present related comments below.

Theme 1.1. Nuclear is not clean and it is not the solution

R236 This number and the following represent an anonymous individual identifier. Because it is the dirtiest energy on the planet! Do some research on the waste and radiation poisoning everything.

R922 *Even if technology improved over the years let's not forget Chernobyl. Yeah it can be cleaner than coal and oil but still wind, hydro and solar are cheaper to maintain and more safe and without much waste.*

R2505 *Safety and Nuclear Power Plant that is an Oxymoron, It is not safe for neither Humans Nor the Planet.*

R1775 *Focus your next video on exploring how safe Nuclear waste is. After that then maybe we can deliberate on the cleanliness of Nuclear energy.*

R4001 *There is no such thing as "100% SAFE NUCLEAR POWER PLANT".*

R5150 *Our safe energy future does not include or need nuclear fission or fusion.*

R5435 *Nuclear energy is pretty dirty, the uranium has to be concentrated several times to achieve the grade that is sufficient for harvesting enough energy from it.*

R6049 *What about nuclear wastes? They're highly radioactive and really bad for the environment.*

R6068 *And don't forget nuclear fuel that must be replaced, and nuclear waste is highly radioactive and must be buried in the ground.*

R5107 *What do they do with nuclear waste? In case of a nuclear accident will it be safe still?*

R4547 *Must definitely Nuclear is not clean and sustainable energy neither is it safe*

R533 *Are you sure Nuclear Power Plant is 100% safe? How do you explain what happened at Fukushima?*

R6198 *When you say safe nuclear power my first thinking is Chernobyl*

R172 *Actually hydroelectricity is much cleaner than nuclear.*

Other individuals agree nuclear is safe, yet they are not convinced it is clean. They also mention the production of nuclear waste as a counterargument against cleanliness. With regards to safety, they acknowledge that technology has been improving remarkably since the 1960s. Therefore, the second theme identified is that 'Nuclear is safe but not clean'. We report a few comments related to it below.

Theme 2.1. Nuclear is safe but not clean

R5595 *You are right that the nuclear power plant is safe. But what you didn't mention is where nuclear waste goes?*

R2087 *There are all sorts of new technologies and safer building designs. This isn't the 1960s. The number of people harmed by nuclear waste will be far fewer than those harmed by air pollution, water pollution, and ground pollution from fossil fuel consumption.*

R2673 *I agree nuclear energy is safer too. My only question to this is how is the nuclear waste managed? Nuclear energy is not inherently dirty as long as the waste is properly managed.*

R6123 *Sure nuclear energy is clean compared to fossil fuel powered plants. Instead of wasting uranium making bombs it should be used to generate electricity. If a better way could be found to dispose of the radioactive waste it would be a plus...*

R88 *0 people died in Fukushima due to radiation. And you had 4 times the worst possible nuclear accident—nuclear meltdown. Fukushima is like a proof of how safe nuclear energy is.*

R6239 *Seems it would be easy to do a simple search regarding the latest nuclear tech and how it can be made to be idiot proof and far safer than all other energy generation solutions*

Furthermore, a number of individuals compared nuclear energy to solar energy, pointing out the latter is clean and easily available in the UAE. The third theme identified is 'Solar is clean and easily available'.

Theme 3.1. Solar is clean and easily available

R13 *What's wrong with the solar power 365 days of sun Clean and clear?*

R51 *Germany proven in 2014 they made more power out of solar and wind turbines they couldn't store the energy!*

R135 *Solar panel can replace oil in place of electricity generation*

R172 *About solar, wind or hydro I'd say it may be clean but nuclear?*

R372 *And I thought solar panels were clean and sustainable energy source*

R139 *Nuclear is not clean, affordable or safe. Wind and solar are.*

Still focusing on solar energy, other individuals remarked that it may actually not be a very efficient and effective solution. Hence, we identified a fourth theme, as follows: 'Solar is not efficient nor effective yet'.

Theme 4.1. Solar is not efficient nor effective yet

R16 *Harnessing solar energy using solar panels is not efficient and effective, because solar panels needs a lot of space and you get only a small amount of energy using solar panel compare to oil and coal.*

R125 *Not feasible or reliable. Nuclear is so much better.*

R246 *The issue with wind and solar is simply a problem with the arithmetic. There simply isn't enough land or natural resources to power the planet at its current rate of growth with wind/solar/geothermal/hydro etc.*

R247 *solar and wind energy aren't enough for the country, that [is] why we are forced to use nuclear oil and gas energy*

R252 *the future is definitely not solar and wind. It is the most inefficient source of energy and it takes up a lot of land.*

R258 *They know wind/solar power doesn't work. They come with actual solutions.*

A fifth theme was identified regarding concerns about nuclear waste. Some individuals wondered how nuclear waste will be treated, and how nuclear energy can be defined as being completely clean if there is nuclear waste to be dealt with. Therefore, we labelled this theme as follows: 'What about nuclear waste?'.

Theme 5.1. What about nuclear waste?

R5164 *Wait a minute. Nuclear waste is clean?*

R5291 *He did not mention the nuclear waste which is harmful.*

R5292 *How is nuclear waste treated?*

R5330 *Nuclear waste is also not good for the planet.*

R5506 *How about the nuclear waste? Where to dump it?*

R5519 *And what about nuclear waste? Where do we dump them? Are they recyclable?*

R5523 *How about uranium waste?*

R5800 *What about nuclear waste? Is it safe?*

R5805 *Cleanest? What about nuclear waste?*

As discussed in the data analysis section, we applied a hierarchical cluster analysis to quantitatively assess the strength of associations between occurrences. In Appendix A, we show the dendrogram relative to the cluster analysis. Below, we report the proximity plot related to the largest cluster and the clusters closest to it. It can be noticed how the words

R29 (BBC) *Why . . . Solar would be better?*

R134 (BBC) *Why nuclear power and not solar? They could run the country in clean solar but chose nuclear with massive waste products that must be stored for 1000 years before it's safe?*

R230 (BBC) *They could do solar so easily.*

R261 (BBC) *How about solar?*

R331 (BBC) *Why not go solar, all that sunshine going to waste!*

R549 (BBC) *Surely the most sustainable form of energy in the UAE would be solar?*

R20 (CNN) *There was no need with solar and oil in abundance.*

R31 (CNN) *Solar energy is best suited for your climate.*

Other Facebook users, similarly to the comments on the Nas Daily post, acknowledge that solar, alone, could not represent the solution. Some even identify limits, such as dust, that the relevant literature has actually put forward [28]. We labelled the second theme as 'Solar alone cannot be the solution'.

Theme 2.2. Solar alone cannot be the solution

R88 (BBC) *If you study these topics then you yourself should understand that wind and solar on their own are simply incapable of meeting global energy demands, both due to existing limitations of the technology itself as well as the necessary infrastructure.*

R544 (BBC) *Smart move! The oil won't last forever. Ah, and solar panels are fine for providing electricity for individual houses, NOT for large buildings nor for any industry. I'm not sure whether you can use individual solar panel to provide air-conditioning to the bus stops (yes, they are air-conditioned). Nor can you cover what looks like a rocky desert with solar panels, as the desert is an ecosystem too, and of course you don't put solar panels on dunes either.*

R551 (BBC) *Energy storage and large scale supply is still an issue that inhibits solar, still needs more research. Plus sandstorms and general sand movement from and wind can obstruct solar panels and lower efficiency.*

R96 (BBC) *Furthermore, solar and wind also have environmental impact due to the minerals required in their construction. Not as bad as fossil fuels, but not negligible.*

R146 (BBC) *Solar power isn't always readily available i.e.,; at night.*

R204 (BBC) *Solar energy is not economically feasible in UAE due to thick dust and short day hours.*

R242 (BBC) *I'd suggest to learn a little about the limits of solar and the massive benefits of nuclear.*

R44 (CNN) *When compared to the net carbon cost for Solar, (nuclear) it's a much environmentally friendly way to generate electricity.*

R62 (CNN) *Why not to invest in renewable solar energy than to invest in this highly risk and controversial energy source.*

A group of respondents appear to be praising the move towards nuclear energy, especially when contextualized with a lower consumption of fossil fuels, which historically had dominated the energy mix of the UAE. The third theme is labelled as 'Nuclear energy is a good step towards reducing fossil fuels consumption'.

Theme 3.2. Nuclear energy is a good step towards reducing fossil fuels consumption

R2 (BBC) *Good for them, I was impressed by the green city projects, this is one more step toward moving away from oil. If the worlds petroleum leaders are moving away from fossil fuels that should be a good sign the rest of the world should follow suit. If not for the planet, for their economies.*

R146 (BBC) *Like it or not, nuclear will be our future without fossil fuels.*

R326 (BBC) *Until the research is done to make renewables more viable for large scale power demands then nuclear is a viable midway point as its less harmful than fossil fuels, but doesn't have to supply demand issues that currently hinder renewables.*

R362 (BBC) *Who told that we gonna move according to your country's moves! The UAE have reduced the dependence on the fossil fuels to half in the past 10 years.*

R522 (BBC) *Despite the risks involved, nuclear energy remains one of the safest, most efficient, and most reliable energy sources currently available today. In order to reach our renewable energy goals, and weaning our planet off of fossil fuels, nuclear energy HAS to be part of the equation. Fusion energy is ideal, obviously, but that's still many years away from becoming a viable solution. Until then, fission power has to do the job.*

R44 (CNN) *Kudos to UAE for investing in post-oil future.*

At the same time, other users have raised doubts about the nuclear energy implementation, listing a great deal of related geo-political risks. We therefore identify the theme with the label: 'Nuclear energy presents serious risks in the Middle East'.

Theme 4.2. Nuclear energy presents serious risks in the Middle East

Comments related to this theme point towards risks in the geographical area mainly due to perceived intrinsic risks of the nuclear technology and due to perceived tensions between countries in the region. This can be, at least partially, linked to potentially poorly contextualized views towards countries in the Gulf [29]. It is also important to notice that this theme emerges in reference to international media. Whilst it is important to identify such a theme and consider it in terms of policy indications, we do not explicitly report comments relative to this theme as we, the authors, found them potentially disrespectful.

3.3. Analysis Applied to 'Local Media' Comments Data (The National and Gulf News)

When inspecting the comments given to local media posts, the clear theme that emerged centered around pride and gratitude, with a number of users congratulating the UAE for the milestone achieved. 'Congratulations UAE' is the theme identified. This appears to be aligned with the theme of 'gratitude' towards the country, which seems to also be present among the substantial share of expatriates living in the UAE [30].

Theme 1.3. Congratulations UAE

R2 (Gulf News) *Congratulations.*

R3 (Gulf News) *Great accomplishment.*

R31 (Gulf News) *Congratulations UAE.*

R91 (The National) *Congratulations on this incredible milestone.*

R94 (The National) *Proud to be part of UAE.*

R102 (The National) *Amazing and great news.*

3.4. Brief Summary of Results

We summarize the results of the themes' extraction in Figure 2. It appears that the Nas Daily post created a reaction against the statement that nuclear energy is 100% clean, with individuals commenting that is not the case, especially when compared with renewable energy sources. This theme seems to be rather prevalent among the comments given to the Nas Daily post. Instead, when focusing on comments on the international media posts (i.e., BCC and CNN), a theme around risks of nuclear energy in the Middle East emerged. This is remarkably different to the assessment of the comments on the posts of Gulf News and The National, where the main common theme regards congratulating the UAE for the milestone achieved.

Themes extracted from comments to NAS DAILY	Themes extracted from comments to BCC & CNN	Themes extracted from comments to Gulf News & The National
<p>Nuclear is not clean and it is not the solution</p> <p>Nuclear is safe but not clean</p> <p>Solar is clean and easily available</p> <p>Solar is not efficient nor effective yet</p> <p>What about nuclear waste?</p>	<p>Why not Solar?</p> <p>Solar alone cannot be the solution</p> <p>Nuclear energy is a good step towards reducing fossil fuels consumption</p> <p>Nuclear energy presents serious geopolitical risks in the Middle East</p>	<p>Congratulations UAE</p>

Figure 2. Summary of the main themes identified.

3.5. Sentiment Analysis

In Figure 3, we present the results of the sentiment analysis. We report, by the post considered, the share of positive, neutral, and negative sentiments, as well as the total count of comments included in the analysis. After applying a series of tests of proportions, we can highlight that a significantly greater share of respondents are associated with positive comments when considering the Gulf News and The National posts as opposed to the Nas Daily post. Again, in comparison with the Nas Daily post, it also seems that the share of positive comments found in relation to the CNN post is significantly greater, whilst at the same time, we found a statistically significant greater share of negative comments too, thereby displaying a very polarized discussion. Instead, no significant difference was found between the share of positive comments when comparing the BBC and the Nas Daily post.

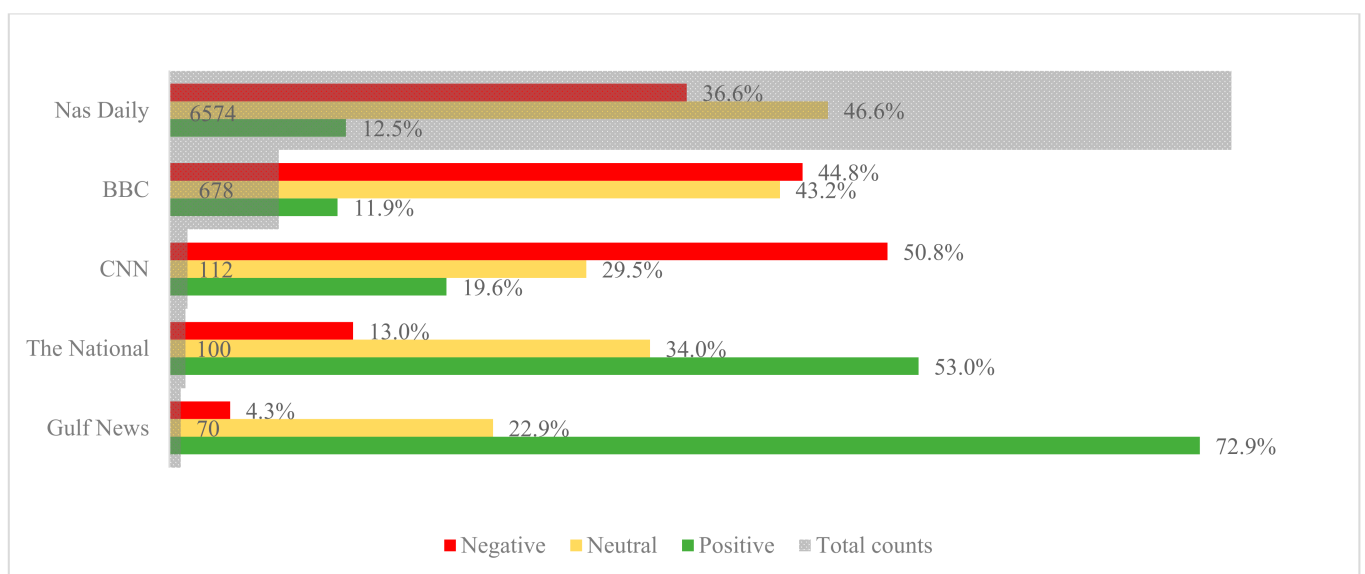


Figure 3. Sentiment analysis results (counts and %).

All in all, it can be noticed that local media receives a much greater share of positive comments, whereas international media seems to be associated with a much greater share of negative comments. Remarkably, the positive view towards nuclear energy in the UAE that seems to emerge from the comments on local media is aligned with the results of surveys conducted with samples of UAE residents [31]. It is important to also observe that the Nas Daily post seemed to receive a substantial share of negative comments, albeit this was lower compared to the analogous shares detected among the comments on international media posts.

4. Discussion

This work presents a framework used to analyze comments from social media to draw themes and assess reactions to posts. We applied this in the context of nuclear energy, but a number of additional applications could be explored, for instance, with regards to attitudes towards COVID-19 vaccines. The study presents a number of limitations. First, we considered a number of posts from local and international media identified on Facebook. The analysis of comments and reactions to additional posts and in different platforms could be considered as part of future research. Furthermore, it would be interesting to attempt to map users' characteristics to the comments for a greater level of detail in the analysis, for instance, distinguishing between users residing in the country of investigation versus users residing abroad. This could help better contextualize variations in the comments and provide more tailored recommendations for communication initiatives. At this stage, our analysis remains mostly descriptive. Despite these limitations, this work presents important findings comparing local media, international media, and social media influencer-produced posts, allowing the provision of initial recommendations in terms of communication around nuclear energy projects.

Based on the findings of this study, we highlight the need for the following actions. The video posted by Nas Daily on nuclear energy generated the greatest volume of comments, although Facebook users raised several doubts around statements that seem to highlight an overly positive picture of nuclear energy. Statements, such as '100% safe', could be avoided for a more balanced discussion, where risks connected to this technology are acknowledged and contextualized. So, if on the one hand social media influencers can help generate an outstanding reach, their content needs to be carefully reviewed. It also appears important to provide discussion around the role of nuclear energy in the broader energy strategy, discussing the reasons why a sole investment in renewable energy might not be the best strategy for a given country. As concerns around geopolitical tensions seem to be present, especially when inspecting comments on international media posts, it would be advisable to give evidence and raise awareness of the steps taken towards a peaceful development of nuclear energy, as acknowledged, for instance, by the IAEA [32]. It finally seems important to prioritize the management of international communication as it appears that locally, there are no substantial nuclear energy acceptance issues, as previously found [33]. All in all, and in line with previous research, communication in the area of nuclear energy needs to build trust whilst taking into account the role of the emotions of the stakeholders, where potential risks are properly contextualized and discussed [34].

In terms of methodological implications concerning the assessment of views towards energy sources, practitioners are advised to consider the use of social media data to complement traditional survey data. They could be used at the inception of a study to help identify the key questions to include in the survey and help finetune the language used. At the same time, this data could be used at the end of a research project, whereby the views obtained from a survey can possibly be better contextualized with the inclusion of social media data. In instances of limited funding, this could be a potential alternative to traditional focus groups or in-depth interviews. Whilst it was not investigated in this work, there are indications that individuals not only comment on the social media posts, but also on previous comments of other users', hence generating dynamics that could be interesting to assess in the area of views towards energy sources [35].

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Institutional Review Board Statement: Ethical review and approval were waived for this study as data is publicly available online and, in addition, statements are reported in the manuscript anonymously.

Informed Consent Statement: Not applicable.

Data Availability Statement: Anonymized data can be made available upon request to the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

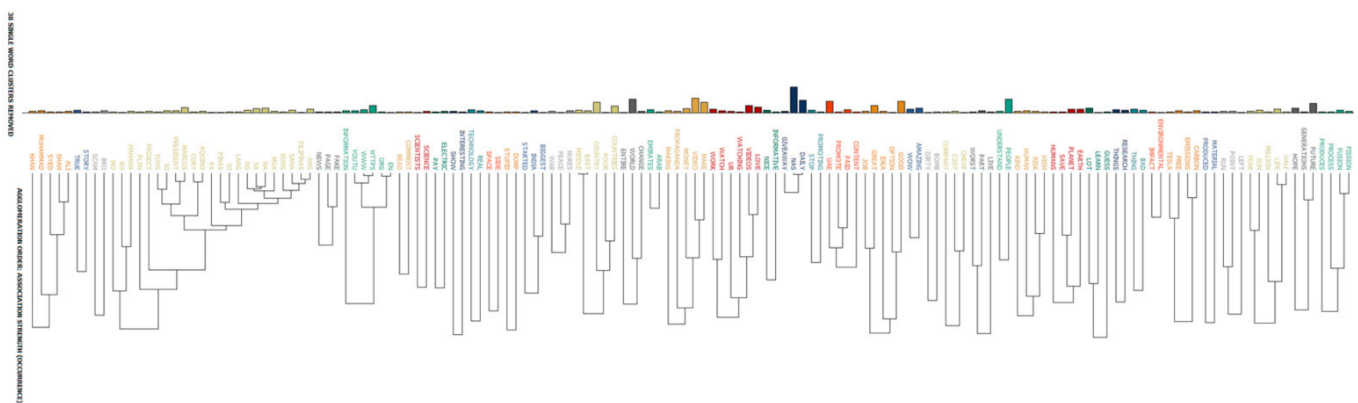


Figure A1. Hierarchical analysis applied to the comments on the 'NAS daily' post (dendrogram).

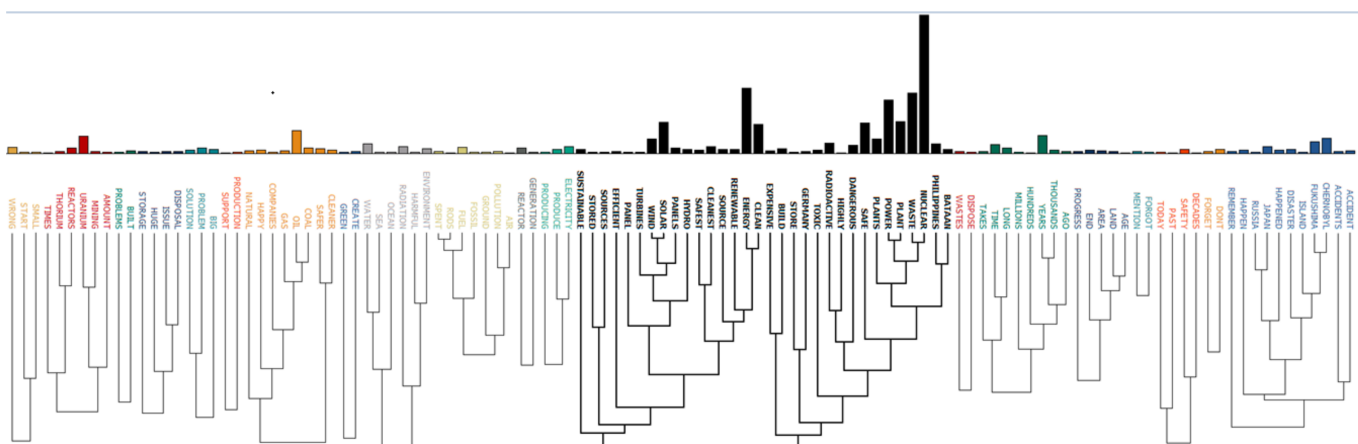


Figure A2. Hierarchical analysis applied to the comments on the 'NAS daily' post (dendrogram-continued).

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