Tracing online information about wind power in Sweden: An exploratory quantitative study of broader trends

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Jutta Haider
Björn Ekström
Elisa Tattersall Wallin
David Gunnarsson Lorentzen
Malte Rödl
Nora Söderberg

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Introduction

This report presents the main findings of an exploratory quantitative study of how information about wind power circulated online in Sweden between May and November 2022. The focus of this study is on larger trends, types of claims and dominant relations concerning wind power on social media, especially Twitter and to a lesser extent YouTube and Facebook, as well as the role of search engines, specifically Google Search, in these constellations. The study explores the circulation of both information supported by research and information that is not necessarily backed up by research-based evidence.

Discussions about wind power are shaped by social norms and influenced by local culture and history (Karakislak, et al. 2021). They are often antagonistic, politically charged and sometimes polemical (Borch et al., 2020; Hindmarsh, 2014). In Sweden, public opinion on wind power is predominantly positive but has become more negative in recent years. The differences in opinion are consistent with demographic characteristics. For example, women and urban populations express themselves somewhat more positively and men and rural populations somewhat more negatively. Furthermore, there is a statistically confirmed alignment of opinion with the political left-right scale, with opinion on the left more in favour of wind power development and opinion on the right less so (Jönsson, 2022). Although wind energy is generally considered a sustainable and renewable energy source (Energimyndigheten, 2021; Wizelius, 2015) and the general opinion is positive (Jönsson 2021), planned wind farm developments in Sweden are often stopped at the municipal level (Jönsson, 2022).

It is important to note that several of the points made against wind power can also be made against other infrastructure developments, such as airports, roads, motorways, railways, or seaports. Many of these concerns create tensions and call for trade-offs. The reasons for opposition to wind power are varied and range from feared loss of property value, impact on landscapes, fear of noise and light pollution, to concerns about harm to wildlife and marine environments, to name just a few (e.g., Bolin et al. 2021; Bjaerstig et al. 2022). A common concern, which is also the subject of research, is that wind turbines are harmful to certain species of bats and birds (*see: Naturvårdsverket, n.d. for a list of research and synthesis reports in the Swedish context*). At the same time, much ecology and biology research has found that wind power is the energy source with the least harmful impact on ecosystems (Anshelm, 2013; Sayed et al. 2021). In Sápmi, criticism relates moreover to the continued exploitation and industrialisation of Sápmi land for energy production, which has a negative impact on the landscape and the indigenous Sámi population, for example through the fragmentation of reindeer herding areas (Eftestøl et al. 2023; Skarin at al. 2021). Similar issues with public acceptance of wind farms and opposition can be observed in other Scandinavian countries (e.g., Borch et al., 2020; Heidenreich, 2016), across Europe (e.g., Ruddat, 2022; Sonnenberger & Ruddat, 2017) or in North America (e.g. Fergen et al. 2021).

Much of the material analysed for this report, but of course not all, presents a critical and sometimes highly critical view of wind power. It is impossible to provide a comprehensive overview of all the issues that arise in the present context. As noted above, much of the criticism is well-known and has already been documented and investigated. Nevertheless, we have chosen to explore the occurrence of three specific concerns in one of the datasets in this study, namely the notion that wind turbines are a major source of microplastics, that they are therefore a major source of bisphenol A in the environment (Bolin et al., 2021), and that they cause various illnesses in people living near them (Taylor & Klenk, 2019; Karasmanaki, 2020). There is little scientific evidence to conclusively support either claim. Research that has identified and quantified the main emission sources of microplastics in the environment in Sweden and other countries shows that the majority comes from motor traffic (tyres, road markings), artificial turf, laundry, litter and, in the sea, also from boat hulls and fishing gear (Hann et al. 2019; Swedish Environmental Protection Agency, 2019). Research has not been able to establish a link between living near wind farms and a higher risk of heart disease, pregnancy problems, stroke, or diabetes, as well as some other health concerns and diseases. However, there is evidence that prolonged exposure to wind turbine noise can cause sleep disorders in some people. The most common adverse health effect is annoyance from wind turbine noise. The experience and level of annoyance also depend on the individual's attitude towards wind power and increase when wind turbines are visible (Karasmanaki, 2022).

In the literature and public discussion, it is often noted that there are different types of information and specifically false information: namely misinformation, disinformation, and mal-information. There is a plethora of different typologies, terms, and concepts to define the phenomenon of false information and especially its spread online (Kapantai et al. 2021). The most common definitions

are based on the following distinctions: Misinformation is false information that is shared by mistake, while disinformation is false information that is shared with the intention to mislead. Mal-information is genuine information that is shared with the intention to mislead. This can include information that should remain private being shared publicly, or correct information being shared in a misleading way, for example, content that originally referred to a different time or place (Wardle & Derakhshan, 2017). These terms are limited in describing the impact that incorrect information and its dissemination can have on society and individuals. Their usefulness is often limited because they presuppose knowledge of the intention of a producer or disseminator of information in a problematic way (Fathaigh et al. 2021). So, although there is good evidence of falsity for some of the claims that are repeatedly shared about wind power, especially in social media, we are talking here about larger patterns of information.

The overarching research question of this report is: Which understandings of wind power in Sweden are prevalent in Google Search and on major social media platforms? The report is moreover guided by the following questions:

- What connections can be identified in Google Search between search terms and search results, and between search terms, autosuggest terms and related searches?
- Which topics are central to Swedish discussions about wind power on Twitter and how are these topics related to each other?
- What role do Facebook groups play in shaping the image of wind power in Sweden through the dissemination of wind power-related content?

The next section describes the methods and materials that were collected and produced, as well as how the data were analysed. This is followed by a presentation of the results, focusing on Google searches and results, Facebook interaction patterns for news media content, Facebook interaction patterns for YouTube videos and Twitter conversations. A final section summarises the main findings in relation to the above questions. A summary in Swedish concludes the report.

Data production and analysis

The project collected data from several platforms, namely Google Search (incl. Google Trends), Facebook, YouTube, Twitter, and also online news. The data was collected and compiled between May and November 2022, in the run-up to and immediately after the Swedish elections. An additional Twitter dataset covers the period from January to September 2022. The data consists of hundreds of thousands of data points. They are anonymous and aggregated at a high level. The data collection was based on the keyword *vindkraft* (Swedish for "wind power"). It did not aim to capture positive or negative content. Different digital methods were combined in the creation and analysis of the dataset. These are "techniques for the study of societal change and cultural condition with online data" (Rogers, 2019, p. 3). In the following sections, the methods of data collection and analysis are described in relation to the respective platforms.

Google Search dataset

Data production for the Google Search dataset was initially conducted using the Research Assessment Tool (RAT) (Lewandowski & Sünkler, 2012, 2013, 2019). The data were retrieved on 22 November and 9 December 2022. Search queries and results were collected by specifying the search term *vindkraft* as the first query used to retrieve related search terms from RAT. Each query was then used to automatically invoke Google Web Search for search results by scraping the search engine results page (SERP). This produced a dataset that included the search results as Uniform Resource Locators (URLs), their positions in the search results list, the domain names, and screenshots of each result. A total of 252 actual search queries were retrieved from RAT, with a total of 5710 search results retrieved as URLs. The process also provided a dataset listing the autosuggest terms and related searches, monthly searches, and average monthly searches. A total of 744 autosuggest terms and related search queries were identified. The analysis was then conducted using the R programming language and associated data science software packages, including *Tidyverse* (Wickham et al., 2019), *readxl* (Wickham et al., 2022), *kableExtra* (Zhu et al., 2021), *Psych* (Revelle, 2022), *Packcircles* (Bedward et al., 2022) and *URLtools* (Keyes et al., 2019). The dataset further includes data on relative search volume for the term *vindkraft* in Sweden and metrics for related searches as provided by *Google Trends*, as well as screenshots of graphs and lists generated by the *Google Trends* tool.

Facebook dataset

The Facebook dataset consists of two parts, one to explore the circulation of news media content about wind power in Facebook groups, and one to understand the circulation of YouTube videos in Facebook groups.

- News media content: Data production for the first part of the dataset was initiated on 15 September 2022 by scraping the URLs of 100 entries from Google News for each month up to the Swedish election, i.e., from January to September (example: vindkraft after:2021-12-31 before:2022-02-01). The results include different genres such as news articles, editorials, opinion pieces and press releases and come from a variety of sources, ranging from the morning and evening press to public service media, and trade journals to news aggregator services. Each URL was then submitted to the social monitoring tool *CrowdTangle Link Checker* (CrowdTangle, 2021) provided by Meta Inc. This task was completed by 3 October 2022. This provided a dataset that listed the number of Facebook interactions, comments, shares and reactions for each article. 440 of these had been shared in Facebook groups, which were merged into a single file. News media content without Facebook interaction data was omitted. The names of the Facebook groups are not disclosed for integrity reasons.
- Youtube videos and autosuggest terms: The dataset of Youtube videos about wind power was created on 14 September 2022 by compiling a list of the URLs of the 50 most viewed YouTube videos in 2022. This list was obtained via the Youtube API in response to entering the search query *vindkraft* into the Youtube search function. Each URL was then submitted to Meta Inc's social monitoring tool *CrowdTangle* Link Checker (CrowdTangle, 2021) on 15 September. This provided a dataset that listed the number of Facebook interactions, comments, shares and reaction numbers for each video. Thirty-three of these videos were shared in Facebook groups and the data from these interactions were combined into a single file. The names of the Facebook groups are not disclosed for

integrity reasons. In addition, the SEO tool *You Autocomplete Me* (You Autocomplete Me, 2022) retrieved autosuggest terms for the YouTube search function on 29 September 2022.

In the two parts of the dataset that emerged from the *CrowdTangle* data production process, Facebook interactions are divided into three types: (1) Comments are text expressions written in response to Facebook posts; (2) Reactions are responses to posts, including thumbs up, thumbs down and emojis; (3) Shares are interactions where a post has been re-posted or forwarded to other Facebook pages or groups.

Analysis was performed using the R programming language and associated data science software packages, including *Tidyverse* (Wickham et al., 2019), *Lubridate* (Spinu et al., 2022), *kableExtra* (Zhu et al., 2021), Psych (Revelle, 2022), *URLtools* (Keyes et al., 2019) and *Plotly* (Sievert et al., 2022). Network diagrams were created using *Gephi* (Bastian et al., 2009). Each item of news media content and Youtube video was then qualitatively classified employing a classification scheme based on a previous study on Youtube content (Tang et al., 2021), i.e., three broad categories were used: favourable, general, and unfavourable views on wind power (Table 1).

Table 1. Coding scheme of depictions of wind power news media content and Youtube videos

Code	Description	Count
Favourable	Documents portraying wind power benefits.	168
General	Documents discussing advantages and disadvantages with wind power.	100
Unfavourable	Documents that describe adverse aspects of wind power or are highly critical of one or more aspects of wind power.	205

News media content was evaluated based on its headline, byline and lead. The reason for this decision is that these elements are visible when a link is shared on Facebook without having to click on it. Youtube videos were classified based on their title and content. Documents, i.e. news media content and Youtube videos, were classified as unfavourable if they described adverse aspects of wind power or were highly critical of one or more aspects of wind power. Documents were classified as general if they addressed both the advantages and disadvantages of wind energy or neither. Documents were favourable as positive if they predominantly highlighted one or more advantages of wind power.

Twitter dataset

The Twitter dataset is composed of two parts. The first part was created by searching for the keyword *vindkraft (vindkraft*)*. The second part of the dataset was created by searching for the keyword *#svpol*. It serves to place the results of the analysis of the first part in the broader context of conversations in the Swedish Twitter space in the run-up to the 2022 election.

- The first part of the Twitter dataset was created in two steps. In the first step, we used the *Tags* tool (Hawksey, 2010). The tweets were downloaded automatically, in real-time and seven days backwards, starting on 22 May 2022 and ending on 4 October 2022, so the data collection ended three weeks after the Swedish general elections. The term initially submitted to the tool was *vindkraft*. The query was eventually extended by the truncated query *vindkraft** (from 5 September 2022). The final dataset consisted of 72,194 tweets, although not all tweets are unique as the dataset also includes retweets. All Twitter handles were permanently removed and replaced with generic numbers (such as "User_300") to anonymise the data.
- The second part of the Twitter dataset was created by searching with the hashtag *#svpol* ("Swedish politics", cf. Larsson, 2014; Gunnarsson Lorentzen, 2017). To search the archive and customise the data collection tool, we used the open-source application *Focalevents* (Gallagher, 2022). In this second step, only hashtags, URLs and timestamps

were collected, from 1 January 2022 to Election Day on 11 September. The second dataset consisted of 834,011 tweets, retweets included.

The tweets were analysed in several steps. The *Python* programming language was used to prepare the data for visualisation. For the first set, which contained tweets in full text without stop words, we performed topic modelling, a statistical method that infers topics from documents and indicates how much of each topic is present in each document. Each topic consists of a set of words that are related to each other. Based on this, we created co-occurrence networks in which words of the same topic are connected as nodes and edges. For the second dataset, we built similar networks based on co-occurring hashtags.

Subsequently, the visualisation software *Gephi* (Bastian et al., 2009) was used to visualise the topic modelling and co-hashtag analyses using network graphs. For additional text analysis of the full tweet dataset from part one, the corpus analysis software *AntConc* (Anthony, 2005) was employed to search the dataset for specific keywords and visualise words that co-occur together with them. Finally, the *Voyant* tools application (Sinclair & Rockwell, 2003) helped to create word clouds visualising the most frequent words in the entire Twitter dataset.

Results

This section provides an overview of the study's results, broken down by dataset. First, an overview of Google search queries and search results is given, followed by an analysis of Facebook interactions with news media content and Youtube videos, including a section on Youtube autosuggest terms. Finally, some results from the examination of the Twitter dataset are presented.

Google Search queries and search results

This section focuses on how Google search results on wind power come about in terms of search queries, autosuggest terms and related search queries.

Key takeaways

- The domains that appear most frequently on search results pages when searching for wind power and related terms belong to public authorities, energy companies and news media.
- The URLs that appear most frequently on search results pages when searching for wind power and related terms are of public authorities, interest and advocacy organisations, and energy companies.
- The number of searches for the term vindkraft in Sweden rose sharply in the period leading up to the election, peaked on 9 September 2022 and then declined. The related search that saw the strongest increase in September 2022 was nackdelar med vindkraft (disadvantages of wind power).
- The top 10 average monthly search queries relate to four types of queries: Building your own wind turbine, wind turbine efficiency, wind turbine operation, and offshore wind power. The query wind turbine at home (vindkraftverk hemma) has the highest number of average monthly searches (5400).
- Swedish geographical location queries mainly retrieved search results from public service, public authorities, and energy companies.

Frequency table – domains

Table 2. Frequencies of domains in SERPs

Unique domains	Mean	SD	Min	Max
987	5.785208	15.30483	1	236

Top domain frequencies

The most common domains in the dataset include government organisations, energy companies, interest and advocacy organisations, non-profits, news outlets and Wikipedia (Table 3).

Table 3. Top ten most frequent domains in SERPs

Domain	Count
energimyndigheten.se	236
group.vattenfall.com	180
svenskvindenergi.org	129
naturvardsverket.se	123
naturskyddsforeningen.se	109
vindkraftsnyheter.se	106
energiforetagen.se	93
svt.se	88
sv.wikipedia.org	82
svenskvindkraft.com	81

Moreover, at position 1 in the SERPs, the most common domains include government organisations, energy companies, interest and advocacy organisations and news outlets (Table 4).

Table 4. Top ten most frequent domains in SERPs at position 1

Domain	Count
energimyndigheten.se	18
group.vattenfall.com	18
naturvardsverket.se	12
windforce.se	11
svenskvindenergi.se	10
svt.se	9
energiforetagen.se	7
naturskyddsforeningen.se	7
sunwind.se	6
ox2.com	5

Frequency table – URLs

Table 5. Frequencies of URLs in SERPs

Unique URLs	Mean	SD	Min	Max
2910	1.962199	3.600344	1	60

Top URL frequencies

The most common URLs in the dataset include interest and advocacy organisations, government organisations and energy companies (Table 6).

Table 6. Top ten most frequent URLs in SERPs

URL	Count
https://www.myfuelcell.se/vindkraft	60
https://www.naturskyddsforeningen.se/artiklar/vanliga-fragor-om-vindkraft/	56
https://www.energiforetagen.se/energifakta/elsystemet/produktion/vindkraft/	55
https://svenskvindkraft.com/smaskalig-vindkraft/	48
https://www.energimyndigheten.se/nyhetsarkiv/2021/ny-statistik-over-installerad-vindkraft-2020/	47
https://www.bixia.se/energi-i-fokus/vindkraft---en-viktig-del-av-energiomstallningen	46
https://www.naturvardsverket.se/amnesomraden/vindkraft/	46
https://www.windforce.se/vindkraftverk.php	41
https://www.boverket.se/sv/PBL-kunskapsbanken/lov--byggande/anmalningsplikt/bygglov-for-anlaggningar/vindkraftverk/	34
https://www.scb.se/hitta-statistik/statistik-efter-amne/energi/tillforsel-och-anvandning-av-energi/manatlig-elstatistik-och-byten-av-elleverantor/pong/tabell-och-diagram/elforsorjning/	33

At position 1 in the SERPs, we found the most frequent URLs to be energy solution retailers, interest and advocacy organisations, government authorities, and energy companies (Table 7).

Table 7. Top ten most frequent URLs in SERPs at position 1

URL	Count
https://www.sunwind.se/product/show/?id=1793&Vindkraftverk-X400---12V	6
https://www.windforce.se/vindkraftverk.php	6
https://group.vattenfall.com/se/var-verksamhet/vindprojekt/kriegers-flak	5
https://www.energiforetagen.se/energifakta/elsystemet/produktion/	5
https://www.energimyndigheten.se/nyhetsarkiv/2021/ny-statistik-over-installerad-vindkraft-2020/	5
https://www.naturvardsverket.se/amnesomraden/vindkraft/	4
https://www.smhi.se/kunskapsbanken/meteorologi/vind/skalor-for-vindhastighet-1.252	4
https://www.vattenfall.se/elavtal/energikallor/vindkraft/	4
https://www.windforce.se/vindkraft-windstar3000.php	4
https://group.vattenfall.com/se/var-verksamhet/vindprojekt/faq-vindkraft/ar-vindkraft-lonsamt	3

Google Trends

Figure 1 below is a screenshot from Google Trends (trends.google.com) for the years 2021 and 2022. It shows that the number of searches (relative to all searches) for the term *vindkraft* (wind power) in Sweden first rose sharply in the summer and autumn of 2022 and then declined.

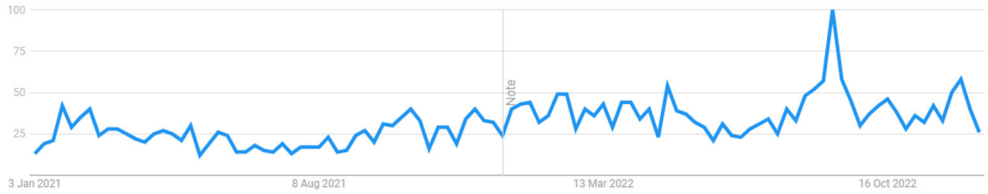

Figure 1. Screenshot, Google Trends, 2021-2022, term: vindkraft, location; Sweden

Zooming in on September 2022 (Figure 2) shows that the peak occurred on Friday, September 9, which was the last workday before the election.

Figure 2. Screenshot, Google Trends, September 2022, term: vindkraft, location; Sweden

According to Google Trends, the top related queries in this period from 1 to 31 September were *vindkraft sverige*, *vindkraftverk*, *nackdelar med vindkraft* (wind power Sweden, wind turbines, disadvantages of wind power). Of these three search terms, disadvantages of wind power and wind turbines recorded the largest increases and are classified as rising searches.

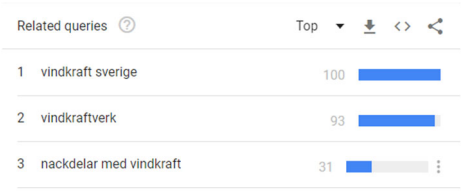

Figure 3. Screenshot, Google Trends, related queries (top)

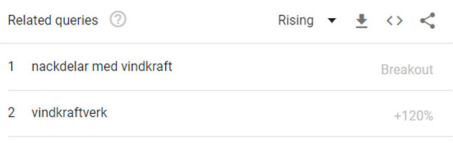

Figure 4. Screenshot, Google Trends, related queries (rising)

To explain: Related queries are terms (incl. combinations of terms) that users entered into the search engine during the same search session. Google Trends breaks down those related queries by two different metrics and this way distinguishes between top searches and rising searches (Google, 2023). Applied to the case of wind power, this means that top searches are the terms that were searched for most frequently in Sweden during the same search session as the term *vindkraft*, in the image above during 1-31 September 2022. Rising searches are terms that were searched for together with the term *vindkraft* and had the largest increase in search volume in September 2022. For each rising search term, the percentage growth of the term compared to the previous period is given.

The search term *vindkraftverk* increased by 120%. The phrase *nackdelar med vindkraft* (disadvantages of wind power) lacks such a figure and is instead assigned the label breakout. This indicates that it has increased by more than 5000% (Google, 2023).

Search queries, autosuggest queries and related searches

We also drew on search queries, autosuggest queries and related search queries obtained by querying the Google Keyword Planner via RAT (Table 8). Queries averaging higher than 5400 were omitted with the motivation that these only included general search queries on wind power (*vindkraft* and *vindkraftverk*), which skewed the visualisation.

We note that the top 10 average monthly search queries relate to four types of queries: Building your own wind turbine (examples: *eget vindkraftverk*, *vindkraft hemma*), wind turbine efficiency (examples: *hur mycket el producerar ett vindkraftverk*), wind turbine operation (examples: *hur fungerar vindkraftverk*) and offshore wind power (example: *havsbaserad vindkraft*). The search query *vindkraftverk hemma* stands out in terms of average monthly searches (5400), while the similar search query *eget vindkraftverk* records only 880 average monthly searches. The remaining eight search queries in the list have a monthly average of 720 search queries.

Table 8. Top ten monthly average searched terms, autosuggest terms, related search terms

Query	Monthly average searches
vindkraftverk hemma	5400
eget vindkraftverk	880
hur mycket el producerar ett vindkraftverk	720
hur fungerar vindkraftverk	720
små vindkraftverk	720
havsbaserad vindkraft	720
små vindkraftverk för villor	720
vindkraft hemma	720
litet vindkraftverk på taket	720
litet vindkraftverk	720

Next, we visualised the 50 topmost queries and their average monthly searches using a circular packaging plot (Figure 5). Nodes represent each Google search query, and their sizes represent the number of average monthly Google searches made.

As per Figure 5, the ten topmost search queries are replicated through the large pink node and the adjacent pink and orange nodes. The left, green nodes moreover relate to wind turbines coupled with kilowatt search terms (*små vindkraftverk 5 kw, vindkraftverk 10 kw*), wind turbine costs (*vad kostar ett vindkraftverk*) and queries directed towards a specific geographical location (*markbygden vindkraft*).

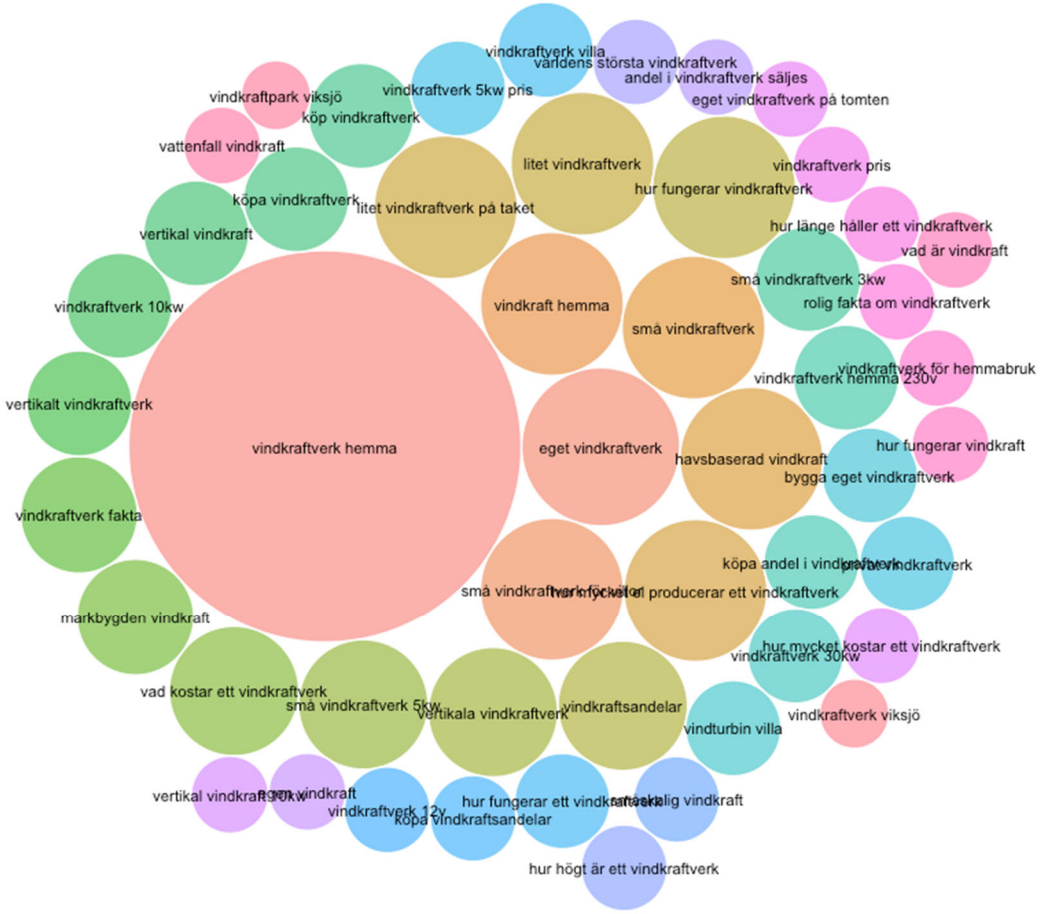

Figure 5. Monthly average search terms, autosuggest terms and related Google search queries for *vindkraft*

Queries relating to the purchasing and development of small wind turbines (*vindturbin villa*, *bygga eget vindkraftverk*) can furthermore be seen in the turquoise and blue nodes, as can queries relating to the investments regarding wind turbines (*köpa andel i vindkraftverk*). Apart from the priorly mentioned forms of queries, we also see queries relating to the persistence of wind turbines as a pink node (*hur länge håller ett vindkraftverk*) and general queries relating to wind turbines' functions and measures (*hur fungerar ett vindkraftverk*, *hur högt är ett vindkraftverk*).

Search results of Swedish geographic location queries

In addition, we manually grouped a subset of the retrieved search terms that included place names. i.e., geographic locations in Sweden (i.e., *vindkraft gotland*, *vindkraft ripfjället*). This provided some insights into which results are obtained for Google searches about windpower with a local focus.

Table 9. Frequency table for grouped queries and SERPs

Unique domains	Mean	SD	Min	Max
267	2.576779	3.8774342	1	36

As can be seen in Figure 6, searches that included place names mainly retrieved results from public service, including Sveriges Television (36) and Sveriges Radio (22), public authorities such as the Swedish Energy Agency (29) or the Swedish Environmental Protection Agency (8), and energy companies such as Vattenfall (17), Jönköping Energi (9) or OX2 (8). These are the combined results for all queries in our data set that included place names. The search results for individual queries pertaining to particular locations differ both from each other and from the combined results below.

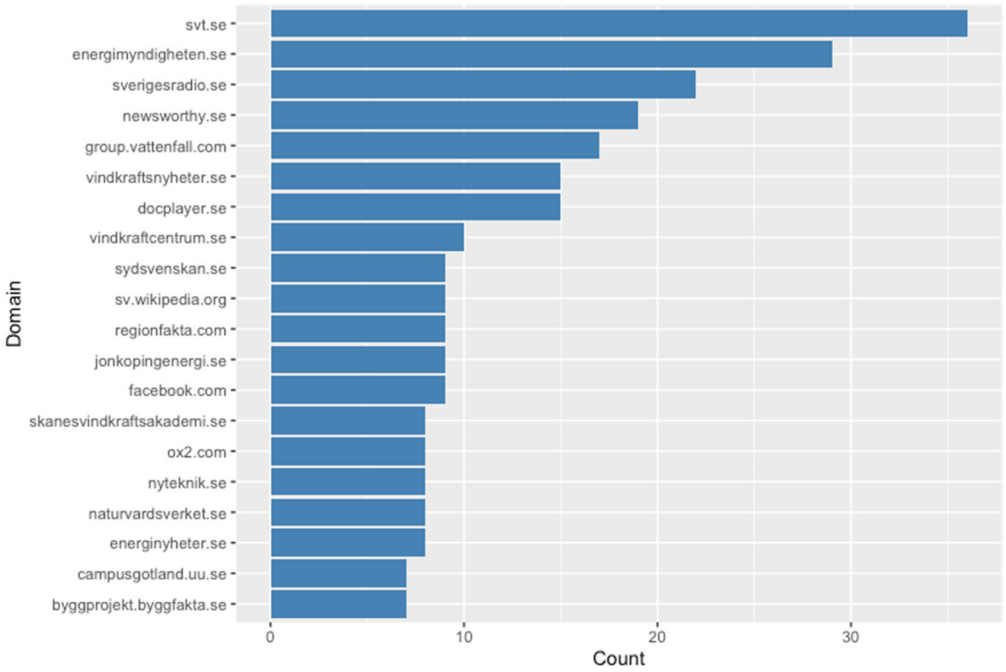

Figure 6. Top 20 domain frequencies for geographic location queries

News websites and aggregators such as Newsworthy (19), Vindkraftsnyheter (15), Sydsvenskan (9) and the social media platform Facebook (9) are also prominent. Other domains include the document-sharing platform Docplayer (15), Wikipedia (9) and Regionfakta (9), an aggregation service for official Swedish statistics.

Facebook interactions with news media content

To clarify which understanding of wind power prevails on major social media platforms, this subsection describes the spread of Swedish news media content on Facebook during the study period. The results are used to outline the prevalence and distribution of different views on wind power, how relationships are established between Facebook groups and URLs, and the distribution of and relationship between different types of interactions.

Key takeaways

- News media content that portrayed wind power unfavourably tended to receive more Facebook shares and reactions than favourable content.
- News media content that portrayed wind power favourably or in general terms tended to receive more Facebook comments than unfavourable content.
- The news media content with the most interactions on Facebook was about a wind turbine that had fallen apart.
- The content with the second and third highest number of interactions contrasted wind power with nuclear power.
- Of the ten pieces of news media content with the most interactions, eight portrayed wind power unfavourably.

Frequency table

Table 10. Frequency table of news media content interactions in Facebook groups

	Count	Mean	SD	Min	Max
Comments	71506	162.51364	604.3768	0	11278
Reactions	196035	445.53409	1342.1267	0	22173
Shares	25604	58.19091	204.6485	0	2620

Top news media article interactions

Looking at the top interactions with news media content in the dataset (Table 11) shows that the news media content with the most interactions concerns a wind turbine that had fallen apart. The majority of the ten pieces of news media with the most interactions portrayed wind power unfavourably and/or held critical views of wind power. The content with the second and third most Facebook interactions contrasted wind power with nuclear power.

Table 11. Top ten most interacted news media content in Facebook groups

Headline	URL	Count
Vindkraftverk på Hästkullen har rasat ihop	https://www.svt.se/nyheter/lokalt/vasternorrland/vindkraftverk-pa-hastkullen-har-rasat-ihop-ingen-person-skadad	36071
Ni gjorde kärnkraften olönsam - skyll inte på marknaden	https://www.gp.se/debatt/ni-gjorde-k%C3%A4rnkraften-ol%C3%B6nsam-skyll-inte-p%C3%A5-marknaden-1.79433675	14694
”Vill man få ett stabilt elnät i södra Sverige går det bara att välja kärnkraft.”	https://www.sydsvenskan.se/2022-08-01/vill-man-fa-ett-stabilt-elnat-i-sodra-sverige-gar-det-bara-att-valja-karnkraft	7450
Vi behöver inte ett enda vindkraftverk	https://www.gp.se/fria-ord/vi-beh%C3%B6ver-inte-ett-enda-vindkraftverk-1.77333929	5815
Magda har dubbelfel om vindkraft till havs	https://www.expressen.se/ledare/malin-siwe/magda-har-dubbelfel-om-vindkraft-till-havs/	5672
Stenevi vill fyrdubbla vindkraften – staten ska satsa 100 miljoner	https://www.aftonbladet.se/nyheter/samhalle/a/Rr059A/marta-stenevi-vill-fyrdubbla-vindkraften-i-sverige	5551
Elbilars batteri och sol/vindkraftverk	https://abounderrattelser.fi/elbilars-batteri-och-sol-vindkraftverk/	5449
Ytterligare vindkraftverk avstängda i Björkvattnet efter att vinge gått av	https://sverigesradio.se/artikel/ytterligare-vindkraftverk-avstangda-i-bjorkvattnet-efter-att-vinge-gatt-av	5357
Andreas vädjan till grannarna: ”Arrendera inte ut för vindkraft”	https://www.smalanningen.se/2022-04-05/andreas-vadjan-till-grannarna-arrendera-inte-ut-for-vindkraft	4837
”Vi behöver vattenkraft, vindkraft och kärnkraft”	https://www.svensktnaringsliv.se/sakomraden/hallbarhet-miljo-och-energi/vi-behover-vattenkraft-vindkraft-och-karnkraft_1187750.html	4771

Top domains featured in the dataset

Looking at the top domains in the dataset (Table 12), Sveriges Television is the most common top domain in the dataset. Public service organisations, Sveriges Radio and Sveriges Television, are the top two domains in the dataset. They are followed by the newspapers Göteborgs-Posten and Dagens Nyheter.

Table 12. Top ten most interacted news media content domains in Facebook groups

Domain	Count
svt.se	79
sverigesradio.se	32
dn.se	24
gp.se	24
alandsradio.ax	15
di.se	14
sydsvenskan.se	13
expressen.se	12
nt.se	10
nyteknik.se	10

Time series – monthly posts

News media content on wind power posted on Facebook during 2022 peaked in February, April, May, and July (Figure 7).

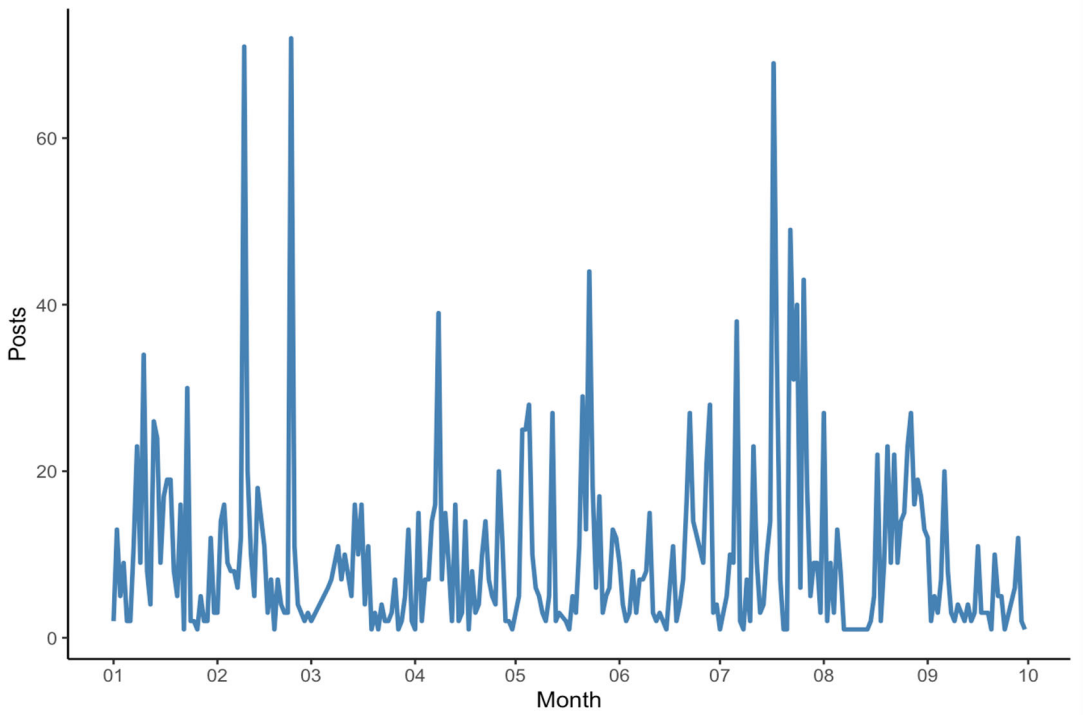

Figure 7. Monthly distribution of news media content posted in Facebook groups

From January to September, posts of news media content about wind power fluctuate in waves. A first wave can be observed in January, followed by two high peaks in mid and late February. Another peak can be seen in February, followed by a series of posts in May, leading to another peak in the second half of the month. After a few weeks of lower activity, fluctuations occur again at the end of June, peaking at the end of July. There is little to no activity in early August, with a few smaller waves of Facebook posts occurring towards the end of the month and in September.

Interaction relationships

The following scatterplots show the distribution of interaction types in comments, shares and reactions to news media content concerning wind power in Facebook groups. Each data point represents a piece of news media content. Figure 8 shows the distribution of reactions compared to shares. Figure 9 shows comments compared to shares. Figure 10 also shows the distribution of reactions versus comments. Figure 11 shows the distribution of reactions, comments, and shares in total.

The news media content with the most shares in the dataset presents wind power in a negative light. In particular two pieces of news media content that depict wind power unfavourably stand out in terms of reactions and shares. The local estimated scatterplot smoothing shows a curve towards reactions.

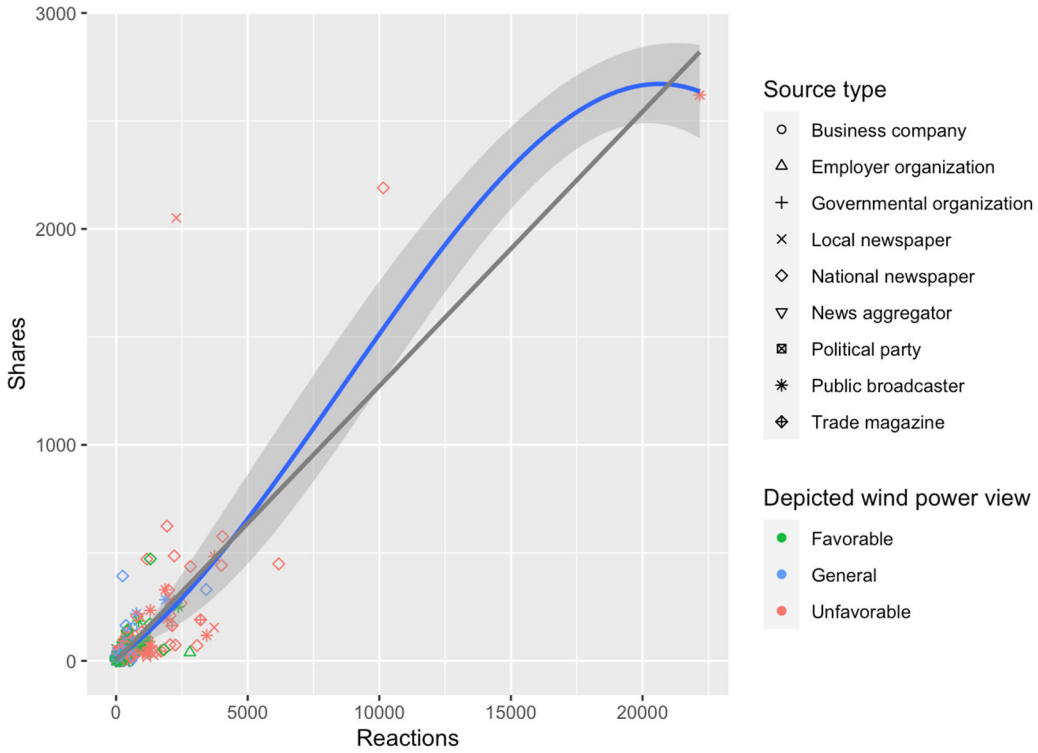

Figure 8. News media content reactions and shares in Facebook groups (n = 440)

Moreover, news media content portraying wind power unfavourably tends to be shared more often than news media content offering a favourable view of wind power (Figure 9).

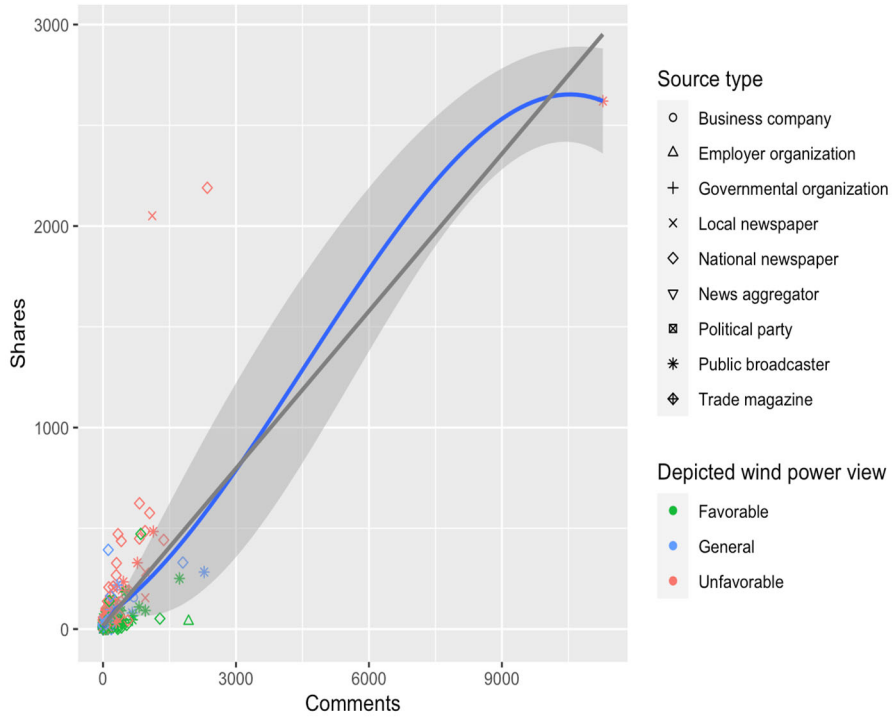

Figure 9. News media content comments and shares in Facebook groups (n = 440)

On the other hand, content with favourable views on wind power tends to receive more comments than unfavourable depictions. One news media article depicting wind power unfavourably is a clear outlier in terms of comments and shares. The local estimated scatterplot smoothing shows an even increase with a curve towards comments for outliers. Our data do not allow any conclusions to be drawn about the content or character (e.g., favourable, or unfavourable) of the comments. Concerning reactions compared to comments, news media content with unfavourable views of wind power tends to get more reactions than news media content portraying wind power favourably (Figure 10).

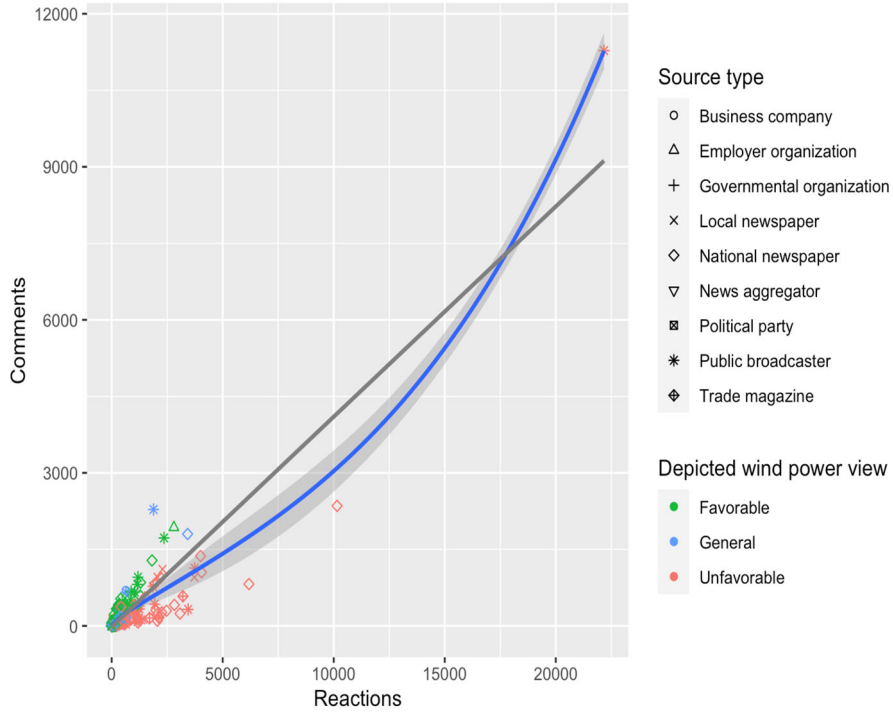

Figure 10. News media content reactions and comments in Facebook groups (n = 440)

News media content offering favourable views on wind power tends to get more comments than news media content with unfavourable views. In particular, one news media item presenting wind power unfavourably stands out in terms of the number of comments and reactions. The local estimated scatterplot smoothing shows an even increase with a curve towards comments for outliers.

The distribution of the three variables (reactions, comments, shares) is also visualised as a 3D plot (Figure 11). It shows that news media content depicting wind power unfavourably tends to get more reactions compared to shares and comments.

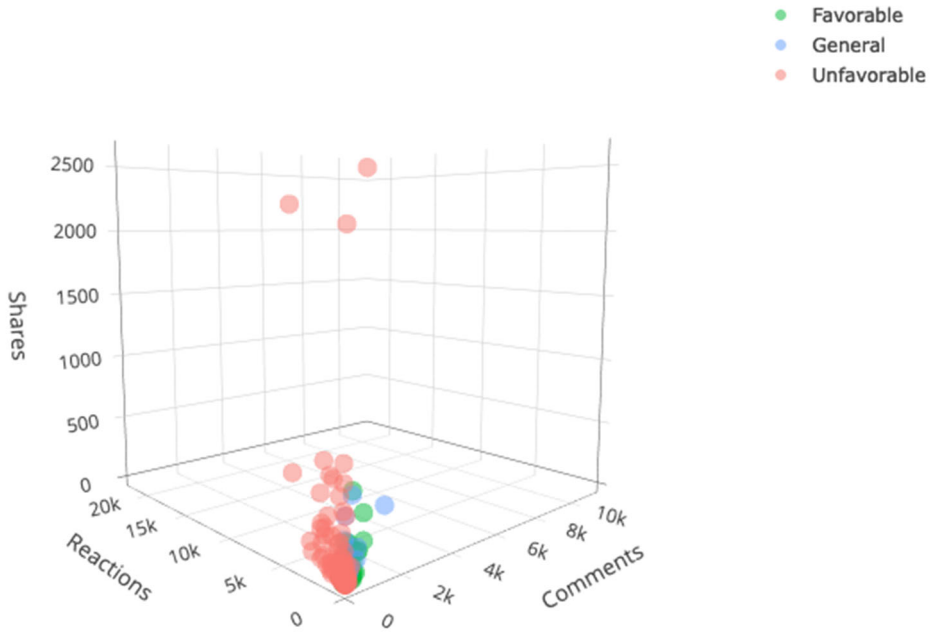

Figure 11. News media content reactions, comments, and shares in Facebook groups (n = 440)

News media content with favourable views of wind power tends to be even in terms of comments and reactions, but not as widely shared. News media content depicting wind power in general terms tends to serve as a middle ground. The pieces of news media content with most interactions portray wind power unfavourably. Some are clear outliers in terms of reactions and shares.

News media content – Facebook group relations

In the network below (Figure 12) news media content is visualised in terms of the extent of interaction with it in Facebook groups. Grey nodes represent Facebook groups. Red nodes represent news media content with unfavourable portrayals of wind power. Blue nodes represent news media content that talks about wind power in general terms. Green nodes represent news media content with favourable portrayals of wind power. The size of the nodes represents the number of relationships, and the centrality implies link interrelation.

Figure 12. News media content relations with Facebook groups

In the main cluster, several Facebook groups tend to interact with several of the unfavourable pieces of news media content. There is a core that posts news media content that associates wind power with negative implications. Green, i.e., positive representations are more likely to be found in the lower part of the network plot. The same is the case for blue, i.e., general representations. The general and favourable representations have in common that they occasionally mix with the unfavourable core. The relationships between Facebook groups - and news media content - are predominantly unfavourable, i.e., red, with occasional favourable outliers and general outliers.

Facebook interactions with Youtube videos

As in the previous section on Facebook interactions with news media content, this section presents Facebook interaction patterns for Youtube videos on wind power. The distribution of interactions with Youtube videos is explained, as well as the relationships between Facebook groups and Youtube video URLs, and the relationship between different forms of interactions.

Key takeaways

- The majority of the 50 most viewed Youtube videos retrieved when searching for *vindkraft* portrayed wind power in a negative light. Interaction data of the 33 most-watched Youtube videos were gathered in the dataset.
- The ten Youtube videos with the most Facebook interactions depicted unfavourable/critical views.
- Arguments mentioned in the unfavourable/critical Youtube videos concern unprofitability, inefficiency, environmental concerns, and costs.
- Unfavourable depictions of wind power in Youtube videos were prominent in terms of reactions, shares, and comments.

Frequency table

Table 13. Frequency table of Youtube video interactions in Facebook groups

	Count	Mean	SD	Min	Max
Comments	19789	599.6667	759.1327	1	2770
Reactions	98273	2977.9697	4739.4446	0	22687
Shares	35390	1072.4242	1291.1064	1	5710

Top Youtube video interactions

The Youtube video on wind power that was most interacted with on Facebook in our dataset contrasts hydropower with wind power (Table 14). Most Facebook interactions with Youtube videos about wind power in our dataset relate to unfavourable portrayals of wind power. The two topmost Youtube videos on wind power in terms of Facebook interactions have more than 20 000 interactions each.

Table 14. Top ten most interacted Youtube video URLs in Facebook groups

URL	Count
https://www.youtube.com/watch?v=nrMuTTULKe4	27664
https://www.youtube.com/watch?v=CJcIXznbsV4	23668
https://www.youtube.com/watch?v=gckqg-r_oFs	12235
https://www.youtube.com/watch?v=SD0e5y1pDnc	12169
https://www.youtube.com/watch?v=ksuR15ulMsI	9173
https://www.youtube.com/watch?v=4Ob5Lfc7LVY	9116
https://www.youtube.com/watch?v=WzsjcCrQ26E	7622
https://www.youtube.com/watch?v=3TQE0Kch48k	6038
https://www.youtube.com/watch?v=wk9URPZ-BOk	5644
https://www.youtube.com/watch?v=ugkaUOzsjvs	5337

Time series – monthly posts

Facebook group posts of Youtube videos concerning wind power peaked in April, May, June, July, and September 2022 (Figure 13).

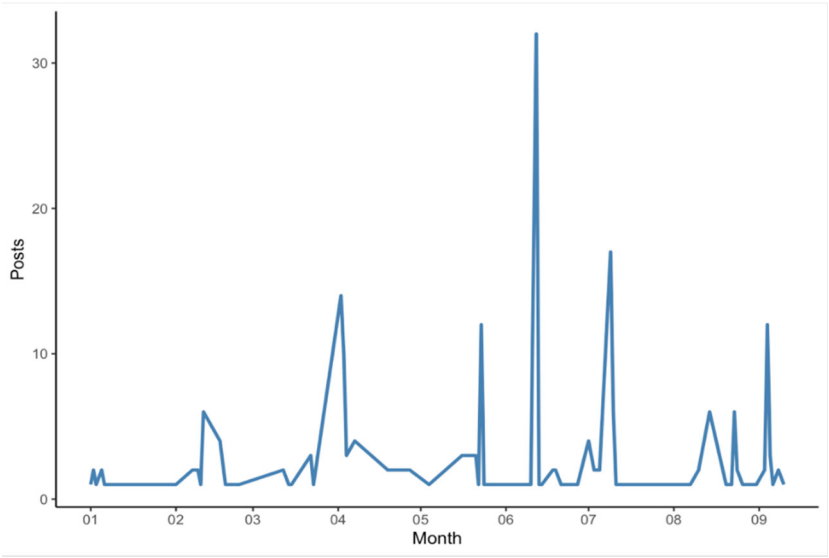

Figure 13. Monthly distribution of Youtube videos posted in Facebook groups

Interaction relationships

The following scatter plots show the distribution of types of interactions across comments, shares and reactions to Youtube videos on wind power in Facebook groups. Each data point is a piece of news media content. Figure 14 shows the distribution of reactions compared to shares. Figure 15 shows comments compared to shares. Figure 16 shows the distribution of reactions versus comments. Figure 17 illustrates the distribution of reactions, comments, and shares overall. Unfavourable portrayals of wind power in Youtube videos are prominent in terms of both the number of reactions and the number of shares (Figure 14).

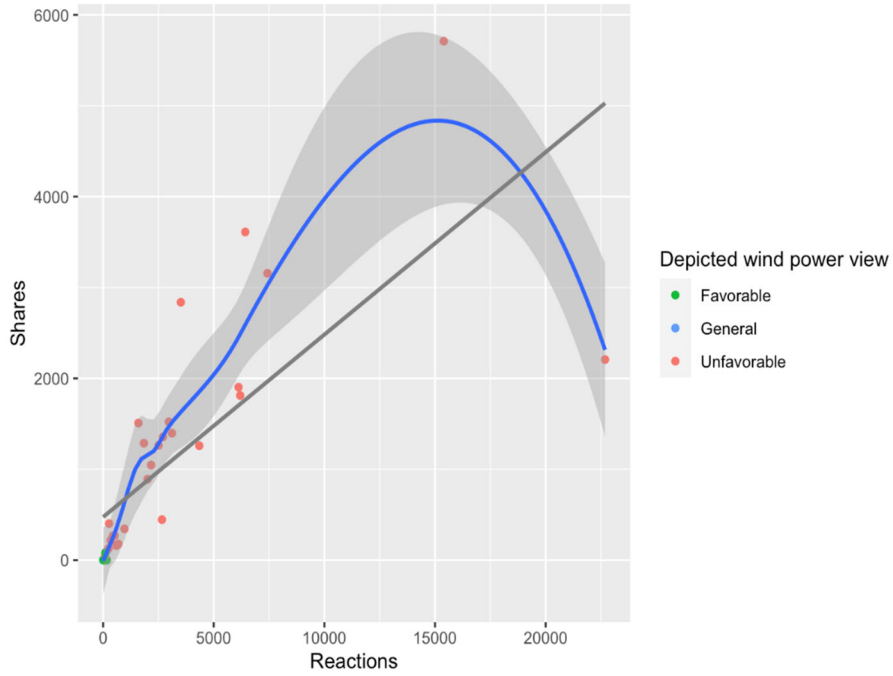

Figure 14. Youtube video reactions and shares in Facebook groups (n = 33)

The local estimated scatterplot smoothing shows an even increase with a slight curve towards reactions for outliers. Accordingly, unfavourable portrayals of wind power in Youtube videos are prominent in terms of both the number of comments and the number of shares (Figure 15).

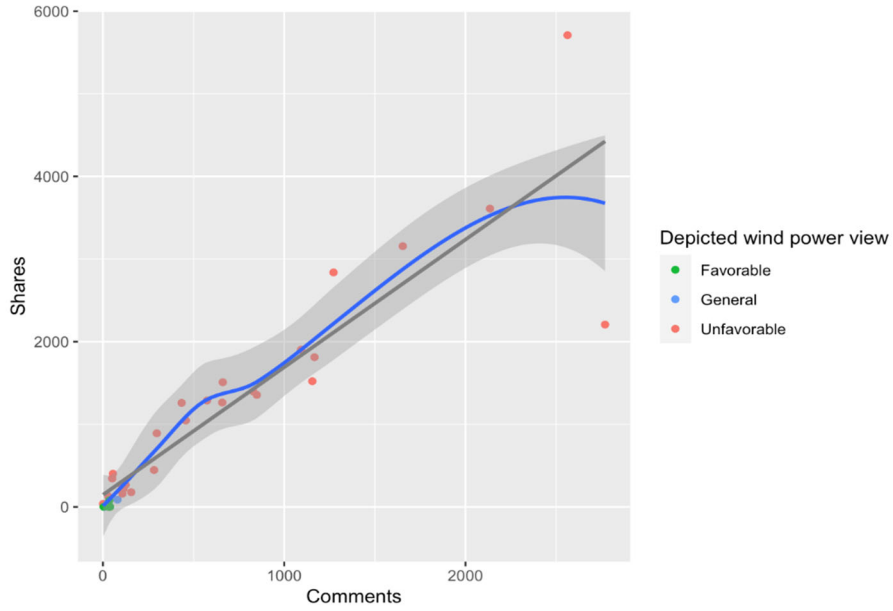

Figure 15. Youtube video comments and shares in Facebook groups (n = 33)

One Youtube video, in particular, stands out, both in terms of the number of comments and the number of shares. The local estimated scatterplot smoothing shows an even increase with a slight curve towards comments. In addition, unfavourable portrayals of wind power in Youtube videos are conspicuous in terms of both the number of comments and the number of reactions (Figure 16).

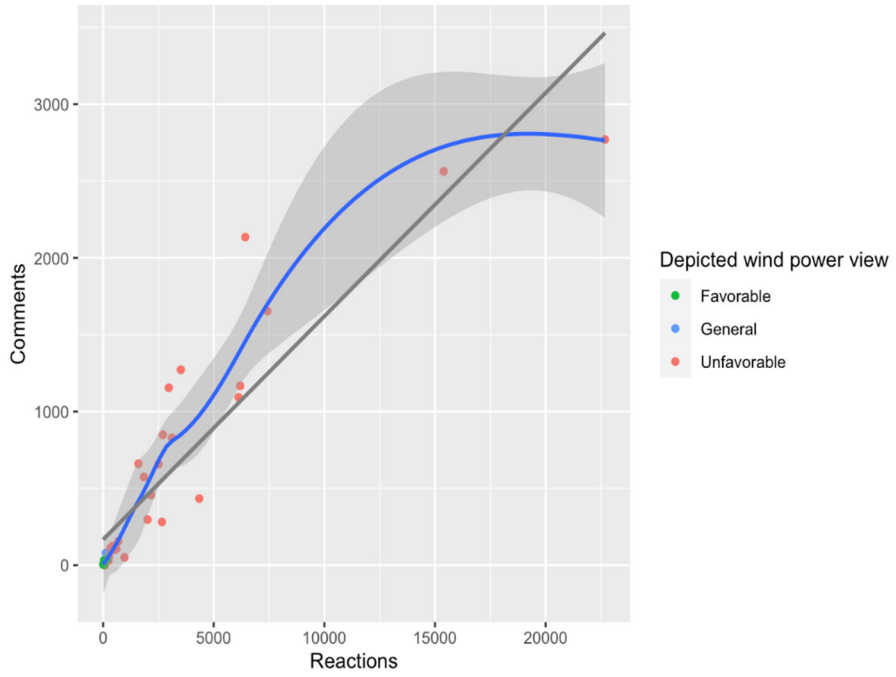

Figure 16. Youtube video reactions and comments in Facebook groups (n = 33)

The local estimated scatterplot smoothing shows a slope towards reactions for outliers. Two Youtube videos stand out in terms of both the number of comments and reactions. Visualised as a 3D plot (Figure 17), Youtube videos portraying wind power unfavourably tend to get the most reactions, comments, and shares.

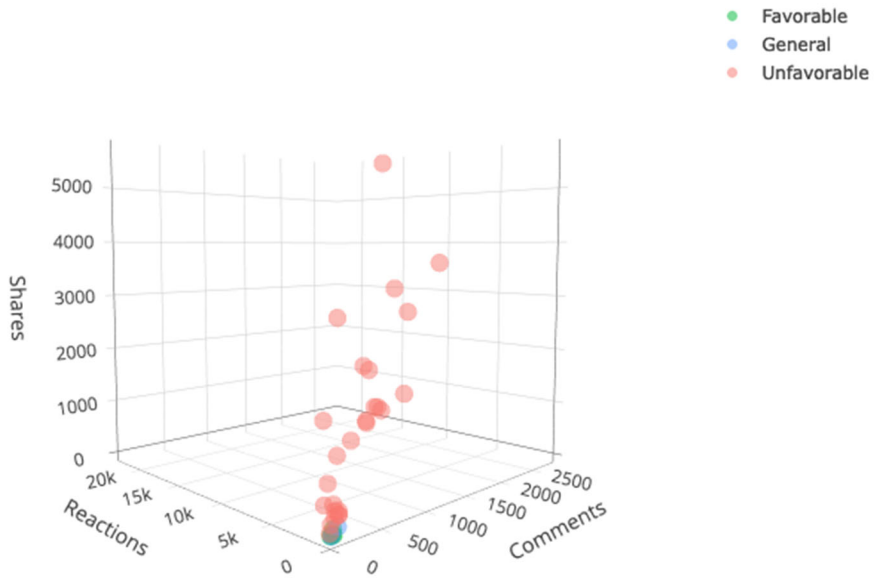

Figure 17. Youtube video reactions, comments, and shares in Facebook groups (n = 33)

Youtube videos in which wind power is portrayed in a favourable or general way usually have a low response in Facebook reactions, shares and comments. The Youtube videos with the most interactions portray wind power unfavourably, with some of them being clear outliers in terms of reactions and shares.

Youtube videos – Facebook group relations

In addition, the Youtube videos are visualised in relation to the extent of interaction with them in Facebook groups (Figure 18). Grey nodes represent Facebook groups. Red nodes represent Youtube videos with unfavourable portrayals of wind power. Blue nodes represent Youtube videos in which wind power is portrayed in a general way. Green nodes represent Youtube videos with favourable portrayals of wind power.

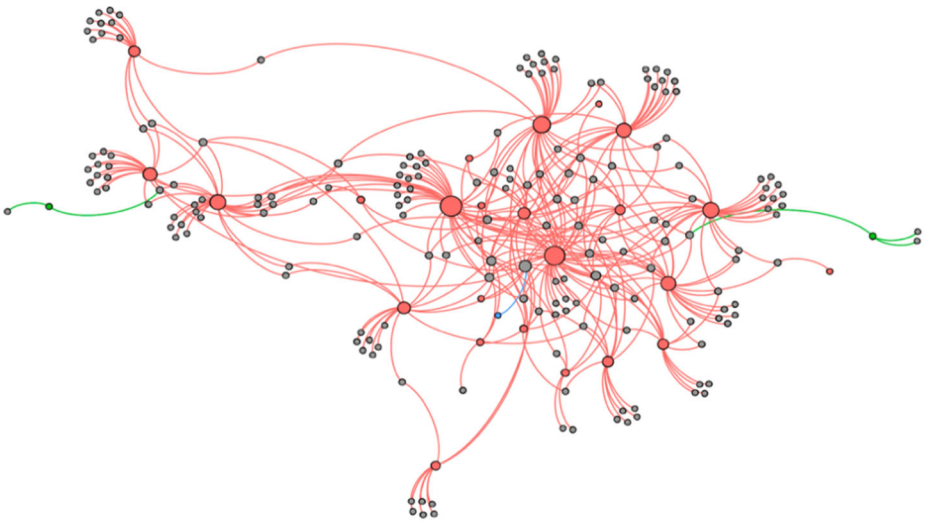

Figure 18. Youtube video relations with Facebook groups

In the main cluster, several smaller clusters of Facebook groups tend to redistribute some of the Youtube videos that portray wind power in an unfavourable light. The network prominently features unfavourable (i.e. in red), relations with occasional favourable and general outliers.

Youtube autosuggest terms

We also plotted Youtube autosuggest terms related to queries on *vindkraft* (Figure 19). The search terms relate mainly to local wind power projects (examples: *vindkraft lyrgsåsa*, *kråktorpet vindkraft*, *björnberget vindkraft*), forms of energy production pitted against each other (examples: *vindkraft vs kärnkraft*, *vindkraft eller kärnkraft*, *vindkraft vs solkraft*), information about how wind power works (examples: *vindkraft fysik*, *hur fungerar vindkraft*, *vindkraftverk fakta*), problems with wind turbines(examples: *vindkraftverk haveri*, *vindkraft buller*, *vindkraftverk brinner*, *olönsam vindkraft*) and installing wind turbines at home (examples: *vindkraft, privat*, *vindkraft hemma*, *mini vindkraft*, *vindkraft villa*).

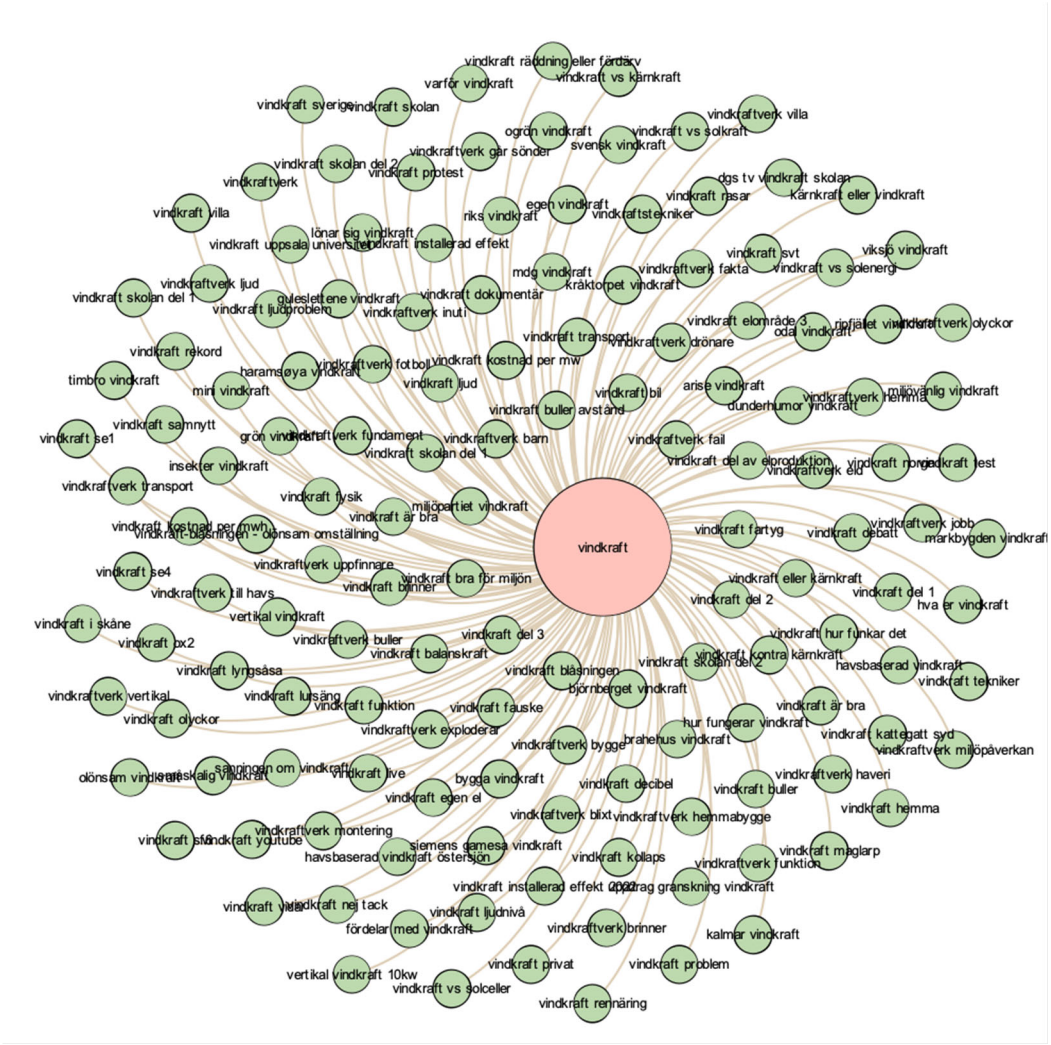

Figure 19. Youtube autosuggest terms relating to *vindkraft*

Twitter conversations

This section deals with wind power narratives on Twitter. The results of our first Twitter dataset are examined to establish which words, topics and hashtags appear most frequently. We then zoom into three themes to see which words appear in specific claims about wind power. Finally, we examine the second Twitter dataset to look at the positioning of the hashtag *#vindkraft* in conjunction with the hashtag *#svpol* to see where wind power featured in Swedish political conversations on Twitter in the run-up to the 2022 general election.

Key takeaways

- Tweets about wind power frequently also mention nuclear power.
- The use of hashtags (#) is relatively uncommon in the dataset, at roughly 9 per cent. The most used hashtags are related to Swedish politics and energy production.
- Zooming in on three themes found in the general online discussion on wind power showed that illness is mainly used as a metaphor for wind power, but it is also mentioned as an effect of wind power. Turbine blades are often related to microplastics and bisphenol A.
- The use of the *#vindkraft* hashtag in Swedish political discussions on Twitter increased in the lead-up to the 2022 general elections. The hashtag *#vindkraft* occurs in tweets together with other hashtags related to energy production, fuel prices and transport, showing the context of these discussions.

To provide an overview of the Twitter dataset, Figure 20 below shows the most frequently occurring words in the collected tweets, excluding stop words (e.g., prepositions, common verbs etc.) in the form of a word cloud. This figure was created using *Voyant* tools.

Figure 20. Full Twitter data word cloud

The keyword used in the creation of the dataset was *vindkraft*, which also makes it the most common term in the word cloud. Looking at the visualisation, we see that the second most common term is *kärnkraft* ("nuclear power"), followed by *Sverige* (Sweden), *havsbaserad* (offshore), *el* (electricity), *bygga* (build) and *blåser* (blows). If we zoom in further, we can also see, for example, that certain users are mentioned frequently. Since we have permanently deleted the user handles, these only appear in the dataset in pseudonymised form (e.g. user_56). However, this still indicates that specific users were prominent and possibly dominant in discussions about wind power on Twitter. Also mentioned in the dataset are several political parties, which is reflected in the word cloud.

Key topics and hashtags in the Twitter data

Topic modelling was performed to gain an idea of the topmost topics within the dataset. The following figure (Figure 21) shows a network graph of the terms and topics prevalent in the dataset, created in Gephi.

The map below shows not only the most common topics, but also how the topics are connected. With the layout algorithm chosen, words that are connected to many other words tend to be positioned centrally, but the strength of the connections also influences the positioning. An example of this is *vindkraft* (wind power), the most frequently occurring word in the dataset with numerous connections. However, this word has many connections with words that themselves have fewer connections, so both they and *vindkraft* are on the periphery of the network. Meanwhile, *kärnkraft* (nuclear power) forms its own central cluster in the wind power dataset because it has stronger connections to other words, which in turn have many other connections. Similarly, offshore wind power (*havsbaserad*) is closer to nuclear power in the centre because of its many connections. At the edges of the diagram, there are some smaller clusters related to wind power and energy production in neighbouring Scandinavian countries. For example, there is a small Norwegian cluster in the upper right corner. Tweets in these languages were collected in our dataset because *vindkraft* (wind power) is spelled the same in several Scandinavian languages. This also shows that there is some degree of overlap between languages and contexts in Twitter.

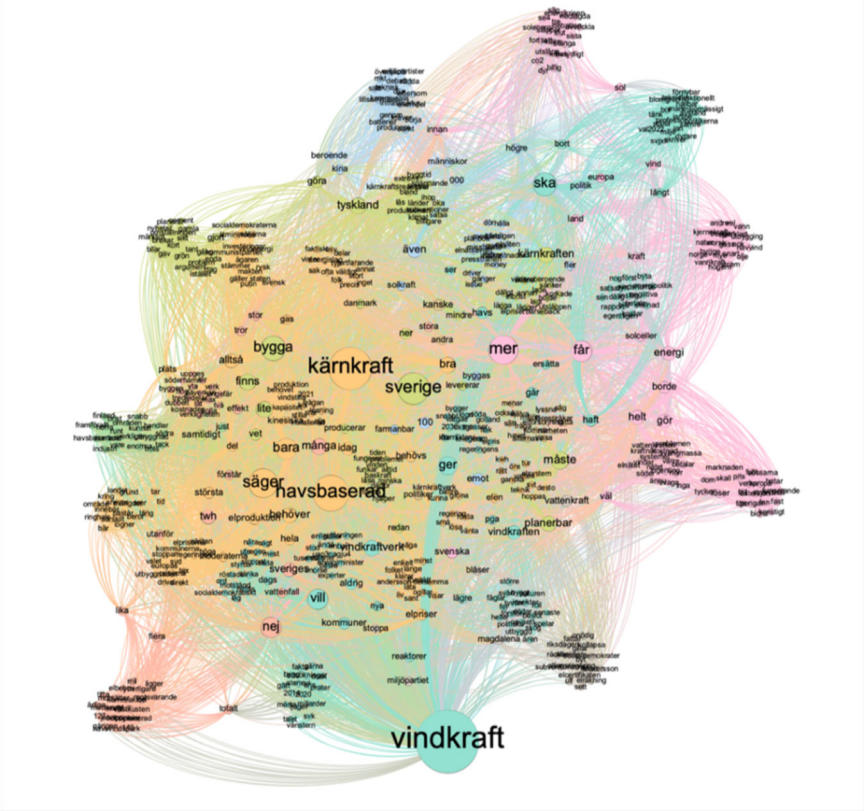

Figure 21. Topic modelling of the Twitter data

Another way of understanding a Twitter dataset is through co-hashtag analysis. Hashtags are a form of metadata added to individual tweets to connect them to a larger conversation on a topic (Gunnarsson Lorentzen, 2016; 2017). The co-hashtag analysis visualisation below (Figure 22), created in *Gephi*, shows the topmost hashtags in the wind power Twitter dataset (excl. #vindkraft).

Figure 22. Co-hashtag analysis of the Twitter data

Figure 22 shows that the most common hashtags related to Swedish politics and the 2022 general elections (#svpol, #valet2022, #val2022, #almedalen2022, etc.), as well as energy production and other energy sources (#kärnkraft, #vattenkraft, #solkraft, #kolkraft, #energikris, #energipol etc.). Similar to the previous figure, the Scandinavian neighbouring countries can also be recognised here by the appearance of the hashtags #norge and #danmark.

Another notable finding is that nine per cent of the tweets in this dataset contain hashtags, which is slightly less than other Twitter datasets. Previous studies have found that between 13-21 per cent of tweets contain hashtags, depending on the context (Enli & Simonsen, 2018; Gerlitz & Rieder, 2013). A large proportion of the hashtags in this dataset occur only once, suggesting that there is not always a consensus on which hashtags to use. These once-used hashtags can be seen in Figure 22 as small nodes on the fringes of visualisation. However, for confidentiality reasons, the words in these hashtags are not shown.

Zooming in on three themes in the Twitter data

As mentioned in the introduction, some recurring points of criticism are advanced against wind power. We decided to search the Twitter dataset for some of those to see if they also appear here, and if so, in what form. These are claims about 1) illness associated with wind power, 2) the spread of microplastics from the turbines, and 3) the spread of bisphenol A from the turbines. All three are briefly explored in this section using visualisations created with the AntConc software.

It should be emphasised that we only identified mentions of these three topics in a small part of the dataset. They occurred 402, 346 and 32 times respectively in a dataset of 72 194 tweets. So, although these claims are familiar in the context of opposition to wind power, they do not appear to make up a large part of the Swedish discussion on Twitter. Nevertheless, it may be of importance to briefly examine them here to see in what kind of narratives they occur.

Cancer and illness as a metaphor for and an effect of wind power

One claim circulating against wind power is that people fall ill from being near wind turbines for too long. Using AntConc, the Twitter dataset was searched for mentions of illness using the following keywords: *sjuk*, epilepsi, cancer*, yrsel* and *infraljud.* (sick*, epilepsy, cancer*, vertigo and infrasound). Two keywords were truncated to allow for ending variations such as *sjukdom*, *cancersjuk* and similar.

These five keywords appear in only a small subset of the dataset. Only 402 tweets (out of 72 194 tweets) include one or more of these keywords in different variations. Reading the tweets, it is clear that illness is mainly used as a metaphor for wind power or related topics. We see that the Swedish word *sjukt* (which translates to "sick" in English) is used to speak out against wind power and the current situation in Sweden. In Swedish colloquial language, the word sick is not only used for an actual illness, but also to express that something is wrong, twisted, or bad. Examples of visible narratives are that something about wind power is sick or bad, that proponents of wind power suffer from mental illness, or that electricity costs are sick or scandalously high. To a lesser extent, illnesses are also discussed as an effect of wind power, with statements that people get cancer, heart defects or other illnesses from wind power. It is often difficult to detect irony in tweets outside their context, but there also seem to be some tweets mocking people who say that wind turbines make them ill. Another finding is that words that refer to illness in other ways, such as healthcare, health insurance and healthy food, appear in relation to wind power in tweets arguing that the state should spend more money on healthcare rather than wind power.

The search results are visualised as a collocation word cloud (Figure 23), showing the words that occur most frequently together with the five keywords (*sjuk*, epilepsi, cancer*, yrsel, infraljud*). This means that the keywords themselves do not appear in the visualisation, but only the most frequently occurring words. It should be noted that there was no stop word function in this version of AntConc, so these types of words are also visible in the word could below.

Figure 23. Words appearing most frequently in relation to the illness keywords.

Microplastics

We also searched the Twitter dataset using the following keywords based on variations of the Swedish translation of microplastics: *mikroplast*, microplast*, mickroplast**. As we found that microplastics appeared in different variations in the dataset, we used truncations to search for different spellings. In total, these three keywords with different endings appeared in 346 tweets (out of 72 194). The narratives in this subset revolve around the wind turbines themselves, such as the rotor blades, and how they are said to release or disperse large amounts of microplastics as they move.

The figure below (Figure 24) is a collocation cloud and shows the words that occur most frequently together with the three microplastics keywords, excluding the keywords themselves. The figure also shows which certain terms are used in combination with microplastics. Of particular interest is the frequent occurrence of the terms 'well-known' (*välkänt*), but also 'phenomenon' (*fenomen*). Their presence might suggest a form of rhetorical language used to make a claim appear certain and less disputed.

Figure 24. Most frequent words appearing in relation to microplastics keywords.

Bisphenol A

In connection with microplastics, there is also the claim that wind turbines release the chemical compound bisphenol A. A search using the following three keywords *bisfenol a*, *bisfenol**, *bispehnol** (deliberately misspelt) revealed that this issue only appeared in 32 tweets (out of 72 194) and that it appeared mainly in connection with microplastics, turbine blades and hormones. As before,

AntConc's collocation function is also used here (Figure 25), which means that the keywords themselves do not appear in the figure.

Figure 25. Most frequent words in relation to bisphenol A

Wind power in discussions on Swedish politics, the #svpol example

To situate the results from the first Twitter dataset revolving around the search term vindkraft (wind power), we also explored a second dataset concerning Swedish politics. As is described in the methods chapter above, the second Twitter dataset was created from searches using the hashtag #svpol (Swedish politics) between January 1, 2022, and September 11 2022, the day of the elections.

With the use of this dataset, we explored the context of the *#vindkraft* hashtag in relation to the *#svpol* hashtag dataset during this time span. To illustrate how mentions of wind power shifted during this period, we focused on the months of January (Figure 26) and August (Figure 27), which are the first and last full months of data in this second dataset. For clarity, we only included hashtags which co-occur with *#vindkraft* and excluded all other hashtags which occur in the larger *#svpol* dataset. Therefore, only one cluster of hashtags will be shown in the following visualisations.

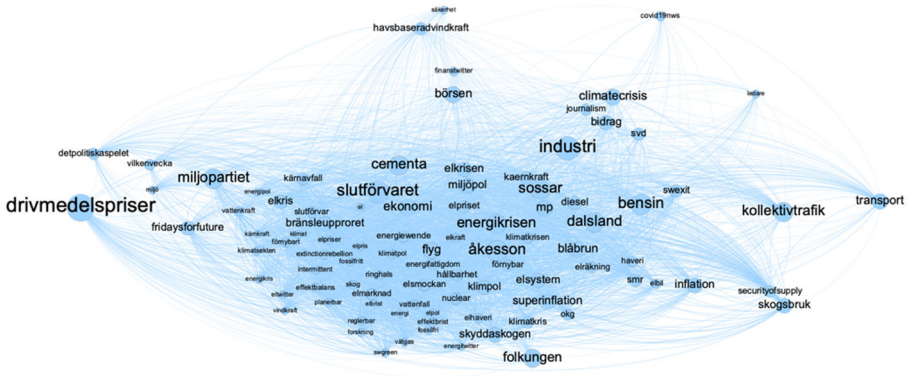

Figure 26. Co-hashtag analysis of the #svpol data and wind power, January 2022

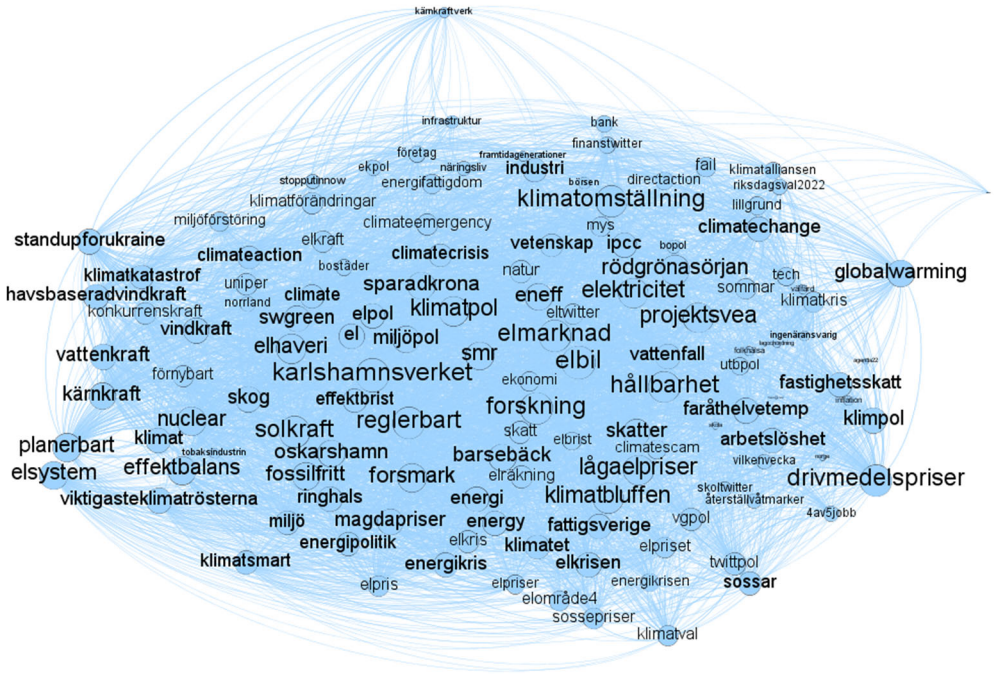

Figure 27. Co-hashtag analysis of the #svpol data and wind power, August 2022

The two figures above illustrate and confirm that discussions about wind power occur in the context of discussions about energy production, fuel prices and transport. The use of *#vindkraft* increased from January to August, which makes it appear as a larger node in the month just before the Swedish general elections. That said, *#vindkraft* is still a small hashtag compared to many other hashtags. This is also in line with the results of the first Twitter dataset, which showed that hashtags are generally used to a lesser extent in discussions about wind power than what is otherwise common on Twitter.

Summary

Google Search

The strong increase in search interest in the weeks before the parliamentary elections can be interpreted as an indication that wind energy played a role in the political discussions and election campaigns during this period. The related search with the strongest increase in the month of the election concerned the disadvantages of wind power. This suggests that a focus on problems with wind power gained traction during this period. Regarding relationships between search terms and search results, and between search terms, autosuggest terms and related searches in Google Search, it was possible to retrieve search terms via RAT to analyse the level of monthly average searches for individual queries via Google Search. In addition to the general search queries for *vindkraft* and *vindkraftverk*, the results show that four types of search queries stand out in particular in terms of the average monthly searches in Google Search: queries on installing wind turbines at home, queries about wind turbine efficiency of wind turbines, queries about how wind turbines work and operate, and queries about offshore wind power. Google search users interested in wind power in Sweden seem intent on finding web content related to the use of wind turbines to generate energy at home, as evidenced by the frequency of searches such as *vindkraftverk hemma* (wind turbine at home) and *små vindkraftverk för villor* (small wind turbines for family homes).

When analysing the totality of search terms, autosuggest terms and related search queries on the topic of wind power, one finds that other prominent search queries concern the purchase of wind turbine shares and the cost of wind turbines. Concerning the localised search terms discussed earlier, two particular forms of queries relate to local wind power initiatives in Sweden. These are specific wind turbine producers or initiatives at the municipal level to prevent wind farms from being established, which is reminiscent of previous research (Persson, 2021; Silverberg, 2022).

Twitter

As for central topics in the Swedish Twitter discussion about wind power, some topics emerged as particularly prominent in the analysis. The most notable is nuclear power, which appears in all analyses as a central topic in relation to wind power discussions on Twitter. These two energy sources are often compared and contrasted in the discussions. Looking at other common words, we also see *havsbaserad,* which refers to offshore wind power. Other terms related to these topics are *blåser* (blows), and *bygga* (build), which appear in discussions about the building of new wind farms and wind turbines, as well as the reliability of wind power for energy production, arguing that wind does not always blow.

Looking specifically at hashtags used in the Twitter dataset, we find that they mainly relate to Swedish politics and energy production. Besides wind power and nuclear power, other forms of energy sources also appear here, with hashtags for hydropower, solar energy, oil and coal. These energy sources do not appear as clearly in the analyses related to the content of the tweets, which shows that some topics are mainly used as hashtags. It should be noted that the use of hashtags in the wind power Twitter dataset is less prevalent than is common on Twitter, at only nine per cent.

Previous studies have found that between 13-21 per cent of tweets typically contain hashtags, but this is contextual, with some topics or users using hashtags more and others less frequently (Enli & Simonsen, 2018; Gerlitz & Rieder, 2013). Other visible hashtags relate to energy and climate change in different ways, such as the hashtags for fossil-free, energy efficiency and electric cars. Both the co-hashtag analysis and the topic modelling revealed clusters or words that refer to other Scandinavian countries, showing that there is some overlap between languages and contexts in Twitter conversations.

In the dataset related to hashtags found in Swedish politics (*#svpol*) discussions on Twitter, the hashtag wind power (*#vindkraft*) occurs in clusters together with energy production, fuel prices and transport. Comparing January 2022 with August 2022, it is clear that the hashtag wind power (*#vindkraft*) has gained prominence in the run-up to the 2022 Swedish general election. This suggests that either more tweets were written about wind power in the second half of 2022 than at the beginning of the year, or that more users used hashtags to reach their desired audience.

Facebook

In examining the role of Facebook groups in shaping the image of wind power in Sweden through the dissemination of wind-power-related content, our results show that critical or unfavourable portrayals of wind power tend to get the highest interaction numbers. Eight of the pieces of news media content that were interacted with the most showed unfavourable or critical portrayals of wind power and the article with the most interactions was about a broken wind turbine. These results suggest that content discussing problems with and advancing critical views of wind power performs best on Facebook, at least in Facebook groups.

The pattern of Facebook interaction with new media content is similar to that with Youtube videos. Yet, since the most viewed Youtube videos on wind power generally present an unfavourable view, this result is less significant. Still, since Facebook groups can drive traffic to YouTube, it is worth mentioning. The ten Youtube videos with the most interactions on Facebook all portray wind power unfavourably and emphasise perceived problems such as unprofitability, inefficiency, environmental destruction, and costs. In our dataset, most Facebook group posts with links to Youtube videos on wind power were published in June 2022.

In terms of the type of interactions, links to news media content with an unfavourable view of wind power received more shares and reactions than those expressing a favourable view or portraying wind power in general terms. However, favourable or general content tended to receive more comments than unfavourable content. For Youtube videos, unfavourable portrayals of wind power lead in terms of reactions and shares, as well as comments in Facebook groups.

Our analysis shows that interaction with media content and Youtube videos critical of wind energy and wind turbine development is particularly pronounced in Facebook groups. As can be seen from the network diagrams (Figure 17), this content is shared in group clusters, which encourages further dissemination. Our results show that Facebook groups tend to highlight negative aspects of wind power, regardless of whether they are supported by evidence or not. News media content and Youtube videos with unfavourable views of wind power are shared and interacted with in Facebook groups. As high engagement increases the visibility of content in Facebook groups, this content is highlighted in the feeds of the groups. This likely structures the discussion internally to a group and transfers it to discussions in neighbouring groups.

Summing up

In terms of prevailing views, there are discrepancies between Google Search and social media, both Twitter, Facebook, and YouTube. While there was a significant and large increase in Google searches on the disadvantages with wind power in the month of the general election, the most popular search terms during our study period concerned different topics. They were about factual information, technical issues, and finances, but mainly the installation of small wind turbines for private use. Most of the URLs and domains in the search results generated from the most common Google searches belong to public authorities, public service, and energy companies. In contrast, on social media an image has emerged where wind power is portrayed as less reliable compared to other energy sources. Nuclear power in particular is a constant point of comparison. As negative news and unfavourable content about wind power are shared more frequently on and between social media platforms than positive content, this likely reinforces a negative understanding of wind power.

Svensk sammanfattning

Den här rapporten presenterar resultaten från en explorativ kvantitativ studie om hur information om vindkraft har cirkulerat online i Sverige under 2022. Fokus ligger på narrativ, aktörer och dominansrelationer beträffande vindkraft på sociala medier samt Google Söks roll i detta.

Diskussioner om vindkraft formas av både sociala normer och lokal kultur och historia (Karakislak, et al., 2021). Nutida debatt om vindkraft är ofta antagonistisk, politiskt laddad och ibland polemisk (Borch et al., 2020; Hindmarsh, 2014). Den allmänna opinionen om vindkraft i Sverige är huvudsakligen positiv, men har blivit mer negativ under de senare åren. Personer som bor i städer samt kvinnor är ofta mer positivt inställda jämfört med män samt de som bor på landsbygden (Jönsson, 2022). Vindkraft förstås generellt sett som en hållbar och förnybar energikälla (Energimyndigheten, 2021; Wizelius, 2015). Planerad vindkraftsutbyggnad i Sverige stoppas dock ofta på kommunal nivå (Jönsson 2022). Ett liknande vindkraftsmotstånd har också setts i andra skandinaviska länder (se till exempel Borch et al., 2020; Heidenreich, 2016). Som med all energiproduktion finns det legitima frågor och problem. Dock förekommer också påståenden om vindkraft för vilka det saknas vetenskapliga bevis.

Med hjälp av digitala metoder har projektet samlat in data från plattformarna Google Sök, Facebook, Youtube och Twitter. Den huvudsakliga datainsamlingen genomfördes mellan maj och november 2022, med vissa data insamlade från januari 2022. Insamlade data är helt anonyma, aggregerad på hög nivå och består av hundratusentals kvantitativa datapunkter. Datainsamlingen har som utgångspunkt baserats på sökordet *vindkraft* och har därför inte specifikt fokuserat vare sig på positiv eller negativ information.

I projektet undersöktes Google Söks roll i att föra fram vissa typer av påståenden om vindkraft i Sverige, vilken förståelse av vindkraft som framförs i relationer mellan söktermer och resultat, samt mellan söktermer, autoförslag-termer och relaterade sökningar. Vidare kartlade projektet centrala ämnen i svenska diskussioner om vindkraft på sociala medier, främst på Twitter men även på Facebook och Youtube, och undersökte vilken bild av vindkraft som uppstår i samspel mellan nyhetsmedier och olika sociala medier.

Resultaten visar att de mest frekvent förekommande domänerna i Google-resultaten är myndighetsorganisationer, energibolag och nyhetsmedier. De mest frekventa URL:erna går till myndigheter, intresseorganisationer och energibolag. I projektet undersöktes också spridning av Youtubevideor om vindkraft på Facebook. De tio mest interagerade Youtube-videorna speglar en ofördelaktig eller kritisk syn på vindkraft. I dessa videor lyfts argument mot vindkraft som berör olönsamhet, ineffektivitet, miljöproblem samt generella kostnader.

Vid undersökning av delning av nyhetstexter i Facebook-grupper fann vi att 440 URL:er delades i grupper mellan januari och september 2022. Den mest förekommande interaktionen skedde kring en artikel om en vindkraftsturbin som havererat. Vidare var texter som jämför vindkraft och kärnkraft framträdande i form av interaktioner. Åtta av de tio artiklar som fick mest interaktion speglar problematiska eller ofördelaktiga aspekter av vindkraft. Överlag får artiklar som lyfter ofördelaktiga aspekter fler delningar i Facebook-grupper, jämfört med artiklar som lyfter fördelaktiga aspekter. Samtidigt kan vi se att nyhetstexter och pressreleaser som lyfter fördelaktiga eller generella nyheter kring vindkraft får mer kommentarer i Facebook-grupper.

Vid analys av Twitter-data kunde vi se att tweets om vindkraft ofta också nämner kärnkraft. Hashtaggar är relativt ovanliga i tweets om vindkraft, och återfinns bara i ca 9 procent av de insamlade inläggen. De vanligaste hashtaggarna markerar att det handlar om politik i Sverige och elproduktion. Vid fokus på vanligt förekommande teman i argument mot vindkraft såg vi att sjukdom och cancer används som en metafor för vindkraft i första hand, och i andra hand lyfts sjukdom fram som en effekt av vindkraft. Vingarna på vindkraftverken lyfts fram i relation till mikroplaster och bisfenol A. I den andra uppsättningen Twitterdata innefattandes hashtaggen #svpol kunde vi se att användningen av hashtaggen #vindkraft ökade när det svenska valet 2022 närmade sig, och tog större plats i augusti i jämförelse med januari. Vidare ser vi att #vindkraft-hashtaggen är positionerad i samma kluster som hashtaggar om elproduktion, bränslepriser och fordonsfrågor. Överlag kan vi se att det finns en koppling mellan de studerade plattformarna, där innehåll om vindkraft från en plattform delas och kommenteras på en annan.

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