

Mapping Controversy

The Atlas

Citizen perspectives on Power-to-X technologies



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Introduction

Climate-related interest in transitioning away from fossil fuels has led to many recent technological developments in green energy. Power to X is one such development; the idea is that surplus renewable electricity from wind, solar or water can be used to produce other energy types, such as hydrogen fuel, in a more environmentally friendly manner.

But Power-to-X is not without its controversies. Debates about the economic and technological feasibility of Power-to-X have emerged at the same time as Denmark and many other countries have begun investing vast resources in its development. Industry experts are unsure about the public opinion, as Power-to-X will mean building more facilities such as windmill parks and hydrogen plants in Denmark that could meet a NIMBY-response.

The technology of Power-to-X is so new that we were curious to see if we would find elements of a budding controversy online - therefore we sought to examine a local public debate, the expert knowledge presented in the academic conversation, and what information is currently most represented in an online search and from whom. We focused on hydrogen in a Danish context for our mapping.

Graph 1

What do users talk about when discussing news articles related to hydrogen in Fredericia? (Facebook)

Open Fredericia Dagblad's Facebook page
Query "brint"
Note date + title of posts deemed relevant

HARVEST

Search for relevant posts using date

Facepager

Collected list of 13 relevant posts

Scrape text from all comments of posts (Note: managed 7 before API + account limits reached)

Facepager

Export CSV file with comment text

CSV

Export Gephi file (188 nodes)

GEXF

Network mapping. Terms to Terms. Nodes: 300. All other settings default.

Python

Export CSV file with 201 terms

Extract noun phrase list from text using Cortext, minimum frequency = 2, list length = 200, max length = 2, sample size = 250

Python

ANALYZE

VISUALIZE

Run modularity. Colour nodes by modularity, size by weighted degree.

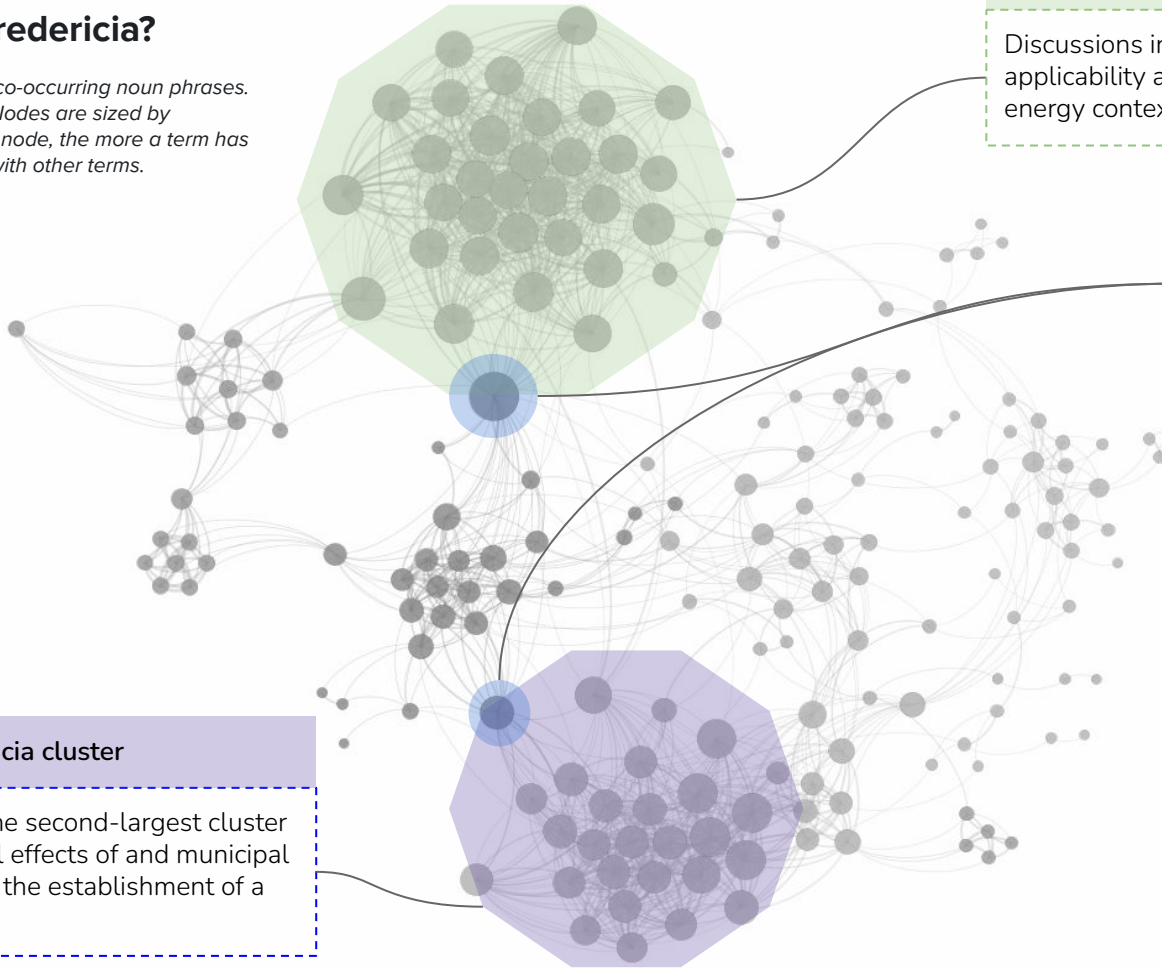
Apply Force directed layout with Force Atlas 2, stronger gravity, gravity = 0.05, prevent overlap

Gephi

Export PNG image: Network of co-occurring noun phrases

What do users discuss when commenting on Facebook news articles related to hydrogen in Fredericia?

Mapped as a network of co-occurring noun phrases in Facebook comments. Nodes are sized by modularity; the larger the node, the more a term has appeared in connection with other terms.



Hydrogen processes/energy production cluster

Discussions in the largest cluster concern the applicability and use of hydrogen in the green energy context.

Their central positioning and many connections indicate that “kommune” and “transport” are central to several discussions.

“Transport”

Commenters discuss both the use of hydrogen as a future fuel for the transport sector as well as the logistics and safety of transporting hydrogen.

“Kommune”

This node bridges discussions of the municipal hearing process for the establishment of the hydrogen plant, role of municipalities in the government’s future climate plans, and citizen hopes and fears for the municipality’s future in regards to industry and sustainability.

Local citizen/Fredericia cluster

The discussions in the second-largest cluster have to do with local effects of and municipal processes regarding the establishment of a hydrogen plant.

Story

In 2021 plans were announced to build a hydrogen plant on the outskirts of Fredericia, a town in Jutland. We wanted to see how the public was reacting to this news.

In a corpus taken from Facebook comments on local news articles related to hydrogen, the nodes in this network represent noun phrases, and the nodes are linked by edges when they appear in the same comment. As we have applied Force 2 Atlas, nodes are placed closer when the comments using them have a similar content. The resulting visual clusters, some of which are labeled in the image, correspond to different topics.

In the hydrogen processes and energy production cluster, some commenters believe the production of hydrogen via energy from windmills is an important part of lessening dependence on fossil fuels. Others are doubtful of the feasibility of this process and how “green” it truly is.

In the local citizens/Fredericia cluster, some locals express distrust, concerns about risk, lack of citizen involvement in decision-making, and lament more industry in Fredericia. Others are excited for the opportunity for Fredericia to be a leading technological city, trust that authorities have taken care of risk procedures, and look forward to the possibility of more jobs.

What is interesting to note is that **the clusters lie completely separated from one another, meaning that the discussion and controversy over the hydrogen plant is taking place on different levels and means different things to different citizens.**

Graph 2

What are the main terms in academic articles regarding Hydrogen in Denmark? (Scopus)

What are the main terms in academic articles regarding Hydrogen in Denmark? (SCOPUS)

Analysis of terms in publications regarding Hydrogen in Denmark on SCOPUS

xxx pages in category

Search for publications about hydrogen in Denmark

SCOPUS

List of articles regarding hydrogen in Denmark

CSV

Harvest the articles

SCOPUS

HARVEST

Generate .csv of recurring terms in the articles' abstract

CSV

Build visualisation of recurring terms in the articles

Cortext

Network generated - retouch network in Gephi

Network

Network will show nodes made up of terms that are recurring in the abstracts

Google Slides

ANNOTATE

Network visualization

PNG

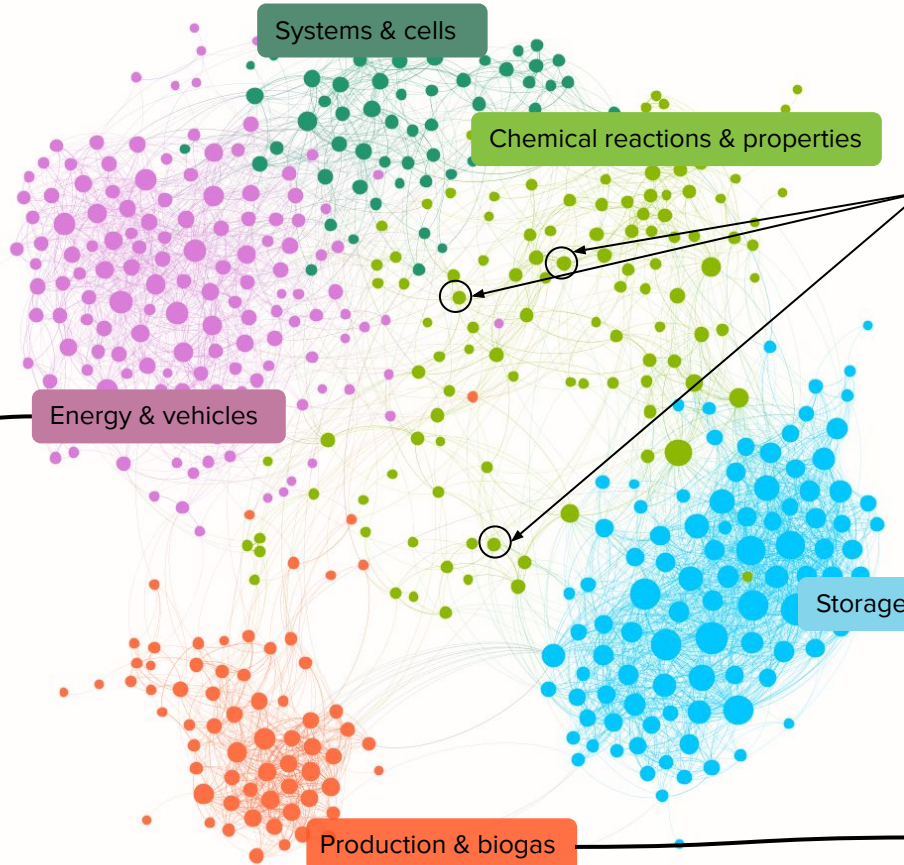
VISUALIZE

Gephi properties:
Run ForceAtlas 2 with stronger gravity and 0.05 gravity value
Run modularity,
nodes->ranking->degree min 3 max 15
nodes->color->partition->modularity class
Preview: Node opacity 80
Node outline opacity 60
Proportional labels
Node border removed
Edge opacity 35

Gephi

What are the main terms in academic articles regarding Hydrogen in Denmark?

Network constructed with co-occurring terms from abstracts pulled from SCOPUS articles with 20 different search queries related to the hydrogen field in Denmark



Some of the nodes are more centrally located meaning they are terms that are being used in various discussions:

- recent advances
- low cost
- long term
- hydrogen storage

The cluster is more closely connected to the nearby clusters which could mean it is more central in the academic discussion in general. Here we find nodes that consist of quite general terms like “wind turbines” and “electricity demand”.

The “storage and release” and “production and biogas” clusters are quite dense and more isolated from the rest of the network, indicating more specialized/technical content.

Story

The idea for this network came in conjunction with the Facebook network. The idea that we could identify knowledge gaps between the public and the academic circles needed to be supported by a network of terms that appears in academic articles. We then wanted to cross reference these terms to see if there were recurring terms between the two networks, and if there wasn't at all, what would that mean?

There are two clusters that are denser and less intensely connected to the other clusters, which indicates more technical knowledge. The terms from these clusters in the hydrogen network are nowhere to be found in the Facebook network.

If we want to explore some kind of relation, we have to dive deeper into the energy & vehicles cluster.

This is where we meet terms like “wind turbines”, “hydrogen vehicle”, “transport” and “fueling”, which are also represented in the Facebook network.

Some terms that bridge several clusters are concerned with the feasibility of various hydrogen production methods, fuels and more. Will these processes and experiments remain specialized research or will technological development/innovation mean they will ultimately have larger implications for society?

The public discussion contains terms and phrases from the academic world, but falls short on discussing the technicalities in the field - this sort of information, at least on SCOPUS, is directed towards academics, engineers or people otherwise technically engaged in the field. **So who is facilitating the information that is more available to the public?**

Graph 3

Who facilitates the information available on Google regarding “Power to X in Denmark”? (Google)

Analysis of URL-pages about Power to X in Denmark

24 Web Entities identified on Google search ("Power to X Denmark")

Search Google for relevant URLs.
Search terms: "Power to X Denmark"

Google

24 Web Entities are identified and put into Hype

Crawl limited to a 1-click depth

Crawl and harvest

Hype

Generate .csv of webentities, number
of crawled pages & URLs

CSV

Build visualisation of connection
between original and scraped URLs

Hype

Network generated
Retouch network in Gephi

Who facilitates the information available on Google regarding "Power to X in Denmark"?

Network

Network will show nodes made
up of URLs
Divided in original and
discovered URLs

Google
Slides

Network
visualization

PNG

ANNOTATE

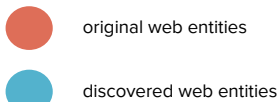
VISUALIZE

Gephi properties:
Run ForceAtlas 2 with stronger
gravity and 0.05 gravity value
Removed nodes with less than three
neighbors with k-core: 3
Sized by in-degree min: 3 - max: 15
Run Label adjust layout
Colored by Crawled:true/false
Proportional labels
Edge opacity: 35

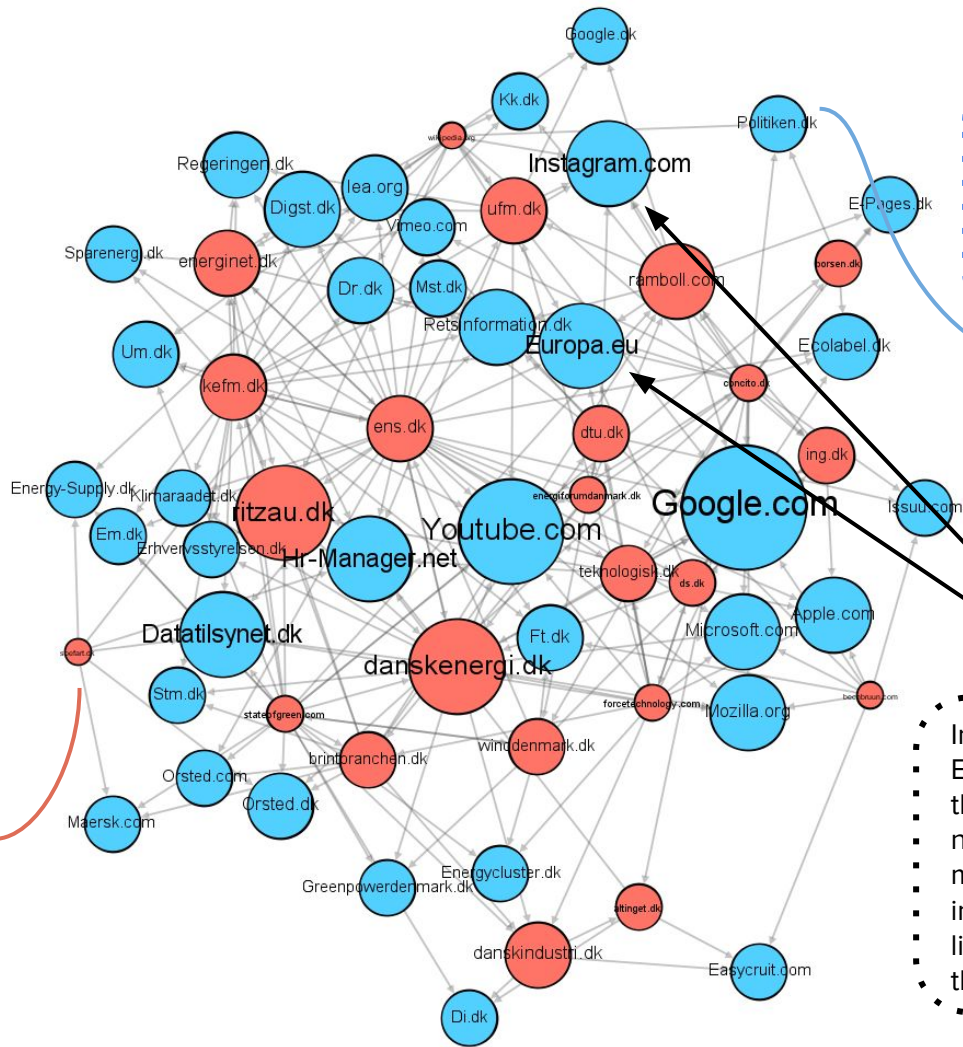
Gephi

Who facilitates the information available on Google regarding “Power to X in Denmark”?

Mapped as a network that shows the pages discovered when crawling (first degree) the top 24 web entities that arise when searching for “Power to X Denmark” in Google.



The original web entities are mainly dominated by three different types of pages: **political** (Ministries & Agencies), **expert media** (Maritime, business & political) and lastly **engineering consultancies and experts**.



The discovered web entities on the other hand, contain both **mainstream media** as well as **social media**.

Instagram and Europa.eu are among the largest nodes in the network, meaning that many of the other pages in the network are linking to them/citing them.

Story

The top pages that appear when we conduct a Google search tell us something about the actors facilitating the online information on a given subject. The third graph reflects the 24 dominating web entities that we discovered when Googling “Power to X Denmark ” and the pages they link to. The red nodes represent the original web entities and the blue nodes represent the discovered pages. The nodes are sized by in-degree, which means that the larger the node, the more the page is linked to by other pages.

Google, Youtube and Instagram are some of the biggest nodes, though the size needs to be interpreted with caution due to media effects. By following the links, we discovered that social media sites, such as Instagram, not only represent standard integrated hyperlinks but also represent relevant content. Social media is being used to share content about PtX on expert media, and it is interesting that neither LinkedIn nor Facebook emerged in our network but Instagram did.

PtX is a political hot topic and industrial movement, and it is expected that the dominant actors who facilitate the information available on Google have a common aim in representing the Danish hydrogen and PtX value chain. Since the EU is funding PtX related projects in order to promote the green transition, it makes sense that we see Europa.eu as one of the largest discovered nodes. Furthermore we see that the maritime industry paper Søfart links to a lot of pages, which tells us about its role as a facilitator of information regarding PtX in Denmark.

The dominant actors who facilitate the information available on Google are mainly representative of the expert side of the story. The results leave us with a curiosity to follow the network, and to look into whether we would get the same or different results when Googling “Windmills Denmark” - or by doing the same search with PtX over the next year, two years, five years - to see if the network of narrators will change.



**Thank you for
your time!**
