Climate Myths in Social Media

A mapping of Facebook and Twitter/X during the period 2020-2024.





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Content

1	Introduction
2	Key findings
3	Data and definitions
4	Facebook
5	Twitter/X
6	Method
7	Litterature



Introduction

Preface

The Greatest Threat to a Livable World

Facts are the foundation for an enlightened society. Without facts and the ability to create a shared understanding, the basis for our democracy and social order erodes. Uncertainty can lead to paralysis and further to apathy. Therefore, Bellona believes that disinformation and misinformation about climate change are some of the greatest threats of our time.

In this report, Bellona and Analyse & Tall reveal that myths and false information about climate permeate the comment sections of posts by Norwegian politicians, parties, and media on Facebook and X. 43 percent of climate-related comments on Facebook go against scientific consensus and are based on pure nonsense. It is alarming that the parent company Meta now wants to discontinue its professional fact-checking system and potentially worsen the situation. The internet is also subject to "shittification" – a perception that products and services only get worse.

The climate myths being spread on social media also confirm a new trend. Over half of these comments promote a viewpoint that *climate solutions do not work*. In 2025, it is impossible to deny that climate change is happening and that it is caused by humans; the resistance now focus on sowing doubt about the solutions, which in many cases require strong measures and significant investments.

This trend is extremely dangerous, and its significance cannot be understated. Bellona sees this as particularly threatening to children and youth, who are vulnerable to misinformation. According to The Norwegian Media Authority's surveys, children and young people are more likely to get news from social media than from traditional media. Without editorial oversight or fact-checking, the consequence could be a generation of disillusioned youth who either actively work against change or simply believe that nothing can be done.

Bellona knows that it is worthwhile to fight, and we will continue to be a living example of this. The climate struggle is about making things better, less polluting, more efficient and stable, and securing a future for everyone. To do this, we must combat mis- and disinformation. We look forward to the Norwegian Ministry of Culture and Equality's upcoming strategy to strengthen the population's resilience against disinformation, which will be presented this spring.

Frederic Hauge

The Bellona Foundation

Background

2024 is on track to be the warmest year measured since 1940. The Copernicus Climate Change Service describes it as "virtually certain" that 2024 will be the warmest year ever recorded and that we will, for the first time, experience global warming of over 1.5 degrees – compared to preindustrial levels.¹

According to the Paris Agreement from 2015, which Norway and 175 other countries have ratified, the aim is to limit global warming to 1.5 degrees above pre-industrial levels. To achieve this goal, there is consensus that global greenhouse gas emissions must start decreasing by 2025 and be reduced by over 40% by 2030.

The underlying research has been known for a long time. Already in 1965, US President Lyndon B. Johnson was warned by scientists from his own Science Advisory Committee that CO2 emissions were leading to global changes.² In 2023, researchers from Harvard and the Potsdam Institute for Climate Impact Research published a research article showing that Exxon Mobil was aware of human-caused climate change as early as the late 1970s. Their own researchers had developed climate models that predicted global warming as a result of human-made greenhouse gas emissions, while the company simultaneously sowed doubt about this very connection until just a few years ago.³ They did this in part by financing numerous conservative think tanks.⁴ The role that conservative think tanks have played in influencing the public debate about human-made climate change is well-known.

As early as the early 90s, a number of American think tanks began challenging the existing climate research.⁵ It is well-documented how American think tanks like The Heritage Foundation, Cato Institute, and Heartland Institute, as well as European think tanks like Liberales Institute and EIKE, have contributed over decades to producing and spreading claims meant to undermine climate research and the link between human-made greenhouse gas emissions and global warming.^{6,7,8,9,10}

This form of organized climate denial has been a driver in spreading misinformation about the climate problem^{11,12,13} which ultimately has delayed and prevented climate action. Recently published research from 2024 provides insight into the potential consequences of such misinformation for public support of climate research, and especially climate policy and measures.

A study across 12 countries points out that respondents exposed to disinformation show a significant reduction in trust in climate research, reduced willingness to implement climate measures, decreased ability to detect disinformation, and reduction in environmentally friendly behavior.¹⁴ A study conducted across three countries investigated how belief in typical misinformation about wind power correlates with different personality traits and worldviews. They found that conspiracy mentality was the strongest predictor of high agreement with misinformation about wind power, and concluded that resistance to wind power has become mainstream.¹⁵

77

Rhetoric and misinformation on climate change and the deliberate undermining of science have contributed to misperceptions of the scientific consensus, uncertainty, disregarded risk and urgency, and dissent.

- IPCC Sixth Assessment Report (2022) ¹⁶

Attitudes Towards Climate Change

Several studies in recent years have shown that a consistent proportion of Norwegians do not believe that climate change is human-caused, or that human activity is not the primary cause of global warming.

In a 2019 YouGov survey, 48% of Norwegians responded that humaninduced impact was only one of several factors that could explain climate change, while only 35% answered that human emissions were the main cause. 10% believed that human influence did not contribute to climate change, or that global warming does not occur.¹⁷

In a 2022 study conducted by the Policy Institute at King's College London, 24% of Norwegians said they did not believe that climate change was primarily human-caused.¹⁸

A 2023 analysis based on data from the Norwegian Citizen Panel seems to support this finding. From 2013–2023, the proportion of respondents saying the climate is changing but to a minimal extent due to human influence remains around 25 percent.¹⁹

The Extent of Climate Myths and Misinformation

In 2021, we conducted a pilot study to investigate whether climateskeptical content from Norwegian websites reached an audience on social media.²⁰ The analysis showed that content from a few websites was shared and reached a large audience on Facebook and Twitter/X.

In this report, we examined the extent of established myths about climate change, climate policy, and climate measures circulating on Facebook and Twitter/X. The analysis does not track the spread of specific content but looks more broadly at the general debate about the climate problem and its solutions.

What Do We Mean by «Climate Myths»?

This report maps the extent of statements that contradict the scientific consensus on climate change and the need for climate action.

Our mapping is based on an existing framework developed by Dr. John Cook, senior researcher at the University of Melbourne, together with other researchers, to identify what they refer to as climate contrarian content. That is, statements and opinions that go against the prevailing scientific consensus about the climate problem and its solutions.

We have translated the framework into Norwegian categories:

- 1. Global warming does not occur
- 2. Human greenhouse gas emissions do not cause global warming
- 3. Climate change will not be bad
- 4. Climate solutions do not work
- 5. The climate movement and climate researchers are unreliable

In this report, we refer to these five categories as climate myths.



Figure: Our representation of the five categories from the Taxonomy of climate contrarian claims. Coan et. al. (2021) ²⁴





Key Findings

#1 Climate Myths are Common on Facebook

When climate is discussed in the comment sections of Norwegian politicians' and media's Facebook pages from January 1, 2020 – June 1, 2024, 43 percent of the comments contain climate myths.

Climate myths that suggest 1) global warming is not occurring, that 2) human greenhouse gas emissions do not lead to global warming, or that 3) the effects of climate change will not be severe make up 19 percent of all climate myths.

Comments categorized as 4) climate solutions do not work account for 52 percent, while comments categorized as 5) climate researchers and the climate movement are unreliable account for 29 percent of all climate myths.



Figure: When looking at the entire period as a whole, climate myths make up 43 percent of the comment sections of Norwegian politicians, parties and media when climate is discussed. The proportion fluctuates over time.

Analyse & Tall

#2 Significant Increase in Climate Myths on X

Compared to Facebook, we find a far lower proportion of climate myths on Twitter/X. From January 1, 2020 – June 1, 2024, 17 percent of all Twitter messages about climate contain climate myths.

Climate myths that suggest 1) global warming is not occurring, that 2) human greenhouse gas emissions do not lead to global warming, or that 3) the effects of climate change will not be severe make up 19 percent of climate myths on Twitter/X.

Twitter messages categorized as 4) climate solutions do not work account for 57 percent, while comments categorized as 5) climate researchers and the climate movement are unreliable account for 24 percent of all climate myths.



Figure: When looking at the entire period as a whole, climate myths account for 17 percent of all Twitter messages about climate on the platform. Over time, it appears that the proportion of climate myths has increased.

#3 Climate Myths Flourish in «Echo Chambers»

When climate is discussed in relevant interest communities on Facebook, we find groups and pages where the comment sections largely contain climate myths.

We have examined 116 interest communities across 7 overarching categories and find large variations in the prevalence of climate myths in the comment sections.

The highest average proportion of climate myths in comment sections is found (not surprisingly) in the climate-skeptical interest community, with an average of 55 percent. In some of these groups, climate myths make up over 70 percent of the entire climate debate.



Figure: Average proportion of climate myths across all comment sections per category of interest community.

#4 Climate Myths Fluctuate Over Time

Although the proportion of climate myths on Facebook remains steady over time, we see clear patterns in which climate myths are prevalent during different periods.

The Norwegian elections in 2021 and 2023 generally led to increased climate debate, and also an increased proportion of climate myths. The 2021 election contributed to a great deal of debate, and we see that outspoken environmental parties receive many comments containing climate myths.

On Facebook, we see a clear increase in the three categories that deny global warming, human influence, or its effects during the summer months of 2022. These also increase somewhat during the election campaign in August 2023, and in January 2024 we see a new increase.

On Twitter/X, we see that the category "climate solutions don't work" has had a steady increase from March 2022 to August 2023, while "climate researchers and the climate movement are unreliable" has increased in the last months of 2024. The three categories that deny global warming, human influence, or its effects had a steady increase from February 2023 to August 2023, but have since declined.



Figure: Development over time on Facebook.



Figure: development over time on Twitter/X.

#5 The Climate Debate Is Constantly Ongoing

The climate debate engages people in Norway.

In the period January 1, 2020 – June 1, 2024, we find over one million comments and Twitter messages about climate.

Throughout the period, an average of 9.4 comments about climate are written for every post that politicians and media publish about climate on their Facebook pages.

On Twitter/X, an average of over 44,000 tweets about climate are published each year.





Figure: Development over time on Facebook.

#6 Climate Research and Action Are Also Acknowledged

We have also examined how many comments express support for or acknowledge climate research, climate policy, or climate measures.

10 percent of the climate debate on Facebook express support and recognition of climate research, climate policy, or climate measures. The highest proportion is found in the comment sections of politicians (11%), while interest communities have the lowest proportion (7%).

We find a similar tendency on Twitter/X. Around 9 percent are categorized as acknowledging climate research, climate policy, or climate measures.

l out of 10 comments acknowledge climate research



Data and Definitions

Data

This report is based on publicly available data collected from Facebook and Twitter/X in the period January 1, 2020 – June 1, 2024.

We chose to examine Facebook because 3.55 million Norwegians have a Facebook profile and 65 percent of them use the platform daily. This makes it the most used social media in Norway today. However, we know that the age distribution on the platform is skewed, with those over 40 being most active on Facebook, while those between 18–29 are least active. Significantly fewer people report using Twitter/X in Norway. 1.15 million Norwegians have a profile and 9% report using the platform daily. We have nevertheless chosen to include it as much political discussion takes place on the platform. After Elon Musk bought the platform in 2022, there has been much debate about whether the platform better facilitates the spread of misinformation as a result of new user terms and less moderation.

Data from Facebook and Twitter/X was collected through APIs and Apify. We do not have access to closed groups or private profiles.

We have searched for content on both platforms using search term lists that capture specific themes or phenomena. In total, we have searched for 9 overarching categories. Together, these contain 354 search terms used to find relevant content for the analyses.

Limitations

Searching for content based on search terms has an inherent limitation in that we only find content that we already know about. We have tried to reduce this potential bias by repeatedly searching for content and adding new search terms that we uncover or removing search terms that prove to be poor matches for the report's focus.

Because Facebook and Twitter/X are evolving platforms, there will always be a discrepancy between the content that is available at any given time and the content that we have collected at a certain point. This is because the platforms themselves, administrators on Facebook, or users themselves may have moderated or deleted comments without us being able to identify that something is missing. Our analysis is therefore based on what we must assume is moderated content.

Privacy and data protection

The purpose of this analysis is to look at the trends for certain debates over time. We do not examine what individuals write or think about the topics. The data subjects are anonymized by Facebook, so we do not know who has written what comment. On Twitter/X, we have only collected tweets that are captured by the search terms. We have chosen to alter the wording and sentence structure on content highlighted in the report, but the meaning will remain the same.

Data From Facebook

To map the public debate on Facebook, we have searched for published posts on public Facebook pages of Norwegian media, parties, and politicians that contain one or more of the search terms we have used to delineate relevant debates on climate and environment. Both the posts and comments to these posts are included in the analysis. The analysis period is January 1, 2020 to June 1, 2024.

Media pages: For Norwegian media pages, we have searched for content from 385 local, regional, and national media. From their pages, posts were collected in the time period August 1, 2020 to June 1, 2024.

Politician pages: The population consists of Facebook pages associated with the nine parties that were elected to the Norwegian Parliament in the current period (2021 – 2025). The pages were selected according to the following criteria:

- Local party pages
- National party pages, including youth parties
- The parties' regional pages
- Party leaders, deputy leaders, and Party Secretary
- Cabinet ministers during the period
- Parliamentarians during the period
- The Parties' five top Parliament candidates from each constituency in 2021

Beyond the broad public debate that takes place via these Facebook pages, we have also examined interest communities in the form of open Facebook groups and pages that thematically touch upon the broader climate debate. Together, these 116 groups and pages have 1.4 million group memberships or followers. They are categorized within 7 overarching categories:

- Nuclear power (4)
- Energy policy (10)
- Climate scepticism (10)
- Nature conservation (8)
- Energy prices (3)
- Transport (5)
- Wind power (76)

Our selection of interest communities is based on manual searches for presumably thematically relevant groups and pages. We have not had the opportunity to examine debates in private or closed groups on Facebook that require group membership to read the content.

Data From Twitter/X

We have collected publicly available tweets back in time. The collection was performed using the mentioned search terms that can be linked to the debates we wish to examine. In this way, we have obtained activity in Norwegian in the period 2020–2024. We have limited the search to Norwegian, using Twitter/X's own categorization of the language used in a tweet.

Because we search back in time on the platform, there will be content that we do not capture because it was removed after it was published. This may be because the content was removed by Twitter/X itself as it violates the platform's guidelines, by the user behind the content, or as a consequence of the user profile being suspended or removed from the platform. This means that content that was removed before our collection began is not included in our data.

Data Used for the Analysis

The analysis is based on comments to Facebook posts that address climate issues and tweets. On Facebook, we have filtered out comments that do not address climate issues, in order to only look at the climate debate in relevant comment sections.

On Twitter/X, we have only collected messages that contain one or more of our defined 354 search terms, and then filtered out messages that nevertheless do not address climate. This assessment was carried out using a large language model.

In total, the analysis is based on slightly more than 1 million comments and tweets, in the time period January 1, 2020 - June 1, 2024.



Analyse & Tall

Analytical Process



Analyse & Tall

What Are Climate Myths?

The focus of this report has been to map the extent of statements that conflict with scientific consensus on climate change and the need for climate measures. In this report, we refer to these as climate myths. According to the Norwegian Academy of Science and Letters' dictionary, a myth is a "widespread, common belief or notion that does not correspond to reality".

Dr. John Cook, senior researcher at the University of Melbourne, has collected extensive documentation of climate myths on the website Skeptical Science since 2007. The website has collected over 250 myths about climate research, policy, and measures that are categorized within four overarching categories: ²³

- 1. It's not happening
- 2. It's not us
- 3. It's not bad
- 4. It's to difficult to do anything about

Our mapping is based on an updated framework that Cook, together with other researchers, has developed further to identify what they refer to as climate contrarian content, i.e., statements and opinions that go against the prevailing scientific consensus on the climate problem and solutions. The taxonomy was peer-reviewed in 2021 and is published in the journal Nature, which provides a solid methodological foundation.²⁴ Since 2021, the framework and machine learning model (CARDS) that the researchers developed have been reused in a number of analyses and research articles. ^{25,26,27,28}

In January 2024, the Center for Countering Digital Hate published a report where they used the CARDS model, short for Computer-Assisted Recognition of climate change Denial and Skepticism, to classify claims about climate in over 12,000 YouTube videos.²⁹ Among other things, they found a large increase in claims that they refer to as "New Denial," namely that climate solutions don't work or that climate researchers and the climate movement are not credible.

Because the CARDS model is trained in English, and not Norwegian, we have chosen to use large language models to map the Norwegian debate. To do this, we have translated the English version of the mentioned framework into Norwegian. In this translation work, we have particularly based ourselves on the materials for Coan et. al. (2021)'s work, which reviews the subcategories of the five overarching claims in the framework and provides a number of examples of what these include. ³⁰

Our Classification of Climate Myths

We have translated the framework on the right into Norwegian categories. Because we have been concerned with investigating more than just these five overarching categories in the climate debate, we have also added three other categories for our classification:

- 1. Global warming is not happening
- 2. Human greenhouse gas emissions are not causing global warming
- 3. Climate impacts are not bad
- 4. Climate solutions won't work
- 5. Climate movement and climate science is unreliable
- 6. Acknowledges climate research, climate policy, and climate measures
- 7. Addresses climate
- 8. Not relevant (does not address climate)

We have chosen to deviate from the taxonomy when nuclear power is discussed. In the original taxonomy, "nuclear is good" is placed under category *4*. *Climate solutions don't work*. We have added a nuance that positive statements about nuclear power do not necessarily mean that one does not acknowledge the climate problem or other climate solutions, unless this is specifically mentioned. Positive statements about nuclear power are therefore categorized as category *7*. *Addresses climate*, unless the content predominantly falls into one of the other six categories.



Figure: Taxonomy of climate contrarian claims. Coan et. al. (2021) ²⁴

We have instructed GPT-4 to classify comments in our dataset. Specifically, we have asked GPT-4 to categorize comments as:

Contains climate myths:

1. Global warming is not happening

Categorization Step by Step:

- 2. Human greenhouse gas emissions are not causing global warming
- 3. Climate impacts are not bad
- 4. Climate solutions won't work
- 5. Climate movement and climate science is unreliable

Does not contain climate myths:

- 6. Acknowledges climate research, climate policy, and climate measures
- 7. Addresses climate
- 8. Not relevant (does not address climate)

To gain further insight into GPT-4's classification, we asked it to provide a rationale for each comment it classified. On the following pages, we show examples of how comments have been classified within the five categories of climate myths.









INSTRUCTIONS TO GPT-4



CONTAINS CLIMATE MYTHS

DOES NOT CONTAIN CLIMATE MYTHS

Examples of Climate Myth Categorization

«1. Global warming is not happening»

"The Earth is about 5 percent greener than just 20 years ago. Global temperature has remained steady with a declining trend, and far more cold records are being set than heat records."



We are being lied to on a daily basis in the name of the climate crisis and the green shift. The fact that people swallow this as truth strongly reminds me of the tale 'The Emperor's New Clothes'. We have no climate crisis, we have natural climate changes, and the green shift is just a new and expensive invention!



It was warned in the 60s that within 10 years, the planet would be doomed. Then new warnings have come at regular intervals. For fear and warning. Weather was similarly extreme in certain years in the 1700s too.



The climate over the last 100 years has been the planet's most stable. So which climate goal has not been achieved?

Only idiots believe those windmills are important. It's allowed to believe... some in gods and others in 'climate crises'.

We have no climate crisis, even though YR and Storm paint their weather maps blood red, and have begun to call all weather extreme weather.

The only Norwegian with a Nobel Prize in physics, Ivar Giaever, says there is no climate crisis.

What human-caused climate changes?



Nonsense... we have no climate crisis..



Global warming? Just bull***t, it's been warmer before?

What climate changes have manifested themselves up north so far? Lots of snow?



God forbid that the climate goes in cycles, gets a bit warm one year, then cold the next year. We're probably heading toward an ice age sometime in the future.

The sea hasn't risen half a meter, the Arctic isn't ice-free, neither is Kilimanjaro, the planet isn't boiling, and the polar bear is doing just fine.

«2. Human greenhouse gas emissions are not causing global warming»

Norway is one of the world's cleanest countries... and we have NO influence on the climate. The ONLY influence climate has on us... is an increased need for psychological help against climate anxiety



No one can deny climate changes which we have had at all times. Read some history and this especially applies to the youth who believe climate change started when the UN climate panel was established.





that climate change is now humancaused. CO2 levels are low.

It is not scientifically documented

If it had been man-made, I would have understood it, but everyone with a normal brain knows that it isn't

"Do you really believe humanmade CO2 affects the climate? That must be the biggest conspiracy theory I've heard.

Climate fight'??? Well, some apparently sincerely believe they can control the planet's climate?

It's the sun that affects the climate. We have no ability to influence it!!



Why do humans believe that we have any say in the climate here on Earth. This is sectarian thinking and lifestyle. And is not recommended.

The Earth has changed climate at all times and it is the sun that regulates it all



Who pays these researchers who come up with all this nonsense, the sun controls the climate



People are so gullible as soon as you mention climate, the Earth manages this by itself and has done so for many millions of years



I see natural cycles that have existed for millions of years.

«3. Climate impacts are not bad»

There is absolutely no climate crisis. Must stop believing in conspiracy theories? There have been much higher CO2 levels in the atmosphere and a warmer planet many times before and it went completely fine?



Are you not sensible enough to read up on climate and understand that it actually isn't a problem, then you don't need to subject more people to your conspiracy theories and neurotic stories about the "climate crisis"

Now the newspapers and TV channels must stop spreading fear propaganda! The weather has varied greatly in all centuries, and will continue to do so. We have had ice ages and heat waves many times in Earth's lifetime, so this is nothing new.



in the atmosphere? Do you think the Earth will drown if the ice melts?

The only proven consequence of increased CO2 is a greener planet.

Do you know that there is 100

times more CO2 in your lungs than

Before we called it summer and sun, now it's climate hysteria and danger warnings if it's warm for a few days?

The whole climate thing has become hysteria. Sun and good weather is nothing new.

Don't be afraid of climate changes. We've always had them (Read up on this).



So good it will be with warm summers and winter then?



Hysteria, 14 days of sun doesn't make a crisis

The reality of the climate crisis is that there is no crisis and never has been.

How do grown adults manage to make up so much nonsense? We have much less extreme weather now than in earlier times.



«4. Climate solutions won't work»



Yes but think about the oil pollution that happens with 2000 I hydraulic oil in addition to other oil that spurts out of each damaged wind turbine. Environmentally friendly



Here we're now supposed to save CO2 and environment. When we today know that a wind turbine cannot earn back its CO2 production cost during its lifetime. We also know that it's a very effective spreader of plastic and harmful substances throughout its entire lifecycle



The heavily subsidized greenwashing will cost us dearly, not only in money and destroyed nature A M Nature, environmental and economic destruction is really in the wind these days A M





polluting and nature-destroying power production, which removes one natural gem after another Nonsense and rubbish. Cutting out

If only more would understand

that this is inefficient, short-lived,

fossil fuels would be like cutting off the legs of 95% of the world's population

Norway no longer has an energy policy, the fanatical climate policy has taken over and removed all common sense from responsible politicians

Large wind turbines have become the climate winner. These spew out microplastics, but are still promoted as the future

No to EU, EEA, ACER, the electricity exchange and the electricity mafia ⁶ No to greed, fraud, greenwashing, lies and power arrogance..



Maybe it's time to end the madness of the green shift



It's not a given that climate fanatics' climate solutions actually save the world either

It's the high lords who are going to make a lot of money on the green shift?

Not only is it so expensive and ordinary people are becoming increasingly poorer, it's polluting and noisy, and destroys marine life.

If all of Norway stops with oil and stops driving petrol and diesel cars, it will have 0 effect on a global level.

«5. Climate movement and climate science is unreliable»



Why haven't these researchers changed the climate if they believe it's possible? Can you explain why the previous statements about ice melting at the poles that should have happened several decades ago haven't happened? And why hasn't the sea risen several meters as these researchers have threatened for several decades?



same opinion as you and everyone else who blindly trust 'researchers' and 'politicians'? I have zero trust in people who say that wind turbines and taxes and fees help with the climate crisis



That UN Secretary General Antonio Guterres is a greedy guy walking around with a straw in his pocket. And now he wants Norway to share the oil surplus. Time for that guy to get out of the UN.

Climate researchers are bought and paid for. Money always decides!!

The international climate panel consists of many well-paid researchers, who get paid for their 'findings' I also saw the list of those who were registered as researchers, and there were famous names like Mickey Mouse, and Donald Duck

Researchers get paid, science is something else



The climate scam is money. People should understand that



I am not a member of the climate cult 😝

You accept that 1,200 measuring points on the globe are sufficient to measure the Earth's average temperature,,,??



They control the weather with geoengineering weather manipulation chemtrails chemicals with planes all over the world.

The reason people focus on Al Gore is that he has made millions from his 'business'. In addition, he has allegedly bought a large beach property, despite having preached that the sea will rise dramatically.



Facebook



Climate Myths Get More Positive Feedback on Facebook

Climate myths receive on average more "likes" on Facebook than statements that acknowledge climate research, climate policy, or climate measures.

- Category 1: 4,8 likes on average
- Category 2: 4,4
- Category 3: 4,2
- Category 4: 5,8
- Category 5.5
- Category 6: 2.5

On average, statements that acknowledge climate research receive more "haha" and "angry" emoji reactions than the five other categories, which may indicate that this type of content is being ridiculed on the platform.



- 1. Global warming is not happening
- 2. Human greenhouse gas emissions are not causing global warming
- 3.Climate impacts are not bad
- 4. Climate solutions won't work
- 5. Climate movement and climate science is unreliable
- 6. Acknowledges climate research, climate policy, and climate measures

Frequently Used Representations

We see that climate myths often contain the same type of representations of the climate problem, causal relationships, or people who acknowledge climate research.

Among comments classified as climate myths on Facebook, reference to "climate hysteria" is the representation that appears most frequently among typical representations.

That the sun is the real cause of global warming is also a frequently used representation, with over 8,000 comments.

Derogatory terms about those who acknowledge climate problems and solutions (climate fanatic, climate crook, climate hag, climate sect, climate idiot, etc.) are used in over 3,600 comments.

Different versions of "there is no climate crisis" or "the climate crisis does not exist" are used over 3,000 times.

References to wind power having a microplastic problem occur almost 2,000 times. The "climate hoax" is referenced around 1600 times.



Figure: Overview of frequently used representations in comments with climate myths on Facebook. A comment may contain several of the representations and thus appear in several of the categories above.

Posts Abut Climate Over Time

In this report, we have looked at the comment sections of posts that address the broader climate debate.

In the period, a total of 100,293 posts were written across media pages, political party pages, and interest communities. In total, the media organizations have written the most about climate, but when we look at the average of posts per group and page, it becomes clear that the interest communities around the climate debate are the most active (bottom figure).

Not surprisingly, we see that the activity of the political party pages increases significantly in connection with the Norwegian elections in 2021 and 2023.



Proportion of Climate Myths in Comment Sections

The proportion of climate myths (categories 1–5) in the comment sections of media pages, political party pages, and interest communities fluctuates over time.

We see that the proportion increases for political party pages during the parliamentary election in 2021, while the proportion for media remains fairly stable with a downward trend. For interest communities, we see an increase in recent years.



Climate Myths in Comment Sections of Norwegian Media

It is in the comment sections of Norwegian media Facebook pages that we find the largest proportion of climate myths in the period investigated.

Of the 30 media pages that on average have the highest proportion of climate myths in their comment sections, we find 18 local media. 6 regional media and 8 national media.

On average, however, it is the national media sites that have the highest proportion of climate myths in their comment sections, with 45 percent, followed by the regional (40%) and the local (35%).



Figure: Proportion of climate myths of the total climate debate in the comment sections of local, regional, and national media pages on Facebook throughout the period. Each page must have published at least 10 posts about climate, received at least 100 comments where at least 10 of these contain a climate myth.

Climate Myths in Norwegian Political Party Comment Sections

Looking at the time period as a whole (2020–2024), the Progress Party (FrP), Green Party (MDG), and Rødt appear most engaged in the climate debate, measured by how often they write about climate on average per active party page.

FrP publishes the most about the climate change debate, both measured in average and total numbers during the period. It is also in FrP's comment section that we find the largest proportion of climate myths.



Figure: Average number of climate-related posts for each party. FrP and MDG appear to be the parties most concerned with this topic.



Figure: Proportion of climate myths out of the total climate debate in the comment sections of all party pages that have written about climate during the period.

Climate Myths in Interest Community Comment Sections

The 50 largest interest communities, measured by proportion of climate myths in comment sections, have a large following. In total, these groups and pages have 597,983 members and followers.

On average, these groups and pages have 12,000 members and followers. A profile on Facebook can have membership in multiple groups and pages, and because many of the interest communities have overlapping or similar themes, we must expect significant overlap here.

The largest groups have over one hundred thousand members, and we therefore assume that these interest communities together have the potential to reach several hundred thousand people with their content.



Figure: Proportion of climate myths out of the total climate debate in comment sections of interest communities on Facebook. Each page/group must have at least 2000 followers, have published at least 10 posts about climate, received at least 100 comments where at least 10 of these contain a climate myth.





Twitter/X

Low Support for Climate-Denying Content on Twitter/X

In Norwegian, climate myths appear to take up less space on Twitter/X compared to Facebook. But we also find that climate-denying content receives less support on the platform, in the form of "likes" and "retweets," compared to tweets that acknowledge climate research.

Climate-denying content (categories 1-3 of climate myths) receives an average of 3.8 likes and 0.4 retweets. On average, this type of message has 260 views.

In comparison, content that acknowledges climate research receives an average of 7.5 likes and 1 retweet. On average, this type of message has 353 views.

This may be related to which profiles share the content.



Figure: Tweets that acknowledge climate research appear to receive higher support on the platform. Average number of "likes" in blue and average number of "retweets" in orange.

Development Over Time

During the overall time period (2020–2024), we find a total of 222,055 tweets about climate, using a keyword list consisting of 354 search terms across 9 categories.

Over time, we see that the five climate myth categories are increasing in number, while tweets acknowledging climate research, climate policy, and climate measures appear to have high fluctuations in connection with Norwegian elections (yellow line).



- 1. Global warming is not happening
- 2. Human greenhouse gas emissions are not causing global warming
- 3.Climate impacts are not bad
- 4. Climate solutions won't work
- 5. Climate movement and climate science is unreliable
- 6. Acknowledges climate research, climate policy, and climate measures





Method

Use of Large Language Models for Classification

As part of this project, we have used OpenAl's large language model, GPT-4, to classify content according to the translated taxonomy. GPT-4 is an artificial intelligence neural network. During the time of writhing this report, it was the largest of the models in the GPT series and was published in March 2023.

Such language models are trained by being presented with large amounts of human-written text and learn to understand the relationship between words and the context in which they occur. These generative language models can take an incomplete sentence and make a prediction of the next subsequent word in the sentence. For example, if it takes in the sentence "The capital of Norway is," it will say that the most likely following word is "Oslo." Other less likely words might be "beautiful" or "lovely," while a word like "rickety" would be extremely unlikely. Large language models like GPT-4, which are trained on very large amounts of text, gain both a more nuanced language understanding and a large amount of knowledge. This enables it to solve a wide range of tasks, such as programming or answering complex legal questions.

Moreover, GPT-4 is a generative model, which means it can generate new text in line with an instruction or prompt. On that basis, one can write a detailed and precise instruction to get the model to solve a wide variety of tasks, making it a very flexible tool.

Classification with GPT-4

In this project, we have developed a comprehensive instruction for GPT-4 based on the previously described taxonomy for climate myths. We have fed GPT-4 with this instruction as a prompt before sending content for categorization.

To ensure that GPT-4 classifies comments in a way that is as consistent as possible with human understanding of them, a human annotator has reviewed a sample of the dataset and classified them within the same categorizations that GPT-4 was asked to use. In this way, we can compare GPT-4's results with the results from the human review.

If one considers the human classification as true or correct, one can find a measure of how accurate GPT-4's classifications are.

It is nevertheless important to emphasize that there is uncertainty associated with the estimates that this method provides, as we do not have the ability to manually review all of the over one million classifications.

Validation of the Results

We have worked with validation of results in two rounds. First, two annotators classified a randomized selection of about 600 comments. Our two annotators had an agreement of 0.88, which is considered "excellent" agreement. We therefore decided that the remaining sample to validate GPT-4's results would be conducted by one annotator.

We have manually classified a sample of a total of 4,072 comments that GPT-4 has also categorized. We see that our human assessments correspond very well with GPT-4's assessments, as we have an agreement of 0.87.

Overall, it appears that GPT-4, compared to our classifications, assesses content somewhat more conservatively, and more often classifies content as *8. not relevant* or *7. addresses climate*, where we categorize this within some of the other six categories. In our coding of the sample, climate myths constitute 47.3% of the climate debate, which is somewhat higher than GPT-4's classification of the entire data basis in this report.

How Well Does GPT-4 Perform Across Different Categories?

Categori	Agreement with annotator
1. Global warming does not occur	80%
2. Human greenhouse gas emissions do not cause global warming	78%
3. Climate impact are not bad	60%
4. Climate solutions do not work	64%
5. The climate movement and climate researchers are unreliable	60%
6. Acknowledges climate research, climate policy, and climate measures	62%
7. Addresses climate	44%
8. Not relevant	96%

In the table on the left, we can see the extent to which GPT-4 agrees with the human annotator when it has categorized a comment within each individual category. We see in particular that the disagreement is substantial regarding category 7. Addresses climate.

The main portion of this disagreement comes from the fact that about 40% of the comments that GPT-4 classifies within this category are categorized as 8. Not relevant by the human annotator.

This means that GPT-4 overestimates the scope of comments addressing the general climate debate, which in turn means that our results in reality underreport the *proportion* of climate myths in the total climate debate.

How Well Does GPT-4 Perform Across Different Categories?

Climate myth according to GPT	Not a climate myth according to annotator (%)	Different climate myth according to annotator (%)
1. Global warming does not occur	10%	10%
2. Human greenhouse gas emissions do not cause global warming	9%	13%
3. Climate impact are not bad	20%	20%
4. Climate solutions do not work	32%	4%
5. The climate movement and climate researchers are unreliable	31%	9%

Categories 1–5 represent various climate myths, while categories 6–8 are meant to capture all comments that do not promote climate myths. It is therefore less serious if GPT agrees with the annotator that a comment promotes climate myths but only disagrees about which climate myth it promotes, compared to if it disagrees with the annotator on whether a climate myth occurs or not.

The table on the left shows the percentage of comments that GPT has classified as a climate myth, where the annotator disagrees. In category 2, for example, 9 percent of the comments are ones where the annotator believes no climate myth occurs at all, and 13 percent of the comments are ones where the annotator believes a different climate myth occurs than what GPT believes.

If one reads the ranking of climate myths to be in increasing degree of severity, one sees that GPT's confusion about whether something constitutes a climate myth increases the less severe the degree is.

How Well Does GPT-4 Perform Across Different Categories?

Furthermore, it may be interesting to see how GPT classifies comments within the overarching categories *Climate Myth*, understood as categories 1–5, and *Not climate myth*, understood as categories 6–8.

Of the total number of comments, approximately 2.3% were classified as *Climate Myth* by GPT but were classified as *Not climate myth* by the annotator. The opposite case, where a comment is categorized as *Not climate myth* by GPT and as *Climate Myth* by the annotator, accounts for approximately 2.4% of the total comments.

GPT's net overall misclassification between *Not climate myth* and *Climate Myth* is therefore 2.4% – 2.3% = 0.1% of the total number of comments. GPT thus has a very slight bias in favor of categorizing a comment as *Not climate myth*, and is therefore marginally more conservative in this classification than the annotator.

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Methodological Challenges and Limitations

- Each comment and tweet is assigned only one category. In reality, a piece of text can contain multiple viewpoints that may fall under several categories.
- The difference in format between Twitter/X and Facebook (short vs. long texts) may have an impact on the language model's classification of content. We have not investigated this.
- Due to the large data volume, we do not have the ability to review all classifications performed by the language model. Our classification of a randomized sample of over 4,000 posts shows that our annotators largely agree with the language model's assessments.
- We do not expect the language model to be able to distinguish between the intentions of the senders of the statements in our dataset. Irony, sarcasm, and humor can be difficult to understand even for other humans, and presumably this can lead to misclassification.

- Since GPT-4 is not developed by us, we have little insight into the basis for the various decisions it makes. Our only influence on this process is through the instructions we give it before it analyzes the data, which makes it challenging to fine-tune the model to make the decisions we want.
- Since the model only relates to each individual comment in isolation, it has no perception of the surrounding context, and it has problems understanding, among other things, that comments that reproduce other people's problematic attitudes are not necessarily an expression of the same attitudes.
- The high degree of agreement between our qualitative assessment of the sample and GPT's classifications may indicate that the thorough instruction/framework underlying it leads to high precision. Nevertheless, it has been beyond the scope of this project to evaluate the use of different types of large language models and the effect of different types of instructions.



Litterature

Litterature

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