MedieKultur | Journal of media and communication research | ISSN 1901-9726

Article – Theme section

Flying green?
Representing 'sustainable aviation fuels' in the Danish media

Anders Horsbøl[1] & **Mikkel Eskjær**[2]

1. Associate Professor, Department of Communication and Psychology. Aalborg University. horsboel@ikp.aau.dk
2. Associate Professor, Department of Communication and Psychology. Aalborg University. eskjaer@ikp.aau.dk

Abstract

In recent years, high hopes have been expressed in so-called 'Sustainable Aviation Fuels' (SAF) as a new technology to make aviation more environmentally friendly. This study examines public negotiations of SAF in Denmark, centering on how news media frame SAF, and how different actor groups are represented. We examine the negotiations of SAF from 2018-2023, when SAF entered the mediated public sphere as a new(s) topic. The analysis differentiates between three public arenas: national mainstream media, regional/local media, and trade journals devoted to energy and mobility. Drawing on a systematic sample and combining quantitative framing analysis with qualitative in-depth readings, the study finds that political-regulative, technology, and optimistic climate frames are the most prevalent, across different public arenas. We identify a dominant discourse of climate tech governance, not least driven by the use of elite sources from business, politics, and science. These sources contribute to projecting SAF events into the future, magnifying SAF as potentially groundbreaking.

Keywords

sustainable aviation fuels, SAF, framing, news media, discourse studies, public negotiation

MedieKultur 2025, 79 49-69

Published by SMID | Society of Media researchers In Denmark | www.smid.dk

Introduction

The climate crisis poses a challenge for existing mobility practices, lifestyles, and transportation infrastructures based on fossil fuels. While new transportation technologies and alternative fuel are being developed to replace fossil fuel, flying constitutes a particular challenge as electrification is expected not to be technically feasible within the foreseeable future. Moreover, flying has been associated with guilt or shame due to relatively high carbon emissions. The notion of 'flygskam' ('flight shame'), which took off in Sweden a few years ago, has since travelled to other countries (Wormbs & Söderberg, 2021; Becken et al., 2020).

Faced with these challenges, the aviation industry is expressing high hopes in so-called 'Sustainable Aviation Fuels' (SAF). It includes fuels based on carbon capture utilization and hydrogen produced by electrolysis, the latter also referred to as power-to-X. Whereas the term SAF has been dismissed as an oxymoron (Budd et al., 2013), the technological aspirations of the aviation industry seem to resonate with mainstream political ambitions on green energy transition. In Denmark, for instance, the political ambitions include the goal of a full transition to "green domestic flights" by 2030 as well as energy policies for power-to-X and carbon capture and utilization (Regeringen, 2023). The Danish government describes this as an act of "leading the way" in climate policies (Regeringen, 2023), thereby assuming that Denmark takes a position as a frontrunner when it comes to SAF.

In the scholarly landscape, this article is situated at the intersection of news studies and discourse studies on how new energy technologies are publicly articulated. We view SAF as an example of a wider field of allegedly green energy technologies, including carbon capture, power-to-X, and geoengineering, that are currently entering the public sphere. High expectations are expressed for the potential of these technologies to mitigate climate change by reducing carbon dioxide emissions. At the same time, economic interests and political ambitions are vested in the technologies, and they have been met with criticism, not least from NGOs, for not substantially mitigating climate change and for possibly creating new environmental problems. Thus, the case of SAF in Denmark provides a window for exploring how new energy technologies are being publicly discussed and negotiated, to what extent certain understandings prevail, and which conflicts, if any, are articulated.

Studies on SAF in the social sciences are mostly quantitative surveys of public attitudes (Anderson et al., 2022). They are dominated by a so-called 'public acceptance of technology' approach. We position our study in relation to this approach by taking a step back and examining public *negotiations* of SAF, prior to any public acceptance. In these negotiations, SAF is ascribed meaning and emerges as a broader social phenomenon, not just as a technical entity. Thus, we contend that public acceptance of technology is preceded by a period of public negotiations where different technologies, actors, and frames are presented and debated in public. These technological, cultural, and social deliberations typically take place in different media spheres. Logically, they precede any

public acceptance or rejection as they articulate and make sense of the topic under question. Acceptance of SAF – which is only one possible outcome along with other possible responses such as uncertainty, resistance, and apathy (Batel & Devine Wright, 2015) – thus relies on some sort of public understanding or meaning-making of SAF.

This is where news media enter the picture. They report on new technological issues like SAF in an (ideally) accessible language. As such, news media provide crucial information on how SAF emerges as a new public phenomenon, towards which we may subsequently take a stance. News media are moreover important as public forums for different actors, providing a space for articulating interests and perspectives on SAF, which are distributed to a wider public. Our study centers on how SAF is framed by news media, and how different actors and groups raise their voice during these public negotiations. Thus, our overarching research question concerns how SAF is negotiated in the news as a precondition for any subsequent public acceptance. While we argue that this process is important, we also acknowledge the complex causal relations between different agendas (media, politics, public) that are involved in the process (McQuail, 2010, p. 512–513).

Methodologically, this study integrates quantitative and qualitative approaches to textual analysis. It combines quantitative analysis of content distribution with qualitative in-depth readings of media framing. The latter includes analyses of what is assumed, stated, or contested when aviation fuels are presented as 'green' or 'sustainable'. This way, the study goes beyond simply studying public acceptance of SAF; it examines the conditions of acceptance as these are presented and negotiated in different media spaces.

We begin by reviewing the relatively limited literature on media coverage of SAF and similar renewable fuels. This is followed by a presentation of our methodology and research design. Next, we present the major findings, which are subsequently discussed in light of the green transition as a broader process of energy transformation.

SAF and the media: From public acceptance to public negotiations

The scholarly literature on SAF and similar notions such as 'low carbon jet fuels', 'biofuels', 'renewable jet fuels', and 'alternative jet fuels' is largely technical. Within the social sciences and humanities, a considerable body of research investigates the social or public acceptance of these technologies, drawing mainly on quantitative surveys (Anderson et al., 2022). Several studies point to limited public knowledge, resulting in uncertain estimates about future public support (Jensen & Andersen, 2013; Filimonau et al., 2018; Løkke et al., 2021). Other studies examine whether customers are willing to pay extra for flying sustainably, showing that perceived significant reductions in greenhouse gases condition such willingness (Rice et al., 2020; Xu et al., 2022).

As already indicated, our research takes another direction. In the pursuit of investigating public negotiations of SAF, we draw on a rather limited field of research on media coverage of so-called sustainable fuels. Concerning 'sustainable' fuels, Eklöf and Mager

(2013) have investigated how biofuels are negotiated in both old and new media, *in casu*, the Swedish press and Google search results. The findings show that actors from industry and policy (i.e., government and government agencies) dominate both press and Google search. Most news articles operate "within the 'sustainable biofuels' discourse, agreeing that biofuels can have both good and bad sides and that policy should be about figuring out how to support the good varieties" (Eklöf & Mager, 2013, p. 461). In a similar study, Kim et al. (2014) look at how American newspapers present ethanol to the public. Findings indicate "that ethanol has been presented largely as a policy issue, rather than a technology or an economic issue" (Kim et al., 2014, p. 229). Interestingly, environmental concerns were found to be the main reason for both supporting and opposing biofuels. This points to what has elsewhere been termed green-on-green conflicts (Warren et al., 2005) or simply green conflicts (Eskjær & Horsbøl, 2023). These are marked by a clash of different environmental concerns, for instance, carbon reduction, biodiversity, and landscape values. Many green conflicts center on the use of land, as in the study mentioned above by Kim et al. (2014), where land is used for producing biofuels or animal food, but also for nature conservation.

Studies concerned particularly with aviation argue that notions of sustainable aviation are regularly contested. Walker and Cook (2009) have carried out a discourse study of the language employed in a professional conference on climate change and aviation. The analysis indicates that aviation policy is "highly contested" and constitutes an "exciting melting pot of different discourses struggling for synthesis" (Walker & Cook, 2009, p. 388). The analysis further demonstrates that ecological modernization (Hajer, 1995), a discourse that emphasizes technological and managerial solutions, dominates this struggle. Budd et al. (2013) also point to the contested nature of aviation and the fact that the very notion of 'sustainable aviation' is disputed. Other studies have dismissed sustainable aviation as an oxymoron and examined it as an ideological move in discursive struggles on aviation policy (Griggs & Howarth, 2013). Addressing flying within academia, recent studies have examined how academic work has become entwined with flying – and how the aeromobility romance may come to an end (Bjørkdahl & Franco Duharte, 2022).

Furthermore, Christley and Ullström (2024) have studied competing discourses around the future of aviation in Sweden, contrasting the aviation industry with the flight-free movement. Drawing on Hajer's discourse analysis, the study employs the notion of 'discourse coalition'. The latter is defined as, "a group of actors that, in the context of an identifiable set of practices, shares the usage of a particular set of story lines over a particular period of time" (Christley & Ullström, 2024, p. 4, leaning on Hajer, 2005, p. 302). Two distinct discourse coalitions, competing in defining the future of aviation, are investigated. Whereas 'Green flying' "anticipates aviation to maintain a dominant role as a necessary and appreciated mode of transport that contributes to uphold the existing socio-economic paradigm", the 'Staying on the ground' approach "imagines an alternative

future where air travel is reduced and no longer seen as a desirable norm and practice" (Christley & Ullström, 2024, p. 12).

Another Swedish study presents a policy analysis of how the different political parties understand possible aviation futures (Kulanovic & Nordensvärd, 2021). The study finds three main frames in a polarized discursive landscape. The first is a frame about neoliberal sustainable aviation, where the government has a limited role vis-à-vis the market. The second frame is about green Keynesian sustainable aviation, where the government is ascribed a steering role through taxation, regulation, and support for industry and research. Finally, an oppositional frame is about national environmentalists' aviation, where the government should steer towards an environmentally friendly future with less aviation. The authors observe that the frames are clearly distributed along different political positions and parties. They further argue that the split between a neoliberal and Keynesian frame on the one hand, and an environmentalist frame on the other, undermines a solid compromise on future aviation policy.

Another line of research concerns how media coverage of aviation is linked to sustainability. In a diachronic study of aviation discourses in German news, Rahn (2022) observes a shift from a dichotomy between economic and climate change rationales to a new "narrative of economic transformation towards innovative industries and technologies" (Rahn, 2022, p. ii). The latter is considered an opportunity for German industry to become a 'forerunner' in developing climate-friendly aviation technologies. In an international study, Peeters et al. (2016) examine global media representation of different 'solutions' for sustainable aviation, which include alternative forms of fuel over the past 20 years. The authors observe a recurrent pattern of media coverage in which "many of the proposed solutions emerge and are hyped in the media, only to subsequently disappear again from public discourse" (Peeters et al., 2016, p. 39). In this process, they tend to be replaced by other proposed solutions, all of which "constitute technology myths" (Peeters et al., 2016, p. 40).

In a broader perspective – though still narrower than the wider fields of environmental communication and climate change communication – there is a substantial body of studies on media coverage of renewable energy technologies, ranging from wind power, solar energy, geothermal energy, hydropower, to more recent power-to-X technologies. These studies are often informed by frame analysis or discourse studies (Djerf-Pierre et al., 2015; Stauffacher et al., 2015; Mišić & Obydenkova, 2021; Horsbøl, 2024). Across the field, frames focusing on technology, economy, environment, and civil society have been identified as prevalent. For instance, a study of newspaper coverage of biogas in Finnish newspapers identifies storylines of environment, economy, policy, and technology (Lyytimäki, 2018). It concludes that biogas is seen as an energy production to complement the existing energy system, while adversaries opposing biogas are completely lacking in news coverage.

In a comprehensive study of media reports on renewable energy in 11 countries across the globe, Rochyadi-Reetz et al. (2019) covered solar energy, offshore wind power, geothermal energy, and hydropower. Using Entman's (1993) four frame dimensions (problem, cause, recommendation, and moral evaluation), the study found three key frames: i) a "positive mainstream frame", emphasizing positive aspects of renewable energies; ii) a "critical economic and technological evaluation frame", focusing on economic and technological problems of renewable energies; and iii) a "critical environmental and social evaluation frame", highlighting environmental and social problems (Rochyadi-Reetz et al., 2019). Moreover, the positive mainstream frame was found to be predominant cross nationally. While differences between countries could be observed, the share of the positive mainstream frame remained above 50% in all 11 countries. At the same time, it should be noted that some renewable energy technologies, not least the construction of wind turbines, have been subject to heated controversies due to their local impact. Media reports on these controversies have been investigated using approaches such as discourse studies or frame analysis (Horsbøl, 2020; Bjärstig et al., 2022).

To sum up, the literature refers to multiple forms of contestations over the nexus between aviation and sustainability. At the same time, it points to a predominance of mostly optimistic views of renewable technologies combined with policy regulations. These optimistic assessments cut across aviation fuels and different kinds of renewable energy technologies. Some studies also indicate that voices from industry and politics dominate media reporting. In general, the studies resonate with existing overviews of environmental discourses, presented in seminal works by Dryzek (2021) or Hajer (1995). They also correspond with the three "metadiscourses" of global environmental climate governance identified by Bäckstrand and Lövbrand (2007). The first is the aforementioned discourse on ecological modernization, where the market is a key driver. The second discourse is labelled green governmentality, which signifies a more centralized and science-driven approach. Finally, the discourse of civic environmentalism advocates a more fundamental transformation of consumption patterns. The literature indicates that these three discourses all are present in the debate on sustainable aviation, with the discourses of ecological modernization and green governmentality as the most powerful.

Although Scandinavia features prominently in extant research, there is a gap in the literature concerning media representations and how different environmental discourses are articulated in relation to sustainable aviation. This study adds to the limited research by presenting an empirical study on how SAF is negotiated in the news media. As such, it contributes to the wider field of media studies of emerging green technologies and to the yet wider field of discourse studies of the environment.

Method and data

We examine the representation of SAF in the Danish media from 2018-2023. It covers the period SAF enters the mediated public sphere as a new(s) topic. The analysis differentiates between three public arenas: national mainstream media, regional/local media, and trade journals devoted to energy and mobility. Drawing on a systematic sample (n = 209) from the database Infomedia, the study identifies the dominant frames in the media representation (Entman, 1993) as well as their distribution in different media. Here, a frame denotes the interpretative framework that is applied to SAF. Consequently, a frame is semantically different from a theme, as it forms the basis for deciding what is important about SAF and how SAF should be assessed. Moreover, the study identifies all quoted sources documenting to what extent different actors are given a voice in media reports.

To investigate how SAF is negotiated in the news, we ask the following research questions:

RQ1: How has SAF emerged as a news topic?
RQ2: How is SAF framed by Danish news media?
RQ3: What are the main sources populating news coverage of SAF?
RQ4: How has media representations of SAF evolved?

Data has been collected by accessing a database (Infomedia) of all Danish news using the following search string: "(flybrændstof OR SAF OR "sustainable aviation fuel") NEAR/9 (grøn* OR bæredygtig*) [4..]". This search strategy results in articles that present air fuel in relation to sustainability. The NEAR/9 command allows for a maximum distance of nine words between the two sets of terms, allowing for both intra- and extra-sentence semantic connections. In addition, by adding the search command [4..], we have aimed for a focused sample. This type of query only yields articles where search words appear four times or more. It reduces noise by excluding articles where sustainable air fuel is mentioned in passing or in conjunction with sustainability in otherwise unrelated matters.

The sample consists of three news categories: national dailies (print only), regional/local news (web and print), and trade news (web and print). All national dailies (n = 7) are represented in the sample. The number of regional/local media houses (n = 38) covering SAF reflects how several local communities believe they will benefit from sustainable aviation. Finally, trade news on SAF is restricted to a relatively limited number of outlets (n = 23).

The sample (n = 209) is based on a probability sample. Since the frequency between web news and other media outlets differs considerably, we have, for practical reasons (i.e., reducing sample size) used a two-tier systematic sampling strategy. For online trade news, the sampling ratio is 1:10; for other types of news, it is 1:2. Subsequent data analysis have been weighted accordingly.

We combine approaches from content analysis and close readings. The quantitative part is based on a coding scheme consisting of 11 variables and 40 values, including five different frames. It was developed and tested in two pilot tests, where both authors coded a purpose sample of 2×10 articles. Subsequently, we discussed and re(de)fined the coding categories and coding practice to achieve a more precise and reliable coding. For instance, the criteria for identifying frames were specified, as were the guidelines for identifying sources. We coded only one frame for each article. Thus, we have coded for the most prevalent frame in each article, not for subframes. However, in the close readings of the analysis, we complement the quantitative frame analysis with text analysis that includes observations on the co-presence of different frames within the same article.

The following five frames were arrived at inductively, following a series of in-depth readings and pre-coding of data.

- *Technology*: Focus on SAF as a new technology that includes new chemical processes and infrastructures
- *Political-legislative*: Focus on legislation and administration of SAF
- *Growth*: Focus on how SAF may contribute to economic growth, jobs, and business development
- *Climate, optimistic*: Focus on how SAF contributes to CO_2-reduction and climate change mitigation
- *Climate, critical*: Focus on problematizations of SAF as 'sustainable', including its contribution to climate change mitigation

The frames are further described in the findings section. Despite the inductive approach, there is considerable overlap with the frames identified in the scholarly literature on renewable energy (Lyytimäki, 2018; Rochyadi-Reetz et al., 2019). We return to these in the discussion.

As for sources, we define a source as a textual instance of an utterance. Utterances include direct quotations, paraphrases, summaries, and nominalizations, where both the source and the content of the utterance, no matter how elaborated or condensed, are visible in the media text.

To test intercoder reliability, ten randomly selected articles were coded by both authors. Recommendations vary regarding sample size for reliability tests, ranging from 5-25% of content units to calculations based on the desired confidence level (Lacy & Riffe, 1996). Our sample size is on the lower end (≈ 5%). The subsequent test, based on Freelon (2010), showed a 90.7% intercoder agreement across 22 variables, equivalent to 0.76 in Cohen's kappa. There are different interpretations of Cohen's kappa. Cohen considered the range between 0.61-0.80 as "substantial" intercoder agreement, while others regard the same range as "moderate" (McHugh, 2012). The least conservative interpretation considers everything above 0.75 as "very good" (Bryman, 2012, p. 280).

Findings

SAF takes off: The formation of an agenda

RQ1 is concerned with how SAF has emerged as a news topic that has helped transform public discussions on aviation. Figure 1 visualizes the overall development of how SAF emerged as a news topic.[1] It demonstrates a sharp increase in media attention from almost nothing in 2017 (n = 10) to nearly a thousand news items in 2023 (n = 955). Media attention to SAF appears to have peaked in 2023, as we have witnessed a slight decrease in 2024. Most likely because of emerging disillusions with the pace of the technological and political foundation of SAF.

The sharp increase in 2022 was sparked by a goal set by the Danish prime minister in her televised new year's speech. Here, the government set the target that by 2025, there

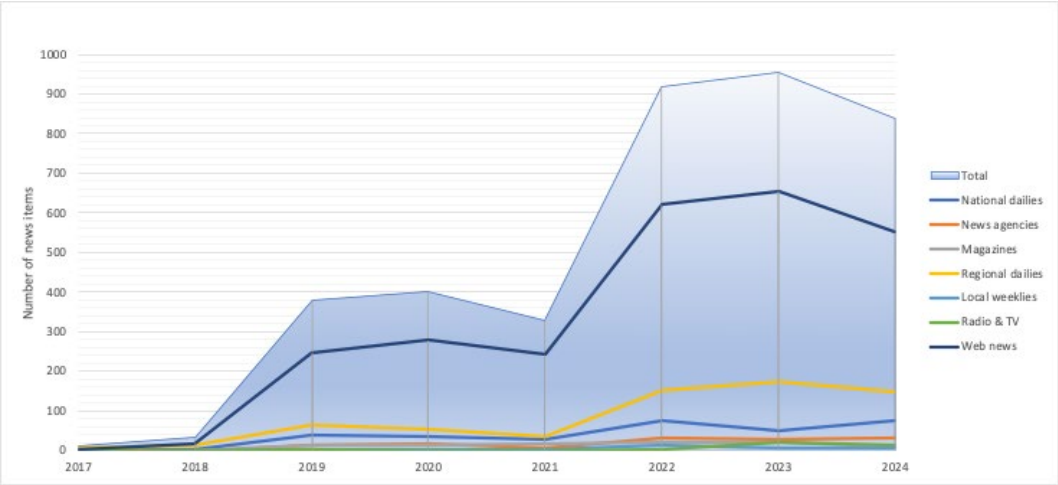

Figure 1. SAF in news media (2017-2024)

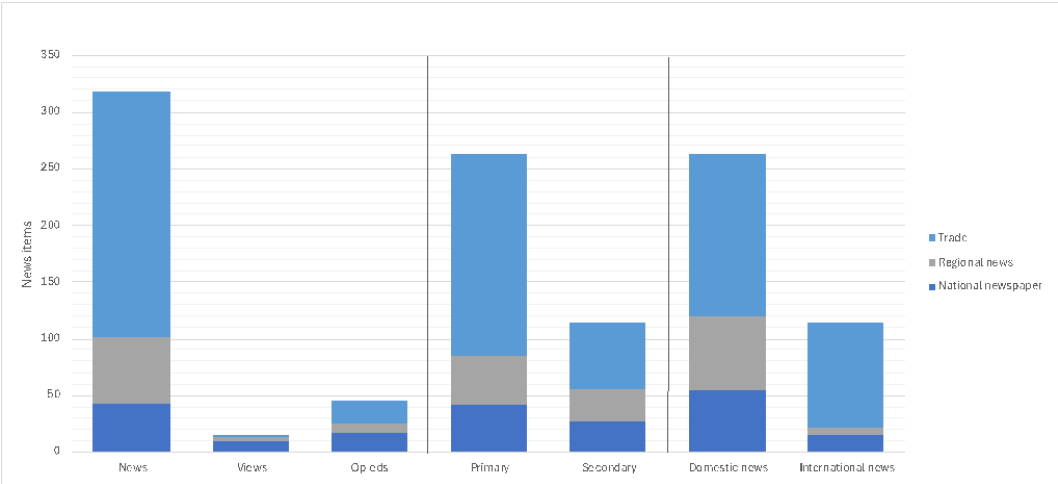

Figure 2. Genre, focus, geography (2018-2023)

would be domestic flight based on SAF. By 2030, all domestic air travel should furthermore be sustainable.

Figure 2 presents the editorial makeup of the SAF agenda in Danish news media. It points to a relatively specialized domestic agenda with limited public engagement, as indicated by the low number of op-eds.

Framing SAF

RQ2 is concerned with how SAF is framed by Danish news media. As shown in Figure 3, three frames (political-regulative, technology, and optimistic climate) stand out, accounting for a total of 83% of the articles. The frames growth and critical climate, on the other hand, play a minor role, with a share of each between 6-7%.

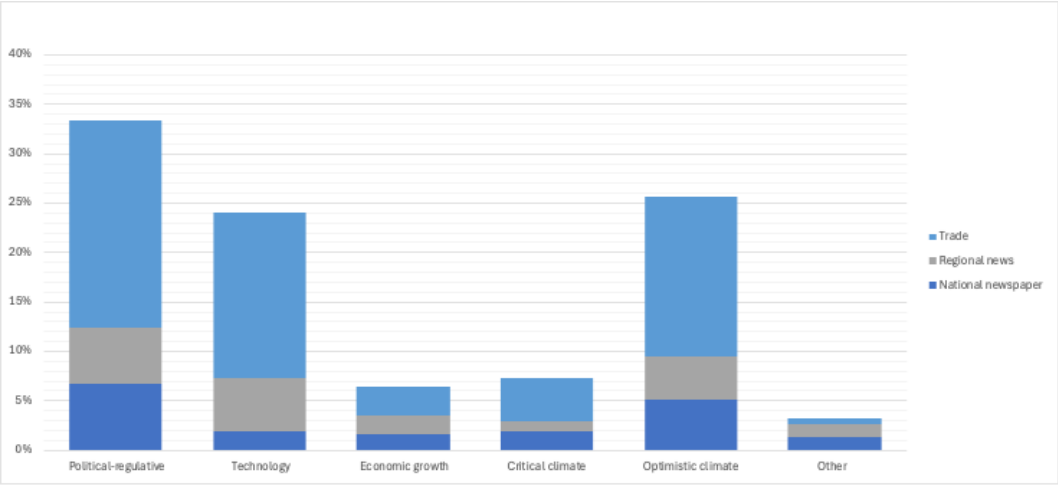

Figure 3. Frame frequency and distribution (2018-2023)

The *political-regulative* frame is the most prevalent (33%). It also gives voice to players outside the political system. They call for measures such as a public climate foundation for SAF production (Herning Folkeblad, 2022.01.03), clearer framework conditions for a future hydrogen production and infrastructure (Jyllands-Posten, 2023.11.22), and state support to get the SAF production chain in place (energy-supply.dk, 2022.09.13). This frame also concerns proposals coming from the political field, such as a planned air tax. Unsurprisingly, the most widely discussed proposal is the prime minister's stated objective that green domestic flying will be possible within a few years. The latter is used by several actors to point out the need for public regulation and investment.

Whereas articulations in the political-regulative frame are generally argumentative, in the *technology* frame (24%), they tend to be rather explanatory or descriptive. This way, the technology and production process behind SAF is explained in general terms or focused on specific technological achievements or projects. A recurrent topic is how the production of SAF is already technologically feasible, for example, according to a

newly published scientific report (Fyens.dk, 2019.10.29). Another topic is how fuel companies have agreed to establish new stocks of SAF in Denmark (Børsen, 2023.09.17), or that Danish researchers have developed a new method for carbon capture (Ingeniøren, 2021.10.08).

The *optimistic climate* frame (26%) foregrounds the contribution of SAF to climate change mitigation. For example, reports on how an airline company, as the first domestic airline, is using biofuel, are presented as a step towards reducing CO_2 emissions and making "the airline industry sustainable in the long run" (Jydske Vestkysten, 2021.05.07). A similar framing can be found in international news about Virgin Airlines' intention to fly across the Atlantic on SAF, resulting in an alleged 70% reduction of carbon emissions (Herning Folkeblad, 2022.12.12).

The *critical climate* frame also employs a climate perspective, but from the opposite direction. Here, SAF is presented as detrimental to climate change mitigation. As noted, this frame is significantly less present in the media. It includes reported claims from the European Consumer Organization BEUC that aviation companies are using SAF as greenwashing, since real sustainable fuel is not yet "ready on the market" (Ekstrabladet, 2023.06.22). Similarly, the coverage of a report by the trade organization Danish Aviation (Dansk Luftffart) describes SAF in its current state as insufficient for achieving climate ambitions due to the expected rise in air traffic (Information, 2020.05.08).

Finally, and somewhat surprisingly, the *growth* frame also plays a minor role. Whereas growth potentials for Danish businesses are often mentioned, it rarely constitutes the main framing. Mostly, growth potentials are related to large businesses at specific locations (Port of Esbjerg, the cement factory Aalborg Portland, or Arcadia eFuels in Vordingborg).

Largely, the five frames are equally distributed across the media geography, i.e., national newspapers, regional news, and trade journals (see Figure 3). However, the major exception is the technology frame, which is less present in national newspapers and more present in trade journals. Thus, while the style and audiences differ in the three news arenas, the framing of SAF is quite alike, except for the technology frame.

Co-articulating frames: Climate tech governance as new(s) discourse

The distribution of frames provides important insights into public negotiations of SAF. However, it is equally important to acknowledge that frames are often *co-articulated*. Within the same article, climate considerations relating to carbon emission reductions can feature along with technological descriptions or political issues. With the exception of the critical climate frame, the frames are often seamlessly combined.

This way, media coverage of SAF is characterized by bundling different perspectives in the individual articles, including climate, technology, economic growth, and political regulation. In this co-articulation of frames, we detect an updated version of the discourse of ecological modernization (Hajer, 1995), which integrates sustainability concerns, tech-

nological innovations, state initiatives, and market mechanisms. To capture the co-articulation of these elements, we will refer to this as a discourse of *climate tech governance*. Apart from the bundling of perspectives, this discourse is characterized by features of nomination and projection.

A key feature in the discourse is the very *nomination* of the discussed phenomenon (Reisigl & Wodak, 2016). We see it in word combinations like 'sustainable aviation fuels', 'fossil free aviation fuel', 'CO_2 neutral aviation fuel', 'green aviation fuels', and, of course, 'SAF'. Common to all these nominations is the nexus of the substantive 'aviation fuel' and attributive adjectives that signify an environmental or climate-friendly quality. Only occasionally do we find this nomination hedged by a prefix like 'so-called', by comparative adjectives ('greener' instead of 'green'), or, as in the case of the critical climate frame, by problematizing the very notion of SAF. Most of the time, the nexus between aviation fuel and sustainability is simply taken for granted. Far from being restricted to the optimistic climate frame, it runs through most news reports on a more fundamental level as a discursive undercurrent.

Another feature of the climate tech governance discourse is its *projective* nature. While news, by definition, is about recent events, SAF is rarely only about what (just) happened. Often SAF is projected towards a wider future. For instance, the initial mix of a few percentages of biofuel in aviation fuel is reported as a "small, but important step" (Jydske Vestkysten, 2021.05.07). Similarly, the test of a new chemical plant is called an event that "may turn out to be revolutionary" (nordjyske.dk, 23.08.16), and a launch of a research facility is headlined as a "groundbreaking local project [that] can show the way to greener air traffic" (Viborgfolkeblad.dk, 23.10.15). In these instances, the actual event is inscribed into a wider horizon and loaded with significance due to its future promises. Seemingly small or insignificant events become magnified by their revolutionary potential. At the same time, concrete events function as a means to ground future projections. Thereby, SAF is represented not as a technological Fata Morgana but based on real inventions, physical sites, and local projects. However, these tangible aspects are *potentialized* in a double sense. First, the technology of future aviation is yet to be invented – and when invented, they will secure a bright future.

Sources and discourse coalitions

RQ3 explores the main sources populating news coverage of SAF. Figure 4 shows how the media draw on a wide range of sources. However, findings also point to a clear dominance of certain types of sources. Most prevalent are business sources (39%), mostly from the energy and aviation industry. Next come political sources (20%) dominated by national politics, while experts (14%) are mostly university researchers from the energy field. Further down the list, we find interest groups like Danish Industry and Danish Aviation (8%). Thus, media representations of SAF make use of elite sources strong in economic,

academic, or organizational capital. By contrast, NGOs, other media sources like social network sites, and individual citizens each account for less than 5%.

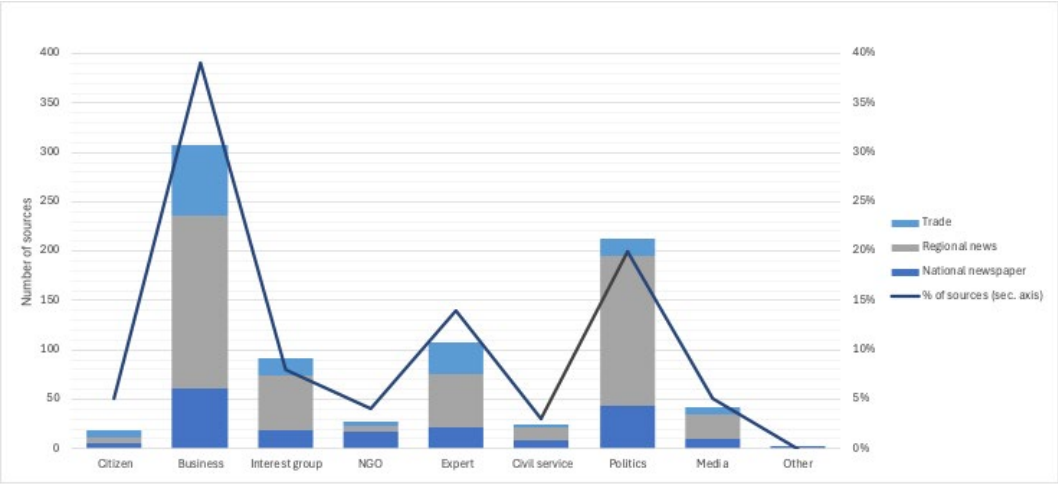

Figure 4. Sources (2018-2023)

In Figure 5, we see that sources are not evenly distributed across frames. Unsurprisingly, political sources and interest organizations have the highest share in the political-regulative frame. Also foreseeable, expert sources often articulate the technology frame, although the highest share of expert sources is found in the critical climate frame. It is worth noticing that NGO sources are completely absent in the optimistic climate frame, while widely used in the critical climate frame and, not least, the political-regulative frame.

Business sources play a particular role. Not only do they dominate the growth frame, but they are also prevalent in the optimistic climate and technology frames. Thus, a remarkable two thirds of sources in the optimistic climate frame are from businesses. In contrast, business sources are less prevalent in the political-regulative frame, although this is partly balanced by a high share of interest groups, which include trade and industry associations. Thus, the findings indicate that businesses' sources not only represent SAF as a means for economic growth, but they also contribute significantly to the articulation of SAF as climate-friendly and a technology and political issue.

An illustrative example is news about collaboration between large energy companies (Ørsted), transportation businesses (Mærsk, DSV, SAS), airlines (SAS), and Copenhagen Airport to establish a facility for hydrogen production (Berlingske, 2020.05.25). Although mixed with issues of electrolysis technology, export potentials, and political regulation, the business quotes mainly frame the project as an important climate contribution, making widespread reference to the official Danish goal of 70% carbon emission reduction by 2030 and climate neutrality in 2050. This exemplifies how the use of business sources plays a key part in combining the frames.

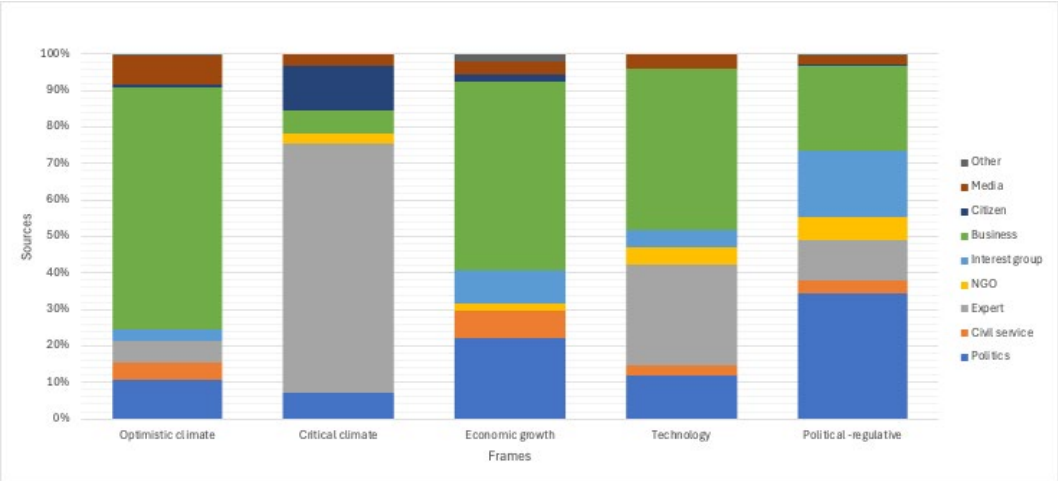

Figure 5. Frames and sources (2018-2023)

Building on these observations, we suggest that a discourse coalition (Hajer, 2005) is instrumental in sustaining the discourse of climate tech governance. Representatives from diverse fields such as energy, airlines, trade organizations, national politics, and universities all use similar frames in making sense of SAF. The 'partners' in these coalitions represent well-organized groups with substantial economic and/or knowledge capital. In a discourse coalition perspective, the media provide a set of practices that help distribute the voices of this discourse coalition. The media furthermore enable each coalition player to observe that players from other societal fields are aligned with the discourse of climate tech governance. Assembling powerful actors and giving them a voice in the media arguably helps strengthen the position of the climate tech governance discourse.

Developments: Realism and permanent revolution

We have studied SAF in the Danish media from the term's early introduction to its dissemination in various media (RQ1–3). Here, we look at how media coverage has developed during the emergence of this new discursive phenomenon (RQ4). In terms of frame distribution, no clear development can be observed (see Figure 6), although a slight increase in the critical climate frame can be observed at the end of the sampling period. It might indicate a shift towards a less marginal position for more critical assessments of SAF. The numerical values, however, are low, and it remains to be seen if this is a random fluctuation or a lasting tendency.

By contrast, there are discernible developments *within* the frames. By 2023, several articles using the political-regulative frame raise concerns about the realism of the government's SAF ambitions. In a letter to the editor, the director of the trade association Green Power Denmark criticizes the speed of the transition to "green power" (Helsingør Dagblad, 23.03.26). The prospect of a "green business adventure" for Danish companies will be missed if not enough renewable electricity is produced to enable the production of

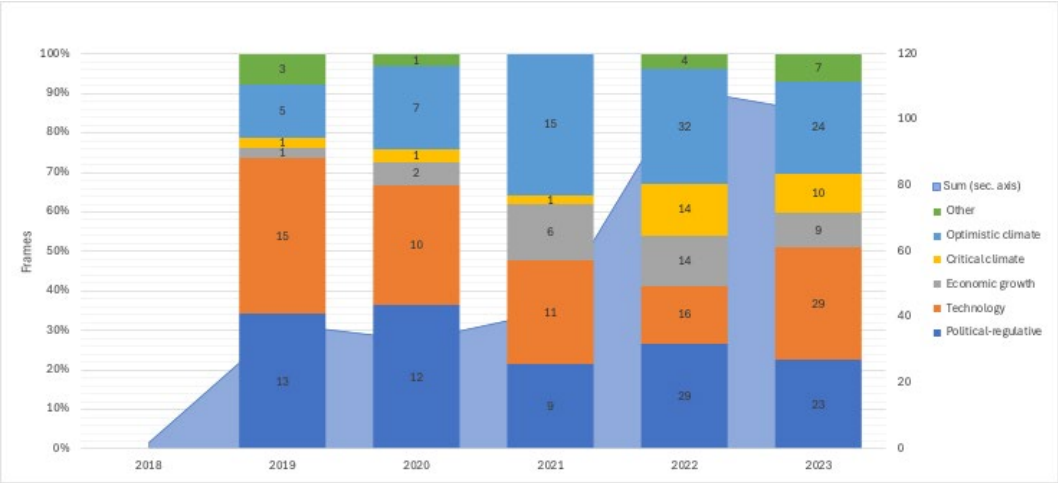

Figure 6. Frame development (2018-2023)

green fuels, including SAF. The letter points to several political measures that stand in the way, such as preventing private companies from applying for installation of offshore wind turbines at their own expense, or the lack of political decisions concerning new infrastructures for hydrogen transportation that will connect domestic and foreign markets. This inertia is contrasted with government support in neighboring countries as well as the US. In a similar vein, an article headlined "lack of green electricity is causing cracks in the future Danish golden egg" interviews important players in the Danish power-to-X industry. They all raise concerns over the lack of green power and the uncertainty surrounding the planned hydrogen pipeline. The lack of infrastructure investments is vividly compared to "starting up car production in a country with no roads to drive on" (JyllandsPosten, 2023.11.22).

The examples illustrate how the media increasingly question the realism of the government's ambitions of green domestic flights in 2025. Using one of the abundant aviation metaphors in SAF reporting, they fear the project will be "driven into the hangar" (Energiwatch, 23.09.20). Confronted with these concerns, the energy and climate minister maintains that the ambition is feasible, while acknowledging that the government has recently prioritized carbon capture and storage at the expense of power-to-X (the energy source of SAF production) to reach climate targets for 2030. What we are seeing in these articles is how the initial hype of SAF is replaced by growing concerns and skepticism about SAF. Given the short timeline, there simply seems to be a lack of both political will and sufficient infrastructure investments to realize the ambitions of SAF.

All the same, SAF is inscribed into a larger framework of energy policies that involves decisions on carbon capture and storage as well as power-to-X to reach political climate goals. Although these policies are occasionally challenged, they remain within the scope of the climate tech governance discourse. As such, it demonstrates how this discourse

produces a set of premises and a horizon of meaning that allow for different viewpoints and controversies.

Outside the discourse of climate tech governance, a more systemic criticism is raised. Here, the government's plans for "green aviation" are contextualized quite differently (Information, 2023.11.09). By pointing out that the share of carbon emissions from domestic flights (4%) dwarfs in comparison with (Danish) international flights (96%), the government's ambitions come across as merely symbolic. Moreover, the article explains how the climate effect of international aviation is even worse because of water vapor in the condensation streaks. Finally, a planned tax on aviation is compared to much higher price hikes in public transportation, and the article makes the case for stronger public support for trains and buses as an alternative strategy. It concludes by noticing that there is "no way around aiming for less flying both domestically and abroad for a long time to come". This criticism is not a rejection *tout court* of technological efforts to mitigate climate change. Rather, it interrogates government plans in more detail by exposing the adverse effects of flying. Parallel to the more critical stance within the political-regulative frame, it represents a more pointed criticism within the critical climate frame.

Summing up, we can observe quantitative indications of minor shifts towards a more realistic and negative framing of SAF. This is followed by qualitative developments where the negative framing becomes more pointed, while questions are raised on the realism of SAF ambitions within the climate tech discourse. At the same time, news projecting SAF events into the future as potentially groundbreaking remains a feature of the coverage. Diachronically viewed, the media representation of SAF thus displays two seemingly independent strands: a movement towards more realism vis-à-vis government ambitions, and a permanent optimism as to the future potential of SAF.

Conclusion and discussion

Conclusion

Our findings show a sharp increase in media attention to SAF from 2017 to 2023, mainly in trade journals and in relation to domestic issues. Moreover, the political-regulative, technology, and optimistic climate frames are the most prevalent, even across different public arenas. Frequently, frames are co-articulated in news stories, resulting in a discourse of climate tech governance. Within this discourse, the nexus between aviation and sustainability is taken for granted. This nexus is furthermore projected into the future, magnifying SAF as potentially groundbreaking.

We find that elite sources from business, politics, science, and interest organizations dominate news reporting. In contrast, NGOs and individual citizens play a minor role. Business sources constitute the dominant source in most frames, not least the optimistic climate frame. This use of business sources contributes significantly to promote SAF as a solution towards CO2 reduction.

Finally, we find no clear development in the relative strength of frames, although we observe a slight tendency towards a more critical assessment of SAF ambitions. At the same time, however, optimistic projections of SAF's future potentials remains a steady undercurrent in media coverage.

Discussion

Our findings resonate with similar studies of SAF and renewable energy (Lyytimäki, 2018; Rochyadi-Reetz et al., 2019, Kulanovic & Nordensvärd, 2021), both in terms of identifying individual frames and a dominant discourse. However, by identifying a discourse on green tech governance, we add two new dimensions to the general discourse of ecological modernization (Hajer, 1995): first, a set of nominations that assume a link between aviation fuels and sustainability; and second, a futuristic projection that represent recent SAF events as potentially groundbreaking. Connected to that discourse, we also find conceptions of Denmark, or Danish industries, as potential forerunners in the development of SAF. This echoes similar findings in Rahn's (2022) study of the German media debate. Similar to a Swedish study on future aviation (Christley & Ullström, 2024), we also suggest a strong discourse coalition based on elite sources that promote the climate tech governance discourse. In contrast, the coalition supporting the 'staying on the ground' imaginary is largely missing in our data, probably due to our focus on news and trade media representations. Thus, in our study, the composition of sources from mostly business, politics, and universities provides the basis for a (corporative) triple helix approach to SAF. However, a quadruple helix including civil society is not in sight.

The scholarly literature often refers to aviation policies as a contested field (Walker & Cook, 2009; Griggs & Howarth, 2013; Kulanovic & Nordensvärd, 2021). Our findings, however, show that public negotiations of SAF in Denmark is a (yet) relatively uncontested phenomenon. While criticism of specific government instruments is emerging, the debate is largely consensual. It differs from other debates on renewable energy technologies such as wind turbines (Bjärstig et al., 2022) or carbon capture and storage (Arning et al., 2019), which are far more polarized. This may partly be due to the limited share of critical voices from citizens or NGOs, which are more vocal in wind turbine controversies, sometimes representing opposing views and ideologies (Eskjær & Horsbøl, 2023). Another explanation could be that controversies surrounding aviation fuel are largely invisible to the public. To ordinary customers, SAF offers a smooth and painless transition to green aviation.

Thus, in contrast to wind turbines and photovoltaic plants, SAF is not associated with any physical obstacles. However, this may only last as long as the focus remains detached from the production of SAF. A study on power-to-X imaginaries in a Danish municipality has looked at local media reports. It finds a striking difference in presentations of power-to-X as either a green growth adventure or an actual production facility that requires use of scarce local land (Horsbøl, 2024). If and when production requirements get real, a simi-

lar difference may emerge in relation to SAF. So far, however, media reporting has ignored such obstacles, focusing on the promises rather than the practicalities.

SAF has experienced a steep rise in media attention, peaking in the last years of the study period. It is tempting to predict that SAF's media career will follow the pattern described by Peeters et al. (2016). They show that media representations of sustainable aviation tend to fade away relatively quickly. Will SAF be yet another example of a hyped solution that will soon disappear from the public agenda, only to be replaced by another?

We do not know yet, and in the Danish case, the investment of political capital by the prime minister could indicate a different trajectory. Nevertheless, it is striking that the *history* of (failed) sustainable aviation solutions is virtually absent in our data corpus. Media memory, it seems, is rather short and does not extend beyond SAF. Thus, the success of SAF is predicated on a promising, albeit lofty, future. One may wonder if a historic dimension could have challenged and qualified the futuristic orientation of SAF news.

Limitations and further research

As the first Danish study of public negotiations of SAF, this study has a few limitations, which we hope will stimulate further research. First, while our search formula captures the emergence of SAF as a media topic, there are still multiple ways of articulating and addressing aviation fuel and sustainability. Our sample, for instance, includes notions of 'alternative fuels' or 'renewable fuels', which should be added to future data inquiries. Second, our mixed-methods approach could be supplemented with more quantitative approaches, for instance, on SAF collocations. Or by qualitative studies, for example, on visual representations of SAF. Third, whereas we focus on aviation, a broader starting point on renewable energy could provide different insights into how aviation is integrated into public negotiations of the green energy transition. Our findings point to the integration of SAF with issues such as power-to-X, carbon capture, and energy infrastructure. These links deserve further exploration. Finally, we would like to invite comparative studies of how various parts of the green (energy) transition are represented in the news media. Our study would then add to the larger picture of public negotiation of paths and technologies towards green energy.

Notes

1 Based on same search string as our sample except that the search function [4..] has been omitted. Search is extended to 2017-2024 to provide more comprehensive overview.

References

Anderson, B. J., Mueller, D. W., Hoard, S. A., Sanders, C. M. & Rijkhoff, S. A. M. (2022). Social science applications in sustainable aviation biofuels research: Opportunities, challenges, and advancements. *Frontiers in Energy Research*, *9*, Article 771849. https://doi.org/10.3389/fenrg.2021.771849

Arning, K., Offermann-van Heek, J., Linzenich, A., Kaetelhoen, A., Sternberg, A., Bardow, A., & Ziefle, M. (2019). Same or different? Insights on public perception and acceptance of carbon capture and storage or utilization in Germany. *Energy Policy*, *125*, 235-249. https://doi.org/10.1016/j.enpol.2018.10.039

Bäckstrand, K., & Lövbrand, E. (2007). Climate governance beyond 2012: Competing discourses of green governmentality, ecological modernization and civic environmentalism. In M. E. Pettenger (Ed.), *The social construction of climate change: Power, knowledge, norms, discourses* (pp. 123-147). Ashgate.

Batel, S., & Devine-Wright, P. (2015). Towards a better understanding of people's responses to renewable energy technologies: Insights from social representations theory. *Public Understanding of Science*, *24*(3), 311–325. https://doi.org/10.1177/0963662513514165

Becken, S., Friedl, H., Stantic, B., Connolly, R. M., & Chen, J. (2020). Climate crisis and flying: Social media analysis traces the rise of "flightshame". *Journal of Sustainable Tourism*, *29*(9), 1450-1469. https://doi.org/10.1080/09669582.2020.1851699

Bjärstig, T., Mancheva, I., Zachrisson, A. Neumann, W., & Svensson, J. (2022). Is large-scale wind power a problem, solution, or victim? A frame analysis of the debate in Swedish media. *Energy Research & Social Science*, *83*, 102337. https://doi.org/10.1016/j.erss.2021.102337

Bjørkdahl, K., & Franco Duharte, A. S. (Eds.). (2022). *Academic flying and the means of communication*. Springer. https://doi.org/10.1007/978-981-16-4911-0

Bryman, A. (2012). *Social research methods* (4th ed.). Oxford University Press.

Budd, L. C. S., Griggs, S., & Howarth, D. (2013). Sustainable aviation futures: Crises, contested realities and prospects for change. In L. C. S. Budd, S. Griggs, & D. Howarth (Eds.), *Sustainable aviation futures* (pp. 3-36). Emerald Group Publishing.

Christley, E., & Ullström, S. (2024). Desired or contested futures? Competing discourse-coalitions for sustainable aviation in Sweden. *Critical Policy Studies*, *19*(3), 414-435. https://doi.org/10.1080/19460171.2024.2402785

Djerf-Pierre, M., Cokley, J., & Kuchel, L. J. (2015). Framing renewable energy: A comparative study of newspapers in Australia and Sweden. *Environmental Communication*, *10*(5), 634-655. https://doi.org/10.1080/17524032.2015.1056542

Dryzek, J, (2021). *The politics of the earth: Environmental discourses* (4th ed.). Oxford University Press.

Eklöf, J., & Mager, A. (2013). Technoscientific promotion and biofuel policy: How the press and search engines stage the biofuel controversy. *Media, Culture & Society*, *35*(4), 454-471. https://doi.org/10.1177/0163443713483794

Entman, R. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of Communication*, *43*(4), 51-58. https://doi.org/10.1111/j.1460-2466.1993.tb01304.x

Eskjær, M. F., & Horsbøl, A. (2023). New environmental controversies: Towards a typology of green conflicts. *Sustainability, 15*(3), Article 3. https://doi.org/10.3390/su15031914

Filimonau, V., Mika, M., & Pawlusiński, R. (2018). Public attitudes to biofuel use in aviation: Evidence from an emerging tourist market. *Journal of Cleaner Production*, *172*, 3102-3110. https://doi.org/10.1016/j.jclepro.2017.11.101

Freelon, D. G. (2010). ReCal: Intercoder reliability calculation as a web service. *International Journal of Internet Science*, *5*(1), 20-33.

Griggs, S., & Howarth, D. (2013). *The politics of airport expansion in the United Kingdom: Hegemony, policy and the rhetoric of 'sustainable aviation'*. Manchester University Press.

Hajer, M. A. (1995). *The politics of environmental discourse: Ecological modernization and the policy process*. Clarendon Press.

Hajer, M. A. (2005). Coalitions, practices, and meaning in environmental politics: From acid rain to BSE. In D. Howarth, & J. Torfing (Eds.), *Discourse theory in European politics: Identity, policy and governance* (pp. 297-315). Palgrave Macmillan.

Hajer, M., & Versteeg, W. (2005). A decade of discourse analysis of environmental politics: Achievements, challenges, perspectives. *Journal of Environmental Policy & Planning*, *7*(3), 175-184. https://doi.org/10.1080/15239080500339646

Horsbøl, A. (2020). Green conflicts in environmental discourse: A topos based integrative analysis of critical voices. *Critical Discourse Studies*, *17*(4), 429-446. https://doi.org/10.1080/17405904.2019.1617757

Horsbøl, A. (2024). Mediating Power-to-X: A case study of green imaginaries and environmental conflicts in local Danish news media. *Nordicom Review*, *45*(2), 217-237. https://doi.org/10.2478/nor-2024-0020

Jensen, M., & Andersen, A. H. (2013). Biofuels: A contested response to climate change. *Sustainability: Science, Practice and Policy*, *9*(1), 42-56. https://doi.org/10.1080/15487733.2013.11908106

Kim, S. H., Besley, J. C., Oh, S.-H., & Kim, S. Y. (2014). Talking about bio-fuel in the news. *Journalism Studies*, *15*(2), 218-234. https://doi.org/10.1080/1461670X.2013.809193

Kulanovic, A., & Nordensvärd, J. (2021). Exploring the political discursive lock-ins on sustainable aviation in Sweden. *Energies*, *14*(21), 7401. https://doi.org/10.3390/en14217401

Lacy, S., & Riffe, D. (1996). Sampling error and selecting intercoder reliability samples for nominal content categories. *Journalism & Mass Communication Quarterly*, *73*(4), 963-973. https://doi.org/10.1177/107769909607300414

Lyytimäki, J. (2018). Renewable energy in the news: Environmental, economic, policy and technology discussion of biogas. *Sustainable Production and Consumption*, *15*, 65-73. https://doi.org/10.1016/j.spc.2018.04.004

Løkke, S., Aramendia, E., & Malskær, J. (2021). A review of public opinion on liquid biofuels in the EU: Current knowledge and future challenges. *Biomass and Bioenergy*, *150*, 106094. https://doi.org/10.1016/j.biombioe.2021.106094

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia Medica*, *22*(3), 276-282. https://pmc.ncbi.nlm.nih.gov/articles/PMC3900052/

McQuail, D. (2010). *McQuail's mass communication theory* (6th ed.). Sage.

Mišić, M., & Obydenkova, A. (2021). Environmental conflict, renewable energy, or both? Public opinion on small hydropower plants in Serbia. *Post-Communist Economies*, *34*(5), 684-713. https://doi.org/10.1080/14631377.2021.1943928

Peeters, P., Higham, J., Kutzner, D., Cohen, S., & Gössling, S. (2016). Are technology myths stalling aviation climate policy? *Transportation Research Part D: Transport and Environment*, *44*, 30-42. https://doi.org/10.1016/j.trd.2016.02.004

Rahn, J. (2022). *Aviation discourses in news: The influence of the political climate on climate politics*. Uppsala University, Department of Archaeology and Ancient History.

Regeringen. (2023). *Vejen til grøn luftfart*. https://skm.dk/media/0xefayun/vejen-til-groen-luftfart-udspil-om-groen-luftfart.pdf

Reisigl, M., & Wodak, R. (2016). The discourse-historical approach. In R. Wodak, & M. Meyer (Eds.), *Methods of critical discourse studies* (3rd rev. ed.) (pp. 23-61). Sage.

Rice, C., Ragbir, N. K., Rice, S., & Barcia, G. (2020). Willingness to pay for sustainable aviation depends on ticket price, greenhouse gas reductions and gender. *Technology in Society*, *60*, 101224. https://doi.org/10.1016/j.techsoc.2019.101224

Rochyadi-Reetz, M., Arlt, D., Wolling, J., & Bräuer, M. (2019). Explaining the media's framing of renewable energies: An international comparison. *Frontiers in Environmental Science*, *7*. https://doi.org/10.3389/fenvs.2019.00119

Schäfer, M. S., & Painter, J. (2021). Climate journalism in a changing media ecosystem: Assessing the production of climate change-related news around the world. *Wiley Interdisciplinary Reviews: Climate Change*, *12*(1), e675. https://doi.org/10.1002/wcc.675

Sengers, F., Raven, R. P. J. M., & van Venrooij, A. T. (2010). From riches to rags: Biofuels, media discourse and resistance to sustainable energy technologies. *Energy Policy*, *38*(9), 5013-5027. https://doi.org/10.1016/j.enpol.2010.04.030

Stauffacher, M., Muggli, N., Scolobig, A., & Moser, C. (2015). Framing deep geothermal energy in mass media: The case of Switzerland. *Technological Forecasting and Social Change*, *98*, 60-70. https://doi.org/10.1016/j.techfore.2015.05.018

Walker, S., & Cook, M. (2009). The contested concept of sustainable aviation. *Sustainable Development*, *17*(6), 378-390. https://doi.org/10.1002/sd.400

Warren, C. R., Lumsden, C., O'Dowd, S., & Birnie, R. V. (2005). 'Green on green': Public perceptions of wind power in Scotland and Ireland. *Journal of Environmental Planning and Management*, *48*(6), 853-875. https://doi.org/10.1080/09640560500294376

Wormbs, N., & Söderberg, M. W. (2021). Knowledge, fear, and conscience: Reasons to stop flying because of climate change. *Urban Planning*, *6*(2), 314-324. https://doi.org/10.17645/up.v6i2.3974

Xu, B., Ahmad, S., Charles, V., & Xuan, J. (2022). Sustainable commercial aviation: What determines air travellers' willingness to pay more for sustainable aviation fuel? *Journal of Cleaner Production*, *374*, 133990. https://doi.org/10.1016/j.jclepro.2022.133990