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Decoupled Temporal Tensions

Evolving Articulations of
Climate Change and Economic Growth in Finnish Media

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ACADEMIC DISSERTATION

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Abstract

This article-based doctoral dissertation examines how climate change and economic growth have been articulated in Finnish mainstream news media between 1990 and 2023, and how processes of depoliticisation and repoliticisation have shaped that relationship. Seen through the lens of articulatio theory, the thesis conceptualises climate change and economic growth as key discursive signifiers whose relationship structures what becomes politically feasible in climate change coverage. The motivation for this work derives from the influential role of news media in shaping public discourse and framing societal priorities, especially in contexts involving contested or complex issues like climate change and its impacts on economic growth.

The study argues that although climate change has become increasingly visible in Finnish news media, it is predominantly represented within depoliticised, growth-compatible frames that stabilise the hegemonic economic paradigm. Climate change is widely acknowledged as a serious, even existential, threat by the public, yet it is most often articulated as a technical, managerial, or individualised problem rather than as a site of structural political conflict. Economic growth, by contrast, remains largely naturalised as an unquestioned societal objective, which constrains how climate policy and mitigation can be discussed.

This synopsis chapter begins with a brief description of the relationship between climate change and economic growth in general, what kinds of systemic links they have, and highlighting how the latter has been accelerating the former despite policy efforts and public claims on decoupling the two. Understanding this connection sets the stage for a discussion of how Finnish mainstream media have historically portrayed these interconnected topics and the depoliticisation and repoliticisation of them. Drawing on prior research on Finnish economic journalism and the public and media discourse on austerity economics, the chapter explores how the neoliberal “there is no alternative” logic potentially constrains both economic and environmental reporting, positioning the economy as the unquestioned baseline against which all other societal issues are measured.

Empirically, the thesis consists of four case studies that analyse both the volume and the discursive framing of climate change coverage. The results show that climate change and economic growth are rarely articulated together, despite their material interdependence. When linkages do appear, for example around the Stern Review, IPCC reports, or energy-security debates following Russia’s invasion of Ukraine, climate change is typically integrated into economic discourse through frames of innovation, competitiveness, and green growth rather than through more antagonistic or post-growth articulations.

Crises play a central role in this dynamic. Moments of economic, political, and ecological disruption temporarily open discursive space for system-critical climate framings to emerge, but these repoliticising articulations remain fragile and are often reabsorbed into growth-oriented narratives supporting status quo. The depoliticisation processes can be understood through the metaphor of magnets that repel each other: external forces such as crises are required to bring climate change and economic growth together even momentarily, before naturalised forces again push them apart. Hence, the thesis demonstrates how media discourse simultaneously enables climate awareness while limiting the scope of legitimate political response.

Article I claims climate coverage can withstand temporal crises and regain salience after brief drops in media attention. Written in the aftermath of the first of the first spring of the COVID-19 pandemic, it discusses how media attention cycles have affected Finnish climate coverage and how the amount of news on climate change has increased over time despite the initial slumps. Article I covers climate coverage in Finland's largest daily newspaper Helsingin Sanomat from 1990 to mid 2020.

Article II's key argument for the present study is that mainstream media tends to represent climate policy and climate action as subservient to the goals of economic policy. The article analyses the way the Finnish national broadcaster Yle covers national strategy documents on climate and energy futures from the point of view of frame theory.

In Article III, I focus on the evolving language of climate change coverage and news on economic growth as it appeared from 2000 through 2023 in Helsingin Sanomat and the tabloid Ilta-Sanomat. In the article, I argue that while the climate change discourse in the media has become more diverse, it is still kept separate from the real of economy and economic growth. Article III also introduces novel theoretical and methodological applications to analysing climate coverage by combining the longitudinal computational analysis of Dynamic Topic Modelling with articulation theory.

Continuing this methodological theme, Article IV evaluates the way automated data collection and its caveats may influence the research process and validity and argues that, if issues related transparency and reproducibility are addressed sufficiently, text scrapers are valid tools for data collection for longitudinal studies in media studies. Article IV also highlights one additional issue with the evolving language in climate coverage: the formerly popular term "greenhouse effect" ("kasvihuoneilmiö") is replaced by "climate change" ("ilmastonmuutos") in the news media when discussing climate issues by 2008.

Methodologically, the study combines qualitative critical discourse analysis with longitudinal computational methods, including dynamic topic modelling, to examine large-scale patterns of language use over time. By integrating automated text analysis with articulation theory, the thesis shows how hegemonic stability and discursive contingency coexist in media discourse, making it possible to trace both enduring structures of depoliticisation and moments of reconfiguration.

Overall, the thesis contributes to media and climate communication research by showing that the central challenge of climate journalism is not merely one of visibility or scientific accuracy, but of the discursive conditions under which climate change can be understood, contested, and acted upon within a growth-oriented political economy.

Acknowledgements

At the end of 2019, we took a leap of faith with my wife Barbora as I applied for the researcher position at the Finnish Environment Institute Syke. Given my multidisciplinary background and the climate journalism projects I had been involved in, the two research projects I was hired for, ORSI – Towards an eco-welfare state and DECENT – Towards deliberative climate and energy foresight, felt like the perfect match for my interests, as was the transition from media and communications to research. Almost immediately after settling in, the COVID pandemic began. The future work planned, especially for the interaction work package (WP) for ORSI, had to change. Meanwhile, the new circumstances of remote work and lack of travel as part of work sparked an idea of pursuing doctoral studies which might now become possible. I received stupendously warm support from very early on from not only my wife and my family but also from my then superior Sanna-Riikka Saarela and colleague Jari Lyytimäki who both lead the Syke WP in DECENT and was part of ORSI's Syke WP and had hired me to Syke along with Annukka Berg and Sanna-Riikka. This support continued with the support of my current supervisor Soile Kulmala, and the work communities of both Syke and Puistokatu 4. Thank you all!

My interests have always been rather diverse which is also why I have become a jack-of-all-trades in many fields from computer science to economics to writing and podcasting. During the Hyvän sään aikana climate book project I became immensely interested in climate psychology and the effects language used about climate change and policy, and the inherent contradictions, especially related to psychology, politics and economics. As I was part of the media analysis WP in DECENT, the idea for my PhD topic eventually crystallised as having to do with analysing journalistic media content on climate change. During the first COVID summer, I became one of the authors of a research article that was to become the first to be included in my PhD. Meanwhile, I wrote my research plan and expanded my scope to both include the critical juxtaposition between climate change and economic growth, and to include a more data-science approach of utilising natural language processing (NLP) methods for large-scale text analysis. So, in the autumn of 2020, I applied for the doctoral programme of interdisciplinary environmental sciences (DENVI) at the University of Helsinki, and began my studies in January 2021 with a fantastic trio of supervisors: Jari from Syke with whom I worked practically daily, and from University of Helsinki Risto Kunelius, whom I already

knew from my Tampere university days, and Arho Toikka, whose work I had become acquainted with whilst writing my research plan. Everything fit to place perfectly for me to start my PhD journey with a perfect combination of challenges, support, and life circumstances. I would also like to thank Eva Heiskanen and Eetu Mäkelä for their support in the doctoral thesis committee, the examiners Mervi Pantti and Markus Ojala, the preliminary examiners John Downey and Peter Berglez, who also agreed to serve as my opponent on a cold January Friday.

Now, a bit over four years later, and with two children added to the mix, I can say with extreme clarity that I could not have done the work without my wonderful wife Bára, who supported me, my studies, and my work throughout the journey. Daniel and Nikolas, our boys, are the best gifts we could have had, and a significant amount of words of this thesis and the case studies included have been written or dictated during our nap walks around the capital area coastlines. This work is dedicated to them.

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List of original publications

This thesis is based on the following publications:

I Lyytimäki, J., Kangas, H. -L., Mervaala, E., & Vikström, S. (2020). Muted by a Crisis? COVID-19 and the Long-Term Evolution of Climate Change Newspaper Coverage. Sustainability, 12(20), 8575. https://doi.org/10.3390/su12208575

II Vikström, S., Mervaala, E., Kangas, H. L., & Lyytimäki, J. (2023). Framing climate futures: the media representations of climate and energy policies in Finnish broadcasting company news. Journal of Integrative Environmental Sciences, 20(1). https://doi.org/10.1080/1943815X.2023.2178464

III Mervaala, E. (2025). Climate Change Versus Economic Growth: Quantifying, Identifying and Comparing Articulations in News Media Using Dynamic Topic Modeling. Environmental Communication. https://doi.org/10.1080/17524032.2025.2458222

IV Mervaala, E., & Lyytimäki, J. (2024). Towards efficient and reliable utilization of automated data collection: Media scrapers applied to news on climate change. The Journal of Data Mining & Digital Humanities (JDMDH), NLP4DH, 15. https://doi.org/10.46298/jdmdh.13123

The publications are referred to in the text by their roman numerals.

Declaration of Authorship Contribution

This document describes the thesis author's participation in the co-written research articles representing three of the four case studies discussed in the present study. Article III did not have co-authors.

Scale Explanation:

1 = Significant participation, 2 = High participation, 3 = Moderate participation, 4 = Low or no participation.

Table 1 Muted by a Crisis? COVID-19 and the Long-Term Evolution of Climate Change Newspaper Coverage (Article I)

Authors	Research Idea & Planning	Data Collection	Data Analysis & Interpretation	Reporting of Results	Manuscript Preparation & Writing
Lyytimäki	1	2	3	3	2
Kangas	4	4	2	3	3
Mervaala	4	4	3	4	3
Vikström	4	4	4	4	3

The thesis author participated with minor contributions to the initial conceptualisation of the article and reporting of the results, with moderate participation to the analysis, and writing of this article. Although automated data collection methods were piloted by the researcher for the data collection, ultimately manual data collection methods established by Lyytimäki were used.

Table 2 Framing climate futures: the media representations of climate and energy policies in Finnish broadcasting company news (Article II)

Authors	Research Idea & Planning	Data Collection	Data Analysis & Interpretation	Reporting of Results	Manuscript Preparation & Writing
Vikström	2	1	1	1	1
Mervaala	2	4	4	4	3
Lyytimäki	2	3	4	4	4
Kangas	4	3	3	4	4

The author contributed mainly to the initial theoretical framing and planning phase, particularly in relation to frame analysis and theoretical discussions. Vikström led the article from thereon, with the author's direct involvement in data collection and analysis being minimal, participating primarily through reviewing and providing feedback on coding iterations. The author's participation resumed during manuscript preparation and editing phases for the parts concerning the theory and methodology of the study, and the discussion and conclusion chapters.

Table 3 Towards efficient and reliable utilization of automated data collection (Article IV)

Authors	Research Idea & Planning	Data Collection	Data Analysis & Interpretation	Reporting of Results	Manuscript Preparation & Writing
Mervaala	1	1	1	1	1
Lyytimäki	2	1	3	3	3

The author played a central role in this article, primarily driven by their critical perspective on automated text analysis and data collection methods. The researcher's contributions included formulating the research idea, comprehensive execution of data analysis and interpretation, and manuscript preparation and writing, comparing automated methods developed by them with traditional manual approaches previously utilised by Lyytimäki.

1 Introduction

Climate change, or what many now refer to as the climate crisis, is an issue of unparalleled significance. In journalistic news media, it has been described as the "biggest story in the world" (Howard, 2015), "the everything story" (Hertsgaard & Pope, 2023), "biggest story of our time" (Free Press Unlimited, 2024), and "the greatest story never told" (Svendsen et al., 2011; Marshall, 2014). Yet, despite its global scope and urgency, it is often overshadowed by other seemingly pressing local and immediate concerns. These issues – ranging from political events to economic downturns – tend to dominate media narratives, reducing space for sustained discussion on what has become a defining challenge of our time.

This marginalization is compounded by the multifaceted nature of climate change itself. Far from being a singular issue, it functions as an umbrella topic that encompasses a wide array of interconnected concerns. From individual consumption patterns, such as meatless diets and sustainable fashion, to broader societal issues like air travel, urban planning, and public health, climate change touches virtually every aspect of human life.

This broad reach, however, does not translate into a corresponding expansion of the conceptual frameworks through which it is understood or addressed. Oftentimes this leads to, climate change – and by extension, *politically feasible* climate policy and action – being discussed within and limited by the dominant paradigm of *economic growth* – distinct here from "the economy" in general: the focus is on growth as a normative objective that sets the limits of the politically thinkable. Media representations, in particular, often frame discussions about climate change within the parameters of economic development, whether at the local, national, or global level. This is not a case of absent climate–economy coupling: climate is often articulated inside economic reasoning through cost–benefit analysis and integrated assessment models (Stern, 2006; Nordhaus, 2013), which can stabilise the growth paradigm rather than contest it.

However, the tone of the discussion has shifted: mitigating climate change was long seen through the lens of economic costs, but the narrative of economic *benefits* rose to prominence in 2006 coinciding with the release of the Stern Review (Stern, 2007; Yohe & Tol, 2008) and the release of Al Gore's influential film "The Inconvenient Truth" (Stecula & Merkley, 2019; Grundmann & Scott, 2014; Boykoff, 2008). This shift strengthens a containment linkage: climate action becomes legible chiefly as efficiency, innovation, competitiveness, or risk

management rather than as a question of economic purpose or limits. This tendency to confine climate discourse within the bounds of an economic growth-centric framework significantly limits our ability to imagine alternative approaches. It constrains not only the language we use to describe the impacts of climate change but also the ways in which we conceptualise mitigation strategies – from individual household consumption choices to macroeconomic policies and regulatory frameworks.

Despite journalism's work to articulate differing opinions in a shared public space, some values and paradigms are seldom questioned in the mainstream journalism. One such societal paradigm has been the frame of elevating the pursuing economic growth as the priority that dictates the limits for development across the society from policy to budgeting to news media discourse. Recently, since the economic crisis of 2008, it is also often accompanied with austerity economics (Harjuniemi, 2023a, pp. 73-85). While this economic paradigm today appears largely hegemonic, that was not always the case. Rather, it is the result of a a long-term political and cultural project that has stabilized growth as the primary horizon of economic and political imagination (Kallis et al., 2018; Schmelzer et al., 2022; Harjuniemi, 2020; Blyth, 2013). Hence, any climate action or policy that does not support it tends to face the same structural exclusion as proposals that contest core assumptions in other policy domains: they are rarely seriously considered. This gives at least a partial explanation to why climate can be widely accepted as real while proposals for solutions that imply post-growth trajectories remain marginal.

At the same time, climate change has attained the status of an overarching global crisis and is no longer widely contested as a phenomenon per se. However, proposed responses remain largely confined within growth-oriented economic frameworks, despite growing evidence that such constraints limit meaningful mitigation (Stoddard et al., 2021). This disconnect suggests that climate change and economic growth are not naturally coupled in media discourse; rather, they are kept separate. This separation reflects discursive boundaries that shield the prevailing economic paradigm from scrutiny (Harjuniemi, 2020), particularly in journalistic representations of sustainability (Litofcenko et al., 2020) even though, at the level of expert policy talk, climate and economy may appear tightly coupled such as in the case carbon pricing (Grubb et al., 2023).

This juxtaposition is not limited to how the climate and economic growth two are discussed in politics or in journalistic texts. The boundaries of traditional journalistic practices and its role in the society are increasingly challenged by climate reporting, raising questions about objectivity, advocacy, and the role of journalists in public debates (Howarth, 2012). Journalists themselves covering climate change are often be labelled as environmental activists (Beling Loose & Villar Belmonte, 2023; Eide & Kunelius, 2020). Similar labels, at least with as

negatively perceived connotations, are rarely attached to journalists specialising in economic or business affairs, despite the normative assumptions embedded in economic reporting. One explanation for this asymmetry lies in the political implications of climate reporting. Because meaningful climate action often entails challenging existing societal and economic arrangements (Huttunen 2024), climate journalists may be perceived as implicitly supporting systemic change. In turn, such reporting can be interpreted as threatening established power relations and the growth-oriented economic paradigm, making climate journalists more vulnerable to accusations of activism than their colleagues working on the economic beat (Pepermans & Maeseele, 2014). Historically, mainstream media have tended to support existing power relations and growth-oriented economic arrangements, which helps explain why reporting that questions these arrangements more easily attracts accusations of activism and bias (Herman & Chomsky, 2002; Lahsen, 2024; Van Dijk, 1995; Berkowitz & Beach, 1993; Gonçalves, 2017).

Conventional distinctions between objective reporting and partisan commentary become blurred, particularly when journalists expose systemic failures in addressing climate change. Hackett and Gunster (2017) argue for a "pro-climate framing" that moves beyond traditional and often very rigid objectivity standards, advocating for a journalism that bridges between conventional reporting and the urgency expressed by engaged citizens. The demand for this shift aligns with broader critiques of journalistic objectivity. As with other environmental risks such as oil spills or nuclear power, climate change, too, strains or reshapes traditional journalistic norms – especially "balance" and "objectivity" – in ways that redefines professional rules of reporting and public debate (Wetts, 2020; Howarth, 2013). The nature of these debates necessitates engaged reporting, prompting calls for a participatory model of journalism. This approach envisions the media not as neutral observers but as active contributors to public discourse, enhancing public engagement and democratic debate, voicing the concerns of not only their audiences but also of the experts and activists.

The labelling of climate journalists as activists often stems from misunderstandings of evolving professional roles. Research shows that reporting grounded in scientific consensus and interpretive context is frequently mischaracterized as advocacy, even though it reflects a shift away from false balance rather than a rejection of objectivity (Brüggemann & Engesser, 2017; Fahy 2017). Rather than undermining journalistic standards, this approach actually aligns with an emerging paradigm of objectivity as evidence-based judgment that acknowledges both scientific knowledge and the urgency of the climate crisis (Fahy, 2018; Schäfer, 2021).The demand for more engaged reporting, then, is both necessary and justified: the science behind climate attribution – linking extreme weather events to climate change – is probabilistic, methodologically complex, and

often counterintuitive, making it difficult for non-expert audiences to interpret without journalistic mediation (Shepherd, 2016; Mann et al., 2017). As a result, climate journalists increasingly have had to adopt more explanatory and interpretive approaches that address context, uncertainty, and relevance, moving beyond traditional event-driven reporting to support public understanding and engagement (Osaka & Bellamy, 2020; Painter, 2020). The challenge lies in the responsibly for conveying the risks, uncertainties, and policy implications of climate change without succumbing to accusations of partisanship. Solutions to addressing climate change challenge the current growth-based model upon which the current economic – and political – systems are based on.

Currently, there is little empirical evidence that greenhouse gas emissions can be decoupled from economic growth at an absolute level while expecting that gross domestic product (GDP) continues to increase. Although some countries have achieved *relative* decoupling, meaning that emissions have grown more slowly than GDP, these gains have largely been driven by structural shifts, outsourcing, or short-term efficiency improvements rather than sustained reductions in absolute emissions. As a result, relative decoupling has so far proven inadequate for achieving the deep and rapid emission cuts required to meet climate targets (Vadén et al., 2020).

The risks of climate change have been disseminated by the scientific community to the public for quite some time: the essential message of IPCC has not changed since 1988 (IPCC, 1988). In the current millennium, this knowledge could be assumed to be general knowledge: as the earth climate changes, temperatures rise, and the amount and magnitude of natural disasters, wildfires, floods, storms and droughts grows (IPCC, 2018). Climate predictions have also become an integral part in risk assessment for insurance companies – and for economic forecasts (Collier et al., 2021). Yet, the assumptions of bias – accusations of challenging the system as a revolutionary, often "leftist", plot – remain and embolden as the crisis progresses (Oreskes & Conway, 2010). Such accusations are directed not only at explicitly radical climate activism, including calls for confrontational or disruptive action (Malm 2021, Malm & Carton 2024), but also at more moderate, policy-oriented approaches that remain within established political institutions and frameworks (Gough, 2017). While the media frequently highlights contradictions between short-term economic imperatives and long-term environmental sustainability, these juxtapositions are rarely interrogated critically. Instead, they are often treated as irreconcilable, further entrenching existing power structures and limiting opportunities for transformative change. (Evans & Teers-Tomaselli, 2023; Lahsen, 2024).

In the present thesis, I approach the articulation of climate change and economic growth in the media through a critical discourse-theoretical perspective that foregrounds their internal dynamics, tensions, and historical shifts. While the

empirical focus is on how climate change and economic growth are articulated together (or kept apart) in media discourse, the normative ethos of the study is to identify whether and how the dynamic of the two themes could be enhanced.

The theoretical framework is primarily drawn from critical discourse approaches concerned with processes of depoliticisation and repoliticisation, with articulation theory playing a central role in understanding how meanings become stabilised, contested, or transformed over time. Depoliticisation, and the corresponding call for repoliticisation, provides a lens for examining how public economic discourse and climate discourse interact, and how this interaction has contributed to the stagnation or narrowing of climate policy debates in both political and media arenas.

In economic discourse, the hegemony of the market paradigm has increasingly led to public choices becoming politically viable if and only when they can operate under or be aligned with the neoliberal market rule paradigm. According to Brown (2015), the distinctive signature of this hegemony has led to the widespread economization of non-economic domains, activities and subjects – including cases that do not necessarily involve their marketization or monetarization. As per Bourdieu (2002), this development has led to "the depoliticization of the economic" as market rules have become naturalised in the society. Hence, the neoliberal market economic paradigm is no longer perceived as subject to political debate or contestation (Morgan 2003, Swyngedouw 2017).

In Finland, as in many other countries, this development has elevated economic expertise and elite actors above other forms of socio-economic knowledge, reinforcing the central institutional position of the Ministry of Finance relative to other ministries (Harjuniemi, 2020; 2023a). The depoliticisation of the economy – effectively elevating it to a position that frames the boundaries of what is politically possible – has severely limited the political choices presented as viable options to the public in both the political and media discourses. Political choices are frequently framed as too complex for ordinary citizens, or even elected representatives, to evaluate independently, which in turn legitimises repeated appeals to expert authority as the basis for decision-making (Sloterdijk, 2005).

Within this context, economic expertise has acquired a particularly elevated epistemic status. Labels such as "economists" and "economics" function as labels of authority that can legitimise claims presented as objective, necessary, or unavoidable, even when they rest on contested assumptions. This dynamic resembles what critical cultural and political-economic scholarship has described as the naturalisation of economic knowledge, whereby economic propositions attain a quasi-religious status that resists challenge or alternative interpretation. This process echoes Stuart Hall's account of ideology as "common sense," in which historically contingent assumptions become taken-for-granted truths, resistant to political challenge (Hall, 1986; Peck, 2010). In Finnish media, especially since

1990s onwards, economists have assumed the role of an assumed everything-expert whose opinion has weight in not only the economy but every field that has an economic side to it – including climate policy (Harjuniemi, 2023a; 2023b).

Several commentators have noted that while the depoliticisation of economics often coincides with the politicisation of other social domains (Marsdal, 2013; Davidson, 2016), climate change appears to constitute a partial exception. Despite its severe social and political implications, climate discourse has undergone a parallel process of depoliticisation, despite becoming again visibly more (re)politicised more recently.

Geographer Erik Swyngedouw (2010) has noted the paradox that climate change is at the same time both politicized and depoliticized. He critiques the consensual framing that reduces the issue to a humanitarian struggle against rising CO_2 concentrations, for two reasons. By narrowing policy-making to scientific rationality, the narrative eliminates dissenting voices and renders science the sole foundation for decisions. This is accompanied by the apocalyptic imagery that casts climate change as an all-encompassing threat, obscuring structural inequalities and silencing social conflicts. The "us vs CO_2" framing objectifies the enemy (as material, natural entity) and forecloses democratic debate, turning climate into a technical problem to be solved only by an international governance regime (such as the UN Framework Convention on Climate Change). This regime relies on consensus, participatory negotiation, and technocratic decision-making that ties science directly to politics while preserving market-based socioeconomic organization (Swyngedouw 2010). Methmann and Rothe (2012) note that portraying climate change as a global risk reinforces the existing technocratic, risk-management approach in international governance rather than considering let alone suggesting alternatives to the status quo. The scientific framing of climate action as fighting CO2 conceals the political struggles over alternative visions for society (Goeminne, 2010; Swyngedouw, 2017).

Crises – or crisification – however, may provide innings for attempting repoliticization. From Antonio Gramsci (2011 [1947]) to Milton Friedman (1962), crises have been discussed as pivotal moments – opportunities to reshape what is accepted as the status quo. Climate action movements have issued systems-level challenge via highlighting links between capitalism, powerful carbon interests, and social justice (Urry 2011, pp. 90–93), attempting repoliticization within the climate discourse. Such challenges have also been present in movements such as the Occupy movement that formed after the 2007–2008 global financial crisis. As I will discuss later, these systems-level critiques and anti-capitalist sentiments, while always present in the climate movement, re-emerged roughly a decade later with heightened urgency and public visibility. This renewed mobilisation coincided with the adoption of the "climate crisis" framing, which also gained traction in media coverage (Howard, 2015).

Depoliticisation serves as a central organising concept in this thesis, structuring the analysis of a series of crises that unfold over the period 1990–2023, including the overarching climate crisis, economic crises, the COVID-19 pandemic, and the war in Ukraine. Although these crises differ in scale and temporality, they are examined as critical moments in discourse – sites where established meanings are disrupted and temporarily reconfigured, offering insight into how political alternatives are either opened up or excluded (Laclau & Mouffe 1985, pp. 112–113). Climate change and economic growth are then seen as contested key signifiers that structure and stabilise our collective discursive meaning making. They serve as central reference points around which other concepts are organised and given meaning.

Crises are often categorised based on their speed and perceived endpoint. Compared to slowly progressing environmental crises, short-lived crises such as financial collapses or pandemics, appear to demand immediate action, and responses are guided by well-established paradigms. (Matthews, 2023) Economic crises, for instance, are generally understood as disruptions within the economic system and are approached with a familiar repertoire of policy instruments, alongside an expectation of eventual resolution and recovery (Reinhart & Rogoff, 2009).

By contrast, climate change represents a qualitatively different kind of crisis. Rather than constituting an episodic and expected disturbance within an otherwise stable system, it challenges the conditions under which existing economic, social, and political systems operate. As Latour (2018) argues, contemporary ecological crises undermine the very notion of a clear "after" to the crisis, as there is no external or stable ground to which societies can return. The absence of a clearly defined endpoint renders climate change more difficult to address through conventional crisis-management frameworks and weakens the sense of "urgency" typically associated with acute emergencies. Moreover, the scale and depth of transformation required to mitigate climate change are extensive and structural, making the crisis appear insurmountable when compared to short-term or geographically bounded crises that offer more readily identifiable solutions (Maloy, 2024).

Contemporary Western, neoliberal societies appear to operate in a state of continuous crisis (Davidson, 2017), leaving little space for long-term, proactive policymaking. Climate and environmental issues are often deprioritized in favour of addressing more immediate concerns. Some research indicates that people struggling with economic insecurity tend to deprioritize long-term environmental challenges in favour of pressing financial concerns (Lundquist, 2024). For instance, the Yellow Vest protests in France highlighted how climate policies that fail to incorporate principles of a just transition can trigger backlash, especially when economic pressures dominate public concerns (Martin & Islar, 2021). The

designation of a situation as a "crisis" often triggers tangible emergency responses. When the COVID-19 pandemic was declared a global emergency, cities were locked down, and extraordinary legal measures were enacted. Similarly, financial crises often result in visible austerity measures and economic restructuring.

In contrast, when governments or cities declare a climate emergency, the actual response rarely matches the severity of the problem. There is a disconnect between the language of climate "crisis" and the political and societal actions that follow, and the news media plays a significant role in this process of articulation. The warnings on the impacts of climate change have been made public and spread throughout the media, but the climate action performed has been lacklustre and, generally, not compromising the status quo. (Maloy, 2024; Evans & Teer-Tomaselli, 2023) This can be seen in how climate change and climate action are addressed within and in relation to the goals of economic policy. As the veneer of science-based decision-making continues to be upheld, the dissonance between action and language grows.

Following articulation theory, meanings are understood not as fixed or intrinsic, but as produced through contingent linkages between ideas, practices, and discourses. As developed by Laclau and Mouffe (1985) and elaborated in cultural studies by Stuart Hall (1986), the concept of *articulation* refers to the process through which particular elements of public discourse are temporarily connected in ways that stabilise a dominant meaning and interpretation – while always remaining potentially open to contestation and rearticulation. Crucially, articulation highlights how dominant interpretations are constructed through political and discursive struggle. Hence, discourses, rather than reflecting objective or necessary relationships, "reflect" and serve the dominant social order.

By examining the articulations of depoliticising and repoliticizing language and narratives used to frame climate change and economic growth in media coverage, this study seeks to uncover the underlying tensions and contradictions that shape public understanding and discourse. In addition to analysing the internal dynamics of climate change representations in the media, this study will assess the relative prominence of climate change and economic growth as topics in media coverage and their interrelationship.

An overarching theme of this present study is to explore how climate change and economic growth are represented as either mutually reinforcing or as opposing forces in public discourse, sometimes appearing, through processes of depoliticisation, as if they were two repelling magnetic poles. By bridging media representation with policy discourse, this research not only highlights the media's role in shaping public perceptions but also provides a foundation for reimagining pathways toward a more equitable and environmentally sustainable future.

2 The structure of the study and research questions

In this study, the complex, systemic issues of representations of climate change and economic growth are translated into four sub-projects addressing different facets of Finnish climate change representations and the connection between climate change and economic growth in the media.

Article I addresses the issue of "short-lived" crises, exemplified by the COVID-19 pandemic, taking media space from issues both thematically and temporally longer such as climate change, covering the frequencies of how climate change coverage was affected in the Finnish mainstream media as the pandemic began in 2020 and how long the effect lasted.

Article II focuses on the Finnish national broadcaster Yle's news on climate and energy policy. The study integrates media analysis with futures studies and focuses on the media framings and representations of futures related to key national-level energy and climate strategy documents.

Article III addresses the connection between climate change and economic growth in the media by analysing 24 years of news data from HS and IS via the aforementioned application of Articulation Theory to quantitative approach of the NLP method Dynamic Topic Modelling, displaying the evolution of the topics discussed within the two main themes.

And finally, Article IV addresses the issue of automated data collection in comparison to manual with the case of documenting climate change coverage in HS. The study, while mostly a methodological one, also reveals the connection between different search query words and their interaction on climate change coverage over time.

These four research articles collectively build the case for the thesis in exploring how media representations of climate change have evolved in the first decades of the 21st century. On an empirical level, it provides an analysis of the journalistic coverage of climate change and its associated topics. The thesis consists of four case studies that investigate both the factors affecting climate coverage and the coverage itself. It contributes to the research on this topic, particularly in northern Europe and smaller language areas, where research has been relatively scarce compared to the more extensive studies of global climate change coverage available in English and other major languages.

Methodologically, the thesis focuses on applying, assessing, and developing novel approaches for automatable and Natural Language Processing (NLP) tools for media analysis. It also seeks to bridge the often-perceived gap between digital-era methods and traditional theoretical-methodological approaches within media and communication studies scholarship. This includes addressing challenges associated with such methods, such as the risks of outsourcing analytical tasks to algorithms and coding errors that may lead to incomplete data collection.

From these methodological considerations partially stems also the seminal theoretical contribution of the study of bringing together Articulation Theory, a cultural and media studies approach, and an NLP method called Dynamic Topic Modelling (DTM). By combining Articulation Theory with DMT, this study bridges computational text analysis with critical cultural and media studies. This approach allows for a more nuanced understanding of how climate change discourse is shaped within media narratives and how economic paradigms influence coverage.

From this foundation emerge three principal research questions, each synthesizing key aspects of the theoretical and empirical framework. These questions serve not only as the analytical backbone of the study but also as the means through which the central contributions of the four included research articles are articulated. By addressing these questions, the thesis brings together its conceptual underpinnings and empirical findings into a coherent set of results.

A key, overarching research question for this thesis is: ”How have the dynamics of depoliticisation and repoliticisation of climate change and its relationship with the economic growth paradigm been represented in the Finnish media?” (RQ1). More specifically, the study focuses on how the leading newspaper in Finland, Helsingin Sanomat (HS), the tabloid Ilta-Sanomat (IS), and the national broadcaster Yle, discuss climate change while, at the same time, seemingly keeping the theme of economic growth – a key factor accelerating climate change – relatively separate from the climate discourse, and vice versa.

While the main focus of the present study is on the varying representations of climate change in the media, a significant contribution is also made to the analyses and understanding of the frequency of climate change coverage. A secondary research question is then: ”How have climate change and economic growth been articulated in relation to one another in media discourse during the study period, and what role have different crises played in bringing these discourses together – or keeping them apart?” (RQ2).

Via case studies I, III and IV, a time-period of 34 years of climate-related news coverage in Finnish mainstream media is covered. Between 1990 and 2024, the amount of coverage and the way the issue is covered has changed significantly, with the overall increase in average monthly publication frequency exceeding the levels many times over. The fluctuation of the coverage, and possible reasons to it, is also addressed, as well as the effects of comparably short-lived crises such as the

COVID-19 pandemic and the Russian war in Ukraine have had in the climate change coverage. As discussed previously, throughout the study period, there have been several economic events and crises that may have affected also climate coverage, and in Article III especially, the relationship between the two themes is empirically examined in conjunction with each other and apart.

The third and final research question of the study considers the methodological aspects of the study design: "To what extent can computational and automated discourse-analytical methods support the analysis of macro-level articulations by examining routine language use in media texts, and how effectively do such approaches capture the ways in which climate change and economic growth are discursively connected, disconnected, or reconfigured during periods of crisis?" (RQ3)

In the next few following chapters, I will first present an overview of how climate change and economic growth have been represented in the Finnish media, and how they have also remained largely distinct, despite their deep interconnections in policy and societal debates. This separation raises critical questions about depoliticization and its effects on how climate coverage is shaped and constrained within the dominant economic paradigm. Before delving into media representations of these issues, however, it is first necessary to have a deeper understanding of the theoretical and methodological background of the case studies and the present study. After this, I will offer a brief description of the relationship of climate change and economic growth outside the media – how economic growth and climate change intersect in policy, politics, and broader societal structures.

3 Theoretical background

In this chapter, I will first introduce the key theoretical approaches of the articles presented in the thesis as meso-level mechanisms, focusing on the media and communication theories, accompanied by descriptions of how they connect to the interplay of media and politics. Following this, I will outline an overarching theoretical perspective based on the concept of depoliticization. This serves as an integrative framework that ties my key findings together and informs my interpretation of the results. In this chapter I focus on the core theoretical contents. Further chapters will add more details as I discuss the empirical evidence.

3.1 Attention Cycle and Quantity of Coverage Theory

The research in Article I is grounded in agenda-setting theory and media studies frameworks. It draws on the Issue Attention Cycle and Quantity of Coverage Theory. Both of these help explain fluctuations in media attention to environmental issues.

Agenda-setting theory is one of the cornerstones in the field of media studies, developed by Maxwell McCombs and Donald Shaw in 1972. It suggests that the media does not merely inform the public but also and perhaps more importantly influences what issues people consider important and thus shapes their perceptions of reality. The agenda-setting perspective highlights how media coverage influences public and policy attention, suggesting that the quantity of media coverage can significantly shape perceptions of issue importance. At its core, agenda-setting theory suggests that media outlets do not dictate the issues entirely but rather set the parameters within which the public defines their priorities. This process is influenced by various factors, including editorial decisions, market pressures, and technological constraints. The theory has since been expanded and critiqued, with scholars exploring its implications across different contexts and cultures, and it has also been applied to environmental and climate issues.

The issue attention cycle as developed by Anthony Down s (1972) describes how media coverage evolves over time for a particular issue. This cyclical pattern typically begins with the emergence of an issue into public awareness, followed by increasing media attention as it gains prominence. The attention peak is often

followed by a period of sustained focus, after which coverage gradually declines until the issue fades from public view. The theory originally examined the rise of environmental concerns in the media in the 1960s and early 1970s. Understanding the attention cycle is crucial for grasping how issues gain and lose prominence over time. It highlights the dynamic nature of media coverage and the cyclical pattern in which issues are brought to light and subsequently pushed aside. In Finland, research on environmental news coverage have previously found similar cyclical patterns as Downs described in his original work (Suhonen, 1994; Lyytimäki, 2012).

Closely resembling agenda-setting, the quantity of coverage theory (Mazur & Lee, 1993) posits that the volume of news coverage directly influences the public's perception of an issue's importance. The more frequently an issue is covered by the media, the higher its perceived prominence among the audience. This theory emphasizes the cumulative effect of repeated exposure to information about a particular topic. For instance, extensive coverage of climate change in the media over recent years has likely contributed to its increasing visibility and concern among the public.

Article I also incorporates the concept of media "carrying capacity," which recognises the finite space for news topics and competition among issues for visibility (Hilgartner & Bosk, 1988). In practical terms, it means that media outlets have limited space and resources to cover all possible issues, leading to selective attention and prioritization.

Additionally, Article I considers the interplay between short-term crises and long-term sustainability challenges, particularly through the lens of competing and converging narratives in media discourse. As Articles III and IV also focus on frequencies of climate change coverage, their results will also be viewed via these theoretical frameworks later in this present thesis.

The cyclical dynamics described by Downs and by Quantity of Coverage theory are not merely descriptive fluctuations in attention but can be understood as part of broader politicization processes. Periods of heightened visibility often coincide with openings for political contestation, whereas declines in attention tend to coincide with the stabilization, or naturalization, of dominant interpretations. In this light, media attention cycles are not only indicators of salience but also mechanisms through which issues are periodically politicised and depoliticised.

3.2 Articulation theory

Articulation theory, as developed by Ernesto Laclau and Chantal Mouffe (Laclau & Mouffe, 1985), and Stuart Hall (Grossberg, 1986; Hall, 2011), provides a framework to understand the construction of social meaning, identities, and

relations within a discursive context. Central to their approach is the rejection of essentialist conceptions of society and identities, advocating instead for an open-ended, relational ontology. This introduction briefly describes articulation theory's foundational principles, theoretical implications, and methodological relevance, offering a lens to examine the contingent and negotiated nature of social formations.

According to Stuart Hall (Grossberg, 1986), an articulation is

> "the form of the connection that can make a unity of two different elements, under certain conditions. It is a linkage which is not necessary, determined, absolute and essential for all time. You have to ask, under what circumstances can a connection be forged or made? The so-called 'unity' of a discourse is really the articulation of different, distinct elements which can be rearticulated in different ways because they have no necessary 'belongingness'. The 'unity' which matters is a linkage between the articulated discourse and the social forces with which it can, under certain historical conditions, but need not necessarily, be connected."

The *unity* created by articulation is inherently a "complex structure," where elements are connected not only by their similarities but also by their differences. Showing this demands explicitly demonstrating the mechanisms that link dissimilar features, as no inherent or automatic correspondence between them can be assumed. Because this combination constitutes a *structure* — an organised, articulated whole rather than a random assortment — it contains defined relationships among its components, including patterns of dominance and subordination. (Hall, 2018, pp. 172-221)

Articulation, within this framework, refers to the practice of establishing a relationship among discursive elements such that their identity is transformed as a result. The processes that create articulations, maintain existing, hegemonic articulations, and that lead to disarticulations do not, however, transpire in a vacuum. Laclau & Mouffe (1985) conceptualise articulation as a dynamic process that underpins the constitution of discourses. A discourse is not merely a collection of linguistic expressions but a structured totality arising from the articulation of differential positions, which they term "moments." In contrast, "elements" signify differences that remain external to discursive articulation. Articulation does not presume an a priori unity of elements; rather, it operates through a *partial* fixation of meaning. This partiality is key, as the theory underscores the impossibility of achieving a fully structured, closed system of (discursive and social) relations. The openness of any discursive formation renders it susceptible to rearticulation, reflecting the inherent contingency of social practices.

A pivotal contribution of articulation theory is its critique of essentialist notions of totality and identity. Essentialism, whether at the level of social totalities or individual elements, presumes fixed and inherent characteristics. Laclau and

Mouffe argue that identities are instead overdetermined, meaning they are constituted through multiple, often conflicting, discursive relations. This rejection of fixity extends to the concept of "society" itself, which is seen not as a coherent, unified entity but as an "impossible object." The social, according to Laclau and Mouffe, is constituted in the interplay of necessity and contingency. Necessity arises through the temporary stabilisation of meaning – what they term "nodal points" – while contingency reflects the perpetual openness and fluidity of these articulations. In this view, society is a horizon rather than a self-enclosed totality, shaped by ongoing struggles for hegemony. The concept of the "field of discursivity" encapsulates the broader terrain of meaning-making, which exceeds any particular discourse. Within this field, no single discourse can achieve a final closure; all are subverted by the "surplus of meaning" inherent in the discursive realm. This surplus generates the conditions for both stability and change, as every articulation is, eventually, subject to dislocation and reconfiguration. (Laclau & Mouffe, 1985, pp. 111-113)

Discursive practices, therefore, are not limited to linguistic phenomena but encompass the materiality of institutions, rituals, and social practices (Laclau & Mouffe, 1985, p. 109). The material and the symbolic are interwoven, challenging the dichotomy between discursive and non-discursive realms. For instance, the discourse on climate change, while constituted through discursive practices, also materializes on various institutions, laws, and the behaviours the discursive practices affect – also in relation to other discourses such as the one on the economic growth paradigm.

Articulation theory finds its political expression in the concept of hegemony as defined by already by Antonio Gramsci (2011 [1947]). Hegemony involves the construction of a dominant discourse that organises and gives meaning to social relations (Laclau & Mouffe, 1985, pp. 134-136). This process is inherently contingent, as it requires the articulation of diverse demands and identities into a coherent—albeit provisional—framework. Hegemonic practices rely on the construction of "equivalence" among disparate elements, transforming particularities into moments of a unified discourse. For example, in a specific political context, diverse grievances (e.g., climate injustice, global economic inequality) may be articulated under a common banner, such as a demand for a just transition. This articulation is never fixed, as it remains open to contestation and rearticulation.

Antagonism plays a crucial role in this process. It arises when a discourse encounters its limits, often in the form of competing articulations. The boundaries of a hegemonic formation are thus defined through struggle, with antagonistic practices shaping the contours of social identity and meaning. To accompany articulation, Hall speaks of a similar term representing linkages that highlight the process of interlinkage and its respective effects – the conjuncture. A conjucture

can be thought of as a moment where different forces and tensions gather and collide. According to Hall (Hall & Massey, 2012), societal history moves from one conjuncture to another, often actioned by crises that are prompted by aforementioned struggles. As conjuncture shifts, the ways in which, for example, climate change is articulated with economic growth – and vice versa – changes, prompting disarticulations and rearticulations. It is in such shifts, and, to an extent, in such crises where the possibilities of a change emerge, albeit without predetermined solutions. (Koivisto & Lahtinen, 2012).

As such, articulation theory offers a theoretically robust methodological framework for analysing social and political phenomena. By focusing on the contingent and relational nature of meaning-making, it enables researchers to explore how identities, practices, and institutions are constructed, stabilised, and contested. This approach requires a rejection of reductive explanations that posit a single causative principle, such as economic determinism or cultural essentialism. Instead, articulation theory emphasises the interplay of multiple, overlapping discourses. For example, an analysis of economic growth discourse would examine how various discursive practices—legal, cultural, economic, environmental—intersect to produce and sustain particular gendered identities and power relations.

A notable aspect of articulation theory is its treatment of "floating signifiers." These are elements that resist full articulation within a particular discourse, retaining a degree of ambiguity and openness. Floating signifiers are pivotal in moments of social transformation, as they provide sites of contestation and rearticulation. For instance, the term "freedom" can be variously articulated within liberal, socialist, or nationalist discourses, reflecting its contingent and malleable nature.

In conclusion, articulation theory provides a nuanced lens to examine the dynamics of meaning-making, identity, and power in social and political life. By rejecting essentialist notions of fixed identities and totalities, it foregrounds the contingent and relational nature of social formations. Its emphasis on overdetermination, the field of discursivity, and the politics of hegemony offers a compelling framework for understanding the complexities of the social world.

In recognising the incompleteness and openness of all articulations, the theory underscores the transformative potential of social practices. This insight is particularly valuable in contexts of political struggle, where the rearticulation of identities and demands can challenge existing power structures and forge new possibilities for collective action. Articulation theory thus invites us to rethink the nature of social relations, not as predetermined or immutable, but as sites of ongoing negotiation and contestation.

3.3 (De)politicisation as an integrative framework

In political theory, (de)politicisation refers to the shifting boundaries between what is treated as a matter of political contestation and what is presented as technical, inevitable, common sense or beyond dispute. Politicisation occurs when an issue becomes subject to public debate, disagreement and decision-making; depoliticization describes the opposite movement, in which an issue is framed as the domain of experts, markets or natural necessity – for example when an issue is elevated to be out of reach of national politics to a global issue. Repoliticisation, in turn, denotes the reopening of previously closed spaces for contestation. (Hay 2013; 2014; Flinders & Buller, 2006; Rancière 1999).

As mentioned in the introductory chapter, critics media's coverage of climate change has often been described as "post-political" – pointing to a regime in which conflict is suppressed in favour of technocratic consensus. Erik Swyngedouw (2018) argues that climate discourse has become a paradigmatic domain through which post-politicisation operates, staging climate change as a universal humanitarian threat while at the same time silencing any antagonisms and suppressing potential socio-ecological futures and solutions that would challenge the status quo. In this setting, media's role is then not only to reflect debates on climate change and economic growth but to actively maintain the cage within which the proper climate discussion is to take place. These limits, in turn, shape public subjectivity and the imaginary horizons of possible futures. As discussed in Article II, these futures are then presented within frames that promote status quo.

The technocratic consensus created in the media allows for presenting climate change as a matter for experts, scientists, and policy technicians. The terrain of "legitimate" discourse is then narrowed down to risk management, emission accounting, and (technological) innovation, actively sidelining systems-level structural conflicts over production, inequality, and power (Carvalho 2010, Boykoff & Boykoff 2004). Because these expert-driven frames are embedded in policy, political actors, and (economic) institutions that remain oriented toward growth, the resulting articulations of climate change are then shaped and constrained by the economic growth paradigm.

As per Swyngedouw (2017), media, too, fixates on seemingly concrete concepts – such as measured greenhouse gas emissions – as the object-cause of climate concern, reducing a complex socio-ecological struggle to measurable variables. This, in turn, allows, both within media and the dominant economic paradigm, for commodification in terms of carbon offsets and markets and sustains the idea that climate breakdown can be solved without transforming the capitalist system and its social relations. When focusing on measurable greenhouse gasses such as CO_2, post-political media coverage, then, partakes in the erasure of antagonism and refuses to name political adversaries to climate action, such as fossil capital (Mann,

2021), and remains silent on global North's responsibility of climate change (Klein, 2014).

Simultaneously, depoliticised crisis-talk, resembling what Debord (1967) described as a spectacle that transforms structural contradictions into manageable, media-friendly events, spreads from austerity economics and the growth paradigm into climate discourse. While the crisis-induced urgency discourse stirs fear, it also channels that affect into technocratic governance – legitimising experts and neutering any critique towards the system. On the other hand, climate action itself tends to be framed as economic threat rather than political project especially in conservative and centrist outlets (Stecula & Merkley, 2019; Císař et al., 2025). As a result, there is little room for systems-level critique.

At the same time, citizen action is articulated in terms of the individual consumer choices or lifestyle changes. In this way, media convert citizens into individualised environmental subjects, diverting attention from companies, states, and structural drivers (Berglez, 2009; Carvalho, 2010). Consequently, social movements for climate action tend to also become depoliticised and detached from the systems-level crisis, as media coverage shifts attention toward their tactics or emotionality rather than their structural critique, and, in some cases, reframes demands that are framed as "radical" into more moderate and consensual concerns (Huttunen, 2024).

Despite these powerful hegemonic discursive articulations, repoliticisation does occur. As previously mentioned, the 2007–2008 finance crisis prompted visible anti-establishment movements that challenged the neoliberal order. A decade later, social movements focused on the climate crisis gain unprecedented traction as youth climate strikes spread globally. Also, routine media reporting on extreme weather events, record breaking temperatures and biodiversity loss has become both more frequent and adds to the pressure – which is only natural, as the effects of climate change have become more severe and visible over time.

In this thesis, the perspective of depoliticisation/repoliticisation acts as an umbrella under which the aforementioned sub-theories operate. Agenda-setting-aligned Quantity of coverage and Attention cycle theories focus on how media visibility opens political space (repoliticisation) or closes it by keeping issues off the agenda (depoliticisation), producing cycles of contestation, routinisation, and fatigue. Attention is therefore not merely a measure of salience but a precondition for discursive and political struggle: without sustained visibility, no articulation can stabilise, yet moments of heightened attention also create openings for repoliticisation. Articulation theory acts as a tool for understanding the mechanisms of how language operates in the depoliticization and repoliticisation processes in the media discourse(s). It opens a way of examining how meanings are forged and sustained produce either to raise political antagonism or promote naturalized consensus. In this way, articulation theory offers also methodological

devices to move beyond the attention/agenda power of media to tackle the contested discursive power of public discourse.

The meso-level mechanisms – here captured by focusing on attention and articulations – through which media make issues visible, meaningful and relational. However, visibility, framing and articulation do not occur in a vacuum: they are embedded in broader political logics that either open space for contestation or close it down. The (de)politicisation framework makes explicit these macro-level dynamics and thereby integrates the various theoretical tools employed in this thesis.

4 Methodological background

In this chapter I will introduce the main methodological approaches appearing in the four case studies, and their role within the (de)politicisation framework.

4.1 Frame theory

For Article II, Frame theory was an integral part in identifying how policy documents related to climate and energy strategies were framed in the news media. From the point of view of the thesis, it offers a wider lens through which to examine the Finnish climate policy coverage while also allowing for introducing the viewpoint of future studies via Jim Dator's four futures scenario archetypes (Dator, 2019; Dator, 2014) as frames of their own.

In brief, Frame theory is a critical framework for understanding how media constructs and conveys meaning by organising information into interpretative schemas, or "frames" (Gitlin, 2003; Hardnack, 2019; Craib, 1978; Nisbet, 2009; Goffman, 1974). These frames shape audience perceptions by selecting, emphasising, and excluding specific aspects of a narrative (Entman, 1993). In media analysis, frames are understood as devices that not only structure attention but also embed particular values, ideologies, and priorities, actively constructing social realities (Berger & Luckmann, 2011). This process underscores the media's role in shaping public opinion and influencing policy discourse.

Nisbet (2009) extends frame theory to the analysis of climate change in the media, identifying a series of frames used to represent the issue. These include the scientific uncertainty frame, which highlights debates and gaps in climate science; the economic development frame, emphasising the costs or benefits of addressing climate change; the public accountability frame, focusing on government and corporate responsibility; and the moral/ethical frame, which appeals to principles of justice and intergenerational equity. By shaping how climate change is understood, these frames influence public engagement, policy preferences, and political mobilisation. In Article II, Nisbet's frames are accompanied by Jim Dator's (2019) future scenarios of societal change that represent variations or combinations of four alternate scenario archetypes that are based on economic growth. Dator's "four futures" are "continuation", "decline and collapse", "limits and discipline" and "transformation, of which the first "continuation" represents the current hegemonic status quo.

Frame theory is a valuable tool for examining how power relations, cultural norms, and institutional practices mediate the representation of social issues. By analysing frames, scholars can explore the interplay between media content, audience cognition, and broader sociopolitical contexts, shedding light on the media's role in agenda-setting, discourse formation, and collective meaning-making.

From the point of view of the broad politicisation framework, frames can naturalize an issue (depoliticize it) or highlight conflict, responsibility, or values (repoliticise it). For example, the four futures themselves already contain applicable aspects of depoliticization and repoliticization with "continuation" and "collapse" representing different aspects of a future in which climate policy is set to status quo and the economic paradigm prevents any further change – and, consequently, the latter two, "limits and discipline" and "transformation" offer frames for future in which at least some form of repoliticization has taken place.

4.2 Qualitative content analysis

The analysis of the news articles in Article II relied on a qualitative media content analysis designed to examine how climate change and climate policy are made meaningful in public discourse *and* how these meanings project, delimit, or normalise particular futures. To capture both present-oriented framings and future-oriented imaginaries, the analysis combined approaches from climate-framing research with futures studies. The coding schema was partly deductive, drawing on Matthew C. Nisbet's (2009) typology of climate-change frames and Jim Dator's (2019) "four futures" scenario archetypes.

Coding focused on (1) article characteristics, (2) actor visibility and affiliations (and related agency cues), (3) climate frames, (4) future scenario archetypes, and (5) the time horizons of reported change. While frames and scenario archetypes were primarily theory-driven, categories for actor occupations and temporal horizons were developed inductively during coding to remain sensitive to context-specific constructions of agency and temporality. NVivo was used for qualitative text coding and code management.

To strengthen reliability and reduce interpretive bias, two independent coders conducted the analysis. Discrepancies were addressed through iterative discussion rounds, refining category interpretations where needed until agreement was reached. This procedure supported a transparent, future-sensitive reading of media texts, treating "the future" not as a separate topic, but as an organising dimension of climate-policy communication that becomes visible through both framing choices and recurring scenario logics.

4.3 Text scraping

The proliferation of digital content has transformed the way we access and consume information. The internet now hosts an unprecedented amount of data, including news articles, academic papers, social media posts, and online reviews. For scientists and researchers, this vast digital repository presents a unique opportunity to gather valuable insights and knowledge.

However, extracting meaningful data from these sources can be challenging due to the sheer volume and complexity of the information available. Web scraping techniques are used to automatically extract data from websites, online databases, or other digital sources. Web scraping involves using specialised software or scripts to navigate through a website's structure, identify relevant data, and collect it for further analysis, sometimes utilising the site's application programming interface (API). (Grimmer et al., 2022)

For Article III and Article IV, text scraping methods were introduced as part of the data collection. While Article IV consisted of comparing the applicability of automated data collection method, scrapers, to manual data collection, Article III applied such scrapers to collect the majority of the research data with manually completing parts of the data that were omitted due to issues with the scraper functionality.

For when it was used, automated data were obtained using Python-based web scrapers utilizing the Sanoma API. The scrapers mimicked the manual approach, collecting data in batches of 50 articles, as the manual online search provides after each click of the "show more" button, from oldest to newest, including full texts where possible, using the newspaper3k Python package. Another scraper used was based on the Finnish Media Scrapers project (Mäkelä & Toivanen, 2021). After the data collection, duplicates were removed from the datasets, and further data cleaning took place as part of the DTM in Article III.

Caveats related to this approach, such as scrapers not being able to scrape some articles or the search APIs not returning some relevant articles, are described extensively in Article III and Article IV.

4.4 Dynamic Topic Modelling

The exponential growth of textual data in the digital age has underscored the need for robust methods to explore and model latent patterns within large-scale corpora. Probabilistic topic modelling methods such as Latent Dirichlet Allocation (LDA) and its extensions have been widely used to uncover latent themes in textual data (Blei et al., 2003). The topics in these models are essentially represented by "bags-of-words" consisting of words most probably to be included in a single topic.

However, these approaches are limited in their ability to capture the temporal dynamics critical for longitudinal media research. To overcome this limitation, Dynamic Topic Modelling (DTM) approaches have been developed, allowing for the analysis of topic evolution over time. These methods enable the detection of emerging, shifting, and declining trends, topics, and themes within a dataset by incorporating temporal information, such as the publication dates of news articles, into the modelling process (Blei & Lafferty, 2006). By employing time-specific priors or integrating autoregressive components, DTM facilitates the tracking of how topics evolve across temporal intervals, such as time-splices of yearly quarters as in Article III, revealing subtle yet significant changes in discursive focus (Wang et al., 2008). This temporal dynamism makes DTM particularly valuable for analysing long-term trends in domains such as news media or social media, policy debates, and scientific literature.

In Article III, the neural topic modelling technique BERTopic was used as the tool for DTM, owing to its flexibility, ease of use, and capability to generate interpretable topic representations. At the core of the model lies in leveraging Bidirectional Encoder Representations from Transformers (BERT) embeddings combined with clustering algorithms to identify semantically coherent topics within textual data, which have been demonstrated to produce superior contextual word and sentence vector representations (Grootendorst, 2022).

Unlike traditional topic modelling approaches such as LDA which rely on bag-of-words representations, BERTopic utilises contextual embeddings to capture nuanced semantic relationships between words and documents. Additionally, BERTopic's DTM functionality is enhanced by its ability to visualise topic distributions over time, providing an intuitive means to analyse thematic shifts and the emergence or decline of specific topics.

From the point of view of articulation theory and the larger depoliticisation framework, the results achieved via this tool represent both the quantitative and the qualitative – and allow for demonstrating empirically processes that have been previously discussed theoretically (for example in Kenis & Mathjis 2014, Swyngedouw 2018).

And as the digital social science community becomes increasingly accustomed to utilising generative AI and large language models for research purposes, it is good to distinguish traditional topic modelling approaches from the hallucination-prone LLM approaches to text analysis tasks. Having experimented with such systems and services (Mervaala & Kousa, 2025), there are significantly less issues with replicability and transparency in using traditional topic modelling for media analyses. I will discuss this theme further in the later chapters still.

5 Climate change and economic growth

The relationship between climate change and economic growth is intricate and multifaceted, influencing and influenced by global development trajectories. While economic growth has historically been associated with improved living standards, technological advancements, and increased wealth, it has also significantly contributed to environmental degradation – and to climate change. Conversely, the effects of climate change pose substantial risks to economic stability and future growth prospects. In order to understand how and why their connection is represented in the media the way it is, this short chapter endeavours to explain, how the two are connected.

Most often, economic growth is defined as an increase in the production of goods and services, typically measured through Gross Domestic Product (GDP). While GDP growth has become the dominant indicator of economic "health" in policymaking and public discourse, it represents a historically specific and contested way of conceptualising economic success. Within ecological economics, growth is understood not merely as an abstract macroeconomic process, but as a material expansion of energy and resource throughput, with direct implications for environmental degradation and climate change (Georgescu-Roegen, 1971; Daly, 1996).

Traditionally, growth has been thought to be a function of capital accumulation, labour force expansion, technological innovation, and improvements in productivity (Solow, 1956). While economic growth is often discussed in terms of such macroeconomic processes, the impacts of the microeconomic level factors and actors are also important. The coverage of individual consumer choices, households-level issues, and how changes in "the economy" will affect peoples' daily lives remain relevant for the media coverage of the topic of economy.

Ecological economics challenges the assumption that continuous economic growth can be reconciled with ecological sustainability. Rather than viewing the environment as an externality, ecological economics views the economy as embedded within finite biophysical systems governed by thermodynamic limits (Martínez-Alier, 2002). From this perspective, anthropogenic, or human-caused, climate change is not an unintended side effect of otherwise successful development, but a structural outcome of growth-oriented economic systems reliant on increasing energy and material consumption.

The consequences of climate change are extensive as they affect ecosystems, sea levels, weather patterns, and biodiversity. Increased frequency and severity of extreme weather events such as droughts, floods and hurricanes pose significant risks to human health, food security, water supply, and economic and societal stability (Pörtner, 2021; IPCC, 2018).

Economic growth drives activities that contribute to climate change, while climate change impacts can hinder economic growth, creating a cyclical and challenging relationship. As economies grow, emissions increase, accelerating climate change. The resulting environmental impacts then damage economic systems, creating a feedback loop that is difficult to break (Stern, 2007).

Climate change poses an existential risk to the whole economy by affecting natural resources, infrastructure, and human health. These impacts can (and eventually will) slow economic progress and introduce new development challenges. Extreme weather events damage infrastructure such as roads, bridges, and buildings. The costs of repair and reconstruction divert funds from other economic activities, affecting overall economic productivity (Hallegatte et al., 2017). Climate change also affects the availability of vital resources like water and arable land. Altered precipitation patterns, including droughts and flood-inducing rains, and increased temperatures can reduce agricultural productivity, threatening food security and leading to higher food prices (Nelson et al., 2014). Worsening environmental crises also lead to increasing prevalence of diseases, heat-related illnesses, and poor air quality, leading to less healthy workforce reducing labour productivity (Haines et al., 2006).

Climate change does then introduce serious uncertainties that affect investment decisions. Risks of stranded assets in fossil fuel industries and the unpredictability of climate policies can deter long-term investments (Bos & Gupta, 2019). Estimations of negative impacts on economy are dire with some of the most recent reports claiming extreme weather events have cost economy $2 trillion over the last decade (ICC, 2024) and that the global cost of climate change damage is estimated to be between $1.7 trillion and $3.1 trillion per year by 2050 (WEF, 2023). This includes the cost of damage to infrastructure, property, agriculture, and human health. The cost is expected to increase over time as the impacts of climate change become more severe, with the poorest countries in the world being at greatest risk from the economic impacts of climate change. (Toivanen et al., 2023, pp. 117-119)

As we have seen, the interplay between climate change and economic growth has been at the crux of environmental policy. Traditional economic growth models have contributed to climate change, while the adverse effects of climate change threaten future growth prospects. Addressing this complex relationship requires a fundamental shift towards sustainable development practices that balance economic objectives with environmental stewardship. During the time-period

covered in these research articles, Finnish climate policy has changed in various ways, which can also be seen in the strategic policy documents themselves discussed in Article II. The consecutive governments of prime ministers Juha Sipilä (2015–2019), Antti Rinne (2019) and Sanna Marin (2019–2023) had significant differences in their way of discussing the economic policy in the context of climate change. Sipilä's government emphasised the role of "bioeconomy" and allowed the increase of forest felling in Finland to levels that were perceived as unsustainable by the scientific community (Sundman, 2018). Following the increased attention to climate issues and the pivotal 2018 IPCC report, the Rinne-Marin government made climate issues more central to the general economic policy, focusing in "green transition" (Toivonen, 2023). In the next chapter, I will discuss how this relationship has appeared in the news media.

The seminal work by Meadows (et al.) resulting in the 1972 release of The Limits to Growth set the stage for bringing together the economic and the environmental via acknowledging planetary boundaries. Throughout the 1970s, anthropogenic climate change was rarely on the public agenda, despite some scientists' warnings on the potential of the greenhouse effect increasing the global average temperature. This is partially due to most experts and the general public at that time found it difficult to believe that human activities could alter the climate of the entire planet (Weart, 2008). Finally, a turning point was reached in 1988 when unusually hot weather gave concrete evidence to support the scientific theories, resulting in such weather anomalies being reported as signs of global warming (Lyytimäki, 2012). The same year saw the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) establishing the Intergovernmental Panel on Climate Change (IPCC). Even then, however, climate discourse had already taken on depoliticised features. As a result, the "mainstream" climate policies that developed over the following decades came to focus on adjusting the existing economic order to address climate change, rather than promoting more fundamental systems-level transformations.

As climate change and other environmental deterioration only worsen if the current economic growth trends continue, the goal of unlinking or decoupling economic growth from the environmental issues has gained traction. Based on current scientific research, though, it appears not to be possible to absolutely decouple economic growth and the growing use of natural resources (Haberl et al., 2020; Vadén et al., 2021). Based on the study by Haberl et al. (2020), any achieved decoupling has so far been only *relational* – meaning that as long as the GDP continues to increase, so will the absolute consumption of natural resources. The same applies to GHG emissions: even though it is possible to lower emissions of CO2 and other GHGs relatively, their absolute amount is likely to increase hand-in-hand with the GDP (Parrique et al., 2019). Nevertheless, decoupling remains a central narrative in policy documents and media discourse, sustaining the

expectation that economic growth could continue largely unchanged despite the necessary climate actions.

The disconnect between climate change (mitigation) and economic growth, and the apparent unlikeliness of absolute decoupling, has become an essential theme in the decades-long discussion on degrowth and postgrowth. Degrowth scholarship argues that ecological crises cannot be resolved within economic systems that are structurally dependent on perpetual growth. Instead, it calls for a planned reduction of material and energy in high-income economies, alongside a reorientation toward social well-being, care, and sufficiency (Kallis et al., 2012; Slameršak et al., 2024). Postgrowth approaches similarly question the unquestioned norm of GDP growth but adopt a more pluralistic stance, focusing on alternative indicators of prosperity and democratic economic governance (Jackson, 2017).

Ideas of both degrowth and postgrowth challenge the popular vision of green transition and green growth trajectories which are – in essence – built on the promise of investing in green and low or zero carbon industries while maintaining the consumption and growth patterns of the past. With no strict stance on limiting consumption, this has led to, for example, forms of sustainable energy increasing the overall energy supply while the overall energy consumption has also increased. (Hickel 2020) Any impactful green transition would then require degrowth on fossil-heavy, unsustainable industries while investing in a systems level transformation on energy systems, food production and a change in overall consumption patterns on a global scale.

Despite their growing presence in academic research, degrowth and postgrowth perspectives remain marginal in mainstream media coverage of climate change and economic policy. Media discourse continues to be dominated by growth-oriented frames, privileging narratives of green transition and technological optimism while sidelining more transformative critiques of consumption, production, and economic scale. This asymmetry reflects broader power relations in economic policymaking, where established institutions and actors retain a vested interest in sustaining the growth paradigm.

6 Media, climate change and economic growth

Mainstream media remains a key arena where critical issues such as climate change or economic growth are made publicly meaningful: through selection, framing, and agenda-setting, journalism shapes how these topics are perceived, debated, and prioritised by the public and policymakers (Entman 1993, McCombs & Shaw 1972;1992). This section examines climate change and economic growth have historically been portrayed in the media, globally and in Finland.

6.1 Climate change in the media

Mainstream media serves as a primary conduit for information dissemination, significantly impacting public opinion and knowledge (Entman, 1993). By selecting which stories to tell and how to tell them, including shaping the meanings of terms, words and the narratives themselves, the media can highlight certain aspects of a topic while downplaying or omitting others, thus influencing the audience's understanding and attitudes – and honing the agenda of the public discussion. Over longer periods of time, climate change coverage appears to follow the media attention cycles (Downs, 1972), with the focus on environmental issues oscillating in intensity and a new normal of higher coverage frequency reached after each period of intensification (Schmidt et al., 2013; Djerf-Pierre, 2013). Attention cycles of climate coverage have been analysed numerous times, often focusing on coverage in specific countries (Saunders et al., 2018; Poberezhskaya, 2015; Semujju, 2013; Uzelgun & Castro, 2015). Relevant to the present study, a research article covering five countries, the United States, Finland, France Russia and India (Ylä-Anttila et al., 2018) applied the concept to the interplay of ecology and economy 1997–2013, and found that ecological arguments increased over time while economic arguments decreased.

Climate change has risen to prominence as a news topic simultaneously with the rise of social media's role as an integral part of our communication infrastructure (Eide & Kunelius, 2020), and its role in climate science communication has increased significantly (Pearce et al., 2015). Mainstream media outlets also have societal influence by providing materials and content for social media, while the relationship with social media has become more and more

reciprocal as news media finds and highlights stories already gaining traction on social media (Holton et al., 2015). This applies to climate change coverage as well: the 2009 "Climate gate" is an early example of a story that first broke in social media – before being taken up in news media (Schäfer, 2012).

Though the emergence of social media has offered the potential for more open and inclusive discussions, expanding public spaces for debate has also led to challenges with uncivil behaviour. Hence, climate change communication has been closely examined, sparking significant debates about whether it is possible to convey climate science without political bias – an increasingly pressing issue in the current age of generative AI, as well (Schäfer, 2012; Schäfer, 2024; Pearce et al., 2015). Consequently, disinformation and misinformation about climate change, including several conspiracy theories, have spread on social media efficiently and with ease, and it has been suggested that microblogs may have greater influence than news articles due to short social media posts being more memorable to some (Treen et al., 2020).

Climate journalism is often associated with direct observation, covering for example, extreme weather events, temperature abnormalities, and changes in the wildlife. It is, however, fundamentally shaped by its sources, particularly those within political and scientific institutions. The space in which journalism operates is influenced by elite disagreements and the presence of alternative voices (Bennett, 1990; Bennett, 1996), and given the consensus-seeking, very modestly polarised media environment in Finland (Seuri et al., 2024), views diverging from the norm of the day, even in climate journalism, can be said to be rare or at least stem from significant external factors (climate protests and activism can sometimes become such). In practice, the range of viewpoints represented in news tends to expand when political elites publicly disagree; when elite consensus holds, media debate narrows and alternative frameworks struggle to gain visibility. This helps explain why growth critique often appears episodically (e.g., during crises or protest waves) rather than as a stable interpretive frame in economic and climate reporting (Livingston 2016).

In climate reporting, science plays a central role. It provides both the foundation for evidence-based narratives but also a fundamental point of contention. The Intergovernmental Panel on Climate Change (IPCC) has been instrumental in establishing a global, scientific consensus on climate risks. Journalistic reliance on this authority has helped counteract short-term perspectives (Engesser & Brüggemann, 2016), though media coverage often simplifies complex scientific findings (Collins & Nerlich, 2016).

However, and partially because of this relationship with the scientific community, climate journalism is also subject to some of the basic vulnerabilities in media practices. The fossil fuel lobby has historically amplified scientific uncertainty to delay climate action, fuelled climate denialism, and questioning the

efficacy of methods to mitigate climate change (Boykoff, 2011; Oreskes & Conway, 2010; Franta, 2021; Franta, 2022; Mann, 2021), and journalism's tendency to present "both sides" has sometimes sustained these uncertainties. Controversies like "Climategate" in 2009, where media scrutiny of scientists' leaked emails influenced public trust, illustrate how journalistic norms – such as conflict-driven reporting – can unintentionally hinder climate action (Mann 2021). On the other hand, The IPCC itself has faced criticism for being overly conservative in its projections (Merry & Mattingly, 2024).

Also, structural inequalities shape climate science communication, as developing nations – often most affected by climate change – have limited representation in global research efforts. This disparity affects the visibility of critical issues, such as climate adaptation and regional vulnerabilities. (Wang et al., 2024; Yohe et al., 2006)

Maintaining a strong and transparent relationship between journalism and climate science is crucial. While journalistic practices can sometimes amplify doubt, they also serve as a conduit for public engagement. Strengthening this relationship requires a careful balance between journalistic independence and responsible science communication.

Studying climate change coverage in the media has traditionally been saturated by an Anglo-American point of view. In previous studies, climate change is often framed in the media through lenses of catastrophe, uncertainty, or conflict (Nisbet, 2009). These frames can affect public engagement: Catastrophic Framing emphasises the severe consequences of climate change, which may induce both fear but also desensitisation or helplessness in the readership (O'Neill & Nicholson-Cole, 2009). Uncertainty framing focuses on scientific debates – often suffering from false-balance bias – that potentially undermine public trust in climate science (Antilla, 2005, Boykoff & Boykoff 2004). Scholarship on organised climate denial shows how networks of corporate, think-tank, and advocacy actors have promoted doubt and delay, often by amplifying uncertainty and attacking regulation. While originating most visibly in the United States, these repertoires and networks have had transnational influence, contributing to the resilience of market-centred and growth-friendly approaches to climate policy. (Dunlap & Brulle 2020)

Conflict framing on the other hand highlights disagreements among different stakeholders, prompting possible polarisation of the public opinion (Boykoff, 2008). One key framing has to do with the economic impacts of climate policy and climate action, though not necessarily the (often negative) economic impacts of climate change itself (Nisbet, 2009).

Beyond these individual frames, climate journalism is increasingly shaped by what post-political scholars describe as a combination of apocalyptic urgency and technocratic closure. While climate change is presented as an existential crisis, the

range of socially and economically acceptable responses is kept narrow, typically confined to market-friendly, growth-compatible solutions (Swyngedouw 2017, Kenis & Lievens 2015). This produces a paradoxical form of depoliticisation: the problem is dramatized, but its structural causes and alternative futures remain largely outside legitimate debate.

A recent example of this dynamic can be seen in a study focusing on Czechia (Císař et al. 2025), where mainstream media do not deny climate change per se, but instead they "deny any discussion of mitigation measures". Hence, addressing climate change becomes technocratic and constrained, limiting the debate to how much to delay or minimize action, not what kind of society we want. Climate discourse in Czechia has been relatively limited and "uninterested", and between 2003 and 2023, the two consecutive former presidents Klaus and Zeman conveyed and boldened climate scepticism (Vopálenská 2021).

Today, comparable to economics as an overarching topic, climate change has transitioned from being more of a special topic within the environmental news to something that "cuts across beats" as Brüggemann & Engesser put it (2016, p. 400), spreading through science, business, energy and sports sections.

The trends in climate journalism vary significantly across countries due to factors such as politics, media systems, and cultural influences. The United States, for example, has a unique combination of weak public service media and a highly commercialized private sector, yet it hosts major digital platforms like the *Huffington Post* or *InsideClimate News*. Western Europe showcases diversity, from the democratic-corporatist model in Nordic countries to the polarised pluralism seen in countries like Italy. In developing regions, media landscapes differ notably: while print circulation has declined in Africa, the Middle East, Australasia, and Latin America, Asia experienced a 40% increase, particularly driven by India and China's rapid expansion in print, online, and social media sectors. South America reflects a shift towards social media as the primary news source for climate change, notably in Brazil, Argentina, and Chile, whereas Mexico still relies heavily on television and radio despite the rise of online media. These diverse national and regional variations are essential considerations when examining the global landscape of climate journalism, highlighting the need to account for these differences in any comprehensive analysis. (Schäfer & Painter, 2021)

6.2 The history of climate change in Finnish media

Many of the climate coverage trends do not directly translate to the Nordic media sphere. For instance, comparatively speaking, the Finnish media landscape

has had a very limited amount of polarisation. As the focus of this thesis is strictly in Finnish media, and more specifically the relationship between climate change and economic growth, it is important to point out, that of concerns and critiques of climate journalism do not apply.

Finnish climate journalism has developed within a media system that is often characterised as consensus-seeking, institutionally strong, and only modestly polarised (Seuri et al., 2024). While climate change is rarely contested as a fact in Finland, but the political and economic implications of climate action are typically framed within a relatively narrow horizon of "responsible" policy options.

The roots of this pattern can be traced to longer traditions of Finnish environmental journalism. In his pioneering study of Finnish environmental reporting, Suhonen (1994) showed that environmental issues have historically entered the Finnish news through professional routines, institutional agendas, and episodic events rather than through sustained critical scrutiny of underlying socio-economic structures. Environmental problems became newsworthy when they could be attached to authoritative actors, dramatic events, or international negotiations, while more systemic critiques of industrial society or growth-oriented development struggled to become routine journalistic frames. This institutionalised logic remains highly relevant for climate journalism.

Previous longitudinal research of Helsingin Sanomat (HS), Finland's leading daily newspaper, further illustrates how climate change has been integrated into the Finnish public sphere in punctuated and uneven ways. The first ever mention of global warming caused by rising levels of carbon dioxide as a result of human activities in Helsingin Sanomat can be found from November 1956 – after which global warming was mentioned in the newspaper once a year on average for the following 30 years (Karppinen 1993).

Lyytimäki (2012) shows that although the greenhouse effect was already mentioned in HS earlier, climate change remained largely absent from public debate until the 1970s, when warming was often framed ambivalently or even positively in a northern country context. In a society where cold weather threatened agriculture and livelihoods, warmer conditions were sometimes welcomed rather than problematised. Climate change, in other words, was not initially politicised as a collective risk requiring transformation but rather interpreted through everyday material and cultural experiences.

By the late 1980s, mentions of global warming or greenhouse effect in HS had jumped from the average of once a year to several dozens per year (Karppinen 1993). Climate change gradually became more visible as part of broader environmental and transboundary pollution debates, including acid rain, nuclear accidents, and industrial pollution in Eastern Europe. Yet even as scientific concern increased and the IPCC was established in 1988, Finnish media coverage remained cyclical and event-driven. Between 1990 and 2010, nearly 5,500 HS

articles mentioned climate change, but attention fluctuated strongly and remained relatively low until the mid-2000s. Major peaks were triggered by international climate summits, energy policy disputes, and high-profile scientific or political interventions, while attention waned during periods of economic downturn, political stalemate, or winters that visually contradicted global warming in everyday experience (Lyytimäki, 2012).

These patterns mirror the issue-attention dynamics discussed in international scholarship but acquire a specifically Finnish form. Climate change has repeatedly been elevated to a matter of national importance, yet this elevation has often taken a technocratic shape, focused on international negotiations, expert assessments, and policy targets rather than on contestation over social priorities, consumption, or economic models. The way *Helsingin Sanomat* treated the Stern Review as a serious economic warning while framing Al Gore's *An Inconvenient Truth* more dismissively is indicative of how economic authority and elite credibility shape what counts as legitimate climate knowledge in Finnish journalism.

This institutional framing helps explain why Finnish climate journalism appears simultaneously strong and narrow. On the one hand, trust in climate science has remained high and overt denialism has had only limited and episodic visibility (Kumpu, 2024). Climate change itself is not questioned in the media, and the public finds the topic a serious threat to Finland – while also seeing opportunities for economic competitiveness in solving it (Hyry, 2019; Hyry, 2023; Hyry, 2025). Especially when compared to the Finnish climate awareness and concern, Finnish climate policies have remained relatively passive (Lyytimäki 2012) and, more recently, focusing on how to manage the transition, not whether alternative futures should be pursued.

Moments of repoliticisation do occur, particularly when climate policy collides with economically and culturally central sectors such as forestry, energy, and industry. In these moments, distributional conflicts and competing expert claims enter the news, temporarily widening the range of legitimate controversy. However, these openings are typically short-lived and remain bounded by the assumption that economic growth and international competitiveness must be preserved.

Recent studies focusing on media framings of Finnish climate movements (Huttunen, 2024; Huttunen & Albrecht, 2021), found that media tends to portray activists as naïve, emotional, or disruptive, focusing on their tactics such as disruptive protest activities, activists' interpersonal relations and skipping school, rather than their critique of fossil capitalism and state inaction. The apparent goal of such framings is to divert attention from the movement's systemic critique and climate justice claims.

Such framings resonate with post-political dynamics, in which dissent that challenges the foundations of fossil capitalism is symbolically included but

substantively neutralised. By focusing on activists' behaviour rather than their critique of growth, inequality, and state inaction, the media reproduces a narrow horizon of what counts as "reasonable" climate politics.

Taken together, the Finnish case illustrates a distinctive form of post-political climate communication. Climate change is widely acknowledged as real and serious, and it is repeatedly brought into public discussion through journalism. Yet the institutional routines of a consensus-oriented media system, combined with reliance on authoritative experts and economic policy elites, restrict the range of futures that can be imagined and debated. As in the global patterns discussed above, ecological crisis becomes visible, but the social and economic order that produces it remains largely shielded from sustained contestation.

6.3 Economic paradigms in Finnish media

As discussed in earlier chapters, economic journalism in Finland can be seen as structured around a narrow and highly institutionalised understanding of what the economy is and how it should function. Rather than being a plural arena of competing visions, economic policy is typically presented in the media as a domain of expert management governed by necessity, efficiency, and fiscal discipline. The economic discourse in the media reflects this as being limited by the dual hegemony of neoliberal economics and austerity politics (Harjuniemi 2023a, pp. 73-85).

The 1970s marked a pivotal shift in global economic policy. In response to stagflation and economic crises, neoliberal thinkers like Milton Friedman and Friedrich Hayek advocated for policies that reduced government intervention and championed free-market capitalism (Boas & Gans-Morse, 2009). This shift was characterised by deregulation, privatisation, and an emphasis on individual responsibility over collective welfare, with a heavy emphasis on austerity economics (Blyth, 2015).

In Finland, a consensus between political parties, interest groups and business elites on changing the focus of economic and societal policies towards fiscal frugality and supporting business was reached in 1977. This new trajectory did not, however, conflict with the expanding of the welfare state until the end of the 1980s, and the costs of social services initially stayed on the same level and then accelerated despite rapid growth of the Finnish GDP. (Saari, 2010)

The rhetoric supporting austerity politics spread began truly to spread in the speeches of the politicians and experts during the Finnish depression of the 1990s. At this time, the Ministry of Finance took over as the institution in charge of the Finnish economic policy, and most future governments have taken their instructions and "cutting lists" seriously and incorporated them into their

government programmes – sometimes even before the elections take place. (Outinen, 2023, pp. 34-53)

From a media perspective, this institutional reconfiguration had far-reaching effects. Economic journalism became heavily dependent on a narrow set of authoritative sources: the Ministry of Finance, central banks, employer organisations, and orthodox economists. These actors function as what Hall et al. (1978b, pp. 53–77) term "primary definers", setting the boundaries of legitimate debate. Alternative economic perspectives – including Keynesianism, feminist economics, ecological economics, or degrowth – are not censored, but they are structurally marginalised because they are not embedded in the dominant policy institutions that journalists routinely rely on.

Harjuniemi (2023b) strengthens this interpretation by showing that Finnish economic and political journalists themselves perceive the economic policy debate as insufficiently pluralistic. Interviewed journalists describe routine dependence on a narrow group of authoritative experts and institutions, alongside a widely shared policy consensus that sets the boundaries of acceptable debate. In Harjuniemi's analysis, these dynamics illustrate how "primary definers" (Hall et. al, 1978a; 1978b) shape the sphere of "legitimate controversy" (Hallin 1984) in economic journalism: journalists may seek balance, but the range of viewpoints treated as credible and realistic remains institutionally constrained.

This produces a characteristic form of depoliticisation. Economic policy appears in the news not as a contested field of social priorities but as a domain governed by constraints, competitiveness, and fiscal rules. Political conflict is displaced by expert consensus, and disagreement is framed as irresponsibility or ignorance. In this environment, after the brief Nokia boom in the late 1990s and early 2000s (Poutanen, 2018), the austerity economics mindset that had resurfaced during the European debt crisis went virtually unopposed in Finland as politicians and the experts present and interviewed in the media narratives were of the same mind (Ylönen & Remes, 2015, pp. 170-173).

The result is a media environment in which economic growth is not merely reported but continuously normalised as the horizon of possibility. Growth becomes common sense: the unspoken baseline against which all policies — including climate policy — are evaluated. This is a textbook example of what post-political theorists describe as the foreclosure of antagonism: when one model of society becomes so dominant that alternatives appear unrealistic, irrational, or invisible (Swyngedouw, 2017).

This has direct implications for climate journalism. If economic growth is treated as non-negotiable, then climate change can only be addressed in ways that do not threaten the growth paradigm. Journalistic narratives may acknowledge environmental limits, but they tend to translate them into calls for green innovation, market-based solutions, and technological fixes — rather than opening

space for political debate about consumption, inequality, or the organisation of production.

In this sense, the absence of degrowth and post-growth perspectives in mainstream Finnish media is not simply an editorial omission. It is the outcome of professional routines and institutionalised sourcing practices that privilege growth-oriented expertise and render systemic alternatives difficult to articulate. This structural bias helps explain why economic and climate journalism can appear pluralistic while reproducing a remarkably narrow vision of the future.

6.4 The crossing paths of climate change and economic growth in the media

Generally, economic growth itself is predominantly portrayed positively in the media, often associated with prosperity, job creation, and improved living standards (Jacobs et al., 2021). Media narratives often align with political and corporate interests that prioritise GDP growth as a key indicator of success. "Sustainable economic growth" is listed as the main goal of Finland's economic policy on the Ministry of Finance's website (2023).

Some media sources, *Helsingin Sanomat* among them as discussed in Article III, offer critical perspectives on unrestrained economic growth, pointing out issues such as environmental degradation, inequality, and unsustainable resource use. However, these views are generally less prevalent in mainstream media. (Tranter et al., 2017; Jingala & Chaudhry, 2023) In Finland specifically, the hegemonic status of the Ministry of Finance and its point of view often supersedes other points of view.

The relationship between climate change and economic growth has been frequently framed as antagonistic, with media reports focusing often on the short-term economic costs of climate action and implementing environmental regulations, such as job losses or increased energy prices (Carvalho & Burgess, 2005; Nisbet, 2009). Environmental regulations are also often framed as burdensome and hindering to economic growth, especially in industries reliant on fossil fuels. Throughout the 2010s, alternative narratives began to emerge that highlighted the potential for economic opportunities from addressing climate change, with the idea of "green growth" emphasises that environmental sustainability and economic growth can be mutually reinforcing through innovation and investment in green technologies (Bowen & Hepburn, 2014). Reports on job creation in the renewable energy sector, for example, showcase economic benefits of transitioning to a low-carbon economy (IRENA & ILO, 2024).

While the green growth narrative appears to reconcile ecological sustainability with economic expansion, it also performs a powerful depoliticising function. By

framing climate change as a problem of innovation and investment rather than of power, consumption, and inequality, it absorbs ecological crisis into the existing economic order. This limits public debate to questions of speed and efficiency, rather than opening space for contestation over alternative socio-economic futures.

This dissertation's findings suggest that the marginality of degrowth/postgrowth perspectives in mainstream news is not only an outcome of editorial choice but is also shaped by professional routines and institutionalised sourcing. Journalistic norms of objectivity, balance, and reliance on authoritative expert sources tend to privilege actors embedded in established policy and economic institutions. As a result, growth-affirming perspectives are more readily available and "credible" within routine source networks, whereas growth-critical expertise is less institutionalised and therefore less likely to be cited, normalised, or sustained as part of legitimate controversy. This dynamic is consistent with research on indexing and the role of primary definers in setting the boundaries of acceptable debate.

While climate journalism has its own dynamics of scientific authority and politicisation, the ways climate policy is narrated in news are also shaped by the conventions of economic reporting – particularly the institutionalised dominance of growth-oriented policy expertise. The next section therefore turns to the media construction of economic growth and economic policy in Finland.

7 Case studies

This dissertation comprises of four individual articles. In the following section I will give a short introduction to each of the articles and discuss briefly how each article contributes to the thesis. I will address the methodological and theoretical aspects of the articles later in this synopsis chapter.

Article I: Muted By a Crisis? Covid-19 And the Long-Term Evolution of Climate Change Newspaper Coverage

Article I of this thesis explores the dynamics of the attention of climate change in media coverage. More generally, it focuses on how a long-term issue like climate change is or can be overshadowed by more immediate, short-lived crises, such as the COVID-19 pandemic. The study draws for a data set spanning three decades (1990–2020) from Finland's leading national newspaper *Helsingin Sanomat*. It examines the fluctuations in climate change reporting and identifies key factors that contributed to both surges and declines in coverage intensity.

The long-term analysis reveals an overall upward trend in climate coverage, punctuated by notable peaks and troughs. These fluctuations can be linked to – or even explained by – factors such as the conclusion of specific newsworthy events or policy processes (e.g., international climate negotiations), the absence of exceptional weather anomalies, reduced activity from influential figures (e.g., policymakers, business leaders), and the impact of competing news cycles and reporting fatigue following periods of heightened focus on climate issues. In Figure 1 (from Article I), such key news events are shown with the evolution of the overall climate change coverage.

As a case study, the article zooms into early months of the COVID-19 pandemic in 2020. This period saw a dramatic, though not unprecedented, drop in climate-related reporting, as pandemic news dominated the media landscape. The article contextualises this phenomenon, investigating how long the effects of such crises persist and how they influence the broader trajectory of climate coverage.

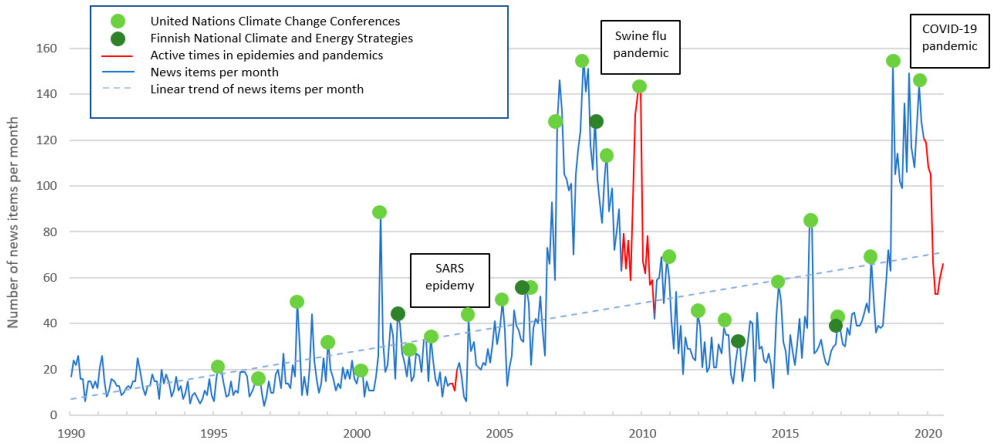

Figure 1: Overview of monthly news coverage of climate change by HS, Jan 1990–Jul 2020 and selected news events potentially increasing (climate policy events shown as green dots) and decreasing (virus outbreaks shown as a red line) climate coverage. (Article I)

From the perspective of this thesis, Article I highlights the challenges of sustaining attention on enduring issues like climate change amidst the media's responsiveness to acute events. It underscores the vulnerability of long-term environmental concerns to being temporarily displaced in public discourse and offers insights into the interplay between thematic and temporal competition for media visibility. Through this exploration, the article contributes to understanding the resilience and fragility of climate change as a media agenda in the face of competing societal crises.

Article II: Framing Climate Futures: The Media Representations of Climate and Energy Policies in Finnish Broadcasting Company News

Article II of this thesis delves into how media representations of the future shape and reflect climate change and energy policy discourses. By integrating media analysis with futures studies, the article examines the framing and depiction of futures in news coverage related to key national energy and climate strategy documents in Finland. Using qualitative content analysis of online news articles published by Finland's national public broadcaster – renowned for its commitment to high-quality journalism and trusted by the public (Reunanen et al., 2023) – the study provides insights into the evolving narratives surrounding climate action.

The findings reveal that between 2015 and 2020 – between the Paris Agreement and the COVID-19 pandemic, both significant conjunctures – coverage

on climate futures became increasingly multifaceted, incorporating a broader range of frames and future scenario archetypes. This shift indicates a growing awareness of climate risks and a richer discourse around climate action. However, the study also highlights persistent challenges: climate change is often framed as an isolated policy issue, with mitigation and adaptation efforts positioned as secondary to economic policy objectives. In Figure 2 (from Article II), the most frequently appearing frames and scenario archetypes have to do with themes that connect to economic development and growth narratives.

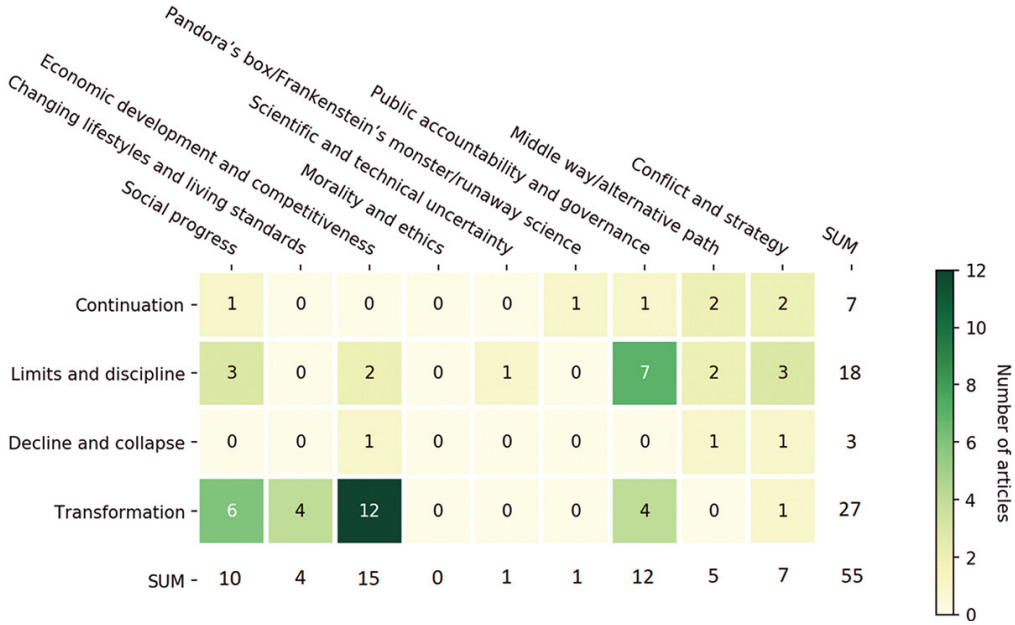

Figure 2: Frames and scenario archetypes in articles focusing on the climate policy documents. (Article II)

From the thesis perspective, Article II underscores the critical role of media in shaping public perceptions of future-oriented climate and energy strategies. It identifies the tensions between framing climate change as an urgent, standalone issue versus embedding it within broader economic and policy agendas. This exploration contributes to understanding how media narratives influence the prioritisation and integration of climate action within national policy frameworks and public consciousness. The article also represents the classic frame analysis type of studies, offering comparison in study design within the present thesis as "human labour" analysis in Article II can be compared to the more automated methods utilised in Articles III and IV: for example, while the analysis performed by individual researchers in Article II are deeper on the level of an individual story, the datasets included in the automated content analysis are orders of magnitude larger. Article II is also the only article that analyses the news content produced by the national broadcaster Yle and not the private media company Sanoma.

Article III: Climate Change Versus Economic Growth: Quantifying, Identifying and Comparing Articulations in News Media Using Dynamic Topic Modelling

Article III represents the key foundation of this thesis, offering a comprehensive longitudinal analysis of how climate change and economic growth have been portrayed and interconnected in Finnish news media over a 24-year period (2000–2023). Employing Dynamic Topic Modelling (DTM), the study bridges modern Natural Language Processing (NLP) techniques with traditional media analysis theories, providing a novel methodological framework for examining the evolution of these critical themes.

The analysis, based on 39,375 news articles, reveals significant shifts in discourse. The dataset comprised of 14,765 news stories returned from the news outlets' archives with the search term "ilmastonmuutos" ("climate change") and 24,610 stories with the search term "talouskasvu" ("economic growth"). Climate change, initially discussed primarily in terms of emissions and international agreements, gradually became integrated into narratives surrounding sustainable energy practices and broader socio-economic concerns. Similarly, economic growth, a topic that was previously kept distant, emerged within climate change coverage with an increased focus on governmental, business, and societal dimensions. These discussions often critiqued capitalism, while emphasizing welfare and education as essential components of a sustainable future. Figure 3 (from Article III) displays the evolution of the topics within their main themes: how often climate change is appearing as a topic within news on economic growth, and how often economic growth appears within news on climate change.

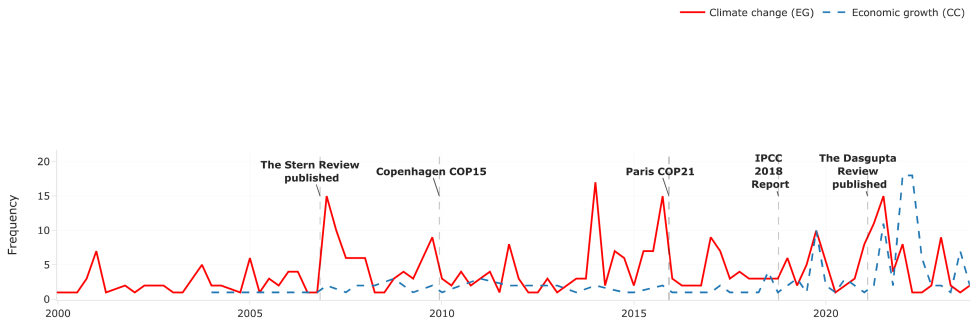

Figure 3: Climate Change and Economic Growth represented in each other's dynamic topic models. (Article III)

By applying articulation theory to the results of DTM, the article demonstrates how media narratives have increasingly aligned economic and environmental

concerns. This integration reflects a growing recognition that sustainable economic growth is pivotal in addressing climate challenges.

From the thesis perspective, Article III stands out for its innovative use of computational methods to trace the discursive intersection of two major societal issues. It not only provides a detailed temporal analysis of changing media narratives but also situates these shifts within the broader socio-political and economic landscape, such as the global economic crises and the COVID-19 pandemic, and the broader questioning of economic growth at the cost of the environment, making a critical contribution to the understanding of climate change coverage and its intersection with economic growth.

Article IV: Towards Efficient and Reliable Utilization of Automated Data Collection: Media Scrapers Applied to News on Climate Change

Article IV has a methodological focus. It investigates the opportunities and challenges posed by automated data collection methods in social sciences and humanities research, using newspaper coverage of climate change in Finland as a case study. With abundant data available in digital archives, automated tools promise efficiency, scalability, and reduced reliance on time-consuming manual data collection. However, they also introduce risks, such as incomplete contextual understanding, unrecognised systematic errors, and potential gaps in data acquisition.

The article compares two approaches to collecting climate-related news coverage from Helsingin Sanomat, Finland's leading national newspaper. The manual method involved using the public website and web search functions to identify and gather relevant headlines, while the automated approach utilized a Python-based script to scrape headlines via the *Helsingin Sanomat* search API. The study highlights that while the automated method is highly efficient, it has limitations in ensuring comprehensive and contextually accurate data acquisition. Many of these challenges, however, can be mitigated with targeted adjustments and manual oversight. Overall, the article underscores the importance of critically evaluating the trade-offs between manual and automated approaches in research, particularly in ensuring data quality and contextual accuracy. By addressing these challenges, the article contributes to methodological advancements in analysing media representations of climate issues over time. These approaches also created the basis for the data collecting environment for Article III.

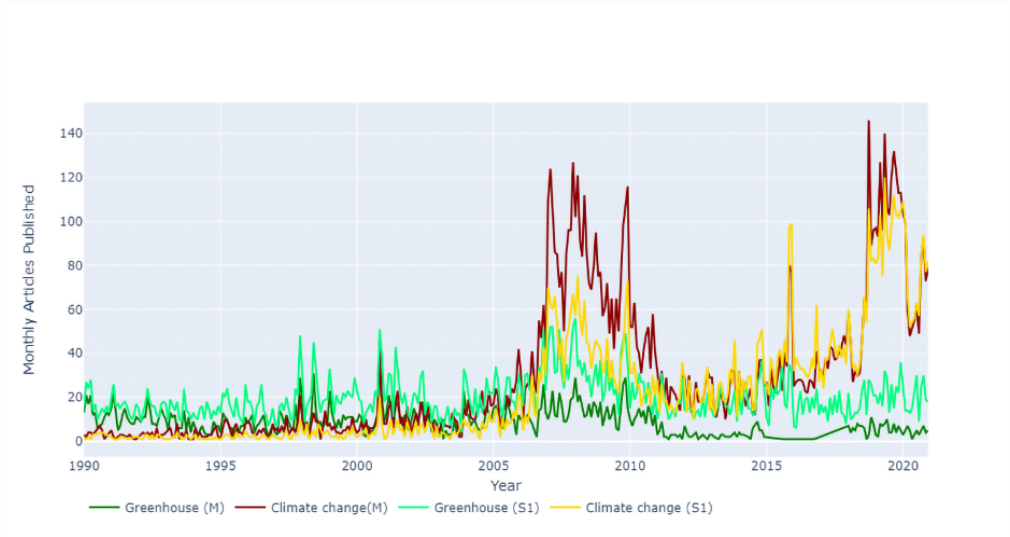

Figure 4: Results of search queries for "climate change" and "greenhouse" for manual and scraped datasets. (Article IV)

Beyond the methodological reflection, Article IV sheds light on the evolving frequencies of climate change coverage in the Finnish media, reinforcing the finding of an overall upward trend identified in Article I.

Another key finding relates to the language of climate change coverage (see Figure 4). The study shows changes in trending terms on the subject: out of the three search terms examined, "kasvihuoneilmiö" ("greenhouse effect") is a more dominant term within the theme until around 2006-2008 after which "ilmastonmuutos" ("climate change") overtakes it as a more broadly used term. "Ilmaston lämpeneminen" ("climate warming") sees milder similar shift but remains deeply articulated to the overall climate change coverage. This shift can also be seen as an example of the articulation process as the scope of the theme expands past what could be "contained" by sticking to using "greenhouse effect". The connection of the terms is also briefly discussed in Article III.

Article	Research problem	Theoretical framework and methodology	Data
Article I: Muted by a crisis? COVID-19 and the long-term evolution of climate change newspaper coverage	The impact of sudden crises on climate change coverage in Finland.	Attention cycle, agenda setting, and quantity of coverage used to analyse the impacts of (short-lived) crises on climate change coverage in Finland.	News articles published on Helsingin Sanomat from 1990 to July 2020 and consists of 14332 news articles collected from the digital online archive of HS with the search strings “ilmastonmuutos” (“climate change”) and “ilmaston lämpeneminen” (“warming of the climate”), and compound words with the word “kasvihuone” (“greenhouse”)
Article II: Framing climate futures: the media representations of climate and energy policies in Finnish broadcasting company news	Framings of climate and energy policy futures and documents in Yle’s online news coverage.	Qualitative frame analysis used to examine Nisbet’s frames and Dator’s four future scenarios applied to coverage of climate and energy future strategies in Finland.	Online news stories covering the six selected climate and energy policy documents published during 2015–2020 by the Finnish public broadcaster Yle. The final sample consisted of 55 news stories.
Article III: Climate Change versus Economic Growth: Quantifying, Identifying and Comparing Articulations in News Media Using Dynamic Topic Modelling	Representations of climate change and economic growth in the Finnish daily newspaper and tabloid coverage.	Articulation theory applied to the results of Dynamic Topic Modelling (DTM).	Dataset 1 focused on climate change ("ilmastonmuutos") from 2000 to 2023 across Helsingin Sanomat and Ilta-Sanomat archives, including content from the now-merged business newspaper Taloussanomat, totalling 14,765 articles. Dataset 2 focused on economic growth ("talouskasvu") during the same period, with 24,610 articles. They comprise a total of 39,375 news stories.
Article IV: Towards efficient and reliable utilization of automated data collection: Media scrapers applied to news on climate change	Tracking climate coverage via automated and manual methods, and caveats related to the methods used.	Comparisons of automated data collection methods (text scraping) and manual data collection.	Two datasets of the same time-period of 1990-2020 climate change coverage in Helsingin Sanomat: manually collected dataset consists of 14750 and the scraped dataset of 14669 articles.

Table 4: The individual articles of the thesis

8 Data used in the thesis

The data used in the thesis comprises mostly of news articles of the largest Nordic daily newspaper, Helsingin Sanomat, obtained via the news outlet's online archive. Additional insights are brought by Article II that focuses on the climate and energy strategy document coverage of the Finnish national broadcasting company Yleisradio (Yle). The data are comprised solely of articles of journalistic and editorial texts that have been published in Finnish mainstream news outlets. Other forms of journalistic media – such as television and radio – have not been considered in the thesis.

Articles I and III use headlines, not full texts, from HS, and Article III expands these data to Ilta-Sanomat and Taloussanomat, part of Ilta-Sanomat, and uses full texts of the said articles, as well. Article I displays the climate change coverage of HS from 1990 to July 2020 and consists of 14332 news articles collected from the digital online archive of HS with the search strings "ilmastonmuutos" ("climate change") and "ilmaston lämpeneminen" ("warming of the climate"), and compound words with the word "kasvihuone" ("greenhouse") included if connected to climate change. The dataset is based on data collected for earlier studies (Lyytimäki & Tapio, 2009; Lyytimäki, 2015; Lyytimäki, 2012) and then complemented from 2015 onwards. The data was collected "manually" from the news outlet's online archive.

Article II focuses on the online news covering the six selected climate and energy policy documents published during 2015–2020 by Yle. Of the 227 items published on climate issues, the final sample consisted of 55 that focus on or mention the studied climate policies.

Article III includes two datasets, one of which contains all news articles published between 1 January 2000 and 31 December 31 2023 and are returned by the search query "ilmastonmuutos" ("climate change") on both Helsingin Sanomat and Ilta-Sanomat online archives, and the other from the same time period with the search query "talouskasvu" ("economic growth"), a total of 39,375 news stories. The stories from the tabloid Ilta-Sanomat also contain all stories that would have been published via Taloussanomat, a business-focused newspaper that was incorporated into Ilta-Sanomat during the time period. The total number of stories on climate change was 14,765 news articles while the economic growth dataset had 24,610 news articles. There were a total of 632 overlapping stories between the two datasets.

And finally, Article IV consists of two similar datasets that cover the same search keywords as in Article I – with one, manually collected dataset (MD) continuing the dataset used for Article I from January 1st 1990 now through December 31st 2020 with a total of 14750 news stories in the dataset. The second dataset collected via automated scrapers consists of 14669 news stories.

9 Findings

In the following chapter, I describe in depth the findings of the thesis from the point of view of the research questions and analyse them through the lens of depoliticization and repoliticization, while linking and finding connections between the individual articles discussed in the previous chapter. I pay particular attention to how climate change and economic growth are articulated around specific nodal points in Finnish media discourse, and how these articulations shift across crises and conjunctures.

9.1 Attention dynamics: Crises, Conjunctures and the (Re)Politicization of Climate Change

In articles I and III but also in IV it was apparent that the shock of a short-lived societal crises – such as the economic and debt crises that began in 2007 or the COVID-19 pandemic – have not had a lasting negative impact on the overall attention level of climate coverage. After an initial, drastic slump, the monthly media attention to climate has returned at least its pre-crisis level. The 34-year trend of growing attention also tells a tale of climate change coverage solidifying as an integral and increasingly important news topic and a major signifier in political discourse. It also shows how significant momentary spikes upwards often lift the media attention to a new and higher baseline. These results confirm Downs's (1972) original hypothesis in a way that closely parallels the findings of an earlier longitudinal study of Swedish environmental news coverage (Djerf-Pierre 2013).

More specifically, Article I highlights how the long-term increase in media attention to climate change is punctuated by notable peaks that correspond to international events such as the United Nations Climate Change Conferences (COPs) or globally significant scientific reports (IPCC, The Stern Review). These moments of heightened political and scientific activity often catalyse intensive public discourse, strengthening climate change as a pressing global issue. The study also reveals significant drops in coverage. This can be due to many factors, such as reporting fatigue, the cessation of specific events, and competition from other news stories, underscoring the episodic nature of climate narratives, where moments of intense focus are interspersed with periods of relative silence. Such

fluctuations reflect the tension between the urgency of addressing climate change and the media's preference for dramatic, short-term events. Shifting media attention also reflect media's reliance on preferred sources, such as political elites, international organisations, and known experts and their institutions which are most readily available during high-profile events but less visible outside them.

The challenge to increase the attention and lessen the fluctuation of climate coverage lies in embedding climate issues within broader societal narratives, beyond the temporal constraints of news cycles. Though often challenging, recent examples of successful linkages of climate change to contemporary crises do, however, exist. For instance, as the COVID-19 pandemic began, the science of climate change increasing risks of cross-species viral transmission (Carlson et al. 2022) became a popular narrative. Likewise, Russia's invasion to Ukraine in spring 2022 and the resulting energy crisis connected to a climate narrative of sustainable energy production as part of decoupling the European energy grid from Russian import, and by default, then also from fossil fuel dependency. (European Commission 2022)

In Article I, the monthly coverage of climate change exhibited four distinct peak periods. The declines from these peaks can be attributed to various factors, including the conclusion of specific news events or policy processes (such as international climate policy meetings), the absence of notable weather anomalies (e.g., typical winter weather and normal snow coverage in Finland), reduced activity by influential figures (such as policymakers and business leaders), and the combined effects of competing news priorities and reporting fatigue after periods of extensive climate coverage. During the initial months of the COVID-19 pandemic in 2020, climate coverage experienced a significant, though not unprecedented, decline from its previous peak. However, the enduring reality of anthropogenic climate change, the gradual integration of climate concerns into diverse societal sectors, and recent policy initiatives/frameworks (such as the European Green Deal) surrounding "green" or sustainable recovery efforts suggest that climate coverage is unlikely to diminish significantly in the foreseeable future. In Article III, similar slump is seen as Russia escalates its war in Ukraine in the spring of 2022, as new high peaks in climate coverage are reached again in the following summers.

One of the most interesting, and perhaps one of the most important, systemic, and, considering this study, most relevant, shifts in the frequency of news stories on climate change happens in its relation to the stories on economic growth, as discussed in Article III. The pivotal year of 2018 is the last when stories on economic growth are published more frequently than on climate change. The relationship stays this way for the remainder of the time-period covered in Article III, until the end of 2023, and the two themes are temporally synchronised only during the slumps of COVID spring of 2020 and the Russian escalation of 2022.

This initial shift coincides with the release of the highly impactful IPCC report in October 2018 on the coattails of the then new youth climate activist movement such as Fridays for Future that began to gather momentum and visibility from August onwards.

As discussed in Article III, it is important to note that the increase in climate change coverage is both absolute rather and relative. The overall volume of articles published in the newspapers remained relatively stable over the study period, meaning that the rise in climate change coverage does not merely reflect an expansion of news output, but a reallocation of scarce resource of editorial attention. This shift highlights a changing relationship between climate change and economic growth in media coverage. From 2018 onwards, economic growth receives consistently less attention than climate change, and the highest peaks in climate change coverage exceed those of economic growth across the period examined.

Figure 5 illustrates this development clearly. The two themes attract comparable levels of attention around the first release of the Stern Review (legend 2) and again during COP15 in Copenhagen in 2010 (legend 4), and they peak simultaneously during the Paris Agreement in 2015 (legend 7). However, a decisive and lasting reversal occurs in 2018, coinciding with the release of the IPCC Special Report (legend 8), after which climate change maintains a higher level of media prominence than economic growth.

Viewed through the lens of depoliticisation and repoliticisation, these coverage dynamics suggest a recurring pattern in which moments of intensified attention create temporary openings for repoliticisation. These attention peaks are followed by processes through which climate discourse is restabilised within more familiar and less contested frames in Finnish media. The fact that climate change can and has become a stable, routinised issue in Finnish media can also mean that it is "domesticated" as a topic – present yet depoliticised – precisely because its coverage no longer fundamentally challenges prevailing economic or political arrangements. At the same time, some articulations that emerge during periods of intensified attention are retained and incorporated into the broader vocabulary of climate discourse. The recurring upticks associated with major nodal points of crisification (Figure 5) thus function as moments of heightened discursive openness, creating temporary potential for repoliticisation. Following each such episode – whether or not it is followed a slump in coverage – the overall level of climate reporting tends to stabilise at a higher baseline. This pattern suggests that crisis-driven increases in visibility may simultaneously enable limited discursive change while contributing to longer-term processes of depoliticisation through normalisation.

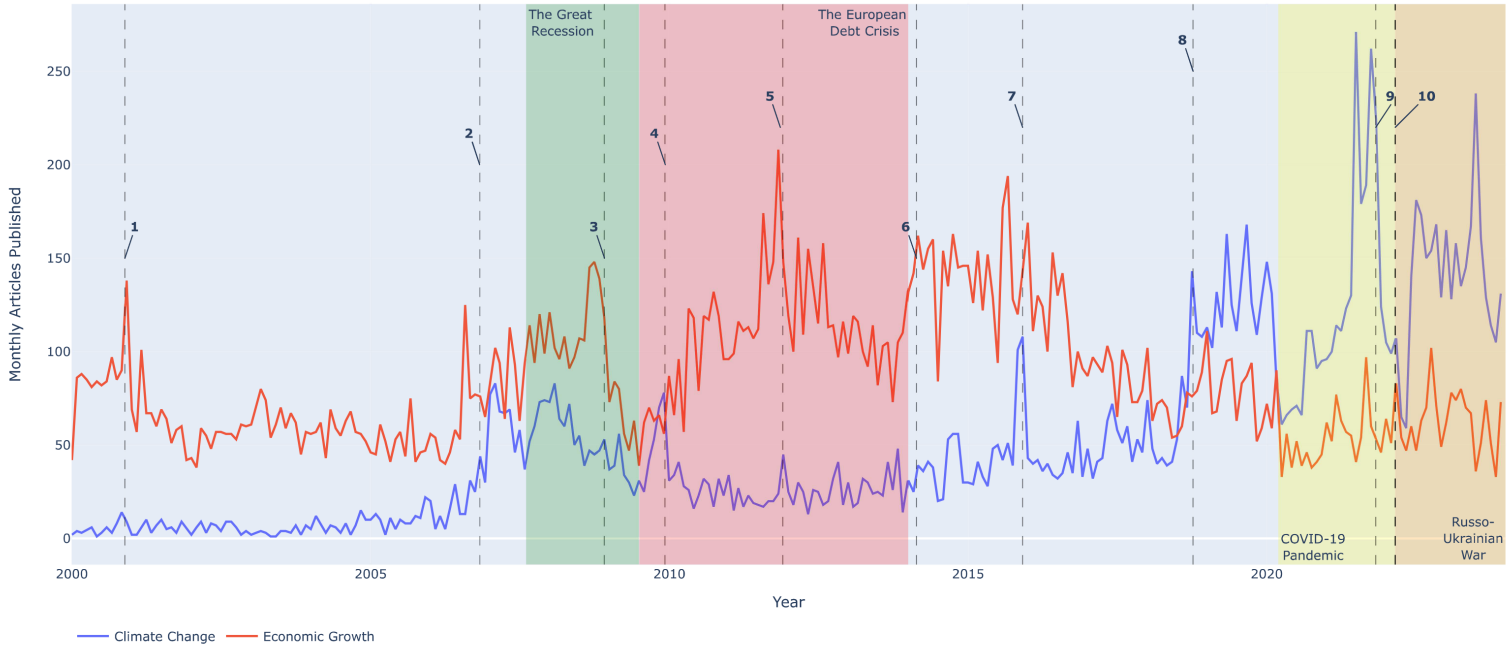

Figure 5: Amounts of news articles on climate change and economic growth 1.1.2000–31.12.2023. ARTICLE III. Legends: (1) COP06 Hague, (2) Stern Review, (3) COP14 Poznań, (4) COP15 Copenhagen, (5) COP17 Durban, (6) Russo-Ukrainian Conflict Starts, (7) COP21 Paris, (8) IPCC 2018 Report, (9) COP26 Glasgow, (10) Russia Invades Ukraine. Green colour indicates The Great Recession, red The European Debt Crisis, yellow the COVID-19 Pandemic, and orange the escalation of the Russo-Ukrainian War.

The peak moments for climate coverage (around COPs, the 2018 IPCC report and the Fridays For Future movement, and the war in Ukraine) mark conjunctures in which climate change is temporarily rearticulated around new nodal points such as "crisis", "security" or, in 2018, "climate justice" and youth activism. However, the rapid return to a new but stable baseline indicates that these repoliticising impulses are rather quickly reabsorbed – and at least partly depoliticised – into routinised news cycles. This is true especially with the COP-related language of carbon dioxide levels and emissions trading, the "1.5°C target", and "global consensus" that echo insights made earlier by Swyngedouw (2018). In other words, climate change becomes more salient on the media agenda, but its politicisation remains episodic and fragile, emerging most clearly around conjunctural shocks before receding into more routinised and thus depoliticised coverage.

9.2 Stabilised Frames and Episodic Repoliticisation in Climate Coverage

Climate change frames in Finnish media, as discussed in these case studies, are rooted in technocratic and science-driven discourses, focusing on the implications of policies and scientific findings. Over time, these narratives have diversified, encompassing a wide range of societal themes. Climate issues now appear not only in environmental sections but also in politics, culture, lifestyle, and economic reporting. This broadening range and diversity of frames reflects the growing recognition of climate change as a crosscutting societal challenge rather than a siloed environmental issue.

Political initiatives and discussions on green technologies and sustainable investments have positioned climate change both as an economic challenge and business opportunity. The lack of polarising debate across the environment–economy divide may, however, have limited the range of frames available for discussing climate change, reminiscent of the monotonous austerity economics coverage in the Finnish media (Harjuniemi, 2023, pp. 73-85).

The economic growth paradigm has been able co-exist with the climate crisis relatively unchallenged (see also Article III and, considering how climate policy is framed as subservient to the goals of economic policy, Article II). When both economic growth and climate change are articulated within depoliticised, technocratic frames, their relationship produces minimal friction, reducing the need for contestation and limiting the scope for disruptive or transformative debate.

Lifestyle sections often frame climate change through the lens of consumer behaviour, emphasising individual choices such as adopting veganism, avoiding flights or other ways to reduce one's individual carbon footprints. While possibly

empowering, these kinds of narratives also risk oversimplifying systemic issues by placing strong responsibility on individuals. Such frames discussed in Article I appear also as top 20 topics in Article III topic modelling, showing the media emphasis on the role of solving climate change by individual actions. In Article III, the second most popular topic of the climate change dataset is focused on private car usage, with electric cars taking over the topic in late 2018. Top topics on food, air travel, climate activism, and circular economy, often articulated via themes such as recycling and second-hand clothes, add to the emphasis of the role of the individual. Similar to Article III, also Article I shows how climate frames have become a significant part of cultural discourse, appearing in theatre, literature, and art.

As discussed earlier, Article I highlights that during the pandemic, climate coverage in Finnish media declined sharply, and similar slump is seen later in Article III with Russian war escalation in Ukraine. The overlap between climate and COVID-19 reporting also introduced new comparative representations, framing the pandemic as a smaller, immediate threat compared to the long-term crisis of climate change. Such comparisons illustrate how media frames adapt to contextual shifts, integrating diverse crises into a more cohesive discourse. Same can also be said about the impact of the war in Ukraine to the climate-adjacent discourse on energy dependence to Russian fossil fuels that are visible in the second most popular topic of the economic growth dataset in Article III that focuses on Russia and oil.

These moments represent moments of contingency – nodal points where a topic's dominant framing shifts (Kunelius, 2020). Such convergence of narratives also presents opportunities for cross-sectoral learning and public engagement. For instance, the parallels drawn between pandemic preparedness and climate action underscore the importance of scientific knowledge and assessment, raise questions about collective responsibility, and highlight resilience planning. These shared themes can potentially enhance the salience of climate narratives, even amidst competing news priorities.

As Article I demonstrates, the presence or absence of influential actors significantly shapes climate narratives. Statements from policymakers, business leaders, and activists often catalyse media coverage, framing the public debate. For example, the visibility of Greta Thunberg and the climate strike movement during the late 2010s introduced a moral urgency to the discourse, shifting the focus from technocratic solutions to intergenerational accountability and ethical considerations. Similarly, international climate events, such as the Paris Agreement negotiations, can serve as focal points that anchor the climate discourse within broader geopolitical, institutional, and policy-oriented discourses, situating climate change within established news logics and arenas of political relevance.

The episodic nature of media coverage poses significant challenges for climate narratives. It highlights the need for sustained storytelling that transcends individual events and maintains public engagement over time. As Article I notes, issue fatigue and the media's "carrying capacity" (Hilgartner & Bosk, 1988) can lead to declining interest, even as the underlying problems still persist – or gradually becomes worse.

The evolution of climate frames, as documented in Article I, reflects broader societal shifts in understanding and addressing climate change. From episodic peaks to sustained discourse, these frames play a critical role in shaping public perceptions, policy priorities, and collective action. Overall, the analysis shows that while some topics (e.g., global negotiations, scientific assessments) remain relatively constant in coverage, others, especially those tied to personal lifestyle choices, fluctuate significantly, particularly around major policy shifts and public debates. This underscores the multifaceted nature of climate change discussions in the media, highlighting tensions between systemic interventions and the individual-level framing of responsibility.

From the point of view of depoliticisation, it is useful point out that the frames are organised around a relatively small set of technocratic and individualising nodal points. Climate changed media discourse is anchored to "emissions", "technology", "innovation" and various lifestyle choices. Together, they can powerfully compartmentalize and stabilise a discourse, making climate action appear as a matter of expert management or individual responsible consumption – rather than a structural conflict. The prominence of topics such as private car use, food, air travel and circular economy in the topic model results reflects this configuration: climate change becomes primarily thinkable as a question of how individuals and firms can adapt their behaviour within the existing economic order, not whether that order itself should be transformed. From the point of view of economic growth, climate change is presented as an opportunity with talk of "investments" and "green growth".

At the same time, the findings also point to some cracks in the stabilised, routinised framing in which climate change is acknowledged but largely addressed within technocratic, growth-compatible, and non-contested terms. The visibility of the climate strike (2018 onwards) movement, as well as the spread of climate activism topics in Article III, point explicitly to the way acts of repoliticization of climate change can find space in the discourse in nodal points such as "climate justice", "youth" or "future generations". These articulations shift the framing of climate change away from questions of technocratic optimisation toward issues of intergenerational responsibility, inequality, and systemic transformation.

Such moments can be understood as instances of potential repoliticisation, in that they temporarily expand the range of legitimate questions, actors, and frames within climate discourse. This, however, raises a further issue: how far does this

expansion go beyond the short-term visibility created solely by attention peaks, and to what extent do the new articulations introduced in these moments persist afterwards? In other words, do they continue to shape what can be said and thought about climate change once their most disruptive force has faded? From an articulation-theoretical perspective, once such signifiers enter public discourse they rarely disappear entirely. Even when their political force is partially domesticated, they may not fully retreat beyond the boundaries of what can be meaningfully articulated.

In conclusion, the evolution of climate frames in Finnish media shows a pattern of depoliticized stability punctuated by short-lived repoliticised episodes. Technocratic and individualising nodal points dominate the everyday coverage, while more conflictual or justice-oriented articulations surface primarily around protests, international summits or crises. In this sense, the media both normalises climate change as a cross-cutting societal issue and constrains the range of legitimate political responses to it, shaping what can be articulated within what Daniel Hallin (1986) famously termed the sphere of legitimate controversy.

9.3 Articulations of climate change and economic growth via Dynamic Topic Modelling

The topics representing the changes in articulation of climate change as a news issue in Article III support the findings in Article I but also offer a lens through which one can analyse the different methodological approaches to analysing climate change coverage.

The Dynamic Topic Modelling performed with *BERTopic* yielded a total of 69 individual topics on climate change. Each topic comprises the most frequent and relevant words used in the articles grouped together by the algorithm, thus facilitating the exploration of how these topics evolve over time. Each topic is presented as an evolving set of time-splices of three months. In the article, each topic is listed as an output of the DTM by order of popularity with the most popular topic, "Temperature anomalies", addressed as "topic 1", and so on. (For more technical details of the topic modelling and its parameters, see Article III).

As expected, many high-profile topics peak in frequency around major events. For instance, “Climate agreements” (topic 10) spikes near COP meetings, most notably at the 2015 COP21 in Paris and again in 2017 when the U.S. announced withdrawal from the Paris Accord. The key vocabulary of the topic also evolves, with references shifting from “Kyoto” to “Paris” and increasing mentions of “1.5° C goal” and “developing nations.” Another leading topic, “Temperature anomalies,” shows pronounced seasonal patterns and increased coverage over time, culminating in a record peak of 68 articles per splice in spring 2023.

Beyond large-scale diplomatic and scientific themes, there is a marked emphasis on individual action. Topics such as "Food" (topic 6) and "Cars" (topic 2) illustrate how everyday consumption and lifestyle choices have become central to climate change discussions. The rise in discourse about plant-based diets, debates over meat consumption, and the rapid uptake of electric vehicles all underscore this focus. Although these topics occasionally include words referencing systemic changes – e.g., through climate protests demanding broader societal reforms – they are frequently framed within narratives of individual consumer responsibility, echoing previous scholarship (Boyer et al., 2021; Bushell et al., 2017; Sarras 2025) and the results in Article I.

The pivotal moment for heightened systems critique comes at the combined effect of global activism movement and the IPCC report in late 2018, which is also visible in the articulations of systemic themes discussed within climate change coverage. This is explicitly seen from thereon in the economic growth topic within the climate change dataset that begins to reveal words such as "welfare", "capitalism", "Marxist", "inequality", "ecological", and "marginalisation". Similarly, in the climate change topic within the economic growth dataset, mentions of "impoverishment", "living standards" and, in spring 2023, "degrowth researchers" are seen.

The long time-series on dynamic topic modelling shows that the relationship between the discourses on economic growth and climate change has become increasingly interwoven over time but it still retains significant separations. Article III displays, that if one would take into account solely the categorisation of the Sanoma news archives, out of the almost 40,000 news articles only 632 appear to explicitly address both economic growth and climate change.

This overlap coincides generally during the yearly global climate summits but the most significant peaks by far take place in the spring months of 2022 as Russia had just begun its war on Ukraine. A closer look at the articles released during those peak months of April and May 2022 reveal that while the Russian war appears to cast a shadow on both the Finnish and the world economy, the main concern tends to be the overall lacklustre growth of the Finnish economy with both Russia and "too ambitious" climate policy briefly mentioned as culprits. Nevertheless, the overlap is not significantly intense: energy, economics and climate come together with the question of EU buying Russian gas and the call for swift transition towards renewable energy in order to end Russian energy dependency – with an added climate-political benefit.

This disparity demonstrates that, while the themes are becoming more interconnected in politics, the Finnish mainstream media and dominant political discourse continue to treat them largely as separate entities. This finding is pivotal for understanding the fragmented nature of public discourse, as it highlights the challenges in developing cohesive frames that simultaneously address the dual

imperatives of economic development and climate action – and by doing so can also concretely pose the *contradictions* of the key articulations of these discourses. As long as this does not happen, news media itself can be seen as an actor that disarticulates and maintains the disarticulation of climate change and economic growth. There are, then, signs of structural powers that keep climate and economic growth at an arm length from each other, despite the obvious and strengthening connection during some key moments throughout the time-period. This applies for the linkage of mainstream economics and climate change in the 2006 Stern Review (Stern, 2006), as well as for the articulations of biodiversity and nature footprint to the economic discourse and decoupling the 2021 Dasgupta Review (Dasgupta, 2021).

Despite this critical main tendency, one can also see that over the years, the media discourse on economic growth has indeed diversified and that the media has also began to engage more seriously with climate change considerations. Simultaneously, climate change discussions increasingly incorporate themes of economic growth. While this mutual engagement suggests partial integration of these discursive domains, the quantitative evidence as displayed by the dynamic topic modelling results underscores a persisting weakness between their serious coupling in media representations. For example, in the 1990s, climate change questions had only some implications for energy policy, most clearly in connection to the debate about nuclear power in Finland. The 2006 Stern Review can be seen as a milestone for engagement from the point of view of the economic paradigm: following this moment it became more broadly possible – even if not very common – to discuss climate change in the "language" of economics. Still, the discussion of climate economics had to cede due to the following financial crises of 2008 onwards. This low point culminated in the failure of the Copenhagen COP meeting and resulted in "the lost decade" for climate policy (Toivanen et al., 2023, pp. 117-144).

The financial crises did, however, sharpen system-level critiques of the neoliberal order, and movements such as Occupy in 2011 developed a language of economic and political injustice that was subsequently taken up across other activist domains. When climate–economic discourse entered a more explicitly system-critical phase in the late 2010s, the system critique discourse was therefore already to a degree available. Importantly, elements of this critique were also echoed and reframed in authoritative scientific assessments, particularly in the IPCC's Fifth Assessment Report and the 2018 Special Report, which foregrounded structural drivers, societal transformation, and the limits of incremental change (IPCC 2014; 2018). By articulating the climate crisis in terms that extended beyond technical mitigation and efficiency, these reports provided institutional and epistemic legitimacy to system-critical framings. This, in turn, enabled climate action groups to advance critiques of existing economic arrangements in ways that

could be taken up by mainstream media as evidence-based and credible rather than purely activist. As a result, concepts previously associated with economic protest movements could be more readily translated into climate discourse, facilitating processes of repoliticisation within media narratives.

Analysis of topic modelling across the sub-datasets (economic growth and climate change) reveals that, while economic growth emerges as a prominent topic within climate change discussions, the language surrounding it often reflects a "business-as-usual" perspective. Economic growth, then, operates as a powerful nodal point that organises climate discourse into a largely depoliticised configuration. When climate change and growth are articulated together, it is predominantly through “business-as-usual” signifiers such as competitiveness, innovation and efficiency, which domesticate climate action within the hegemonic growth paradigm. The previously mentioned scarcity of articles that can be found in both datasets – indicating on a meta-level that the topics are being kept apart partially via editorial categorisation as well – can itself be read as a form of depoliticization: by maintaining climate and growth as separate discursive domains, the media forecloses more antagonistic articulations that would frame some economic structures and principles as part of the climate problem.

The topic modelling results indicate that around 2018 new momentary nodal points demanding system change and welfare and mentioning workers’ rights and injustice begin to finally enter the climate–economy articulation, signalling a tentative repoliticization of the nexus linking climate change and economic growth. Further granularity can be observed within the topic-level analysis of the climate change dataset, which includes subcategories for Finnish and global climate policies. This differentiation highlights the diverse scales at which climate policy is debated and the complex interplay of local and global priorities in shaping these discussions. Direct capitalism critique and highlighting issues of welfare, workers’ rights and injustice begin appearing near and after the pivotal 2018 fall.

These findings and reflections underscore the suitability of articulation theory for making sense of the intersections of climate change and economic growth discourses. Articulation theory facilitates the identification of justifications and logical connections within discourses, enabling meaningful interpretations of their overlaps and disjunctures. The integration of dynamic topic modelling methods within this theoretical framework opens a chance for a robust synthesis of empirical examination of large-scale textual datasets and theoretical analysis of the changing articulations of the themes examined. These findings highlight the utility of combining qualitative insights with automated methods to uncover latent patterns and shifts in discourse. My approach here expands Simon Lindgren’s theoretical and methodological contributions of applying clustering words in vector space to articulation theory, with specific words, such as in his example

feminism, or terms, such as climate change, representing nodal points (Lindgren, 2020, pp. 120-121).

While Lindgren himself notes that Laclau and Mouffe would not likely ”agree that their ‘elements’ are equal to mere words, or that their theory would be compatible with machine learning”, a *temporal* topic modelling approach that operates on a level of word clusters and not singular words could be seen as coming closer to the original concept of articulation: “Starting from a word embedding model, with similarity scores calculated between words, one can envision the idea of grabbing a word in the jumble of the model and pulling it out like a thread where the word is stringed along with its most similar word, and in turn with the most similar word to that word, and so on.” (Lindgren, 2020, p. 124)

On the one hand, the persistent framing of climate policy as subordinate to economic goals underscores the need for critical engagement with hegemonic discourses and the development of alternative narratives that prioritise climate action. On the other hand, the increasing convergence of climate change and economic growth discussions suggests opportunities for fostering integrated approaches to policy and communication. However, the ongoing separations in media representations highlight the remaining challenges in journalistic work in bridging these discursive gaps.

Seen through the lens of moments of repoliticisation (and their persistent depoliticisation), the articulations of climate change and economic growth in Finnish media are marked by a persistent tension. On the one hand, the growth paradigm remains the hegemonic frame within which “economic”, hard climate policy is made intelligible and politically somewhat feasible, keeping more radical alternatives at the margins. On the other hand, the post-2018 emergence of explicitly system-critical topics suggests that repoliticizing articulations are possible and do occasionally gain traction, especially in conjunctural moments when climate-related moments of crisis, social movements and economic debates intersect. Whether these articulations of repoliticisation will stabilise into more durable counter-hegemonic configurations or will be rearticulated and reabsorbed into more politically acceptable frames such as the green growth narrative, remains an open question that this thesis can only partially answer. I will discuss the articulations of depoliticisation and repoliticization of climate change and economic growth further in depth in chapter 11.

10 Methodological lessons

The various approaches displayed in the four cases studies also raised some issues concerning the methodological aspects which I will discuss briefly in this short chapter. First, I will focus on the risks related to data collection from the point of view of digital news archives and automated data collection, after which I will go through potential issues with computer-assisted text analysis.

10.1 Data collection

While the first two case studies (Article I and II) rely on manual human labour, the latter two (III and IV) use and discuss automated methods. One of the central contributions of Article IV is precisely the systematic comparison of these approaches and the methodological trade-offs involved in relying on API-based data extraction rather than manual archival work.

The increasing importance of web scraping reflects a broader transformation in the research environment: access to data through platform-provided APIs has become more restricted, selective, and less transparent over time. While APIs are often presented as transparent research interfaces, in practice they provide only partial and curated access to platform data, shaped by commercial and institutional priorities rather than research needs (Bruns, 2019; Grimmer et al. 2022). As a result, scraping from user-facing interfaces has become a necessary workaround for many forms of longitudinal and large-scale media research.

Scraping, however, is not unproblematic either. News outlets' consumer interfaces are designed for readers, not researchers: articles must typically be individually loaded before they can be saved, and full-text searches operate through proprietary systems that do not expose the editorial metadata structures underlying the archives. Researchers cannot search or filter content according to internal newsroom categories, editorial desks, or tagging systems unless these are made visible through the interface. Consequently, the researcher has little control over how stories are indexed, categorised, or retrieved by the outlet's own systems.

This has important implications for the study of journalism. Editorial categorisation is not a neutral technical layer but part of journalistic practice itself: decisions about tagging, topic hierarchies, and archive structures shape what counts as a climate story, an economic story, or a political story. When these classification practices are hidden behind interfaces, researchers are forced to

work with externally visible proxies rather than the newsroom's own internal logics. This raises a broader question about the relationship between editorial classification systems and journalistic judgment, routines, and institutional.

A further source of uncertainty in longitudinal digital media research is the temporal degradation of data access. Over time, archives change not only in technical form but also in content and meaning. Articles may be removed or partially deleted, links may break, and search results may no longer reproduce earlier corpora. In addition, the language of meta-categorisation evolves: key terms change, merge, or disappear. A clear example is how the term *"greenhouse effect"* functioned as an umbrella category in the until 1990s before being largely replaced by *"climate change"* and *"global warming"* in the early 2000s (Weart, 2008; Lyytimäki, 2012). Such shifts affect not only public discourse but also what can be retrieved from digital archives.

Additionally, when data is collected utilising online archives only – and not utilising digital versions of the printed edition – one also has to give up on analysing such editorial decisions as which stories get put on the front page and which do not. Earlier studies such as Pertti Suhonen's (1994) longitudinal study of environmental news in Helsingin Sanomat took this into account but also focused on smaller datasets and manual archival work.

Another fuzzy factor in data collection for longitudinal studies is the temporal degradation of data access which, in addition to possible changes to the language of meta-categorisation and the interface itself, but also

a) manifest in removal of news articles or their contents from the online archives,
b) or changes in the key terms and their meanings, as seen in the term "climate change" replacing the earlier catch-all term "greenhouse effect" in the early 2000s.

From this follows that one needs good understanding of the examined topic and the (general) evolution of its discourse, but also more comprehensive documentation on the usage of the outlets' publication systems and potential changes made to them.

10.2 Text analysis

From the perspective of data analysis, it is clear that automated methods do offer some benefits, as discussed in Article III.

A key advantage utilising natural language processing tools such as topic modelling is – obviously – their scalability. While topic modelling can effectively analyse also smaller datasets, its true value becomes evident as datasets expand beyond the capacity of manual analysis. This scalability was particularly evident in

the contrast between two articles within this research. Article II, which employed frame analysis, relied heavily on human labour to analyse a limited dataset of 119 news stories, ultimately focusing on in-depth reading of 55 articles. In contrast, Article III, which utilised dynamic topic modelling, analysed mediated climate discourse in a data set of completely different order of magnitude nearly 40,000 news stories.

This comparison underscores the transformative potential of automated methods in media analysis. In smaller datasets, human labour can still yield meaningful and nuanced insights. However, as datasets grow exponentially, the limitations of manual analysis become apparent. Dynamic topic modelling not only overcomes these limitations but also enables researchers to detect patterns and thematic shifts across large bodies of content, providing a more comprehensive view of how media discourses evolve over time. In particular, it makes it possible to examine how different discourses provide context for one another, how some come to dominate while others recede, and how boundaries between them are maintained or blurred.

A hybrid approach with a larger emphasis on human labour and qualitative analysis is likely provide deeper analysis but will at the same time potentially face other limitations. Manual (or: human eye/reading) validity checks are still needed to verify the quality of the data even when using heavily automated methods. A best of both worlds approach of combining elements of automated and manual methodologies may continue to provide the most fruitful results in the future as well. Still, even in the current era of data-intensive research, there are still no well-established or standardised methods for systematically aligning large-scale computational results with human interpretive reading.

A relatively novel approach to dynamic topic modelling of media texts applied in Article III was focusing of topics discussed within climate change and economic growth discourses by removing individuals from the data. As seen in a similar paper focusing on the Danish climate coverage (Meier & Eskjær, 2024), individuals such as political leaders and celebrities may overtake topics or even become topics on their own (as happened with Greta Thunberg and Donald Trump in for Meier & Eskjær). By removing the individuals from the data, it was possible to focus on the topics themselves and not the actors within the stories, allowing a better (or different) for focus on the articulations of terms and words (instead of names of individuals). It is true that this approach works partially against certain types of media analysis approaches. A long tradition on journalism research (Hall et al. 1978a) has emphasized the importance of sources in developing media narratives. Studying sources and individuals is, of course, important in certain contexts: If sources used for a certain topic are always the same or of the same mind, alternative views on the said topic are not present in the media, leading to monotonous coverage that may end up not only dulling the topic as having the one,

undisputed and allowed narrative but, more importantly, also risk hiding power relations and vested interests.

That being said, dynamic topic modelling aligns well with principles of articulation theory. By identifying recurring themes and their temporal evolution, it supports the exploration of how the inherently instable dynamic fields of meaning are constructed, contested, and stabilised within media narratives. The capacity to process vast amounts of data enhances the robustness of such analyses, providing insights that would be impractical through manual methods alone. This methodological comparison highlights the dual advantages of depth and scale in media analysis. While frame analysis allows for detailed exploration of individual narratives, dynamic topic modelling opens avenues for identifying overarching trends and dynamics across extensive datasets. By modelling topics as distributions of co-occurring terms whose prominence shifts over time, such approaches display discourse as an ever-changing field of likelihoods, tendencies, and gradients of meaning. This perspective resonates with articulation theory's emphasis on contingency and instability, while also marking a departure from purely interpretive traditions.

Large-scale topic modelling aligns also with a broader transformation in how knowledge, meaning, and relevance are produced in the age of (generative) artificial intelligence, where patterns of association, frequency, and co-occurrence increasingly structure public knowledge, visibility, and governance through probabilistic logics. Analysing discourse at this level is therefore not merely a technical convenience but a way of engaging with the emerging epistemic conditions under which public meaning is now formed.

11 Articulating Climate Change and the Economic Paradigm

Building on the findings presented in the previous chapters, in this chapter, I now will discuss how climate change and economic growth are – or have been -- articulated in Finnish media discourse through the dynamics of depoliticization and repoliticization. While Chapter 9 displayed how media attention, frames and topic-level developments unfolded over time, this chapter focuses on the connection between climate change and the hegemonic economic paradigm. I will attempt to apply articulation theory to discuss potential ways for mitigating the disconnect between these themes from the point of view of depoliticisation.

Articulation theory helps in exploring how particular meanings become stabilised or contested through the work of nodal points that organise chains of equivalence and difference within the wider field of discourse. For Laclau and Mouffe (1985), *nodal points* are signifiers that have *already* become discursively charged: they function as temporary centres of meaning around which political struggles are organised. Precisely because they are sites of contestation, their meaning is never fully fixed but continuously negotiated.

In contrast, empty or *floating signifiers* refer to signifiers whose meaning has *not yet been* stabilised and therefore remains relatively open. Their “floating” character allows them to serve as discursive resources through which new meaning relations and chains of equivalence can be constructed. In this sense, floating signifiers provide the raw material for potential rearticulation, while nodal points represent moments where such articulatory work has already begun to crystallise. Across different conjunctures and crises, signifiers may move between these positions, functioning either as stabilising anchors or as openings for depoliticising and repoliticising articulations.

Delving deeper into the context in which I see articulation theory applicable to the relationship of climate change and the growth-dependent economic paradigm, I turn to Lawrence Grossberg’s interview of Stuart Hall (Grossberg, 1986). In it, Hall crystallises a useful understanding of Laclau and Mouffe’s theory, highlighting the "lines of tendential force" that articulate historical-political formations. The analysis in the rest of this chapter is divided into two segments: articulations of depoliticisation and moments of repoliticisation.

11.1 Articulations of depoliticisation

From a depoliticisation perspective, I have shown how Finnish media discourse is often anchored in technocratic and individualising nodal points that restrict the horizon of possible political responses. Climate change is articulated through expert authority, scientific risk assessment, efficiency, innovation and consumer responsibility. Such frames fit – from the outset, — well to the discursive horizon of the dominant economic paradigm and thus tend to weaken structural or systemic critique. This overall depoliticising configuration is further reinforced by the media's clear tendency to separate climate change and economic growth as largely distinct discursive domains. Further, when media cut across these domains, they integrate them either through emerging nodal points that resonate with economic growth such as "green growth" or by subsuming climate change under economic frames such as "competitiveness". This discursive boundary making and negotiating allows the media and public discourse depoliticize climate change while still devoting substantial amount of attention to it. As a whole, this discursive structure narrows the range of legitimate political conflict and the stabilises meanings that render structural alternatives unthinkable.

I consider the current growth-reliant and growth-enforcing economic paradigm as having assumed numerous religious traits from *unquestionability of the holy* growth to the moralistic and sacrificial aspects of it (Obadia & Wood, 2011). This characteristic has been well exemplified in the field of economics by the ubiquitous support for austerity drives with the "there is no alternative" -mantra (Lindholm, 2024). Rather than to suggest a direct equivalence between economic discourse and religious belief, I use this analogy analytically to point to the moralisation, sacralisation and depoliticization of economic growth as is often visible in the neoliberal austerity economics discourse (Harjuniemi, 2019; Raschke, 2019), Through the hegemonic status of the economic growth paradigm, economy and market-based articulations have spread to varying fields from biology to religion to science (Uskali, 2013, pp. 101-123; Mautner, 2010).

From this point of view, the economic paradigm fits in well with Stuart Hall's example on religion (Grossberg, 1986). Just as religion, we can see the economic paradigm as the powerful historical-political formation to which so many facets of the societal discourse – including climate discourse – have to be adjusted to: the media coverage, environmental and climate policy, and the language used and the way we generally think about climate change have to be limited to fit within the economic paradigm.

To paraphrase Hall (Grossberg, 1986): in particular social formations, where *economic growth* has become the valorised ideological domain, the domain into which all the different cultural strands are obliged to enter, no political movement in that society can become popular without negotiating the *economic* terrain.

Hence, such social formations force not only political climate movements but also the language of the media, and by extension the language of everyday people discussing the *climate*, to "get into" limits of dominant *economic* discourse. This helps create a caged environment in which climate change is discussed through a vocabulary already shaped by economic discourse.

By "negotiating" the economic terrain, I refer not to a voluntary strategic choice but to a structural condition of intelligibility: political claims must be articulated in ways that resonate with the dominant economic common sense in order to be recognised as legitimate or reasonable. The "social formations" in question are those in which economic growth functions as a hegemonic organising principle of political consciousness, shaping how social problems are understood, evaluated, and debated. In such contexts, climate change becomes "languaged" through economic categories – costs, competitiveness, efficiency, investment – thereby narrowing the range of meanings and political possibilities available for public deliberation.

Similar limitations have been studied within the economic discourse itself within the media. Research on media coverage of economic policy during the financial and sovereign debt crises of 2007–2014 shows how the rise of austerity economics – closely linked to the longer trajectory of neoliberal economic governance since the 1970s – narrowed the range of policy options presented as legitimate or realistic in public debate (Harjuniemi, 2020). As discussed in Article II, when climate policy is articulated as subordinate to the goals and constraints of economic policy, these same discursive conditions extend into climate reporting. An austere economic atmosphere then not only shapes how economic issues are discussed in the media but also constrains the ways in which climate change and its possible solutions are framed, debated, and evaluated.

11.2 Moments of repoliticisation

While the forces of depoliticisation make it difficult for climate change coverage reach beyond the limits of the language of the economic paradigm, this is not entirely impossible. Experts challenging the status quo do get coverage from time to time, and alternate ways to arrange our (economic) system are occasionally mentioned or proposed. These are, however passing moments in the general flow of news stories. Oftentimes they take place in one-off special interviews, such as with a world-known celebrity economist whose book may have been recently translated to Finnish. In such cases, ideas from outside the hegemonic paradigm are presented often in a distinctly performative manner – they are highlighted as an exception whose message will not have any kind of lasting effect on the everyday mainstream news cycle. This dynamic can be seen, for instance, in the way

respected heterodox economists are framed as anomalies rather than as contributors to legitimate policy debate. A telling example is the headline of a Helsingin Sanomat interview with Mariana Mazzucato: *"'The world's scariest economist' tells how to save capitalism"* (Raeste, 2019). While the interview grants visibility to a critique of prevailing economic assumptions, the framing simultaneously exoticises and neutralises the challenge by positioning it as extraordinary, provocative, and ultimately compatible with the existing system. In doing so, the critique is acknowledged without fundamentally destabilising the dominant economic discourse.

The analogy between austerity economics and climate inaction clarifies how hegemonic paradigms persist – despite sustained scientific critique and other repoliticization efforts. It is telling that critical economic research has shown (time and again) that austerity economics does not work as promoted. The goal of austerity economics is said to be ensuring economic growth or hindering the effects and length of economic downturns. However, the way austerity economics has been applied historically has not worked without dire societal consequences, and the academics have not stayed silent on the issue. One key, historical example of this was during the first austerity drive lead by the British prime minister Margaret Thatcher in March 1981 when 364 leading economists wrote to The Times to argue strongly against the then government's fiscal and monetary policy. The Thatcher government decided to ignore these policies and went through with the plan, leading to prolonging and deepening the depression, in line with the warning. The austerity drive did lead to curbing the rampant inflation that had been 13 per cent in 1981 but at the cost of a high and long-lasting unemployment. (Lindholm, 2019)

Global climate inaction mirrors the effective sidelining of science-based advice, even as scientific warnings continue to receive public visibility. Just as in the case of critiques of austerity in the 1980s, numerous similar letters, similarly ignored, have been published in past years. In 2021, almost 15,000 scientists issued a global warning against ignoring climate change (Ripple et al., 2024; Ripple et al., 2022). If the economic paradigm that began in the Thatcher-Reagan years has largely become a global norm, the same applies to ignoring of science if it challenges the primary objectives of it.

The austerity economics paradigm does not accept any other goals for economic policy unless its own primary goals are not first met. On a national level this means the welfare of its citizens and financing of its services such as the healthcare or education sectors are of no importance before the primary goals are achieved (Outinen, 2023, pp. 31-53). The same applies to any environmental policy, which then will eventually have global repercussions on top of the ones felt on a national level.

Contradictions do, however, exist. For instance, while it is very common to justify economic austerity by tightening the belt and making sacrifices to ensure the future generations are not burdened by excessive debt (Toivanen et al., 2023, pp. 117-144), the same reasoning is not enough to justify consuming less or pursuing less growth in order to assure the future generations have a habitable planet to live on.

The impacts of the austerity economics paradigm were seen in the way environmental policy was difficult to fit into the economic policies of Juha Sipilä's government (2015–2019) as the enacted policy was contradictory at best with simultaneous signings of international environmental agreements and reducing carbon sinks by increasing forestry cuts at the same time (Toivanen et al., 2023, pp. 117-144; Mervaala, 2019). In an interview with me for Hyvän sään aikana (2019) Sipilä spoke of many market-driven, technological fixes ("teknofiksit") emphasising the responsibility of the individual consumer and even envisioned a future where petrol stations would introduce voluntary compensation mechanism at the fuel pump.

Articulation theory helps to describe and explain how climate change and environmental issues are integrated into the neoliberal economic paradigm. Hall's (Hall 1982, Grossberg 1986) view that ideologies are historically contingent and malleable is key to understanding this process. The dominant ideology maintains its hegemonic status by absorbing potential contradictions, A good early example of this in climate politics is Stern **Review (2007)** and the coinciding framing of climate change as an *economic opportunity* (Stecula & Merkley, 2019). This rearticulation did not resolve the underlying tension between economic growth and climate action but rather it modified the meanings attached to previously more open, floating signifiers, such as "viable climate solutions", by redefining them in terms compatible with economic efficiency, competitiveness, and growth. As a result, these signifiers gained a more stabilised meaning within the dominant economic discourse, allowing climate action to be discussed in new terms while remaining bounded by existing ideological limits. This reconfiguration allows climate concerns to be incorporated into mainstream discourse without challenging the fundamental principles of economic growth. For instance, renewable energy is frequently promoted as an opportunity for economic expansion, job creation, and technological innovation. By articulating environmental action as compatible with, or even the cause for, economic growth, potential contradictions are neutralised, enabling the hegemonic economic paradigm to absorb climate critique while remaining largely intact.

While articulation work allows for the visibility of concerning environmental issues, it also limits the scope of potential solutions. Transformative approaches that would challenge the growth paradigm such as degrowth, circular economies, or redefining progress beyond GDP are marginalised. The hegemony of the

economic growth paradigm ensures that acceptable climate solutions are those that do not disrupt the fundamental tenets of neoliberalism. Some recent interventions by climate scholars and activists, however, suggest that the hegemonic strategy may be losing credibility, as mounting ecological crises increasingly strain the plausibility of reconciling continued economic growth with curbing climate change (Malm 2021; Malm & Carton 2024).

Addressing climate change effectively requires repoliticisation – which in turn requires re-articulation that prioritises ecological sustainability over economic growth. Articulation theory suggests that such a shift is possible but demands deliberate efforts to forge new connections between ideas, practices, and social forces. Activists, academics, and media practitioners play crucial roles in constructing alternative discourses and exposing the limitations of the current paradigm. As any counter-hegemonic action, this will face with fierce resistance by powers upholding the current hegemonic structures. This shift would require not only policy changes but also a transformation of societal values and economic structures. Concepts such as degrowth, decoupling and circular economies provide the ingredients for this reconfiguration, but they come with their own burden as especially degrowth-related terminology is seen as problematic as it may backfire in unforeseeable ways (Drews & Antal, 2016).

Could this repoliticization take place? From the findings we can see that the growth-oriented configuration is not always stable. Moments such as the release of the 2018 IPCC report, the rise of youth climate activism and conjunctural crises like the COVID-19 pandemic or the war in Ukraine generate openings for repoliticization. In these moments, new potential nodal points such as climate justice, climate inequality, climate change as systemic change, intergenerational responsibility, or energy security can briefly reconfigure the climate–economy articulation and their antagonisms that are otherwise hidden behind the depoliticised narrative. Similar "moments of rupture" were documented by Harjuniemi (2023b) as crisis-induced anomalies, such as the COVID-19 period of major monetary and fiscal stimulus, had potential to temporarily widen the institutionally established boundaries and open space for more pluralistic economic reporting, indicating how repoliticisation is often episodic and crisis-driven rather than structurally sustained. In other words, these episodic shifts do not overturn the hegemonic growth discourse, but they demonstrate the contested and contingent character of climate politics in the media.

Hence, the articulation of climate change and economic growth is best understood as a struggle between depoliticizing and repoliticizing forces. Depoliticisation narrows the space of legitimate climate debate by stabilising certain nodal points and excluding others, while repoliticization reintroduces conflict, expands the field of discursivity and enables alternative imaginaries – and potentially creates lasting change to the overall discourse(s).

12 Conclusions

This thesis began with discussing the difficult relationship between climate change and continuous economic growth. I set out to examine how climate change and economic growth are articulated in Finnish mainstream media, and how processes of depoliticisation and repoliticisation shape that relationship over time. By combining critical discourse theory with qualitative and computational analysis of large-scale news data, the study has traced how climate change has become simultaneously more visible and more constrained as a political issue.

Addressing RQ1, the findings demonstrate that climate change in Finnish media is predominantly represented through depoliticised frames that emphasise the hegemonic economic growth paradigm leading to often technocratic, growth-oriented and expert-led framings. While climate change is acknowledged as a real and serious – even existential – threat to humanity, it is most often articulated in ways that minimise political conflict and avoid questioning the underlying economic growth paradigm that itself can be deemed a culprit in accelerating it. Repoliticising moments do occur, particularly around crises, international summits, and social movements, but these remain episodic and fragile.

In line with previous studies (Berglez et al. 2009), individual consumption choices and personal responsibility of solving climate change remain prevalent in climate change coverage despite loudening demands for systemic changes that would, as a feature of the sustainability transformations needed, eventually also lead to changes in individual consumer behaviour. Overall, the media discourse fluctuates between short-lived openings for contestation and longer periods of stabilisation, in which climate change is normalised as a technical or behavioural challenge rather than a site of structural political struggle.

With respect to RQ2, the analysis shows that climate change and economic growth are rarely articulated *together* in Finnish media, despite their material and political interdependence. Quantitative results from Article III indicate that explicit co-occurrence of these themes is limited, and when linkages do emerge, they are typically confined to specific conjunctural moments such as the release of the Stern Review, the 2018 IPCC Special Report, or energy-security debates following Russia's invasion of Ukraine. Even in these cases, climate change is most often integrated into economic discourse through growth-compatible frames, such as innovation, competitiveness, or investment, rather than through more antagonistic articulations that would problematise growth itself. This persistent

separation highlights the role of media as an active site of disarticulation, maintaining boundaries between climate and economic discourses and thereby constraining the range of politically legitimate responses.

Crises do however create moments when the two come together momentarily: the anticapitalistic rhetoric more salient throughout economic crises prompt systems-critical vocabulary to be included in the climate action discourse, which then filters through to the media coverage, as well. Another example is the spring of 2022 when Russia's invasion brought climate change, energy and the economy together.

The findings suggest that the hegemonic growth-oriented configuration is not fully stable. From 2018 onwards, system-critical vocabularies – such as climate justice, inequality, intergenerational responsibility, and welfare – begin to appear more visibly in climate-related coverage. While such articulations do not displace the hegemonic growth paradigm, they indicate that media discourse is contingent and contested rather than fixed, and that repoliticisation remains a structural possibility under certain conditions.

The dominant discourses in the mainstream media present us what is "allowed" (or: easy) to say in a given society in a given time – points of view that do not contradict the societal status quo can be presented as common-sensical with ease and often do not require any solid arguments to support them. Anti-hegemonic points of view that pursue challenging or deconstructing the dominant paradigms, on the other hand, are met with intense scrutiny. Though this setting has perhaps not directly affected how the public perceive these issues (Suhonen 1994), it has undoubtedly impacted on how and by what language people are discussing them. After decades of highlighting the importance of economic growth over virtually any other issue (Lindholm, 2019), the attempts to question it for the preserving of a habitable planet is a laborious task to communicate. One key example of this disconnect comes from the quantitative results of Article III as the topic of climate change is kept apart from economic growth and vice versa.

RQ3 concerned the methodological contribution of the study. The findings show that computational and automated discourse-analytical methods can meaningfully support the analysis of macro-level articulations by examining routine language use in media texts. Dynamic topic modelling, when combined with articulation theory, enables the identification of both stabilised discursive patterns and moments of reconfiguration that would, on large datasets, be difficult to capture through qualitative analysis alone. Rather than replacing close reading, the approach adopted here demonstrates how large-scale quantitative methods can be used to operationalise critical theory, making visible the shifting boundaries of depoliticisation and repoliticisation across time.

The main contribution of this thesis is therefore threefold. Empirically, it provides one of the most comprehensive longitudinal analyses of climate change

coverage in a small-language media environment, demonstrating how climate visibility can increase without a corresponding expansion of political possibility. Despite shifting the focus to climate change coverage from environmental news, this work can also be seen as continuation of the research done by Suhonen (1994), Lyytimäki (2012) and Kumpu (2024), contributing to a timeline of Finnish environmental news coverage research spanning cumulatively two-thirds of a century. Theoretically, it advances articulation theory by showing how hegemonic stability and discursive contingency coexist in media discourse, and how nodal points may be temporarily reconfigured without being fully transformed. Methodologically, it contributes to the growing field of computational communication studies by demonstrating how automated text analysis can be integrated into critical, theory-driven research rather than applied as a purely descriptive tool.

While contributing to an analysis of a small language climate change coverage, the narrow geographical and linguistic focus of these studies does limit the generalisability of their results. The Finnish media environment is also not directly comparable to more polarised ones such as the ones in the United States or the United Kingdom as historically Finland has been a country of high trust in journalism and low polarisation in the media (Seuri et al., 2024; Reunanen et al., 2023). The geographical focus does, however, offer a comprehensive view on a Nordic welfare state that, in the past, has been touted as one of the world's leading climate actors (Climate Change Performance Index, 2025). The comparisons do not have to be limited to other Nordic countries, as especially for international themes and events the ways in which topics are covered does often follow similar trends globally (Ylä-Anttila et al., 2018).

While the Finnish media context is characterised by relatively low polarisation and high institutional trust, the patterns identified here are not unique to Finland. Similar dynamics of depoliticised climate coverage, growth-oriented framing, and episodic repoliticisation have been observed across diverse media systems (Boykoff & Boykoff, 2007). At the same time, the specific institutional and cultural features of the Finnish case provide valuable insight into how even comparatively consensual media environments can limit political imagination around climate change.

Ultimately, this thesis shows that the challenge facing climate journalism is not simply one of increasing attention or improving scientific accuracy. Rather, it concerns the deeper discursive conditions under which climate change becomes speakable, actionable, and politically meaningful. Whether the repoliticising articulations identified in this study will stabilise into more durable counter-hegemonic configurations or be reabsorbed into domesticated narratives such as green growth remains an open question. What this research makes clear, however, is that media discourse plays a central role in shaping that outcome.

13 Recommendations

Climate change remains a multifaceted issue difficult to grasp within journalistic media, especially news journalism. Over time, it has shifted from a relatively specialised topic within environmental reporting to a theme articulated across a wide range of societal domains, including economic growth, systemic risks, and individual responsibility. Yet this expansion has not necessarily resulted in deeper politicisation. Instead, through processes of depoliticisation, climate change in Finnish media appears increasingly omnipresent but also fragmented, routinised, and frequently individualised, limiting its capacity to challenge dominant social and economic arrangements.

From an articulation-theoretical perspective, this fragmentation reflects how climate change is repeatedly connected to familiar and professionally legitimate frames such as consumption choices, technological solutions, and expert management while more anti-hegemonistic or systemic articulations remain marginal. As previous research has shown, systemic issues are rarely addressed at the systemic level in news coverage; instead, they are translated into individualised problems and solutions, a tendency shaped by journalistic routines, professional norms, and the reluctance to question established power structures (Harjuniemi, 2023a, pp. 67-85; Torok et al., 2020).

Systems level, global journalism that would address linkage between issues demands a lot more resources from not only the media and its journalists but also the readership, who may opt out of reading descriptions of how each issue is holistically connected. As Berglez (2011) argues, such reporting challenges conventional media logic by requiring creativity and sustained contextualisation from journalists rather than episodic event-driven coverage. While climate change, like economic growth, increasingly cuts across all sections of the news, journalistic practices remain historically shaped by categorical divisions inherited from print journalism, divisions that continue to structure online news production and constrain how interconnected issues are articulated.

Online news media is, in principle, less constrained by the rigid sectional logics of print journalism. Content can be organised dynamically, personalised for individual users, and distributed through algorithmic systems that shape the rhythm, order, and prominence of stories. This creates potential opportunities to foreground linkages between issues – for example, by situating climate change within economic, political, or cultural contexts more fluidly. From this

perspective, climate journalism could increasingly be understood not as a specialised beat, but as part of a more holistic, systems-level form of journalism, as suggested by Eide and Kunelius (2020).

At the same time, online journalism introduces new analytical challenges regarding what exactly is being studied. The case studies in this thesis focus on news articles as they appear on media outlets' websites in their relatively stable, archived form. This approach necessarily omits several important dimensions of online news production, most notably the optimisation and frequent modification of headlines for click-through rates – a key framing device designed to capture attention and elicit affective responses, which may change multiple times within a single day.

A recent trend in Helsingin Sanomat illustrates how framing practices are evolving in the online environment. The outlet has introduced category-like label-headlines that appear alongside actual headlines on the website and are replicated when stories are shared on social media. These semi-categories may replace or complement traditional, relatively neutral sections such as "foreign affairs" with more thematic or affective framings that guide the reader's interpretation. While many of these labels remain descriptive such as "YK:n ilmastokokous" ("UN climate meeting"), others fall outside conventional news categories. One story on the everyday impacts of climate change, for instance, was framed under the heading "Vitsaukset" ("Plagues"), evoking biblical imagery (Elonen 2025). Such headline-level framings have the potential to prime readers to approach the story through a particular moral or emotional lens.

These framings are also not static: On the newspaper's online front page, the semi-category is next to the headline but in the article's own page it moves to accompany the byline. Regardless of how a story is presented on the front page or in social media feeds, the article itself retains its own headline and byline, while the semi-category is repositioned as accompanying metadata. These labels are also embedded in the page's source code, for example as social-media share titles. From a methodological perspective, this highlights the potential for future research designs that combine text scraping with metadata analysis to study such framing processes more comprehensively in online news environments.

From a methodological perspective (and in relation to RQ3), the accelerating processes of datafication and the rapid development of artificial intelligence (AI), large language models (LLMs) and machine learning present both significant opportunities and serious challenges for media and communication studies. On the one hand, computational methods open new possibilities for analysing large-scale media corpora and tracing discursive change over time. On the other hand, these methods raise critical questions concerning transparency, replicability, data sensitivity, and, perhaps most fundamentally, the researcher's understanding of how such tools operate. The natural language processing methods employed in this

thesis represent a class of tools that are, in principle, transparent and replicable. Given access to the same data, and provided that library versions, parameters, and analytical steps are documented in sufficient detail, analyses such as those conducted using BERTopic can be reproduced with reasonable accuracy. This degree of methodological control is central to their scientific credibility.

By contrast, privately owned and commercially operated AI-systems such as OpenAI's LLM chatbot – ChatGPT – function as opaque research environments. As demonstrated in recent work by myself and a colleague (Mervaala & Kousa 2025), such systems can change substantially even over short periods of time, including the removal of models, the introduction of new features, and undocumented modifications that materially affect outputs. From the standpoint of replicability alone, these characteristics render such systems problematic for research use. If tools or models are decommissioned or altered in ways that cannot be traced or reproduced, the analytical environment itself becomes unstable.

These challenges are compounded by the difficulty, or even impossibility, of obtaining detailed information about model versioning, training data, or unannounced updates. For this reason, future research using LLMs for text analysis would benefit from operating within environments that researchers can control directly, such as locally hosted or otherwise self-managed systems. Such arrangements would allow for careful documentation of model versions, analytical pipelines, and iterative development processes, while also mitigating legal and ethical concerns related to data protection and copyright, particularly when working within the EU regulatory context.

LLMs for text analysis have been criticised widely (Bender et al. 2021, Ollion et al. 2023, Baumann et al. 2025), and I would urge future research to be done within an environment the researcher has control over, such as via a local or otherwise self-run environment where versioning of models and steps taken to develop the tool used for analysis can be recorded and documented in detail. Operating within a closed system would also protect the data used as any sensitive or copyrighted material will raise both legal and research ethical questions in using third party private services especially if the data does at any point of the chain of actions leave the reasonably well-regulated EU area. If such generative artificial intelligence applications, LLMs and large action models (LAMs) could be used in a manner that is scientifically sound and the severe issues concerning reproducibility, transparency, and unintended confabulations are addressed, some form of a near-qualitative automated analysis could potentially be included as part of the research workflow.

There are, however, other ethical issues related to the use of LLMs and other energy-intensive tools: their climate and environmental footprints. Paradoxically, AI, and internet-based services more broadly, have been virtually exempt from climate responsibility, as they have been traditionally painted to either playing

significant part in solving environmental crises (Masterson, 2024) or representing a form of "intangible growth" ("aineeton kasvu" in Finnish) suggesting that it happens in a state without "matter" and, hence, has no environmental footprint to speak of (Hellström & Bhatia, 2025).

The environmental impacts of the internet already supersede aviation, and the heavy investments to AI-services by technology giants such as Microsoft, Google, and Amazon has led to their emission to hike by tens of percentages within just a few years – so much, that some of them have already essentially given up on their climate or carbon neutrality goals (Kerr, 2024; Nguyen, 2024). In a 2025 study, it was estimated that AI systems may have an annual carbon footprint as large as New York City or 80 million tons of CO2 and an annual water consumption of the global annual consumption of bottled water (De Vries-Gao et al. 2025). These developments highlight the need for future research to critically assess whether computational approaches are proportionate to their analytical benefits, or whether similar outcomes could be achieved through less carbon-intensive and more methodologically robust means.

Importantly, these methodological and environmental concerns are not merely technical issues, but also discursive ones. The widespread framing of AI as an inevitable, world-changing force that is capable of simultaneously driving economic growth and solving complex societal challenges such as climate change mirrors the depoliticised narratives identified in this thesis. In this sense, artificial intelligence itself emerges as a contemporary techno-optimist nodal point: a domain in which economic growth and climate action are articulated as mutually reinforcing rather than politically contested. This observation provides a natural point of transition to examining generative artificial intelligence as a depoliticised theme that increasingly binds together the discourses of climate change and economic growth in media narratives.

As discussed earlier, techno-optimistic solutions occupy a prominent and largely depoliticised position in mainstream climate policy and media discourse. Technology has long been framed as a primary driver of economic growth and societal progress (Rawson, 2021), and this framing has repeatedly served to reconcile environmental concern with the continuation of growth-oriented economic arrangements. The current boom in generative AI follows this pattern closely. Massive investments that amount to hundreds of billions of dollars have been justified through promises of rapid economic returns and far-reaching societal benefits, including claims that AI will play a decisive role in solving climate change.

From the perspective of climate change, however, these promises are largely disconnected from the material and environmental realities of generative AI. While earlier applications of AI have demonstrated limited and context-specific climate-positive impacts, generative AI systems are, in aggregate, energy- and

resource-intensive, and their expansion is likely to exacerbate rather than mitigate environmental pressures. In this sense, generative AI functions as a contemporary example of a depoliticised techno-fix: a solution that symbolically absorbs environmental concern while deferring more structural questions about consumption, growth, and power.

Importantly, generative AI also has implications for climate discourse itself. As LLM chatbots become increasingly integrated into everyday information practices – including news consumption and search – these systems begin to participate in the articulation of climate knowledge. Evidence already suggests that privately owned chatbots can be rapidly repurposed into vehicles for climate denialism or geopolitical propaganda, and that biases in training data, combined with the phenomenon of so-called hallucinations, can lead to the stochastic spread of misinformation and disinformation (Makhortykh et al., 2024). Even in the absence of overt manipulation, the fact that such models operate on inevitably outdated data introduces systematic distortions into how climate knowledge is reproduced and presented.

From an articulation-theoretical perspective, this is particularly significant. Generative AI systems do not merely reflect existing discourses; they amplify and stabilise them by privileging dominant, high-frequency patterns in their training data. As a result, already hegemonic framings such as techno-optimist, growth-compatible, and depoliticised narratives of climate action are reinforced, while marginal, system-critical, or emerging articulations struggle to gain visibility. In this way, generative AI risks becoming a powerful new mechanism of discursive dominance: one that naturalises prevailing articulations of climate change and economic growth while narrowing the horizon of what can be meaningfully questioned or reimagined in public debate.

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Muted by a Crisis? COVID-19 and the Long-Term Evolution of Climate Change Newspaper Coverage

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Abstract: The reason for the emergence of environmental issues in public debate have been widely studied, while the reasons for the disappearance of environmental issues from the public agenda are researched to a far lesser extent. This article presents how the newspaper coverage of climate change has evolved in Finland. The study is based on long-term (1990–2020) data from the leading national-level newspaper. The climate coverage has been characterized by an increasing overall trend and remarkable fluctuations in the intensity of debate. The monthly coverage of climate change had four distinctive peak periods. The drops from peak levels are explained by several factors, such as the end of a specific news event or policy process (e.g., international climate policy meetings), lack of weather anomalies (e.g., normal winter weather and snow coverage), silence of key influencers (policy-makers, business elite), and news competition together with reporting fatigue following abundant climate coverage. The first months of the intense phase of the COVID-19 pandemic in 2020 showed a deep, but not unprecedented drop in climate coverage from the preceding peak level. The persistence of anthropogenic climate change, gradual mainstreaming of climate concerns across different societal sectors, and recent policy debates around so-called green or sustainable recovery suggest that climate coverage is not likely to be muted in the near future.

Keywords: agenda setting; climate change; COVID-19; environmental communication; news media; press coverage

1. Introduction

"Can coronavirus bring boomers and zoomers together on climate?" This question was posed by the online magazine Grist in April 2020, during the execution of exceptional policy measures imposed by governments around the world as a response to the COVID-19 pandemic [1]. The question, aptly addressing different vulnerabilities of the older and younger generations, echoed a key issue of sustainability transition, namely the capability of societies to simultaneously tackle the implications of short-term and long-term challenges for different groups. The acute crisis caused by the COVID-19 pandemic and more gradual erosion of socio-ecological systemic resilience caused by challenges such as climate change or biodiversity loss must be managed through balanced orchestration of multiple actors, as noted by many science-based advisory bodies [2,3]. However, such orchestration is challenging because of the different uncertainties, values, and interests involved. Louder calls for "green deals" simultaneously addressing economic and environmental concerns through sustainable investments have been voiced, but the chorus is not without discord. Demands for the easing of environmental regulations in order to overcome the acute economic hardships caused by the pandemic and its management have been voiced as well [4].

In contemporary information-intensive societies, media and social media representations are at the heart of the knowledge sharing, diffusion of new ideas, and mobilization of action. Media representations are important in both democratic and non-democratic regimes as sources of information, disinformation, and misinformation.

In this paper, we aim to draw lessons for environmental communications capable of addressing both the rapidly emerging acute crisis situations and much slower socio-ecological processes related to many key issues of sustainability transitions. We study the long-term evolution of media coverage of climate change and the impacts of examples of short-term factors—including the COVID-19 pandemic—on news reporting. In addition, we study the interaction of climate change and health crises reporting. To do so, we chart the long-term newspaper coverage of climate change from the media archive of *Helsingin Sanomat*, the leading newspaper in Finland.

2. Dynamics of Climate Coverage: A Short Review

The English-language media coverage of climate change has been studied extensively and increasing attention has been paid to other widely spoken languages as well [5–9]. The English-speaking—especially the U.S. and British—media has a considerable impact on global news coverage. Mazur [10] found that the English-speaking media in different countries were strikingly similar in how they give attention to short-term and long-term environmental crises. Knowledge of smaller languages remains scarce and scattered, partly because studies published in vernacular forums often remain difficult to find and utilize.

A more diverse set of languages may enrich the research field since different patterns of attention are possible in different countries and language areas [11]. Climate change is a prime example of a complex issue that involves different uncertainties and disputes over scientific truth fueling public debate [12]. For example, the climate debate in the United States has been strongly influenced by the disputes between parties labelled as alarmists or sceptics [13]. The visibility of such controversies has been relatively low in the mainstream media of Nordic countries such as Finland, characterized by a democratic-corporatist communication system [14,15].

Previous research on the dynamics of the climate change debate and media coverage of environmental and sustainability issues has mainly addressed the reasons for the emergence of issues in the public agenda, while the reasons for the decline of coverage have received less academic attention [6,16–18]. It has been noted that media attention has a "carrying capacity", meaning that the number and length of news items are limited and can give attention only to selected issues at a given time [19]. In particular, the availability of frontpage space in newspapers and time on primetime television or radio broadcasts has been a key issue for public and policy agenda setting. While online communication has somewhat reduced the importance of the space limitations in newspapers and time limitations in television or radio broadcasts, media organizations still have considerable power as gatekeepers [20]. What issues do get media attention really matters as the news coverage is an important source of information on issues such as climate change for multiple audiences, including not only citizens but also decision-makers [8,10].

The impacts of other crises on the media visibility of climate change have received only limited academic attention so far. This is a potentially serious research gap since many environmental issues are long-term processes spanning decades or centuries and involving interplays between different issues and actors. The volume of debate around a certain issue can fluctuate and the absence of a news issue from public debate does not necessarily mean the absence of the underlying sustainability problem. There is little correlation between the actual severity of environmental risk and the quantity of media coverage [10,21]. News cycles can end with the post-problem phase where the environmental problem—whether successfully solved or not—receives only occasional attention, as suggested by Downs (1972) half a century ago [22].

As postulated by the Quantity of Coverage Theory, the quantity of media attention an issue receives may be more important than the content of the news items [10,23]. The more an issue gathers attention

in the media, the more likely it is that the audience sees it as important [24,25]. Liu et al. [26] (p. 406) argue that for an issue to gather attention, "Something must happen to push that concern above the noise threshold of other issues". This can lead to short-term crises pushing the longer-term issues such as climate change away from public attention. On the other hand, weather anomalies or natural disasters may increase the attention on climate change as an underlying problem, even if they do not have a clear link to climate change [27]. The question is not only one of internal dynamics of a certain issue; instead, issue saliency is also affected by the complex interplay between different issues. As suggested by TV news reporting in Sweden, media attention on certain environmental issue generates interest in and visibility for environmental issues in general [28]. For example, awareness of climate change can support reporting on biodiversity as rising temperatures pose a threat to many species adapted to the cold climate of northern Europe.

Due to the competition for the media space, only some crises become news stories. There are also other important factors impacting how crises are covered in the media. Crisis coverage in Western media is often tied to the sufferers of the crisis, due to the "othering" of the developing country victims. For instance, the 2004 Indian Ocean tsunami had white Western tourist victims, and thus it became a global news story [29]. In addition, the news coverage of the tsunami was disproportionately focused on the Western tourism, similarly with hurricane Wilma in Cancun in 2005 [30]. However, the 2005 Pakistan-Kashmir earthquake, despite its very high number of casualties, did not receive much information in the Western media [30]. The COVID-19 crisis deviates from these more local crises. Starting from China, and spreading to Europe and the U.S., along with other parts of the world, it is basically impacting everyone. It is also a highly visible global news topic likely to replace other news topics [31–34].

As the notion of agenda-setting suggests [16,35,36], if an issue disappears from the media debates, it is likely to vanish from the public agenda and from the policy agenda. Lack of public salience may also influence the interest of research funders and lead to insufficient environmental monitoring and knowledge generation that, in turn, deepens the vicious circle of societal silence. All of this makes it difficult to implement the pre-emptive actions needed to avoid crossing ecological thresholds or tipping points that make the problems obvious to everyone but that may involve systemic shifts, making return to the previous state impossible [37].

3. Materials and Methods

Finland provides a context of a northern European, affluent and industrialized nation characterized by a strong welfare state. It has an export-oriented economy with strong clusters of forest and metal industries and more recently information and communication technologies. The country has a cold climate and sparse habituation, with about a quarter of the population living in the metropolitan area of the capital Helsinki, on the southern coast of the country. Together with other Nordic countries, Finland occupies top positions in several cross-national comparisons of sustainability [38]. Earlier, Finnish climate policies have been criticized for lacking ambition and being overly aligned with the interests of large energy producers and the heavy industry [39]. The current (2019) government program presents a demanding national goal of reaching carbon neutrality by 2035 and becoming carbon negative soon after that [40].

High readership of quality newspapers and strong trust in journalistic media content has been one of the strengths of climate reporting—and environmental reporting more generally—in the Nordic countries. The media system in Finland is characterized by the relatively strong position of quality press, despite declining print circulation [15]. Over the last decade the digitalization and new patterns of media consumption, staff cutbacks, dwindling subscription rates and increasing competition have seriously challenged environmental journalism. The role of newspapers as gatekeepers of the public debate has eroded, but they still serve as an important hub of information often referred in debates on social media [20].

The analysis focuses on the most widely read newspaper in the country, *Helsingin Sanomat* (HS). It can be characterized as a quality or prestige newspaper independent of political parties. It has a daily circulation of 340,000 including both print copies and digital subscriptions [41]. The material studied here includes 14,333 articles on climate change from the years 1990–2020. The dataset is based on data collected for earlier studies [42–44] (see Supplementary Materials), complemented here with new data from 2015 onwards. The data were obtained from the digital online archive of HS. The search strings include the terms "climate change" ("ilmastonmuutos" in Finnish) and "warming of the climate" ("ilmaston lämpeneminen"). In addition to this, compound words including the term "greenhouse" were included if connected with climate change. The search strategy is described in detail in [43].

The collection of long-term data from electronic archives involves some caveats and limitations [45]. The visual design and composition of the sections of the newspaper were renewed several times, including a change from broadsheet to tabloid on 8 January 2013. Such changes may have an influence on the number, length, and presentation style of news items. Updates in search engines and content and categorizations of the database may influence the search results. It is also possible that some items related to climate issues are missing from the sample because of the limited set of keywords. However, test searches indicated that adding search terms would complicate the search without substantially increasing the number of relevant hits [43]. Furthermore, the current set of keywords is in line with other studies focusing on other languages, creating possibilities for cross-national comparisons.

The start date of the data collection is based on the availability of data in the database and the end date is the latest possible for this study, representing the period (July 2020) when Finland was momentarily lifting its COVID-19 pandemic response restrictions first time since the pandemic began.

Our analysis framework outlines the long-term evolution of climate coverage and scrutinizes the factors contributing to the rise and decline of coverage. The Quantity of Coverage Theory states that the quantity of news items is the best indicator of how important an issue is considered to be [10,24]. Building on this theory, the first part of our analysis focuses on the volume of climate change debate. We focus on the monthly coverage numbers in order to allow for the analysis of short-term fluctuations. In order to visualize some factors behind the increasing climate change news coverage, we pinpoint the United Nations Climate Change Conferences and Finnish National Climate and Energy Strategies with the climate chance news coverage.

The sample includes items focusing on climate issues and items mentioning them only in passing. Therefore, a coding based on the titles was developed to identify items focusing mainly on climate issues, some other environmental issue, energy-related issues or on other issues entirely [43]. Together with the information about the section of the newspaper available from the database, this coding was considered adequate to give an overall picture of the key categories of climate discussion. One caveat is that the titles designed to attract audiences do not necessarily summarize the content of the news item in an undistorted way. This does not diminish the importance of titles, since they nevertheless frame the issue and guide interpretation.

Content analysis is a popular method with which to study media reporting [46,47]. In addition to the quantitative analyses, qualitative approaches are often used to analyze the dominant and emerging themes, framings, narratives, and discourses around environmental, climate change, and energy issues [6,48–50]. The media analyses data sets can be large, and this makes qualitative content analyses based on human interpretation very laborious. Therefore, the qualitatively oriented studies have mostly focused on narrowly defined cases, very short timelines or small samples. For example, Kangas et al. [51] studied the climate change discourse of bioenergy focusing on stump utilization in Finland, and Gkiouzepas and Botetzagias [52] studied a random sample of 100 Greek news items on climate change.

Here, we combine a quantitative approach which aimed to outline long-term development with qualitative investigation based on identification of relevant time periods and selection of a limited set of news items allowing for in-depth interpretations. The qualitative analysis focuses both on manifest contents directly expressed through wordings and latent contents referring to between-the-lines type

of information [47]. Here we focus (1) on the factors behind the greatest rises and falls in the climate change news coverage and (2) on the relationship between climate and health reporting [53]. Qualitative analysis always involves subjective judgements. In order to reduce potential bias, the material was analyzed through multiple rounds of interpretation.

We focus on the peak periods in the climate change news coverage in order to allow more detailed identification of topics discussed during the high volume of the coverage and potential factors influencing the coverage. In addition to the screening of all titles, the content of selected news articles during the peaks is analyzed. The analysis is supported by insights from earlier grey and scholarly literature describing climate debate during the study period, e.g., [39,43,54].

To study the impacts of shorter-term crises on long-term climate crisis media coverage, we selected three health-related crises that were impacting Finland (as well as the rest of the world) during the timeframe studied. The crises selected were the SARS epidemic, swine flu pandemic, and COVID-19 pandemic. We defined the times the crises were active based on the health information provided by the Finnish Health Library Duodecim [55]. All overlapping news items addressing both climate and health issues from the selected time periods were read focusing on two dimensions: (1) What were the dominant topics emphasized by the news item and which themes remained as latent ones, and (2) was the news item specifically comparing climate crisis with a health crisis, and if so, how?

4. Results

4.1. Temporal Development of the Climate Coverage

The sample studied here consists of 14,333 newspaper items, indicating that climate change has occupied a considerable space in newspaper coverage. Climate issues were mentioned in about 150 items per month during the most intensive phases of the debate. The coverage was characterized by rapid fluctuations and a general increasing trend (Figure 1). Both domestic and international factors explain the changes. International meetings of the Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCC) induced short-term periods of heightened attention. Four conferences of the parties are clear as distinctive peaks in the debate (COP3 in Kyoto, December 1997; COP6 in the Hague, November 2000; COP15 in Copenhagen, December 2009; COP21 in Paris, November–December 2015). After these news events, the coverage typically dropped immediately. Despite their high policy importance, released of national energy and climate strategies do not manifest as events occupying the headlines.

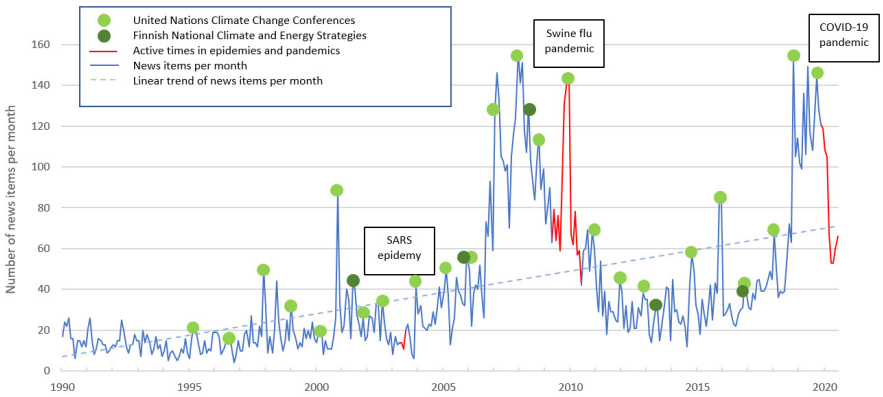

Figure 1. Overview of monthly news coverage of climate change by the newspaper Helsingin Sanomat, January 1990–July 2020 and selected news events potentially increasing (climate policy events shown as green dots) and decreasing (virus outbreaks shown as a red line) climate coverage.

While the early peaks of heightened coverage were caused by single news events, the longer periods of heightened attention were caused by several contributing factors. The first such period between late 2006 and early 2010 started to build as a combination of factors, such as reporting of energy prices and climate-related natural catastrophes, science-based warnings, and the Stern report on the economic implications of climate change, as well as EU-level and domestic policy debates. Additionally, the international visibility of the Al Gore's documentary film Inconvenient Truth served as a background for domestic debate, even though the film itself received only minor attention in Finland. The peak in early 2007 was strongly influenced by an interview with a prominent national business influencer showing unexpectedly deep climate concern, followed by equally climate-conscious statements by politicians and other actors. An editorial headline from January 2007 explicates, "The interview with Ollila reveals rapid changes in attitudes". Importantly, the mild winter weather and snowless sceneries of southern Finland provided journalists with convenient framings within which to discuss climate policies and establish links to both everyday experiences of the people and results of climate science [44]. After the heightened debate during early 2007, the coverage decreased later in the year, despite several major scientific assessments released by the International Panel on Climate Change (IPCC). The debate spiked again in early 2008. The winter weather was again exceptionally mild, and debates related to international climate policies fed the news with concerns related both to the changing climate and proposed mitigation measures. No single climate-related issue dominated the news content and soon the debate started to decrease. The decreasing trend of coverage was interrupted by a sharp peak in late 2009, mainly caused by the Copenhagen climate change conference [56]. The disappointing results of the meeting were briefly reflected in early 2010 but during the spring the coverage dwindled, in part because of reporting fatigue resulting from intensive coverage [57].

The coverage stabilized during the subsequent years and remained at a higher level compared with the period prior to 2007. This was somewhat surprising, especially since the economic downturn sparked by turmoil on the US real estate markets also reached the Finnish economy. Earlier studies have indicated that environmental reporting tends to decline during times of economic hardship [44,58]. The decennial average number of items mentioning climate change per month increased from 15.1 in the 1990s to 51.9 in the 2000s and 48.2 in the 2010s. During the past decade, the period of high attention started to build up in late 2018 and lasted until early 2020. One key contributing factor was the release of the IPCC Global Warming of 1.5 °C report [59], which raised attention because of the more direct expressions and even distressing language about the risks of not meeting the targets set at the Paris climate meeting. A news headline from October 2018 stresses "The message of climate scientists is clear: Making excuses must finally stop". The climate strike movement with young Swedish activist Greta Thunberg as a leading figure brought moral pleas to the forefront of the public climate debate [60,61]. A letter to the editor headline from February 2019 paints a picture: "Serious-faced Greta Thunberg is like the future itself that has come to call us to account—But how can a 16-year-old bear such a burden?" Earlier climate coverage in Finland can be characterized as technocratic and focused primarily on reporting of science-based results and economic implications of climate and energy policies [39,43].

Climate change mitigation was discussed in relation to the plans for the EU Green Deal and it was one of the key issues in the Finnish parliamentary elections of 2019. Unlike previous peaks characterized by short periods of highly active debate, this time the high-level coverage was sustained month after month. Between October 2018 and February 2020, the average number of climate news articles per month was 120.0, meaning that every copy of the newspaper featured about four stories focusing on or mentioning climate issues.

4.2. Health Crises and Climate Change Media Coverage

The drop from peak levels was rapid as the COVID-19 pandemic occupied news space. The monthly average number of news items during March–April 2020 (57.7) dropped radically from January–February (106.5). However, the monthly drop of 38 news items (or a 36.2% drop from the previous month) in March 2020 was not an unprecedented one. Greater monthly drops occurred

in December 2000, January 2010, January 2016, and November 2018, related to returns from high levels of reporting during the UNFCCC meetings. Earlier major international virus outbreaks had smaller impacts, although the SARS (Severe Acute Respiratory Syndrome) epidemic in 2002–2003 was one factor potentially explaining the low level of climate coverage. During the so-called swine flu (A(H1N1)v 2009) pandemic (2009–2010) the climate coverage spiked and dropped largely because of the Copenhagen COP15 climate meeting.

Some climate change media coverage overlapped with the reporting of the three health related crises studied, but there were considerable differences between the health crises. During the SARS epidemic outbreak there were no news items covering both climate change and the SARS epidemic. The number of news items covering both the swine flu pandemic and climate change was small (five news items) during the swine flu pandemic. The news items covered two issues: green recovery and comparison of the health and environmental crises. In the case of COVID-19 the situation was very different. In total, 20 percent of news items mentioning climate change also mentioned COVID-19 (Figure 2). COVID-19 and climate change media content were connected especially when reporting covered issues such as air travel, veganism, car sales, green recovery, and Donald Trump's 2020 presidential campaign. Some news items also compared the two crises, stating often that COVID-19 is a small threat compared to the long-term climate change crisis.

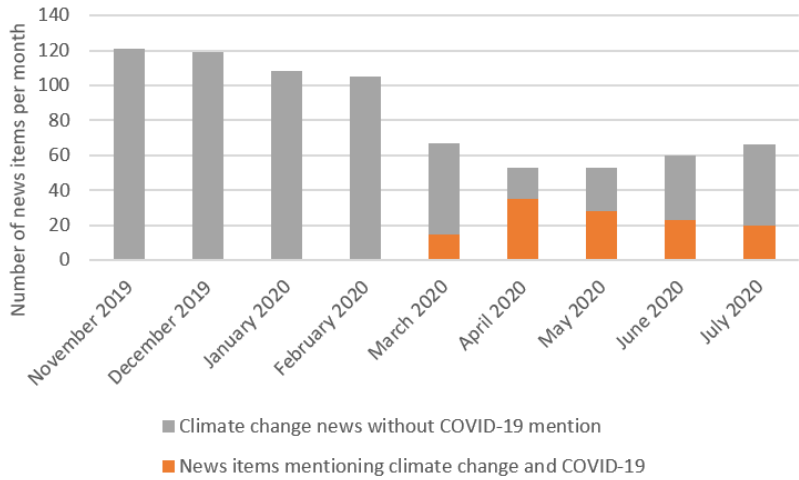

Figure 2. Climate change media coverage in Helsingin Sanomat during the COVID-19 outbreak, divided into news items with and without COVID-19 mentions.

4.3. Reporting Across Newspaper Sections

Less than a third (29.9%) of the sample focused on climate issues, while a quarter focused on other environmental (17.7%) or energy (8.0%) issues (Figure 3). Energy was typically mentioned from the perspective of energy production and energy sources, while energy consumption received only minor attention. Nearly half (44.4%) of the items focused on issues outside the environmental or nature genre. These items included a range of topics, such as climate policies as one factor of government decision making (domestic news) or consumer choices (lifestyle sections), climate risks addressed in theatre plays or in books (culture pages) and carbon emissions of vehicles (motoring pages). The results indicate that climate concerns are not isolated within environmental reporting but are widely discussed and potentially taken into account in decisions and policies outside the domain of environmental protection, too [62]. The culture and lifestyle sections in particular tend to connect climate issues with other topics.

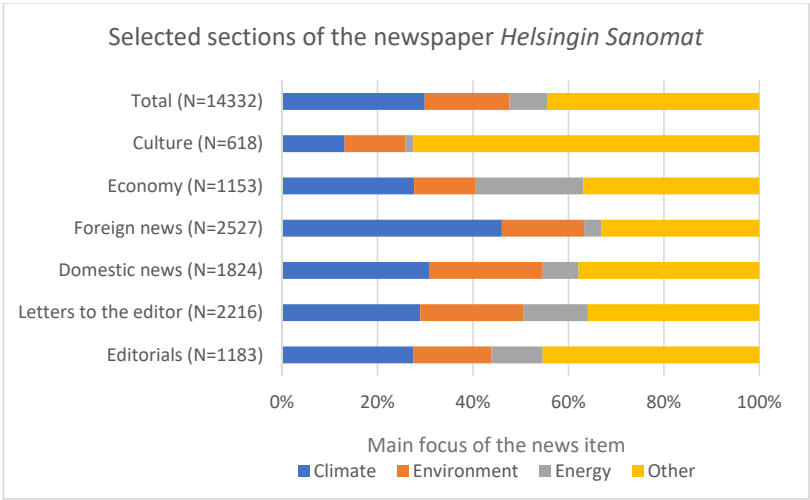

Figure 3. Overview of the main focus of news coverage of climate change by Helsingin Sanomat, January 1990–July 2020.

Domestic news in this sample mainly focused on national-level climate policies, but some attention was also paid to local-level effects and risks, as well as locally-based climate change mitigation and adaptation measures. Energy issues were featured during policy debates focusing on forest-based bioenergy, use of peat, nuclear energy, and public subsidies and environmental effects of wind energy. These debates have been driven by polarizations between parties emphasizing different environmental and economic effects of energy production [51,63–65]. Despite persistent societal disagreements, such debates are prone to fade from the headlines in the absence of topical national-level policy processes and decisions.

Foreign news was the top section when measured by the number of climate related stories published during the whole study period. The popularity was largely explained by the attention given to international climate meetings and EU-level climate and energy policies [56]. The year 2019 was the top year with over 300 foreign news items addressing climate issues.

The science section popularized the results of climate science at a relatively steady pace. The highest annual number of climate news items in this section was in 2018. Interest in climate science was heightened partly because of the IPCC special report published that year [59]. However, overall visibility of the IPCC was low. Only 48 titles directly mentioned the IPCC, most of them either presenting warnings about future climate change or questioning the credibility of the IPCC, especially during the so-called "climategate" episode in 2009. It should be noted that the episode received only modest attention compared to in many other countries [66,67] and, more generally, the visibility of climate skeptic or denialistic views in titles remained very low in the sample. Climate research was also often referred to in sections other than science news.

Inclusion in editorials and opinion pieces fluctuated. In the early 2010s editorials showed a particularly radical drop. During 2011–2013 the number of editorials addressing climate change was less than one tenth of the frequency during 2007–2009. Discussion in the Letters to the Editor section declined gradually and reached its lowest level in 2017 at only four percent of opinion pieces published compared to 2008.

The treatment of climate issues in the newspaper sections focusing on culture and arts is one indication of the widening scope of the climate debate [62]. In 2019 climate coverage hit its record level in these sections. Climate change or climate risks were mentioned typically as a side topic or background for other issues. Sports remained the major newspaper section with the lowest proportion

of climate news. Climate issues were mentioned only occasionally and most often in news items describing the risks of warming weather for outdoor winter sports.

Sections focusing on lifestyle issues mentioned climate change typically as a side topic of consumer choices. This involved an underlying tension between environmental effects and consumer behavior. For example, news stories focusing on cars routinely mention the carbon dioxide emissions but at the same time create framings supporting the use of privately-owned cars—together with car advertisements, which fell outside of the sample studied here. Recent coverage increasingly emphasized the possibilities of individual consumers to make environmentally and climate friendly choices.

Coverage of climate issues in newspaper sections related to the economy in 2019 was about half of the level of coverage during the previous peaks of coverage of 2007 and 2008. This is rather surprising since during the 2010s climate change become widely acknowledged not only as a reality for many businesses but also as an economic opportunity, especially for firms focusing on green technologies. The lack of environment-economy controversy may have decreased the news appeal [54]. It is also possible that nowadays climate issues are increasingly discussed under various labels falling outside the key words used to collect the sample. This may also partly explain why energy issues seem to be addressed relatively rarely in recent climate coverage. For example, current news coverage related to energy may speak about "emissions" or "emission trade" without mentioning terms related to greenhouse gases or climate change.

5. Discussion

The long-term evolution of environmental news is influenced by many factors, such as the gradual changes in public awareness and policy interests and accumulation of scientific understanding of socio-ecological changes. As shown by the results presented here, the climate change debate is characterized by rapid and radical short-term fluctuations that easily mask the long-term evolution. The main reasons for a decline of coverage related to an environmental issue after the periods of heightened debate as noted by earlier literature include issue fatigue and competition with other news topics [19,22,68]. Both were evident in the Finnish case. Issue fatigue refers to declining levels of interest among both journalists and audiences. This is a key explanatory factor, but as the recent period of high-volume debate between October 2018 and February 2020 suggests, wide-based treatment of climate issues outside the core environmental or energy debate also helps to sustain a high level of coverage over a relatively long period. New climate-related viewpoints step in as debate over individual news events dwindles.

Competition with other news topics can lead to replacement with a "hotter" news topic partly irrespective of the importance of the topic as assessed based on science-based evidence. Such competition may prevent an issue from becoming widely recognized in the first place. This type of non-recognition prevailed in Finland in the early phase of the debate until late 1990s. The recent relatively high proportion of climate news that also addresses COVID-19 suggests that in addition to competition, convergence of different news topic may be a relevant approach for studying the evolution of the media debate on sustainability issues.

A decline in coverage may involve a realization of a "false alarm" created by exaggerated initial findings not supported by subsequent analysis [21]. Only weak signs of this were detected based on our sample. Interest among journalists may also decline if a consensus over a controversial issue is reached or all arguments by opposing parties have been addressed. In our sample, the visibility of climate skeptic views was low, and the controversies were mostly related to the implications of climate policies.

Much of the fluctuation in our sample was related to so-called calendar journalism, i.e., news topics that are regularly occurring. Such topics include annual international climate conventions attracting hundreds or even thousands of journalists or more or less regularly occurring socio-ecological processes such as wildfires or algal blooming during summer heat waves [26,42]. As shown by our results, the news coverage is typically intensive during the event and evaporates soon after the event is

over. This creates a challenge for the follow-up of policy decisions or ecological processes with long-term effects.

The newspaper coverage of climate change news showed a pattern of gradually increasing long-term attention between periods of heightened coverage. These patterns partially followed different phases of environmental debate as postulated by the issue attention model [22] but also indicated a rising baseline level as suggested by the punctuated equilibrium model [17].

The pre-problem stage of the climate debate had already occurred before the sample studied here. The first peak of news coverage of climate change—or the then greenhouse effect—occurred back in the late 1980s [58]. Compared to the peaks in 2000s, the first periods of intensive coverage were relatively minor ones and mainly introduced the concepts of the greenhouse effect, alongside other global environmental issues such as the ozone hole and loss of biodiversity.

It should be noted that even though environmental issues are nowadays routinely addressed, and coverage of climate change has increased radically from the early 1990s, they remain marginal compared with other news topics such as entertainment, sports, or politics. Earlier research has indicated that on average only 0.4% of all coverage in HS mentioned climate issues and 0.1% of all coverage focused on climate issues between 1990 and 2014 [42].

The decrease in the climate change coverage in early 2020 resulted mainly from the emergence of COVID-19 as a competing news topic. Climate coverage dropped radically in many other countries during March and April 2020 as well [69]. This suggests that the short-term changes in climate coverage can be strongly governed by external factors instead of internal dynamics of the environmental debate. Thus, applicability of the original issue-attention model [22] focusing on the internal dynamics of environmental news is limited. Models putting more emphasis on the external factors influencing the complex interplay of environmental debate are better equipped to explain the evolution of current climate coverage.

Models focusing on interrelations between different issues are also important because climate issues have gradually been mainstreamed into various arenas. As the climate debate has matured, it has gained discursive power. For example, Kotilainen [70] suggests that the climate debate is an important source of new concepts related to COVID-19. He notes that new concepts have been invented by replacing the word "climate" with the word "corona" in compound expressions commonly used in the Finnish language. He gives examples such as corona crisis (koronakriisi) treated in a similar way to climate crisis (ilmastokriisi), corona anxiety (korona-ahdistus) derived from climate anxiety (ilmastoahdistus), and corona refugee (koronapakolainen) from climate refugee (ilmastopakolainen). He also notes the use of new expressions such as corona believers or corona zealots by those who belittle the seriousness of the pandemic. Such belittling appears to follow the logic of climate skeptics. Such intersection between different debates may provide fruitful learning opportunities for sustainability transitions.

Typical characteristics of environmental changes as slowly emerging, abstract global level phenomena make it difficult to create news framings and narratives empowering and activating people. Potential solutions are often portrayed in a distanced manner, as highlighted by the climate coverage of international level policy negotiations about future greenhouse gas reduction targets. Furthermore, reporting addressing the easily observable (alleged) symptoms of environmental change, such as exceptionally mild winter weather, may shift public attention away from the long-term driving forces and from the underlying systemic relationships. While the Finnish case highlights issues that are important in the Nordic context it can also provide lessons for other countries. Importantly, media coverage of heat waves, droughts, wildfires, storms, floods, and other climate-related issues highlighted in other countries [71–74] appear to share the focus on immediate effects and lack of representations of long-term effects of human actions. Taken together, these case studies suggest that media coverage reports on local-level symptoms of global environmental change rather than potential long-term remedies preventing or curing the problem.

The COVID-19 pandemic adds a new layer to these concerns because of the danger of focusing on short-term management of the crisis and recovery strategies. On the other hand, the temporary reduction of environmental pressures has attracted considerable public and policy attention and debates over sustainable or green investment schemes become have become part of the climate debate. Together with media coverage addressing moral claims raised by activists such as Greta Thunberg, this raises expectations of the critical re-evaluation of assumptions related to economic growth and well-being [75].

There are several limitations that should be noted. First, the study is based on one news outlet. Secondly, only material published in a printed newspaper was included despite the increasing importance of online and social media debates. Third, content analysis allows only limited interpretations on the motivations of news sources or effects of the communication. Furthermore, generalizations must be made with caution, since this research focuses on a distinctive language of Finnish, belonging to the Finno-Ugric languages together with Estonian, Hungarian, and several Uralic languages. Finnish is the official language of Finland, an EU member state with 5.5 million inhabitants. Furthermore, the study represents only the first attempt to study the interactions of climate change and short-term crises news coverage and it offers only limited content analysis. Improving the data analysis methods (e.g., data mining with big data and machine learning) would allow for more comprehensive analysis in future studies. Computer-based methods already offer opportunities for the analysis of large datasets [76,77].

6. Conclusions

The fluctuations in climate coverage have been influenced by several factors including competing news events, changes in journalistic practices brought by new communication technologies and commercial pressures of the newspaper industry, accumulation of scientific knowledge on climate change, activity of news sources, expectations and actual results of international climate policy negotiations, domestic debates over energy policies, and weather anomalies connected with climate change. In Finland, the mild and snowless winter weather has a particularly strong connection with the high level of climate news.

Media attention on climate change dropped in early 2020 because of COVID-19 but based on previous patterns of media coverage and scientific understanding of climate change as a global level, persistent socio-ecological challenge, the coverage is likely to bounce upward. The timing and height of this upward bounce is highly uncertain. At least two key drivers for climate coverage can be anticipated. First, an increase in climate coverage may be fueled by climate-related catastrophes such as large-scale wildfires resulting from elongated heat waves. Second, climate coverage may build up from the economic recovery actions highlighting climate change mitigation and adaptation as the key issue for sustainable and resilient post-COVID economies.

The storyline of the "boomers and zoomers" article by the magazine Grist ended with a hopeful message about the similarities between the COVID crisis and climate crisis, emphasizing that management of both problems requires listening to scientists, being prepared and—importantly—being kind and generous with each other [1]. This advice may sound naïve, but it addresses a key issue. Climate change is a prime example of a complex and collective problem that requires well-meaning collaboration between different actors [78,79]. In other words, without kindness complex problems cannot be solved.

Media reporting can play an important role in sustainability transitions not only by screening out unreliable information but also by creating common understanding. Journalistic media can build bridges between different topics and actors as well as creating representations and framings focusing not only on immediate concerns and controversies but also on the root causes of and complex interactions related to long-term climate change and acute crisis such as COVID-19. On the one hand, the media can create and deepen polarizations and paralyze decision-making by creating mistrust toward science and policy-making. The media can also forestall changes by uncritically serving as a lapdog for rather than a watchdog over the ruling elites. Case studies of climate debate provide important in-depth

understanding of specific contexts of reporting, but further studies are needed to build a coherent understanding of key differences and commonalities behind the context-specific reporting.

Climate change is an example of global change characterized by long-term processes spanning decades and centuries or even longer timeframes. The media news representations have traditionally cast attention on short-term, dramatic, and tangible events of immediate interest. The challenging new task for news media is to bridge these two ends of the temporal and spatial spectrum in a way that informs and inspires key actors.

Supplementary Materials: The earlier dataset describing the years 1990–2010 is freely available from the Finnish Social Science Archive: http://urn.fi/urn:nbn:fi:fsd:T-FSD2828. The updated data is available upon request from the authors.

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RESEARCH ARTICLE

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Framing climate futures: the media representations of climate and energy policies in Finnish broadcasting company news

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ABSTRACT

Media representations of the future are a key component of climate change and energy policies. This study integrates media analysis with futures studies and focuses on the media framings and representations of futures related to key national-level energy and climate strategy documents. It utilizes qualitative content analysis of online news articles of Finland's national public broadcasting company committed to high-quality journalism. The results show that a more multifaceted coverage of climate action increased during the study period of 2015–2020, especially in terms of frames and future scenario archetypes, and indicate gradually widening awareness of climate risks. However, climate change has been framed as an isolated policy area, and climate change mitigation and adaptation remain framed as subordinate to economic policy targets.

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1. Introduction

High-quality journalism is a key part of the agenda setting in democratic societies, especially related to environmental issues such as climate change (Sachsman and Valenti 2020). However, journalism faces multiple challenges. Because of the rise of television and, later, because of various online platforms, even the most esteemed newspapers have partly lost their traditional dominant position as the "fourth estate" (Temple 2018). The role of journalists as vigilant watchdogs of the policymakers has been challenged by staff cuts in editorial offices and increasing commercialization. The media landscape has fragmented, and the future of high-quality journalism is uncertain, also due to the increasing influence of stakeholder PR and digitalization, that is reshaping the relationships of information producers and users (Schäfer and Painter 2020).

Many have stressed the difficulties of climate change journalism requiring lots of expertise but attracting relatively small audiences and even expelling some advertisers (Sachsman and Valenti 2020). Despite the challenges, news media still acts as a key player in the interplay of the scientific, policy and public agendas. Most people's knowledge of issues such as climate change originates from news media, and especially public service

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news media serve as important hubs of news production in many countries (Aalberg 2017; Schäfer and Painter 2020).

Solving complex societal problems, such as climate change, under democratic regimes requires news media that are capable of successfully setting a public agenda for science-based and solution-oriented policy (Boykoff 2011). Journalists influence public perceptions of climate policy, its successes, failures and contexts (Kortenkamp and Basten 2015). Ideally, journalists provide messages that accurately represent scientific consensus and set climate policies into relevant frames and scales (Sachsman and Valenti 2020). Journalists should be able to not only represent different actors' views in a balanced manner and present the most promising technological and policy solutions but also look at them critically (Chadwick 2017). In practice, such an ideal role is hard to play. The role of non-commercial public service news is especially important in bringing science-based, long-term and intangible global policy issues into public attention (Boykoff 2011). Concerns over "fake news", misinformation and disinformation further highlight that public service media have a particularly important role in providing allegedly objective and impartial information on a non-commercial basis.

This article focuses on the democratic-corporatist media system of Finland, characterized by a long history and a broad diffusion of mass media, a high degree of professionalization and self-regulation of media, as well as strong political media tradition, but current independence from political groups (Hallin and Mancini 2004). Importantly, communication services conceived as public goods are a key aspect of this media system. Finland is a country with a high level of press freedom and strong independent media operating in a context of an economically affluent welfare society.

In particular, the focus is on the Finnish public service broadcast company (Yle) that aims to provide its audiences with reliable, high-quality and comprehensive information. According to Reuters Institute's Digital News Report (Reuters 2022), 84% of Finns find Yle trustworthy. The company emphasizes media accountability, independence and societal responsibility, and declares that it presents the "whole of multivoiced Finland" (Yle 2020). The request for supporting democracy, participation and equality is also based on the law governing the role and operation of the company (Finnish Broadcasting Company Act 22.12.1993/1380). In comparison to the largest commercial newspapers in Finland that limit access to their content via a paywall, Yle's news content is freely available for the public to read, making it a much more accessible channel to find knowledge on issues such as climate change.

Representations of climate policies are an interesting case study to scrutinize the challenges of public service media as the stronghold of impartial journalism. Accusations of both too alarmist reporting and the underestimation of risks in an era of "climate crisis" have been voiced (Risbey 2008). We aim to cover several gaps. General level framings in the climate debate have been widely studied (e.g. Scholte et al. 2013; Ballantyne 2016; Schäfer et al. 2017) but here we focus on framings connected with specific policy documents. Studies of English-language print news reporting still dominate the field and also in countries such as Finland the overall development of climate change news in print media is relatively well known (Lyytimäki et al. 2020). Here we focus on the under-researched area of online news by public service media. Agency is another widely studied topic in climate change media content analysis (Boykoff 2011). For example, the influence of science advice bodies such as the International Panel on Climate

Change, environmental and industry advocacy groups and think tanks, individual persons such as Al Gore or Greta Thunberg or companies such as ExxonMobil on the development of climate debate has been thoroughly addressed (Boykoff 2011; Murphy 2021; Supran and Oreskes 2021). Here agency is studied from the perspective of future action. We aim to advance an interdisciplinary understanding by integrating the perspectives of media analysis and future studies. We combine Matthew C. Nisbet's (2009) typology of the media frames applicable to climate change with Jim Dator's (2009, 2014) model scenario archetypes of social change, "the four futures", as detailed in the next section.

We analyse how the media frames climate change in public debate on climate policies and the related policy documents and how the future perspectives of related social change are narrated, what characteristics different stakeholders emphasize, which actors have a say and what are the dominant topics in the news. The next section justifies our specific research questions: (1) How are climate policies and the futures in them represented and framed in public service journalism? And (2) Which actors have agency through their visibility in public media articles covering climate policies?

2. Theory, methods, and material

2.1 Framing climate policies and futures in media

Climate policies contain framings of both the current situation, climate change as a policy problem, and an idea for a preferable future based on complex power relations and social imaginaries (Lakoff 2010; Fischer and Forester 1993). Vice versa, politics are embedded in imagining the climate future (Granjou et al. 2017). Popularizing the policies in news media adds another layer of framing that may follow, complement, or oppose the framings offered by the policy documents (Stoddard et al. 2021). This layer of framing is not usually formed independently from the policymakers' aims, but with different operational journalistic norms, such as personalization, dramatization, novelty, authority-order bias and balance (Boykoff 2011, p. 100).

Framing is a widely used concept with roots in both psychology and sociology (Cacciatore et al. 2016). Generally, *a frame* refers to how an issue is portrayed and understood. Framing theory in mass media, as presented by Goffman (1974), highlights the importance of how data is selected, interpreted, processed and communicated. According to Boykoff and Roberts (2007), framing permeates all facets of interactions between science, policy, media and the public. Analysing which kinds of frames are present in the news helps to reveal how media shape policy debates by legitimating certain viewpoints while discouraging or precluding others. Using frames to communicate complex issues via metaphors and storylines makes policy proposals easier to understand and places them in a context that is perceived as relevant. As Stecula and Merkley (2019) point out, certain media framings of climate change emphasizing potential economic harms or uncertainty of climate mitigation policies have had an adverse reaction to people's propensity to support and engage in climate action. The opposite is seen with framings highlighting the economic benefits of climate action. The media framing of climate change is also in flux and can obtain different sub-topics in different times, such as the COVID-19 pandemic (Lyytimäki et al. 2020) or expand to cover various traditional topics

such as economic development or employment (Nisbet 2009). An effective frame links new concepts to existing narratives that are familiar to its intended audience.

Here we focus on two aspects of framing: how different frames represent different futures and temporalities related to climate policies and how they construct agency for different actors. Climate change is a prime example of an environmental issue including different temporalities ranging from immediate consumer choices to policy issues debated under election cycles of a couple of years, energy investments looking over decades and ecological and climatological processes evolving through centuries. In environmental news, near-term actions and actors involved often receive excessive attention (Lyytimäki 2007). Here the focus is on temporalities relevant to national-level policy making. Framings of the long-term futures represent a crucial terrain of climate reporting, and at the same time, remain a major challenge to journalists, policy-makers and the public (Moser 2016; Eide and Kunelius 2020). Agency is another key issue since media can provide – or deny – actors a space to present their views (Murphy 2021; Supran and Oreskes 2021).

To analyse media representations of climate change as a policy issue from a future-oriented perspective, we combine and adapt Nisbet's (2009) frame typology with scenario archetypes on the social change proposed by Dator (2009) (Table 1). There are some parallels between Nisbet's (2009) framing typology and Dator's (2009) four futures approach. Dator's scenarios are, in essence, tools of framing or, as Nisbet puts it, storylines that set a specific train of thought in motion.

Nisbet (2009) argues that the suggested frames take no position on any specific policies and may include pro, anti, and neutral arguments. For example, an economic

Table 1. A typology of the frames and scenario archetypes applicable to climate change (adapted from Nisbet 2009; Dator 2009).

Frame	How the frame defines climate change as a policy issue
Social progress	A means of improving the quality of life or solving problems on a societal level
Changing lifestyles and living standards	An arena of cultural choices, identities and external demands on an individual level
Economic development and competitiveness	An affair of economic investment; a market benefit or risk; or a point of local, or national competitiveness
Morality and ethics	A matter of right or wrong; or as a matter of respect or disrespect for limits or thresholds
Scientific and technical uncertainty	A matter of expert understanding or consensus; a debate over what is known versus unknown, or peer-reviewed, confirmed knowledge versus hype or alarmism
Pandora's box/Frankenstein's monster/runaway science	A need for precaution or action in the face of possible catastrophe and out-of-control consequences; or alternatively as fatalism, where there is no way to avoid the consequences or chosen path
Public accountability and governance	An affair of political discussion, serving the public interest or serving special interests, emphasizing issues of control, governance, transparency, participation, responsiveness or ownership
Middle way/alternative path	A need for third, alternative or neutral way between conflicting or polarized views or options
Conflict and strategy	A game among elites, such as who is winning or losing the debate; or a battle of personalities or interest groups (usually a journalist-driven interpretation)
Scenario archetype	**How the scenario archetype defines societal change related to climate change**
Continuation	Business as usual, status quo growth
Limits and discipline	Behaviours to adapt to environmental limits
Decline and collapse	System degradation or failure as crisis emerges
Transformation	New technology, business or social factors that change the game

argument can be used to support climate policies, such as creating green new jobs, or against climate action by arguing climate policies may hinder economic growth due to, for example, implementing stronger regulation. Additionally, the frames often translate to certain types of frame devices such as metaphors, terms or catchphrases. As "creating green jobs" translates to the economic development frame relative to climate change, larger policy proposals such as "Green New Deal" can evoke several additional frames such as ones related to energy transition and social progress.

According to Dator (2009), all the possible future scenarios of societal change are either a variation or a combination of four growth-based alternative scenario archetypes. These archetypal scenarios include "continuation", "decline and collapse", "limits and discipline" and "transformation". Dator assumed that "continuation" or "continued growth" is the dominant scenario in public and policy debate as it has been the assumed baseline for the future of all modern governments and economies. The dismal "decline and collapse" scenario has been salient in various forms, including the Cold War-era nuclear disaster dystopias or more recent climate fiction genre (Death 2022). This scenario highlights the risks of uncontrolled changes. The scenario of a "disciplined society" often arises to counter the continued growth that is seen as undesirable for its implications of over-consumption and increasing inequalities, and as unsustainable on a planet of finite resources. It can also be seen as a well-organized gradual shift or even as a continuation of the current society as opposed to seeing it as the disruptive future of the "transformational society". Here we understand the disciplined society as a relatively smooth development path following the ideals of eco-modernism, green and circular economy (Loiseau et al. 2016) while transformational society represents a sustainability transition process characterized by leverage points (Abson et al. 2017).

Here we test the capability of integrated analysis of frames and future archetypes to produce understanding of the climate debate. In addition to drawing an overall picture of frames and futures by the online reporting of a public broadcaster, we pay special attention to economic aspects that can be considered as a particularly policy-relevant theme. Both Nisbet's frames and Dator's futures also include the point of view of economics which can be seen as an overarching theme.

2.2 Data and content analysis

The analysis focuses on the online news covering the six selected climate and energy policy documents published during 2015–2020 by Yle. This allows the detection of differences, if there are any, between media representations of, firstly, the different policy documents within this five year period and, secondly, the two governmental periods. The policy documents are summarized in Table 2. They include two government programmes: (Prime Minister's Office 2015, 2019) and four other policy documents that implement the two government programmes and the EU's climate and energy policies in Finland. The government programme is the most important strategic document of a government in Finland (Paloheimo 2003; Tiili 2008). The Finnish government programmes are long and detailed, and they outline the political priorities and objectives in various fields (Kekkonen and Raunio 2011).

The most important new climate change objective in the 2015 government programme was the decision to phase out the use of coal in energy production during the

Table 2. Policy documents and the analysed media items.

Code for the media items related to the policy document	Policy document	Publication date	Type of document and the reference	Mentions of the term *climate* per page and the total number of pages*	Media items related to the policy document (n = 55 for all the documents) and all the media items from the search (n = 227 for all the documents)	Main new climate targets, policies and actions
PD1	*Finland, a Land of Solutions*	29 May. 2015	Government programme (Prime Minister's Office 2015)	0.22 (74)	7 (38)	• Finland achieves 2020 climate change targets ahead of time, by 2019 • The share of renewable energy will increase to more than 50% during the 2020s • The phasing out the use of coal in energy production during the 2020s • Cutting imported oil use by half during the 2020s • Increasing the share of renewable transport fuels to 40% by 2030
PD2	*Government Report on National Energy and Climate Strategy for 2030*	24 November 2016 (final publication: 31 January 2017)	National climate and energy strategy (Prime Minister's Office 2016)	2.72 (68)	17 (26)	• No new permits for coal power plants • A proposal for an act to phase out coal use in energy production • Increasing wood use in district heating and biofuel production • Increasing biofuel use in road transportation and in the light fuel oil used for the heating of buildings • Tendered subsidies for new wind power plants during 2018–2020, totalling 2 TWh
PD3	*Government Report on Medium-term Climate Change Plan for 2030: Towards Climate-Smart Day-to-Day Living*	25 Sept. 2017	Medium-term climate change plan (Ministry of the Environment 2017)	4.04 (146)	1 (31)	• The reduction of transport emission by half by 2030 compared with 2005 levels • An obligation to blend the fuel oil used for heating with 10% bioliquid • Phasing out oil heating in central government premises by 2025 • Halving the amount of food waste in institutional kitchens by 2030

(*Continued*)

Table 2. (Continued).

Code for the media items related to the policy document	Policy document	Publication date	Type of document and the reference	Mentions of the term *climate* per page and the total number of pages*	Media items related to the policy document (n = 55 for all the documents) and all the media items from the search (n = 227 for all the documents)	Main new climate targets, policies and actions
PD4	*Unified Climate Policy Goals of the Parties in Parliament*	20 Dec. 2018	Government announcement (Prime Minister's Office 2018)	11.00 (2)	5 (25)	• Finland supports carbon neutrality in the EU before 2050 • Finland supports the goal to tighten the EU's emission reduction goal for 2030 to at least 55% of the 1990 level • Finland's greenhouse gas emissions will be negative in the 2040s • Finland's electricity and heat production must be made nearly emission-free by the end of the 2030s'
PD5	*Inclusive and Competent Finland: A Socially, Economically and Ecologically Sustainable Society*	6 June 2019	Government programme (Prime Minister's Office 2019)	0.58 (214)	11 (53)	• Finland will be carbon neutral by 2035 and carbon negative soon after that • Finland supports tightening the EU's emissions reduction target to at least 55% below the 1990 level • Electricity and heat production in Finland will be made nearly emission-free by the end of the 2030s • Cutting the use of peat in energy production by half by 2030 • Phasing out fossil fuel oil use in heating by 2030 • Cutting the amount of food waste by half by 2030
PD6	*Fair Transition towards Carbon Neutral Finland: A Roadmap for Achieving the Carbon Neutrality Goal*	3 Feb. 2020	Government announcement (Prime Minister's Office 2020)	7.00 (5)	14 (54)	• The renewal of energy taxation • Sectoral plans for carbon neutrality • A roadmap for a fossil-free transport sector • A new medium-term climate change plan in 2021 • A new climate and energy strategy in 2021 • A climate change plan for the land use sector

*In the main document, excluding appendixes.

2020s. Otherwise, the programme's climate efforts mainly focused on forest-based bioenergy promotion in different sectors. This echoed the strong emphasis on bioenergy in earlier government programmes (Kivimaa and Mickwitz 2011). In 2016, the climate- and energy-related objectives of the government programme 2015 were outlined as concrete actions in the National Energy and Climate Strategy for 2030 (Prime Minister's Office 2016). The Medium-term Climate Change Plan for 2030 (Ministry of the Environment 2017) continued the implementation of the government programme and the EU's climate policy targets. The focus of the emission reductions in the plan was put on the transport sector. In addition, eight parties in the Finnish Parliament agreed on common climate policy goals in 2018 (Prime Minister's Office 2018).

The government programme 2019 (Prime Minister's Office 2019) outlined multiple important new climate change policies, of which the most important one was to achieve carbon neutrality in Finland by 2035. As the prime minister changed, a roadmap for the transition towards climate-neutral Finland was formed in the government programme 2020 (Prime Minister's Office 2020). The roadmap mainly outlined the need for new sectoral plans and roadmaps towards climate neutrality rather than concrete new policy targets and measures.

The media data sample was collected from one week period after the publication of each of the six policy documents, 2015–2020. The study period was selected as the focus is the media representations of finalized climate strategies and plans. However, the published policy documents are only the outcomes of the often lengthy and eventful process of policy planning and negotiation. This process, as well as the time before the official procedure, are significant phases of policy agenda-building and communication, also within the media sphere (e.g. Hopmann et al. 2012). However, it is assumed that the publication of these strategy and plan documents are media events where all the preceding processes culminate.

The media data were obtained from the online archive of Yle. The search strings include the terms "climate", "emission", "carbon" and "greenhouse" (*ilmasto, päästö, hiili* and *kasvihuone* respectively in Finnish). Since the aim was to acquire a comprehensive sample of the climate debate, the search strategy resulted in 111 hits not related to climate issues. These were removed from the final sample. Furthermore, of the 227 items focusing on climate issues, most do not mention the studied climate policies. Thus, the final sample consisted of 55 items that focus on or mention the studied climate policies.

In 2020, Yle's online and mobile services reached on average 3.1 million Finns every month (Yle 2021). According to Yle, their online services reached 73% of Finns over the age of 15 every week. Yle Uutiset ("Yle News") publishes hundreds of news articles weekly on a broad spectrum of both domestic and international topics. While "climate" does not have its own news segment on the site menu structure, such as the segments "Politics" and "Nature", Yle has introduced several specific, overlapping "topic words" for climate-related news, such as *hiilineutraalius* ("carbon neutrality") and *ilmastonmuutoksen hillitseminen* ("climate change mitigation").

The analysis mainly relies on qualitative media content analysis (Macnamara 2005; Neuendorf and Kumar 2016). The analysis framework outlines the types and topics of the articles and scrutinizes the actors' affiliations and their gender balance, the frames and future scenario archetypes and the time frames of reported change in the articles. The construction of the coding categories was partly deductive, based on a theory, Nisbet's

Table 3. Coding variables and coding schema.

Coding variables	Definition	Coding and categories in coding schema
Type	Type of the media item	• News • Column
Topic	• Topic of the media item • Linkages to aspirations or forecasts of future development • Linkages to technology, social justice impacts of climate policy, and climate activism	Open coding
Primary actors	Actors whose actions have been reported, and/or who have had a first-hand impact on the content, e.g. as interviewees	Occupation • Government and governing parties • Opposition parties • Other public sector • Companies • Business and advocacy organizations • Academic institutions and researchers • Media and journalists • eNGO's • Fourth sector (informal volunteering, self-organizing activism and hybrid organizations) • Citizens • Other
Secondary actors	Actors who have been mentioned by other actors	Coding schema identical with the coding schema of the primary actors
Frame	How the climate change as a policy issue is portrayed and understood (Nisbet 2009)	• Social progress • Changing lifestyles and living standards • Economic development and competitiveness • Morality and ethics • Scientific and technical uncertainty • Pandora's box/Frankenstein's monster/runaway science • Public accountability and governance • Middle way/alternative path • Conflict and strategy
Scenario archetype	Growth-based narrative of societal change (Dator 2009)	• Continuation • Limits and discipline • Decline and collapse • Transformation

(2009) typology of frames and Dator's (2009) typology of scenario archetypes. As Nisbet's approach to framing derives specifically from communicating climate change, it offers an inherently relevant typology for our topic. Furthermore, as the policy documents contain both current and future framings for climate policies, the combination of Nisbet's framings for climate change and Dator's scenarios serve as a relevant approach to interpreting the policies' representations in media. The categorizations of the actors' occupations and the time frames of reported change were constructed inductively during the coding. The coding categories are summarized in Table 3. The analysis was conducted using NVivo for text coding, Excel for grouping media items, and Excel and Python for visualization. The Excel codebook is provided in Appendix. The coding was based on two independent human coders. Potential bias caused by reliance on subjective expert judgements and differences in interpretations was addressed through iterative discussion rounds until a complete agreement was reached.

There are several limitations that should be noted. The case study is based on one news outlet, the online news of the Finnish public broadcaster (Yle). It should be noted that Yle's online news search is by no means perfect and will not always provide the desired results, especially if the search term used is too specific or rare, or if the search string is too similar to a more popular search term. For example, the search application programming interface (API) may guess that the researcher actually meant to search for *lasikatto* ("glass ceiling") when they in fact intentionally searched for *lajikato* ("biodiversity loss"). Using broader search terms covering the overall topics of our interest ensured that the dataset was not likely to omit any news articles relevant to our study. The sample size of media articles related to each policy document is limited. This is partly due to the search periods that consist of a week after the publication of each policy document (starting from the publication date) in order to capture the initial representation. It is also possible that there are articles that discuss single policy actions or regulated technologies without mentioning any of the search terms. The amount of those articles is likely to be small and their relevance to analysing overall climate policy representations is limited. In some of the analysed articles, the climate policy document only had a small role, whereas some of them were centred around representing the documents. Finally, content analysis allows only limited interpretations of the intentions and meaning construction of the communication. Furthermore, we used predefined typologies of frames and scenario archetypes. These models are, of course, broad tools with which to envision the present and the future. By using this approach, the analysis may have missed additional frames and scenario archetypes that weren't included in these categories. To address this, we supplemented the frame typology (Table 1) with an additional frame that was identified as being used in the media material, "Changing lifestyles and living standards" to capture defining climate change as an arena of cultural choices, identities and external demands on an individual level.

3. Results

3.1 Article types and topics

Out of the 55 articles directly related to the six policy documents, 87% were journalistic articles and the rest were columns written by journalists and invited writers. When looking at the sample of all climate change-related articles in the study periods (n = 227), the studied climate policy documents were mentioned in just a minority of them (Figure 1). However, the Energy and climate strategy (2016) was a notable exception as it was mentioned in 65% of the articles in the study period. There is no clear temporal trend, but a slight increase from 2019 onwards is likely to reflect increasing overall public interest and the policy mainstreaming of climate issues (Lyytimäki et al. 2020). Notably, the 2020 study period took place in early February, before COVID-19 news displaced climate change news. Topic categorization of the 172 articles not related to the policy documents showed that 50% of the articles focused on another climate change or environmental issue, 13% on other national policy issues and 38% on other issues that were largely not environmental. These shares are generally in line with the earlier focus of the climate debate in Finland (Lyytimäki 2011).

The topics of the articles related to the climate policy of the Government programme (2015), henceforth referred to as PD1, included the objectives of phasing out the use of coal and replacing it with renewable energy sources, replacing fossil oil with biofuels, permitting new energy sources, such as horse manure, in bioenergy production, and the feasibility of electric cars in varied transportation needs. Social justice was mentioned in an article, published on 25 May 2015, that focused on road user charges planned by the government. The article stated, repeating the government's message, that there should be a procedure to compensate domestic transport industry entrepreneurs so that they wouldn't be burdened with additional costs. Four out of the seven articles were focused on technological possibilities for climate change mitigation.

Energy and climate strategy (2016) was most frequently covered in the media articles. Henceforth the related media articles are referred to as PD2. The articles focused on the biofuel policies, acceptability of increasing car fuel prices, electric cars, the impact of EU energy policies on Finnish climate policy objectives, renewal of the wind power subsidy system, and finally, the impacts of the policy objectives, especially on wood prices and renewal of car fleet. Many of the articles reported judgements and comments of different actors, for example, two of the articles presented a reaction of two energy sector companies. Of the 17 articles, 14 were focused on technological possibilities for climate change mitigation. Social justice was discussed in an article that reported the process of lobbying against wind power, published on 24 November 2016. The article quoted politicians' comments on the speculated health effects of wind turbines on local people.

The Medium-term climate change plan (2017), was covered in one article, henceforth referred to as PD3. The article reported the perceptions of the sitting and the previous ministries of the environment of the policy objectives and their adequacy for mitigating climate change. The articles covering the eight parties' unified climate policy goals (2018), henceforth referred to as PD4, were focused on the changing role and ambition of Finland in climate policy field, also in relation to the EU, and the process of party politics behind the policy output. Of the 5 articles, one was technically focused.

The Government programme (2019), set climate change to the core of national policy topics, "climate change" being the first term mentioned in the policy document. Henceforth the related media articles are referred to as PD5. The articles that covered the climate policies in the government programme were focused on the perceptions of the opposition of the climate policy objectives, the differing perceptions of ministries on

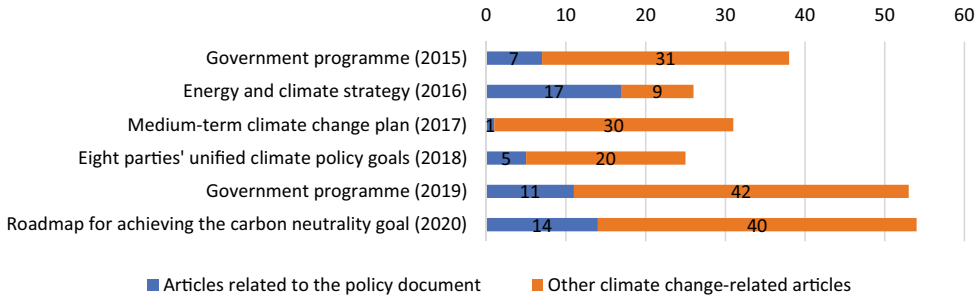

Figure 1. The number of articles related to the climate policy documents compared to other climate change-related articles after the publication of each policy document.

the adequacy of wood production in relation to the needs of bioeconomy, the long-term development of road traffic, and the role of business subsidies in mitigating climate change. The perspective of social justice was included in two articles, both published on 12 June 2019. The first of them reported the governments' aim to increase funds for development cooperation and allocate them to climate change adaptation. The other quoted opposition politicians' comments from the first parliamentary discussion of the governmental programme, one of them criticizing the social effects of the economic costs of climate policy. Two of the articles were technically focused.

The topics of the articles related to the most recent policy document, the roadmap for achieving the carbon neutrality goal (2020), henceforth referred to as PD6, included summaries and expert evaluations of the policies and their impacts, presenting the efficiency of the policy measures in reducing emissions, reporting the political process, and the effect of the policies to the national and municipal economy. Three articles had a technical focus: the first focuses on how the decision to decrease industrial electricity tax impacts emission levels, the second on representing the nuclear power views of the Green League, and the third on the feasibility of electric cars in long-distance driving. Social justice perspectives were included in four articles, all via quoting interviewees. In two articles, published on 3 February 2020, representatives of environmental NGOs' criticized that postponing impactful climate decisions is socially irresponsible and that employment impacts of using peat for energy have been overestimated and falsely used as an argument. In an article, published on 7 February 2020, a representative of the Finns Party criticized that the climate policies increase regional inequality. The fourth article, published on 8 February, quoted a representative of the Centre Party who called for climate action that is socially just and "not only punish the daily lives of the poor".

3.2 Actors and agency

The dominance of politicians and civil servants was expected in the articles that were related to national climate policies (Figure 2). In total, the public sector represents 57% of the primary actors in the articles and 31% of the secondary actors. The private sector has also had a visible role, representing a fourth of both the primary and secondary actors. Several companies were present as secondary actors, mostly representing fields that are influenced by the policies, but sometimes also as climate solution innovators. Mentions of large companies' actions were common, as were mentions of their stances related to sectors impacted by the policies and having weight in economic policy discussion in Finland, such as forestry, steel production and energy production. Academic institutions and researchers represented a tenth of all the primary actors. The visibility of environmental NGOs was rather low, especially compared with business and advocacy organizations. Environmental NGOs were only represented as primary actors in articles related to PD6. The visibility of fourth sector actors was very low in climate policy news reports. Notably, the presence of individual citizens, randomly picked out to represent the views of ordinary citizens, is more extensive than organizational forms of civil society, eNGOs and the fourth sector together.

The visibility of different stakeholder groups varied between the policy documents. The government and ministers were the most frequently mentioned actors in PD6 and PD2. On one hand, the targets of the policy documents, climate neutrality roadmap and

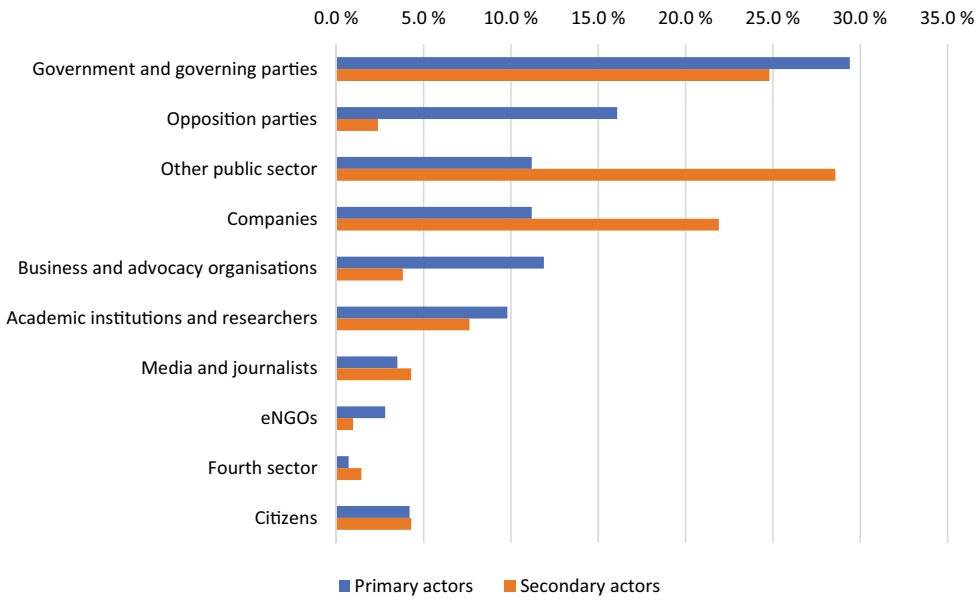

Figure 2. Actors' affiliations in articles related to the climate policy documents.

energy and climate strategy, were strongly framed as the government's outputs, and on the other hand, the discussion was linked to the responsible ministers. Government and ministers were often primary actors also in PD4. This was mainly due to the discussion on the process of outlining the joint climate targets for most parliamentary parties. Governing parties as well as opposition parties had the most visibility in PD5. The climate objectives of the government programme provoked discussion both within the government, on a party level, and between governmental and opposition parties.

The visibility of companies, and business and advocacy organizations was largest in PD2 (40% of occurrences of all actors). One of the main focuses of the media discussion on the energy and climate strategy was how the energy sector and companies see the plans of action. The share of the private sector was also large in PD1, being nearly 30%, partly due to the focus on biofuels and their producers. The visibility of academic institutions and researchers was highest in PD1, where the share was 35%, also due to the discussion on the biofuels' socio-technical potential. Environmental NGOs only had primary roles in PD6, although their views of the policies were frequently quoted and even raised in the headlines. The fourth sector representatives were only the main actors in PD2, whereas the visibility of citizens spread over the news of four of the policy documents.

3.3 Frames and future representations

Global scenarios by the IPCC and various national scenarios and future outlooks have played a key role in constructing and narrating the climate policies, but none of the analysed articles mentioned the scenarios behind the policies. However, in a third of the articles, visions of potential alternative progressions and pathways were constructed by journalists or interviewees. These ranged from speculations about the real-world

implications of different policy implementation measures to predicting technological development, human behaviour development and future outlooks based on reported scientific results (for example, on the implications of climate change).

The articles integrated several frames and scenario archetypes of social change simultaneously. Figure 3 presents the identified dominant frames and scenario archetypes. Using Nisbet's (2009) frames typology, "economic development and competitiveness", "public accountability and governance" and "social progress" were most frequently present. All frame types were identified except the "morality and ethics" frame. More skewed distribution was identified from the scenario archetypes of social change (Dator 2009), "transformation" and "limits and discipline" being the most frequent ones.

The most frequent frame and scenario archetype combination was "economic development and competitiveness" connected to "transformation". In these articles, the represented main goal of climate action was enabling innovation and the benefit of the national economy. Climate targets were subordinate to economic policy and analysed through economic variables, such as employment, exports, competitiveness, taxation, subsidies, investments and regional development. For example, an article published on 4 February 2020 represented the increasing competitiveness of national industry as a primary goal of government's decision to reduce the industrial electricity tax and presumed that it would also support transition to low-carbon energy production and clean energy system. Technology was the driver of change, highlighting the potential of new innovations supporting the development of dominant industries, such as forest biofuels and other bioenergy. The transformation of mobility, especially through the changing car traffic fuels, was a key theme, in discussing the economic feasibility of biofuels. Some articles illustrated in detail how much a certain industrial investment related to climate change mitigation provides employment in different phases of

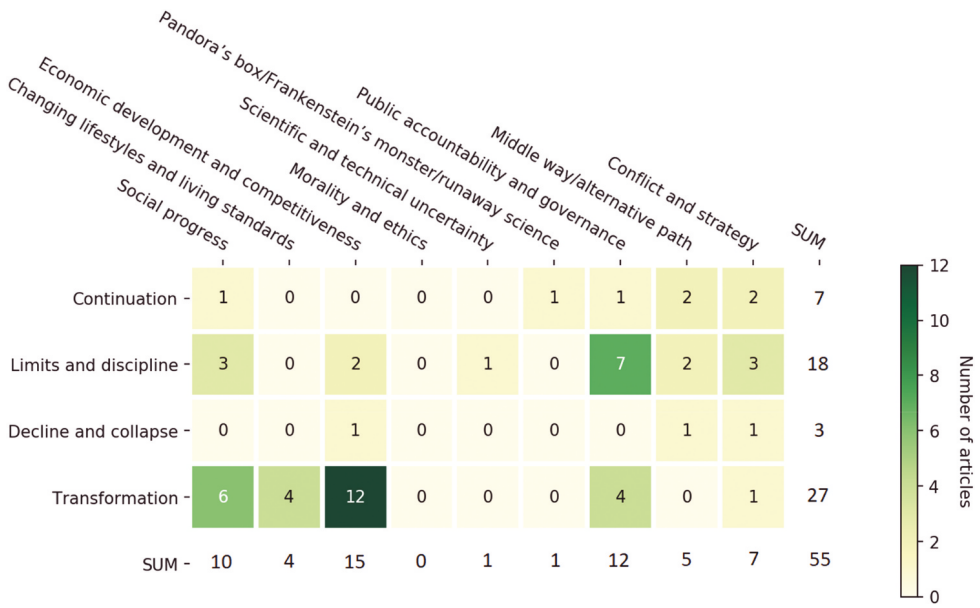

Figure 3. Frames and scenario archetypes in articles focusing on the climate policy documents.

construction and use, with no mention of actual emissions reductions. The representatives of the private sector were often primary actors in the articles, and they also strongly brought up the impacts of climate policies on corporation earnings and bureaucracy. For example, an article published on 25 November 2016 focused on the evaluations of two energy sector CEOs on how the outlined investment aid, supporting the transition towards a low-emission energy system, supports their businesses.

The combination of the "social progress" frame and the "transformation" scenario focused on urban and infrastructure development, food system transformation and integrating justice deliberation and support schemes in climate policy implementation. For example, an article published on 12 June 2019 envisioned how new experimental hyperspectral cameras could help reducing food waste throughout the production chain. Economic and technological perspectives were strongly present in also the "social progress" frame emphasizing the perceived importance of employment and livelihoods of the vulnerable groups and the societal benefits of technological development. The articles that combined the "public accountability and governance" frame with the "limits and discipline" scenario typically covered the climate policy negotiation process and results from the perspective of their effectiveness and feasibility. The headline of an article published on 3 February 2020 gives an example: "Experts call government's new climate action inadequate – 'More courage and political will needed'".

A comparison of the frames of the articles related to different policy documents shows that while most of the policy documents were addressed with several frames, there are differences between the documents (Figure 4). In the articles related to two earlier policy documents (PD1 and PD2), climate change was most often framed as a question of "economic development and competitiveness". That was the case in nearly half of the articles. The frame was used to a lesser extent in the most recent PD5 and PD6, where the shares were 18% and 14%. The "social progress" frame was used in articles related to all the policy documents except PD3, but more often the three recent policy documents, with shares ranging from 20% to 40%. The "public accountability and governance" frame was used in articles on the majority of the policy documents, with shares ranging from 21% to 60%. The "conflict and strategy" frame was used in PD3 and in articles related to the two most recent policy documents, with shares of 36% for PD5 and 14% for PD6. The articles from 2019 and 2020 focused on portraying conflicting views of different actors, the government and opposition, or the government and critical stakeholders, and analysing who were the "winners and losers" of climate action. The personal voice of journalists was typically strong in articles using the "conflict and strategy frame", and even stronger in articles using the "middle way/alternative path" frame. In the latter article group, the focus was on critical analysis of the speeches and deeds of the policymakers, often given in commentaries. Also, the "middle way/alternative path" frame was used in articles related to the two most recent policy documents, with shares of 18% (PD5) and 21% (PD6). The "changing lifestyles and living standards" frame was used in PD1, PD2 and PD6 with shares ranging from 7% to 14%. Lifestyle-centred articles covered the impacts of car use, fuel prices and electric vehicles on lifestyles. The articles using the "scientific and technical uncertainty" frame and the "Pandora's box" frame were included in PD2.

The "transformation" scenario archetype stood out in articles related to the two earlier policy documents (PD1 and PD2) where the shares of the narrative were 71% and 82% of the articles (Figure 5). It was also present as a dominant narrative in the

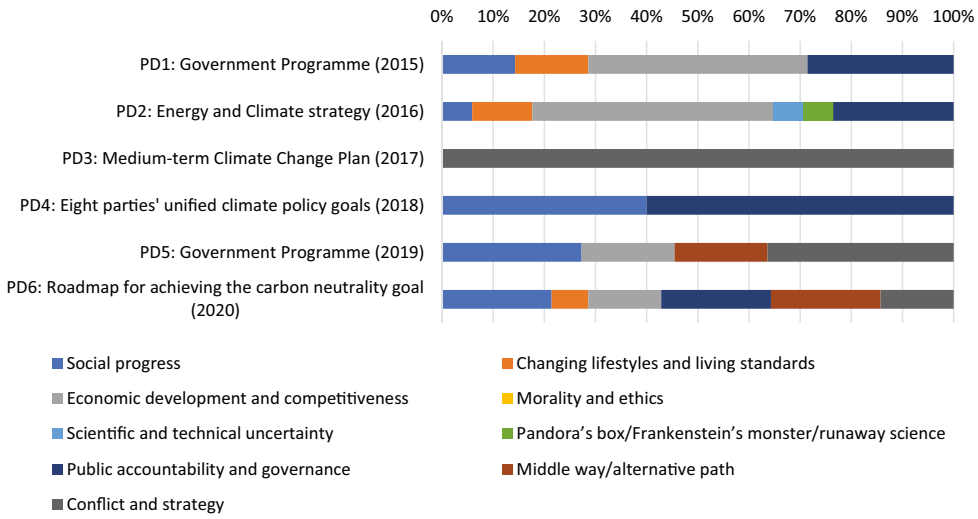

Figure 4. Frames in articles focusing on the climate policy documents.

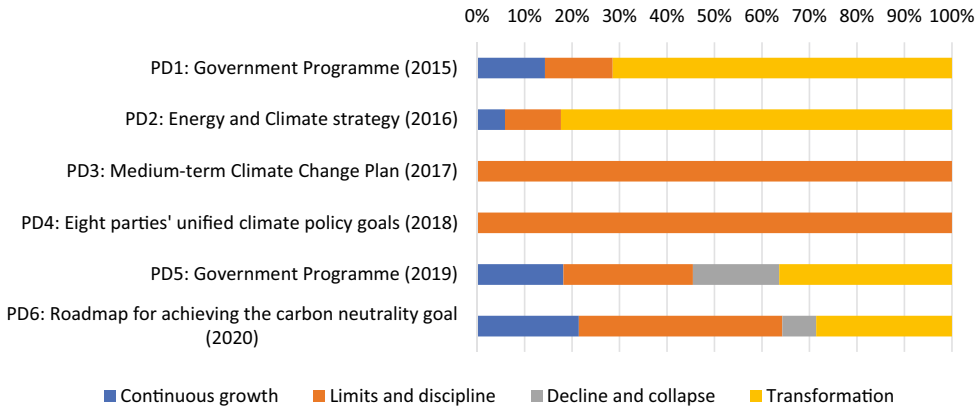

Figure 5. Scenario archetypes in articles focusing on the climate policy documents.

articles related to the two most recent documents (PD5 and PD6), with shares of 29–36%. The "limits and discipline" frame was the only narrative used in articles on all policy documents and it was used in all the articles included in PD4 and PD3. The shares in PD1 and PD2 were 12–14% and in PD5 and PD6 they were 27–43%. The shares of the use of "continuation" scenario were 6–14% in PD1 and PD2 and 18–21% in PD5 and PD6. In this article group, the articles reported outputs that categorically opposed climate policies and their implementation, focused on the political game and parties' power relations, or reviewed other megatrends without integrating them with climate change. The "decline and collapse" frame was used in articles related to the two most recent documents, with shares of 18% for PD5 and 7% for PD6. These articles emphasized that declining economic conditions and a lack of money restrain climate change mitigation actions.

4. Discussion

Several high-profile scientific assessments emphasizing the urgency of more stringent climate policies have been published since the late 2010s (e.g. IPCC 2021). This accumulating scientific evidence influences policy-making via multiple routes, including media representations affecting the formation of the public agenda. Given the increasing pressures facing commercial news media (Temple 2018) the public broadcasters are in many countries in a key position to foster science-based climate debate. In Finland, public broadcaster aims to support democracy and provide comprehensive and reliable information, as stipulated by the law and operationalized by the strategy of the broadcast company Yle (Yle 2020). However, successful climate mitigation and adaptation call for more than high quality environmental media coverage: if climate issues are framed as isolated environmental issues, profound economic, political and cultural implications are likely to remain unnoticed (Lyytimäki 2011).

Our analysis shows some encouraging general-level signals. First, our sample supports earlier studies (Ylä-Anttila et al. 2018; Lyytimäki et al. 2020) indicating that the mainstream media, including public broadcaster Yle, gives considerable space to climate issues. However, public attention is not guaranteed. Climate change is a long-term, global and non-tangible policy issue and national climate strategies are a challenging news topic, and therefore some decisions or documents with high relevance for climate change mitigation and adaptation can be left with relatively little media attention. Second, the sample shows that in the mainstream media discussion related to Finnish climate policy documents, the juxtaposition of climate denialism and alarmism or statements on scientific uncertainties do not seem to be very accentuated (see e.g. Cann and Raymond 2018). This does not indicate a societal agreement on the most appropriate framings of climate action and related futures. Instead, it indicates a maturation of climate policy as a news genre. A public broadcaster can legitimately report about climate policy issues without a need for "balanced reporting" giving a voice to the climate sceptic actors (Boykoff 2011). However, this does not mean a complete absence of sceptical voices that can still be found in online comments of the news.

The results show a high diversity of framings and division of future projections related to climate policies. More extensive integration of climate change and policies into long-term social progress and systemic change in the news reports could advance the integration of just transition thematic and therefore forestall polarization around the topic (Brüggemann et al. 2020; Pearson et al. 2021). In some countries, the public-service media has already taken a bigger role in providing an arena for future-oriented societal-level discussion. In Britain, the BBC has a "Future" section on its website completely dedicated to envisaging societal transition in the face of climate change (among other drivers). The Swedish national broadcaster SVT launched a climate newsletter in 2021. As of July 2021, the only Nordic public broadcaster to have a special section on its webpage for climate change is Denmark's DR, which falls under the section "Knowledge" on its site. Yle, on the other hand, is the only Nordic public broadcaster to dedicate a section to "Nature", often featuring news on the impacts of changing climate on the Arctic nature.

The economic framing of climate change seems to most adamantly cling to the status quo frames. It could be argued that, partly as Dator (2009) assumed, "continued growth" and "transformation" in economic terms are seen as the default models for the society's

(climate) future. In previous studies of public media discussion, climate action has been heavily subordinate to economic policy (Ylä-Anttila et al. 2018). A transformation, as presented in the results, is closer to green economic transition with incremental technological development (Söderholm 2020) than a systemic transition to sustainability (Geels 2011). "Creating green jobs" has become a very popular target in economic and societal development, and this is strongly present in the analysed articles. The representations of transformation also include a premise of continued economic growth, in contrast to discussions on degrowth transition (Büchs & Koch, 2019). Overall, the success of the climate policies was mainly discussed against economic criteria in the analysed articles. The opposition parties' representatives, to whom economic rhetoric and critique offer powerful arguments against the government's policy action (Harjuniemi 2021), had a significant share of being the primary actors in the articles. In some cases, climate targets were presented as an entitlement for an economic goal.

Such framings have been identified in similar media studies before. A study on the media coverage of the German Renewable Energy Act from 2000–2017 uncovered such shifts in the media framings (Dehler-Holland et al. 2021). Over the 18-year-period the coverage shifted from positive accounts of the renewable energy industry, often emphasizing the economic gains the renewable technologies bring, towards emphasizing the costs that the act imposes on society, particularly on households, reminiscent of the conservative anti-climate talking points highlighted by Nisbet (2009). The authors fear such a shift in framing, if generalized, may endanger public support for climate action and long-term renewable goals.

Nisbet (2009) notes the economic consequences frame can be used to both oppose and promote climate policy, depending on the actors in question. An analysis of climate change coverage between 1997 and 2013 in the United States, Finland, France, Russia and India (Ylä-Anttila et al. 2018) discovered a shift from emphasizing the negative economic consequences of climate change mitigation to economic growth and environmental protection as mutually supportive rather than competing goals. Our study shows that the economic angle is indeed relevant to many of the actors, from politicians to business owners, from the public sector to the lobbyists.

The media representations of the climate policy documents are more variable over time than between different types of documents. Notably, the only legally binding policy document in the material (Ministry of the Environment 2017) has aroused the least public discussion in the media. Media topics arousing strong conceptions and emotions can take space from potentially more impactful topics (Freedman 2018; Davis 2019). Overall, a more multifaceted treatment of climate policies increased during the study period, especially in terms of frames and scenario archetypes. However, based on the analysis, politicians are frequently referred actors that are allowed to comment on policy documents often without a critical or investigative journalistic angle. This may be explained by the complicated characteristics of climate science and policy, and the unfamiliarity of journalists with climate issues, especially in the articles related to the earlier policy documents. This is not only the case with their comments but also with their frames of climate change and scenario archetypes of social change. Hence, the media articles noticeably reflect the spirit of the prevailing national-level political atmosphere. In the articles related to the latter policy documents more often multiple actors and their

perspectives are included in the same article, which has sometimes led to frames that emphasize conflicting views or a middle way between them.

5. Conclusions

Public broadcasting services provide an important opportunity for science-based climate and energy news production in an age of increasing commercialization, fragmentation and polarization of media and social media debates. Here a sample of online content provided by the Finnish Broadcasting Company Yle was studied. The results show that a more multifaceted coverage of climate action increased during the study period of 2015–2020, especially in terms of frames and future scenario archetypes, and indicate gradually widening awareness of climate risks. Media coverage related to climate and energy policy strategies give relatively little attention to future representations of smooth continuation of business-as-usual or gloom-and-doom representations highlighting decline and uncontrollable collapse. Instead, the future is more often seen through a lens of well-organized energy transformation, or a change process motivated by an increasing understanding of limits to growth. However, the emission reduction potential of system-level changes has been discussed vaguely as the news often emphasizes specific technologies, isolated policy decisions or consumer choices and individualized responsibility. Climate change has been framed as an isolated policy area, and climate change mitigation and adaptation remain framed as subordinate to economic policy targets. The results indicate a maturation of climate policy as a news topic and highlight the need for developing media reporting practices sensitive to consideration of alternative, long-term futures.

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Data availability statement

The authors confirm that the data supporting the findings of this study are available within the supplementary materials of the article.

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RESEARCH ARTICLE

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Climate Change Versus Economic Growth: Quantifying, Identifying and Comparing Articulations in News Media Using Dynamic Topic Modeling

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ABSTRACT

Climate change and economic growth are often portrayed as incompatible in both scientific literature and the media, yet they are treated as separate themes. This study analyses 24 years of Finnish news data (2000–2023, n = 39,375) using dynamic topic modeling to explore how these themes intersect and have evolved over time. Results reveal that climate change emerged as a distinct topic within the economic growth dataset, and vice versa. Initially focused on emissions and international agreements, the discourse within economic growth coverage evolved to connect climate change with sustainable energy practices and broader socio-economic issues. Conversely, economic growth appeared in the climate change news discussing governmental, business, and societal perspectives, often critiquing capitalism and emphasizing welfare and education. The findings demonstrate a gradual shift toward integrating economic and environmental narratives, suggesting that sustainable economic growth is increasingly viewed as essential in addressing climate change. In applying articulation theory to dynamic topic modeling, the study highlights the importance of contextualizing machine-driven methodology results within broader socio-political and economic landscapes.

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Topic modeling; media; climate change; economic growth; articulation theory

Introduction

Are we being told that economic growth should be sustained in a world grappling with climate change? This question forms the core of this study, which explores the evolving narratives of climate change (CC) and economic growth (EG) in Finnish media from 2000 through 2023. So far there is little to no evidence of the kind of decoupling of global CO_2 emissions and the growth of gross domestic product (GDP) needed for ecological sustainability (Vadén et al., 2020, 2021). Yet, in the contemporary discourse, CC and EG are often represented as opposing forces and ultimately incompatible within media narratives. However, with the rising discourse around green growth, these perspectives are increasingly portrayed not just in opposition but also as potential partners in fostering a sustainable economy. This shift marks a significant transformation in media representation (Vikström et al., 2023; Ylä-Anttila, Vesa, et al., 2018).

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Legacy media plays an important role in amplifying issue salience, sustaining public attention, and creating pressure on authorities, and remains central to the national conversation, especially in times of high-stakes political discourse (Langer & Gruber, 2021). This study aims to address the critical need to understand how media framing can influence public perception and policy responses to climate change and economic challenges. In 2009, Nisbet published an influential paper on frame analysis in the context of CC coverage, including how the EG frame is closely connected to the CC coverage (Nisbet, 2009). Nisbet views frames as linking two concepts in such a way that the audience of the framing accepts the (new) connection between the concepts after exposure to the linkage. As Ylä-Anttila et al. (2022) have shown, it is possible to identify such linkages in media debates on climate change utilizing topic modeling, a natural language processing (NLP) method used to identify topics in textual data (Blei et al., 2003).

Using two corpora of Finnish news articles, this research employs neural topic modeling via BERTopic (Grootendorst, 2022) – an advanced machine learning technique for NLP – to analyse how narratives around CC and EG have evolved. By integrating Articulation Theory (AT) (Clarke, 2015; Grossberg, 1986; Laclau & Mouffe, 1985), this study aims to unravel the connections between these themes and their broader socio-economic and political contexts, allowing us to examine the subtle nuances in language that reflect shifts in public understanding and policy orientation over time.

Therefore, the primary research questions for this study are: How have CC and EG been articulated in the Finnish media in general, and how have those articulations evolved from 2000 through 2023? A secondary question is to examine how CC is portrayed in the news on EG and vice versa. And finally, the article intends to assess the usability of BERTopic's Dynamic Topic Modeling (DTM), a form of topic modeling including temporal variables (Blei & Lafferty, 2006; Grootendorst, 2022), as a tool for identifying articulations in news data over time.

In the media, EG has been an overarching umbrella theme for several other topics that, while being large on their own, can still be argued to fall under the general topic of EG. For example, EG is present in public discussion when discussing anything from employment figures to justification of cuts to the services provided by the welfare state (van Oorschot et al., 2012), and is highlighted especially when discussing economic policy. This is not surprising as EG is traditionally seen as the primary goal of economic policy (Tobin, 1964). The Ministry of Finance of Finland, too, lists EG as one of the starting points for economic policy (Ministry of Finance Finland, 2023).

Among frequently used media framings, also climate change and its mitigation easily become subsets of EG and economic policy (Nisbet, 2009; Vikström et al., 2023). On the other hand, similar to EG, CC can be said to have grown into an umbrella-like thematic position of having a subsets of topics including green energy transition and climate-friendly diets (Doyle, 2011; Stoddart et al., 2021). Systemic changes called for by scientists (IPCC, 2018; Pörtner et al., 2021; Vadén et al., 2021) to perform the sustainability transformation to mitigate climate change are rarely mentioned, whereas incremental progress and miniscule changes are highlighted (Barkemeyer et al., 2017; Vu et al., 2019).

The significance of this study lies not only in its contribution to academic discourse but also in its potential impact on policy formulation and public perception. Comparing the evolution of two potentially overlapping but greatly contradicting issues such as CC and EG via topic modeling offers a novel way to examine their represented relationship in the media. By identifying and analysing the articulations of CC and EG in the media, this study aims to provide insights into the complex interplay between economic and environmental priorities as portrayed to the public. The power dynamics present in the media coverage, and the power of the media itself as articulating the changing world for the public, remain pervasive within the context of this study.

Earlier research

Abundant research has traced the evolution of CC as a distinctive news topic, and in recent years, there have been an increasing amount of studies utilizing topic modeling and other NLP methods for CC coverage and communication (Bohr, 2020; Schäfer & Hase, 2022). In most instances, the

topic modeling in question is a well-established topic modeling method Latent Dirichlet Allocation (LDA) (Blei et al., 2003). For example, a vast 2020 study (Bohr, 2020) examined 52 U.S. newspapers' climate change coverage of 20 years utilizing LDA-based DTM. Other instances include a study covering news articles from 2017 and 2018 containing keywords "climate change" or "global warming" (Rabitz et al., 2021), and a 2022 study covered English-language Pakistani climate coverage from 2010 to 2021 (Ejaz et al., 2023). Eikelboom et al. (2024) analysed English-language newspapers covering climate change news published during 26 Conference of Parties (COP) meetings. An LDA-based modeling has also been used to analyse climate discourse in Twitter (Uthirapathy & Sandanam, 2023).

An extension of LDA called Structural Topic Modeling (Roberts et al., 2014) approach has been used, for example, to identify shifts in the media framing of the German Renewable Energy Act between 2000 and 2017 (Dehler-Holland et al., 2021), and in 2021 on issue attention and themes in climate change coverage in 10 countries between 2006 and 2018 (Hase et al., 2021). Meier and Eskjær (2024) used the same method to examine 32 years of climate change coverage in Danish newspapers. Though Finnish climate change coverage is closely monitored (Kumpu, 2024; Lyytimäki & Tapio, 2009; Mervaala & Lyytimäki, 2024a), similar longitudinal analysis utilizing topic modeling has not been performed.

As EG is such an integral part of any country's economic policy, and politics in general (Jacob & Osang, 2020; Stigler, 1975), it is not surprising that country-specific studies on EG as a news topic are rarer – within the hegemonic discourse, EG may not appear to be as distinct a subject as CC. However, Jacobs and Tschötschel (2019) do use a 10-year-period of economic growth coverage as a case for methodological fitting of LDA and critical discourse analysis.

The media framing of climate change, a long-term crisis, and its mitigation has changed over time: recently the COVID-19 crisis acted as a critical event altering the climate change media discourse, including the frames of green recovery (pandemic seen as an opportunity for climate action) and parallel crises with similar causes related to unsustainable human intervention in the natural world (Stoddart et al., 2021).

A 2009 study (de Vreese 2009) found that the way the EG coverage was presented had varying impacts depending on its positivity or negativity. Negative portrayals of economic consequences decreased people's economic expectations and their approval of the EU enlargement, whereas positive interpretations resulted in more optimistic economic evaluations and greater backing for enlargement.

While there have been more broad topic modeling approaches to discourse analysis (Jacobs & Tschötschel, 2019; Jo, 2019), applications for articulation theory in particular have not significantly emerged. Topic modeling methods such as LDA has been utilized to reliably discover latent themes in textual data (Blei et al., 2003), they fail to account for the temporal dynamics of the data relevant for longitudinal media research. To address this limitation, various approaches to DTM have been developed to address the evolution of topics over time, enabling the identification of shifting and fading trends, topics and themes present in the dataset (Blei & Lafferty, 2006). This is done by incorporating temporal information such as the publishing dates of the news articles into the modeling process.

Utilizing DTM in conjunction with AT offers a nuanced insight into the evolution of various elements and their interconnections, providing a way to understand the prominence of particular ideological components and the shifts in their relationships with others. AT emphasizes that elements within a discourse are not invariably linked; they can be detached and reattached to diverse ideological sequences based on the prevailing discursive practices (Grossberg, 1986). Similarly, DTM provides a lens to observe the temporal dynamics of word associations with specific topics.

Articulation theory and dynamic topic modeling

Analysing the relationships between CC and EG is challenging due to the expanding and increasingly blurred border areas of both themes. The rapid evolution of language in the digital age has made interpretations of media messages increasingly fluid. At the intersection of communication

studies and computational analysis, this research combines two frameworks that can help clarify these transformations: AT and DTM. While prior studies that have applied topic modeling to cluster content thematically, this approach uses AT to interpret how meaning is actively constructed and reshaped across discourses, thus adding a deeper cultural and ideological dimension.

AT explores how particular linkages are formed within a discourse. It suggests that meanings of words and concepts are constantly constructed through socio-political and cultural intersections (Clarke, 2015; Grossberg, 1986; Laclau & Mouffe, 1985). The concept of articulation first became part of the cultural theorists' vocabulary, and was only later adopted by discourse theorists, who focused on the production of social relations through language. Within cultural studies, articulation provided a framework for analysing historically specific social forms, such as ethnicity and gender, which emerged as central themes alongside class struggle in shaping social structures (Hall, 1985, p. 92; Kortesoja, 2023, p. 13).

According to Laclau and Mouffe (1985, p. 105), an "articulation" is a practice that establishes relationships among elements, altering their identity in the process. The resulting structured totality is termed "discourse". Within this discourse, the altered, articulated positions of these elements are referred to as "moments", while any unarticulated difference is termed an "element".

Building upon this, Simon Lindgren describes in his book Data Theory (2020, pp. 120–122) "discourse" as the fixation of meaning within a domain. Using tools like BERT to examine news text reveals how words cluster together based on actual language use, effectively mapping the "structured totality". This real-world language use, as seen in media and as used by its consumers, embodies what Laclau and Mouffe would call "articulation". It is through this process that relations among words (signifiers) are established, positioning them in relation to others and thus sustaining and crafting meanings.

In Laclau and Mouffe's terminology, societal entities derive their meanings via practices termed "equivalential articulation" that align them with other meanings (Laclau & Mouffe, 1985, p. 116). This alludes to the overarching mechanism of connotation. For instance, within environmental discourse, "climate" has obvious environmental connotations, but the same word can also represent the political or economic "climate" or "atmosphere" within the business economics discourse, alongside the meanings related to CC.

The discourse streamlines societal understanding by forging chains of equivalence, facilitating the establishment of hegemonic articulations (Laclau & Mouffe, 1985, p. 170). A word embedding model can capture this as it assigns similarity scores that represent the probability of the co-appearance of words in a given corpus. Visualizing this within a word embedding model, where similarity scores are determined between words, one can imagine selecting a word from the model's bags of words and, as Lindgren puts it, pulling it out like a thread where this word is then connected with its closest counterpart, which is subsequently connected to its next closest term, and so forth. This structured network of relationships centers around key signs, termed "nodal points" (Laclau & Mouffe, 1985, p. 112). For instance, terms like "climate change" and "economic growth" serve as such, anchoring other related discursive moments.

In topic modeling, the meaning of a topic emerges from the constellation of words that are statistically associated with it, similar to how meanings are articulated through the relational dynamics among cultural elements in AT. Building on top of topic modeling, DTM offers a way to track the ebbs and flows of topics within vast media landscapes over time (Blei & Lafferty, 2006). However, on its own, DTM lacks the interpretive lens necessary for analysing the socio-political dynamics that articulate these topics. The combination of DTM and AT enables visualizing the dynamic process of meaning-making in media content. DTM identifies potential articulations in large datasets, while AT provides a framework to qualitatively analyse why these articulations occur and how they reflect broader cultural and societal forces. This integrated methodology thus shifts the focus from merely mapping topics to understanding the dynamic processes through which meaning is constructed, deconstructed, and reshaped. In this way, DTM serves as a complementary tool rather than direct representation of discourse analysis.

As Lindgren discusses AT specifically, he notes that "in order to bring the advantages of interpretive, critical, social theory closer to those of large-scale, unsupervised, data science techniques, we must be open to make such creative compromises risking failure and error from some perspectives and success from others" (Lindgren, 2020, p. 120). This entails "(re)purposing social science theories and methodologies in ways that feed into new questions and new readings of the results of the computational methods."

AT is a sociological and cultural construct that examines how different elements or identities connect to form a coherent whole while remaining distinct. These connections evolve and change over time and cultural contexts. The connection between AT and DTM lies in grouping elements like words, concepts, and identities to form larger structures represented by topics.

As Kortesoja (2023, p. 2) explains, "articulation is a discursive practice that enables signifying elements to connect to produce new meanings, which are essential to social and political action." This connection between signifying elements aligns with the way DTM identifies clusters of co-occurring words and tracks their evolution over time, but articulation theory adds a layer of cultural interpretation, clarifying why these clusters may emerge, evolve, and take on significance in a particular socio-political context.

Essentially, in DTM, a topic represents an articulation – an interconnected unity formed from disparate elements (words, phrases, and documents) that share common themes over a period. This unity is contingent and constructed rather than inherently existing, aligning with Stuart Hall's notion of articulation (Clarke, 2015).

Data and methodology

Data collecting and its caveats

The data for the analysis consists of news articles published on major Finnish news outlets between 1 January 2000 and 31 December 2023. The news outlets selected were Helsingin Sanomat (HS), the largest daily Nordic newspaper, an evening tabloid Ilta-Sanomat (IS) and an economics and business-oriented online newspaper Taloussanomat (TS) that was incorporated into IS during the time period covered in the data.

We used a custom Python-based text scraping script that collects news stories of set parameters directly from the archives of the news outlets (Mäkelä & Toivanen, 2021). The script utilizes the application programming interface (API) of the outlets' online search function. Hence, our data consists of every story included in the search results provided by the news outlet, including all journalistic news contents, editorials and opinions retrieved with the search queries. The choice of relevant articles related to CC or EG was made within the search API which itself was based on the news outlets' internal guidelines and categorization system: the two subsets used the outputs of the search query for the word "talouskasvu" (economic growth) and "ilmastonmuutos" (climate change). In essence, this means that the API returns the exact same result that the online news archives would return, and the labels for the categorization originate from the media outlets. The articles may then not have the search query itself within the text and, vice versa, the search term may be found in articles published by the outlet that are not within the search results due to incomplete labeling.

The caveats for this approach include the possibility that there may be stories omitted from the dataset that perhaps *should have been* labeled as EG or CC-stories but for some reason have not been included. However, as it stands, the data set represents news outlets own, conscious recognition that these stories where part of given themes.

Since the stories included are indeed the ones deemed to be relevant – by the media outlets themselves – to the two themes, the topics identified within those stories allow examining how the themes are articulated – and how those topics have evolved.

The dataset for stories on climate change published between 1 January 2000 and 31 December 2023 contained 15,219 stories, pre-cleaning. The dataset of stories on economic growth contained 24,678 stories, pre-cleaning. The datasets overlapped very little as there were only 632 news stories that existed in both corpora, which in and of itself infers that the themes are indeed seen rather separate in the media environment. These articles mainly coincide with the COP climate conferences apart from the spring of 2022 when there is a peak of over 30 articles that appear in both datasets in April and May of 2022.

The rationale for modeling the datasets separately is firstly that the EG dataset is almost twice as large as the CC dataset which, if the datasets were modeled together, would lead to emphasizing the vocabulary and thematic topics present in the EG dataset over the CC dataset. This would also serve against the objective of trying to identify topics as articulations specific to CC and EG. By modeling the datasets separately, the topics are formed based only on the words appearing their respective key themes: a topic on Finnish politics is articulated differently in CC and EG models, for instance. The fact that the datasets overlapped with only 632 stories supports this approach.

The data was cleaned following a standard procedures in natural language processing (Tabassum & Patil, 2020) which included removing a list of stop words, words common in Finnish language, and a manually compiled list of words and phrases that featured frequently as parts of the news story structure such as "Lue lisää" ("Read more"), or parts of texts that had nothing to do with the story itself but were left intact by the scraper such as error messages related to embedded content. As embedding was used, the cleaning was done in two parts, as HTML elements and other characters not related to the stories themselves were removed before the embedding process, and then the stop word list was accounted for as part of the modeling process.

As we were only interested in issue-based representations of the topics, the names of individuals were also removed from the datasets. Individual people momentarily peaking in media attention during the 24-year period would have a distorting effect on topics. The removal of individuals was done with the aid of a Named Entity Recognition (NER) corpus for Finnish language (Luoma et al., 2020).

Though the long time-period covered data set provides insights into the prevalent topics and their trends, it is important to acknowledge the potential impact of terminology shifts on the outcomes of the search query. While the term for economic growth ("talouskasvu") has not changed in the 23 years in question, the term covering topics of climate change and global warming has partially shifted from "greenhouse effect" ("kasvihuoneilmiö") and "global warming" ("ilmaston lämpeneminen") to "climate change" ("ilmastonmuutos"). These distinctions are important as each term carries unique connotations and reflects different aspects of environmental concerns – they are not interchangeable i.e. they suggest different articulations. The term "greenhouse effect" focuses on the physical mechanism of trapping heat, "global warming" refers specifically to the increase in average global temperatures, while "climate change" encompasses a broader range of impacts, including changes in weather patterns, ocean conditions, and ecosystem disruptions. Given the focus on the socio-economic implications of environmental issues, particularly in relation to economic growth, "climate change" was deemed a sole sufficient search term.

Based on the search API results, and following the global trend of popularizing the term "climate change" (Liu & Huang, 2022), this rearticulation happens between 2006 and 2008, and a total of 501 articles could be found with the search query "kasvihuoneilmiö" that were not included in the original CC dataset. Earlier research on Finnish climate media discourse supports these findings, and the 501 articles left out throughout the 24-year timeframe do not have a significant effect on the total coverage of the issue when compared to coverage data for all three terms (Mervaala & Lyytimäki, 2024b).

As scrapers may run into issues for instance with dynamic story elements requiring scrolling by the reader, the datasets represent only a close-to-maximum sample. The search queries also returned some stories headlines and links that were no longer available. Such articles appear on the search engines for the website reader but the headlines lead to an empty page or a broken

link or, in one instance, a dynamic article with broken code. On Ilta-Sanomat and Taloussanomat site, the only empty articles were video-based stories that were either removed or did not have any text content apart from the video.

After the original collection of the data, some manual "refilling" of text content of the Helsingin Sanomat articles was done to include content truncated or omitted due to previously mentioned issues. Before comparison and analysis took place, both datasets were cleaned to ease the topic modeling processing. The final cleaned CC dataset consisted of a corpus of 14,765 articles while the final cleaned EG dataset had 24,610 news articles.

Topic modeling with BERTopic

After both datasets were deemed ready for analysis, they were processed individually using BERTopic version 0.13.0, the neural topic modeling technique used for this study. At the heart of the model lie Bidirectional Encoder Representations from Transformers (BERT), which have been demonstrated to produce superior contextual word and sentence vector representations (Grootendorst, 2022). BERTopic uses pre-trained transformer-based language models to generate document embeddings that are then clustered and represented as topics with class-based term-frequency–inverse document frequency (TF-IDF) procedure. The flexibility of utilizing these three steps allows for BERTopic to consider the context of the *words* more comprehensively in comparison to earlier prominent topic modeling methods such as LDA and Non-negative Matrix Factorization (NMF), while also supporting DTM. Unlike traditional topic modeling methods that are mixed-membership models, such as LDA, in BERTopic there are no topic distributions are generated within a single document. Each document – or in this case, a news story – is assigned a single topic.

As traditional topic modeling techniques are static and do not accommodate sequentially-organised sets of documents, the first (DTM) technique was introduced as an extension of Latent Dirichlet Allocation (LDA) to model the evolution of topics over time (Blei & Lafferty, 2006). BERTopic's builds on this by initially creating a comprehensive set of topics using the entire dataset and then assigning more granular, time-specific topics to each main topic (Grootendorst, 2022).

Following Sánchez-Franco et al. (2023), the process of utilizing BERTopic for the dataset includes the following steps: data pre-processing, dimensionality reduction, clustering, topic identification and merging, creating descriptions, and finally, reducing dimensions to 2D for visualization (see Appendix).

The parameters set for BERTopic were experimented on until arriving to coherent and consistent results as supervised by the author. The textual datasets were embedded using TurkuNLP's Finnish language "sbert-cased-finnish-paraphrase" model from the sentence-transformers library. To enable effective clustering, UMAP (Uniform Manifold Approximation and Projection) was applied to reduce the dimensionality of the embeddings. The UMAP parameters were set to n_neighbors = 15, min_dist = 0.1, n_components = 5, and cosine distance as the metric. These settings ensured that local and global document structures were captured adequately, making it feasible to identify meaningful clusters. Clustering was performed using HDBSCAN (Hierarchical Density-Based Spatial Clustering of Applications with Noise), which automatically detects the number of clusters based on density, with the parameters: min_cluster_size = 10, min_samples = 10, and euclidean distance as the metric. This allowed for the identification of distinct document clusters without requiring the pre-specification of the number of topics. Once the clusters were established, topics were represented using class-based TF-IDF (c-TF-IDF) to extract the most representative keywords for each topic. We adjusted the diversity parameter to 0.7 to balance keyword relevance and distinctiveness. A diversity score of 0.7 ensures that while the most representative keywords are selected, the topics also maintain a degree of uniqueness, reducing keyword overlap between topics.

The overall configuration mirrors the default settings of BERTopic, with the exception of the diversity parameter adjustment, which was selected to optimize the interpretability of the topic keywords by maintaining a balance between highly relevant and distinct terms across topics.

Results

Background: salience of economic growth and climate change

Throughout the early 2000s, EG articles are far greater in number compared to CC which is understandable as the EG dataset is twice as large as the CC dataset. After the first significant peak around the collapsed COP-6 climate change negotiations of The Hague in 2000 (Grubb & Yamin, 2001) the frequencies remain static until 2006 when the gap starts to narrow. The amounts of articles are almost even for the first time around the time of the Stern Review published in November 2006. This marks also the first permanent boost of CC coverage to a new sustained level.

In the CC dataset, non-climate events and crises apparent on the timeline include the economic crisis of 2008 and the beginning of the COVID-19 pandemic in early 2020 visible as a slump in all CC coverage (Lyytimäki et al., 2020).

Though by 2008 CC had become both a global and a local political theme, especially during the 2008 U.S. presidential election (Bomberg & Super, 2009), the financial crisis of 2007–2008 and the following recession, often dubbed The Great Recession, lead to widespread decline in public concern about CC (Obani & Gupta, 2016; Scruggs & Benegal, 2012). Finnish coverage at that time follows similar patterns but is explained partly by different reasons (see Figure 1).

After Barack Obama became president, and the recession showed signs of winding down, we see the first flipping in the order of the themes as CC briefly overtakes EG at the time of the COP15 climate change conference in Copenhagen (see legend 4 in Figure 1). According to the Media and Climate Change Observatory (Boykoff et al., 2019b), COP15 marks the all-time highest point of global climate coverage. After the disappointing outcome of the conference (Parker & Karlsson, 2018) and the start of the European Debt Crisis that lasts until 2014, the gap between CC and EG again widens to even a larger one than before 2006, and this state of affairs lasts until the 2015 COP21 climate conference in Paris. Largely publicized as a success (Parker & Karlsson, 2018), the Paris accord in late 2015 appears to both bring EG and CC briefly closer together again and create another increase in the permanent level of climate coverage and a new decline in EG. Overall, and as mentioned in previous studies, IPCC reports and COP conferences tend to create peaks in climate coverage around the world (Parks, 2020; Schmidt et al., 2013) and, according to this dataset, Finland is no exception.

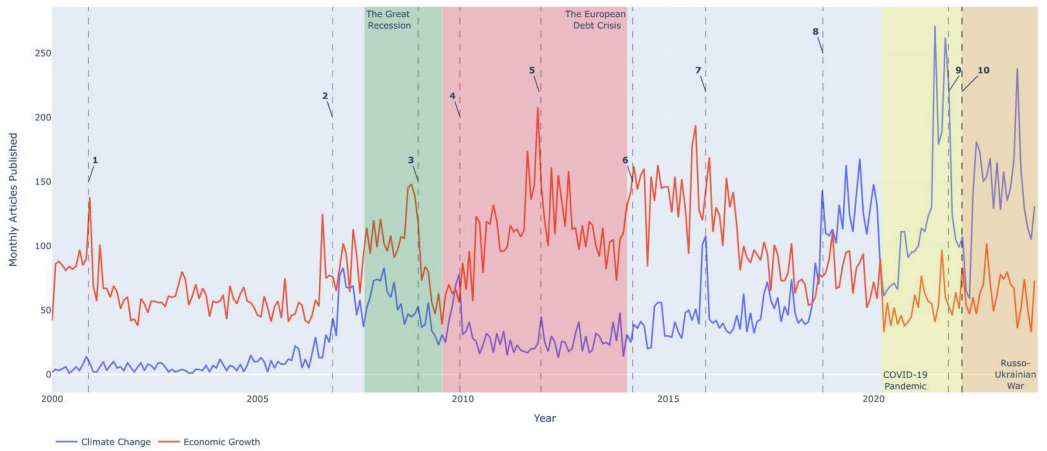

Figure 1. Amounts of news article son climate change and economic growth 1.1.2000-31.12.2023. Legends: (1) COP06 Hague, (2) Stern Review, (3) COP14 Poznań, (4) COP15 Copenhagen, (5) COP17 Durban, (6) Russo-Ukrainian Conflict Starts, (7) COP21 Paris, (8) IPCC, 2018 Report, (9) COP26 Glasgow, (10) Russia Invades Ukraine. Green color indicates The Great Recession, red The European Debt Crisis, yellow the COVID-19 Pandemic, and orange the escalation of the Russo-Ukrainian War.

The pivotal moment for the media attention relationship of CC and EG can be seen coinciding the publication of the highly influential IPCC report in October 2018 (IPCC). The report solidifies yet another boost on CC coverage but also sees CC overtake EG seemingly permanently in media attention. At the start of the COVID-19 pandemic in early 2020, the gap narrows again briefly but returns again to the "new normal" quickly and delivering the highest peaks for climate change in July and October 2021. After a similar shock drop after the Russian invasion to Ukraine on 24 February 2022 the same trend continues even throughout the Russo-Ukrainian war until the end of the year 2023 with peaks coinciding with extreme temperatures in July 2022 and July 2023.

The share of stories categorized as CC or EG is of course a small fraction of the overall articles published in the newspapers. Since 2017, HS publishes on average around 2900 articles per month (Mäkelä et al., 2020), and the highest peak of CC coverage in July 2021, 202 stories, represents a 6.8% share of the articles published of the news content (Mervaala & Lyytimäki, 2024a). As the number of overall articles published remains fairly stable, the increase in articles categorized "CC" and the decrease of stories categorized "EG" are absolute – not relative.

Identifying topics

In traditional topic modeling, determining the optimal number of topics often involves either statistical optimization or manual, human evaluation (Grimmer et al., 2022). For this study, the latter approach was chosen, manually assessing model coherence and interpretability across a range of potential topic numbers.

Initial BERTopic modeling with default settings yielded 200 topics for the EG dataset and 149 for CC. After manual inspection and accompanied coherence testing, fine-tuning was implemented to reduce the amount of topics, as the initial results were too granular with many overlapping topics. After fine-tuning the hyperparameters as described earlier, a minimum document frequency threshold of 30 to retain only topics represented in at least 30 articles. This threshold was chosen after experimentation as it provided a balance between coherence and granularity, yielding interpretable topics without an excessive number of minor themes. After this, the remaining closely related or near-identical topics were merged manually based on their calculated proximities and BERTopic's topic hierarchy function. The final amounts of topics were reduced to 90 topics for EG and 69 topics for CC, with c_v coherence scores of 0.661 for the EG model and 0.634 for the CC. A c_v coherence score of 0.6 or higher is generally considered good quality (Farea et al., 2024; Mapundu et al., 2024).

Each topic consists of words that are commonly used in articles identified as belonging to that particular topic. The algorithm groups similar documents together and identifies the most frequent and relevant words within those groups to define each topic. This process allows for the tracking of how topics evolve over time.

The top topics in both datasets are very distinct. In Tables 1 and 2 samples of top 24 topics per theme are shown as how they appear in the topics data frame. The global topics cover the entire 24-year period, with the words per topic representing estimates of the salience of each subject throughout the entire corpus. Each topic has been named based on the most common words associated with it and a manual examination of the topic evolution within the DTMs (see visualizations in the Appendix). At this stage it was also possible to validate whether some topics were too generic to represent any coherent topic. As per earlier study on topic modeling and frame analysis (Yli-Anttila, Eranti, et al., 2018), topic 8 was removed from the EG dataset as too generic as it discussed a variety of topics from daily life to the Talvivaara mine leaks and, after closer inspection of the stories, consisted of mainly blogs, columns and opinion pieces. Hence, topic 25 on COVID-19 Pandemic is added to Table 2. The top words per global topic are displayed in Tables 1 and 2.

Climate change

As CC coverage in the media is often sporadic (Anderson, 2009; Boykoff et al., 2019a; Schmidt et al., 2013), the topics often spike in usage during the event and then return to previous levels, despite

Table 1. Top words per topic for Climate Change dataset, n = docs per topic.

Topic	Top words per topic (translated)	n
1. Temperature anomalies	measurement history, hottest, globe, average temperature, meteorologist, record, degrees, heat record, warmer, summer	993
2. Car traffic, emissions	traffic, electric cars, reduce, diesel, fuels, EU, emissions, car, government, price	729
3. Finnish forestry	biodiversity, Europe's, million, carbon sinks, nature's, carbon, commission's, carbon dioxide, harvesting, Finland's	572
4. Finnish climate policy	government, by year, forests, Finnish, emissions, goal, Climate panel, companies, climate, reduce	528
5. Melting glaciers	climate, glacier, meter, Greenland's, ice sheet, researchers, sea ice, warming, melting, Antarctic	523
6. Food	meat, reduce, animals, milk, agriculture's, diet, kilograms, climate change, grow, grocery	502
7. Baltic sea, wildlife	Baltic Sea, condition, nutrients, meter, sea, WWF, climate change, researchers, Archipelago Sea, phosphorus	470
8. Forest fires, wild fires	forest fires, wildfires, evacuated, dead, Australia's, state, authorities, south, in California, forest	447
9. Global climate policy	UN, president's, government, United States, Washington, China, plan, by year, climate change, senate	391
10. Climate agreements	climate agreement, Kyoto, climate conference, Paris, G8, meeting, degrees, EU, climate change, Glasgow	391
11. Climate activism	extinction rebellion, Greenpeace, demonstration, police, movement's, rebellion, morally, protesters', compensate, activists	370
12. Floods, droughts	floods, reported, Japan's, rains, state's, climate change, storm's, human, drought, died	366
13. EU climate policy, carbon tariffs, emission rights	Europe's, reduce, EU, Union's, emission rights, Commission's, renewable, Parliament's, energy's, member states'	318
14. Oil, fossil fuels	Exxon, engine, oil giant, climate change, Arabian, New, Mobil, fuels', price, palm oil	313
15. Economic growth	economy's, economic growth's, government's, central bank, public, market, money, grow, inflation, percent	301
16. Climate reports, IPCC	report, climate, climate panel's, information, UN, causes, IPCC, globe, climate change, warming	263
17. Air travel emissions	air traffic, EU, Helsinki, flying, emissions, euros, airplanes', amount, Europe's, turbulence	258
18. Children and youth	youth, children, child, grown-ups, family, affect, worry, climate change, voluntarily, father	221
19. Nuclear power	nuclear power plants, Germany, nuclear power, climate change, reactor's, Fukushima's, Fortum, Commission's, to build, natural gas	220
20. Circular economy, plastics	organic waste, clothing's, plastic, garment's, waste, sustainable, kilos, chemicals, buy, VTT	210
21. Species extinction	species, climate, animal, birds, researchers, climate change, warming, nature's, mosquitoes, areas	202
22. Atmosphere, emissions	carbon dioxide emissions, growth, coal's, energy's, fuels', million, China, in the atmosphere, greenhouse gases', climate's	196
23. Finnish politics	SDP (social democratic party), Center Party, chairperson, elections, support, climate change, party, government, Greens, Finns Party	196
24. Construction, urban planning, heating	construction, district heating, Helsinki, green areas, underfloor hearing, buildings, in cities, water-circulating, residents, facades	196

slight increase in the overall climate change coverage. The Paris Accord is a good example of this as, though the topic 10 representing climate agreements peaks always near COP meetings, near the Paris COP21 in the fall of 2015 the topic peaks higher than ever before, and then peaks again in the summer of 2017 when president Donald Trump announced the withdrawal of the U.S. from the Paris Accord.

The wordings used in the topics evolve accordingly: the quarter preceding the COP21 summit discusses France, the summit, and previous climate agreements including the Kyoto protocol. During the summit, similar relevant words are accompanied by the 1,5 C goal. "Paris" replaces "Kyoto" after 2015 and is referred to consistently, though both remain in top words for the global topic (see Table 1). The weight of "developing nations" becomes more prominent toward the end of the dataset, and the final uptick can be dated to the extreme heat in summer 2022.

Table 2. Top words per topic for Economic Growth dataset, n = docs per topic.

Topic	Top words per topic (translated)	n
1. Stock market	stocks, stock exchange's, stock prices, fell, investors, index, prices, in the United States, shares, stock markets'	1146
2. Russo-Ukrainian crisis, oil	Russia's, Ukraine, Crimean, rouble's, war, Russians, oil's, country's, sanction's, crisis	1030
3. European Central Bank, inflation	ECB, euro area's, central bank, interest rate, governor, Europe's, percent, council's, main refinancing rate, monetary policy's	985
4. FED, US monetary policy	Fed, interest rate, central bank, chairman, Open Market Committee, monetary policy, inflation, Federal, percent, refinancing rate	957
5. Finnish elections	SDP, Centre Party's, party's, politics, government's, in elections, candidates, election's, president's, Swedish Peoples Party	945
6. OPEC, oil	oil, price, crude oil, gasoline, OPEC, dollar, IEA, per barrel, North Sea, Saudi Arabia	776
7. EU economic growth	France, Europe, grew, economic growth, economy, Prime Minister, Germany, Paris, percent, French	754
9. Budgeting, MoF, cuts	government's, public, Ministry of Finance's, Finance Minister, cuts, euro, municipalities', economic, million, budget's	560
10. Greek debt crisis	Greece, democracy, IMF, in Greece, debts, Eurozone, Syriza, Greeks, billion, euros	553
11. German economic growth	Germany, Europe's, economic, Berlin, grew, percent, economic growth, GDP, Eurozone's, Bundesbank	528
12. Climate change	Kyoto, energy, IPCC, Earth's, climate change, UN, United States, fossil, emissions trading, transportation	523
13. Corporate tax, economic growth	taxation, companies', euros, government's, state's, corporate tax, labor, billion, economic growth, tax revenues	517
14. Labor unions	government's, labor market organisations, STTK, Finnish Confederation of Professionals, employer's, unemployment, employees, Industrial Union, SDP, Prime Minister	489
15. Africa, developing nations	Africa's, UN, Africa, ANC, poverty, Ethiopia's, poor, developing countries', development aid, countries	453
16. IMF forecasts, global economy	IMF, global economy, Portugal's, International Monetary Fund's, estimates, to the percentage, international, economy, grow, warns	444
17. Swedish economy	SEB, Sweden, crown, to the percentage, Stockholm, GDP, Riksbank, Swedes, economy, finance minister	433
18. Bank forecasts	to the percentage, estimates, grow, economy, forecast, research institute, export, for the year, Handelsbanken, anticipates	421
19. Labor statistics	unemployment rate, Statistics Finland, work, unemployed, Ministry of Economic Affairs, TEM, employment, immigration, Finns, income	420
20. Chinese economy	China's, Peoples Congress', corruption, Taiwan, in Beijing, Hong Kong's, party, United States, Tiananmen, Chinese	418
21. Italian economy	in Italy, state's, government's, Europe's, public, Commission's, economy's, Eurozone's, debt, banks'	363
22. US economic growth	growth rate, United States', per annum, Department of Commerce's, quarter, consumption's, economic growth, growth, economists', GDP	360
23. Eurozone debt crisis	Europe's, Eurozone countries', monetary union's, from the euro, Germany's, countries', crisis countries', economy's, banks', debt crisis's	332
24. Japanese economy	Japan, BoJ, yen's, country's, central bank's, from the previous, quarter, economy's, United States', into dollars	297
25. COVID-19 pandemic	coronavirus's, pandemic's, economy's, China, virus, epidemic, estimates, forecast's, impacts, disease's	283

The most popular topic of the whole dataset is "Temperature anomalies" which also includes the dataset's highest peaks of 68 stories in spring 2023 (see Appendix Figure A1). The topic rises in spring and summer months, and since 2020, each year's peaks are higher than the previous. Since 2015, topic 1 connects with "Finnish forestry" (topic 3), "Forest fires, wildfires" (topic 8), "Floods, droughts" (topic 12), and "Finnish politics" (topic 23), during election season. For example, during the spring 2019 election, climate change was a very prominent theme during the campaign season, and the election was dubbed "the climate election" (Hassinen, 2019). In spring 2021, "Finnish forestry" peaks together with topic 1, and has the 2nd highest peak of 46 stories as new EU forestry regulation was an active topic in the media coincided with the municipal election season. Later, topic 3 returns as an election topic for the spring 2023 election.

"Food" (topic 6) is another interesting theme to focus on. After a slow start the topic picks up speed in 2006–2008 with mentions on animal-based diet and artificial meat can be seen alongside known meat product brands. In 2018 the topic jumps to a new level as the conversation turns to

demands of vegetarian lunches provided by schools. The largest peaks are seen in the between spring 2018 and summer 2019 as several food-related articles were published, including research on cow feeds to decrease methane emissions, and introduction of the first ever weekly vegan lunch in Finnish schools and kindergartens, as well as the "vegetarian lunch day" introduced to the Finnish Army. After 2018 increase in popularity the food topic never falls back to the preceding lower levels before the COVID-19 pandemic. For 2019, the topic turns to milk, beef and carbon footprint. Overall, the subject is divided over issues related to animal-based food such as meat, milk and cheese products, and half on plant-based diet, emissions, and food waste (see Table 1). Final mentions of the topic include "cutting down meat consumption," "changing diet," and "ilmastoruokaohjelma," the national climate food program, that was later scrapped (Pennanen, 2023). It is due to the higher frequencies starting from 2018 to 2020 that the topic reaches number 6 in the overall global topic popularity.

The second most popular topic in the whole CC dataset revolves around different forms of road traffic and use of private cars in particular. After a very modest start in the early 2000s, different "environmental" car solutions start appearing in the corpus with the first mentions of hydrogen-powered cars. The first significant peaks of the topic in January 2007 (22) and January 2008 (23) involve natural gas and cars powered by it, and overall discussion of carbon emissions, diesel fuel tax, and public versus private transport. After intermittent and decreasing peaking until 2010, the topic winds down until 2017 after which the electric car hype gradually takes the topic to the top tier with an average of 15 articles published every quarter until the end of 2022. The highest peak, 32, is reached in the summer of 2021. As a topic, the heavy focusing on electric vehicles coincides with the Finnish purchase subsidy for fully electric cars from 2018 to 2022 and the scrapping premium campaign from December 2020 to the end of 2021 (Traficom.fi, 2023). As the 2023 parliamentary elections also featured debates related to gas and diesel prices, the topic finally peaks both in spring (26) and summer of 2023 (31).

Economic growth

In the EG dataset, the intensity of the topic spikes are more prominent but at the same time less "sharp" in comparison to the CC topics. This can be due to the events and issues discussed in the news stories having seemingly longer timespans than the climate change ones – from the point of view of the media portrayals, that is. For example, Topic 1, *the Stock market*, remains fairly static with 10–20 articles per quarter with few peaks that tend to coincide rather with economic downturns than booms. One example of a more varying theme is the Eurozone crisis where two similar topics emerge at similar times: the smaller of the two covering the EU crisis countries in general (topic 23) but the dominant one focusing solely on the Greek debt crisis (topic 10) which was indeed a heavily debated theme in Finnish general elections in both 2011 and 2015 (Harjuniemi et al., 2015). The topics have similar paths initially between 2010 and 2012 but the second peak of 2014–2015 lifts the Greek crisis past the general debt topic to number 10 while creating the fifth highest peak in the dataset with 52 articles. Greek politics and comments of the country's "austerity drive" keep the topic alive well until the autumn of 2023 while the more generic debt topic "dies off" in July 2021.

The same is true for the second most popular topic in the EG dataset, "Russo-Ukrainian conflict." The topic is raised so high on the list due to the first peak starting at the Russian invasion to Crimea in 2014 and the second peak, highest of the whole dataset at 78 news articles, starting in 2022 when Russia started their invasive war in Ukraine. From 2014 onwards, the consecutive effects of the Russo-Ukrainian conflict on the Finnish economy and its economic growth can be seen in the topic evolution in, for example, the sanctions impeding the export of Finnish products to Russia. Words such as "sanctions," "accept," "ruble," and "export" start appearing in the EG-theme only after the annexation while the topic stops including words like "atmosphere for investments," "Tax Free purchases," and "Russian tourists." Throughout the period, the topic includes words related to fossil fuels, and, indirectly, to climate change, such as "oil," "energy," "oil

profits," "fires," and "the arctic dimension." Other evergreen theme words include understandably "war," "conflict," "military spending" and words related to political relationships (Table 2).

Topic 25, *the COVID-19 Pandemic*, is an interesting one as it does exist as a topic covering SARS, swine flu, and other epidemics around for the first 20 years of the dataset and remains in very modest, maximum five articles per quarter. Then, at the end of 2019, "corona virus" and "China" are added to the vocabulary, with later additions related to employment and economic stimulus and growth. The topic peaks in 2020 with 57 articles and stays relatively high until it starts declining at the end of 2021 and collapses completely to 1–2 articles per quarter as Russia invades Ukraine in February 2022.

On evolving articulations

After identifying each topic's dominant keywords and representative documents from the DTM output, a closer examination of them uncover how specific discourses were articulated, disarticulated, or rearticulated over time. This involved examining how certain phrases, terms and meanings became dominant (or marginalized), observing the interplay of power dynamics, and noting moments of rearticulation – where discourse shifted or was repurposed in response to socio-political events. By iterating between DTM's quantitative outputs and AT's focus on the contingent (re)construction of meaning, it was possible to further refine topic labels, examine the potential power relations embedded in competing narratives, and ultimately offer a more nuanced understanding of how CC and EG discourses were dynamically articulated in the media. In practical terms, it was possible to identify how certain keywords are rearticulated such as how "Paris" replaces "Kyoto" as a word representing a "nodal point" for global climate goals, or how some words begin to appear together such as "milk," "meat," and "carbon footprint" in the "food topic" after 2018, representing Laclau & Mouffe's "chains of equivalences."

As shown in the previous sections and descriptions above, some topics undergo notable fluctuations, while others remain considerably static throughout the 24-year timeframe. On a general level, the top topics give an understanding how the themes, CC and EG, are represented in the media. As expected, many of the topics had to do with climate negotiations and reports, the energy sector, and basic statistical data, many of the top topics elevate individual responsibility and actions of ordinary people. From DTM's perspective, these patterns highlight clusters of language that rise and fall together, but AT's lens allows us to see how such clusters are linked and discursively shaped in the media coverage.

The consumption choices of food and diet, private motoring, flight transport, and, to an extent, circular economy are, as topics, all thematically linked to the often-used narratives of individual behavior and responsibility as a consumer and as an eco-citizen (Boyer et al., 2021; Bushell et al., 2017) instead of addressing systemic issues that are at the core of CC, including the systemic dependency on EG. In Figure 2, the connection between topics related to cars, food, both topics on climate activism and youth, air travel emissions and circular economy go on very similar

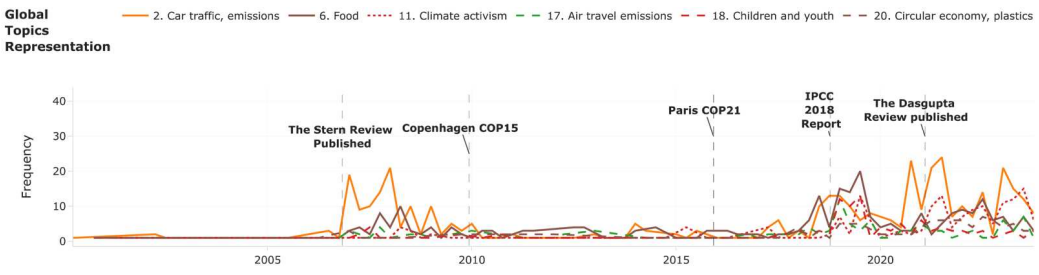

Figure 2. A subset of top CC topics, floating Y-axis.

trajectories. The largest booms for the topics appear between the 2006 Stern Review and COP 15 in 2010, and then again after 2018. By examining how these topics are articulated, we see a recurring narrative of individual responsibility one in which citizens are often exhorted to modify personal consumption (e.g. flying less, eating sustainably), while larger systemic structures remain relatively unquestioned. Maintaining status quo is apparent in the ways such topics are articulated. In topic 2, cars are discussed so as to how to continue private car usage instead of questioning it, and the changes in articulation tend to focus on, as discussed earlier, either which kinds of cars are discussed (fuel cell, biogas, electric, diesel) or, for example, the impacts of public transport, such as a new metro line, or regulation, such as congestion pricing, for the private car traffic.

Similarly topics focusing on individual actions such as climate protests and activism which, more often than not, demand systemic change and addressing the issue of CC with the seriousness the scientific community has demanded, are articulated as acts that take place within the minority of the youth and young individuals, reminiscent of the narrative where it falls on the youth to solve CC – excusing the current generation in power unwilling to perform the said systemic changes.

Whereas CC included many topics to do with individuals and individual choices, such topics are nowhere to be found in the top EG topics. The individuals appear in the EG topics mainly as their professions such as politicians or as an aggregate in the form of statistics or surveys. The actors in these topics rather tend to be institutions, banks, countries, and companies, concepts like taxation and export, and statistical data rarely linking them to individual roles or responsibilities. This discrepancy reveals how media coverage of EG tends to institutionalize climate concerns within the language of the economic paradigm without broadening the scope to question the viability of the economic system itself. AT spotlights these asymmetrical power relations, showing how references to systemic change are often sidestepped or marginalized, thereby reinforcing the current economic paradigm.

It is also worthy pointing out that the discussion on systemic change and changes in the economic system altogether may not be represented in traditional economics news as newspapers tend to focus on business economics in their economic news coverage, with the exception of rare superstar economist interviews and long-form journalism stories that have the time to dive into deeper questions such as the feasibility of the current economic system in addressing climate change. Some interesting grouping does occur, though, as seen in Figure 3 visualizing the subset of topics on Finnish elections, EU economic growth, commentary on budgeting and cuts, often via the authority of the Ministry of Finance, the Greek debt crisis, and the Eurozone debt crisis.

Altogether, the combination of DTM outputs which chart fluctuations and co-occurrences of particular words and phrases and articulation theory revealing deeper ideological linkages underscores that while discourses on individual actions evolve over time, the articulation of EG as a largely institutional concern remains steadfast. This dynamic interplay suggests that the media's discursive strategies may ultimately shape how citizens and policymakers conceptualize the trade-offs between climate action and economic priorities.

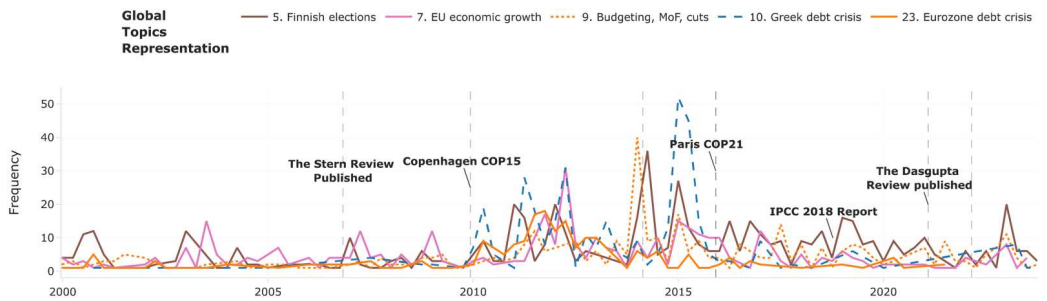

Figure 3. A subset of top EG topics, floating Y-axis.

Articulations and interaction of climate change and economic growth

Climate change can be seen as an individual topic in the EG dataset as the 12th most popular topic. The spikes align with the previously mentioned important climate events, with the last boost starting from the Dasgupta Review early 2021 (Dasgupta, 2021) and ending later that year near the Glasgow Cop26.

The words and terms appearing in the climate change topic on a corpus level include the Kyoto protocol, agreement, fossil, greenhouse gasses, IPCC, 2030, energy and the United States. The topic is first mentioned in late 2000 with mentions of the Kyoto protocol, climate agreement and carbon emissions, but also morale. Emissions, emission taxes and emission reduction targets appear to dominate the first decade of the dataset, and after the Copenhagen 2009 COP15 (United Nations Climate Change Conference) the topic adds emissions trading and permits to the vocabulary. Before the 2015 Paris COP, the discourse seems to be connecting the broader theme of climate change with the energy sector and the concept of "circular economy." The articulation suggests a narrative where sustainable practices in energy production and consumption are seen as pivotal in addressing climate change.

As expected, "climate agreement" is included in the vocabulary from late 2015 onwards. This implies that global collaborative efforts and formal agreements are being highlighted as essential mechanisms to tackle climate change. In the following years, the associated words include terms like "emission peak," "renewable energy," and "greenhouse gas emissions." This suggests a discourse where economic growth is potentially being discussed in the context of sustainable energy practices and their impact on emissions. In essence, at this juncture, the representation of EG is situated within a broader discourse that seeks to reconcile the imperatives of economic growth with the pressing challenges and commitments related to climate change. The new wave of climate activism also debuts in the topic in the summer of 2019.

After these changes, the topic remains fairly homogenous until the end of the decade. The impacts of the COVID-19 pandemic on the topic representations are only momentary and introduced to the discussion human and wildlife safety and biodiversity more broadly before returning to fossil fuels and climate goals soon after the Dasgupta review is published. The following appearances of the topic mention green transition, decoupling, coal usage, large stimulus packages, and the evergreen theme for the topic, emissions trading, but in mid-2023 a cross-generational shift appears with mentions of climate anxiety among youths and words like "millennials," "generations," and "boomers," suggesting such cross-generational terms being articulated into the topic at that time.

In summary, the topic showed a progression from discussions around carbon dioxide emissions, Kyoto Protocol, and environmental concerns in the early 2000s to more recent discussions about sustainable development, renewable energy, and global climate agreements. The economic implications of environmental regulations, the role of renewable energy in fostering sustainable growth, and the challenges and opportunities presented by international climate agreements. The articulation of terms related to renewable energy suggests a narrative where economic growth is intertwined with sustainable energy practices. This might indicate discussions around how economic growth can be achieved without compromising environmental sustainability. The mention of *emission peak* and *greenhouse gas emissions* points to the challenges of managing emissions while pursuing growth. The discourse during this period revolved around the tension between industrial growth and its environmental impact. The broader context might also touch upon how international agreements or standards influence national or regional strategies for economic growth, especially given the global nature of climate change discussions.

Economic growth in the CC dataset is the 15th most popular topic. On a corpus level, it addresses climate change from the points of view of the government, business, and the societal progress in Finland. In the first years, the Kyoto protocol dominates the topic. After that the topic appears in junction with the publication of the Stern review in 2006 with mentions of a "capitalism," "unethical," "energy policy," and "energy self-sufficiency." The linkage with economic growth

during this period might be contextualized within the framework of international commitments and their potential impact on national economies.

During the economic crash, the topic evolves to critique capitalism and question economic growth with mentions of "market fundamentalism" and "ethics." During the next few years the topic raises themes related to the welfare state including differences in income and basic income, but also the culture of economics, the world economy, and planetary boundaries, natural resources, general well-being and values, and the United Nations Development Programme (UNDP). The consistent articulation of terms related to education, well-being, and economic growth indicates an evolving discourse where socio-economic development is being reimagined in more holistic, environmentally conscious terms. Planetary boundaries and natural resources interplay with traditional business news terms such as "stock owners" and "investments" with the additional mentions of "solidarity tax" and "the financial wise," a reference to the finance and economic pundits and elite often quoted in the media. In 2019, before the COVID slump, the topic focuses on "economic growth,, "the financial system," "economists," "welfare," "work," and "immigration." After 2020, the topic deals mainly with the COVID crisis and its economic consequences such as inflation and finance politics with only a few mentions of climate-related issues.

Overall, the topic oscillates between various themes that tie economic growth to environmental considerations. Whether it's international agreements, the role of specific countries, sustainable practices, or the direct mention of EG, the discourse appears to grapple with the challenge of harmonizing growth aspirations with the imperatives of mitigating climate change.

It is worthy pointing out that CC in EG dataset presents a view on the economics that differs from the traditional status-quo EG coverage, while EG in CC dataset is articulated in very generic business economics terms. This difference in articulations may explain why the datasets share only 632 articles that appear in both of them. The interplay of the topics on the timeline (Figure 4) also reveals that EG does include CC already since the beginning of the time-period but EG debuts in the CC dataset as late as 2004. CC in EG also has several peaks near important climate events while EG in CC seems to become a larger topic only after 2018 and peaks for the first time simultaneously with CC in EG in late 2019.

Both topics underscore the global nature of the climate change challenge, highlighting international agreements like the Kyoto Protocol. They also emphasize the necessity of sustainable practices in economic growth. While the EG dataset places emphasis on the economic implications of environmental regulations and the role of renewable energy, the climate change dataset focuses more on the broader social implications, touching upon aspects like education and well-being. Both topics showcase a shift from early 2000s discussions around international agreements to more recent narratives that are holistic and encompass broader socio-economic considerations, demonstrating the evolving nature of the discourse over the past two decades.

In essence, the comparison underscores the intricate relationship between economic growth and climate change. While each dataset offers a distinct lens – one more economic and the other more environmental – they both converge on the shared understanding that future economic growth must be in harmony with environmental imperatives.

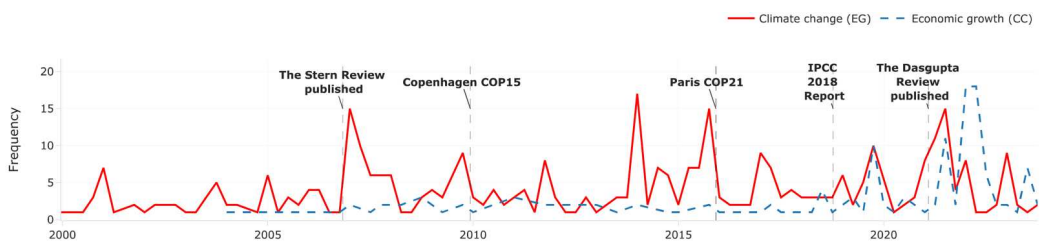

Figure 4. CC and EG represented in each other's dynamic topic models.

A final, key finding of this theme traces back to the categorization of the news stories by the media outlets. The fact that out of the total 39,897 (39,375 after cleaning) news articles only 632 were included in both of them indicates that the themes are by default not reported on together. Despite research and calls from the scientific community to understand the acceleration of CC as a result of the growth-locked economic system (Copiello & Grillenzoni, 2020; Paulson, 2022; Slameršak et al., 2024), and the increasing amount of economic risk forecasts related to climate change (Bilal & Känzig, 2024; Kikstra et al., 2021; Kotz et al., 2024), the connection does not appear to be relevant for the news media.

As public perception of such abstract themes is likely to be formed and influenced via the framings used in the media (Wiest et al., 2015), understanding this disconnect present in the media framings may help to formulate more impactful messaging in both environmental communication and climate policy in the future. Additionally, the topics present in the themes, including how they have evolved over time, can instruct potential fine-tuned articulations to be utilized as they have already been made familiar to the public by their salience in the media.

Discussion

As the BERT-based approach to topic modeling, and DTM especially, differs from the earlier LDA-based approaches and is able to capture more accurate contextual representations, combining the method with human validation this approach should be rigorous enough to distill accurate articulations from textual data. Relying solely on topic modeling and the representations of DTMs would be likely to lead to shallow interpretations, especially if the research lacks in understanding not only the thematic substance but also the algorithms in question. As noted before by, for example, Ylä-Anttila, Eranti, et al. (2018) such algorithms are not expected to lead to a fully automated discourse analysis but to enhance, expand and evolve the research capabilities to the era of big data.

While BERTopic seems promising and versatile as a tool for performing such analysis, it is by no means the only method developed for such tasks. Additional BERT-based methods similar to BERTopic such as the combined UMAP dimensionality reduction method and a BERT-LDA hybrid approach have also been introduced to attain more precise context-based features for improved topic modeling (George & Sumathy, 2023).

Further research for this topic could be to incorporate Structural Topic Modeling (STM), another developed form of topic modeling, in order to include more meta data variables than just publication date and publication to the model such as different media content categories, people and other entities mentioned and the authors of the stories, to name a few. Such approach has already been used with a Danish climate news corpus by Meier and Eskjær (2024). Their article also offers an interesting comparison to topics in CC coverage present in another Nordic media environment.

Climate denialism, for example, is much more prominent in the Danish findings, perhaps partially explained by there not being a counterpart to a denialist "celebrity" comparable to Bjørn Lomborg in Finland. It would also be interesting to see whether the results of the Danish models would change if individuals would be removed from the set, as first Lomborg and later president Donald Trump become tightly attached to the denialism topics. Individuals are, indeed, topics in their own right in the Danish study, as exemplified by topics #12 (Greta Thunberg) and #51 (Donald Trump).

A recent study on the Finnish coverage of climate skepticism covering HS and IS finds the most significant peak of skepticism coinciding with the Climategate in 2010, and does not mention topics related to climate skepticism like the Sunspot theory, or Lomborg (Kumpu, 2024). Otherwise, the study's 89 topics mirror closely to this study's CC model's, including soft topics like cinema, music and literature, and hard topics such as nuclear power and oil, with economic growth as its own topic #60. More related topics appear in the theme "Business & Economy," often seen as a topic in other studies.

In a recent article utilizing LDA, McAllister et al. (2024) turned the focus on 35 non-Annex I, "vulnerable," countries, and found that "economics of energy transitions" ranked the second most popular topic, with first being international governance and development. Similar focus on economic aspects of climate change was found earlier in the 2021 (Hase et al., 2021) study on climate change coverage in 10 countries. The largest theme "causes of & solutions to climate change" contains many individual topics present in the present study with some also brushing shoulders with economic growth. It is for example interesting to see "divestment" as a relatively popular topic within the theme, as well as a topic on carbon price, tax and trading. "Cars & driving" is its own topic but "sustainability and consumption" seems to be mainly about food-related issues and not circular economy, for example. Compared to the other mentioned studies, topics on individual's climate action seem to be more present. The theme closest to EG, "economic impacts," on the other hand, is the smallest, dividing to topics "energy & oil industry," "travel industry," and costs due to disasters – and is accompanied with a caveat of low validity scores. In the supplementary material to the article, some relevant similarities are identified as the impact of events on public attention is revealed. As in the present study, Hase et al. saw peaks during COPs but also the US withdrawal from Paris Agreement and the release of the Stern review. Overall, in previous research utilizing topic modeling, the relationship between CC and EG is not discussed from the point of view of decoupling or their interconnectedness but rather EG as a concept is either absent or is present as a separate theme on economic impacts of CC (Vu et al., 2019) or economic impacts of, for example, energy sector transition or policy – and economic growth itself is not questioned or discussed as a systemic cause for CC. Economy-related CC framings as uncovered by Nisbet (2009) are rare, as well, though often referenced.

While the research illuminated the temporal evolution of various climate-related topics, it also underscored the intricate interplay between global events and the frequency of topic mentions. For instance, the prominence of topics like "Car Traffic, emissions" and "Climate agreements" was noticeably influenced by key global events and policy decisions. This observation aligns with articulation theory, which posits that meanings are not fixed but instead are constructed and reconstructed through social practices, discourses, and material conditions (Hall, 1985).

The DTM approach not only captured the overarching themes but also highlighted nuanced shifts in discourse over time. For instance, the topic "Economic Growth" saw an evolution in its associated terms, suggesting a potential transition in the discourse from viewing climate change as a hindrance to economic growth to possibly perceiving it as an opportunity, especially with the introduction of terms related to green growth.

Furthermore, the analysis of individual consumption topics such as "Food" and "Car Traffic" offers insights into how discourse may have evolved in response to societal changes, technological advancements, and increased awareness about sustainable practices. This further reinforces the importance of contextualizing machine-driven topic modeling results within broader socio-political and economic landscapes. An overarching theme of sustaining the status quo is apparent both in such specific topics as mentioned and in topics that are more generic and tangential to systemic structures and transformations.

Building on these findings, there are noteworthy implications for both policy formulation and public perception. The shifts observed in discourse – from EG as a perceived obstacle to climate action toward articulating it as an opportunity through green growth – underscore how evolving narratives can shape, and be shaped by, policy agendas. As governments and organisations strive to balance environmental sustainability with economic imperatives, understanding how climate change (CC) topics are articulated over time can help policymakers craft strategies that resonate more effectively with public concerns. While focusing on individual (consumption) behaviors can serve as a valuable entry point for engagement campaigns, policy incentives, and educational programs – given that such articulations already exist in the public consciousness – this emphasis may end up inadvertently reinforcing the status quo. In other words, by concentrating on personal responsibility rather than broader systemic factors, more transformative solutions can be sidelined.

By highlighting the media's role in constructing and reconstructing meanings, this analysis reveals that public perception is not merely reactive but is deeply intertwined with the discourses promoted by policy actors and news outlets. In turn, these discourses ultimately shape how climate and economic priorities are weighed in public debates.

To conclude, while machine-driven methods like BERTopic offer valuable insights and can handle vast datasets, they are most effective when combined with critical theoretical frameworks and human expertise. This synergy ensures that the interpretations derived are both data-driven and theoretically grounded. In other words, the distinction between "data-driven" and "theoretical" can be overcome.

Conclusion

In the present study it was discovered that while CC has been articulated via generally more "softer" topics, the theme has undergone tonal shifts toward more "harder" news while still covering topics such as culture and individual consumption. Throughout the 24 years, articulating EG tends to happen through "harder" topics, and CC represents one of the "softest" topics within it. While initially differing, CC within EG and EG within CC appeared to move toward each other from the peak year of 2018 onwards. From AT's point of view, the combined effect of the climate activism movement and the release of the IPCC report in late 2018 could be said to represent the clearest example of a *moment of contingency* (Grossberg, 1986) where a theme's dominant framing shifts. For CC, the changes in articulation are very clear as several topics peak and go through transformations, and the same is true for the way CC is covered within its EG topic.

The integration of dynamic topic modeling with articulation theory has established a novel and nuanced understanding of the ways in which media representations evolve over time. Notably, it sheds light on the dynamic construction and reconstruction of meanings around the topics such as the ones focussed on in this research.

The research underscores the role of articulation theory in deciphering the layers of discourse embedded within vast datasets. Hegemonic concepts such as economic growth were seen to undergo subtle transformations in their articulations, reflecting the ever-changing socio-political and economic landscapes, and ideological struggles. Similarly, complex and difficult to grasp phenomena like climate change, often challenging to distill into singular narratives, were dissected to reveal the multifaceted ways they are understood, discussed, and represented.

While DTM offers a powerful lens to capture these shifts, articulation theory provides the critical analytical framework to interpret them. The melding of these two approaches facilitates a deeper comprehension of not only what topics dominate the discourse but also how they are woven into the larger fabric of societal understanding and meaning-making, and the molding of common-sense.

In an era marked by rapid information dissemination and the proliferation of big data, our approach underscores the imperative of methodologies that are both data-driven and theoretically anchored. Only then can we hope to capture the complexities of global discourses and the myriad ways they shape, and are shaped by, our collective understanding of pressing issues like climate change.

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IV

Journal of Data Mining and Digital Humanities

EPIsciences overlay journals

Towards efficient and reliable utilization of automated data collection: Media scrapers applied to news on climate change

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Abstract
Automated data collection provides tempting opportunities for social sciences and humanities studies. Abundant data accumulating in various digital archives allows more comprehensive, timely and cost-efficient ways of harvesting and processing information. While easing or even removing some of the key problems, such as laborious and time-consuming data collection and potential errors and biases related to subjective coding of materials and distortions caused by focus on small samples, automated methods also bring in new risks such as poor understanding of contexts of the data or non-recognition of underlying systematic errors or missing information. Results from testing different methods to collect data describing newspaper coverage of climate change in Finland emphasize that fully relying on automatable tools such as media scrapers has its limitations and can provide comprehensive but incomplete document acquisition for research. Many of these limitations can, however, be addressed and not all of them rely on manual control.

keywords
text scraping, automation, media analysis, climate change

I INTRODUCTION

Despite the digital era's advancements, manual data collection continues to dominate humanities and social science studies, notably in media studies where the significance of digital communication is ever-increasing. Online news sources can be said to have overthrown the offline media: According to Pew Research (Shearer and Mitchell, 2021), more than 80 % of Americans get their news from digital devices. Most print newspapers publish also online versions of their news content, and these online versions have exhibited modest variations in content compared to their print counterparts (Hoffman 2006; Mensing and Greer 2013). For example, as headlines remain static in print versions, it is a common practice to test different headlines online to attract wider audiences (Hagar and Diakopoulos 2019).

The growth of online data has spurred the development of various automated data collection tools, such as media scrapers and public application programming interfaces (APIs), enhancing accessibility to vast datasets (Sirisuriya 2015; Aitamurto and Lewis 2013). However, the ease of collecting big data has potentially overshadowed inherent biases and errors, leading to biases such as the availability bias, the tendency of researchers to use data easily available to them and then justify it afterwards (Mahrt and Scharkow, 2013). Additionally, for document selection, Grimmer et al. (2022) distinguish four types of bias that may influence the representativeness of the dataset: resource bias, incentive bias, medium bias and retrieval bias.

While web scraping is often viewed as a technical phenomenon, there is a growing discourse on the “softer issues” surrounding it, including ethical and legal considerations (Murray State University et al. 2020; Khder 2021; Zimmer 2010; Bruns 2019). The field is

evolving, especially as platforms like Facebook, Instagram and X (formerly known as Twitter) have restricted data access.

Research on automated data collection has proliferated since the turn of the millennium, focusing largely on social media contents (Scharkow 2013; Venturini and Rogers 2019). However, less attention has been given to utilizing automated methods for newspapers, with warnings about the trade-offs between automation and reliability (Deacon 2007; Mahrt and Scharkow 2013; Wijfjes 2017).

Media content analysis has traditionally involved small samples and qualitative approaches due to labor-intensive collection and coding. The shift towards automated research methods is motivated by the potential for larger sample sizes, despite reliability trade-offs (Broersma and Harbers 2018; De Grove et al. 2020; Wijfjes 2017; Blatchford 2020). Challenges and caveats related to computational methods, including supervised machine learning, have been discussed, emphasizing the need for emphasizing the danger of overestimating the benefits of automation (De Grove et al. 2020).

Media studies often lean towards manual or semi-automated collection methods, with less emphasis on fully-automated tools or "theory-driven online scraping" (Lodhia 2010; Khder 2021).

In Figure 1, we summarize the evolution of data usage and data collection methods and issues related to the reliability of data archiving from platform to platform. The aim of this article is to critically examine the pros and cons of different data collection methods and the evolution from manual and semi-automated data collection to fully automated practices. It is based on a case study focusing on newspaper data on climate change, showing the development of climate change news from 1990 up to 2020.

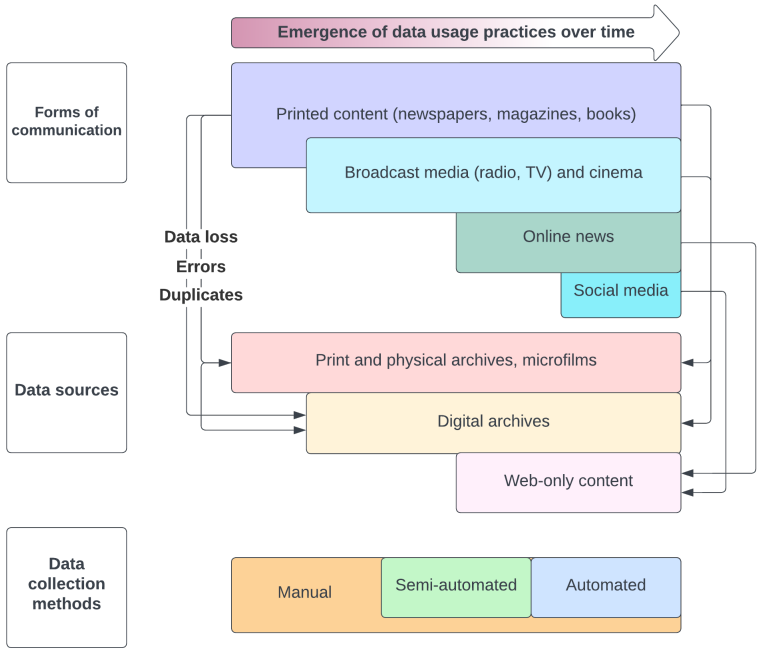

Figure 1. Evolution of data usage for media studies. The figure expresses data sources and usages of different media.

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II METHODS AND MATERIALS

Our focus is on the news coverage of climate change in the Finnish newspaper Helsingin Sanomat (HS), given its high societal relevance, interdisciplinary character, and extensive previous studies on its climate coverage (Suhonen 1994, Lyytimäki 2011, Kumpu 2016, Teräväinen et al. 2011, Ylä-Anttila et al. 2018, Boykoff et al. 2019, Lyytimäki 2020). HS, the most widely circulated newspaper in the Nordic countries. It serves as one source for monitoring media coverage of climate change in 58 countries (Boykoff et al. 2022). More generally climate change has become a common subject in digital humanities and media studies.

The manual data (MD) for comparison comprises 14,750 news stories headlines retrieved from HS's online archive, spanning from January 1st, 1990, to December 31st, 2020. These stories, collected into a spreadsheet, were identified using specific climate-related queries (search screening full texts and using Finnish search terms for climate change, warming of climate and greenhouse effect) and included even those items mentioning climate issues tangentially (Lyytimäki 2011, 2015, Lyytimäki et al. 2020). Duplicates and irrelevant hits were removed based on manual inspection. Various factors, such as changes in the newspaper structure and search engine properties, influenced the data's format and content, with different information available across years and some data, like cartoons and advertisements, excluded.

Automated data were obtained using two different scrapers utilizing the Sanoma API. The first scraper (S1) mimicked the manual approach, collecting data in batches of 50 articles, mimicking the batch size of articles the manual online search provides after each click of the "show more" button, from oldest to newest, including full texts where possible, using the newspaper3k Python package. The second scraper (S2), based on the Finnish Media Scrapers project (Mäkelä and Toivanen 2021), performed 93 queries to the API, breaking down the search period into weekly segments and yearly intervals for each query term. As the manual dataset consisted only of headlines, publication dates and the article urls, the scrapers were set to collect only those data.

Both scraped datasets underwent cleaning to remove identical duplicates and ensure uniform formatting. The final comparison between manual and scraped datasets involved further cleaning and unifying data formats, focusing on the months the articles were published.

It is crucial to recognize that while MD, S1, and S2 all access the same news archive, the methodologies employed by each distinctly shape the dataset's composition. This underlines the significance of the data collection process itself, as it inherently filters and frames the information extracted from the archive. Therefore, any disparities in the collected data are attributed to the differences in collection methods and the inherent biases each method may introduce, rather than variations in the source material except in the cases when changes had been made to the archive's content or categorization in the times between the manual and scraped data collection.

While we acknowledge that inherent differences in the approaches of MD, S1, and S2 methods may lead to variations in the collected data, the comparison aims to highlight the nuances and potential biases each method introduces. The objective is to understand the trade-offs between manual and automated data collection, aiming to highlight the nuanced insights each approach offers and the unique biases they may introduce to the research on newspaper articles.

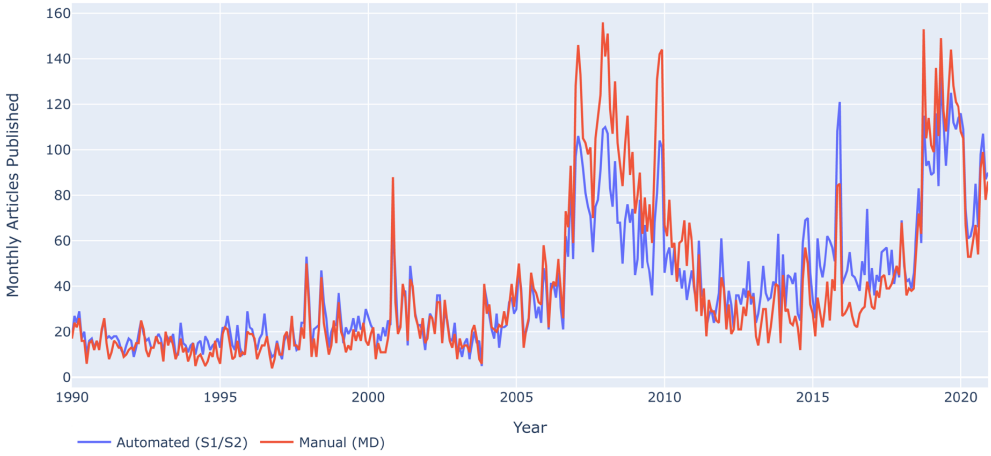

Figure 2. Articles on climate change published on Helsingin Sanomat 2000 – 2020 collected from online archive. The figure shows clear peaks in the frequency of climate change coverage but also highlights differences between the datasets.

III RESULTS

Compared to the manual dataset (MD) of 14750 news articles, neither of the datasets collected via the automated scrapers gave the exact same result. Also, different scraping techniques resulted in different amounts of articles.

The S1 scraper queries resulted in 8227 stories on climate change, 7441 stories on greenhouse and 1576 on climate warming. After removing duplicates there were 14669 news articles published between January 3rd 1990 and December 31st 2020. The first article of the dataset details record heat in England and the last headline of the dataset declares that the year 2020 was the warmest year on record in Finland.

Initially, the S2 scraper provided the least amount of results: 7970 stories on climate change, 7437 on greenhouse and 1575 on climate warming with a total of 14553 articles after removing duplicates. Representing both retrieval and resource bias (Grimmer et al., 2022), the reason for the scraper collecting fewer articles than the other two is that the scraper ran into problems with either broken articles, manifesting as blank pages or error messages, or articles consisting of dynamic content that prevented scraping the full texts of the articles. After correcting this and limiting the results to article headlines only, S2 resulted in an almost identical result as the first scraper with only one article more, on climate change, than S1. From here on, we will discuss only the S1 dataset.

The full manual dataset of 14750 articles had 81 articles more than the 14669 of S1 (See Figure 2). While the difference between the datasets is only half a per cent in total numbers, the differences become more apparent when comparing certain peaks in the data: In November 2000 S1 dataset showed 69 published articles and MD 88 articles. Other similar peaks include February 2007 (S1: 106, MD: 146) and February 2008 (S1: 109, MD: 156). From 2011 to 2018, the S1 seems to take over and contain more results. The largest peaks of S1 align with the December 2015 Paris Accord when S1 displayed 121 results and MD only 85. From 2018 to the beginning of 2020, MD displays more results on average and after that S1 again until the end of the year 2020.

On closer inspection, including a detailed manual review of the discrepancies, focusing on the type and content of articles that differ between the datasets, the articles

causing the differences are mainly smaller commentaries, opinion pieces or editorials, and on a smaller scale, television or radio programming details. For December 2007 MD has 156 articles and S1 had 109 articles. The differences appear to come from more opinion piece articles included in the manual dataset compared to the scraped set. While some opinion pieces and editorials were included in the scraped set, MD included numerous relevant ones such as a small comment piece titled "Vuoden viherpesu" ("Green Wash Of The Year").

In the opposite case of December 2015, the surplus of articles in the scraped dataset is mainly the result of several different editions of the same story published on two different sections of the site such as "ulkomaat" ("foreign") and "ilta" ("evening"). In addition, some opinion pieces were included in the scraped set that were not present in the manual set.

When calculating the percentage of matching articles between the datasets, using their unique identifiers, the article headlines and urls, the datasets were only 84,2 % identical. The differences can be mostly explained by differences in coding the articles in the manual set and the automatically retrieved headlines from the online archive which in turn may also change over time especially if the articles were subjected to A/B testing, usually changing the articles' headlines to optimize online readership, during or after the data collecting. It should be pointed out that in February 2023 an editor of Helsingin Sanomat admitted to modifying headlines of their online and print versions differently and an editor of the evening tabloid Iltalehti stated that negative (online) headlines work better as they interest people more (Sillanmäki, 2023).

These kinds of discrepancies should, however, be also accounted for when assessing different ways of obtaining data. A more reliable way to compare articles would be to use the articles' hyperlinks that are not likely to change over time.

Considering a stricter approach to removing duplicates, some articles were indeed almost identical to each other when it comes to the headline and even the article content despite having different hyperlinks. Removing duplicates based solely on the title or solely on the hyperlink may still leave different versions of the article in the datasets as some archived articles from the beginning of the datasets' time period may have both the print version and the online version of the article available online with individual hyperlinks with minor variations in the online headline. In some cases, the same article was published twice within the same month with a different hyperlink. Also, the same or very similar headlines may lead to a "full" and an "abridged" version of the story. A combination of filtering by unique hyperlinks and headlines with the possible addition of publication month and content comparison may be a more accurate, though more cumbersome, approach.

IV DISCUSSION

4.1 Automation as a solution

Updates in search engines and content and categorizations of the database may distort search results updating old data. It is also possible that some items related to climate issues are missing from the sample because of the limited set of keywords. Therefore, it is vital to conduct test searches to ensure that the right balance is found between exclusion and inclusion. This, in turn, requires expertise on the qualities of the issues under scrutiny. For example, coverage of biodiversity loss or energy policy may overlap with climate change coverage.

While manual data collection can offer a relevancy filter of sorts already during the collecting process, it is slow as all the details of the articles have to be manually copied and pasted or written in the data set document. The manual collecting process raises also issues with repeatability and handling errors in the original tasks found out later during the process.

Especially with vast datasets, noticing an error after the data has been collected, it may not be possible to repeat the process afterwards due to limited human resources. The speed of automated data collection depends mainly on the processing power attributed to the scraper and the amounts of articles published during the period in question. For example, scraping article headlines for the search query "climate change" can take anything between a few seconds to a few minutes. For manual collection, the time spent can be considerably longer (Lauer et al. 2018), often beyond the resources available. Although automated scraping significantly enhances cost-efficiency and data breadth, it is not without trade-offs. For instance, automated methods may inadvertently capture irrelevant data, necessitating post-collection filtering that can be both labor-intensive and prone to oversight. This underscores the importance of a balanced approach that weighs the speed and scope of automation against the precision and context sensitivity of manual data collection.

The automated method offers the possibility to collect much larger datasets much quicker and therefore the possibility of more comprehensive scopes for studies even if the data would have to be filtered down later. Manual collection can also suffer from a lack of timeliness as collecting the data can be too slow to produce data fast enough for topical analysis on fast emerging or quickly evolving topics. Apart from the comparable slowness, additional human errors and biases can be coped with via well-established ways such as intercoder reliability tests.

Relying on automated methods may easily lead to omissions in reliability testing as data collected automatically can be assumed to have been collected "objectively". In order to find the most reliable solution, testing between different automated methods and comparing results to similarly produced manual samples would be one way to address this issue, albeit time-consuming. The need for such testing increases with the gaps between data collection sessions as changes in APIs may result in different search results.

Especially with larger datasets consisting of thousands or millions of data points, systematic errors, that might have been caught more easily by human eyes, may go unnoticed by the researcher relying on automated data collection. Therefore, testing the methodology via smaller test runs is encouraged. While a scraper can perform perfectly fine for 90 per cent of the news articles, the remaining ten per cent may cause issues for the whole dataset. For example, a single misplaced comma or a semicolon scraped in the scraped data may mess up the following rows and columns. Additionally, especially on archived content, the scraper may hit a wall due to bad or obsolete programming. Such issues arise most often when scraping for full articles as each news story is a page of its own for the scraper to run into error-inducing content which at best may lead to empty content cells in the dataset. For these reasons, error handling is very important in the scraping process.

Causes for such systemic errors can also change over time. For example, changes in the newspaper website infrastructure such as adding CAPTCHA, a program that checks whether the user is human or a machine, and other anti-scraper measures will affect the results and possibly prevent for example collecting full texts of articles especially if the articles themselves are behind a paywall. Additionally, the introduction of the so-called "dynamic articles" that feature semi-interactive and interactive elements that reveal text as the reader scrolls down the article, also affects collecting the full texts of the articles, as they often require more sophisticated scraping techniques, frequently requiring site-specific programming. Such dynamic articles may be challenging for manual data collection as well.

Finally, there are possible issues with timestamping the data. As the data is for the exact times when the articles were published and modified are available via scraping, there is a need to normalize the ordering of the data in the dataset whether it be by year, month, day or by minute. Whereas in fast-paced social media communication it may be important to know the publishing time by the second, in online news media analysis the timestamping may not

need to be as detailed. The article can also be modified or republished after its original publication which may lead to the article being misplaced in the dataset depending on which variable one uses to sort articles by – for example "time published" or "time modified". Though an issue of potentially limited relevance, should an article be updated for instance at the change of a month, it may be duplicated in a collection of datasets updated monthly. Additionally, the order of the articles may be relevant for consequential articles covering short-lived, fast-paced events.

4.2 Common challenges

There are also several common challenges for both manual and automated data collection. Changes in visual design and composition of the sections of the newspaper may have an influence on the number, length, and presentation style of news items. For example, during the study period, the composition of the printed version of HS was renewed several times, including a major change from broadsheet to tabloid on 8 January 2013. (Sanoma 2012). The data itself may not be complete as the provider may have altered the archive over the years. These kinds of archive alterations may not have had any nefarious intentions behind them as they may have been part of restructuring the archive for better accessibility or functionality and may be limited to actions such as removing duplicates or recategorizing content. In some cases, in the HS dataset, duplicate versions of articles were found even with a different hyperlink as they represented different versions such as online and print versions of the same article with only minimal changes.

Proper (automated) comparison of the manual and scraped datasets requires some unification and cleaning for the data. As the manual collecting process for large datasets often includes more than one researcher and may stretch to long periods of time, differences in recording the data are bound to be more frequent compared to automated scrapers that perform the task without variations. Omitted details can for example be added to the manual datasets using even the same automated tools used for scraping. It should be noted that each comparison case is different, and the methods and tools required to address such issues should be assessed by case and by data type.

The transformation of news media from static text to dynamic, multimedia narratives presents both opportunities and challenges for data collection. Visual elements like photographs, infographics, and videos are integral to modern storytelling and can significantly influence audience perception. However, these non-textual elements are often not captured by traditional scraping techniques, highlighting a gap in our methodology that future studies will need to bridge to fully understand media impact. Additionally, in recent years we have seen an uptick in different kinds of more complex news content such as the aforementioned dynamic news articles, and interactive news articles with sliders, polls and calculators, both providing valuable journalistic content and even significant amounts of text data to the reader but more complex to include as part of a text-based study. Embedded content may also prove to be difficult to access in the future, especially if it is included content that has since been deleted from the source. Deleted Tweets from Twitter/X, for example, are not accessible via those news articles that have embedded them in the middle of the news text after the deletion. Even though the contents of such Tweets would have been written out within the news text, they often are not verbatim and, if not in the native language of the publication, are translated.

These issues reflect the overall evolution of a news article and the structural changes of news over time. Are both a long-form written piece and a news item including infographics and info boxes considered individual news stories? What about stories that are ever-changing or constantly updated such as articles following the global carbon budget diminishing every minute or articles related to the COVID-19 pandemic with daily updates on infections and

victims? One way to individualize an article could be based on the article's hyperlink. Then, if the article is changed, the hyperlink stays the same. This, however, does not take into account the potential changes in the message the article conveys to the reader. An article's headline can change several times during the day of the publication due to click optimization, A-B testing, and localization to name a few reasons (Hagar and Diakopoulos 2019). The "original" headline could be said to be the one appearing on the paper version of the newspaper but then articles without a printed counterpart would have to be omitted.

It is therefore paramount for the transparency and reproducibility of the data that a timestamp of the data collection is included also in the dataset. As changes and corrections in the text are often highlighted in the articles in question after the fact, the timestamp, while not covering the change, can at least indicate whether the article was included in the dataset before or after the alteration.

The issue with the changing headlines is a recent one but an important one. While we do not focus on the messaging and framings in the headline in this article, the changes made to headlines that appear to the readers in different forms over different times, devices and platforms is an important topic for media studies and would have to involve tools closely monitoring such changes. A similar approach could and should be applied to the changes in the content of the articles. In fact, there are some instances that already collect and publish changes in headlines and content of news publications online[1].

4.3 Editorial decisions and the evolution of the language used

The caveats for any use of automated online search functions of newspapers include the possibility that there may be articles omitted from the dataset that could be argued to be categorized as related to a topic such as "climate change" but for some reason have not been included. These omissions could, however, be argued to represent in a rather transparent way the views of the news outlets. If an article is not included in the search results, whether on purpose or not, the media outlets communicate to their readers that the article in question is in fact not relevant in that context. The lack of categorization of the "missing articles" may, of course, have other, "human" reasons, too. The time and resource constraints at the media organization may play a role, as well as potentially the expertise dealing with the categorization, especially if done manually, may lead to the omission of some articles appearing relevant to climate scientists but perhaps not to the media in question. The primary category attached to the article may also be a factor, as several crises such as food shortages may in fact have to do with climate change but are not categorized primarily as such.

The historical topic relevancy is also a factor, and search strategies should allow comparisons between different times and places. Climate change provides an example of a global issue with shared key terminology across different contexts, but languages differ in their emphasis as exemplified by the lack of use of the term "global warming" in Finnish debate. The language used to describe climate change has evolved considerably over the years, which is apparent in the data as we look at the yearly datasets by the scraper search queries: in 1990 there were 18 articles categorized as "climate change", 16 articles as "climate warming", and 295 articles on "greenhouse*", respectively, while in 2020 the respective figures were 1052, 82, and 288. Not only did the amount of the articles increase but also the shift to using the term "climate change" ("ilmastonmuutos") instead of "greenhouse effect" ("kasvihuoneilmiö") is apparent. By sheer quantity, the switch seems to have happened between 2006 and 2007, which coincides with the publication of the influential Stern Review

[1] For example, there are several bot accounts on X (formerly known as Twitter) that highlight changes made to newspaper articles such as "Editing The Gray Lady" or @nyt_diff and @HS_muutokset that reveal changes made on the main page of the New York Times and Helsingin Sanomat websites.

on the Economics of Climate Change (Stern 2007) released in October 2006. In fact, by November 2006, "climate change" has surpassed "greenhouse effect" in sheer quantity of articles in both datasets (Figure 3) despite the counts of the latter remain notable in S1.

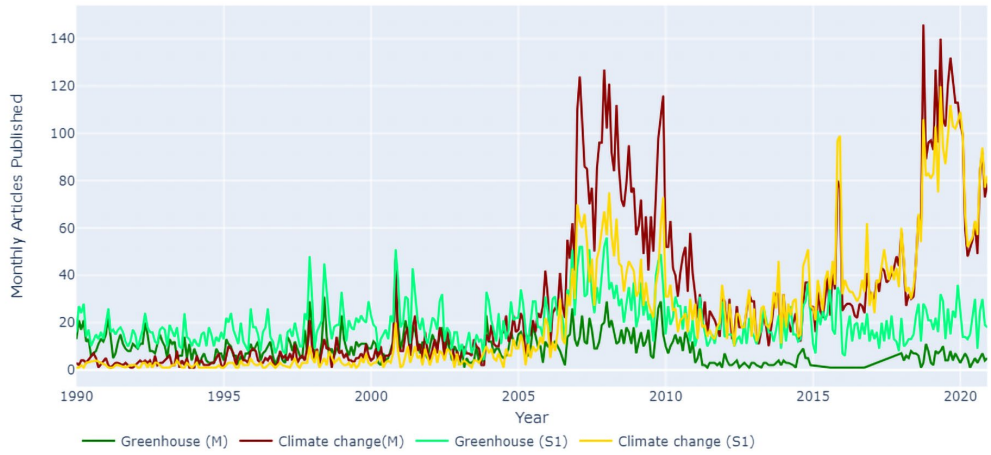

Figure 3. Results of search queries for "climate change" and "greenhouse" for manual and scraped datasets.

Additionally, even if the news story on climate change has been categorized by a news outlet in the category "climate change", the article may still be omitted from search results with the search query "climate change" for some other reason unknown to the public. For example, recent climate coverage in Finland often deals with carbon sinks of the Finnish forestry not necessarily mentioning the term climate change and labelled under energy policy rather than climate policy. The same retrieval bias applies to the concept of "emissions" as relevant stories may include references to emission targets but not climate change specifically. Furthermore, the apparent easiness of using such digital databases may tempt simplification in framing a complex topic such as climate change and prompt conclusions omitting the context. Similar simplification has been found for example in the coverage of Africa (Madrid-Morales 2020).

All in all, the Finnish newspaper archiving system does offer a wide array of opportunities for research: Historical newspapers are comprehensively digitalized with public and free access as their copyrights have already expired. While there are no comprehensive digital archives for more recent media coverage, the consolidation of media companies has led to archives combining materials from some previously independent newspapers. In these cases, the availability of copyrighted materials depends on the right owner.

Access to such easy-to-use digital archives may also limit the usage of a certain database over another. HS not only provides the digital archive from 1990 onwards but also an archive of digital replicas of their newspapers from 1889 to 1997 in PDF format. Full texts are made available for subscribers. The PDF archive is, however, not as easy to analyze via automation and machine learning and would require for example tools related to computer vision.

Compared to research on print editions or their virtual counterparts such as PDF copies, online news archives are unable to provide information on the visibility given to the article on the day of publication. Though the front page of the print edition and the main

stories on the web page do frequently differ, online news archives only tell when the story was been published with possible additions of its categorization and type.

Finally, as Grimmer et al. (2022) point out via Harford (2014), if what data is available is dictated by the incentives of the institutions producing them, it may not in the end represent the population of interest as it can lead researchers to flawed interpretations and conclusions drawn from the data, with the previously recognized retrieval and resource biases also playing a notable part.

V CONCLUSION

Our findings reveal the impracticality of an exhaustive data collection strategy, challenging the notion that completeness equates to comprehensiveness. Instead, our research underscores the need for strategic sampling, where the focus is on capturing a representative swath of articles that collectively provide insight into the evolution and nuances of issues such as climate change coverage. Whether collected via automated scrapers or manual methods, it is very likely that all the news articles published will not be included in the dataset. There is a risk of complete lack and omissions of data for poorly deposited early years and risks related to diversifying presentation formats for recent years. Significant caveats should be addressed remaining caveats always communicated effectively.

In order to avoid the research methodology becoming a black box, we advocate for meticulous documentation of data collection processes. This includes detailing the algorithms, API settings, and decision-making criteria employed during data scraping. Such transparency not only enhances the reproducibility of research but also allows for a critical evaluation of the methodologies used, promoting trust and verifiability in the findings. This is not limited to only including timestamps for the collecting periods but also the selected settings/features/attributes of the APIs and other relevant scraper features used. Typically, there is a routine expectation for transparency regarding the process of subjective data collection, especially in human-based methods. However, this level of scrutiny is often overlooked when it comes to automated methods.

On the other hand, this responsibility could be shifted or partially shared if the data are not collected by the authors themselves but are provided by an external entity such as a company specialized in media analysis and scraping or even the news outlet itself. In the latter case, one then has to trust the outlet that they provide all the news stories on the topic they deem relevant. Additionally, in both the former and latter cases, the data collection becomes a true black box as reproducing the data collection is not possible based on solely the research article.

While our study concentrates on the frequency and amount of climate change articles, we acknowledge that this is a mere slice of the narrative. The visibility and prominence given to these articles — such as front-page placement or feature positions on websites — play a crucial role in shaping public discourse. Future research could enrich our understanding by incorporating these dimensions, potentially utilizing sophisticated tools to analyze digital replicas and virtual formats for a more holistic picture of media influence.

Finally, we highlight the importance of securing public non-commercial databases collecting and storing media data. As media conglomerates and social media companies apply stricter commercially based data policies, such public databases become increasingly important both for manual and automated approaches.

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