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research article

How policy narratives shape sustainability governance: a case study of urban transport policy discourse

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Recent research in sustainability science has highlighted the crucial role of imaginaries, stories and narratives in shaping how sustainability governance is understood. One example is Adloff and Neckel's framework of ideal-typical sustainability trajectories: modernization, transformation and control. This article examines how these trajectories can help analyse sustainability policy making when viewed through the theoretical lens of the Narrative Policy Framework (NPF). To do this, we reinterpret the sustainability trajectories as policy paradigms and identify the broader cultural and institutional macro-level narratives that underpin them. We ask how these overarching sustainability policy paradigms shape the way specific sustainability-related policy processes unfold. Empirically, we analyse how macro-level narratives within the modernization and transformation paradigms influence local policy discourse on sustainable urban transport in the Swiss city of Zürich over a 12-year period. Methodologically, the study introduces an innovative approach for assessing how actors' ideal-typical discourse network positions align with macro-level narratives, and how these patterns structure actual policy discourse networks. Our findings provide some evidence that macro-level narratives do influence the structure of policy discourse. More broadly, the results suggest that the policy paradigms of modernization, transformation and control offer valuable starting points for applying the NPF to sustainability-related policy domains. For policy makers, these paradigms also provide a useful way to situate and interpret the stories told in everyday policy making.

Keywords sustainability policy • narrative policy framework • sustainability imaginaries • discourse networks • urban transport • policy process theory • text analysis • natural language processing

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Introduction

Sustainability is a normative concept about intra- and intergenerational justice within planetary boundaries (World Commission on Environment and Development, 1987;

Steffen et al, 2015; Raworth, 2017; O'Neill et al, 2018). But it also is a story about the future; 'a sustainable world is a fiction' (Martens, 2006: 40).

Sustainability is intimately tied to stories and narratives. As a normative concept, sustainability always starts out as a vision for the future, before being translated into (policy) actions, and used to legitimize these actions. Various configurations of actors leverage the concept of sustainability, rephrase, translate and adapt it in ongoing discourse (Göpel, 2016) and policy making (Lubell and Morrison, 2021). In doing so, actors constantly rebuild and reify visions and imaginaries for future societal pathways.

Sustainability science has long recognized how deeply sustainability governance is intertwined with storytelling, imagination and narratives. In the policy sciences, literature within the narrative policy framework (NPF) reminds us regularly that narratives are not to be underestimated when trying to understand, explain, shape and predict policy processes.

In this study, we bring together theoretical work on sustainability trajectories from sustainability science with policy theory to offer a new perspective on understanding policy processes in sustainability-related fields. We first relate recent work on sustainability trajectories or 'grand' stories of sustainable futures by Adloff and Neckel (2019) and Adloff and Neckel (2021) to the concept of macro-level narratives, specifically in the form proposed by Stauffer (2023).

Following Stauffer (2023), we translate ideal-typical sustainability imaginaries into policy paradigms. We isolate the cultural and institutional macro-level narratives that tell the stories of these paradigms and their elements of narrative form. We then ask: to which degree do macro-level narratives aligned with specific sustainability policy paradigms influence specific sustainability policy processes? As a way forward to answer this research question, we develop a novel heuristic to measure the degree to which a policy process follows macro-level narratives by relying on comparisons to ideal-typical positions (motifs) within policy processes that are congruent with macro-level narratives. In an empirical application, we formulate such motifs referring to modernization and transformation macro-level narratives we expect to find within local policy discourse around sustainable urban transport in the Swiss city of Zürich. We then apply our heuristic in an analysis of empirically observed policy discourse, based on automated discourse network extraction from a large media corpus.

Theoretical background

Sustainability imaginaries in ideal-typical sustainability trajectories

Adloff and Neckel (2019) develop three ideal-typical trajectories or 'futures of sustainability'. These are modernization, transformation and control. These trajectories are not actual futures. On the one hand, in practice, they might be understood as ideal reference points and imaginations of a future state that actors can refer to in discourses. On the other hand, such ideal-typical trajectories may serve as a reference frame for the sociological description of observed empirical practices in sustainability governance.

Imaginaries, as 'collective imaginations' (Adloff and Neckel, 2021) are the central element of ideal-typical sustainability trajectories. At their core, the imaginaries

contained in the three ideal-typical trajectories are substantially differentiated in their reliance on different ontological stances towards nature.

Modernization

Trajectories or futures of sustainability as modernization are fundamentally based on anthropocentric approaches to nature and ecosystems, which assign them purely instrumental value, akin to the weak sustainability concept (Ott et al, 2011). Nature is seen as providing ecosystem services (Guerry et al, 2015) and thus can be assigned a (monetary) value. This 'natural capital' is exploited in a manner that maximizes human well-being, distributed over time and space. Imaginaries within modernization trajectories describe futures that leave current (capitalist) principles of economic activity and lifestyles defined by individualist consumption largely untouched. These principles are further associated with ever-increasing technological progress driven by market pressures, and technologies are leveraged to tackle environmental problems or improve efficiency. Never-ending economic growth ensures that steadily increasing living standards and sustainability challenges are welcomed as growth opportunities. The 'Green Deal' programme by the European Commission, carbon trading markets or, on a smaller scale, relying on reducing resource use through companies selling 'green' alternatives to products are all examples of modernization imaginaries at play.

Transformation

Trajectories or futures of sustainability as transformation are based on an imaginary that starts from a perspective on nature, which not only assigns nature intrinsic value, but also might reject an anthropocentric ontological distinction between nature and culture/society. In line with principles of strong sustainability (Ott et al, 2011), transformation trajectories further are taking place in a way that rules out complete substitution of natural resources through technical processes (Lenz, 2021). For example, the totality of a forest is seen as containing intrinsic value that goes beyond the sum of its functions in providing clean air, recreation or timber, and sustainability thus starts from an ambition to at least maintain natural capital, while ensuring a good life for all humans. Transformation imaginaries entail fundamental, often civil society–driven changes in society in a Polanyi (1944) 'Great Transformation' sense. Proponents envision a post-growth, solidarity society overcoming current lifestyles of limitless consumption and related energy demand and resource extraction (Wiedmann et al, 2020). Forms of communal eco-living, non-extractive forms of sharing economies, community-supported agriculture or Indigenous approaches to interacting with natural resources such as the Māori Te Mana o te Wai (Te Aho, 2019) are all examples of macro-level narratives of transformation informing practice.

Control

A third set of trajectories, sustainability as control, is driven by an imaginary revolving around central ideas of resilience, inevitability and emergency. Within control imaginaries, powerful entities (such as autocratic states) solve sustainability crises by leveraging emergency powers to mitigate consequences of crises (also in possibly undemocratic ways) and prevent future crises. With regard to their

orientation towards nature, control imaginaries start from the fundamental assumption of the possibility of technological steering of natural systems, as well as social systems (seen, for example, as embedded within a larger 'Earth System'). As such, specific forms of science, especially engineering approaches to system design, play a prominent role in control trajectories. In control imaginaries, control of the Earth System is desirable and, in eco-modernist variants of the imaginary, is also seen as a way for society to decouple or at least isolate itself from the vagaries and unpredictability of the natural world (Adloff and Hilbrich, 2021). Especially concerning climate change, large-scale geoengineering policy suggestions are expressions of control imaginaries, but also high- or low-technology mass surveillance based measures of autocratic regimes to combat environmental pollution problems (such as littering).

Macro-level policy narratives in sustainability imaginaries

When considering the role of stories, imaginaries and narrative construction within the policy sciences, the framework standing out with regard to its devotion to these aspects of the policy process is the NPF (Shanahan et al, 2018). Work on sustainability imaginaries within the sustainability science literature maps especially well to the NPF concept of macro-level narratives.

Macro-level narratives within the NPF are the most general, broadest possible narratives within a three-tier hierarchy of micro-, meso- and macro-level narratives (Shanahan et al, 2018).

NPF narratives on all three levels require a common narrative form with four essential components, which contribute in a significant way to the intuitive appeal of the framework. These components of narrative form are: (1) the *setting*, describing the general context of the narrative and underlying problem to solve, (2) the (archetypical) *characters*, often including a hero solving a problem, a villain causing the problem or preventing a solution, and a victim negatively affected by the problem, (3) the *plot*, which is the story linking the aforementioned narrative elements, and (4) a *moral*, often a type of policy solution (Shanahan et al, 2018).

There have been different conceptualizations of macro-level narratives, ranging from those emphasizing them as predominantly cultural frames (Ney, 2014) to those focusing more on institutional dynamics (Peterson, 2019). Most recently, Stauffer (2023) has argued for a theoretical refinement of what macro-level narratives entail, which elegantly combines both cultural and institutional aspects, and which we will utilize in our study.

Stauffer (2023) argue that macro-level narratives within the NPF have been still theoretically underdeveloped and certainly empirically under-researched. They propose a clarifying conceptualization of macro-level narratives, which we will refer to in our understanding of macro-level narratives. Their conceptualization of macro-level narratives is tied to the concept of a policy paradigm (Carson et al, 2009; Daigneault, 2014), which describes relatively stable ideas about how the world works and should work in a specific policy domain.

Macro-level narratives then are a policy paradigm in 'story form' (Stauffer, 2023: 33). There are three types of macro-level narratives that contribute to telling the story of a policy paradigm. While paradigm macro-level narratives tell stories about

the paradigm itself, cultural macro-level narratives are about deeper values tied to it and institutional macro-level narratives are about the formal and informal rules that should give access to decisions. Meso-level narratives, in contrast, are about a specific policy. A macro-level narrative constrains, enables and shapes meso-level narratives.

The conceptualization of macro-level narratives provided by Stauffer and Kuenzler (2021) enables us to understand the three ideal-typical sustainability trajectories by Adloff and Neckel (2019) as three deductively identified policy paradigms with associated macro-level policy narratives. The paradigms crucially feature different understandings of sustainability as a normative concept (told in cultural macro-level narratives) and ideas about who should and will play a leading role in the imagined sustainability trajectory (told in institutional macro-level narratives). In the following, we will discuss macro-level narratives and their elements of narrative form by paradigm.

Modernization paradigm

In terms of *setting*, the key difference especially between modernization and transformation paradigms lies in their orientation towards the role of economic growth and the desirability of sufficiency strategies to reduce the resource use impact of human activities. These differences follow from differing cultural macro-level narratives underpinning them. Modernization macro-level narratives start from a perception of the inevitability of economic growth to realize human prosperity. If this is assumed, the only way for ensuring the carrying capacity of the planet is steadily increasing efficiency in the use of resources as inputs of economic activity, with the eventual goal of decoupling economic growth from resource use entirely. This can be referred to as single decoupling (Schneidewind, 2018), emphasizing efficiency and consistency with current lifestyles.

When it comes to *characters*, for macro-level narratives around sustainability policy, the role of the *victim* is especially interesting. Sustainability policy paradigms generally starts from a recognition of problems with current use of natural resources, threatening the carrying capacity of the planet over time, but feature different victims in their cultural macro-level narrative. The cultural macro-level narrative of modernization rests on weak sustainability, which is decidedly anthropocentric. The construction of non-human victims therefore is only a proxy for consequences on human victims; non-human victims only matter if some human interest is involved. In macro-level narratives of modernization, victims such as 'the poor' or, more generally, groups of resource-deprived humans, may also be present in the sense of needing economic growth to climb out of poverty, a tension in the concept of sustainable development harking back to its founding documents as a political programme to reconcile environment and development (World Commission on Environment and Development, 1987).

The different paradigms feature starkly contrasting *heroes* and *villains* in their institutional macro-level narratives. In modernization institutional macro-level narratives, heroes are entrepreneurial private-sector actors who are held back by the villains of the story, which are any actors that prevent them from unleashing their innovations. Such villains are likely to be either bureaucratic actors or civil-society groups intent on preserving a status quo.

The specific *plots* of each macro-level narrative emerge from the combination of specific cultural and institutional narratives. In macro-level narratives of modernization, it is the private-sector heroes who are unshackled from constraints and leverage the power of on average beneficial competition and open markets to find innovative solutions to realize single decoupling. The same conditions allow for another leap in economic growth, which also ensures that more and more generations of humans are lifted out of poverty.

The *moral* of a policy narrative is often a policy solution, or, in the macro-level narrative form, rather the set or types of appropriate instruments (Stauffer, 2023). For the ideal-typical macro-level narrative of modernization, a strong moral can be found in so-called innovation-friendly policies, economic and market-based instruments and deregulation.

Transformation paradigm

Transformation paradigms are told through cultural macro-level narratives that go beyond efficiency strategies to reduce resource use and are rather oriented towards so-called double decoupling, which emphasizes both an extended understanding of human well-being coupled with changes in lifestyles towards resource-light behaviour (sufficiency strategies) (Sandberg, 2021; Jungell-Michelsson and Heikkurinen, 2022). In doing so, macro-level cultural narratives within the transformation paradigm start from a *setting* that questions the possibility and desirability of continuous economic growth itself.

As such, a somewhat diffuse concept of 'the planet' or 'the environment' is often invoked as a *victim* of current (especially economic) practices. While references to these diffuse terms may be common to all narratives told within the different paradigms, the key differentiation marking cultural macro-level narratives within the transformation paradigm is their adherence to principles of strong sustainability (Ott et al, 2011). Strong sustainability crucially involves assigning intrinsic value to natural resources and non-humans inhabiting the planet. As such, non-human victims, from chimpanzees and dolphins to plants and rivers, feature prominently. In being sustainability narratives, imaginaries generally also start with a recognition of problems with current use of natural resources regarding distributive justice, within and between generations. Here, macro-level narratives of transformation stand out with more strongly emphasized references to intra-generational equity and therefore involving references to marginalized groups already suffering from, for example, climate injustices in current society as victims.

In the transformation paradigm, the predominant macro-level institutional narrative features civil-society organizations as *heroes* at the centre of a great transformation, which is actively opposed to big corporations, their lobbyists or captured state actors who, as the *villains* of the story, are driven by motives of self-interest, greed and exploitation. In macro-level narratives of transformation, societies across the world experience moral revolutions, which act as deep leverage points (Fischer and Riechers, 2019) and enable a general reorientation towards the common good, ethics of living in harmony with nature and an emphasis on deriving happiness from immaterial sources beyond capitalist consumption. Such widespread changes in lifestyles are brought about by minimizing the dominant role of extractive private-sector actors and transferring power to (radically) democratic, community-based forms of convivial living.

The *moral* of macro-level institutional and cultural narratives within the transformation paradigm is oriented towards policies promoting a cultural shift towards less resource-intensive lifestyles, which might utilize regulative, informative or incentive-based approaches towards favouring certain lifestyle elements such as recycling, care work or soft mobility but also higher levels of taxation to create public, convivial spaces. At the same time, this requires that policies regulate extractive forms of economic activity, for example through favouring economic activity in the forms of cooperatives or social entrepreneurship.

Control paradigm

In comparison to transformation and modernization, the *setting* for the macro-level narratives told within the control paradigm is predominately characterized by its unique focus on the emergency framing of current environmental problems. These problems are assumed to chart a way towards inevitable ecological collapse. Crucially, the macro-level cultural narratives, starting from this emergency setting, also combine this with an assumption that many current, especially democratic, decision-making processes are ill-suited to take the necessarily strong measures to either avoid or mitigate the worst effects of such collapse.

Macro-level institutional narratives within the control paradigm therefore rely especially on authoritative or authoritarian *heroes*. These are a combination of a strong state, which is not shy in utilizing its monopoly of force, and scientific authorities, which supply the necessary knowledge, means and justification for control of the Earth System (including its human inhabitants). *Villains* may be both civil-society or private-sector actors who are either non-compliant with control prescriptions (polluting companies, for example) or not aligned with the specific prescriptions of rationality imposed by the narrative (such as privacy or human rights advocates). Slow-moving democratic institutions may also be seen as villains not able to react fast enough to ensure adequate resilience in a time of emergency. In macro-level narratives of control, with their ideal-typical focus on Earth System perspectives, the *victims* may be less individualized but can be found in the threatened collective well-being or abstracted utility of societies.

Macro-level narratives within the control paradigm, both cultural and institutional, have a relatively straightforward *plot* where a strong actor acts decisively to enforce necessary societal changes for humanity to survive and mitigate a coming emergency, limiting harmful economic activity and possibly geoengineering local and global Earth System components to a large degree. In order to do so, they are helped by the best possible science and engineering to guide actions. For the *moral* of macro-level narratives within the control paradigm, the key policy instrument is the stick (Bemelmans-Videc et al, 1998); well enforced, evidence-backed regulation by a possibly authoritarian state.

As such, the control policy paradigm related to sustainability policy making is likely most relevant in authoritarian political systems. Interestingly, there has been a strand of literature within NPF scholarship, which is attempting to tease out how policy narratives are crafted in authoritarian settings (van den Dool and Schlaufer, 2024). There, most theoretically interesting in intersection with the control paradigm are narrative strategies of the state. For example, an analysis of Russian waste management debates suggest that different actors will define waste management as

a low- or high-complexity issue depending on their objectives, namely to limit (for the government) or to broaden (for civil society) the debate on the controversial issue (Schlaufer et al, 2021). NPF research in the Russian context has also demonstrated that governmental actors typically use an angel shift strategy (Uldanov et al, 2021; Schlaufer et al, 2023) to accentuate the heroic role of enforcing policy reforms or technocratic solutions. In China, narrative stories of power, rising and decline are used to legitimize state roles (Van Gerven, 2019).

Our translation of the control trajectory into the control sustainability policy paradigm, in combination with existing NPF work, has a crucial consequence for empirical work, which is also relevant for the remainder of this article. In many concrete meso-level policy processes in liberal democracies, orientations towards control paradigms may probably exist, but may not be very frequent. On the other hand, in authoritarian settings, as existing NPF work shows, narratives in the transformation paradigm, especially, may not be accessible to many actors. Therefore, the type of political system should be considered a priori when working with these paradigms (as we will also do in the empirical analysis in this article).

Influence of sustainability imaginaries on specific policy processes

Macro-level narratives are especially important for the way they may shape policy narratives at the micro- and meso-level, and in turn, specific policy processes (Stauffer, 2023). By specific policy processes we mean policy processes situated within distinct subsystems involving specific combinations of jurisdictional levels, policy issues and phases of the policy process (Angst, 2020).

Understanding how macro-level narratives influence specific policy process (instead of having a general, vague effect) is crucial for policy making on sustainability transformations. Sustainability policy is in many ways about addressing issues occurring at different scales, from local problems such as concrete, block-by-block climate adaptation measures to global challenges for collective action such as reaching agreement on climate treaties. In the end, sustainability policy is about enabling action at different levels and in different policy domains.

For research on the macro-level narratives telling the stories of different sustainability policy paradigms, the core question to start from is therefore about their actual reach and significance for specific policy processes. The following question is therefore foundational to any work investigating the role of macro-level narratives related sustainability policy making in the policy process:

> To what degree do macro-level narratives aligned with specific sustainability policy paradigms influence specific sustainability policy processes?

To answer this question, the work by Adloff and Neckel (2019) is an interesting offer for inferential and descriptive empirical research. It is in our opinion unrivalled in its general scope and deductive potential. In contrast, other applied work on the ideational and narrative elements of sustainability governance is often theory-building or inductive (Fried et al, 2022; Riedy and Waddock, 2022; Feola et al, 2023). The key challenge now becomes how to detects the presence of the three macro-level narratives in a policy process.

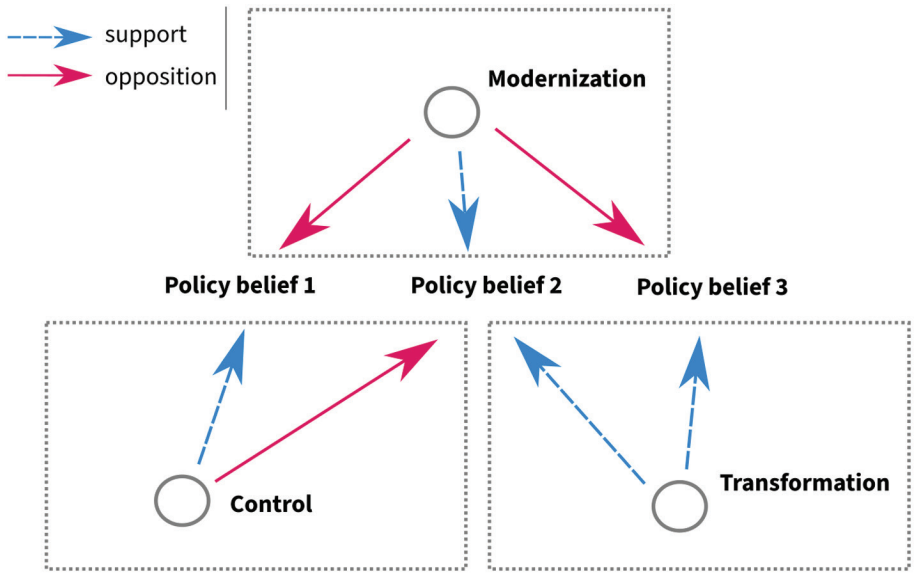
A heuristic to measure the presence of macro-level narratives in specific policy processes

How can we come up with an empirical test to assess the degree to which a specific policy process is shaped by macro-level narratives? Here, we suggest a heuristic based on measuring the stances of actors towards different policy beliefs and comparing them to ideal-typical stance sets. This heuristic has advantages in being broadly applicable across policy domains, data-gathering methods and policy process stages.

Our heuristic relies on deducing ideal-typical sets of possible stances an actor would hold *if they were perfectly aligned with a given policy paradigm*. Stances describe qualitative orientations towards key policy beliefs within a sustainability-related policy domain. Our understanding of policy beliefs draws from how they are conceptualized as policy core beliefs in the Advocacy Coalition Framework (Sabatier, 1988; Weible et al, 2009). The focus on policy beliefs ensures that an analysis is well situated within a specific policy subsystem. Figure 1 illustrates this approach in a stylized example. We use the term *motif* to refer to a specific set of stances.

We can then leverage these motifs in an empirical setting in two distinct ways. First, we can estimate the way in which specific policy processes are characterized by alignment to paradigms. To do so, we can compare the degree to which actual empirically observed sets of stances by actors in a policy field are aligned with ideal-typical motifs. Second, we can estimate the relative dominance of the paradigm and its associated macro-level narratives in a specific policy process. One way to do so is to estimate the relative power of each narrative to explain the observed structure.

Figure 1: Stylized example on mapping sustainability policy paradigms to a specific policy process through motifs of stance sets



Notes: Ideal-typical sets of stances towards a set of policy beliefs within the domain (motifs) are associated with policy paradigms. Circles indicate actors (here ideal-typical actors perfectly in line with macro-level narratives telling the story of the paradigm), arrows indicate stances towards policy beliefs.

Methods

Code and data to reproduce the analysis presented here are made available in an open online repository at: https://doi.org/10.5281/zenodo.17801344.

Case: modernization versus transformation in 12 years of urban transport policy discourse in the city of Zürich

As an empirical case study to investigate the degree to which ideal-typical sustainability policy paradigms are present in a specific policy process, we focus on policy discourse on urban transport policy within the Swiss city of Zürich. *Policy discourse*, as a non-material complement to more material aspects of policy making, is an aspect of the policy process where macro-level narratives in our conceptualization should be detectable. We focus specifically on modernization and transformation paradigms given the political system and specific, local policy domain we are investigating and chose to disregard the control paradigm here a priori.

Recent global sustainability discourse assigns an ever-increasing importance to the role of cities (Angelo and Wachsmuth, 2020). A key aspect of urban sustainability transformations relates to the sustainability of urban transport systems, which should combine reduced greenhouse gas emissions and a decoupling from resource use with considerations for societal equity (Hull, 2008). Target 11.2 of the United Nations' 2030 Agenda for Sustainable Development, for example, aims at 'safe, affordable, accessible and sustainable transport systems' (United Nations, 2015: 21). Throughout the world, these very general goals are often not controversial. However, actual policy making on transportation, mobility or traffic issues in urban context often is very contentious (Marquet et al, 2024; Shrestha et al, 2024).

The high salience and staying power of mobility issues on the public and policy agenda is understandable. Transport system governance shapes cities and touches the daily life of large proportions of people living in urban and suburban areas. As such, the urban transport domain is both relevant and well-suited to explore sustainability policy paradigms and for the NPF more broadly (Loyola et al, 2023).

We specifically focus on the case of the city of Zürich in our empirical investigation of policy discourse around urban transport over a period of 12 years from 2012 to 2024. Cities and urban areas have historically followed a development centred on individual car use, fostering car-oriented urban planning (Bratzel, 1999; Miner et al, 2024; Schröder and Klinger, 2024). Zürich, Switzerland's biggest city, is no exception.

Over more than a decade, the city administration (with a consistent majority of social democrat, green and left alternative parties in city council and parliament) set goals towards adapting urban infrastructure and traffic regulations to promote a modal shift away from individual car use and towards transport modes seen as more sustainable. This has been accompanied by controversial political debate and several popular votes. Key for context is especially that the city of Zürich has limited decision-making power over parts of its road network, which is under the jurisdiction of the generally more conservative canton (state) it is part of. While the policy process under scrutiny in our case is particularly relevant in the Swiss context, we believe that the approach of our study generalizes well to other cities with public, democratic discourse on urban sustainable transport issues. In terms of our contributions to theory, Zürich is

a 'most likely' case (Flyvbjerg, 2006: 231). We would highly expect our deductively identified macro-level narratives to structure discourse here and if not, this would cast doubt onto their theoretical usefulness.

Urban transport policy discourse networks

In our empirical test, we formalize our measurement of sustainable urban transport discourse as a discourse network (Leifeld, 2013; 2020). This network has three components: actors, beliefs and stances (see Figure 2). An extended formal and conceptual introduction to our variant of a discourse network conceptualization can be found in Angst et al, 2025.

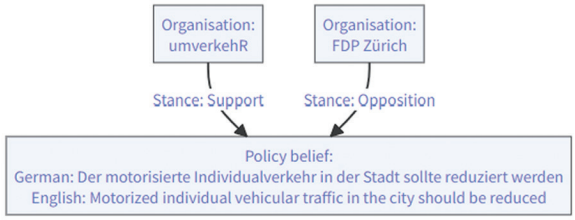
Actors in our network are organizational actors participating in societal discourse from all societal sectors. Our focus on organizational actors follows an established practice in governance network research (Scott and Ulibarri, 2019). For stances in our discourse network conceptualization, we restrict the set of possible stance qualifiers to two classes: support or opposition. Every time an actor is observed to express a stance towards a policy belief in the media that fits one of those two classes, a time-stamped edge is added to the network. Figure 3 gives a minimal empirical example for the basic structure described in the urban transport policy domain.

Discourse network data gathering

We constructed the discourse network of urban transport policy discourse in Zürich analysed in this study using automated methods to process more than a million paragraphs from Zürich-related newspaper articles. Our processing pipeline leverages various natural language processing and machine learning tools to extract information on actors and their stance to policy beliefs. The technical foundations and internal validity tests of our approach are documented in extended detail in Angst et al (2025) and Walker and Angst (2025). We thus only provide a brief non-technical description

Figure 2: Basic components of a discourse network as conceptualized in this study

Figure 3: Example of a discourse network with two actors (organizations), two qualified stance relations and one policy belief around urban sustainable transport governance



of the data-gathering procedure and processing pipeline in this article in the appendix. Most importantly, the entire processing pipeline results in a set of 7,118 stances of 72 unique organizational actors, who were mentioned at least twice during the observed time period, regarding six policy beliefs displayed in Table 1.

For the purpose of this study, we also carried out an additional qualitative interview campaign to assess the external validity of our approach (complementing the internal validity tests in Angst et al, 2025). We conducted a total of 11 guided interviews (see Interview Guidelines section in the appendix) with representatives of organizational actors classified in our data, selected to be broadly representative of our sample based on societal sectors. We interviewed representatives of two political parties (moderately left and right-leaning), five interest groups and civil-society organizations, three administrative agencies and one private firm.

For each interview, we created a customized automated report about the classifications of our model related to the stances of the specific organization over a ten-year period. Interviewees were then asked to assess how well the classifications captured the actual stances of the organization. Responses were recorded, transcribed and analysed based on an inductively generated coding scheme with three assessment categories. These were 'agreement' and 'disagreement' with the classifications, as well as 'undifferentiated', where interviewees found the classification not adequately capturing the subtleties of their stances.

The analysis showed that for almost all topics, the majority of interviewees agreed with the model's classification. Only for one topic (motorized individual traffic)

Table 1: Sustainable transport topics and associated main policy belief per topic used to construct discourse network

	Topic (German)	Topic (English)	Main policy belief (German)	Main policy belief (English)
1	Motorisierter Individualverkehr	Motorized private transport	Der motorisierte Individualverkehr (MIV) in der Stadt soll reduziert werden	Motorized private transport in the city should be reduced
2	Öffentlicher Verkehr	Public transport	Die Nutzung und der Stellenwert des öffentlichen Verkehrs soll gefördert werden	The use and importance of public transport should promoted
3	Parkplatz	Parking	Das Parkplatzangebot in der Stadt soll reduziert werden	The number of parking spaces for motorized private transport in the city should reduced
4	Fahrradinfrastruktur	Cycling infrastructure	Das Fahrrad als Mobilitätsform soll gefördert werden	The bicycle as a form of mobility should be promoted
5	E-Mobilität	E-mobility	E-Mobilität in Form von E-Autos, E-Bussen, E-Scootern und E-Bikes soll gefördert werden	E-mobility in the form of e-cars, e-buses, e-scooters and e-bikes should be promoted
6	Fahrgeschwindigkeit	Driving speed	Zur Minderung von Emissionen soll die Fahrgeschwindigkeit in der Stadt reduziert werden	Driving speed in the city should be reduced to reduce emissions

were the respondents divided. In three topics (e-mobility, cycling, reduction of traffic speed), interviewees added that while they agreed with the classifications in principle, their real-world positions contained additional nuances (for example, supporting e-mobility, but not everywhere). Some interviewees suggested potential reasons for shortcomings of the automated approach. These mostly referred to limitations of media data generally, such as gatekeeping or fluctuations in general interest in topics.

Discourse network motifs of modernization and transformation macro-level narratives in urban transport policy in Zürich

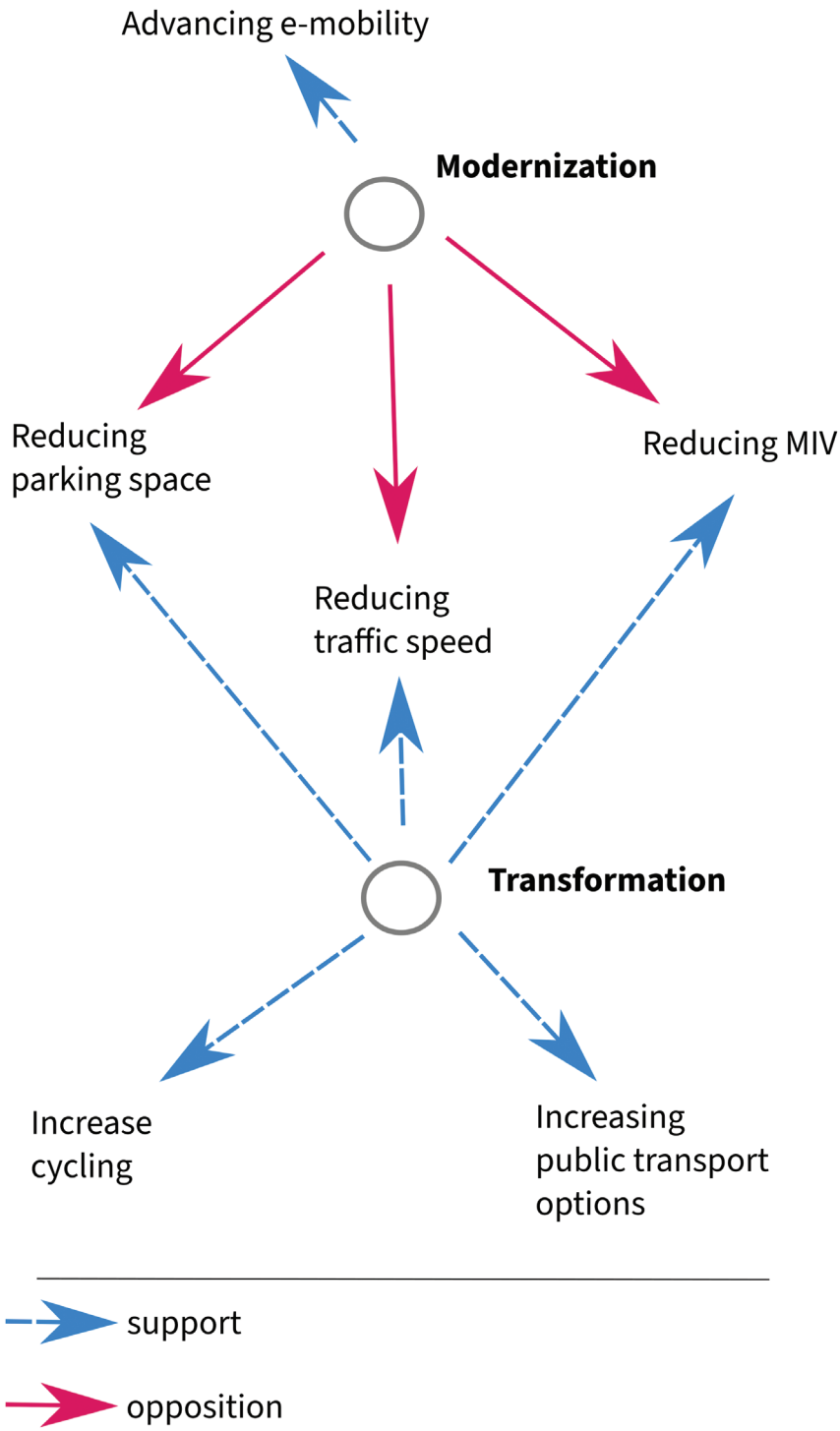
Here, we ask: what would an actor look like in our discourse network on urban transport policy in Zürich who aligned perfectly in their positioning in the policy discourse with the macro-level narratives being told in either the policy paradigm of modernization or transformation?

Figure 4 illustrates our answer to this question. The figure displays concrete discourse network motifs we will argue would represent ideal-typical adherence to sustainability policy paradigms of transformation and modernization in our specific policy process under study. In our mapping of paradigms to motifs, we decided not to assign a stance for every belief for every narrative. We did so in order to focus on the most clear-cut matches, to arrive at strong ideal-types.

The ideal-typical discourse network motif associated with *modernization* is on the one hand characterized by opposing stances to reducing motorized individual traffic, reduction of parking space and traffic speed. On the other hand, the motif is characterized by a supporting stance towards advancing the role of electric mobility. The electrification of the transport system is a core way in which macro-level narratives of modernization manifest in transport discourse in our opinion, as it captures the core tenet of modernization imaginaries, which envision a future in which adaptations to current lifestyles are largely unnecessary due to technological progress. The electrification of the transport system, especially the electrification of the motorized individual vehicle, plays a crucial role in many mobility narratives (Holden et al, 2020). In a stereotypical modernization imaginary, it enables a continuation of current car-centric transport system designs with zero carbon emissions. This is also the reason for us assigning opposing stances to reducing traffic speed, parking space and motorized individual traffic in the ideal-typical modernization motif, as these are all belief statements related to reducing the role of individual vehicle use in transport systems. However, in macro-level narratives of modernization, such a reduction is not necessary. Also, the importance of the association of (traffic) speed with progress should probably not be underestimated in modernization imaginaries, which are often characterized by visions of acceleration.

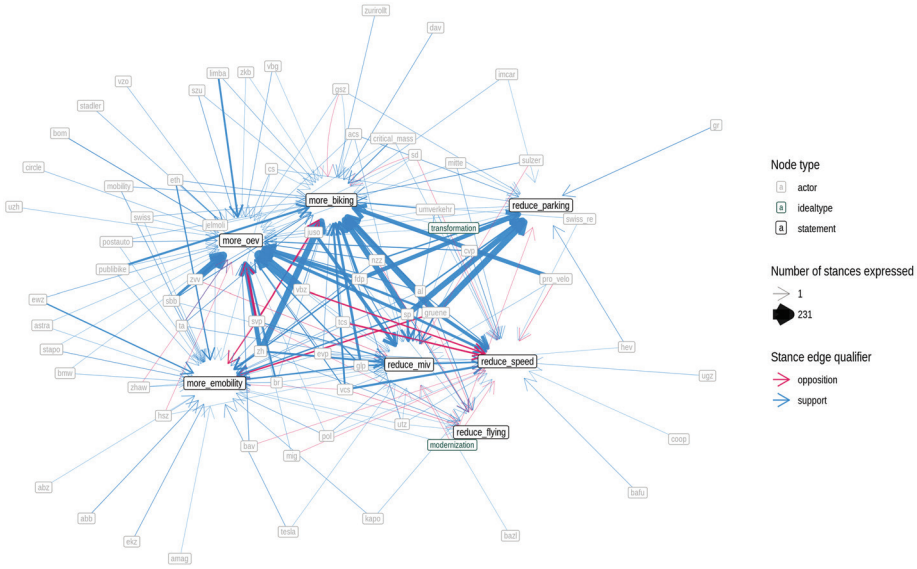
The ideal-typical *transformation* network motif is characterized by supporting stances towards reducing parking space, reducing traffic speed, reducing motorized individual traffic, increasing cycling and increasing public transport options (Kallenbach, 2020). Transformation macro-level narratives are characterized by promoting a cultural shift to less resource-intensive, 'slower' lifestyles (Holden et al, 2020). In transport policy, this aligns with a primary preoccupation in the promotion of modal shifts in the system, instead of continuing current modal splits among transport modes. In our case, this especially relates to the promotion of modal shifts towards bicycles

Figure 4: Ideal-typical discourse network motifs associated with macro-level narratives of modernization and transformation for local policy discourse on urban transport with the city of Zürich



Note: Circles indicate actors present in discourse, arrows indicate stances towards beliefs.

Figure 5: Discourse network of urban transport policy in Zürich between 2012 and 2024



Notes: Position of modernization and transformation imaginaries as ideal-typical stance profiles highlighted in green. Arrows indicate the most prevalent either opposing (red) or supporting (green) stance of an actor towards a policy belief statement within the time period.

and public transport, as well as support of measures to reduce the modal share of car use in the city.

Figure 5 highlights the ideal-typical network motifs within the empirically observed discourse network of urban transport policy in Zürich.

Finding narratives

To answer our main research question, a procedure needs to evaluate the way in which theoretically deduced ideal-typical narratives, operationalized in the form of ideal-typical discourse network motifs, relate to empirically observed discourse network structure. To achieve this methodologically, we carry out three tests.

Test 1: Similarity distributions of actors to motifs

In this step, we compute the similarity of each actor to ideal-typical motifs of modernization and transformation. On the one hand, this informs clustering in Test 2, but it also allows for a first naive check of distributions against a uniform distribution of similarity scores, which would indicate that similarity to ideal-typical motifs has no structuring power at all. To compute similarities, we transform the initial time-stamped, valued bipartite graph of actor–belief relations into an aggregated, binary, bipartite graph of actors–belief–*stance* relations. This involves an aggregation step and an explosion step.

In the aggregation step, we first define a time window for aggregation. Then, we reduce the potentially numerous time-stamped stance edges within a time window

for each actor to a single stance edge, keeping only the most prevalent category per time window per actor. We have shown in an earlier study that in the presence of an unbiased classifier, stance inertia and data redundancy, this significantly increases internal validity of the stance measurement (Angst et al, 2025). This leaves us with a valued, bipartite graph per time period, where each actor only has a single edge value (stance classifier) per policy belief. For the purpose of the analysis presented in this study, we aggregated over the entire time period in question.

In the explosion step, we then 'explode' the valued bipartite graph into a non-valued (binary) version by creating qualified belief nodes. Qualified belief nodes are the set of belief nodes created by computing every possible combination of belief and stance classifier. For example, given a belief node *x* and a set of stance classifiers *support, opposition*, this would replace the initial belief node with two new nodes *xsupport* and *xopposition*. If an actor expressed a support stance towards *x* (an edge valued with the stance classifier *support*), in the exploded graph, an unvalued edge would then be added connecting them to *xsupport*.

For this binary, bipartite graph, we can now calculate a suitable similarity metric for node similarities, especially given that its incidence matrix is a set of binary vectors, which makes it possible to calculate a large number of graph and non-graph similarity metrics. Similarity metrics all have different properties and thus advantages and disadvantages. In our case, we use the so-called dice coefficient as implemented in the R package igraph (Csárdi and Nepusz, 2006), which, for two nodes, is twice the number of common neighbours of the nodes divided by the sum of the degrees of the nodes. We chose to do so because the dice metric, by virtue of multiplying the numerator and summing the total degrees in the denominator, emphasizes overlapping beliefs and somewhat guards against actor nodes with many stance expressions automatically scoring higher.

Test 2: Clustering of stance profiles

The main idea behind the clustering step is to inductively find groups of actors that are similar to each other in their discourse network position, without considering macro-level narratives. We can then assess how well inductively identified clusters are placed within the space drawn up by similarity to macro-level narratives. All clustering relies to a certain extent on subjective judgements in parameter settings. Here, we use k-medoid clustering to cluster the bipartite incidence matrix of the exploded discourse graph directly, as implemented in the R package cluster (Maechler et al, 2023). k-medoids clustering relies on a single parameter *k*, setting the number of clusters. We chose to compute the clustering with $k = 4$, based on an automated approach to the so-called elbow method implemented in the R package parameters (Lüdecke et al, 2020) and checking against the visual separation of clusters after dimensionality reduction in uniform manifold approximation and projection (UMAP) (see Figure 8).

Test 3: Dimensionality reduction

As a final test, we reduced the multidimensional data underlying the discourse network, specifically the incidence matrix of the exploded discourse graph, into two-dimensional space. To do so we relied on UMAP (McInnes et al, 2018), as implemented in the R package umap (Konopka, 2023). The results can be seen as higher-level positioning of actors in the discourse within two axes, which are not

directly interpretable qualitatively anymore but represent the underlying structure of the discourse, given UMAP's assumptions. It is displayed in Figure 8, which also shows the results of the clustering step undertaken in Test 2 in the lower-dimensional space.

In our case, we make use of the fact that after UMAP, the discourse position of all actors can be represented by two values (their x and y coordinates in Figure 8). This allows us to use a multivariate Bayesian regression model to predict how well the similarity of all actors to ideal-typical motifs for each actor predicts these two values, ergo their position in the discourse.

The multivariate model we use can be written in simplified form as $Y = \beta 0 + \beta 1 Xtransformation + \beta 2 Xmodernization + \epsilon$ (Sinay and Hsu, 2014). With n denoting the number of observations (actors), Y is the $n \times 2$ matrix of response variables (UMAP coordinates), *Xtransformation* and *Xmodernization* denote the $n \times 1$ predictor variables (similarity scores to the two ideal-types for each actor), the β variables are 1×2 matrices of regression coefficients (one for each response variable per β variable) and ϵ denotes the $n \times 2$ error terms.

We estimate the multivariate regression model using the R package brms (Bürkner, 2017), using a Gaussian likelihood and quite uninformative Normal (0, 5) priors for all parameters. We used four chains with 2,000 iterations (of which 1,000 were discarded after warmup) to estimate the posterior distributions.

We kept the model very simple on purpose, checking only for predictive capabilities of the model without formulating an explicit causal model. Formulating a causal model to predict UMAP coordinates as the response variables does not make much sense, given that UMAP coordinates have no direct qualitative interpretation. Given the absence of a causal model, we also refrain from interpreting the predictors themselves as causal effects. We are solely interested in the predictive power of the model as an indication that we should not rule out the structuring power of macro-level narratives. To assess this, we estimate Bayesian $R2$ (Gelman et al, 2019) values of our model, which amounts to measuring the increase in explained variation in comparison to a baseline intercept-only model $Y = \beta 0 + \epsilon$.

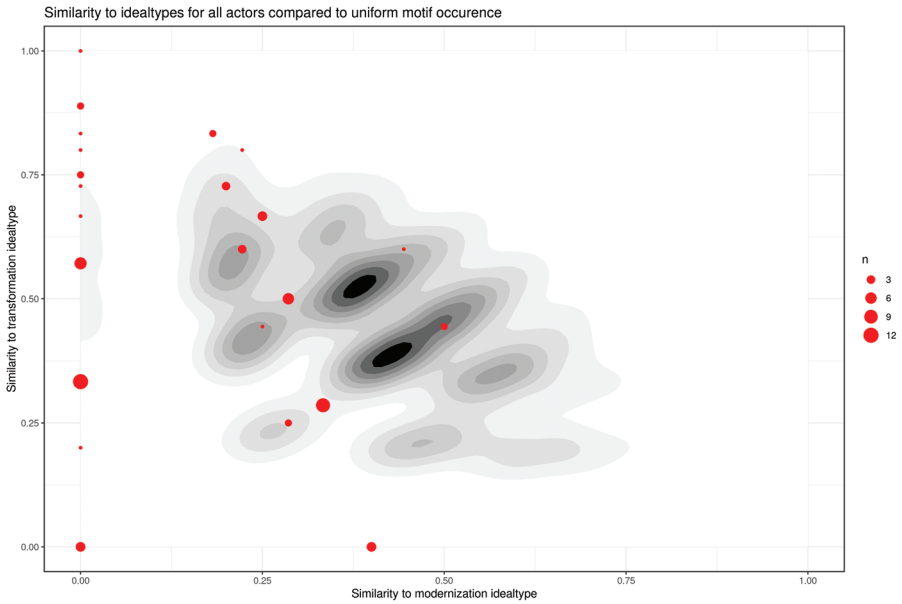
Results

Test 1: Similarity distributions of actors to ideal-types

Our similarity computations make it possible for us to assign each actor a similarity score, based on their aggregated discourse activity over time, with regard to their alignment with modernization or transformation macro-level narratives. These scores range from 0 to 1, with 0 indicating maximal dissimilarity and 1 indicating perfect alignment.

Figure 6 shows the similarity score to ideal-type distribution across all actors. It is crucial to consider here that not all combinations of scores are actually possible. This is most obvious when considering that an actor cannot be maximally aligned with both ideal-types but, somewhat less obvious, there exist a large number of other impossible combinations of scores as well. Figure 6 highlights this fact in showing the actual possible scores in a density plot, which displays the distribution of similarity scores to modernization and transformation ideal-types that would occur if all possible stances in the discourse were uniformly distributed (thus each possible stance profile for an actor would occur at the same rate). The figure highlights that structuring

Figure 6: Similarity distributions for all actors to ideal-typical stance profiles for modernization and transformation (red dots, size indicates number of actors at position), compared to distribution of similarity scores if all possible stances occurred at uniform rate (grey-scaled density mapping, darker indicates higher occurrence)



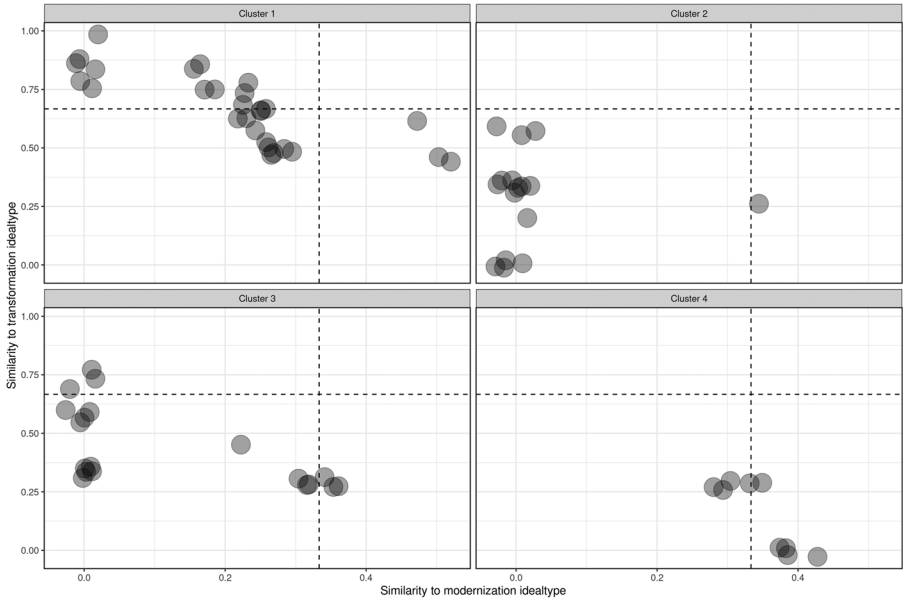
the discourse space in reference to the two policy paradigms seems plausible, as empirically observed scores along the two main axes occur much more often than under a uniform distribution.

Test 2: Clustering of stance profiles

Figure 7 shows the similarity distributions to ideal-types within each cluster of the four-cluster solution. This is done to assess if inductively identified clusters of actors in the discourse separate along the axes drawn up by similarity to the two ideal-types. For ease of interpretation, the eighth decile of each similarity score distribution is plotted as a dotted line, separating the plots into four quadrants. The off-diagonal quadrants indicate strong alignment with ideal-types, the bottom left quadrant indicates less pronounced alignment with any ideal-type, and the top right quadrant would imply strong alignment with both paradigms (although most of the space within the top right quadrant is impossible to be filled).

Generally, the conclusion that can be drawn based on the comparison of bottom-up clustering with similarity distributions to ideal-types is that the two paradigms structure a significant part of the discourse. No cluster is spread across the off-diagonal of quadrants to a large degree, which would indicate the presence of very modernization- and transformation-aligned actors at the same time within the cluster. Instead, two clusters tend strongly towards one or the other ideal-type (Clusters 1 and 4), while the other two clusters do not seem to operate in obvious reference to the either one.

Figure 7: Similarity distributions to ideal-typical stance profiles for modernization and transformation, within clusters of the four-cluster solution based on k-medoids clustering



Notes: Dotted lines indicate eighth decile of scores per score distribution. Darker points indicate overplotting, indicating the presence of multiple actors at the given position.

Test 3: Dimensionality reduction

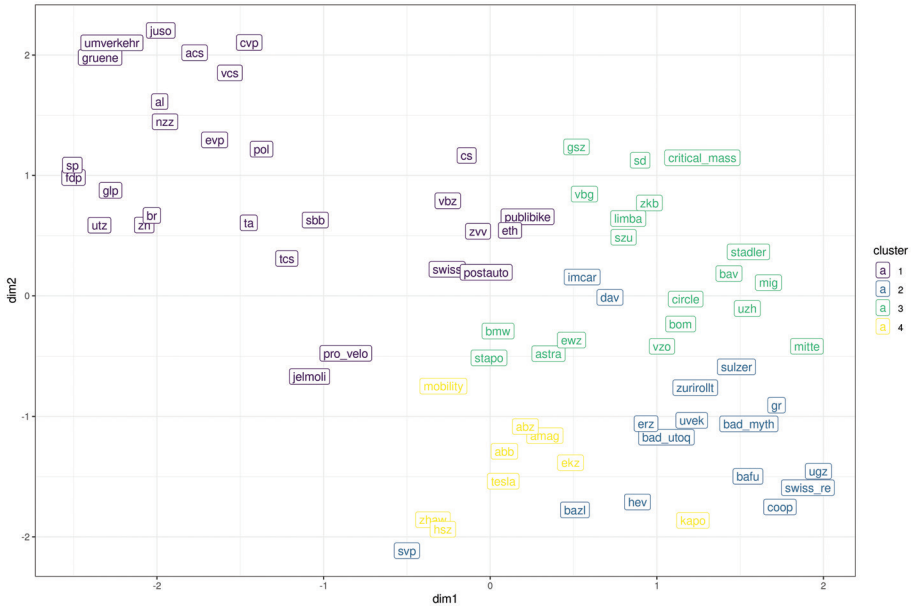
The results of applying UMAP to the discourse network for dimensionality reduction is shown in Figure 8.The actual test undertaken based on this dimensionality reduction is now to predict the position of actors within this reduced space, using a multivariate Bayesian regression model with only similarity to ideal-types as predictors.The model drawn up converged successfully, with R-hat scores consistently equalling 1.00 and satisfactory effective sample size measures.

The results of the modelling step here indicate that macro-level narratives can predict the overall structure of the discourse in the form captured after dimensionality reduction.The Bayesian R-squared values of the model are 0.49 (with a [0.39, 0.58] 88 per cent credible interval) for predicting the first UMAP dimension and 0.62 (with a [0.54, 0.68] 88 per cent credible interval) for predicting the second UMAP dimension. Again, it is crucial to note here that the model was set up purely for assessing its predictive capabilities and we refrain from interpreting its parameter values any further than this.

Discussion

Overall, using three different empirical tests, we find evidence that policy discourse on urban sustainable transport policy in Zürich can be understood as structured in orientation towards modernization and transformation macro-level narratives – to a degree.What our results also illustrate is that theoretically deduced macro-level narratives, originating in ideal-typical sustainability imaginaries, are what they are – ideal-types.

Figure 8: Four-cluster solution highlighted in dimensionality reduction based on UMAP



In real-world settings of complex policy-making processes, ideal-types can turn into caricatures. As such, our results are likely to point to the usefulness of taking these sustainability policy paradigms as starting points, not ends in themselves, to explore sustainability-related policy domains. Such domains abound in the Anthropocene, in our opinion, from more classical environmental policy fields such as energy, water or forest policy to analyses of cross-cutting subsystems, such as urban planning or tourism.

For the NPF more generally, first, our study illustrates the theoretical usefulness of the conceptualization of macro-level narratives within the NPF contributed by Stauffer (2023). Understanding macro-level narratives as telling the story of policy paradigms has been genuinely useful to translate ideational concepts developed within the sustainability science literature to policy process theory, we find. Second, we also think our proposed heuristic to measure the presence of deductively identified policy paradigms in policy discourse network structure via alignment to ideal-typical network motifs should generalize well to other policy domains. We could also easily see ways for further creative approaches to mapping motifs to the NPF, for example by adding actor type attributes (focusing on characters) or encoding policy instruments (focusing on morals).

There are a number of limitations to our study, of which we want to highlight three specifically.

First, an interesting wrinkle relates to actors engaged in sustainability-related policy processes, who do reject the whole notion of sustainability as a normative concept of relevance. This may for example be due to rejecting the fundamental premise of the Anthropocene, that humanity has become a globally relevant driver of Earth System dynamics; that humanity is responsible for endangering the long-term carrying capacity of the planet; or simple nihilism and discounting of the ethical relevance of

the well-being of future generations. This points to the necessity of further theoretical work on sustainability policy paradigms.

Second, theoretical work is also definitely needed to further explore the usefulness of the control paradigm, which we suggest as a likely form for sustainability to make its way into authoritarian policy narratives. As an example, related to this article's domain of sustainable transport policy, what effectively are mass surveillance systems in urban settings are sometimes justified in part by emergency framings around the need to better steer transport systems in cities, particularly in China (Liang et al, 2018; Curran and Smart, 2021). Beyond studying the control paradigm in explicitly authoritarian systems, where research can build on existing NPF work, one line of research may also be the exploration of the prevalence of macro-level narratives of control in policy domains in liberal democratic system where policy discourses contain more strongly authoritative arguments, such as more classical environmental protection policy.

Third, we study policy discourse in our study. Policy discourse is an essential part of the policy process, but does not equate the policy process. How sustainability policy paradigms feature in other aspects of the policy process is a fascinating avenue for future research.

Conclusion

We had two main goals for this article. First, to argue that sustainability imaginaries of modernization, transformation and control as developed by Adloff and Neckel (2019) can be understood as containing macro-level policy narratives telling the story of distinct policy paradigms in sustainability policy making. And second, building on this, to test if such macro-level narratives meaningfully structure empirically observed policy discourse in a specific case of sustainability policy, namely sustainable urban transport policy, using the case of Zürich.

We have been able to translate sustainability imaginaries into policy paradigms and associated macro-level narratives in a relatively straightforward way, which speaks for the synergy between both approaches. As a lens to observe sustainability policy making, macro-level policy narratives telling the story of policy paradigms of modernization, transformation and control have intuitive appeal and the potential to generalize the study of different sustainability policy fields.

A line of research oriented towards tracing the larger narratives underlying sustainability policy has the potential to operate at a unique level of comparability between very heterogeneous sustainability policy processes. Sustainability is a normative concept and always oriented towards a future world. All sustainability policy processes thus must tell some story about the future with certain commonalities and should be comparable on this aspect. We would thus like to see future work exploring the relative orientation towards deductively identified sustainability policy paradigms in different contexts, also going beyond the imaginaries by Adloff and Neckel (2019) we relied on here (for example, Glasser, 2016; Wiedmann et al, 2020).

For policy analysts and practitioners engaging with sustainability policy making, we would recommend exploring the perspective offered by looking for the presence of sustainability paradigms of modernization, transformation and control. The paradigms offer a potentially informative way to make sense of different stories about sustainability told in day-to-day policy work. Grasping dominant narratives can

inform evaluations about what is feasible in policy making or what not. Sometimes this may actually point out that work is most needed on cultural narratives, or deep leverage points, to highlight a final connection to sustainability science literature (Fischer and Riechers, 2019). After all, the stories we tell about a sustainable future matter for the type of future we get.

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Data availability statement
All data and code to enable replication of computations presented here based on the discourse network graph originating from our processing pipeline are available in an open online repository at: https://doi.org/10.5281/zenodo.17801344. For further computations using a discourse network graph following our conceptualization, we also provide a small R package at: https://urban-sustainability-lab-zurich.r-universe.dev/diskurs. For the processing pipeline creating the discourse network graph, given agreements with the publishing companies making the raw media data available to us, we cannot provide access to the raw data. To facilitate investigation of the automated processing and put it under scrutiny, we have made the classification API, which includes all non-LLM-based pipeline components, available at: https://zenodo.org/records/14702518. The LLM-based stance classification classifier component of the pipeline is made available as a Python package at https://pypi.org/project/stance-llm/.

Contributor statement
MA conceptualized the study and drafted the manuscript. NM, VW and MP provided feedback to the manuscript. MA carried out the analysis reported in this article. NM designed and carried out the interview campaign to assess external validity. VW led the development of the LLM-based stance classifier. All co-authors were involved in annotating test and training data.

Conflict of interest
Mario Angst is president of the board of a local bike messenger co-operative in Zürich committed to offering sustainable transport services. Neitah Müller is a member of and was a candidate for parliament for the political party Grünliberale. Both activities are likely to influence their subjective perception of local urban sustainable transport discourse but they have tried to mitigate this as much as possible during work on this project.

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Appendix

Brief description of automated discourse network extraction pipeline

The processing pipeline used to generate the discourse network data for the analysis presented in this article consists of a number of steps. This section outlines the pipeline in an abbreviated form. An expanded outline, including further evaluation metrics is published in a separate article at Angst et al (2025).

The code to reproduce the classification API is available at: https://doi.org/10.5281/zenodo.14702517.

First, we filter articles to a subset of Zürich-related articles, based on either the section an article appears in or a set of possible phrase matches for typical place names for Zürich. Second, we split articles into paragraphs, based on paragraph breaks encoded in the articles. In the following steps of the pipeline, processing then happens on the paragraph level. Third, each paragraph then runs through a relevance filter, which consists of a machine learning classifier trained on 4,320 manually annotated paragraphs to detect references to sustainable transport discourse (80:20 train-test split, f1-score 0.84, precision 0.88, recall 0.81). Fourth, every paragraph passing a relevance cutoff threshold of 0.5 in the relevance filter step is assigned between zero and seven urban sustainable transport discourse topics by a rule-based model, mainly relying on phrase matches tested for high precision. A set of seven urban sustainable transport topics (see Table 1 – one topic (reduction of air travel) was not used in this study due to the focus on local transport policy of its analysis) was developed through qualitative content analysis and close reading of newspaper articles. In the same step, for each topic, a main 'watershed' policy core belief was identified (see also Table 1). Fifth, in parallel, for every paragraph, a named entity recognition model pretrained on German news articles in combination with entity linking based on a database of manually curated regex matches is used to detect organizations occurring in paragraphs and link them to a unique organizational identifier (for example linking an abbreviated and spelled out version of an organization, such as 'SVP' and 'Schweizerische Volkspartei' to the same entity).

These initial processing and classification steps result in a database containing information on which organizations co-occur with which urban transport topics in which paragraphs. In a final step, to build the discourse network graph, for every unique combination of paragraph, organization and topic, a stance detection classifier, based on a custom large language model (LLM) interface implementation (documented in Walker and Angst (2025) and available as a Python package at https://pypi.org/project/stance-llm/) is used for a zero-shot classification of the stance of each organization regarding the main policy belief in each topic it co-occurs with based on the paragraph text. A possible stance class in this step was also 'irrelevant' next to 'support' and 'opposition', indicating the very common possibility that an organization occurred in a paragraph but did not express any stance towards the main policy belief for the topic occurring in the paragraph. In this stance classification step, we use a self-hosted, pretrained LLM called Llama-3-SauerkrautLM-70b-Instruct[1], a version fine-tuned for German LLM of Llama-3 provided by the company Meta[2]. Generally, the performance of the LLM-based stance classification procedure, based on comparisons against a manually annotated test set of 1,700 stances is good (f1-score

(weighted) 0.74, precision 0.67, recall 0.72). However, as we show in Angst et al (2025), windowed aggregation, where information on stances of organizations is pooled over a time period (here simply picking the most often occurring stance regarding a policy belief in each period) greatly increases internal validity of the classification. Leveraging information redundancy and stance inertia properties of media data on discourse in this way, test metrics (depending on the size of aggregation windows) achieve values of around 0.9 and higher in both micro- and macro-level variants of f1, precision and recall scores.

Our raw data consists of a data set of 1,921,681 Zürich-related German media articles (online and print) from 1 January 2012 to 14 April 2024 made available to us via Swissdox@LiRI by the Linguistic Research Infrastructure of the University of Zürich. We process articles from three major Swiss news publications (*Tages-Anzeiger*, *Neue Zürcher Zeitung*, *20 Minuten*) as sources. All of these media sources dedicate specific sections to local news about Zürich. In their ideological orientation, our media sources range from the more right-leaning, economically liberal *Neue Zürcher Zeitung* (NZZ) to the moderately left-leaning *Tages-Anzeiger* (Udris, 2023).

The complete list of sources, including their Swissdox identifier in parentheses is: Tagesanzeiger (TA), nzz.ch (NZZO), Neue Zürcher Zeitung Folio (NZZF), NZZ Campus (CAMP), Neue Zürcher Zeitung am Sonntag (NZZS), Neue Zürcher Zeitung (NZZ), Neue Zürcher Zeitung am Sonntag Magazin (NZZM), bellevue.nzz.ch (NZZB), 20 Minutes (ZWAS), 20 Minuten (ZWA), 20 Minuten Friday (ZWAF), 20 Minuten Online (ZWAO), züritipp (Tages-Anzeiger) (TAZT), Zürich Express (ZUE).

For the analysis presented in this article specifically, an additional filtering step was undertaken for organization to include only organizations that occurred at least two times (the median occurrence; there exists a large number of organizations that only occur once) over the entire time range between 2012 and 2024, in order to better leverage the internal validity gains that can be achieved through windowed aggregation.

Interview guidelines for interview campaign to assess external validity of automated data gathering

Introduction to interview

Danke Frau/Herr XY, dass Sie sich die **Zeit genommen haben**, das schätzen wir sehr. Ich erkläre Ihnen das Vorgehen und erzähle Ihnen kurz

- von unserem **Projekt**,
- **wer wir** sind,
- was wir **machen**,
- und der **Zweck des heutigen Interviews**.

Danach **starten wir** mit dem Interview.
Zum Vorgehen.

- Das Interview besteht aus **drei Teile mit je einer Hauptfrage**, die ich an Sie richten werde. Daraus ergeben sich je nachdem noch weitere Fragen.

- Alles zusammen wird ca. **45 min bis 1h** dauern.
- Ich werde das **Interview aufzeichnen**, um es später auswerten zu können. Dafür brauche ich noch Ihr mündliches Einverständnis.
- Es ist **anonymisiert**.
- Ich werde vor dem Starten des Interviews das **Aufnahmegerät** anstellen und Sie **nach Ihrem Ein-verständnis fragen**, worauf Sie mir Ihre Antwort geben.
- Nach dem Interview werden wir Sie **zu entsprechender Zeit** wieder über das Projekt mit einem **Schlussbericht** informieren.

Zu uns und dem Projekt.

Wir sind ein **Forschungsteam von vier Personen**, die an diesem Projekt arbeiten. Projektleiter ist Mario Angst. Dann haben wir noch eine **Doktorandin** und eine **wissenschaftliche Hilfsassistenz und mich**, auch wissenschaftliche Hilfsassistenz.

Das Projekt heisst sustainability.discourses.

- Es ist ein Projekt der Digital Society Initiative der Universität Zürich.
- Wir erforschen **gesellschaftliche Diskussionen rund um städtische/ urbane Nachhaltigkeit**.
- Also es interessiert uns, **welche Themen gerade diskutiert werden, wer einbezogen und nicht einbezogen wird und welche Erzählungen zu urbaner Nachhaltigkeit es gibt**.
- Wir zeichnen uns speziell dadurch aus, dass wir **automatisierte Modelle entwickeln** um gesellschaftliche Diskussionen zu verfolgen.
- Das heisst, wir **automatisieren das Ganze, wir trainieren Machine Learning Modelle, um für uns Daten wie Medienartikel auszuwerten** (ev. Website zeigen).
- Im Moment **fokussieren wir uns spezifisch auf nachhaltige Mobilität** in der Stadt Zürich – wie beispielsweise die Themen Velowege oder **Tempo 30**.

Ziel der Interviews

Wir **bauen automatisierte Modelle**, doch diese haben immer auch **Grenzen**.

- Um **gesellschaftliche Diskussionen wirklich zu verstehen** und auch zu verstehen, wie **gut unsere Modelle** sind, brauchen wir von Zeit zu Zeit einen **Realitätscheck**.
- Hier **kommen Sie ins Spiel**. Mit ihrer Hilfe wollen wir unsere **automatisierte Diskursanalyse über-prüfen** und unseren **Horizont in dem Thema erweitern.**

Gut. Haben Sie **noch Fragen?**

Ich werde jetzt das **Aufnahmegerät an machen** und stelle Ihnen die Einverständnisfrage, die Sie mir beantworten. OK.

Sind Sie einverstanden damit, dass das Interview mit Ihnen aufgenommen wird?

Guided part on external validity assessment

The external validity assessment took part as the third part of a long interview, which included two previous parts on general attitudes towards urban sustainability

transformations and specifically towards urban transport. The guideline to structure the third part is reproduced in Table 2.

Table 2: Interview guideline for external validity assessment interview

Erzählstimuli (Erzählaufforderung)	**Inhaltliche Aspekte erfragen, falls nicht erwähnt (exm. Frag.)**
Teil III **Konfrontation mit Modell-Output**	Ziel: Abgleich Modell-Output und tatsächlicher Position des Akteurs
Schauen Sie sich diesen Report an. Hier sehen Sie, wie Ihre Organisation in den Medien seit 2012 in der gesellschaftlichen Diskussion rund um nachhaltige Mobilität vorkam. Was sind ihre Gedanken dazu?	- Sind Sie **damit einverstanden**, wie Ihre Haltung zu Thema XXX anhand unseres Modells klassifiziert wurde? - **Gemäss Modell sehen wir hier**, dass Sie plötzlich nicht mehr gegen XXX waren, was ist Ihre Meinung dazu? - **Ihre Organisation kam im Jahr** XXX plötzlich oft in den Medien zum Thema XXX vor? Macht das Sinn? Was könnte der Grund gewesen sein?

Notes

[1] Specifically the variant published to the model hosting platform Hugging Face at: https://huggingface.co/VAGOsolutions/Llama-3-SauerkrautLM-70b-Instruct.

[2] Also available at: https://huggingface.co/meta-llama/Meta-Llama-3-70B.