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A Social Sciences and Humanities research agenda for transport and mobility in Europe: key themes and 100 research questions

Marianne Rygghaug ^a, Ivana Subotički ^a, Emilia Smeds ^c, Timo von Wirth ^b, Aline Scherrer^d, Chris Foulds^e, Rosie Robison^e, Luca Bertolini ^f, Eda Beyazit İnce^g, Ralf Brand^h, Galit Cohen-Blankshtain ⁱ, Marc Dijk^j, Marlene Freudendal Pedersen^k, Stephan Gössling^l, Robert Guzik^m, Paula Kivimaaⁿ, Christian Klöckner^o, Hristina Lazarova Nikolova^p, Aleksandra Lis^q, Oriol Marquet^r, Dimitris Milakis^s, Milos Mladenović^t, Gijs Mom^u, Caroline Mullen^v, Nathalie Ortar^w, Pucci Paola^x, Catarina Sales Oliveira^y, Tim Schwanen^z, Tauri Tuvikene^{aa} and Alexander Wentland^{ab}

^aNorwegian University of Science and Technology, Norway; ^bErasmus University Rotterdam, The Netherlands; ^cUniversity of Westminster, UK; ^dFraunhofer Institute for Systems and Innovation Research ISI, Germany; ^eAnglia Ruskin University, UK; ^fUniversity of Amsterdam, The Netherlands; ^gIstanbul Technical University, Turkey; ^hRupprecht Consult Gmb, Germany; ⁱHebrew University of Jerusalem, Israel; ^jMaastricht University, Netherlands; ^kAalborg University, Denmark; ^lLund University, Sweden; ^mJagiellonian University, Poland; ⁿFinnish Environment Institute (SYKE), Finland; ^oNorwegian University of Science and Technology, Norway; ^pUniversity of National and World Economy Sofia, Bulgaria; ^qAdam Mickiewicz University, Poland; ^rBarcelona University, Spain; ^sGerman Aerospace Center, Germany; ^tAalto University, Finland; ^uEindhoven University of Technology, The Netherlands; ^vLeeds University, UK; ^wENTPE-Lyon University, France; ^xPolitecnico di Milano, Italy; ^yUniversity of Beira Interior, Portugal; ^zUniversity of Oxford, UK; ^{aa}Tallinn University, Estonia; ^{ab}University of Munich, Germany

ABSTRACT

Transport and mobility systems need to be transformed to meet climate change goals and reduce negative environmental and social effects. Despite EU policies having targeted such problems for more than three decades, transitions have been slow and geographically uneven. For effective change to happen, transport and mobility research needs fresh perspectives and better integration of knowledge from the Social Sciences and Humanities. Based on a Horizon Scanning approach, which allowed for a great deal of openness and variety in scholarly viewpoints, this paper presents a novel research agenda consisting of 8 themes and 100 research questions that may contribute to achieving environmentally sustainable mobility transitions within Europe. This research agenda highlights the need to not only support technological solutions for low-carbon mobility, but the importance of transformative policies that include new processes of knowledge production, civic participation and epistemic justice. We contend that the agenda points to the need for further research on the dynamics of science-society interactions.

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CONTACT Ivana Subotički  ivana.suboticki@ntnu.no  Norwegian University of Science and Technology, Norway
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1. Introduction

Transport and mobility lie at the heart of contemporary society and global challenges. It provides access to many of the key functions of everyday life such as employment and education and generates social and environmental benefits (Holden et al., 2020; Freudendal-Pedersen, 2016; Urry, 2016). However, whilst the acceleration in the volume of mobility during the twentieth century was closely entwined with the rise of car-based mobility to global scale dominance (Urry, 2004), this has also contributed to exceeding planetary boundaries, particularly relating to: climate change and biodiversity loss (Rockstrom et al., 2009); air pollution, noise, congestion, traffic fatalities, and public health costs (Sovacool et al., 2021); and the weakening of social cohesion and space for public life (Adams, 2001; Sheller & Urry, 2000).

Policy makers across the world have aimed to address these negative impacts for the last three decades. Notably, in Europe, the European Commission (EC) has been committed to “sustainable mobility” since the 1992 Green Paper on the Impact of Transport on the Environment, and the EC’s (2019) current policy framework for growth, the European Green Deal – focuses on achieving a climate-neutral society by 2050, including “accelerating the shift to sustainable and smart mobility” as one of eight thematic priorities. However, despite the best of policy intentions, sustainable mobility transitions have been slow (Peters et al., 2020; Smeds & Cavoli, 2021) and car-based mobility, air travel, and CO₂ emissions from transport continue to grow (IEA, 2022).

During this period of limited progress on decarbonising mobility, EU transport (as well as research and innovation) policies have predominantly focused on developing and demonstrating novel transport technologies. Funding for transport research and policy experimentation within the EU Framework Programmes has been strongly framed around advancing EU competitiveness, envisioning cities as places where technological “solutions” can be tested to benefit not only citizens but also economic growth (Halpern, 2014). The EC (2017) has adopted a Strategic Transport Research and Innovation Agenda that outlined roadmaps for seven priority research areas,¹ among which urban space, social equity, civic participation, public policy and governance are scarcely mentioned. Third, the EC Directorate-General for Mobility and Transport’s (2020) Sustainable and Smart Mobility Strategy lays out how the EU’s 2050 climate target can be achieved for transport, but is limited by its emphasis on “smart solutions” (e.g. automated, and low-emission vehicles) and digital platform services (e.g. “mobility as a service”).

Across these examples, the following is clear: First, the lack of progress in reducing mobility CO₂ emissions in Europe shows that the EC policy focus on transport technology solutions and enhancing economic competitiveness is insufficient in addressing the monumental challenge of transitioning to climate-neutral mobility systems – particularly as the EC’s (2019) emphasis is now not only on decarbonisation, but also mechanisms to ensure a Just Transition. Second, we observe a bias towards economics, psychology, and engineering disciplines in the framing of EC policy, while other perspectives from the social sciences and humanities (SSH) are less prominent. Although Economics and Psychology represent Social Sciences, disciplines such as Sociology, Geography, Political Sciences and Anthropology are not well represented, and Humanities disciplines such as History, Communication Studies, Languages, and Cultural Studies are almost completely absent. This is not something new. An applied focus on planning and engineering

transport infrastructures, technologies, and networks to facilitate the speed and efficiency of mobility and to develop key modelling techniques for trip forecasting (e.g. discrete choice and econometric analyses that predict the rational behaviour of agents within the transport system) has for a long time been prominent within transport policy and research (Schwanen et al., 2011). These and other techno-economic issues like leveraging electrification and digitalisation for mobility transitions are high-priority research topics in policy.

However, the dominance of the techno-economic paradigm has its disadvantages as it does not offer in-depth understanding of how new technologies and services become embedded in societies and systems, and with what effects (Rip & Kemp, 1998; Latour, 2005). This is one of the areas where SSH perspectives offer added value, for instance by bringing attention to the way that the design of mobility systems and specific “solutions” (re)produce social exclusion and inequalities in access across different social groups (Law, 1999; Martens, 2012; Pereira et al., 2017; Suboticki & Sørensen, 2021; Verlinghieri & Schwanen, 2020). A second important contribution from SSH is seeing travel as a derived demand stemming from the need to access different everyday activities, which has spawned accessibility research (Kwan, 1999; Mokhtarian & Salomon, 2001; Silva et al., 2017). Lastly, the most recent generation of SSH research on transport and mobility has challenged the neoclassical perspective of cost minimisation and stressing the need for broader notions of mobility as not only thinking about travel as a sense of movement from A to B, but also in terms of cultural representations and embodied experiences (Sheller & Urry, 2006; Kaufmann et al., 2004; Steg, 2005; Cresswell, 2010).

Overall, SSH research complements the dominant techno-economic approaches of Transport Studies by providing valuable input on the conditions under which new technologies, services, or policies can contribute to desired system transitions (Ryghaug & Skjølsvold, 2023; Skjølsvold et al., 2022). SSH, thus, contributes with underlining the socio-technical nature of mobility transitions, including the importance of historical, geographical, cultural, and user-centred perspectives for understanding transformation (see e.g. Ryghaug & Toftaker, 2014; Dijk & Yarime, 2010; Mom, 2013; Milakis et al., 2017; Anfinson et al., 2019). This means we should strive to include SSH to a larger extent in European policy and research on mobility transitions in Europe.

This paper focuses specifically on the contributions that SSH research could have in achieving mobility transitions within Europe. Set within the EU-funded Energy-SHIFTS project,² our contributions are in direct response to calls for advancing SSH perspectives as a complement to the dominant techno-economic framing of EU energy research and innovation policy (Foulds & Christensen, 2016; Genus et al., 2018; Foulds & Robison, 2018), within EC’s Strategic Energy Technology (SET) Plan and the programming of Research & Innovation funding of Horizon Europe (Foulds et al., 2019). Our starting point is that policy and research co-evolve and influence each other, and thus how priority areas for funding transport research are determined, and by whom, matters (Royston & Foulds, 2021; Silvast & Foulds, 2022).

The primary aim of this paper is to analyse and interpret what SSH scholars think the priority areas for future research should be in order to support transport and mobility systems in Europe to transition towards greater environmental sustainability and social justice. Based on a Horizon Scan involving a cross-section of European SSH transport and mobility scholars, we present a research agenda comprising eight themes that

span 100 priority research questions. Our discussion of this agenda will demonstrate the necessity of SSH perspectives for achieving sustainable and just mobility transitions. The agenda's target audiences are fellow researchers, and EU policymakers who decide the framework conditions and funding opportunities for research. The secondary aim of this paper is a methodological and epistemological reflection on whether a Horizon Scanning approach is effective for diversifying transport and mobility research, compared to practices of scientific agenda-setting that are currently prevalent within transport research. Our discussion of transport scholarship includes both disciplinary, geographical and gender diversity.

2. Horizon scanning methods: the step-by-step processes

We conducted a systematic Horizon Scanning exercise to identify future priority SSH research questions related to transport and mobility.³ Horizon Scanning is an approach “used to gain foresight about emerging opportunities and risks, identify knowledge gaps at the frontiers of fast-evolving phenomena, and set strategic priorities for decision-makers or researchers” (Foulds et al., 2019, p. 10). It has mainly been used as a foresight exerciseto establish emergent research agendas in line with policy needs (Rudd, 2011) in various fields, such as the UK food system (Ingram et al., 2013) and agriculture (Pretty et al., 2010). It has also become a well-established method in policy circles to help anticipate problems and design novel solutions. It is a unique deliberative methodology that, in our case, elicits views from established SSH scholars working in the field of transport and mobility across Europe.

Arguably literature reviews constitute one type of Horizon Scanning, which are based on existing published literature (i.e. that has already been funded and deemed relevant), with value added by discussing the literatures in terms of empirical, methodological and theoretical gaps (Van Wee & Banister, 2016). However, we did not adopt this approach because it could have constrained the scope of possible research avenues by anchoring future agendas to past work. Our approach gave participating scholars the freedom to advocate for truly novel lines of enquiry by teasing out research priorities based on their wider experiences and insights.

The first step in the Horizon Scanning was to establish a Steering Group, which consists of the first five authors of this paper. The Group was responsible for determining the scope of the process and overseeing its implementation (see the Terms of Reference in Ryghaug et al., 2019 for a detailed explanation of the process). In addition to the Steering Group, 28 SSH scholars working on transport and mobility were hand-picked as members of the Working Group (WG). To ensure a multitude of perspectives, we prioritised recruiting a diversity of members based on their discipline, interdisciplinary experience, gender, geography, research interests, and career stage (for a full overview of recruitment criteria, see Foulds et al., 2019, pp. 17–18). Extensive scoping for group members was conducted through: 10 expert interviews with key members in the field; literature review of key contributions (Suboticki et al., 2021); utilising existing networks; and internet searches for remaining gaps in WG composition. Four WG members had to withdraw,⁴ leaving a total of 24 members that participated in the full Horizon Scanning exercise and as the co-authors of this paper. These 24 members represented 17 different countries, and their current institutional locations were spread across Northern Europe (8), Eastern

Europe (4), Southern Europe (5) and Western Europe (7). 14 members identified as men, and 10 as women. Together, the group represented 15 SSH disciplines.

In the first survey round, WG members recruited additional scholars working in the field to solicit their research priorities. WG members and this wider research community were asked to submit 3–5 priority questions that they deemed the most pressing. Respondents were also asked to qualitatively justify their proposed questions. Altogether, this process generated a list of 299 questions from 86 different respondents. Of respondents taking part in the survey, 67% identified as male and 33% as female. They represented 17 disciplines, with Geography being the most represented (23%), followed by Transport Planning (17%), Urban Planning (10%), Science and Technology Studies (8%), and Psychology and Sociology (6% each). Only one group member represented the Humanities and identified as a historian. Respondents represented 26 different nationalities and they were institutionally located in 22 countries, with most being in UK (13%), followed by Germany (10%), Italy and Poland (9%), the Netherlands (8%) and Finland and Portugal (6%).

The list of 299 submitted questions was then evaluated by Steering Group to judge whether they fell within the scope of SSH; were answerable and based on a realistic research design; were concrete enough in relation to subject, intervention and outcome; and addressed a knowledge gap. Based on these evaluations, some questions were deleted due to being of purely techno-economic nature, thus not being grounded in SSH perspectives on transport and mobility. Some questions were also incomplete and edited to meet the criteria (see Foulds et al., 2019, p. 19 for more explanation of selection and editing criteria used). The chair and co-chair of WG Steering Group conducted a double review of the editing process conducted by the rest of the Group to ensure consistency and validity. A total of 59 questions were deleted because they did not meet the criteria. However, 43 additional questions were generated from the 299 questions submitted through the survey questions as many of them were composed of several questions and nine questions were merged due to overlap. In sum, the process resulted in a final list of 274 questions.

The second survey round aimed at identifying the top 100 top priority research questions through voting. As has been done in previous Horizon Scanning⁵ exercises, we limited the exercise to 100 questions to capture the breadth of the field, whilst keeping the exercise practically comprehensible to those analysing and suggesting questions (see also Sutherland et al., 2011). We also argue that the round number is strategically useful when targeting policymakers regarding what research needs more funding. WG members evaluated the list of 274 questions by scoring them on a scale of 1 (“definitely exclude”) to 5 (“definitely include”). All questions with a median of 5 and the 95 top scoring questions with a median 4 were included, whilst all questions with median 1–3 were excluded. The process resulted in a list of 81 questions when similar and overlapping questions were merged (see Ryghaug et al., 2020 for a more detailed description of the process).

WG members then had the opportunity to provide qualitative feedback on these questions and propose 19 questions that they thought were missing, in order to arrive at a final list of 100 questions. Thus, WG members were invited to champion questions that did not get a top score in the voting procedure, or to suggest a small number of priority questions missing from the list of 274 questions to ensure that a diversity of topics was covered and that important questions were not left out. The deliberation around the results and what

questions to add was conducted through two online workshops. During the second workshop the WG members discussed how to inductively group the final list of questions, arriving at 8 themes with a similar research focus. The strategy was to explicitly avoid constructing themes according to disciplinary orientation or transportation mode, to cater for interdisciplinary research and avoid “siloeing” of policy input. The themes were not rated according to importance and should not be interpreted as rigid categories, as there are many overlaps and questions that could fit into several categories. Thus, other ways of organising the questions are possible. The questions and themes should also not be considered as an end point, but as points of departure that can stimulate expansion of the SSH research agenda among transport scholars and EC stakeholders alike.

The eight themes and 100 priority questions call for a wide engagement by different disciplinary fields and approaches, both theoretically and methodologically. Analysing who contributed to the 100 priority questions reveals that participants holding 23 different nationalities, being institutionally based in 21 different countries, contributed to the resulting questions. Most questions were prioritised through “blind” quantitative scoring, where participants did not know the profile of the fellow scholar who had proposed the question (only 19 out of 100 questions were chosen in a workshop setting). This rejects the hypothesis that the prioritised questions would be the outcome of power as expressed in unconscious bias or social interaction. Many questions that scored high (and therefore on the list) were however proposed by participants based in Northern and Western Europe, thus, some geographical bias persist in our sample. For instance, there is only one question each from the Czech Republic, Greece, Poland, and Turkey. We come back to how well the method catered for diversity in the Discussion section, but as with all qualitative methods, a different WG composition would have resulted in different question suggestions and scoring. We still think that gaining insights from the subjective perspectives and experiences of established scholars in the field is a valuable contribution that goes beyond the framing of existing research and policy priorities. The effort invested in catering for a diversity in the sample of scholars also allowed for robust data from which to construct a future research agenda.

3. Results

The Horizon Scanning resulted in 100 SSH research questions that the WG members (referred to as “scholars” in the rest of this section) deemed most important to explore in the next five to ten years. The questions were grouped into eight themes (Figure 1). In this section, we limit ourselves to presenting the research priorities that the eight themes point towards, and briefly discuss the relation of these themes to existing literature and debates within the field, providing a few questions as illustrative examples. The full list of 100 priority questions is provided in the Supplementary Material to this article.

Theme 1: co-producing knowledge and professional practices

The questions in this theme focuses on how to facilitate learning across different professional practices, such as between research, policy and planning, partly to close what may be called the “implementation gap” (Banister & Hickman, 2013). One example of a question within this theme is: “How should the transport and mobility research field



Figure 1. Eight key themes generated by the Horizon Scanning (listed in random order).

develop in order to: facilitate processes of learning across different professions, domains and sectors; foster more transdisciplinary research, with systems thinking at its heart; and maximise the impact of SSH research on sustainable transitions?”. Questions such as this highlight the importance of input from different fields and ways to improve knowledge-producing and interdisciplinary processes such as co-producing knowledge with citizens, putting inclusion, justice, geographical and cultural differences at the centre of future research inquiry.

Other questions in this theme are concerned with conceptual debates such as “surveillance capitalism” (Ferreira, 2018). Many of the questions are critical of previous systems of transport and mobility (policy and planning), describing them as too technocratic, uncritical, and biased towards growth-centric thinking. One example is: “How can transport planning frames become less dominated by economic thinking; in particular, what can be done to lessen the influence of economic growth concerns on the development of mobility agendas?”. In contrast to such approaches, this theme’s questions reiterate the benefits of building on analytical lenses that stress mobility cultures and the implicit

power structures encoded in scientific knowledge and socio-technical imaginaries (Epstein, 2008; Jasanoff & Kim, 2015). It is pointed out that conducting large-scale mixed-methods comparisons of mobility practices and mobility imaginaries (political cultures and collective sense-making of future mobility) should be a point of departure for future research.

Theme 2: scenarios, futures, visions and transition pathways

The second set of questions focuses on what sustainable transport and mobility systems might or should look like in the future, and possible transition pathways to achieving such futures. The questions cover visions, scenarios, and imaginaries of the future, including fossil-free and alternative mobility cultures, the roles of different trends and technologies, and associated drivers for and barriers to change. As in current research, the desired direction of transitions, novel imaginaries, and the creation of alternative mobility visions, are highlighted (Nikolaeva & Nello-Deakin, 2019; Timms et al., 2014; Hajer & Versteeg, 2019). Scholars prioritise questions on participatory visioning of alternative mobility futures, including slow mobility such as walking and cycling (Sales Oliveira, 2019; Fullagar et al., 2012), shared and smart mobility, and mobility in a degrowth society (Kallis et al., 2012). The questions foreground social change and social organisation as important for changing path-dependencies (e.g. Gössling et al., 2019). For example, questions like: “What kind of shifts in the social organisation of practices are needed to halt the growth in air traffic?”.

Scholars stress the relevance of anticipating social barriers and drivers as a key aspect of developing new transition pathways through questions such as: “What are the non-technological and non-economic drivers and barriers of transitions towards zero-carbon transport systems?”. Emerging socio-technical and market dynamics, and their influence on mobility futures, are also addressed, in particular, relating to the “digital turn” (Ash et al., 2016). Scholars prioritise questions regarding the implications of big-tech companies developing novel Artificial Intelligence solutions for mobility services and the institutional change dynamics, such as the evolution of a platform economy in the mobility sector (Barns, 2020).

System transitions are prone to conflicting societal goals and trade-offs between competing pathways across different sectors. One prioritised question is: “In which ways can synergies or conflicts between energy goals and other goals – such as the reduction of air and noise pollution, traffic accidents, lacking physical activity, land use, and biodiversity loss – slow down or accelerate a transition to sustainable mobility; and which (changeable) factors may influence these relationships between goals?” Complementing this, research into developing multiple transition pathways that deliver co-benefits across sectors are highlighted.

Theme 3: dominant mobility regime and car dependency

The third theme includes questions which focus on what stabilises, changes, or disrupts lock-ins created by the dominant mobility regime, where the car dominates. Questions focus on how new technologies and governance solutions may contribute to either strengthening or reducing car-dependency. Three innovations appear in the questions

as potential barriers or solutions for moving away from car dependency: automated vehicles, micro-mobility, and shared mobility. While automated vehicles are regarded as an opportunity to enhance traffic safety, reduce congestion, and allow more productive activities on-the-move (Milakis et al., 2017), some questions ask for more critical investigations and caution against potential lock-ins that such vehicles could cause. As other literature finds, micro-mobility, represented through technologies such as e-kick-scooters, and shared mobility, are primarily seen as potential solutions (Becker et al., 2020; Jochem et al., 2020; Sperling, 2018). This is mirrored in questions such as: “How may shared-mobility services be used to reduce the dominance of private car ownership?”

The potential for changing the (auto)mobility regime is addressed in a cluster of questions on governance and reorganisation. Scholars call for a conceptualisation of the stability in the current regime, in particular to address the reinforcing power dynamics of incumbents in both politics and industry (Geels, 2014; Tyfield, 2014). One example is: “In what ways do state politics and power dynamics contribute to keeping automobility regimes stable over time?” Questions within this theme also address potential solutions, such as reorganising the car industry, securing large-scale investments towards a less car-centred pathway, and lowering travel needs. They also call for geographical differentiation because governance solutions may look quite different for geographies that are still rapidly motorising. The questions call for separate research on the potential for less energy-consuming mobility in such contexts, noting this is insufficiently researched.

Theme 4: governance, policy and incentives

This theme includes questions regarding governance, policies and incentives for shaping transport and mobility systems. The theme differs from Theme 2 in its focus on current, rather than future systems. Despite some progress on sustainable mobility, knowledge what policies are effective is needed. Scholars identified research gaps regarding what decision-support tools, policy mixes, and enabling institutional frameworks could promote night trains, walking and cycling, and freight transport (both road and maritime). Addressing recent transition debates, one important task that scholars identified is the formulation of “phase-out” policies (Rogge & Johnstone, 2017; Khalaj et al., 2020), or what has been termed “exnovation” (Loorbach et al., 2017). One question focused on how the EU needs to reform its own policy instruments to achieve phase-out effects for car dominance.

Scholars also problematise the role of the state in governing markets and private sector activities, given the significant volumes of private capital currently flowing to mobility technology and platform entrepreneurs (Noy & Givoni, 2018). One relevant question is: “How will driverless vehicles affect urban areas and land use (e.g. for parking), and how can such effects be governed?”, which points to the need for spatial planning perspectives, in addition to traffic – and technology-focused perspectives (Cohen & Cavoli, 2019). Scholars are concerned with how government can “keep pace” with the entry of new micro-mobility and e-commerce delivery services, especially through regulation that ensures the creation of public value (Docherty et al., 2018), and thus another question posed is: “What regulations and accountability measures are needed to ensure that mobility data are best utilised for the common good?”.

Existing research on transport and mobility governance tends to focus on policy “content”, rather than the policy processes (Marsden & Reardon, 2017). Some questions call for more sophisticated policy formulations. e.g. policy processes that can ensure just and egalitarian mobility systems, as well as critical examination of existing decision-making practices (e.g. (un)productive ways politicians and bureaucrats shape mobility transitions). For example, the questions highlight the need for policy processes and data that can account for the complexities of how different social categories (e.g. gender) intersect with mobilities (e.g. Smeds et al., 2020). Scholars also asked: “How can transport and mobility policies be developed in a more geographically- and place-sensitive way?”.

Theme 5: participation and citizen engagement

Questions in this theme focus on public participation and citizen engagement. These are central topics of debate in urban development, and increasingly so in transport planning. Yet participatory transport planning remains underused, albeit to varying degrees across localities and countries (Bickerstaff et al., 2002; Elvy, 2014; Gil et al., 2019). Given that so-called low-carbon transport technologies and new mobility arrangements may reinforce or deepen inequalities (Mattioli, 2016; Mullen & Marsden, 2016), scholars were adamant that participation and engagement in mobility transitions merit more attention, in order to mitigate unintended effects or even contribute to radical changes in energy demand. The effectiveness of current approaches to transport development was raised by asking “What are the most effective approaches to involving citizens and non-experts in the planning, development, and evaluation of new transport systems and future mobility scenarios?”. Scholars also proposed questions oriented towards how engagement itself can better be organised to integrate a wider range of stakeholders. One question emphasises the need for engagement in goods movement to achieve collaborative urban freight planning. This signals that current engagement efforts are limited in scope and that development of new engagement methods is needed.

The questions in this theme also address how transition can be citizen-led e.g.: “What engagement methods and approaches are most appropriate in generating citizen-led visions of mobility futures?” Involvement of citizens can both foster acceptance and opposition to new low-carbon solutions, and approval might also change before and after implementation (Gehl, 2013; Schuitema et al., 2010). With this, also normative considerations about what the role of citizens and civil society should be in such transformations (Frantzeskaki et al., 2016) are deemed important. Lastly, the questions in this theme point to a discussion on the distribution of responsibility in transport transformations and how different governance models can legitimize civic engagement (see also Theme 8).

Theme 6: mobility practice and mobility needs

Questions in this theme focus on everyday experiences with and meanings of mobility, including different ways in which current transport systems influence people’s perceptions of mobility practices, the values attached to these practices, and the roles of particular actors. Some questions aim to uncover the underlying human needs and collective aspirations that trigger unsustainable mobility practices and ways to alter them, e.g.:

“What makes individuals perceive air travel as necessary and desirable; and what factors could change such perceptions?” It is acknowledged that mobility needs co-evolve with arrangements of institutions, norms, routines, and relational human capacities and knowledge. Thus, stimulating change in existing interrelated social practices and mobility cultures remains a reoccurring aspect for mobility research (Shove & Walker, 2010) and is a central aspect of the questions in this theme. The particular role of mobility education for children, who are currently predominantly educated for automobility (Carvalho & Sales Oliveira, 2017) and the way mundane artefacts such as children’s toys are framing experiences with particular mobility cultures and re-signifying the norms of unsustainable mobility (Stockmann & Graf, 2020), are also highlighted, thus pointing out that early socialisation and education of children and adolescents should be further researched.

Cultural aspects are also highlighted in terms of interaction with e-commerce and (freight) mobility, and some questions aim to explore how patterns and dynamics of consumer culture have consequences for sustainability of mobility. Similarly, questions address further digitalisation trends in practices, for example in terms of: “How are social media algorithms influencing lock-ins related to current mobility behaviours and practices?” This may involve aspects such as online booking engines, online advertising for mobility services, or social media platforms, as discourse accelerators for reinforcing car use.

Another relevant aspect addressed in this theme is the embodied experience of mobility users with different modes of transport, such as the question asking: “How can users’ sensory and emotional experiences with different transport technologies and mobility practices better inform efforts to change mobility habits?” Indeed, research has recently pointed to the relevance of emotions and sensual experience for travel quality, by applying flow theory to cycling experiences for instance (Te Brömmelstroet et al., 2021).

Finally, an overarching topic in this theme is the role of interventions to contribute to increasing human well-being, prosperity, and quality of life. Scholars address the potential trade-offs between reducing distances, speed, and frequencies of traveling, while at the same time enjoying a similar or even higher quality of life. In this way this theme opens new avenues of research that go beyond technological innovations and translate assumptions about the sufficiency principle into mobility research. Related dilemmas between human prosperity and mobility growth have begun to be recently addressed by, for example, Bertolini (2020).

Theme 7: risks, disruptions and negative or unanticipated consequences

This set of questions is concerned with disruptive events and disruptive drawbacks and risks related to low-carbon, automated transport technologies. Several of these questions specifically focus on the challenges and lessons connected to the global pandemic situation caused by COVID-19 (Kanda & Kivimaa, 2020; Benita, 2021), but may contribute to broader learnings on how to deal with possible future disruptive events to mobility and transport systems (Marsden et al., 2020), such as those caused by climate change.

In relation to COVID-19, scholars note that the pandemic has massively disrupted people’s routines and triggered creativity, solidarity and humanity for change and adaptation. The pressing question voiced by the scholars is whether we will bounce back to the old “normal” or if and how we could reach a new and better normal. One question asks:

“What lessons can be drawn from the impacts of the COVID-19 pandemic on mobility practices; and how can these lessons be fed into future transformations of transport and mobility systems, such as public transport, biking, home office solutions for example?”

Questions also focus on the unintended social consequences of low-carbon transport technologies and emerging automated vehicles. The focus in research on technological interventions has typically been on first-order or direct effects. Several questions therefore look more broadly on ways of minimising potentially undesirable effects. Relatedly, the theme raises questions about whether new vehicle technologies and mobility services may lead to reproduce spatial/geographical and socio-economic inequalities, as existing literature also highlights (Mullen & Marsden, 2016; Docherty et al., 2018; Jenkins et al., 2016).

Theme 8: social justice and inclusion

This theme focuses on the relationship between transport and mobility transformations and questions of justice, which is of rising concern in mobility studies (Lucas et al., 2016; Martens, 2016; Van Wee, 2011). Scholars were still concerned with the causes of exclusion and unjust distributions of new low-carbon transformations, as well as the possible avenues to foster more inclusive and just systems. Transport-related inequalities are documented in the SSH transport research (Banister, 2018; Lucas, 2012; Pereira et al., 2017), but how new policies and transport and mobility transformations reinforce and create new inequalities is called to attention. One example is: “In what ways are policies aiming to achieve sustainable transport and avoid car dependency (e.g. congestion pricing, low-emission areas) deepening transport-related inequalities?” It is also important to note that the questions emphasise the “deepening” of inequalities, suggesting that it is not only a matter of whether inequalities are present or not, but also how they are entrenched in new technologies and practices.

Most questions in this theme are concerned with how the transport systems and new mobility configurations can be made more inclusive. Whilst one question is relatively open in this regard; “How can green mobility transitions be socially inclusive?” – others put the spotlight on certain technologies, groups and areas considered to be especially vulnerable. Many vulnerabilities are documented in current research (Camarero & Oliva, 2019; Carvalho & Sales Oliveira, 2017; Lucas, 2012), but the questions argue for underexplored areas to be prioritised, such as rural areas and elderly populations.

Questions also address on how technologies can be governed to ensure social justice. For example, “How can micro-mobility and shared-mobility implementation be organised and regulated in order to achieve transport justice; in particular, what can be done to reduce the risk of transport exclusion?” One of the questions asks how mobility justice may be accounted for in the evaluation of the mobility solutions. Understanding justice-related implications thereby brings an ethical lens to transport policy and research.

Lastly, some questions are also concerned with the intersection between mobility justice and other inequalities, such as those related to gender and energy poverty. The concept of energy poverty is thus useful to capture how multiple vulnerabilities intersect with mobility needs.

4. Discussion

The previous section described the themes and topics the 100 priority questions generated for future research, and how they link to existing discussions within SSH research. In this section, we consider the novelty of this agenda across *all* themes. We have organised this discussion around six dimensions; (i) research and EU policy focus, (ii) transport's impacts, (iii) travel categories, (iv) scientific disciplines, (v) methodological approaches, and (vi) types of questions, inspired by Holden et al.'s (2019) effort to synthesise the literature on "sustainable mobility" over four generations. We discuss cross-cutting issues closely related to these dimensions before we in Section 4.2 discuss the diversity of perspectives obtained through the Horizon Scanning exercise.

4.1 A research agenda of transport and mobility studies?

The evolution of Transport Studies is usually characterised, as in all sciences, by paradigm shifts (Kuhn, 1962). In contrast, our Horizon Scan provides for a more "bottom-up" approach to agenda-setting, which allowed for a great deal of *variety* and *overlapping* paradigms. The Horizon Scan also came with some limitations, particularly in how the resulting questions continue to overlook certain perspectives *within* SSH research on transport and mobility. Here we discuss what is included and excluded in the 100 priority questions.

4.1.1 Research and EU policy focus

As noted in our Introduction, EU policy and transport and mobility research have influenced each other over time. EU policy influences what type of research is conducted, while research has also influenced the policy focus. The relationship between policy and research is not straightforward, however. Our Horizon Scanning generated many priority questions on "smart" mobility technologies and services. Since these are novel, they were unsurprisingly perceived as a gap for SSH research. However, we also know that EU policy has pushed a focus on "smart" mobility, particularly during Horizon 2020. Our findings thus point to the need for further research on the dynamics of science-policy interactions. Society at large typically views smart mobility through the lens of technological determinism, as if technologies "emerge" organically because of unstoppable scientific progress or have irreversibly "arrived" to reshape society. An important question is to what extent SSH scholars' priorities might align with, further legitimise, or indeed subvert, such narratives.

4.1.2 The impact of transport and mobility

Previous generations of transport and mobility research have focused mostly on economic and environmental impacts of travel, while also increasingly recognising social impacts (Holden et al., 2019), including the distributive justice of access to transport services and mobility opportunities. The research agenda promoted in this paper goes beyond distributive justice: pointing to the need to understand how new low-carbon mobility practices and policies may produce unintended negative consequences, affecting the most vulnerable groups in society. The agenda puts justice at the very centre of transport policy, including more theoretically informed perspectives on democracy, participation, procedural and epistemic justice (Schwanen, 2021). The way in which

public engagement and decision-making may give voice to broader sets of publics is foregrounded. Furthermore, the question of transport impact is framed as a matter of impact on broader energy transitions, compared to the preceding generations of research with a narrower view on environmental impacts (Holden et al., 2019). Thus, questions that investigate how transport and mobility may be transformational and lead to structural and/or radical change are emphasised.

4.1.3 Travel categories: mobilities and modes of transport

The research questions reflect the fact that a wide variety of transport modes are central to sustainable and just mobility transitions. However, perhaps more interesting is that these modes were understood as entangled. This means that the focus was not solely on the technology, but on the type of policies, planning, infrastructures, and mobility practices needed for alternative solutions to be successful. This opens up an avenue for less technology-centric thinking and caters for research that can capture the socio-technical dynamics of transitions. In contrast to previous research, we also find that freight, micro-mobility, and slow mobility are central to the agenda. There was also greater focus on how travel can be disrupted, either intentionally by, for instance, creating car-free zones, or unintentionally as in the case of the COVID-19 pandemic. How to dismantle car dependency and the system upholding the centrality of the car is considered a key aspect of transport and mobility transitions.

4.1.4 Scientific disciplines

A wide variety of SSH disciplines are represented in the 100 priority questions. Analysis of the background of the participating scholars proposing the prioritised questions revealed that they represent 17 (sub)disciplines. Overall, there is, however, a dominance of Social Science disciplines as opposed to Humanities such as History, or Communication Studies. This resulted in only a couple of questions being specifically focused on historical development or the media. Several questions do focus on cultural aspects of mobility, which could be framed as central to humanities research. Moreover, whilst the approach was set out to be relatively open to different ways of framing research problems, the dominance of a transitions-focused framing from the outset may have resonated more with certain disciplines than others, even though sustainability transitions research is a rather heterogenous field (Köhler et al., 2019).

4.1.5 Methodological approaches

The research agenda caters for different methodological approaches, including many approaches prevalent within previous generations of research: case studies, modelling, qualitative interviews and fieldwork, big data, and analysis anchored in the multi-level perspective (Holden et al., 2019). The agenda, however, brings attention to producing more practice-oriented solutions and actionable knowledge that is useful for policy-makers in practice. Many questions still remain exploratory, which assumes that some translation work is needed from knowledge production and research outputs, to actionable and applied recommendations to policy makers. Compared to previous research generations, the agenda emphasises transdisciplinarity and other approaches to knowledge co-production; stressing cross-fertilisation and stronger integration across the policy-society divide. This includes more public engagement through citizen science,

living labs, real-world experiments, and action research, thus suggesting that transformations are also needed in research practice.

4.1.6 Type of questions

The Horizon Scanning resulted in different types of research questions. On the one hand, a significant portion of the questions are theoretical and conceptual in nature, with relevance across the different themes, such as how the research field should develop to facilitate processes of learning across different professions, domains and sectors. On the other hand, a portion of the questions is more applied in nature, focusing on very specific problems such as what policy tools are most effective in supporting increased cycling in cities. We think this mixture offers a good avenue for cross-fertilisation of disciplinary approaches, paradigms, and between real-world transformations and scholarly advancement. SSH scholars clearly prioritise research that directly addresses societal challenges; notably, this does not mean that most of the 100 priority questions aim at direct applied relevance, but also include normative and theoretical questions, pointing to the diversity in which SSH scholars understand “research impact” (Bandola-Gill, 2019).

In sum, we argue that the novelty of the research agenda presented in the 100 research questions rests in its attention to diversity of research needed and the diversity of solutions needed for reaching sustainable mobility goals. The questions do not guarantee that better and more sustainable outcomes will be achieved through their exploration, but they do indicate novel research pathways that need to be explored according to the scholars. Most notably, it signals a high degree of diversification of the research field in various directions.

4.2. Diversity of perspectives

Our Horizon Scanning approach sought to maximise the diversity of participating SSH scholars in order to avoid pre-existing imbalances in perspectives within transport and mobility research. Questions and voting were conducted in an open manner, building towards a gradual and democratic consensus through several iterations and deliberations. We argue that this approach is reflected in the wide-ranging nature of our 100 priority questions. However, our results show that maximising the diversity of participants in a Horizon Scanning exercise cannot address all power asymmetries in research agenda-setting.

One example is the gender imbalance in the transport sector. Women are underrepresented within the EU transport sector with only 15% female membership in most transport research and advisory boards and political committees (TRANSGEN, 2007). Our Horizon Scan sought to achieve a gender balance in WG membership with approximately 41% of women participants. However, examining our results, a total of 67% of the research questions generated by the initial survey were proposed by men, and 61% of the final 100 prioritised questions were proposed by men. Without our efforts to recruit many woman scholars these results might have been more skewed, yet overall, our results still reflect some imbalances persistent in transport and mobility research.

Another imbalance relates to geography. Our Horizon Scan sought to involve scholars from the entire range of Horizon 2020-eligible countries. We already know that Western and Northern European institutions were vastly overrepresented within Horizon 2020

funding allocations (Abbott & Schiermeier, 2019). Beyond these empirics, the geographical diversity of participating scholars can be related to an emerging debate on decolonising transport and mobility research (Schwanen, 2018; Verlinghieri & Middleton, 2020; Wood et al., 2020). This involves moving away from the dominance of theories, concerns and empirical cases emerging out of North and West European research institutions. For instance, within the European context, this involves more actively engaging with perspectives from Central and Eastern Europe.

Considering the breakdown of participants behind the top 100 questions (see the Methods section) we can consider whether the overrepresentation of questions that were prioritised *and* posed by scholars based in Northern and Western European stems from the dominance of “frames” anchored in these geographical contexts: the overarching concepts through which questions are articulated, e.g. the notion of a “transition” towards “sustainable” or “smart” mobility. For example, in the post-socialist countries of Europe, the meanings associated with these terms, and the extent to which a shift away from automobility represents a desired direction of societal development across politicians and the majority of local populations, may differ considerably (Tuvikene, 2018; Cavoli, 2021). Although our research agenda displays sensitivity to the need for context-specific and participation-intensive development of transition pathways (theme 2, 5), greater prominence of the priorities defined by scholars based in Central and Eastern Europe in future Horizon Scans would allow these questions to be articulated by CEE scholars themselves. Only through moving towards such a knowledge production approach can Horizon Europe-funded research support the EC’s broader mission of a Just Transition across all of Europe, in its diversity. Another angle to consider is whether the 100 questions reflect the framing of the Horizon Scan as an exercise feeding into programming of Horizon Europe funding, i.e. tailoring of questions to policy concerns. This aim was reiterated throughout the process, although details on Horizon Europe plans were not provided, and the primary emphasis was on showcasing the distinctiveness of SSH perspectives. Interestingly, there was little discussion of Horizon Europe priorities and how conducive these might be to SSH research, during our workshops. From a perspective of academic integrity, the strength of the Horizon Scanning exercise was that participants seemed to clearly propose questions that reflected their genuine scholarly concerns.

Lastly, also in this exercise, there is an imbalance of questions towards the social sciences as opposed to the humanities. Although much emphasis was put on diversity of group participants during recruitment, only one of the scholars represents the History discipline. We would claim that this is a general reflection of the status of the field of transport and mobility research within the humanities and not a flawed recruitment procedure. In turn, the results show that the social science scholars have not scored questions within the humanities highly. A strategy from both research funding institutions and initiatives from humanities scholars is needed to make perspectives from the humanities pertinent in mobility research. This being said, we still would argue that many of the questions prioritised in the list can be answered through humanities perspectives. Thus, the questions can also be interpreted as an invitation to broader engagement of a variety of humanities disciplines.

In spite of asymmetries in the representation of scholars, many of the prioritised questions are aimed at empirically exploring asymmetries in the field and how they can be overcome through future research. Our Horizon Scanning approach stands out as a

rare effort, in having clearly defined criteria for participation representation. Further reflections from participations on the Horizon Scanning process are also provided by Bharucha et al., 2021. We therefore argue that the approach inspires future efforts at increasing interdisciplinary SSH perspectives, equal representation of European regions, and gender mainstreaming – both within transport and mobility research, and within related EU Research and Innovation policy.

5. Conclusion

In this paper, we have sought to gain insight into what prominent SSH scholars in the field of transport and mobility find the top important priority areas and research questions for supporting transport and mobility systems in Europe to transition towards greater environmental sustainability and social justice. The Horizon Scanning method allowed us to gain a broad overview of future agendas for SSH research and demonstrate the impact of increasing diversity with regards to who is setting the agenda: a need identified in the current debates on how to accelerate just and sustainable energy and mobility transitions (Delina & Sovacool, 2018; Stern et al., 2016; Skjølsvold & Coenen, 2021).

One implication of the study that relates both to transport and mobility policy and practitioners is that there is still a marginalisation of SSH in transport planning that needs to be dealt with if we are to meet environmental, social and climate goals. To what extent do recent EU policy frameworks appear accommodating towards the types of SSH research questions that we have presented? The EU Green Deal announcement, the evolution of the SET-Plan actions, and DG MOVE's recent mobility strategy, certainly all maintain a technological focus that underplays societal dynamics and SSH concerns. Yet, we would tentatively argue that the framing of Horizon Europe may raise some hope for greater cross-cutting prominence of the SSH, compared to Horizon 2020. A significant portion of Horizon Europe funding is structured around five "missions" (following Mazzucato, 2018). This could be seen as representing a shift away from a growth-focused perspective, towards a public value-focused perspective focused on "grand societal challenges" and collaborative governance across academia, businesses, and governments (Schwanen, 2021). Two "mission boards", including social scientists, local and national policy-maker members, have announced missions on "climate-neutral and smart cities" and "a climate resilient Europe".⁶ Both boards emphasise issues within the remit of SSH expertise and resonate with our Horizon Scan themes: governance arrangements, justice and inclusion, civic participation, transitions and structural change; the former emphasises low-carbon mobility innovation in the urban context, whereas the latter acknowledges the role of mobility services and public space for well-being, social resilience and livelihoods. The caveat is that there is a lack of clarity as to how these EU missions will be practically implemented, especially at the local to regional levels.

As shown by Kropp (2021), the ultimate possibilities for SSH research within EU Framework Programmes depend on evolving bureaucratic arrangements (framing of SSH in policy documents, structuring of specific funding programmes, relative size of finalised budgets for SSH versus engineering/physical sciences, etc.), rather than initial policy framing. Therefore, whilst this paper has clarified a set of SSH research priorities, the literature, as well as our past experience of working with funders, suggests that SSH scholars still need to mobilise as an epistemic community to proactively ensure that the

commitment of Horizon Europe to SSH “on paper” translates into greater priority given to SSH research in practice. This is exactly what the Energy-SHIFTS project aimed to do by feeding SSH priorities directly into Horizon Europe programming. Indeed, an interim version of this paper’s research agenda was both submitted to the European Commission team with oversight responsibilities for SSH matters in Framework Programmes (Ryghaug et al., 2020), as well as presented to other high-level EC officials and Member State representatives.

We reflect on two ways to strengthen the priority given to SSH research on transport and mobility within EU research innovation policy. First, SSH scholars must further improve the articulation of SSH-relevant models of research impact. We agree with the principle that science should benefit society. However, it remains unclear to EU policy-makers exactly how SSH can have societal impact. Within EU transport funding, there is a long-standing focus on applied research where mobility and land use “solutions” are tested in demonstration projects and testbeds (Halpern, 2014). Kropp (2021) argues that this demonstration logic reflects the EC’s market-based perspective on considering research impact as commercialisation and market uptake; we agree that current EU priorities for transport and mobility research fall in line with the linear model of innovation for advancing competitiveness (see Joly, 2017). The linear model is less relevant to SSH, which the EC must recognise. While space for theoretically-focused work within SSH must be protected, we agree with the principle that science – including SSH – should benefit society. An important task for SSH researchers it thus to influence Horizon Europe in mainstreaming alternative models of innovation (Ryghaug & Skjølsvold, 2021) and to ensure that EU funding criteria are reformed on this basis. One such alternative is focusing more on social innovation (Wittmayer et al., 2020).

Second, to enhance the geographical diversity of SSH scholars within EU funding programmes, national research funding agencies need to be mobilised. This means SSH researchers need to simultaneously influence national governments and EU bodies to incentivise cross-regional research collaboration (across North, West, Central, Eastern and Southern Europe). The EC’s own research and innovation policy narrative underlines that some countries are “lagging behind” other countries that are “innovation leaders” (ECA, 2022), yet again this is framed in instrumental terms of the EU’s global competitiveness, rather than coherently aligned with the EC’s Green Deal narrative regarding a Just Transition that recognises the socio-economic path-dependencies that determine the starting points of different EU countries for research and innovation. Two examples of diverse scientific agenda-setting involving SSH scholars include the Joint Programming Initiative and the European Institute of Technology’s Climate-KIC (Knowledge and Innovation Community), but they remain at the margins of EU research and innovation policy in terms of budget and prominence.

We began this article by arguing that the technological and market-based focus of EU policy and funding has failed, during the last twenty years, to foster transitions towards low-carbon mobility, at sufficient speed to reach EU climate targets. Many decades of transport research shows that the development of successful transition pathways to sustainable mobility must include consideration of broader changes in governance capacities and political dynamics to enable transformative change at local, national and regional scales (Smeds & Jones, 2020). To conclude, we reiterate that expanding policy focus to

a wider range of SSH perspectives on transport and mobility is both urgent and enabled through exercises such as this Horizon Scan.

Notes

1. These areas were connected and automated transport; electrification; vehicle design and manufacturing; low emission alternative energies; network and traffic management; smart mobility and services; and innovation and optimisation in infrastructure design.
2. www.energy-shifts.eu
3. All 100 questions are listed in the Appendix.
4. The four members withdrew prior to completing the first survey rounds; two withdrew due to other commitments and two for unknown reasons.
5. For the distinction between Horizon Scanning approaches and Delphi studies in general, see for example: Hines et al., 2019
6. https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/missions-horizon-europe_en

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ORCID

Marianne Ryghaug  <http://orcid.org/0000-0003-3942-6810>

Ivana Subotički  <http://orcid.org/0000-0002-8808-0353>

Emilia Smeds  <http://orcid.org/0000-0002-8968-3500>

Timo von Wirth  <http://orcid.org/0000-0002-7851-4736>

Luca Bertolini  <http://orcid.org/0000-0002-4476-0648>

Galit Cohen-Blankshtain  <http://orcid.org/0000-0003-4728-9924>

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