Sustainable Mobility – challenges for a complex transition

Frieder Rubik, Erling Holden, Peter H. Feindt, Gerald Berger

Introduction

Mobility is a top concern in current debates about a transition towards more sustainable patterns of consumption and production. In the European Union (2011) , the transport sector accounts for about 33% of final energy consumption (Eurostat, 2014, p. 52) and 20.2% of greenhouse gas emissions (ibid, p. 146). Moreover, transport infrastructures contribute to landscape fragmentation and the destruction of habitats and ecosystems, and many public transport systems do not keep pace with urban and spatial development. At the same time, European citizens travel more frequently, longer distances and faster than ever before, for work and leisure; and mobility is a key sector of the European economy, employing about 16.6 million people in the EU-27.[1]

Key players such as the European Commission in their 2011 *White Paper* call for a change of direction: 'Looking 40 years ahead, it is clear that transport cannot develop along the same path' (CEC, 2011, p. 4). The mobility domain is also included in the European Commission's seven Flagship Initiative, "A resource-efficient Europe", of the Europe 2020 Strategy. Moreover, sustainable mobility is a cornerstone of the Commission's European Innovation Partnership on Smart Cities and Communities that was launched in 2012.

[1] Calculation based on Eurostat SBS data bank (data from 2007) encompassing the following sectors: Manufacture of motor vehicles, trailers and semi-trailers; manufacture of other transport equipment; sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel, land transport & transport via pipelines; water transport; air transport; supporting and auxiliary transport activities & activities of travel agencies.

However, the challenges are formidable. First, the complex and systemic nature of mobility patterns means that linear interventions which launch single instruments for insulated problems often are either ineffective or produce problematic unintended effects. Examples are the introduction of free Park and Ride options to reduce congestion in inner urban centres, which tend to attract more car travel (Parkhurst et al., 2012: 324ff); or free bus rides which induce low value travel and lead to reduction of cycling rather than of car use (van Goeverden et al., 2006). While the transport sector produces technological and organisational innovations at a fast pace, these do often not enhance the sustainability of travel patterns and mobility.

Second, there seems to be little consensus about the precise nature of a more sustainable system of mobility, echoing wider divisions between strong and weak understandings of sustainability (e.g., Baker, 2007). The interpretive flexibility of the term sustainability often covers disagreement, in particular about the fundamental strategic question whether the dominant reliance on the car needs to be reduced or whether the system of automobility can be transformed into a sustainable one.

Third, the dominance of the car creates path dependencies and vested interests. Consequently, among several possible approaches to achieve sustainable mobility, focus appears to be on enhancing resource efficiency and less on changing modal split and travel behaviour.

Fourth, mobility needs are quite different for different parts of the population and in different locations, requiring complex and differentiated strategies and public policies. In the area of sustainable passenger mobility, the focus of this special issue, these four challenges are pervasive. Passenger mobility is deeply entrenched in people's everyday needs, practices and lifestyles, and travel decisions are taken locally. Both features add to complexity and contribute to the continuation of car dominance. Furthermore, users assess transport options against their individual needs and values; as a result, social and economic aspects such as the accessibility of the work place or the convenience of the travel experience often trump environmental

considerations. Consequently, the evaluation of sustainable systems of mobility will vary considerably across user groups and locations.

In the remainder of this paper we reflect on these four challenges as a background to this special issue on sustainable mobility before discussing the contribution of the papers. A synthesis and outlook complete this introductory paper.

Challenge no. 1: The non-sustainability and complexity of the mobility system

The first challenge to sustainable mobility is the complex and systemic nature of the issue. Over the last 100 years, both population and mobility have grown remarkably. However, while the global human population grew fourfold, motorized passenger kilometres and tonne-kilometres by all transport modes grew by a factor of about 100 (IEA, 2009). The trend of increased travel, particularly by road and air, is likely to continue for decades, at least at a global scale (IEA, 2012).

While transport growth has been widely perceived as economically and socially beneficial (OECD, 2000), negative social and environmental impacts of increased motorized mobility, in particular road and air travel, have been broadly acknowledged:

- Transport is a major consumer of energy and material resources. Almost 30 per cent of the world's final energy consumption is used for transport, mostly from non-renewable energy resources (IEA, 2010; 2012).
- Production of vehicles and transport infrastructure requires large amounts of materials and accounts for 20–40 per cent of the consumption of materials such as aggregates, cement, steel, and aluminium (OECD, 2000, p. 28).
- Transport is a major contributor to local, regional, and global pollution of air, soil and water. Transport activities cause about 20 per cent of anthropogenic CO_2 emissions worldwide and almost 30 per cent in OECD countries (IEA, 2009; 2012).

- Transport infrastructures, mainly roads, consume 25–40 per cent of land in OECD urban areas and almost 10 per cent in rural areas (OECD, 2006, p. 49). 93% of land used for transport in the EU-15 is for roads, 4% for railways and less than 1% for airports (EEA, 2008, p. 26). Between 1990 and 1998, an estimated 30,000 ha of land were used for motorway construction in the EU 15 (OECD, 2006, p. 49)
- 1.2 million people worldwide are killed on roads yearly and up to 50 million more are injured. About 30 per cent of the EU population is exposed to urban traffic noise levels that cause significant nuisance and health problems (Peden et al., 2004; OECD, 2000).
- Access to mobility services has been uneven, resulting in more unequal access to public and private services and instances of social exclusion (Root et al., 2002; Tillberg, 2002; Rudinger, 2002; Uteng, 2006).

These observations have lead to the diagnosis of an unsustainable mobility system (Black, 2010; Schiller et al., 2010; Castillo and Pitfield, 2010; Litman and Burwell, 2006; Banister, 2005). Without major changes in policies and practices, the future development of the transport system could well extend the unsustainable trends of the last century.

However, its systemic and complex nature makes mobility patterns difficult to influence. Already the technological part of a transport system is composed of at least three sub-systems. The first sub-system is the motorized means of transport. Here, sustainable mobility requires an assessment of both the technological development of the means of transport and the total distance travelled by each mode. Thus, sustainability claims are not limited to artefacts such as vehicles but pertain to the level of mobility in society. The second sub-system is the transport infrastructure. Here, sustainable mobility requires an assessment of all relevant impacts during construction, use and maintenance of infrastructure for each mode of transport. The third sub-system is the energy system, in particular the fuels used to propel the various means of transport. Here, sustainable mobility requires a comparative assessment of both conventional energy

systems including possible improvements, and alternative energy systems. The energy assessment should include both the provision and use of transport and energy facilities (infrastructure). An assessment of the sustainability of a transport system requires a life-cycle approach that includes all three sub-systems (Høyer, 2000).

When addressing the sustainability of a transport system, the term 'mobility' is an attempt to capture the difference between revealed and potential mobility (Sager, 2005).[2] A revealed measure of mobility is the aggregate of all journeys that have been made during a specific period of time. Mobility would then be identical to the sum of all single transports. Sustainable mobility would require minimization of the negative impacts from travel, without assessing the necessity or net social benefit of the overall level of travel activity. Potential mobility, in contrast, does not require actual travelling, but indicates that a person or a good is mobile because it can move or be moved easily and quickly from one place to another. Mobility is the quality of being mobile and indicates the capacity to cover distance in physical space. An assessment of the sustainability of mobility then includes the *level* of travel. Our understanding of sustainable mobility considers mobility as both revealed and potential. Accordingly, we use the term 'sustainable mobility' rather than 'sustainable transport'. [3]

This resonates with recent attempts to integrate the demand side in mobility studies, in line with the wider move in sustainability research to complement sustainable production studies with an analysis of sustainable consumption and lifestyles (e.g., Spaargaren, 2003; 2011). Here, travel

[2] The distinction between potential and revealed measures of mobility is a parallel to the difference between having rights and exercising them.

[3] A note on terminology: In the literature on transport and sustainable development the terms sustainable mobility, sustainable transport, sustainable transportation and sustainable transport systems are often used synonymously (Holden, 2007). 'Sustainable transport' seems to be the preferred term in North America, whereas 'sustainable mobility' is preferred in Europe (Black, 2003).

behaviours, that is the consumption of mobility services, is understood as a social practice that is embedded in various structural contexts, including social norms, family and work situation, spatial location etc. Technological transport innovations are usually only adopted if they suit the mobility needs, habits and routines of the (potential) users (Nijhuis, 2013).

In mobility systems, the technical aspects of the transport system (vehicles, infrastructure etc.), the organisational models (e.g., individual car ownership, car and bike sharing, ticketing schemes), the regulatory framework, the user habits etc. are all co-evolving. These interactive dynamics create path dependencies which make it difficult to alter the overall direction of development. Making the mobility system sustainable would require a long-term transition where technical and non-technical developments align in mutually reinforcing processes (Geels at al., 2012).

The current mobility system in Western countries is dominated by the car and the socio-technological 'regime of automobility' (Geels and Kemp, 2012). The self-expanding 'system of automobility' (Urry, 2004) is taking hold across the globe, with, for example, China now being the world's biggest market for automobiles. The effect is often 'car dependence' (Mattioli, 2014) of individuals and locations. Car ownership or at least access to cars becomes necessary for social inclusion and participation. Social exclusion threatens not only car deprived persons, but also people who suffer from economic stress caused by the costs of 'forced car ownership' (Currie and Delbosc, 2011), including 'oil vulnerability', i.e., vulnerability to rising fuel costs (Dodson and Sipe, 2007). At the same time, public transport users in car dependent areas often suffer from time poverty due to long travel times.

The self-reinforcing path dependence of the automobility system includes the biased development of institutions (Low and Astle, 2009) and even the formation of technological expectations among policy-makers (Upham et al., 2013). As a result, social imagination, policy

deliberations and institutional settings for decision-making are often tilted towards automobility and against alternative modes of transport.

Despite the deep structural entrenchment of the self-expanding system of automobility, several scholars have pointed to evidence that car use and ownership in Western societies, or at least in many Western cities, might have reached its peak. Discussions about 'peak car' (Goodwin, 2012; Newman and Kenworthy, 2012) or 'peak travel' (Millard-Ball and Schipper, 2010) suggest that a conflation of economic factors ('peak oil', rising fuel prices), spatial development limits ('Marcchetti wall'), social trends (ageing society), cultural trends (new urbanism) and public policies (demand management, improved public transport) might have reversed the trend of ever increasing demand for transport. The emergence of socio-economic trends away from automobile culture and car dependence would open new opportunities for public policy. Supporting sustainable mobility would be easier if policies had to support rather than reverse existing trends.

Challenge no. 2: Sustainable mobility: A concept with interpretive flexibility

While there is a growing consensus that the current mobility system is not sustainable, there is no political or scientific agreement on a definition of sustainable mobility (Black, 2010; Schiller et al., 2010; Castillo and Pitfield, 2010; Litman and Burwell, 2006; Banister, 2005). Rather, the use of the concept has to an increasing extent reflected socially desirable attributes of local and project level problems, largely ignoring the global challenges it was meant to address (Holden et al., 2013). A diversity of definitions and interpretations of the concept has been presented, raising concerns that the concept might become diluted and end up as mere rhetoric with little guidance for policy makers and scientists.

The sustainable passenger transport literature shows a shifting focus over the last two decades. Sustainable passenger transport problems are now being addressed by researchers from a

number of scientific disciplines (e.g. sociology, psychology, and anthropology) applying different methodological approaches (e.g. case studies, qualitative modelling, and institutional analyses) (Black and Nijkamp, 2002). The definition of the concept has changed to reflect a more differentiated consideration of different types of passenger transport such as work related travel, everyday reproduction travel (e.g., Shiftan et al., 2003; Castillo and Pitfield, 2010; Amekudzi et al., 2009; Banister, 2011a) and leisure-time travel (e.g. Black and Nijkamp, 2002; Mokhtarian, 2005a, b; Næss, 2006; Banister, 2008; Holden and Linnerud, 2011). This has added to our understanding of the challenges posed by sustainable passenger transport but also to the complexity in defining, measuring, assessing and evaluating sustainable mobility.

More importantly, the definition of sustainable mobility has changed to include a broader set of transport impacts on society. Gudmundson and Højer (1996) focused on impacts on the environment and social equity. Black (2010) has added impacts on health and security and Lautso and Toivanen (1999) quality of life considerations. More recently, several studies have widened the list of impacts to include economic growth (e.g. Shiftan et al., 2003; Castillo and Pitfield, 2010; Amekudzi et al., 2009).

Issues addressed by these and other studies under the heading of sustainability include: protecting wildlife and natural habitats, reducing levels of noise, promoting economic growth, facilitating education and public participation, reducing congestion levels, minimizing accidents and fatalities, ensuring stakeholder satisfaction, enhancing aesthetic dimensions of neighbourhoods, supporting cultural activities, increasing tourism's contribution to GDP, promoting liveable streets and neighbourhoods, and minimising transport-related crime (Holden et al., 2013).

If the entire list is included, sustainable mobility is about every aspect of transport which is desirable in society and the concept could become meaningless. One way to look at this is a concern with the dilution of the concept and to call for clarification of the main dimensions of

sustainable development, e.g. by going back to the Brundtland Report (WCED, 1987) and then adapting these dimensions to sustainable mobility (Holden et al., 2013). Such a clarification and adaptation would be an important challenge for research on sustainable mobility.

However, mobility researchers cannot solve problems of conflicting societal values and interests, but can help to clarify public understanding of options and trade-offs. Even if not clearly and unanimously defined, the concept of sustainable mobility can still serve as a point of reference for meaningful discussions about integrated transport concepts. Like the notion of sustainability in general, sustainable mobility is a concept that provides a large degree of interpretive flexibility. Like a boundary object (Star, 2010), it allows very different professions and communities to interact and to develop integrated mobility solutions for specific concepts; in this context, it is typical for boundary objects that some communication will be more structured than others. This suggests that some discussions about sustainable mobility, for example empirical scientific research, will be highly structured, while some social and political discussions might be much more open and less straightforward. However, as a boundary object, the concept of sustainable mobility allows to link a wide range of social practices and to develop communicative networks.

Challenge no. 3: The main approaches to sustainable mobility

Logically, mobility can become more sustainable along three lines: people can travel more efficiently, they can travel differently, and they can travel less. Accordingly, *three main approaches* for sustainable mobility can be distinguished: an efficiency, an alteration, and a reduction approach. All three approaches are well established within the sustainable mobility literature, e.g.: the IPAT equation (Commoner, 1972; Ehrlich and Holdren, 1971), the ASIF equation (Schipper and Lilliu, 1999); the ISA model (Dalkmann and Brannigan, 2007); the SMART model (Holden, 2007); social, technical and infrastructural emission drivers (Sager et

al., 2011); and the STPM index (Black, 2003).[4] In a similar vein, Banister (2008) suggests cleaner technologies, a modal shift to more efficient modes of transport and a reduction of transport volumes (through reducing the need to travel or minimizing distances) as three approaches to sustainable mobility. Peters and Dütschke (2014), referring to Xenias and Whitmarsh (2013), distinguishes 'three relevant options [...]: 1) making current modes of transport more efficient, e.g. by changing to alternatively fuelled vehicles, 2) increasing the share of more efficient modes of transport like public transport, and 3) reducing transport kilometres'. More concretely, Banister (2011a) calls for four approaches to sustainable mobility: 1) Reducing the need to travel by the use of ICT; 2) modal shifts from car to public transportation, cycling and walking; 3) reducing the distance between central functions in city areas; and 4) innovations in transport and communication to increase efficiency.

Notably, all these approaches require different types of innovation: on the one hand, technical innovations, e.g. new propulsion technology such as the electric car; on the other, organisational innovations, e.g., car and bike sharing schemes, integrated ticketing, or intermodal transport links. Technical and organisational innovations are often linked, in particular in the context of the ongoing ICT revolution, e.g., when mobile phone apps support transport services, inform and guide potential customers and reduce transaction costs for users.

Turning to the three approaches in more detail, the *efficiency approach* suggests that the environmental performance and accessibility for low-mobility groups can be improved through

[4] I = P * A * T. Human Impact (I) on the environment equals the product of P = Population, A = Affluence, T = Technology. ASIF: CO_2 = Activity * Structure * Intensity * Fuels. ASI – Avoid, shift, improve. SMART: SM = g (A,R,T) where SM = sustainable mobility, A = changing transport patterns and public transport use, R = reducing growth in transport, and T = increasing pace of technological change. STPM index: based on the difference between the level of sustainable mobility and the level of potential mobility, standardized by population size and units of measurement.

more efficient novel technologies. The concept 'technology' is here used in a broad sense; it includes the use of both 'hard technology' (e.g., more efficient vehicle technology and fuels) and 'soft technology' (e.g., more efficient transport logistics). Moreover, more efficient technologies are to be implemented in all parts of the transport system, including motorized transport vehicles, the transport infrastructure and the energy system.

The *alteration approach* attempts to change existing transport patterns. Accordingly, the prevailing transport patterns, dominated by the car and plane, are to be shifted towards more collective forms of transport, namely an affordable and well-functioning public transport system[5] which would induce substitution of car and air travel with increased use of buses, trains, and trams – which, under present occupancy rates, are all more energy efficient than cars and planes (MiSA, 2012). Moreover, an affordable and well-functioning public transport system would increase accessibility for low-mobility groups. Also, the alteration approach comprises the idea of substituting walking and cycling for individualised motorized travel.

The *reduction approach* assumes that more efficient technologies and realistic scenarios for a modal shift will not be sufficient to meet important sustainability targets, in particular reduction of energy consumption and emissions. Some efforts should therefore be made to reduce unnecessary travel, e.g., through telecommuting. The necessity of travel, however, is established within the context of culturally embedded social practices, e.g., social expectations about physical presence at the work place or for social occasions (e.g., Nijhuis, 2013).

Current policy patterns concentrate on improving the efficiencies of transport modes. The support of modal shift is relevant, but it often seems that this deals more with a relative alteration, instead of an absolute shift among modes. Of still minor importance is the reduction

[5] While travel by plane is also a collective form of transport, its high energy consumption per passenger kilometre is comparable to travel by car.

approach. It is in contract to the traditional logic of transport policy to aim for ever increased (potential) mobility; it is hard to address since policy-makers are reluctant to intervene in people's lifestyles; it is also difficult to implement, as it requires a comprehensive tool box and rebounds may occur (Sorrel, 2007; Maxwell et al., 2011).

Challenge no. 4: Different users, different needs, different policies

All three approaches – efficiency, alteration and reduction – require the adoption of complex innovations by the users of the transport system. More environmentally efficient cars, such as hybrid cars or electric vehicles, need to suit the needs of the prospective customers. A modal shift or the reduction of transport volumes requires the users to change their travel patterns, purposes, or destinations (Puhe and Schippl, 2014; Julsrud, 2014). The diffusion of innovation theory (Rogers, 2003) highlights that successful innovations need to provide relative advantages to users, must be compatible with existing habits, should not be too complex, and can be easily tried and observed.

In any case, adoption of mobility innovations requires a certain degree of behaviour change by users. Without claiming to do any justice to the extensive literature on sustainability related behaviours, we want to highlight four important points: *First*, most travel, in particular everyday travel, is embedded in broader routines and habits that help people to organise their daily lives. Scholars like Jackson (2005) or Shove have demonstrated that technological and organisational innovations are assessed and adopted in the context of everyday standards of 'comfort, cleanliness and convenience' (Shove, 2003). Hence, novel technologies often have the effect to raise these standards rather than to save energy and other resources. *Second*, habits and routines are normally not altered unless they are disrupted by unforeseen events, such as the closure of a highway for maintenance, or life-course changing events such as moving house or jobs or starting a family (Nijhuis, 2013). *Third*, everyday routines are very different for different parts

of the population and for different locations, and accordingly not only will travel habits differ but different approaches might be effective in influencing travel behaviour of different groups (Julsrud, 2014; Mattioli, 2014; Puhe and Schipl, 2014). *Fourth*, policy initiatives for more sustainable mobility will often be viewed in the context of their implications on everyday routines, making public support for such policies an independent critical variable for a transition towards sustainable mobility (Puhe and Schipl, 2014).

A user or demand focused perspective on mobility has already generated much research into differences between user groups (cf. Julsrud, 2014; Mattioli, 2014; Puhe and Schipl, 2014). Mobility typologies have been based on socio-demographic characteristics, geography, values and attitudes, and patterns of travel behaviour. Previous research to which the papers relate suggests also that age/life cycle and family status appear to be key determinants of transport behaviour. Statistically derived user typologies, however, have rarely been linked to research into the consumer perspective.

From a behaviour change perspective the sustainable mobility agenda has been linked to other agendas, such as public health, since the encouragement of walking and cycling is supposed to both increase the sustainability of mobility behaviour and to reap health benefits for the individual (Avineri and Goodwin; 2010). The design of public space and a wide range of measures can support sustainable travel behaviour at the local level. As Puhe and Schippl (2014) and Hildermeier and Villareal (2014) suggest, ‘progressive’ cities adopt a wide range of measures: excellent public transport links that allow more or less direct commuter travel from suburbs into the centre and from residential to commercial areas; an attractive and extensive cycle lane network; location of major retail and office centres near train stations and other public transport hubs; dense intermodal links; convenient up-to-date user information through ICT such as mobile phone apps; car-sharing and bike-sharing schemes; travel plans for all major employers; etc. These cities are often regarded as providing high quality public space, urbanity,

and an improved quality of life, linking sustainable mobility to broader dimensions of sustainable lifestyles.

Policies promoting sustainable mobility may address the production as well as the consumption side of mobility. On the *production side*, policies address issues such as resource scarcity, material and energy efficiency, reduction of site-specific emissions, optimisation of waste streams etc., aiming to support or induce a greening of manufacturing processes and of the provision of transport services. Production-related policies are often complemented by *product-related* instruments, in particular safety requirements or environmental norms such as or fuel efficiency emission standards. *Demand-side* related policies, on the other hand, address the mobility patterns of users, e.g. through the restriction of parking space or ICT supported traffic management systems.

Sustainability oriented policies in the mobility domain, can adopt variegated approaches and instruments, including regulatory, market-based-instruments or information-based instruments (Holden, 2007; Banister et. al, 2000). To be effective, these instruments should contribute to a coherent policy framework and aim to stimulate, enable and empower the actors along the mobility domain to engage in more sustainable production and consumption.

Regulatory instruments impose standards on products and processes and use physical planning to steer behaviour more or less directly in the desired direction. They indicate and prescribe certain Do's and Dont's. Regulatory instruments in the field of mobility mostly respond to health and safety concerns (e.g. speed limits, environmental zones, lanes for public transport), which are often linked to environmental issues and to modifications in spatial planning. Some refer to the emissions during vehicles use, others restrict the use of vehicles on a regional and/or temporal level. Another important regulatory approach is spatial (or land-use) planning which regulates the nature and location of development, from the level of master planning for new settlements to the granting of planning permissions for specific sites. While spatial planning

was long dominated by the paradigm of spatially separated use functions (living, working, shopping), more recently different models like urban sprawls, monolithic compact cities, green cities or decentralised concentrated cities have emerged (cp. Holden, 2007).

Market-based instruments intend to change relative prices through taxes and subsidies in order to affect user behaviour. Ideally, taxes can be used to internalise external costs of transport, for example by taxing emissions (Pigou, 1920); an alternative is to use fuel as a proxy for emissions and levy a differentiated fuel tax. Marked-based instruments combine "carrots" and "sticks"; they are applied across a wide range within the mobility area. They address car purchase, car use and scrapping of vehicles, petrol consumption, and use of mobility infrastructure (Fergusson and Skinner, 2000). While historically, most market-based instruments were mainly introduced for fiscal reasons, some more recent instruments appear to be more specifically designed to influence targeted behaviours: measures like CO_2-differentiated tax schemes (OECD, 2009), congestion charges (Bellman et al., 2009; Kopp and Prud'homme, 2008), fuel duty escalator, user charges (Kodransky and Hermann, 2011), road tolls or bonus-malus schemes (Callonec and Sannié, 2009; ADEME, 2011) are examples of policy options often discussed to change modal split.

Information-based instruments are grounded in the assumption that better informed consumers will make more socially desirable decisions; they aim at providing environmental information and raising awareness in order to enable consumers to make an informed choice, that is, voluntarily change their behaviour (Stern, 1999; 2000). Examples are rankings and labels for vehicles based on their environmental performance, precisely their fuel consumption, CO_2 emissions and noise. Often governments encourage the business sector to make such information available (e.g. by supporting the promotion of internet platforms or eco-labelling schemes). Marketing campaigns can also contribute to consumer information and advice on sustainable mobility, and promising results have been reached by dialogue marketing (Bamberg

et al., 2008; Bamberg, 2009). Governments can also influence markets and mindsets by stimulating and supporting voluntary self commitments by businesses. Finally, governments and public entities themselves can act as role models through green public procurement, e.g. commissioning of buses with the latest green technology.

The articles in this Special Issue

The origins of this special issue relate back to the CORPUS[6] research project which was funded under the European Commission's 7th Framework Programme for Research and Development. The main objective of the project was to develop new integrative modalities of knowledge brokerage at the policy-science interface in three policy areas of sustainable consumption (food, mobility, and housing). In each of the three policy areas, workshops and intensive discussions between policy-makers and researchers were organised on (i) current trends and stakeholder interests, (ii) policy instruments, and (iii) future scenarios. In order to reflect on these three issues more profoundly, the project team initiated special issues to stimulate academic debate, in this case on sustainable mobility that reflects on trends, but also elaborates on current and future research perspectives. A call for papers received more than 70 proposals, of which 20 were invited to submit full papers. After in some cases several rounds of double-blind peer review, six papers were finally included in this special issue.

Although this was not envisioned in the original call, the contributions to this special issue take up the four challenges outlined above: a systemic perspective, the interpretive flexibility of the concept of sustainable mobility, the need for a broad mix of efficiency, alteration and reduction approaches, and increasing attention to the user side of transport systems with differentiation

[6] CORPUS is the acronym of the project title "Enhancing Connectivity Between Research and Policymaking in Sustainable Consumption". CORPUS had the project number 244103 in FP7 and ran from 2010-12.

of the sustainability impacts and mobility patterns of different groups. Methodologically, the papers represent a broad range of approaches. Two comparative case studies are accompanied by a case study with future scenarios, an online survey with a large sample size and two studies with data from national travel surveys, allowing for analysis of very large sample sizes.

Julia Hildermeier and *Axel Villareal* (2014) analyse how the concept of sustainable mobility has been translated into very different projects, depending on local contexts which include actor networks, interests, political traditions and transport systems. Their comparison of two high-level pilot projects for electric vehicles – Autolib' in Paris and BeMobility in Berlin – demonstrates how different visions about future mobility determine the expected contribution of electric vehicles to urban transport. The authors distinguish a 'conservative' approach which 'essentially reproduces the dominant mode of private passenger car transport through adding a shared electric car fleet', and a 'progressive' approach which integrates electric cars into an intermodal transport system. The paper conveys several lessons: first, the strong influence of public policy on problem definition and selection of alternatives, and therefore in shaping innovation pathways; second, the key role of public funding for pilot projects; third, the instrumental value of publicly funded pilot projects for new players to muscle their way into the market for automobile-related services; fourth, the organisational, political and technological complexity of urban mobility projects; and fifth, the importance of wider industrial strategies pursued by both private and public players in shaping the vision and the shape of urban mobility innovations.

Also taking a comparative perspective, *Maike Puhe* and *Jens Schippl* (2014) argue that a transition in user attitudes and travel behaviour is on its way. Based on interview meetings in Copenhagen, Budapest and Karlsruhe, they find that today's young urban adults are less fond of cars than the previous generation and display comparatively sustainable patterns of mobility behaviour, with walking, cycling and to a lesser degree the use of public transport as the

dominant travel routines. These travel choices resonate with the young adults' environmental values and concerns but were not driven by them. Instead, Puhe and Schippl found pragmatic motives to be dominant: their participants simply wanted fast, easy and cheap travel. This raises the question how their relatively sustainable mobility behaviour can be stabilised over time. Alarmingly, many young adult study participants expected to own a car later in life and to use cars more often once they receive a higher income and start a family. Puhe and Schippl stress the importance of introducing organisational innovations and new business models. For example, valuation of car and bike sharing among their participants grew with familiarity and observability. In contrast, electric cars were seen as a limited innovation in not solving problems like congestion.

Many policy-makers and industrial players see the electric car as a leading solution for the future of mobility. *Anja Peters* and *Elisabeth Dütschke* (2014) analyse how consumers perceive the new 'wunderkind' of individual mobility. By including regular and potential users, their study allows to identify main differences between these groups. Based on an online survey in Germany, they differentiate four groups according to their affinity to electric vehicle ownership. Owners display a reinforced profile of car ownership in general: male with family, middle aged, above average income. The EV is rarely the only or first car in the household. Peters' and Dütschke's results suggest that turning disinterested consumers into EV owners requires several steps: participants who were interested in EVs considered their usefulness, compatibility with existing habits and resonance with social norms higher than those who were not interested. Participants with a manifest purchase intention ranked EV's usefulness, compatibility and compliance with social norms even higher. They differed from actual EV users only in their more sceptical perception of the triability of EVs and their lower willingness to pay a higher price for such vehicles. The results suggest that potential early adopters of EVs will likely display similar attitudes and perceptions to the very small group of current EV users. Lower

prices, better accessibility to the average consumer and aligning the image of EVs with predominant social norms are suggested as strategies to enhance adoption, which could be supported through public policies such as tax exemptions, purchase incentives and field trials. These findings suggest that policies to support the introduction of EV's will also help to reinforce cultural and use patterns of automobility, and will over-proportionally benefit male, middle aged and above average income groups.

Giulio Mattioli's (2014) contribution focuses on the effects of a car-dominated transport system on social inclusion and exclusion, or more specifically on mobility-related exclusion. He argues that in a motorising world, access to a car becomes a key factor for an individual's ability to participate in a broad range of social activities from the job market to consumption opportunities and community life. Mattioli presents an integrated analytical model of 'car dependence' as a structural and self-reinforcing feature of social development with spatial, economic and social dynamics intertwined on various temporal scales. Car dependence not only creates negative environmental externalities but reinforces social inequality. Based on a secondary analysis of the British National Travel Survey for the years 2002-2010, Mattioli demonstrates that a far above-average share of people in carless households displays several characteristics of a marginal socio-demographic profile. The predictors for (lack of) car ownership are much more pronounced in peripheral and rural than in metropolitan areas. Accordingly, "households without cars are much more concentrated in marginal social groups in more car dependent areas" (Mattioli, p. 18). Carless individuals make fewer trips and travel shorter distances; this difference is much greater the less densely populated the area. Furthermore, "carless individuals in car dependent areas rely much more on the car" (Mattioli, p. 19). Mattioli complements these findings with a cluster analysis of carless travellers that generates five distinct groups: immobile people, long distance week travellers, a car reliant group with little work or education related travel, public transport commuters, and finally slow and local travellers. Again, mobility-

induced social exclusion is more pronounced in the more car dependent peripheral and rural areas where "the lack of a car more often than not corresponds either to immobility or dependence on others for lift" (22), a situation that applies mostly to over 60s. The "intensity of car deprivation is higher in areas where car dependence is stronger" and more concentrated (Mattioli 2014, p. 7 manuscript).

Tom-Erik Julsrud (2014) starts with the proposition that "understanding the variation and complexity of different mobility styles has become an urgent issue in consumer-oriented transportation research". Based on almost 20,000 travel diaries from the 2009 Norwegian National Travel Survey, he deploys a combined factor and cluster analysis with 32 variables to identify five patterns of everyday mobility which are based on travel activities, not on, e.g., values and attitudes. The five types differ in the typical individual's life stage, involvement in work life and overall travel intensity: 'Busy drivers' are typically middle-aged males with small children; 'young urbanites' are over-represented among 'public transport and bicycle users'; 'locally mobile seniors' undertake few trips but mostly by car; men and the 45-54 age bracket are dominant among the group of 'car commuters'; 'active youth' comprises mostly young people with many trips who often travel as passengers in cars, by public transport or walking. Julsrud also finds some interesting differences between these groups of everyday travellers and their long-distance travel patterns. Busy drivers, for example, also undertake the most long-distance trips. Busy drivers and car commuters tend to use the car for long-distance travel as well. Public transport and bicycle users joined these two groups in an above-average frequency of air travel for holiday purposes. Julsrud suggests some important policy implications of his findings. The five groups arguably differ in their accessibility for Banister's (2008; 2011b) strategies for sustainable mobility. ICT, which can best substitute work travel, is most suited to reduce travel needs for car commuters and busy drivers. A modal shift will be difficult for busy drivers with their complex travel patterns and for locally mobile seniors with physical

impairments. Reducing travel distances through more compact spatial planning resonates only with the travel patterns of one group, the public transport and bicycle users. The adoption of technological innovations such as low emission vehicles would fit busy drivers, car commuters and locally mobile seniors, but the higher costs are a significant barrier in particular for the latter group while the operational range of electric vehicles might not yet meet the needs of the first two groups. Consequently, policies that are effective to change one group's mobility or purchasing behaviour might be ineffective for others.

Robin Hickman, Patricia Austin and David Banister (2014) present the city of Auckland, New Zealand, as a case of "Hyperautomobility", i.e., extreme reliance of the transport system on the individual car transport. This car dependence developed rapidly after strategic decisions in the 1950s to funnel transport investments into road building. Since then, low-density spatial development, suburban lifestyles and reliance on motorized individual transport have formed a mutually reinforcing constellation with a structurally entrenched path dependence. The authors develop scenarios to explore what sustainable mobility could mean under such circumstances. Their conclusions suggest that a combination of technological change towards low emission vehicles and radical changes in the modal split towards public transport, driven by motives of environmental stewardship, are required. Such radical structural change will depend on supporting governance. Using the Foucauldian notion of governmentality, Hickman, Austin and Banister suggest that incumbent policy images are dominated by technical solutions and mobility designs tend to favour motorists over pedestrians or cyclists by default. Furthermore, the dominant preference for a weak state and unobtrusive policy measures both embody and veil unequal power relations which systematically marginalise alternatives to car mobility and render them politically unimaginable. The findings from Auckland suggest that the ongoing transitions towards car-dominated transport systems in many emerging economies might lock in a development trajectory that could be difficult to reverse in the future.

Conclusions from the special issue and suggestions for future research

Overall, the contributions to this special issue demonstrate that any transition to sustainable mobility is a very piecemeal, contested and often fragmented process. Projects that appear to contribute to more sustainable mobility are often driven by business and political agendas and might have unintended, even counter-productive effects, as the case study about electric vehicle pilot projects in Paris and Berlin demonstrates. While young European urbanites have adopted more sustainable travel patterns, these might be difficult to stabilise over time, given deep-seated cultural images about life style expectations and related mobility patterns, as the research by Puhe and Schippl suggests. The findings by Peters and Dütschke confirm that electric vehicles will do little to change travel attitudes and that their further diffusion will require compliance with long-standing expectations by car buyers about prices and use patterns. Obviously, electric vehicles will not contribute to reducing car dependency, which, as Mattioli demonstrates, increases mobility-induced social exclusion for those with limited or no access to a car. Policy options are further complicated by the fact that different user groups have very different needs, and policies that fit groups who rely on public transport will often have little appeal to groups which rely heavily on the car, as Julsrud shows. In contexts of hyperautomobility, such as Auckland as studied by Hickman, Austin and Banister, the articulation of policy choices and developmental trajectories that do not reinforce reliance on the car can be almost impossible due to deeply entrenched cultural images.

The options discussed in this special issue confirm that there is little agreement on what constitutes sustainable mobility, and how it can be achieved. The struggle toward sustainable mobility takes very different forms in different places. The choices made are pervaded by vested interests and entrenched imaginaries, and often reinforce existing inequalities.

The contributions in this special issue suggest at least three avenues for future research: First, we need a better understanding how abstract concepts of sustainable mobility are adopted in

local contexts and shaped by local actor constellations. It is at the local level where novel solutions develop surprising and often counter-productive effects. Comparative case studies with larger numbers of cases could help to develop an analytical framework, to identify factors of success and to derive usable lessons for policy and practice.

Second, more attention to the social dimension of sustainable mobility will not only allow to better understand the structural determinants of transport related inequalities, but it will also help to challenge the often unquestioned dominance of car-centred solutions in public debate, and to probe claims for improved social benefits from alternative approaches.

Finally, the contributions suggest an urgent need to engage more systematically with the power dimension of mobility patterns and mobility choices, in particular the structural power emerging from silenced mobility needs which are not well served by dominant transport systems, from culturally entrenched imaginaries about desirable forms of mobility, and from the privileged ability to shape technological and organisational innovations through the control of research and development capacities, access to capital and political influence.

Overall, these are enormous research challenges that require collaboration across established disciplines and reflection on underlying concepts and assumptions. The quest for sustainable mobility will therefore remain an area of great interest for critically oriented studies of environmental policy and planning.

References

Amekudzi, A.A., Khisty, C.J. and Khayesi, M. (2009). Using the sustainability footprint model to assess development impacts of transportation systems. Transportation Research Part A 43: 339-348.

Avineri, E. and Goodwin, P. (2010) Individual behaviour change: Evidence in transport and public health. Project Report. Department for Transport, London, [http://eprints.uwe.ac.uk/11211/2/] (accessed 2 January 2014).

Baker, S. (2007). Sustainable development as symbolic commitment: Declaratory politics and the seductive appeal of ecological modernisation in the European Union. Environmental Politics, 16: 297-317.

Bamberg, S., (2009). The Munich Dialogue Marketing Campaign for New Citizens – Using residential relocation as a starting point for breaking car use habit. In: Geerken, T. and Borup, M. (2009): *System Innovation for Sustainability 2 – Cases Studies in Consumption and Production - Mobility*, Greenleaf Publishing Ltd, Sheffield, p. 79-90.

Bamberg, S., Heller, J., Heipp, G., and Nallinger, S. (2008). Multimodales Marketing für Münchner Neubürger. Entwicklung, Evaluation, Ausblick. *Internationales Verkehrswesen* (60) 3/2008, p. 73-76.

Banister D. (2005) *Unsustainable Transport*, London, Routledge

Banister, D. (2008) The Sustainable mobility paradigm, Transport Policy 15: 73-80

Banister, D. (2011a) The trilogy of distance, speed and time, Journal of Transport Geography 19: 950-959

Banister, D. (2011b). Cities, mobility and climate change. Journal of Transport Geography, 19: 1538-1546.

Banister, D., Stead, D., Steen, P. et al. (2000) European Transport Policy and Sustainable Mobility. London: Spon Press.

Bellmann, J., Eichinger, A., Eisenkopf, A., Knorr, A. (2009). *Urban Congestion Charging with an Environmental Component. The Central London Congestion Charge.* FÖV Discussion Papers 47. [http://192.124.238.248/fbpdf/dp-047.pdf] (accessed 26 November 2012)

Black, W.R. (2003) Transportation: A Geographical Analysis. London: The Guilford Press

Black, W.R. (2010), Sustainable Transportation: problems and solutions. New York: Guilford Press

Black, W.R. and Nijkamp, P. (Eds) (2002) Social Change and Sustainable Transport. Bloomington, IN: Indiana University Press.

Callonec, G. and Sannié, I., 2009. *Evaluation of the economic and ecological effects of the French 'bonus malus'*. ECEEE Summer Study, Paris. [http://www.eceee.org/conference_proceedings/eceee/2009/Panel_2/2.273/Paper/] (accessed 22 September 2011).

Castillo, H. and Pitfield, D.E. (2010). ELASTIC – A methodological framework for identifying and selecting sustainable transport indicators. Transportation Research Part D, 15, 179-188.

CEC (2011) White paper. Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, COM (2011) 144 final, Brussels, Commission of the European Communities.

Commoner, B. (1972) 'The Environmental Cost of Economic Growth', in: *Population, Resources and the Environment*, Government Printing Office, Washington, DC. pp. 339-63.

Currie, G., and Delbosc, A. (2011). Mobility vs. affordability as motivations for car-ownership choice in urban fringe, low-income Australia. In: K. Lucas, E. Blumenberg, & R. Weinberger (Ed.), Auto motives. Understanding car use behaviours. Bingley: Emerald.

Dalkmann, H. and Brannigan, C. (2007) *Transport and Climate Change*, Sourcebook Module 5e, GTZ, Eschborn.

Dodson, J., and Sipe, N. (2007). Oil vulnerability in the Australian city: assessing socioeconomic risks from higher urban fuel prices. Urban Studies, 44 (1), 37-62.

EEA (2008) Beyond transport policy: exploring and managing the external drivers of transport demand. Technical Report No. 12, EEA, Copenhagen.

Ehrlich, P.R. and Holdren, J. P. (1971) *Science, New Series*, Vol. 171, No. 3977, pp. 1212-1217.

Eurostat, (2014). Energy, transport and environment indicators. Pocketbook 2013. Available at: [http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-DK-13-001/EN/KS-DK-13-001-EN.PDF] (Accessed 20 January 2014)

Fergusson, M. and I. Skinner, (2000). *EU - Fuel and Vehicle Tax Policy.* Stockholm, Swedish Environmental Protection Agency. Available at: [http://www.ieeplondon.org.uk/ publications/pdfs/2000/EUfueland vehicletax.pdf] (Accessed 22 September 2011).

Geels, F.W., Kemp, R., Dudley, G., and Lyons, G. (eds.) (2012). Automobility in Transition? A Socio-Technical Analysis of Sustainable Transport. New York. Routledge.

Geels, F.W. and Kemp, R. (2012). The Multi-Level Perspective as a New Perspective for Studying Socio-Technical Transitions. In Geels, F.W., Kemp, R., Dudley, G., & Lyons, G. (Eds.). Automobility in Transition? A Socio-Technical Analysis of Sustainable Transport (pp. 49-79). New York. Routledge.

Goodwin, P. (2012) Three views on peak car, Transport Policy and Practice, Volume 17.4 , pp. 8-29.

Gudmundsson, H. and Höjer, M. (1996), Sustainable development principles and their implications for transport. Ecological Economics, pp. 269-282.

Hickman, R., Austin, P. and Banister, D. (2014): Hyperautomobility and governmentality in Auckland, Journal of Environmental Policy and Planning, forthcoming.

Hildermeier, J. and Villareal, A. (2014) Two ways of defining sustainable mobility: Autolib' and BeMobility, Journal of Environmental Policy and Planning, forthcoming.

Holden, E. (2007) Achieving sustainable mobility: everyday and leisure-time travel in the EU. Ashgate, Aldershot.

Holden, E and Linnerud, K (2011) "Troublesome Leisure Travel: The Contradictions of Three Sustainable Transport Policies", Urban Studies, 48(14): 3087–3106.

Holden, E., Linnerud, K. and Banister, D. (2013) "Sustainable Passenger Transport: Back to Brundtland". Transportation Research Part A: Policy and Practice, 54: 67–77.

Høyer, K.G., 2000. Sustainable Mobility – The Concept and Its Implications. Western Norway Research Institute, Sogndal.

IEA (2009). Transport, Energy and CO2. Moving Toward Sustainability. International Energy Agency, Paris.

IEA (2010). World Energy Outlook 2010. The International Energy Agency, Paris.

IEA (2012). Energy Technology Perspectives 2012. Pathways to a Clean Energy System. International Energy Agency, Paris.

Jackson, T. (2005) Live Better by Consuming Less?: Is There a "Double Dividend" in Sustainable Consumption? Journal of Industrial Ecology, 9, 19-36.

Julsrud, Tom Erik (2014): Activity-based patterns of everyday mobility: The potential for long-term behaviour change across five groups of travellers, Journal of Environmental Policy and Planning, forthcoming.

Kodransky, M. and Hermann, G. (2011). Europe's Parking U-Turn: From Accommodation to Regulation. New York.

Kopp, P. and Prud'homme, R. (2008). *Urban Tolls: Price and congestion. Some lessons for a better urban public policy.* http://www.biu.ac.il/soc/ec/seminar/data/20.04.09/The%20Stockholm%20Toll%20-1.pdf (accessed 26 November 2012)

Lautso, K. and Toivanen, S. (1999), SPARTACUS system for analysing urban sustainability. Transportation Research Record 1670, 35–46

Litman, T., and Burwell, D., (2006), Issues in sustainable transportation. Int. J. Global Environmental Issues.

Low, N. and Astle, R. (2009). "Path dependence in urban transport: An institutional analysis of urban passenger transport in Melbourne, Australia, 1956–2006." Transport Policy no. 16 (2):47-58.

Mattioli, G. (2014): Where sustainable transport and social exclusion meet: households without cars and car dependence in Great Britain, Journal of Environmental Policy and Planning, forthcoming.

Maxwell, D., P. Owen, L. McAndrew, K. Muehmel and A. Neubauer (2011). Addressing the rebound effect. Eur Comm DG Environ, Brussels.

Millard-Ball A. and Schipper, L. (2010): Are we reaching peak travel? Trends in passenger transport in eight industrialized countries, Transport Reviews, 1-22.

MiSA (2012). Norwegian High Speed Railway Project Phase 3. Final report. MiSA Environmental System Analyses, Trondheim.

Mokhtarian, P.L. (2005a) Travel as a desired end, not just a means. Transportation Research Part A 39, 93–96.

Mokhtarian, P.L. (2005b) When is getting there half the fun? Modelling the liking for travel, Transportation Research Part A 39, 97–123

Næss, P. (2006) Urban Structure Matters. Abingdon: Routledge.

Newman, P. and Kenworthy, J (2012): 'Peak Car Use': Understanding the Demise of Automobile Dependence, Curtin University Sustainability Policy (CUSP) Institute, Perth, Western Australia, http://www.parliament.tas.gov.au/ctee/Council/Submissions/Professor%20Newman%20submission%2014%20Aug%2012.pdf (last access 2 January 2014)

Nijhuis, J.O. (2013): Consuming mobility: a practice approach to sustainable mobility transitions; Wageningen: Wageningen Academic Publishers.

OECD, (2000), Environmentally Sustainable Transport, futures, strategies and best practices. Synthesis Report of the OECD project on Environmentally Sustainable Transport EST. Available at: http://www3.cfac.unisg.ch/org/idt/cfac_ui.nsf/338a93192a5036c7c12568ff0040fed0/E9A90BA721A9D5C2C125765400441767/$FILE/Environmentally+sustainable+Transport_Synthesis.pdf (accessed 20 January 2014)

OECD (2006) Decoupling the Environmental Impacts from Transport from Economic Growth, Paris.

OECD (2009) *Incentives for CO_2 emission reduction in current motor vehicle taxes.* Working Party on National Environmental Policies – Working Group on Transport, Paris. Available at:

http://www.internationaltransportforum.org/jtrc/RoundTables/feb10-18Braathen1.pdf (accessed 22 September 2011)

Parkhurst, G., Kemp, R., Dijk, M. and Sherwin, H. (2012). Intermodal Personal Mobility. A Nich Caught Between Two Regimes. In: Geels, F.W., Kemp, R., Dudley, G. and G. Lyons. Automobility in Transition? New York and London, Routledge, pp. 308-334.

Peden, M. et al. (eds) (2004), World report on road traffic injury prevention (Geneva: World Health Organisation).

Peters, A. and Dütschke, E. (2014): How do consumers perceive electric vehicles? A comparison of German consumer groups, Journal of Environmental Policy and Planning (forthcoming).

Pigou, A. (1920) The Economics of Welfare. London: Macmillan.

Puhe, M. and Schippl, J. (2014): User perceptions and attitudes on sustainable urban transport among young adults: Findings from Copenhagen, Budapest and Karlsruhe, Journal of Environmental Policy and Planning (forthcoming).

Root, R.A., Schintler, L. and Button, S., (2002). Women and Travel: The Sustainability Implications of Changing Roles. In W. R. Black & P. Nijkamp, eds. Social change and sustainable transport. Indiana Univ Pr, pp.149–156.

Rogers, E.M. (2003). Diffusion of innovations. New York: Free Press.

Rudinger, G., (2002). Mobility Behaviour of the Elderly: Its Impacts on the Future Road Traffic System. In W. R. Black & P. Nijkamp, eds. Social change and sustainable transport. Indiana Univ Pr, pp.157-164.

Sager, J. Apte, J.S., Lemoine, D.M. and Kammen, D.M. (2011) “Reduce growth rate of light-duty vehicle travel to meet 2050 global climate goals”, Environ. Res. Lett. 6 024018

Sager, T. (2005) 'Freedom as mobility: implications of the distinction between actual and potential travelling', *Mobilities*, 1, 465-88.

Schiller, P.L., Bruun. E.C. and Kenworthy, J. R. (2010) An Introduction to Sustainable Transportation: Policy, Planning, and Implementation, Earthscan.

Schipper, L. and Lilliu, C.M. (1999) Transportation and CO2 Emissions: Flexing the Link. A Path for the World Bank, Washington, The World Bank.

Shiftan, Y., Kaplan, S. and Hakkert, S. (2003). Scenario building as a tool for planning a sustainable transportation system. Transportation Research Part D, 8, 323-342.

Sorrell, S. (2007). The Rebound Effect: an assessment of the evidence for economy-wide energy savings from improved energy efficiency, UK Energy Research Centre, London.

Spaargaren, G. (2003). Sustainable Consumption: A Theoretical and Environmental Policy Perspective." Society & Natural Resources no. 16 (8):687-701.

Spaargaren, G. (2011). Theories of practices: Agency, technology, and culture: Exploring the relevance of practice theories for the governance of sustainable consumption practices in the new world-order." Global Environmental Change no. 21 (3):813-822.

Star, Susan Leigh. 2010. "This is Not a Boundary Object: Reflections on the Origin of a Concept." Science, Technology & Human Values no. 35 (5):601-617.

Stern, P. C. (1999) Information, incentives, and proenvironmental consumer behavior, Journal of Consumer Policy, 22, pp. 461–478.

Stern, P. C. (2000) Toward a coherent theory of environmentally significant behavior, Journal of Social Issues, 56, pp. 407–424.

Shove, E. (2003). Comfort, Cleanliness and Convenience: The Social Organization of Normality Oxford, Berg.

Tillberg, K., (2002). Residential Location and Daily Mobility Patterns: A Swedish Case Study of Households with Children. In W. R. Black & P. Nijkamp, eds. Social change and sustainable transport. Indiana Univ Pr, pp.165-172.

Upham, P, Kivimaa, P. and Virkamäki, V. (2013). "Path dependence and technological expectations in transport policy: the case of Finland and the UK." Journal of Transport Geography no. 32 (0):12-22.

Urry, John. 2004. "The 'System' of Automobility." Theory, Culture & Society no. 21 (4-5):25-39.

Uteng, T.P., 2006. Mobility: discourses from the non-Western immigrant groups in Norway. Mobilities, 1(3), pp.437-464.

van Goeverden, C., P. Rietveld, et al. (2006). "Subsidies in public transport." European Transport 11: 5-25.

WCED (1987) Our Common Future. World Commission on Environment and Development, Oxford: Oxford University Press.