



Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

Original research article

Transport needs in a climate-constrained world. A novel framework to reconcile social and environmental sustainability in transport



Giulio Mattioli

Institute for Transport Studies, University of Leeds, Room 113, 1-3 Lifton Place, LS2 9JT Leeds, UK

ARTICLE INFO

Article history:

Received 4 August 2015

Received in revised form 12 March 2016

Accepted 24 March 2016

Available online 21 April 2016

Keywords:

Transport

Human needs

Energy demand

Intergenerational justice

Climate change mitigation

Car dependence

ABSTRACT

The amount of energy and carbon emissions that is required to satisfy transport needs in developed countries is high, has increased rapidly in the past few decades, and is likely to continue to do so in the future. In some contexts, such as car-dependent peri-urban and rural areas, the satisfaction of basic needs has come to depend on extensive use of carbon-intensive transport modes. This creates a tension between social and environmental sustainability, and gives rise to justice dilemmas. In this article, a novel framework is proposed to conceptualise the connections and tensions between justice in transport and accessibility, on one hand, and the consequences of transport emissions on global and intergenerational justice, on the other hand. The framework is based on the integration of philosophical (human needs theory) and sociological (structuration theory) perspectives. While human needs are anthropological invariants, need satisfiers are relative, contextual and historical. Over time, satisfiers can become more travel- and carbon-intensive through unintentional structuration processes. This encourages a critical look towards how the role of transport in need satisfaction has changed over time, how it might change in the future, and the role of 'excess travel' practices in pushing the envelope of transport needs.

© 2016 The Author. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

1. Introduction

The second half of the twentieth century has seen a phenomenal growth in distance travelled worldwide [84]. In Great Britain, passenger kilometres per year have increased by 352% between 1952 and 2013, almost entirely as a result of increasing distances travelled by car [18]. While in a number of developed countries (per-capita) car travel seems to have peaked [54], it is still increasing rapidly worldwide, as developing countries catch up with developed ones.

This dramatic increase has raised both environmental and social concerns, both of which have implications for justice. Because of large dependence on oil, transport contributes greatly to climate change. Transport is the only sector where greenhouse gas (GHG) emissions have increased (+14%) between 1990 and 2012 in the EU-28, notably for road transport (+17%) and international aviation (+93%) [24]. What makes climate change problematic, from a justice perspective, is that any benefits of current emissions accrue to present generations, notably in developed countries, while the negative impacts of climate change "will fall disproportionately upon

developing countries and the poor persons within all countries, and thereby exacerbate inequities in health status and access to (...) resources" (IPCC, 2007, quoted in Vanderheiden [101] p. xiii). This raises difficult questions of *global* and *intergenerational* justice [38,101]. While proponents of 'weak sustainability' argue that current emissions are used to build up man-made capital which will more than compensate for degraded natural capital in the future, a 'strong sustainability' perspective "regards natural capital as providing some functions that are not substitutable" and therefore defines sustainability as "leaving the future generations a stock of natural capital not smaller than the one enjoyed by the present generation" ([47], p. 147). From this perspective, as recently argued by the Rockefeller Foundation-Lancet Commission on planetary health, "we have been mortgaging the health of future generations to realise economic and development gains in the present" ([105], p. 1973).

The distribution of energy consumption and emissions is unequal both between and *within* countries, including developed ones, with high-impact households responsible for a very large share of the total [76], and this is particularly true for transport [6]. Transport emissions are more unequally distributed than domestic energy emissions, and more strongly associated with income: as a result, transport typically explains most of the difference in direct

E-mail addresses: g.mattioli@leeds.ac.uk, giulio.mattioli@gmail.com

emissions between groups at the high and low end of the spectrum [8,25].

The spectacular growth of travel distances in developed countries has drawn increasing attention to inequalities in transport and in access to services and opportunities, leading to the rise of the *transport and social exclusion* research agenda [13,57,58,88]. This literature moves from the recognition that historical increases in travel distances and motorisation have resulted in increasing *need* to cover long distances and use powered transport modes (cfr. [49]), to investigate how individuals whose ability to travel is limited, e.g. because of lack of access to car or public transport, are more at risk of social exclusion.

However, in transport and social exclusion research, questions of *inequality* are typically not framed in *justice* terms. It is only in recent years that efforts have been made to integrate theories of justice and ethics into this field (e.g. [2,26,62,64,65,73,74,100]). However, these approaches are still in their infancy, and they generally focus narrowly on transport and access to services and opportunities, without taking into account transport externalities and their justice implications – including threats to global and intergenerational justice arising from climate change. Even when they do (e.g. [100]), these are generally considered separately from inequalities of access, thus obscuring the interrelationships between the two domains (but see Refs. [66,73,74,95]).

In this article, I put forward and discuss a framework to conceptualise the connections and tensions between justice in transport and accessibility, and the consequences of transport emissions on global and intergenerational justice. This is done in the conviction that, as I shall try to demonstrate, there is a latent tension between ensuring fair levels of access in developed countries and achieving a rapid reduction in transport emissions and energy consumption, i.e. that reconciling justice goals in the two domains is fraught with difficulties. The conceptual approach proposed in this paper highlights such challenges, and the fundamental reasons behind them. It does so by focusing on the *need* for carbon-intensive travel, how it arises and its consequences for intra- and intergenerational justice. This is in contrast with much existing literature where the two issues are considered separately.

The framework proposed is based on the integration of philosophical and sociological perspectives, namely human needs theory [20,45,69] and structuration theory [40]. The goal of bringing together these two strands of thought is to overcome what can be seen as the complementary limitations of social science and philosophical approaches.

Social science approaches to inequality can be criticised for what Walker [102] calls 'limited claim making', i.e. the tendency to make *descriptive* claims about patterns of distributive *inequality* ("how things are"), without making related *normative* claims about *justice* ("how things ought be"). In Walker's words, this means "assuming that injustice is self-evident and unproblematic, that evidence of spatial-distributional inequalities can be simply equated with injustice, (...) without needing to explain for what reason" (p. 13). I argue that this limitation, which Walker detects in 'uncritical' environmental justice scholarship, applies to much transport and social exclusion research as well, since the number of works integrating justice perspectives is still limited.

On the other hand, however, philosophical approaches to justice can overlook the role of social structures and, in the words of philosopher Wolff [106] (p. 191), sometimes fail to "interpret the world we live in (and) investigate why it is society does the things it does". This is why I propose to integrate into the framework structuration theory, which is particularly well-suited to clarify these issues.

The article is organized as follows. First, the argument is put forward that there is a tension between ensuring fair levels of access and achieving a rapid reduction in transport emissions and

energy consumption in developed countries. This is demonstrated based mostly on the data for the UK. In Section 3, the theoretical framework is presented by describing the role of transport in the satisfaction of basic human needs (Section 3.1) and illustrating how structuration processes play out in daily and long distance travel (Section 3.2). Finally (Section 4), key lessons are drawn, and an agenda for future research and policy-making is sketched.

2. The tension between environmental and social goals in transport

In this section, three propositions are put forward. First, *current transport needs in developed countries are too carbon- and energy-intensive*.

The Joseph Rowntree Foundation's 'Minimum Income Standard' (MIS) research [14] is a valuable source to assess which goods and services are considered as necessary for a minimally decent standard of life in the UK. The MIS is calculated based on the results of focus groups, targeted at different types of households and informed by expert opinion, which are updated every two years. Within these focus groups, negotiations are conducted on what are the basic necessities that every household should be able to afford. This approach is based on the relative deprivation understanding of poverty [97] whereby "individuals, families and groups can be said to be in poverty when (...) their resources are so seriously below those commanded by the average individual or family that they are, in effect, excluded from ordinary living patterns, customs and activities" (p. 32). As illustrated by Walker et al. [103], MIS research can be used to investigate which energy-consuming goods and services are considered as necessary, and how this evolves over time. This also allows for an investigation of the minimum transport needs of British households, as illustrated by previous research [22,93].

Druckman and Jackson [21] have used data from the first MIS wave (2008) to model the level of GHG emissions required to support an acceptable standard of living in the UK. In the resulting 'Reduced Consumption Scenario', GHGs are 37% lower than actual figures, which is broadly in line with UK emission reduction targets for 2020. In this scenario, transport emissions account for 26% of the total, but this is based on the assumption that car use is unnecessary for all household types, i.e. that services and goods can be conveniently accessed by alternative modes of transport, although a provision is made within the MIS for taxi hire to cover specific car dependent 'once a week' trips such as food shopping and hospital visits [21] (p. 1795).

The assumption that most trips can be made without a car is highly questionable, and indeed subsequent waves of the MIS study have turned it around. In 2010, the standard was revised to include ownership of one or two cars for most household types living in rural towns, and for all households living in villages and hamlets [22] (p. 34). This was justified in light of "the location of services and employment, family responsibilities, and limited local public transport" [93] (p. 96), and corresponds to an increase of up to 24% of the weekly budget for the households concerned (as compared to urban areas). The 2012 update [15] extended the entitlement to car ownership to all families with children, regardless of residential location, as this was considered essential "in order to meet the needs of both parents and children and particularly to enable them to have opportunities and choices relating to work and social activities" (p. 16), partly as a result of 'inflexible' and increasingly expensive public transport. In the most recent wave (2014), the range of trips that have to be made by car or taxi has been further extended, again as a result of worsening public transport [14].

While the GHG emissions of post-2008 Minimum Income Standards have not been modelled, these would likely be higher than in the Reduced Consumption Scenario calculated by Druckman and

Jackson [21], as a result of the increased amount of car travel that is now included. This makes it more difficult to reconcile carbon reduction with the standards of living presently deemed acceptable in the UK.

The second key proposition is that *the carbon- and energy-intensity of satisfying transport needs in developed societies have increased over time*. The discussion of MIS research conducted above shows how, even in a relatively short period of time (2008–2014), the need for car-based mobility has increased in British society. This mirrors the more general finding that a greater number of energy consuming items (e.g. computer, internet access and tumble-dryers) are included in MIS 2014 as compared to 2008 [103]. The ‘attitudes to necessities’ module of the ‘Poverty and Social Exclusion in the UK’ (PSE) survey [63] provides a survey-based alternative to MIS research which is better suited to track change over a longer period of time. Four surveys between 1983 and 2012 asked the public which goods and services constitute “a necessity that adults should not have to do without”. Table 1 shows the trends for a selection of items that are clearly related to energy consumption and/or travel.

The Table shows that the percentage of the British population who find the car a necessity doubled between 1983 (22%) and 2012 (44%). This increase is second only to that of ICT appliances (internet, computer, mobile phone) and the dishwasher, and contrasts with the stability of home heating (endorsed by virtually all respondents in all years). The increasing need to own a car can be interpreted as a by-product of motorization growth and increasing distances between residences and essential activity destinations [88]. While these broad trends seem to have halted or slowed down in recent years [54,70], evidence from the MIS studies discussed above suggests that government cuts to bus funding since 2010 [10] have further increased car dependence in the UK. Therefore, it cannot be excluded that carbon- and energy-intensity of satisfying transport needs in the UK will continue to increase in the future.

The third and last proposition is that, *in contexts and situations where transport needs are particularly carbon and energy intensive, the trade-offs between addressing injustice in transport and access and working towards climate justice are heightened*. This proposition is based on two assumptions, which need to be made explicit.

First, it is assumed that, in order to mitigate climate change, *at least some reductions in emission levels will have to be achieved within transport*. One possible objection to this is that moving towards climate justice may be possible without reducing carbon dependent mobility practices, if emissions from other activities could be fundamentally curbed. If that were possible, arguably there would be no reason to link social and climate justice in transport. There is, however, at least one major problem with this argument, namely that even radical reductions in emissions in other sectors might not be sufficient to avoid dangerous climate change, if current trends in transport are allowed to continue unchecked. For example, the IPCC has found that “for some countries (e.g., the UK) an *unrestricted growth of tourism would consume the whole carbon budget compatible with the +2 °C target by 2050*” [28] p. 756, quoted in [87] p. 23, emphasis added). The recent international commitment to “achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of (the twenty-first) century” [98], widely referred to as a commitment to “net-zero emissions by 2050”, only reinforces this point.¹

Second, this paper assumes that *efforts to manage (i.e. reduce or limit the increase of) travel demand are an essential part of climate change mitigation in transport*. In other words, it is assumed that technological innovation will not be sufficient on its own to achieve the emission reduction goals for transport. This is supported by a body of evidence showing how in the twentieth century technological improvements have been offset by ‘human factors’ such as increasing travelled distances, increasing car modal share, decreasing vehicle occupancy rates, and a shift towards larger and more powerful vehicles [84]. Looking ahead, the *Intergovernmental Panel on Climate Change* (IPCC) considers reducing GHG emissions in transport “a daunting task” [92] p. 605, since “the continuing growth in passenger and freight activity could outweigh all mitigation measures” (p. 603). Accordingly, Anable et al. [1], based on modelling of transport energy demand for the UK, argue that “given the many uncertainties and risks involved in decarbonising our energy supply, there are strong arguments for pursuing both demand and supply side solutions” in the pursuit of emissions reduction in transport (p. 137).

If one accepts these arguments, then it follows that the higher the carbon intensity of transport needs, the greater the tension between social and environmental goals in transport. This may lead to a double-bind situation where making progress on both fronts at the same time is virtually impossible – a dynamic which can be illustrated in both directions.

First, policy measures to reduce transport emissions may increase transport-related social exclusion. Indeed, many early British studies on transport disadvantage were motivated also by concerns for the social impacts of the sustainable transport agenda [11,19,46,48,61,81] and this topic continues to draw attention [60]. In a nutshell the problem is that, where and when the car is needed for access to essential services and opportunities, measures restricting its use or increasing its costs potentially threaten social inclusion and may be considered unfair towards already disadvantaged groups. Notably, the equity effects of pricing policies such as road pricing [55,81] and fuel tax increases [46] have raised particular concerns. Even where and when public transport is a viable alternative to automobility, improvements to mainstream public transport services aimed at encouraging modal shift away from cars (pursuing *patronage goals*) may divert funding from the pursuit of *coverage goals*, i.e. catering for suppressed travel demand and satisfying the access needs of the most disadvantaged [104]. This can also be seen as a conflict between providing for the needs of (former) car drivers and satisfying those of carless individuals [78].

This tension is particularly acute in peri-urban and rural areas where the car is more of a necessary good [68,93] and as a result the negative social impacts of anti-car policies are magnified [46]. This might hamper the implementation of transport demand reduction policies in peri-urban and rural areas, but it is there that transport per capita emissions are the highest [8,12,25] and should thus be reduced the most. This is even more important considering that in developed countries these areas are now home to an important share of the population. For example, in England and Wales, 33 per cent of the population lived in the “rural hinterlands around cities” in 2011 [96]. In the UK, between 1945 and 1991, the largest population gains have been in the areas with the highest transport-energy consumption [7], although this appears to have changed in more recent years [96].

While social justice concerns can hamper the implementation of carbon reduction policies, the reverse is also true. Environmental concerns can effectively make it taboo to implement measures that would improve the situation of the transport disadvantaged. Indeed, transport and social exclusion scholars in the UK and elsewhere have argued that, where modal alternatives are clearly unsuitable, promoting car ownership and use is the only effective way to ensure access to essential services and opportunities

¹ Of course, climate justice reaches beyond transport, as it includes carbon emission from a multitude of activities, and therefore there is a case for thinking about how the broader climate justice agenda generates implications for the environmental and social justice agendas in transport. However, this would require a much more elaborate exploration than possible in one paper.

Table 1
Percentage of the UK population considering selected energy-consuming items as necessities, 1983–2012.

	1983	1990	1999	2012	Percentage change (first year – 2012)
Heating to keep home adequately warm	97	97	95	96	–1.0
Washing machine	67	73	77	82	+22.4
Telephone	43	56	72	77	+79.1
Television	51	58	58	51	0.0
Car	22	26	36	44	+100.0
Holiday away from home, not staying with relatives	63	54	56	42	–33.3
Internet connection at home	–	–	6	41	+583.3
Home computer	–	5	11	40	+700.0
Mobile phone	–	–	8	40	+400.0
Visit friends or family in other parts of the country four times a year	–	39	41	27	–30.8
Holidays abroad once a year	–	17	20	18	+5.9
Dishwasher	–	4	7	10	+150.0

Source: PSE UK, Necessities of life survey, 1983–2012.

[57,59]. This argument is particularly common in the US, where motorisation and car dependence are very high and car availability is virtually an essential precondition for job access [3]. However, 'auto programs' (e.g. short-term car loans, financial aids for vehicle purchase, driving lessons and maintenance) have failed to scale up from local to national level in countries such as France, the UK and the US, for reasons including excessive cost, the risk of undermining public transport and the fundamental conflict with environmental objectives [30]. More broadly, while much transport and social exclusion research highlights the need to increase travel in order to improve well-being among low-mobility individuals, this is often at odds with the agenda of reducing mobility for the sake of the environment ([13] p. 306).

According to Mattioli [66], the fact that climate concerns hamper policies to alleviate transport disadvantage and vice-versa can lead to a 'transport policy stalemate' for decision makers interested in both objectives. The British Sustainable Development Commission [95] acknowledges this tension, and the challenge of ensuring "fairness in a car dependent society", but argues that this can be overcome by adopting a clear hierarchy of measures for (environmentally and socially) sustainable transport. In this framework, higher priority is given to structural measures that *reduce the need to travel* (by car), such as changing land use and the built environment (minimising distances between destinations) and promoting ICT-based 'virtual mobility'. These are considered as 'win-win' measures, able to simultaneously reduce the negative environmental impacts of transport and transport disadvantage. On the other hand, lower priority is given to measures, such as modal shift, efficiency improvements and capacity increases for powered transport, as these would trade the two goals against each other.

3. Theoretical framework

In this section, I introduce a novel framework to conceptualise the connections and tensions between justice in transport and accessibility, and the consequences of transport emissions on global and intergenerational justice. It is beyond the scope of this article to establish a comprehensive justice framework where specific rights, duties and responsibilities are defined. Rather, what is proposed is a number of conceptual tools that, in combination, make it possible to frame the issue in a novel way, moving beyond the mere recognition that a tension exists between the two transport policy goals. Establishing such a framework is a necessary, although clearly not sufficient, first step towards the definition of specific rights and duties to reconcile the two concerns.

The framework draws on notions from human needs [20,45,69] and structuration theory [40]. In the following, I illustrate how the two theories can be employed to better conceptualise the tension between social and climate justice in transport.

3.1. What are transport needs?

3.1.1. Human needs theory

So far in this article the term 'need' has been used in a generic way. It is crucial, however, that this seemingly straightforward notion is given a coherent theoretical foundation – something which human needs theory has sought to do. While this school of thought was originally motivated by global development concerns [20,69], it has been recently argued that it is also well placed to contribute to "many current ethical arguments for global and inter-generational justice in the face of threats from climate change" ([45] p. 1191). Indeed, human needs theory makes three key assumptions that are useful for those wanting to reconcile social and environmental concerns. These are illustrated in the following.

First, a *distinction between needs and wants* (or preferences). According to Doyal and Gough [20], needs are "instrumentally linked to the avoidance of *serious harm*, while (wants) are not" (p. 42, emphasis added), with 'serious harm' defined as failure to achieve the universal goal of "minimally disabled social participation", i.e. individual action within a culture (p. 55). Another crucial difference is that, while wants are *intentional* and *relative goals*, i.e. they vary among persons and cultures, needs are *objective, extensional* and *universal goals* ([20] p. 39–42), i.e. their specification "is independent of individual preference" (p. 49) and "of any particular social environment" (p. 90) as they ultimately arise from humans' biological background ([45] p. 1199).

Doyal and Gough [20] distinguish between *basic needs* (physical health, autonomy of agency and critical autonomy) and a greater number of *intermediate needs* including: adequate nutritional food and water; adequate protective housing; a non-hazardous work and physical environment; appropriate health care; security in childhood; significant primary relationships; physical security; economic security; safe birth-control and child-bearing; basic education (p. 170). Max-Neef et al. [69] provide a simpler (and somewhat vaguer) list of human needs including: subsistence, protection, affection, understanding, participation, leisure, creation, identity and freedom (p. 199). Indeed, numerous such lists exist in the literature, and they tend to overlap ([45] p. 1202). In the context of this article, what matters is not so much the specific needs identified but the basic notion that there exist a number of needs that are the same for all human beings.²

It follows from the above that "everyone has a moral right to optimal need satisfaction" ([20] p. 222) and that "satisfaction of basic needs has normative *precedence* over the satisfaction of wants" (p. 3). To this right corresponds a duty to "to help all humans

² While in this section we draw on the works of both Doyal and Gough [20] and Max Neef et al. [69], it must be noted that there are differences between their understanding of human needs. These however are beyond the scope of this article.

to optimise their need satisfaction” (p. 104), and this must be discharged mainly by agencies and social institutions, which individuals have the duty to support (p. 104–108). Unlike wants, needs are inherently *satiabile*, meaning that “thresholds can be conceived where serious harm is avoided” ([45] p. 1202). After this has been achieved, however, “nothing (...) dictates how any remaining surplus should be distributed” ([20] p. 101), and “poverty would still be possible but only with respect to wants as opposed to needs” (p. 237). This illustrates the similarities between human needs theory and the sufficientarian approach to distributive justice ([45] p. 1202).

The second key distinction is that *between needs and need satisfiers*. Doyal and Gough [20] make a compelling case against relativist approaches that deny the notion of universal needs. However, this does not mean overlooking the variety of ways in which humans can, and do, satisfy those needs. In fact, the most important feature of human needs theory is arguably the attempt to conceptualise this “duality of universality and particularity” ([20] p. 151). As I shall try to demonstrate, in order to grasp the dialectic between social and climate justice in a changing world, it is essential to keep both the ‘universal’ and the ‘relative’ in focus.

Max-Neef et al. [69] define need satisfiers as “everything which (...) contributes to the actualization of human needs”, including (among other things) “forms or organization, political structures, social practices, (...) values and norms, (...) types of behaviour and attitudes” (p. 201). While in this definition satisfiers are distinct from economic goods (p. 201), Doyal and Gough [20] p. 69 adopt a broader understanding which includes all “objects, activities and relationships which can satisfy our basic needs”. It is this second understanding which is adopted in the remainder of this article.

As illustrated above, the most fundamental attribute of needs is their *invariance*. This applies both to space, as the same human needs exist in all cultures, and to time, as they change at best “with the pace of evolution” ([69], p. 204). *Need satisfiers*, however, are inherently variable in both space and time, i.e., they are cultural and historical. As Max-Neef et al. argue [69] “one of the aspects that define a culture is the choice of satisfiers” and “cultural change is (...) the consequence of (...) adopting new or different ones” (p. 200).

Doyal and Gough [20] (p. 159, 302) assign the task of identifying need satisfiers in a specific social context to research following Townsend’s relative deprivation approach (1979), such as MIS and PSE studies in the UK (Section 2). However, they are highly critical of what they see as relativist excesses in this approach (p. 32–33, 109). In their view, the fact that the relative and contextual nature of need satisfiers is emphasised, while the universal substratum of human needs is glossed over (or explicitly denied), means a defence of the cultural status quo and leads to inconsistencies.

The third key point for the argument presented here is the *global and intergenerational scope of human needs*. From the universalism of human needs theory it follows that “national boundaries are no longer seen as demarcating self-contained spheres of moral responsibility” ([20], p. 108). Similarly, since it is assumed that future generations will have the same needs as present ones, there is no defensible case for compromising their chances of need satisfaction [45]. In a climate- and resource-constrained world, this constrains the right to need-satisfaction to “the highest level (...) which is generalizable over the relevant population” ([20], p. 108), and the relevant population includes both the present world population and future generations. As Doyal and Gough’s own empirical analysis suggests, it is questionable whether the best levels of need-satisfaction observed in developed countries are generalizable over such a broad ambit, given the high levels of energy consumption and carbon emissions that they entail (p. 293–294). This encour-

ages a critical look towards the energy and carbon intensity of need satisfiers in developed countries, including crucially transport.

3.1.2. The role of transport in need-satisfaction

Human needs theory has inspired empirical studies comparing levels of need-satisfaction at the aggregate level of nation states [20]. Studies investigating the relationships and tensions between ‘human development’ and energy and carbon demand (e.g. [94]) have also focused on this macro level. This is not the approach adopted here. Rather, in this section I elaborate on the role of transport in need-satisfaction, building on the key tenets of human needs theory. The proposed framework is then contrasted with the approach prevailing in transport and social exclusion research.

I argue that in order to understand the role of transport and car use in need-satisfaction it is necessary to assume that there are *hierarchical chains of need satisfiers*. Indeed as Doyal and Gough [20] (p. 40) note, in everyday discourse, “description of needs are hierarchical”, e.g. goods are required for undertaking activities which, in turn, contribute to the satisfaction of some overall need. Also, individual need-satisfaction is crucially affected by societal structures such as the system of material production, as well as by the natural and man-made environment ([20], p. 230–241).

An example helps illustrate the role of transport in chains of need satisfiers (Table 2). In most contemporary societies, participation in paid employment is the main way for households to acquire the economic resources necessary to satisfy the need for subsistence. According to Doyal and Gough [20] (p. 185) “paid labour is particularly important for individual autonomy in most societies because the income it creates provides direct access to other intermediate needs”. This makes paid employment an essential opportunity that (working-age) individuals must be able to access in order to be socially included. Given the spatial differentiation of home and work in our societies, a certain amount of travel is generally required to access employment opportunities. It is acknowledged that in certain contexts, such as most of the US [3], car use (and ownership) is essential for participation in the labour market, including crucially securing a job.

In the illustrative example in Table 2, each satisfier in the chain has a necessary relationship with the higher-order element. In detail: there is no way to achieve subsistence without (direct or indirect) participation in the labour market; there is no alternative to travelling substantial distances to the workplace; it is impossible to travel to work with alternative modes. In reality, most chains of need satisfiers are not be quite as rigid. In many cases, multiple ways of satisfying the higher-order satisfier exist, although as a general rule, flexibility is higher for lower- than for higher-order satisfiers. For example, in a country like the UK, it is often possible to access work, grocery shops and health care without a car. However, it might be impossible to satisfy the needs for subsistence and protection without access to work, grocery shops and health care. Two further examples of chains of need satisfiers are shown in Table 2. Both refer to travel purposes (food shopping and visits to the hospital) which are identified as requiring car-based mobility in MIS research [14]. This demonstrates the ‘derived demand’ nature of travel, i.e. its role in ensuring access to a variety of activities.

It is important to note that, in Table 2, the transport-related energy and carbon impact of need satisfaction is a function of the two lowest-order satisfiers in the chain: the amount of travel required and the mode of transport. Given global and intergenerational constraints on need-satisfaction, the resulting energy and carbon consumption should be generalizable to the world population and to future generations, i.e. it should not deplete limited resources including the absorptive capacity of the atmosphere. When this is not the case (as probably for the chains in Table 2),

Table 2
Chains of need satisfiers including transport and car.

Need		Subsistence (Max-Neef et al., 1992); economic security (Doyal & Gough, 1991)	Subsistence (Max-Neef et al., 1992); adequate food (Doyal & Gough, 1991)	Protection (Max-Neef et al., 1992); adequate healthcare (Doyal & Gough, 1991)
Need satisfiers	1st order (societal level)	System of employment at the societal level including division of labour, distribution of workplaces across space, etc.	System of food production and distribution at the societal level including e.g. distribution of retailers across space, etc.	Health system at the societal level including distribution of health care services across space, etc.
	2nd order	Paid employment	Food shopping	Visits to the doctor and hospital
	3rd order		Travel	
	4th order		Car	

a dilemma arises whereby satisfying the needs of present generations in a given society entails serious harm for other human beings across the globe and in the future.

Based on this framework, it is possible to propose a definition of car dependence that is grounded in normative considerations. The concept of car dependence is widespread in transport studies, although a great number of alternative definitions exist. Very broadly, the term is used as “(a) testimony of the difficulty of moving away from the car system, despite the increasing awareness of the negative externalities” ([72], p. 3). In the ‘need-based’ definition put forward here, there is car dependence when car use (4th order need satisfier) is essential to be able to travel (3rd) to access services, opportunities and social networks and/or to undertake practices (2nd) which, within current societal structures (1st), are essential for the satisfaction of human needs. In a car dependent situation *the satisfaction of human needs is conflated with access to an energy-demanding, low-order need satisfier*. When this is the case, lack of car availability entails serious harm and injustice. However, given concerns about the global and intergenerational generalizability of high levels of car ownership and use, strong car dependence also means *stronger trade-offs between different types of injustice*. This conclusion can be generalised: tensions of this kind arise every time the satisfaction of human needs becomes dependent on low-order and energy-demanding need satisfiers.

It is useful to contrast the approach sketched here with that prevailing in transport and social exclusion research [11,13,57,58,81,88]. Even though this is not always stated explicitly, this strand of research can be seen as a reaction to the dominance of utilitarian approaches in transport decision-making, such as welfare economics, and related tools for the evaluation of policies (Cost-Benefit Analysis) [62,64]. While these are often presented as normatively neutral, they have important, albeit rarely discussed, ethical implications, and they have indeed been criticised for creating socially inequitable outcomes [100]. In utilitarian approaches, the goal is the maximisation of utility, i.e. of wants and preferences, rather than needs. By contrast transport and social exclusion research typically assumes that there are key services and opportunities that all must be able to access to achieve social inclusion. In doing that, it implicitly endorses the key distinction between wants and needs, and the normative priority of the latter. This is why efforts to integrate theories of justice and ethics into this field typically build on egalitarian and sufficientarian approaches to justice [2,62,100]. In practice, this leads to the argument that interventions to ensure accessibility should be prioritised over other transport investments [13,62].

However, the second key distinction of human needs theory, i.e. that between needs and need satisfiers, is generally not reflected in transport and social exclusion research. This can be explained

by the intellectual origins of this research tradition. The relative deprivation approach to poverty set out by Townsend [97] has been very influential on British policy, leading to the establishment of the Social Exclusion Unit (SEU) in 1997 [56]. It was SEU, in turn, which kick-started the wave of transport and social exclusion studies in the UK (and worldwide), with the famous report ‘Making the Connections’ [88]. As a result, most research in this area emphasises the relative and contextual nature of the goods and services required to achieve ‘transport inclusion’ (i.e. the need satisfiers), but does not make reference to underlying universal human needs. Arguably, this makes it more difficult to reconcile social and environmental concerns.

This is particularly true when need satisfiers at the bottom of the chain, such as car ownership and use, are used as indicators of transport-related social inclusion. This means implicitly assuming that the car (fourth order satisfier in Table 2) is required for a chain of need satisfiers leading up to (at least) a fundamental human need – i.e. assuming high levels of car dependence. While this might be true in some contexts, it is important that a reasoned case is made to demonstrate the existence of such a chain of necessity. Overestimating the role of the car in need satisfaction is not a harmless mistake, as it results in serious trade-offs between social and environmental goals.

Differences in trip rates, travelled distances and travel time are also sometimes used to support claims of inequality in transport and social exclusion research. In the framework proposed here, such measures of travel behaviour refer to third-order need satisfiers. Since different modes can be used to travel, and these have different environmental impacts, the risk of social-environmental trade-offs is lower here than in the case of car ownership and use. However, such claims implicitly assume that the high levels of travel currently observed are inherently required to be able to access essential services and opportunities. This obscures the fact that, in principle, there are different ways in which need satisfaction could be achieved with less travel, e.g. if the distribution of activity locations across space was different.

Claims of inequality referring to accessibility to services and opportunities (second order satisfiers) further reduce the potential for trade-offs, as they shift the focus from actual travel to potential for access, and from transport to the activities that matter for social inclusion. This highlights that transport, just like other energy infrastructures, is not a need *per se*, but rather a means to an end [52,83].

Finally, claims about how socio-spatial structures (first order satisfiers) should be reshaped are common in transport and social exclusion research, resulting in recommendations to ‘reduce the need to travel’ and introduce forms of ‘accessibility planning’ ensuring that essential services and opportunities are within reach of all

sectors of the population [88]. These have the greatest potential for reconciling social and environmental goals, as improved accessibility by alternative modes can be regarded as a win-win measure. However, even such claims typically take for granted the necessary relationship between customary practices, systems of provision and human needs. In doing this, they reduce the scope for imagining alternative ways of satisfying human needs, which require the least possible amount of energy and carbon emissions.

The above discussion illustrates a general principle: *the trade-offs between social and environmental goals are strongest when claims of inequality refer to lower-order need satisfiers, but become weaker as one moves towards higher-order satisfiers*. In current transport and social exclusion research, inequality claims referring to higher- and lower-order satisfiers are juxtaposed, often without a clear hierarchy, and generally without any reference to fundamental, universal human needs. This is not a problem as long as the focus is on a single national society and the environmental consequences of travel are considered outside the scope. However, if one looks for an approach capable of reconciling social and environmental justice concerns, this is clearly insufficient.

The added value of the framework proposed in this article is that the full sequence of need satisfiers – from travel and transport mode at the bottom up to the basic human need at the top – is brought to light. This highlights the root of the problem, i.e. the configuration and the rigidity of the chains of need-satisfiers, encouraging to imagine forms of need-satisfaction that fit environmental constraints. Often, this would mean imagining scenarios where travel to services and opportunities (in their current form) can be made by less environmentally damaging modes of transport. Sometimes, however, this will require questioning current social structures and practices such as e.g. the spatial distribution of health care facilities, physical co-presence at work or a food distribution system based on a small number of large retail units.

Crucially, the framework encourages to think about *changes* in need satisfaction over time, and about the role of transport within this. Such dynamic processes are the focus of the next section.

3.2. Structuration processes in transport

The question of how societies reproduce themselves and change over time is the key question for sociology. In Europe, this has generated debates on the respective roles of and relationships between *agency* and *structure* [82]. Traditionally, the most significant conflict has been that between proponents of the primacy of structure, whereby individual action is ultimately determined by social structures, and proponents of the primacy of agency, whereby social structures are ultimately the product of the actions of humans. The influential work of Giddens [40] aims at transcending this opposition, arguing for a dynamic understanding of the ‘duality of agency and structure’. In this context, the notion of structuration indicates that “the properties of social systems are seen as both medium and outcome of the practices of actors, and those system properties recursively organise the practice of actors” ([82], p. 525).

In Giddens’ theory, the unintended consequences of human action play an important role in explaining social change (1984, p. 5–16). The conduct of individual actors, through a composition effect, results in aggregate outcomes (often on a broader temporal and spatial scale) which have little relationship with the original intentions of individual actors – they are “everyone’s doing and no one’s” (p. 9). Such aggregate outcomes, in turn, may contribute to shape the conditions of further action “in a non-reflexive feedback cycle (causal loops)” (p. 14). In other words, structural constraints to human action in the present are often the unintentional, aggregate by-product of previous actors’ agency, making human history something which is ‘created by intentional activities but is not an intended project’ (p. 27).

Normative considerations about how societies ought to function are clearly absent from Giddens’ sociological theory. On the other hand, as illustrated in Section 3.1.1, human needs theory sees social change as equivalent to the process whereby the satisfiers of universal human needs change over time. It has little to say, however, on how such change happens. Hence the interest of integrating the two theories, i.e. providing an account of how need satisfiers change over time. From this perspective, the flow of action aimed either at need- or want-satisfaction has unintended consequences, bringing about change in social structures and thus triggering processes that alter need-satisfiers over time. This might lead to a lock-in of need satisfaction into carbon intensive patterns, as illustrated in Section 2 for transport.

It is important to note that the lock-in is not just at the level of social processes and institutions, but also of physical infrastructures. Previous research in this area has highlighted for example the ‘carbon lock-in’ of technological systems [99], and their complex relationships with social and political institutions within socio-technical systems (e.g. [4,71,39]). While this paper acknowledges the importance of technological and physical infrastructures, the discussion in this section is couched in the language of structuration theory, as this highlights how individual action on the demand side of energy consumption has broader implications than generally assumed. This in turn is crucial for drawing the *normative* implications of such processes, as discussed in the concluding section.

Adopting a structuration perspective on transport needs means acknowledging that, over the long run, the aggregate outcome of individual travel behaviour can alter the role of transport within chains of need satisfiers. This is crucial if one is to understand how ‘transport needs’ have become more energy- and carbon-intensive over the past decades, and might continue to do so in the future (Section 2). In the next two sections, such structuration processes are illustrated with reference to car use and long-distance travel.

3.2.1. Car dependence

There is a substantial body of research on how car travel creates the preconditions for more car travel at a subsequent point in time, thus creating a self-reinforcing dynamic. This process is often referred to as ‘car dependence’ [66,67], and is a prime example of structuration process in transport.

Newman and Kenworthy [75] demonstrate how concerns about congestion lead to the provision of more road space through ‘predict and provide’ approaches to transport planning. This results in car-oriented spatial development which, in turn, creates the need for further car ownership and use, increasing energy consumption in the process. Dupuy [23], drawing on notions of ‘club’, ‘fleet’ and ‘network’ effects usually applied to telecommunications, demonstrates how increasing motorisation widens the accessibility gap between drivers and non-drivers, and how this in turn encourages further growth in car ownership. Dennis and Urry [16] illustrate how the automobile has brought about increasing fragmentation and disembedding of space, which in turn requires the use of a vehicle to be suitably re-embedded. Such positive feedback dynamics in the automobile system are emblematic of the ‘carbon lock-in’ of fossil fuel-based techno-institutional complexes [99], as well as of a form of infrastructure operation that results in unmanaged growing demand [83].

Historical accounts generally highlight the luxury nature of automobiles in the early days of motorisation, as they were typically owned by wealthy households and used for leisure purposes (e.g. [29,80]). From this perspective car travel was initially aimed essentially at want-satisfaction. Other historical evidence however suggests that since the very beginning cars were used to improve need-satisfaction, allowing for instance doctors in rural areas to reach their patients more quickly [27]. Overall, this suggests that

the travel practices of a small section of the population, aimed at both want- and need-satisfaction, have triggered a decades-long process of change in social, spatial and technological structures which has progressively turned the car into an important need satisfier (see Section 2).

3.2.2. Long distance travel

The contribution of long distance and international travel, notably by air, to energy consumption and carbon emissions is increasing rapidly [24,36,42,86,84]. This is projected to continue and accelerate dramatically in the coming decades [87]. There is a stark contrast between the emission reductions required to attain climate goals and even the most optimistic projections for tourism travel [17,43,87]. To make matters worse, while in the road transport sector considerable hope is currently being placed on a rapid electrification of the vehicle fleet, such a 'technological fix' is not on the horizon for the aviation sector. The implication is that some form of demand reduction or demand management policy will be necessary [5,9,17,44,77,85].

However, this area has been relatively overlooked in accounts of sustainable mobility, and our understanding of the dynamics and the determinants of demand for long-distance passenger travel is still limited. While there are arguably important structural drivers of increasing long-distance travel, including changes in technology, trade, and production processes (e.g. globalisation), this section focuses on what Frändberg has called the 'institutionalisation' of long-distance travel [31–36]. This can be defined as the process whereby long-distance travel in the present creates the preconditions for further travel in the future, through the expansion of activity spaces over increasing distances. This has clear resonances with Giddens' structuration theory and with accounts of how developed societies have become increasingly car dependent ([37], p. 110).

From this perspective, the 'locking-in' of long distance travel plays out both at the individual and the societal level, and through a variety of mechanisms [31–35]. Within an individual's life course, long-distance travel earlier in life can lead to further travel later on, as a result e.g. of acquisition of travel skills and the establishment of social networks that need to be maintained [53]. International residential relocation – ranging from temporary moves abroad to outright migration – can have similar effects. This plays out across generations as well, with individuals with a migration background and children of high-mobility individuals more likely to develop routines of long-distance travel of their own.

The work of Frändberg on young Swedes also suggests that most international travel is still related to leisure travel purposes such as holidays, and that frequent and routinized cross-border trips are still the preserve of the wealthiest sectors of the population [33]. Therefore, it would seem fair to assume that most of this travel is currently aimed at want-, rather than need-satisfaction.

The crucial question, however, is whether current long distance travel is setting in motion processes that will eventually make it an essential need satisfier. The most obvious way in which this could happen is through its role in the maintenance of social networks that stretch over long distance [53]. Indeed, in their theory of human need, Doyal and Gough identify "significant primary relationships" with "primary support groups and close confiding relationships" as a universal need (1991, p. 206–207) and Max-Neef et al. [69] (p. 206) list "friendships and family" as a key need satisfier related to the human need for "affection". For at least some population groups, maintaining such relationships requires long distance and/or international travel, often by air. As a result, and given current trends towards internationalisation, one might expect that long-distance travel will increasingly be regarded as a need satisfier in the future [31].

Interestingly, PSE figures for the past 30 years in the UK (Table 1) do not show such a trend, as all items related directly or indirectly to long-distance travel ('holiday away from home', 'visit friends or family in other parts of the country four times a year', and 'holidays abroad once a year') are either as likely or less likely to be considered a necessity in 2012 than in the 1980s and 1990s, even though this might just reflect a more general decline in generosity [63].

4. Discussion and conclusions

This article has introduced a number of concepts, drawn from human needs and structuration theory, which are helpful for thinking the tension and the possible reconciliation of social and climate justice in transport. Fig. 1 illustrates graphically how concepts from the two theories can be combined in a single framework. In every culture, need satisfiers exist that aim at the satisfaction of invariant human needs. Such need satisfiers are part of social structures, and contribute to determine how, in practice, individuals go about satisfying their needs. At the same time, the flow of action aimed either at need- or want-satisfaction tends to alter need-satisfiers over time, creating a feedback-loop.

This article has argued that the amount of transport-related energy and GHG emissions that is required to satisfy human needs in developed societies (i.e. the carbon intensity of need satisfiers) is high, has increased rapidly in the past few decades, and might continue to do so in the future. It has demonstrated that such increase is the emergent result of how needs (and wants) have been satisfied in the past. Finally, it has argued that when and where the circumstances conflate the satisfaction of human needs with extensive use of carbon-intensive transport modes (e.g. in very car dependent contexts), this gives rise to a difficult dilemma for justice.

However, the justice implications of the process described above have been overlooked by dominant approaches to research on transport inequalities, which are generally grounded in a relative deprivation understanding of poverty. My argument in this article is that they deserve more research and policy attention. From a research perspective, in the remainder of this section two possible directions are highlighted. From a policy perspective, the aim of this article is to contribute to *agenda setting*. Agenda-setting is the first stage of the 'policy cycle', when "a social problem (is) defined as such and (...) the necessity of state intervention (is) expressed" ([51], p. 45). While the importance of the further stages of the policy cycle (policy formulation and decision making, implementation, evaluation) is acknowledged, these are beyond the scope of this paper.

First, it is urgent to better *understand how the role of transport in need satisfaction changes over time* through structuration processes, all the while bringing to light their normative implications. The goal is not just to understand "how people collectively contribute, intentionally or unintentionally, by their activities to the respecification of what are normal, expected and necessary levels of mobility, and thereby to the locking-in of long-term unsustainable practices and to the successive escalation of mobility demands" ([37], p. 110), but also to draw out the justice implications of such developments for human need satisfaction, and for the trade-offs between social and environmental sustainability. This is in contrast with current sustainable transport policy, in which emerging social structures, such as the stretching of social networks over greater spaces, are ignored and considered 'taboo' ([41], p. 204).

Research efforts in this vein should of course adopt a *historical* perspective, investigating how need satisfaction reached such levels of transport- and carbon- intensity in developed countries. In energy research, there is increasing attention on how specific social practices have become more resource intensive over time (e.g. [89,90]), and on the justice implications of such trends [103].

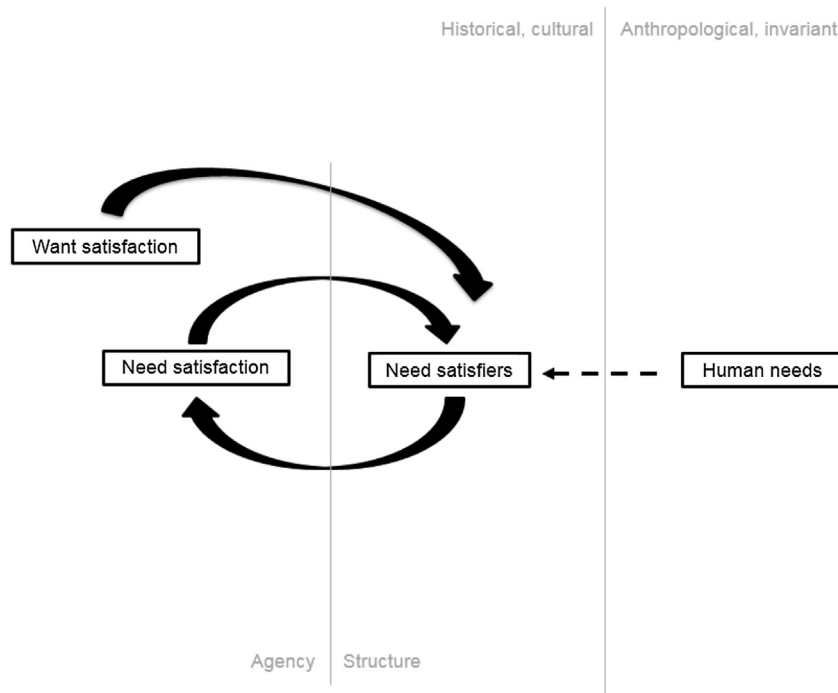


Fig. 1. Graphical representation of the integrated framework.

However, comparable studies in the field of transport research are still few and far between [79].

At the same time, it is also necessary to adopt a *future-oriented* perspective, investigating “how structuration processes can be transformed in more sustainable directions” ([37], p. 106). The challenge here is not just “one of imagining and realising versions of normal life that fit within the envelop of sustainability” [91], p. 1), but also one of making sure that such ways of living ensure the satisfaction of universal human needs at an optimal level. It is crucial here that the need satisfiers that predominate in a given society are not reified, as it is often the case in research inspired by the relative deprivation approach. They should rather be “understood as products which are the result of historical factors and, consequently, liable to change” ([69], p. 202). Human needs theory, with its nuanced understanding of the dialectic between the universality of human needs and the relativity of satisfiers, provides a welcome antidote to this tendency. It must be noted however that, in the short-term, bringing about change is easier for lower-order elements in chains of need satisfiers. Modifying higher-order need satisfiers, such as customary activities and socio-spatial structures, is only possible in the longer term.

Also, such future-oriented thinking should not just adopt a *curative* perspective, but also, and perhaps more importantly, a *preventive* one. Once the satisfaction of human needs becomes conflated with extensive use of carbon-intensive transport modes, a Pandora’s box of justice dilemmas is opened, and the chances of reconciling social and climate justice are greatly diminished. Therefore, it is of the utmost importance to adopt a preventive approach, identifying well in advance structuration processes that might give rise to environmentally damaging forms of need satisfaction, and imagining policies that might prevent this from happening. An obvious example of such a nascent process is the rise of long distance and air travel and the related development of social networks at the global scale (Section 3.2.2).

Second, *there is a need for a greater research attention to ‘excess travel’*, i.e. carbon-intensive travel patterns that do *not* arise from need-satisfaction. As Gössling and Cohen [41] observe, the fact that “a large share of transport is unrelated to specific transport needs”

is a currently a major taboo in transport policy, where “there is a general notion that all transport is necessary” (p. 201). However, the normative priority of needs over wants would dictate that energy consumption for wants be curtailed first, as this would not result in serious harm. In fact, curtailing excess mobility might be the only way of achieving emission reductions while allowing for increases in travel demand among the transport disadvantaged. This is close to the ‘social welfare’ approach to transport advocated by Lucas [57], where (car) travel is redistributed from privileged to disadvantaged households.

A second reason for investigating what Chatterton et al. [12] call ‘energy decadence’ relates to the preventive approach advocated above. Carbon intensive practices related to want-satisfaction among privileged sectors of the population might push the envelope of what is considered normal, triggering structuration processes that increase the travel- and carbon-intensity of need satisfaction for all. This is the process whereby luxury goods turn into necessities ([21], p. 1081), and practices once regarded as ‘excess’ turn into customs [50].

While there are good reasons for limiting excess travel, this does not mean that it is a simple and straightforward task. As Doyal and Gough warn, “in all societies (...) those with power and privilege usually fight tenaciously to defend the high levels at which they satisfy both their needs and wants, irrespective of the damaging consequences on others” ([20], p. 101) and “the extent to which it will be morally acceptable to reduce their autonomy through forcing them to do so in the name of the rights of the poor” (p. 118) is an open question. The question remains open today, and it has become even more pressing in light of climate change concerns.

To conclude, this article has made the case for greater consideration of a human needs-based approach in research on transport justice. While this approach has been touched upon in the transport literature before (e.g. [65]), there have been few elaborate discussions to date. In concluding this article, some possible limitations of this approach must be acknowledged. As Martens [65] (p. 1047) notes, in practice translating basic needs into travel needs, and distinguishing needs from wants can be very challenging. Since the circumstances that make a trip essential for need satisfaction are

often highly individualised and context-specific, any policy aiming to assess these circumstances may be construed as paternalistic, intrusive and contrary to notions of personal freedom and privacy. On the other hand, as Mullen and Marsden [74] argue, reconciling the different aspects of mobility justice requires a consideration of which types of activities should be given priority, and which should not be provided for. This highlights a tension between liberal notions of unrestricted personal freedom in the transport sphere and energy and climate justice concerns. While there is an important debate to be had about to what extent these can be reconciled, this is clearly beyond the scope of this article.

Acknowledgements

The author would like to thank Elizabeth Shove, Neil Simcock, Caroline Mullen and three anonymous reviewers for their helpful comments on previous versions of this work. This research was funded by the Engineering and Physical Sciences Research Council (grant numbers EP/K011723/1 and EP/M008096/1) as part of the RCUK Energy Programme, and by EDF as part of the R&D ECLEER Programme.

References

- [1] J. Anable, C. Brand, M. Tran, N. Eyre, Modelling transport energy demand: a socio-technical approach, *Energy Policy* 41 (2012) 125–138.
- [2] E. Beyazit, Evaluating social justice in transport: lessons to be learned from the capability approach, *Transp. Rev.* 31 (2011) 117–134.
- [3] E. Blumenberg, M. Manville, Beyond the spatial mismatch: welfare recipients and transport policy, *J. Plann. Lit.* 19 (2004) 182–205.
- [4] R. Bolton, T.J. Foxon, Governing infrastructure networks for a low carbon economy: co-evolution of technologies and institutions in UK electricity distribution networks, *Competition Regul. Netw. Ind.* 12 (1) (2011) 2–26.
- [5] A. Bows-Larkin, All adrift: aviation, shipping, and climate change policy, *Clim. Policy* 15 (6) (2014) 681–702.
- [6] C. Brand, J.M. Preston, ‘60–20 emission’—the unequal distribution of greenhouse gas emissions from personal: non-business travel in the UK, *Transp. Policy* 17 (2010) 9–19.
- [7] M. Breheny, The compact city and transport energy consumption, *Trans. Inst. Br. Geographers* 20 (1) (1995) 81–101.
- [8] M. Büchs, S.V. Schnepf, Who emits most? Associations between socio-economic factors and UK households’ home energy, transport, indirect and total CO₂ emissions, *Ecol. Econ.* 90 (2013) 114–123.
- [9] S. Cairns, C. Newton, Predict and Decide. Aviation, Climate Change and UK Policy, Environmental Change Institute, 2006.
- [10] Campaign for Better Transport, Buses in Crisis. A Report on Bus Funding Across England and Wales 2010–2015. Campaign for Better Transport, 2015.
- [11] N. Cass, E. Shove, J. Urry, Changing Infrastructures, Measuring Socio-spatial Inclusion/exclusion. Final Report, Department of Sociology, Lancaster University, 2003.
- [12] T. Chatterton, J. Barnes, G. Yeboah, J. Anable, Energy Justice. A spatial analysis of variations in household direct energy consumption in the UK, European Council for an Energy Efficient Economy (ECEEE) 2015 Summer Study on Energy Efficiency (2015).
- [13] G. Currie (Ed.), *New Perspectives and Methods in Transport and Social Exclusion Research*, Emerald, Bingley, 2011.
- [14] A. Davis, D. Hirsch, M. Padley, A Minimum Income Standard for the UK in 2014, Joseph Rowntree Foundation, 2014.
- [15] A. Davis, D. Hirsch, N. Smith, J. Beckhelling, M. Padley, A Minimum Income Standard for the UK in 2012. Keeping Up in Hard Times, Joseph Rowntree Foundation, 2012.
- [16] K. Dennis, J. Urry, *After the Car*, Polity Press, Cambridge, 2009.
- [17] G. Dubois, P. Peeters, J.-P. Ceron, S. Gössling, The future mobility of the world population: emission growth versus climate policy, *Transp. Res. Part A* 45 (2011) 1031–1042.
- [18] DfT, Passenger Transport by mode, since 1952, in: *Transport Statistics Great Britain: 2014*, DfT, 2014 (retrieved 06.09.15) <https://www.gov.uk/government/statistical-data-sets/tsgb01-modal-comparisons#table-TSGB0101>.
- [19] L. Dobbs, Wedded to the car: women: employment and the importance of private transport, *Transp. Policy* 12 (2005) 266–278.
- [20] L. Doyal, I. Gough, *A Theory of Human Need*, Palgrave MacMillan, New York, 1991.
- [21] A. Druckman, T. Jackson, The bare necessities: how much household carbon do we really need? *Ecol. Econ.* 69 (2010) 1794–1804.
- [22] A. Druckman, D. Hirsch, K. Perren, J. Beckhelling, Sustainable income standards: possibilities for greener minimum consumption, in: *RESOLVE Working Paper*, University of Surrey, 2011, pp. 11–14.
- [23] G. Dupuy, From the magic circle to automobile dependence: measurements and political implications, *Transp. Policy* 6 (1999) 1–17.
- [24] Eurostat, Greenhouse Gas Emissions, Eurostat Database, 2015 (retrieved 09.06.15) http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_air_gge&lang=en.
- [25] E. Fahmy, J. Thumim, V. White, The Distribution of UK Household CO₂ Emissions: Interim Report, Joseph Rowntree Foundation, York, 2011.
- [26] J. Farrington, C. Farrington, Rural accessibility, social inclusion and social justice: towards conceptualisation, *J. Transp. Geogr.* 13 (2005) 1–12.
- [27] É. Faugier, Prendre le volant, prendre le pouvoir? La longue route du peuple vers l’égalité de la mobilité: l’exemple du département du Rhône (1890–1960), in: M. Flonneau, L. Laborie, A. Passalacqua (Eds.), *Les transports de la démocratie. Approche historique des enjeux politiques de la mobilité*, Presses Universitaires de Rennes, Rennes, 2014, pp. 131–148.
- [28] Fishedick, et al., Industry, in: Edenhofer (Ed.), *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, 2014.
- [29] M. Flonneau, City infrastructures and city dwellers: accommodating the automobile in twentieth-century Paris, *J. Transp. Hist.* 27 (1) (2006) 93–114.
- [30] S. Fol, G. Dupuy, O. Coutard, Transport policy and the car divide in the UK, the US and France: beyond the environmental debate, *Int. J. Urban Reg. Res.* 31 (4) (2007) 802–818.
- [31] L. Frändberg, International mobility biographies: a means to capture the institutionalisation of long-distance travel? *Curr. Issues Tourism* 9 (4–5) (2006) 320–334.
- [32] L. Frändberg, Paths in transnational time-space: representing mobility biographies of Young Swedes, *Geografiska Annaler* 90 (1) (2008) 17–28.
- [33] L. Frändberg, How normal is travelling abroad? Differences in transnational mobility between groups of young Swedes, *Environ. Plann. A* 41 (2009) 649–667.
- [34] L. Frändberg, Activities and activity patterns involving travel abroad while growing up: the case of young Swedes, *Tourism Geogr.* 12 (1) (2010) 100–117.
- [35] L. Frändberg, Temporary transnational youth migration and its mobility links, *Mobilities* 9 (1) (2014) 146–164.
- [36] L. Frändberg, B. Vilhelmson, Personal mobility: a corporeal dimension of transnationalisation, *Environ. Plann. A* 35 (2003) 1751–1768.
- [37] L. Frändberg, B. Vilhelmson, Structuring sustainable mobility: a critical issue for geography, *Geogr. Compass* 4 (2) (2010) 106–117.
- [38] S.M. Gardiner, A perfect moral storm: climate change, intergenerational ethics and the problem of moral corruption, *Environ. Values* 15 (3) (2006) 397–413.
- [39] F. Geels, R. Kemp, G. Dudley, G. Lyons, *Automobility in Transition? A Socio-technical Analysis of Sustainable Transport*, Routledge, Abingdon, 2011.
- [40] A. Giddens, *The Constitution of Society*, University of California Press, Los Angeles, 1984.
- [41] S. Gössling, S. Cohen, Why sustainable transport will fail: EU climate policy in the light of transport taboos, *J. Transp. Geogr.* 39 (2014) 197–207.
- [42] S. Gössling, P. Peeters, Assessing tourism’s global environmental impact 1900–2050, *J. Sustain. Tourism* 23 (5) (2015) 639–659.
- [43] S. Gössling, D. Scott, C.M. Hall, Challenges of tourism in a low-carbon economy, *WIREs Clim. Change* 4 (2013) 525–538.
- [44] S. Gössling, P. Upham (Eds.), *Climate Change and Aviation*, Earthscan, London, 2009.
- [45] I. Gough, Climate change and sustainable welfare: the centrality of human needs, *Camb. J. Econ.* 39 (2015) 1191–1214.
- [46] D. Gray, J. Farrington, J. Shaw, S. Martin, D. Roberts, Car dependence in rural Scotland: transport policy, devolution and the impact of the fuel duty escalator, *J. Rural Stud.* 17 (1) (2001) 113–125.
- [47] M.C. Gutiérrez, The concept of weak sustainability, *Ecol. Econ.* 17 (3) (1996) 147–156.
- [48] B. Huby, N. Burkitt, Is the new deal for transport really better for everyone? The social policy implications of the UK 1998 White Paper on transport, *Environ. Plann. C* 18 (2000) 379–392.
- [49] I. Illich, *Energy and Equity*, Calder & Boyars, London, 1974.
- [50] T. Jackson, E. Papathanasopoulou, Luxury or ‘lock-in’? An exploration of unsustainable consumption in the UK: 1968–2000, *Ecol. Econ.* 68 (1) (2008) 80–95.
- [51] W. Jann, K. Wegrich, Theories of the policy cycle, in: F. Fischer, G.J. Miller, M.S. Sidney (Eds.), *Handbook of Public Policy Analysis*, CRC Press, Boca Raton (FL), 2006.
- [52] C. Knoeri, J.K. Steinberger, K. Roelich, End-user centred infrastructure operation: towards integrated end-use service delivery, *J. Clean. Prod.* (2015).
- [53] M. Kowald, K.W. Axhausen, *Social Networks and Travel Behaviour*, Ashgate, Farnham, 2015.
- [54] T. Kuhnimhof, D. Zumkeller, B. Chlond, Who made peak car, and how? A breakdown of trends over four decades in four countries, *Transp. Rev.* 33 (3) (2013) 325–342.
- [55] D. Levinson, Equity effects of road pricing: a review, *Transp. Rev.* (2010) 33–57.
- [56] R. Levitas, The concept and measurement of social exclusion, in: C. Pantazis, C. Gordon, R. Levitas (Eds.), *Poverty and Social Exclusion in Britain*, The Policy Press, Bristol, 2006.

- [57] K. Lucas (Ed.), *Running on Empty. Transport, Social Exclusion and Environmental Justice*, Policy Press, Bristol, 2004.
- [58] K. Lucas, Transport and social exclusion: where are we now? *Transp. Policy* 20 (2012) 105–113.
- [59] K. Lucas, G. Currie, Developing socially inclusive transport policy: transferring the United Kingdom policy approach to the State of Victoria, *Transportation* 39 (2012) 151–173.
- [60] K. Lucas, K. Pangbourne, Assessing the equity of carbon mitigation policies for transport in Scotland, *Case Stud. Transp. Policy* 2 (2) (2014) 70–80.
- [61] K. Lucas, T. Grosvenor, R. Simpson, *Transport, the Environment and Social Exclusion*, Joseph Rowntree Foundation, 2001.
- [62] K. Lucas, B. van Wee, K. Maat, A method to evaluate equitable accessibility: combining ethical theories and accessibility-based approaches, *Transportation* (2015).
- [63] J. Mack, S. Lansley, S. Nandy, C. Pantazis, Attitudes to necessities in the PSE survey: are minimum standards becoming less generous? *PSE Work. Paper* (2012) (Analysis series No. 4).
- [64] K. Martens, Basing transport planning on principles of social justice, *Berkeley Plann. J.* 19 (2006) 1–17.
- [65] K. Martens, Justice in transport as justice in accessibility: applying Walzer's 'Spheres of Justice' to the transport sector, *Transportation* 39 (6) (2012) 1035–1053.
- [66] G. Mattioli, Car dependence, sustainability and the transport policy stalemate: the potential trade-offs between intra- and inter-generational equity, *Int. J. Sustain. Policy Practice* 8 (1) (2013) 45–57.
- [67] G. Mattioli, Where sustainable transport and social exclusion meet: households without cars and car dependence in Great Britain, *J. Environ. Policy Plann.* 16 (3) (2014) 379–400.
- [68] G. Mattioli, M. Colleoni, Transport disadvantage, car dependence and urban form, in: P. Pucci, M. Colleoni (Eds.), *Understanding Mobilities for Designing Contemporary Cities*, Springer, Heidelberg, 2016.
- [69] M. Max-Neef, A. Elizalde, M. Hopenhayn, Development and human needs, in: P. Ekins, M. Max-Neef (Eds.), *Real-life Economics: Understanding Wealth Creation*, Routledge, London, New York, 1992, pp. 197–213.
- [70] D. Metz, Saturation of demand for daily travel, *Transp. Rev.* 30 (5) (2010) 659–674.
- [71] E. Moe, Energy, industry and politics: energy, vested interests, and long-term economic growth and development, *Energy* 35 (4) (2010) 1730–1740.
- [72] Mo. Ve Association, *Car Dependence Within City Regions*, Mo.Ve Association, Venice, 2008.
- [73] C. Mullen, M. Tight, A. Whiteing, A. Jopson, Knowing their place on the roads: what would equality mean for walking and cycling? *Transp. Res. Part A* 61 (2014) 238–248.
- [74] C. Mullen, G. Marsden, Mobility justice in low carbon energy transitions, *Energy Res. Soc. Sci.* (2016) (in press).
- [75] P. Newman, J. Kenworthy, *Sustainability and Cities: Overcoming Automobile Dependence*, Island Press, Washington, DC, 1999.
- [76] Oxfam, *Extreme Carbon Inequality. Why the Paris Climate Deal Must be the Poorest, Lowest Emitting and Most Vulnerable People First*, Oxfam International, 2015 (retrieved 09.03.16) https://www.oxfam.org/sites/www.oxfam.org/files/file_attachments/mb-extreme-carbon-inequality-021215-en.pdf.
- [77] P. Peeters, J. Higham, D. Kutzner, S. Cohen, S. Gössling, Are technology myths stalling aviation climate policy? *Transp. Res. Part D* 44 (2016) 30–42.
- [78] G. Pflieger, S. Fol, C. Benit-Gbaffou, Social accessibility, environmental justice and metropolitan coherence: what is the role of public transport? 11th World Conference on Transport Research (2007).
- [79] C.G. Pooley, Balancing social justice and environmental justice: mobility inequalities in Britain since circa 1900, in: C. Divall, J. Hine, C. Pooley (Eds.), *Transport Policy: Learning Lessons from History*, Ashgate, Farnham, 2016.
- [80] C.G. Pooley, J. Turnbull, Coping with congestion: responses to urban traffic problems in British cities c: 1920–1960, *J. Hist. Geogr.* 31 (2005) 78–93.
- [81] F. Rajé, The impact of transport on social exclusion processes with specific emphasis on road user charging, *Transp. Policy* 10 (2003) 321–338.
- [82] G. Ritzer, *Sociological Theory*, eighth edition, McGraw-Hill, New York, 2010.
- [83] K. Roelich, C. Knoeri, J.K. Steinberger, L. Varga, P.T. Blythe, D. Butler, P. Purnell, Towards resource-efficient and service-oriented integrated infrastructure operation, *Technol. Forecasting Social Change* 92 (2015) 40–52.
- [84] A. Schäfer, J.B. Heywood, H.D. Jacoby, I.A. Waitz, *Transportation in a Climate-constrained World*, The MIT Press, Cambridge, Massachusetts, 2009.
- [85] A.W. Schäfer, I.A. Waitz, Air transportation and the environment, *Transp. Policy* 34 (2014) 1–4.
- [86] D. Scott, S. Gössling, What could the next 40 years hold for global tourism? *Tourism Recreat. Res.* 40 (3) (2015) 269–285.
- [87] D. Scott, C.M. Hall, S. Gössling, A review of the IPCC Fifth Assessment and implications for tourism sector climate resilience and decarbonization, *J. Sustain. Tourism* 24 (1) (2016) 8–30.
- [88] SEU, *Making the Connections: Final Report on Transport and Social Exclusion*, Office of the Deputy Prime Minister, London, 2003.
- [89] E. Shove, *Comfort, Cleanliness and Convenience: The Social Organization of Normality*, Berg., Oxford, 2003.
- [90] E. Shove, M. Pantzar, M. Watson, *The Dynamics of Social Practice: Everyday Life and How It Changes*, Sage, London, 2012.
- [91] E. Shove, N. Spurling, Sustainable practices. Social theory and climate change, in: E. Shove, N. Spurling (Eds.), *Sustainable Practices. Social Theory and Climate Change*, Routledge, Abingdon, 2013, pp. 1–13.
- [92] Sims, et al., Transport, in: Edenhofer (Ed.), *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, 2014.
- [93] N. Smith, D. Hirsch, A. Davis, Accessibility and capability: the minimum transport needs and costs of rural households, *J. Transp. Geogr.* (2012) 93–101.
- [94] J.K. Steinberger, J.T. Roberts, From constraint to sufficiency: the decoupling of energy and carbon from human needs 1975–2005, *Ecol. Econ.* 70 (2010) 425–433.
- [95] Sustainable Development Commission, *Fairness in a Car Dependent Society*, Sustainable Development Commission, 2011.
- [96] E. Thomas, I. Serwicka, P. Swinney, *Urban Demographics. Where People Live and Work*, Centre for Cities, 2015.
- [97] P. Townsend, *Poverty in the United Kingdom*, Penguin, Harmondsworth, 1979.
- [98] UNFCCC, *Adoption of the Paris agreement—Proposal by the President—Draft decision—/CP.21, United Nations Framework Convention on Climate Change, Paris, 2015 (retrieved on 8.03.16) <http://www.webcitation.org/6djDMHZAT>*.
- [99] G.C. Unruh, Understanding carbon lock-in, *Energy Policy* 28 (12) (2000) 817–830.
- [100] B. van Wee, Transport and ethics, in: *Ethics and the Evaluation of Transport Policies and Projects*, Edward Elgar, Cheltenham, 2011.
- [101] S. Vanderheiden, *Atmospheric justice*, in: *A Political Theory of Climate Change*, Oxford University Press, New York, 2008.
- [102] G. Walker, Environmental justice, in: *Concepts, Evidence and Politics*, Routledge, Abingdon, Oxon, 2012.
- [103] G. Walker, N. Simcock, R. Day, Necessary energy uses and a minimum standard of living in the United Kingdom: energy justice or escalating expectations? *Energy Res. Soc. Sci.* (2016).
- [104] J. Walker, Purpose-driven public transport: creating a clear conversation about public transport goals, *J. Transp. Geogr.* 16 (2008) 436–442.
- [105] S. Whitmee, A. Haines, C. Beyrer, F. Boltz, A.G. Capon, B.F. de Souza Dias, R. Horton, Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health, *Lancet* 386 (10007) (2015) 1973–2028.
- [106] J. Wolff, *Ethics and Public Policy: A Philosophical Inquiry*, Routledge, Abingdon, 2011.