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Socio-technical transition governance and public opinion: the case of passenger transport in Finland

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Abstract

As a governance perspective, transition management views the engagement of a wide variety of stakeholders in policy development as a necessary element in furthering sustainability through enhanced social learning. Yet as a literature it has paid relatively little attention to public consultation on socio-technical change. Here we set transition management in the context of longstanding debates in science and technology studies, technology assessment and deliberative democracy. Empirically, we use national survey data on Finnish public opinion of state support for future transport options. Showing how transport practices and attitudes to transport innovation policy vary with both demography and geography, we argue that these differences have implications for policy legitimacy. We suggest that, both given and despite the practical difficulties of deliberative democracy, use of participative opinion surveying to better understand social groups with needs and interests that differ from national averages, may help to enhance policy legitimacy and hence the success of transition management.

Keywords

Low carbon transport; technology governance; transition management; innovation policy; legitimacy; digital democracy

1. Introduction

In the context of sustainability transitions research (Markard et al., 2012) urban mobility transitions have become a key focus (e.g. Banister et al, 2011; Geels, 2012), requiring novel policy approaches (e.g. Mäkinen et al., 2015). Yet relatively little attention has been paid to public opinion in informing these processes. While there is some work on the role of public attitudes and behaviour in relation to transition models (Whitmarsh, 2012) and also on the relationship between grassroots social movements and transitions (Seyfang et al, 2014; Martin and Upham, 2015), the purposeful and managed engagement of publics in socio-technical innovation has been relatively little considered within the transitions literature. This deficit includes those specific aspects that we contribute to here: a limited level of evidence on the nature of public opinion with regard to innovation options; a lack of discussion of how public consultation and engagement might be integrated with conceptions of the change processes posited in the transitions literature, as well as managed practically; and a lack of discussion of how public opinion differences (heterogeneity) might hinder or further transition-related policy-making, including with regard to perceived policy legitimacy. Here consultation is treated as a specific form of engagement – one in which the purpose is to elicit opinion for the purpose of informing policy. Not all engagement is consultative.

Transition management is intended as a socially inclusive and participative response to the view that neither central planning by governments, nor market forces, are sufficient to bring about the types of change that complex, persistent and interconnected social, economic and environmental problems require (Kemp et al., 2007; Loorbach, 2009). It is conceived of as a form of multi-level

governance in which state and non-state actors are brought together to co-produce policies, with the aim of co-ordinating science, innovation and sectoral policy (Kemp et al., 2007). While transition management offers analytic concepts and descriptive characterisation of socio-technical change processes, the approach is also prescriptive, offering designs for sustainability governance (Loorbach, 2010). It departs from (and extends) the innovation studies literature by its explicitly normative stance, adopting sustainability as an explicit objective. The approach is conceptually rooted in innovation studies (Geels and Schot, 2007) and hence provides a correspondingly appropriate perspective with which to examine public opinion of innovation policy.

Despite the emphasis on network building and stakeholder participation in the transition management literature, relatively little has been said on the role of policy legitimacy within transition management processes, particularly with respect to public opinion and its diversity; nor has much been said of this in relation to the distributional consequences of transition management policies for different social groups. Here we discuss some of the issues involved, using public opinion survey results relating to low carbon transport innovation. We take one country, Finland, but the general issues are widely applicable.

Although transition management is a relatively recent development in research, discussions of public participation in policy development are longstanding. Science and technology studies (STS) theorists have argued for more authentic public participation in technological innovation, as a means of enhancing the legitimacy of innovation processes, for several decades (e.g. Wynne 1973; Sclove, 1995). Similarly, participation has long been on the agenda of urban and planning studies, including transportation planning (Wellman, 1978). Participation has been discussed in all senses of the public, from individuals through to civil society and in a variety of settings, from technology design through to use (Nahuis and van Lente, 2010). The question of how to meaningfully engage publics in processes of both scientific and technological innovation remains a live one (Mulgan, 2015) that is all too often treated as unproblematic (Macnaghten and Chilvers, 2014), with science engagement practice often appearing unaware of the relationship of engagement to debates of how democratic governance might respond to demands for participation that go beyond representation-based democracy (Hosch-Dayican, 2014).

Participation is closely connected to theories of policy legitimacy. Participation in policy processes and the demonstrable transparency of those processes are considered by legitimacy theorists to support perceived procedural legitimacy (Suchman, 1995), with legitimacy broadly defined as: “a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman’s, 1995: 574; Dendler, 2013). Procedural legitimacy thus relates to the process through which policy is derived, while the more general legitimacy of the State rests on the belief in its rightfulness and moral authority (Barker, 1990). Procedural legitimacy is relevant to a broad range of policy and practice, including research and innovation processes (Upham and Dendler, 2014). Technological legitimacy arguably also has connections with technology acceptance and the success with which new technologies are embedded within a society (Breukers and Upham, 2014).

Here we are concerned with the question of how to further policy legitimacy as part of transition management processes and more generally as part of innovation policy, with particular reference to differentiated public opinion. Other dimensions of legitimacy are also relevant here. These include legitimacy enhancement through policy serving the interests of the perceiver (Tost, 2011) and also through policy being effective, achieving intended and desirable outcomes (consequential legitimacy) (Suchman, 1995; Dendler, 2013). Hence the legitimacy of socio-technical transitions policy is theoretically enhanced where policy is (i) considered to be developed through due process, which often means with some degree of consultation; (ii) perceived as in some respect in one's interests; and (iii) as leading to outcomes that are perceived as effective and desirable generally. As we show, for a given policy, public views on the expression of particularly the latter two criteria may differ. This of course applies not only to transition management policies, but to any policy: rarely will there be full, societal-wide consensus on a given policy. Thus this aspect of transition management relates to broader debates of how demands for extra-institutional political participation may be accommodated by existing political decision-making structures (Hosch-Dayican, 2014) and how this may be furthered through the use of digital technologies, including for public consultation (Dahlberg, 2014).

Transitions models have been critiqued for a neglect of geography (e.g. Smith et al., 2010), which we show to be important in this context. Efforts at remedying this include those by Coenen et al (2012) and Raven et al (2012), who have emphasised the importance of both geographical proximity and networks in transition processes. Again, though, despite the limited work on introducing spatiality and a relational approach into transitions thinking, there appears little to no work in the transitions literature on the role of geographically-based differences in public opinion and their implications for the legitimacy and design of national policy.

Drawing the above together, our research questions concern: (i) the differentiated nature of public opinion on state support for low carbon, socio-technical innovation options in an exemplar sector: land-based passenger transport; and (ii) the theoretical and practical implications of such differences for transition management policy. In terms of the structure of the paper, in section 2 we provide further detail on transition management as a governance perspective. Given our focus on technological innovation, we set this in the context of long-standing debates on public engagement in the science and technology studies literature. We argue that there is a need to take account of public opinion in technological innovation for both normative (legitimacy) and instrumental (public acceptance) reasons. We suggest that opinion surveying has a potential role to play in these processes, particularly in revealing group differences that have a bearing on policy legitimacy. In section 3 we illustrate this capacity to reveal group differences empirically and in section 4 we discuss the value of opinion surveying alongside qualitative, discursive forms of engagement. We emphasise that all forms of public consultation and engagement have implications for social power relations and that, given existing patterns of these power relations, there is a need for those in transition management roles to be transparent regarding the degree of influence that publics may expect, as well as regarding their own roles.

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2. Theory

2.1 Transition management

As an approach to governance, transition management proposes and applies "an instrumental, practice-oriented model" to influence ongoing sustainability transitions through reflexive and evolutionary governance (Markard et al., 2012). The perspective is systems-based: it assumes that social, technological, economic and other phenomena and actors are connected more or less directly and therefore that interventions or pressures at one point in the system may induce or influence change elsewhere. The need for reflexivity that transition management emphasises is in part analytical, but also democratically normative: the networks that social, economic and governmental actors form and foster are not treated uncritically but are seen as potentially - even with transition management fora (Hendriks, 2008, 2009) - involving limited transparency and accountability (Loorbach, 2009). As an ideal at least, transition management is an attempt to increase the broader social legitimacy and effectiveness of new forms of governance by: (a) offering a structural perspective on system change that itself builds on a multi-level perspective of interconnected social and technological change (Rip and Kemp, 1998); and (b) proposing and testing new fora and methods of governance, particularly the bringing together of different actors and/or actor perspectives.

From a transition management perspective, change arises through the interaction of three types of activities (Kemp et al, 2007; Loorbach, 2007) and a fourth, cross-cutting activity:

1. Strategic level: processes of problem structuring, vision development, strategic discussions, long-term goal formulation, culture change etc.; this includes governance activities related to long-term changes, which are not institutionalised in regular political cycles and have a time horizon of 30-50 years;

2. Tactical level: processes of agenda building, negotiating, networking, coalition building, identification of 'barriers' etc.; this includes steering actions (planning and control, financial support and programmes) and institutions (rules, regulations, organisations, networks, routines, infrastructure) related to the dominant sociotechnical regime and transition paths, having a time horizon of 5-15 years;

3. Operational level: processes of experimenting and evaluating, project building, implementation of governance, and autonomous actions to achieve individual goals, etc.; this is the level at which radical innovations emerge, referring to activities with a time horizon of up to 5 years (though it may take much longer for an innovation to break out of the niche);

4. Reflexive level: this is distributed among the foregoing levels and concerns all forms of reflection by societies on their own activities, particularly analysis and debate by independent analysts and commentators.

Transition management aims to align these activities. Such management is conceived of as taking place in the context of three levels of socio-technical systems: the socio-technical *niche*, *regime* and *landscape*, forming a hierarchy that structures practices and conditions transitions (Geels, 2002). In

isolated niches, innovations gradually become more powerful; at the landscape level change pressures the socio-technical regime; and at the regime level destabilisation pressures enable niche-innovations to gain their own momentum. Niches can be 'protected spaces' such as R&D laboratories, subsidised demonstration projects, or small market niches; regimes are the dominant pattern of existing technologies, regulations, user patterns, infrastructures and cultural discourses; and the landscape is the wider context, including spatial structures (e.g. urban layouts), political ideologies, societal values, beliefs, concerns, the media landscape and macro-economic trends (Geels, 2012: 473).

Transition theorists also observe that transitions tend to depend on particular conditions. De Han and Rotmans (2011) conceive of these as: cultural and structural tensions; internal inconsistency (stress); and pressures from inside or outside of the regime. De Han and Rotmans (ibid) also speak of particular, sequential patterns or processes that transitions undergo, namely: *empowerment* of niche innovations from within the niche, such that innovations become strong enough to compete with the incumbent technologies or modes of organisation in the regime; *reconstellation* in the sense of the development of new connections of socio-technical actors and arrangements in the regime, in response to pressures conceived of as external to the regime; and *adaptation*, the accommodation of the regime to the innovation as the regime comes to a new, stable state. As socio-technical constellations build in strength, they become materially and cognitively installed and the form of the regime is viewed as changing to accommodate the now mainstreamed innovation.

2.2 Key issues in public engagement in innovation policy

While the above outlines some key concepts from transition theories, there are further considerations before one may begin to consider public consultation and engagement as part of transition management. To briefly rehearse some of these, we draw selectively on an STS categorisation by Delgado et al (2011). Firstly in terms of the *rationale* for engagement, in its most limited form, public involvement may simply take the form of consultation seeking policy legitimation. Much organised public engagement in scientific and technological development is not intended as consultation, but primarily as communication and inspiration, using affectively and intellectually appealing methods. Despite the limitations (though also importance) of this, in terms of transition management, effective one-way information provision still has a role to play in the process of *shared* vision development and in engendering support for particular visions (cf. Smith and Raven, 2012) and for new sustainability niches, not least through trust-building.

The second question of *who* (which publics or population segments) should participate in technology development is also in part a function of the purpose of the engagement. If strict public representation is an objective, then in a large scale context stratified polling (the systematic selection of respondents so as to provide a demographically representative sample) is required (Rowe and Frewer, 2000). More problematic, but again a feature of all engagement methods, are situations in which information on demographic relationships to the characteristics of interest is unavailable in advance of a survey. Here a broad scoping survey and/or qualitative work (interviews, focus groups, ethnography etc) may help to reveal characteristics of interest that can then be followed up with additional survey(s).

This brings us (thirdly) to the *mode of initiation* and conduct of engagement: in principle the terms of engagement, including topics and questions of interest, can be determined in partnership with the populations or constituencies concerned and alternative visions noted or explored. Such discussion will likely enhance the legitimacy of the results and outcomes through enhanced transparency of the process (Rowe and Frewer, 2000).

Fourthly, the *timing* of engagement (at what point in the development of a given process engagement takes place) will depend on the purpose, context and constraints of the situation. Parts of an affected population may prefer early and on-going input to a decision process, indeed maximum influence over that process, but this may or may not be politically and institutionally possible (or desirable, depending on one's view). In principle, early engagement gives more time to shape decision-making, which is particularly important in the case of technological innovation, but ultimately engagement at any stage only serves the ends of those engaged if those entitled to take implementing decisions choose this to be so.

Having rehearsed the above considerations, we can now bring these together with transition management thinking to make a number of further points. First, increased public engagement may or may not facilitate a given transition, not least because increased debate may complicate argument closure. The main instrumental rationale for early public engagement is that this allows an airing of dissent and objections that may then be managed or responded to with, for example, tailored messaging or minor modifications at one end of a spectrum, through to substantial changes at the other, reflecting different objectives in terms of power sharing (Arnstein, 1969). Instrumental benefit would come from the avoidance of wasted resources, while in terms of the normative rationale, the benefits would be in the form of enhanced procedural legitimacy. However in market economies, pure procedural legitimacy is not sufficient. Firms and investors need consistent signals to take the risks that major system transitions involve. From this perspective, public engagement needs to facilitate closure of debate, rather than prolonging it. As mentioned, participation beyond representative democracy also needs to be reconciled with the functioning of extant political structures. In general, in the context of low carbon energy transitions, therefore, there is a tension between social deliberation and the recognition of value plurality on the one hand and the need for rapid deployment of new technologies on the other. Notions of participative planning, be these locality-focussed or technology-focussed, reflect ethics and logics that are different from commercial logics and the demands of climate mitigation.

Secondly, different engagement or consultation methods (as well as their absence), may have different advantages and disadvantages in terms of democratic norms and quality of process, depending on intention and design. All forms of engagement and consultation can be said to express the reflexive and social learning themes of transition management, but they nonetheless clearly differ. Arguably qualitative engagement (e.g. through interviews or focus groups) should be used initially in an engagement or consultation process intended to reflect the upper end of Arnstein's (1969) ladder of participation, to elicit participatively derived and hence theoretically more legitimate problem frames. These could then be used as a basis for initial polling, with further qualitative work as appropriate, particularly if group differences are observed. The purpose of this process would also vary. If the context was one of power-sharing and negotiation, then models of co-

produced public policy (Parrado et al, 2013) and joint problem framing (Mauser et al, 2013) would be appropriate, expressing the reflexive and social learning dimensions of transition management. The above complications would then apply, however.

Having outlined the rationales for public engagement in transition management and how this might take place, as well as some of the associated issues and difficulties, we now provide an example of differentiated public opinion on low carbon innovation policy options in the case of land-based passenger transport. While this work is experimental rather than part of a live policy process, the empirics nonetheless illustrate the types of opinion difference that may arise in a transition management process that seeks to take account of public opinion. As stated, we particularly focus on demographic differences, as these provide a basis for discussing policy legitimacy in the case of differing consequences and interests.

3. Materials and methods

The research design is exploratory and inductive: the aim is to explore sociotechnical transitions governance in relation to public consultation and engagement, empirically seeking to examine how publics in three different work-to-travel areas view state support for various policy options for advancing low-carbon mobility transition in personal transport. The purposes of the survey (of which the research questions are corollaries) were: (1) to reveal public opinion on transport innovation and innovation policy options, particularly state support for these; (2) to identify the nature of any associated opinion differences within the population; (3) to provide an empirical basis for discussion of public engagement in transition management processes. Although related previous work was taken into account when selecting data categories (e.g. demographic differences), the work is undertaken primarily in a reflexive, theory-building mode rather than for hypothesis-testing, with the exception of geographic-related differences, as elaborated on below.

3.1 Survey design

The survey data comes from the FIPTrans project on low carbon, system level transitions for transport (Temmes et al, 2014). Public opinion was elicited with an online survey instrument designed to take 20-30 minutes to complete and administered by a market research firm to 1,000 people in contrasting travel to work areas (TTWAs). In each TTWA, demographic representation was sought in terms of gender, age and social class. The TTWAs are the Helsinki, Tampere and Oulu regions of Finland, selected to represent, respectively, a capital city with an extensive public transport system including metro, trams and buses; a regional city with a bus system; and a smaller, more peripherally- and rurally-located city with a bus system. The locations were assumed to have patterns of transport use that differ according to their differing public transport infrastructure availability, with also the possibility of different perceptions on innovation priorities that reflect different economic interests and outlook generally. In particular, we hypothesised that views in Oulu would differ from those in Helsinki and Tampere, which indeed they do for many questions.

3.2 Question selection and development

The formulation of the questions was informed by the most relevant UK national surveys (Natcen, 2011; Yougov (2013), enabling us to take advantage of previous surveys on the same topic. Through an iterative process, the final set of questions was selected and designed to focus specifically on Finnish transport innovation options, with variants also specific to the Finnish climate (notably a distinction between winter and non-winter in questions on transport practice), on the basis of previous work on the project <references removed for review>.

Question selection and development was also undertaken so as to represent a range of technological, behavioural and legislative options, as referred to in previous transitions work on transport (Geels, 2012) and previous work on 'sustainable' transport policy options (Banister, 2008). In particular, we wanted to ensure inclusion of both 'soft' and 'hard' options – those that involve social and institutional innovation as well as those in which the innovation is primarily technological. Existing Finnish opinion surveys were also taken into account to avoid duplication and to provide additional context, notably an online public and stakeholder survey conducted by the Ministry of Transport and Communications, which returned locally and nationally-specific context, and the results for Finland of a 2010 Flash Eurobarometer poll on the future of transport (EC, 2011).

The vehicle technology selection in the questionnaire is informed by several sources: a report for the UK Low Carbon Vehicle Partnership (LCVP) (PE International, 2013) regarding plausible vehicle types through to 2030; McKinsey (2009) on the relative global potential of a number of options and which makes the point that fuel efficiency measures would make up the majority of the CO_2 abatement potential globally and regionally through to 2030, but which also emphasizes biofuels, traffic flow improvement and driving style; VTT's (2012) Low Carbon Finland 2050 scenarios, which makes the fundamental observation that "land use and structure of the community has the closest correlation with the amount of passenger transport needed" (p.28); a stakeholder-supported report on the positive employment implications of low carbon technology innovation in passenger transport (European Climate Foundation, 2013); and the VTPI (2010) online transport demand management encyclopedia. When selecting policy-technology options for the questionnaire we are also aware of the strong pressures to maintain the private car with incremental modifications: the automobility regime remains strong, despite some 'cracks' (Geels, 2012: 479). In other words, in scoping the technological innovation and policy options, we have not excluded the private car.

Finally, we include questions on transport practice and environmental attitudes in recognition of the way in which "transport and travel choices are rooted in the structure of activities undertaken by individuals and families" and "attitudes to transport must also be rooted in deeper values and aspirations of how people want to lead their lives" (Goodwin and Lyons, 2010, p.16): attitudes to transport and associated innovation policy are considered as situated in ways of life and practice, not as discrete phenomena.

4. Selected survey results

In this section, results are selected to support discussion of public engagement in transition management. The results selection emphasises opinion differences and their related demographic

and geographical correlates, the purpose being to illustrate how such differences have the potential to influence the perceived legitimacy of specific policies among the public. In each Travel to Work Area, demographic representation was sought in terms of gender, age and social class. In fact, as is common with panel surveys, the sample is significantly older, contains more retirees, fewer students and is better educated than the census population ($p<0.05$). While this has been corrected with weighting factors, if the objective of public engagement in transition management is to understand and take account of the range of views, then there is a strong case for making particular efforts to reach groups who tend to ignore consultation or engagement efforts, or who find it difficult to respond.

4.1 Geographic differences

A key premise of the survey design is that dependence on differing transport modes and a wider variety of differences between the locations may affect attitudes to innovation policy options in ways that are difficult to anticipate. As stated, we therefore selected potentially contrasting travel to work areas, with potential for large samples of contrasting travel type. Helsinki is southerly located, a relatively cosmopolitan capital city with a bus, tram and metro network and a milder climate than northern Finland; Tampere is a regional city 90 minutes north of Helsinki by train; while Oulu is further north, smaller again and climatically sub-arctic.

The findings on regional differences in views on biofuels (Table 1) may in part be explained by the size of the cities and their economic base. Thus, Oulu has a less well-developed public transport system, explaining greater reliance on cars and bicycles than Helsinki, with Tampere in between. Road traffic congestion in Finland is generally not a major issue but is visible in the Helsinki region. Oulu has traditionally had a significant forest-based industry which is likely to contribute to the positive opinions on forest fuels and the sustainability of forests.

Table 1 Patterns of region-related difference

Question	Geographic difference across TTWAs
4 Frequency of transport mode use (winter/non-winter)	Significant difference for all but winter walking Car use: Oulu>Tampere>Helsinki Cycling Oulu>Tampere>Helsinki
6b How serious a problem is traffic congestion in towns and cities in your opinion?	Helsinki perceives congestion more and differs at $p<0.001$ for comparison with Tampere and $p<0.047$ for Helsinki compared to the Oulu region
11a Finland should prioritise biofuel research above other transport technology options, such as electric vehicles	Oulu region agree more strongly, significant difference at $p<0.003$
11b I trust forests are used sustainably for biofuel production in Finland	Regional differences at $p<0.001$ Higher uncertainty and scepticism in Helsinki region; greater trust in Oulu
11c More of national timber should be used to produce biofuels in Finland	Stronger agreement in Oulu than Tampere or Helsinki ($p<0.001$)
11e Mainly just forest wastes	Barely significant regional difference at $p<0.044$, with most

(bark and trimmings) should be used to produce biofuels in Finland	people agreeing with the proposition

4.2 Gender differences

Gender differences have implications for public support for policy and this is particularly the case in transport, where differing social roles based on gender and/or care-taking, both historic and contemporary, may lead to gender differentiation in transport use. Here Kruskal-Wallis tests show significant gender differences for responses to several questions (Table 2, all differences significant, $p<0.003$).

Table 2 Patterns of gender-related difference

Question	Gender differences
3c Access to and ownership of vehicles	More men own a car; men less likely to say that their family owns a car; men more likely to own a bike
4 Use of transport modes	Men use a car more frequently in winter and non-winter; men use public transport less; men use bicycles more in both seasons; fewer men walk, both seasons
5 Climate change perceptions	Men are more climate-sceptic
6a Current level of car use has a serious effect on climate change	Fewer men strongly agree that car use has a serious effect on climate change
6b How serious a problem is traffic congestion in towns and cities in your opinion?	Fewer men strongly agree that traffic congestion is a very serious problem
11a Finland should prioritise biofuel research above other transport technology options, such as electric vehicles	More men strongly agree that Finland should prioritise biofuel research; more women unsure
11b I trust forests are used sustainably for biofuel production in Finland	More men strongly agree and substantially more women 'don't know' (the latter is replicated across several questions, including: additional use of the national timber stock for biofuels, timber importation for biofuels, use of forest waste for biofuels and prioritisation of electric vehicles.

4.3 Age-related differences

Many of the responses have age associations and differences for both practices and attitudes, summarised in Table 3. Age has associations with practices partly as a result of transport regulations (access to a driving licence is age-limited) and also in relation to income (itself partly differentiated by age). The underlying reasons for the attitudinal differences in Table 2 are less obvious than the practice-related differences and merit qualitative follow-up.

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Table 3 Patterns of age-related difference

Question	Age group differences
4c Frequency of bicycle use in winter	15-24 year olds cycle more frequently (p<0.001)
4c Frequency of cycling at other times of year	75+ year olds cycle more than 55-74; median frequency the same as 35-54
4d Walking frequency	15-24 year olds walk more frequently (p<0.001)
5 Perceptions of climate change	15-54 groups significantly more varied than 55+ (p<0.018)
6a Current level of car use has a serious effect on climate change	More 15-34 year olds agree (p<0.022)
6b How serious a problem is traffic congestion in towns and cities in your opinion?	15-24 year olds more likely to think this a serious problem
7 Changes in travel habits	25-34 more likely to use public transport more than 2-3 years ago (p<0.002)
11a Finland should prioritise biofuel research above other transport technology options, such as electric vehicles	15-24 year olds most averse and most unsure (p<0.039). Only 75+ year olds have a positive median.
11b I trust forests are used sustainably for biofuel production in Finland	Opinion shift from negative to positive with increasing age (p<0.001)
11c More of national timber should be used to produce biofuels in Finland	Opinion shift from negative to positive with increasing age (p<0.010)

4.4 Income-related differences

There are significant, income-based differences for transport practice and to a lesser extent for a number of attitude questions (Table 4). The practice differences are to be expected and we suggest have implications for the legitimacy of particular policy investments, with different social groups directly benefiting (or not benefiting) from particular policies. Where age is a plausible co-correlated factor (Qu3c and 4a-d), partial correlation tests controlling for age show that significant income correlations remain (p<0.001).

Table 4 Patterns of income-related difference

Question	Income differences
3c Vehicle ownership	Income-based difference for 'I own a car', 'my family has a car' and 'I have permanent right to use of a car' (p<0.001)
4a How often do you use a car?	Usage increases with income, more so for non-winter (p<0.001)
4b How do you use public transport (train, bus, metro)?	Income group €20-35k is a more frequent user of public transport than €45k+ (p<0.003)
4d How often do you take care of daily businesses by walking without using other modes of transport?	Lowest income group walks most frequently (p<0.001)
11a Finland should prioritise biofuel research above other transport technology options, such	Lower income is correlated with less support for prioritising biofuel research

as electric vehicles	
11b I trust forests are used sustainably for biofuel production in Finland	Lowest income group least trusting, €45k+ group most trusting (p<0.001)
11d Timber from other countries should be imported to Finland to produce biofuels	Agreement highest in €45k+ group (p<0.003)

In addition to the above differences, regression analyses with binary and ordered probit models confirm the difference tests and indicated additional relationships. These include, for example, a higher probability that those with more advanced education will disagree with the proposition that Finland should prioritise biofuel research above other transport technology options, such as electric vehicles (p<0.001).

5. Discussion

5.1 Implications for technology policy legitimacy and acceptance

It is clear from even this short selection of survey results that there are significant public opinion differences linked to both demography and geography, regarding the different ways that the Finnish state might support low carbon innovation policy for sustainability transition in personal transport. Table 5 below highlights some of the implications of the differences for public policy legitimacy in Suchmann's (1995) broad sense of norm and value congruence between the state and its citizens. We include some of the aggregate survey results for comparison.

Table 5 Selected survey results and implications for policy legitimacy and transition management (TM)

Survey result	Issues and implications
Aggregate survey results	
Strong public approval for variants of the private car	Policy supportive of incremental innovation has relatively strong public support, potentially complicating consensus-based vision-building at all levels of TM.
Most use a car frequently, but support innovations that facilitate public transport, cycling and walking.	Indicates support for policy that is inclusive rather than exclusive of options, supporting vision-building and culture change at the strategic level of TM.
Electric vehicles are seen as important but do not have the same level of broad support as biofuels.	Relative to electric vehicles, State support for Finnish-sourced, second generation biofuels may garner a higher level of overall public support in the short to medium term, disfavouring TM processes supportive of electric transport.
Public investment in integrated ticketing for public transport and cycling is viewed as likely to make as much difference to respondents' lives as the development of more fuel efficient conventional vehicles.	Again indicates support for policy that is inclusive rather than exclusive of options, supporting vision building and culture change at strategic level of TM. Perhaps offers an entry point for reducing the population's general pro-car attitudinal disposition.
Although anthropogenic climate change is accepted by the large majority (74%), 15% think that climate change is not due to	For a quarter of the population, anthropogenic climate change may not be a convincing policy justification, causing continuing difficulty in gaining legitimacy for problem

human activity; another 4% think there is no climatic change; 7% don't know.	structuring at the strategic level of TM.
Group and population differences	
Geography	
Higher car use and lower public transport use in the Oulu region; stronger environmental concern in the Helsinki region.	Geography is significant, reflected both in transport practices and environmental concerns. This is likely to affect perceptions of policy legitimacy and underlines the importance of geography in TM efforts.
Non-winter frequency of bicycle use is highest in Oulu, then Tampere and lowest in Helsinki. But fewer people walk daily in Oulu.	Transport practices may reflect the availability of public transport infrastructure, particularly the tram, bus and metro system available in Helsinki but also longer commuting distances in the Helsinki region. This underlines the context-specificity of the operational level of TM.
On perception of climate change, while the median for all three regions is similar, Oulu and Tampere have similar upper quartiles of respondents who believe that 'the world's climate is changing, but that human activity has no effect on it during this century'.	As above, possibly more so outside of Helsinki.
On the bio-economy for transport, there were significant regional differences for all but one question. Helsinki respondents are sceptical of the sustainability of current forest utilisation, while Oulu is significantly more supportive of using more of the national timber stock for biofuel.	As above, this raises issues of centre-periphery differences that merit further investigation. Also, the region surrounding Oulu is more rural than in Helsinki and Tampere, perhaps indicating a closer economic link to the use of bio-resources. Region-specific design of public engagement processes and experiments linked to TM may (but equally may not) facilitate perceived policy legitimacy.
Gender	
Significantly more men than women say that they own a car, but gender distributions of having a permanent right to use a car do not differ. However men make disproportionate use of car travel.	May indicate differing ownership attitudes and hence support for policy affecting car use. This links to the pro-car attitudes that TM must deal with in the transition to other transport modes.
Men are more climate-sceptic, being doubtful about either the effect or actuality of anthropogenic climate change. Fewer men than women agree strongly that car use has a serious effect on climate change and fewer men agree strongly that traffic congestion in towns and cities is a very serious problem.	May affect policy legitimacy and likely to affect male response to climate messaging.
Women are significantly more likely to register don't know as a response to whether the State should prioritise biofuel	Policy legitimacy requires improved communication and information provision (note that this may or may not enhance public policy support).

research above other transport technology options and to related questions on the use of timber for biofuel production.	
Age	
The youngest and oldest groups cycle most; the youngest group (15-24) walks the most.	Likely in part reflecting differential access to vehicles, differing practices have implications for the distribution of policy impacts and legitimacy. Yet the relevance of age and life stage is rarely discussed in TM contexts.
The youngest group (15-24) are most averse to prioritise biofuel research above other transport policy & technology options.	As above.
Income	
There are significant income-based differences for 'I own a car', 'my family has a car' and 'I have permanent right to use of a car'. In all cases the differences are particularly between the highest and lowest income groups.	As above. Note that in this and the next several differences, the low and high income brackets are, respectively, 20-35k and 45k+ euros. In other words, the difference is barely a factor two. Yet the relevance of income differentials is rarely discussed in TM contexts.
Median car usage increases with income, more so for non-winter. People in lower income brackets are more frequent users of public transport.	As above.
People in the lower income brackets agree more strongly with the proposition that the current level of car use has a serious effect on climate change and regarding traffic congestion.	As above and also implying the possibility of a link between transport practice and environmental attitude. Likely to also reflect age associations.

In section 2, we argued that institutionalised public engagement in - and consultation on - innovation policy is consistent with the collective, social learning ambitions of transition management and that there are choices to be made regarding the motives and modes of this engagement. We also argued that public opinion is likely to in any case impinge on transition processes. In Table 5 we can see how this influence might manifest in terms of citizen support for public policy in the exemplar case of low carbon transport. Firstly, the population at an aggregate level can be characterised as somewhat conservative, valuing incremental technological innovations such as more fuel efficient conventional vehicles, biofuels and hybrids, but also as inclusive in its perception of how mobility services are delivered, valuing public transport related investments too. While most accept that changes are required to mitigate climate impacts, a significant minority does not, with climate scepticism stronger outside of the capital city and among men generally. This also indicates that more localised approaches to transition management efforts (and approaches differentiated in terms of actor characteristics) might be more successful in engaging the public in associated processes.

From our results we conclude that state support for mobility service innovation generally is likely to be viewed as legitimate, but that policy scoping should include 'soft' as well as 'hard' forms of mobility innovation and that climate-related discourse should be used cautiously. While biofuel-related messaging would align relatively well with livelihood interests in Oulu, opinion in Southern Finland is more sceptical, particularly among the young. Women are more likely to be receptive to pro-environmental messaging supportive of niche developments, showing less climate scepticism and higher perception of urban traffic congestion, but they are at the same time are more uncertain about the relative merits of different technological options.

The latter implies a role for public information provision in forms that better connect to the interests of women, but the implications are more significant than for messaging alone and point to a potential policy dilemma or at least choice: there is majority support for relatively incremental innovations relating to the private car, but women, young, elderly and less affluent people are already using low carbon transport options. Moreover, in the transport sector it is increasingly implausible that the technological options required to meet stringent decarbonisation targets can be deployed in time at sufficient scale (Hoen et al, 2009). Despite the stronger male support for private car innovations beyond conventional technology, there is therefore also a case for giving high priority to policy that strengthens existing low carbon forms of transport provision. This would not exclude support for private car innovation, but it would take account of the possibilities that the demographic and geographic differences offer and would respond to the constrained timescale for introducing new technologies. Such an approach would also acknowledge existing path dependencies, particularly those associated with the private car (Banister et al., 2011; Upham et al., 2013) and would acknowledge that low carbon, technological developments associated with the private car have only recently begun to move beyond the niche level (apart from first generation biofuels). While the regional variation in public opinion stands to complicate transition management efforts, particularly where common national visions are sought, simply moving the incremental innovations beyond the niche would represent a major achievement in itself.

5.2 The politics of transitions management

It is clear that as a perspective that seeks to support the steering of socio-technical change in specific, namely 'sustainable' directions, transition management has an explicit political dimension (compared to the implicit politics of innovation studies). It may have some of its roots in systems analysis, but it is far from wholly analytic. Moreover, there are already a wide range of more or less powerful actors operating in the same space that transition management seeks to contribute to. Considering the options for engagement of citizens in policymaking thus requires consideration of the merits and designs of different models of democracy and consideration of how to intervene in situations where there are already strongly competing interests. These issues are not new to transition management theorists but they do continue to be under-discussed (Shove and Walker, 2007).

Transition management theory focuses on the means and modes of changing structures, cultures and practices in particular functional sectors (Frantzeskaki and de Haan, 2009), transport (or mobility) being of course just one instance. Building new networks and experimenting with initiatives

outside of formal institutions are commonly advocated as means of leveraging forces operating at the niche, regime and landscape levels in mutually reinforcing directions. While publics have not figured strongly in this vision, the connectedness of contemporary information and communication technologies have already empowered citizens and citizen-consumers seeking change, as anticipated in the early days of the internet (Scammell, 2000). Similarly citizen and stakeholder consultation on new policies by public authorities, as well as topic-based polling undertaken for interest groups and others, is already common practice.

What is less common, however, are formalised ways of using surveys and other consultative techniques in policy-making. The dominant political model in Europe and other democratic states is representative democracy, with participative models only marginally institutionalised, if at all. As a consequence, organised lobbying of political representatives is a key route for those attempting to influence policymaking. For example, at the European level, the voluntary European Parliament (EP) Transparency register of lobbyists[1] lists (as of 15.06.15) 7,824 registered organisations, about half of which are in-house lobbyists and trade/professional associations[2]; in recent years the total number of Europe-registered lobbyists has continually increased.

Moreover, it seems that where transition management theorists advocate learning experiments and broader network formation outside of formal institutions, they have done so more in recognition of the role of new networks in generating ideas, agendas and generally supporting change (Loorbach, 2010), than for an explicit, normative commitment to participatory democracy and policy legitimacy. Hence transition management interventions have been critiqued for sometimes involving a degree of capture by commercial interests (Hendriks, 2008, 2009). Moreover, in general, transition management experiments seem to involve a relatively small number of selected change agents and stakeholders (e.g. Nevens and Roorda, 2014; Nevens et al, 2013) rather than the public or publics at large.

Given and despite the above, there is both a normative and a theoretical case for more explicit and systematic public engagement in transition management processes, with publics as key stakeholders, while also acknowledging that this raises further questions about how to structure engagement and consultation processes. The need to attend to geography that Coenen et al (2012) emphasise in the context of production networks is equally relevant in the context of public opinion. While the geographic differences identified here are notable, in other contexts such as energy system transition, the broad literature on siting controversies as a sub-field of environmental planning also has much to offer. This literature emphasises the role of governance, institutional trust, perceived equity and place attachment (e.g. Upham and Shackley, 2006; Devine-Wright, 2008), all of which have strong local dimensions. Indeed objections to technological innovation often play out at the implementation stage and this is one of the instrumental rationales for early consultation and engagement (Breukers and Upham, 2013). To the extent that many transport innovations also

[1] http://ec.europa.eu/transparencyregister/info/homePage.do?locale=en

[2] The remainder: 25% NGOs, 12% professional consultancies/law firms/self-employed consultants, 7% think tanks and academic institutions, 5% public sector organisations, with religious and other public or mixed entities making up less than 1%; see Library of the European Parliament (2013).

require physical road and rail infrastructure with which to operate, objection or support may also be locally expressed. In short, geography matters for public opinion too.

5.3 The means of engagement

A further issue, again relating to the theme of social reflexivity in transition management theory, concerns the way in which different engagement and consultation techniques enable the assembly of different types of information, with different associated possibilities for use. Arguably the key advantage of online questionnaire surveys as part of a mix of consultation and engagement methods, is that consultation can be rapid and iterative. However some of the characteristics of *online* surveys are problematic, not least of which is that different social groups have different propensities to use online technology (Zickuhr and Smith, 2012). User groups known to make limited use of digital and online technology would thus need to be consulted face to face or by telephone. Moreover, questionnaire surveys provide relatively shallow and brief forms of responses compared to interviews and group discussion. Unlike focus groups and other deliberative methods (consensus conferences, citizens' panels or town hall style events), they also perform poorly in terms of the level of interaction between participants and between the latter and sources of expertise (Rowe and Frewer, 2005). Use of an information choice questionnaire (ICQ) format does entail substantial information provision and hence in principle can elicit informed choices (e.g. De Best-Waldhober et al. 2009), but ICQ are typically completed by individuals rather than groups.

If the objective is to briefly consult rather than open up discussion, though, then closed style survey responses may be suitable. Additional opinion elicitation options with different characteristics include multi-criteria assessment, which elicit criteria weightings and option scoring; and budget allocation exercises, which again oblige a focus on priorities. That said, surveys can and often do use ranking questions, again intended to reveal priorities. Where pricing and cost are important, discrete choice methods and willingness to pay may be applicable. It is also possible to moderate qualitative discussion online, increasing the number of participants relative to physical panels or focus groups, but again subject to caveats regarding access.

In terms of the timing of engagement, while it would be difficult to establish a consistent relationship between the extent of public engagement and the nature of public responses to new technologies and associated developments, there is nonetheless an implicit or explicit assumption in much of the public engagement in planning literature that early engagement is preferable to late engagement (Upham et al, 2009). Again the participative theme in the planning and technology assessment literatures, while arguably as important as ever, sits somewhat uneasily with the urgency of the transition to low carbon energy systems in the context of climate change. It can also be observed that public opinion influences transition drivers and dynamics at all stages, regardless of the ambitions and interventions of other actors seeking to facilitate or perform transition management. Indeed socio-technical transitions theory emphasises cultural and structural tensions on the regime, internal inconsistencies or intra- or extra-regime pressures as necessary conditions for niche development and regime change. It should also be noted that although transition management assumes and advocates social steering, a wide variety of actors using a wide variety of means are already active in seeking to further their own agendas and interests in socio-technical systems.

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6. Conclusions

We have argued that public input to innovation policy is implied in the socially directive nature of transition management and is normatively and pragmatically desirable for reasons of policy legitimacy and acceptance. Accordingly we have surveyed public opinion on low carbon transport innovation policy, analytically identifying opinion differences, showing how this relates to material differences in demography and geography and arguing that opinion heterogeneity has implications for policy legitimacy. We have discussed the implications of previous work on public engagement in technology assessment for transition management, drawing on the STS literature for its longstanding contribution in this regard. We have suggested that iterative, participative use of opinion surveys, in the context of qualitative work, may help to further the ambitions of digital democracy agendas. In illustrating the associated issues and challenges, we also add to the transitions sub-literature that seeks to re-embed conceptualisations of transitions in their geographical contexts, providing evidence that geography matters for public opinion of transport innovation and arguing that geographically associated differences matter for policy legitimacy.

The observed heterogeneity of and geographical variation in public opinion, as well as the path dependencies linked to existing socio-technical systems, pose challenges for societal vision building for transformative change, as well as for the operationalization of these visions. This heterogeneity, however, also implies that transition management needs to pay attention to demography and geography from the outset: surveys may, for example, indicate the likelihood of the success of niche experiments in particular regions. Although the issues raised by seeking to account for public opinion as part of technology governance processes are difficult, arguably requiring politically-sensitive management skills, public opinion matters for pathways of socio-technical change. Congruence between public opinion, policy design and policy direction should help to legitimate the policy support that new technologies and social innovations need in order to compete with incumbent, path-dependent systems. Public opinion has the potential to strengthen or weaken stresses that are internal or external to the regime – and to constitute those stresses themselves. This in turn has implications for the transition processes of niche empowerment, reconstellation and adaptation, required as regime components realign to a new state. Finally, we would observe that while we have here begun to develop conceptions of the role of public opinion in transitions and of the potential role of iterative and participative opinion surveys in advancing transition management processes, we are very aware that building meaningful public consultation into policy processes poses considerable challenges (Pidgeon et al, 2014). One of the main challenges is the complexity of transitions, requiring not only iterative surveys, but also a more widely organised public debate over their consequences and management. .

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References

Arnstein, S., 1969. A ladder of Citizen Participation. American Institute of Planners 35(4), 216–244.

Banister, D. 2008. The sustainable mobility paradigm. Transport Policy, 15: 73-80.

Banister, D., Anderton, K., Bonilla, D., Givoni M. and Schwanen T., 2011. Transportation and the environment. Annual Review of Environment and Resources, 36: 247-270.

Barker, R. 1990. Political legitimacy and the state. Oxford: Clarendon Press.

Breukers, S. and Upham, P. 2014. Organisational aspects of public engagement in energy infrastructure planning: the case of early-stage European CCS projects. *Journal of Environmental Policy and Planning.* DOI:10.1080/09640568.2013.851597

Chilvers, J. 2007. Deliberating Competence: Theoretical and Practitioner Perspectives on Effective Participatory Appraisal Practice. Sci. Technol. Human Values 33(2): 155–185.

Coenen, L. and Benneworth, P. and Truffer, B. 2012. Toward a spatial perspective on sustainability transitions. Research policy, 41 (6): 968 - 979

Creswell, J.W. and Plano Clark, V.L., 2011. Designing and conducting mixed methods research. Thousand Oaks, CA: Sage Publications.

Dahlberg, L. 2011. Re-Constructing Digital Democracy: An Outline of Four "positions, New Media & Society 13 (6): 855-872.

De Best-Waldhober, M., Daamen, D. and Faaij, A. 2009. Informed and Uninformed Public Opinions on CO2 Capture and Storage Technologies in the Netherlands, International Journal of Greenhouse Gas Control 3: 322-332.

De Haan, J. and Rotmans, J. 2011. Patterns in transitions: Understanding complex chains of change. Technol. Forecast. Soc. Change 78(1): 90–102.

Delgado, A., Kjølberg, K.L., Wickson F., 2011. Public engagement coming of age: From theory to practice in STS encounters with nanotechnology. Public Underst. Sci. 20(6): 826–845.

Dendler, L. 2013. Sustainability Meta Labelling: Prospects and potential challenges for institutionalisation [PhD Thesis]. Manchester, UK: The University of Manchester, https://www.escholar.manchester.ac.uk/item/?pid=uk-ac-man-scw:196283

Devine-Wright, P. 2008. Reconsidering public acceptance of renewable energy technologies: a critical review. In: Delivering a Low Carbon Electricity System: Technologies, Economics and Policy. Grubb M, Jamasb T, Pollitt MG (Eds.). Cambridge University Press, Cambridge.

EC, 2011. Future of transport. Analytical report. Flash Eurobarometer. Directorate General Communication and The Gallup Organization. Brussels. http://ec.europa.eu/public_opinion/flash/fl_312_en.pdf <accessed 13.01.15>

Einsiedel, E, Jelsøe, E and Breck, T, 2001. 'Publics and the Technology Table: The Consensus Conference in Denmark, Canada and Australia,' Public Understanding of Science 10: 83–98.

European Climate Foundation, 2013, Fuelling Europe's Future: how auto innovation leads to EU jobs, ECF, Brussels, http://www.europeanclimate.org/index.php/en/news/116-fuelling-europe-s-future <accessed 30.07.13>

Frantzeskaki, N., and de Haan, H., 2009. Transitions: Two steps from theory to policy, Futures 41: 593-606.

Frantzeskaki, N., Loorbach, D. and Meadowcroft, J. 2012. Governing societal transitions to sustainability. Int. J. Sustain. Dev. 15(1): 19–36.

Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Research Policy 31 (8–9): 1257–1274.

Geels, FW, 2005, Technological transitions and system innovations: a co-evolutionary and socio-technical analysis, Edward Elgar: Cheltenham.

Geels, F.W., Schot, J., 2010. The Dynamics of Socio-Technical Transitions: A Socio-Technical Perspective, In: Grin, J., Rotmans, J., Schot, J. (Eds.), Transitions to sustainable development: New directions in the study of long term transformative change. Routeledge, New York, London, pp. 30-101.

Geels, FW, 2012, A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies, Journal of Transport Geography 24: 471-482, http://dx.doi.org/10.1016/j.jtrangeo.2012.01.021.

Goodwin, P and Lyons, G, 2010, Public attitudes to transport: interpreting the evidence, Transportation Planning and Technology, 33:1, 3-17.

Greene, W.H. and Hensher, D. A.., 2010, Modeling Ordered Choices: A Primer. Cambridge: Cambridge University Press.

Healey, P, de Magalhaes, C., Madanipour, A et al., 2003, Place, identity and local politics: analysing initiatives in deliberative governance, in M. A. Hajer and H. Wagenaar (Eds) Deliberative Policy Analysis – Understanding Governance in the Network Society, Cambridge University Press, Cambridge, pp. 60–87.

Hendriks, C M, 2008, On inclusion and network governance: the democratic disconnect of Dutch energy transitions, Public Administration 86(4), 1009-1031.

Hendriks, C., 2009. Policy design without democracy? Making democratic sense of transition management. Policy Sciences 42(4): 341-368.

Hoen, A. Geurs, K., de Wilde, H., Hanschke, C. and Uyterlinde, M. 2009. CO_2 emission reduction in transport Confronting medium-term and long term options for achieving climate targets in the

Netherlands.Netherlands Environmental Assessment Agency and ECN, Bilthoven and The Hague, http://www.rivm.nl/bibliotheek/rapporten/500076009.pdf <accessed 13.01.15>

Hosch-Dayican, B., 2010. Political involvement and democracy. How benign is the future of post-industrial politics? PhD dissertation, University of Twente, http://www.utwente.nl/mb/pa/uploads/Hosch-Dayican%20-%20Political%20Involvement%20and%20Democracy.pdf

Huntington, S.P., 1974. 'Postindustrial Politics: How Benign Will It Be?', Comparative Politics 6: 163-191.

Inglehart, R., 1977. The Silent Revolution: Changing Values and Political Styles among Western Democracies, Princeton: Princeton University Press.

Jacobsson, S. and Lauber, V., 2006. The politics and policy of energy system transformation--explaining the German diffusion of renewable energy technology. Energy Policy 34, 256-276.

Kemp, R and S van den Bosch, 2006, Transitie-experimenten. Praktijkexperimenten met de potentie om bij te dragen aan transities, TNO/Drift, Delft, The Netherlands.

Kemp, R, Loorbach, D, & Rotmans, J, 2007, Transition management as a model for managing processes of co-evolution towards sustainable development, International Journal of Sustainable Development & World Ecology, 14(1), 78–91. doi:10.1080/13504500709469709

Library of the European Parliament, 2013. Lobbying the EU institutions, Library Briefing, Library of the European Parliament, Brussels, http://www.europarl.europa.eu/RegData/bibliotheque/briefing/2013/130558/LDM_BRI(2013)130558_REV1_EN.pdf <accessed 30.03.14>

Loorbach, D., 2007. Transition Management. New Mode of Governance for Sustainable Development. Erasmus Universiteit Rotterdam, Rotterdam, p. 327.

Loorbach D. and Rotmans J. 2010. The practice of transition management: Examples and lessons from four distinct cases. Futures 42(3), 237–246.

Markard, J., Raven, R., Truffer, B., 2012. Sustainability transitions: An emerging field of research and its prospects. Res. Policy 41, 955 – 967.

Matti, Simon. 2009. Exploring Public Policy Legitimacy: A Study of Belief-System Correspondence in Swedish Environmental Policy. Doctoral Thesis, Luleå University of Technology, Sweden: Luleå University Press.

Matti, S. and Sandström, A. 2011. The Rationale Determining Advocacy Coalitions: Examining Coordination Networks and Corresponding Beliefs. Policy Studies Journal 39(3): 385–410.

Martin, C. and Upham, P. 2015 A conceptual model of the mobilisation of values in grassroots innovations, Journal of Cleaner Production (Special Volume on "Transitions to Sustainable Consumption and Production within Cities"). Available online 28 April 2015. doi:10.1016/j.jclepro.2015.04.062

McKinsey and Company, 2009, Roads towards a low carbon future: reducing CO2 emissions from passenger vehicles in the global road transportation system, McKinsey and Company, New York City, http://www.mckinsey.it/idee/practice_news/roads-toward-a-low-carbon-future-reducing-co2-emissions-from-passenger-vehicles-in-the-global-road-transportation-system.view <accessed 31.07.13>

Macnaghten, P., Chilvers, J. 2014. The future of science governance: publics, policies, practices. Environ. Plan. C Gov. Policy 32(3): 530–548.

Mäkinen, K., Kivimaa, P., Helminen, V., 2015. Path creation for urban mobility transitions - Linking aspects of urban form to transport policy analysis. Management of Environmental Quality: An International Journal 26 (4): 485 – 504.

Mauser, W., Klepper, G., Rice, M., Schmalzbauer, B. S., Hackmann, H., Leemans, R., et al. 2013. Transdisciplinary global change research: The co-creation of knowledge for sustainability. Current Opinion in Environmental Sustainability, 5, 420–431.

Mulgan, G. 2015. Designing digital democracy: a short guide. Nesta blog, http://www.nesta.org.uk/blog/designing-digital-democracy-short-guide?gclid=CJXX0PK3kcYCFafItAodhXgAaQ, 25/05/15, accessed 15/06/15.

Nahuis R, van Lente H. 2008. Where Are the Politics? Perspectives on Democracy and Technology. Sci. Technol. Hum. Values 33 (5): 559–581.

Natcen (2012) British Social Attitudes Survey, NatCen Social Research: London, http://www.natcen.ac.uk/our-research/research/british-social-attitudes/ <accessed 13.01.15>

Nevens F, Roorda C., 2014. A climate of change: A transition approach for climate neutrality in the city of Ghent (Belgium). Sustain. Cities Soc. 10, 112–121.

Nevens F, Frantzeskaki N, Gorissen L, Loorbach D. 2013. Urban Transition Labs: co-creating transformative action for sustainable cities. J. Clean. Prod. 50, 111–122.

Parrado, S., Van Ryzin, G.G., Bovaird, T. and Löffler, E. 2013. Correlates of Co-production: Evidence From a Five-Nation Survey of Citizens, International Public Management Journal, 16:1, 85-112, DOI: 10.1080/10967494.2013.796260

PE International, 2013. Life cycle CO2e assessment of low carbon cars 2020-2030, LowCVP, London, http://www.lowcvp.org.uk/lowcvp-viewpoint/reports.asp <accessed 30.07.13>

Pidgeon N, Demski C, Butler C, Parkhill K, Spence A. 2014. Creating a national citizen engagement process for energy policy. Proc. Natl. Acad. Sci. 111 (Supplement 4), 13606–13613.

Raven, R., 2005. Strategic Niche Management for Biomass: a comparative study on the experimental introduction of bioenergy technologies in the Netherlands and Denmark. PhD thesis. Technische Universiteit Eindhoven, Eindhoven.

Raven, R.P.J.M., Schot, J.W. & Berkhout, F., 2012. Space and scale in socio-technical transitions. Environmental Innovation and Societal Transitions, 4, 63-78.

Rip, A. and Kemp, R. 1998. Technological Change. In Human Choice and Climate Change, Vol. 2. ed. SteveRayner and ElizabethMalone. Columbus, OH: Battelle Press.

Rotmans, J., Kemp, R., Asselt, M.v., 2001. More evolution than revolution: transition management in public policy. Foresight 3(1), 15-31.

Rowe, G. and Frewer, LJ, 2005. Public Participation Methods: A Framework for Evaluation. Sci. Technol. Hum. Values 25 (1), 3–29.

Scammell, M. 2000. The Internet and Civic Engagement: The Age of the Citizen-Consumer. Polit. Commun. 17(4), 351–355.

Sclove, RE. 1995. Democracy and Technology. The Guilford Press, New York.

Seyfang, G., Hielscher, S., Hargreaves, T., Martiskainen, M. & Smith, A. 2014. A grassroots sustainable energy niche? Reflections on community energy in the UK. Environmental Innovation and Societal Transitions, 13, 21-44.

Shove E, Walker G., 2007. CAUTION! Transitions ahead: politics, practice, and sustainable transition management. Environ. Plan. A 39(4), 763–770.

Smith A, Raven R. 2012. What is protective space? Reconsidering niches in transitions to sustainability. Res. Policy 41(6): 1025–1036.

Smith, A., Voß, J.-P., Grin, J. (2010). Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. Research Policy 39: 435-448.

Sondeijker, S., Geurts, J., Rotmans, J., Tukker, A., 2006. Imagining sustainability: the added value of transition scenarios in transition management. Foresight 8(5), 15-30.

Stirling, A, 2011, Pluralising progress: From integrative transitions to transformative diversity, Environmental Innovation and Societal Transitions, 1 (1), 82-88.

Suchman, M.C., 1995. Managing Legitimacy: Strategic and Institutional Approaches, The Academy of Management Review 20 (3), 571–610.

Temmes, A., Virkamäki, V., Kivimaa, P., Upham, P., Hildén, M., Lovio, R. 2014. Innovation policy options for sustainability transitions in Finnish transport. Tekes, Helsinki, http://www.tekes.fi/globalassets/julkaisut/transportation_roadmap.pdf

Topf, R., 1995. 'Beyond Electoral Participation', in: H.-D. Klingemann and Fuchs, D. (eds.) Citizens and the State, Oxford: Oxford University Press, pp. 52-91.

Tost, L., 2011. An integrative model of legitimacy judgments. Academy of Management Review 36 (4), pp. 686–710

Upham, P. and Shackley, S. 2006. The case of a proposed 21.5 MWe biomass Gasifier in Winkleigh, Devon: implications for governance of renewable energy planning, Energy Policy 34: 2161-2172.

Upham, P., Whitmarsh, L., Poortinga, W., Purdam, K. and Devine-Wright, P. (2009) *Public Attitudes to Environmental Change –a selective review of theory and practice*, report for RCUK/LWEC, http://www.lwec.org.uk/audiences/society

Upham, P., Kivimaa, P., Virkamäki, V. 2013. Path dependence and expectations in transport Innovation policy: the case of Finland and the UK, Journal of Transport Geography, 32:12-22.

Upham, P. and Dendler, L. 2014. "Scientists as policy actors: a study of the language of biofuel research", Environmental Science and Policy 47: 137-147.

VTPI, 2010, Online transport demand management encyclopedia, Victoria Transport Policy Institute, BC, http://www.vtpi.org/tdm/tdm12.htm <accessed 31.07.13>

VTT, 2012, Low Carbon Finland 2050, VTT, Helsinki, http://www.vtt.fi/sites/lowcfin/?lang=en <accessed 30.07.13>

Van den Bosch, S., 2010. Transition experiments: exploring societal changes towards sustainability. Erasmus Universiteit Rotterdam, Rotterdam, p. 272.

Van der Brugge, R., Van Raak, R., 2007. Facing the adaptive management challenge: insights from transition management. Ecology and Society 12(2).

Wellman, B. 1978. Public Participation In Transportation Planning. Traffic Quarterly 31 (4): 639-656.

Whitmarsh, L. 2012. How useful is the Multi-Level Perspective for transport and sustainability research? J. Transp. Geogr. 24(0): 483–487.

Wynne B. 1973. At The Limits of Assessment. In: Technology Assessment and Quality of Life. Stober GJ, Schumacher D (Eds.). Elsevier Scientific Publishing Company, Amsterdam.

Yougov, 2013. Tracking British attitudes to climate change, Yougov, London, https://yougov.co.uk/news/2014/04/16/a/ <accessed 13.01.15>

Zickuhr, K. and Smith, A. 2012. Digital Differences, Pew Research Centre, Washington, http://www.pewinternet.org/files/old-media/Files/Reports/2012/PIP_Digital_differences_041312.pdf