Beyond the regime: barriers to and opportunities for integrated sustainability policy assessment

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Abstract

The concept of radical, systemic, decadal innovation - or a 'transition' - inevitably challenges dominant actors and institutions. Yet, the inability of current (incremental, short-term) policy approaches to adequately tackle persistent, long-term, complex and cross-sectoral problems suggests such a transition is needed. This paper explores the extent to which current policy assessment practices and institutions are able to support and foster such radical societal changes, and critically considers an alternative framework for sustainability assessment. In the first part of the paper, we present findings from in-depth interviews and documentary studies of processes surrounding Committees of Inquiry in Sweden that expose a range of institutional constraints at the interface between policy makers and knowledge providers to dealing with long-term and cross-sectoral issues. The findings indicate that these constraints can be addressed by establishing arenas for social learning through a broader mandate and developing key personal skills and resources to facilitate effective stakeholder participation. In the second part of this paper, we present the concept of Integrated Sustainability Assessment (ISA; Weaver & Rotmans, 2006), a cyclical, participatory process through which a shared interpretation of sustainability for a specific context is developed and applied in an integrated manner. We discuss initial findings from the EU-funded MATISSE project, which aims to achieve a step-wise advance in ISA of European policies. In particular, we report on our experiences of using both participatory and modelling methods to integrate insights from expert and non-expert stakeholders into processes of knowledge construction and policy assessment. We reflexively consider the value of these methods and tools for establishing arenas for social learning, developing sustainability-focussed policies, and, ultimately, fostering sustainability transitions. Finally, we discuss policy implications of our research findings.

1. Introduction

Sustainable development (SD) is, at least in rhetoric, an increasingly prioritised issue. At EU level this is expressed in the Sustainable Development Strategy (European Commission, 2001b) that followed the Gothenburg Strategy, and in the original goals of the Lisbon Strategy, although the latter has become clearly focused on jobs and growth (Radaelli, 2007). At national level there are corresponding strategies addressing sustainability issues (e.g., Department for Environment Food and Rural Affairs, 2005; Regeringskansliet, 2006). However, while sustainability is an aspirational goal for certain sections of Europe's policy-making, in reality current practice is very much embedded in a policy-making paradigm of sectoral division. Integrative concepts such as SD have problems reaching the mainstream agenda (Nilsson & Eckerberg, 2007), due to fragmentation in policy-making, and sectoral approaches. The task of integrating different aspects of sustainability into mainstream policy-making largely remains (Lafferty & Hovden, 2003; Lenschow, 2002; Nilsson & Persson, 2003).

Previous research the EU Framework Six MATISSE[1] project has highlighted the challenges to addressing sustainability within current policy assessment frameworks, which tend to use a technocratic approach and to rely on standard economic evaluation methods and tools (Hertin et al., 2007). A major misalignment which faces researchers and policy-makers interested in advancing the sustainability agenda is between the institutional context of policy-making (based on short-term, electoral cycles and typically restricted to sector-specific focus) and the long-term, cross-sectoral and - above all - *systemic* nature of sustainability problems.

In this paper, we address the fundamental question: *How can we foster long-term, strategic sustainability policy-making in Europe?* We use the case study of sustainable personal/passenger mobility in Europe to try and address this. We introduce the concept of Integrated Sustainability Assessment (ISA), which is intended to offer a framework in which sustainability policy-making might be advanced. Our research, which has involved developing and testing novel ISA tools and methods for a case study on mobility, suggests this framework is a promising alternative to conventional impact assessment approaches to supporting a transition to a more sustainable Europe. Thus, our secondary research question addressed in this paper is: *What is the value of ISA, and of ISA tools and methods, for establishing arenas for social learning, developing sustainability-focussed policies, and, ultimately, fostering sustainability transitions?*

This paper uses the findings from interdisciplinary, multi-method research conducted within the MATISSE project to address these questions. This research has involved literature reviews, policy interviews, simulation modelling, and deliberative stakeholder interactions. In the next section, we discuss - with reference to concepts from the transitions literature - the barriers to effective sustainability policy-making, particularly focussing on sustainable mobility policies. Then, in section 3, we discuss our research - including the concepts and methods used and our findings - on ISA, including initial tests of ISA tools and methods. Finally, in section 4 we conclude and draw implications for future research and policy.

2. What are the barriers to long-term, strategic sustainability policy-making in Europe?

In this section, we introduce the conceptual framework used in our research, which stems from the transitions literature. This has enabled us - through literature reviews and stakeholder engagement work - to elucidate the lock-ins to unsustainability within European mobility systems and the opportunities for radical, systemic innovation. Furthermore, we draw on findings from interviews exploring institutional barriers to sustainability assessment in the Swedish system of Committees of Inquiry – one of the most important forums, and a highly institutionalised system - for linking science and stakeholder participation with policy-making in Sweden.

[1] Methods and Tools for Integrated Sustainability Assessment (MATISSE). See: www.matisse-project.net

2.1 Transitions and social learning frameworks

In analysing the barriers to, and opportunities for, innovation, we have drawn on the emerging 'transitions' literature, and in particular the 'multi-level perspective' (MLP) of Kemp and Rip (1998). The MLP identifies three functional levels within any societal system (e.g., mobility, housing, healthcare), namely 'niche', 'regime' and 'landscape'. Each level represents increasing structuration and coordination of activities, ranging from individual technologies and grassroots movements (at niche level) to larger-scale social structures and institutions (regime) and social/ecological trends (landscape) (Geels & Schot, 2007; Giddens, 1984).

The *regime* comprises dominant actors, institutions, practices and shared assumptions (Rotmans et al., 2001). While it provides stability and cohesion of societal systems, it also tends towards optimising the current system through incremental change, using the capabilities and resources of dominant players. System innovation, or radical change, is restricted since habits, existing competencies, past investment, regulation, prevailing norms, worldviews and so on, act to lock in patterns of behaviour and result in path dependencies for technological and social development (Geels, 2005). At the micro-level, *niches* have been identified in historical empirical studies of transitions as the typical loci for radical innovation, operating at the periphery of, or outside, the dominant meso-level regime. The macro-level comprises a *landscape* of changing economic, ecological and cultural conditions, in which the regime may be more or less well-suited to fulfil its functions. As this landscape changes, the regime may experience stress and is typically slow to adapt, whereas niches more quickly evolve. The gradients within the socio-technical landscape determine how easy or difficult particular changes are to bring about (Kemp & Rotmans, 2004). Most recently, Geels and Schot (2007) have developed a taxonomy of dynamic processes of transitions, using these concepts.

The transitions literature also highlights the relevance of *learning* - including 'social learning' - as crucial for fostering social change (van de Kerkhof & Wieczorek, 2005). The literature on learning for sustainability highlights the need for both 'single-loop' and 'double-loop' (or social) learning (e.g., Siebenhüner, 2004). While single-loop learning involves adaptation and error correction in respect of a fixed goal, social learning is more fundamental and connects error correction to adjustment of underlying objectives, values, norms and beliefs. Social learning is needed for re-conceptualisation and re-framing within issue domains (Argyris & Schön, 1978, 1996; Glasbergen, 1996; Hall, 1993).

Stakeholder interaction - particularly bringing together regime and niche players - is crucial for social learning, since it exposes (radically) different perspectives. Social learning can be viewed as a participatory process designed to elucidate the nature and importance of stakeholder goals; reach democratic environmental solutions; encourage the implementation of consensus-based goals; and improve management of conflicts over, e.g., natural resources (Pahl-Wostl, 2006). Social learning is thus important in achieving sustainable resource management in complex situations with many stakeholders involved (Collins & Ison, 2006; Folke et al., 2005; Keen et al., 2005; Pahl-Wostl & Hare, 2004; Social Learning Group, 2001; Steyaert & Jiggins, 2007). Building on this body of evidence for the value of learning (particularly social learning) for sustainability assessment, we have incorporated social learning - for both researchers and stakeholder participants - as a central aim for our research.

2.2 Barriers to radical innovation in mobility systems

In the case of mobility, we observe a number of landscape pressures and internal tensions being experienced by the prevailing road transport regime. Mobility demand in Europe is rising due to increasing households and population, increasing incomes, increases in speed and convenience of travel, and other factors (Skinner et al., 2004). This rising demand is resulting in a range of intractable problems, including congestion, emissions of greenhouse gases and local air pollutants, noise, accidents, depletion of resources, and inaccessibility of amenities and services (e.g., European Commission, 2001a; European Environment Agency, 2006). For example, transport is the sector with the highest increase of greenhouse gas emissions in recent decades, rising within Europe by 24% between 1990 and 2003 (European Environment Agency, 2005). Given

these problems, and their associated economic, social and environmental impacts, the current mobility system may be considered in many respects unsustainable. Furthermore, regime actors are responding to these landscape pressures in divergent ways. For example, while major automotive firms are investing in ethanol vehicles, the natural gas and oil industries have responded by lobbying the UK government to impose standards in order to constrain and delay ethanol commercialisation (Taylor, 2006). These examples of tensions are what de Haan and Rotmans (2006) refer to as 'stress' - internal misalignment within the regime - which is typically a precursor to transition (Geels, 2005).

Despite these problems and pressures, there are barriers to radical innovation. The prevailing mobility paradigm constitutes a regime locked in to a stable state of oil- and car- dependence, dominated by the practice of personal mobility. Infrastructure, manufacturing, and consumer behaviours enforce this regime. In relation to infrastructure, the built environment has co-evolved alongside personal motorised transport, so that amenities and workplaces are often only accessible by car. Vehicle manufacturing has developed along 'technological trajectories' (Dosi, 1984), which constrain the development of vehicle and fuel technologies to the development of core competences, particularly in internal combustion engine (ICE) and Budd-type steel chassis (Nieuwenhuis & Wells, 1997). Within wider society, too, there is considerable resistance to changing behaviour to more sustainable forms (Norton & Leaman, 2004). Driving is not only perceived to be the most convenient and is often the cheapest form of transport, it is also tied to social values and identity (Steg et al., 2001). In the UK, for example, there is a widespread association between car ownership and 'having a good lifestyle' (Black et al., 2001; Whitmarsh, 2005). This is despite public recognition of the need to tackle rising congestion and other transport problems (Lethbridge, 2001). Much of the inertia in the transport system may be attributed to deeply entrenched habits of car use (Bandura, 1971; Urry, 1999; Verplanken et al., 1998). Due to these psychological, technological and institutional dependencies, there is typically widespread resistance to radical change (Elzen, 2005).

The current policy regime is also poorly equipped to deal with the intractable problems associated with mobility. There has been a largely piecemeal, incremental and technical approach to dealing with transport problems. First, there is a preference for technological solutions to environmental and sustainability problems - the so-called 'techno-fix' approach - in policy-making. These are argued to offer economic as well as environmental benefits - a win-win outcome (European Commission, 2002) - a standpoint that avoids the more challenging issue of changing consumer behaviour. While techno-fixes such as hydrogen fuel cell vehicle offer environmental and economic benefits, they do not address wider social problems (e.g., lack of accessibility to amenities; lack of affordability; accidents and obesity) associated with road-transport (Whitmarsh & Wietschel, in press).

Second, current policy measures to foster more sustainable mobility by influencing individual travel decisions (e.g., congestion charging, vehicle taxation) have had little effect relative to the underlying growth in demand. In some cases, interventions to reduce demand or foster modal shift have had the reverse effect (Goodwin et al., 2004). The case of biofuels also highlights a partial (and problematic) solution to unsustainability problems with great uncertainties; the actual carbon savings are for many feedstocks and energy carriers questionable (Righelato & Spracklen, 2007). The actual Net Energy Balance for different biofuels for transport is still under research and studies shows a mixed picture and limited potential for current biofuels (Hill et al., 2006; Schmer, 2008); biofuel potential is probably most efficiently used in the heat power sector (Azar et al., 2003) and the potential impact of biofuel targets can lead to increases in food prices and conflicts over land use for other social needs (See for example The Royal Society, 2008, for a recent review). Biofuels as a case thus captures several of the problems with the current short-sighted approaches in policies. Finally, the benefit of technical measures to reduce vehicle emissions and noise has often been outstripped by increases in vehicle numbers, engine size, travel frequency and trip length (European Commission, 2001b). It is therefore increasingly recognised that incremental technological or policy improvement may be insufficient to address this type of persistent problem (Kemp & Rotmans, 2004). Instead, radical, systemic innovation - a 'transition' (e.g. Rotmans et al., 2001; Smith et al., 2005) - is required to move away from the current land-based transport regime and towards a more sus-

tainable mobility system. Studies that have considered possible sustainable mobility transitions highlight the need for both technological and institutional changes (e.g., electric and fuel cell vehicles, customised mobility, teleworking, zoning policies) to achieve a radical reconfiguration of transport systems for sustainability (Elzen, 2005; Kemp & Rotmans, 2004).

2.3 Results from recent Committees concerning transport

The system of Independent Committees of Inquiry is one of the most important arenas linking science and policy in Sweden (e.g. Nilsson & Eckerberg, 2007). They function as an important part of the Swedish policy-making procedures, preceding the formulation of actual polices within ministries, and act as an arena that brings together experts, stakeholders and politicians. However, the extent to which these Committees actually integrate sustainability concerns in to assessments varies. In this paper we only present some early results relating to the integration of sustainability in transport policy, and as a comparison, climate change. Generic results on institutional barriers in these two fields is currently in press (Nykvist & Nilsson, 2008).

A series of interviews with Committee members was conducted covering six recent committees related to Transport and Climate Change. The study covered both types of committees that exist in Sweden; the larger "parliamentary committees" that includes representatives from all political parties, often larger in scope and mandate, and the smaller committees called "Särsklid Utredare", employing a smaller secretariat. The latter tend to be more technical or implementing in character, but both types usually directly include, or rely on, external reference groups that include representatives from involved ministries and agencies and additional experts.

Among the Committees reviewed, three were dedicated to transportation only; in terms of Public transport (Statens Offentliga Utredningar, 2005); the introduction of biofuels and the implementation of EUs biofuels directive (Statens Offentliga Utredningar, 2004); and finally, the taxation of road transport. In this paper, we draw on results from the two first, illustrating key challenges in the transport sector.

In the first case, the Committee for public transport did explore visions of a future public transport system, building on previously established targets for sustainable development in the transport sector (Prop, 1997/98:56). The Committee also conducted extensive participatory exercises. However, the mandate of the Committee emphasised coordination and development primarily *within* the public transport sector. As a result, the vision (for 2020) is a description of the envisioned positive development, but without concrete goals for modal shift to public transport in relation to private car use. Interviews showed that sustainability in the transport sector is viewed as inherently difficult. Long time-horizons are not easy to manage in the current policy paradigm, and the process of integrating new societal goals such as sustainability is subject to great inertia. The following statement from an interviewee in the Committee on collective transport illustrates both: "*Well, this I'm not so certain of… I mean, regarding a long-term sustainable development. To begin with, it's not a very old concept, with Brundtland…, and it's also… It is actually incredibly difficult. It's the time perspective…*"

In the second case, a committee assessing the implementation of the EU biofuels directive and the introduction of biofuels in general was the focus of attention. The committee was substantially smaller, and to some extent more technical. The first part of the assessment concerns the implementation of the Biofuels directive, with a short time horizon for analysis covering the 2010 timeframe of the directive. The final report included visions for a +25 years outlook, although the focus of attention was short to medium term. Although forward looking in instructions, this inquiry turns out to be rather limited in scope and assessments by both the instructions given and, and the much more politically contested topic. The setup as a "Särsklid Utredare" does not include representatives from all parties, and the assessment turns out to be more dominated by the policies of the current government (and its supporting parties) and other influential actors in support of a rapid introduction of biofuels. One of the interviewees in this case explained; *"in [the context of] this inquiry, there are incredibly strong economic*

interests behind [the topics] being assessed […] to get statements that express that certain fuels is the future is tremendously important". And regarding the politicised topic of the inquiry, the following answer was given to the question on how assessments can contribute to the development of more sustainable polices. "*I believe that those decisions are taken outside the inquiry at the end of the day. Already before the instruction are formed, or [later] when the bill is written."*

Why has policy-making failed to address sustainability issues such as those associated with road-transport? Our research suggests this is due in part to vested interests and institutional inertia - which tends to preserve the status quo and maintain power. Secondly, as the literature on integration of environmental policy reviewed above shows, and as is confirmed in research conducted in MATISSE, the sectoral divisions within government structures remain and integration is only partial. Thirdly, it is a result of lack of skills/experience to include diverse tools and perspectives in assessments; particularly citizens' views are lacking. It is, however, important to recognise that it is in the first instance a lack of clear instructions to be broad, participatory and long-term in the assessments that constitute the institutional barrier and produce inertia. Lack of individual skills and capacities are not mitigated unless it is expected, and explicitly stated in the instructions that such wider analysis should be conducted (Nykvist & Nilsson, 2008). Finally, the role of a skilful chair, that brings together different opinions among politicians and other actors is emphasised in many of the studied committees.

To sum up, recent developments in policymaking around sustainable transport in Sweden shows a very partial and fragmented policy landscape. Many interesting developments can be seen and there is a take-off of alternative fuels and technologies (Nykvist & Whitmarsh, submitted). The result, however, is moderate adjustment to fuel taxation, no strategic plan for the expansion of public transport, and a rapid introduction of Ethanol as the primary solution to combat CO2 emissions in the transport sector. Although the introduction of biofuels constitutes an interesting and important trend; it is only a partial solution - not enough to constitute a transition to sustainable transport and also in itself a potentially short sighted option that risks building new lock-in effects when the global demand reaches its upper limit of sustainable levels of production.

2.4 Lessons from climate change policy-making

In contrast to the patchwork of policies on sustainable transport, our research on Swedish Committees confirms previous studies (Nilsson, 2006; Nilsson & Eckerberg, 2007) that policy learning and more long-term approaches to policy-making has indeed been developing over time for climate change. In this case, a series of broader Parliamentary Committees have addressed the national strategy on Climate Change. In the study conducted in MATISSE (Nykvist & Nilsson, 2008), two of the Committees were of this kind, and both revealed greater learning opportunities, and a broader perspective on sustainability. In terms of both policy outcomes and actual CO2 mitigation outcomes, greater progress has also been made, while the transport sector remains the problematic exception (Swedish Environmental Protection Agency, 2007). Also these Committees addressing Climate Change suffer from the same type of institutional barriers (Nykvist & Nilsson, 2008); but over time, the successive assessments on Climate Change policies have shown a substantial amount of policy learning (Nilsson & Eckerberg, 2007). Long-term polices in place include concrete reductions targets for 2012 (-4%, baseline 1990) and 2020(-25%, baseline 1990) and a goal of lowering emissions enough to secure no more than 2 degree C rise by 2050 (Prop, 2005/06:172).

Committees acting as an arena for learning and broader inclusion of stakeholders turn out to be an important function. Over time, this has contributed to enabling policy change in relation to Climate Change and eased the institutional barriers that exist. For sustainable transport, such a series of strategic committees do not exist, and potentially short sighted solutions are also an outcome.

3. Integrated Sustainability Assessment & its potential to deliver a sustainability transition

3.1 Integrated Sustainability Assessment

In response to the need for more strategic and systemic policy approaches to addressing persistent problems of unsustainability and to overcome the barriers to radical innovation discussed above, the MATISSE project is developing and testing tools and methods for Integrated Sustainability Assessment (ISA). ISA represents a fundamentally holistic and participatory approach to sustainability assessment (Weaver & Rotmans, 2006; cf. Gibson et al., 2005). ISA has been defined as a cyclical, participatory process of scoping, envisioning, experimenting, and learning (Figure 1) through which a shared interpretation of sustainability for a specific context is developed and applied in an integrated manner, in order to explore solutions to persistent problems of unsustainable development (Weaver & Rotmans, 2006). Consistent with the transitions and social learning literatures, stakeholder involvement is conceived of as being central to this process.

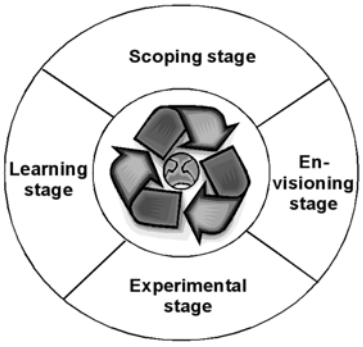

Figure 1. Integrated sustainability assessment

By conducting a pilot ISA of mobility, using newly-developed ISA tools and methods, we are interested in the potential for ISA to support strategic policy assessment in respect of sustainable mobility, and ultimately to deliver a sustainability transition. In particular, we are focussing on its value as a framework for exploring alternatives to the prevailing regime, enabling us to incorporate novel views and solutions, and addressing the importance of institutional and governance structures.

3.2 Developing novel ISA tools and methods

Here, we focus on a particular sub-set of ISA tools and methods developed within the MATISSE project, namely *transition simulation models* and *deliberative stakeholder workshops.*

3.2.1 Transition simulation model

Drawing on the MLP and on the social change and transitions literatures, we have developed a generic transition simulation model which captures both structure and agency and explicitly resolves the landscape, regime and niches within a particular social system (see Bergman et al., submitted; Haxeltine et al., in press). Our approach has predominantly used 'agent-based' modelling techniques to represent the regime and niches as aggregate 'agents', and consumer-citizens as simple individual actors. While we do not have a systems dynamics module included, we do combine our agents with systems dynamics thinking, in the interactions of agents with each other and with the landscape. The model also includes simple consumer/citizen agents who provide 'support' (an abstract concept that encompasses generation of resources and power through market, political and cultural processes) to the regime/niche sub-system agents; their decision to support a sub-system is based on the sub-systems' respective attractiveness (i.e. utility maximisation, using a formula similar to that of Schwoon 2005).

In the mobility application of the transition model, the *regime* is defined as private mobility using petrol/diesel internal combustion engine (ICE) technology. At time point 0 (year 2000), *public transport* is identified as an 'empowered niche' (i.e. it has enough structure and support

to potentially challenge the regime). Other niches are: *hybrid-electric vehicles, biofuel-powered vehicles, hydrogen fuel cell vehicles, urban ICT-centred lifestyles, car sharing, and slow modes*.

Agents are defined over a set of key variables called 'practices'. Practices are broadly defined and include technology production and consumption, transport service provision and use, and infrastructure provision and use. We have identified the least number of practices that can differentiate the various niches, empowered niches, and regime and which impact on the environmental, social and economic mobility criteria identified as relevant by stakeholders and the transport literature: *CO2 emissions [gCO2/pkm]; Cost [€/y]; Private mobility [pkm/y]; Public mobility [pkm/y]; ICT use [alignment with ICT trend; %];* and *Built environment [Mixed vs. single zone use; %].*

Five landscape and policy signals are used as exogenous inputs to the model, in an attempt to capture major predicted changes and plausible relevant policies (see Nykvist & Whitmarsh, submitted): *climate change influence on values* strongly pushes supporters' preferences towards lower CO2 emissions, while acceptance of higher external cost, due to a *rise in oil prices*, increases consumer's price practices, i.e., to accept a high price for the same quality of transport. Both are implemented as increasing step functions, appearing in the 2010s, and reaching maximum strength in 2022. The increase is not steady, but assumed to follow a step pattern, as society reacts to particular events. An *ICT wave* starts in 2007 and increases linearly over time, increasing ICT use amongst supporters. The policies of *public transport investments* and *planning of built environment* also act as weaker but steadily growing linear signals increasing public mobility and support for a planned urban environment with less transport requirement over time. These public policy measures are assumed to change gradually, because of the need to put into place large programs of expenditure and planning.

Figure 2 shows results from batch runs of the mobility application of the transition model. This suggests a biofuel (and hybrid) transition in road transport will occur in the medium term (around 2030), while hydrogen fuel cell vehicles take off in the longer term (by 2050). Behavioural/institutional niches (e.g., car-sharing, slow modes) see little growth.

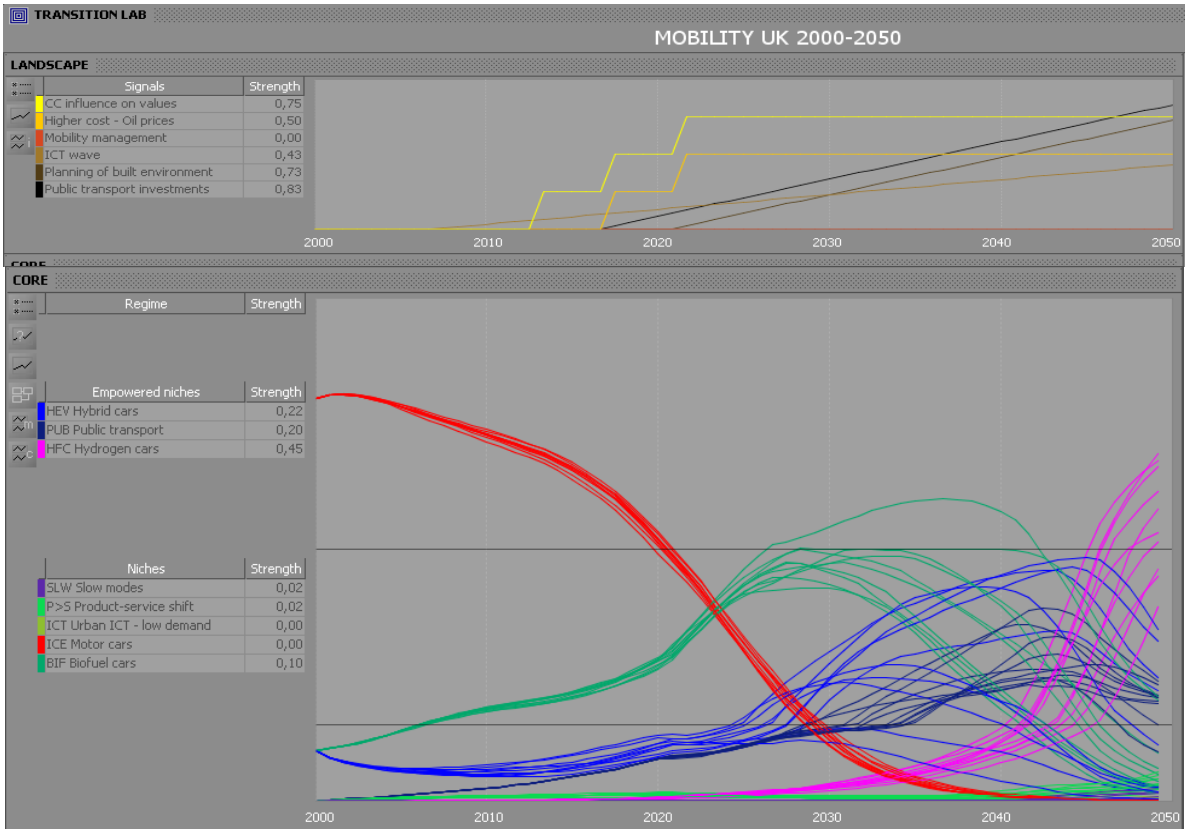

Figure 2. Batch runs of mobility application of the MATISSE transition model

3.2.2 Deliberative stakeholder workshops

In total, four stakeholder workshops on sustainable mobility were convened between February 2006 and June 2007: two with more 'expert' European stakeholders - i.e. professionals with knowledge about transport systems and transport technologies (from research/academia, automotive sector, energy sector, NGOs and government); and two with UK citizens - i.e. transport users. (Details of these workshops can be found in: Whitmarsh, 2007; Whitmarsh et al., 2007a; Whitmarsh et al., 2007b; Whitmarsh & Nykvist, in press) The workshops elicited stakeholders' criteria for sustainable mobility and their suggestions for how to achieve this future (i.e., visions of and pathways to sustainable mobility). Two different stakeholder engagement approaches were used according to participants' level of professional expertise in relation to transport: *expert focus groups and questionnaires*; and *citizen workshops and questionnaires*.

- *Expert focus groups and questionnaires.* As part of two joint workshops of several EU research projects on sustainability of transport technologies, MATISSE researchers conducted focus groups with, and distributed self-completion questionnaires to, stakeholders with interests and expertise in sustainable transport and hydrogen transport technology (workshop 1, N=44; workshop 2, N=32). Stakeholders were shown presentations of the aims of MATISSE (first workshop) and initial modelling and stakeholder findings (second workshop). Stakeholders were then allocated to one of several focus groups to discuss sustainable transport technologies and sustainable transport. Each group lasted around one hour and was facilitated by members of the MATISSE project team; at the end, participants were asked to fill in a self-completion questionnaire with more focussed questions that allowed respondents to express their opinions anonymously and elicited learning outcomes.
- *Citizen workshops and questionnaires.* Two workshops were organised in Norfolk, UK as part of two events to engage the public in science or environmental issues. A methodology similar to that developed by Kasemir et al. (2003) in the EU-funded ULYSSES project was used, in which spontaneous feelings and concerns are initially elicited via a 'visioning exercise', followed by expert input, followed by deliberation and elicitation of participants' informed opinions. Lessons from the Dutch COOL project were also applied (van de Kerkhof, 2006). Each workshop lasted 2½ - 3 hours, with a short coffee break. Self-completion questionnaire were distributed at the end of each workshop, which asked focussed questions and elicited learning outcomes. Each workshop involved around 15 participants.

3.3 Key results from our ISA of mobility

Scoping and envisioning phases. Our desk research exposed a range of social, economic and environmental problems associated with the prevailing road transport regime, which demand both technological and behavioural-institutional change. The scoping phase helped us frame the assessment in terms of a *range* of possible solutions, rather than simply a technological solution: initially, our case study focussed on hydrogen but was broadened to include behavioural-institutional innovations and a range of technological alternatives.

Our findings indicate different stakeholder groups agree on the need to address problems of unsustainability in the transport sector, and identify broadly similar environmental, social and economic criteria for sustainable transport. Many of these have been raised in previous research (e.g., SUMMA, 2005) and are reflected in European transport policy aspirations (European Commission, 2001a). Furthermore, our analysis has exposed different priorities and concerns amongst the stakeholder groups who participated in the research. Amenity of transport was more important for citizens, while experts focussed on pragmatic and technological issues. Both groups favoured modal shift and novel technologies, and citizens also supported demand reduction measures, to foster sustainable mobility. However, other UK research on citizens' attitudes suggests there are significant challenges to introducing demand management policies (Lethbridge, 2001). In sum, the diverse interests and expertise of stakeholders ex-

posed through our research have proven valuable in defining socially-robust concepts of sustainable mobility that can inform the ISA process.

Experimenting phase. Drawing on the stakeholder engagement work and on other sustainable mobility studies, we identified key areas of innovation (niches) and activities (practices) to include in our mobility transition model, and relevant policies to assess using this novel modelling tool. The model results indicate the potential for mobility niches to develop and potentially overthrow the incumbent regime. Hydrogen fuel cell vehicles were found to eventually dominate road-transport (after 2030), while biofuels and ICE-electric hybrids are the main alternatives to the regime in the next 10-30 years. This is because a) biofuels and hybrids are already developed, and b) they fit better into current infrastructures. The model shows that technological transitions are more likely than lifestyle change transitions; and that more radical forms of change require considerable pressure, sustained over a long time, from the landscape and from consumers. This radical institutional change is less likely to occur than change which is consistent with the interests of dominant (regime) actors. This argument is supported by the stakeholder work. We see a divergence in the preferred pathways – technological versus lifestyle change – to sustainable transport futures between the stakeholders more closely aligned with the regime (automotive firms, energy companies, policy makers, mainstream public) and the more environmentally conscious citizens we engaged with.

These results afford us insights into the difficulties of social change: there is resistance to radical change amongst the more powerful people; however, it is precisely those people who have the resources to bring about change. So, viable social change occurs when innovations are consistent with the interests of powerful groups, and to some extent the existing infrastructures and systems. This is also evident from historical studies of transitions (e.g., Geels, 2005; Smith et al., 2005).

Related to this, we can also assess the extent to which a sustainability transition is likely to be achieved within European transport through a combined analysis of the stakeholder work and modelling outcomes. Stakeholders identified a hydrogen transition (and other technological transitions) within transport as most likely to offer environmental and economic benefits (supply security, economic competitiveness, and reduced emissions), but also as potentially contributing to broader social problems associated with road transport (e.g., congestion, accidents, inaccessibility) particularly if private mobility demand increases as a result of such a technological transition. They also highlighted concerns about the impacts of increased biofuel use in transport. On the other hand, the citizens we engaged with were concerned with social aspects of sustainable transport, such as health and amenity. In terms of sustainability criteria, environmental and economic dimensions were apparently prioritised by many regime stakeholders, while social dimensions were more prevalent amongst (green) citizens' discussions. The modelling results, which show a technological transition as more likely than a behavioural/institutional transition, indicate that economic and (where consistent with this) environmental considerations for transport will be prioritised over social aspects of sustainable transport. The two strands of this conclusion are illustrated in Figure 3.

Learning phase. Eliciting input from both expert and non-expert stakeholders enhanced the social robustness of our ISA process. Furthermore, our assessment of learning outcomes from the process highlight that we have achieved both conventional (technical, adaptive) and social learning. Our stakeholder survey found three out of ten stakeholders felt they had changed their views about the topics discussed in the groups (see Whitmarsh et al., submitted). When asked what they had learned from the expert focus groups and citizens' workshops, in total three-quarters of stakeholders (rising to 83% of citizens) felt they had learnt something. Responses often referred to learning about other participants' points of view, as well as technological aspects, transport in other countries, and the complexity of transport issues.

There has also, of course, been considerable learning within the project amongst researchers - from stakeholders, as well as from the desk research and modelling work conducted. As mentioned, the results of our stakeholder engagement work (and desk research) was vital for the scoping stage of our ISA; rather than restricting our assessment to hydrogen-based transport (as

originally intended), we have broadened it to encompass a range of technical and behaviour options for addressing 'unsustainable mobility' (Whitmarsh & Nykvist, in press). As indicated in this paper and elsewhere (e.g., Tuinstra et al., in press), stakeholder perspectives have, in fact, been incorporated into each stage of the ISA process: scoping, envisioning, experimenting and learning.

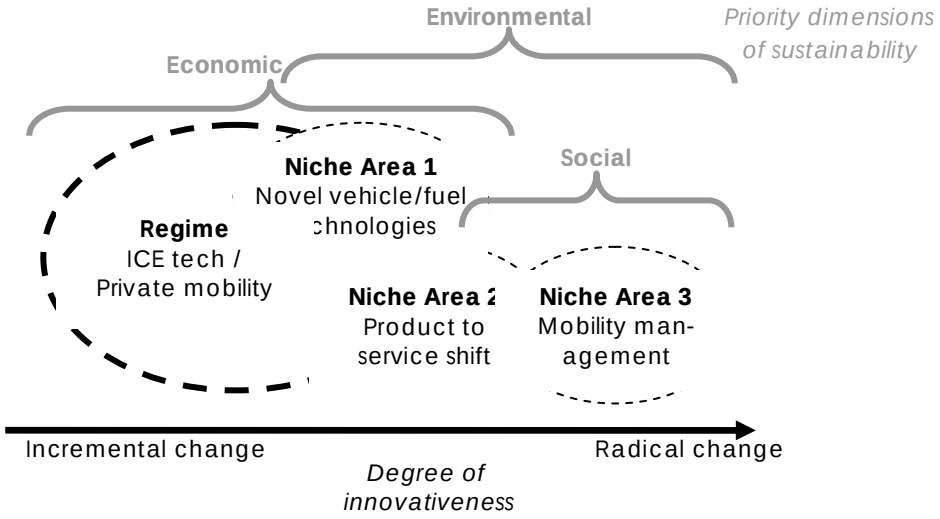

Figure 3. Indicative model of the relative innovativeness and priority dimensions of sustainability for the road transport regime and three niche areas. The regime and niche area 1 favour economic dimensions; niche areas 2 and (particularly) 3 are more aligned with social dimensions; environmental aspects are a feature of all three niche areas. The regime favours incremental change, while niches 1, 2, and 3 are, increasingly, more radical. (The outlines of all three niches and the regime are broken because of the dynamic and heterogeneous composition of niche/regime membership.)

4. Conclusions and implications for sustainability policy-making and assessment

Although sustainable development is an aspirational goal for European policy-making, in reality there are various barriers to achieving this aspiration. These exist at the technical and social level, but are also embedded within the governance and assessment context. Crucially, sustainability policy-making is hampered by a tendency towards sector-based, short-term and often techno-fix perspectives. In the case of transport, this is exemplified by a focus on hydrogen and biofuel vehicle technologies, which do not address (or exacerbate) many aspects of unsustainability in the mobility system. A more holistic perspective suggests there is a need for both technological and behavioural-institutional innovations to achieve a sustainable mobility transition. Furthermore, our policy interviews with Swedish Committee members suggest appropriate institutional contexts for advancing sustainability should apply a broad mandate and a strategic perspective. Over time, committees given such instructions have acted as learning arenas resulting in policy change in the case for climate change policies, and a similar development would be needed for a transition to take off in the area of sustainable transport.

In this paper, we have described a novel assessment framework - Integrated Sustainability Assessment (ISA) - that may help address mobility problems in a more systemic, integrated manner and overcome governance barriers to radical innovation. Our initial steps to advance ISA suggest the process is valuable for structuring a sustainability assessment of mobility; and our novel ISA tools and methods have helped us include a range of stakeholder perspectives and form a long-term and cross-sectoral view about mobility systems.

Policy implications from our multi-method research are that:

1) Citizen and other stakeholder views should be included in policy-making and assessment. In particular we found citizens to be *more* supportive of mobility management –

and social dimensions of sustainable transport than (predominantly regime) expert stakeholders, who tend to favour technological solutions above all;

2) Niches should be fostered and successful experiments (e.g., congestion charging) up-scaled (see literature review findings in: Nykvist & Whitmarsh, submitted);
3) Without longer term and *cross-sectoral* thinking, we risk locking society into (new) potentially unsustainable transport solutions; and the biofuels options constitute such a risk. This was suggested by the modelling results and policy interviews, and is consistent with much of the transport literature.

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