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Participation of Experts and Non-Experts in a Sustainability Assessment of Mobility

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ABSTRACT

The complexity, ambiguity and subjectivity that surround persistent problems of unsustainability, such as mobility, highlight the importance of stakeholder engagement in both knowledge production and policy development. This paper reports on research within the EU-funded MATISSE project to develop tools and methods for Integrated Sustainability Assessment (ISA), a novel interdisciplinary and participatory approach to sustainability strategy development. Two different methods – expert focus groups and citizen deliberative workshops – were employed to elicit knowledge and preferences of European stakeholders in respect of sustainable mobility. Findings from these exercises indicate areas of both convergence and divergence in the visions of sustainable mobility futures depicted by different stakeholder groups. Stakeholders agreed on the need to address problems of unsustainability in the transport sector, and identified broadly similar environmental, social and economic criteria for sustainable transport. 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 and choices; however, a range of barriers to achieving sustainable mobility was also identified by participants. Stakeholder feedback suggests the process was valuable and acted as a forum for social learning and the co-production of knowledge by citizens and experts, while at the same time empowering these groups to participate in an important social issue such as transport. The value and limitations of these methods for ISA are discussed and avenues for further research proposed. Copyright © 2009 John Wiley & Sons, Ltd and ERP Environment.

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Introduction

In this paper, we discuss work within the EU-funded MATISSE project to involve a range of stakeholder groups in sustainability assessment. Recent years have seen a growth in interest – amongst both policy-makers and researchers – in involvement of societal actors beyond the scientific community in science and policy (see, e.g., House of Lords Select Committee on Science and Technology, 2000). This interest stems, at the most profound level, from post-modern epistemological challenges to scientific hegemony (Beck, 1992) and a realization that legitimate and effective policy-making demands a more participatory approach (van de Kerkhof, 2006). Scientific controversies, technological risks and environmental problems highlight the need to reconsider the science–policy relationship (see, e.g., Irwin and Wynne, 1996). Risk assessments, for example, have exposed 'pervasive uncertainties and unacknowledged assumptions' (Owens, 2000, p.1142). These epistemological and democratic concerns have served to reduce the distance between 'experts' and 'citizens' (Jasanoff, 1997) and define new categories of 'lay experts' and 'citizen scientists' (see, e.g., Irwin, 1995).

Thus, there have been calls to reconcile supply and demand for science (Sarewitz and Pielke, 2007), and to move towards 'co-producing' knowledge (see, e.g., Pohl, 2008) and 'up-streaming' stakeholder engagement in the policy-making process (Rogers-Hayden and Pidgeon, 2007). In contrast to traditional science, this focus on participation is consistent with the notion of post-normal science (Ravetz and Funtowicz, 1991a, 1991b) or 'Mode 2' science, which is more inter-disciplinary, socially accountable and applied than traditional scientific models of knowledge production (Gibbons *et al.*, 1994).

Stakeholder engagement is seen as particularly relevant to sustainability decision-making given the complexity, ambiguity and subjectivity that surround persistent problems of unsustainability. 'Sustainable mobility', for example, means different things to different groups and implies trade-offs between different desirable characteristics, such as freedom of movement, economic competitiveness and environmental protection (European Commission, 2001a, 2006; Joint Expert Group on Transport and Environment, 2000; SUMMA, 2005). Stakeholder participation is thus advocated for substantive, normative and instrumental reasons (Fiorino, 1990). That is, it can improve the quality of decision-making by drawing on diverse knowledge; allow explicit representation of diverse social values and personal preferences in decisions about what future we 'should' and 'would like to' have; and potentially – through the process itself – foster trust, ownership and learning amongst participants (Pahl-Wostl, 2006).

Along similar lines, Blok (2007) points to three benefits, or virtues, of public deliberation: *civic virtue* (producing more informed and involved citizens), *governance virtue* (enhancing the legitimacy of decisions) and *cognitive virtue* (fostering learning). He concludes that cognitive virtues of participation will be greater in cases characterized by radical uncertainty, fact–value overlap and intractable controversies, such as environmental issues (cf. Funtowicz and Ravetz, 1993).

There is much literature that has examined the types of learning – or cognitive virtue – that may be pursued and achieved through stakeholder participation in sustainability science (e.g. Siebenhüner, 2004). This research suggests there are different levels at which learning can occur – ranging from technical, through conceptual, to paradigmatic (Van de Kerkhof and Wieczorek, 2005), also classified as 'single-loop learning', 'double-loop learning' and 'triple loop' or 'deutero-learning' (Argyris and Schön, 1978, 1996; Hall, 1993). While single-loop learning involves adaptation and error correction in respect of a fixed goal, double-loop learning is more fundamental and connects error correction to adjustment of underlying objectives, values, norms and beliefs. Double-loop learning is needed for re-conceptualization and re-framing within issue domains. Triple-loop learning is learning at the meta-level, or 'learning to learn' (Argyris and Schön, 1978). Social interaction appears to be particularly appropriate to foster double-loop learning since it involves an encounter with other stakeholders' beliefs and values. This interest in learning through collective engagement has led to a growing popularity of 'social learning' as a framework for sustainability assessment and management (see, e.g., Keen *et al.*, 2005; Social Learning Group, 2001; Steyaert and 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.

Important countervailing evidence for the value of citizen involvement in sustainable policy development also exists, however. In an investigation of Munich's transport policy development, Hajer and Kesselring (1999) found

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that new, more democratic practices produced *less* effective (in terms of sustainability) outcomes, compared with their neo-corporatist counterparts. Nevertheless, the authors conclude that experiments with new democratic practices should not be abandoned, not least because they provide opportunities for incorporating new players and forms of knowledge into policy-making. Rather, the challenge remains to consider how such new practices interact with, and could potentially transform, broader institutional arrangements and governance structures.

Developing Effective Participatory Methods for Sustainability Assessment

Building on the evidence that considering diverse perspectives can improve the validity and applicability of assessment (Gibson *et al.*, 2005), the challenge for researchers is to identify effective methods and enabling frameworks for achieving this. Empirical research shows that there are practical barriers to effective stakeholder participation, such as adoption of inappropriate participatory approaches, lack of managerial skills or capacity, inadequate policy and legislation, and flawed institutional practices (e.g. Owens, 2000; van de Kerkhof, 2006).

To overcome some of these procedural obstacles in pursuing participation, recent research and practical initiatives have attempted to advance current methods and approaches for enabling dialogue and engagement with the public and other stakeholders in the science and policy spheres. Participatory Integrated Assessment (PIA) has been developed as an interactive and iterative participatory process that aims to accommodate the uncertainties, complexities and value diversities by taking into account the social context in which scientific and political activities operate. PIA techniques involve stakeholders in different phases of the assessment processes for the purpose of supporting policy-making (see, e.g., Hisschemöller *et al.*, 2001; Schlumpf *et al.*, 1999). One particular participatory method, Consensus Conferences (Joss and Durant, 1995), has enabled 'lay people to exercise their scientific citizenship' and opened up 'technoscientific black boxes' (Blok, 2007, p. 164). In the Netherlands, the concept of Transition Management has been implemented by the government to foster sustainable development. This process involves forming a network of social actors with divergent interests and expertise working together to define the unsustainability problem, develop sustainability 'visions' (long-term concepts) of the future, identify appropriate 'pathways' (scenarios) and policies to achieve that future, and evaluate the process (see, e.g., Rotmans, 2005). These emerging participatory approaches have been influential in our development of Integrated Sustainability Assessment methods, discussed in the next section.

Stakeholder Involvement in Integrated Sustainability Assessment

In response to the need to deal with persistent problems of unsustainability, the European project, MATISSE[1], developed and tested approaches for Integrated Sustainability Assessment (ISA), as a fundamentally participatory approach to sustainability assessment (Weaver and Rotmans, 2006; cf. Gibson *et al.*, 2005). The MATISSE project aimed to advance ISA in EU policy-making by improving the tool-kit and methods available for developing and assessing sustainability strategies. 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 and Rotmans, 2006).

Specifically, in our research within the project, we have worked with stakeholders to

- construct 'visions' of, and 'pathways' to, sustainable futures – that reflect their experiences, views and concerns;
- understand their decisions and interactions – and represent these in simulation models;
- test and improve participatory methods for policy assessment and social learning and
- disseminate our research and raise the profile of institutions involved in MATISSE.

Stakeholders thus had two main roles in the project: knowledge/expertise providers; and shapers and recipients of research findings. Communication and learning have involved a *two-way exchange* between stakeholders and project researchers.

[1]Methods and Tools for Integrated Sustainability Assessment (MATISSE). MATISSE was supported by the Sixth Framework Programme of the European Union. Contract number 004059 (GOCE) See www.matisse-project.net

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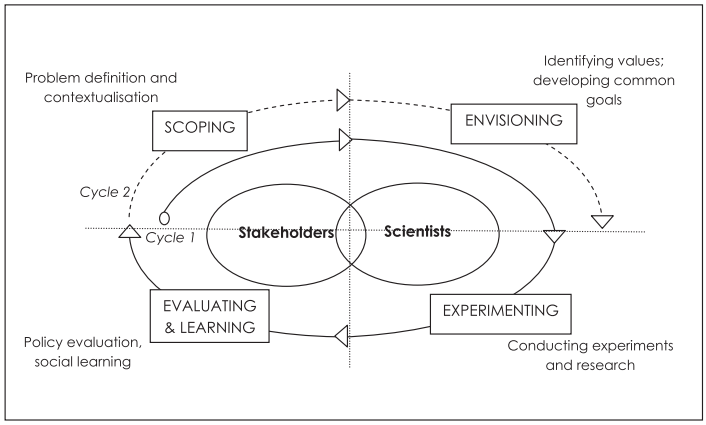

Figure 1. Integrated sustainability assessment (adapted from Weaver and Rotmans, 2006)

This paper represents an early investigation into the value of participatory methods for ISA. The aim of the research reported here is twofold: first, to elicit the perceptions, knowledge and experiences of different stakeholder groups in respect of sustainable mobility; and second, to foster social learning amongst stakeholders and researchers, using appropriate participatory methods. Preliminary results from this research, and its use in developing simulation models, were outlined by Whitmarsh and Nykvist (2008); here we detail full results and analyse findings in terms of the participatory and social learning literatures discussed above.

A Case Study of Integrated Sustainability Assessment for Mobility

Mobility systems today are characterized by environmental, social and economic unsustainability in a number of respects. Road-based land transport suffers from serious problems such as congestion, emissions of greenhouse gases and local air pollutants, noise, accidents, depletion of resources and inaccessibility of amenities and services (see, e.g., European Commission, 2001a; European Environment Agency, 2006). Policy solutions to tackle these persistent problems have focussed on improving technologies and (to some extent) encouraging modal shift, but these have done little to address the underlying growth in mobility demand (European Commission, 2001b). It has therefore been argued (see, e.g., Kemp and Rotmans, 2004) that a *transition* – radical systemic innovation (see, e.g., Geels, 2005) – is required to move away from the current transport regime and towards a more sustainable mobility system. Such a transition is likely to require both technological and institutional changes (e.g. electric and fuel cell vehicles, customized mobility, teleworking, zoning policies) (Elzen, 2005; Nykvist and Whitmarsh, 2008).

Stakeholder perspectives on transport technologies and policies have been elicited in several previous studies (e.g. Bristow *et al.*, 2004; O'Garra *et al.*, 2005; Office of Science and Technology, 2005; Sayer, 2003). This research tends to elicit *expert* stakeholder opinion and highlights a need for both technological and non-technological measures to tackle rising transport demand. It also exposes divergent values and objectives amongst different stakeholder groups, such as transport service providers, road users and researchers (Bonsall *et al.*, 2005; Ison and Wall, 2003).

Studies also exist of *public* perceptions of transport planning and policy (e.g. Bickerstaff and Walker, 2001; Loukoupolos *et al.*, 2005; Richardson *et al.*, 2007). This research highlights significant challenges to introducing demand management policies. For example, while the UK public expresses concern about pollution and congestion levels (Lethbridge, 2001) and acknowledges the link between transport and climate change (DEFRA, 2002; Department for Transport, 2009), there is growing resistance to measures to curb car use (e.g. raising road or fuel taxes; Lethbridge, 2001; Owen *et al.*, 2007; Richardson *et al.*, 2007). This highlights the widespread association between driving on one hand, and quality of life, status and identity on the other (see, e.g., Steg *et al.*, 2001), and the range of barriers to changing travel behaviour, including habits (Verplanken *et al.*, 1998), limited (or unattractive)

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alternatives to driving (Davies *et al.*, 1997; Lorenzoni *et al.*, 2007; Lyons *et al.*, 2008) and perceived inequity of pricing policies (King *et al.*, 2009).

Both expert and public perspectives on transport have typically been elicited through conventional survey or interview approaches (e.g. Department for Transport, 2009). While these provide valuable insights into the likely effectiveness and acceptability of transport policies, they do not allow for exploration of the inconsistencies and trade-offs associated with transport. For example, these surveys highlight the apparent contradiction between the public's acceptance and experience of problems with road transport on one hand and their unwillingness to change their behaviour on the other. Here, qualitative methods afford us insights into the deeper institutional and social aspects of such sustainability dilemmas (Lorenzoni *et al.*, 2007), while deliberation can also expose dissonant attitudes and behaviour and lead to greater willingness to change behaviour (King *et al.*, 2009). Furthermore, the little research that has been conducted to elicit the views of the non-expert public on novel transport technologies such as hydrogen and fuel cell vehicles suggests that only a small minority know anything about these technologies (O'Garra *et al.*, 2005). This highlights a need to provide deliberative fora in which non-experts can learn about and interact with scientific and technical information about emerging technologies and proposed policies. Moreover, recent empirical work suggests that 'transport forums' designed to elicit stakeholder perspectives in the planning of urban transport systems can play a valuable role in local democracy (Ward, 2001). Real-world examples of stakeholder involvement in transport policy development and assessment highlight the potential to strengthen the institutional arenas for social learning in order to promote the integration of sustainability principles into policy-making (Nykvist and Nilsson, 2009). The research reported here thus applies deliberative methods to sustainable transport assessment in order to create a more meaningful role for non-experts and a method for understanding discourses and institutional dimensions of citizen–transport system interactions.

Our research builds on and extends this previous work on stakeholder perspectives of sustainable transport futures. However, in contrast to this earlier work, the aim of the MATISSE research was to elicit both expert and non-expert stakeholder perspectives about sustainable mobility futures and pathways, and to identify where these groups hold similar and divergent views. The aim of this strategy was not only to provide a robust assessment of sustainable mobility, but also to inform debates about participatory processes of governance and assessment. In this sense, our study employs a more integrative and reflexive focus than in most previous studies on transport futures, by assessing the potential for different transport technologies and policies to meet society's needs and preferences for transportation.

Research Approach

Early on in the project, we identified relevant transport 'stakeholders' – i.e. those who can influence transport decisions or who may be affected by these decisions (see, e.g., Grimble and Chan, 1995) – and have endeavoured to invite representatives from these groups to workshops at which participants have been asked to define sustainable mobility and suggest pathways to achieve it. In practice, we were unable to engage directly with all relevant stakeholder groups (partly due to cost constraints, discussed later); thus, literature reviews have provided a means of engaging with some groups (e.g. public transport providers) by proxy.

Stakeholders were invited to attend a workshop, and asked to complete questionnaires, as part of the process of identifying 'visions' of, and 'pathways' to, sustainable futures (i.e. sustainable mobility in Europe), and to measure learning during the workshops. 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*. The two respective designs are described below.[2] The rationale for using both group discussion and individual self-completion questionnaires for the formal stakeholder engagement processes is that

[2] We chose to use different methods in dealing with citizens and experts because of their divergent backgrounds and prior knowledge. However, using different approaches means we cannot always directly compare the findings from these workshops. Nevertheless, the results provide *indicative* differences in the understanding and priorities of these two groups. Similarly, the different geographical scope of the two sets of workshops (experts – European focus; citizens – East of England regional focus) should be considered when comparing the two sets of findings.

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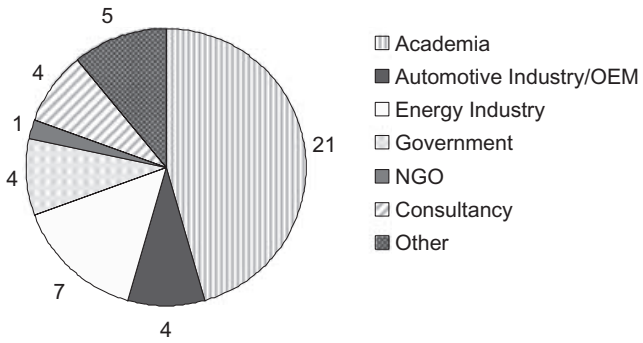

Figure 2. Background of expert participants (Workshop 1)

there are general advantages and limitations to each method. For example, qualitative approaches can expose the range of beliefs and their construction in a social setting; while quantitative methods allow researchers to ask more focussed questions and to compare responses from different groups. Thus combining these qualitative and quantitative research methods provides a complementary strategy for knowledge elicitation and social learning.

Focus Groups 1

The aims of the first set of focus groups and questionnaires were to elicit stakeholders' visions of sustainability in relation to both transport in general and hydrogen transport technology in particular; and their views on viable pathways, and any barriers, to sustainable hydrogen-based transport. This paper focuses on findings relating to sustainable transport in general; participants' views on hydrogen technologies are reported elsewhere (Whitmarsh and Wietschel, 2008).

Participants at this workshop, held in Frankfurt in 2006, included researchers and consultants, an NGO representative, policy-makers and members of the automotive and energy industries from across Europe, with interests and expertise in hydrogen and transport technologies (see Figure 2). While this does not represent a comprehensive range of transport stakeholders, it includes key decision-makers in hydrogen technologies and sustainable transport (Whitmarsh and Wietschel, 2008). Furthermore, most of the participants can be considered *experts* in hydrogen technologies and sustainable transport, with researchers constituting the largest proportion of participants.

All workshop participants ($N = 44$) were assigned to one of five focus groups according to the stakeholder 'category' they represented (i.e. automotive industry, energy industry, research/academia, consultancy, NGO and policy/government). The groups comprised both heterogeneous and homogeneous categories of stakeholders; this enables a comparison of group dynamics and social learning amongst similar and diverse stakeholder groups. Group 1 comprised all research stakeholders, and Group 5 all energy industry; the remaining groups had mixed stakeholder composition. All represented a gender mix, except Group 4 (all men).

At the end of the focus group discussion, participants were asked to fill in a self-completion questionnaire with more focussed questions that allowed respondents to express their opinions anonymously. All 44 questionnaires were returned completed.

Focus Groups 2

The second set of focus groups held in Frankfurt in June 2007 used the same approach as the first, namely pre-assigned groups and self-completion questionnaires. The workshop presentations and stakeholder questions posed in these focus groups and questionnaires built on the findings from the previous workshop in 2006 and modelling work conducted in the interim. Thus, the aims of the June 2007 focus groups and questionnaires were to elicit feedback from stakeholders on the appropriateness of the visions, pathways and model results produced in MATISSE, to discuss the relative contributions and drawbacks of hydrogen, biofuels and other alternatives in fostering sustainable mobility, to feed stakeholders' views and needs into the ISA planning process and tool

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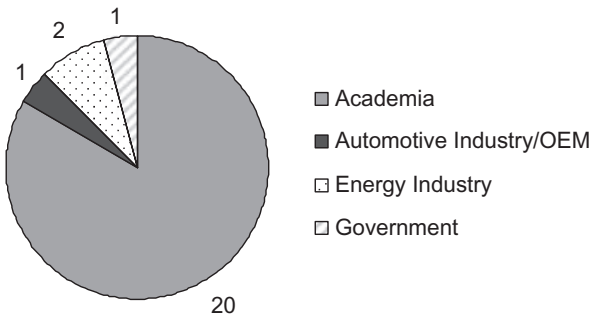

Figure 3. Background of expert participants (Workshop 2)

development in the project and to foster social learning, through group discussion, amongst both stakeholders and researchers.

As before, workshop participants ($N = 32$) were assigned to focus groups according to their stakeholder 'category' and gender. Again, the groups comprised both heterogeneous and homogeneous categories of stakeholders: two groups were homogenous groups of research stakeholders (both mixed gender), and two were heterogeneous groups of research, policy and industry stakeholders (one all male; one mixed gender). As before, most participants came from academia (see Figure 3).[3] This is a higher proportion of researchers than attended the previous stakeholder workshop, in which under half were researchers. There is notable overlap between the two workshops in terms of attendees: participants from the first workshop (as well as the wider stakeholder community) were invited to the second. Around half the participants at the second set of focus groups had attended the first set.

Citizen Workshops and Questionnaires

Two three-hour workshops were organized in Norfolk, UK, in September 2006 and March 2007. 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' (of which around 20 minutes was spent working individually to identify visions and 40 minutes discussing these in small groups), followed by 30 minutes of expert presentations (on problems of unsustainability in transport, and various technological and behavioural options for addressing them) with one hour of group discussion and deliberation, and finally elicitation of participants' informed opinions via a voting exercise (on preferred options for sustainable transport) and self-completion questionnaires (on preferences, learning outcomes and demographic characteristics). Lessons from the Dutch COOL project were also applied. In particular, in the visioning exercise we asked participants to identify two, rather than one, future visions (their 'ideal' and 'expected' future transport systems) to help them think more freely about alternative developments (van de Kerkhof, 2006). The citizen workshop design was intended to allow participants to 'observe' the process of knowledge elicitation/construction for themselves, with flipchart notes from the small group discussions stuck to the wall (and key points from these groups summarized by the lead facilitator) and the outcome of the voting exercise immediately visible. Participants were also asked in the evaluation questionnaire whether they would like to be sent results from the research. Providing feedback in this way is intended to highlight the value of participation and foster a sense of collaboration in the research.

The aim of the workshops was both to elicit information about citizens' perceptions and concerns, and to provide information about novel transport technologies and policies. In this sense, the workshops involved two-way exchanges of information, and were intended to result in mutual learning between citizens and researchers.

Each workshop involved around 15 participants.[4] Participants included 34 men and 26 women and a range of age groups (24 or under, 8; 25–44, 14; 45–64, 14; 65 or over, 3; not stated, 21). The population was relatively

[3] There are minor disparities here between the stakeholder categories defined in advance for participants and summarized above, and those identified by stakeholders themselves as indicated in the questionnaire responses.
[4] In most cases, participants attended only one workshop, though a few came to more than one. Most attendees lived in Norfolk.

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representative of the local population, although workshop participants had a higher average level of education than the local (or national) population (see Whitmarsh, 2007, for further demographic details). Importantly, the citizen workshops, which 'piggy-backed' on broader programmes of public events in order to reduce costs (e.g. advertising, room hire), inevitably drew relatively educated and environmentally aware participants, and so do not necessarily represent the wider regional (Norfolk) or national (UK) populations. To mitigate this limitation, the views of stakeholders elicited in other studies (mentioned earlier), are also discussed where they deal with the same topics as addressed in this study.

Results

Stakeholders' Visions of, and Pathways to, Sustainable Mobility

Table 1 summarizes the definitions of sustainable mobility that emerged from stakeholder workshops conducted within MATISSE. Overall, we see that environmental, social and economic criteria were mentioned; yet

	Experts		Citizens
	Criteria	Group(s) which mentioned[1]	Criteria
Environmental	Renewable (inexhaustible supply)**	All	Renewable-fuelled vehicles
	Low/zero emissions – particulates and GHGs; no toxic waste	2, 3, 5	Low/no pollution; clean vehicles**
	Efficiency	1, 2, 4, 5	Energy-efficient vehicles
Economic	Competitiveness	1, 2, 3, 4	Job creation, cheap/affordable
	Flexibility/synergy between sectors	1, 2, 3	
	Prices reflect real value/externalities	1, 2, 4, 5	Fiscal/policy change to cut pollution/congestion
	Available infrastructure	2, 3, 4, 5	Integrated**
Social	Energy supply security	2, 3, 4	
	Diversity of supply	1, 2, 4, 5	
	Low/no congestion	2, 4	Modal shift and reduced demand; local amenities/workplaces [liveability]
	Political, industrial and public support	1, 2, 3, 4	
	Safety	4	Safety
	Social inclusion	1	Public transport**, walking and cycling; accessible
	Personal freedom	3, 5	Personal transport, moderate levels of transport
			Reliable/regular, fast, fun, enjoyable, choice, clean, aesthetic [amenity/utility]

Table 1. Stakeholder criteria for sustainable mobility (see also Whitmarsh and Wietschel, 2008)
** Most popular responses.
[1] Based on first set of expert focus group discussions, group composition is as follows:
- Group 1 = 10 research stakeholders only (4 women, 6 men)
- Group 2 = 3 research, 1 consultancy, 1 policy, 1 NGO, 3 energy industry and 1 automotive industry stakeholders (2 women, 8 men)
- Group 3 = 2 research, 4 consultancy, 2 policy-makers, 1 automotive industry and 1 energy industry stakeholders (1 woman, 9 men)
- Group 4 = 2 automotive industry, 1 energy industry and 3 research stakeholders (6 men)
- Group 5 = energy industry stakeholders only (2 women, 4 men).

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environmental aspects (emissions, depletion of resources) tended to be emphasized. For citizens, integrated, public transport was also very important. A comparison of the two stakeholder groups suggests that transport users (i.e. citizens) focussed more on the experiential aspects of transport. The attractiveness/amenity of transport was evidently more important for citizens than for experts, who focussed on macro-level pragmatic and technological issues such as energy supply. The emotional, hedonic and symbolic dimensions of transport (Jain and Lyons, 2008; Steg *et al.*, 2001) remind us that day-to-day transport decisions are often not the outcome of 'rational' processes (Verplanken *et al.*, 1998), representing a challenge for changing travel behaviour.

There is also some divergence *within* the broad 'expert' category, consistent with evidence from previous studies that highlights the different positions and values held by transport stakeholders (e.g. Bonsall *et al.*, 2005). While all groups mentioned renewable energy sources as a sustainability criterion, only one group (comprising only researchers) mentioned social inclusion. Similarly, safety was only mentioned by one group, although this group comprised a mixture of stakeholder categories.

Past research has defined sustainable mobility in terms of similar social, economic and environmental aspects. For example, the EU-funded 'Sustainable Mobility, Policy Measures and Assessment' project (SUMMA, 2005), defines sustainable mobility in terms of economic (accessibility, transport operation cost, productivity/efficiency, costs to economy), environmental (resource use, direct ecological intrusion, emissions to air, emissions to soil and water, noise, waste) and social dimensions (accessibility and affordability, safety and security, fitness and health, liveability and amenity, equity and social cohesion, and working conditions in the transport sector). MATISSE stakeholder criteria for sustainable mobility are a subset of SUMMA criteria.

Tables 2 and 3 summarize stakeholders' preferred policy options for sustainable mobility. Both groups support modal shift and novel vehicle/fuel technologies, while there is more support for reduced transport demand (i.e. slow modes and local lifestyles) amongst the citizen group than amongst the expert group. Economic policies are more popular amongst expert stakeholders than amongst citizens.[5]

Preferred options for future transport (MATISSE citizen workshops)		Total*
Behaviour/value/infrastructure change	Walking/cycling to work, shops etc.	**52**
	Car-free developments	**38**
	Improved public transport	**32**
	More teleworking (i.e. working from home)	**15**
	'Home zones'	**16**
	Car sharing	8
	Bike pool	6
	Car pools/hire	5
	Road–rail system (individual pods on tracks)	5
RD&D, technology	Hybrid cars (e.g. Toyota Prius)	**13**
	Hydrogen and fuel cell cars/buses	**11**
	Biofuel cars/buses	7
	Jet packs	4
	Bus tracking system	4
	GPS	2
	Improved road signage	4
Economic policies	Congestion charging	9
	No change from present	1

Table 2. Citizens' preferred options for future transport
* Participants were asked to allocate ten votes between options (a pre-defined list was provided, but participants could also add options) at the citizen workshops in September 2006 and March 2007.

[5] In part, such differences may arise because of the type of participant who participated in the workshops – i.e. primarily transport technology experts and more environmentally aware citizens – and the variation in question format – pre-defined list versus open ended – between the two groups.

DOI: 10.1002/eet

Preferred options for sustainable mobility (MATISSE expert workshop)		Total*
Behaviour/value/infrastructure change	Support/provision of public transport	6
	Modal shift/car sharing	3
	Local lifestyles/reduced demand/land-use planning	2
	Reduction of energy consumption	2
	Changing/influencing behaviour	1
	Changing attitudes (question need for SUVs)	1
	Abolish paradigm of endless economic growth	1
	Individual transport by car/individual transport	2
RD&D, technology	R&D of new technologies	4
	Subsidies for alternative fuels and infrastructure	2
	Increase vehicle/fuel efficiency	1
	Demonstration projects	1
	H_2 is long-term solution; biofuels only mid-term	1
Economic policies	Pricing policies	6
	Taxation	4
	Shipping and operation taxes/tolls	1
Regulation/targets	Reduced parking in cities	1
	Regulation	1
	Carbon intensity target on fuel supply	1
	No answer	2

Table 3. Expert stakeholders' preferred policy options for sustainable mobility
*Coded responses to the open-ended survey question 'What policies are most appropriate to foster sustainable mobility in Europe?' asked at the June 2007 expert workshop.

The second expert workshop explicitly addressed participants' views about the role of transport technologies in fostering sustainable mobility. Responses indicate that participants see technological solutions as crucial for sustainable mobility; almost two-thirds agreed that 'introducing new transport technologies is the main way to foster a sustainable transport system in Europe' (see Table 4). This confidence in technology, which was also expressed in the expert focus groups, contrasts with the preference for behaviour-change approaches amongst citizen participants.

Previous research to elicit stakeholders' perspectives on transport policies also highlights the need for both technological and non-technological measures to tackle rising transport demand (see, e.g., Bristow *et al.*, 2004; Office of Science and Technology, 2005; Sayer, 2003). Compared with another recent survey of UK transport stakeholders (Archer, 2007) – which found vehicle regulation and tax incentives were most popular – there is less support for regulation and more support for modal shift amongst both groups of MATISSE stakeholders.

The support for demand management measures amongst the citizen groups is noteworthy. As discussed earlier, representative UK surveys of public attitudes to transport and transport policy highlight significant challenges to introducing demand management policies. This suggests that the citizens who took part in the MATISSE workshops were more environmentally conscious than the broader UK population.

Stakeholders' Perspectives on Barriers to Sustainable Transport

Participants in the small group discussions of the citizens' workshops identified a range of political/institutional (22), cultural (17), financial (13), physical (7) and technological (5) barriers to achieving their ideal transport future (see Table 5). Implicitly, participants recognized a number of 'lock-ins' that further the continuation of unsustainable transport, including physical and cultural dependence on cars.

The greater focus of citizens on cultural, political and institutional barriers, rather than technological obstacles, is consistent with the participants' visions of ideal transport, which focussed on lifestyle changes. Many citizens

DOI: 10.1002/eet

Attitude statement (questionnaire in 2007 expert workshop)	Agree strongly (5)	Agree (4)	Neither agree nor disagree (3)	Disagree (2)	Disagree strongly (1)	Mean	SD
Introducing new transport technologies is the main way to foster a sustainable transport system in Europe	6	9	2	6	1	**3.52**	1.27

Table 4. Expert stakeholders' views on the role of transport technologies in fostering sustainable transport

Category	No of times mentioned
Financial	
Money/economics (e.g. limited funding)	9
Corporate interests/profit motive	4
Cultural/psychological	
Mindsets/preferences	4
Car culture	5
Unattractiveness of public transport	2
Individualism	1
Convenience/time pressures	3
Enjoy air travel	1
Want choice	1
Political/institutional	
Lack of political will/leadership	5
Politics (general)	2
Short-termism	3
Risk aversion/inertia	3
Inconsistency (over time)	1
Dependence on fuel/oil	3
Lack of personal control/influence	3
Social inequality (e.g. rich can afford fines)	2
Physical lock-ins	
Urban sprawl	2
Built-in dependence on cars	2
Distribution of social networks	1
Inadequate infrastructure for cycles	1
No local seaport	1
Technological	
Technological indeterminism	3
Difficulties with energy sources (general)	1
Not enough biofuels	1

Table 5. Barriers to ideal transport identified in citizens' small-group discussions

implicitly placed responsibility with governments; indeed, three participants explicitly expressed a lack of personal influence in respect of improved transport.

Although technological and infrastructural issues were uppermost in the responses given by experts, 'lack of vision, leadership and policy' was also amongst the most popular responses to the question of barriers to achieving long-term, widespread sustainable use of hydrogen in road transport at the February 2006 workshop (Whitmarsh *et al.*, 2007). In the 2007 workshop, expert stakeholders were asked about the barriers to achieving sustainable transport in its broader sense. Here, they focussed more on institutional and social barriers. In particular,

DOI: 10.1002/eet

participants described institutional and infrastructural inertia impeding change in transport systems. They also referred to the emotional and cultural barriers to tackling car use. One member argued 'people personalize cars; the most emotional link you have to a product is to your car; it's a symbol, a flag you wave'. Indeed, research was cited that points to the reluctance of most people to give up their car in the face of economic disincentives: 'if gasoline prices increase people tend not to cut down on car use, but rather give up cigarettes or change other aspects of living, like housing'. This was seen as another type of lock-in because 'people get used to this way of thinking'. This cultural inertia was linked to infrastructure and available alternatives to driving: for example, living in a city where parking is expensive or very difficult makes driving less attractive than using public transport; on the other hand, where cities do not have good public transport or car share schemes, driving may be the more feasible option ('In Heidelberg, the alternatives are not so good; I need my car').

Blurring the Lay–Expert Divide

There was evidence from the expert focus groups that opinions expressed as 'experts' and organizational representatives sometimes conflicted with personal values and experiences. These examples illustrate disparity between organizational policies and personal views on sustainability:

> I think I'll switch the microphone off [laughs], because this is not the house line. I mean we definitely espouse from the [name of political organization] side much greater use of inter-modal transport, and modal shift [. . .] But as an actual user of public transport every day, I despair about its prospects really improving. It's not a particularly pleasant experience, it's not very reliable, in bad weather it's very unenjoyable [. . .] I just don't think it can compete (policy stakeholder).
>
> In my very personal view, we should of course focus more on public transport [. . .] and reduce car ownership of course, but as a representative of the automobile industry [laughs], there will be a demand for personal mobility in the future, but how we meet these demands has to be rethought . . . (automotive industry stakeholder).

Indeed, we were surprised at the degree to which these stakeholders – many of whom would probably be 'winners' in a transition to a hydrogen economy – had such balanced and broad perspectives about hydrogen transport technologies. The reason for participants' reflexivity may be that, while these individuals are experts and stakeholders working for organizations with a stake in hydrogen, they also express personal opinions and experiences about transport. Many may also be aware of wider policy approaches to sustainable transport beyond simply hydrogen technologies. Consequently, the views expressed in these groups were often not 'the party line' (that is, their employer's policy) but a more balanced and nuanced perspective of sustainable transport and energy systems based on both personal values and professional expertise. Van de Kerkhof (2006) notes that instructing stakeholders to participate 'a titre personnel' (i.e. not representing the formal position of their organization) was an important deliberative component of the Dutch COOL stakeholder dialogues on climate change.

Conversely, as mentioned, participants in the citizen workshops were often well educated and some had relatively in-depth knowledge about sustainable transport technologies and policies. Many also raised very similar sustainability criteria to those suggested by experts.

These observations highlight an important limitation of the distinction between the categories of 'expert' and 'non-expert', and 'scientist' and 'citizen'. All participants – in both the expert and non-expert workshops – are of course both transport users and citizens, regardless of the degree of technical knowledge they possess. In a sense, transport users may be defined as 'expert' since they hold first-hand experiential knowledge of transport systems (often in several countries). Furthermore, societal and environmental values inevitably influence personal perspectives on sustainable transport (which highlights the need to include a diverse range of societal groups in sustainability assessments, as discussed earlier). This blurring of the scientist–citizen and expert–lay boundaries has been the focus of much study within the Sociology of Scientific Knowledge (SSK) and post-normal science literatures reviewed earlier (e.g. Funtowicz and Ravetz, 1993; Irwin, 1995). These traditions have challenged the hegemony of scientific knowledge and argued for more reflexive and inclusive processes of social knowledge production. We consider the approaches adopted in this research to be effective in providing fora for a range of societal groups to deliberate and participate in sustainability assessment for transport. Furthermore, they allow for scientists and citizens to engage with and learn from each other to produce more socially robust and reflexive forms of knowledge.

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Learning Amongst Stakeholders and Researchers

The questionnaires provided an opportunity to explore whether the stakeholder engagement methods had fostered social learning amongst *stakeholders* (Tables 6 and 7). In total, three out of ten stakeholders felt they had changed their views about the topics discussed in the groups. (Interestingly, a similar proportion of participants in a recent UK deliberative investigation changed their views about personal car use as a result of participation; King *et al.*, 2009.) 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. A comparison of homogenous and heterogeneous expert groups shows no significant difference in this respect (see Whitmarsh and Wietschel, 2008). Surprisingly though (particularly given the differences in stakeholder sustainability criteria, mentioned earlier), the *perception* of difference amongst stakeholders varied: in the second expert workshop, two participants (one in Group 4, a heterogeneous group, and one in Group 2, a homogeneous group) noted the divergence of opinions, while two (both in Group 4) felt there was consensus amongst discussants.

In respect of learning outcomes (Table 7) 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. It is interesting to note the divergence in optimism versus pessimism in participants' (particularly citizens') attitudes on leaving the workshops. Whereas five citizen participants highlighted the challenges in bringing about change, or government inaction, eight mentioned hope, enthusiasm, choice and public support for sustainability.

Observational evidence also indicates that some participants revised their opinions during the course of discussion. For example, one woman in a heterogeneous expert group initially presented an unambiguous argument for renewable-based hydrogen; after other participants raised problems and trade-offs associated with renewables, such as biomass, the woman conceded that renewable sources are not an unproblematic solution to future energy needs, and suggested that new sources might have to be found. A further aspect of participant learning is indicated by the greater number of ideas generated through discussions than when participants worked individually (Whitmarsh, 2007). While this may point to time constraints in completing the individual visioning exercise, it is also probable that the social process of discussion itself generated novel ideas amongst participants.

To what extent is there evidence of double-loop learning, or 'reframing' mobility, in light of the participatory process? On the part of the *stakeholders* who participated in the research, there appears to be little evidence of such a reframing. Although around one-third of experts felt they had changed their views as a result of attending the workshops, none of these mentioned that they now questioned the concept of mobility *per se* or the idea (or notion) of mobility as a societal 'right'. Furthermore, when we look at the preferred policies and criteria for sustainable mobility, reduced demand was not emphasized by the expert workshop participants in their quantitative survey responses. On the other hand, the citizens were more supportive of reduced demand and alternatives to transport (though these are unrepresentative of wider societal views about transport). Only in the qualitative expert

Do you feel the break-out discussion has changed your views about any of the topics discussed?	Citizens (Sept 06) *N* = 14	Citizens (Mar 07) *N* = 15	Experts (Feb 06) *N* = 44	Experts (Jun 07) *N* = 24	**Total**
Yes	21	33	33	29	**29**
No	29	27	56	42	**39**
Don't know	14	–	12	21	**12**
No answer	36	40	–	8	**21**
What, if anything, do you feel you have learned from the break-out discussion [workshop]?					**Total**
Total no. of responses indicating learning	79	87	73	63	**76**

Table 6. Stakeholder deliberation and learning outcomes from the workshops (quantitative results) (%)

DOI: 10.1002/eet

What, if anything, do you feel you have learned from this break-out discussion [workshop]?		
Citizens Sept 06	Technological aspects	4
	New points of view/others' attitudes	3
	Complexity/difficulty of change in transport	2
	About other countries	1
	Problems with rural areas	1
Citizens Mar 07	Technological aspects	3
	New insights (general)	2
	New points of view/others' attitudes	4
	Public support for sustainability/saving the word	1
	Enthusiasm/hope	1
	About other countries	1
	About UEA's research	1
Experts Feb 06	New insights/points of view	7
	About other countries, specifically China/India	5
	Issues surrounding sustainability	4
	Technological aspects	4
	Importance of lifestyle	2
	Reinforcement	1
	Not easy to answer how to transition	1
	Importance of energy storage	1
	Dependence on many factors	1
	Policy making appears to be holding back introduction of H_2	1
	Automotive industry sees limit in traffic growth	1
	Broader approach to the problem	1
	Agreement on energy mix	1
Experts Jun 07	Divergent opinions (despite sharing same analysis)	2
	Consensus between discussants	2
	Complexity and contingency	2
	Information about H_2	1
	Problems of introducing H_2 cars	1
	Multiple solutions needed for H_2 and biofuel introduction	1
	Discussion too focussed on supply, not individuals' acceptance	1
	Different technologies are necessary	1
	Global view is necessary	1
	Renewable energies will become competitive due to rising oil prices	1
	Transport modes and modal split for different distances	1
	Wind energy considered for H_2 production	1
	Various	1
	Learning during whole workshop	1
	Experts are relatively clueless	1
	No answer	9

Table 7. Stakeholder learning outcomes (qualitative results)

discussions do we see an acknowledgement of the benefits of alternatives to transport and reduced demand. However, overall, economic and environmental criteria were consistently emphasized over social criteria, which suggests an interest in eco-efficiency and competitiveness instead of equity, inclusion and so on.

On the other hand, there has been not only considerable single-loop learning but also a 'reframing' of mobility amongst the project *researchers*. This learning occurred through both the participatory processes and from the desk

DOI: 10.1002/eet

research and modelling work conducted. For example, the results of our stakeholder engagement work were vital for the scoping stage of our ISA. Rather than restricting our assessment to hydrogen-based transport (as originally intended), we broadened it to encompass a range of technical and behaviour options for addressing 'unsustainable mobility' (Whitmarsh and Nykvist, 2008). As indicated in this paper and elsewhere (e.g. Tuinstra *et al.*, 2008), stakeholder perspectives have, in fact, been incorporated into each stage of the ISA process: scoping, envisioning, experimenting and learning. The way in which these stages unfolded and built up sequentially is described further elsewhere (Whitmarsh *et al.*, 2009).

Discussion

Stakeholders' Perspectives on Sustainable Mobility

In this paper, we have outlined work carried out within the EU-funded MATISSE project to engage with transport stakeholders as part of an integrated sustainability assessment of mobility. Our findings indicate that 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 policies and choices, to foster sustainable mobility. However, other UK research on citizens' attitudes suggests there are significant challenges to introducing demand management policies. (Lessons from the London congestion charge show, though, that attitudes may change in favour of demand management policies after their successful introduction; Downing and Ballantyne, 2007). The results indicate a role for both technological and behavioural strategies in fostering sustainable mobility.

Importantly, the workshops also provided insights into the institutional dimensions of citizens' engagement in transport systems. Participants recognized 'lock-ins' to unsustainable transport and identified a range of cultural, political and institutional barriers to lifestyle change in favour of sustainable mobility. Citizens, as well as experts, located responsibility for fostering sustainable transport primarily with governments rather than with society or themselves. The perceived lack of personal influence in respect of improved transport suggests a need to promote public engagement with transport issues and to improve alternatives to driving to encourage uptake. This public engagement should also highlight the benefits of these alternatives for personal health and social interaction, as well as for environmental quality, and ultimately aim to shift the status and symbolism associated with cars towards more sustainable forms of mobility.

The Value and Limitations of Stakeholder Participation in ISA

It has been argued elsewhere (European Commission, 2001b; Whitmarsh and Wietschel, 2008) that sustainable transport demands long-term planning and systemic, cross-sectoral rather than end-of-pipe, policy solutions. Here, we have presented research that informs such an integrated policy approach, by drawing on stakeholder perspectives to develop long-term sustainable transport visions. The diverse interests, perspectives and expertise of stakeholders exposed through our research have proven valuable in defining socially robust concepts of sustainable mobility that can inform the ISA process and, more broadly, our understanding of socio-technical transitions (see Whitmarsh *et al.*, 2009). Furthermore, the overlap between 'citizen' and 'expert' categories noted earlier cautions us against reifying the distinction between experts and non-experts in the transport case, and reinforces the importance of inclusive processes of knowledge production.

We have highlighted the *two-way learning* that occurred as a result of stakeholder engagement. Of the stakeholders who attended the workshops, most learnt something about sustainable transport and about other

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people's perspectives.[6] These correspond to different levels of learning, namely single- and double-loop (or instrumental and social) learning, both of which have been identified as necessary for social change (Argyris and Schön, 1978, 1996; van de Kerkhof and Wieczorek, 2005). In addition, some citizens appreciated the opportunity to 'have their say' on issues of local importance, such as transport (Whitmarsh, 2007). As noted above, the perceived lack of personal influence amongst stakeholders in respect of improved transport suggests a need to promote such public engagement (cf. Owens, 2000).

The benefit to researchers was also in respect of learning: we elicited the knowledge and explored the values of diverse stakeholder groups in order to co-produce more socially robust sustainability assessments (cf. Pohl, 2008). Further we have identified the need in future work to ensure adequate funding for stakeholder work. Budget constraints forced us to find creative ways to stretch our funding to cover this valuable work, for example by 'piggy-backing' on other events to conduct our workshops. While this provided a cost-effective and accessible way of making contact with stakeholders, not all representative stakeholder groups for our case study could be directly involved. Furthermore, amongst those who were involved, there was a larger proportion of academic stakeholders compared with industry or other groups; although we have found much agreement amongst these different stakeholder groups (e.g. about the importance of renewable energy sources for sustainable transport), other research suggests they may have less in common, with academics placing more weight on environmental criteria (e.g. Bonsall *et al.*, 2005). Further research should focus on providing a more balanced representation of stakeholder groups in deliberative exercises, perhaps by providing incentives to participants from under-represented groups (e.g. industry).

One final lesson that was learnt during the process was to recognize the value of participation by providing feedback on the outcomes of stakeholder interaction – both immediately following a stakeholder workshop and subsequently once results had been written up. This enabled us to return to the same set of (expert) stakeholders for the second workshop and legitimately ask them to participate again in group discussion and questionnaires.

We conclude that deliberative workshops such as these provide valuable fora to co-construct knowledge and elicit informed views of citizens and experts (the *cognitive virtue*). They can also empower these groups to participate in an important social issue such as transport (the *civic virtue*). However, such workshops inevitably attract the most interested and committed participants, rather than the 'silent majority' (including the most marginalized social groups). These 'intensive' methods should therefore be complemented by 'extensive' methods to elicit the views of the representative majority in society. A major challenge for researchers is to connect these two approaches in meaningful ways in order to maximize the benefits of participation outlined in this paper and the representation of groups. Further work should also explore whether bringing together experts and non-experts within *the same* deliberative process (see, e.g., Burgess *et al.*, 2007) offers greater scope for learning than using separate, tailored methods for groups with different levels or types of expertise. Similarly, it would be valuable to directly compare outcomes from repeated stakeholder interactions with those from one-off deliberative events to consider whether deeper social learning (along with trust, empowerment and so on) develops over time.

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[6] It is worth recognizing that learning was measured primarily using retrospective self-reports at the end of the workshops. Although this is a less reliable indicator of learning than a quasi-experimental design of pre- and post-workshop measures of participants' knowledge and values, such a design would have restricted the time available to conduct the workshop itself (which was constrained by event organizers and participants' availability). To supplement this measure, we also used observational measures, which provided additional insights into group learning (described above).

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