Social Learning for Sustainability: Perspectives from a Styrian Case Study

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Executive Summary:

Scholars of sustainable development emphasize the importance of social learning to build adaptive capacity and resilience towards co-evolving elements of socio-ecological systems. Socio-ecological systems are complex, characterized by incompleteness of knowledge, uncertainty of outcomes, the existence of multiple legitimate perspectives and often, the irreducible incommensurability of values (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010). Co-evolving elements include the environment, governance, technology, behavior and culture.

It has been argued that learning is a key governance and implementation process in the complexity inherent to environmental decision-making, valuation and planning. Learning processes can lead to transformational responses which are essential for changing deeply entrenched paradigms of values, behavior and decision making. While learning receives wide attention in literature, there is a lack of systematic evaluation of learning processes and barriers to learning processes in existing instruments for transitioning to sustainable pathways. There is also a gap in the theory – practice link for practicable ways of implementing learning theories in decision making tools for sustainability.

Through an empirical study of two Austrian communities in transition to energy self-reliance, this research attempts to connect learning theories to sustainability practice and evaluates the learning processes and barriers in this transitioning to sustainability. A comparative evaluation of learning over time was possible due to previous research conducted on learning in the communities in 2005. Research methods included online surveys and personal interviews with members of two South Austrian communities, and local and regional experts, as well as comparison with data collected from these communities in 2005.

Results indicate participants are confident about their knowledge on the technologies and their respective role and impact in the transition to a renewable energy system. Civil society members continued to be perceived to have the greatest role to play, with social and economic barriers to transitioning being more significant than technological barriers. The economic argument continued to be perceived to be more persuasive than the environmental protection or national security argument in supporting renewable energy sources.

Findings also point to the relevance of experiential learning for creating individual-scale pathways towards sustainable consumption. Participants also indicated a reduced sense of complexity associated with transitioning to renewable energy systems, signaling a potential increase in the adaptive capacity for coping with co-evolving systems. The communities displayed a high level of collaboration with neighboring municipalities. However, transition
processes did not seem to facilitate broader citizen participation or conflict resolution for decision making.

Outcomes from this research point to strengths and weaknesses of a widely used transition tool, lending suggestions for improving the design and implementation of benchmarking as a policy tool by focusing on the social barriers in the public’s transition to sustainability. The analysis suggests the need for learning-centered decision-making, citizen participation and conflict resolution processes in benchmarking tools. Given the shortness of the duration of the project, a significant language barrier and the small sample size, results of this research should be used with caution. Further research on joint action and processes enhancing mutual understanding is desirable.

**Key Findings:**

1. Participants continued to exhibit high levels of declarative, procedural and effectiveness knowledge on renewable energy systems.

2. Participants continued to frame the issue with similar preferences. Non experts felt that social and economic barriers were equally challenging, whereas experts rated economic barriers as being most challenging. Technical barriers continued to be least important for both groups.

3. Civil society continued to be perceived to have the greatest role in enabling the transition to a sustainable energy system in 2005 and 2011.

4. Participants continued to believe that the economic argument was the stronger than the argument for environmental protection or national security to support the transition to sustainability.

5. Perceived complexity of transitioning to a renewable energy systems seemed to decreased from 2005 to 2011.

6. Both experts and non-experts perceived decision-making, personalities and communication and various interest groups as being the main sources of conflict related to becoming more sustainable. Differences in interpretation of data and values were less conflict ridden.

7. Participants’ changed their views on the ways to resolve conflict, from ‘finding compromise’ in 2005 to ‘provide better information’ in 2011.

8. The e5 program was perceived to be most effective in creating public awareness and creating a fruitful discussion than improving mutual understanding, enhancing a
community's morale, increasing economic benefit, or increasing the use of renewable energy technologies in the transition to sustainability.

9. Participants felt that examples of success stories of completed projects and financial incentives were the more effective in encouraging renewable energy adoption, than reduced energy charges, or more information on renewable energy technology.

10. Non-experts acquired most of their knowledge via the internet and through local technical experts, whereas experts turned to scientific literature and regional e5 representatives for information regarding renewable energy systems.

11. Energy independence was the primary motivation for joining the e5 program.

Recommendations

A. Focus on creating greater awareness of the financial incentives available and success stories within the community using shared media. Seek to increase public participation in the transition to renewable energy systems. Since economic and social barriers are the more important than technological barriers, efforts should be made to identify and address community-specific economic and social issues, for example barriers to participation in public transit. This will also help the diffusion of the most appropriate technology for the local context.

B. Decision-making, communication, personalities and various interest groups were considered to be the biggest challenges. Training e5 program staff in participatory decision-making processes and conflict resolution strategies and frequently employing these methods may help enhance mutual understanding and help reach compromise in challenging circumstances. Creating boundary objects between various communities of practice in the communities and creating shared projects may also help. Recognizing and encouraging the work of boundary agents will ensure continued collaboration in projects.

C. Since energy independence was the primary motivation to joining the e5 program, and the economic argument is considered to be the most effective argument supporting the transition, more research and publishing information on economic benefits may be of assistance to the communities.

D. Sustained participation in renewable energy programs such as the e5 seemed to have reduced the perceived complexity of the transition. Participation in transition programs should be encouraged by regional and federal authorities.
E. Appropriate renewable energy sources other such as bioenergy and hydropower should be publicized, and completed projects should be recognized. The idea being that these technologies should become the norm through widespread social acceptance.
Introduction

Knowledge on the impact of human activity on nature and the resulting changes in ecological and social systems is rapidly expanding. The uncertainty associated with the extent of the impact on these two co-evolving systems however, lends complexity to the task of adapting to them. This is particularly true for long-range policy formation which requires forecasting in order to plan and prepare for eventualities.

Decision-making through uncertainty requires institutional processes that are flexible enough to accommodate re-opening of dialog and a future re-examination of assumptions in the scenario that there is new knowledge or understanding. Decision-making for coping and adaptation to the outcomes of socio-ecological processes such as climate change often takes place in a high-stakes environment, for example after a disaster. Furthermore, to ensure a democratic process in environmental decision-making, policy-makers must evaluate multiple legitimate perspectives and acknowledge conflicting values regarding the environment.

The literature on adaptation therefore argues that attention must be paid not only to the outcomes of the decision-processes but to the quality of the process itself. A decision-making process dealing with a continuously changing system must itself have the capacity to adapt and continuously learn, in other words, the actors involved in the decision-making process must be able to continuously learn to build their capacity to adapt. The learning among actors, referred to as social learning, therefore becomes an integral governance process. Social learning, the literature emphasizes, is an “on-going social process focused on dialogue and exchange that can incorporate knowledge from various perspectives and different social levels” (SEI, 2009 p.) creating possibilities for changes in underlying values and framing of sustainability issues and the possibility for joint action and mutual understanding. A policy process embedding learning is in contrast to one which seeks to change behavior and create positive outcomes without influencing underlying values. Literature on social learning states that for a situation whose outcomes are uncertain, the focus of decision making should shift from the outcomes oriented ‘substantive rationality’ to a ‘procedural rationality’ which embeds social learning. While learning can have any direction, learning for sustainability has a normative basis which should be made clear prior to a decision-making deliberative process. These processes should create learning without pressurizing or being used as persuasion tools, instead focusing on building trust and creating relationships across boundaries of communities of practice. This may be possible to achieve through deliberation “among a diverse group of social actors, with different types of knowledge and perspectives, (are thus) central in the creation of new responses to threats for socio-ecological systems” (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010, p. 1712).
The importance of social learning is widely discussed in a wide variety of literature belonging to diverse fields, for example, political science, sociology, economics, psychology, organizational management and natural resource management (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010). Every field of expertise however, has a different conceptualization of this phenomenon. Within environmental management, the social learning outcomes of participatory approaches and sustainability appraisal methods have been evaluated to a limited degree. In the field of urban planning, social learning can be conceptualized within theoretical framework of communicative action planning. Despite the attention to the theoretical understanding of learning processes in decision-making, learning processes in sustainability transition tools are often poorly designed, rarely formalized and most likely are an outcome of an informal, pre-existing culture of learning in a community.

This project evaluates the learning outcomes in two Austrian communities who participated in a sustainability multi-criteria evaluation (MCE) workshop in 2005 and subsequently became part of the e5 program, a sustainability networking, benchmarking and certification tool (Mader & Leindl, 2007). The study uses a theoretical framework of learning types, created by researched Eneko Garmendia and Sigrid Stagl as part of the research project in 2005 used to evaluate the social learning aspect of the participatory MCE process. Participants were surveyed before and after the MCE workshop. The 2005 framework was repeated in 2011 to identify whether, over time, there was a change in values, framing of issues or perception of barriers and possible solutions. Methods included online and mail surveys, interviews and site visits.

Given the small sample size, the shortness of the duration of the study, and a significant language barrier during interviews, recommendations emerging from this study no doubt require further research.

This following report is divided into five sections beginning with a brief discussion of the theoretical foundation of social learning and communicative action planning in relation to sustainability and urban planning. Following this section, I introduce the analytical framework used by Garmendia and Stagl in 2005. The next section discusses historical and present day results, leading to the discussion and recommendations section.

1 Assessment of Renewable Energy Technologies on Multiple Scales- A Participatory Approach (ARTEMIS) project conducted by the Sustainable Europe Research Institute (SERI) in 2005. (Sustainable Europe Research Institute, 2005)
2 Institute for Environmental Sciences and Technologies (ICTA), Autonomous University of Barcelona, Spain
3 Environmental Economics Unit, Institute for Public Economics, University of the Basque Country, Spain
4 Department of Socio-Economics, WU Vienna, Vienna University of Economics and Business, Austria
Concepts of Social Learning

“Generally, social learning is (then) a process of coordinated learning with cognitive and normative dimensions, from the individual learning in a social context to policy changes at the international level” (Stagl, 2007, p. 57).

'Social learning refers to the process by which changes in the social condition occur - particularly changes in popular awareness and changes in how individuals see their private interests linked with the shared interests of their fellow citizens. This is a product of individuals learning how to solve their shared problems in a manner that is responsible to both, factual correctness and normative consent (meaning legal and social responsibilities)' (Webler, Kastenholz, & Renn, 1995, p. 445).

“Individuals learn by observing the behaviors of others in addition to directly experienced reinforcement” (Bandura, 1977) (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010, p. 1713).

The application of social learning theory provides insight into both organizational and structural aspects of decision making for climate change adaptation, as well as ideas for enhancing participation in, and behavioral changes for, sustainability related activities in communities.

The following section explores the theoretical foundations of the idea of ‘learning as sustainability’ on three scales –

i. At the city level (communicative action planning and adaptive capacity in urban planning processes);

ii. Organizational learning; and

iii. Individual learning.

1. Communicative Action Planning and Adaptive Capacity

Habermas’s theory of learning states that learning has the potential to take place through either social interactions in which information is transmitted or through deliberation and discussion (Habermas, 1984). Furthermore, learning through social interactions, or social learning requires the creation or enhancement of a social space for what Habermas referred to as ‘communicative action’. It is argued that learning social communicative action can lead to wider change through social networks and wider societal and institutional structures (Reed, et al., 2010).
Communicative action planning in fact, emerged from the gridlock, complexity and uncertainty characteristic of environmental decision making of the 1980s, when “regulatory agencies, legislatures and courts were increasingly incapable of reaching decisions and enforcing them in a manner that was timely, cost effective and equitable (Weber, 1998)” (Goldstein, 2009, p. 2).

Advocates of communicative action planning propose that collective deliberation, consensus finding and sustained and guided dialog can enhance conflict resolution by building trust, clarifying motivational interests and engaging in joint fact-finding (Goldstein, 2009). Since then, communicative action planners have explored the broader scope of the process, suggesting that deliberation has the potential to alter adversarial relationships (and reconcile conflicting goals), beyond the specific dispute, as “stakeholders remained engaged with one another and gained trust and interdependence” (Goldstein, 2009). The goals of relational changes are as significant as the resolution of the conflict in itself, emphasizing the shift from the substantive to the procedural aspects of management.

Furthermore, the focus of collaborative practice has moved beyond conflict resolution based planning processes involving stakeholders to processes encouraging social learning and organizational change (Goldstein, 2009). These processes focus on ongoing engagement and the coordination across scales when consensus alone is incapable of addressing institutional obstacles to climate change adaptation and mitigation (Goldstein, 2009). Examples of processes suggested through the communicative action planning perspective are multi-stakeholder consensus processes to learning networks, civic roundtables, and community reconciliation processes (Goldstein, 2009).

2. Social learning in organizations

A learning approach seeks to engage the whole person and organization, seeking open sharing of information and trust building between groups of individuals considered to be vital components of the shift towards “learning as change”. Open sharing is perceived as essential for moving from a knowledge economy (formal and technical knowledge, human capital, patents etc.) to a knowledge society (knowledge that changes people) (Stagl, 2007).

In the organizational management context, Argyris and Schoen (Argyris & Schoen, 1978) articulate definitions of single loop and double loop learning. Double loop learning creates changes in underlying values and assumptions and is therefore distinct from single loop learning involving learning within a given mental model (Stagl, 2007).

According to this theory, individuals tend to avoid challenging established values for three reasons (Pelling & High, 2005):
• Individual risk aversion that leads actors to avoid direct interpersonal confrontations and public discussion of sensitive issues which might expose the actor to future negative repercussions.

• A desire to protect others by avoiding the testing of assumptions where this might evoke negative feelings and by keeping others from exposure to blame.

• A wish to control the situation by keeping your own view private and avoiding any public questioning which might refute it.

The literature highlights the importance of converting individual knowledge to the knowledge of the entire organization, implying the transfer of tacit and explicit knowledge (Stagl, 2007). An atmosphere of open sharing of ideas results in group learning. Several authors emphasize the importance of the nature, context or environment in which learning takes place, as “learning is embedded in a set of social systems and organizational structures (Akgün et al 2003; Easterby-Smith 1997; Stein 1997)” (Stagl, 2007, p. 57).

Etienne Wenger’s Communities of Practice approach provides an extensive analytical framework for the role of social identities and social networks and the ways by which individuals and communities are constantly negotiating and forging identity through collaboration, participation, observation and dialog creating and sharing values and practices (Wenger, White, & Smith, Learning in Communities, 2010).

In traditional economics, the concept of rationality has been dominant and decision making processes have received far less attention. Evolutionary and ecological economists are exploring the role of learning in relation to technological evolution as well as corporate sustainability. Learning, it is argued is about changing the mental models of the world (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010).

Sterling (2001) suggests that in the context of sustainability single loop learning is “learning about sustainability”; learning examining the assumptions influencing the perceptions of a system is “learning for sustainability”; and learning which is participatory, creative and reflexive is “learning as sustainability” (Sterling, 2001), (Stagl, 2007).

O’Connor (2000) argues that when decision making processes seek to be more than strategic actions to satisfy individual actors, they have the potential to create learning. This process is a social process of learning, requiring trust, identity and solidarity with the respective community, products of communication and mutual understanding (or empathy). O’Connor argues that mutuality reaches stability through constant feedback. Aspects of mutuality are
strengthened through “reciprocal actions and exchange of symbols that reaffirm shared values and conviction” (O’Connor, 2000).

3. **Individual based learning:**

Social learning in the context of individual behavior and its interrelationships with institutions is important from the point of view of understanding “how, when, with whom and how much people cooperate” (Stagl, 2007).

From an anthropological perspective, behaviors are culturally produced and socially learned by observation and interaction in a social group.

Kolb (1984) proposes the theory of experiential learning in adults (ELT), consisting of four stages: concrete experience, reflection on the experience, abstract conceptualization and active experimentation (Stagl, 2007). At any time, an individual can be engaged in one grasping experience (concrete or abstract learning) and one form of transformative experience (active or reflective learning). The theory posits that learning occurs through experience, and therefore the environment shaping the experience is important. For example, an information rich environment comprised of a variety of sources, such as peers, social networks, websites etc. is important at the abstract conceptualizing stages, and competence building or formal training would enable transformative learning to take place (Kolb, 1984) (Stagl, 2007).

The Stockholm Environmental Institute defines social learning as the “process by which agents and organisms continuously frame and reframe the issues at stake”, developing the enhanced content and relational capabilities to deal with complex systems and problems “which individuals often cannot resolve on their own” (Nilsson & Swartling, 2009). Adaptation is described as a challenge of a complex system, since processes in various subsystems interact and cover a range of temporal and spatial scales of varying dynamics. For example, even though the overall vulnerability to climate change of a country is low, subgroups of the population may be highly exposed and affected (O’Brien, Sygna, & Haugen, 2004) (Nilsson & Swartling, 2009). Co-management and enhanced mutual understand has the potential to lead to joint ownership of knowledge, which may be one part of avoiding the tragedy of the commons (Ostrom, Burger, Field, Norgaard, & Policansky, 1999), (Nilsson & Swartling, 2009).

4. **Social Capital and communities of practice:**

The emphasis on interpersonal relationships and trust are useful analytical tools from the theory of social capital, a contested field. Relationships may exist that tie individuals into networks or communities. Community relationships may provide spaces for reproduction of knowledge and refinement of practice, whereas networks allow exchange of information.
Both of these can both enhance or undermine adaptive capacity –

a. groupthink, refusal to change or making a virtue out of not learning,

b. flow of information through networks may be present, but this “says nothing about the appropriateness of the message being conveyed” (Pelling & High, 2005).

Therefore, while the idea of social capital may help map out informal sites and routes of learning, it cannot “help in making judgments on the appropriateness of the actions that result” (Pelling & High, 2005, p. 5).

5. Mapping organizational adaption

Institutions may be formally defined or informal. Formal institutions have openly negotiated rules and boundaries, which constrain agency, but are amenable to change by the actions of individuals or groups. Informal institutions are observed in social norms and values, and have a dialectical relationship to agency – “giving shape to, whilst being reproduced by, repeated rounds of customary behavior” (Pelling & High, 2005, p. 3).

Informal institutions are perceived to be difficult to work with by their very nature. Traditionally seen as having conflicting goals with the formal institution (example corruption), in the field of climate change, informal institutions are positive forces, leading to context-rich horizontal learning, innovation and adaptation. The spaces of informal interaction that lie outside the formal institution but interact with them can be described as shadow spaces (Pelling & High, 2005). These spaces and relationships “represent(s) an alternative view of the social architecture of organizations, focusing on the relationships that are meaningful to people rather than the formal, official relationships sanctioned by the management” (Pelling & High, 2005, p. 4).

These informal spaces should not, it is argued, be controlled by the formal management as part of building adaptive capacity, rather, recognized “but allowed to have a life of their own” (Pelling & High, 2005, p. 4). Pelling and High (2005) articulate four key factors influencing the shape of adaptive outcomes in organizations: social context, learning, adaptive capacity and adaptive actions.

Social context, for example membership of communities of practice, command over bridging and bonding ties, the location within the community of practice

Adaptive capacity, distinct from adaptive actions, as maybe capacity to adapt exists but the decision has not been made, or the resources to make the decision do not exist, for example, access to information to question values and undertake second order learning.
Adaptive action may emerge as a result of these resources or a sense of individual agency.

Learning from either the social context, or from the individuals personal reflections can lead to changes in values leading to adaptive action, including reassessing skills and physical abilities.

![Figure 1: A Model for Organizational Learning and Adaptation](image)


Pelling and High(2005) identify six types of adaptive action:

1. Learning to learn (deutero-learning) – learning to operate with ongoing adaptation.
2. Learning from experience (single/double loop learning) – reflecting on the merits of improving what is being done or doing something new.
3. Managing resources - to improve adaptive capacity.
4. Institutional modification - attempts to change the social context, for example by realigning their connections of social capital or by challenging or supporting particular institutions. This can also include lobbying on the behalf of a policy coalition.
5. Individual action on the environment - material adaptations.
6. Collective action on the environment - the can include group reappraisal of past actions, reflection on the use of resources, and changing institutions but these are not expanded on in this figure where the focus is on the experience of an individual acting within an organization.
6. **Mechanisms for social learning:**

Etienne Wenger’s Communities of Practice theory of social learning identifies three elements which can be used as analytical tools to identify social learning in a given social context (Wenger, Conceptual Tools for CoPs as Social Learning Systems: Boundaries, Identity, Trajectories and Participation, 2010):

- **Boundary objects:** “Bridging and boundary organizations: These concepts highlight how the organizational structure and the architecture of governance can bring together different communities of practice. The term “bridging organizations” stems from the literature on adaptive co-management in social ecological systems, where they have been found to play a key role in “trust-building, vertical and horizontal collaboration, learning, sense-making, identification of common interests, and conflict resolution” (Hahn et al. 2006:586). "A boundary object is an entity shared by several different communities but viewed or used differently by each of them.” (Star and Griesemer 1989)” (Nilsson & Swartling, 2009, p. 4).

- **Shadow systems:** “Shadow systems refer to informal interactions existing outside of, but interacting with, formal institutions and inter-relationships (Stacey 1996)” (Nilsson & Swartling, 2009, p. 4).

- **Conflicting goals:** “Goal conflicts can refer to actors having different primary goals or that two or more goals in and of themselves are in conflict with each other, for example, economic and environmental. Sometimes, cooperation is only possible once the actors have redefined their self-interests, for example because of a change in how an issue is framed” (Nilsson & Swartling, 2009, p. 4).
Conceptual Framework for the Analysis

Drawing from learning theories from organizational management, Paolo Freire’s pedagogy of learning (Freire, 1970) and Etienne Wenger’s communities of practice theory (Wenger, White, & Smith, Learning in Communities, 2010) among others, four hypotheses were developed by Garmendia and Stagl in 2005 to evaluate learning outcomes of three participatory multi-criteria workshops in Raabau and Lödersdorf in Austria, Spain and the UK. This report builds upon the Austrian case study.

Garmendia and Stagl identify four elements of social learning that are particularly relevant for the transition to sustainability (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010).

The first element concerns the acquisition of cognitive knowledge. Argyris and Schon’s in their organizational management theory define this learning as single loop or instrumental learning (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010). This type of learning leads to changes in action without necessarily changing underlying values associated with the theory of the action. Garmendia and Stagl (2010) employ Kaiser and Fuhrer’s typology of cognitive knowledge to identify three cognitive learning processes:

1. Declarative knowledge, containing insights into how systems work and the state of a problem.
2. Procedural knowledge relating to learning how to achieve a certain goal.
3. Effectiveness knowledge relating to the relative effectiveness of various actions to reach a certain outcome.

The learning of cognitive knowledge leads to the first hypothesis of this study:

**Hypothesis 1.** There are changes in knowledge within an existing frame of reference, which involves effectiveness knowledge: contains (procedural) knowledge about the relative effectiveness of different behaviors to reach a certain outcome (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010).

The second category of learning relates to Argyris and Schon’s idea of double loop learning. This learning relates to moral development, or the ability to make decisions about right and wrong based on changes in underlying values and assumptions. This type of learning enhances mutual understanding and the capacity to scale up issues from the individual to the local and global, and even beyond the wider collective to non-human species, future generations and under-represented groups. This type of mutual understanding, or the development of empathy is a critical step to developing an environmentally friendly consciousness and the desire to act
It is argued that a sense of mutual understanding can lead to justice and respect. This is the point of behavioral shifts – from learning logical and empirical facts to changing normative and affective values (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010).

The development of mutual understanding amid different conflicting perspectives needs

1. Learning about underlying reasons for behavior
2. Reflecting and acquiring knowledge about other people’s groups’ interests and values.
3. Developing a sense of empathy and solidarity with a larger collective – human (future generations, underrepresented populations) and non-human species.

Hypothesis 2 deals with a change in the appraisal of facts on the basis of a change in underlying values and assumptions, through a greater understanding of other people’s needs and perceptions (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010).

Hypothesis 2 is divided into three categories of learning in the context of this research (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010):

Hypothesis 2.1 The participants learn how to structure and restructure the problem at hand and change their perception of the problem.

Hypothesis 2.2 There is an increased understanding of the other participants’ viewpoints that results in a positive change in attitudes towards them.

Hypothesis 2.3 Participants refine their knowledge about societal needs, esp. future generations and non-human species, expanding their views from the individual to the collective.

The uncertainty and lack of complete information regarding the co-evolution of socio-ecological systems makes them complex systems. To transition to sustainability within these complex, co-evolving systems required the capacity to adapt to these systems. The ability to make decisions despite uncertainty requires the “move from the primacy of pieces to the primacy of the whole, from absolute truths to coherent interpretations, from self to community, from problem solving to creating” (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010, p. 1715). “Adaptive learning and adjustment, guided by a much wider range of human experience and understanding that disciplinary science, are also necessary” (Kay, Regier, Boyle, & Francis, 1999) (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010, p. 1715).

Garmendia and Stagl identify four aspects of learning related to complexity and uncertainty

1. Practicing holistic or integrative thinking, a systems approach
2. Learning to deal with conflict-ridden situations, through cooperation and conflict resolution skills
3. Acquiring the capacity to realize joint action, across different scales and communities of practice (Snyder & Etienne, 2010).
4. Taking steps for institutional change and joint action.

Evaluating learning enabling a systems thinking approach, conflict resolution, joint action, institutional change and across communities of practice, leads to Hypothesis 3 and 4.

**Hypothesis 3.** Participants’ views about the complexities and uncertainties involved in planning for sustainable futures has changed.

**Hypothesis 4.** Participants find ways for institutional change and joint action that open up the possibility to collaborate with others individuals. This also implies dealing with conflict riding issues in a constructive way (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010).

Learning between actors, particularly for transitioning to sustainability must enable the linkage and transfer of knowledge and experience between the individual, the societal and the global. Learning within a range of levels and across geographical scales is desirable. To deal with uncertainty and complexity stakeholders must be empowered to change their frames of reference, assumptions and values; develop empathy with the collective and find ways to deal with conflict through joint action and sharing of resources. Appraisal and participatory processes that facilitate one or more of these outcomes are rewarding and worth pursuing (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010).

**Hypothesis 5.** The network of information (formal and informal) between various levels and institutions is perceived as a channel for exchanging knowledge and information between various actors within a community of practice and across geographical, institutional, community of practice scales and boundaries.

**Table 1 summarizes the underlying concepts of learning for sustainability and the resultant hypotheses:**

<table>
<thead>
<tr>
<th>No.</th>
<th>Hypothesis</th>
<th>Underlying learning</th>
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• Effectiveness knowledge  
-- of various actions to reach a sustainability goal. |
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• Enhances understanding of other |
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<td></td>
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<td>• Developing empathy with a societal, global and non-human collective</td>
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<td>• Perceive the issue through a different framework</td>
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<td>• Understanding of the role of various stakeholders involved in a decision-making process</td>
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<th>Participants’ views about the complexities and uncertainties involved in planning for sustainable futures has changed.</th>
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<td>4. Participants find ways for institutional change and joint action that open up the possibility to collaborate with others individuals. This also implies dealing with conflict riding issues in a constructive way.</td>
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<td>5. The network of information (formal and informal) between various levels and institutions is perceived to be a channel for exchanging knowledge and information between various actors within a community of practice and across geographical scales.</td>
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<th>• Practice holistic and integrative thinking</th>
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<td>• Learn conflict resolution skills and want to find solutions through cooperation</td>
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<td>• Have capacity for joint action across scales and communities of practice</td>
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<td>• Take the steps toward institutional change through joint action</td>
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<td>• Learning is transferred within a level of society and also across scales and boundaries, geographical, institutional and through communities of practice.</td>
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Source for hypothesis 1-4: (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
Methods

This report studies how two communities, Raabau and Lödersdorf are transitioning to sustainable consumption and renewable energy production. Data was collected through included mail and online surveys and interviews with key stakeholders in the two communities and the sustainability network in the region. Observations were also made through site visits to various local businesses, the local waste-water treatment facility and one residence.

Case studies of the experiences of these two communities helped evaluate the central question of this study: Given the significance given to the role of social learning in enhancing adaptive capacity in the literature and given the experiences in these communities, do existing participatory and sustainability transition management tools create opportunities for social learning in small communities? The implications from this analysis will inform recommendations for improving transition management processes at the local level and empirically test the notion that participatory processes enhance social learning and therefore create pathways to sustainable energy use.

A 2005 study conducted by the Sustainable Europe Research Institute (SERI) named ARTEMIS (Assessment of Renewable Energy Technologies on Multiple Scales- A Participatory Approach) and a parallel study conducted Eneko Garmendia and Sigrid Stagl that measured the social learning outcomes in a select group of diverse stakeholders connected to the sustainability efforts of Raabau and Lödersdorf, prior to and after participatory workshops, and multi-criteria evaluation and scenario building sessions, provided the baseline data and the analytical framework of this study (Sustainable Europe Research Institute, 2005).

To evaluate social learning over time the theoretical framework of the 2005 study was replicated in this project, so that results of this study could be qualitatively, and where feasible quantitatively, compared to the learning outcomes of the 2005 study. Insights from this comparison can shed light on how the interim sustainability appraisal processes can be improved to accommodate greater social learning. All the original participants of the 2005 study were invited to participate in this research. As per the 2005 study, participants of the 2005 study were identified by searching for those who have the highest influence on a decision and those who were most affected by a decision (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010).

Prior to the 2005 study, the municipalities of Raabau and Lödersdorf had successfully applied for funding to participate in the e5 program, a national sustainability benchmarking and certification network, with affiliations to a Europe-wide sustainability certification program. The e5 program is used to assess and certify local communities with respect to their attempts,
relative to their potentials, to use energy more efficiently and to intensify the use of renewable energy as a contribution to sustainable development (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010).

In 2005, more than 14 citizens, mayors, e5-team6 and other stakeholders in Raabau and Lödersdorf in Austria took part in two workshops and a final meeting where recommendations were presented. However sample sizes for the surveys were lower, since not all participants could attend both workshops, and because it was not always possible for the same participant to represent an organization, and not all participants completed both questionnaire, making it impossible to directly compare responses (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010).

The 2011 study’s survey questions addressed five hypotheses, of which four were reproduced from the 2005 study. The fifth hypothesis tested the perceived social learning-effectiveness of the e4 sustainability network over the period between 2005 and 2011. Data was collected on a Likert scale (1 to 7, with 7 being the maximum) through online and mail questionnaires. The 2011 online survey received a response rate of 47 percent, whereas the 2011 mail survey response rate was 14 percent. Twenty two responses were received in total.

Given the small sample size, statistical analyses to study the significance of observed differences in preferences should be considered with caution. The Wilcoxon non-parametrical test together with other descriptive statistics were used to test hypotheses. Personal interviews and observations from site visits also provided insight. However, due to the shortness of the length of the author’s visit to Raabau and Lödersdorf this study embodies a very limited understanding of the nuances and hidden dynamics in the communities. Furthermore a significant language barrier limited the author’s ability to engage in a deep conversation regarding local sustainability efforts. This report is therefore undoubtedly represents an outsider’s perspective.

Participants in this study included residents and e5 representatives in the communities and technical experts at the local, regional and national scales. Comparing differences in responses between the expert and the non-expert communities (all of whom are also residents in the two communities) can give us insight into differences in perceptions of the two communities. Where significant, these differences are explored in the analysis below.
Empirical Application of the Framework

Part 1: Historical research

Two projects from 2005 provided the baseline data in order to identify variation in learning over time in 2011. The first is a participatory research project named ARTEMIS for the Assessment of Renewable Energy Technologies on Multiple Scales – A Participatory Approach, conducted by the Sustainable Europe Research Institute (SERI) based in Vienna. The aim of the ARTEMIS project was to improve upon participatory multi-criteria evaluation (MCE) processes of future energy scenarios, based on various social, economic, environmental and systemic-technological factors, through application and critical assessment. As part of the project, energy scenarios were developed for Austria for 2020, addressing electricity and heat generation from renewable energies, and to a lesser extent, energy efficiency measures at a national scale and local scale for two communities in Styria – Raabau and Lödersdorf. Evaluation criteria were developed in collaboration with stakeholders and weights were attached to these criteria as per social preferences, ranging from environmental concerns to economic and social impacts (Sustainable Europe Research Institute, 2005). The evaluation and ranking of these scenarios was calculated by the use of a multi-criteria evaluation method (MCE) known as PROMETHEE, a preference ranking organization method. The MCE produced a ranking of energy scenarios at the national and local scales, and for the national scale, different preference profiles were developed for all stakeholders, creating a better understanding of national social preferences, understanding potential conflicts and areas for compromise in the energy field and the consequences of technology pathways (Sustainable Europe Research Institute, 2005). At the local level, the MCE rankings were to be used to aid decision-making in the communities as they participated in the e5 program which assessing and certifies local communities with respect to their attempts to become more energy efficient and increase reliance on renewable energy sources (Sustainable Europe Research Institute, 2005).

Based on the ARTEMIS study, a second project in which researchers Eneko Garmendia and Sigrid Stagl measured the quality of participatory processes with respect to its social learning outcomes in three case studies, once of which involved the communities of Raabau and Lödersdorf in Austria. Garmendia and Stagl defined social learning as learning which “encompasses a dimension of changes in values, norms, frameworks and skills that transcend the sphere of explicit cognitive knowledge; enhancing a chance for mutual understanding, joint action and institutional change” (Garmendia & Stagl, Social Learning in Public Participation for Sustainability). They identified three main hypotheses: 1. There is a change in knowledge within an existing frame of reference (single loop learning); 2. There is a change in the evaluation of facts on the basis of modified values and assumptions (double loop learning), and 3. People find ways to deal with complex issues, pathways for joint action and consider transferring this
learning to other settings (triple loop learning) (Garmendia & Stagl, Social Learning in Public Participation for Sustainability).

Methods included closed ended questionnaire based on Likert scale responses completed at the beginning of the first and at the end of the final deliberative workshop (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010). Considering the small sample size, data was compared using the Wilcoxon non-parametric test. Information was also collected through personal interviews.

Results indicated that while participants became more familiar with different renewable energy sources, and learned to compare between different energy mixes and their relative contribution to sustainability (single loop learning), and modified their assumptions by perceiving social parameters and values to be more relevant after the workshop; they did not change their perceptions about complexity or uncertainty. The participatory process did not help participants to improve their level of mutual understanding (double loop learning). Since the communities were independently driven to participate in the e5 program, the perception of the role of future generations remained high. Participants felt that participatory decision-making was constructive and were optimistic about future joint action and considered transferring the integrated assessment method and stakeholder participation processes to other settings (Garmendia & Stagl, Social Learning in Public Participation for Sustainability).

After the workshop, actual joint action took place when Raabau and Lödersdorf collaborated to participate in the e5 program to become more sustainable communities (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010).

This report seeks to examine whether processes between 2005 and 2011 assisted in joint action and enhancing mutual understanding and whether underlying values framing perspectives have been altered through these processes. If so, this report seeks to identify processes that may have created these changes and suggest improvement for enhancing and operationalizing social learning concepts into existing transition mechanisms being used in the two communities.
Part 2: 2011 Results

Given the small sample size (22 respondents), Friedman’s non-parametric test and the Wilcoxon post-hoc test for 2 related samples were used together with other descriptive statistic to test the five hypotheses. For the same reason, results should be considered with caution, and further research is required to test robustness of the recommendations emerging from this study. Please refer to Appendix A for the online and mail survey instrument in German and appendix B for its English translation.

The following section describes findings for each hypothesis. Where appropriate, responses from the 2005 study are discussed and differences between the 2005 and 2011 responses are identified.

Results:

**Hypothesis 1** deals with acquisition of various types of cognitive knowledge - declarative, procedural and effectiveness knowledge.

*Declarative knowledge (Q1):* Participants displayed a high level of familiarity with the roles of different renewable energy sources in Austria, both before and immediately after the 2005 workshop. The preparation required in making proposals to seek funding for participating in the e5 program may have been the reason for this high level of awareness in 2005.\(^5\) Given this high level of knowledge before and after the workshop, in this study, participants were asked to rank the relative importance of various renewable energy sources. Experts perceive solar energy, bio energy and hydropower to have a similar role, with a mean value of 5.7, although agreement on the role of bioenergy was the greatest with a standard deviation of .9 for bioenergy, versus 2.5 for both solar energy and hydropower. The non-experts, most of who live in the two communities were asked about the role in their region. They weighted solar power as having the maximum role, followed by bioenergy and geothermal energy. There was greatest consensus on the role of solar power (mean value = 6.2, standard deviation =.9), followed by bioenergy (mean value = 5, standard deviation = 2.3), geothermal energy (mean value = 3.1, standard deviation = 1.6), hydropower (mean value = 3.1, standard deviation = 2.1), wind energy (mean value = 2.4, standard deviation = 1.7), and hydrogen and fuel cells (mean value = 1.7, standard deviation = .8).

*Procedural knowledge (Q2):* Both experts and non-expert participants continued to display a high degree of familiarity with various types of energy mixes, with 2005 a mean value = 5.22 and Standard Deviation = .667; and 2011 non-expert mean = 5; standard deviation = 1.2 and

\(^{5}\) (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
expert mean value of 5.4 and standard deviation of 1.7. However, the standard deviation of the aggregated group responses has increased between 2005 and 2011 to 1.36. In other words, there is a lower consensus regarding the various types of energy mixes within the larger group.

**Effectiveness knowledge (Q3):** In 2005 participants demonstrated a high level of effectiveness knowledge- regarding the effectiveness of various energy mixes in creating a positive impact, with a mean value of 5.33, and standard deviation = .866. In 2011, while overall knowledge remains high, the increase in standard deviation within the group responses indicated that the group agrees less about the impact of various energy mixes (2011 mean = 5.33; Std. Dev. = 1.24).

**Hypothesis 2** deals with the changes in the framing of the issue, perceived barriers and roles of various actors.

**Framing the issue (Q4):** In 2005, the weight attached to the social parameter changed in a statistically significant manner after the deliberative workshop. There were no statistically significant changes in the way participants weighted economic or technical barriers, i.e. they did not change the way they framed the issue in terms of these two factors. Economic parameters were consistently weighted more heavily before and after the workshop (mean before =5.44, mean after = 5.11) as compared to social (mean before = 3.5, mean after =4.33) and technical (mean before =2.62, mean after =3.13). This trend has continued to 2011. Non-expert participants rated both economic and social parameters are moderately high (mean 4.2 each, with standard deviation of 1.8 and 1.9 respectively), the experts felt that economic barriers were the most challenging (mean value 5.14, Std. Dev 1) followed by social parameters (mean value 3, Std. Dev. 1.4). Technical parameters were perceived to be the least challenging by both the groups. Since there was a statistically significant increase in the weight associated with social barriers to a more sustainable energy system after the 2005 workshop, the 2011 responses were compared across the three categories using Friedman’s non-parametric test for related samples. There was a statistically significant difference in perceived role of economic, social and technical challenges (x2 = 7.918 and P = .019). Post-hoc analysis with Wilcoxon Signed-Rank test revealed that there were no statistically significant differences between the weights associated with social barriers and economic (Z = -1.35 and P = .177) or social barriers and technical barriers (Z= -1.58 and P=.113). There was a statistically significant difference in the weight attached to economic parameters versus technical parameters, with economic parameters being considered more challenging (Z= -2.76 and P = 0.006).

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6 (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
The role of different actors (Q5): In 2005, participants did not change their perceptions about the contribution scientists and engineers; politicians and the civil society, in the transition to a sustainable energy future, with mean values after the workshop being 5.0, 4.78 and 5.44 respectively.\(^7\) 2011 Mean values of expert group’s responses were 4.7, 5.2 and 5.8, with the most agreement on the role of civil society (standard deviation .69, versus 2.2 and 2.7 for scientists and politicians respectively). The non-expert residents responses had a mean value of 4, 5.5 and 5.6 respectively, with maximum agreement regarding civil society members with a standard deviation = 1.2. Comparing the categories of the 2011 responses (aggregated across experts and non-experts), revealed no statistically significant differences in the perceived agency between politicians and scientists/engineers (Z = -2.07, P = 0.38) and between civil society members and politicians (Z = -.105, P = .916). However, there was a statistically significant difference in the perceived role of the civil society versus scientists and engineers, with civil society being perceived to be able to contribute more significantly to a move towards a more sustainable energy future than scientists and engineers (Z = -2.745, P = 0.006).

Interests that support or hinder transitions to sustainability (Q6): In 2005, participants did not change their views on how economic, environmental protection or national security interests support or hinder the transition to a sustainable energy system, with mean values after the workshop being 4.38, 6.33 and 5.33 respectively.\(^8\) This trend continues in 2011, with experts ranking economic interests most supportive of the transition with a mean value of 4.7, and standard deviation of 2.5; followed by environmental protection (mean value = 4, standard deviation 1.4) and national security (mean value 1.7, standard deviation = 1.3). Non experts too echoed this pattern with economic interests being weighed the most (mean value = 3.7, standard deviation = 1.8), followed by environmental protection (mean value = 2.7, standard deviation 1.8) and national security (mean value = 2.2, standard deviation = 1.8). Aggregating expert and non-expert data and comparing preferences for 2011 revealed no statistically significant differences in the perceived agency between the environmental protection argument and the economic interest argument (Z = -1.602, P = .109). However, there was a statistically significant difference in the perceived role national security versus economic interests, with economic interests being the more potent argument supporting the transition to a more sustainable energy future (Z = -3.136, P = .02). Similarly, the environmental protection argument was perceived to support the transition to a greater extent than national security rhetoric (Z = -2.907, P = .004).

\(^7\) (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
\(^8\) (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
Increased mutual understanding: As per the 2005 study, there was no clear evidence that the workshop increased mutual understanding or familiarity among the participants. This question was not included in the 2011. More research is required to estimate if current processes are creating opportunities for enhancing mutual understanding.

Scaling up from the individual to the interests of the collective and non-human (Q9 &10): In 2005, participants’ perceptions about the relevance of future generations and non-human species was high before the workshop and remained high after the workshop. There was no significant change in perceptions (mean value of responses after the workshop - 5.33 and 4.33; and standard deviation being .866 and 1.118 respectively).

In 2011, participants’ continue to think of future generations and non-human species as being important, however there is greater variation of responses in the group (mean values =  5.42 and 4.19 with standard deviation being 1.75 and 2.2. respectively).

Hypothesis 3. Deals with participants’ views about the complexity and uncertainty involved in planning for a sustainable energy future.

Perceived complexity of transitioning to a renewable energy system and the certainty of the outcomes of the transition (Q 7&8): In the 2005 study, while there were no significant changes in perception of the complexity and certainty of sustainable energy systems, participants did view the task of increasing renewable energy use as being rather complex (mean value 4.1, standard deviation = 1.17) and outcomes of sustainable energy sources as being very certain (mean value 5.8, standard deviation = .44) at the end of the workshop.

The 2011 study indicates that participants perceived the task of increasing renewable energy use as being relatively less complex (non-experts – mean value 3.4, standard deviation = 1.28; experts mean 2.8, standard deviation = 1.77). Participants continue to perceive the consequences from the increased use of renewable energy sources in Austria as very certain (non-experts mean 4.7, standard deviation = 1.31, experts mean 6.85, standard deviation = .377).

Hypothesis 4. Deals with finding ways for institutional change, joint action and dealing with conflict in a constructive way.

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9 (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
10 (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
11 (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
**Satisfactions with current institutions (Q11):** In 2005, participants were unsatisfied with current institutions (mean 3.7, standard deviation = 1.325, values before the first session of the workshop). The 2011 study indicated a similar neutral response (non-expert mean 3.5, standard deviation = 1.6; expert mean 3.5, standard deviation 2.14), however an increased standard deviation indicates there is less consensus in the group regarding the effectiveness of existing institutions.

**Opportunities for joint action:** In 2005, participants saw opportunities for joint action and following the workshop, Raabau and Lödersdorf have actively pursued sustainability goals through the e5 program, which connects sustainability actors and efforts across Styria and Austria\(^{12}\). Given the short duration of this research project, the identification and assessment of joint action between actors within the communities will require further research.

**Perceived sources of conflict (Q12):** This question was introduced in the 2011 study to identify the participants’ views on the sources of conflict regarding the use renewable energy sources. Both experts and non-experts perceived decision-making, personalities and communication and various interest groups as being the main sources of conflict. Differences in interpretation of data and values were less conflict ridden. Experts: Interpretation of data (mean 3.1, sd = 1.7), Various interest groups (mean 4.1, sd = 2.5), Decision-making (mean 6.1, sd= 0.69), Values (mean 3.4 sd= 2.1), Personalities and communication (mean 4.4, sd = 2.4). Non experts: Interpretation of data (mean 2.6, sd = 1.5); various interest groups (4, sd = 1.5); decision-making (4.42, sd = 1.4); values (3.8, sd = 1.7); personalities and communication (4.1, sd = 1.4).

Analysis of an aggregation of expert and non-expert data revealed that there were statistically significant differences in the perceived roles of various sources of conflict i. Decision-making processes cause are perceived to be more contested than the interpretation of data (Z = -3.542, P = .00); (ii) personalities and communication issues are perceived to cause more conflict that the interpretation of data (Z = -3.241, P = .001); and (iii) decision-making processes cause more conflict than differences in values (Z= -2.437, P = 0.015). Therefore a focus on communication, and decision-making processes would benefit the communities, in addition to disseminating information and creating awareness on various renewable energy systems.

**How best to deal with conflict (Q13)?** In 2005, prior to the deliberative workshops, participants' believed that better information would assist communities in dealing with conflicts in relation to the use of renewable energy sources (‘provide better information’: mean = 6.22, standard deviation = .833). After the workshop, the call for better information became a secondary concern, a statistically significant difference and the search for compromise was perceived to

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\(^{12}\) (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
be most effective in dealing with conflicts (‘focus on finding a compromise’: mean= 4.56, standard deviation = 1.13).

In 2011, there is a statistically significant difference in the role of better information, focusing on finding compromise and using conflict to reach new solutions in resolving conflict in relation to the use of renewable energy sources ($\chi^2 = 10.133$ and $P = 0.006$). There were no statistically significant differences in the perceived conflict resolution agency of providing information versus using conflict to reach new solutions ($Z = -1.768$, $P = 0.77$); and focusing on compromise versus using conflict to reach new ideas ($Z = -1.592$, $P = .111$). However, there was a statistically significant difference in the perceived role of providing information instead of focusing on finding a compromise to resolve conflict. In 2011, participants once again believe that providing better information is a better way to resolve conflicts in relation to the use of renewable energy systems than focusing on finding a compromise ($Z = -2.37$, $P = .017$), a shift from the 2005 workshop.

How constructive is participative deliberation (Q14)? In 2005, participants found participatory approaches during the MCE workshop as having led to constructive discussions with a mean value of 4.89. Standard deviation reduced significant indicating widespread agreement in this regard (Std. Dev. before workshop = 1.454; Std. Dev. after workshop = .859). In 2011, participants continue to find participatory approaches conducive to constructive discussion (mean = 4.67, Std. Dev. 1.55).

Can this approach be used in other settings (Q15)? In 2005, participants were positive that this approach can be used in other decision-making settings, with a mean value of 5.12 and a standard deviation of 0.804. In 2011, this mean value decreased to 4.47 with an increase in standard deviation (1.72).

Hypothesis 5. Deals with the e5 program, in particular perceived effectiveness, perceptions on the most effective tools to encourage the use of renewable energy, personal confidence, sources of information and learning and the motivation for joining the program.

E5 program and social aspects of transitioning (Q16): There was a statistically significant difference in the perceived effectiveness of the e5 program in creating a fruitful discussion versus improving mutual understanding ($Z = -2.6$, $P = 0.009$), with the program being more effective in creating a fruitful discussion than improving mutual understanding. Similarly, the

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13 (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
14 (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
15 (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
program was perceived to be more effectiveness in increasing public awareness than enhancing the community’s morale (Z = -2.95, P =0.003), or improving mutual understanding regarding energy issues (Z=-2.96, P=0.007). No other statistically significant differences in perceived effectiveness were revealed.

**E5 program and economic aspects of transitioning (Q17):** The program was perceived to be more effective in helping reduce energy costs than creating economic value in the community (Z =-3.0, P =0.002).

**E5 program comparing public awareness, economic benefit and technical goals (Q18):** There was also a statistically significant difference in the perceived effectiveness of the e5 program in achieving public awareness, economic and technical goals (x2 =21.4; P =0.00). Post-hoc analysis with Wilcoxon Signed-Rank Tests was applied with a Bonferroni correction so that P <0.01, revealed a statistically significant difference in that the program was considered to be more effective in increasing public awareness than motivating the use of new technology or creating economic value (Z –2.74, P=.006; and Z=–3.21, P=0.001, respectively).

**What are the effective transitioning tools (Q19)?** In 2011, there is a statistically significant difference in the perceived effectiveness of various actions in assisting communities transition to sustainable energy systems (x2 = 27.896 and P = .000). Post-hoc analysis with Wilcoxon Signed-Rank Tests was applied with a Bonferroni correction so that P <0.01, revealed there was a statistically significant difference the perceived effectiveness of showing completed projects versus reduced energy charges, information on renewable energy and measures in neighboring communities, with examples of completed projects being more effective. (P= 0.004, 0.000 and 0.000 respectively). Similarly, the reduced energy charges were perceived to be more effective than measures in neighboring communities (Z = -2.48 and P=.01), and financial incentives being more useful in convincing participation in sustainable energy programs than information on renewable energy and measures in neighboring communities (P =0.002 in both cases).

**E5 impact on knowledge, confidence to share and personal motivation to use less energy (Q20):** There was no statistically significant difference to the weights associated with these three outcomes, with mean values of 4.5, 4.5 and 5.0 respectively, indicating a moderately high degree of positive change in knowledge, confidence and personal motivation of the participants to reduce energy use since participation in the e5 program (standard deviation = 1.96, 1.86 and 1.89 respectively).

**Sources of information (Q21):** In 2011, there is a statistically significant difference in the extent to which these sources of information are used by the participants. Post-hoc analysis with Wilcoxon Signed-Rank Tests was applied with a Bonferroni correction so that P <0.005, revealed there was a statistically significant in the use of the internet as a source of information as
compared to every other category, with a mean value of 5.19, followed by Local Technical Experts (mean value 2), as compared to e5 experts in Graz (mean 1.57), Local e5 coordinators (mean 1.38), Scientific Literature (mean 1.85), Styrian municipalities (mean 1.47), Austrian Municipalities (mean 1.28), International communities (mean .9) and Literature from utility companies (mean 1.28). A quick look at the descriptive statistics segregated by the two groups—expert and non-expert participants—reveal that while non-experts weighted the internet (mean value 5) and local technical experts (mean 2.3) as the preferred sources of information, experts view the internet (mean 5.1), scientific literature (mean value 2.8) and e5 coordinators in Graz as their preferred sources of information (2.5).

**Motivation for joining e5 (Q22)**: Participants rate the reasons for joining the e5 network as follows a. Increased energy independence (mean value 5.8), Illustrating an example (mean value 5.2), Prosperity of future generations (mean value 5.2), to reduce energy costs (mean value 5), to consume less energy (mean value 4.9), access knowledge on renewable energy systems (4.7), and access financial support (3.7). Of these, there was a statistically significant difference between the weight associated with increasing energy independence as compared to accessing financial support ($Z=-3.276$, $P=.001$) or accessing knowledge ($Z=-2.63$, $P=0.008$), with participants weighing energy independence as their prime motivation in joining the e5 program over financial support or accessing information.
Discussion

Transitioning to a renewable energy system and adapting in a co-evolving socio-ecological system is a complex task, often with uncertain outcomes. It has been argued that the decision-making process dealing with a continuously changing system must itself have the capacity to adapt and continuously learn, in other words, the actors involved in the decision-making process must be able to continuously learn to build their capacity to adapt. This social learning has the capacity to change underlying values and assumptions, enhance mutual understanding and facilitate conflict resolution in a constructive way. While there has been a great amount of discussion in the literature on the role of social learning, it is much harder to empirically estimate if processes create learning. This study took off from a previous study in 2005, which attempted to identify if learning occurred before and after a multi-day participatory multi-criteria analysis for allocating funding to different projects in two communities in Styria, Austria. The two communities had collaborated to apply for funding to participate in the e5 program, a national network with international members that seeks to assist communities’ transition to sustainable energy systems by measuring their annual progress against their potential. Participants of the 2005 study included local residents, local e5 representatives, and local, regional and national technical experts.

This study sought to identify if there were changes in the preferences and perspectives of the participants of the 2005 study after six years of being consistently involved in sustainability related decision-making and planning processes. The primary tool to guide the communities in this period has been the e5 program. This study also sought to compare the expectations of joining this program with perceived outcomes and processes suggesting ways to improve participation, or the program itself. Research showed these communities are supported by a regional planning mandate focused on improving the quality of life in the region and creating greater energy independence in the area. In other words, there was political support for transition activities. The region is also home to a dense green technology industrial cluster, making sustainability an economic development strategy for the state government.

Results in the study indicated that:

12. Overall, participants had a high degree of knowledge of the role of various renewable energy technologies. At the local level, participants placed more importance on solar energy than any other source. Interviews with a local energy expert indicated that solar energy was very popular due to its high visibility. Installing solar panels was becoming normative in the two communities.

13. Participants continued to exhibit high levels of knowledge on the procedural and effectiveness axes of cognitive learning, indicating that participating continued
participation of decision-makers in networks and programs is a good strategy to ensure confidence of knowledge of renewable energy systems.

14. Participants continued to frame the issue with similar preferences. Non experts felt that social and economic barriers were equally challenging, whereas experts rated economic barriers as being most challenging. Technical barriers continued to be least important for both groups.

15. The civil society continued to be perceived to have the greatest role in enabling the transition to a sustainable energy system in 2005 and 2011. In 2005, scientists and engineers were perceived to having more of a role than politicians. This changed in 2011, where both the expert and the non-expert groups rates politicians as having more of a role than scientists and engineers.

16. Participants continued to believe that the economic argument was the stronger than the argument for environmental protection or national security to support the transition to sustainability.

17. Perceived complexity of transitioning to a renewable energy systems decreased from 2005 to 2011.

18. Both experts and non-experts perceived decision-making, personalities and communication and various interest groups as being the main sources of conflict related to becoming more sustainable. Differences in interpretation of data and values were less conflict ridden.

19. After the 2005 workshop, participants changed their views and felt that finding compromise was the better solution to dealing with conflict than providing better information. In 2011 however, providing better information was once again perceived to be the best way to resolve conflict ridden situations. This is quite interesting as interpretation of data was less of a problem than the more communicative aspects of transitioning – decision making, personalities, negotiating diverse interest groups and personalities.

20. The e5 program was perceived to be most effective in creating public awareness and creating a fruitful discussion than improving mutual understanding or enhancing a community’s morale.

21. The program was perceived to be more effective in creating public awareness than increasing economic benefit of the use of renewable energy technology. In other words, it is most effective as a public awareness tool.

22. Participants felt that examples of success stories of completed projects and financial incentives were the more effective in encouraging renewable energy adoption, than reduced energy charges, or more information on renewable energy technology.
23. Non-experts acquired most of their knowledge via the internet and through local technical experts, whereas experts turned to scientific literature and regional e5 representatives for information regarding renewable energy systems.

24. Energy independence was the primary motivation for joining the e5 program.

In conclusion, although social learning has taken place over the years, learning leading to conflict resolution, enhancing mutual understanding and joint action has occurred to a lesser extent than needed. No change in how participants frame of the issue and the perceive the role of various actors and barriers involved, can itself mean that these are the main challenges faced in transitioning to sustainability. The following recommendations may help existing programs such as the e5 to create new strategies and target specific barriers to accelerate the transition to a renewable energy system in the region.

**Recommendations**
A. Focus on creating greater awareness of the financial incentives available and success stories within the community using shared media. Seek to increase public participation in the transition to renewable energy systems. Since economic and social barriers are the more important than technological barriers, efforts should be made to identify and address community-specific economic and social issues, for example barriers to participation in public transit. This will also help the diffusion of the most appropriate technology for the local context.

B. Decision-making, communication, personalities and various interest groups were considered to be the biggest challenges. Training e5 program staff in participatory decision-making processes and conflict resolution strategies and frequently employing these methods may help enhance mutual understanding and help reach compromise in challenging circumstances. Creating boundary objects between various communities of practice in the communities and creating shared projects may also help. Recognizing and encouraging the work of boundary agents will ensure continued collaboration in projects.

C. Since energy independence was the primary motivation to joining the e5 program, and the economic argument is considered to be the most effective argument supporting the transition, more research and publishing information on economic benefits may be of assistance to the communities.

D. Sustained participation in renewable energy programs such as the e5 seemed to have reduced the perceived complexity of the transition. Participation in transition programs should be encouraged by regional and federal authorities.

E. Appropriate renewable energy sources other such as bioenergy and hydropower should be publicized and completed projects should be recognized. The idea being that these technologies should become the norm through widespread social acceptance.
### APPENDIX A: 2005 Survey

#### Appendix A

**Appendix A1. Relevant sections of the questionnaire**

1. How familiar are you with what role different renewable energy sources can play in Austria in the next 15 years? (Please circle)
   - (Q1) not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much

2. How familiar are you with which energy mixes can achieve a more sustainable energy system for Austria?
   - (Q2) not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much

3. How familiar are you with the different impacts of more sustainable energy mixes?
   - (Q3) not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much

4. Are difficulties in changing to a more sustainable energy system in Austria mostly due to:
   - (Q4) economic parameters?
     - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much
   - (Q5) social parameters?
     - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much
   - (Q6) technical parameters?
     - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much

5. How much can the following actors contribute to a move towards a more sustainable energy system?
   - (Q7) Scientists and engineers
     - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much
   - (Q8) Politicians
     - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much
   - (Q9) Members of civil society
     - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much
   - (Citizens, NGOs, etc.)

6. To what extent do the following arguments support the increased use of renewable energy sources in Austria?
   - (Q10) Economic interests
     - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much
   - (Q11) Environmental protection
     - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much
   - (Q12) National security
     - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much

7. Of those participants with whom you do not agree, to what extent did the workshops increase your familiarity with their reasoning?
   - (Q13) not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much

8. How relevant are the needs of future generations when deciding about an increase in the use of renewable energy sources in Austria?
   - (Q14) extremely unimportant: 1 : 2 : 3 : 4 : 5 : 6 : 7 : extremely important

9. How relevant are the needs of non-human species when deciding about an increase in the use of renewable energy sources in Austria?
   - (Q15) extremely unimportant: 1 : 2 : 3 : 4 : 5 : 6 : 7 : extremely important

10. Increasing the use of renewable energy sources in Austria is...
    - (Q16) extremely simple: 1 : 2 : 3 : 4 : 5 : 6 : 7 : extremely complex

11. The consequences from the increased use of renewable energy sources in Austria are
    - (Q17) extremely uncertain: 1 : 2 : 3 : 4 : 5 : 6 : 7 : extremely certain

12. How useful do you find the current institutions for the transition to a more sustainable future?
    - (Q18) not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much

13. Can you see opportunities for joint action in the search of more sustainable energy future in Austria?
    - (Q19) not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much

14. In case you think there are conflicts in relation to the use of renewable energy sources, how could they be best dealt with?
    - (Q20) Provide better information
      - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much
    - (Q21) We need to focus more on finding compromise
      - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much
    - (Q22) Perceiving conflicts as a source of dialogue can lead to the emergence of new ideas
      - not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much

15. How useful do you find the participatory integrated approaches as a basis for constructive discussions?
    - (Q23) not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much

16. Can you imagine that this approach of integrated assessment and stakeholder participation could work in a different setting?
    - (Q24) not at all: 1 : 2 : 3 : 4 : 5 : 6 : 7 : very much

17. How would you evaluate your experience during the workshop?

Source: (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
APPENDIX B: 2005 Results

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Source: (Garmendia & Stagl, Public Participation for sustainability and social learning: Concepts and Lessons from three case studies in Europe, 2010)
APPENDIX C: 2011 Survey

Questionnaire.

Q1. How familiar are you with what role different renewable energy sources can play in Austria/your community in the next 15 years?

- Solar energy  small role (1) ------ large role (7)
- Wind energy  small role (1) ------ large role (7)
- Geothermal energy  small role (1) ------ large role (7)
- Bioenergy  small role (1) ------ large role (7)
- Hydropower  small role (1) ------ large role (7)
- Hydrogen and fuel cells  small role (1) ------ large role (7)

Q2. How familiar are you with which energy mixes can achieve a more sustainable energy system for Austria/your community?

Not very familiar (1) ----- Very Familiar (7)

Q3. How familiar are you with the different impacts of more sustainable energy mixes?

Not very familiar (1) ----- Very Familiar (7)

Q4. Are difficulties in changing to a more sustainable energy system in Austria/your community mostly due to:

a. Economic Parameters  Not at all (1) ---- Very much (7)
b. Social Parameters  Not at all (1) ---- Very much (7)
c. Technical Parameters  Not at all (1) ---- Very much (7)

Q5. How much can the following actors contribute to a move towards a more sustainable energy future?

a. Scientists and Engineers  Not at all (1) ---- Very much (7)
b. Politicians  Not at all (1) ---- Very much (7)
c. Members of civil society  Not at all (1) ---- Very much (7)

Q6. To what extent do the following arguments support the increased use of renewable energy sources in Austria/your region?

a. Economic Interests  Not at all (1) ---- Very much (7)
b. Environmental Protection  Not at all (1) ---- Very much (7)
c. National Security  Not at all (1) ---- Very much (7)
Q7. Increasing the use of renewable energy use in Austria is:

   Extremely simple (1) ---- Extremely complex (7)

Q8. The consequences from the increased use of renewable energy sources in Austria are:

   Extremely uncertain (1 ---- Extremely certain (7)

Q9. How relevant are the needs of future generations when deciding about an increase in the use of renewable sources in Austria?

   Not very (1) ---- Very much (7)

Q10. How relevant are the needs of non-human species when deciding about an increase in the use of renewable energy sources in Austria?

   Not very (1) ---- Very much (7)

Q11. How useful do you find current institutions for the transition to a more sustainable future

   Not at all (1) ---- Very much (7)

Q12. To what extent are the following reasons for a conflict regarding the use of renewable energy sources in Austria/your community is?

   a. Interpretation of data
      Not at all (1) ---- Very much (7)
   b. Various interest groups in society
      Not at all (1) ---- Very much (7)
   c. Decision making
      Not at all (1) ---- Very much (7)
   d. Values
      Not at all (1) ---- Very much (7)
   e. Personalities and communication
      Not at all (1) ---- Very much (7)

Q13. In case there are conflicts in relation to the use of renewable energy sources, how could they be best dealt with?

   a. Provide better information
      Not at all (1) ---- Very much (7)
   b. Focus more on finding compromise
      Not at all (1) ---- Very much (7)
   c. Perceive conflicts as a source of dialogue leading to new ideas
      Not at all (1) ---- Very much (7)

Q14. How useful do you find participatory integrated approaches as a basis for constructive discussion?

   Not at all (1) ---- Very much (7)
Q15. Can you imagine that the approach can work and the integrated assessment and stakeholder involvement in other applications?

Not at all (1) --- Very much (7)

Q16. How effective is the e5-program in terms of the following social aspects:

a. mobilizing previously uninterested stakeholders  
   Not at all (1) --- Very much (7)

b. creating a fruitful discussion in the community  
   Not at all (1) --- Very much (7)

c. educating and informing young people  
   Not at all (1) --- Very much (7)

d. increasing community morale  
   Not at all (1) --- Very much (7)

e. motivating politicians to act on energy issues  
   Not at all (1) --- Very much (7)

f. increasing public awareness  
   Not at all (1) --- Very much (7)

g. influencing personal values and attitudes towards the environment  
   Not at all (1) --- Very much (7)

h. changes in energy use  
   Not at all (1) --- Very much (7)

i. improving mutual understanding in the community  
   Not at all (1) --- Very much (7)

Q17. How effective is the e5-program in terms of the following economic aspects:

a. reducing energy costs  
   Not at all (1) --- Very much (7)

b. creating economic value  
   Not at all (1) --- Very much (7)

Q18. How effective is the e5-program in terms of the following technological aspects:

a. encouraging the use of renewable energy technologies  
   Not at all (1) --- Very much (7)

Q19. To what extent are the following effective in transitioning to sustainable energy systems?

a. Examples of completed projects  
   Not at all (1) --- Very much (7)

b. Reduced energy charges  
   Not at all (1) --- Very much (7)

c. Financial incentives  
   Not at all (1) --- Very much (7)

d. More information on renewable energy  
   Not at all (1) --- Very much (7)

e. Measures in neighboring communities  
   Not at all (1) --- Very much (7)

Q20. Since the participation of Austria on the e5 program, to what extent:

a. has changed your knowledge about renewable energies  
   Not at all (1) --- Very much (7)
b. has increased your confidence regarding sharing information on renewable energy?

C. has been your personal motivation to use energy more efficiently changed?

Q21. Which of these sources of information regarding renewable energy systems do you use:

a. internet 
Not at all (1) --- Very much (7)

b. e5 coordinators in Graz
Not at all (1) --- Very much (7)

c. local e5 representatives
Not at all (1) --- Very much (7)

d. local technical experts
Not at all (1) --- Very much (7)

e. scientific literature
Not at all (1) --- Very much (7)

f. other Styrian municipalities
Not at all (1) --- Very much (7)

g. other Austrian municipalities
Not at all (1) --- Very much (7)

h. communities in other countries
Not at all (1) --- Very much (7)

i. literature from utility companies.
Not at all (1) --- Very much (7)

Q22. Please rate the following reasons for joining the network e5 terms of their importance:

a. to reduce energy
Not at all (1) --- Very much (7)

b. to consume less energy
Not at all (1) --- Very much (7)

c. in order to ensure the prosperity of future generations
Not at all (1) --- Very much (7)

d. to increase the energy independence
Not at all (1) --- Very much (7)

e. to illustrate an example
Not at all (1) --- Very much (7)

f. to gain access to financial support
Not at all (1) --- Very much (7)

g. to gain access to knowledge about renewable energy systems.
Not at all (1) --- Very much (7)
APPENDIX D: 2011 Survey Results in Detail

**Hypothesis 1.** There are changes in knowledge within an existing frame of reference, which involves effectiveness knowledge and contains procedural knowledge about the relative effectiveness of different behaviors to reach a certain outcome.

Survey Q1: How familiar are you with what role different renewable energy sources can play in Austria/your community in the next 15 years?

- Solar energy
- Wind energy
- Geothermal energy
- Bioenergy
- Hydropower
- Hydrogen and fuel cells

Hypothesis 1 deals with the acquisition of various types of cognitive knowledge - declarative knowledge, procedural knowledge and effectiveness knowledge.

Results from the 2005 case study did not indicate any statistically significant changes in responses to questions 1-3 after the MCE workshop. Participants exhibited a high degree of familiarity with the role of different renewable energy sources in Austria, the effectiveness of various energy for achieving a more sustainable energy system in Austria and the impacts of each energy mix. This was attributed to a high level of knowledge held by participants before the workshop acquired through the process of applying for e5 program funding.

Mean values in the expert group were solar energy, bioenergy and hydropower = 5.7, wind energy = 3.8, geothermal energy = 2.8, and hydrogen and fuel cells = 2.8. Although solar, bioenergy and hydropower were weighted similarly, there was maximum consensus on the role of bioenergy, with a standard deviation = .9, versus 2.5 for solar and wind both. The non-experts, most of who live in the two communities were asked about the role in their specific community. They ranked solar energy as having the greatest role to play (mean value = 6.2, standard deviation =.9), followed by bioenergy (mean value = 5, standard deviation = 2.3), geothermal energy (mean value = 3.1, standard deviation = 1.6), hydropower (mean value = 3.1, standard deviation = 2.1), wind energy (mean value = 2.4, standard deviation = 1.7), and hydrogen and fuel cells (mean value = 1.7, standard deviation = .8).

In 2011, there was a statistically significant difference in perceived role of energy source (x2 =47.34 and P = 0.00). Post-hoc analysis with Wilcoxon Signed-Rank Tests was conducted with a Bonferroni correction applied, resulting in a significance level set at P < 0.01 Median (IQR) perceived roles for solar energy, wind energy, geothermal energy, bioenergy, hydropower and hydrogen and fuel cells were 7 (6 to 7), 3 (1 to 4), 3 (2 to 4), 6 (4 to 7), 4 (1.5 to 7) and 2 (1 to 3)
respectively. There were no statistically significant differences between solar energy and bioenergy (Z = -1.908 and P = 0.56), geothermal and wind (Z = -0.493, P = 0.622), hydropower and wind (Z = -2.08, P = 0.037), hydrogen and fuel cells and wind (Z = -1.61, P = 0.105), hydropower and geothermal (Z = -1.275, P = 0.202), or fuel cells (Z = -2.213, P = 0.027), bioenergy and hydropower (Z = -1.686 and P = 0.092). However, there was a statistically significant increase in the importance attached to solar energy versus wind, geothermal, hydropower and hydrogen and fuel cells. Similarly, there was a statistically significant increase in the importance attached to bioenergy as compared to wind energy (Z = -2.08, P = 0.037), geothermal energy (Z = -3.2, P = 0.001), and hydrogen and fuel cells (Z = -3.677 and P = 0.00); and hydropower was considered as having more of a role than hydrogen and fuel cells (Z = -3.12, P = 0.002).

Survey Q2. How familiar are you with which energy mixes can achieve a more sustainable energy system for Austria/your community?

While both experts and non-expert participants continued to display a high degree of familiarity with various types of energy mixes (Q2), with 2005 a mean value of 5.22 and Std. Dev. = 0.667, and 2011 non-expert mean = 5; Std. Dev. = 1.2 and expert mean value of 5.4 and Std. Dev of 1.7, the standard deviation of the aggregated group responses has increased between 2005 and 2011 to 1.36. In other words, there is a lower consensus regarding the various types of energy mixes within the group.

Survey Q3. How familiar are you with the different impacts of more sustainable energy mixes?

Similarly, in 2005 participants demonstrated a high level of effectiveness knowledge—regarding the effectiveness of various energy mixes in creating a positive impact (2005 mean = 5.33; Std. Dev. = 0.866) whereas in 2011, while overall knowledge remains high, the increase in standard deviation within the group responses indicated that the group agrees less about the impact of various energy mixes (2011 mean = 5.33; Std. Dev. = 1.24).

Hypothesis 2. There is a change in the appraisal of facts on the basis of a change in underlying values and assumptions, through a greater understanding of other people’s needs and perceptions.

Hypothesis 2 deals with changes in underlying values and assumptions and how participants frame the sustainability issue. Participants understand the role of various actors and there is an enhancement of mutual understanding and concern for larger societal needs, especially future generations and non-human species.

Hypothesis 2.1 Deals with the framing of an issue and with the perception of the issue. Participants frame the issue at hand as having economic, social or technical parameters of varying significance.
Survey Q4. Are difficulties in changing to a more sustainable energy system in Austria/ your community mostly due to: a. Economic Parameters; b. Social Parameters; or c. Technical Parameters?

In 2005, the weight attached to the social parameter changed in a statistically significant manner after the deliberative workshop. There were no statistically significant changes in the way participants weighted economic or technical barriers, i.e. they did not change the way they framed the issue in terms of these two factors. Economic parameters were consistently weighted more heavily before and after the workshop (mean before =5.44, mean after = 5.11) as compared to social (mean before = 3.5, mean after =4.33) and technical (mean before =2.62, mean after =3.13).

In 2011, there was a statistically significant difference in perceived role of economic, social and technical challenges ($x^2 = 7.918$ and $P = .019$) in changing to a more sustainable energy system in Austria. Post-hoc analysis with Wilcoxon Signed-Rank Tests was conducted with a Bonferroni correction applied, resulting in a significance level set at $P < .017$. Median (IQR) perceived roles for economic parameters, social parameters and technical parameters were 5 (3.5 to 6), 4 (2 to 5) and 3 (2 to 4), respectively. There were no statistically significant differences between social parameters and economic parameters ($Z = -1.35$ and $P = .177$) and technical parameters and social parameters ($Z= -1.58$ and $P= .113$). However, there was a statistically significant difference in the weight attached to economic parameters versus technical parameters, with economic parameters being considered more challenging ($Z= -2.76$ and $P = 0.006$).

Whereas the non-expert community members rated both economic and social parameters are moderately high (mean 4.2 each, with standard deviation of 1.8 and 1.9 respectively), the experts felt that economic barriers were the most challenging (mean value 5.14, Std .Dev 1) followed by social parameters (mean value 3, Std. Dev. 1.4). Technical parameters were the least challenging.

Survey Q5. How much can the following actors contribute to a move towards a more sustainable energy future? a. Scientists and Engineers; b. Politicians; c. Members of civil society

In 2005, participants did not change their perceptions about the contribution scientists and engineers; politicians and the civil society, in the transition to a sustainable energy future, with mean values after the workshop being 5.0, 4.78 and 5.44 respectively.

In 2011, there was a statistically significant different in the perceived role of these actors ($x^2 = 10.53$ and $P = 0.005$). Post-hoc analysis with Wilcoxon Signed-Rank Tests were conducted with corrections, setting a significance level at $P<0.017$. Median (IQR) perceived roles for scientists and engineers, politicians and members of the civil society were 4 (3.5 t0 5), 6 (4.5 to 7) and 6
There were no statistically significant differences in the perceived agency between politicians and scientists/engineers (Z = -2.07, P = 0.38) and between civil society members and politicians (Z = -.105, P = .916). However, there was a statistically significant difference in the perceived role of the civil society versus scientists and engineers, with civil society being able to contribute more significantly to a move towards a more sustainable energy future than scientists and engineers (Z = -2.745, P = 0.006).

**Survey Q6. To what extent do the following arguments support the increased use of renewable energy sources in Austria / your region? a. Economic Interests; b. Environmental Protection; and c. National Security.**

In 2005, participants did not change their views on how economic, environmental protection or national security interests support or hinder the transition to a sustainable energy system, with mean values after the workshop being 4.38, 6.33 and 5.33 respectively.

In 2011, there was a statistically significant different between the perceived role of the three arguments ($x^2 = 12.870$ and $P = 0.002$). Post-hoc analysis with Wilcoxon Signed-Rank Tests were conducted with corrections, setting a significance level at $P<0.017$. Median (IQR) perceived for economic, environmental protection and national security argument for transitioning to a more sustainable energy system were 4 (2.5 to 6), 3 (1.5 to 5) and 1 (1 to 3.5) respectively. There were no statistically significant differences in the perceived agency between the environmental protection argument and the economic interest argument (Z = -1.602, P = .109). However, there was a statistically significant difference in the perceived role national security versus economic interests, with economic interests being the more potent argument supporting the transition to a more sustainable energy future (Z = -3.136, P = .02). Similarly, the environmental protection argument was perceived to support the transition to a greater extent than national security rhetoric (Z = -2.907, P = .004).

**Hypothesis 2.2** There is an increased understanding of the other participants' viewpoints that results in a (positive) change in attitudes towards them (Garmendia and Stagl paper).

As per the 2005 study, there was no clear evidence that the workshop increased mutual understanding or familiarity among the participants. This question was not included in the 2011. More research is required to estimate if current processes are creating opportunities for enhancing mutual understanding.

**Hypothesis 2.3** Participants refine their knowledge about societal needs, esp. future generations and non-human species and the forces that impact this transition: environmental interests, economic interests and interests of national security.
Survey Q9. How relevant are the needs of future generations when deciding about an increase in the use of renewable sources in Austria?

Survey Q10. How relevant are the needs of non-human species when deciding about an increase in the use of renewable energy sources in Austria?

In 2005, participants’ perceptions about the relevance of future generations and non-human species was high before the workshop and remained high after the workshop. There was no significant change in perceptions (mean value of responses after the workshop - 5.33 and 4.33; and Std. Dev. being .866 and 1.118 respectively).

In 2011, participants’ continue to think of future generations and non-human species as being important, however there is greater variation of responses in the group (mean 5.42 and 4.19 with Std. Dev. Being 1.75 and 2.2. respectively).

**Hypothesis 3.** Have participants’ views about the complexities and uncertainties involved in planning for sustainable futures changed?

Survey Q7. Increasing the use of renewable energy use in Austria is: extremely simple (1) ---- extremely complex (7).

Survey Q8. The consequences from the increased use of renewable energy sources in Austria are: extremely uncertain (1)… extremely certain (7).

In the 2005 study, while there were no significant changes in perception of the complexity and certainty in sustainable energy systems, participants did view the task of increasing renewable energy use as being rather complex (mean 4.1, Std. Dev. 1.167) and outcomes of sustainable energy sources as being certain (mean 5.8, Std. Dev. .441) at the end of the workshop.

The 2011 study indicates that participants perceived the task of increasing renewable energy use as being relatively less complex (non-experts - mean 3.4, Std. Dev. 1.28; experts mean 2.8, std. dev. 1.77). Participants continue to perceive the consequences from the increased use of renewable energy sources in Austria as very certain (non-experts mean 4.7, Std. Dev. 1.31, experts mean 6.85, std.dev. .377).

**Hypothesis 4.** Participants find ways for institutional change and joint action that open up the possibility to collaborate with others individuals. This also implies dealing with conflict riding issues in a constructive way.

Survey Q11. How useful do you find current institutions for the transition to a more sustainable future (1: not at all --- 7: very much)
In 2005, participants were unsatisfied with current institutions (mean 3.7, Std. Dev 1.325 – values before the first session of the workshop). The 2011 study indicated a similar neutral response (non-expert mean 3.5, Std.Dev. 1.6; expert mean 3.5, std.dev. 2.14), however an increased standard deviation indicates there is less consensus in the group regarding the effectiveness of existing institutions.

**Can you see opportunities for joint action in the search for the transition to a more sustainable future?**

In 2005, participants saw opportunities for joint action and following the workshop, Raabau and Lödersdorf have actively pursued sustainability goals through the e5 program, which connects actors across the state and the nation. Given the short duration of this research project, the identification and assessment of joint action between actors within the communities will require further research.

**Survey Q12. To what extent are the following reasons for a conflict regarding the use of renewable energy sources in Austria/your community is? a. Interpretation of data; b. Various interest groups in society; c. Decision making; d. Values; e. Personalities and communication**

This question was introduced in the 2011 study to identify the participants’ views on the sources of conflict regarding the use renewable energy sources.

There was no statistically significant difference in perceived significance by the expert group of various sources of conflict. Mean values were as follows: Interpretation of data (3.1, std dev. 1.7), Various interest groups (4.1, std.dev.2.5), Decision-making (6.1, std dev. 0.69), Values (3.4 std dev. 2.1), Personalities and communication (4.4, std dev. 2.4). Non-experts too perceived decision-making, personality and communications and various interest groups as most likely the source of conflict. Mean values were Interpretation of data (2.6, sd. 1.5); various interest groups (4, sd. 1.5); decision-making (4.42, sd. 1.4); values (3.8, sd. 1.7); personalities and communication (4.1, sd. 1.4).

Aggregating responses, there is a statistically significant different in the perceived significance of various sources of conflict (x^2 = 21.835 and P = 0.00). Post-hoc analysis with Wilcoxon Signed-Rank Tests were conducted. Median (IQR) perceived for sources of conflict were: namely interpretation of data 3 (1 to 4), various interest groups in society 5 (2 to 6), decision-making 5 (4 to 6), values 4 (3 to 5), and personalities and communication 4 (3 to 5.5). The statistically significant differences in the perceived roles of various sources of conflict were i. Decision-making processes cause are perceived to be more contested than the interpretation of data (Z = -3.542, P = .00); (ii) personalities and communication issues are perceived to cause more conflict that the interpretation of data (Z = -3.241, P = .001); and (iii) decision-making processes cause more conflict than differences in values (Z= -2.437, P = 0.015). Therefore a
focus on communication, and decision-making processes would benefit the communities, in addition to disseminating information and creating awareness on various renewable energy systems.

**Survey Q13.** In case there are conflicts in relation to the use of renewable energy sources, how could they be best dealt with? a. Provide better information; b. Focus more on finding compromise; and c. Perceive conflicts as a source of dialogue leading to new ideas.

In 2005, prior to the deliberative workshops, participants’ believed that better information would assist communities in dealing with conflicts in relation to the use of renewable energy sources (‘provide better information’: mean = 6.22, Std.Dev. = .833). After the workshop, the call for better information became a secondary concern, a statistically significant difference and the search for compromise was perceived to be most effective in dealing with conflicts (‘focus on finding a compromise’: mean= 4.56, Std. Dev = 1.13).

In 2011, there is a statistically significant difference in the role of better information, focusing on finding compromise and using conflict to reach new solutions in resolving conflict in relation to the use of renewable energy sources ($x^2 = 10.133$ and $P = 0.006$). Post-hoc analysis with Wilcoxon Signed-Rank Tests revealed that median (IQR) perceived ways to deal with conflict were: Providing better information 6 (5 to 7), Focus more on finding a compromise 5 (4 to 6.5), Perceive conflicts as a source of dialogue leading to new ideas 6 (4 to 7). There were no statistically significant differences in the perceived conflict resolution agency of information and using conflict to reach new solutions ($Z = -1.768$, $P=0.77$); and focusing on compromise versus using conflict to reach new ideas ($Z = -1.592$, $P=.111$). However, there was a statistically significant difference in the perceived role of providing information versus focusing on finding a compromise to resolve conflict. In 2011, participants once again believe that providing better information is a better way to resolve conflicts in relation to the use of renewable energy systems than focusing on finding a compromise ($Z = -2.37$, $P = .017$).

**Survey Q14.** How useful do you find participatory integrated approaches as a basis for constructive discussion?

In 2005, participants found participatory approaches during the MCE workshop as having led to constructive discussions with a mean value of 4.89. Standard deviation reduced significant indicating widespread agreement in this regard (Std. Dev. before work shop = 1.454; Std. Dev. after workshop = .859).

In 2011, participants continue to find participatory approaches conducive to constructive discussion (mean =4.67, Std. Dev. 1.55).
Survey Q15. Can you imagine that the approach can work and the integrated assessment and stakeholder involvement in other applications?

In 2005, participants were positive that this approach can be used in other decision-making settings, with a mean value of 5.12 and a standard deviation of 0.804. In 2011, this mean value decreased to 4.47 with an increase in standard deviation (1.72).

Hypothesis 5. The network of information (formal and informal) between various levels and institutions is perceived to be a channel for exchanging knowledge and information between various actors within a community of practice and across geographical scales.

Survey Q16. How effective is the e5-program in terms of the following social aspects:

a. mobilizing previously uninterested stakeholders; b. creating a fruitful discussion in the community; c. educating and informing young people; d. increasing community morale; e. motivating politicians to act on energy issues; f. increasing public awareness; g. influencing personal values and attitudes towards the environment; h. changes in energy use; i. improving mutual understanding in the community.

In 2011, there is a statistically significant difference in the perceived effectiveness of the e5 program in assisting communities to achieve these social goals ($x^2 = 25.681$ and $P = .001$). Post-hoc analysis with Wilcoxon Signed-Rank Tests was applied with a Bonferroni correction so that $P < 0.01$, revealed there was a statistically significant difference in the perceived effectiveness of the e5 program in creating a fruitful discussion versus improving mutual understanding ($Z = -2.6$, $P = 0.009$), with the program being more effective in creating a fruitful discussion than improving mutual understanding. Similarly, the program was perceived to be more effectiveness in increasing public awareness than enhancing the community’s morale ($Z = -2.95$, $P = 0.003$), or improving mutual understanding regarding energy issues ($Z = -2.96$, $P = 0.007$). No other statistically significant differences in perceived effectiveness were revealed.

Survey Q17 & 18. How effective is the e5-program in terms of the following economic aspects:

a. reducing energy costs; b. creating economic value.

The program was perceived to be more effective in helping reduce energy costs than creating economic value in the community ($Z = -3.0$, $P = 0.002$).

There was also a statistically significant difference in the perceived effectiveness of the e5 program in achieving public awareness, economic and technical goals ($x^2 = 21.4$; $P = 0.00$). Post-hoc analysis with Wilcoxon Signed-Rank Tests was applied with a Bonferroni correction so that $P < 0.01$, revealed a statistically significant difference in that the program was considered to be
more effective in increasing public awareness than motivating the use of new technology or creating economic value (Z = -2.74, P = .006; and Z = -3.21, P = .001, respectively).

Survey Q19. To what extent are the following effective in transitioning to sustainable energy systems?

- f. Examples of completed projects
- g. Reduced energy charges
- h. Financial incentives
- i. More information on renewable energy
- j. Measures in neighboring communities

In 2011, there is a statistically significant difference in the perceived effectiveness of various actions in assisting communities transition to sustainable energy systems (x^2 = 27.896 and P = .000). Post-hoc analysis with Wilcoxon Signed-Rank Tests was applied with a Bonferroni correction so that P < 0.01, revealed there was a statistically significant difference the perceived effectiveness of showing completed projects versus reduced energy charges, information on renewable energy and measures in neighboring communities, with examples of completed projects being more effective. (P = 0.004, 0.000 and 0.000 respectively). Similarly, the reduced energy charges were perceived to be more effective than measures in neighboring communities (Z = -2.48 and P = .01), and financial incentives being more useful in convincing participation in sustainable energy programs than information on renewable energy and measures in neighboring communities (P = 0.002 in both cases).

Survey Q20. Since the participation of Austria on the e5 program, to what extent: a. has changed your knowledge about renewable energies?; b. has shared your confidence, knowledge about renewable energies with community members changed? C. has been your personal motivation to use energy more efficiently changed?

There was no statistically significant difference to the weights associated with these three outcomes, with mean values of 4.5, 4.5 and 5.0 respectively, indicating a moderately high degree of positive change in knowledge, confidence and personal motivation of the participants to reduce energy use since participation in the e5 program (Std. Dev. = 1.96, 1.86 and 1.89 respectively).

Survey Q21. Which of these sources of information regarding renewable energy systems do you use: a. internet; b. e5 coordinators in Graz; c. local e5 representatives; d. local technical experts; e. scientific literature; f. other Styrian municipalities; g. other Austrian municipalities; h. communities in other countries; i. literature from utility companies.
In 2011, there is a statistically significant difference in the extent to which these sources of information are used by the participants. Post-hoc analysis with Wilcoxon Signed-Rank Tests was applied with a Bonferroni correction so that $P < 0.005$, revealed there was a statistically significant in the use of the internet as a source of information as compared to every other category, with a mean value of 5.19, followed by Local Technical Experts (mean value 2), as compared to e5 experts in Graz (mean 1.57), Local e5 coordinators (mean 1.38), Scientific Literature (mean 1.85), Styrian municipalities (mean 1.47), Austrian Municipalities (mean 1.28), International communities (mean 0.9) and Literature from utility companies (mean 1.28). A quick look at the descriptive statistics segregated by the two communities within the participants – experts and non-experts, reveal that while non-experts weighted the internet (mean value 5) and local technical experts (mean 2.3) as the preferred sources of information, experts view the internet (mean 5.1), scientific literature (mean value 2.8) and e5 coordinators in Graz as their preferred sources of information (2.5).

Survey Q22. Please rate the following reasons for joining the network e5 terms of their importance: a. to reduce energy; b. to consume less energy; c. in order to ensure the prosperity of future generations; d. to increase the energy independence; e. to illustrate an example; f. to gain access to financial support; g. to gain access to knowledge about renewable energy systems.

Participants rate the reasons for joining the e5 network as follows a. Increased energy independence (mean value 5.8), Illustrating an example (mean value 5.2), Prosperity of future generations (mean value 5.2), to reduce energy costs (mean value 5), to consume less energy (mean value 4.9), access knowledge on renewable energy systems (4.7), and access financial support (3.7).

Of these, there was a statistically significant difference between the weight associated with increasing energy independence as compared to accessing financial support ($Z = -3.276$, $P = .001$) or accessing knowledge ($Z = -2.63$, $P = 0.008$), with participants weighing energy independence as their prime motivation in joining the e5 program over financial support or accessing information.
References


