Factors influencing the societal acceptance of new, renewable and energy efficiency technologies: Meta-analysis of recent European projects

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Abstract

The paper addresses the conditions for the successful introduction of sustainable energy technology projects in different geographic, institutional and cultural contexts. Our aim is to identify *contextual and process-related factors* influencing the level of *societal acceptance and techno-economic successfulness* achieved in energy projects that aim to mitigate climate change (renewable energy, energy efficiency and advanced technologies). Our focus is on successfulness on the level of individual projects, but we also consider how 'lessons learned' in individual projects diffuse into the wider context of energy planning. In our conclusions, we identify key challenges for project managers and policy makers.

Introduction

When speaking of technology transfer, we often think of the transfer of technologies from 'more' to 'less' developed countries or contexts. Yet the problem of technology transfer is more general and complicated: it relates to the social and cultural embeddedness of technologies. Learning through local experiments is crucial for technological development, but the transfer of these local experiences from one site to another is not unproblematic. Renewable and other new energy technologies are prime examples of both the importance of local experiments, and the problems of transferring them to other sites.

Some countries and localities have very successful experiences with the development and diffusion of renewable energy technologies, whereas similar projects have become highly controversial in others. These differences are not fully explicable in terms of natural endowments, as evidenced by the uptake of solar energy in Austria, Germany and Greece, but not other Mediterranean countries (Tsoutsos 2002), or the emergence of local opposition to wind energy projects more visibly in the UK, France, the Netherlands and Greece than, for example, in Denmark or Germany (Predace 2003; Szarka 2006; Breukers and Wolsink 2007).

The paper addresses the conditions for the successful introduction of new energy technology projects in different geographic, institutional and cultural contexts. We identify *contextual and process-related factors influencing the level of societal acceptance and techno-economic* *successfulness achieved in new energy projects.* While addressing the challenge of introducing technologies in new contexts, we also reflect on *the generative potential of technology transfer*: new contexts create new problems for technology deployment, but they also give rise to new innovative solutions.

The paper is based on research conducted within an EU-funded project called Create Acceptance (for a summary see Create Acceptance 2007). The research focuses on factors influencing the societal acceptance of new energy technologies (energy efficiency and geothermal energy, bioenergy, wind energy, solar energy, hydrogen and CO2 capture and storage). The data consist of a meta-analysis of 25 case studies in different geographic regions – West Europe, North Europe, Central and Eastern Europe ,South Europe and South Africa– as well as in different local settings within these regions. The analysis focuses on cases exhibiting various degrees of successfulness in terms of societal acceptance and techno-economic outcomes.

We first present our research approach and the way in which we operationalize societal acceptance. We then give a brief overview of the database and meta-analysis approach employed. As findings, we first discuss factors influencing societal acceptance in terms of different technologies, contexts and stakeholder involvement approaches. We then go on to discuss the role of context as a problem, but also as a source of new solutions, and conclude by outlining implications for project managers and policy makers.

Understanding societal acceptance of new energy projects in their context

Our review of prior literature in the field revealed that the phenomenon of ‘social’ or ‘societal’ acceptance is poorly conceptualized (Create Acceptance 2007). This makes it difficult to compare or accumulate findings from previous studies into a coherent picture of the societal acceptance of new energy technologies in Europe today. In particular, four issues in traditional acceptance studies deserve more attention. First, some studies measure ‘public acceptance’ in terms of public opinion surveys, others focus on acceptance by specific social groups, but hardly any studies aim to understand societal acceptance in the broad spectrum of actors that represent the social life in which new energy technologies are developed and applied. In this study, we define societal acceptance more broadly to include the views and actions of the expert and policy community, as well as of social interest groups, NGOs, technology users, local residents and the general public.

Second, societal acceptance cannot be reduced to the characteristics of the technology, or to characteristics of the social groups who accept it or fail to do so. Acceptance develops as a technological project, its relevant social groups and other features of its application context co-evolve. Here, context refers to the historical, cultural, institutional, social, economic, material and geographical settings that surround, shape and are shaped by the technology at the local and at the national level. Societal acceptance is thus not a one-way process in which stakeholders either accept or reject a project. Rather societal acceptance is a socially constructed outcome of a process in which project, stakeholders' views and other features of the application context become mutually aligned, resulting in both project and context changes.

Third, societal acceptance is a dynamic process rather than a static feature of a technology. Context is not static: it includes social movements, evolving policy cultures, and the timing of policy developments vis-à-vis the project. Stakeholders are an important part of the context, and their involvement in the project is one of the ways in which context influences the project. Thus, societal acceptance is not merely a dichotomy in our study, but can range from active support to active resistance, and it is a dynamic phenomenon that evolves as people interact with a new technology. For example, different transition paths to renewable energy in different countries shows how cultural, economic and technological development in energy are strongly intertwined and historically path-dependent (e.g., Jacobsson et al. 2004; Van der Vleuten and Raven 2005). They indicate that in certain national and local contexts, renewable energy technologies have been 'in the making' for decades. They have gradually matured in specific institutional and cultural contexts, combining scientific and industry expertise with the development of user competences and feedback from positive experiences. The development of the technology has co-evolved with culturally appropriate institutions that fit the technology. These experiences have also influenced the cultural meaning attached to the technology in those contexts.

Fourth, societal acceptance is but one issue that determines overall successfulness of a new energy project. In our study, we have sought to identify factors underlying societal acceptance, and to understand the role of societal acceptance in overall project success. Yet, it is difficult to make a clear distinction between societal acceptance and other aspects of the successfulness of a new technology. We have *operationalised* the societal acceptance of individual new energy projects as the extent to which *alignment is achieved among the expectations* of the project managers and stakeholders, and the resources and demands of application context (Hodson et al. 2007). We term this aspect of project successfulness 'process successfulness'. A fully successful project is thus one that has managed to coordinate the various interests of the actors related to the project at the end point of the project. The other dimension of successfulness, 'outcome successfulness', refers to the techno-economic outcomes of the project as defined by the project managers. A fully successful outcome thus provides the designated features and functions, largely within the timescale and budget originally planned.

Database and meta-analysis approach

In order to study recent more and less successful sustainable energy projects, a database was collected in the form of previous projects from different parts of Europe and dealing with the different technologies. In order to examine the role of poverty in societal acceptance, we also included a case study from South Africa. This database consists of 25 project case studies (Table 1). Moreover, an overview report of the political, socio-economic and energy profiles of the covered regions, including an overview of general attitude towards the deployment of various new energy technologies in the respective regions has been compiled, which serves as a background and overall context for the case studies.

Table 1. Overview of the cases in terms of technology and regional coverage.

	Energy conservation	Biomass	Wind	Solar	Hydrogen	C0$_2$ capture and storage (CCS)	Other
WEST EUROPE	Hannover social marketing for energy efficiency (Germany)	Crickdale Bioenergy Power Station (UK) Bracknell Biomass CHP Energy Centre (UK)	EOLE 2005 wind energy programme (France)		London CUTE hydrogen fuelling station (UK)	CRUST CO_2 capture & storage project (Netherlands)	Blue Energy (Netherlands)
		Bioenergy Village Jühnde (Germany)			Berlin H_2ACCEPT bus trials (Germany)	Schwarze Pumpe CO_2 capture and storage project (Germany)	
NORTH EUROPE	Low energy housing (Finland)	Västerås Biogas Plant (Sweden) Lund Biogas Plant (Sweden)			ECTOS hydrogen project (Iceland)	Snohvit CO_2 capture & storage project, Hammerfest (Norway)	
EAST & CENTRAL EUROPE		Pannon Power biomass conversion (Hungary)	Suwalki region wind project (Poland) Szelero Vep wind project (Hungary)	Pommerania region solar energy project (Poland)			Podhale region geothermal project (Poland
SOUTH EUROPE	Trinitat Nova's Ecocity energy efficiency (Spain)	Umbria local biomass projects (Italy)		Barcelona Solar Ordinance (Spain)			
				PV Accept solar project (Italy)			
OTHER				Solar home systems and solar water heaters (South Africa)			

Some of the cases were based largely on existing, published material, whereas others required original research. In all cases, published studies were complemented with interviews in order to obtain the necessary data for our analysis. The cases were analysed using a five-step framework (Hodson et al. 2007), focusing on (1) the visions articulated at early stages of the project and the social interests to which they referred; (2) the actors and expectations involved in the project; (3) the engagement of various publics in the project and the way in which expectations were negotiated; (4) the way the vision was translated into action; and (5) success in terms of outcomes – i.e., the gap between visions and actualities – and in terms of processes – i.e., the extent to which different social interests were co-ordinated in the project.

A meta-analysis of the cases was conducted to determine the influence of three sets of factors. We made a separate analysis of differences in project successfulness owing to differences in (a) technology-specific factors, (b) factors specific to the national or local context, and (c) differences depending on various forms of stakeholder interaction, project management and alignment of expectations. In the following, we first discuss the findings of the study pertaining to the role of these different factors (technology, context and stakeholder interaction). We then go on to reflect on the generative potential of technology transfer by considering the projects not merely as problems, but also as sources of new solutions.

Findings: factors influencing the emergence of societal acceptance of energy innovations

We found that the cases exhibited quite different levels of societal acceptance, ranging from projects accepted by all stakeholders to projects that were terminated due to local resistance. Even projects with very similar technical designs could exhibit highly different outcomes in terms of societal acceptance, which in turn could also influence the techno-economic successfulness of the project. These differences can be understood as the result of a co-evolution of new technologies, their institutional contexts, and social action and meaning. Societal acceptance is not merely an issue of stakeholders accepting or rejecting a specific technology, but rather pertains to the way in which the technology project is designed and introduced into the context (e.g. Green 1999) .

Technology-specific factors

Some of the factors pertaining to societal acceptance and project success or failure were specific to certain technologies. Even though renewable energy and efficiency technologies are a separate category of technologies in some respects – i.e., in a policy context, and in terms of market competition – their applications on the project and local level are quite different: physically, historically, economically and socially. Thus, the different technologies involve some variation in terms of critical stakeholders and issues, and desirable outcomes in terms of societal acceptance. For example, in our case studies, users and supplier networks were more often the critical stakeholders in energy efficiency and solar energy projects, whereas local residents were more often critical for bioenergy and wind power facilities. Levels of public understanding about the different technologies vary, and some technologies involve fundamental issues of principle for some stakeholders. Moreover, 'accepting' involves quite different kinds of activities from the stakeholders' perspective. Some of the cases indicate that the regional familiarity with aspects of the different technologies support acceptability (e.g. the use of biomass in a rural context in Germany or the use of PV panels in Italy). Here, the innovation could be linked to the traditional use of renewable energies (or to culturally already accepted practises such as agriculture or forestry) in a step-by-step approach.

Table 2 presents a number of critical issues for some of the energy technologies covered on the basis of our own and other authors' recent experiences. It is important to note that the critical issues that we have identified are based on a limited set of cases, and are thus indicative of the range and variety of issues arising in connection with different technologies, rather than exhaustive. Moreover, new issues are likely to emerge to join them in time. It is important to understand the culturally and historically evolving nature of societal acceptance: some impacts and relationships only become evident in concrete applications of the technologies and in the kinds of social dynamics that they initiate. Hence, societal acceptance is an evolving and changing phenomenon, because it does not relate only to the technology itself but to the economic and social networks that build up around it.

Table 2. Technology-specific issues in societal acceptance

	Key problems and uncertainties
Household energy efficiency	High public awareness and participation needed; Existing public acceptance high but understanding low; Small-scale investments: high transition and transaction costs; Competing technologies
Solar energy	Costs; Difficulty of developing economies of scale; Importance of user involvement and user perceptions; Lack of trust in reliability and quality; Insufficient technical experience in installation firms; Problems in access to grid connections
Bioenergy	Siting issues; Management of the economics and social and environmental impacts of input logistics; Variable level of public awareness and understanding in different regions; Concerns about environmental and other local impacts
Wind power	Siting issues; Land-use intensity; Local costs and benefits and their equitable distribution; Diverging views of landscape preservation; Concerns about environmental and other local impacts, Problems in access to grid connections
Hydrogen	Managing public expectations; Management of risks: Siting of distribution infrastructure
CO_2 capture and storage	Low public awareness and understanding; Immature technology; Perception that companies are involved in order to improve image; NGO resistance on issues of principle; Storage and safety issues emerging?

The role of context

We addressed context first through the definition of geographic location (national and regional) as a way to approach the diversity of institutional, historical and cultural issues influencing the societal acceptance of new, sustainable energy projects. We identified four broad categories of contextual factors that influenced the societal acceptance of new energy projects at the national and local level: political and policy issues, socio-economic factors, cultural factors and geographic factors. These factors are briefly outlined in Table 3.

Table 3. Types of national and local context factors influencing societal acceptance

Factors pertaining to the national and local context
Political and policy issues • Types of government policies on new energy technologies and related topics • Stability of national policy • Policy culture and administrative procedures • Distribution of power (national and local level) Socio-economic and infrastructural factors • Availability and perception of natural resources • Interest in employment opportunities and regional economic development • Perception of foreign investment • Importance of energy independence • Energy prices; technology and other input prices, costs • Competing technologies and industries Cultural factors • Trust in institutions • Tradition of top-down vs. bottom-up initiatives • Environmental awareness • Historical experiences • Attitudes to new technology Geographic factors • Climate • Availability of suitable locations

In terms of political and policy issues, issues like the presence of specific supportive (or restrictive) policy instruments are fairly obvious, but also the stability of policy instruments had an influence on public confidence in the new technology projects. Moreover, national and local policy cultures and administrative procedures provided variable conditions for projects to seek alignment among different interests, and differences in the distribution of power provided projects, their supporters and opponents variable access to centres of power.

While the availability of natural resources is an ‘objective factor’, we found that perceptions of the abundance of different energy sources could be quite different, and could influence public confidence in the projects. We found socio-economic issues, such as regional economic or social development needs, to be important in promoting a number of projects, but the case studies also indicated that issues of development were often subjects of controversies in which projects could become embroiled. In a similar vein, different regions welcomed investments from other countries or economic centres differently: at some sites, foreign investment was a sign of progress, whereas at others it was viewed with suspicion. Moreover, the importance attributed to energy independence at the national and regional level could significantly boost the societal acceptance of some projects, whereas low energy prices, high production factor costs and competing technologies and industries were problems that many projects had to grapple with.

Cultural factors relate to historically shaped traditions and beliefs that the project needs to deal with. These include the level of trust in different institutions involved in the project, such as large corporations, local business or local government. Moreover, different local traditions influence the ability of projects to mobilize bottom-up initiatives or to introduce top-down plans without resistance. Levels of environmental awareness influenced the relevance of environmental arguments (such as combating climate change) in justifying the projects. Furthermore, we found that different technologies have variable track-records in terms of positive or negative historical experiences among the local population. And overall attitudes to new technologies can also influence the acceptability of a project: novelty can be a bonus in some regions, but a cause for concern in others.

Finally, geographic factors such as climate naturally influence the types of projects that are acceptable in different locations. A very important geographic factor, both at the national and the local level, pertains to the availability of suitable locations: for example, the possibility to utilize existing industrial sites, or to locate facilities where they can support local development.

Stakeholder involvement and project management

The previous sections indicate that the key challenges for project management and stakeholder involvement vary according to technology and geographic context. However, we also identified more generic factors pertaining to the kinds of social networks that build up around new energy projects and to the negotiation and alignment of expectations. These networks were naturally different for different projects, but could involve experts and technology providers, other businesses (as project partners, suppliers or competitors), authorities and politicians at the national and local level, non-governmental organizations and other interest groups, local residents and users. Moreover, it is important to note that stakeholders' positions often evolved during the course of the negotiations: stakeholders are thus not monolithic and their positions are not static.

Stakeholders' expectations that required negotiation pertained to a range of factors. Some of them can be termed "genuine differences of interest", such as the *distribution of costs and benefits* (e.g., the distribution of economic costs among actors, the balance between local and global environmental benefits). There were also sometimes *fundamental value conflicts*, for example about the instrumental vs. intrinsic or amenity value of nature, or different views on desirable future economic and social development. Moreover, *fundamental limits to knowledge and certainty* were also present, such as genuine uncertainties about the performance, impacts and relevance of different new energy technologies. Other kinds of issues can more readily be termed "organisational problems", such as *creating trust* when there was a lack or precedents or poor earlier experiences, *communication problems* such as articulating the vision of the project or understanding local concerns, culture and communication patterns, or *negotiation problems*, such as finding suitable procedures for negotiation and arbitration or defining roles and responsibilities.

It is important to realise that expectations are not only ‘negotiated’ in formal discussions and negotiations. ‘Negotiating expectations’ refers to all kinds of moves, counter-moves and adaptations to the technology project before and during the course of the project. Some were present already at the design stage – in how the project was planned to integrate as wide a range of expectations as possible. During the progress of the project, alignment creation was more an issue of negotiating contradictory expectations by adapting the project to stakeholders’ needs or attempting to influence their positions.

The cases highlighted the importance of early interaction with the relevant stakeholders. Our case studies thus provide some further evidence in support of the argument that involving stakeholders at an early stage in the project allows them to influence project design, to gain sufficient information on the project to alleviate their concerns, and to allow project managers to understand the local context and integrate it into project design (e.g., Khan 2005; Soerensen et al. 2001; Szarka 2006; in an international development context, see also Chambers 2005). Nonetheless, the case studies also show that participation is not a panacea for project success in terms of techno-economic outcomes. We could say that early-stage participation is a facilitating condition for project success, but not always a necessary one (cf. McLaren Lorigan in press). Apart from formal participation structures, the cases also revealed the importance of interactive, face-to-face communications in communicating the vision of the project and gaining information about the local context. An important task for communication in the projects was to create a forum and ‘vocabulary’ for discussing the project among stakeholders. This was especially important for technologies that are unfamiliar of ‘invisible’ like energy efficiency. Moreover, face-to-face communications were also important in gaining information about stakeholders’ concerns.

In terms of the role of project management and stakeholder involvement, many of our findings confirm the observations made in previous empirical and review studies (e.g. Devine-Wright 2004; Upreti and van der Horst 2004; Khan 2004; Rohracher 2005). Some management principles and procedures appear to be widely applicable to many kinds of energy projects. Managers whose projects were successful recognized the dependence of the project on the co-operation of stakeholders. These managers were able to promote societal acceptance by:

- Having or developing a constructive relationship with the local community
- Viewing the project from a broader perspective and understanding local processes and contexts
- Establishing continuity and reserving sufficient time and patience to align different interests
- Using contextually appropriate procedures
- Coordinating among many different factors and stakeholders.
- Reflecting on action (even in turbulent situations) and evaluating experiences at various stages of the project
- Being flexible and adapting expectations and plans to circumstances.

The dynamics of societal acceptance: context as a problem and as a source of new solutions

There are reasons to stress the role of context in new energy projects. New energy projects are currently proliferating and populating new contexts in Europe, and these contexts may be quite different from the ones in which they originated. This highlights the importance of policy, institutional, market and cultural contexts. New energy projects also often have a number of impacts on their immediate environment, some of which may be positive, but other may be negative or perceived of as such. Whichever way, they bring about or require change in the local context.

New energy projects almost invariably make use of ideas, technologies and artefacts that derive from beyond the local context in which they are applied. This can entail a positive introduction of new knowledge and resources into a location where they did not previously exist. However, the analysis of controversial and successful projects shows that new technologies cannot be merely ‘dropped’ into a new context without preparation or adaptation.

In ideal situations, new technologies are ‘reinvented’ in the local context. Our case study on the Barcelona Solar Ordinance case (Schaefer 2006) exemplifies how ‘reinvention’ can work. Local NGOs and authorities, frustrated with the slow adoption of solar energy, adopted an idea from a foreign context (an exemplar from a German city). This led to the development of a new type of legislation mandating solar thermal panels for all new buildings and ones undergoing fundamental renovation. Yet the local actors processed the new idea intensively in order to understand how it could be produced using local resources, and how it could be modified in order to ensure local benefits. Gaining acceptance for the new legislation required, for example, that local construction companies and service providers redefined their interests by learning to see it as a business opportunity and by gaining the necessary competencies. Thus, local reinvention of the technology-in-context required the involvement of the full range of interested parties.

Our meta-analysis highlighted the importance of achieving local embeddeness as an important success factor. In the concluding section, we outline the key challenges for project managers in embedding their projects into the local context. But this approach only provides a partial picture of the role of local context. The lack of “fit” between projects (technologies) and local context appears as a problem. But the concept of “local reinvention” also points to the notion that this problem engenders new, innovative solutions that enhance the technology but suggesting new configurations of local fuel production, energy generation, energy supply and use, and the supporting institutions.

So, for example, the above-mentioned case of the Barcelona Solar Ordinance has had wider consequences (Schaefer 2006). The notion of local legislation spread to other municipalities in the region. This was facilitated by the circulation of a model document outlining the provisions of such legislation, but also by communication of the example of a city that had enacted it at the local level. Ultimately, it was adopted on the national level for the whole of Spain. It even went beyond the borders of Spain to the City of Cape Town in South Africa. In an adaptation and consultation process the Solar Water Heater By-law as it is called in Cape Town is embedded in its new context, e.g., the houses of the poor are exempted from having to install solar water heaters in new or modified houses. This example shows that adopting new technology in a local context can lead to the development and diffusion of supportive institutions. Creating acceptance for supportive institutions is also an important part of creating acceptance for sustainable technologies.

As another example, we can highlight the innovative socio-technical solutions for large-scale biogas co-digestion production and use developed in two very different contexts (Brohmann 2006; Heiskanen 2006). Both involved local residents, farmers and government, but in very different ways and with different implications for project design, feedstocks and outputs.

The Jühnde project is located in a rural village in Lower Saxony. Because the project aimed at a high level of environmental quality, biogas production from silaged plant material and manure was selected. In order to avoid mono-cultivation of energy plants, the new concept of double-cropping (i.e. a farming system with two yields per year) and a biogas-fuelled CHP plant was designed. An additional heating plant fuelled with regional residual wood chips covers the winter peak period. Local residents had an important role, as they needed to invest in converting their heating system to accommodate district heating. It was thus crucial that the project was based on a highly participatory design process in which local residents participated at all stages. In this context, biogas production was linked to the goal of local energy independence, i.e., gaining autonomy from large energy producers by producing electricity and heat locally, at the same time promoting local economic development. It also took on a character of local self-determination, and enjoys widespread support in the region due to political, economic, social and cultural embeddedness. It has also attracted interest among other villages in the region, and lessons from Jühnde are currently being transferred to other sites and other regions – even abroad.

The Växtkraft project, in the town of Vesterås in Sweden, resulted in a very different solution for large-scale biogas co-digestion. Owing the urban context and the involvement of a waste management company, the plant was designed to co-digest sorted organic waste and silage. Many problems were encountered during the 10-year planning process. One of these involved the siting of the project and resulted in the idea to reformulate the biogas to vehicle fuel quality. Local residents needed to participate by sorting their waste, and toward the end of the project they also became potential customers of the biogas fuel station. This led to the development of a communication concept that highlighted the interaction between town and countryside in the form of the local cycling of nutrients and energy sources. Owing to the complexity of the distribution systems related to such the rural-urban fuel cycle, the project has developed experiences in logistics that has provided lessons for other sites.

These cases highlight the relevance of variations in local context for developing new kinds of applications for existing technologies and thus expanding the range of potential uses. But they also highlight the generative role of local negotiation processes. When the projects encountered problems in the local context, they were forced to find solutions. These solutions are relevant in terms of social learning on site, but also can have wider applications. The focal idea might derive from outside the local or regional context. In the case of the "Bioenergy Village", which aims to shift from fossil energy sources to a fully renewable base, the initial idea came from the academia and had to be adapted to the local context with active participation of the population. By trying to adapt the projects' visions to the expectations present in its context, the projects thus combined different types of knowledge, and engaged with an active search for solutions together with local actors. This is an example of how innovation arises from the necessity to translate foreign ideas into local contexts (e.g., Powell et al., 2005).

We thus stress that local experiments are indeed extremely important for the further development of emerging alternative technologies. In many of the cases, we could see that the social networks that were mobilized around the projects could extend to influence the regional and national level. Positive experiences gained at individual sites could expand to the regional level or even influence national policies. Likewise, in other cases, local controversies expanded, as has occurred in the establishment of national-level resistance organizations in the UK and France. Societal acceptance is thus not merely an issue for individual projects, but also a more general "public good". Thus, in the following section, we highlight challenges not only for project managers, but also for policy makers.

Conclusions: challenges for project managers and policy makers

Project managers can influence the societal acceptance of new energy technology projects in many ways. We summarize them in terms of five central challenges that project managers encounter when attempting to introduce energy technologies in a manner that promotes societal acceptance:

(1) Identifying critical issues and stakeholders for evolving technologies
Project managers need to understand how the technology interacts with its context, and also how the specific design of the project influences its relation with stakeholders. Issues requiring consideration pertain to four broad categories: (1) issues pertaining to broader policy debates, issues of principle and overall public perception, (2) requirements for user involvement and the need for user adaptation, (3) requirements of the project in terms of economic, social and technical integration and (4) siting issues and impact on the local economy, social structure and health, safety and the environment. For different technologies, depending on their physical characteristics, typical modes of application and level of maturity, different issues are relevant. For the less mature technologies, such as carbon capture and storage and hydrogen, the public policy and perception issues are currently dominant, but

other issues such as siting and local impacts are likely to emerge as they move from demonstration to deployment. Some technologies require extensive involvement, adaptation and acceptance by the users, such as small-scale solar energy and energy efficiency investments. They struggle more with issues of costs and user perceptions of quality. Other technologies like wind and biomass need to deal with their relations with local residents and integration into the local economy and social structure. It is important to note, however, that critical issues are not only dependent on generic technologies, but also on project designs. Societal acceptance is thus not only acceptance of a technology, but of the specific configurations in which different parts of society encounter it.

(2) Introducing appropriate projects in appropriate contexts

It is important that project managers consider the political and policy, socio-economic, cultural and geographic conditions existing in different locations, as well as the timing of projects vis-à-vis changing framework conditions. Such contextual factors provide different conditions for project design and implementation, such as opportunities to integrate with the local economy, appropriate institutions to partner with, or appropriate procedures to involve various stakeholders. Contextual factors have three kinds of managerial implications. Firstly, they can be used to identify more or less suitable contexts for different projects. Secondly, they can be used to alert project managers to special features of the local context that need to be taken into account when designing and carrying out projects. Thirdly, project managers should develop relations with their stakeholders that allow them to explore the context of their projects. Last but not least, managers have to take into account that the implementation of the project will affect the context and might result in changes of the external environment. These – sometimes not foreseen – implications might cause skepticism or even resistance against the planning and should be faced beforehand through appropriate assessment tools.

(3) Interacting with the 'right people' in the 'right way' and 'at the right time'

In this context, 'right people' refers to partners that bring resources and support the project but also enable the project to interact with its external environment, and to the stakeholders who are influenced by or can influence the project. The case study projects show that there are no a priori reasons for any stakeholder group to represent any other group (i.e., e.g., no obvious reasons for municipal decision makers or NGOs to have the same expectations as local residents). This challenge requires that project managers identify the stakeholders, issues and concerns in the local context (for example, the extent and types of external effects resulting from the project; the potential user adaptation required; and the potential links of the project to broader policy debates). The 'right way' of interacting ensues from the kinds of concerns, issues and people involved. Examples of better and worse practices in the cases indicate some generic issues, such as starting early and continuously, the importance of articulating concerns, mutual learning, and the need to ensure clarity of purpose and division of power and responsibilities. Formal structures usually facilitate the process and make it more transparent, empowering and credible, but should be complemented with face-to-face interaction and 'keeping in touch'. Yet formal participation processes do not preclude the need for project managers to listen and learn continually. Project managers should not only involve stakeholders, but also be prepared to involve themselves.

(4) Reflecting on action at appropriate stages

Projects can only be planned up until a given point in time; implementing a project requires action, and action provides further lessons for the plans and designs. Ideally, the knowledge gained through action and observation of the consequences of action should lead to learning and should thus influence the way in which the project is managed. This can be termed reflection in action (Schön 1987). In the context of managing a new energy project, successful reflection on action can be translated into questions that need to be asked at different stages of the project. Table 4 presents a summary of the questions that our case study projects had to address pertaining to the societal acceptance of their projects. It is roughly divided into the 'design stage' and 'implementation'. With the benefit of hindsight on previous projects, we have moved to the earlier 'design stage' some questions that are usually addressed at a later stage. Thus, we recommend that if projects desire to create societal acceptance, they will start asking these kinds of questions early on, but continue monitoring their social impacts and stakeholder relations throughout the project, and develop a reflective approach to issues and new information arising in the course of action.

Table 4. Questions requiring reflection at different stages of the project

Questions to be answered at the design stage	Questions to be answered during implementation
How does the project interact with the local context (or alternative contexts considered): • what kinds of external effects does it involve; does it require user adaptation? • in which ways might it benefit or harm the local context (physical, economic, social or symbolic) and how equitably are the benefits and risks distributed? • what synergies or competition may the project involve with other ongoing developments? • how does it relate to historical experiences and existing competences of those present in the local context? Who are potential partners and stakeholders of the project on the local, national and international level: • whose resources could be important for the project: who might be important 'bridges', 'champions' or 'multipliers'? • who might the project influence and who might exert an influence in it? • how does the project relate to stakeholders' interests and concerns? How will stakeholders be involved and their concerns addressed: • how will stakeholders be informed about the project and how will its vision be communicated? • how will information about stakeholder's concerns be collected? • how early can stakeholders be involved in the project and what aspects of the project design could they influence? • how will different stakeholders interests be represented? • how will stakeholder involvement be integrated in the time frame of the project?	How are communications managed on an ongoing basis: • how does the project keep 'in touch' with its stakeholders (formal and informal channels)? • do new stakeholders emerge as the project evolves? • how can stakeholders monitor the progress of the project and the unfolding of its impacts How is competence developed during the project? • in what ways can stakeholders interact with the project as it unfolds? • what competences are needed for making use of local resources and how do such competences develop? • is there evidence of mutual learning and adaptation? How does the project deal with issues that arise during the project: • issues of representation and division of responsibilities and powers? • resolving potential conflicts among different stakeholders' interests? • dividing attention between stakeholder management and other aspects of project management (technical, operation, market, financial, etc.) When and how should the project 'take stock' and reflect on achievements and remaining problems: • evaluation and milestones? • opportunities for modifying the project according to lessons learned?

(5) Devoting due attention to managing both the societal acceptance and the techno-economic aspects of the project

Ideally, projects should be successful both in terms of techno-economic outcomes and in terms of processes, i.e. societal acceptance. The projects included in our meta-analysis indicate that this is possible, and that successful processes are likely to contribute to successful outcomes – and unsuccessful processes to unsuccessful outcomes – even though the relationship between outcome and process is not straightforward or deterministic. Yet in order to achieve successful outcomes, project managers need to consider other aspects of the project. These include *technical and infrastructure* issues such as selecting the most viable technologies and gaining access to grid connections. They also include *operational issues* such as engaging and managing the labour force and contractors, and managing the logistics of fuel supplies. Attention is also needed for *market issues* require attention, such as market access and competition with other technologies, energy sources and industries, as well as for *financial issues*, such as gaining and maintaining investor confidence and dealing with policy support instruments that influence the viability of the project. Managerial tasks related to societal acceptance processes and to techno-economic outcomes are not totally independent of one another (for example, managing the labour force, local contractors or investor relations obviously depends on the ways in which the process is managed and different stakeholders' interests are aligned). Yet project managers thus face the challenge of dividing their attention among these different management tasks and balancing between the potentially conflicting demands of different stakeholders, including stakeholders at different levels (local, national and international). As some of the given cases indicate, it is of high importance that the project managers share their visions about the future development – with and without the implementation of the project – with local interest groups, politicians and independent stakeholders.

Our study also has implications for policy makers. It indicates that successful demonstration and early deployment projects are not only important for technical development, but also for user learning, credibility and for the evolution of supportive institutions and cultural practices. It was pointed out by some of the cases that a process of joint learning and the development of know-how within a system of comprehensive stakeholder working groups, and with the participation of local politicians, create a high level of confidence. This strengthens the planning, as well as the trust in the technology and even the decisions of politicians who are – especially in the public sector - responsible for co-funding or co-financing infrastructure projects. We found evidence for the important role of political promoters: success – in terms of technical and institutional implementation – was ensured by integrative persons trusted by the public, like mayors (in the case of a small village) or the head of the environmental department (in the case of a larger city). Policy makers are very important in early stages of development when the supportive policies are not yet fully in place.

In some of the cases, we could see how locally developed institutions and cultural practices supported the design and the implementation of the new technological approach by linking the information and planning steps with traditional activities like fairs, festivals and the meetings of local associations – under the patronage of political notables. Thus, projects and institutions started to spread even beyond their local context. They thus can support (or in negative cases, undermine) societal acceptance on a broader, regional level. Societal acceptance has the nature of a 'public good'; it does not benefit only the individual project, but also other projects that will follow it. Thus, public policy should support project managers in cultivating an interactive approach to the local contexts in which the projects are introduced. Stakeholder interaction and local reinvention should not be seen merely as a way to solve local problems of societal acceptance, but also as a way to find new innovative solutions that promote the socio-technical evolution of new, sustainable energy technologies.

The next stage of the Create Acceptance project aims to develop a set of management tools for project managers to involve the different stakeholder groups like neighbors, investors, NGO, media as well as politicians and to deal with the previously described challenges (for more details, see Raven et al. 2007). By testing the tools in five demonstration projects all over Europe, we aim to refine them into a project management support system for managers of new, sustainable energy projects.

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