



## **Behavioral Foundations of Sustainability Transitions**

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## **Behavioral Foundations of Sustainability Transitions**

**Ardjan Gazheli (UAB), Miklós Antal (UAB), Jeroen van den Bergh (UAB)**

### **Abstract**

Writings on sustainability transitions generally do not say much about the particularities of the behavior of individuals and organizations. This is somewhat surprising since an important problem which transition management needs to tackle is inertia or resistance to change. Transition policy needs to account for the bounded rationality and social interaction of agents so as to arrive at a more realistic view of the limits and opportunities for realizing a transition. System failures like lock-in, unpredictability and surprise in innovation systems, and network interaction between agents have received some attention, but their behavioral underpinnings can be improved. The identification of relevant stakeholders in transition processes and their unique behavioral features is crucial for understanding how to stimulate transitions. In this paper we investigate opportunities to integrate various theories and disciplinary views on behavior into thinking about sustainability transitions with the aim to arrive at recommendations for more effective policies. For this purpose, we combine insights from the literatures on agency in sustainability transitions, on environmental policy under bounded rationality and social interactions, and on behavioral foundations of learning and innovation.

### **Contribution to the Project**

In this paper we investigate opportunities to integrate various theories and disciplinary views on behaviour into the thinking about sustainable transitions, so as to arrive at recommendations for more effective policies. We examine both how to tackle behavioural barriers and how to employ behavioural opportunities. We combine insights from the literatures on agency in sustainability transitions, behavioural economics, and behavioural theories of innovation and learning. This will deliver insights about behavior of individuals and organizations that can serve as a basis for the modelling work and policy analysis in both Area 2 and the broader WWWforEurope project.

**Keywords:** Agency, behavioural economics, bounded rationality, innovation, learning, sustainability, transition

**Jel codes:** D03, P28, P36, Q58

## 1. Introduction

The development of the current economy characterized by an overuse of natural resources and a high pressure on environmental systems to a greener, even sustainable economy has been conceived as a socio-technical transition. This emphasizes that next to the implementation of more sustainable technologies, changes are needed in social and regulatory institutions, sectoral composition, industrial networks, user practices and consumer preferences. This likely will involve gradual and radical changes in subsystems of the overall socioeconomic system (Rotmans et al., 2000; Geels, 2002). Transitions can be seen as a scaling up of system innovations, which change the structure of technological and socioeconomic subsystems and their connections (Jacobsson and Bergek, 2011). This points at the relevance of behavior of, and relations between, various stakeholders. Current writings on transitions discuss the types of policies that can manage, govern, and facilitate transitions (Kemp et al., 1998; Kemp and Loorbach, 2003). Most of this literature, however, adopts a rather abstract and high-level view in which agents and their behavior often receive scant and implicit attention. In line with this, it does not connect well to disciplines that have accumulated a great deal of knowledge about individual behavior and behavioral change on the basis of experimental and empirical evidence. A serious risk is then that unrealistic, unfeasible strategies, policies and scenarios will be focused on. This paper aims instead to offer a disaggregate and behaviorally explicit perspective on the role of the various stakeholders in transition processes, which allows for a detailed and precise analysis of the feasibility and effectiveness of transition policies.

Agents with different behavioral characteristics play a role in the distinct stages of transitions, notably predevelopment, take-off, acceleration and stabilization (Rotmans et al., 2001). They influence the transition process through their goals, knowledge, information, capabilities, power, interactions, relations and interests. They include economic agents, such as consumers, producers, and investors; institutions, such as governments and local authorities; and social agents such as citizens, labor unions and NGOs (Geels, 2010). Agents, which have to undergo behavioral change during a particular transition stage, will sometimes show resistance to change or inertia. Other agents, however, may play crucial catalyzing roles in transition processes (“change agents”). In addition, new stakeholders may appear or changes in power structures or preferences may occur. Stakeholders may also join forces to cause changes that otherwise would be impossible, such as in the case of labor unions and employers striking long term agreements. For all these reasons, policy makers do well to take seriously into account proven behavioral features when designing transition policies. Apart from these, gender issues and differences require attention as they can sometimes clarify differences in behavioral features (e.g., risk perception), and as it has been suggested that the unsustainability of our modern economy is in part due to the dominance of masculine factors in the business world as well as politics. Moreover, various studies indicate that environmental concerns differ between men and women, although some claim that is really a methodological artifact (Boeve-de Pauw et al., 2012).

In existing writings on transitions, the role of agency has received some attention and in fact represents the principal behavioral view on transitions. According to theories of human agency, individuals are agents who are engaged proactively in their own development and make things happen by their actions. This approach offers original policy lessons, but – as we will argue – it also implies serious limitations in terms of understanding and guiding behavior. Agency is often connected to power (Smith et al., 2005). The idea here is that groups and organizations with different interests will try to alter the balance of power through a

change in the particular political, economic or institutional influence they possess. Since power can delay or even obstruct but also foster transitions, it is necessary to seriously considering power relations in the analysis of transition policies.

This paper will combine insights about the role of agents in transitions, the behavioral characteristics of these agents, and the behavioral basis of learning and innovation, and interpret these insights in the context of sustainability transitions. Our main purpose is to identify the types of bounded rationality and other-regarding preferences of individuals and groups which have to be recognized by regulatory policies in order to influence the feasibility and effectiveness of transition management. We do this by pointing out behaviors of stakeholders and social interactions that can act as barriers to, or offer opportunities for making, a transition. Attention is given to the various stakeholders involved in transitions, such as consumers, producers, investors, the financial sector and innovators. These have distinct behavioral features, which may require the use of particular policy instruments.

The paper is organized as follows. In section 2 we review how behavioral aspects associated with particular social science theories are integrated into current writings on sustainability transitions. Section 3 examines relevant insights about consumer behavior. In section 4 we introduce behavioral findings that apply to producers, investors and the financial sector. Section 5 underlines the importance of learning and innovation from a transition perspective. In section 6 we briefly discuss some behavioral aspects of governments. Section 7 concludes.

## **2. Behavior in social science theories for transition studies**

The study of sustainability transitions applies theories from different research fields such as history, political science, sociology, science and technology studies, innovation research and evolutionary economics (Markard et al., 2012; Kemp and Loorbach, 2006). Four main approaches have been used so far to integrate insights from these disciplines in order to describe and understand sustainability transitions: the innovation systems approach, the complex systems approach, the evolutionary systems approach and the multi-level perspective (MLP) (van den Bergh et al., 2011). The four approaches overlap to some extent but also identify unique system elements and processes. So far, most attention has been given to the MLP (Geels, 2011). Here, three different system levels are distinguished: regimes, niches and landscapes. A regime is a network of actors that dominates a socio-economic system, niches are those parts of the system where radical innovations are most likely to develop, while the landscape level represents the surroundings of the regime-niches sub-system. A growing body of research focuses on processes within, and interactions between, these levels to understand why certain systems overcome barriers to change whereas others are unable to make a transition to a more sustainable state.

Barriers to sustainability transitions are numerous. Arthur (1989, 1994) identified technological lock-in caused by increasing returns as a crucial obstacle: widespread technologies can attract new users through network effects or scale economies in production leading to lower prices instead of through better performance. This will delay or deter the entry of innovative new products or services to the market. As a consequence, substantial investments are often necessary for sustainability transitions to create a level playing field, including changing or adding to existing infrastructures. Apart from technology, psychological and political factors are essential. Important sources of resistance may include unsustainable mechanisms at the landscape level (such as the existence of tax havens that allow large companies to pay much lower

taxes than small ones) or the lobbying power of regime actors to protect their interests at the disadvantage of environmental innovations. Changes in regulations, market conditions and behavioral motivations may thus be needed to foster sustainability transitions (Unruh, 2000). We focus here on the latter, although these are evidently related to the first two aspects.

Transition management helps to overcome these barriers by trying to govern, facilitate and direct the process of societal change (Loorbach, 2010; Loorbach and Rotmans, 2006). In accordance with the focus on power, governance approaches (Rotmans et al., 2001) – and the literature on technological transitions with insights from complex systems theory (e.g., Kauffman and Macready, 1995) – had the largest influence on transition management strategies. The process of transition is not controlled directly; instead, transition management influences and adjusts each step of it. After structuring the problem, a transition agenda is developed, transition experiments are set up and carried out, and ultimately the lessons of these experiments are evaluated (InContext, 2012).

A number of social science theories can help to understand the barriers to and opportunities for transitions. Geels (2009; 2010) examines the potential contribution of seven main general theories in the social sciences to socio-technical transitions: rational choice, structuralism, functionalism, interpretivism, evolutionary theory, relationism, and conflict and power struggle. The latter, when applied to environmental issues, is also known as “political ecology” (Greenberg and Park, 1994). We are interested here particularly in the behavioral dimensions of such theories. We therefore briefly examine the most relevant of these theories with regard to their behavioral foundations. In addition, we extend the list with four other, seemingly appropriate theories, namely behavioral economics, social network theory, public choice theory and institutional theory.<sup>1</sup> The result is shown in Table 1.

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<sup>1</sup> This list is not exhaustive. For example, van den Bergh and Kemp (2008) examine relevant insights for transition studies within economics broadly, and identify many sub-disciplines that provide insights about systemic changes. Examples are grand development theories (Marx, Schumpeter, Rostow), (multisector) economic growth theory, development economics, industrial economics, international economics (notably studies of transition from communism to market democracies) and environmental and resource economics. Surely, other disciplines offer relevant insights within particular subdisciplines as well.

Table 1: Behavioral dimensions of social science theories applied to transition studies (partly inspired by Geels, 2009; 2010)

<i>Theory</i>	<i>Description</i>	<i>View on behavior in a transition</i>
Rational choice	Individuals and firms are assumed to be self-interested and maximize their utility or profits (Friedman, 1953). Representative agents are assumed, which implies no or limited heterogeneity of behavior. Perfect information is the default and price information is regarded as important to guide individuals in the direction of socially optimal (market) outcomes. Rational choice can relate to behavior in a market context (focus of economics) and non-market domains such as social behavior (studies of discrimination, crime, and human capital) (Becker, 1976). In addition, rational choice has seen application in political science, sociology and philosophy (Hechter and Kanazawa, 1997).	A transition is seen as the result of changing decisions in response to resource or other scarcities, altering market prices in the economy. This results in substitution processes at all levels, learning and innovation. The resulting sectoral (supply) and demand changes, if quick and substantial, can be seen as a transition. Governments should take care that the prices are right, i.e. reflect all negative (environmental) and positive (innovation) externalities. Lock-in is not central (even though some have proposed that it is a negative externality). Neoclassical economics, as a special case of rational choice theory, emphasizes markets and market solutions (or taxes) to sustainability problems, and subsidies to address innovation externalities. Transitions are seen as smooth, gradual processes due to the dominant equilibrium approach with immediate responses to changes in marginal costs and benefits due to policies or external changes (van den Bergh and Kemp (2008).
Structuralism	Structuralism arose as a theoretical framework in linguistics. In anthropological investigations, structuralism focuses on the underlying patterns of human thoughts which forms the basis for cultural structures and categories. Such processes are not seen as deterministic, but as operating and having diverse outcomes in different cultures. Culture, like language, is composed of hidden rules that govern the behavior of its people. It is seen as a dialectic process involving a thesis, an antithesis, and a synthesis (Levi-Strauss, 1973). Agents are seen as trapped in cultural “deep structures”, thereby leaving little space for agency and change.	Transitions are explained as a change in traditions and cultural values. Change comes about as a shift in the actors’ beliefs, ideologies and public opinion. This shift is also reflected in policy makers’ actions in the form of new regulations. Braudel (1993) distinguishes between three different phases of transitions to the welfare state. In the first, known as the ideological phase (1815-1870), social reforms concentrated on poverty-related problems. In the second, known as the phase of mobilization (1870-1914), militant labor (trade unions and political parties) enacted power struggles in defense of their interests. In the third phase, the so-called political/governmental one (after World War I), the state acquired a central role by implementing new laws and social measures.
Functionalism	Refers to an approach in psychology which considers behavior as active adaptation to the environment, emphasizing the causes and consequences of human behavior (Corsini, 1999). The causal mechanism is the fulfillment of system needs/goals by actors who fulfill functions, tasks and roles. Within it, different theories such as system dynamics, integrated system theory, soft system approaches and complex system theory address dynamic interaction between the system elements.	A transition is triggered by an external disturbance interrupting the equilibrium of the system. The focus is on the ability of actors to adapt to the external change, create and follow new goals and norms, maintain these new goals over time and disseminate them in society (Geels, 2010). One example of a complex system theory to explain ecosystem cycles and possibly socio-economic system dynamics is the adaptive cycle composed by four phases: exploitation, conservation, release and reorganization (Holling, 2001).

Behavioral economics	Economic agents are seen as boundedly rational due to limitations in information processing. In addition, the importance of social interactions and other-regarding preferences is recognized. This accounts for a wide diversity of behaviors which defies aggregation or generalization. Specific instances of this are decisions under uncertainty, intertemporal choice, decision-making heuristics, routines and habits, and other-regarding preferences such as altruism, reciprocity, norms, etc. (Kahneman, 2011; Lindbeck, 1997; Cheema and Soman, 2006; Meier and Stutzer, 2008).	Individual's and firms' decisions deviate from rational behavior. Agents are boundedly rational and use other-regarding preferences when making decisions. These may act as a barrier to sustainability transitions and affect the effectiveness and efficiency of transition policy. Behavioral economics will generate new insights for policies (Gsothbauer and van den Bergh, 2011). This pertains to market-based instruments, framing of policy issue to create social-political support, and the role of information provision in general (e.g., the use of defaults). In addition, habits and routines and factors underlying their change constitute an important area of for transitional change.
Evolutionary economics	Economic systems, processes and problems are described by evolutionary concepts and algorithms. Core notions are diversity (of technologies or behaviors), a population of agents, selection environment, and innovation. The approach offers a micro-level explanation for various economic phenomena such as market functioning through coevolution of demand and supply, demography of firms, diffusion of new technologies, path-dependence and lock-in, group formation and competition, and differential economic growth (Hodgson, 1993).	A transition can be described as the sum of cumulative small innovative steps and macro-level change emerging as a consequence of population-level interactions (e.g. Safarzyńska et al., 2012). Features of individual agents are regularly described by behavioral economics. Other-regarding preferences are important, because they determine population level network interactions (Windrum and Birchenhall, 1998; Safarzyńska and van den Bergh, 2010b). Policies stress the importance of information, example behaviors, network formation and niche support. Recombinant innovation or hybrid technologies are seen as a way to escape lock-in.
Social network theory	Views social relationships in terms of nodes and ties, where nodes represent individual agents within the networks, and ties the relationships between them. The theory focuses on the social interactions of persons, groups and organizations. The approach, with specific mathematical and statistical methods, is widely used in sociology (Wasserman and Faust, 1994). According to the theory, the attributes of individuals are less important than their relationships and ties with other actors within the network.	A transition is understood as the diffusion of innovations, ideas or technologies. Individual and social learning are the most important parameters. The approach is often combined with evolutionary methods as these recognize intra-population interactions through networks. Its potential importance to transitions is that it provides information about the potential diffusion of lifestyles and environmentally relevant behaviors under different conditions. The latter applies both to consumers and firms, which tend to have unique, distinct networks of influence and information exchange. Possibly, the role of power as a barrier to, or factor fostering, a transition can also be understood in a social network setting.
Public choice theory	The political and policy process is seen as based on interactions between various self-interested stakeholders such as voters, politicians and bureaucrats. In this sense, it holds the middle between economics and political science (Guartney et al., 2008). Individuals, interest groups, politicians and bureaucrats are considered as self independent actors with own information and goals. Decisions are guided by a cost-benefit trade-off of actions whereby it often is assumed that agents attempts to maximise	Change is studied by using various standard tools such as utility maximization, game theory and decision theory. The interaction between different stakeholders is analyzed under alternative conditions (e.g., constitutional rules) by modeling political processes. The role of special interest groups and their lobbying power is also considered. Some work has been done on different type of changes at a state level focusing on anarchy, autocracy, revolution and even war. The most fundamental and general subject studied is the origin and functioning of the government, as



	their net benefits. Benefits take the form of monetary and non-monetary rewards (Libecap, 1989; Mueller, 1989).	a group of individuals assuming executive functions.
Institutional theory	Studies the processes by which structures like rules, norms and routines are established. It focuses on the creation, diffusion and adoption over space and time of these elements. The theory is divided old institutionalism, charting the formal-legal and administrative arrangements of government and the public sector, and new institutionalism, considering rational actor models and cognitive/cultural explanations of behavior (Meyer & Rowan, 1977; Powell & DiMaggio, 1991). In economics scholars have argued that institutions can play an important role in reducing transaction costs, information costs and associated forms of market uncertainty (Hodgson 1988; North, 1990; Williamson, 1985).	Transitions rely on the application of new solutions that improve technical efficiency. Ultimately these innovations reach a level of legitimization where failure to adopt them is seen as “irrational and negligent” or they become legal mandates (Babson Faculty College, 2012). At this point organizations will adopt the novelty even if it does not improve efficiency. Besides technical innovations, new institutions can be created, for instance around new technologies. This does not only require new resources but also new ideas and knowledge at the organizational level (Scott, 2011). The role of institutions is important in transition processes since they reduce uncertainty through providing agents with information, guidance and limits, and as they manage conflict and foster cooperation, or provide direct incentives for innovation (Edquist and Johnson, 1997).
Theories of conflict and power struggle	These deal with conflicting goals and interests of agents. The importance of agents organizing in different groups and thereby exercising their collective power is highlighted. This goes back to Marx (1859). Theories of conflict and power struggle strongly deviate from the view that societies are being held together by norms, values and shared goals. Instead, they see societal change as the outcome of power conflicts and struggle, and order as the result of powerful groups exercising their power and suppressing opponents.	A transition or discontinuity arises when power is shifted from one organization (industry association, government agency, labor union or special interest group) to another. For the same reason, stability is maintained when one powerful group or elite keeps the power and does not allow changes to protect its vested interests. The power of regime actors, and how they organize themselves in order to influence policy makers are stressed. Niches will use the same strategy in order to obtain subsidies and favorable conditions from policy makers (Avelino and Rotmans, 2009). Technological or institutional lock-in can be conceptualized as dominant power avoiding change.

Agency has dominated transition studies so far and its role is best understood through conflict and power struggle theories. Agency, which is the individual's ability to carry out successfully an action and obtain an expected outcome (Giddens, 1984), is central in different steps of transitions and will determine whether, when and in which manner a transition will occur (Grin et al., 2011). Power – the ability to make others do something even without their will (Dahl, 1957) – facilitates agency (Smith et al., 2005). Avelino and Rotmans (2009) identify the importance of power in each step of a transition by paying particular attention to power relations between niches and regimes. Regimes try to protect the status quo by exercising constitutive power<sup>2</sup>, while niches exercise innovative or destructive power: they represent the new and try to destroy existing structures. During the pre-development phase, niches create and discover new resources and organize themselves into networks, while regimes try to defend the status quo and absorb the niches. If niches resist, the take-off phase starts and the power struggle begins. According to Loorbach and Rotmans (2006), if regimes succeed in imposing their dominance, a so-called “backlash”<sup>3</sup> occurs; otherwise the acceleration phase starts which is characterized by transformative power. As the regime lost most of its power in the take-off phase, niches are able to redistribute resources or to create new ones. Finally, in the stabilization phase, niches try to form a new regime by exercising constitutive power. What is needed now to make these statements understandable and testable is behavioral underpinnings. Regimes and niches consist of many agents, some similar others very different (competing or complementary). Safarzynska and van den Bergh (2010a) have tried to understand various types of power from an evolutionary perspective of multi-level (group) selection. Surely, other approaches are feasible.

Another discipline which considers the behavioral factors in the decision-making processes of agents is behavioral economics. While economic theory and policy have long been dominated by the rational agent theory, slowly but irreversibly behavioral economics is becoming more important. It focuses on two broad topics: bounded rationality and limited self-interest (Rabin, 1993; Camerer, 1999; Gsottbauer and van den Bergh, 2011). The first addresses inconsistencies in the economic agent's decision-making process, including the analysis of choice under uncertainty and intertemporal decision-making, while the second considers all types of other-regarding preferences such as fairness, comparison, status-seeking, reciprocity, spite, imitation and altruism. Sustainability transitions involve different stakeholders like consumers, producers, investors, the financial sector and innovators. Different insights from behavioral economics can shed light on particular features of these stakeholders. This then can provide relevant information about effective policies aimed at each stakeholder to promote a sustainability transition.

### **3. Behavioral aspects of consumers in a sustainability transition**

Consumer decisions like buying products, consuming water and energy or discarding waste have important environmental consequences. Changing such decisions is part of a sustainability transition. The fact that some people behave in a very pro-environmental way in relation to waste recycling while being very environmentally harmful in terms of their transportation decisions suggests that a consistent set of consumer preferences may be rare (Steg and Vlek, 2008). One explanation for this may be deviations from rationality. In this section we review some major environmentally relevant behavioral factors that influence

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<sup>2</sup> Constitutive power represents the power to institute or establish new resources.

<sup>3</sup> A backlash means that new niches are destroyed by regimes and the old system is consolidated.

consumer decisions. We first look at other-regarding social considerations, then discuss bounded rationality at the individual level.

### *Consumers' other-regarding behavior*

A first group of behavioral features includes altruism and reputational concerns (Bénabou and Tirole, 2006). Altruism is concern for the welfare of others. Helping others by making personal sacrifices can have important consequences for economic behavior (Simon, 1992). The supply of public goods, for example, strongly depends on the level of altruism. It is affected by several factors, including gender, identity and intrinsic rewards in the form of personal gratification. Andreoni and Vesterlund (2001) find that women tend to show more altruistic behavior when altruism is expensive, while men are more altruistic when it is cheaper. Pandey and Griffitt (1977), however, document that it cannot be concluded that one sex is generally more helpful than the other. Altruism and reputational concerns may stem from intrinsic motivations that can be discouraged by extrinsic motivations like rewards or punishments. A famous example is the introduction of a fine for parents arriving late to pick up their children at school that only aggravated the problem which it was intended to solve: parents arrived even later, because they no longer felt guilty after paying the fine (Gneezy and Rustichini, 2000). Carpenter and Mayers (2007) also found that altruism and reputational concerns which are positively associated with socially beneficial behavior (volunteering, in this case) can be crowded out by monetary incentives. The reduction of positive feelings after doing something good ("warm glow") is partly responsible for this (Andreoni, 1989, 1990). Thus, rewards and punishments can be counterproductive if they crowd out community-oriented aspirations.

Studies further find that individuals do not use their full bargaining power in bilateral transactions (as opposed to competitive markets) and participants of group-level public goods dilemmas are willing to invest in costly punishments to maintain cooperation (Ostrom et al., 1992). Aspiring for fairness or reciprocity are deviations from the rational actor model that seem to be rooted in the evolutionary history of our species and influence decision-making already in non-humans (Santos and Hughes, 2009; deWaal and Luttrell, 1988). Both deviations can be explained by assuming a mix of selfish and equality-oriented (or inequality-averse) players that evaluate psychological costs and benefits of social comparison and prefer avoiding losses to acquiring gains (Fehr and Schmidt, 1999). A number of environmental dilemmas related to resource utilization can be understood as public goods games where fairness and reciprocity play an important role. A key message of behavioral studies for sustainability transitions is that cooperation has to be fostered in these games by considering fairness, making good intentions clear and avoiding defective behavior (Rabin, 1993; Falk and Fischbacher, 2006).

An unconscious desire for fairness (and power) can also be in the background of the quest for social status. In his "Theory of the Leisure Class", Thorstein Veblen (1899) draws attention to differences in social status and how life is determined by the social vestiges of society rather than just utility. More recently, Johansson-Stenman and Martinsson (2006) showed that in the process of choosing a car brand, people (even many of those who would not admit this) are more concerned about status and image than environmental issues. But, according to biologists, altruism might even function as a costly signal of status. This is corroborated by the observation that consumers increase the consumption of costly green products when they are shopping in public (Griskevicius et al., 2010).

Environmental and social behavior is strongly affected by moral and normative concerns too. Norms and rules often materialize in groups like families, groups of friends or social organizations. As people like to feel part of these groups, they are influenced by other members and the norms of the group (Tajfel et al., 1971; Tajfel and Turner, 1986). As leaders of “virtual groups”, role models can have a similar influence on people’s behavior. Thus, creating opportunities for environmentally beneficial behaviors to spread through social groups is important to facilitate transitions. In the case of energy saving, for example, norms can sometimes be more powerful than information provision in motivating behavioral change (Goldstein et al., 2008). Cialdini (2003; 2007) highlights the difference between descriptive norms (dominant behaviors) and injunctive norms (approved or disapproved behaviors in a particular society). If the aim is to change behavior, focusing on injunctive norms is the appropriate strategy. If, on the other hand, the goal is to prevent negative behavior, both injunctive and descriptive norms can be used in persuasive messages.

The powerful role of norms is, to a large extent, rooted in the human desire for conformity which also drives imitation and behavioral copying. Imitation can both hinder and foster a transition. As marketing efforts of profit-seeking companies can increase the imitation of dirty technologies and habits, this behavior can be a significant barrier to transitions. On the other hand, imitation is often used to adapt to changes (Bandura, 1977), so its relevance for the take-off and acceleration phase of transitions may be substantial. Rather than showing rational behavior, people are likely to copy others’ behavior in a crisis or when they are overwhelmed by uncertainty (Cialdini, 1993; Roe, 1996), which helps to understand why a window of opportunity can exist for the take-off of sustainability transitions. When a critical mass of people imitating and diffusing the same innovation is reached, imitation becomes a force that helps the transition instead of hindering it (Witt, 1997). The current trend of increasing interconnectedness in social networks and the level of communication in a society underlines the potential role of these mechanisms in fostering or accelerating behavioral changes in line with sustainability (Bentley et al., 2011; Rogers, 1995).

### *Consumers’ bounded rationality*

Apart from the role of social interactions and other-regarding preferences, the limited rationality of individuals is the other main issue which has to be considered when devising strategies for transitions. To begin with, individual agents often show habitual behavior (Verplanken and Aarts, 1999). The more frequently an action is repeated and the more closely it is associated with a reward, the stronger the mental habit will be. Individual habits are learned, stored and retrieved from the memory when the particular situation with which the habit is associated is perceived by the agent (Aarts et al, 1998; Aarts and Dijksterhuis, 2000). In accordance with Lewin’s 3-step theory (1947), the process of changing unsustainable consumer practices can start with the “unfreezing” of environmentally detrimental habits, followed by learning in a transitional period of adaptation, and finally the new, sustainable behavior can be “frozen”.

To develop more sustainable habits, the emotional appraisal of consumer activities has to change. Gatersleben (2007) points out the role of affect to explain environmental behavior. She uses the example of car use, which is largely driven by affective and symbolic motives. Generally, people attribute a high affective value to objects they own. In behavioral economics this is known as the endowment effect, according to which the value of a good increases as it becomes property. Hence, agents require a higher compensation for an object they own than what they are willing to pay to buy the same object (Kahneman

et al., 1990). The endowment effect is a significant motivation to stick to existing consumption behaviors and, more generally, to prefer the status quo (Thaler, 1980).

A related cognitive bias results from the role of framing, which – in contrast with the prediction of rational actor theory – has a non-negligible influence on choices (Tversky and Kahneman, 1981). In other words, the same contents presented differently result in different decisions. This is not only true for communication (to which the word framing refers), but also for decisions like purchasing commodities stimulated by commercial advertising. Thaler and Sunstein (2008) mention the choice of food in a school canteen. Often there is no neutral choice architecture, so devising it wisely – e.g. putting the healthiest and most sustainable food products at the front – can significantly affect choices. Using the right frames in environmental communication is also essential (Lakoff, 2010). The effectiveness of climate change communication, for example, largely depends on the proper management of risk perceptions (CRED, 2009). Framing climate change impacts in terms of gains and losses affects agents' perception as well as their attitudes towards mitigation. Spence and Pidgeon (2010) suggest that climate change communication should focus on the benefits of mitigation instead of stressing the bad consequences as a result of inaction in order to elicit positive attitudes towards mitigation and higher perceived severity of climate change. Furthermore, not just the contents but also the complexity of the presentation can influence outcomes. Complex messages about environmental behavior, for example, provide opportunities for people to use psychological defense mechanisms, which result in deviations from rational behavior (Antal and Hukkinen, 2010).

In intertemporal decision-making, which affects environmentally relevant choices, individuals' rationality is limited. The standard assumption of exponential discounting, like in cost-benefit analyses, does not capture the variety of intertemporal decision-making observed in the real-world (Frederick et al., 2002). People have been found to discount more strongly in contexts of environmental relevance – like investing in renewable energy or energy conservation equipment – than in purely financial contexts (van den Bergh, 2008). In addition, for savings decisions or bad habits like smoking and other addictions, a number of studies have shown that agents' preferences are not constant over time and inconsistent with exponential discounting (Ashraf et al., 2006; Thaler and Sherfin, 1981; Wertenbroch, 1998). Instead, agents often discount the value of later rewards by a factor that increases with the length of the delay, which results in so-called hyperbolic discounting. However, a complete description of time preferences and decisions is still lacking (Heinemann, 2005).

#### **4. Behavioral aspects of producers, investors and the financial sector in a sustainability transition**

The literature presents different views regarding firm behavior. Some of these describe firms as perfectly rational, always focused on profit-maximizing strategies, while others describe them as boundedly rational, unable to perform such strategies in complex and continuously changing environments of competitors, technologies, and preferences. In this section we examine the main behavioral aspects related to the decision-making processes of producers, investors and financial institutions.

### *Producers*

Traditionally, firms in competitive markets are assumed to be as profit-maximizing entities. Alchian (1950) argued that although not all firms are profit-seeking, the selection pressure of competitive markets will increase the proportion of such firms within the total population of firms. Friedman (1953) tried to generalize this argument for profit-maximizing behavior. Winter (1964) and Hodgson (1999) criticize their views for reflecting an incorrect understanding of evolutionary mechanisms, notably selection processes. They instead argue that evolutionary selection does not mean that profit-maximizing strategies are perfectly replicated, because many firms simply do not know why they were successful, and even if they do, others cannot perfectly observe and copy the relevant details of successful strategies. As the operational environment of firms and technologies becomes more complex, it turns out to be more difficult to access and process information in order to maximize profits (Foxon, 2006). A similar conclusion appears already in Cyert and March (1956).

Nevertheless, firms have been argued to make more (often) rational decisions than consumers (Armstrong and Huck, 2010). Reasons for this include the rationalization of organization and management processes, the reduction of economically disadvantageous behavioral biases due to professional, educated decision-making, and the repeated execution of actions that enables learning and performance improvement. In addition, pressure to adapt decisions in the face of competition can make firms more rational. On the other hand, several factors hamper perfect rationality. For example, a sense of fairness can motivate monopolists to set prices below the ones predicted by neoclassical theory (Kahneman et al., 1986), individuals' career aspirations can overrule firms' interests in decision making (Kamoche, 2000), firms' routines and internal political processes can hamper rational and rapid adaptation to external changes (Nelson and Winter, 1982), and firms can imitate the strategies of their competitors instead of acting like isolated optimizers (Bentley et al., 2011).

Routines have received much attention in the literature. A routine denotes a complex set of skilled individuals that interact simultaneously and sequentially. The interactions depend on earlier contacts (learning, adaptation) and organisation-specific "language". Altered demand or product prices, ambitions to acquire new markets, or goals to increase the company's market share are reasons to periodically revise routines. However, these revisions are not as predictable in reality as rationality would dictate: they depend on random changes in the collection of interactive firm employees and their unique, often irreplaceable, capabilities (Nelson and Winter, 1982).

Just as in the case of routines, the periodic revision and optimization of whole business strategies is imperfect from a purely rational perspective. Firms generally seek a satisfactory rather than maximum profit and do not change strategies if the realized profits are within the targeted range. Dixon (2000) reaches this result considering a duopoly market, while Oechssler (2002) simplifies and generalizes the results reached by Dixon using techniques from stochastic evolutionary game theory. Empirical data from the manufacturing sector indicate that firms shift to more aggressive strategies only if their profits fall below the industrial average (Cyert and March, 1956). Profits realized by competitors are often used as thresholds in strategic planning.

A further argument pointing to the non-rational nature of firms pertains to the over-optimism of business decision makers. The illusion that everything is under control and will work out fine has three main reasons: organizational pressure plus two cognitive biases known as anchoring and competitor

neglect (Lovallo and Kahneman, 2003). Organizational pressure refers to the fact that firms undertake only those projects that look most promising on paper (because of budget constraints), so executives have to accentuate the positive aspects of their proposals. Anchoring means that managers stick to initial information described by preliminary proposals that are overly optimistic, even if detailed financial analysis reveals potential difficulties at a later stage. In addition, companies focus on their own capabilities and often neglect those of competitors, especially when they enter new growing markets and increase capacities without considering that others may follow the same strategy.

Finally, behavioral differences between men and women may affect through gender composition of management teams the behavior of firms. The implementation of equal opportunity policies so far has not result in a wide equal representation of men and women in high-ranking positions. According to Gneezy et al. (2003), this is explained by the fact that women can be less effective than men in competitive as opposed to noncompetitive contexts. Male leaders are generally more competitive and more likely to take on larger risks than women (Niederle et al., 2009; Hogarth et al., 2012). While this can be capitalized in risky renewable energy investments, women's ability to act efficiently in non-competitive environments is critical for fostering cooperation in communities. In other words, both can possibly play different roles in making sustainability transitions come true.

#### *Investors and the financial sector*

In financial markets, it is often considered normal that trading volumes are high. The reason for this, however, is not so clear. How can millions of daily transactions benefit both buyers and sellers? The heterogeneity of rational investors and differences in information prohibit a simple answer this question (DeBondt and Thaler, 1995). Two alternative explanations are offered: "differences in opinion" and "overconfidence". The "differences in opinion" theory emphasizes differences in prior beliefs and divergence in the interpretation of public information (Varian, 1985; 1989). According to the "overconfidence" theory, investors overestimate the probabilities of certain outcomes (and their own ability to predict these outcomes), so they trade much more than rational investors would do.

Several studies on financial markets lend support to the overconfidence theory. Kim and Nofsinger (2003) use data from the Japanese stock market to argue that after periods of high returns trading volume increases as a result of the increased overconfidence of investors. Statman et al. (2004) obtain similar results using US data. Overconfidence can also be partly explained by gender: male investors of the US stock market trade more than female investors, which is consistent with psychological studies showing that men are more overconfident than women (Barber and Odean, 2001). Certain institutions can be particularly prone to overconfidence and excessive risk taking (Solow, 2011). Rotheli (2010) argues that the tendency of banks to increase credit supply during an upswing and cut it excessively during recession was a significant cause of the current financial crisis. This can be attributed to the overconfidence of banks.

Glaser and Weber (2004) warn that the link between psychological characteristics and actual market behavior is not always strong and more empirical studies are necessary to confirm behavioral theories. Their own analysis – in line with the results of Biais et al. (2004) – finds no correlation between overconfidence (as measured by calibration questions) and trading volumes. They conclude that "differences in opinion" better explain the high levels of trading volumes in financial markets than overconfidence and they call for empirical research on the link between different facets of overconfidence



(e.g. the better than average effect, illusion of control and unrealistic optimism) and market behavior. Understanding the basis of investor behavior can help to devise appropriate information strategies and incentives to stimulate investments in sustainability projects. Possibly, the overconfidence explanation requires more information on investor behavior to facilitate self-reflection, while the “differences in opinions” explanation calls for more information on projects.

Another puzzling behavior in stock markets is the tendency of investors to sell winning shares quickly and hold losing shares for longer periods. This is known as the disposition effect in behavioral finance (Levy et al, 2000; Shleifer, 1999). Just as the endowment effect in the case of consumers, this can be explained by prospect theory (Kahneman and Tversky, 1979). According to this, perceptions of potential losses and gains determine people’s choices in risky situations, not the expected utility that can be calculated from a concave utility-of-wealth function (Rabin and Thaler, 2001). Furthermore, people’s capacity to assess probabilities is very limited. For example, they overweight probabilities of events that happened more often recently.

A third surprising behavior, associated with the so-called equity premium puzzle, is that investors buy bonds even though stocks (in the long run) perform consistently better. Loss aversion combined with a frequent evaluation of portfolios by agents relying on “mental accounting” can produce this behavior (Benartzi and Thaler, 1996; Thaler et al., 1997). Loss aversion – an important element in prospect theory – refers to people’s tendency to prefer avoiding losses to acquiring gains (Tversky and Kahneman, 1992; Kahneman et al., 1990). Mental accounting denotes cognitive activities that individuals use to serve the same function as regular accounting in organizations (register gains and losses, limit losses to an acceptable level, etc.). The behavior of loss-averse investors relying on mental accounting can be unexpected: for example, more frequent access to information about stock/bond returns can be disadvantageous, because it can shift investments to the least risky assets offering the lowest returns in the long run. This may be bad news for investments in renewable energy.

Gender differences have been studied in relation to risk attitudes in financial markets. Such studies focus mainly on issues regarding the level of risk perception between genders. Their findings suggest that female investors are more risk averse than male ones (Eckel and Grossmann, 2008; Sapienza et al., 2009; Adams and Funk, 2011). This is relevant information for design of sustainability transition policy to deal with the uncertainty of large investments in, for example, renewable energy projects.

## **5. Behavioral underpinnings of, and limits to, innovation and learning**

### *Innovators, the spreading of novelty and learning*

Innovators are crucial agents in sustainability transitions. Like all others, they show deviations from rational decision-making. Innovation studies are, however, quite disconnected from behavioral research. As a result, knowledge about the behavioral aspects of the innovation process at the niche, regime and landscape level is scarce.

The niche level is the most important place where innovation happens. Firms, communities, NGOs and other niche actors generate diversity by changing the way they create products, provide services and organize activities. As part of this process, technology, the quality of products and services, and social practices can change. In the different steps of the innovation process, various behavioral biases can play a



role (Suurs, 2009). First, when choosing a problem to be addressed by the innovation team certain proposals may encounter barriers because of psychological or practical resistances to change, e.g. habits or routines. As innovation is often a long-term process, predictions (about future preferences, market conditions, etc.) are important and the limited forecasting ability of innovators increases the role of subjective expectations. If these expectations are influenced by the opinions of colleagues or competitors, a herd effect can follow. Next, in the collaborative phase when ideas are generated, combined and selected, in-group relations and the personal characteristics of innovators become important. The dominance of certain members in the innovation team and individuals' career aspirations on the one hand, and mutual help and reciprocity on the other hand, can significantly influence the outcomes of group decisions. In addition, over-optimism and organizational pressure introduce biases similar to the ones explained in the *Producers* subsection. Later, when ideas and products are tested, the context can be different from real-life situations. Different perspectives taken or even the different presentation of trial results can influence decisions (Schultz, 2000; Biswas and Pechmann, 2011). This is especially important for the assessment of the policy relevance of small-scale local experiments in sustainability transitions. Finally, reviewing the performance of innovations can be costly, so decisions about continuing in the same track or switching directions is often made without complete information which can increase the role of behavioral biases. Anchoring, for example, may influence these reviews and also affect what "milestones" decision makers use for the assessment. To achieve the long-term goals of sustainability transitions, such biases have to be considered in periodical progress reviews.

Although the transitions literature focuses on niche-level innovations and talks about it as a threat to regimes, regime actors themselves also generate novelty. In fact, as firms grow in scale and diversity they increase investments in research and development (R&D), which is a basis of innovation (Baker and Sinkula, 1999). These innovations, however, often work against sustainability goals, create demands for new products and services and shape consumer preferences in negative ways. Furthermore, even if innovations are positive, they are rarely radical, partly because of the status quo bias (Samuelson and Zeckhauser, 1988; Kahneman et al., 1991). Nevertheless, even incremental changes can be very important from a resource use perspective due to the size of these actors. More fundamental changes can be expected if the status quo bias and the perceived risks of losing ground through unsuccessful "green" investments can be reduced.

At the landscape level, innovation refers to changes in high-level policies or large-scale changes in social practices. Policy makers, of course, are not exempt from individual biases, so providing decisions support tools for them can often improve their choices. Research institutes, universities and consulting agencies can provide these tools. At the same time, rationality at the individual and public level can be at odds with each other in the "commons dilemmas" of politics. In the worst case, even corruption can hinder innovative policies at the landscape level. On the other hand, innovation at all three levels is made necessary by landscape changes, such as population growth, ageing and climate change. Perceptions of these changes are subject to numerous cognitive and behavioral biases that often hinder sustainability transitions (Takács-Sánta, 2007). This means that helping consumers, producers, investors and policy makers to innovate can foster a sustainability transition.

Broadly defined, the process of innovation also includes the diffusion, adoption and use of new technologies (Lundvall, 1988). From this perspective, learning has a double role: it allows for accumulating

knowledge which enables innovation, plus it helps the spread of innovations. Unsurprisingly, it is one of the key elements of transition management (Kemp et al., 2007).

So far we have not paid any attention to the role of prices and price corrections in guiding innovation. Taking bounded rationality of firms and other agents as a starting point does not imply that prices are irrelevant. It is probably true that agents do not respond efficiently to price information as is assumed by the rational actor model, which suggests the need for additional instruments. However, as is argued extensively in van den Bergh (2013), correct prices reflecting environmental externalities are a necessary condition for environmental innovations. Without correct prices innovations are likely to go in the wrong direction or come about too slowly.

The connection between innovation studies and gender has not received much attention. Ljunggren et al. (2010) who investigate gender and innovation in Norway point out that innovation studies has focused almost exclusively on industries dominated by men while there is a lack of research in industries dominated by women, such as the service and public sector. Samson (2006) in a review on gender and innovation states that gender issues are kept apart and not often considered in research fields such as science, technology and innovation, contributing to the incomplete integration of insights about innovation at a the firm level and potential innovation policy at an institutional level.

#### *Learning in the context of innovations for sustainability*

Learning, next to and in combination with innovation, is critical to transitions at any level. Organizations learn by acquiring knowledge from internal or external sources and then process this knowledge through adaptation, transformation and diffusion (Jiménez-Jiménez and Sanz-Valle, 2011). As organizational learning helps R&D and the improvement of capabilities, it also facilitates innovation and may enhance business performance (Baker and Sinkula, 1999; Han et al, 1998). Both qualitative and quantitative empirical studies corroborate these findings (Forrester, 2000; Yeung et al., 2007; Hult et al., 2004; Keskin, 2006; Lee and Tsai, 2005).

Individual learning is a central condition of innovation within organizations. A first type of it, trial and error, is the ability to learn from negative outcomes. This can be a particularly effective way of learning (Bandura 1973; 1977), but the overestimation of the importance of negative outcomes (i.e. a behavioral bias) can limit the acceptance of innovations that did not perform perfectly in a trial period. This, together with risk-related adoption barriers (consumers' acceptance of technological alternatives like for example the development of alternative fuels and engines in the automotive sector), can substantially slow down transitions to sustainable solutions (Wiedmann et al., 2011). A second type, learning-by-doing, refers to the ability of workers to improve their productivity by practicing, self-perfection and minor innovations (Arrow, 1962). While repeating actions can serve incremental improvements, it can also result in rigid routines that hamper transitions. Learning-by-doing is particularly important for the cost reduction of technologies (Soderholm and Sundqvist, 2007). Learning curves empirically quantify the impact of increased experience and learning on the cost of technologies. Such curves are increasingly applied in the planning phase of renewable energy investments. These technologies have higher initial costs than more traditional technologies, but they offer more potential for innovation and cost reduction (Grubler et al., 2002).

Learning-by-doing is often understood to occur mainly at the level of individuals and firms. Many innovations, however, involve the cooperation of multiple agents or stakeholders, so learning-by-doing at a group or societal level is also important. The so-called “social learning-by-doing” or “learning by interacting” (Lundvall, 1988, 1992), one pillar of the innovation systems approach, is an attractive way to analyse past innovation initiatives and to generalize findings through comparing different factors of innovation. A study of the role of social learning-by-doing factors in the context of major sustainability innovations in transport is van den Bergh et al. (2007). Hekkert et al. (2007) identifies two drawbacks of innovation systems approach. The first refers to the fact that innovation systems are considered as being quasi static in character and the second that the literature is mainly focused on the macro level and not on the entrepreneur or micro level. A way to better understand innovation systems is by focusing on how a number of functions are served in the system (Jacobsson and Bergek, 2004), which has given rise to the name “function of innovation systems”. This approach focuses on the processes taking place in innovation systems and successively leads to technology development and diffusion. The functions included are: entrepreneurial activities, knowledge development, knowledge and diffusion of networks, guidance of search, market formation, resources mobilization and the overcome of resistance to change. This approach is relevant for policy purposes in order to improve the innovation system functioning by simulating weak functions and removing blocking mechanisms that are considered as barriers to sustainability transitions.

Social learning in a broader sense is crucial for both the creation and the adoption of innovations, since transitions involve cooperation in innovation phases between multiple stakeholders (Nooteboom, 2000; Jacobsson and Bergek, 2011; van den Bergh and Stagl, 2003). One of the most common types of social learning is imitation, which is a low-cost option in information-rich environments (Boyd and Richerson, 1985). Directed copying of particularly successful features and undirected (random) copying are the two main options. Unconsciously replicating others’ behavior is particularly far from the assumptions of the rational actor model.

Furthermore, social learning can take place through persuasion (Hovland et al., 1953; Hovland, 1957). The “balance theory of persuasion” states that people prefer consistency in their opinions and behaviors. Suggesting inconsistency is thus a potential way to evoke behavioral change. Due to self-defense mechanisms, however, the direction of change is uncertain: environmentally unsustainable behaviors can persist or even strengthen if inconsistencies between behavior and sustainability are emphasized. Moreover, there are mixed empirical results about the effectiveness of persuasion messages (Petty and Cacciopo, 1981) some pointing out that transforming attitudes is not always necessary for behavioral change (Greenwald, 1968).

## **6. Behavior and structure of governments**

One could exclude the government from the behavioral analysis of transitions, in line with many policy theories assuming governments as exogenous to the economy. However, transition thinking generally sees governments as players in the system characterized by limited means, bounded rationality, internal organizational complexity and conflicting aims between different governmental agencies or levels. We do not offer here a very deep and complete analysis as this would require a separate paper. Instead, we offer some food for thought.

The bounded rationality of governments and institutions is considered from two perspectives. First, policy makers are boundedly rational themselves and second, they design policies for boundedly rational economic actors.

Decisions of policy makers, supposedly serving government or social purposes, are not necessarily more rational than decisions of consumers or private companies (Glaser, 2006). In fact, market conditions provide stronger incentives for consumers and especially for producers to act as rational agents than for the government.<sup>4</sup> Bounded rationality of governments is due to political myopia, the lack of direct accountability to voters, and regulatory capture. These biases are particularly important for transition policies which have to balance long-term societal goals with short-term concerns (Kemp and Loorbach, 2003).

To better understand the bounded rationality of the government the public choice model might serve as a starting point. It sees the political process as consisting of multiple actors (politicians, civil servants, voters, and NGOs, labor unions and business representatives) who act in a self-interested manner. This is often complemented with assigning these actors rationality, but one could easily replace this by relevant categories of bounded rationality. Public choice theory allows one to analyze the costs and benefits distribution among the different stakeholders involved in the political process (Hahn, 1990), which could be complemented by how power is distributed (Avelino and Rotmans, 2009; Safarzynska and van den Bergh, 2010a) to arrive at a more complete behavioral model. This already suggests that it is difficult, or better a simplification, to see the government as perfectly serving the public interest, that is, striving towards a social welfare state. This can further be clarified from another angle. Namely, social welfare is not a clear and unique goal - apart even from all kinds of theoretical discussions, such as Arrow's (1950) theorem about the impossibility of aggregating citizens' or voters' preferences into social preferences. A relevant pragmatic view here is that different representatives or parties in the political spectrum adhere to very different implicit social welfare functions, which motivate particular choices regarding solidarity, fairness, efficiency and the separation of private and public spheres. In other words, next to bounded rationality, diversity of stakeholders and their opinions and behaviors is important to explain the political process and finally governmental behavior.

Secondly, in theory, policies should be designed to take into consideration behavioral characteristics of all actors they affect. James (2012) investigates the contribution of behavioral economics to tax reforms in the UK. By comparing a local property tax (the "poll tax") with the value added tax, he identifies behavioral factors that determine success. The property tax was implemented without taking into account fairness considerations. For instance, it had to be paid by some individuals after they had inherited property regardless of their ability to pay. As a result, the policy failed. On the contrary, the value added tax was considered fair and it was accepted by local communities. Another example is the design of choice architectures as mentioned in Section 3, giving particular attention to default options and framing of choice alternatives (Thaler and Sunstein, 2008). Behavioral considerations are crucial in several fields closely associated with sustainability transitions, for instance, in energy saving in the building sector (Xu et al., 2013). Empirical results show that merely financial incentives or providing information on individual consumption generally do not trigger sufficient behavioral change. Therefore, education is suggested to be an important element of strategies delivering higher energy savings.

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<sup>4</sup> One could argue, though, that the government is increasingly involved in market interactions – think of privatization and liberalization of various governmental activities.

## 7. Conclusions

The need for a transition to a sustainable economy is widely recognized. How to realize it is subject to much debate and disagreement. We aim to feed these discussions with insights about behavioral foundations of transitions – in terms of barriers as well as opportunities. Some of the insights from the various threads of research reviewed in this article can offer fresh perspectives for thinking about transition policies.

Transitions are difficult to foster given that they can encounter impeding factors such as increasing returns to scale and path-dependency, which often result in lock-in into suboptimal solutions. Moreover, the power of vested interest groups and behavioral anomalies such as non-rational resistance to change can hamper a transition. We presented a range of influential social science theories and the views they provide on the behavioral foundations of transitions. We explored the potential contribution of behavioral economics in relation to different stakeholders involved in sustainability transitions, notably consumers, producers, investors and financial institutions. This way we could identify the types of bounded rationality and other-regarding preferences of individuals and groups that regulatory policies have to account for in order to effectively influence the direction, content and speed of sustainability transitions.

Since consumer decisions have important consequences for the environment, they are crucial for sustainability transitions. We identified a number of consumer behaviors that are direct consequences of bounded rationality and other-regarding social considerations. Habits, affect, framing of choices, altruism, fairness, status quo bias and imitation are some of the features which policy makers have to keep in mind when designing transition policies.

Limited rationality is not only seen in consumer choices but also in firms' decisions. We reviewed different studies highlighting the bounded rationality of firms in terms of routines, over-optimism, anchoring, etc. Overconfidence, differences in opinion, and the disposition effect are some important features explaining the bounded rationality of investors and financial institutions. In the case of governments we pointed out two different types of bounded rationality. Policy makers are boundedly rational themselves and to make it more complex consist of different groups with different interests and behavioral characteristics. As a result, governments cannot be assumed to consistently function to act in the interest of society. In addition, they have to consider behavioral characteristics in the process of policy design which makes their task difficult.

The paper indicated the crucial role of behavioral analysis of “environmental innovations” in sustainability transitions. Behaviour at the niche level is important as most novelty occurs here. However, we also pointed out behavioral issues related to the innovation of actors at the regime and landscape levels. Insight about this is relevant considering the size and power of regime actors and the upscaling of innovations leading changes at a landscape level. Connected to innovation, individual and social learning were studied from a behavioral perspective. The latter is crucial to change and innovation in an increasingly interconnected world where many innovations are affected by social interactions.

Last but not least, at different places in the text we identified gender issues as a crucial element in sustainability transitions. Differences between women and men relate to many behavioral dimensions, for instance attitudes toward risk, environmental values, the capacity to cooperate and show altruism, the interest to exert power, competitive behavior, consumer behavior (possibly sensitivity to advertisement), and performance in markets. Insight about these can inform the formulation of effective transition policies. The specific role of gender in environmental innovation is neglected and needs more study.

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## **Project Information**

### **Welfare, Wealth and Work for Europe**

#### **A European research consortium is working on the analytical foundations for a socio-ecological transition**

##### **Abstract**

Europe needs a change: The financial crisis has exposed long neglected deficiencies in the present growth path, most visibly in unemployment and public debt. At the same time Europe has to cope with new challenges ranging from globalisation and demographic shifts to new technologies and ecological challenges. Under the title of Welfare, Wealth and Work for Europe – WWWforEurope – a European research consortium is laying the analytical foundations for a new development strategy that enables a socio-ecological transition to high levels of employment, social inclusion, gender equity and environmental sustainability. The four year research project within the 7<sup>th</sup> Framework Programme funded by the European Commission started in April 2012. The consortium brings together researchers from 33 scientific institutions in 12 European countries and is coordinated by the Austrian Institute of Economic Research (WIFO). Project coordinator is Karl Aiginger, director of WIFO.

For details on WWWforEurope see: [www.foreurope.eu](http://www.foreurope.eu)

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