Renewable Energy Decision-Making: Style and Awareness of Cognitive Processes Beyond Rational Choice

D I S S E R T A T I O N
of the University of St. Gallen,
School of Management,
Economics, Law, Social Sciences
And International Affairs
to obtain the title of
Doctor of Philosophy in International
Affairs and Political Economy

submitted by

Sylviane Chassot

from

Zurich

Approved on the application of

Prof. Dr. Rolf Wüstenhagen

and

Prof. Dr. Lucia Reisch

Dissertation no.4339

Difo-Druck GmbH, Bamberg, 2014

The University of St. Gallen, School of Management, Economics, Law, Social Sciences and International Affairs hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St. Gallen, October 22, 2014

The President:

Prof. Dr. Thomas Bieger

Like the proverbial drunkard who looked for his lost keys under the lamppost because that's where the light was, policy analysts have looked for answers to their questions about energy use in the light of economic theory. As the analogy suggests, the theory shines a bright light, but illuminates only part of the field. And as the analogy also suggests, that is often not where the keys are to be found.

Paul C. Stern (1986: 200)

Acknowledgements

This thesis was written at the Chair for Management of Renewable Energies at the University of St. Gallen and was co-funded through several research projects for the Swiss Federal Office of Energy, the Internationale Bodensee-Hochschule IBH, the German Federal Ministry for the Environment and Raiffeisen. Moreover, a fellowship for prospective researchers by the Swiss National Science Foundation enabled me to spend one year at the Department of Psychology at The Norwegian University of Science and Technology.

This research wouldn't have been possible without survey participants who dedicated their time to answer questions (and to conduct reaction tasks, and eye-tracking experiments, etc). Several survey participants joined the discussion about the future of our energy system and expressed their own concerns. Seeing that a lot of other people, practitioners, policy makers, are thinking and working on similar questions like me has been a great inspiration for this research.

One place where I spent hour by hour working on my thesis and at the same time had the sounds of life around me has been the Cappuccino, a coffee place in Winterthur. Writing a dissertation can be a lonely business, which it wasn't for me thanks to this place and thanks to my family and friends. I am grateful to my friends for believing in me. Thanks to Annemarie and René, who offered me another peaceful place to work when I felt like a change of scenery from home and office. And to my family. My sisters, my mom and my dad, for being there and loving me, for listening to my moans, and simply for being my family.

At the University of St. Gallen I greatly enjoyed collaborating with students, and some of them contributed significantly to this research. In particular, I would like to mention Nicole Fahr, Fritz Beglinger, Christian Bärtsch, Paul Seng, Helen Burkhardt, Laura Antonini and Maurin Gregorin.

During the last four years, the Institute for Economy and Environment at the University of St. Gallen has become a second home. I am grateful for the support from my colleagues, for example from my friend and co-author Nina Hampl, to mention just one in the place of many.

I could always count on the great support from my supervisor and co-author Rolf Wüstenhagen. I've received guidance when I was lost in a sea of literature and data, and I was free to explore when I felt like going to break new grounds.

St. Gallen, May 2014, Sylviane Chassot

Preface

This research has been conducted in the context of the energy transition from conventional to renewable energies in German speaking Europe. The goal of this work has been to contribute to academic research, but also to provide empirical insights on energy decision-making that are relevant to practitioners and policy makers. In order to adequately address the audience of the five papers, two papers of this thesis are published in German-language journals, three are written in English.

Table of Contents

Abstract

Energy has become as important to our economy as water is for a human body. With technological development, the options to choose from how to generate energy have increased and renewable energy technologies have started to conquest the energy industry. Offering important advantages in terms of climate protection and technology risk, renewable energies such as photovoltaics, solar, geothermal and wind energy challenge incumbent energy technologies such as coal, gas or nuclear power. However, the attitude on different energy technologies is "part of who we are" (Peters and Slovic, 1996) and changing such an attitude concerns the emotional makeup and personal worldviews. This thesis provides empirical evidence how different investors and stakeholders think about renewable energy technologies, and how their thinking influences their decision-making.

The theoretical framework subdivides "thinking" into different types of cognitive processes. One classification of cognitive processes is the one that Daniel Kahneman (2011) titled "Thinking, fast and slow". This is one more of numerous dichotomies to distinguish unconsciously occurring, fast and automatic from conscious, slow and controlled cognitive processes. With the style-awareness model of cognitive processes, this thesis proposes to leave the dichotomy of dual process theories behind, and distinguishes holistic from analytical thinking on one layer, and unconscious from conscious thinking on the other layer.

The five research papers of the thesis align along the diffusion process of an innovation: Paper I focuses on venture capitalists, which are typical early stage investors. Paper I shows that venture capitalists with individualistic worldviews react particularly sensitive to regulatory exposure of renewable energy deals. To policy makers, this implies that careful framing of policy instruments is important to ensure effectiveness of policy tools. Paper II discusses public acceptance of renewable versus nuclear energy. Paper III focuses on large-scale energy investors, in particular utility companies and institutional investors. Finally, for adoption of an innovation, the development of new products such as renewable electricity tariffs is due (Paper IV), as well as customer acceptance thereof (Paper V). Whereas Paper I discusses critical reactions to government intervention, Paper V shows that, when choosing an electricity tariff, customers appreciate guidance through policy makers.

Zusammenfassung

Energie ist für unsere Volkswirtschaft so wichtig geworden wie Wasser für den menschlichen Körper. Dank des technologischen Fortschritts steht heute eine Palette von Technologien zur Energieerzeugung zur Auswahl, und erneuerbare Energien erobern zunehmend die Energieindustrie. Erneuerbare Energien wie Photovoltaik, Solarenergie, Geothermie und Windenergie bieten gegenüber konventionellen Technologien wie Kohle, Gas und Atomenergie entscheidende Vorteile bei der Beschränkung des Klimawandels und der Reduktion technologischer Risiken. Jedoch ist die Einstellung zu verschiedenen Energietechnologien in der Persönlichkeit verankert (Peters und Slovic, 1996), und eine Veränderung dieser Einstellung betrifft damit die persönliche Weltanschauung und die emotionale Befindlichkeit. Diese Doktorarbeit zeigt empirisch, wie verschiedene Investoren und Anspruchsgruppen über erneuerbare Energien denken, und wie dieses Denken Entscheidungen beeinflusst.

Der theoretische Rahmen der Arbeit unterteilt „Denken“ in verschiedene Arten kognitiver Prozesse: Das „Stil und Wahrnehmungs-Modell“ kognitiver Prozesse unterschiedet zum einen zwischen bewusst und unbewusst ablaufenden Denkprozessen, und zum anderen zwischen holistischem und analytischem Denken.

Die fünf Studien der Doktorarbeit lassen sich einordnen in den Diffusionsprozess einer Innovation: Studie I fokussiert auf Risikokapitalgeber, welche typischerweise in einer frühen Diffusionsphase investieren. Die Studie zeigt, dass Risikokapitalgeber mit individualistischer Weltanschauung empfindlich reagieren, wenn ein Investment in erneuerbare Energien von regulatorischen Rahmenbedingungen abhängt. Studie II diskutiert die öffentliche Akzeptanz erneuerbarer Energien versus Atomenergie. Studie III fokussiert auf Grossinvestoren, insbesondere Energieversorgungsunternehmen und institutionelle Investoren. Am Ende des Diffusionsprozesses steht die Entwicklung und Adaption von Produkten auf dem Massenmarkt. Studie IV diskutiert die Verbreitung von Ökostromprodukten aus der Sicht eines Energieversorgungsunternehmens, und Studie V untersucht die Akzeptanz eines Ökostromprodukts als Standardangebot. Während Studie I eine kritische Haltung gegenüber der öffentlichen Hand thematisiert, zeigt Studie V, dass Stromkunden bei der Wahl eines Produkts gern die Empfehlung einer öffentlichen Institution befolgen.

1 Introductory Chapter

1.1 Background and Problem Statement

"Perhaps because of its technical, economic, and thermodynamic advantages, a renewable power sector would have six benefits over one reliant on conventional power plants, including (1) lower negative externalities per kWh, (2) more stable and predictable fuel prices, (3) fewer greenhouse gas emissions, (4) less water use, (5) improved efficiency, and (6) greater local employment and revenue." (Sovacool and Watts, 2009: 99). In a review of 164 energy scenarios, the IPCC special report on renewable energies depicts the correlation of renewable energy deployment and CO_2 emissions: The higher the share of renewables in the energy mix, the less CO_2. In addition to mitigating climate change, most scenarios project that energy costs will be lower by 2050 in a renewable than in a conventional energy scenario. Some renewable energy technologies are already cost competitive today, and a projection of the learning curves suggests a continuing price decline in the next decades (IPCC, 2011; Kost et al., 2014). Beyond the concerns on CO_2 emissions and costs of different energy technologies, another argument speaking for renewables simply is: people prefer solar and wind over fossil and nuclear energy (e.g. Greenberg, 2009; Kaenzig et al., 2013). So what can governments do to enhance investments in renewable energies?

1.1.1 Investments in Renewable Energy: Current State and Outlook

Throughout the last decade, the renewable energy industry has undergone periods of impressive growth. Within only five years, from 2006 to 2011, new investments in renewable energies nearly tripled from $100 billion in 2006 to $279 in 2011 (UNEP, 2014). Maintaining the 2011-level in renewable energies until 2035 would result in 18% renewables of global primary energy demand – the share of renewable energies required for the *New Policies Scenario* (IEA, 2013: 224). As a middle way between the 450 (ppm) Scenario and the Current Policies Scenario, the New Policies Scenario assumes that current government commitments are implemented in policies in a „cautious manner" (IEA, 2011: 39). In terms of mitigation of climate change, the *450 Scenario* would be preferrable, and would require a share of renewable energy of 26% in global total primary energy demand. Investments in 2011 showed that the New

Policies Scenario is in reach, and, with more effort, the 450 Scenario is not inconceivable, either.

However, investors have recently cut their investments in renewable energies again to $244 billion in 2012 and to $214 billion in 2013 (UNEP, 2014). Thus, in-depth understanding of investor behavior is of crucial importance to build the infrastructure for a more sustainable energy future, because such understanding enables the design of behaviorally informed (Karsten and Reisch, 2008; Reisch and Oehler, 2009; Stern, 2014) energy policies.

Taking one step back, one might be wondering why energy policies are necessary at all to enhance investments in renewable energies. In a perfect market economy, where energy prices would include all external effects such as technology risks of nuclear power and CO_2-emissions of fossil energy, investments would flow into those energy technologies with the least external effects, because they would also be the most affordable option. In reality however, external effects are often not included in the price an energy consumer pays (e.g. Hohmeyer, 1992). Due to discount rates on future costs, the cost advantage of renewable energy sources, which is that solar and geothermal energy are free resources, diminishes (Kaenzig and Wüstenhagen, 2010). Energy policies may either internalize external effects of energy technologies, or they can enhance competitiveness of technologies with less external effects through remuneration for these technologies. Currently, emphasis is on the second approach with feed-in tariffs and other remuneration schemes to attract investors to renewable energies.

1.1.2 Scope: Investment Behavior Across Innovation Modes

For a systematic overview of potential renewable energy investors, it is useful to think in terms of innovation modes renewable energies go through. Industry reports distinguish the following innovation modes: 1) technology research and development, 2) commercial scale-up, 3) adoption (IRENA, 2013; UNEP, 2014).

1) For early **technology research**, one of the most important investors to spur the development of an innovation is the **government** itself. Through renewable energy policy goals and incentives and subsidies for education and research on renewable energy technologies, governments may contribute to the development of renewables (IRENA, 2013). Technology research is closely linked to **technology development.** The characteristic activity of this stage is applied R&D in demonstration plants – a

capital-intensive stage (IRENA, 2013) with a high degree of uncertainty (e.g. Ruhnka and Young, 1991). Typically, **business angels** and **venture capital investors** fit this investor profile (Pechtl et al., 2010; Wüstenhagen and Teppo, 2006).

2) **Commercial scale-up** requires investments in equipment manufacturing and adjustments in energy regulation (e.g. feed-in laws, admission procedures, etc). Thus, in particular in direct democracies, public acceptance of renewable energies (Wüstenhagen et al., 2007) is a precondition for successful commercial scale-up. Due to lower risks compared to earlier stages, potential financing sources widen from venture capital and private equity to project finance in collaboration with banks and public equity markets (Hampl, 2012). Typical investors in equipment manufacturing and large-scale power plants are owners of energy assets, in particular **utility companies**, but also **institutional investors** such as pension funds and asset management companies. Simultaneously to the development of large-scale infrastructure for generation of renewable energies, this stage involves the development of renewable energy products to market renewable energy applications across sectors and customer segments. The challenge of the commercial scale-up stage is to overcome the "valley of death"[1] (IRENA, 2013; Bürer and Wüstenhagen, 2009) through the development of products for market penetration in terms of depth and width. In the case of renewable energy, commercial scale-up requires investments of incumbent energy companies. The latter are typically bound by sunk costs of the infrastructure they have already built, and thus path dependent in the sense that they are willing to pursue the current path of established technologies as long as possible (e.g. Lovio et al., 2011).

3) The final development stage, **adoption**, "encompasses efforts to introduce existing commercial technologies into new markets. (…) Innovation at this stage typically involves novel marketing, business models" (IRENA, 2013: 8). In the case of renewable energies, **utility companies** are potentially important suppliers of new renewable energy products. Another important stakeholder, even though often overlooked, are **energy consumers** who ought to adopt the innovaton.

This thesis aims at a better understanding of actors and stakeholders of the three innovation modes.

Within the technology research and development stage, a survey with venture capital (VC) investors sheds light on VCs' perception of risk related to renewable

[1] The technology "valley of death" is "the period of low or uncertain cash flows that occurs after initial venture funding has peaked, but before commercial transactions can sustain an individual firm" (IRENA, 2013: 8)

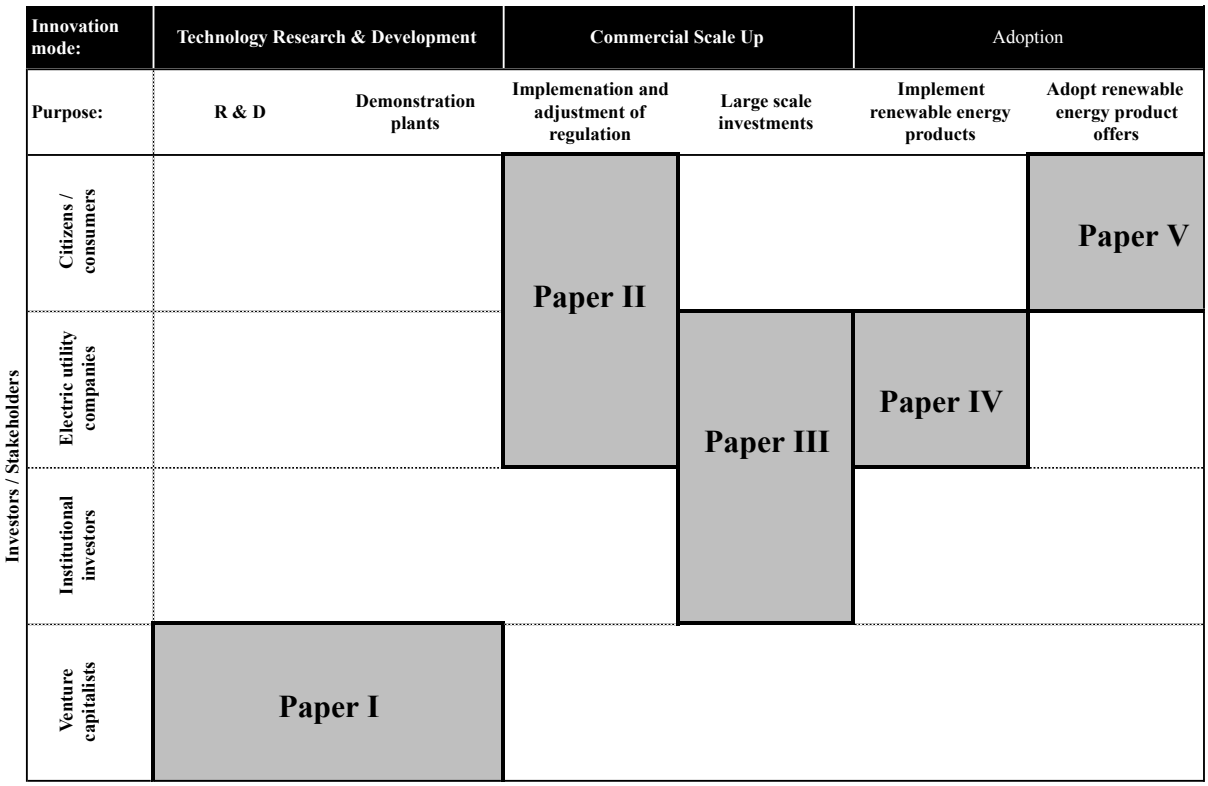
energy deals, particularly focusing on the perception of regulatory risk (cf. Paper I in Figure 1).

Paper II focuses on public perception of the phase out of nuclear power and relates it to the perception of renewable energies. It provides empirical evidence on energy attitudes from a series of household surveys, and discusses implications to electric utility companies.

Paper III analyses large-scale investment decision-making of utility companies who have a strong strategic motive to invest, and of financial investors such as pension funds, insurance companies and other asset management companies, who have high financial leverage and are important financing partners.

As for the adoption stage, Paper IV and Paper V focus on marketing of renewable electricity through a green default. Paper IV is written from the point of view of a utility company and is a case study of the implementation of a green default. Paper V has emerged from the same case, but is written from the customers' point of view and discusses customer acceptance of a green default.

Figure 1. Research plan in terms of investors and stakeholders across innovation modes (adapted from IRENA, 2013; Hampl, 2012)



1.1.3 Research Question

"Renewable energy is proving to be commercially viable for a growing list of consumers and uses. Renewable energy technologies provide many benefits that go well beyond energy alone. More and more, renewable energies are contributing to the three pillars of sustainable developments – the economy, the environment and social well-being – not only in IEA countries, but globally." (IEA, 2002)

"We rushed into renewable energy without any thought. The schemes are largely hopelessly inefficient and unpleasant. I personally can't stand windmills at any price." (James Lovelock, Independent Scientist, 2010[2])

The statements, both talking about the same technologies, illustrate how polarized the discussion on renewable energies is. The second statement hints at the influence of personal worldviews and affect-laden images of renewable energies. To the extent that energy decision-makers – electric utility companies, policy makers, consumers, private investors – are not consciously aware of the influence of their personal worldviews and affective images when it comes to wording energy preferences, the rational-choice assumptions of clearly defined and consistent preferences[3] have to be complemented. Furthermore, even if decision-makers where perfectly aware of all factors beyond risk-return considerations that influence energy preferences, rational choice assumptions cumber the inclusion of such factors in economic modeling. In consequence, as Stern (1986) put it, "voluminous evidence has accumulated that the rational choice assumptions that underlie energy demand models are fundamentally incorrect about consumers' behavioral processes". Almost 30 years later, on the occasion of the launch of the journal Energy Research & Social Science, the journal's editor Sovacool (2014) and Stern (still) call for research that considers "human understandings of energy systems" and their role for decision-making processes (Stern, 2014).

As mentioned earlier, this thesis analyses renewable energy decision-making of venture capitalists (Paper I), citizens as voters (Paper II), strategic and financial investors (Paper III), utility companies (Paper IV) and electricity consumers (Paper V). The relevant literature to analyze these actors' behavior emerges from different

[2] http://www.theguardian.com/environment/blog/2012/jun/15/james-lovelock-fracking-greens-climate

[3] For a precise definition of rational-choice assumptions and a critical discussion, see for example Sen, 1977.

subfields of economics. The thesis adds to these literatures by focusing on decision-making factors beyond rational choice. Specifically, these "factors" can be considered as concepts within the family of dual process theories. Rational choice typically requires what Evans (2008; Frankish and Evans, 2009) calls system 2 processes: Slow and controlled, consciously occurring explicit processes that require high effort. System 1 processes, on the other hand, occur according to Evans fast and automatically without conscious awareness, are implicit and require low effort. The influence of system 1-thinking is particularly high if a decision has to be made in an unfamiliar context, if information is scarce and the topic complex (Petty and Cacioppo, 1986). When it comes to decision-making related to an innovation such as renewable energies, these criteria are met for the majority of decision-makers beyond the niche of renewable-energy experts. Empirical values – be it data on financial performance of renewable energy investments or even just the neighbor telling about his new photovoltaic system – are still scarce. The more necessary information for a purely rational risk-return assessment is lacking, the more decision-makers have to rely on cognitive processes that emerge from intuition, gut feeling, and are driven by unconsciously held associations to energy technologies, beliefs and worldviews. In an attempt to shed light on this type of cognitive processes, the main research question of this thesis is ***How unconsciously occurring, holistic and analytical thinking influences renewable energy decision-making***. More specifically, the next section on theoretical foundations suggests a refinement of dual process theories by distinguishing cognitive processes in terms of awareness (unconscious vs. conscious), but also in terms of style (holistic vs. analytical). This leads to the style-awareness model of cognitive processes, the theoretical framework within which the different papers may be placed.

The thesis comprises of five pieces of "empirical-descriptive" research (Reisch and Oehler, 2009: 34) on investor and stakeholder behavior, in order to enhance the design of energy policy instruments that take decision-making factors beyond rational choice into account.

1.2 Theoretical Foundations

1.2.1 The Debate Among Dual Process Theorists

"System" or "Type" 1 and 2 are the two most commonly used terms under which cognitive processes are subsumed[4]. Using these broad and abstract terms is one way to deal with the fact that from different study areas in psychology and decision-making sciences, a plethora of attributes for the two types of processes has emerged.[5] Within each research tradition, different terminologies for similar things evolved in parallel, but often without referring to each other:

„This disconnectedness of the various fields is a reflection of modern psychology. There is now so much research conducted and reported in various fields that authors struggle to keep up with the literature in their own traditions and favoured paradigms. For example, few cognitive psychologists take the time to read social psychology and vice versa. This state of affairs permits parallel discovery of phenomena and theoretical ideas, and this is precisely what seems to have happened in the case of dual-process theories in cognitive and social psychology. There are many striking similarities in the theories developed in these different traditions, as well as some important differences of emphasis".

(Frankish and Evans, 2009: 11)

However, according to Evans (2009), it is not only the lack of consistency in terminology that causes confusion, but also that some authors refer to dual process theories when analyzing *how* cognitive processes influence decision-making (i.e. unconsciously or consciously, Wilson, 2009), whereas others refer to the *what*, to the type of content of a cognitive process (i.e. holistic or analytical, Slovic et al., 2004). According to Evans (2008), dual process theories concern the *how*, the architecture of cognitive processes, whereas he attributes holistic and analytical thinking to different cognitive *styles*.

[4] For a discussion on the difference of the terms, see Evans, 2009: 34

[5] For reviews of dual process theories within psychology of learning, seocial cognition and decision-making, see Evans, 2008; Evans, 2009; Evans and Stanovich, 2013; Frankish and Evans, 2009; and within social psychology, see Smith and Collins, 2009.

1.2.2 Style of Cognitive Processes

Cognitive style is defined as "a person's typical or habitual mode of problem solving, thinking, perceiving and remembering" (Rayner and Riding, 1997: 6). Early experiments to assess a person's cognitive style come from Witkin (1949a). Witkin asked his subjects to place a rod in a frame in the upright position, with the frame in one experimental condition being tilted. Some subjects – the "field dependents" – adjusted the rod such that it was vertical to the frame even if the frame was tilted up to 30 degrees, whereas the "field independents" placed the rod such that it was vertical to gravitational force. Suprisignly, equivalent results have been found in experiments where subjects had to find an upright position for their own body in a tilted room (Witkin, 1949a, 1949b). Witkin concluded that "the common denomintar underlying individual differences in performance in all these tasks is the extent to which a person is able to deal with a part of a field separately from the field as a whole, or the extent to which he is able to dissemble items from organized context – to put it in everyday language, the extent to which he is *analytical*." (1978, cited in Tennant, 1988: 81, emphasis added by author).

Throughout the following decades in research on cognitive styles and just as in dual process theories, an abundance of terms have emerged (see Rayner and Riding, 1997, for a review). Witkin's dichotomy of field dependent and field independent cognitive style has remained influential and reappears in Riding's (1997: 30) wholist-analytic style-dimension, which describes wether someone processes information "in wholes or parts". Riding and Cheema (Riding and Cheema, 1991; Riding, 1997) suggest a two-dimensional typology of cognitive processes: the wholist-analytic dimension is one axis, the verbal-imagery dimension the other. The verbal-imagery style dimension describes wether a person "is inclined to represent information during thinking verbally or in mental pictures" (Riding, 1997: 30).

However, orthogonality of the two dimensions analytical-holistic and verbal-imagery has been doubted (e.g. Kozhenikov, 2007), and indeed, dual process theorists such as Epstein (1994) and Slovic (2004) distinguish only two systems; a holistic[6] *and* images-based thinking system as opposed to an analytic *and* words-based thinking system. Nevertheless, the suggestion by Riding and Cheema to distinguish two independent dimensions to describe cognitive processes emerged from interesting experimental findings, in particular the observation that cognitive processes sometimes

[6] Riding and Cheema use the word „wholist", but the description of the style resembles what the other authors cited here call „holistic". This thesis suggests to use the word „holistic", but doesn't find a conceptional difference to the „wholist" cognitive style.

occurred “spontaneously without conscious effort”, whereas others do require a “conscious decision to generate an image or verbal response” (Riding, 1997: 36). Holistic thinking may occur with or without conscious awareness (e.g. Slovic et al., 2004), and the same holds according to the unconscious thought theory (Dijksterhuis and Nordgren, 2006; see below) for analytical thinking. In sum, the authors above discussed evidence for

1) unconsciously occurring, holistic,
2) unconsciously occurring, analytical
3) consciously occurring, holistic, and
4) consciously occurring, analytical

cognitive processes. Thus, this thesis suggests the level of awareness – the distinction between consciously and unconsciously occurring cognitive processes – as a more appropriate label for the second dimension to classify cognitive processes. The question of awareness refers, just as Evans (2008) argued, to the question how a cognitive process occurs and is rooted in dual process theories, whereas the description of a cognitive process as analytical or holistic refers to cognitive style. Thus, the novel element of the style-awareness model of this thesis is to merge the research streams on cognitive styles and dual process theories, in order to leave the dichotomy of dual process theories behind.

1.2.3 Awareness of Cognitive Processes

Unconscious cognitive processes probably fascinate human beings since the first day of a *conscious* human mind. The origins of research on unconscious cognitive processes go back to Plato’s division of the soul into reason, spirit and appetite (Plato, 1993, cited in Frankish and Evans, 2009), to Aristotle’s text „on sleep and dreams“, and they resonate in Schopenhauer’s (1851 / 1970) philosophy. Among psychologists, Sigmund Freud was the first who tried to systematically use the unconscious in clinical psychology. Jung (e.g. 1933, 1967) further developed this approach in clinical psychology and enriched the new understanding of the unconscious. At that time in scientific psychology, the school of behaviorism was founded in the early twentieth century and dominated research throughout the two world wars until the cognitive revolution in the 1960ies. Until then, the unconscious remained mostly unconscious to academic psychologists. Thereafter, within psychology of learning, analytical, but unconsciously occurring thinking has become a central concept to explain the

acquisition of knowledge and skills (i.e. by "sleeping over it") (Piaget, 1976).[7] Under the flagship of unconscious thought theory, Dijksterhuis and Nordgren (2006) have introduced the distinction between unconscious holistic and unconscious analytical thinking into social psychology. They illustrate unconscious analytical cognition with a statement from Schopenhauer:

"One might almost believe that half of our thinking takes place unconsciously . ... I have familiarized myself with the factual data of a theoretical and practical problem; I do not think about it again, yet often a few days later the answer to the problem will come into my mind entirely from its own accord; the operation which has produced it, however, remains as much a mystery to me as that of an adding-machine: what has occurred is, again, unconscious rumination."

(Schopenhauer, 1851/1970: 123–124, cited in Dijksterhuis and Nordgren, 2006)

Importantly, the authors cited above do not question the existence of holistic, unconsciously occurring processes, but add that unconscious thinking might also be analytical (Piaget, 1970).

1.3 Research Agenda: Cognitive Processes and Energy Decision-Making

This thesis provides empirical evidence on the influence of different cognitive processes on energy decision-making of professional investors and lay people. The five research papers do not neatly fill the landscape of all types of cognitive processes, but exemplify some of them with a particular focus on unconsciously occurring cognitive processes. Psychologists have developed a range of methods to measure unconsciously occurring cognition (e.g. Chassot and Wüstenhagen, 2013). However, as Uhlmann et al. state in a review on the use of these methods in organizational research, "Organizational scholars have largely underutilized a highly impactful

[7] Academic psychologists' understanding of the unconscious builds on psychoanalysis by Freud and Jung. Nevertheless, academics maintain a critical distance to clinical psychologists. Piaget, invited to speak about possible links between psychoanalytic and cognitive theories: "I shall not try to criticize psychoanalytic theories, nor to introduce new ideas, but I am convinced that one day cognitive psychology and psychoanalysis must merge and form a general theory" (Piaget, 1970: 64). This disconnectedness has prevailed across time and research subfields: "It is highly noteworthy, however, that although a historic link can be drawn between intuition and the work of Jung (1933), there is a notable absence of modern authors who define the concept in Jungian psychoanalytic terms." (Hodgkinson et al., 2008).

discovery (…): nonconscious processes and the implicit measures developed to capture them." (2012: 554). The Implicit Association Test for example is an in psychology largely used implicit measure (Uhlmann et al., 2012; Fazio and Olsen, 2003). The IAT quantifies to what extent somebody associates two attitude objects, e.g. "flower" and "insect" to the associations "good" and "bad". Thus, the IAT measures holistic, crudely integrated associations to an attitude object. The IAT was developed by Greenwald and Banaji, who use the terms implicit and unconscious as synonymes (1995: 4). To other authors, the question of awareness is less clear; Fazio and Olsen argue that „people generally are aware of their automatically activated racial attitudes. (...) However, such indications of awareness may not arise in other domains, and we do not question that it is possible for people to possess, and be influenced by, attitudes of which they are unaware." (2003: 318). In energy research, the Implicit Association Test has been applied to show that implicit cognition predicts political support for energy sources (Truelove et al., 2013; Siegrist et al., 2006). Paper III of this thesis measures professional investors' implicit associations to renewable vs. fossil energy and discusses how they influence investment decisions. Regarding the question on the level of awareness of implicit associations on energy sources, Figure 2 suggests based on Fazio and Olsen that, in the moment of a portfolio allocation decision, an investor is not consciously aware how his implicit associations influence his decision.

Another concept that belongs to holistic thinking is intuition. According to Hodgkinson et al. "intuition occurs almost instantaneously, is affectively charged but does not have any accompanying verbalization or conscious awareness of the problem-solving process" (2008: 2). Intuitive decision-making is the focus of Paper V, which discusses how different choice architectures enhance intuitive decision-making for the choice of an electricity tariff.

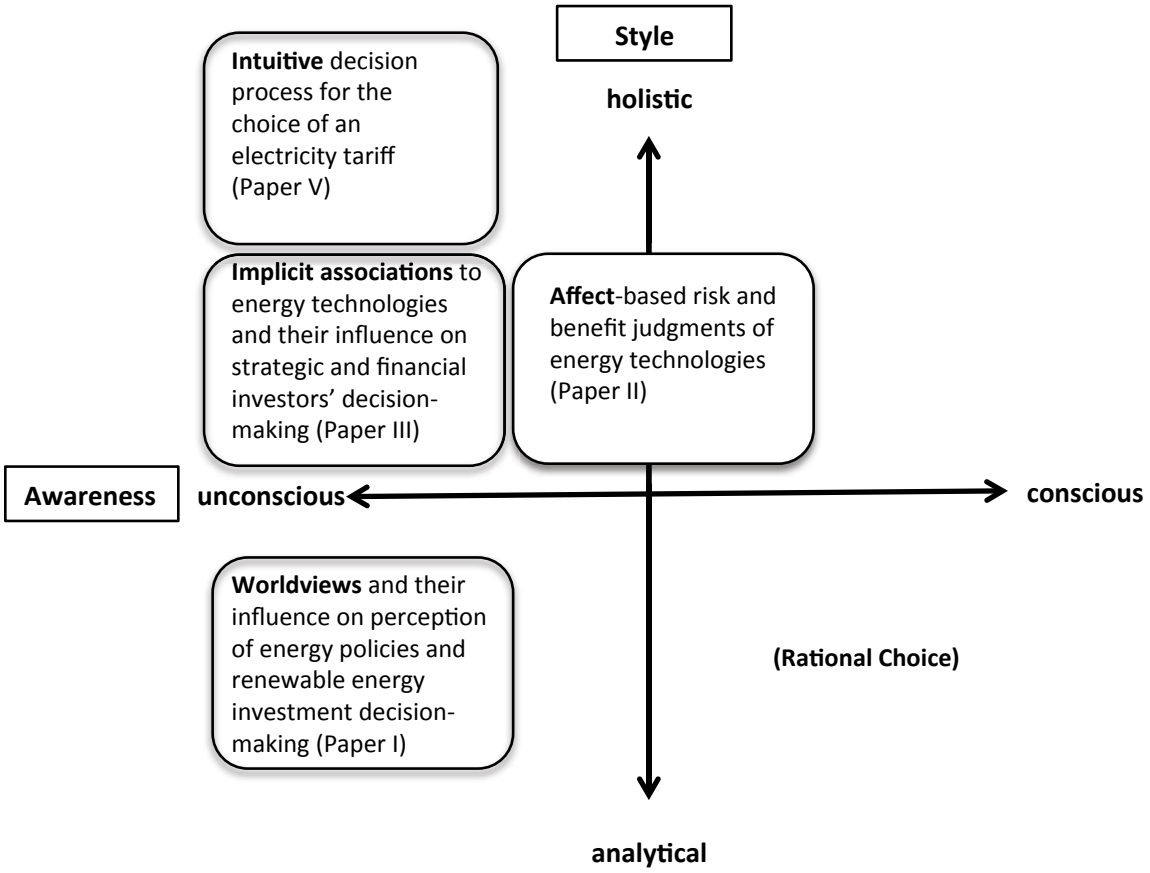
Under the headline "Risk as Feelings" (Slovic et al., 2004; Loewenstein et al., 2001) several authors suggest that holistic thinking materializes in the affect heuristic and that affect – "a faint whisper of emotion" (2004: 312) – drives risk perception. Importantly, according to the definition by Slovic et al. (2004), affect occurs *with or without consciousness* of a person. In energy research, affect is considered as an important concept for understanding the perception of nuclear energy. In particular, empirical evidence suggests that lay people infer from perceived risk on perceived benefit (and vice-versa) of the technology (Finucane et al., 2000; Siegrist et al., 2000). Paper II departs from this view and shows how perceived benefit of nuclear energy

evolved after the Fukushima-hazard, when not only perceived risk of nuclear energy was high, but also perceived benefit of an alternative thereto, which is renewable energy.

Peters and Slovic (1996) analyze the role of affect in combination with an analytical concept, which is a person's worldviews[8]. Worldviews are defined as "orienting dispositions" (Dake, 1991), "generalized attitudes toward the world and its social organization" (Peters and Slovic, 1996: 1430). They express a person's group or individual orientation on one axis, and to what extent one favors a rule-governed over an anarchic society on the other axis. Cognitive processes that are based on worldviews are more differentiated than affect-based thinking, as the latter simply expresses the "goodness" or "badness" (Slovic et al., 2004) of a stimulus. However, Peters and Slovic (1996) suggest that people develop worldviews early on in life and influence a broad range of attitude objects such as nuclear power, but also health, environmental and technology risks more in general (Peters and Slovic, 1996; Schwarz and Thompson, 1990; West et al., 2010). Thus, worldviews are deeply held beliefs and in specific decision-making situations, one may not be consciously aware of the influence of personal worldviews because it has become an ingrained habit to behave and decide in accordance with personal worldviews. The influence of worldviews on the perception of regulatory exposure of renewable energy investments is the topic of Paper I.

[8] The concept of worldviews originally evolved from Grid and Group Cultural Theory (Douglas, 1970; Schwarz and Thompson, 1990; Wildavsky, 1987).

Figure 2. Style-awareness model of cognitive processes and placement of concepts relevant for this thesis. Adapted from Riding (1997)



To sum up this preview of the next five chapters, Table 1 gives an overview of the five papers. Each paper draws on empirical evidence from a different research method. By definition, unconscious cognitive processes are not accessible via introspection. Thus, even if an interviewee or survey participant was willing to reveal her unconscious thinking, any methodological approach that relies on participants' introspection to capture unconscious cognition is bound to failure. This challenge is not at all unique to the topic of this thesis; as Gerring (2012) puts it, most, if not all important social science concepts are latent, and thus not directly observable. Narrowing down the latent concept of interest is one approach to facilitate accurate measurement (Gerring, 2012). Thus, the here suggested refinement of dual process theories may not only clarify some confusions in dual process theories, but also enhance accuracy of the methodological approach.

Table 1. Overview of the five papers of the cumulative dissertation

Paper	Title	Investor Type / Stakeholders	Research question	Research method	Co-Author(s)	Publication status	Language	Study area
I	When energy policy meets free-market capitalists: The moderating influence of worldviews on risk perception and renewable energy investment decisions	Venture Capitalists	To what extent is the impact of regulatory risk on the decision to invest in renewable energy moderated by investors' worldviews?	Choice-based conjoint experiment	Prof. Dr. Nina Hampl, Prof. Dr. Rolf Wüstenhagen	Published as an article in Energy Research & Social Science 14(3): 143-151.	English	Europe & United States
II	Sustainable? A cross-country analysis of the socio-political acceptance of the nuclear phase out in Germany and Switzerland focusing on opportunities for strategic influence	Citizens as voters	How does the perception of renewable energies influence willingness to phase out nuclear energy?	Surveys (longitudinal and cross section)	n.a.	Published as an article in Betriebswirtschaftliche Forschung und Praxis 14(3): 247-265	German	Germany / Switzerland
III	The impact of implicit cognition on strategic and financial investors' response to renewable energy - evidence from an Implicit Association Test	Strategic and financial investors	1. What is the impact of implicit cognition on energy investments? 2. How do implicit cognition and ist influence on energy investments differ between managers of financial versus strategic investors?	Implicit Association Test	Prof. Dr. Christian A. Klöckner, Prof. Dr. Rolf Wüstenhagen	Submitted to the Journal of Applied Research in Memory and Cognition	English	Switzerland
IV	When The Green Product Becomes the Default How an Electric Utility Company Makes Behavior Change Easy for Customers	Electric utility company	How can a utility company implement a green default?	Case study	Prof. Dr. Rolf Wüstenhagen, Nicole Fahr, Peter Graf	Published as an article in Zeitschrift OrganisationsEntwicklung 13(3): 80-87.	German	St.Gallen (Switzerland)
V	Utility companies as choice architects: eye tracking the influence of hard and soft default rules on electricity tariff choice processes	Electric utility customers	How does a soft default rule (i.e. policy recommendation for one product option change customers' attention to product attributes such as price and quality?	Eye-tracking experiment	n.a.	Working paper	English	St.Gallen (Switzerland)

References

Bürer, M-J, Wüstenhagen, R. 2009. Which Renewable Energy Policy Is a Venture Capitalist's Best Friend? Empirical Evidence from a Survey of International Clean Energy Investors. . *Energy Policy,* **37**(12), 4997-5006.

Chassot, S, Wüstenhagen, R. 2013. Implicit cognition and renewable energy investments: An empirical analysis of differences between financial and strategic investors. Final report. Berne: Swiss Federal Office of Energy; 2013 [contract no. 8100087].

Dake, K. 1991. Orienting Dispositions in the Perception of Risk: An Analysis of Contempriary Worldviews and Cultural Biases. *Journal of Cross-Cultural Psychology,* **22**(61), 61-82.

Dijksterhuis, A, Nordgren, LF. 2006. A Theory of Unconscious Thought. *Perspectives on Psychological Science,* **1**(95).

Douglas, M. 1970. *Natural Symbols, Explorations in Cosmology*. New York: Vintage Books.

Evans, J. 2009. How Many Dual-Process Theories Do We Need? One Two, or Many? In Evans, J, Frankish, K (Eds.), *In Two Minds: Dual Processes and Beyond* (pp. 33-54): Oxford University Press.

Evans, JS, Stanovich, KE. 2013. Dual-Process Theories of Higher Cognition: Advancing the Debate. *Perspectives on Psychological Science,* **8**(3), 223-241.

Evans, JSBT. 2008. Dual-Processing Accounts of Reasoning, Judgment, and Social Cognition. *Annual Review of Psychology,* **59**, 255-278.

Fazio, RH, Olson, MA. 2003. Implicit Measures in Social Cognition Research: Their Meaning and Use. *Annual Review Psychology,* **54**, 297-327.

Finucane, M, Alhakami, A, Slovic, P, Johnson, SM. 2000. The Affect Heuristic in Judgments of Risks and Benefits. *Journal of Behavioral Decision Making,* **13**, 1-17.

Frankish, K, Evans, J. 2009. The Duality of Mind: A Historical Perspective. In Evans, J, Frankish, K (Eds.), *In Two Midns: Dual Processes and Beyond* (pp. 1-29): Oxford University Press.

Gerring, J. 2012. *Social Science Methodology: A Unified Framework* (2nd ed.). Cambridge: Cambridge University Press.

Greenberg, M. 2009. Energy Sources, Public Policy, and Public Preferences: Analysis of US National and Site-Specific Data. *Energy Policy,* **37**, 3242-3249.

Greenwald, AG, Banaji, MR. 1995. Implicit Social Congition: Attitidues, Self-Esteem, and Stereotypes. *Psychological Review,* **102**(1), 4-27.

Hampl, NL. 2012. *Energy Investment Decision-Making under Uncertainty: The Influence of Behavioral and Social Effects.* PhD, University of St. Gallen, St. Gallen.

Hodgkinson, GP, Langan-Fox, J, Sadler-Smith, E. 2008. Intuition: A Fundamental Bridging Construct in the Behavioral Sciences. *British Journal of Psychology,* **99**, 1-27.

Hohmeyer, O. 1992. Renewables and the Full Costs of Energy. *Energy Policy,* **20**(4), 365-375.

IEA. 2002. Renewable Energy… into the Mainstream: International Energy Agency (IEA).

IEA. 2011. World Energy Outlook: International Energy Agency (IEA).

IEA. 2013. Renewable Energy Outlook. *World energy outlook*: International Energy Agency (IEA).

IPCC. 2011. Summary for Policymakers. In Edenhofer, O, Pichs-Madruga, R, Sokona, Y, Seyboth, K, Matschoss, P, Kadner, S, Zwickel, T, Eickemeier, P, Hansen, G, Schlömer, S, von Stechow, C (Eds.), *Ipcc Special Report on Renewable Energy Sources and Climate Change Mitigation*. Cambridge, United Kingdom, and New York, NY, USA: Cambridge University Press.

IRENA. 2013. Renewable Energy Innovation Policy: Success Criteria and Strategies *IRENA working paper*: International Renewable Energy Agency.

Jung, CG. 1933. *Modern Man in Search of a Soul*. London: Trubner.

Jung, CG. 1967. Über Die Zwei Arten Des Denkens *Symbole Der Wandlung. Gesammelte Werke* (Vol. 5, pp. 525).

Kaenzig, J, Heinzle, S, Wüstenhagen, R. 2013. Whatever the Customer Wants, the Customer Gets? Exploring the Gap between Consumer Preferences and Default Electricity Products in Germany. *Energy Policy,* **53**, 311-322.

Kaenzig, J, Wüstenhagen, R. 2010. The Effect of Life Cycle Cost Information on Consumer Investment Decisions Regarding Eco-Innovation. *Journal of Industrial Ecology,* **14**(1), 121-136.

Kahneman, D. 2011. *Thinking, Fast and Slow*. London: Allen Lane.

Karsten, J, Reisch, LA. 2008. Sustainability Policy and the Law. *German Policy Studies,* **4**(1), 45-66.

Kost, C, Mayer, JN, Thomsen, J, Hartmann, N, Senkpiel, C, Philipps, S*, et al.* 2013. Stromgestehungskosten Erneuerbare Energien: Franhofer ISE.

Kozhevnikov, M. 2007. Cognitive Styles in the Context of Modern Psychology: Toward an Integrated Framework of Cognitive Style. *Psychological Bulletin,* **133**(3), 464-481.

Loewenstein, GF, Weber, EU, Hsee, CK, Welch, N. 2001. Risk as Feelings. *Psychological Bulletin,* **127**(2), 267-286.

Lovio, R, Mickwitz, P, Heiskanen, E. 2011. Path Dependence, Path Creation and Creative Destruction in the Evolution of Energy Systems. In Wüstenhagen, R, Wuebker, R (Eds.), *Handbook of Research on Energy Entrepreneurship*. Cheltenham UK and Lyme US: Edward Elgar Publishing.

Pechtl, H, Gloszat, E. 2010. Motive Und Entscheidungskriterien Von Business Angel. *Betriebswirtschaftliche Forschung und Praxis,* **62**(6), 581-602.

Peters, E, Slovic, P. 1996. The Role of Affect and Worldviews as Orienting Dispositions in the Perception and Acceptance of Nuclear Power. *Journal of Applied Social Psychology,* **26**(16), 1427-1453.

Petty, RE, Cacioppo, JT. 1986. *The Elaboration Likelihood Model of Persuasion*. New York: Springer.

Piaget, J. 1970. The Affective Unconscious and the Cognitive Unconscious. In Piaget, J (Ed.), *Structuralism*. New York: Basic Books.

Piaget, J. 1976. *Piaget's Theory*. Berlin Heidelberg: Springer.

Plato. 1993. *Republic* (Waterfield, R., Trans). Oxford: Oxford University Press.

Rayner, S, Riding, R. 1997. Towards a Categorisation of Cognitive Styles and Learning Styles. *Educational Psychology,* **17**(1-2), 5-27.

Reisch, LA, Oehler, A. 2009. Behavioral Economics: Eine neue Grundlage für die Verbraucherpolitik? *Vierteljahrshefte zur Wirtschaftsforschung,* **78**(3), 30-43.

Riding, RJ. 1997. On the Nature of Cognitive Style. *Educational Psychology,* **17**(1-2), 29-49.

Riding, RJ, Cheema, I. 1991. Cognitive Styles – an Overview and Integration. *Educational Psychology*, **11**(3-4), 193-215.

Ruhnka, JC, Young, JE. 1991. Some Hypotheses About Risk in Venture Capital Investing. *Journal of Business Venturing,* **6**, 115-133.

Schopenhauer, A. 1970. *Essays and Aphorisms (R.J. Hollingdale, Transl.)* (Vol. Original work published 1851). London: Penguin.

Schwarz, M, Thompson, M. 1990. *Divided We Stand: Redefining Politics, Technology and Scoial Choice.* Harvester Wheatsheaf: Hemel Hempstead.

Sen, AK. 1977. Rational Fools: A Critique of the Behavioral Foundations of Economic

Theory. *Philosophy & Public Affairs,* **6**(4), 317-344.

Siegrist, M, Cvetkovich, G, Roth, C. 2000. Salient Value Similarity, Social Trust, and Risk / Benefit Perception. *Risk Analysis,* **20**(3), 353-362.

Siegrist, M, Keller, C, Cousin, M-E. 2006. Implicit Attitudes toward Nuclear Power and Mobile Phone Base Stations: Support for the Affect Heuristic. *Risk Analysis,* **26**(4), 1021-1029.

Slovic, P, Finucane, M, Peters, E, MacGregor, DG. 2004. Risk as Analysis and Risk as Feelings: Some Thoughts About Affect, Reason, Risk, and Rationality. *Risk Analysis,* **24**(2), 311-322.

Smith, ER, Collings, EC. 2009. Dual-Process Models: A Social Psychological Perspective. In Frankish, K, Evans, JS (Eds.), *In Two Minds: Dual Processes and Beyond* (pp. 197-216). Oxford: Oxford University Press.

Sovacool, BK. 2014. What Are We Doing Here? Analyzing Fifteen Years of Energy Scholarship and Proposing a Social Science Research Agenda. *Energy Research & Social Science,* **1**, 1-29.

Sovacool, BK, Watts, C. 2009. Going Completely Renewable: Is It Possible (Let Alone Desirable)? *The Electricity Journal,* **22**(4), 95-11.

Stern, PC. 1986. Blind Spots in Policy Analysis: What Economics Doesn't Say About Energy Use. *Journal of Policy Analysis and Management,* **5**(2), 200-227.

Stern, PC. 2014. Individual and Household Interactions with Energy Systems: Toward Integrated Understanding. *Energy Research & Social Science,* **1**, 41-48.

Tennant, M. 1988. *Psychology and Adult Learning.* London: Routledge.

Truelove, HB, Greenberg, MR, Powers, CW. 2013. Are Implicit Associations with Nuclear Energy Related to Policy Support? Evidence from the Brief Implicit Association Test. *Environment & Behavior,* **45**(8).

Uhlmann, EL, Leavitt, K, Menges, JI, Koopman, J, Howe, M, Johnson, RE. 2012. Getting Explicit About the Implicit: A Taxonomy of Implicit Measures and Guide for Their Use in Organizational Research. *Organizational Research Methods,* **15**(4), 553-601.

UNEP. 2014. Global Trends in Renewable Energy Investment 2014. Frankfurt am Main: Frankfurt School UNEP (United Nations Environment Programme) Collaborating Centre for Climate & Sustainable Energy Finance.

West, J, Bailey, I, Winter, M. 2010. Renewable Energy Policy and Public Perceptions of Renewable Energy: A Cultural Theory Approach. *Energy Policy,* **38**, 5739-5748.

Wildavsky, A. 1987. Choosing Preferences by Constructing Institutions: A Cultural

Theory of Preference Formation. *The Americal Political Science Review,* **81**(1), 3-22.

Wilson, TD. 2009. Know Thyself. *Perspectives on Psychological Science,* **4**(4), 384-389.

Witkin, HA. 1949a. Perception of Body Position and oft he Position oft he Visual Field. *Psychological Monographs: General and Applied*, **63**(7), i-46.

Witkin, HA. 1949b. The Nature and Importance of Individual Differences in Perception. *Journal of Personality,* **18**(2), 145-170.

Witkin, HA. 1978. *Cognitive styles in personal and cultural adaptation*. Worcester, MA: Clark University Press.

Wüstenhagen, R, Teppo, T. 2006. Do Venture Capitalists Really Invest in Good Industries? Risk-Return Perceptions and Path Dependence in the Emerging European Energy Vc Market. *International Journal of Technology Management,* **34**(1/2), 63-87.

Wüstenhagen, R, Wolsink, M, Bürer, MJ. 2007. Social Acceptance of Renewable Energy Innovation: An Introduction to the Concept. *Energy Policy,* **35**, 2683-2691.

2 Paper I

When Energy Policy Meets Free-Market Capitalists: The Moderating Influence of Worldviews on Risk Perception and Renewable Energy Investment Decisions[9]

Sylviane Chassot[*], Nina Hampl[†], Rolf Wüstenhagen[*]

Abstract

Whether or not targets to increase the share of renewable energy will eventually be met critically hinges upon the effectiveness of policies to mobilize private investment. However, just as energy policy can create opportunities, it can also create risk. This paper adds to a growing stream of literature at the intersection of energy research and social sciences that empirically investigates investor perceptions of regulatory risk, and their influence on investment decision-making. Based on choice experiments with 29 venture capital investors from Europe and the United States conducting 1064 investment decisions, we show that high levels of regulatory risk have a negative effect on the likelihood to invest in renewable energy. Furthermore, we find that investors' worldviews moderate the impact of perceived regulatory risk: respondents who expose strongly individualistic "free-market" worldviews are less likely to invest in renewable energy ventures with high regulatory exposure than other investors.

Keywords: Renewable Energy; Regulatory Risk; Worldview; Venture Capital

JEL-codes: C81; D81; G11; G24; Q42; Q48

[9] Paper I is published as an article in *Energy Research & Social Science* 14(3): 143-151. An earlier version of this paper was awarded with the Elsevier Student Paper Award 2011.

[*] Institute for Economy and the Environment, University of St. Gallen, Switzerland.
[†] Institute for Strategic Management, Vienna University of Economics and Business, Austria.

2.1 Introduction

An extrapolation of current energy trends into the future is not sustainable. A culmination of increasing concerns about climate change, the nuclear accident in Fukushima, and discussions on energy security in a world with growing energy demand have led to a call for increasing the share of renewable energy. Building up a cleaner energy infrastructure requires significant investment. UNEP (2014) reports that total global investment in renewable energy was $214 billion in 2013, which is a decrease of 14% compared to 2012. The main reasons for the decline in investment indicated in this report are twofold: (1) a sharp decline in technology cost, making investments in a given amount of renewable energy capacity cheaper than before, but also (2) the instability in policy support for renewable energy in some key markets in Europe and the United States. While the former is a positive development, the latter raises a serious concern with regard to achieving ambitious policy targets. The International Energy Agency estimates that $26 trillion need to be invested in energy infrastructure by 2030 in the New Policies Scenario, and that this number increases to $36 trillion in the 450-Scenario, which has the goal of stabilizing the atmosphere at below 2°C temperature change (IEA, 2012). Thus, government policies to promote renewable energy need to be designed in order to spur the required levels of investment. The absence of such investment-grade policies (Hamilton, 2009) leads not just to a lack of capital flowing into renewable energy projects, but to continued allocation of capital to conventional sources of energy.

At least two factors have been offered in the energy policy and economics literature to explain the puzzling gap between renewable energy targets and actual levels of investment. First, recent research has pointed to the importance of regulatory risk[10] (Barradale, 2010; Dinica, 2006; Holburn, 2012; Johnston et al., 2008; Lüthi and Prässler, 2011; Lüthi and Wüstenhagen, 2012; Mitchell et al., 2006) – mirroring the findings of the UNEP report (UNEP, 2014). While policy makers tend to assume that political incentives create opportunities for renewable energy investors, those policies might actually be viewed as a possible source of risk by investors, leading to disappointing levels of capital flowing into the sector. Second, recent work inspired by behavioural economics suggests that a purely rational risk-return perspective may fall short of explaining the observed investment behaviour and how it is influenced by energy policy. Real-world investor decision-making in the energy industry seems to be

[10] We define regulatory risk as „the risk that regulatory agencies will change policy decisions“ (Holburn, 2012: 654). In this paper, we use regulatory and policy risk as synonyms.

more characterized by bounded rationality (Simon, 1955) leading to path dependence and carbon lock-in (Unruh, 2000).

Despite its importance, this bounded rationality view on the role of energy policy and regulatory risk in renewable energy investment is still an under-researched field. Our paper responds to recent calls for more research in this area (Sunstein and Reisch, 2013; Wilson and Dolatabadi, 2007; Wüstenhagen and Menichetti, 2012). Focusing on one particular type of investor, venture capitalists, we investigate a specific "behavioural" effect, namely whether investors' general worldview influences their level of risk perception with respect to regulatory risk, and thus negatively influences investment in renewable energy. Albeit venture capitalists typically do not directly invest in power generation facilities, they provide capital to technology start-ups, who in turn rely on a favourable investment environment in the downstream sector to find demand for their products (Bürer and Wüstenhagen, 2009). Thus, venture capitalists are important gatekeepers for new energy technology, which will then eventually be applied in power generation projects, financed by e.g. institutional investors and banks. Uncertainty related to policy support in the asset finance sector also has an important indirect impact on the sentiment in public markets, which provide growth capital to renewable companies. Venture capitalists that typically exit investments through initial public offerings (IPOs) are thus also sensitive to the overall investment climate in this financial sector. The focus on venture capitalists therefore provides an interesting perspective on energy policy from the upstream and innovation-focused side of the financing continuum. Additionally, understanding venture capitalists' investment decision-making is particularly in demand, as recent figures show that renewable energy investment in the venture capital/private equity sector dropped by 46% from 2012 to 2013 to levels observed eight years ago (UNEP, 2014).

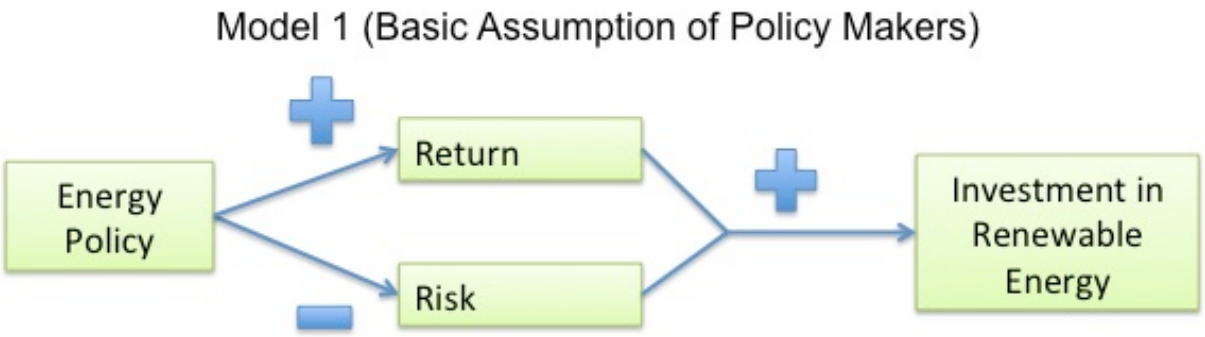
With empirical evidence from choice experiments with 29 venture capitalists from the United States and Europe conducting 1,064 experimental investment decisions, we address the following research question: to what extent is the impact of regulatory risk on the decision to invest in renewable energy moderated by investors' worldviews? Our results show that high regulatory risk has a negative influence on investment decisions in renewable energy. We further provide empirical evidence that investors' worldviews moderate the relationship between regulatory risk and the decision to invest in renewable energy. Investors with an individualistic ("free-market") worldview perceive risks induced by high regulatory exposure more pronounced than other investors.

2.2 Literature Review

2.2.1 Policy Makers Versus Investors – Two Perspectives on Energy Policy

A general assumption behind the introduction of renewable energy policies is that investors are more likely to invest in renewable energies in the presence of such policies than they would be in their absence. For example, in the case of feed-in tariffs or investment incentives, policies are designed to provide attractive returns to renewable energy investors. Policy makers tend to pay less attention to the other side of the equation, i.e. the implications of regulatory risk on investments (cf. Figure 3).

Figure 3. A simple model of how policies influence renewable energy investment. Adapted from Wüstenhagen and Menichetti (2012)



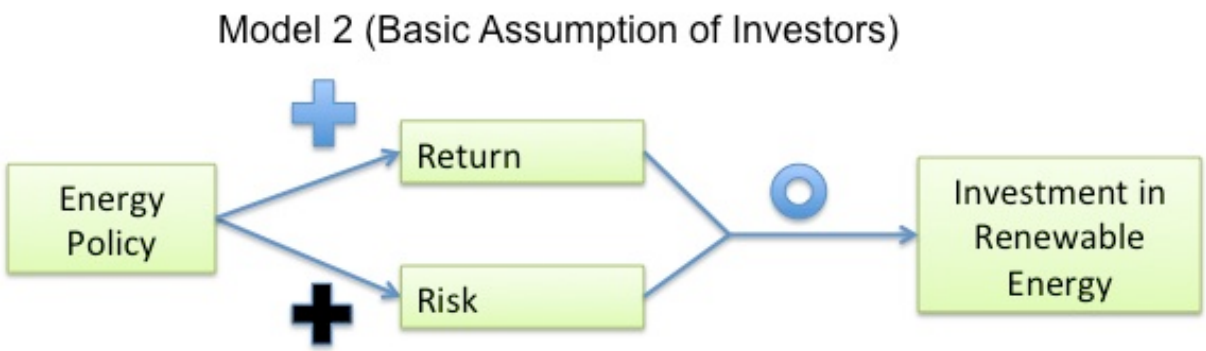
Investors, on the other hand, may have very different views on energy policy. Rather than seeing renewable energy policies as a source of opportunity – as assumed and intended by policy makers – they might interpret them as a source of risk. This alternative view of the policy-investment nexus has been presented as a possible explanation for puzzling findings about renewable energy policy effectiveness (Barradale, 2010). For example, it has been shown that countries with seemingly similar policy frameworks had widely differing outcomes in terms of the amount of new capacity installed (Lüthi, 2010), and the "price of policy risk" (Lüthi and Wüstenhagen, 2012) could be a central factor in explaining observed differences.

Energy policy encompasses a rich toolbox of different instruments. In addition to remuneration schemes such as feed-in tariffs or investment subsidies (economic factors), energy policy frameworks are also characterised by so-called non-economic factors such as grid access, legal security and duration of administrative processes (Lüthi and Prässler, 2011; Lüthi and Wüstenhagen, 2012). Several studies have investigated the impact of economic and non-economic policy aspects on investment

decisions by various types of investors (Chassot and Wüstenhagen, 2013; Dinica, 2006; Langniss, 1999; Lüthi and Prässler, 2011; Lüthi and Wüstenhagen, 2012). Studies that investigate the attractiveness of different policy schemes show that feed-in tariffs are the most appealing financial support scheme from the investors' point of view (Bürer and Wüstenhagen, 2006). Feed-in tariffs decrease the price risk for electricity output and have thus emerged as one of the most effective and most prominent energy policy instruments to promote investments in renewable energies. However, if different policy aspects are jointly investigated, studies show that for investment decisions the relative importance of non-economic policy factors such as the administrative process duration or the risk of negative policy changes (regulatory or policy risk) is higher than the level of total remuneration and the type of policy scheme (Lüthi and Prässler, 2011; Lüthi and Wüstenhagen, 2012).

In this perspective, well-designed policies decrease (perceived) regulatory risk and other types of risks (e.g. price risk) in investment decisions, which in turn has a positive influence on renewable energy project developers' cost of capital (Baratoff et al., 2007; de Jager and Rathmann, 2008) as it lowers the risk premium (Lüthi and Wüstenhagen, 2012). The variations in the risk level that different renewable energy policy frameworks imply are an important indicator for investments – and as a consequence for future installed capacity and policy effectiveness in the longer term (Wüstenhagen and Menichetti, 2012). Thus, compared to the policy maker's point of view on the relation between renewable energy policies and investment, the investor's perspective actually seems to place a higher emphasis on risk aspects, cancelling out some or all of the intended positive effect of policies (cf. Figure 4).

Figure 4. An alternative model of how policies influence renewable energy investment. Adapted from Wüstenhagen and Menichetti (2012)



2.2.2 Venture Capital Investment in Renewable Energy

A variety of investors is involved in financing renewable energy, ranging from venture capitalists investing in early-stage technology firms to project financiers engaging in the later stages of the innovation cycle, i.e. deployment. While later stage investment typically appears in larger quantities, venture capital has been shown to be a crucial element of the commercialization process of a range of innovative technologies (Baum and Silverman, 2004; Florida and Smith, 1990), and has recently gained prominence in clean energy. Since 2004, one fifth of investments in clean energy technology development has come from venture capitalists (UNEP, 2014). Venture capital can be defined as "professional equity capital co-invested with the entrepreneur to fund an early stage (seed, start-up) or expansion venture" (EVCA, 2013). Venture capitalists have developed specific skills and processes that allow them to engage in the early stages of the innovation cycle and manage risks that other investors (e.g. banks) tend to avoid. As opposed to later stage investors, venture capitalists can typically not rely on quantifiable financial data. To compensate for this information asymmetry, venture-capital specific skills are in particular to co-invest with the entrepreneur, to pursue a staged financing approach, to syndicate deals, and to apply portfolio diversification (Wright and Lockett, 2003; Gompers, 1995).

Despite critical comments about the adequacy of the venture capital model for the capital-intensive energy industry (Kenney, 2011), "cleantech", including renewable energy and other technologies to increase resource-efficiency, has recently become the third-most important category of venture capital investing. On the one hand, venture capitalists act as innovation agents and thus accomplish a unique task in the diffusion process of renewable energies. On the other hand, their approach to assess an investment opportunity is in principle not different from what later stage investors do: like other investors, venture capitalists weigh the risks and return prospects of an investment opportunity when taking a decision to invest. Typical risks involved in venture financing decisions include technology risk (DeSarbo et al., 1987; MacMillan, 1985; MacMillan et al., 1987; Petty and Gruber, 2011; Tyebjee and Bruno, 1984; Zider, 1998), people risk (DeSarbo et al., 1987; Franke et al., 2006; Franke et al., 2008; MacMillan, 1985; MacMillan et al., 1987; Petty and Gruber, 2011; Zider, 1998), market adoption risk and regulatory risk (Wüstenhagen and Teppo, 2006). While the importance of regulatory risk varies across industries, it has been shown to be a relevant factor in clean energy venture capital investing (Bürer and Wüstenhagen, 2009), and also for later stage investors such as project developers (Lüthi and Prässler,

2011; Lüthi and Wüstenhagen, 2012) and institutional investors (Chassot and Wüstenhagen, 2013; see also Paper III of this thesis).

Research on how venture capitalists perceive regulatory risk and opportunity implied by renewable energy policies shows mixed results. Some policies, such as feed-in tariff schemes that effectively stimulate renewable energy demand, appear to be viewed positively by venture capitalists. However, some venture investors seem to have a reluctant view on regulatory exposure as they find it "harder to manage or even outside their area of influence" (Wüstenhagen and Teppo, 2006: 73).

2.2.3 The Influence of Worldviews on Risk Perception and Investment Decisions

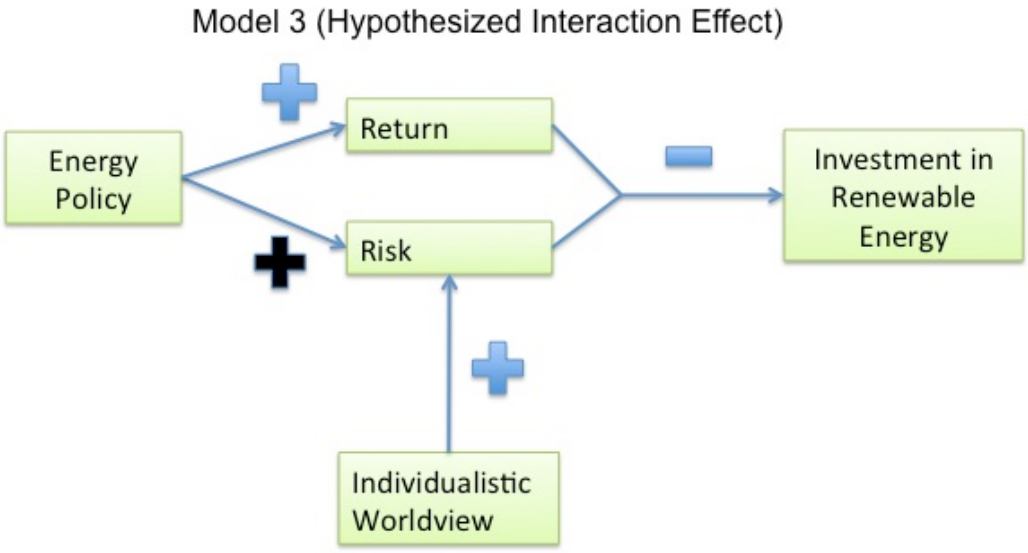
Research in different financial and non-financial contexts shows that risk perception is moderated by personal attributes such as feelings (Loewenstein et al., 2001) and worldviews. Worldviews as a theoretical concept go back to the Grid and Group Cultural Theory, which was initially developed by Douglas (1970). The origins of the theory are in anthropological studies: To provide a common framework for comparison of social groups, Douglas suggests in her book *Natural Symbols* the grid and group analysis. The group dimension measures the degree of cohesion among members of a social group, be it a family, a football team or a cultural group. The grid dimension measures the degree of regulation that governs behaviour of the group members. A plethora of different names for the two dimensions and the resulting worldviews has proliferated (for a review, see Mamadouh, 1999). Wildavksy (1987) for example labels the dimensions with two fundamental questions for human beings, the group dimension being "Who am I?" and the grid dimension "How should I behave?". Douglas (1970) suggests that both dimensions are independently from each other either low or high, leading to four different worldviews, defined as a person's "orienting dispositions" (Dake, 1991) for attitude formation "toward the world and its social organization" (Peters and Slovic, 1996: 1430). A commonly used terminology is the one suggested by Schwarz and Thompson (1990) with the four worldviews fatalist, hierarchist, egalitarian and individualist. Empirical research building on cultural theory tends to exclude fatalists, as their deterministic worldview usually prevents them from actively engaging in societal debate (for a review, see West et al., 2010). In the context of energy and climate-related social science research, the duality between egalitarian and individualistic worldviews has attracted particular attention. A study by West et al. (2010) examines the influence of worldviews on the perception of renewable energies

and renewable energy policies. In six focus group discussions with UK residents, the authors find clear evidence that discussants with an individualistic worldview have very critical views on government intervention in the energy context.

The individualistic worldview relates to a preference for a free-market society, where "the autonomy of individuals and their resulting freedom to bid and bargain with each other" dominates (Schwarz and Thompson, 1990: 6). Lewandowsky et al. (2013) find that subscribing to an individualistic worldview and endorsement of free-market economics is widespread among people who reject climate science.

Building upon these insights from literature and previous empirical research we investigate whether venture capitalists' individualistic (or "free-market") worldviews influence their perception of regulatory risk, and consequently their decision to invest in renewable energy firms (cf. Figure 5).

Figure 5. The moderating influence of worldviews on renewable energy policy effectiveness



We test the following hypothesis: the relationship between renewable energy policy and likelihood to invest is moderated by investors' worldviews, in that venture capitalists with an individualistic "free-market" worldview perceive this risk as more severe than investors that do not have strongly individualistic worldviews. Venture capitalists with individualistic worldviews are therefore more likely to avoid investment opportunities characterized by a high level of regulatory risk.

2.3 Methodological Approach

2.3.1 Choice Experiments and Adaptive Choice-Based Conjoint Analysis

In order to investigate the influence of regulatory exposure on investor decision-making, we conducted choice experiments with venture capitalists. Choice experiments (typically in form of conjoint analysis) are widely used in marketing research to assess the relative importance of different attributes for consumer decision-making (Green and Srinivasan, 1990; Orme, 2007). In recent years, choice experiments and conjoint analysis have spread from their origin in marketing to a wide range of research fields such as entrepreneurship (Lohrke et al., 2010), environmental economics (Ahn et al., 2008; Álvarez-Farizo and Hanley, 2002; Birol et al., 2008; Boxall et al., 1996; Casey et al., 2008; Chattopadhyay, 2009; Farber and Griner, 2000; Friebe et al., 2013; Glenn et al., 2010; Kaenzig et al., 2013; Ladenburg and Dubgaard, 2007; Roe et al., 1996), transportation economics (Hensher, 1994; Hensher, 2010; Train and Wilson, 2008), energy efficiency research (Banfi et al., 2008; Moxnes, 2004; Poortinga et al., 2003) and, most recently, renewable energy investment decision-making (Lüthi and Prässler, 2011; Lüthi and Wüstenhagen, 2012; Wuebker et al., 2014). Typically, respondents are asked to choose among different alternatives (e.g. products, or in our case, investment opportunities) described along a limited number of attributes. Levels of the attributes vary across the presented alternatives. Choice models assume that the decision maker maximizes utility, and that the utility of any given alternative is the sum of the part-worth utilities of the different attribute levels (Backhaus et al., 2010).

We used a specific conjoint method called Adaptive Choice-Based Conjoint (ACBC) by Sawtooth Software to design the choice experiment in a web-based format. ACBC collects preference data in an interactive mode and through three different sections, which increases the information gathered per respondent. In the first section of the interviewing process (the “build your own” or BYO section) the respondents can compose their most preferred investment opportunity by choosing out of a list of previously defined levels for each of the attributes included in the conjoint design. In the second section (the “screening section”) the software generates a series of hypothetical investment opportunities by randomly combining the predefined attribute levels. Respondents have to indicate for each of the presented investment opportunities whether they would invest or not. All selected investment opportunities then enter the third section of the interviewing process (the “choice tournament”). In this last step, the investment options compete against each other in a series of choice

tasks until the most preferred alternative is identified. In each choice task, the respondent needs to choose one out of a group of three investment options (Johnson and Orme, 2007; Orme, 2010).

2.3.2 Experimental Design

We applied a symmetric conjoint design with six attributes and four levels per attribute. For a complete list of the attributes and levels included in the conjoint design, see Table 4. In order to make the conjoint experiment as realistic as possible, we included the most important factors influencing venture capital investment decisions (Petty and Gruber, 2011; Tyebjee and Bruno, 1984).

One of the attributes was used to operationalize our focal variable, the influence of energy policy on investment decision-making. This attribute, representing a firm's degree of regulatory exposure, had four levels ranging from "very low" to "very high". To ensure that all respondents interpret the attributes and levels in a similar way, we added short mouse-over descriptions of each attribute. In this case, the attribute was described as "presence and extentof regulatory risk". A pre-test with six students and twenty professional venture capitalists confirmed the relevance of the chosen attributes and levels.

All investment options that were presented to the respondents were deals in the clean energy domain. Table 2 shows a sample choice task from the ACBC experiment (choice tournament section).

Table 2. Sample choice task from web-based survey

Out of these three investment opportunities in the Clean Energy industry, which one is the best option that you would investigate further?			
Technological Maturity	Works in laboratory	Working prototype	Finished product
Founder Experience	Previous startup founder	Previous executive experience	Graduate student
Regulatory Exposure	Low	High	Very high
Return Potential	10x in 5 years	5x in 5 years	20x in 5 years
	○	○	○

2.3.3 Worldview Measures

In order to measure how strongly the venture capitalists adhere to an individualistic worldview, we used a set of three statements (cf. Table 3). Statement 1 is taken from the European Social Survey (ESS). Statements 2 and 3 are formulated based on quotes from in-depth interviews with 23 venture capitalists by Wüstenhagen and Teppo (2006). Whereas statement 2 assesses the general view on the role of government, statement 3 specifically measures the investors' attitude toward government subsidies. Our scale is similar to the four-items scale by Cherry et al. (2010) for measurement of individualism, but we used a more VC-specific wording. Similar items have also been used by Lewandowsky et al. (2013) based on Heath and Gifford (2006). Answers were given on a 5-point Likert scale with values ranging from 1 (totally agree) to 5 (totally disagree) in order to capture the respondents' agreement/disagreement with the statements. Respondents who agree with the statements in Table 3 are perceived to have a more individualistic "free-market"-oriented worldview than respondents who disagree with the statements.

Table 3. Individualistic worldview statements, 5-point Likert scale (1=totally agree, 5=totally disagree)

No.	Statement
1	Private enterprise is the best way to solve our country's economic problems.
2	If there is no clear need for government, let them stay out of the way.
3	We would never invest in a firm that relies on government subsidies.

2.3.4 Data Collection and Sample

Invitations to participate in the survey were sent out in a mass e-mailing to venture capitalists included in the Thomson ONE Private Equity (formerly VentureXpert) database in March 2010. In total, 176 venture capitalists took part in our survey. The sample was cleaned in several steps for incomplete responses and double entries (44 respondents), respondents from outside of the United States and Europe (16 respondents), and corporate venture capitalists (30 respondents), leading to an extended sample of 86 respondents[11]. For the analysis in this paper, we report on the choices of those 29 out of the 86 respondents in our extended sample who selected regulatory risk as one of the four most important attributes in the conjoint experiment. The other 57 respondents made use of the option offered by ACBC to exclude

[11] More details on extended sample can be found in Wuebker et al. (2013).

attributes that they perceive to be of lower relevance for their investment decision[12]. While this implies that we cannot generalize from our final sample to the importance of regulatory risk in the entire population of venture capitalists, it also means that we capture information from those investors who actually take this attribute into account, and we eliminate the noise from other respondents who might just artificially react to the attribute had we included it in the experimental design for the extended sample. Focusing on the subsample also leads to valid results because our research question does not focus on the overall importance of regulatory risk, but on the moderating effects of worldviews. Finally, we carefully checked for differences in sample characteristics and answers to the worldview statements between the final sample of N = 29 and those respondents who did not select regulatory exposure as a conjoint attribute and did not find any significant results (cf. Appendix).

About 55% of the respondents in our final sample are based in Europe, 45% in the United States. The average respondent works in a venture capital firm that has about 22 employees, has been in business for 11 years, manages 3.5 funds and invests on average 7.15 million USD per deal. For detailed characteristics of the respondents in our sample please refer to the Appendix.

2.4 Results

2.4.1 Part-Worth Utilities of Regulatory Exposure

Each respondent in our sample (N = 29) had to accomplish on average 36.7 choice tasks (includes BYO, screening and choice tournament)[13], which results in a data set of 1,064 experimental investment decisions. Most of the 29 venture capitalists who chose regulatory exposure as one out of six attributes in the conjoint experiment, also chose the attributes founder experience (28 respondents), technological maturity (18 respondents) and return potential (28 respondents). The attributes deal source and lead investor were chosen by 4, respectively 9 venture capitalists only. Table 4 displays the average part-worth utilities and standard deviations per attribute level as a result from

[12] The Adaptive Choice Based Conjoint (ACBC) survey allowed respondents to select four out of six attributes for the conjoint interviewing procedure that they felt are of most importance for the decision to invest in a deal. This feature was applied in order to decrease the complexity of the choice tasks. For more details see Sawotooth Software (2009b) or http://www.sawtoothsoftware.com/help/issues/ssiweb/online_help/index.html?customized_constructed_attri.htm

[13] The exact number of choice tasks per respondent differs due to the adaptive nature of the ACBC interviewing procedure; for more information, please refer to the "Choice experiments and adaptive choice-based conjoint analysis" section of this paper.

the hierarchical Bayes estimation procedure (Johnson, 2000; Sawtooth Software, 2009a). Using the hierarchical Bayes estimation procedure ensures robust coefficient estimates even in case of scarce information such as in the case of the attributes deal source and lead investor.

The average part-worth utilities indicate the effect of a particular attribute level on the overall utility of the average respondent, i.e. the impact on the hypothetical investment decision. This effect can be positive or negative. One needs to bear in mind that part-worth utilities are usually interval data and scaled to an arbitrary constant, thus it is not possible to directly compare utility values of attribute levels across attributes. The utilities in the table are effects-coded zero-centered differentials and sum up to zero within attributes (Orme, 2010).

The results of the conjoint analysis in Table 4 indicate a linear relationship between the attribute levels and part-worth utilities for all attributes, i.e. with increasing risk (e.g. technological risk measured by technological maturity) or return potential the part-worth utilities decrease or increase, respectively. In general, this also holds true for the attribute regulatory exposure, so that the likelihood to invest in renewable energy deals decreases with an increase in regulatory exposure. However, this effect is stronger for high levels of regulatory exposure, whereas the average respondent appears to be almost indifferent between low and very low levels of regulatory exposure.

Table 4. Average part-worth utilities and standard deviations per attribute level

Attributes and Levels	Average Part-Worth Utility	Standard Deviation
Regulatory Exposure		
Low	65.54	36.11
Very Low	64.22	47.33
High	-35.26	40.97
Very high	-94.49	46.62
Return Potential		
20x in 5 years	53.87	34.83
15x in 5 years	25.09	14.33
10x in 5 years	-10.08	19.44
5x in 5 years	-68.88	34.19
Technological Maturity		
In production with customers	54.15	64.11
Finished product	12.45	28.12
Working prototype	-19.76	33.89
Works in laboratory	-46.84	49.14
Founder Experience		
Previous startup founder	50.73	46.35
Previous startup experience	35.35	29.12
Previous executive experience	11.28	40.51
Graduate student	-97.36	43.88

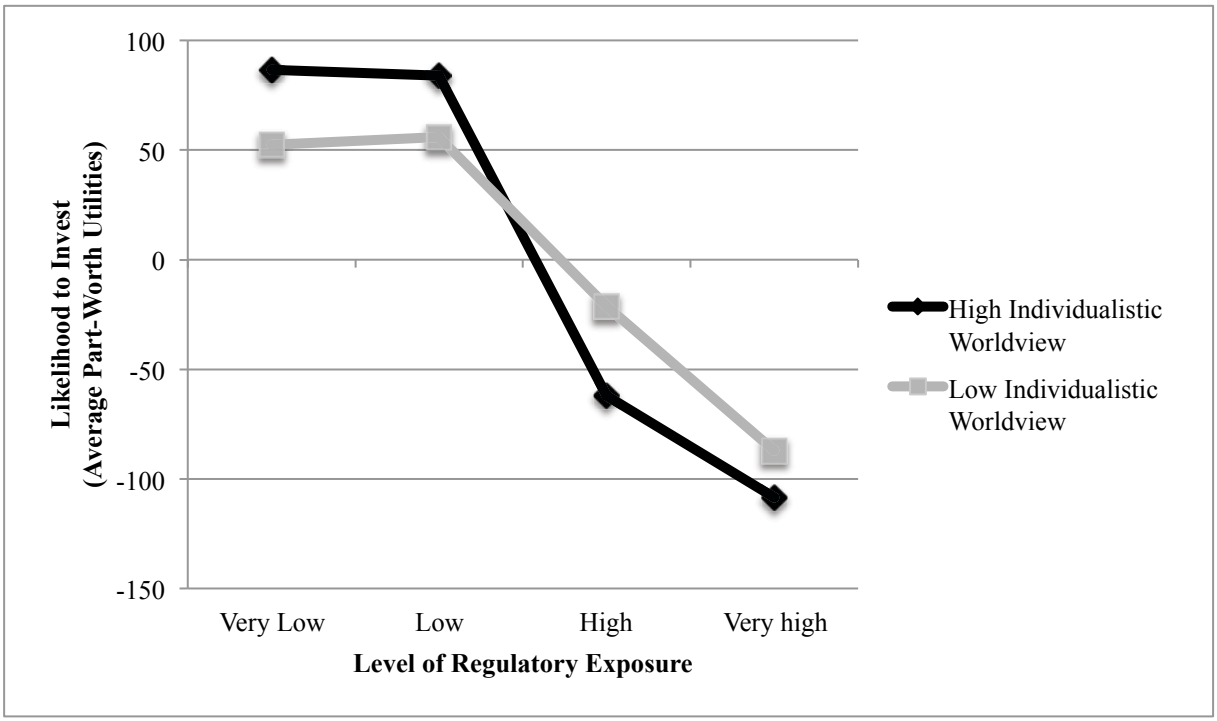
Lead Investor		
Draper Fisher Jurvetson	4.03	15.04
Kleiner Perkins	3.19	14.87
Insight Capital Partners	-2.66	9.25
Khosla Ventures	-4.56	12.81
Deal Source		
Syndicate partner	3.32	10.15
Personal network	2.82	8.59
Met at venture fair	-2.59	6.90
E-Mail business plan	-3.56	9.33

2.4.2 The Moderating Effect of Worldviews

In order to test whether the investors' individualistic worldviews moderate the relationship of regulatory risk and the willingness to invest in renewable energy firms we first calculated the average rating of the three worldview statements in Table 3 per respondent. In a next step we built two distinct groups of respondents, where the first group ("High Individualistic Worldview") on average strongly agreed with all of the three statements (average ratings up to 2.0 from a 5-point Likert scale ranging from 1 = totally agree to 5 = totally disagree) and respondents in the second group were indifferent or disagreed with the statements on average indicating a low individualistic worldview.

Figure 6 below shows the average part-worth utilities per level of regulatory exposure for each of the groups. The difference in part-worth utilities per attribute level shows that the group with a high individualistic worldview is significantly more sensitive to regulatory exposure than respondents with a low individualistic worldview. The detailed results further reveal that the group with a low individualistic worldview differentiates less between low levels of regulatory exposure (reversal in the part-worth utilities), which also indicates their willingness to accept some level of regulatory risk. Thus, our results provide evidence that worldviews influence venture capitalists' risk perception related to the exposure of a renewable energy firm to energy policy and support our hypothesis: investors with a less individualistic and thus more positive general attitude toward government intervention in markets perceive higher levels of regulatory exposure as less risky and are more likely to invest in such renewable energy deals than investors with an individualistic "free-market" attitude.

Figure 6. Average part-worth utilities per level of regulatory exposure and worldview groups



Note: Level of significance indicated for each of the attribute levels relates to the difference in average part-worth utilities between the two groups (t-test, two-sided).

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$.

2.5 Limitations and Further Research

Our study is an innovative contribution to the emerging research stream on energy policy and renewable energy investment, as it is based on a unique dataset with real investors in a sophisticated experimental setting. Our novel approach combines regulatory risk perception, worldviews and investment decision, and provides new and important insights on the impact of energy policies. However, as any early exploration into an emerging field, our research is characterized by a number of limitations that can provide promising starting points for further research.

First, our results are based on 1,064 experimental investment decisions conducted by a final sample of 29 venture capitalists out of a larger group of 86 venture capitalists participating in our over-all survey. The reduction in sample size was necessary because this paper has focused on one particular factor in the decision-making process, regulatory exposure, which several of the surveyed venture capitalists deemed not to be among the top four factors they consider when making an investment. We carefully checked for differences between the final sample and the extended sample, and we are therefore confident about the direction of the observed

effects, but there are limits to how far we can generalize our findings to the entire venture capital population. Future research using larger samples would be helpful in confirming our findings.

Second, venture capitalists are only a specific subset of the energy investment community (Wüstenhagen and Menichetti, 2012; Bergek et al, 2013). While they have been shown to be important agents in the financing of innovation, the magnitude of capital flows in other parts of the industry is more significant. Future research should therefore shed light on other investor types, notably corporate investors, pension funds, banks and insurance companies, in order to investigate to what extent venture capitalists' worldviews and perceptions of regulatory risk are indicative of later stage investors in renewable energy.

Third, we investigated venture capitalists' worldviews by surveying their preference for private enterprise over government intervention, using a simplified scale and focusing on individualistic ("free-market") worldviews. Further research could focus on other worldviews and apply established scales to confirm the effects we observed. For example, the scale developed by Dake and Thompson (Dake, 1991; Dake and Thompson, 1993) for orienting dispositions, which is closely linked to the Grid and Group Cultural Theory. We would caution, however, that applying more comprehensive psychological scales with time-constrained professional investors may pose significant challenges in terms of data collection, resulting in either small samples and/or concerns about self-selection bias. Further research that would develop robust but shorter scales would be particularly valuable.

Fourth, while the use of conjoint analysis enjoys increasing popularity in a wide range of research fields, its application in the context of investment decision-making is still a relatively recent phenomenon. Further research could further validate our findings by comparing stated and revealed preferences, possibly following a case study approach focusing on investor reactions to materializations of policy risk, such as feed-in tariff changes in Spain or the Czech Republic. A particular consideration is that we can only measure the importance of attributes included in our con-joint design. While we used an extensive literature review and qualitative expert interviews to carve out attributes that matter in venture capital decision-making, unobserved factors could influence the results of our analysis and should be investigated in further research. These include, for example, effects of peer pressure or herding behaviour among investors. Also, in an attempt to present respondents a realistic choice task resembling a real investment decision, we devoted only one of the attributes to regulatory risk.

This is a simplification in the light of the many shades of regulatory risk, especially when it comes to later stage investment outside of the venture capital area. Further research could include more nuanced measures of regulatory risk, but the trade-off between zooming in on this particular aspect of investment decision-making and still keeping the choice situation as realistic as possible needs to be carefully considered.

Fifth, we investigated the influence of worldviews on perceptions of regulatory risk in the context of investment in clean energy sources such as solar and wind power. As has been shown by Peters and Slovic (1996), who found that people with an individualistic worldview are more likely than egalitarians to accept nuclear power, worldviews can also correlate with the perception of technology risk. It would be interesting to combine these aspects in further research on energy investment decision-making, in an attempt to disentangle worldview-induced preferences for certain renewable or non-renewable energy technologies and preferences for certain energy policies. For example, it is interesting to note that the UK government has recently framed what effectively looks like a feed-in tariff for nuclear power as a "contract for differences", framing the policy in a way that appeals to an audience holding an individualistic worldview. Conversely, some of the policy risk aversion expressed by investors scoring high on "free-market" worldviews might spill over to technologies benefiting from feed-in tariffs, such as solar photovoltaics. Finally, our analysis provides broad support for the idea that "behavioural" factors play a role in investor decision-making, but we would encourage further research to elucidate exactly how and where this plays out in the decision process. This would ultimately contribute to the recent debate in the decision sciences about dual process theories (Gawronski et al., 2013) or "thinking fast and slow" (Kahneman, 2011), painting a nuanced picture of how analytical and intuitive components are combined by real-world decision makers.

2.6 Conclusions

Achieving policy targets for the transition to renewable energy will require substantial private investment. In the analysis presented in this paper, we confirm previous research that suggests policy makers should pay particular attention to (perceived) regulatory risk, rather than just think about providing attractive returns to investors. We empirically demonstrate that venture capital investors exhibit policy risk aversion, in that they tend to avoid renewable energy investment opportunities if regulatory exposure is perceived to be high. We also show that investors are comfort-

able with taking some policy risk, in that there is little difference between their preference between low and very low levels of regulatory exposure. Finally, we highlight that not all investors are equal, and that worldviews play an important moderating role beyond purely "rational" considerations of risk and return. The aversion to policy risk is more pronounced among investors who hold strong individualistic worldviews and thus prefer "free markets" over government intervention. Our findings have important implications for energy policy. When choosing between various policy instruments to achieve renewable energy targets, policy makers should aim at lowering perceived risk for investors. Furthermore, our findings about the influence of behavioural factors such as worldviews suggest that reducing "objective" levels of risk may be a necessary but not sufficient condition for investor acceptance of policies. Perhaps equally important is that these policies are framed in a way that is consistent with the basic worldviews of key target segments in the investment community. For example, policy-averse venture capital investors might be more likely to accept renewable energy policies that are framed as "mobilizing private capital" rather than as "government intervention", and they may prefer "incentives" over "subsidies.

Acknowledgements

The authors acknowledge funding from the Swiss National Science Foundation, project no. 100014 125044. We acknowledge Robert Wuebker's contributions to the empirical design of the choice experiments. We appreciate comments received by reviewers and participants of the Rent XXV – Research in Entrepreneurship and Small Business Conference 2011, the IAREP/SABE/ICABEEP 2011 Conference, the Academy of Management Conference 2013 and the Swiss Society of Economics and Statistics Annual Conference 2013. Our thanks also go to the editor and two anonymous reviewers of Energy Research and Social Science. All remaining errors are our own.

References

Ahn, J, Jeong, G, Kim, Y. 2008. A forecast of household ownership and use of alternativefuel vehicles: a multiple discrete-continuous choice approach. *Energy Economics*, **30**(5), 2091–2104.

Álvarez-Farizo, B, Hanley, N. 2002. Using conjoint analysis to quantify public preferences over the environmental impacts of wind farms. An example from Spain. *Energy Policy,* **30**(2), 107-116.

Backhaus, K, Erichson, B, Plinke, W, Weiber, R. 2010. *Multivariate Analysemethoden: Eine anwendungsorientierte Einführung* (Vol. 13). Berlin: Springer-Verlag.

Banfi, S, Farsi, M, Filippini, M, Jakob, M. 2008. Willingness to pay for energy-savingmeasures in residential buildings. *Energy Economics*, **30**(2), 503–516.

Barradale, MJ. 2010. Impact of public policy uncertainty on renewable energy investment: Wind power and the production tax credit. *Energy Policy,* **38**(12), 7698-7709.

Baratoff, MC, Black, I, Burgess, B, Felt, JE, Garratt, M, Guenther, C. 2007. Renewable power, policy, and the cost of capital: Improving capital market efficiency to support renewable power generation projects *Prepared for UNEP/BASE Sustainable Energy Finance Initiative*. Ann Arbor, MI: University of Michigan, Erb Institue for Global Sustainable Enterprise

Baum, JAC, Silverman, BS. 2004. Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups. *Journal of Business Venturing,* **19**(3), 411-436.

Bergek, A, Mignon, I, Sundberg, G. Who invests in renewable electricity production? Empirical evidence and suggestions for further research. *Energy Policy*, **56**, 568–581.

Birol, E, Koundouri, P, Kountoyris, Y. 2008. Applications of the Choice Experiment Method in Europe: A Review. In E. Birol, Koundouri, P. (Eds.), *Choice Experiments Informing Environmental Policy: A European Perspective*. Cheltenham UK and Lyme US: Edward Elgar Publishing.

Boxall, PC, Adamowicz, WL, Swait, J, Williams, M, Louviere, J. 1996. A comparison of stated preference methods for environmental valuation. *Ecological Economics*, **18**(3), 243–253.

Bürer, MJ, Wüstenhagen, R. 2009. Which renewable energy policy is a venture capitalist's best friend? Empirical evidence from a survey of international clean energy investors. *Energy Policy,* **37**(12), 4997-5006.

Casey, JF, Kahn, JR, Rivas, AAF. 2008. Willingness to accept compensation for the envi-ronmental risks of oil transport on the Amazon: a choice modeling experiment. *Ecological Economics*, **67**(4), 552–529.

Chassot, S, Wüstenhagen, R. 2013. Implicit cognition and renewable energy investments: An empirical analysis of differences between financial and strategic investors. Final report. Berne: Swiss Federal Office of Energy; 2013 [contract no. 8100087].

Chattopadhyay, S. 2009. The random expenditure function approach to welfare in RUM: the case of hazardous waste clean-up. Resource and Energy Economics, **31**(1), 58–74.

Cherry, TL, García, JH, Kallbekken, S, Torvanger, A. 2014. The development and deployment of low-carbon energy technologies: The role of economic interests and cultural worldviews on public support. *Energy Policy,* **68**, 562-566.

Dake, K. 1991. Orienting Dispositions in the Perception of Risk: An Analysis of Contemporary Worldviews and Cultural Biases. *Journal of Cross-Cultural Psychology,* **22**(61), 61-82.

Dake, K, Thompson, M. 1993. The meanings of sustainable development: household strategies for managing needs and resources. In S. D. Wright, T. Dietz, R. Borden, G. Young, Guagnanp, G. (Eds.), *Human Ecology: Crossing Boundaries. The Society for Human Ecology*. Colorado: Fort Collings.

de Jager, D, Rathmann, M. 2008. Policy Instrument Design to Reduce Financing Costs in Renewable Energy Technology Projects *By Order of IEA RETD Implement Agreement*. Utrecht: Ecofys.

DeSarbo, W, MacMillan, IC, Day, DL. 1987. Criteria for corporate venturing: Importance assigned by managers. *Journal of Business Venturing,* **2**(4), 329-350.

Dinica, V. 2006. Support systems for the diffusion of renewable energy technologies—an investor perspective. *Energy Policy,* **34**, 461-480.

Douglas, M. 1970. *Natural Symbols, Explorations in Cosmology*. New York: Vintage Books.

Ellis, RJ. 1991. Explaining the Occurrence of Charismatic Leadership in Organizations. *Journal of Theoretical Politics,* **3**(3), 305-319.

EVCA. Research and Data - Glossary Retrieved 7 January 2013, from http://www.evca.eu/knowledgecenter/glossary.aspx?id=982

Farber, S, Griner, B. 2000. Valuing watershed quality improvements using conjointanalysis. *Ecological Economics*, **34**(1), 63–76.

Florida, R, Smith, DF. 1990. Venture Capital, Innovation, and Economic Development. *Economic Development Quarterly,* **4**(4), 345-360.

Franke, N, Gruber, M, Harhoff, D, Henkel, J. 2006. What you are is what you like - similarity biases in venture capitalists' evaluations of start-up teams. [Article]. *Journal of Business Venturing,* **21**, 802-826.

Franke, N, Gruber, M, Harhoff, D, Henkel, J. 2008. Venture Capitalists' Evaluations of Start-Up Teams: Trade-Offs, Knock-Out Criteria, and the Impact of VC Experience. *Entrepreneurship Theory and Practice,* **32**(3), 459-483.

Friebe, CA, von Flotow, P, Täube, FA. 2013. Exploring the link between products and service in low-income markets - evidence from solar home systems. *Energy Policy,* **52**, 760-769.

Gawronski, B, Creighton, LA. 2013. *Dual Process Theories*. In: Carlston, DE (Ed.) The *Oxford Handbook of Social Cognition*. New York NY: Oxford University Press

Glenn, H, Wattage, P, Mardle, S, Rensburg, TV, Grehan, A, Foley N. 2010. Marine protectedareas—substantiating their worth. *Marine Policy,* **34**(3), 421–430.

Gompers, P. 1995. Optimal investment, monitoring, and the staging of venture capital. *The Journal of Finance,* **50**(5), 1461-1489.

Green, PE, Srinivasan, V. 1990. Conjoint analysis in marketing: new developments with implications for research and practice. *Journal of Marketing*, 3-19.

Hamilton, K. 2009. *Unlocking Finance for Clean Energy: The Need for 'Investment Grade' Policy*: Chatham House.

Heath, Y, Gifford, R. 2006. Free-market ideology and environmental degradation: thecase of belief in global climate change. *Environment and Behavior*, **38**(1), 48–71.

Hensher, DA. 1994. Stated preferences analysis of travel choices – the state of practice. *Transportation*, **21**(2), 107–133.

Hensher, DA. 2010. Hypothetical bias, choice experiments and willingness to pay. *Transportation Research Part B: Methodological,* **44**(6), 735–752.

Holburn, GLF. 2012. Assessing and managing regulatory risk in renewable energy: Contrasts between Canada and the United States. *Energy Policy,* **45**, 654-665.

IEA. 2012. *World Energy Outlook 2012*. Paris.

Johnson, RM. 2000 Understainding HB: an intuitive approach. *Sawtooth Software Research Paper Series*.

Johnson, RM, Orme, BK. 2007 A New Approach to Adaptive CBC *Sawtooth Software Research Paper Series*.

Johnston, A, Kavali, A, Neuhoff, K. 2008. Take-or-pay contracts for renewables deployment. *Energy Policy,* **36**, 2481-2503.

Kaenzig, J, Heinzle, S, Wüstenhagen, R. 2013. Whatever the customer wants, the customer gets? Exploring the gap between consumer preferences and default electricity products in Germany. *Energy Policy,* **53**, 311-322.

Kahneman, D. 2011. *Thinking, fast and slow*. London: Allen Lane.

Kenney, M. 2011. Venture capital investment in the greentech industries: A provocative essay. In R. Wüstenhagen, Wuebker R. (Eds.), *Handbook of Research on Energy Entrepreneurship*. Cheltenham UK and Lyme US: Edward Elgar Publishing.

Ladenburg, J, Dubgaard, A. 2007. Willingness to pay for reduced visual disamenities from offshore wind farms in Denmark. *Energy Policy,* **35**(8), 4059-4071.

Langniss, O. 1999. *Financing Renewable Energy Systems*. Kiel, London.

Lewandowsky, S, Oberauer, K, Gignac, GE. 2013. NASA faked the moon landing – therefore (climate) science is a hoax: an anatomy of the motivated rejection of science. *Psychological Science,* **24**(5), 622-633.

Lohrke, FT, Holloway, BB, Woolley, TW. 2010. Conjoint analysis in entrepreneurshipresearch: a review and research agenda. *Organizational Research Methods* **13**(1), 16–30.

Loewenstein, GF, Weber, EU, Hsee, CK, Welch, N. 2001. Risk as feelings. *Psychological Bulletin,* **127**(2), 267-286.

Lüthi, S. 2010. Effective deployment of photovoltaics in the Mediterranean countries: balancing policy risk and return. *Solar Energy,* **84**, 1059-1071.

Lüthi, S, Prässler, T. 2011. Analyzing policy support instruments and regulatory risk factors for wind energy deployment —A developer's perspective. *Energy Policy,* **39**, 4876-4892.

Lüthi, S, Wüstenhagen, R. 2012. The price of policy risk - empirical insights from choice experiments with European photovoltaic project developers. *Energy Economics,* **34**(4), 1001-1011.

MacMillan, IC. 1985. Criteria used by venture capitalists to evaluate new venture proposals. *Journal of Business Venturing,* **1**, 119-128.

MacMillan, IC, Zemann, L, Subba Narasimha, PN. 1987. Criteria distinguishing successful from unsuccessful ventures in the venture screening process. *Journal of Business Venturing,* **2**, 123-137.

Mamadouh, V. 1999. Grid-group cultural theory: an introduction. *GeoJournal,* **47**, 395-409.

Mitchell, C, Bauknecht, D, Connor, P. 2006. Effectiveness through risk reduction: a comparison of the renewable obligation in England and Wales and the feed-in system in Germany. *Energy Policy,* **34**(3), 297-305.

Moxnes, E. 2004. Estimating customer utility of energy efficiency standards for refrigerators. *Journal of Economic Psychology*, **25**(6), 707–724.

Orme, BK. 2007. *Which conjoint method should I use? Research paper series* Sequim, WA: Sawtooth Software Inc.

Orme, BK. 2010. *Getting started with conjoint analysis: strategies for product design and pricing research*. Madison, WI: Research Publishers.

Peters, E, Slovic, P. 1996. The role of affect and worldviews as orienting dispositions in the perception and acceptance of nuclear power. *Journal of Applied Social Psychology,* **26**(16), 1427-1453.

Petty, JS, Gruber, M. 2011. "In pursuit of the real deal": A longitudinal study of VC decision making. *Journal of Business Venturing,* **26**(2), 172-188.

Poortinga, W, Steg, L, Vlek, C, Wiersma, G. 2003. Household preferences for energy-saving measures: a conjoint analysis. *Journal of Economic Psychology*, **24**(1),49–64.

Rippl, S. 2002. Cultural theory and risk perception: a proposal for a better measurement. *Journal of Risk Research,* **5**(2), 147-165.

Roe, B, Boyle, KJ, Teisl, MF. 1996. Using conjoint analysis to derive estimates of com-pensating variation. *Journal of Environmental Economics and Management*, **31**(2), 145–159.

Sawtooth Software. 2009a. *The CBC/HB system for hierarchical Bayes: version 5.0 technical paper*.

Sawtooth Software. 2009b. *The Adaptive Choice-Based Conjoint (ACBC) Technical Paper*

Schwarz, M, Thompson, M. 1990. *Divided We Stand: Redefining Politics, Technology and Social Choice*. Hemel Hempstead: Harvester Wheatsheaf.

Simon, HA. 1955. A behavioral model of rational choice. *Quarterly Journal of Economics,* **69**(1), 99-118.

Sunstein, CR, Reisch, L. 2014. Automatically green: Behavioral economics and environmental protection. *Harvard Environmental Law Review*, **38**(1), 127-158.

Train, K, Wilson, WW. 2008. Estimation on stated-preference experiments constructed from revealed-preference choices. *Transportation Research Part B: Methodoligical*, **42**(3), 191–203.

Tyebjee, TT, Bruno, AV. 1984. A Model of Venture Capitalist Investment Activity. *Management Science,* **30**(9), 1051-1066.

Unruh, GC. 2000. Understanding carbon lock-in. *Energy Policy,* **28**, 817-830.

UNEP. 2014. Global trends in renewable energy investment 2014. Frankfurt am Main: Frankfurt School UNEP (United Nations Environment Programme) Collaborating Centre for Climate Sustainable Energy Finance.

West, J, Bailey, I, Winter, M. 2010. Renewable energy policy and public perceptions of renewable energy: A cultural theory approach. *Energy Policy,* **38**, 5739-5748.

Wildavsky, A. 1987. Choosing Preferences by Constructing Institutions: A Cultural Theory of Preference Formation. *The American Political Science Review,* **81**(1), 3-22.

Wilson, C, Dolatabadi, H. 2007. Models of Decision Making and Residential Energy Use. *Annual Review of Environment and Resources,* **32**, 169-203.

Wright, M, Lockett, A. 2003. The structure and management of alliances: syndication in the venture capital industry. *Journal of Management Studies,* **40**(8), 2073-2102

Wuebker, R, Hampl, N, Wüstenhagen, R. 2013. The Strenght of Strong Ties In An Emerging Industry: Experimental Evidence of the Effects of Status Hierarchies and Personal Ties in Venture Capitalist Decision-Making (Working Paper). *University of St. Gallen*.

Wüstenhagen, R, Teppo, T. 2006. Do venture capitalists really invest in good industries? Risk-return perceptions and path dependence in the emerging European energy VC market. *International Journal of Technology Management,* **34**(1/2), 63-87.

Wüstenhagen, R, Menichetti, E. 2012. Strategic choices for renewable energy investment: conceptual framework and opportunities for further research. *Energy Policy,* **40**, 1-10.

Zider, B. 1998. How venture capital works. *Harvard Business Review,* **76**(6), 131-140.

Appendix

Table (Appendix) 1. Descriptive statistics

	Final sample (N=29)			For Comparison (cf. section 2.3.4)				Extended Sample (N = 86)
				Respondents who did *not* select attribute "regulatory risk" (N=57)			Test of difference (p-value of t-test or Chi^2-test)	
Sample Characteristics	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**		**Mean/%**
Firm and Fund Information								
Firm location							0.321	
Europe	16	(55%)		25	(44%)			48%
United States	13	(45%)		32	(56%)			52%
Firm size (number of employees)	29	21.86	32.63	57	16.05	19.70	0.307	18.01
Firm age (years)	29	11.03	7.83	57	13.63	8.47	0.172	12.76
Number of funds [a]	28	3.50	3.44	57	2.60	1.82	0.201	2.89
Deal size (in millions $)	29	7.15	12.80	57	7.88	12.90	0.806	7.63
Investor Information								
Investor age (years)	29	42.48	12.56	57	43.82	10.56	0.603	43.37
VC industry affiliation (years)	29	8.76	7.52	57	9.12	7.58	0.833	9.00
VC investment experience (years)	29	7.00	6.93	57	7.65	7.06	0.686	7.43
Number of boards	29	7.28	7.29	57	8.16	10.56	0.688	7.86
Position in firm							0.127	
Managing director	12	(41%)		16	(28%)			33%
General partner	5	(17%)		7	(12%)			14%
Partner	2	(7%)		15	(26%)			20%
Analyst	8	(28%)		10	(18%)			21%
Other	2	(7%)		9	(16%)			13%
Industry domain experience (years) [b]								
Clean Energy	17	6.12	7.47	28	4.46	4.65	0.364	5.09
Biotechnology	13	6.77	6.57	25	7.88	7.82	0.664	7.50
ICT	14	7.21	7.51	36	9.33	7.83	0.389	8.74
Consumer Related	15	8.73	7.26	29	6.62	6.54	0.333	7.34
Conventional Energy	8	10.63	8.12	11	6.91	6.01	0.266	8.47
Medical/Health	18	5.61	5.77	33	7.45	7.72	0.380	6.80

3 Paper II

Nachhaltig? Eine ländervergleichende Diskussion der gesellschaftspolitischen Tragfähigkeit des Atomausstiegs in Deutschland und der Schweiz hinsichtlich Opportunitäten zur unternehmerischen Einflussnahme[14]

Sylviane Chassot*

Zusammenfassung

Der Atomausstieg bedingt eine Anpassung der regulatorischen Rahmenbedingungen und stellt Energieversorgungsunternehmen (EVUs) vor Herausforderungen. EVUs haben jedoch die Möglichkeit, ihre Bedürfnisse mittels unternehmerischer Einflussnahme in den Gesetzgebungsprozess einzubringen. Ein Ansatz besteht darin, im Namen der Kunden bzw. Wähler zu argumentieren, indem man deren Bedürfnisse aufzeigt. Mittels Meinungsumfragen zeigt diese Studie, wie Stromkunden in Deutschland und der Schweiz den Atomausstieg wahrnehmen. Frühere Studien zum Effekt von Reaktorunfällen haben gezeigt, dass sich langfristig die widerwillige Akzeptanz der Atomenergie wegen Mangels an Alternativen erholte. In dieser Studie tritt dieser Effekt nach „Fukushima“ nicht auf, da das wahrgenommene Potential der erneuerbaren Energien gestiegen ist.

Sustainable? A cross-country analysis of the socio-political acceptance of the nuclear phase out in Germany and Switzerland focusing on opportunities for strategic influence

Abstract

The nuclear phase out implies changes in the regulatory framework and poses new challenges for electric utility companies (EUCs). However, through lobbying EUCs have the possibility to support their interests as part of the policy making process. One

[14] Paper II is published as an article in *Betriebswirtschaftliche Forschung und Praxis* 14(3): 247-265

* Institute for Economy and the Environment, University of St. Gallen, Switzerland.

approach is to lobby in the name of customers or voters by showing their needs to policy makers. With opinion polls in Germany and Switzerland this study shows how electricity customers perceive the nuclear phase out. Earlier studies on the impact of nuclear hazards have argued that in the long term, due to the lack of alternatives, reluctant acceptance of nuclear power recovers. In this study, this effect does not prevail after "Fukushima" because the perceived potential of renewable energy has increased.

Keywords: Nuclear Hazard; Nuclear Phase Out; Renewable Energy; Photovoltaics; Opinion Poll; Social Acceptance; Strategic Influence; Electricity Marketing

JEL codes: C93; D72; M48; Q21; Q38;

3.1 Motivation

Sowohl in Deutschland als auch in der Schweiz wurde im Jahr 2011 der Ausstieg aus der Atomenergie bis 2022 respektive 2035 auf höchster politischer Ebene beschlossen. Für Energieversorgungsunternehmen (EVUs) bedeutet dies, dass ein substantieller Anteil der bisherigen Stromproduktion wegfällt. Dies stellt die EVUs vor die Herausforderung, ihr Geschäftsmodell anzupassen und Alternativen zur Atomenergie aufzubauen. Im Gesetzgebungsprozess, der im Zuge des Atomausstiegs stattfindet, werden EVUs von Politikern konsultiert und nehmen in Gesprächen und Positionspapieren Stellung zu den geplanten energiepolitischen Massnahmen. Im stark regulierten Energiemarkt haben Unternehmen damit relativ viele Mitgestaltungsmöglichkeiten. Eine Strategie zur Einflussnahme ist die informationsorientierte Strategie, in der aufgezeigt wird, wie politische Massnahmen in der Bevölkerung wahrgenommen werden. Diese Studie untersucht, wie deutsche und Schweizer Stromkunden die Entscheidung zum Atomausstieg wahrnehmen.

Die für EVUs entscheidende Frage ist: Welche Technologie hat Zukunft? Obwohl die Entscheidung gegen die Atomenergie auf höchster politischer Ebene gefallen ist, stellt sich die Frage, ob diese Entscheidung eine langfristig verlässliche Grundlage für Investitionen bietet. Der Blick in die Vergangenheit zeigt, dass der politische Entscheid zum Atomausstieg unter sozioökonomischem Druck ins Wanken geraten kann. So hat beispielsweise die deutsche Regierung im Oktober 2010 entgegen früherer Ausstiegspläne überraschend Laufzeitverlängerungen für Atomkraftwerke

gutgeheissen, und auch diese Entscheidung mit Bekanntgabe des neuen Ausstiegsplans Ende Mai 2011 wieder revidiert. Wissenschaftliche Untersuchungen zur Skepsis gengenüber der Atomenergie zeigten nach früheren Reaktorunfällen eine abflachende Wirkung. Rund ein Jahr nach „Tschernobyl" hatte sich die Empörung über das Risiko der Atomenergie in vielen europäischen Ländern wieder gelegt[15]. In der Schweiz wurde der Atomausstieg 1990 an der Urne zugunsten eines Atommoratoriums bis ins Jahr 2000 verworfen, woraus ein Schweizer Stromproduktionsmix resultierte, welcher sich seit 1990 nur marginal verändert hat[16]. Die aktuelle Schweizer Ausstiegsdiskussion weist mit jener nach „Tschernobyl" einige Gemeinsamkeiten auf. Analog zum aktuellen Ausstiegsszenario des Bundesrats sahen bereits 1990 die im Rahmen der Volksinitiative „für den Ausstieg aus der Atomenergie" zugrunde liegenden *Energieszenarien 2025* den Ersatz der Atomenergie durch konventionelle Kraftwerke sowie einen langfristig bedeutenden Zubau an „alternativen Energien", insbesondere der Photovoltaik (PV), vor. Gemäss den damaligen Prognos-Szenarien hätte Photovoltaik bis ins Jahr 2025 rund einen Drittel der installierten Leistung an Kernenergie ersetzen sollen[17]. Das analoge Szenario schlägt der Schweizer Bundesrat heute für den Prognosezeitraum bis 2050 vor[18]. Zweifel an der Versorgungssicherheit sowie Bedenken aufgrund erhöhter CO_2-Emmissionen durch die verstärkte Nutzung von Kohle, Öl und Gas waren schon zu Beginn der 90er Jahre Hauptargumente gegen den Ausstieg[19]. Deshalb lehnten damals 53% der Stimmberechtigten die Schweizer Ausstiegs-Initiative ab.

Die heutige Situation unterscheidet sich im Vergleich zu jener vor 25 Jahren in zwei wesentlichen Punkten: Zum einen ist der Bau neuer Atomkraftwerke (AKWs) heute nicht nur politisch, sondern auch wirtschaftlich nicht mehr opportun. Während die Gestehungskosten bei erneuerbaren Energien in den letzten Jahren laufend gesunken sind[20] und aufgrund von Skalen- und Lernkurveneffekten noch weiter sinken werden[21], sind sie bei AKWs über die Jahrzehnte laufend gestiegen[22]. Das in Grossbritannien geplante AKW „Hinkley Point C" soll daher eine Einspeisevergütung

[15] Vgl. Renn (1990), S. 156.
[16] Vgl. BfE (2013), Tabelle 24.
[17] Vgl. Masuhr (1988) für eine Diskussion der Energieszenarien 2025 sowie Fornallaz (1988) für eine Potential-Analyse für Photovoltaik.
[18] Vgl. BfE (2011) für Szenarien und Schweizer Bundesrat (2013) für aktuelle Kommentare zur Energiestrategie 2050.
[19] Vgl. Browa (1987), S. VI.
[20] Vgl. Wirth (2013), S.7; Kost et al. (2013), S. 8
[21] Vgl. Kost et al. (2013).
[22] Vgl. Grubler (2010).

von umgerechnet 11 Eurocents über 35 Jahre erhalten [23]. Dies ist deutlich mehr, als PV oder Wind an Land ab 2015 gemäss der von Vizekanzler Gabriel vorgeschlagenen EEG-Novelle 2014 in Deutschland noch erhalten sollen. Zum anderen nehmen die Stromkunden den Atomausstieg heute als Umstieg auf erneuerbare Energien wahr. Ein bedeutender Unterschied zu 1990 ist nämlich die Sichtbarkeit umweltschonender Alternativen zur Atomenergie. Insbesondere in Deutschland haben neue erneuerbare Energien wie Photovoltaik, Windenergie, Biomasse und Kleinwasserkraft bereits einen systemrelevanten Anteil an der Stromproduktion erreicht[24]. Am konkreten Beispiel zahlreicher erneuerbarer Energie-Projekte ist sichtbar geworden, was eine Energieversorgung basierend auf erneuerbaren Energien bedeutet. Die vorliegende Studie zeigt, dass für den langfristigen politischen Rückhalt des Atomausstiegs entscheidend ist, dass die Bevölkerung Vertrauen hat in Alternativen zum Atomstrom. Die dezentralen erneuerbaren Energietechnologien sind grösstenteils in Bürgerhand. Sie geben Stromkonsumenten die Möglichkeit, einen Beitrag zu einer umweltfreundlichen Energieversorgung zu leisten. Eine Möglichkeit, die viele bereits mit Begeisterung ergriffen haben. Und so gehen auch die Energieszenarien beider Länder davon aus, dass gerade die dezentrale Photovoltaik beim Atomausstieg eine bedeutende Rolle spielen wird.

Für EVUs jedoch bedeutet der wachsende Marktanteil erneuerbarer Energien in erster Linie eine Herausforderung. Je nach Wetterlage verdrängen erneuerbare Energien aufgrund des Merit Order Effekts konventionelle Technologien mit höheren Grenzkosten aus dem Strommarkt. Der Verkauf von Strom aus Gas und teilweise auch aus Kohle und Wasserkraft rentiert für EVUs nicht mehr[25]. Zudem stellen dezentral und stochastisch ins Netz einspeisende erneuerbare Energien neue Anforderungen an das Stromnetz. Einerseits kannibalisieren erneuerbare Energien also das Geschäft konventioneller EVUs, andererseits nehmen von Richter (2013) interviewte deutsche Unternehmen erneuerbare Energien aber auch als Investitionsopportunität wahr, um die Umweltbelastung des Kraftwerkparks zu reduzieren und eigene Produktionskapazitäten aufzubauen. Zudem wird damit dem Kundenwunsch nach sauberer Energie Rechnung getragen und je nach Finanzierungsmodell können auch attraktive Renditen mit Wind- oder Solarparks erzielt werden. Nichtsdestotrotz stehen gerade kleinere, auf Selbstversorgung ausgerichtete Anlagen wie etwa dachintegrierte

[23] Vgl. Manager Magazin Online (2013), Englands neuer Atomstrom ist teurer als Solarenergie, in: http://www.manager-magazin.de/unternehmen/energie/edf-und-areva-bauen-atomkraftwerk-hinkley-c-in-grossbritannien-a-929090-2.html, abgerufen am 26. Januar 2014.
[24] Vgl. Bode und Groscurth (2011), S. 106; Gawel und Purkus (2013).
[25] Vgl. Richter (2013), S. 1231.

PV-Anlagen im scheinbaren Widerspruch zum Geschäftsmodell eines Energieversorgungsunternehmen. Die Kunden begeistern sich für die Energieerzeugung und damit für die Kernkompetenz eines EVUs. Die vorliegende Studie argumentiert, dass es für EVUs vorteilhaft ist sich für jene energiepolitischen Anreize einzusetzen, welche es ihnen ermöglichen, das Kundenbedürfnis nach dezentral und erneuerbar erzeugter Energie in interessanten Geschäftsmodellen aufzugreifen.

An dieses Resultat führt die vorliegende Studie schrittweise heran. Am Beispiel Deutschlands und der Schweiz fokussiert Kapitel 2 auf die unternehmerische Einflussnahme in Theorie und Praxis. Dabei wird aufgezeigt, wie die Unterschiede in den jeweiligen Strommärkten historisch gewachsen sind und wie sich diese Unterschiede in der Einstellung der Stromkunden widerspiegeln. Kapitel 3 diskutiert Ansätze aus der Literatur, um die Einstellung zu verschiedenen Energietechnologien zu erklären. Anschliessend werden in Kapitel 4 die Ergebnisse der Meinungsumfragen in Deutschland und der Schweiz präsentiert. Hierbei wird die Wahrnehmung von Atomenergie mit jener von Photovoltaik verglichen, welche in diesem Zusammenhang als stellvertretend für die erneuerbaren Energien verstanden wird. Einerseits wird dieser Technologie in Deutschland und der Schweiz ein anteilsmässig vergleichbares Potential für die Stromproduktion zugeschrieben, und anderseits geniesst sie bei den Stromkunden die meiste Akzeptanz[26]. Damit erhalten EVUs auch eine Grundlage um für regulatorische Anreize zu lobbyieren, welche die Geschäftsmodelle für den *Prosumer*, d.h. für den Strom produzierenden und konsumierenden Kunden, lukrativer machen. Die ländervergleichende Analyse der Umfrageresultate zeigt, dass der in Deutschland zügiger vorangehende Ausbau neuer erneuerbarer Energien Unterschiede in der Wahrnehmung der Atomenergie bewirkt hat. Kapitel 5 zeigt Schwachstellen der Studie auf und Kapitel 6 umfassst eine abschliessende Diskussion.

3.2 Einflussnahme auf die Gesetzgebung in Theorie und Praxis

3.2.1 Konzeptioneller Bezugsrahmen

Der Einfluss von Regulierungsbehörden und Politik ist in der Energiebranche gross[27]. Zudem verstärkt die geringe Produktdiversifikation der EVUs deren

[26] Vgl. Kaenzig et al. (2013) für empirische Evidenz aus Deutschland und Chassot et al. (2011) und Chassot und Wüstenhagen (2012, 2013) für die Schweiz.
[27] Vgl. Fiedler et al. (2013), S. 357.

Abhängigkeit von den politischen Rahmenbedingungen im Energiemarkt. Andererseits ist die institutionalisierte Teilnahme am Gesetzgebungsprozess in korporatistischen Staaten gemeinhin akzeptiert und es scheint daher für EVUs opportun, Möglichkeiten zur Einflussnahme zu nutzen.

In einem aktuellen Beitrag untersuchen Fiedler et al. (2013) strategische Handlungsoptionen zur unternehmerischen Einflussnahme in der Energiebranche. Aufgrund von Experteninterviews mit verschiedenen Vertretern der Energieindustrie kommt die Studie zum Schluss, dass informationsorientierte Strategien sowohl gegenüber der Politik als auch den Regulierungsbehörden am häufigsten verwendet werden. Den konzeptionellen Rahmen entlehnen Fiedler et al. der Arbeit von Hillman und Hitt (1999). Demnach versorgen Unternehmen mit informationsorienterten Strategien Politiker und Beamte mit spezifischen Informationen, um damit die regulatorischen Rahmenbedingungen ihren eigenen Interessen entsprechend zu beeinflussen. Spezifische Informationen können etwa Resultate von Forschung und Meinungsumfragen zur Wirkung einer regulatorischen Massnahme in der Bevölkerung sein. Zudem erwähnen Fiedler et al. technische Informationen, die Unternehmen in Gutachten oder Positionspapieren platzieren. Bedingungen für diese Art der unternehmerischen Einflussnahme sind eine hohe Glaubwürdigkeit der Unternehmen sowie gute Beziehungen zu den politischen Entscheidungsträgern. Unternehmen ohne diese notwendigen Ressourcen haben auch die Möglichkeit, via einen Verband zu lobbyieren. Im Gegensatz zur informationsorientierten Strategie unterscheiden Hillman und Hitt die Wählerschaft bildende beziehungsweise nach Fiedler et al. die druck- und konfrontationsorientierte Strategie sowie die finanzielle Anreizstrategie. Die Wählerschaft bildende Strategie umfasst Medienkampagnen zur öffentlichen Meinungsbeeinflussung um damit indirekt Druck auf den Gesetzgeber auszuüben. Diese proaktive Strategie ist zu Beginn des Gesetzgebungsprozesses geeignet, d.h. zum Zeitpunkt, in dem sich ein Regulierungsgegenstand gerade erst manifestiert. Wenn es in späteren Phasen um die konkrete Formulierung und Implementierung der Regulierung geht, wie dies beispielsweise beim Atomausstieg aktuell der Fall ist, eignet sich der informationsorientierte Ansatz zur Platzierung spezifischer Interessen häufig besser. Finanzielle Anreizstrategien spielen gemäss Fiedler et al. in der Energiebranche eine untergeordnete Rolle, da Reputationsrisiken erstens ein Hindernis darstellen und zweitens die Möglichkeiten von Gesetzes wegen eingeschränkt sind.

3.2.2 Energiepolitik und Lobbying in Deutschland und der Schweiz

3.2.2.1 Energiepolitik von 1986 bis vor „Fukushima“

Sowohl in Deutschland als auch der Schweiz haben EVUs beziehungsweise deren Verbände Einfluss auf die Energiepolitik. Sie werden entweder von Politikern im Gesetzgebungsprozess konsultiert oder die Branchenvertreter nehmen zu aktuellen Themen in Gutachten und anderen Foren von sich aus Stellung. In Deutschland umfasst der Bundesverband der Energie und Wasserwirtschaft (BDEW) 1’800 Mitglieder, vom Stadtwerk bis hin zu den grossen Vier. Kommunalwerke sind im Verband kommunaler Unternehmen vereint. Sowohl zwischen als auch innerhalb der Verbände sind die Interessenslagen jedoch sehr divers. Falls die nötigen Ressourcen vorhanden sind, wird Lobbying auf Unternehmensebene im Zuge des Atomausstiegs und des Ausbaus erneuerbarer Energien daher immer wichtiger. Der Verband Schweizerischer Elektrizitätsunternehmen (VSE) umfasst rund 400 Mitglieder und bringt sich mit Stellungnahmen in den Gesetzgebungsprozess ein. Aufgrund divergierender Interessen publizieren jedoch nicht nur die zwei grossen überregionalen Unternehmen Axpo und Alpiq eigene Positionspapiere und Studien, sondern auch grössere Stadtwerke. Nachfolgend werden die wichtigsten energiepolitischen Unterschiede zwischen Deutschland und der Schweiz skizziert und die Rolle der EVUs kommentiert. Dabei wird deutlich, dass die unterschiedlichen Tempi der Nachbarländer im Atomausstieg und im Ausbau der erneuerbaren Energien historisch gewachsen sind.

Im Frühjahr 1986 gab es nach dem Reaktorunfall in Tschernobyl sowohl in Deutschland als auch in der Schweiz eine rege energiepolitische Diskussion. In Deutschland manifestierte sich diese unter anderem im Stromeinspeisegesetz von 1991, während in der Schweiz die eingangs beschriebene Volksabstimmung in einem Atommoratorium endete. Während in Deutschland die Grundlagen für die Förderung von Alternativen zur Atomenergie geschaffen wurden, fehlte in der Schweiz ein klarer politischer Anreiz für den Ausbau neuer erneuerbarer Technologien. Es folgt eine Liste von Faktoren, welche diese unterschiedliche Entwicklung in den Nachbarländern begründeten und fortwährend begünstigten.

Der jeweilige Stromproduktionsmix unterscheidet sich stark: Der deutsche Strommix besteht traditionell zu über 50% aus fossilen Energieträgern, während der Rest durch Atomenergie und erneuerbare Energie gedeckt wird, wie beispielsweise Wasserkraft und in jüngster Vergangenheit überwiegend neue Erneuerbare. In der

Schweiz stammen über 50% des Stroms aus Wasserkraftanlagen und ca. 40% aus Atomkraftwerken. Rund 5% entfällt auf den Import fossiler Energie, während neue erneuerbare Energien nur am Rande eingesetzt werden (bislang vor allem Müllverbrennung). Der unter Ausschluss der Primärenergie grösstenteils CO_2-freie Schweizer Strommix ist über die Jahrzehnte hinweg zu einem identitätsstiftenden Element geworden, welches mit den Pumpspeicher-Wasserkraftwerken zudem beträchtliche Gewinne für die Schweizer Stromhändler abgeworfen hat. Die Schattenseite dieses Erfolgs mit herkömmlichen Energiequellen ist die Tendenz zur Pfadabhängigkeit und damit die Gefahr, eine Innovation wie erneuerbare Energien zu spät als neue Marktopportunität zu erkennen[28].

Förderung erneuerbarer Energien: In Deutschland trat 1991 das Stromeinspeisegesetz in Kraft, womit die bevorzugte Einspeisung erneuerbarer Energien ins Stromnetz gesetzlich verankert wurde. In beiden Ländern messen verschiedene Energieszenarien der Photovoltaik eine bedeutende Rolle beim Atomausstieg zu. Diese gehen für Deutschland bis 2050 von einem PV-Anteil von 15-30% aus. Für die Schweiz sind es im gleichen Prognosezeitrum 21%[29] bzw. im Szenario von Swissolar 20% bis ins Jahr 2025. In Deutschland hat der Ausbau der Photovoltaik nach Novellierung des Energie-Einspeisegesetzes (EEG 2004 und 2009) bzw. der Festlegung der entsprechenden Einspeisevergütung für erneuerbaren Strom bereits massiv zugenommen. Auch in der Schweiz wären viele Hauseigentümer an einer PV-Anlage interessiert. Nach Limitierung der kostendeckenden Einspeisevergütung (KEV) befindet sich jedoch die Mehrheit aller Anträge auf der sogenannten Warteliste. Per Oktober 2013 umfasste diese Liste bereits 27'000 Anträge für PV-Anlagen[30]. In Deutschland wurden per 2011 rund 500 mal mehr PV-Anlagen gefördert als in der Schweiz. Pro Person waren dies 0.014 PV-Anlagen in Deutschland und 0.0003 Anlagen in der Schweiz.

Die Verbände der Energieversorgungsunternehmen äussern sich in beiden Ländern eher kritisch zur Förderung der erneuerbaren Energien. Generell scheinen die Stellungnahmen der Verbände umso kritischer je dezentraler die Technologie[31]. Diesbezüglich herrscht jedoch Uneinigkeit unter den EVUs: In der Schweiz etwa

[28] Vgl. Lovio et al. (2011) für eine Diskussion des Begriffs Pfadabhängigkeit im Kontext des Energiesektors, und Tripsas und Gavetti (2000) sowie Kaplan et al. (2009) für Fallstudien aus anderen Industrien.
[29] Vgl. Wirth (2013), S. 54 für deutsche Szenarien bzw. BfE (2011) und Nordmann (2012) für die Schweiz, sowie Schweizer Bundesrat (2013) für aktuelle Kommentare.
[30] Vgl. Stiftung KEV (2013). Die Mehrzahl der PV-Projekte wurde von privaten Investoren, insbesondere privaten Hauseigentümern, beantragt. Vgl. hierzu Chassot (2012).
[31] Vgl. BDEW (2014a).

bieten kleinere EVUs ihren Kunden teilweise in Ergänzung zur KEV eigene Fördermodelle für PV-Anlagen an[32].

Rolle der Atomenergie: Ähnlich tief verankert wie die Diskussion um den Ausbau der erneuerbaren Energien ist in Deutschland die Bewegung gegen die Atomenergie. Die deutsche Bürgerbewegung gegen die Atomenergie gibt es bereits seit den frühen 70er Jahren. Mit der Vereinbarung vom 14. Juni 2000 wurde schliesslich der Atomausstieg initiiert. Die im Oktober 2010 überraschend gesprochenen Laufzeitverlängerungen waren überwiegend im Interesse der grossen Vier, während der BDEW die Laufzeitverlängerung nur bedingt befürwortete[33]. In der Schweiz war bis vor „Fukushima" eine leichte „nukleare Renaissance"[34] zu spüren. Nach dem Auslaufen des Atommoratoriums im Jahr 2000 gab es in der Schweiz wieder Pläne zum Bau neuer AKWs.

Marktstruktur: Der deutsche Strommarkt wird zwar nach wie vor von den „grossen Vier" dominiert, deren Marktanteil sinkt jedoch kontinuierlich[35]. Seit der Liberalisierung im Jahre 1999 haben alle Kunden die Möglichkeit, den Anbieter zu wechseln und ihren Strom etwa bei einem auf Ökostrom spezialisierten Anbieter zu beziehen. Diese Möglichkeit haben bislang rund 20% der Kunden genutzt[36]. Damit ist erneuerbare Energie im deutschen Strommarkt ein Wettbewerbsfaktor zur Gewinnung von ökologisch orientierten Kunden geworden. Im Gegensatz dazu ist der Strommarkt in der Schweiz bislang nur für Grosskunden liberalisiert. Auch ohne Wettbewerbsdruck im Kleinkundenmarkt haben jedoch einige Stadtwerke ihr Angebot an Ökostromprodukten ausgebaut[37]. Sowohl VSE als auch BDEW stehen hinter der Marktliberalisierung. Obwohl sie für EVUs eine zusätzliche Herausforderung in Form neuer Wettbewerber bedeutet, scheint es angesichts der Liberalisierungstendenzen auf EU-Ebene nicht opportun, sich dagegen aufzulehnen. Mit der Wechselmöglichkeit der Privatkunden wird es für EVUs umso wichtiger, die Bedürfnisse ihrer Kunden zu berücksichtigen.

[32] Für eine Übersicht der regionalen PV-Förderung siehe http://www.swissolar.ch/de/unsere-themen/foerderung/.
[33] Vgl. *BDEW* (2010).
[34] Vgl. *Visschers und Siegrist* (2012), S.3.
[35] Vgl. *BDEW* (2013a).
[36] Vgl. *TNS* (2011).
[37] Vgl. *Chassot* et al. (2013), S. 81.

3.2.2.2 Jüngste Entwicklungen in der Energiepolitik

Der Reaktorunfall in Fukushima erhielt in Deutschland und der Schweiz grosse mediale Aufmerksamkeit. Die Einsicht, dass solche Unfälle auch in einem hochmodernen Land wie Japan passieren können, machte deutlich, dass das „Restrisiko" jederzeit und überall zu einem Unfall führen kann. Beide Regierungen haben noch im März 2011 die Überprüfung ihrer jeweiligen AKWs angeordnet. Zudem manifestierte sich in beiden Ländern im Mai 2011 ein Ausstiegsdatum, nämlich 2022 für Deutschland und 2035 für die Schweiz. Während in beiden Ländern die Vertreter der grossen EVUs bzw. die Besitzer der AKWs den Entscheid kritisierten, begrüssten ihn die Stadtwerke zumindest teilweise[38].

In der Umsetzung des politischen Entscheids schlugen die Länder unterschiedliche Tempi an. Deutschland hat den Anteil der Atomenergie an der Stromproduktion von 2010 bis 2012 bereits von 22 auf 16% reduziert. In der Schweiz hingegen betrug der Anteil Atomenergie im Jahr 2010 38%, während es im Jahr 2012 immer noch 36% waren[39]. Doch nicht nur im Abbau der Atomenergie gibt es Unterschiede, sondern vor allem auch im Ausbau von Alternativen. Die Stromproduktion aus Photovoltaik und Windenergie beispielsweise ist in Deutschland von 2010 bis 2012 von 8 auf 12% gestiegen. In der Schweiz hat diese sich in der gleichen Periode verdreifacht, allerdings lediglich von 0.2 auf 0.6%. Der deutsche Atomausstieg läuft unter dem Motto „Wer A sagt, muss auch B sagen", d.h. wer für den Ausstieg ist muss zeigen, wie die Atomenergie ersetzt werden kann. Mit dem rasanten Ausbau der neuen Erneuerbaren wächst nun aber auch die Einsicht, dass „B" sagen „C" bedeutet – der Ausbau der erneuerbaren Energien kostet Geld. Da die Kosten für das EEG auf den Strompreis umgelegt werden, zahlt letztlich der Kunde. Die politische Diskussion über die den Stromkunden zumutbaren Kosten führte jüngst zu Kürzungen der Einspeisevergütungen insbesondere für Photovoltaik (EEG 2012). Aktuell berät das Parlament bereits die nächste EEG-Novelle mit weiteren Kürzungen der Einspeisetarife für PV und Wind, und erstmals auch Kapazitätsvorgaben im Sinne eines Ausbaukorridors für solche Technologien. Hauptargument für die Kürzung sind die steigenden Kosten des EEG und damit der EEG-Umlage, welche für energieintensive Unternehmen zur Bedrohung wird, zumal die EU-Kommission die Ausnahmen von der EEG-Umlage bei energieintensiven Unternehmen nicht länger

[38] Vgl. Swisspower (2011).
[39] Vgl. BMWi (2013), Tabelle 22 für die Entwicklung der Stromproduktion in Deutschland, und BfE (2013), Tabelle 24 für jene in der Schweiz.

dulden will[40]. Die vom BDEW vertretene Position verlangt in diesem Zusammenhang eine grundlegende Revision des EEG und der Förderung erneuerbarer Energien[41]. Auch in der Schweiz ist die Diskussion über die Kosten der Energiewende entbrannt, jedoch geht es weniger um bereits anfallende Kosten als viel mehr um künftige Ausgaben für die Förderung der erneuerbaren Energien.

Zusammenfassend lässt sich feststellen, dass erneuerbare Energien in Deutschland schon länger und mit mehr finanziellen Mitteln gefördert werden als in der Schweiz. Die Photovoltaik hat hierbei eine Sonderstellung erhalten, da sie gemäss Szenarien künftig einen bedeutenden Anteil des Strommixes ausmachen soll. Da sie es Stromkunden zudem ermöglicht, selbst in die Stromversorgung zu investieren, geniesst der Strom aus Sonnenenergie in der Bevölkerung grosse Akzeptanz[42]. Die erhöhte Sichtbarkeit aufgrund zahlreicher PV-Anlagen führt inzwischen vor allem in Gegenden Süddeutschlands zu Schneeballeffekten, d.h. wenn der Nachbar eine PV-Anlage hat, so will man selbst auch eine auf dem Dach haben[43]. In der Schweiz sind solche Effekte punktuell in jenen Gemeinden zu beobachten, die auf regionaler Ebene PV-Anlagen fördern.

3.3 Wahrnehmung von Atomenergie und Erneuerbaren: Literatur und Hypothesen

3.3.1 Langzeitstudien zum Effekt von Reaktorunfällen

Dieses Kapitel leitet aus der Literatur her, wieso die Wahrnehmung erneuerbarer Energien einen Einfluss auf die Akzeptanz der Atomenergie hat, und wie sich letztere nach einem Reaktorunfall verändert.

Zu Normalzeiten ist das sogenannte Restrisiko der Atomenergie ein abstraktes, für Laien kaum greifbares Thema. Völlig anders ist dies jedoch nach einem Reaktorunfall. So wurde beispielsweise aufgrund der intensiven Medienberichterstattung nach „Fukushima“ sichtbar, welche Konsequenzen das „Restrisiko“ der Atomenergie tatsächlich haben kann. Die Medien verstehen es dabei, die Informationen so aufzubereiten, dass sie den Rezipienten emotional packen. Dies selbst dann, wenn der Schauplatz des Unglücks geografisch weit entfernt liegt. Zahlreiche

[40] Vgl. European Commission (2013).
[41] Vgl. BDEW (2014b).
[42] Vgl. Hübner et al. (2012); Kaenzig und Wüstenhagen (2008); Faiers und Neame (2006).
[43] Vgl. Rode und Weber (2012).

Meinungsumfragen[44] zeigen, dass das wahrgenommene Risiko von AKWs nach einem Unfall deutlich höher und die Akzeptanz der Atomenergie in der Bevölkerung deutlich geringer sind. Obwohl sich also objektiv nichts an der Technologie der AKWs verändert hat – ein Reaktorunfall macht lediglich mögliche Konsequenzen des Restrisikos sichtbar –, haben Reaktorunfälle einen Einfluss auf die Akzeptanz von Atomenergie im eigenen Land. Die Risikowahrnehmung beruht nicht nur auf analytischen Überlegungen, sondern ist stark von affektiven Einflüssen getrieben[45]. Wie die Studie von Renn (1990) für elf verschiedene Länder zeigt, flachte ein Jahr nach „Tschernobyl" dieser emotionale Effekt ebenso wie die Medienberichterstattung wieder ab[46]. Zum Einfluss von „Fukushima" wurden bislang eine Handvoll Kohorten-Studien publiziert, in denen dieselben Personen vor und nach Fukushima befragt wurden. Prati und Zani (2012) analysierten mit Hilfe einer Stichprobe von 32 Befragten die Wirkung von „Fukushima" auf die generelle Einstellung zu Umweltthemen. Die Autoren schliessen mit der Feststellung, dass Reaktorunfälle nicht nur die Risikowahrnehmung und die Einstellung zur Atomenergie verändern, sondern auch das Potential haben, längerfristige Wahrnehmungen wie etwa jene des Klimawandels zu beeinflussen. Studien aus dem deutschsprachigen Raum, welche mehrheitlich von Siegrist und Visschers stammen[47], haben in der Schweiz 496 Personen einmal vor und zweimal nach Fukushima zur Akzeptanz der Atomenergie befragt. Um die Akzeptanz dieser Technologie in der Schweiz zu erklären, fokussieren die Modelle dieser Autoren auf die Wahrnehmung von Risiko und Nutzen der Atomenergie sowie das Vertrauen in die Repräsentanten der Atomindustrie. Obwohl die Wahrnehmung von Alternativen zur Atomenergie wie etwa jene der erneuerbaren Energien bei Siegrist und Visschers in der Operationalisierung der Variable *Nutzen von Atomenergie* thematisiert wird, spielt sie auf konzeptioneller Ebene keine Rolle.

[44] Vgl. Renn (1990) zu „Tschernobyl" sowie Hartmann et al. (2013) für eine Übersicht der Studien zu „Fukushima".
[45] Vgl. Loewenstein et al. (2001).
[46] Dieses Muster in der Medienberichterstattung wiederholte sich nach „Fukushima": die Stichwortsuche zu Atomenergie in den drei grössten deutschen Zeitungen mit Hilfe der Mediendatenbank Factiva ergibt für das Frühjahr 2011 149 Artikel, im Frühjahr 2012 waren es noch 11 Artikel.
[47] Vgl. Siegrist und Visschers (2012), Visschers und Siegrist (2012), Visschers und Wallquist (2013).

3.3.2 Widerwillige Akzeptanz der Atomenergie aufgrund wahrgenommener Notwendigkeit

Die Einstellung zur Atomenergie basiert auf der Wahrnehmung des Risikos und des Nutzens der Technologie. Wie erklärt sich nun der Rebound-Effekt, den oben zitierte Forscher beobachten? Widerwillige Akzeptanz[48] ist ein Schlüsselbegriff, um diese Frage zu beantworten. Meinungsumfragen zeigen, dass der wahrgenommene Nutzen der Atomenergie in den Augen der Bevölkerung darin besteht, Energie kostengünstig zu produzieren ohne dabei CO_2 zu emittieren. In diesem Sinne werden die Atomenergie und die Risiken, die mit ihr einhergehen, widerwillig akzeptiert, denn deutlich weniger Strom oder mehr fossile Energie zu verbrauchen sind für viele Stromkunden keine attraktiven Alternativen. Der Nutzen der Atomenergie korreliert mit der wahrgenommenen Notwendigkeit beziehungsweise Verzichtbarkeit dieser Energie. Der Rebound-Effekt, welcher einige Jahre nach einem Unfall zu einer Renaissance der Atomenergie führen kann, rührt also daher, dass Stromkunden keine glaubhaften Alternativen zur Atomenergie sehen und letztere daher für unverzichtbar halten. Meinungsumfragen zeigen aber auch, dass die Mehrheit erneuerbare Energien der Atomenergie und den fossilen Energien vorzieht[49]. Nicht nur Atomenergie sondern auch erneuerbare Energien haben in der öffentlich-medialen Diskussion nach „Fukushima“ grosse Aufmerksamkeit erhalten. Die Stichwortsuche nach Medienberichten in den drei grössten deutschen Tageszeitungen für das Frühjahr 2011 ergibt 149 Zeitungsberichte zu „Atomenergie“ und 118 Berichte zum Stichwort „erneuerbare Energie“. Der Ausbau der erneuerbaren Energien ist eine von der Bevölkerung gewünschte und mittlerweile auch konkret sichtbare Alternative zur widerwilligen Akzeptanz der Atomenergie. So zeigt die Studie von Hartmann et al. (2013), dass Stromkunden den Wechsel zum Ökostromtarif erwägen. Sie initiieren damit ihren persönlichen Atomausstieg, um mit dem wahrgenommenen Risiko der Atomenergie im Alltag umzugehen, so die Erklärung der Autoren. Der in der Studie von Hartmann et al. erstmals thematisierte Zusammenhang zwischen der Einstellung zur Atomenergie und den erneuerbaren Energien leitet im Kontext eines Reaktorunfalls zu folgenden Hypothesen über, welche spezifisch auf den Zusammenhang von Atomenergie und Photovoltaik fokussieren.

[48] Vgl. Bickerstaff et al. (2008), Corner et al., (2011), Pidgeon et al. (2008), Visschers et al. (2011) für Studien zu „reluctant acceptance“ von Atomenergie.

[49] Gemäss Kaenzig et al. (2013), S. 318 sind deutsche Stromkunden zudem bereit, einen Aufpreis von 16% für erneuerbare Energien zu bezahlen. Zur Kundenpräferenz für erneuerbare Energien vgl. auch Hartmann et al. (2013), Truelove et al. (2013), Greenberg (2009), Pidgeon et al. (2008).

Hypothese 1a: Die Akzeptanz der Atomenergie ist nachhaltig gesunken, wenn das wahrgenommene Potential von Photovoltaik nachhaltig gestiegen ist.
Hypothese 1b: Die Akzeptanz der Atomenergie tendiert langfristig zum Mittelwert zurück, wenn das wahrgenommene Potential von Photovoltaik nicht nachhaltig gestiegen ist.

3.3.3 Akzeptanz von Atomenergie im Modell: Risiko, Nutzen, Vertrauen

Die vorliegende Studie baut auf den vorhandenen Arbeiten von Siegrist und Visschers auf. Dabei nimmt sie das gängige Modell zur Akzeptanz von Atomenergie als Ausgangspunkt und ergänzt es um die Komponente erneuerbare Energie. Das Grundmodell besagt, dass die Faktoren Risikowahrnehmung, Nutzenwahrnehmung, und soziales Vertrauen folgendermassen zusammenhängen: Ebenso wie die Risikowahrnehmung auf affektiven Einflüssen beruht, basiert auch der wahrgenommene Nutzen der Atomenergie auf Affekt[50]. In Experimenten wiesen etwa Finucane et al. (2000) nach, dass die Wahrnehmung des Risikos und jene des Nutzens negativ korrelieren. Die Autoren folgern, dass Individuen ein als riskant eingestuftes Meinungsobjekt automatisch als weniger nützlich taxieren. Ein Reaktorunfall wie „Fukushima“ verändert demnach nicht nur das wahrgenommene Risiko, sondern auch den wahrgenommenen Nutzen der Atomenergie. Siegrist und Visschers (2012) argumentieren weiter, dass dieser Mechanismus auf dem Vertrauen in die Vertreter der Atomenergie beruht, da die technische Beurteilung von Nutzen und Risiko für den Laien eine zu komplexe Aufgabe darstelle. Daher bediene sich der Laie einer Heuristik, und schliesse aufgrund seines Vertrauens in Exponenten der Atomindustrie auf Risiko und Nutzen dieser Technologie. Die gängigen Hypothesen, welche in Ergänzung zu den Hypothesen 1a und 1b getestet werden sollen, lauten deshalb wie folgt:

Hypothese 2: Das wahrgenommene Risiko der Atomenergie hat einen negativen Einfluss auf die Akzeptanz der Atomenergie.
Hypothese 3: Der wahrgenommene Nutzen der Atomenergie hat einen positiven Einfluss auf die Akzeptanz der Atomenergie.
Hypothese 4: Das Vertrauen in die Repräsentanten der Atomenergie-Industrie hat einen positiven Einfluss auf die Akzeptanz der Atomenergie.

[50] Finucane et al. (2000).

3.4 Empirische Untersuchung

3.4.1 Verwendete Daten und deskriptive Statistiken

Um aufzuzeigen, wie sich die Einstellung zur Atomenergie nach „Fukushima“ verändert hat, verwendet diese Studie zweierlei Arten von Umfragedaten.

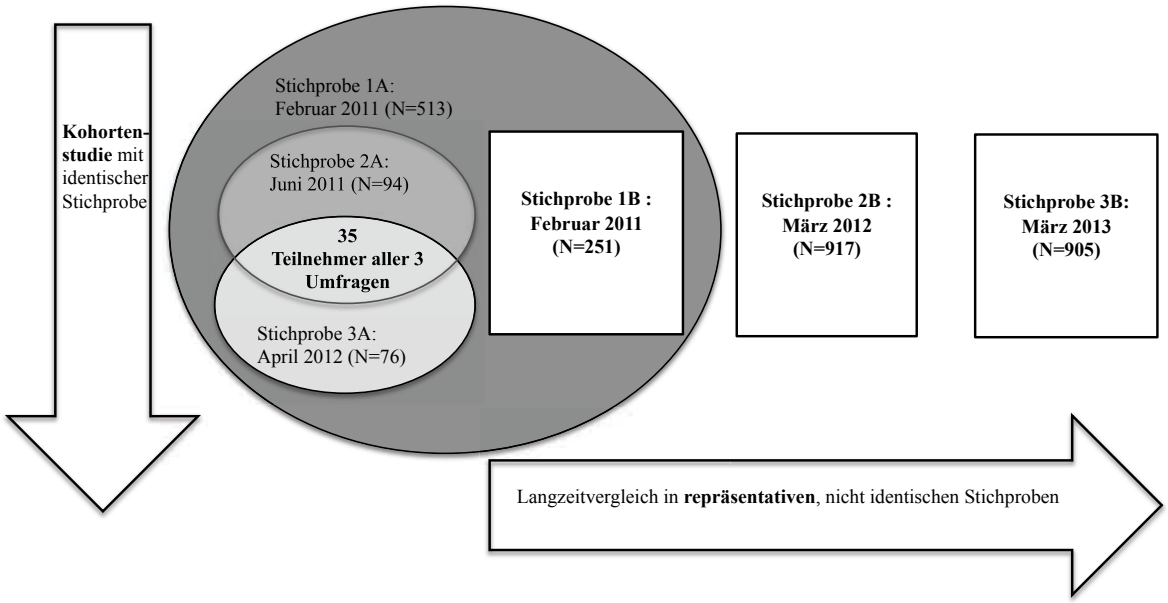
A. *Kohorten-Studie:* Für Datensatz A wurden dieselben Personen zu drei verschiedenen Zeitpunkten befragt. Die Befragung wurde im Bodenseeanrainer-Gebiet durch das Institut für Wirtschaft und Ökologie der Universität St. Gallen durchgeführt. Die Einladung zur Teilnahme an der internetbasierten Umfrage erfolgte über Medienberichte, persönliche Rekrutierung in Friedrichshafen, Konstanz und Dornbirn, sowie über eine Rechnungsbeilage der Sankt Galler Stadtwerke. Die Stichprobe umfasst die Gebiete Ostschweiz, Fürstentum Liechtenstein[51] sowie Befragte aus den deutschen Bundesländern Bayern und Baden-Württemberg. Damit handelt es sich um Befragte, die vergleichbare soziokulturelle sowie klimatische Voraussetzungen haben, jedoch in Ländern mit unterschiedlich gestalteter Energiepolitik leben. Diese Kohorten-Untersuchung erlaubt es, Einstellungsänderungen nach Fukushima *für ein und dieselbe* Person zu analysieren. Die Herausforderung bei diesem Untersuchungsdesign ist die Stichprobengrösse. Wie Abbildung 1 zeigt, ist die Zahl der Umfrageteilnehmer im Laufe der Untersuchung stark gesunken. An Umfrage 1 im Februar 2011, d.h. unmittelbar vor „Fukushima“, nahmen 513 Personen aus dem besagten Gebiet teil. Hiervon hinterliessen 325 Personen eine Email-Adresse und äusserten ihre Bereitschaft, an einer späteren Nachfolgebefragung teilzunehmen. Von diesen 325 Personen nahmen 94 an der Umfrage 2A teil, welche zwischen dem 27. Mai und dem 6. Juni 2011 stattfand. Der Fragenkatalog von Umfrage 2A umfasste 12 identische Fragen, welche bereits in Umfrage 1 abgefragt wurden. Weitere zehn Fragen kamen neu hinzu. Im April 2012 wurde die Einladung zur Umfrage 3A wiederum an alle 325 Personen verschickt. 76 Personen beantworteten neben den 17 Fragen, welche auch in Umfrage 2A vorkamen, zusätzlich vier neue Fragen. Von diesen 76 hatten 35 Personen auch an Umfrage 1 und 2A teilgenommen. Die Stichprobengrösse der Kohorte ist damit vergleichbar mit jener von Prati und Zani (2012), welche 32 Personen zu zwei verschiedenen Zeitpunkten befragt haben.

B. *Repräsentative Befragungen:* Um den Einfluss der Wahrnehmung von Solarenergie auf die Einstellung zu Atomenergie empirisch zu validieren, präsentiert

[51] Für spezifische Deutschland-Schweiz-Vergleiche wurden in der Datenanalyse Befragte aus Liechtenstein ausgeschlossen. Das Fürstentum Liechtenstein verfolgt eine eigene Energiepolitik. De facto ist diese aufgrund der vorhandenen Energie-Infrastruktur aber eng mit dem Schweizer Strommarkt verbunden.

Datensatz B Ergebnisse von repräsentativ durchgeführten Befragungen in der Deutschschweiz. Stichprobe 1B ist das Deutschschweizer Teilsample von Umfrage 1. Die Stichproben 2B und 3B stammen von repräsentativen Haushaltbefragungen, welche unabhängig von der Kohorten-Studie jeweils im März 2012 und 2013 im Auftrag der Universität St. Gallen von einem Marktforschungsinstitut durchgeführt wurden.

Abbildung 1. Studiendesign mit Kohorte sowie repräsentativen Stichproben



Deskriptive Statistiken der verschiedenen Stichproben sind in Tabelle 1 enthalten. Die zweite Spalte zeigt die Gesamtstichprobe der länderübergreifenden Umfrage, welche im Februar 2011 durchgeführt wurde. Von den 513 befragten Personen haben 35 an zwei weiteren Befragungen kurz nach „Fukushima“ im Frühjahr 2011 und im April 2012 teilgenommen (Spalte drei). Diese Kohorten-Stichprobe ist hinsichtlich der Merkmale Geschlecht und Parteizugehörigkeit verzerrt. Bei Regressionsanalysen sind diese Variablen daher stets miteinzubeziehen, damit keine Scheinkorrelationen gemessen werden. Um die Analyse der Kohorten-Stichprobe in einer grösseren Stichprobe zu validieren, erfolgten in den Jahren 2012 und 2013 im deutschsprachigen Teil der Schweiz repräsentative Umfragen (vgl. Spalte fünf und sechs in Tabelle 1). Um auch hier den Vor-Nach-Fukushima-Vergleich zu gewährleisten, wurde die Schweizer Teilstichprobe (Spalte vier) aus der länderübergreifenden Umfrage in die Analyse miteinbezogen.

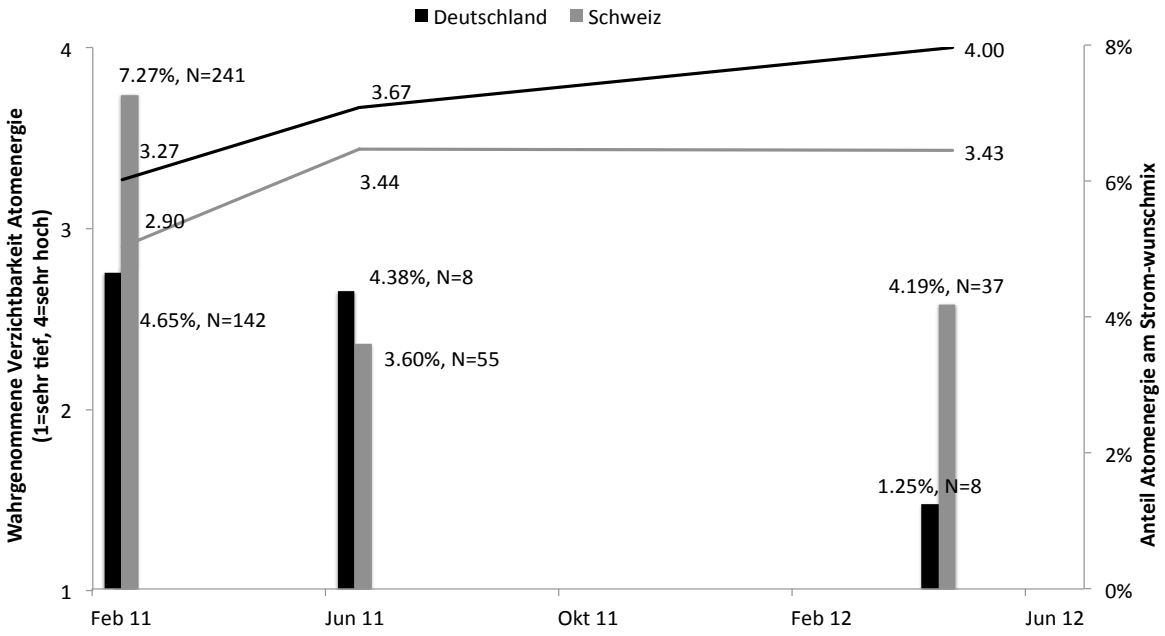
Tabelle 1. Deskriptive Statistiken der Stichproben

	Stichprobe 1A (N=513)	**Stichprobe 1A-3A (N=35)**	**Stichprobe 1B (N=251)**	**Stichprobe 2B (N=912)**	**Stichprobe 3B (N=905)**
Geschlecht (weiblich)	23.14%	20.00%	24.34%	57.02%	51.71%
Alter in Jahren	47.5	51.1	49.61	44.9	43.3
Politische Orientierung					
Sozialdemokratisch	14.91%	25.71%	17.78%	16.99%	18.29%
Grün	16.45%	22.86%	9.78%	6.64%	7.09%
Grünliberal	15.79%	8.57%	15.56%	14.62%	12.11%
Liberal	13.16%	14.29%	17.33%	11.92%	11.31%
Christdemokratisch	12.50%	14.29%	10.67%	10.91%	12.35%
Konservativ	5.92%	2.86%	6.22%	26.88%	24.11%
Andere	21.27%	11.43%	22.67%	12.03%	14.74%
Land					
Deutschland	29.24%	14.29%			
Schweiz	49.12%	74.29%	100.00%	100.00%	100.00%
Fürstentum Liechtenstein	21.64%	11.43%			

3.4.2 Die langfristige Entwicklung der Akzeptanz der Atomenergie

Um die Kunden-Akzeptanz für Atomenergie zu messen, waren die Befragten gebeten, ihren Wunsch-Strommix zu definieren. Für neun verschiedene Stromquellen gaben die Befragten deshalb eine Prozentzahl an, welche Auskunft darüber gibt, wie viel die jeweilige Stromquelle zu ihrem „Wunsch-Strommix“ beitragen soll. Die Balken in Abbildung 2 zeigen den Verlauf des gewünschten durchschnittlichen Prozentsatzes an Atomenergie für Deutschland und die Schweiz. Die Daten weisen in der Schweizer Stichprobe die Tendenz zur Mittelwertrückkehr auf. Der quadratische Trend ist signifikant. Der Quotient für den linearen Term ist signifikant negativ ($\beta_{\text{Anzahl Tage vor / nach Fukushima}}$=-0.644, Standardfehler=0.262, p=0.014). Generell weist die Akzeptanz der Kernenergie damit einen Negativtrend auf. Der quadrierte Term ist jedoch signifikant positiv ($\beta_{\text{Anzahl Tage vor / nach Fukushima}^2}$=0.595, Standardfehler=0.246, p=0.016), was darauf hindeutet, dass die Akzeptanz der Atomenergie in der Kohorte wieder leicht gestiegen ist. Ein ähnliches Muster ist für die wahrgenommene Verzichtbarkeit der Atomenergie zu beobachten. In beiden Ländern ist diese kurz nach „Fukushima“ gestiegen. In der Schweiz hat dieser Wert zwischen Juni 2011 und April 2012 stagniert, während dem die Verzichtbarkeit der Atomenergie nach Ansicht der deutschen Befragten weiter gestiegen ist.

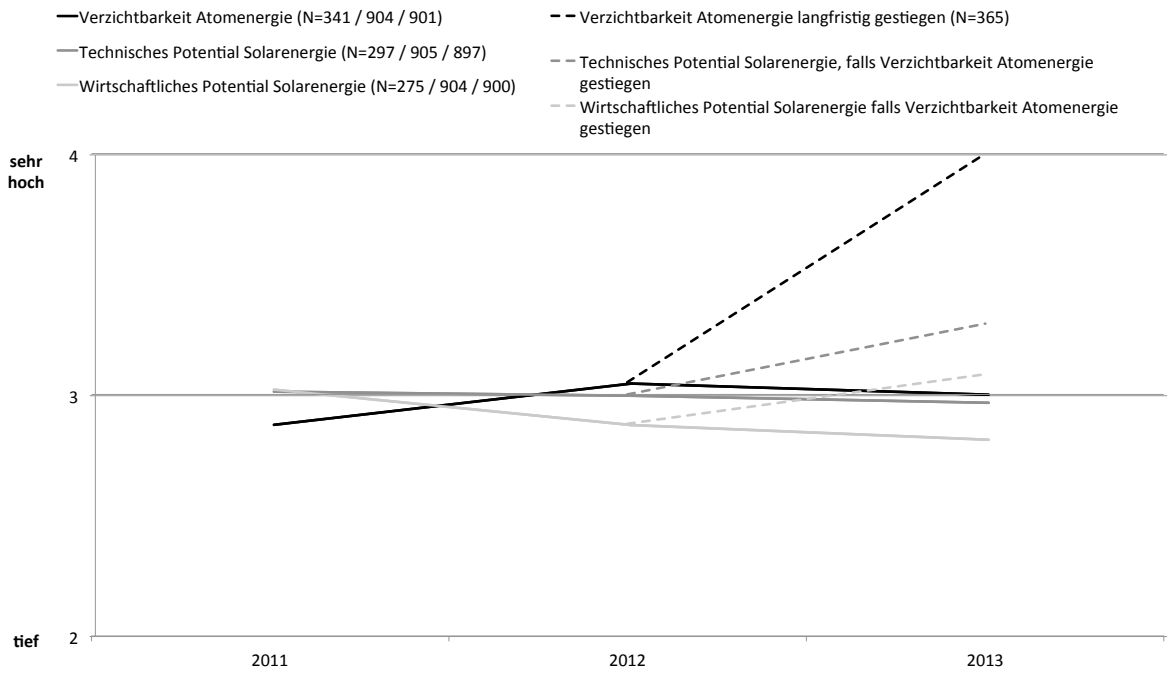
Abbildung 2. Veränderung der Akzeptanz (Balken) und der wahrgenommenen Verzichtbarkeit (Linien) von Atomenergie im Vor- und Nach-Fukushima Vergleich



3.4.3 Vergleich der Einstellung zur Atomenergie und den erneuerbaren Energien

Um die Vermutung zu substantivieren, dass die oben beschriebene unterschiedliche Entwicklung in Deutschland und der Schweiz mit der Verbreitung der erneuerbaren Energien zusammenhängt, wurde der Zusammenhang von Atomenergie und erneuerbaren Energien in den repräsentativen Stichproben für die Deutschschweiz untersucht. Wie Abbildung 3 zeigt, ist die wahrgenommene Verzichtbarkeit von Atomenergie in der Deutschschweiz zwischen 2012 und 2013 gesamthaft konstant geblieben (durchgezogene Linien). Im Vergleich zum Rest der Stichprobe hatten jedoch jene 365 Befragten, welche 2013 dem Verzicht auf Atomenergie uneingeschränkt zustimmten, eine signifikant positivere Wahrnehmung des technischen (2.63 vs. 3.09, $p<0.000$) und wirtschaftlichen (2.75 vs. 3.30, $p<0.000$) Potentials der Solarenergie (gestrichelte Linien). Diese Analyse erhärtet die Vermutung, dass die in Deutschland nachhaltig gesunkene Akzeptanz der Atomenergie mit der Wahrnehmung der erneuerbaren Energien zusammenhängt. Dieser Effekt tritt in der Schweiz bei rund 40% der Befragten ebenfalls auf.

Abbildung 3. Die Akzeptanz der Atomenergie und die Wahrnehmung der Solarenergie im Zeitverlauf in der Schweiz



3.4.4 Risiko, Nutzen, Vertrauen, und Erneuerbare

Um den oben beschriebenen kausalen Zusammenhang zwischen der Wahrnehmung von Atomenergie und erneuerbaren Energien zu testen, wurde der Kohorten-Datensatz innerhalb eines Regressionsmodells verwendet. Insbesondere kamen Daten vom Juni 2011 und jene vom April 2012 zur Anwendung. Damit kann analysiert werden, welche erklärenden Variablen sich nach „Fukushima“ verändert haben. Gleichzeitig lässt sich damit auch die Veränderung in der Akzeptanz der Atomenergie begründen. Die Regression wurde mit einem Tobit-Modell gerechnet, um der linksschiefen Verteilung der abhängigen Variable *Wunschanteil Atomenergie* gerecht zu werden. Das Modell 1 beinhaltet die üblichen, in der Literatur oft verwendeten Variablen zur Erklärung der Akzeptanz der Atomenergie. Modell 1 bestätigt die Hypothese zur Rolle der Risikowahrnehmung, d.h. je eher die befragten Stromkunden der Aussage zustimmen, dass Atomenergie zu riskant sei, desto weniger Atomenergie wünschen sie in ihrem Wunsch-Strommix. Im Modell 2 wird auch der Einfluss der Wahrnehmung der erneuerbaren Energien berücksichtigt. Das wahrgenommene technische Potential der Solarenergie hat einen signifikant negativen Effekt auf den Anteil der Atomenergie am Wunschmix. Damit ist der vermutete Zusammenhang zwischen der Wahrnehmung erneuerbarer Energien und Akzeptanz von Atomenergie bestätigt. In Modell 2 ist auch der Einfluss des sozialen Vertrauens

signifikant positiv, ebenso der Effekt des Geschlechts. Weibliche Befragte wünschen weniger Atomenergie im Strommix.

Tabelle 2. Resultate des Regressionsmodell (Tobit-Modell für Kohorten-Datensatz)

Variablen	Modell (1) Marginale Effekte Anteil Atomenergie am Wunsch-Strommix	Modell (2) Marginale Effekte Anteil Atomenergie am Wunsch-Strommix
Risiko Atomenergie	-9.190**	-12.49***
	(4.116)	(3.633)
Verzichtbarkeit Atomenergie	-1.702	2.956
	(2.676)	(3.006)
Soziales Vertrauen Atomenergie	6.143	11.66***
	(3.784)	(3.361)
Ökonomisches Potential Solarenergie		4.088
		(2.828)
Technisches Potential Solarenergie		-11.49***
		(3.969)
Alter	0.958	0.115
	(2.982)	(3.129)
weiblich	-7.151	-27.41**
	(9.56)	(11.08)
Wohnort in Deutschland	-0.376	-8.62
	(8.156)	(8.551)
Sozialdemokratisch	53.13	58.83
	(3.189)	(1.239)
Grün	7.031	29
	(14.100)	(8.236)
Grünliberal	42.71	34.41
	(3.189)	(1.239)
Christdemokratisch	57.36	45.74
	(3.189)	(1.239)
Konservativ	42.16	39.82
	(3.189)	(1.239)
Andere Partei	59.95	62.7
	(3.189)	(1.239)
Konstante	-61.23	-62.57
	(3.189)	(1.239)
Anzahl Beobachtungen	70	59
Anzahl Befragte	35	34

Standardfehler in Klammern, Variablen sind standardisiert

*** p<0.01, ** p<0.05, * p<0.1

3.5 Einschränkungen der Studie und Forschungsbedarf

Nur eine Handvoll Studien haben bislang den „Fukushima“-Effekt mit einer Kohorten-Stichprobe untersucht. Ein solches Design erfordert gutes Timing und viel Zeitaufwand auf Seiten der Forschenden. Aufgrund der mehrmaligen Befragung ist es aber auch für die Studienteilnehmer relativ aufwändig. Kohorten-Studien mit grossen Stichproben sind daher selten (eine Ausnahme sind die Studien von Siegrist und Visschers). Die Stichprobengrösse der Kohorte ist denn auch der Hauptschwachpunkt dieser Studie. Insbesondere Ländervergleiche sind innerhalb der Kohorte unbedingt durch repräsentative Untersuchungen zu stützen. In der vorliegenden Studie wurde die Kohorten-Stichprobe durch repräsentative Umfragen in der Deutschschweiz ergänzt. Für einen Ländervergleich noch besser geeignet wäre eine länderübergreifende repräsentative Befragung. Des Weiteren wäre eine Kombination von Forschungsmethoden vielversprechend, welche erlaubt affekt-basierte Energie-Einstellungen zu messen. Affektive Einflüsse sind im Unterbewusstsein verankert und werden oft nicht bewusst wahrgenommen. Abfrage-Methoden sind deshalb bei der Messung affektiver Einflüsse limitiert. Ein interessanter und neuerer Ansatz misst beispielsweise die implizite Einstellung zu Energietechnologien mit Hilfe eines Tests für implizite Assoziationen, wie dies etwa Truelove et al. (2013) und Siegrist et al. (2006) getan haben.

3.6 Abschliessende Diskussion

In der Vergangenheit haben EVUs die Möglichkeiten zur unternehmerischen Einflussnahme entweder auf Unternehmensebene oder via Verbände intensiv und oft mit Erfolg genutzt. Zum Ausbau der erneuerbaren Energien haben die EVUs jedoch eine ambivalente Position. Einerseits investieren sie selbst in neue Technologien als Alternative zur Atom- und fossilen Energie, anderseits kannibalisieren dezentrale Technologien wie etwa die Photovoltaik ihr gängiges Geschäftsmodell. Von eminenter Bedeutung für die EVUs ist langfristig die Planbarkeit. Da Investitionen in Kraftwerke einen Zeithorizont von mehreren Jahrzehnten haben, ist es für EVUs wichtig zu verstehen, welche Technologien in Zukunft aufgrund der regulatorischen Rahmenbedingungen opportun sind. Bezüglich Kundenpräferenzen für Energietechnologien sind die Aussagen dieser Studie leicht nachvollziehbar. Falls die

Atomenergie mit Umweltschutz-konformen Energietechnologien ersetzt werden kann, befürworten langfristig die meisten Bürger den Atomausstieg. Die EVUs sind deshalb gefordert, Geschäftsmodelle für dezentrale erneuerbare Energien zu entwickeln, und sich gleichzeitig für die dafür notwendigen regulatorischen und politischen Rahmenbedingungen einzusetzen. Im aktuellen Alltag sind EVUs jedoch stark mit den Folgen der zahlreichen Marktveränderungen beschäftigt, und nehmen gegenüber Regulierungsbehörden und Politikern eher eine reaktive anstatt eine proaktive Haltung ein. Obwohl erneuerbare Energien dem Atomstrom und den fossilen Energien hinsichtlich sozialer Akzeptanz den Rang ablaufen, befürworten die meisten Stromkunden nur dann einen Strommix ohne Atom, wenn dieser mit erneuerbaren Energien produziert wird. Hier besteht gewissermassen auch ein Bruch in der Einstellung: Einerseits wird der Atomausstieg befürwortet, und anderseits steht die Bevölkerung den fossilen Energien, welche die Industrie als Übergangslösung als notwendig erachtet, kritisch gegenüber. Um die Akzeptanz fossiler Kraftwerke zu stärken, sollten EVUs vermehrt und glaubhaft kommunizieren, dass es sich hierbei lediglich um eine Übergangstechnologie handelt. Diese soll die erneuerbaren Energien solange ergänzen, bis genügend Speichertechnologien die Flexibilität im Strommarkt gewährleisten können.

Die Akzeptanz der Atomenergie basiert auf deren wahrgenommener Notwendigkeit und hängt damit ab vom wahrgenommenen Potential der erneuerbaren Energien, die Atomenergie zu ersetzen. Die Präferenzen der Bevölkerung sind aufgrund zahlreicher Umfragen geklärt. Jetzt liegt es an den Entscheidungsträgern, die Rahmenbedingungen so zu gestalten, damit das Potential der erneuerbaren Energien langfristig ausgeschöpft werden kann. Gleichzeitig liegt es an den Energieversorgungsunternehmen und anderen Investoren, dies dann auch entsprechend zu tun. Die Mehrheit der deutschen Stromkunden glaubt an die Machbarkeit des Atomausstiegs. In die gleiche Richtung deuten auch viele repräsentative Umfragen in der Schweiz.

Literaturverzeichnis

BDEW. 2010. Stellungnahme zum Energiekonzept der Bundesregierung. Anhörung des Ausschusses für Wirtschaft und Technologie am 21.10.2010. Berlin.

BDEW. 2013a. Die 10 größten deutschen Stromversorger 2003 bis 2010. BDEW

Bundesverband der Energie- und Wasserwirtschaft e.V.

BDEW. 2013b. Erneuerbare Energien und das EEG: Zahlen, Fakten, Grafiken (2013) *Energie-Info*. Berlin: BDEW Bundesverband der Energie- und Wasserwirtschaft e.V.

BDEW. 2014a. Anpassung der Förderung von solaren Großkraftwerken. Ergänzung der "Voschläge für eine grundlegende Reform des EEG" vom 18. September 2013 *Positionspapier*. Berlin.

BDEW. 2014b. Grundlegende Reform des EEG ist eine Kernaufgabe der neuen Bundesregierung für 2014; abrufbar unter http://www.bdew.de/internet.nsf/id/20140114-pi-mueller-grundlegende-reform-des-eeg-ist-eine-kernaufgabe-der-neuen-bundesregierung-2014.

BfE. 2011. Aktualisierung der Energieperspektiven 2035 (energiewirtschaftliche Modelle) Zusammenfassung.

BfE. 2013. Schweizerische Gesamtenergiestatistik 2012.

Bickerstaff, K, Lorenzini, I, Pidgeon, NF, Poortinga, W, Simmons, P. 2008. Reframing nuclear power in the UK energy debate: nuclear power, climate change mitigation and radioactive waste. *Public Understanding of Science,* **17**, 145-169.

BMWi. 2013. Stromerzeugunskapazitäten, Bruttostromerzeugung und Bruttstromverbrauch. from Bundesministerium für Wirtschaft und Technologie

Bode, S, Groscurth, H-M. 2011. The Impact of PV on the German Power Market. *Zeitschrift für Energiewirtschaft,* **35**, 105-115.

Browa, H. 1987. Delphi-Umfrage über Energieszenarien, ausgearbeitet durch KITec AG. Bern: Eidgenössisches Verkehrs- und Energiewirtschaftsdepartement.

Chassot, S. 2012. Wer investiert in der Schweiz in erneuerbare Energien? Eine Auswertung der Anmeldungen zur Kostendeckenden Einspeisevergütung (KEV), Stand April 2012. Available online: http://www.iwoe.unisg.ch/de/IWOE+News/2012/20121213_KEV-Bericht.

Chassot, S, Curtius, H, Loock, M, Wüstenhagen, R. 2011. 1. St. Galler Kundenbarometer Erneuerbare Energien. St. Gallen.

Chassot, S, Wüstenhagen, R. 2012. 2. Kundenbarometer Erneuerbare Energien. St. Gallen: in Kooperation mt Raiffeisen Schweiz.

Chassot, S, Wüstenhagen, R. 2013. 3. Kundenbarometer Erneuerbare Energien. St. Gallen: in Kooperation mit Raiffeisen Schweiz.

Chassot, S, Wüstenhagen, R, Fahr, N, Graf, P. 2013. Wenn das grüne Produkt zum Standard wird. Wie ein Energieversorger seinen Kunden die

Verhaltensänderung einfach macht. *Zeitschrift OrganisationsEntwicklung,* **3**, 80-87.

Corner, A, Venables, D, Spence, A, Poortinga, W, Demski, C, Pidgeon, NF. 2011. Nuclear power, climate change and energy security: Exploring British public attitudes. *Energy Policy,* **39**, 4823-4833.

European Commission. 2013. Staatliche Beihilfen: Kommission eröffnet eingehende Prüfung der Förderung stromintensiver Unternehmen durch Teilbefreiung von EEG-Umlage; abrufbar unter http://europa.eu/rapid/press-release_IP-13-1283_de.htm.

Faiers, A, Neame, C. 2006. Consumer attitudes towards domestic solar power systems. *Energy Policy,* **34**(14), 1797-1806.

Fiedler, N, Hoffjan, A, Lachmann, M. 2013. Strategische Handlungsoptionen in regulierten Branchen - Unternehmerische Einflussnahme auf regulatorische und politische Entscheidungsprozesse in der Energiewirtschaft. *Betriebswirtschaftliche Forschung und Praxis,* **65**(4).

Finucane, M, Alhakami, A, Slovic, P, Johnson, SM. 2000. The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making,* **13**, 1-17.

Fornallaz, P. 1988. Neue, erneuerbare Energien: Analyse und Synthese von elf Originalstudien, ausgearbeitet durch das Eidgenössisches Institut für Reaktorforschung. Bern: Eidgenössisches Verkehrs- und Energiewirtschaftsdepartement.

Gawel, E, Purkus, A. 2013. Die Marktprämie im EEG 2012: Ein sinnvoller Beitrag zur Markt- und Systemintegration erneuerbarer Energien? *Zeitschrift für Energiewirtschaft,* **37**, 43-61.

Greenberg, M. 2009. Energy sources, public policy, and public preferences: Analysis of US national and site-specific data. *Energy Policy,* **37**, 3242-3249.

Grubler, A. 2010. The costs of the French nuclear scale-up: A case of negative learning by doing. *Energy Policy,* **38**, 5174-5188.

Hartmann, P, Apaolaza, V, D'Souza, C, Echebarria, C, Barrutia, JM. 2013. Nuclear power threats, public opposition and green electricity adoption: Effects of threat belief appraisal and fear arousal. *Energy Policy*.

Hillman, AJ, Hitt, MA. 1999. Corporate Political Strategy Formulation: A Model of Approach, Participation, and Strategy Decisions. *Academy of Management Review,* **24**(4), 825-842.

Hübner, G, Müller, M, Röhr, U, Vinz, D, Kösters, J, Simon, A*, et al.* (2012).

Erneuerbare Energien und Ökostrom - zielgruppenspezifische Kommunikationsstrategien (Abschlussbericht zum BMU-Verbundprojekt (FKZ: 0325107/8)). http://www.genanet.de/fileadmin/downloads/Strom_Wechsel_Frauen/Oekostrom_kurzfassung.pdf

Kaenzig, J, Heinzle, S, Wüstenhagen, R. 2013. Whatever the customer wants, the customer gets? Exploring the gap between consumer preferences and default electricity products in Germany. *Energy Policy,* **53**, 311-322.

Kaenzig, J, Wüstenhagen, R. 2008. Understanding the Green Energy Consumer. *Marketing Review St. Gallen,* **4**, 12-16.

Kaplan, S, Murray, F, Henderson, R. 2003. Discontinuities and senior management: assessing the role of recognition in pharmaceutical firm response to biotechnology. *Industrial and Corporate Change,* **12**(4), 203-233.

Kost, C, Mayer, JN, Thomsen, J, Hartmann, N, Senkpiel, C, Philipps, S*, et al.* 2013. Stromgestehungskosten Erneuerbare Energien: Franhofer ISE.

Loewenstein, GF, Weber, EU, Hsee, CK, Welch, N. 2001. Risk as feelings. *Psychological Bulletin,* **127**(2), 267-286.

Lovio, R, Mickwitz, P, Heiskanen, E. 2011. Path dependence, path creation and creative destruction in the evolution of energy systems. In Wüstenhagen, R, Wuebker, R (Eds.), *Handbook of Research on Energy Entrepreneurship*. Cheltenham UK and Lyme US: Edward Elgar Publishing.

Masuhr, KP. 1988. Volkswirtschaftliche Auswirkungen verschiedener Energieszenarien, ausgearbeitet durch Prognos AG. Bern: Eidgenössisches Verkehrs- und Energiewirtschaftsdepartement.

Nordmann, R. 2012. Ausstieg heisst Umstieg! Rede von Nationalrat Roger Nordmann, Präsident Swissolar, anlässlich der 10. Nationalen Photovoltaik-Tagung.

Pidgeon, NF, Lorenzini, I, Poortinga, W. 2008. Climate change or nuclear power - No thanks! A quantitative study of public perceptions and risk framing in Britain. *Global Environmental Change,* **18**, 69-85.

Prati, G, Zani, B. 2012. The Effect of the Fukushima Nuclear Accident on Risk Perception, Antinuclear Behavioral Intentions, Attitude, Trust, Environmental Beliefs, and Values. *Environment and Behavior*, 1-17.

Renn, O. 1990. Public responses to the Chernobyl accident. *Journal of Environmental Psychology,* **10**, 151-167.

Richter, M. 2013. Business model innovation for sustainable energy: German utilities and renewable energy. *Energy Policy,* **62**, 1226-1237.

Rode, J, Weber, A. 2012. Does Localized Imitation Drive Technology Adoption? A Case Study on Solar Cells in Germany *Working Paper*.

Schweizer Bundesrat. 2013. *Botschaft zum ersten Massnahmepaket der Energiestrategie 2050*. nicht amtlich publizierte Fassung.

Siegrist, M, Cvetkovich, G, Roth, C. 2000. Salient Value Similarity, Social Trust, and Risk / Benefit Perception. *Risk Analysis,* **20**(3), 353-362.

Siegrist, M, Keller, C, Cousin, M-E. 2006. Implicit Attitudes Toward Nuclear Power and Mobile Phone Base Stations: Support for the Affect Heuristic. *Risk Analysis,* **26**(4), 1021-1029.

Siegrist, M, Visschers, VHM. 2012. Acceptance of nuclear power: The Fukushima effect. *Energy Policy,* **59**, 112-119.

Swisspower. 2011. Jahresabschluss von Swisspower. Swisspower unterstützt die Energiewende. Zürich.

Stiftung KEV. 2013. Geschäftsbericht 2012: Stiftung Kostendeckende Einspeisevergütung KEV.

TNS. 2011. Umfrage von TNS Infratest 2011 *Hintergrundpapier*: Im Auftrag der Agentur für Erneuerbare Energien.

Tripsas, M, Gavetti, G. 2000. Capabilities, Cognition, and Inertia: Evidence from Digital Imaging. *Strategic Management Journal,* **21**(10/11, Special Issue: The Evolution of Firm Capabilities (Oct. - Nov., 2000)), 1147-1161.

Truelove, HB, Greenberg, MR, Powers, CW. 2013. Are Implicit Associations With Nuclear Energy Related to Policy Support? Evidence From the Brief Implicit Association Test. *Environment & Behavior,* **45**(8).

Visschers, VHM, Keller, C, Siegrist, M. 2011. Climate change benefits and energy supply benefits as determinants of acceptance of nuclear power stations: Investigating an explanatory model. *Energy Policy,* **39**, 3621-3629.

Visschers, VHM, Siegrist, M. 2012. How a nuclear power plant accident influences acceptance of nuclear power: Results of a longitudinal study beofre and after the Fukushima Disaster. *Risk Analysis*.

Visschers, VHM, Wallquist, L. 2013. Nuclear power before and after Fukushima: The relations between acceptance, ambivalence and knowledge. *Journal of Environmental Psychology,* **36**, 77-86.

Wirth, H. 2013. Aktuelle Fakten zur Photovoltaik in Deutschland. Fassung vom 03.11.2013: Fraunhofer ISE.

4 Paper III

The Impact of Implicit Cognition on Strategic and Financial Investors' Response to Renewable Energy – Evidence From an Implicit Association Test[52]

Sylviane Chassot[*]*, Christian A. Klöckner*[†]*, Rolf Wüstenhagen*[*]

Abstract

In times of fundamental change when organizational capabilities and incentives are lacking or unclear, research has shown that intuitive managerial cognition drives recognition of threats and opportunities – and adoption or non-adoption of an innovation such as renewable energy. The present study examines how intuitive, unconscious and associative thinking – which we call implicit cognition – on renewable vs. fossil energy shapes decision makers' investment responses. In total, 112 strategic (electric utilities) and financial investors (pension funds, banks, insurance companies) participated in one of two separately conducted Implicit Association Tests. Earlier research argues that implicit cognition is particularly influential if an investment relates to the strategic core of a company. Our results confirm this finding, and exemplify the boundaries of the influence of implicit cognition: in both studies, implicit thinking has an influence on strategic investors' decision to invest, whereas it has no influence on financial investors' energy investments.

Keywords: Implicit Cognition; Implicit Association Test; Strategic Investors; Financial Investors; Investment Decision Making; Energy Technologies

JEL codes: C81; D81; G11; G21; G23; L25; L94; O33;

[52] Paper III is under review at the Journal for Applied Research in Memory and Cognition. An earlier version of this paper was awarded with the Elsevier Student Paper Award 2013.

[*] Institute for Economy and the Environment, University of St. Gallen, Switzerland.
[†] Norwegian University of Science and Technology, Trondheim, Norway

4.1 Introduction

Opportunity recognition within an organization is a multilevel process involving not only the individual level, but also the inter-individual, group-, organizational and societal level. However, at the root of this phenomenon "remain individual processes that are poorly understood" (Grégoire et al., 2010: 414). By the end of the 90's, the importance of individual cognitive processes alongside the traditional organizational explanations for managerial decision-making was widely accepted in management research (Kaplan, 2011). As Kaplan (2011: 666) observed, "the most powerful works sought to integrate cognition with these other explanations (capabilities and incentives) into contingent models". In particular in times of fundamental change when organizational capabilities and incentives are lacking or unclear, case study research has shown that managerial cognition drives recognition of threats and opportunities (Garud and Rappa, 1994; Porac et al., 1989; Tripsas and Gavetti, 2000) – and adoption or non-adoption of an innovation (e.g. Tripsas and Gavetti, 2000).

A market innovation implies uncertainty for a manager (Kaplan et al., 2003). For example, for Polaroid, who used to be a leading company in analogue photography, it was not clear ex ante that digital imaging would eventually put analogue photography out of the market (Tripsas and Gavetti, 2000). Under uncertainty, managers rely on personal beliefs (Tripsas and Gavetti, 2000) and intuition (Dane and Pratt, 2007; Khatri and Ng, 2000) to decide whether they should invest. A current example for a disruptive innovation is renewable energy technologies (Hart, 2005). Thus, in order to predict investments in renewable energy technologies, it is helpful to know potential renewable energy investors' intuitive perception of these technologies. However, managerial intuiting occurs at the unconscious level (Dane and Pratt, 2007; Khatri and Ng, 2000). This poses a methodological challenge, because methods that rely on participants' introspection are not suitable to measure managerial intuition (Greenwald and Banaji, 1995). Therefore, we measure strategic and financial investors' perception of renewable energies with an Implicit Association Test (IAT).

Just as psychologists have developed different measurement approaches than management scholars, they also use different terminologies. What management scholars (Burke and Miller, 1999; Dane and Pratt, 2007; Hodgkinson et al, 2008; Miller and Ireland, 2005; Sadler-Smith and Shefy, 2004; Sonenshein, 2007) call intuition is according to dual process theorists such as Sloman (1996) one cognitive function of the associative system. Greenwald and Banaji (1995) clarify that it is the

implicitly – or unconsciously – operating associative system that drives intuition, and that the IAT is a tool to measure implicit cognition.

4.1.1 Research Context

The empirical context of this study is the Swiss energy industry. In May 2011, the Swiss government announced to phase out nuclear power. This implies that 35% of the Swiss electricity mix have to be replaced. Currently, renewable energies (photovoltaics, wind, biogas and biomass, without hydro power) generate 1.4% of electricity in Switzerland (BfE, 2012). However, the Swiss Federal Office of Energy considers solar energy a renewable energy source with high potential and suggests in its renewable energy scenario to cover more than 20% with solar energy by 2050 (Swiss government, 2013). Other scenarios rely more heavily on fossil energy sources, in particular natural gas, to replace nuclear power. Which scenario is realized depends largely on investment decisions of investors.

Gas fired power plants and solar energy are different in several aspects. Gas fired power plants use a conventional energy generation technology that relies on a fossil resource, typically operates with large installed capacities and thus favors a centralized energy system. Solar energy, which is emerging to the mass market, typically operates with smaller installed capacities than gas, and therefore decentralizes the energy system. The fundamental differences of the two technologies link to different worldviews and beliefs about the energy system. Therefore, we argue that deeply held beliefs that manifest themselves in implicit cognition on different energy sources (Peters and Slovic, 1996) have an impact on energy investment decisions.

The most obvious potential energy investors are electric utility companies. They are strategic investors in the sense that energy investments relate to the strategic core of the company. In addition, financing the energy transition provides long-term, low-risk investment opportunities for financial investors such as pension funds, banks, insurance companies (Kaminker and Stewart, 2012; Swiss parliament, 2013). In particular, calls for investment suggest public private-partnerships among strategic and financial investors (e.g. Sonntag-O'Brian and Usher, 2004; WEC, 2013).

So far, investment reactions of Swiss strategic and financial investors are diverse; some utilities have incorporated renewable energies into their investment strategy, others have started to explore renewables with a few plants, and some reluctantly adjust to the decision to phase out nuclear power and replace it by other energy sources (Windisch et al., 2011). According to a detailed investor typology for Swiss

photovoltaics power plants, electric utility companies own 7.5% of all projected installed solar energy capacity (Chassot, 2012). Expert interviews (Beglinger, 2013) show heterogeneity among financial investors, too. A few banks are developing renewable energy financing solutions and invest significant amounts; some pension funds have a few solar energy pilot projects, but the majority of Swiss financial investors at most observe the renewable energy market, without taking stake (Beglinger, 2013). Specifically, financial investors own 1.9% of projected installed solar energy capacity in Switzerland (Chassot, 2012).

In order to understand the heterogeneity in reactions to a disruptive innovation, we suggest taking into account investors' implicit thinking. In particular, we ask the following research questions:

(1) What is the impact of implicit cognition on energy investments?
(2) How does implicit cognition and its influence on energy investments differ between managers of financial versus strategic investors?

4.1.2 Hypotheses

Broad empirical evidence from earlier applications of the IAT shows that implicit cognition influences behavior; for example, Rachlinski et al. (2009) found that judges with implicit biases toward black people where more strict in their judgments of black defendants. Up to now, two applications of the IAT to energy sources are published; Siegrist et al. (2006) measured Swiss students' implicit association toward nuclear vs. hydro power. Truelove et al. (2013) conducted a similar study with american residents. Both studies conclude that implicit attitudes predict political support for energy sources. From the management literature discussed earlier, implicit cognition also has an influence on managerial decision-making. Therefore, we hypothesize for implicit cognition in managerial investment decision-making:

H1: There is a positive correlation of renewable energy investments with the degree of investors' positive implicit cognition on renewable energy.

Depending on the type of company and the importance of the innovation to the company, the relevance of implicit cognition might differ. Grégoire et al. (2010) suggest that implicit cognitive processes are more influential for threat recognition than for opportunity recognition. Barreto and Patient (2013) find that the more an

innovation relates to the core activities of a manager and unsettles the fundament of a company, the more intuitively a manager acts. Khatri and Ng (2000: 78) confirm this result and argue that the high influence of intuition in unstable environments has a positive impact on financial performance of a company. In a survey of managers working for banks, computer companies and utilities, Khatri and Ng used an intuitive synthesis scale to measure how strongly the different managers rely on "pure judgment", "past experience", and "gut-feeling", and find that managers of computer companies rely the most on intuition, whereas those working for banks do so to a lesser extent and utility managers the least. The authors justify this result with the particularly unstable environment of computer companies. On the other hand, the more institutionalized the decision-making process is, the less influential is implicit cognition. For example Crossan et al. (1999: 533) state that "institutionalization can easily drive out intuition. Intuiting within established organizations with a high degree of institutionalized learning requires what Schumpeter (1959) refers to as 'creative destruction' – destroying, or at least setting aside, the institutional order to enact variations that allow intuitive insights and actions to surface and be pursued."

In the context of the current energy transition, we argue that uncertainty in energy markets enhances the influence of implicit cognition among strategic investors, because energy investments relate to the strategic core of an electric utility. On the other hand, financial investors' investment strategies are defined in terms of asset classes. Expert interviews focusing on financial investors' energy investments demonstrate that their decision making process is highly institutionalized in that sense (Beglinger, 2013), which is according to Crossan et al. (1999) a factor that drives out the influence of implicit thinking.
Thus, we further hypothesize that

H2: The correlation of renewable energy investments and implicit cognition on renewable energy is stronger for strategic than financial investors.

4.2 Method

Psychologists have developed a range of tests to measure implicit cognition. A prototype was the word association test by Jung (1969), where subjects had to name all spontaneous associations that came to their mind when confronted with a specific stimulus. Later on, variants of this initial association test emerged, with the Implicit Association Test (IAT) as the most widely used nowadays (for an overview, see

Bargh, 2007; Fazio and Olsen, 2003; Uhlmann et al., 2012). Greenwald and Banaji (1995; Greenwald et al., 1998) developed the IAT in order to assess stereotypes on gender, race, or other sensitive topics the test participants may not be willing to reveal their opinion about (or are not consciously aware of).

The challenge with association methods is that participants have to conduct a high number of association tasks. To some participants the test procedure might appear cumbersome, or even frightening. Nevertheless, different versions of the IAT have attracted more than 1 million participants on the webpage *Project Implicit* alone. However these are samples of lay people, mostly students, whereas samples of professional decision makers are rare.

An IAT tests how strongly the participant associates two target words (e.g. "black" and "white") with two associations ("e.g. "good" and "bad"). In order to test associations, reaction times across 140-180 computer administered sorting tasks are measured. The crucial assumption of the IAT is that participants are faster if the words on the screen are grouped in a way that fits their personal implicit attitude. To test which constellation fits the personal attitude better, in one part of the test "black" and "good" are on one side of the screen and "white" and "bad" on the other side; in the complementary part, "black" and "bad" are on one side of the screen and "white" and "good" on the other side. The final IAT-score is the difference of reaction times across the two constellations.

To measure managerial cognition, scholars often rely on methods that are more convenient such as expert interviews or document analysis – being aware that they might not capture the most relevant – the implicit – part of cognition (e.g. Kaplan et al., 2003). Uhlmann et al. (2012: 554) comment: "Organizational scholars have largely underutilized a highly impactful discovery (…): nonconscious processes and the implicit measures developed to capture them. Despite their limited use, implicit measures hold great promise for organizational research because many phenomena of interest operate outside employees' complete awareness and control."

Therefore, in addition to asking if and why managers invest in renewable and fossil energies, we let them do a series of reaction tasks to capture their unconscious thinking about renewable vs. fossil energy.

4.2.1 Design of the Implicit Association Tests

At the beginning of this research, before we developed the IAT and the additional survey items, we conducted 20 expert interviews with investment decision makers

from electric utility companies (5 interviews), pension funds (6 interviews), banks (6 interviews), and insurance companies (3 interviews). Word-by-word transcriptions of in total 1000 interview-minutes provided an in-depth understanding of the different investors' perspectives on energy investments. This enabled us to use the appropriate wording in the subsequent quantitative part of the study, where we conducted the IAT together with an online survey with in total 112 investors.

We applied the IAT to measure implicit cognition on renewable vs. fossil energy. Instead of "black" and "white", our target words were "solar energy" and "gas" (for a detailed description, see Appendix A. Design of the IATs for Study 1 and Study 2). The final IAT-score ranges from -2 to 2. Cohen (1977) suggests the following cut-off values for association strength: scores between |0.15| and |0.35| imply a slight difference between the two tasks, |0.35|-|0.65| moderate, and values above |0.65| a strong difference. We programmed the test such that a positive IAT-score indicates more positive associations to solar energy (and negative associations to gas), and a negative IAT-score indicates more positive associations to gas (and negative associations to solar energy). The final IAT-score is a *relative* measure of preference for one energy source over the other. If a participant is indifferent between the two, the final IAT-score is lower than |0.15|.

4.2.2 Dependent Variable Energy Investments

In survey questions following the IAT, we collected detailed information about participants' investments in different energy sources. In order to reflect the environment of both strategic and financial investors adequately, we included different asset classes as possible investment channels. The dependent variable is the sum of asset classes a participant uses to invest in solar energy, minus the sum of asset classes a participant uses to invest in gas. A positive number on the dependent variable indicates a relatively high investment exposure to solar energy; a negative number indicates relatively high exposure to gas (for a detailed description, see Appendix B. Dependent Variable Energy Investments With Data From Study 2).

4.2.3 Measurement of Organizational Capabilities and Incentives

While it is a methodological challenge to mix individual-level variables such as cognition with organizational factors, a series of studies suggest combining managerial cognition with organizational capabilities and organizational incentives in the same

model (see Kaplan, 2011 for a review; Barreto and Patient, 2013; Denison, 1996; Kaplan, 2008). As Kaplan (2008), we measured capability in terms of organizational experience. Similarly as Barreto and Patient (2013) and Denison et al. (1996), we used a seven point likert scale to assess organizational (lack of) experience. Specifically, participants had to indicate for each statement how relevant it was regarding their renewable energy investments. The item for lack of capabilities was "Our company does not yet have experience with renewable energy investments".

Organizational incentives or barriers can be strategic or regulatory. The respective item for strategic barriers was "We primarily have to generate return with our investments. The question in which energy source we invest is less important.", and for regulatory barriers: "Investment regulations are not designed for investments in this area."

4.2.4 Samples

Descriptive statistics of the samples of study 1 and 2 are given in Table 5. We addressed investment decision-makers of Swiss strategic and financial investors. Within each company, we approached the person who is responsible for energy investments. Depending on the type of investor, the person in charge for energy investments is at a different level within the hierarchy; within energy utility companies, the head of portfolio management was the most appropriate person to talk to; within small financial investors, we approached those who define the investment strategy, typically members of the boards. Within larger financial investors, more specialized portfolio managers turned out to have the most in-depth insights on energy investment decisions. In sum, 370 financial investors and 66 strategic investors received the invitation to study 1. From June to September 2012, 45 investors participated in the IAT. This sample size is sufficient for an IAT; Greenwald et al. (2003) mention 39 participants as the minimum required sample size.

One difficulty in participant acquisition for study 1 was that test participants had to install a plug-in in order to run the IAT. For study 2, we avoided the plug-in by collaborating with Project Implicit, who hosted the IAT for study 2 on the official Project-Implicit webpage.

The target population in study 2 is identical with that of study 1, but investors who already participated in study 1 were excluded from study 2. In sum, 488 investors received the invitation to the survey. In March and April 2013, a total of 88 managers participated in the online test. Twenty-one participants had to be excluded from the

sample because they indicated that they were not responsible for energy investment decision-making.

Table 5. Descriptive statistics of the samples

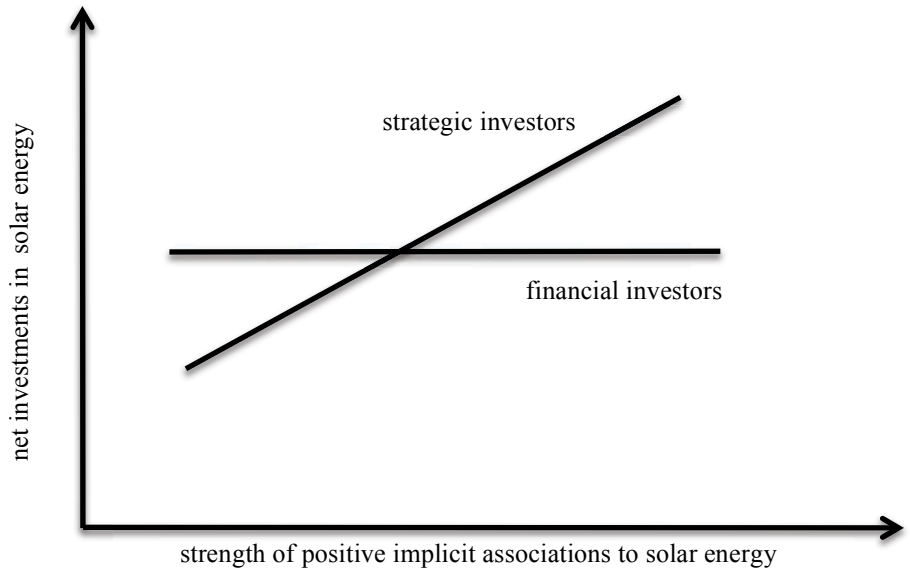
Company type (N)	Study 1 (N=45)	Study 2 (N=67)
Electric utility company	8	16
Banks	2	25
Institutional Investors	35	26
Position within the company (N)		
CEO or member of the board	12	14
Chief financial or investment officer	23	21
Portfolio Manager	5	15
Analyst	1	11
Other	3	6
Demographics (years)		
Age	44.6 years (SD=9.7)	43 years (SD=10)
Experience in investment decision-making	8.1 years (SD=6.7)	7 years (SD=7)
Experience in energy investment decision-making	4.5 years (SD=6.5)	4.1 years (SD=4.9)

4.3 Results

4.3.1 Interaction Effect of Implicit Cognition With Investor Type

To test the hypotheses, we ran OLS regression models with energy investments as the dependent variable, and investor type, IAT-score and the interaction of investor type with the IAT-score as independent variables. In study 1 we focused on the effect of these variables only, in study 2 we included organizational variables such as capabilities and barriers to invest and some control variables. In both studies, we find no significant main effect of the IAT-score on energy investments, whereas the interaction of the IAT-score with investor type has a significant effect on energy investments (see Table 6 for regression results). As an additional test for robustness of our results in both studies, we ran the same models with an ordered logit regression, which confirmed the same pattern regarding our hypotheses (see Appendix C. Robustness Check for the ordered logit regression results). In other words, implicit cognition only has an influence on energy investments among strategic investors; a portfolio manager working for an electric utility company who perceives solar energy more positively than gas invests ceteris paribus more in solar energy than in gas. Portfolio managers of financial investors conduct their energy investments independently of their personal implicit attitude.

Figure 7. Qualitative illustration of the interaction effect of implicit cognition with investor type on energy investments



The size of the interaction effect is similar in both studies (0.647 vs. 0.633). However, the coefficient in study 2 is only significant at the 10%-level, whereas in the ordered logit model, significance is at conventional levels in both studies.

Regarding the organizational factors, the main effect of regulatory barriers is significant at the 10%-level and indicates a negative impact on solar energy investments (in the robustness test, the coefficient is significantly different from zero at the 1%-level). Among the control variables, age has a significantly negative effect.

Table 6. OLS regression results with interaction effect of IAT-score with type of investor

	Study 1		Study 2	
VARIABLES	Net solar energy investments	Robust standard error	Net solar energy investments	Robust standard error
IAT-score	-0.165	0.202	0.113	0.161
IAT-score × strategic investor	0.647**	0.221	0.633 #	0.338
Regulatory barriers			-0.384 #	0.209
Regulatory barriers × strategic investor			0.548	0.360
Strategic barriers			-0.252	0.169
Strategic barriers × strategic investor			-1.053	0.694
Lack of capabilities			0.364	0.282
Lack of capabilities × strategic investor			-1.097	1.452
Age			-0.608*	0.221
Strategic investor	-0.524	0.293	0.087	0.989

Bank			-0.247	0.380
CEO or member of the board			-0.213	0.439
Chief financial or investment officer			-0.599	0.534
Portfolio manager			-0.806	0.566
Constant	0.424**	0.14	0.258	0.370
R-sqaured	0.210		0.703	
Prob > F	0.000		0.000	
Observations	35		32[53]	

All variables are standardized

** p<0.01, * p<0.05, # p<0.1

4.3.2 Discussion

The main result of the two IAT-studies – implicit cognition on renewable vs. fossil energy is associated with the energy investments of strategic investors – is large and robust across samples and model specifications.

The literature discussed earlier offers different explanations as to why implicit cognition only has an effect among strategic investors. Grégoire et al. (2010) might say that electric utility companies perceive renewable energies as a threat to their business model, and that this perception of a threat enhances the influence of implicit cognition. Barreto and Patient (2013) would argue that electric utility companies rely more on implicit cognition because renewable energies relate to their core business. Regarding financial investors, Crossan et al. (1999) would argue that financial investors' decision making process is highly institutionalized, and that this is the reason why implicit cognition has no influence on their investments.

One potential explanation we can rule out is systematic individual differences between strategic vs. financial investors. According to our results, financial investors rely less on implicit cognition. However, Khatri and Ng (2000) found that managers of banks rely *more* on implicit cognition than utility managers. Thus, individual

[53] The regression of study 2 is based on only 32 observations, due to missing values on some of the variables. Of the 67 IAT-scores, 21 were omitted. This filtering is based on Project Implicit's recommendation to not rely on IAT-scores of a participant, if the participant in more than 10% of all tasks showed extremely fast reaction times or committed errors. Of the remaining 46 participants, between 40 to 46 answered each of the other variables included in the regression reported below. However, it was not always the same participants who did not answer one specific question, but in total 14 out of the remaining 46 who have some missing data. This leads to the final 32 observations for the regression model. For a comparison of the subsample used for the regression with the omitted subsample, see Chassot, S, Wüstenhagen, R, Beglinger, F, Bärtsch, C. (2013). Implicit cognition and renewable energy investments: An empirical analysis of differences between financial and strategic investors. *Project report*. http://www.bfe.admin.ch/forschungewg/02544/02810/index.html?lang=en&dossier_id=06122

differences, for example that bank managers are generally more analytical in their cognitive style than utility managers, do not explain the reliance on implicit cognition. Rather than individual differences, a more important factor that determines the influence of implicit cognition is the decision-making context, and in particular the degree of uncertainty in that context (Khatri and Ng, 2000). In the present context of the energy transition in Switzerland, managers of electric utility companies face considerable uncertainty (Windisch et al., 2011) – just as bank managers did during the bust of the dotcom-bubble in 2000, when Khatri and Ng conducted their study.

In light of earlier research that highlights the importance of implicit cognition on investment decisions, it seems surprising that the main effect of the IAT-score is not significant at all. Using empirical evidence for two different types of investors, we exemplify the boundaries of the influence of implicit cognition.

Age has a negative effect with clear significance. The older an investor in our sample of study 2, the less he or she ceteris paribus invests in solar energy. This links back to the discussion during expert interviews at the beginning of this research, where one interviewee of an electric utility talked about the change of mentality that decentralized renewable energies imply; older managers have grown up in the "old", centrally organized Swiss energy system with large hydro and nuclear power plants. One potential reason for the negative effect of age is path dependence, which hinders more experienced strategic energy investors to explore new energy generation technologies that contradict their personal beliefs about the energy system.

4.4 Concluding Remarks

4.4.1 Limitations and Further Research

The main purpose of this research – capturing implicit thinking of managers and relating it to their energy investment decisions – implies a series of limitations.

First, there is a trade-off of accuracy of measurement of variables and quality of the sample; our measurement of implicit cognition on energy is elaborate, but this implied that each of our participants had to conduct about 180 reaction tasks. Therefore, in order to establish a good sample of Swiss investors, we had to cut back on the accuracy of other variables. For example, the most accurate measure of energy investments would have been the exact amount invested in each energy source in Swiss francs. However, this would have required substantial research from our respondents themselves, and the time required to complete the survey would have gone well beyond the usually acceptable 15-20 minutes. Another approach that some

scholars use to solve the trade-off of measurement accuracy and quality of the sample is to conduct a study in the laboratory and invite students to participate. The quality of a sample is two-dimensional; one dimension is the size, the other dimension is to get the relevant people to participate. For this research, the second dimension was more important. In sum, while the „real-world"-sample and the accurate measurement of implicit cognition is the novelty and the strength of this research, the measurement of other variables such as energy investments is weaker, and the sample size could of course have been larger with a student sample.

Second, in order to really understand what motivates and what hinders renewable energy investments, it is important to get as close to the investment decision as possible. The data for investments in this study is self-reported. Observing investment decisions in real time would certainly be an interesting avenue for further research.

Third, there are limitations with regards to causal inferences. Beyond the challenges of measuring implicit cognition, another reason why earlier research on managerial cognition used letters to shareholders rather than interview data as source for managerial cognition, is that this approach makes the effort for longitudinal studies manageable. Longitudinal studies rule out potential reverse causality of managerial action on cognition. However, the research tradition on implicit cognition in psychology emphasizes the long-term stability of implicit cognition. Thus, while investment experience with an innovation may influence implicit cognition in the long term, this is not yet the case when the innovation just appeared on the market. Changes of implicit associations happen very slowly and only after "repetitive and intense experience" (Epstein, 1994: 711). Thus, the IAT is more robust towards reversed causality than other methods. Nevertheless, longitudinal studies on the development of implicit attitudes on energy would be a promising avenue for further research.

Finally, we focused on the role of implicit cognition for energy investments only. It would be interesting to see if similar patterns, in particular interaction effects with investor type, occur for other investment areas, too.

4.4.2 Practical Applications

This paper suggests that in order to influence energy investments of strategic investors, policy makers' toolbox may not include what is needed; it is managers' fundamental beliefs and historical experience that determines their implicit cognition on an innovation and thus their investment approach. Financial investors on the other hand structure their investment decision in terms of asset classes. The highly

institutionalized investment decision process of financial investors rules out any influence of implicit cognition. A straightforward approach to enhance renewable energy investments from the financial sector is to provide the right investment vehicle in a risk-free asset class that is not subject to tightening financial regulation.

Acknowledgements

We acknowledge financial support from the Swiss Federal Office of Energy (SFOE), project SI/500701-01, „Affective Influence on Risk-Return Perceptions of Renewable Energy Investors: An Experimental Analysis of Differences between Financial and Strategic Investors“, and the Swiss National Science Foundation, project PBSGP1_146901.

References

Bargh, JA. 2007. *Automatic processes in social thinking and behavior*: Psychology Press.

Barreto, I, Patient, DL. 2013. Toward a theory of intraorganizational attention based on desirability and feasibility factors. *Strategic Management Journal,* **34**, 687-703.

Beglinger, F. 2013. *Decision making structures and processes of institutional investors regarding investments in renewable energies.* Master's thesis, University of St. Gallen.

BfE. 2012. Schweizerische Gesamtenergiestatistik. Swiss Federal Office of Energy.

Burke, LA, Miller, MK. 1999. Taking the Mystery out of Intuitive Decision Making. *The Academy of Management Executive,* **13**(4), 91-99.

Chassot, S. 2012. Wer investiert in der Schweiz in erneuerbare Energien? Eine Auswertung der Anmeldungen zur Kostendeckenden Einspeisevergütung (KEV), Stand April 2012. Available online: http://www.iwoe.unisg.ch/de/IWOE+News/2012/20121213_KEV-Bericht.

Cohen, J. 1977. *Statistical power analysis for the behavioral sciences*. New York: Academic Press.

Crossan, MM, Lane, H, W., White, RE. 1999. An Organizational Learning Framework: From Intuition to Institution. *The Academy of Management Review,* **24**(3), 522-537.

Dane, E, Pratt, MG. 2007. Exploring intuition and its role in managerial decision

making. *Academy of Management Review,* **32**(1), 33-54.

Denison, Dr, Dutton, JE, Kahn, JA, Hart, SL. 1996. Organizational contest and the interpreation of strategic issues: a note on CEO's interpretations of foreign investment. *Journal of Management Studies,* **33**(4), 453-474.

Eggers, JP, Kaplan, S. 2009. Cognition and Renewal: Comparing CEO and Organizational Effects on Incumbent Adaptation to Technical Change. *Organization Science,* **20**(2), 461-477.

Epstein, S. 1994. Integration of the cognitive and the psychodynamic unconscious. *American Psychologist,* **49**(8), 709-724.

Fazio, RH, Olson, MA. 2003. Implicit measures in social cognition research: their meaning and use. *Annual Review Psychology,* **54**, 297-327.

Garud, R, Rappa, MA. 1994. A Socio-Cognitive Model of Technology Evolution: The Case of Cochlear Implants. *Organization Science,* **5**(3), 344-362.

Greenwald, AG, Banaji, MR. 1995. Implicit social congition: Attitidues, self-esteem, and stereotypes. *Psychological Review,* **102**(1), 4-27.

Greenwald, AG, McGhee, DE, Schwartz, JLK. 1998. Measuring individual differences in implicit cognition: the implicit association test. *Journal of Personality and Social Psychology,* **74**(6), 1464-1480.

Greenwald, AG, Nosek, BA, Banaji, MR. 2003. Understanding and Using the Implicit Association Test: I. An Improved Scoring Algorithm. *Journal of Personality and Social Psychology,* **85**(2), 197-216.

Grégoire, DA, Barr, PS, Shepherd, DA. 2010. Cognitive Processes of Opportunity Recognition: The Role of Structural Alignment. *Organization Science,* **21**(2), 413-431.

Hart, SL. 2005. Innovation, creative destruction and sustainability. *Research-Technology Management*, 21-27.

Hodgkinson, GP, Langan-Fox, J, Sadler-Smith, E. 2008. Intuition: A fundamental bridging construct in the behavioral sciences. *British Journal of Psychology,* **99**, 1-27.

Jung, CG. 1969. *Studies in Word Association*: Taylor & Francis.

Kaminker, C, Stewart, F. 2012. The role of institutional investors in financing clean energy *OECD Working Papers on Fiannce, Insurance and Private Pensions* (Vol. 23): OECD Publishing.

Kaplan, S. 2008. Cognition, capabilities, and incentives: assessing firm response to the fiber-optic revolution. *Academy of Management Journal,* **51**(4), 672-695.

Kaplan, S. 2011. Research in Cognition and Strategy: Reflections on Two Decades of

Progress and a Look to the Future. *Journal of Management Studies,* **48**(3), 665-695.

Kaplan, S, Murray, F, Henderson, R. 2003. Discontinuities and senior management: assessing the role of recognition in pharmaceutical firm response to biotechnology. *Industrial and Corporate Change,* **12**(4), 203-233.

Khatri, N, Ng, HA. 2000. The Role of Intuition in Strategic Decision Making. *Human Relations,* **53**(1), 57-86.

Miller, CC, Ireland, DR. 2005. Intuition in Strategic Decision Making: Friend or Foe in the Fast-Paced 21st Century? *The Academy of Management Executive,* **19**(1), 19-30.

Peters, E, Slovic, P. 1996. The role of affect and worldviews as orienting dispositions in the perception and acceptance of nuclear power. *Journal of Applied Social Psychology,* **26**(16), 1427-1453.

Porac, JF, thomas, H, Baden-Fuller, C. 1989. Competitive groups as cognitive communities: the case of Scottish knitwear manufacturers. *Journal of Management Studies,* **26**, 397-416.

Rachlinski, JJ, Johnson, SL, Wistrick, AJ, Guthrie, C. 2009. Does unconscious racial bias affect trial judges? *Notre Dame Law Review,* **84**(3), 1195-1246.

Sadler-Smith, E, Shefy, E. 2004. The Intuitive Executive: Understanding and Applying 'Gut Feel' in Decision-Making. *The Academy of Management Executive,* **18**(4), 76-91.

Schumpeter, IA. 1959. *The theory of economic development*. Cambridge, MA: Harvard University Press.

Siegrist, M, Keller, C, Cousin, M-E. 2006. Implicit Attitudes Toward Nuclear Power and Mobile Phone Base Stations: Support for the Affect Heuristic. *Risk Analysis,* **26**(4), 1021-1029.

Sloman, SA. 1996. The Empirical Case for Two Systems of Reasoning. *Psychological Bulletin,* **119**(1), 3-22.

Sonenshein, S. 2007. The Role of Construction, Intuition, and Justification in Responding to Ethical Issues at Work: The Sensemaking-Intuition Model. *The Academy of Management Review,* **32**(4), 1022-1040.

Sonntag-O'Brian, V, Usher, E. 2004. Mobilising Finance for Renewable Energies *Renewable Energy Policy Network for the 21st Century (REN21).*

Swiss government. 2013. *Botschaft zum ersten Massnahmenpaket der Energiestrategie 2050*. Retrieved from http://www.news.admin.ch/NSBSubscriber/message/attachments/31931.pdf.

Swiss parliament. 2013. *Supporting pension funds' investments in the energy transition - answer to the interpellation 12.4232 from 27.02.2013*. Retrieved from http://www.parlament.ch/d/suche/seiten/geschaefte.aspx?gesch_id=20124232.

Tripsas, M, Gavetti, G. 2000. Capabilities, Cognition, and Inertia: Evidence from Digital Imaging. *Strategic Management Journal,* **21**(10/11, Special Issue: The Evolution of Firm Capabilities (Oct. - Nov., 2000)), 1147-1161.

Truelove, HB, Greenberg, MR, Powers, CW. 2013. Are Implicit Associations With Nuclear Energy Related to Policy Support? Evidence From the Brief Implicit Association Test. *Environment & Behavior,* **45**(8).

Uhlmann, EL, Leavitt, K, Menges, JI, Koopman, J, Howe, M, Johnson, RE. 2012. Getting explicit about the implicit: a taxonomy of implicit measures and guide for their use in organizational research. *Organizational Research Methods,* **15**(4), 553-601.

WEC. 2013. Time to get real - the case fo sustainable energy investment: World Energy Council.

Windisch, R, Friedrich, E, Wanner, A, Wüstenhagen, R. 2011. 9.7 Milliarden Franken für Strom aus erneuerbaren Quellen. *Schweizer Energieperspektiven,* **12**.

Appendix A. Design of the IATs for Study 1 and Study 2

In the following, we describe the setup of the test bottom up along the IAT's of study 1 and study 2. The easiest way to understand how an IAT works is to participate in one; demo tests are available online on the homepage of Project Implicit, which was founded by Greenwald, Banaji Nosek, who developed the IAT.

We start with the elements that appear throughout the whole test, then describe the two central constellations of the test and finally present the entire layout of the IAT.

Before starting the test, a table with all stimuli words presented to the participants what target word or association category each stimulus belongs to (see Table A. 1). An instruction below the table explained that in the following task, the participants would have to sort these words to the target or association categories the words belong to. Afterwards, the stimuli words each appeared one by one in the middle of the screen, and participants sorted them to the respective side of the screen.

Table A. 1. Stimuli of the energy-IAT of study 1 and study 2

Study 1	**Study 2**	**Study 1**	Study 2
Target words		Stimuli	
Photovoltaics	Solar Energy	solar cells, small-scale, solar energy, renewable energies	solar cell, renewable, solar energy, solar power plant
Gas	Gas	natural gas, large-scale, gas fired, fossil	gas, fossil, gas fired power plant, shale gas
Associations			
return	positive	growth, profit, cashflow, yield	return, growing market, high return, high market potential
risk	negative	insecure, policy risk, downside risk, hazard	loss, shrinking market, low return, low market potential

It is crucial that test participants know clearly which target word or association a stimuli word belongs to. As for the impact of the individual stimuli words themselves, De Houwer (2001) demonstrates that the IAT measures associations towards the main concepts, and not towards the individual stimuli words used in the test.

The most notable difference between study 1 and study 2 are the associations; for the development of study 1 we collaborated with finance specialists and used a wording that is as close to the investors' daily business as possible, therefore the associations risk and return. For the design of study 2 we collaborated with a psychologist who had experience with the IAT from earlier studies.

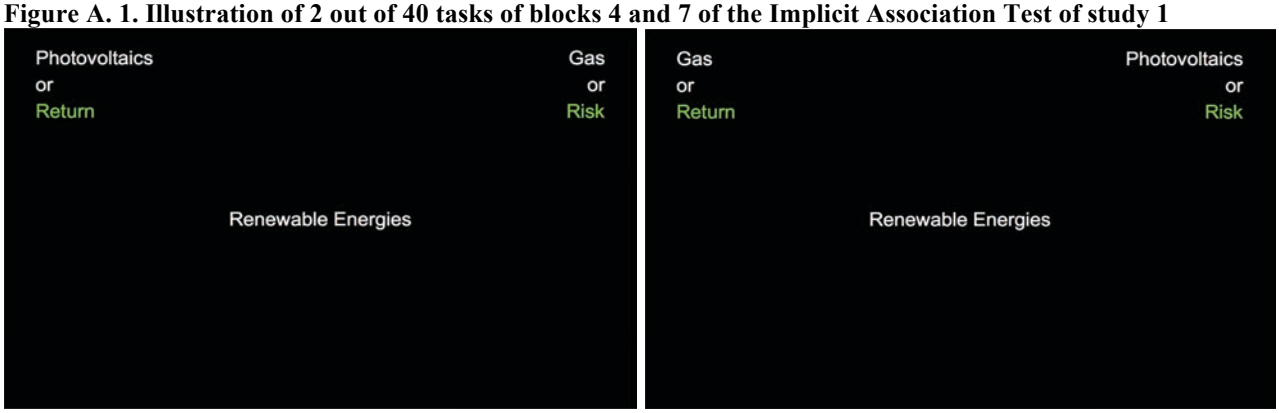
In order to resemble more to the initial version of the IAT from Greenwald et al. (1998), the associations in study 2 where „positive" and „negative". As the

associations in study 1 and 2 are different, so are the stimuli; for risk and return we used more finance-specific stimuli, whereas the stimuli for positive and negative in study 2 relate to the market development more generally.

Another small distinction between study 1 and study 2 is photovoltaics versus solar energy; solar energy seemed to be a more intuitive name than photovoltaics. However, these are methodological details, which should not affect the main result of the IAT (DeHouwer, 2001). The stimuli words for photovoltaics and gas are slightly different in the two studies, too; the experience from study 1 showed that the stimuli "small-scale" and "large-scale" were for some test participants not clearly associated to photovoltaics and gas, respectively. Therefore, we did not use them in study 2.

Throughout the test, participants had to group the words *as fast as they could*. Participants had to do this for different constellations. In one constellation the target word „Photovoltaics" and the association „Risk" were paired on one side of the screen, and „Gas" and „Return" on the other; in the other constellation „Gas" and „Risk" were paired on one side of the screen and „Photovoltaics" and „Return" on the other. The IAT measures differences in reaction times between the two constellations. The assumption of the test is that participants take longer reaction times within the constellation they find counterintuitive. Figure A. 1 illustrates the two constellations. The IAT-software (Inquisit 3.0) allowed randomizing which constellation came first.

Figure A. 1. Illustration of 2 out of 40 tasks of blocks 4 and 7 of the Implicit Association Test of study 1



By pressing either the e-key for stimuli that belong to the left or the i-key for stimuli that belong to the right, participants performed the reaction tasks. In the task on the left of Figure A. 1, the participant would press the "e"-key to sort the word "Renewable Energies" correctly to "Photovoltaics". In the task on the right, the participant would press the "i"-key, because the target word "Photovoltaics" appears now on the right.

If the categorization was false, the participant received this information and had to repeat the categorization. Reaction time was recorded in milliseconds. The entire IAT consisted of 7 different blocks – 5 practice blocks and 2 actual test blocks with twice as many reaction tasks as in the practice blocks. In the practice blocks, participants familiarized themselves with the test. The first practice block only presented the two associations "return" (study 2: "positive") and "risk" ("negative") and participants had to sort the stimuli words to the corner where the respective association appeared (in the example of Figure A. 1, words belonging to "return" ("positive") had to be sorted to the left by pressing the "e"-key, words belonging to "risk" ("negative") had to be sorted to the right by pressing the "i"-key. The second practice block presented only the two target words "Photovoltaics" ("Solar Energy") and "Gas" ("Gas") and the respective stimuli words had to be sorted 20 (16[54]) times. The third practice block combined the target words and the associations: 20 (32) times a stimuli word from Table A. 1 appeared and had to be sorted to the left or the right. The first actual test block (block 4) was exactly the same constellation as in block 3, but this time, 40 (32) stimuli words appeared. After block 4, target words switched sides. If "Gas" ("Gas") was on the left-hand side before, it now appeared on the right. The following two training blocks allowed participants to get used to this new constellation: in block 5, only the target words appeared, in block 6, the target words appeared together with the associations. The final test block 7 was the complement to block 4 (see Table A. 2 for an overview of the 7 blocks). Figure A. 1 displays screenshots of blocks 4 and 7 of study 1, the actual test blocks.

[54] The difference in number of trials between study 1 and study 2 relate to the softwares used to programme the test; we programmed study 1 with the software Milliseconds, whose developers advice the number of trials we used. Study 2 was programmed and hosted by Project Implicit themselves, who suggested a slightly different number of trials. The total of trials is 180 in study 1 and 176 in study 2.

Table A. 2. Design of the entire Implicit Association Tests, including training blocks (blocks 2, 3, 4 were randomly switched with blocks 5, 6, 7 for approximately half of the sample)

Block number and purpose		**Study 1**	**Study 2**	**Study 1**	**Study 2**	**Study 1**	**Study 2**
		Left key assignment		Right key assignment		Number of trials per block	
1	Understand what to do	return	positive	risk	negative	20	16
2	Practice	Gas	Gas	Photovoltaics	Solar Energy	20	16
3	Practice trials for combination of energy sources with associations	Gas return	Gas positive	Photovoltaics risk	Solar Energy negative	20	32
4	Test trials to measure associations of energy sources with associations	Gas return	Gas positive	Photovoltaics risk	Solar Energy negative	40	32
5	Get used to that energy sources switched side	Photovoltaics	Solar Energy	Gas	Gas	20	16
6	Practice trials for new constellation	Photovoltaics return	Solar Energy positive	Gas risk	Gas negative	20	32
7	Test trials to measure associations of energy sources with associations	Photovoltaics return	Solar Energy positive	Gas risk	Gas negative	40	32

Appendix B. Dependent Variable Energy Investments With Data From Study 2

We surveyed investments in energy sources in a detailed grid-item in which participants had to indicate via which asset classes they invest in which energy sources. In study 1, the grid item included seven asset classes, and participants had to indicate via which particular asset class (private or publicly listed equity, real estate, bonds, project finance, commodities or other real assets) they invest in the respective energy source. In study 2, we included four investment channels (project finance, shares, bonds) plus "others" (in order to save time for participants we merged the three least relevant answer options).

As Table B.1 shows, we collected detailed information about participants' investments in different energy sources. In order to reflect the environment of both strategic and financial investors adequately, we included different asset classes as possible investment channels as well as „others". Furthermore, we distinguished between investments the participant conducts himself in his daily business, investments of his or her company, and we were also interested in privately conducted investments.

In order to summarize the detailed data on energy investments for further analysis (e.g. regression analysis), we provide the number of asset classes a participant uses as investment channels below. In the subsequent analysis we focus on investments in photovoltaics and gas only, because our IAT also contrasted these two energy sources. The dependent variable we use to analyze the data of study 2 is given in Table B.2; it is the sum of asset classes a participant uses to invest in photovoltaics, *minus* the sum of asset classes a participant uses to invest in gas. We use *net* solar energy investments because (a) we mirror the setup of the IAT, which is also a measure of relative preference of one energy source over the other, (b) it allows us the cancel out the effect of systematically different investment patterns of financial versus strategic investors; as shown in Table B. 3, there is no significant difference in the dependent variable between strategic and financial investors.

Table B. 1. Investment channels to invest in energy sources and energy efficiency. Percentages indicate how many investors use the respective asset class

"Please indicate for each energy source, via which asset classes you yourself invest in them in your professional daily life. (Multiple answers per energy source allowed.)"	project finance				publicly listed equity				bonds				other			
	Overall (N=58)	Financial Investors (N=42)	Strategic Investors (N=16)	p-value of pr-test	Overall (N=58)	Financial Investors (N=42)	Strategic Investors (N=16)	p-value of pr-test	Overall (N=58)	Financial Investors (N=42)	Strategic Investors (N=16)	p-value of pr-test	Overall (N=58)	Financial Investors (N=42)	Strategic Investors (N=16)	p-value of pr-test
Energy efficiency	22%	14%	44%	0.016	36%	50%	0%	0.000	17%	21%	6%	0.171	22%	19%	31%	0.319
Photovoltaics	24%	14%	50%	0.005	36%	48%	6%	0.003	9%	10%	6%	0.691	21%	16%	31%	0.220
Gas	14%	5%	38%	0.001	29%	40%	0%	0.002	17%	21%	6%	0.171	12%	17%	0%	0.082
Wind energy	29%	12%	75%	0.000	38%	50%	6%	0.002	9%	12%	0%	0.149	10%	12%	6%	0.527
Nuclear energy	2%	0%	6%	0.102	12%	17%	0%	0.082	16%	19%	6%	0.229	7%	5%	13%	0.299

Table B.2. Net solar investments

Net solar investments (number of asset classes for PV minus number of asset classes gas; dependent variable study 2)			
	Overall (N=58)	Financial Investors (N=42)	Strategic Investors (N=16)
-1	26%	26%	25%
0	41%	50%	19%
1	22%	17%	38%
2	10%	7%	19%

Table B. 3. Average net solar investments with t-test for significant differences between strategic versus financial investors

Average net solar investments			
Overall (N=58)	Financial Investors (N=42)	Strategic Investors (N=16)	p-value of t-test
0.172	0.048	0.500	0.102

Appendix C. Robustness Check

Table C.1. Ordered logit regression model

	Study 1		Study 2	
VARIABLES	Net solar energy investments	Robust standard error	Net solar energy investments	Robust standard error
IAT-score	-0.767	0.893	0.495	0.640
IAT-score*strategic investor	2.223*	1.094	3.330*	1.361
Regulatory barriers			-2.012**	0.772
Regulatory barriers * strategic investor			4.207*	1.797
Strategic barriers			-1.022	0.647
Strategic barriers * strategic investor			-5.748*	2.435
Lack of capabilities			2.235	1.581
Lack of capabilities * strategic investor			-7.612	5.250
Age			-3.375**	1.252
Strategic investor	-1.683	1.069	-0.234	3.057
Bank			-1.014	1.520
CEO or member of the board			-0.105	1.231
Chief financial or investment officer			-3.006	2.239
Portfolio manager			-4.144*	1.889
Pseudo R2	0.173		0.489	
Prob > Chi2	0.006		0.000	
Observations	35		32	

All variables (except dependent variable) are standardized

** p<0.01, * p<0.05, # p<0.1

5 Paper IV

Wenn das grüne Produkt zum Standard wird
Wie ein Energieversorger seinen Kunden die Verhaltensänderung einfach macht[55]

Sylviane Chassot[*], Rolf Wüstenhagen[*], Nicole Fahr[†] und Peter Graf[#]

Zusammenfassung

Die Energieindustrie verändert sich grundlegend und dies betrifft uns alle. Der Ausbau erneuerbarer Energie wird von der Politik wie auch von den Kunden vehement verlangt. Deren Eigeninitiative beim Wechsel vom «Egalstrom» zum Ökostromprodukt ist jedoch gering. Ist die Änderung des voreingestellten Standardangebots die Lösung, so dass die Kunden quasi zum Wandel «geschubst» werden? Die Sankt Galler Stadtwerke haben diesen als Nudge bekannten Wandelansatz erfolgreich ausprobiert und dabei einiges gelernt.

When The Green Product Becomes the Default
How an Electric Utility Company Makes Behavior Change Easy for Customers

Abstract

The energy industry is changing radically and this affects us all. The expansion of renewable energy is demanded vehemently by politics as well as by customers. However, electricity customers' own initiative to change from conventional to green power products is low. Is the change of default offers the solution, so that the customers are "nudged" to change? The electric utility company of St. Gallen has successfully implemented a green default and gained new experiences.

Keywords: Electric Utility Company; Corporate Change; Case Study; Nuclear Phase Out; Green Default; Customer Acceptance; Eye Tracking

JEL codes: D22; D83; L94; M31; O38; Q42

---

[55] Paper IV is published as an article in *Zeitschrift OrganisationsEntwicklung* 13(3): 80-87.
[*] Institute for Economy and the Environment, University of St. Gallen, Switzerland.
[†] ZIEL Consulting, Switzerland.
[#] Sankt Galler Stadtwerke, Switzerland.

5.1 Einführung

Die Energieindustrie durchläuft fundamentale Veränderungen. Der Wechsel von fossiler und atomarer hin zu erneuerbarer Energie hat sich über Jahrzente angebahnt aufgrund verschärfter Klimaschutzgesetze, sich erschöpfender fossiler Ressourcen und politischer Risiken der Abhängigkeit von Öl- und Gas-Exporteuren. Durch den atomaren Unfall in Japan im März 2011 erhielt die «Energiewende» die notwendige öffentliche Aufmerksamkeit, um entscheidend voranzuschreiten. So entschieden sich die Regierungen Deutschlands und der Schweiz für den Ausstieg aus der Atomenergie. Für ein Energieversorgungsunternehmen (EVU) bedeutet diese Entscheidung eine große strategische Herausforderung – eine Aufforderung zum grundlegenden Wandel des Unternehmens. Bislang versorgten EVUs ihre Kunden mit einem Strommix, der im Schweizer Durchschnitt zu rund 40 Prozent aus Atomenergie besteht. Nun gilt es, diese 40 Prozent durch Investitionen in erneuerbare Energien und Energieffizienz sowie wo nötig Erdgas und Stromimporte zu ersetzen. Am anderen Ende der Wertschöpfungskette eines EVU wartet jedoch eine weitere Herausforderung: Der erneuerbare Strom muss nicht nur produziert und transportiert, sondern mittels ansprechender Produkte auch an Kundinnen und Kunden verkauft werden. Die in diesem Artikel beschriebene Fallstudie aus der Energiebranche zeigt, worauf beim Wechsel auf ein ökologischeres Standardprodukt zu achten ist und wie Kunden auf eine veränderte Vorauswahl reagieren. Daraus lassen sich auch Erkenntnisse für die Wirkung von «green defaults» in anderen Branchen ableiten.

Laut Ökostromumfrage 2010 bieten 507 der total 730 Schweizer EVU Stromprodukte aus erneuerbaren Energien an. Rund 15 Prozent aller Kunden nutzen diese Produkte, der Absatz aus Stromprodukten erneuerbarer Energien liegt bei 10 Prozent. Damit ist der Marktanteil des erneuerbaren Stroms seit Initiierung im Jahr 1998 rasant gewachsen. Jedoch bestehen diese umweltfreundlichen Produkte zur Mehrheit aus Wasserkraft, und der Absatz der neuen erneuerbaren Energien wie Windenergie oder Photovoltiak verharrt unter 2 Prozent. Soll der Atomausstieg nicht die Klimaschutzziele gefährden, muss daher der Stromabsatz der neuen erneuerbaren Energien bedeutend wachsen. Hier nun sehen sich viele EVUs mit dem Widerspruch konfrontiert, dass der Ausbau der erneuerbaren Energien zwar auf politischer Ebene beschlossen und laut Umfragen auch von Kunden gewünscht wird, jedoch fällt es schwer, die Wechselaktivität der Kunden weg vom «Egalstrom» zum erneuerbaren Produkt weiter anzuregen. Was können Unternehmen in dieser Situation tun?

Wenn der Prophet nicht zum Berg kommt...

...muss der Berg zum Propheten kommen. Dies haben sich beispielsweise die Stadtwerke Zürich bereits 2006 zum Motto gemacht und ein Ökostromprodukt als Standard-Produkt definiert, welches Stromkunden erhalten, wenn sie nicht explizit etwas anderes wünschen. Inzwischen tat es ihnen ein Dutzend Schweizer EVUs gleich. Andere jedoch schrecken vor dieser Umstellung zurück, oft wegen Bedenken, die Kunden damit zu bevormunden und zu verärgern.

Dass die Vorauswahl großen Einfluss auf das Kundenverhalten hat, wird oft mit dem Beispiel der Organspende illustriert: In Österreich liegt die Organspende-Rate bei 99 Prozent, in Deutschland bei 12 Prozent – in Österreich ist die Vorauswahl die Spende, das heisst, Verstorbene werden als Organspender betrachtet und Angehörige müssen die Initiative ergreifen, falls sie eine Organspende verhindern wollen («opt out»-System). Umgekehrt in Deutschland, wo das «opt in»-System gilt. In der Literatur zum Verbraucherverhalten wird hierbei von Entscheidungsarchitekturen gesprochen, und die Vorauswahl als wichtiges Element der Entscheidungsarchitektur wird Default genannt. Die amerikanischen Verhaltungsökonomen Richard Thaler und Cass Sunstein (Thaler und Sunstein 2008) sprechen vom «Schubs», den Kunden brauchen, um in komplexen Wahlsituationen die richtige Entscheidung zu treffen.

Ist der grüne Default legitim?

Laut einer Umfrage zu erneuerbaren Energien und Ökostrom (Hübner et al. 2012) ist die Bequemlichkeit der Kundinnen und Kunden das wichtigste Hindernis beim Stromwechsel. Eine Studienteilnehmerin erzählt:

«Das ist ne Erledigungsblockade haben. Todo-Listen schreiben, die man fleissig abarbeitet, um dann so'n paar kleine Punkte immer auf die nächste Liste mit rüberzuschieben. Und so ein paar Sachen werden halt immer weiter rübergeschoben, also ich hasse Papierkram. Bei mir wächst der immer an, bis ich mich dann irgendwann mal dransetze und den mache. Und dann gibt es so ein paar Sachen, die leg' ich zwar immer wieder oben drauf, aber die verschwinden dann unter dem Wieder-Anliegenden nach hinten. Also, ich glaub eigentlich ganz klassisch. Die Empörung, die man zwischendurch empfindet, reicht offensichtlich nicht aus, sich hinzusetzen.»

(Medienschaffende, interviewt von Hübner et al., 2012)

Dieser Person wäre ein Gefallen getan, würde das EVU von sich aus das Standardangebot auf einen ökologischeren Strommix umstellen. Aktiv eine Entscheidung zu treffen und das Stromprodukt zu wechseln, erfordert mehr Aufwand, als den Default zu akzeptieren. Dies ist laut Sunstein und Reisch (2013) ein Grund, warum Konsumenten den Default oft befolgen. Darüberhinaus werden zwei weitere Wechselhindernisse in der Literatur genannt:

• Kundinnen und Kunden nehmen den Standard als Empfehlung von Entscheidungsträgern wahr, und damit als Handlungsempfehlung.
• Psychologen haben den Besitztumseffekt nachgewiesen; das, was man «besitzt», hat automatisch mehr subjektiven Wert als das, was man nicht besitzt.

Nebst Bequemlichkeit und Preis ist die Trittbrettfahrer-Problematik ein weiteres Hindernis zum selbst initiierten Stromwechsel: Manche Kunden sind nicht gewillt, mehr für Ökostrom zu bezahlen, solange die Mehrheit den günstigeren Strommix konsumiert – die richtige Wahl im falschen System sei nur für die Nische der engagierten Konsumenten eine Option, so die Autoren Karsten und Reisch (2008). Die nachhaltige Wahl zur leichten Wahl zu machen, sei daher gerechfertigt, wenn die Mehrkosten für Kunden in einem günstigen Verhältnis stehen zum gesellschaftlichen Nutzen des umweltfreundlicheren Produkts.

Beispiele aus anderen Bereichen

Es gibt unzählige Beispiele, wo Unternehmen mit geschickter Entscheidungsarchitektur Alltagsentscheidungen lenken können – sowohl Entscheidungen der Kunden als auch Entscheidungen der eigenen Mitarbeiter. Ein Beispiel für letzteres ist der Papierverbrauch einer amerikanischen Universität. Indem die Standard-Druckereinstellung von einseitig auf doppelseitig umgestellt wurde, hat sich der Papierverbrauch der Universität um 44 Prozent (bzw. 4.650 Bäume) reduziert. Dies ist ein Beispiel für einen umweltschonenden und kosteneinsparenden Defaultwechsel. Ein weiteres Beispiel stammt aus der amerikanischen Altersvorsorge. Die Teilnahme am Vorsorgeplan 401k ist in den USA freiwillig. Zu Beginn zahlten Mitarbeiter in die firmeneigene Pensionskasse ein, wenn sie sich ausdrücklich dafür entschieden. Dies führte bei vielen Pensionskassen zu tiefen Teilnahmequoten. Ende der 90er Jahre haben stetig mehr Pensionskassen die automatische Teilnahme am

Vorsorgeplan eingeführt. Dies führte zu einem unmittelbaren Anstieg der Teilnahmequote um 35 Prozent (Madrian und Shea 2001).

5.2 Fallstudie

Die Ausgangssituation der Sankt Galler Stadtwerke

Im November 2010 sprach sich die St. Galler Bevölkerung in einer Volksabstimmung dafür aus, bis 2050 schrittweise aus der Kernenergie auszusteigen – ein klarer Auftrag an die Sankt Galler Stadtwerke, die ihre Kunden bis dahin mit einem Default-Strommix («Basispower») mit rund 50 Prozent Atomstrom, 40 Prozent Wasser, 8 Prozent Strom aus Kehrichtverbrennung, 1 Prozent fossil, 1 Prozent neue Erneuerbare versorgt hatten. Darüber hinaus hatten alle Stromkunden die Möglichkeit, ihren individuellen Mix aus «Aquapower», «Windpower» und «Solarpower» zu gestalten (vgl. Abbildung 4).

Abbildung 4. Stromtarife sgsw 2011 (vor dem Default-Wechsel)

basispower
Unser Mixstrom

Jährlicher Verbrauch des Kunden	< 48 MWh	> 48 MWh < 1000 MWh	> 1000 MWh
Hoch (7 – 20 h)	10,7 Rp.	8,9 Rp.	8,3 Rp.
Nieder (20 – 7h)	7,0 Rp.	6,3 Rp.	5,8 Rp.

aquapower
Strom aus Wasserkraft

	Preis	Anteil an # Kunden / MWh
Preiszuschlag zu Basispower	2,0 Rp./kWh	7% / 7%

windpower
Strom aus Windkraft

Preiszuschlag zu Basispower	7,0 Rp./kWh	0,2% / 0,06%

solarpower
Strom aus Sonnenkraft

Preiszuschlag zu Basispower	75,0 Rp./kWh	4,7% / 0,04%

Preise incl. MwSt., excl. Netzkosten, Metering

Peter Graf, Leiter Energie und Marketing bei den Sankt Galler Stadtwerken (sgsw), stand nach dem Abstimmungsresultat vor der Frage, wie der Volkswille in konkrete Stromprodukte umzusetzen ist. Ein möglicher Lösungsansatz war, den

Vertrieb der bestehenden Angebote erneuerbarer Energien auszubauen. Dies war seit der Lancierung der Ökostromprodukte im Jahre 2000 mit verschiedenen Methoden versucht worden: von Postversand bis zu telefonischer Kundenansprache – jedoch ohne zufrieden stellende Kosteneffizienz.

Der andere Lösungsansatz war, das bisherige Standardprodukt durch ein höherwertiges Stromprodukt zu ersetzen. Aber durfte man das den Kunden zumuten, oder wäre ein teureres Stromprodukt kontraproduktiv in einem demnächst auch für Kleinkunden liberalisierten Strommarkt?

Sankt Galler Stadtwerke (sgsw) in Stichworten

- Unternehmen zu 100% im Besitz der Stadt St. Gallen
- Anbieter und Netzbetreiber für Strom, Gas, Wärme und Wasser
- Investiert in jüngster Zeit in Glasfaser-Telekom-Netzwerk
- Geothermie-Projekt (3% des Strombedarfs der Stadt St. Gallen, 10-20% des Wärmebedarfs)
- 300 Angestellte, Betriebsertrag von 204 Mio CHF, 530 GWh Stromabsatz, Investitionen 46 Mio CHF (2011)
- Zusammen mit sechs weiteren regionalen EVUs Aktionär des Stromzulieferers SN Energie AG, welcher Wasserkraftwerke betreibt und auch Anteile an Schweizer und französischen Atomkraftwerken hält
- Öffentliche Abstimmung der Stadt St. Gallen vom 28. November 2010: 60%-Mehrheit für den Atomausstieg bis 2050 (sofern die Versorgungssicherheit gewährleistet ist)

5.3 2010 die Volksabstimmung, 2011 ein Forschungsprojekt...

Kurz nach der Volksabstimmung im November 2010 wurden die sgsw von der Universität St. Gallen angefragt, ob Interesse besteht, die Akzeptanz des «grünen Defaults» in einem Forschungsprojekt zu untersuchen. Ziel der Studie war,

- herauszufinden, worauf Kunden bei Stromprodukten achten, wenn sie sich im Prospekt oder im Internet über das Angebot informieren
- zu testen, ob ein Standardprodukt akzeptiert wird, selbst wenn es nicht das günstigste verfügbare Produkt ist.

Eye Tracking — Dem Kundenwunsch auf der Spur

Um zu sehen, worauf Kunden bei Stromprodukten achten – Ist es der Strommix, der Preis, das Label, die Empfehlung durch die Stadtwerke? – wurde eine Eye Tracking-Studie durchgeführt. Bei dieser Forschungsmethode setzen sich die Teilnehmer an einen Computer und betrachten ein Bild – in diesem Fall eine Internetseite mit Stromprodukten – und eine Kamera unterhalb des Computers (der

Eye Tracker) verfolgt die Blickbewegungen der Person (siehe Kasten für weitere Informationen zur Methode). Zu Beginn der Eye Tracking-Studie wurden die Teilnehmerinnen und Teilnehmer folgendermaßen instruiert:
«Stellen Sie sich vor, Sie wollen einen neuen Stromtarif bestellen. Im Folgenden werden Ihnen nacheinander verschiedene Anzeigen mit jeweils 4 Stromprodukten gezeigt. Nehmen Sie sich Zeit und entscheiden Sie sich jeweils immer wieder aufs Neue für eines der 4 Produkte. Wenn Sie sich entschieden haben, klicken Sie bitte mit der linken Maustaste in eines der vier Auswahlfelder, um Ihre Wahl zu bestätigen.»
In der Studie bekamen die Probanden neun Webseiten mit den (hypothetischen) Sankt Galler Stromprodukten zur Ansicht. In Abbildung 5 (erste Spalte) sind drei dieser neun Webseiten abgebildet. Variiert wurde jeweils die Darstellung des Preises und die Vorauswahl (Default). Der Default wurde auf drei verschiedene Arten dargestellt:
• Vorauswahl durch Kreuz
• Vorauswahl und Politikempfehlung auf gleichem Produkt
• Politikempfehlung höher als Vorauswahl

Auch die Wirkung verschiedener Preisdarstellungen wurde untersucht. Die Kosten eines Stromtarifes wurden entweder
• gar nicht erwähnt
• in Rappen pro Kilowattstunde angegeben, oder
• in Franken pro Monat auf Basis eines durchschnittlichen St. Galler Haushalts.

In jeder der 9 Darstellungen unverändert war die Beschreibung der vier zur Auswahl stehenden Stromprodukte. Um die Resultate der Eye Tracking-Studie zu validieren, beantworteten die Teilnehmer zusätzlich einen Fragebogen über erneuerbare Energien und Ökostrom. Somit dauerte die Teilnahme an der Studie insgesamt 30 bis 45 Minuten. 66 Kundinnen und Kunden der Sankt Galler Stadtwerke nahmen im Mai 2011 an der Studie teil, 58 Datensätze konnten für die vorliegende Eye Tracking-Auswertung verwendet werden. Die Auswahl der Probanden erfolgte nach einem Quotenverfahren, so dass die Stichprobe die St. Galler Bevölkerung hinsichtlich Alter und Geschlecht proportional abbildet.

Eye Tracking als Methode der Marktforschung

Eye Tracking als Teil der apparativen Methoden der Beobachtung ermöglicht die Messung des tatsächlichen Blickverhaltens von Rezipienten zum Zeitpunkt der Werbemittelnutzung. Mittels Blickaufzeichnung (Recording) kann so ermittelt werden, wohin die Aufmerksamkeit einer Person gezogen wird bzw. über was sie

gerade nachdenkt («Eye-Mind»-Hypothese). So kann mit Eye Tracking beurteilt werden, welche Elemente des Werbe-Stimulus (hier Strommix, Preis, Default-System, Gestaltung) wie lange betrachtet werden und welche Rolle sie in der Entscheidungsbildung spielen. Es können so Reaktionen bezüglich verschiedener Komponenten eines Werbemittels (hier Website) aufgezeichnet werden, ohne die «Ganzheit» des Stimulus zu beeinträchtigen (Djamasbi, Tullis & Siegel 2010, S. 308f.; Poole & Ball 2005, S. 3f).

Resultate des Forschungsprojekts

Anhand der mittels Eye Tracking aufgezeichneten Blickbewegungen konnte die Studie zeigen, worauf St. Galler Stromkundinnen und -Kunden bei der Beschreibung von Stromtarifen am meisten achten. Für jeden Studienteilnehmer wurden alle Blickbewegungen in einem Film registriert. Diese Information von allen Teilnehmern wurde zu sogenannten Heat Maps verdichtet. Je dunkler eine Stelle auf der Heat Map, desto länger wurde diese im Durchschnitt betrachtet (vgl. Abbilung 2, zweite Spalte).

Resultat 1: Strommix und Preis werden am längsten betrachtet

In Spalte 2 in Abbildung 5 ist erkennbar, dass

• jener Stromtarif, der günstiger ist als der Default, praktisch keine Aufmerksamkeit erhielt.

• die Beschreibung der Strommixes und der Preis am längsten betrachtet wurden.

• die Vorauswahl mit Kreuz weniger beachtet wurde als die Politikempfehlung.

Resultat 2: Politikempfehlung hat größeren Einfluss als Vorauswahl durch Kreuz

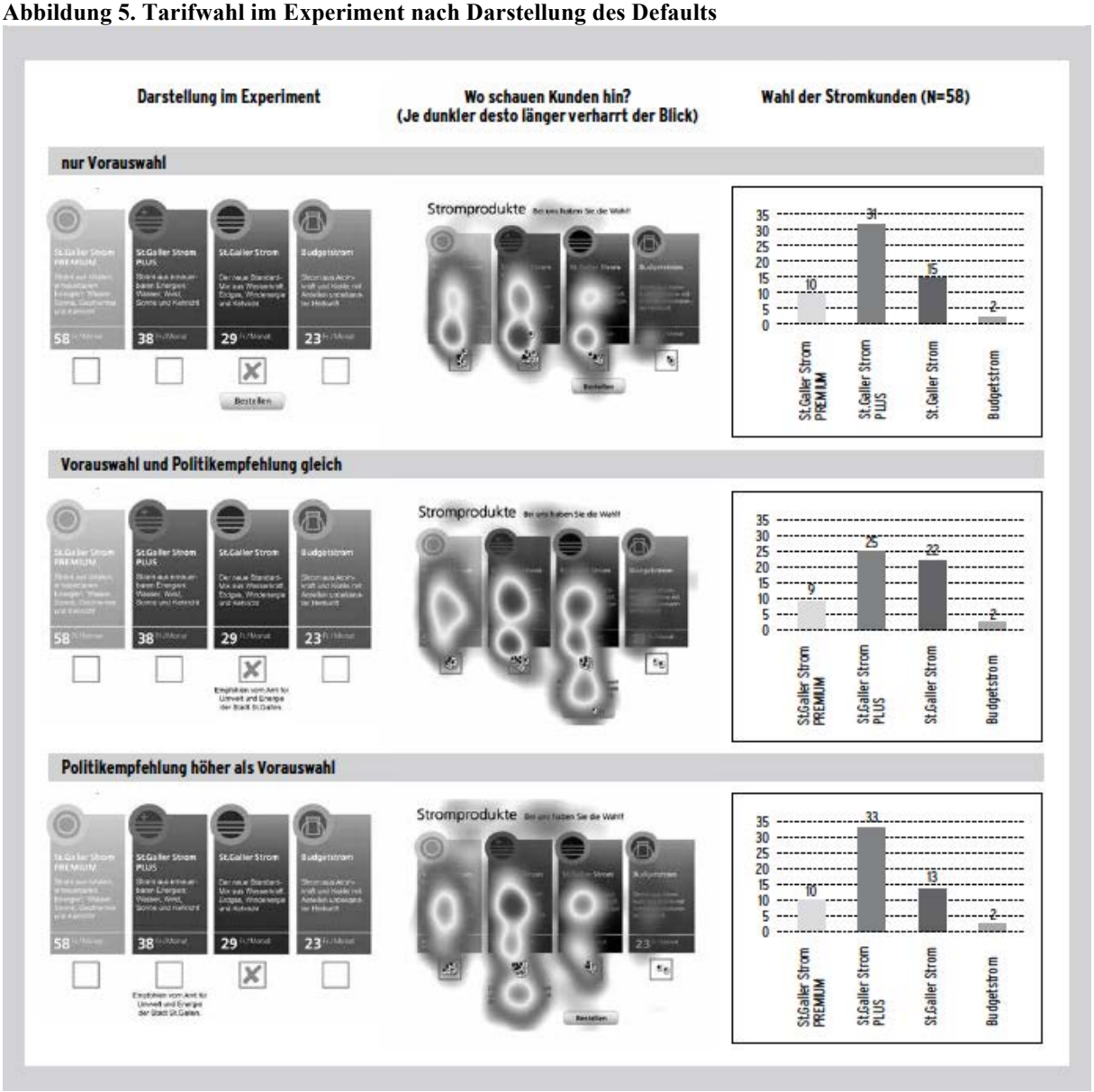
In Spalte 3 von Abbildung 5 sind die Wahlentscheidungen der 58 Teilnehmer für die drei in der ersten Spalte gezeigten Webseiten dargestellt. (Da hier die Wirkung des Defaults interessiert und nicht der Einfluss der Preisdarstellung, wird nicht auf Unterschiede nach Preisdarstellung eingegangen. Als Beispiel wurden die Webseiten mit Preisdarstellung in Franken pro Monat verwendet.)

Bei der Darstellung in Zeile 1 nur mit Vorauswahl durch Kreuz hat sich die Mehrheit für das Produkt entschieden, welches etwas teurer war als der Default. Das Produkt, das noch günstiger war als der Default wurde praktisch nicht gewählt. Ein Proband, welcher konstant das günstigste Stromprodukt gewählt hatte, begründete dies mit der oben erwähnten Free-Rider-Problematik – er werde nicht mehr Geld für Strom aus erneuerbaren Energien bezahlen, solange dies nicht alle Kunden täten.

In der Darstellung in der 2. Zeile wurde zur Vorauswahl durch Kreuz eine Politikempfehlung für das zweitgünstigste Produkt ergänzt. Dieses wurde nun deutlich häufiger gewählt als im Setting ohne Politikempfehlung.

In der Variante mit Vorauswahl auf St. Galler Strom und Politikempfehlung für den teureren St. Galler Strom Plus befolgte wiederum die Mehrheit die Politikempfehlung und nicht die Vorauswahl mit Kreuz.

Abbildung 5. Tarifwahl im Experiment nach Darstellung des Defaults



Zusammenfassend kann zur Wirkung des Defaults gesagt werden, dass ein Kreuz als Vorauswahl in der Studie bewirkte, dass das qualitativ schlechtere Produkt selten gewählt wurde, jedoch relativ oft ein Produkt, das noch besser war als die Vorauswahl durch Kreuz. Die Politikempfehlung hatte noch größeren Einfluss auf die Wahlentscheidung: Einige Studienteilnehmer wechselten von St. Galler Strom zu St. Galler Strom Plus, wenn dies auch die Politikempfehlung war. Jedoch wirkte die Politikempfehlung auch in umgekehrter Richtung: Einige Teilnehmer, die ohne

jegliche Politikempfehlung St. Galler Strom Plus gewählt hatten, wechselten zum ökologisch minderwertigen St. Galler Strom, wenn dies die Politikempfehlung war.

Resultat 3: Vorauswahl keine Bevormundung

Im Befragungsteil der Studie wurde nochmals genauer auf die Einstellung zum ökologischen Stromprodukt als Default eingegangen. Tabelle 3 zeigt, nur vier von 66 Befragten würden sich bevormundet fühlen, wenn der Standard-Mix neu ein Ökostrom-Produkt wäre. Die Mehrheit bewertete diese Maßnahme hingegen als sehr gut oder gut. Niemand befürchtete ein Versorgungsproblem bei einer Umstellung auf Ökostrom als Standard-Mix.

Tabelle 3. Frage zur Akzeptanz des «grünen Defaults» und Häufigkeit der Antworten

Welche der folgenden Aussagen entspricht am ehesten Ihrer Meinung, wenn der Standard-Mix neu der günstigste Ökostrom-Mix und nicht mehr die bisherige Basispower wäre?	
Finde ich sehr gut.	13
Finde ich gut. Denn viele Leute würden aktiv nichts unternehmen, um ihren Strommix zu wechseln, selbst wenn sie bereit dazu wären.	42
Die Umstellung ist akzeptabel, da immer noch die Möglichkeit besteht, sich für einen anderen Mix zu entscheiden.	7
Ich fühle mich durch die Vorauswahl bevormundet.	4
Es gäbe ein Versorgungsproblem, wenn alle die Vorauswahlen wählen würden.	0

5.4 ...2012 die Umsetzung

Im Mai 2011 kommunizierte Bundesrätin Leuthard den Atomausstieg auf nationaler Ebene. Damit war klar, dass die Stadt St. Gallen mit dem Abstimmungsresultat vom November 2010 keinen Irrweg eingeschlagen hatte, sondern für die sgsw eine wichtige Voraussetzung geschaffen hatte, in der Energiewende eine Vorreiterrolle zu übernehmen. Zeitgleich zur Erarbeitung eines neuen sgsw-Marketingskonzepts konkretisierten die Mitarbeiter des Bereichs «Netz Elektrizität» die Strategie, um Strom aus erneuerbaren Energien zu produzieren und ins Netz zu speisen. Das Beispiel sgsw zeigt, dass ein Default-Wechsel nicht nur die Absatzseite, sondern auch die Produktionsseite eines EVUs tangiert.

Nach der Ergebnispräsentation der Eye Tracking-Studie Ende Juni 2011 waren die Bedenken der Stadtwerke, der grüne Default wäre eine Bevormundung der Kunden,

empirisch widerlegt. Die Zusammenarbeit zwischen Universität und sgsw war damit offiziell beendet.

Im Januar 2012 wurde die Tarifänderung umgesetzt. Vier neue Produkte wurden kreiert. Alle Kunden wurden informiert, dass sie ab Januar 2012 neu den St. Galler Strom Basis (bzw. bisherige Ökostrom-Kunden erhielten nach wie vor ein höher wertiges Produkt) erhalten würden, sofern sie sich nicht aktiv für ein anderes Produkt aussprachen. Diese Änderung wurde für alle Kundensegmente gleichermaßen durchgeführt – sowohl für Haushaltskunden als auch Gewerbe und Industrie.
Um die sgsw-Kundinnen und -Kunden auf ihr neues Stromprodukt vorzubereiten, wurde Ende 2011 eine umfangreiche Kommunikationskampagne in der Stadt St. Gallen umgesetzt. Auf Plakaten, in Prospekten, auf einer speziell erstellten Homepage, in Zeitungsinseraten, via persönliches Anschreiben und Kinowerbung wurde über die Tarifrevision informiert.

Kundenreaktionen und finanzielle Auswirkungen

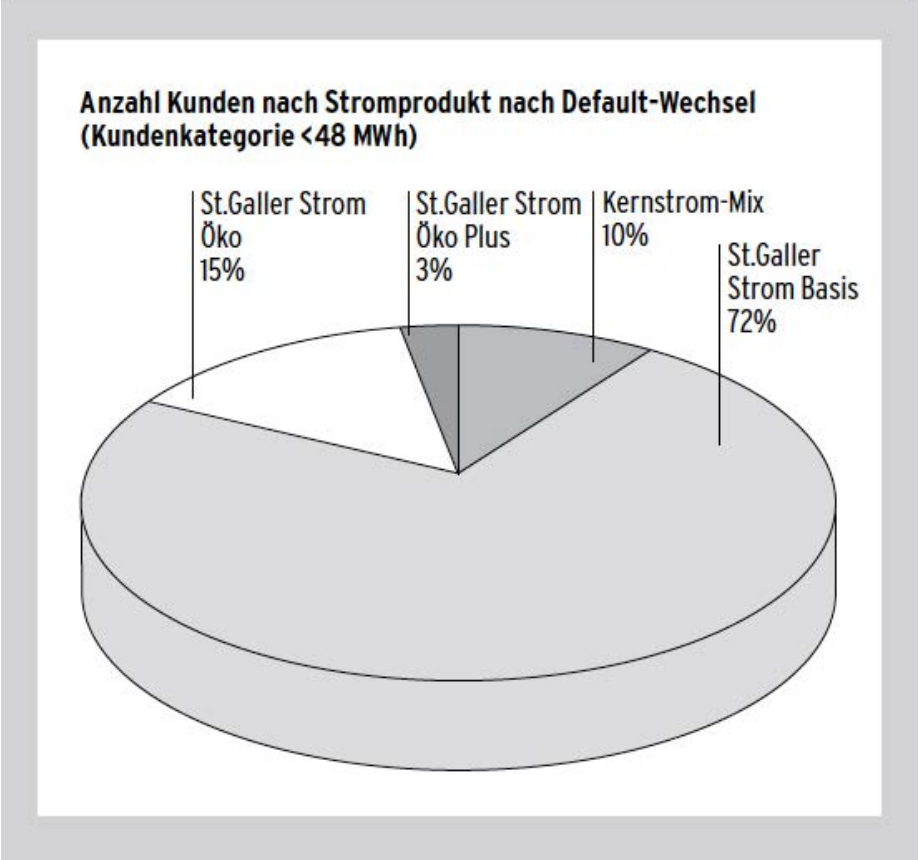
Am St. Galler Forum für Management Erneuerbarer Energien im März 2012 berichtete Peter Graf von den Kundenreaktionen auf den Default-Wechsel. Negative Reaktionen waren teilweise politischer Art («Die Energiewende muss politisch und global herbeigeführt werden!»/«Atomausstieg nein Danke») oder auch spezifischer zur Darstellung der neuen Produkte und Kommunikation durch sgsw («Es ist zu wenig genau beschrieben, was mit dem mehr verdienten Geld gemacht wird.»). Darüberhinaus gab es jedoch auch zahlreiche positive Reaktionen wie «Ich gratuliere zu dieser Initiative und mache gern dabei mit.» sowie wiederum konkretere Rückmeldungen zur Broschüre und der Art der Kommunikation («Schön, dass jede(r) Einzelne entscheiden kann, welche Stromgewinnung er/sie unterstützen will!»).

Kundenreaktionen in Zahlen ausgedrückt bestätigen die Resultate aus der Studie der Universität St. Gallen – die große Mehrheit hat den Default-Wechsel akzeptiert. Nur 10 Prozent haben zum günstigsten «Kernstrom-Mix» zurückgewechselt (vgl. Abbildung 6 für die Marktanteile der vier neuen Stromprodukte bei Privathaushalten). Bei Großkunden waren die Wechselraten höher als bei den Privathaushalten. Insgesamt macht damit der Kernstrom-Mix immer noch 43 Prozent des Stromabsatzes aus, der neue Default St. Galler Strom 42 Prozent, St. Galler Strom Öko 13 Prozent und St. Galler Strom Öko Plus 2 Prozent.

Durch den teureren neuen Default geht das EVU von einem jährlichen Mehrertrag von vier Mio CHF aus. Dieser steht jährlich für den Umbau von

Stromproduktionskapazitäten zur Verfügung. Aufgrund der gewählten Produkte haben die sgsw (Stand März 2012) einen jährlichen Zusatzbedarf von 2 Gigawattstunden Photovoltaik- sowie 6 Gigawattstunden Windkraft. Insbesondere bei der Photovoltaik konnten auch neue Projekte ermöglicht werden. Desweiteren sind Investitionen in neue Produktionskapazitäten geplant.

Abbildung 6. Marktanteil der neuen Stromprodukte bei Kleinkunden (März 2012)



5.5 Fazit

Das Beispiel lehrt:

• bei der Umsetzung einer Tarifrevision kommt es aufs Detail an. Die sorgfältige Planung der Produktgestaltung hinsichtlich Namen der Produkte, Preisdarstellung, Farben, Mix, lohnt sich.

• Flächendeckende und leicht verständliche Kommunikation der Maßnahme ist zentral, um verärgerte Kundenreaktionen abzufangen – und andere Kundensegmente sogar für die Veränderung zu begeistern.

• die graduelle Veränderung des Status quo führt nur sehr langsam – wenn überhaupt – zum Ziel. Mit jahrelangen Marketingbemühungen hatten die Sankt Galler Stadtwerke den Anteil Ökostromkunden von null auf gut 10 Prozent gebracht, mit dem

Default-Wechsel konnten weitere 80 Prozent der Privatkunden für grüne Produkte gewonnen werden.

Wenn auch in diesem Artikel nicht näher beleuchtet, so ist dennoch die enge Zusammenarbeit zwischen Energiebeschaffung, Netze und Vertrieb eine Voraussetzung für den Erfolg. Damit ist eine Tarifrevision nicht nur eine Marketingübung, sondern auch ein Thema der Organisationsentwicklung bei EVUs.
Das neue Default-Produkt der Sankt Galler Stadtwerke enthält noch immer 30 Prozent Atomstrom, welcher im Laufe der nächsten Jahre durch erneuerbare Energien – möglichst viel aus Eigenproduktion – ersetzt werden soll. Der Weg ist noch weit bis zum kompletten Ausstieg, welcher gemäß Energiekonzept der Stadt St. Gallen bis 2035 geplant ist.

Gleiches gilt für die gesamte Schweizer Energielandschaft; einige EVUs sind schon weit voran in der Umsetzung einer neuen, zukunftsgerichteten Energiestrategie, andere befinden sich in einer schwierigeren Ausgangssituation oder zweifeln am langfristigen Bestand der gegenwärtigen politischen Entwicklungen. Das Beispiel der Sankt Galler Stadtwerke zeigt, dass es sich lohnen kann, alte Zweifel zu überwinden und mithilfe der jahrzehntelang erarbeiteteten Kompetenz am fundamentalen Wandel der Schweizer Energieindustrie mitzuwirken.
Denn aus Kundensicht schlägt der Wechsel zu einem ökologischeren Produkt als Standard zwei Fliegen mit einer Klappe: Beziehen alle Kunden ein Ökostromprodukt, haben EVUs eine Antwort auf den Trittbrettfahrer-Einwand, und Kundinnen und Kunden haben einen Punkt weniger, den sie von ToDo-Liste zu ToDo-Liste übertragen müssen. Für Change Manager zeigt unsere Fallstudie auf, wie Abweichungen zwischen sich verändernden Kundenpräferenzen und tradierter Produktpolitik mit Hilfe einer Neudefinition des Standard-Angebots wieder in Einklang gebracht werden können. Oder einfacher gesagt: Definieren Sie das gewünschte neue Verhalten einfach als Ausgangswert, als «the new normal». Das Beispiel Sankt Galler Stadtwerke zeigt, dass aus einem solchen Projekt und der daraus entstehenden positiven Dynamik bei internen und externen Anspruchsgruppen frische Impulse für die Organisation ausgehen.

Literatur

Djamasbi, S, Tullis, T, Siegel, M. 2008. *Generation Y & Web Design: Usability Through Eye Tracking*. Paper presented at the Fourteenth Americas Conference on Information Systems (AMCIS), Toronto.

Hübner, G, Müller, M, Röhr, U, Vinz, D, Kösters, J, Simon, A, *et al*. 2012. Erneuerbare Energien und Ökostrom - zielgruppenspezifische Kommunikationsstrategien, from http://www.genanet.de/fileadmin/downloads/Strom_Wechsel_Frauen/Oekostrom_kurzfassung.pdf

Kaenzig, J, Heinzle, S,Wüstenhagen, R. 2013. Whatever the customer wants, the customer gets? Exploring the gap between consumer preferences and default electricity products in Germany. *Energy Policy,* **53**, 311-322.

Karsten, J, Reisch, LA. 2008. Sustainability Policy and the Law. *German Policy Studies,* **4**(1). 45-66.

Madrian, BC, Shea, DF. 2001. The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior. *Quarterly Journal of Economics,* **CXVI**(4). 1149-1187.

Poole, A, Ball, LJ. 2005. *Eye Tracking in Human-Computer Interaction and Usability Research: Current Status and Future Prospects*. Lancester: Psychology Department, Lancester University.

Sunstein, CR, Reisch, L. 2014. Automatically green: Behavioral economics and environmental protection. *Harvard Environmental Law Review*, **38**(1), 127-158.

Thaler, R, Sunstein, C. 2008. *Nudge*. New Haven & London: Yale University Press.

6 Paper V

Utility Companies as Choice Architects: Eye Tracking the Influence of Hard and Soft Default Rules on Electricity Tariff Choice Processes[56]

Sylviane Chassot[*]

Abstract

In order to comply with renewable energy policy targets and increase market share of renewable energy, electric utility companies have the option to implement a green electricity tariff as default offer. An eye tracking experiment shows how hard (preselection of one product option) and soft (policy recommendation) default rules influence consumers' choice process for an electricity tariff. To simulate this choice process, the eye tracking experiment consisted of dummy webpages with four tariff options from which participants had to choose. 66 Swiss electricity customers conducted nine choice tasks and the eye tracking camera recorded eye movements across tariff options and product attributes. If the preselection is combined with an explicit policy recommendation, total fixation duration and number of fixations on the dummy webpage as a whole are substantially lower compared to the choice tasks where the default appears only as preselection of one tariff. Furthermore, the study shows how different default rules influence the perception of the product attributes electricity mix and price. Whereas weighted fixation durations on the electricity mix are equivalent between choice tasks with and without policy recommendation, the share of fixation duration on price is significantly lower if a policy recommendation is given. In conclusion, consumers follow a more intuitive decision process under a policy recommendation and a more deliberate decision process if no policy recommendation is given.

Keywords: Eye Tracking; Deliberate Decision-Making; Intuitive Decision-Making; Electricity Tariff; Preselection, Policy Recommendation

JEL codes: D81; D83; M31; M38; O33; Q42

---

[56] This paper has been written for the Essay Seminar of the Ph.D. Programme in International Affairs and Political Economy at the University of St. Gallen in spring term 2014.

[*] Institute for Economy and the Environment, University of St. Gallen, Switzerland.

6.1 Introduction

Renewable energy policy is an essential element to tackle climate change. However, from electric utility companies' point of view, converting the power generation portfolio from conventional to renewable sources implies strategic challenges. Electric utility companies (EUCs) face a contradictory situation. On the one hand, according to public votes and consumer surveys, their customers favor electricity from renewable energy sources over conventional technologies such as fossil and nuclear. On the other hand, only a small fraction of electricity customers actively switch to a renewable electricity tariff (Burkhalter et al., 2009; Kaenzig et al., 2013; Litvine and Wüstenhagen, 2011). In Germany for example, yearly power generation from renewable sources amounts to 68 terawatt hours, whereas the consumption of green electricity amounts to about 16 terawatt hours (Herbes and Ramme, 2014). One explanation for this difference is that most renewable energy generators prefer to feed into the public grid and earn the feed-in tariff for the environmental added value, rather than selling renewable electricity via a green electricity tariff. However, with the step-wise decrease of the feed-in tariff in Germany and other countries, producers have to find new ways to market renewable electricity.

EUCs can approach marketing of green electricity products from two angles: they can target their customers with information campaigns such that customers switch to a green electricity product offer, or they can change the default electricity tariff from a product with conventional energy to one with renewable energy. Ölander and Thøgersen summarize the disillusioning performance of the information-based approach: "Information has not been proven a very successful means to promote voluntary behavior change to protect the environment". (Ölander and Thøgersen, 2014: 1). In the case of green electricity tariffs, information campaigns to raise public awareness are suitable to reach the market segment of environmentally active consumers, but are inefficient to conquer mass-markets (Chassot et al., 2013, which is Paper IV of this thesis). In Germany 18% of residential electricity customers have switched to a green electricity tariff (AEE, 2012). A recent household survey among Swiss residential customers reports a share of 26%[57] green electricity customers (Chassot and Wüstenhagen, 2014). Whereas this market share of green electricity tariffs already is remarkable, there still remains an attitude-behavior gap. According to

[57] The relatively high share of green electricity customers in Switzerland is to some extent due to the fact that an increasing number of EUCs already has implemented a green electricity tariff as default product (Chassot et al., 2013).

a yearly representative household survey, customers' desired electricity mix would only contain 10% conventionally generated electricity, whereas solar energy and hydropower, wind, biomass, geothermal energy and waste-to-energy would generate 90% of customers' desired mix (Chassot et al., 2011; Chassot and Wüstenhagen, 2013). Therefore, and due to increasing pressure to increase the share of renewable energies in particular in countries that have decided to phase out nuclear power, an increasing number of EUCs consider the implementation of a green default. As a case in point, this study emerged from a case study on the EUC from St. Gallen (Switzerland). After a public vote in November 2010 for the phase out of nuclear power in the city of St. Gallen, the local EUC was forced to adapt electricity tariff offers and "nudge" (Thaler and Sunstein, 2008) customers into an electricity tariff with less nuclear and more renewable energy. In order to assess how the customers of an electric utility company perceive and react to a green default, an eye tracking experiment with 66 electricity customers facing nine versions of a webpage with four hypothetical electricity tariffs has been conducted. After the study, the utility company of St. Gallen has changed the default electricity tariff to a mix with a higher share of renewable energies and a price-mark up of 9-14% for residential customers (for high and low tariff, respectively). As the eye-tracking experiment predicted, most residential customers stayed with the new default or even took the opportunity to upgrade to one of the two high quality products (see Chassot et al., 2013, for a detailed description of the case).

However, nudging has not remained without criticism. Skeptics argue that "opt-out" choice architectures (people get something unless they actively denounce) may not reflect people's true preferences (Keller et al., 2011). This implies that default options should only be implemented if people's preferences have been clarified before. Further criticism of nudges points out that opt-out settings may be counterproductive, stirring customers' skepticism why a certain option is the default and prompting them to opt out because of distrust (Brown and Krishna, 2004). In order to avoid opt-out reactions out of skepticism, choice architects need to understand how nudging influences consumer perception of a product or service offer – and why (or why not) consumers rely on nudges.

While the power of nudges has been widely demonstrated in different contexts (organ donation, saving behavior, printing, medical decisions), the question how choice architecture changes attention to product attributes such as price and quality points at a research gap. Thus, the purpose of this study is to show how defaults

change customers' electricity choice *process*, focusing on the role of product attributes unter different default settings.

6.2 Previous Research and Hypotheses

6.2.1 Adoption of Green Electricity

Previous research on the adoption of a green electricity tariff has profiled the typical green electricity customer (e.g. Diaz-Rainey and Ashton, 2010; Ozaki, 2011; Rowlands et al., 2003) and analyzed what distinguishes adopters from non-adopters. While this research is important to understand the process of diffusion of innovation from the start, it does not tell EUCs how to convince the remaining customers to switch to green electricity. Social psychologists argue that social influence is an important motivator for behavioral change – telling that the neighbour uses less electricity than the own household has proven one of the most effective measures to promote energy efficiency (Nolan et al., 2008). For the adoption of an electricity tariff, the impact of "social nudges" (Ölander and Thøgersen, 2014) is less clear. Litvine and Wüstenhagen (2011) tested the effectiveness of different information treatments in a field experiment with Swiss electricity customers. 10.4% of customers in the experimental group that received information on the benefit of green electricity switched indeed to a green electricity tariff after the intervention. Participants who received the social-norm treatment did not purchase green electricity after the intervention significantly more often than participants of the control group. Litvine and Wüstenhagen concluded that information on benefit of green electricity is one important factor to increase market share of green electricity. However, "at the same time, our findings provide a vivid illustration of the multitude of factors that need to come together in order to make real behavioural changes. Policies such as green defaults (Pichert and Katsikopoulos, 2008, Karsten and Reisch, 2008) that make such behavioural changes easy for customers may prove very beneficial. The results presented here also provide an empirical justification for such policies in that 73% of consumers in our study reported positive attitudes to renewable energy, so current defaults in the electricity market seem to be far from maximizing customer value (Burkhalter et al., 2009)." (Litvine and Wüstenhagen, 2011: 471).[58]

[58] For additional evidence on residential electricity customers' preference for renewable over nuclear and fossil energy see Greenberg (2009) for a review, and Chassot et al. (2011), Chassot and Wüstenhagen (2012, 2013, 2014), Burkhalter et al. (2009) and Siegrist et al. (2006) for evidence from Switzerland.

From a rational choice point of view, the most obvious explanation for relatively low adoption rates of green electricity is that costs are too high compared to the benefit customers get. Several studies focus on consumers' willingness to pay for green electricity. In a conjoint experiment with German customers, Kaenzig et al. (2013) showed that residential customers are willing to pay 16% more for an electricity tariff that is consistent with customers' preferences from an environmental point of view. Similar results are found with Swiss residential customers (Burkhalter et al., 2009). To measure willingness to pay for conventional versus green electricity tariffs, these studies confront customers with different product options, always including price information. Other surveys from German-speaking Europe show that the majority of customers *do not even know* how much they currently pay for electricity (Chassot et al., 2011).

In short, what is observed in the electricity market is a typical case of an attitude-behavior gap. Interviews with electricity customers illustrate the reason for this gap very visibly: "I intend to change supplier that is more green, but haven't got round to it. You know, when you've got all sorts of things to do at home and you mean to do and you don't. Changing electricity tariff requires thinking and research and involves hassle." (Ozaki, 2009: 9). A similar quote can be found in Chassot et al. (2013) where an electricity customer describes how she moves the change to a green electricity tariff from to-do list to to-do list. The implementation of a choice architecture that facilitates the purchase of a green electricity tariff would be a relief to these customers.

6.2.2 Choice Architecture, Nudges and Defaults

Choice architecture encompasses all elements that define how a product or service is presented to consumers – the number of options, the range, presentation of different product attributes, recommendation for some options, etc. **Nudges** can be considered as the tools used to optimize choice architecture: "A nudge, as we will understand the term, is any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives", (Thaler and Sunstein, 2008: 6). A **default** is one type of a nudge that has particularly strong influence on consumer choice (see Johnson et al. (2012) for a detailed review of nudging tools). Polak et al. (2008) distinguished hard from soft defaults, where a hard default is the preselection of one product option, and a soft default is a recommendation for one option. In light of critics on nudging as a paternalistic policy approach, it is important to note that nudges are appropriate only if

certain conditions are met. Thaler and Sunstein (2008, as cited in Ölander and Thøgersen, 2014) listed the following:

- choices have a delayed effect
- choices are difficult
- choices are infrequent (learning not possible)
- feedback is poor
- relation between choice and outcome is ambiguous

A residential customer's choice of an electricity tariff fulfills all of the above conditions. The choice has a delayed and indirect effect. Green electricity customers do, in the physical sense, still get the same electricity as everybody else. However, the EUC has to guarantee that the total electricity mix has the same share of green electricity as the EUC has green electricity customers. Thus, the effect of purchasing a green electricity tariff has an indirect and delayed environmental benefit through the overall portfolio of the EUC. Choosing an electricity tariff certainly is a difficult task for the majority of customers, as it is a highly abstract product. The fact that choices do not have to be made on a frequent basis does not enhance customer engagement and knowledge on electricity tariff options either.

A series of studies has addressed the question why nudges, and defaults in particular, work. One of the most prominent explanations is inertia (e.g. Sunstein and Reisch, 2013). However, defaults have also proven to work if the choice task is merely clicking on one option on a webpage. For this kind of task, which requires little time and effort, additional explanations are needed. Beyond inertia, one of the most accepted theoretical explanations for the power of defaults is that they are perceived as policy recommendations (Madrian and Shea, 2001; Pichert and Katsikopoulos, 2008). McKenzie et al. (2006) demonstrated that the participants of a series of experiments indeed perceived defaults as policy recommendation and that the perception of a policy recommendation has a causal effect on the choice.

6.2.3 Decision-Making Processes Under Default Rules

Regarding the impact of nudges on choice processes, it is commonly understood that nudges reduce cognitive (over)load (Johnson, 2007; Iyeanger and Lepper, 2000). More specifically, Göckeritz et al. (2010: 514) concluded that nudges influence behavior "through a rather nonconscious, peripheral route of information processing". In addition to showing that nudges *influence* behavior without consumers' conscious

awareness, Göckeritz et al. (2010) found that individuals who rely more strongly on nudges follow a more intuition-based decision *process, overall*. Horstmann et al. define the two processes as follows. “Intuitive processes, on the one hand, are described as unconscious, automatic, fast, parallel, effortless, and having a high capacity. Deliberate processes, on the other hand, are thought to be accessible to conscious awareness, slow, sequential, effortful, rule-governed and having a limited capacity.“ (Horstmann et al., 2009: 4).

What remains unclear at this stage is whether nudges *transform* the whole decision-making process from a deliberate into an intuition-based process, or if those consumers who strongly rely on nudges are ex ante less willing to deliberate and would anyhow make an intuitive choice, with or without nudge. In order to address the research question whether and how nudges transform the descision-making process, a within-subjects design where the same participants fulfill choice tasks with different choice architectures is required.

6.2.4 Methodological Issues

To capture the type of decision processes under different choice architectures, process data is needed (Johnson et al., 2008). Rubinstein (2007) simply measured decision times and concluded that fast decisions are based on intuitive reasoning, as opposed to slower decisions from deliberate reasoning. In a subsequent publication, Rubinstein still concluded from decision times on decision mode, but combined time-measures with eye tracking (Rubinstein, 2008). Similarly, Horstmann et al. consider fixation durations measured in eye tracking experiments as “reliable proxy for levels of processing” (2009: 3). Horstmann et al. instructed participants of their eye tracking experiments to decide either intuitively in one experimental condition or deliberately in the other condition, and recorded gazing patterns. They found that “participants in the deliberate condition showed a higher number of fixations compared to participants deciding intuitively”, and conclude that “the higher number of fixations in the deliberate conditions is due to a higher percentage of inspected information and to more repeated information inspections.” (2009: 14). However, fixation durations were not significantly longer under deliberate decision-making compared to fixation durations under intuitive decision-making. Thus, a combination of fixation durations and fixation counts is a more reliable approach to capture decision modes than only relying on decision times.

Contemporary computer-based eye tracking research to infer on cognitive processes has started in the 1970, (see Rayner, 1998, for a review). In an eye tracking experiment, subjects are confronted with one or several visual stimuli. On the stimuli, the experimenter defines different areas of interest. Eye tracking data show how long and how often different areas of interest the subjects focused on. Areas of interest can for example be different products or product attributes, or both. The crucial assumption of eye tracking studies is the eye-mind hypothesis; by capturing what the subjects focus on, the experimenters can learn something on what subjects think about (Rayner, 1998). In this sense, eye-tracking studies deliver similar information as conjoint experiments do. Simulating several choice tasks with different levels of product attributes such as price and quality, the choice decisions in a conjoint experiment allow inferring on relative importance of the individual product attributes for product choice. The analogue data to relative importances from an eye tracking experiment are fixation durations and fixation counts on product attributes. Meissner and Deckner (2010) suggested combining the two methods to capture decision weights of product attributes through conjoint, and gain additional information on the decision process from eye tracking. For the choice of an electricity tariff, Kaenzig et al. (2013) and Burkhalter et al. (2009) conducted conjoint experiments with German respectively Swiss electricity customers and found that electricity mix is the most important product attribute, followed by price.

6.2.5 Hypotheses

This study suggests that with a soft default (i.e. policy recommendation) for one electricity tariff option, participants employ a more intuition- than deliberation-based decision process. Using the same eye tracking technique as Horstmann et al. (2009), the following hypotheses are tested:

H1a: In choice tasks with policy recommendation, overall fixation duration is shorter than in choice tasks without policy recommendation.
H1b: In choice tasks with policy recommendation, fixation counts are lower than in choice tasks without policy recommendation.

Regarding the question how nudges influence attention to specific product attributes, one interesting finding stems from Heinzle and Wüstenhagen (2012). In a conjoint experiment the authors tested how different versions of the European Union

energy label affected relative importance of product attributes. If energy efficiency was indicated with the previously used label A-G, importance of the label for consumer decision-making was substantially higher than if the label was written in its new and less comprehensible version A+, A++, A+++. Furthermore, under the A+ condition, price was significantly more important for product choice with average relative importance of 43%, as opposed to 35% if the efficiency label was presented as A–G. Heinzle and Wüstenhagen (2012) concluded that without clear guidance through a well known and comprehensive energy efficiency label, consumers pay more attention to price. The present study further analyses if the same effect occurs for the choice of an electricity tariff:

H2: In choice tasks with policy recommendation, fixation duration on the price of the electricity tariffs is lower than in choice tasks without policy recommendation.[59]

6.3 Method

6.3.1 Experimental Design

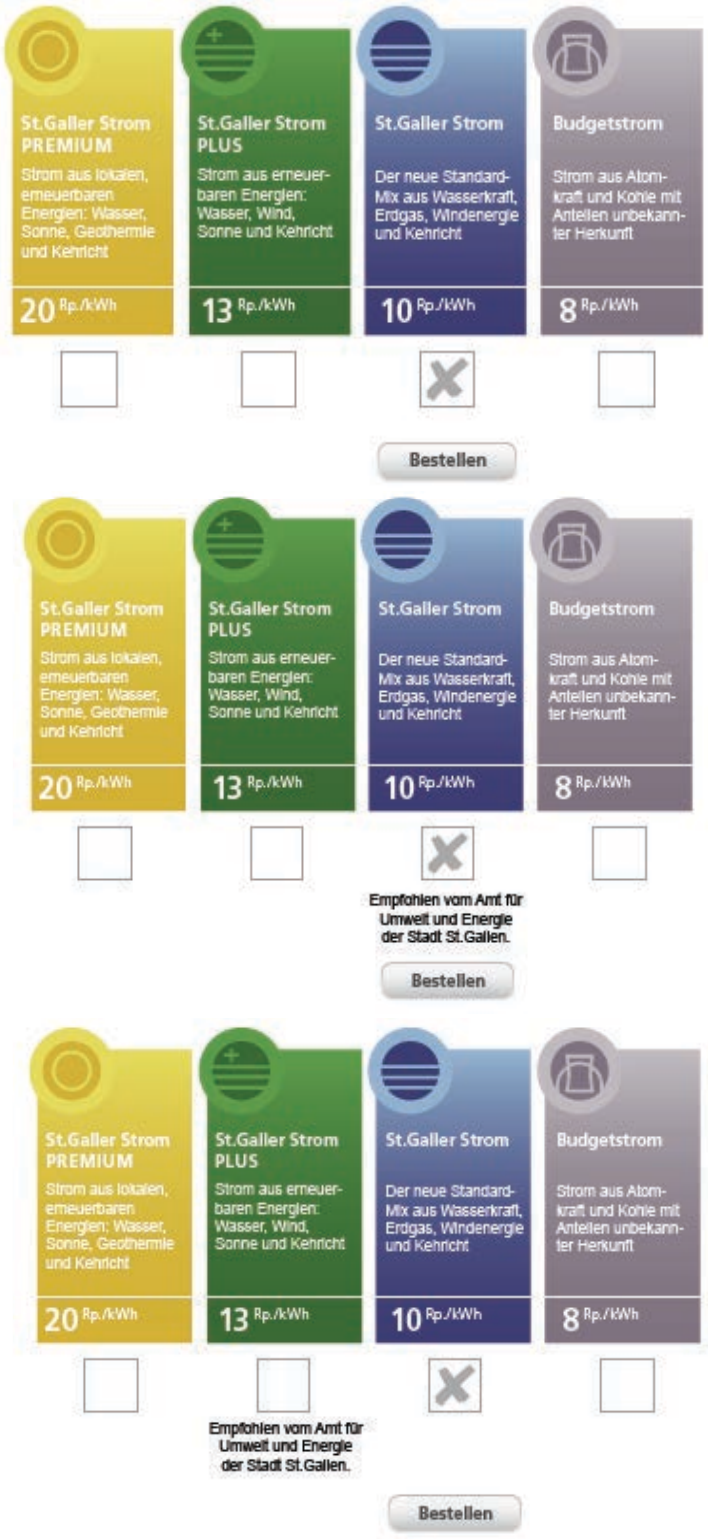
To isolate the effect of a soft default on choice of an electricity tariff, the eye tracking experiment consisted of choice tasks with and without policy recommendation. Specifically, the visual stimulus was a dummy webpage with four electricity tariff options. Each option was given a product name and an emblem representing the main electricity source of the tariff, a description of the mix, and a price. Areas of interest where these three product features, and the default rule. In all nine choice tasks, a hard default in form of a cross for the second cheapest tariff was given. In six choice tasks, the hard default was complemented by a soft default, the policy recommendation, which read "Recommended by the office for the environment and energy of the city of St. Gallen". The policy recommendation was either on the same product as the preselection, or on the second best tariff (see Figure 8 for an illustration of each default setting). In addition to the default, price information was varied. The price of the electricity tariff was either in terms of monthly costs for an average household, in terms of cents per kilowatt-hour, and in three choice tasks, no price information appeared. In sum, two areas were presented in three different ways,

[59] The effect on attention to price is only tested with fixation durations, because fixation counts on individual product attributes was not retained from the experiment.

which led to nine different versions of the choice task. While choice tasks without price information came first, the sequences of tasks was otherwise randomized.

The stimuli were presented on a 17'' monitor. Eye movements were recorded with a Tobii X120 Eye Tracker. This eye tracker tolerates a participant's head movements to a certain extent. Participants could thus move in a natural manner, which ensures validity of the results. The experimental procedure was as follows. Participants, in this case customers of the EUC of St. Gallen, were invited for a visit at the University of St. Gallen.[60] Average duration of one experiment was 30 to 45 minutes. In order to avoid long wait, every participant was assigned a date and time. The experimenter asked participants to sit in front of the computer where the eye-tracking camera was installed. Participants were informed that their eye

Figure 8. Three of nine choice tasks of the eye tracking experiment simulating the choice of an electricity tariff



[60] The eye tracking experiment was conducted by a master student of the University of St. Gallen (Fahr, 2011) under supervision of Prof. Dr. Rolf Wüstenhagen and guidance from the author of this paper.

movements would be recorded. On the first screen that appeared, participants read the following instruction: “Imagine you would order your electricity tariff. In the following you will see several webpages with four tariff options on each page. Take your time and choose one tariff on each webpage. Once you have chosen a product, please click on it to confirm your choice.” Between each choice task, a blank screen appeared for a few seconds. After the choice tasks, the experimenter and the participants looked at the recordings of the participant’s eye movements. Participants were given the opportunity to comment their decision making process to the experimenter, who documented this information in the eye tracking protocol. A series of additional socio-demographic and attitudinal items complement the final database.

6.3.2 Sample

Target population of this study was the residential customer base of the EUC of the city of St. Gallen, comprising of 53,000 households. The final sample consists of 66 participants, who were recruited in a quota process in order to assure representativeness regarding gender and age. Residents of the city of St. Gallen were contacted via email or by letter. As an incentive to participate, three coupons worth 50 Swiss francs and one DVD-video were raffled. Due to irregular gazing patterns, eye-tracking data of eight participants could not be included in the final analysis.

Table 7. Sample characteristics (N=58)

Age (years)	20-29	24.1%
	30-39	17.2%
	40-49	19.0%
	50-59	19.0%
	60-69	12.1%
	70-79	8.6%
Gender	female	51.7%
	male	48.3%
Yearly income in CHF	0-50,000	24.1%
	50-100,000	43.1%
	100-200,000	24.1%
	above 200,000	3.5%
	no information	5.2%
Education	High school	34.5%
	College	6.9%
	University degree	46.6%
	PhD	10.3%
	Other education	1.7%

6.4 Results

For a first visual impression of the eye tracking data, heatmaps provide a helpful summary of fixations per stimulies. The darker an area, the longer was the total fixation duration of the entire sample. **Figure** depicts heatmaps for the three dummy webpages from Figure 8. The heatmap on the left shows that without policy recommendation, the (blue) default tariff serves as a threshold, as very few fixations are on the cheapest "budget" electricity tariff. The "premium" product on the left gets the most attention. While it is interesting to observe participants' attention to the product options, this article focuses on attention to product attributes across products.[61] The heat map on the left shows that the product attributes mix and price both get considerable attention.

Comparing the heat map without policy recommendation (upper heat map in Figure 9) to the other two with recommendation (lower heat maps in Figure 9) gives a first impression how attention changes with a policy recommendation. The clearest difference is that fixations on price are clearly longer without policy recommendation. Furthermore, while in the setting with only the hard default, attention was drawn to the high quality products on the left, on the webpages with a policy recommendation the focal area shifts to the recommended tariff.

Figure 9. Heat maps for three out of nine stimuli (from left to right: only hard default, soft default on same product as hard default, soft default higher than hard default, price always in cents / kwh)

[61] For a discussion of product choice data, see Chassot et al. (2013).

6.4.1 Fixation Duration and Fixation Counts

The numerical analysis of fixation duration and fixation counts per choice task confirms the hypothesis that decision process is more intuitive with than without policy recommendation. This result holds both for fixation counts and fixation durations.

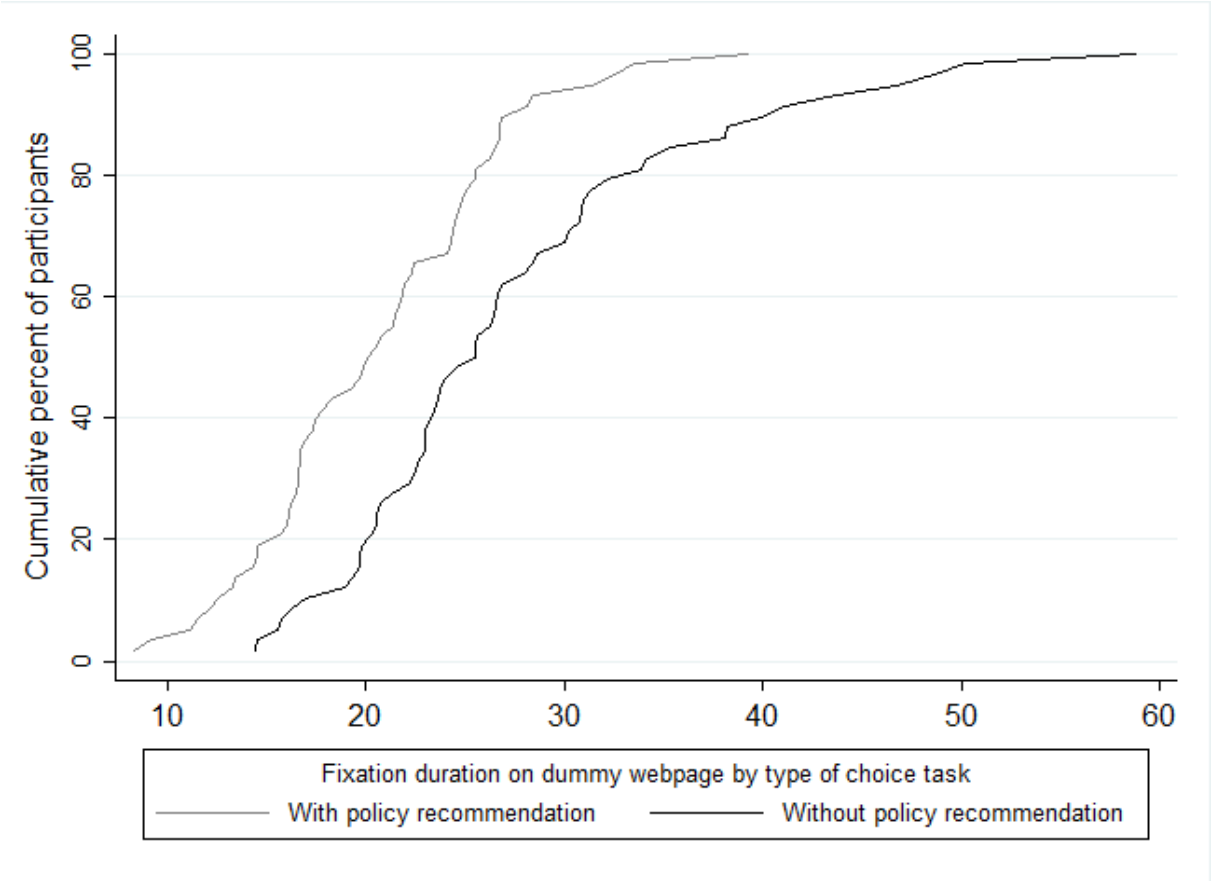
For comparison of results with and without policy recommendation, a mean value per person for dummy webpages with and dummy webpages without policy recommendation was calculated. Average fixation duration in the choice tasks without policy recommendation was 27.5 seconds until participants chose one tariff option. With policy recommendation, average decision time was 20.6 seconds. This difference is quite substantial, in particular in due consideration that the policy recommendation was additional information that participants had to read and process. Together with the fact that fixation counts are significantly lower, too (50 vs. 62), the results indicate a more intuitive decision making process with policy recommendation (Horstmann et al., 2009).

Table 8. Summary statistics of eye tracking data for dummy webpages with and without policy recommendation

	Fixation duration (N=58)		Fixation counts (N=58)	
	Seconds	p-value (t-statistic)	N	p-value (t-statistic)
Without policy recommendation	27.474	0.000	62.167	0.000
With policy recommendation	20.565	(6.630)	50.069	(5.053)

Figure 9 shows the distribution of fixation durations on webpages with and without policy recommendation. Minimum fixation duration with recommendation is eight seconds, maximum duration is 39 seconds. Without recommendation, the minimum is 14 seconds, the maximum 59 seconds. The degree of heterogeneity within the same type of decision task is large but not unusual. Rayner (1998) found that the shortest and longest fixation durations to read a text passage differ by factor five.

Figure 9. Cumulative line plots for fixation duration in seconds by choice task with and without policy recommendation



6.4.2 Panel Data Model to Rule Out Confounding Effects

The within-subjects design of this experiment helps to ensure that differences in decision times and fixation counts are not due to individual characteristics such as gazing types or socio-demographics, but due to the way the stimuli were presented. To rule out a potentially confounding effect of personal characteristics on differences in the decision process under different default rules, panel data regression models were estimated with random effects (Table 9). The dependent variables were fixation duration (model 1) and fixation counts (model 2). Explanatory variables were the type of nudge, but also personal characteristics of participants. Only the type of nudge (whether a policy recommendation was included, and if so, on which tariff) has a significant impact on fixation duration and fixation counts. Thus, the personal characteristics age, income, sex or education do not explain the differences in the decision process. As discussed before, the significantly negative coefficients for webpage dummies with both defaults on the same product (first line) and a higher soft

than hard default (second line) indicate lower decision times and less fixations for choice tasks with than without policy recommendation.

Table 9. Panel data regressions with random effects

Variables	(1) Total fixation duration	(2) Fixation counts
Both defaults on same product[1]	-0.490***	-0.334***
	(0.091)	(0.087)
Soft default higher than hard default[1]	-0.663***	-0.499***
	(0.091)	(0.087)
Age	0.106	0.002
	(0.090)	(0.103)
Gender (female)[2]	0.025	-0.138
	(0.177)	(0.201)
Income 50-100,000[3]	-0.066	-0.346
	(0.191)	(0.217)
Income 100-200,000[3]	0.005	-0.247
	(0.286)	(0.326)
Income above 200,000[3]	0.095	0.168
	(0.456)	(0.519)
Income no information[3]	0.180	-0.060
	(0.385)	(0.438)
College[4]	0.282	0.399
	(0.326)	(0.371)
High school[4]	-0.013	0.047
	(0.186)	(0.212)
PhD[4]	-0.317	-0.219
	(0.332)	(0.378)
Other education[4]	-0.387	-0.405
	(0.608)	(0.692)
Constant	0.410*	0.541**
	(0.235)	(0.265)
Observations	522	522
Number of recordings	58	58

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The variable age with six levels is treated as a numerical variable. Dependent variables and age are standardized.

[1] Reference group: dummy webpages without policy recommendation

[2] Reference group: male participants

[3] Reference group: participants with yearly income of 0-50,000 CHF

[4] Reference group: participants with an academic degree (bachelor, master, MBA)

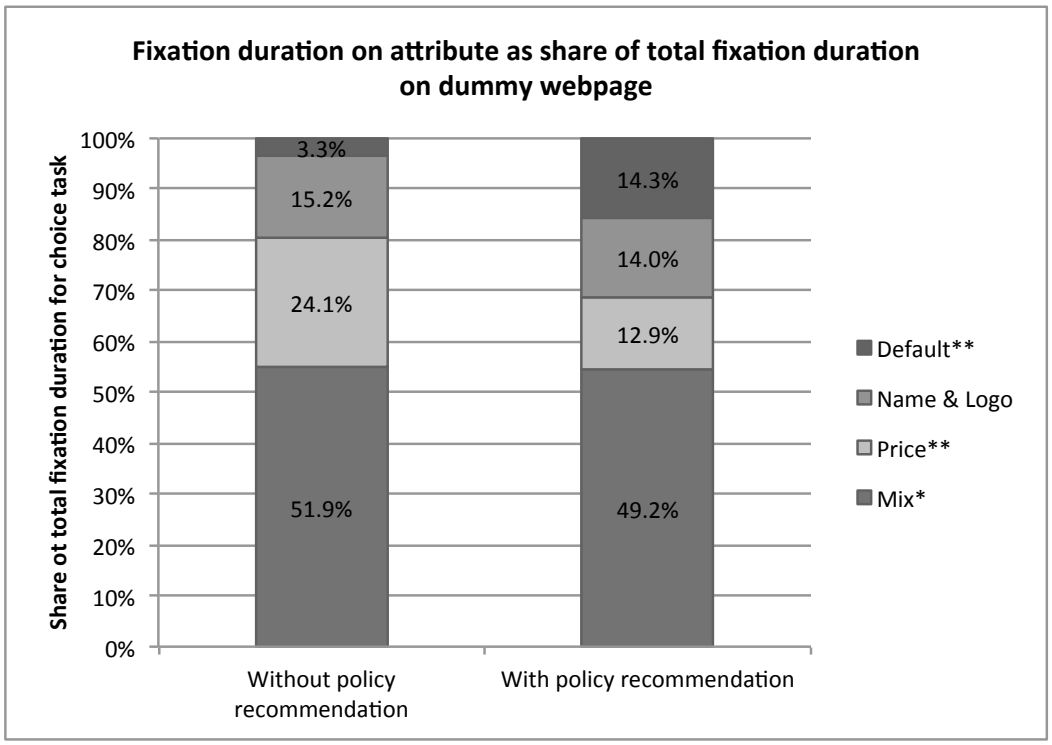
6.4.3 Fixation on Product attributes[62]

Fixation duration was also recorded for individual product attributes, which were electricity mix, price, name and logo of the tariff, plus the default setting. Figure 10 shows average fixation durations as a share of total fixation duration on the webpage. The share of total fixation duration is the appropriate operationalization here in order to cancel out variation in absolute decision times (cf.

Figure 9). The comparison by attribute confirms the hypothesis that attention to price decreases if a policy recommendation is given. Put differently, fixation duration on the prices of the four electricity tariffs almost doubles if no policy recommendation is given.

Attention to the electricity mix on the other hand is only slightly lower with a policy recommendation. This implies that a policy recommendation clearly reduces consumers' price sensitivity, but has only a marginal impact on attention to product quality. Regarding name and the product logo, no significant difference is found. Finally, attention to the default is clearly higher if a policy recommendation is given.

Figure 10. Fixation duration by product attribute and default. ** p<0.01; * p<0.05



[62] One might be wondering to what extent fixation durations are a reliable indicator for product choice. In 96% of all 522 choice decisions, average fixation duration was the highest for the product that was actually chosen py the participants.

6.4.4 Complementing Insights from Eye Tracking Protocol

While the preceding analysis has shown that the policy recommendation significantly changes participants' decision process, data from the eye tracking protocol indicates that participants were not consciously aware of the influence of the nudge. During the interview that followed the eye tracking experiment, participants were asked how strongly the recommendation by the office for the environment and energy influenced their choice. On a four-point Likert scale ranging from "not at all" to "very strongly", 71% of all participants said that they were not at all influenced by the recommendation.

6.5 Conclusion

This study has shown that a soft default, specified here as the policy recommendation by a local authority of the city of St. Gallen, transforms the decision-making process for an electricity tariff from a deliberate into an intuition-based process. The policy recommendation seems to drive the choice process (see also Chassot et al., 2013) and reduces price sensitivity.

For practitioners in the energy industry and policy makers, the study offers insights on how to design choice architecture in order to guide consumers into a desired direction. Importantly, to ensure public acceptance of nudges, customer needs have to be assessed before the implementation of a nudge. In the energy industry, the adaptation of consumption patterns is particularly important in order to meet the policy targets of an ever-increasing share of renewable energy in the global energy mix. For the particular case of the choice of an electricity tariff, the justification for a green default is twofold. First, while the vast majority of residential customers from Switzerland prefers renewable over fossil and nuclear energy and are willing to pay a premium for it, customers do not initiate a change because it is simply not on top of their to-do list. Second, the choice of an electricity tariff is a highly complex task for customers because it is time consuming to collect all relevant information on the environmental impact of the various power technologies. However, while not thoroughly addressed in this study, a critical discussion on the soft paternalism-based approach to guide consumer behavior prevails (for a discussion see Kirchgässner, 2014). Further research might tackle in more detail to what extent and under which conditions consumers accept the statement by Iyeanger and Lepper: "One important

paradox confronting the modern world is that as the freedom of individuals expands, so too does their dependence on institutions and other people.“ (2000: 1004).

As for the case of the research project, after the eye-tracking experiment the EUC was reassured that their customers would accept a green default. A few months after the experiment the EUC launched a comprehensive information campaign to raise awareness and inform customers about the default change. It sent a mailing to all customers, presenting the four new electricity tariffs they offered, and informing customers that unless they would opt out, the second cheapest electricity tariff with improved environmental quality compared to the previous default will be their future electricity product. The layout of the mailing and in particular the presentation of the four tariff options was substantially similar to the presentation in the eye-tracking experiment. In particular, the EUC used a recommendation, too. Whereas most residential customers (consuming less than 48 megawatt hours per year) accepted the new default or, often together with positive feedback to the EUC, even upgraded to a more expensive tariff option, large-scale customers reacted more price sensitive. Within the customer segment of yearly consumption of 48–1,000 megawatt hours, 68% stayed with the new default or even a higher quality product. Among customers consuming more than 1,000 megawatt hours per year, 33% did the same (Graf, 2012).

This study has focused on the question how to guide electricity customers once they are confronted with the choice of a tariff. In real life, this situation typically occurs when somebody moves or when the EUC launches a campaign. Therefore, the results are particularly relevant for EUCs that consider adapting their electricity offer, but they do not address the question how to convince customers to log onto the EUCs website and have a look at the tariff options.

For further research it would be interesting to see the role of the recommending authority; the particular city in eastern Switzerland is one with a high standard of living and loyalty to the local authorities is high. In different geopolitical contexts the impact of a policy recommendation might have a counterproductive effect. Furthermore, the results of an eye tracking study are sensitive to the design of the dummy webpage. In this study, different product options appeared in different colors, to mention only one design-element that could bias participants’ decision for one product option. Future studies may try different designs of the dummy webpage. Furthermore, transferring the research design of this study to other products and customer segments would provide further insights on the scope of the power of defaults.

Acknowledgements

I acknowledge valuable feedback on this paper from Prof. Dr. Daniele Caramani and the participants of the essay seminar at the University of St. Gallen in spring term 2014. The dedicated discussions throughout eight meetings were a great inspiration and support to develop this paper.

References

AEE. 2012. Akzeptanz Erneuerbarer Energien in der deutschen Bevölkerung. *Renews Spezial* (Vol. 56): Agentur für Erneuerbare Energien (AEE).

Bargh, JA, Chartrand, TL. 1999. The unbearable automaticity of being. *American Psychologist,* **54**(7), 462-479.

Brown, CL, Krishna, A. 2004. The Skeptical Shopper: A Metacognitive Account for the Effects of Default Options on Choice. *Journal of Consumer Research,* **31**(3), 529-539.

Burkhalter, A, Kaenzig, J, Wüstenhagen, R. 2009. Kundenpräferenzen für leistungsrelevante Attribute von Stromprodukten. *Zeitschrift für Energiewirtschaft,* **2**, 161-172.

Chassot, S, Curtius, H, Loock, M, Wüstenhagen, R. 2011. 1. St. Galler Kundenbarometer Erneuerbare Energien. St. Gallen.

Chassot, S, Wüstenhagen, R. 2012. 2. Kundenbarometer Erneuerbare Energien. St. Gallen: Universität St. Gallen in Kooperation mit Raiffeisen Schweiz.

Chassot, S, Wüstenhagen, R. 2013. 3. Kundenbarometer Erneuerbare Energien. St. Gallen: Universität St. Gallen in Kooperation mit Raiffeisen Schweiz.

Chassot, S, Wüstenhagen, R. 2014. 4. Kundenbarometer Erneuerbare Energien. St. Gallen: Universität St. Gallen in Kooperation mit Raiffeisen Schweiz.

Chassot, S, Wüstenhagen, R, Fahr, N, Graf, P. 2013. Wenn das grüne Produkt zum Standard wird. Wie ein Energieversorger seinen Kunden die Verhaltensänderung einfach macht. *Zeitschrift OrganisationsEntwicklung,* **3**, 80-87.

Diaz-Rainey, I, Ashton, JK. 2010. Profiling Potential Green Electricity Tariff Adopters: Green Consumerism as an Environmental Policy Tool? *Business Strategy and the Environment,* **Online Version**.

Fahr, N. 2011. *Vermarktung von Ökostrom mittels Green Default-Ansatz am Beispiel der St. Galler Stadtwerke.* Master, Univiersität St. Gallen.

Gerpott, TJ, Mahmudova, I. 2010. Determinants of Price Mark-Up Tolerance for Green Electricity - Lessons for Environmental Marketing Strategies from a Study of Residential Electricity Customers in Germany. *Business Strategy and the Environment,* **19**, 304-318.

Glöckner, A. 2010. An Eye-tracking Study on Information processing in Risky Decisions: Evidence for Compensatory Strategies Based on Automatic Processes. *Journal of Behavioral Decision Making,* **24**, 71-98.

Glöckner, A, Witteman, C. 2010. Beyond dual-process models: A categorisation of processes underlying intuitive judgement and decision making. *Thinking & Reasoning,* **16**(1), 1-25.

Göckeritz, S, Schultz, WP, Rendón, T, Cialdini, RB, Goldstein, NJ, Griskevicius, V. 2010. Descriptive normative beliefs and conservation behavior: The moderating roles of personal involvement and injunctive normative beliefs. *European Journal of Social Psychology,* **40**, 514-523.

Graf, P. 2012. *Green Defaults - Bevormundung oder überfällige Kundenorientierung?* Ökologische Stromtarifrevision. Workshop. Forum für Management Erneuerbarer Energien. St. Gallen.

Greenberg, M. 2009. Energy sources, public policy, and public preferences: Analysis of US national and site-specific data. *Energy Policy,* **37**, 3242-3249.

Heinzle, SL, Wüstenhagen, R. 2012. Dynamic Adjustment of Eco-labeling Schemes and Consumer Choice - the Revision of the EU Energy Labels as a Missed Opportunity? *Business Strategy and the Environment,* **21**, 60-70.

Herbes, C, Ramme, I. 2014. Online marketing of green electricity in Germany - A content analysis of providers' websites. *Energy Policy,* **66**, 257-266.

Horstmann, N, Ahlgrimm, A, Glöckner, A. 2009. How Distinct are Intuition and Deliberation? An Eye-Tracking Analysis of Instruction-Induced Decision Modes *Reprints of the Max Planck Institute for Research on Collective Goods, 2009*.

Iyengar, SS, Lepper, MR. 2000. When Choice is Demotivating: Can One Desire Too Much of a Good Thing? *Journal of Personality and Social Psychology,* **79**(6), 995-1006.

Johnson, EJ. 2008. Man, my brain is tired: Linking depletion and cognitive effort in choice. *Journal of Consumer Psychology,* **18**, 14-16.

Johnson, EJ. 2008. Man, my brain is tired: Linking depletion and cognitive effort in choice. *Journal of Consumer Psychology,* **18**, 14-16.

Johnson, EJ, Shu, SB, Dellaert, BGC, Fox, C, Goldstein, DG, Häubl, G*, et al.* 2012. Beyond nudges: Tools of a choice architecture. *Marketing Letters,* **23**, 487-504.

Kaenzig, J, Heinzle, S, Wüstenhagen, R. 2013. Whatever the customer wants, the customer gets? Exploring the gap between consumer preferences and default electricity products in Germany. *Energy Policy,* **53**, 311-322.

Karsten, J, Reisch, LA. 2008. Sustainability Policy and the Law. *German Policy Studies,* **4**(1), 45-66.

Keller, PA, Halrma, B, Loewenstein, G, Volpp, KG. 2011. Enhanced active choice: A new method to motivate behavior change. *Journal of Consumer Psychology,* **21**, 376-383.

Kirchgässner, G. 2014. Soft Paternalism, Merit Goods, and Normative Individualism.

Litvine, D, Wüstenhagen, R. 2011. Helping "light green" consumers walk the talk: Results of a behavioural intervention survey in the Swiss electricity market. *Ecological Economics,* **70**, 462-474.

Madrian, BC, Shea, DF. 2001. The power of suggestion: Inertia in 401(k) participation and savings behavior. *The Quarterly Journal of Economics,* **CXVI**(4), 1149-1187.

McKenzie, CRM, Liersch, MJ, Finkelstein, SR. 2006. Recommendations Implicit in Policy Defaults. *Psychological Science,* **17**(5), 414-420.

Meissner, M, Decker, R. 2010. Eye-tracking information processing in choice-based conjoint analysis. *International Journal of Market Research,* **52**(5), 591-610.

Nolan, JM, Schultz, WP, Cialdini, RB, Goldstein, NJ, Griskevicius, V. 2008. Normative Social Influence is Underdetected. *Personality and Social Psychology Bulletin,* **34**(7), 913-923.

Ölander, F, Thøgersen, J. 2014. Informing Versus Nudging in Environmental Policy. *Journal of Consumer Policy*.

Ozaki, R. 2009. Adopting Sustainable Innovation: What Makes Consumers Sign up to Green Electricity? *Business Strategy and the Environment,* **Online Version**.

Pichert, D, Katsikopoulos, KV. 2008. Green defaults: Information presentation and pro-environmental behaviour. *Journal of Environmental Psychology,* **28**, 63-73.

Polak, B, Herrmann, A, Heitmann, M, Einhorn, M. 2008. Die Macht des Defauls - Wirkung von Empfehlungen und Vorgaben auf das individuelle Entscheidungsverhalten. *Zeitschrift für Betriebswirtschaft,* **78**(10), 1033-1060.

Rayner, K. 1998. Eye Movements in Reading and Information Processing: 20 Years of Research. *Psychological Bulletin,* **124**(3), 372-422.

Rowlands, IH, Scott, D, Parker, P. 2003. Consumers and green electricity: Profiling potential purchasers. *Business Strategy and the Environment,* **Online Version**.

Rubinstein, A. 2007. Instinctive and Cognitive Reasoning: A Study of Response Times. *The Economic Journal,* **117**(523), 1243-1259.

Rubinstein, A. 2008. Comments on neuroeconomics. *Economics and Philosophy,* **24**, 485-494.

Siegrist, M, Keller, C, Cousin, M-E. 2006. Implicit Attitudes Toward Nuclear Power and Mobile Phone Base Stations: Support for the Affect Heuristic. *Risk Analysis,* **26**(4), 1021-1029.

Sunstein, CR, Reisch, L. 2014. Automatically green: Behavioral economics and environmental protection. *Harvard Environmental Law Review*, **38**(1): 127-158.

Thaler, R, Sunstein, C. 2008. *Nudge: Improving decisions about health, wealth, and happiness*. New Haven, CT: Yale University Press

7 Conclusion

7.1 Overall Findings and Implications

The development in the energy industry during the last four years of writing this thesis has been tremendous. As a case in point, the number of applications to the Swiss feed-in tariff for electricity generated from renewable energies has more than quadrupled from 2010 to 2014 (Stiftung KEV, 2010; 2014). In Germany, where the energy transition is not only visible in peoples' willingness to invest, but also in the share of electricity generated from renewable sources, the share has risen from 16.6% in 2010 to 23.4% in 2013 (Statista, 2014).

At least in some countries, the direction for the future development of the energy system is clear: Renewable energies and energy efficiency shall replace nuclear and fossil energy sources. The energy transition implies a series of challenges and still causes resistance in particular among some practitioners of the energy industry, but also among policy makers and investors. However, as Paper I of this thesis has shown, beyond the practical challenges, personal worldviews influence the at times quite emotional discussion on the role of renewable energies and policies to foster investments in this domain. Paper I concludes that policy instruments should be framed such that they conform with investors' worldviews. As Hardisty et al. (2010) demonstrate, the impact of policy tools is substantially different simply when calling it an "offset" rather than a "tax".

Papers II-V have addressed several aspects of the role of utility companies. Paper II emphasizes that utility companies require reliable policy goals for specific energy technologies in order to know in which technologies they should invest. However, Paper II also argues that citizens will only support the phase out of nuclear power if they perceive credible alternatives with which nuclear energy can be replaced. To some extent, in direct democracies there is a risk of a chicken-egg problem here if citizens on the one hand wait until an alternative energy infrastructure is built before a the majority votes for the phase out of conventional energy sources, and electric utility companies on the other hand hold investments back until the phase out of conventional energy sources has been thoroughly approved in an eventual national referendum. Paper II argues that due to great visibility of renewable energy technologies through countless rooftop photovoltaic installations and windmills in Germany, public support for the phase out of nuclear power is more stable in Germany than in Switzerland. Paper III shows that the question whether a utility company takes the lead as

renewable energy investor depends on decision-makers' deeply held, unconscious associations to renewable versus fossil energy. For financial investors, which are potentially important financing partners, the main challenge at this point is that investment decisions are structured in terms of asset classes, whereas renewable energies have only started to offer investment opportunities via standard (and not strictly regulated) asset classes.

Paper II demonstrates a clear preference for renewable over conventional energy sources among citizens. However, when it comes to the adoption of a renewable electricity tariff, customers reveal an attitude-behavior gap. The majority of electricity customers stick to the electricity tariff that is offered as a default, even if customers do not favor the technologies with which the electricity is generated. Paper IV discusses a case where changing the default tariff has been a profitable solution to overcome the attitude-behavior gap. Paper V suggests that customers accept the default offer because they perceive it as policy recommendation. Thus, whereas some of the venture capitalists cited in Paper I would like to live in a world with as little government intervention as possible, when it comes to the choice of an electricity tariff, people seem to appreciate guidance from a political authority. Obviously, the studied actors of the different papers, for example venture capitalists and electricity customers, could be one person in a professional and a private role. Therefore, while Paper I and III discuss some investors' hesitance toward renewable energies, this is not necessarily a permanent critical attitude an investor has, but the result of institutional constraints in the professional environment that may enhance specific cognitive processes. Thus, policy makers should have in mind

- which is the currently dominant innovation mode of a technology for which they design a policy tool,
- who the active investors and stakeholders in that specific innovation mode are,
- what important institutional constraints could be,
- what type of cognitive processes could influence the actors' decision-making process.

From a theoretical point of view, the main contribution of this thesis is a refinement of dual process theories through the distinction of processes in terms of awareness, but also in terms of style. The papers exemplify unconscious holistic, and unconscious analytical processes in the context of energy decision-making. Previous research has repeatedly argued that unconscious holistic processes greatly influence human behavior. Paper III transfers this proposition to professional investment

decision-makers and exemplifies the boundaries for the influence of this type of thinking, by showing that it has no influence on financial investors' energy investment decision-making. Put differently, another contribution of this thesis is the application of methods developed in psychology in a new context and with unique samples of relevant decision-makers.

7.2 Overall Limitations and Suggestions for Further Research

Whereas the bulk of empirical research using complex methods developed by psychologists relies on student samples, every paper of this thesis provides empirical evidence from those subjects who actually do take the considered decision in their daily life. The advantage of this approach is external validity of the results (Gerring, 2012). The disadvantage of this approach is that it is more challenging to find participants for the surveys. Small sample sizes have been an ever-recurring problem throughout this thesis. However, it is important to note that for the goal of this thesis, which was to explore the role of unconscious cognitive processes, the samples of the empirical studies do not need to be representative for the entire underlying population. Instead, care has been taken to ensure variance on the variables of interest. For example, Paper III has analyzed implicit associations among strategic and financial investors, and how implicit thinking relates to these actors' investment behavior. Therefore, when distributing the survey, we have tried to reach a good split between strategic and financial investors, and to address those who do invest in renewable energies and those who do not. The reached sample sizes are large enough for reliable results from the Implicit Association Test. However, the data collected in the accompanying survey questions on investment behavior do not allow inferring on investment behavior of the entire population of the studied investors. Furthermore, as discussed in more detail in the papers, the measurement focus on cognitive processes implied compromises in the measurement of control variables.

The papers of this thesis transfer theories and methodologies well developed and established in psychology to financial decision-making. Dual process theories are relevant for any human being. However, the degree to which people rely on a specific type of cognitive process might differ in different action contexts – an asset manager for example may rely more on affective reactions being at home than at work (or the other way round). Further research could address to what extent the same people rely on different types of cognitive processes when they act in different contexts. This

relates to the question of transferability of psychological theories and methods to a finance context. Interdisciplinary research has the potential to offer new insights and perspectives, but risks to be misunderstood by both disciplines. In addition, transferring a method that was mostly developed with samples of lay people and students to a population of professional investors also implies new challenges in ensuring accurate measurement (see Chassot et al., 2013, for a detailed discussion).

Importantly, the aim of this research was not to show that cognitive processes are the only factor that influences renewable energy decision-making. Paper III for example shows that for investment decision-makers working for institutional investors, implicit associations to energy do not influence investments, simply because regulatory barriers and a different strategic approach are more important. The papers of the thesis are pieces of mostly explorative research on factors beyond rational choice that drive decision-making – which is not to say that rational choice and underlying circumstances of the decision-making situation do not play a role. Further research could explore in more detail how the institutional and regulatory framework of a decision-maker interacts with cognitive processes.

Each paper presents empirical results from a different research method. This complicates comparability of results across investor types (and papers). For further research it might be worth applying the same method to different investors and stakeholders in order to provide more comparable results and better answer the question how different actors differ in their behavior. However, issuing a caveat here, carefully ensuring that the same research design fits the different actors' realities might be a challenge for such a research project.

For the sake of a clear scope, the thesis focuses on decision-making related to power generating technologies. In terms of energy use, heating and mobility are equally relevant areas for further research.

The papers of this thesis focus on the influence of cognitive processes on energy decision-making, and emphasis is on unconscious thinking. Beyond this common perspective, the papers do not neatly fill the research landscape of dual process theories, but are scattered across cognitive processes, population types and phenomena. As has been suggested by Stern (1986), the thesis follows a problem-oriented and explorative approach. According to Stern, this approach can avoid "blind spots" of a rational choice-perspective, but "cannot be systematic" (Stern, 1986: 200). Put differently, the thesis is divers in terms of studied phenomena, in terms of relevant actors and in terms of empirical methods. Therewith it also illustrates several areas for further research. For example, it would be interesting to see how the influence of

worldviews on venture capitalists' decision-making differs across investment contexts. Moreover, further research could explore in more detail if different types of investors rely to different degrees on specific cognitive processes for the investment decision on the same investment object. In terms of methodology, experimental research designs often allow for the most rigorous measurement of latent concepts (Gerring, 2012). Field experiments with relevant actors and stakeholders would be a particularly promising avenue for further research on energy decision-making.

The introduction to this thesis provides one suggestion how the analyzed cognitive processes may be placed within the style-awareness model of cognitive processes. However, empirical evidence of the papers does not explicitly test if the suggested classification is correct. Nevertheless, I hope it is a helpful framework to guide the reader through my thesis, and that it adds a new perspective to the debate on dual process theories.

References

Chassot, S, Wüstenhagen, R, Beglinger, F, Bärtsch, C. 2013. Implicit Cognition and Renewable Energy Investments: An Empirical Analysis of Differences between Financial and Strategic Investors *Project report*.

Gerring, J. 2012. *Social Science Methodology: A Unified Framework* (2nd ed.). Cambridge: Cambridge University Press.

Hardisty, DJ, Johnson, EJ, Weber, EU. 2010. A Dirty Word or a Dirty World? *Psychological Science,* **21**(1), 86-92.

Statista. (2014). Anteil Erneuerbarer Energien an Der Bruttostromerzeugung in Den Jahren 1990 Bis 2013. Retrieved 30 May, 2014 http://de.statista.com/statistik/daten/studie/1807/umfrage/erneuerbare-energien-anteil-der-energiebereitstellung-seit-1991/

Stern, PC. 1986. Blind Spots in Policy Analysis: What Economics Doesn't Say About Energy Use. *Journal of Policy Analysis and Management,* **5**(2), 200-227.

Stiftung KEV. 2010. Quartalsbericht Für Das 2. Quartal 2010. Stiftung Kostendeckende Einspeisevergütung (KEV).

Stiftung KEV. 2014. 1. Quartal 2014, Stand 01. April 2014. *KEV-Cockpit*: Stiftung Kostendeckende Einspeisevergütung (KEV).

Curriculum Vitae

Sylviane Chassot
Place/Date of Birth: Zürich, Switzerland, January 2, 1986

EDUCATION

09/2010 – 09/2014	PhD Candidate in International Affairs and Political Economy at the University of St. Gallen. Host: Good Energies Chair for Management of Renewable Energies, Institute for Economy and the Environment, (Advisors: Prof. Dr. Rolf Wüstenhagen, Prof. Dr. Lucia A. Reisch)
09/2008 – 06/2010	Master in Science of Economics at Haute École Commercial (HEC) – University of Lausanne
09/2004 – 07/2007	Bachelor in Science of Economics, Minor Studies in Science of Media / Communication and Sociology – University of Berne

ACADEMIC EXPERIENCE

02/2010 –	Research associate and teaching assistant at the Good Energies Chair for Management of Renewable Energies, Institute for Economy and the Environment – University of St. Gallen
09/2012 – 07/2013	Visiting scholar at the Department of Psychology, Norwegian University of Science and Technology

MAIN PROFESSIONAL EXPERIENCE

02/2010 –	Research assistant and project manager at the Good Energies Chair for Management of Renewable Energies, Institute for Economy and the Environment – University of St. Gallen
11/2007 – 06/2008	Internship at Department for Economic Research – Credit Suisse
01/2006 – 03/2007	Chief editor of students magazine „StudiVersum“