



DISCUSSION PAPER

Key variables and success factors in transformations towards a sustainable economy: evidence from case studies in the fields of mobility, energy and resources.

Discussion Paper for the SustEcon Conference “The contribution of a sustainable economy to achieving the SDGs”

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September 2017

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evolution2green is supported by the German Federal Ministry of Education and Research.

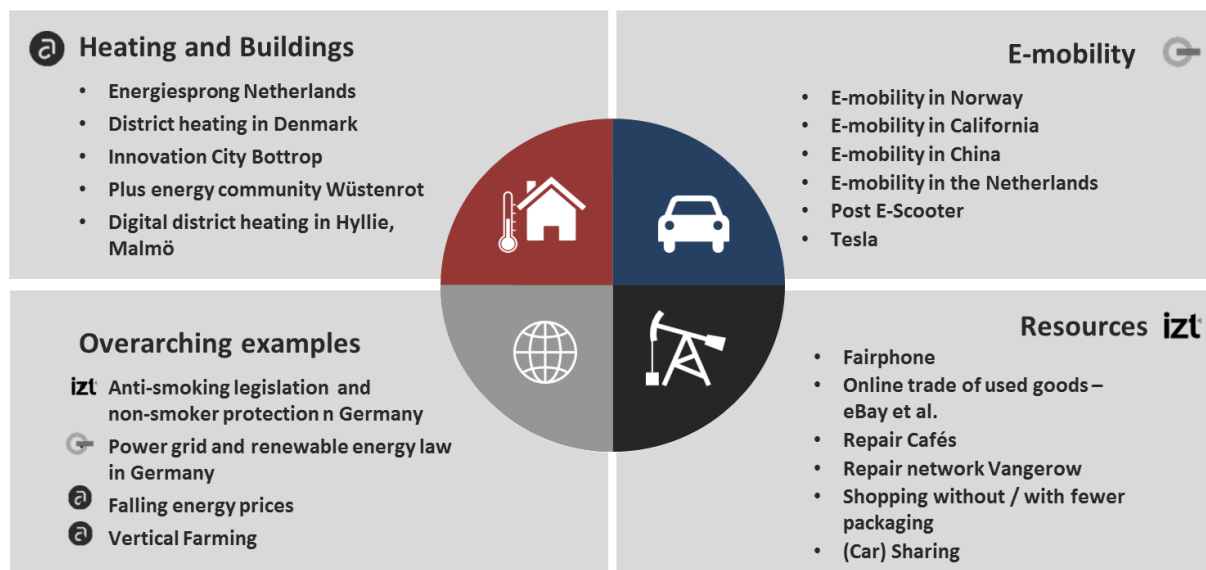
Introduction

An increasing volume of research on sustainability transformations has been shaping our understanding of transformation processes towards ecologically and socially sustainable economies and societies in recent years. Work on socio-technical transitions (i.e. Rip, Kemp 1998; Geels 2002, 2011; Geels et al. 2016) and transition management (Rotmans et al. 2001; Kemp et al. 2007; Loorbach 2010) established important and widely used heuristics, such as the multi-level perspective (MLP) and the four phases or the “s-curve” of transition development (ibid.), as well as governance and policy approaches, incl. strategic niche management and the distinction between strategic, tactical, operational and reflexive elements of transition governance (Kemp et al. 2007; Loorbach 2010). Other authors have – inter alia – concentrated on path dependencies and lock-ins (Unruh 2000; Garud et al. 2010; Vergne, Durand 2010; Clausen, Fichter 2016) and innovation systems (Jacobsson, Bergek 2011).

Most of these contributions however tend to be of conceptual nature and/or are based on the analysis of single sectors/cases. Cross-sectoral analyses of sustainability transformations based on empirical data in a broader set of cases have only rarely been undertaken. Likewise, there exists a gap between birds-eye-view theoretical frameworks such as MLP (Geels 2011), which draw on the analysis of socio-technical systems, and actor-centered, action-oriented approaches, which draw on theories from management studies, business administration and microeconomics (Doppelt 2009; Kristof 2010; Benn et al. 2014). While the latter tend to be more prominent in the business and policy communities, they are mostly lacking the systemic, long-term orientation of the former.

Building on an earlier analysis of path dependencies in 15 areas of transformation (Clausen et al. 2017), this paper attempts to address this gap by presenting preliminary findings from an in-depth empirical study of 21 examples of transformation across the fields of heating, energy and buildings (1), electric mobility (2), as well as resource consumption (3). Additionally, selected examples of overarching interest were included in the sample. The cases cover different spatial scales, speeds, and levels of maturity and were chosen on the basis of a fixed set of criteria, including elements like disruptive potential, complexity, diversity and ability to transform existing socio-technical regimes by breaking out of path dependencies identified earlier in the project¹ (see figure 1 for an overview of the cases analyzed).

¹ This research was carried out as part of Evolution2Green, a broader research project studying transformation pathways towards a green economy, which is currently being carried out by adelphi, the Institute for Future Studies and Technology Assessment (IZT) and the Borderstep Institute with financial support from the German Federal Ministry for Education and Research. Current publications and working papers in German can be downloaded at www.evolution2green.de

Figure 1: Overview of transformation examples analyzed

Source: Evolution2Green.

Research Question and Methods

While the analysis of the cases under investigation in this study has been conducted with multiple research interests at the level of theory as well as policy in mind, the main research question pursued in this paper pertains to the identification of what it is, that makes transformation processes towards sustainability likely to succeed. In other words: What are key variables and success factors in transformations towards a sustainable economy? To what extent do they overlap or differ between scales, sectors and phases of transformation? And what are relevant take-aways for theory and policy, especially in the German context?

Taking the actor-centered “Models of Change” framework (Kristof 2010) as a starting point and - by means of a broad review of current transformation literature – including systemic perspectives and adapting it to the study of sustainability transformations, the authors developed a set of 18 broadly defined and amply cited success factors covering strategies and ideas, actors and their qualifications, time aspects as well as various process dimensions. Together with three additional context indicators, they provide an encompassing set of variables, which are used as the core theoretical lens in the analysis of both, the individual cases, as well as the sample as a whole. Data collection consisted of an extensive review of primary and secondary literature, as well as in some cases interviews.

In the ongoing analysis, qualitative and semi-quantitative research methods are being deployed and triangulated in order to identify the most relevant variables and success factors across cases, as well as their particular expressions and interrelations. The heterogeneity of cases under investigation, as well as the associated research interests within the framework of the project this paper is based on, is both a challenge and asset in this regard, creating a productive tension between depth and breadth. As space is limited, and the detailed cross-sectional analysis of cases still under way, findings presented in the remainder of this paper will focus on the broad strokes of the sample as whole, and the most relevant variables and success factors identified.

Preliminary Findings

Preliminary findings suggest that all variables under investigation are indeed relevant to the unfolding of transformation processes towards a green economy, yet there are some factors, which are more important than others, and they vary significantly between examples, sectors and scales. Not surprisingly, landscape properties and framework conditions were identified to be key in determining the way in which transformation initiatives develop, and how likely they are to succeed. Likewise, change-agents and their qualifications, the conceptual fit and adaptability of their implementation idea, triggers and windows of opportunity, as well as horizontal coordination between sectors were identified to be the most relevant variables across all cases analyzed (see Figure 2 for an overview).

Figure 2: Heatmap showing the relative relevance of key variables and success factors analysed across cases

The color gradient depicts least relevant factors in red, and most relevant factors in green, based on the average of all cases included in the analysis. This does not mean that variables in red are irrelevant across cases: looking at the averages, all factors were deemed to be of almost medium relevance at minimum.

Landscape properties and framework conditions	Time aspects
Problem pressure and perception	Triggers and windows of opportunity
Path dependencies and obstacles	Process speed and rhythm
Further context / background conditions	Change processes
Actors	Horizontal coordination between sectors
Change Agents / promoters and their qualifications	Vertical coordination between political levels
Actors and coalitions supporting a transformation	Institutionalization
Actors and coalitions sceptical towards a transformation	Niche activities
Idea for change / transformation	Participation processes
Conceptual fit and adaptability of implementation idea	Co-benefits
Mix of strategies and instruments	Culture of change and knowledge base
Approach to handling of conflicting goals	Reflexivity, progress tracking and learning processes
	Resource availability

Source: Evolution2Green.

Observation 1: Context is crucial

Landscape properties (in the sense of the multi-level perspective; Geels 2006, 2011) and framework conditions, including problem perception and preexisting path dependencies are of high or very high relevance in almost all cases analyzed. While general environmental awareness and increasing attention to climate change played some role in most cases, more tangible and pressing environmental issues, such as air quality problems in larger cities were identified to be of much higher relevance to the initiation and the relative success of transformation initiatives, as could be observed in the unfolding of e-mobility efforts in California, Norway and China for example, which all had to struggle with serious air pollution problems in their metropolitan areas. Additionally, cases pertaining to processes that have actually transformed or have the imminent potential to transform the bulk of an entire sector within a given geographical scope seem to rely on actual or perceived economic and security risks threatening the viability of the current socio-technical regime (and on the flip-side, arising economic opportunities identified in potential alternatives), be it energy security considerations after the oil crisis in Denmark, or fear of rising energy costs in Wüstenrot – a rural district in south-west Germany aiming to become energy independent by 2020.

Likewise, the absence or weaker expression of path dependencies and obstacles hindering a transformation in Germany seems to be a key factor in the promising development observed in other countries, especially with regard to e-mobility, sustainable heating systems and insulation. For example: the lack of a powerful car industry acting as a veto player in California, the Netherlands, Norway and China as front runners in e-mobility; or different ownership and industry structures in the building and heating sectors in Denmark and the Netherlands allowing for innovative approaches to heating and insulation to be implemented more easily. Furthermore, various longstanding structural conditions and developments that are very specific to the respective cases are often central to the success of the cases analyzed. Government supported activity in the Netherlands regarding both, e-mobility and zero-energy housing refurbishment for example, is building on a century-old corporatist culture of intersectoral collaboration and compromise that is difficult to replicate.

Observation 2: Change-Agents are key

This striking, albeit not necessarily surprising relevance of spatio-temporal context and framework conditions may seem to leave little room for agency. At the same time, individual change-agents and their qualifications play a major role in all the examples analyzed. Entrepreneurial individuals and institutions – oftentimes stemming from the periphery of the incumbent regime and bringing some combination of specific expertise, access to power, influence and/or resources to the table – were essential in all the processes investigated, either in the form of individuals like Elon Musk in the case of Tesla and the rise of the electric car in California and beyond, or in the form of teams of people pooling networks, resources and expertise to effectively use and alter framework conditions, allowing for alternative technologies and practices to take hold and reach scale. Of course, there may be different kinds of change-agents over time preparing, developing and pushing transformation processes forward, and in most cases, they rely on coalitions of supporters and their specific resources and power.

Observation 3: “Sustainable” is not enough of an incentive

Looking at the examples studied, alternative solutions, practices and technologies are only being widely adopted (that is – beyond the 10 to 15 % of the population potentially willing to pay a premium for sustainable products or additional effort in terms of behavior) if they can at least match conventional solutions in terms of costs or immediate utility and comfort. Utility may vary significantly between different target or user groups and may also rely on intangible elements like personal and cultural preference, hence some target or stakeholder groups are more easily accessible than others. The examples analyzed, which have been or are seemingly successful in delivering transformation on a larger scale were or are almost all driven by a bold vision, as well as a strategy to turn around different stakeholder groups by appealing to their specific needs and preferences one by one, until a critical mass is reached that allows transformation in the mainstream. This could be

- mostly market and technology-driven processes initiated by individual entrepreneurs, such as in the case of companies like Tesla, which followed the strategy of making an all electric luxury sports car for wealthy enthusiasts first, and from there on pushing development into other market segments and the mainstream market by developing cheaper models over time, or the Post E-Scooter, which deployed a frugal innovation strategy, producing cheap electric cars for a specific purpose, and from there intends to move into the mainstream consumer market.
- cross-sectoral initiatives, such as InnovationCity Bottrop, a public-private partnership aiming to engage the population of an economically challenged city in the formerly

coal-industry dominated Ruhr area in Germany in energy refurbishment and the testing of novel energy solutions.

- processes mediated by government, such as in the case of Energiesprong, a government-financed market development team for low-cost zero-energy refurbishments, acting as a deal broker and provider of incentives for research and development, as well as initiating regulatory adjustments to provide favorable framework conditions.
- government regulation and planning, such as in the case of heat planning in Denmark, or the development of renewable energy laws in Germany.

These approaches and examples are all rather different in nature, yet they all follow a clear vision and an implementation strategy that is aiming at scale, while at the same time displaying flexibility in terms of implementation strategies.

Observation 4: Strategic leverage of triggers and windows of opportunity seems to be an essential part of almost any transformation process

Looking at the time aspects of the examples analyzed, triggers and windows of opportunity as well as the strategic use thereof, played an important role in the majority of cases. In this context, three different types of triggers and windows of opportunity could be identified:

1. Disruption through technological innovation (i.e. the development of powerful Li-On Batteries in the context of e-mobility), allowing new players to enter existing markets without lagging behind (which is why China is set on reaching technological leadership in the field of electric mobility).
2. Changes in political or regulatory circumstances through new laws, policies and commitments, but also through expiring contracts and regulation (for example energy concessions in the case of Wüstenrot).
3. More general crises and historical events, from the oil crisis creating a window of opportunity for change-agents to transform the Danish heating sector, to the German reunification distracting incumbent energy providers from the passing of renewable energy legislation.

While the latter kind is mostly up to chance, the former two can be attributed to “window preparation” activities by government through targeted research and development support, as well as institutional adaptation to and regulatory support for the diffusion of new technologies and practices.

Observation 5: Coordination is helpful sometimes, but not always

The relevance of different process variables is more heterogeneous across cases than in other categories. One of the more important variables in this category pertains to horizontal coordination between actors from politics, business, civil society and the scientific community. This is crucial where different kinds of knowledge and competencies are relevant for a transformation process to be initiated, or if regulatory changes are needed that rely on the existence of political majorities. Especially in an environment, where resistance towards change from regime actors is relatively high, the diffusion of disruptive innovations and new practices often relies on individual actors moving forward without coordinating their actions with others. They rather wield their success from the fact that they can be introduced without too much coordination – hence leaving little room for regime actors with opposing interests to intervene. For example, the relative independence of the Clean Air Resources Board (CARB) in California together with declining interest by the automotive industry in the process, allowed it to create a regulatory framework for e-mobility in California early on in the 1990s. Later, Tesla was able to launch its first electric car and build up a charging infrastructure

without much political involvement or coordination with other sectors, largely due to significant access to capital.

Observation 6: Large-scale transformation requires large-scale investments

Many small-scale social innovations existing in niches, such as the organisation of repair cafés in local communities or shopping with reduced packaging require the commitment of individuals to making a change on the ground, yet they require few, if any financial resources. Moving from there to transforming large-scale socio-technical systems and regimes, whether it is about changing the design of products to enhance repairability and recyclability, replacing the combustion-engine-driven mode of individual transportation or implementing alternatives to the fossil-fuel-based heating of poorly insulated buildings, however, requires large-scale investments oftentimes not readily provided by existing financial mechanisms. Where governments and investors have been providing and/or reallocating significant resources for alternative solutions to mature and to be brought to scale, such as in the case of renewable electricity in Germany or the development of batteries and electric vehicles in the US, China and other countries, supported by significant subsidies, tax benefits and infrastructure investments to bring them on the market, we begin to see promising developments, including shifts in price structures, that can deliver large-scale transformation. Yet, it also becomes clear that for wholesale transformation in these sectors a lot more investment, private and public, will be required.

Key take-aways for policy and theory

While the analysis is still ongoing and conclusions are hence preliminary at most, a number of takeaways resulting from the observations highlighted above may be drawn for policy and theory alike. Four theses for discussion are presented below – a more in-depth discussion in the form of a longer report (in German) will be produced and made available shortly.

- **Thesis 1:** More attention should be paid to pre-existing framework conditions and path dependencies, both in the formulation of policies, as well as in theory development.
- **Thesis 2:** Developing competencies for transformation needs to become central throughout formal and informal education and training – transformation research needs to further increase its commitment to applicability, empowerment, and the transgression of boundaries between disciplines, as well as between academia and practice.
- **Thesis 3:** More resources should be directed at window preparation, identification, and effective usage strategies.
- **Thesis 4:** The magnitude of the changes and associated investment required to deliver on the necessary transformation towards a green economy needs to be more clearly addressed and communicated in popular and expert discourse.

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