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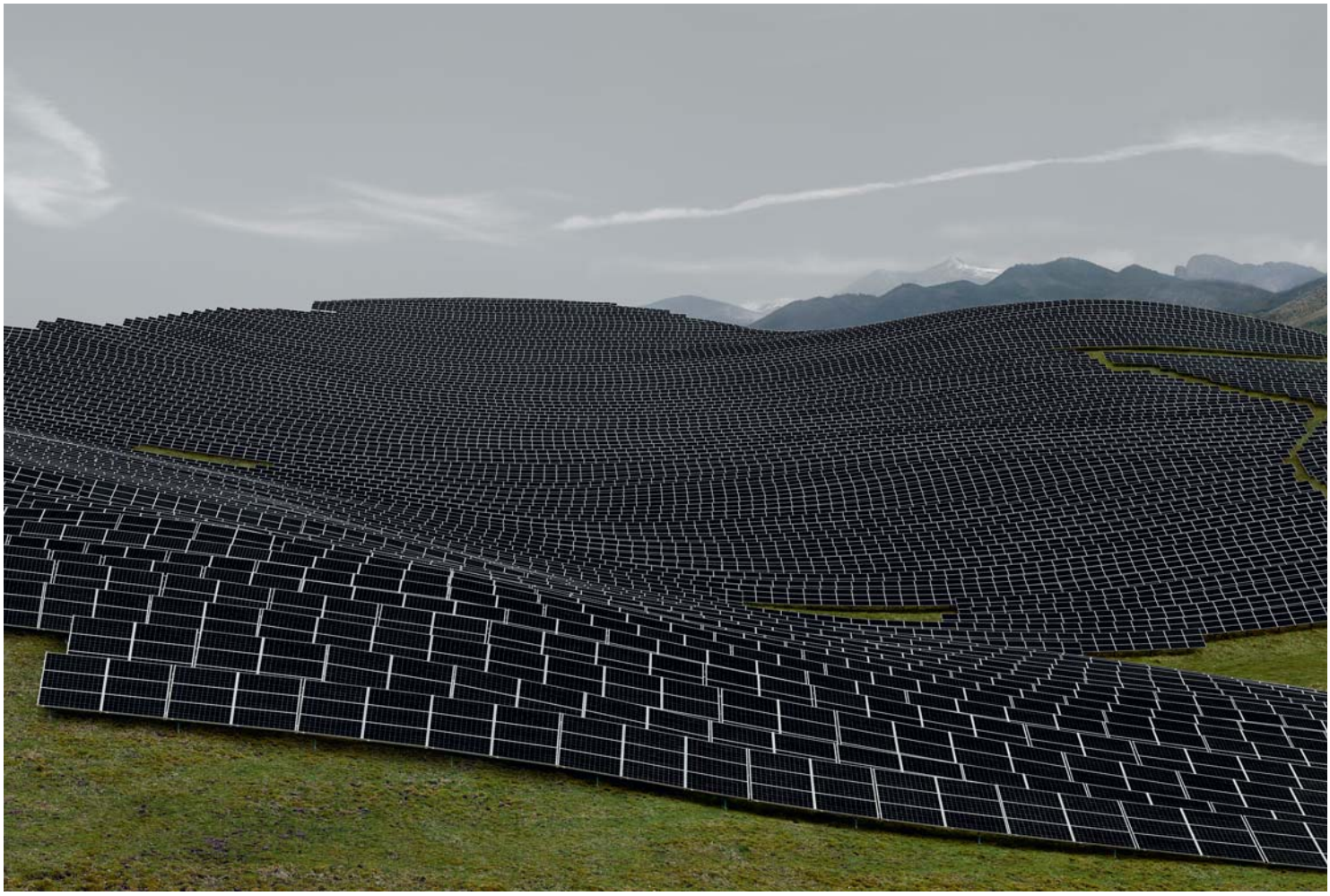

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SUSTAINABLE ECONOMY: PERSPECTIVES OF CHANGE

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Drivers and barriers of sustainability transformations

A comparison of the "Energiewende" and the attempted transformation to organic agriculture in Germany

Why has the German energy transformation been more successful than the attempted transformation to organic agriculture? Through an analysis of the drivers and barriers of both processes, this article identifies key factors that explain the difference in outcome. It becomes clear: transformation strategies should aim to create regulatory frameworks that make it attractive to invest in sustainable alternatives.

Dirk Arne Heyen, Franziska Wolff

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Abstract

This article compares the drivers and barriers of two sustainability transformations in Germany: the energy transformation ("Energiewende") and the attempted transformation towards organic agriculture which has, so far, been less successful. It is based on two case studies rooted in transformation research. While there is rapidly growing literature on energy, there are far fewer analyses of agricultural transformations. Moreover, single case studies dominate. The cross-case comparison presented in this article is a step towards filling this gap. Particularly in their initial stages, the two transformation processes shared similarities: both systems had been coming under pressure due to environmental crises, grassroots movements and niche developments of sustainable alternatives. However, changes to the regulatory system framework made investments in renewable energy more attractive than in organic agriculture, where the profitability of the transformation is still reduced by significant subsidies for conventional agriculture. Moreover, the energy transformation has benefitted from technological improvements and falling costs, an early coalition of supporters, including business actors, and more recently from a broader societal and political consensus.

Keywords

energy transition, organic agriculture, renewable energy, sustainability transformation, transition

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Research on sustainability transformations (or transitions)[1] examines how persistent environmental problems can be addressed when small-scale improvements turn out to be insufficient. In line with international transformation literature (see Köhler et al. 2019 for an overview), we conceptualise transformations as profound shifts in sociotechnical systems in which societal needs (for energy, nutrition, etc.) are satisfied. The shifts include technological, economic and cultural changes which are mutually reinforcing ("co-evolution") (Geels 2005, Geels et al. 2017). Sociotechnical systems are characterised by a number of elements – technologies, infrastructures, products, behaviour, etc. – and by the interrelations between them (figure 1). Their characteristics and interaction also determine the impact on the ecological system. Sustainability transformations imply that a new system configuration performs significantly better in environmental and social terms.

Usually, sociotechnical systems are relatively stable with permanent but only incremental change. Path dependencies and lock-ins reinforce the dominance of a "regime" of specific technologies, practices, regulations and related actors. According to the multi-level perspective (Geels 2002), transformations occur from radical niche innovations which evolve over time into alternative system configurations. System change can be supported by developments and windows of opportunity on a macro level but still include conflicts and power struggles.

This article compares the drivers and barriers of two different sustainability transformations in Germany: the ongoing energy transformation ("Energiewende") and the attempted agricultural transformation ("Agrarwende"). In the first case, we focus on renewable energy in the power sector[2], in the second case on the shift towards organic agriculture[3].

While the transformation of the fossil-nuclear energy system towards a renewable energy system has considerably progressed, the transformation towards organic agriculture occurs only gradually (see schematisation in figure 2). In 2018, renewable energies already provided about 38 percent of gross electricity consumption in Germany (UBA 2019), and have led to a much more decen-

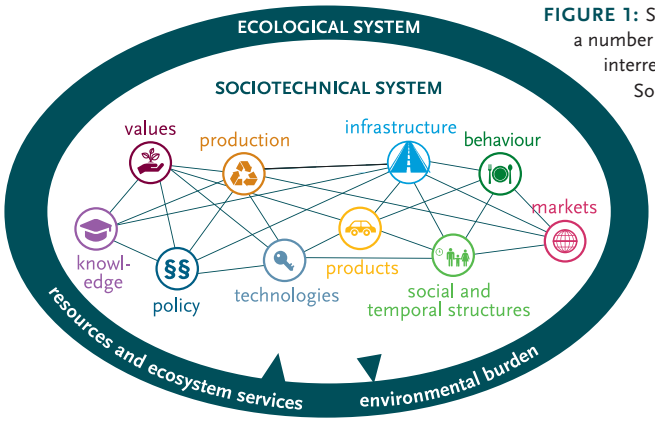


FIGURE 1: Sociotechnical systems like the energy or the agrarian system are characterised by a number of system elements – like technologies, behaviour and infrastructures – and their interrelations. They are embedded in ecological systems through inputs and outputs. Source: Jacob et al. (forthcoming).

tralised generation as well as ownership. In comparison, only 9.1 percent of agricultural land was farmed organically (by twelve percent of all German farms).[4] On the consumer side, the market share of green power tariffs (with differently stringent standards) is at about 24 percent (Bundesnetzagentur and Bundeskartellamt 2019). The market share of organic products bought by consumers, despite significant growth rates over the past years, remains at around eleven per cent (BÖLW 2019); this includes a substantial share of imports.

The cases lend themselves to a cross-case comparison, with shared national framework conditions but different sociotechnical systems and dynamics: which factors have driven or hampered the two processes? In particular, how can we explain the advances – especially on the production side – in the energy transformation compared with those of organic agriculture?

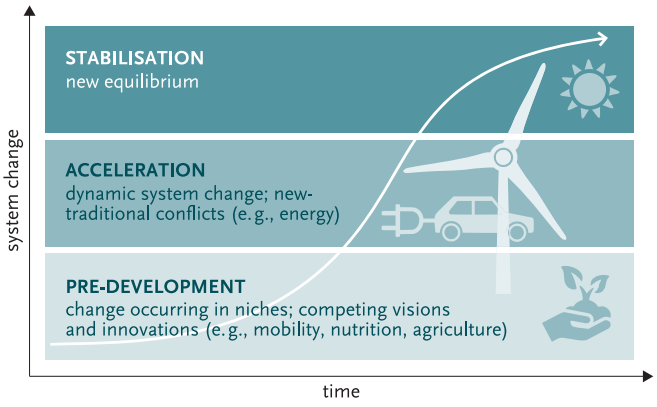
The article is based on two in-depth case studies conducted within the project *Trafo 3.0*. Both case studies used the same analytical approach based on transformation literature, complemented by our own conceptual and empirical work on transformations (Grießhammer and Brohmann 2016, Heyen and Brohmann 2017, Jacob et al. forthcoming, Wolff et al. 2018). Both drew on existing literature and expert interviews. In the following we compare six different drivers and barriers.

Problem pressure and crises as windows of opportunities

A common driver at the beginning of both processes has been increasing problem pressure deriving from existing production patterns, sometimes cumulated in crises and catastrophes. The oil crisis of the 1970s provided a shock to the energy system. It resulted in the strategy of greater independence from imported energy – through alternative energy sources and energy efficiency. In the 1980s, air and water pollution as well as acid rain became central issues. From the mid 1980s, the threat of climate change was increasingly discussed and it continues to exert pressure on the energy system as the single greatest contributor of greenhouse gas emissions. However, the greatest mobilisation resulted from the nuclear disasters in Chernobyl in 1986 and Fukushima in 2011 (figure 3, p. 230). The latter led to the retraction of a recently approved extension of nuclear plant lifetimes by the German federal government and accelerated the nuclear phase-out (see Morris and Jungjohann 2016 for all these events).

Compared with energy issues, the German population has been less receptive to the risks related to unsustainable agricultural land use. While Rachel Carson's *Silent Spring* (1962) raised some early public concerns about the effects of pesticide use in agriculture, a fundamental critique of agriculture's impact on the environment by the German Advisory Council on the Environment (SRU 1985) largely went unnoticed. In the 1990s, a series of agricultural and food related scandals regularly made it into the media but did not induce substantial political reactions. This changed with the outbreak of the BSE crisis ("mad cow disease") – with daily media coverage of culled cattle, spongy cow brains and the fear of a global spread and transmission to humans. In early 2001, two ministers resigned over BSE. The new Minister of Food and Agriculture, >

FIGURE 2: Phases of system change: while the German energy system experiences accelerated change, organic agriculture remains in a pre-development phase. Source: Jacob et al. (forthcoming), based on SRU (2016).



1 There is no consistent distinction in the literature between the terms *transformation* and *transition*. We use the term *transformation* to denote deep sociotechnical change (often labeled *transition* in English literature).

2 In a broad sense, an energy transformation should encompass the decarbonisation of power, heating and mobility. For each sector, renewable energy sources and reduced energy consumption are complementary strategies. Our focus here is on the power sector's transformation towards renewable energies.

3 "Agrarwende" is the German equivalent of the term "Energiewende", denoting the sustainability transformation of agriculture. It encompasses a shift towards a more environmental-friendly and multifunctional agriculture, specifically toward organic agriculture, but also toward greater animal welfare, strengthened rural development and new consumer-producer relations (e.g., community-supported agriculture). Further aspects include a reduction of meat nutrition, more seasonal and regional food, less food waste, improved food sovereignty and consumer protection.

4 *www.oekolandbau.de/service/zahlen-daten-fakten/strukturdaten-zum-oekolandbau*

Renate Künast of the Green Party, then linked the crises to fundamental flaws in the agro-industrial system and proclaimed the "Agrarwende" (agricultural transformation). Soon after, environmental as well as economic pressures also opened up a window of opportunity to strengthen rural development, ecology and animal welfare as part of the 2003 reform of the EU *Common Agricultural Policy (CAP)* (Sanders 2016, Weingarten and Rudloff 2018).

Grassroots movements and pioneers

In reaction to increasing problem pressure, societal values and priorities also changed. Backed by grassroots movements demanding change, visionaries and pioneers advanced sustainable alternatives, provided the "proof of principle" and lay the foundations for their scaling-up.

With regard to power supply, societal resistance developed in the second half of the 1970s vis-à-vis nuclear facilities. Greater independence from large corporations was also an issue. The anti-nuclear movement was initiated by local resistance to individual projects but developed into a broad movement including farmers and religious groups. It gained media and political attention through protest marches and occupations. The Chernobyl disaster gave a boost to the movement and led to numerous local, non-partisan "Energiewende committees" (Fuchs 2014, Grießhammer and Brohmann 2016). Grassroots mobilisation interacted with (conceptual as well as technological) pioneer work on alternatives. In 1980, the book *Energiewende* (Krause et al. 1980) provided an early vision of a more sustainable energy system (though still including domestic coal). Technologically, the engagement and investment of individuals and new small firms triggered the greatest advancements in renewable energies – rather than large research projects and corporations (Morris and Jungjohann 2016).

In the agricultural field, different grassroots movements and pioneers also paved the way for a sustainable transformation. Influenced by new agricultural and soil sciences of the 19th and early 20th centuries (Vogt 2000), advocates of organic and biodynamic agriculture started in the 1920s to take umbrage with some aspects of the emerging "modern" agriculture. Often stigmatised by conventional farmers and rural communities (Moschitz 2012), organic farmers and scientists over time road-tested and disseminated a multitude of innovations – from alternative processes to maintain soil fertility and control weeds and pests, via the breeding of robust farm animals and regionally adapted seed varieties to a more animal-friendly livestock keeping (Lockeretz 2007). A joint identity, common standards and learning were fostered by establishing umbrella associations of organic producers. Innovation also occurred in the processing and distribution of organic products: the limited-assortment organic food stores of the 1970s were gradually diversified and professionalised.

These pioneers were strengthened with the emergence of the environmental movement as of the 1970s. Since the 1980s, various environmental groups campaigned on the impacts of conventional agriculture, supporting the organic agriculture concept and starting to network with organic farmers. Simultaneously, the "new social movements" buttressed the animal welfare and animal rights issues which were (only then) taken up by the organic movement (Niggli 2007). With the Green Party's entry into German Parliament in 1983, national agricultural policy debates gained a new flavour.

Resistance from regime actors and adverse political frameworks

A common barrier in both transformation processes has been the resistance from regime actors and political frameworks that put the sustainable alternatives at a disadvantage. Renewable energies were forced to operate within an unaccommodating energy market for quite some time. The market was dominated by a few large generators in legally protected regional monopolies, based on large fossil-nuclear facilities with guaranteed profits (Morris and Jungjohann 2016). These companies were well connected with both conservative and social-democratic governments at national and federal state level to influence regulation. Even the mere connection of a wind turbine or solar cells by private individuals to the electricity grid remained legally challenging for many years. The energy sector and energy-intensive industries regularly took legal action and embarked on PR strategies against renewable energies and their supporting policies (Morris and Jungjohann 2016).

Similarly, the development of more sustainable agriculture was – and still is – hampered by regime actors and an adverse policy framework which subsidises an unecological production system instead of internalising its environmental costs. The German Farmers' Association, supported by the agribusiness, has long operated under the productionist paradigm "grow or go". Consequently, they rejected stronger ecological standards for farming and discredited organic farming as not being productive enough to feed the world, as too costly for consumers and even as "expropriating" farmers (Niemann 2017). For decades, the agro-industrial lobby had almost exclusive access to agricultural policy-making at national and EU level (Nischwitz and Chojnowski 2019). Only during the red-green coalition of the Social Democrats and Greens (1998 to 2005) did organic producers and non-governmental organisations (NGOs) become much better involved and more influential in Germany (Niemann 2003). However, even then it was not possible to sufficiently alter the overall agricultural policy framework.

Policy support for sustainable alternatives

Over time, public pressure led to policy support for renewable energies and organic agriculture – in particular during the red-green coalition. However, its extent differed decisively. In the 1980s, the federal government began funding renewable energies research on a small scale. Towards the end of the decade, some federal states and municipalities started providing financial support for the construction of renewable energy facilities. In 1990, an unlikely coali-

tion of parliamentary backbenchers from the Christian Democrats, Social Democrats and the Greens drafted the 1991 *Feed-in Act* which passed without much attention in the late night of the final parliamentary session of West Germany. The act stipulated a feed-in priority and financial compensation for renewable energies. It mainly boosted wind and small hydro-power plants but not solar energy generation, for which compensation was too low (Morris and Jungjohann 2016).

In 1998, the new red-green coalition passed the *Renewable Energy Act (Erneuerbare-Energien-Gesetz, EEG)* which laid the foundation for a boom in renewable energies including solar. It did so with technology-specific feed-in tariffs based on different technology costs and guaranteed for 20 years, resulting in full cost compensation and a profit. Thus, the regulatory framework made it financially attractive to invest in renewable energies. While the *European Renewable Energy Directive* and emissions trading system influenced the German energy market only to a limited degree, the EU liberalisation of energy markets in 1998 was more critical: it opened the market for new players with cheaper and/or green power tariffs (Morris and Jungjohann 2016). Finally, the phase-out decisions in 2001 and 2011 on nuclear power (agreed on for 2022) and in 2019 on coal power (targeted for 2038 at the latest) have been decisive steps for the energy transformation.

The situation differs markedly in agriculture, where policymakers at the federal level have limited competences between the making of the European *CAP* in a supranational context and its subnational implementation by the federal states. Policies supporting organic agriculture started at EU level in 1991, when the European Commission sought to protect consumers from misuse of the terms "bio" and "organic". At national level, the promotors of the "Agrarwende" proclaimed ambitious targets, notably to increase the share of organically farmed land and of organic food both to 20 percent by 2010.[5] However, beyond a funding priority for (co-)supporting organic agriculture, the government introduced relatively soft and voluntary instruments to achieve these: a national label and image campaign for organic products and a programme to raise awareness and support research and cultivation (Feindt and Ratschow 2003).

Though these measures had an impact, they did not bring about a substantial transformation. The same holds for measures taken by subsequent governments, such as the establishment of emissions standards for livestock facilities. The big screws – that is, the cost relation between conventional and organic agriculture – were not adequately addressed: only a few EU countries supported a substantial change of the *CAP* subsidy regime, and the German government did not sufficiently drive up the costs of harmful farming practices.

Technological improvements and business cases

Technological advances as well as rapidly dropping prices and investment costs for renewable energies have further driven the energy transformation. Improvements in efficiency and economies of scale in production led to a significant drop in costs per kilowatthour. The prices for photovoltaic (PV) dropped much more and faster than expected in the end of the 2000s, among others due to state-supported PV mass production in China. Return on investment in PV at times skyrocketed despite compensation sinking by five percent annually (Morris and Jungjohann 2016). This development attracted new investors and increasing demand triggered additional economies of scale in production. Increasing divestment from fossil fuel industries sent a complementary signal to the market. Today, renewable energies are on their way to surpass conventional power plants as the cheapest energy source for new installations (Kost et al. 2018) – which will make the energy transformation less dependent of regulatory regimes in the future.

This contrasts with the realm of agriculture where, under present conditions, organic agriculture is still less competitive than conventional agriculture. While it also requires innovation – which is much less supported by R&D subsidies than conventional agriculture or the "bioeconomy" –, its transformation benefits much less from scale effects and sinking technology costs than the transformation towards renewable energy.[6] Organic agriculture characteristics such as lower crop and animal yields per unit or greater labour intensity play a role in its lower competiveness, but can partly be counterbalanced by lower input costs and price premiums (Crowder and Reganold 2015). Ultimately, it is the distortion created by EU subsidies supporting conventional agriculture that handicaps: 70 percent of the 60 million Euro annually paid to European farmers are not tied to any environmental or animal welfare requirements (Heinrich-Böll-Stiftung et al. 2019, p. 8). The EU funding for organic agriculture is minor in comparison. Furthermore, it requires co-financing by the German federal states.

Access to funding for organic farmers and for converting to organic agriculture is also difficult. During conversion, the lack of price premiums limits profitability. While small private initiatives have emerged which buy up land and lease it to organic farmers, there is neither sufficient ecological investment in organic agriculture nor relevant divestment from factory farming. In contrast to national energy markets, passing on additional costs to consumers has become more difficult in internationalised (organic) agricultural markets with competition from cheap labour countries and dynamics from financial speculation. Over the years, the profitability of organic agriculture market segments has fluctuated both with political *(CAP)* and market conditions (Sanders et al. 2012). The motivation to run a profitable farm has become more >

5 Renate Künast, former Minister of Food and Agriculture, in a government statement on February 8, 2001: *http://dip21.bundestag.de/dip21/btp/14/14149.pdf*.

6 The sustainability performance of agriculture does not depend on a handful of technologies (such as PV or wind turbines), but on a multitude of practices embedded in complex biological systems. These range from tillage via weeding to feeding and housing. Moreover, many technological developments – such as precision farming – benefit different farming systems and hence do not improve the competitiveness of organic agriculture vis-à-vis conventional agriculture.

important for conversions than among the organic agriculture pioneers, leading to an incipient "conventionalisation" (Best 2007).

The energy transformation also put a damper on organic agriculture: as feed-in tariffs for biogas made it attractive to grow energy crops, fewer farmers converted their farms to organic agriculture and some even returned to conventional farming (Kuhnert et al. 2013). Moreover, the biogas funding contributed to driving up the costs of buying or leasing land, which affects organic farms in particular (Schmidtner et al. 2014). On the other hand, the organic consumer market experiences a more positive development: products have been mainstreamed in conventional supermarkets and discounters, and bio-supermarket chains have been propagating. The willingness of consumers to pay price premiums has triggered impressive growth rates (BÖLW 2019). Demand for numerous products exceeds domestic production, necessitating imports.

Actor coalitions and degree of societal consensus

The energy transformation also benefited from an increasingly broad coalition of supporters. Early on, this included environmentalists, farmers and religious groups in the anti-nuclear movement. Over time, economic interests – and narratives – started to play a role: firstly, a growing number of investors emerged, from private households and energy cooperatives to small businesses, project developers and financial investors. Secondly, a manufacturer-supplier industry developed for wind turbines and solar panels – although the German solar industry mostly vanished later on due to cheaper panels from China. These stakeholders also supported the energy transformation and the *EEG* after the red-green government was voted out of office in 2005 (Meckling et al. 2015).

Since the Fukushima disaster and the official proclamation of the "Energiewende" by Chancellor Angela Merkel, a broad political and societal consensus in Germany has developed in favour of a nuclear phase-out (Hermwille 2016). Acceptance for an energy transformation has been further facilitated by (inter)national discourses on climate change, the attractive narrative of a "clean energy" future enabled by pioneering engineering (Hermwille 2016) and an increasing number of credible scenario studies on 100 percent renewable energy systems. Dropping costs and reduced feed-in tariffs as well as the latter's increasing conversion to auctions have been important for generating support among economic and politically liberal actors. Despite a lively debate on the transformation's precise governance and speed, in particular a coal phase-out, the fundamental goal of an emission-free electricity system by 2050 is no longer seriously questioned within the political and societal mainstream.

The same does not apply for the transformation towards organic agriculture. On the one hand, alternative agricultural organisations together with environmental, consumer, development and religious groups have called for an agricultural transformation since the late 1980s, cooperating on issues such as genetic modified organisms, food risks, factory farming, agricultural trade and bioenergy. As of 2011, this coalition started to mobilise a broader civil-society movement with annual protest marches (figure 4).[7]

FIGURE 3: Two experts of the International Atomic Energy Agency examine recovery work on Fukushima Daiichi Nuclear Power Station on April 17, 2013 as part of a mission to review Japan's plans to decommission the facility. The Fukushima disaster in 2011 has been a key accelarator of the German energy transformation.

On the other hand, the agricultural, agribusiness and food sectors as well as most major political parties still widely support conventional production. The 20 percent target relating to organic agriculture has been maintained, but governmental support is weak. Unlike in the energy transformation, analyses exploring the environmental relief effect and scenario studies modelling pathways, costs and benefits of a transformation to 20 percent (or even 100 percent) organic agriculture are rare (an exemption is Wirz et al. 2017). Despite the fact that the initial "Agrarwende" for the first time contested the narratives legitimising conventional agriculture at government-level (Gerlach et al. 2005, Boschert 2005), its legitimisation through images of "Heidi"-style farming is still dominant in marketing. And while more and more farms surrender, the German Farmers' Association still exerts a cul-

7 *www.wir-haben-es-satt.de*

tural and discursive hegemony within the sector. Regime actors like the Federal Ministry of Food and Agriculture or the German agricultural society DLG concede that the agricultural system selectively needs to become more "sustainable". However, the guiding vision is not organic agriculture in small rural structures. Rather, these protagonists aim at a highly capitalised, efficient and digitalised "precision agriculture". This lack of a shared vision and its concretisation seriously hampers a long-term transformation.

Conclusions

With regard to their early transformation phases, the two cases resemble each other more than one might expect. Both the conventional energy and the agri-food system came under pressure by three developments: environmental crises and catastrophes, changing societal values and grassroots movements as well as pioneers with niche developments that offered more sustainable solutions. The two cases also share a long-term fundamental barrier: resistance from regime actors in business and politics and policy frameworks (including subsidy regimes) hampering the sustainable alternative.

With the red-green government elected in 1998, both attempted transformations were politically advanced. While this seems to be like another similarity, the details reveal key differences in the kind and extent of policy support – which may explain much of the different progress. The regulatory framework for investment in renewable energies became highly attractive through a legal regime of priority feed-in with technology-specific tariffs guaranteed for 20 years, allowing for planning security and full cost compensation for investors. In comparison, organic agriculture was mainly supported by soft instruments (labelling, marketing, research funding). The limited policy support can partly be explained by bounded national competences which have impeded significant altering of the subsidy regime.

After the termination of the red-green government in 2005, the two processes increasingly differed. The "Agrarwende" mostly stagnated: the influence of the regime actors resurged, their overall rejection of organic agriculture unimpaired. The "Energiewende", however, progressed. We can trace this back to heavily falling technology costs and attractive investment opportunities, strong narratives and concrete transformation scenarios as well as the Fukushima disaster and the prominence of climate change concerns. These factors contributed to forging a broad actor coalition with strong normative motives but also powerful economic interests.

While our analysis is generally in line with transformation research insights, it particularly emphasises the role of economics – in turn influenced by policy – as a decisive factor between the predevelopment of transformations and their breakthrough. Transformation strategies should thus aim to create regulatory frameworks that do not hamper the profitability of the sustainable alternatives and rather make it attractive to invest in these. For instance, profitability of organic agriculture can only be achieved by ending subsidies for harmful practices of conventional agriculture and by internalising its environmental costs consequently. Moreover, our analysis shows that one should be aware of unintended negative side effects of one sustainability transformation to another (in this case, the promotion of bioenergy).

A caveat for learning from our study is, however, that the analysed transformations depend(ed) substantially on changes in the cost structures of producers and investors rather than behavioural changes of consumers: their main contribution is to substitute green power for conventional tariffs, or organic food for conventional products. As a consequence, insights from the outlined cases can best be transferred to other transformations which halt due to the lack of investment incentives. A case in point is the energy transformation of the building sector where energy-related modernisation and renewable energies investments to date remain often financially unattractive. Within the agricultural realm, animal-friendly farming in many cases also re- >

FIGURE 4: Since 2011, a coalition of NGOs organises the annual protest march *Wir haben es satt! (We are fed up!)* in Berlin, calling for a transformation of agriculture. In 2019, this farmer escorts the protesters with his tractor and demands "Systems change, not climate change".

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quires substantial investments and running costs for farmers with uncertain payback from retailers and consumers. Subsidising the cost difference or providing a level playing field through regulatory standards can promote the breakthrough. In contrast, insights from our cases seem less applicable to transformations where fundamental changes in consumer behaviour are required.

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