

UFZ Discussion Papers

Department of Economics

15/2012

The German *Energiewende* under attack - is there an irrational *Sonderweg*?

Erik Gawel, Sebastian Strunz, Paul Lehmann

September 2012

The German *Energiewende* under attack

Is there an irrational *Sonderweg*?

Erik Gawel^{1,2}, Sebastian Strunz¹ and Paul Lehmann¹

¹ Helmholtz Center for Environmental Research – UFZ, Department of Economics, Permoser Str. 15, 04318 Leipzig, Germany

² Leipzig University, Chair of Economics, esp. Institutional Environmental Economics, Grimmaische Str. 12, 04109 Leipzig, Germany

ABSTRACT. The German energy transition repeatedly faces harsh critiques questioning its economic and environmental merit. This article defends the *Energiewende* and argues that Germany has chosen a rational and particularly forceful approach to securing sustainable energy supply. Though current expenditures are high, the long-run benefits of transforming the energy system to a renewables-based system are likely to outweigh present investment costs. Furthermore, support policies for renewables are not redundant – as some critics claim – but complement other policy instruments, such as the emissions trading scheme. The article also addresses the motives behind the discrediting attacks on the German energy policy regime. Defense actions by beneficiaries of the former energy market structure are only to be expected, but the attacks from liberal economists are astonishingly fierce.

KEYWORDS. Energy supply, energy transition, externalities, Germany, renewable energy sources, support policies, sustainability.

JEL CLASSIFICATION. D62, H54, Q 42, Q48, Q53, Q54.

Introduction

Germany's plan to transform its energy system into a purely renewables-based system by 2050 – captured by the German concept *Energiewende* – has drawn widespread attention. Buchan (2012), for instance, reviews the “extraordinary challenge” Germany has set itself and interprets it as “gamble [that] may still come off”. Indeed, it seems ambitious for an economy that mainly relies on exporting a wide variety of industrial products to almost completely remodel its energy system within a few decades. While embedded in an EU-wide energy strategy, the German renewable energy targets are more far-reaching and include a phase-out of nuclear power by 2022. On the one hand, this “German strategy” draws acknowledgment and sometimes even admiration from its neighbors (Boutelet 2011); but on the other hand, there is confusion about the motives behind the energy turnaround: some international observers argue that in Germany “the issue is framed as a moral imperative more often than an economic one” (Birnbaum 2012). This perception may lead to deep skepticism, as portrayed by Hockenos (2012b) in a US view on German energy policy. Thus, two questions on the German energy turnaround emerge: First, is Germany again off track, embarking on a *Sonderweg*? Second, is the *Energiewende* irrational, an economically nonsensical project driven by German *Angst* about the risks of nuclear power?

The first question can be promptly negated. As Hockenos (2012a) shows, the idea “that Germany is somehow on its own in Europe, on the fringe of the continent's mainstream” on the issue, is a myth and a misconception: eleven out of twenty-seven European Union member states currently do not rely on nuclear power and most of them have committed themselves to not doing so in the future; five other European countries are joining Germany in phasing out nuclear power, among them Italy, another G8 member state. Furthermore,

eighteen EU countries have implemented renewable support policies similar to those in Germany. Therefore, it is misleading to describe Germany's energy policy as a *Sonderweg*. What makes the German situation special is not the goal of a sustainable energy system as such but the context of an accelerated transition in a thoroughly industrialized economy.

The second question lies at the heart of this article. Certainly the vision of a sustainable, RES-based energy system is to an extent morally motivated since sustainability issues typically also refer to concerns of justice. However, the present German discussions on the energy transition focus on economic issues as well. Is the timeline too ambitious and the transition pathway too expensive? Should energy policy "pick winners" and support specific technologies? The harshest critiques of the *Energiewende* do not concern its overall goal, which is acknowledged across the political spectrum, but specific policies. In particular, the main policy instrument, a feed-in tariff supporting renewables, draws heavy criticism. Support for photovoltaic power is repeatedly derided as an enormous waste of money. For instance, the former CEO of RWE, one of the four big power generators in Germany, mocked that photovoltaic power in Germany made as much sense as "growing pineapples in Alaska" (Warner 2012). German researchers at the RWI Institute issued a warning of a "cost-tsunami" about to hit Germany: the alleged tsunami was said to be arising from the investments in photovoltaic power that are piling up to a huge mountain of "solar debt" (Fronzel 2010). Similarly, Hans-Werner Sinn of Munich's Ifo Institute coined the phrase "green paradox" to mark RES support policies as expensive and, more importantly, useless attempts to curb CO₂ emissions (Sinn 2011). But the distributional effects of the *Energiewende* are also criticized. Rising energy prices and their impact on low-income households are brought forward to question the envisaged speed of the transformation of the energy system. The most fundamental critique of the *Energiewende*, however, attacks the role of the state in promoting the energy transi-

tion. The head of the German Monopoly Commission cautions against a “command economy” in the making (Mundt 2012). So how irrational is the *Energiewende* really? Are there valid arguments that justify the harsh tone of the attacks?

At this point, a short note on the history of the energy transition might be in order. The *Energiewende* did not materialize out of thin air in 2011. The term was actually coined thirty years earlier by an ecological think tank (Krause et al. 1980), who defined the concept as “growth and prosperity without oil and uranium”. Since 1980, this idea has steadily gained traction in the political discourse. In 1991 the first RES support policy was introduced, with a significant revision and extension in 2000 (the Renewable Energy Sources Act, in short EEG = *Erneuerbare-Energien-Gesetz*). The feed-in tariff system of the EEG is now the main policy instrument for the energy transition and largely responsible for the increase in Germany’s share of RES in overall electricity generation from seven percent in 2000 to presumably twenty-five percent in 2012. Germany’s first coalition involving the Green Party in 2000 implemented not only the EEG, but also a nuclear phase-out. Although the Conservative coalition under Chancellor Merkel reversed this nuclear consensus in 2010, after Fukushima it felt compelled to re-evaluate nuclear power and, in a spectacular policy U-turn, introduced another phase-out in 2011, terminating nuclear power in Germany by 2022. Yet, the Conservatives’ energy concept 2010 already displays very ambitious RES targets, such as an envisaged minimum of eighty percent RES-generated electricity in 2050. In conclusion, the 2011 Conservative nuclear policy U-turn only completed the broad political consensus on the general trajectory of the German energy system towards a low-carbon, nuclear-free system.

This article now addresses the most prominent critiques of German energy policies in more detail. The intensity and vehemence of these critiques is surprising. While defense maneu-

vers by representatives of the old energy regime are to be expected, they form only part of the criticism. More puzzling are the at times furious statements of liberal economists against *Energiewende* policies. To shed some light on the debate, the remainder of this article examines the reproaches and shows that they result from a narrow and one-sided perspective on the energy transition. Consequently, a significant cut in – or even an abolition of – RES subsidies, as proposed by the opponents (Weimann 2008, 2009; Frondel et al. 2008; Frondel et al. 2010), would constitute a very poor policy response. Adjustments to the RES policies may be warranted, but warnings of catastrophic economic consequences seem grotesquely exaggerated.

Too expensive, ineffective and unjust? In defense of the EEG

The most frequent critique of the energy transition says that it is not implemented in a cost-effective way. In particular, support for photovoltaic power is criticized because photovoltaics receives most of the support money despite the fact that its contribution to overall electricity production is relatively small. Hence, investments in photovoltaic power are depicted as wasteful spending of scarce resources (Weimann 2008, 2009; Frondel et al. 2008; Sinn 2011). More drastically, a “cost-tsunami” deriving from misguided technology support is said to loom large over Germany’s economic future (Frondel et al. 2010).

Yet, there are two important objections to the simplified argument above. Firstly, it neglects the time horizon, which is probably the crucial variable in all calculations on the costs of the energy transition. While photovoltaic power today may be more expensive than fossil power generation, rising costs of fossil fuels and declining costs of solar cells may well reverse the balance within a few decades. And as the energy transition is a long-term project, an eco-

conomic evaluation of it should depend on long-term projections, too. Indeed, scenario analyses show that, in the long run, the odds are clearly in favor of renewables, photovoltaics included: the costs of a renewables-based energy system will likely drop to a level lower than the costs of the existing fossil-nuclear energy system at some point in the twenty-first century, the exact point in time depending on the actual development of resource and technology prices (Nitsch et al. 2012). Secondly, monetary expenses do not equal economic costs. Spot market prices for electricity do not reflect the external costs of power generation: the adverse effects of fossil-nuclear power generation, such as radiation risks, oil spills and CO₂ emissions, fail to be represented by actual market prices. If these external costs were to be included in the comparison of a RES-based energy system vs. a fossil-nuclear energy system, the costs of the conventional system would be much higher and the benefits of switching to renewables would emerge much sooner (Ibid.).

Furthermore, critics claim that the EEG is redundant because of its interaction with the European emissions trading system (ETS). Since the ETS sets a binding limit on CO₂ emissions, any emissions reduction via pushing renewables into the electricity sector only leads to rising emissions elsewhere (Sinn 2011): decreasing demand for permits in the electricity sector is fully compensated by cheaper permit prices and hence increasing demand for permits in the remaining sectors regulated by the ETS. The EEG/ETS interaction argument is correct as such but it does *not* allow the conclusion that RES support policies are useless. There are several reasons for this. Firstly, the conclusion is not valid if RES support policies are accounted for when setting the emissions cap. Indeed, the emission reductions following from the EEG have been factored into the German emissions cap (Matthes 2010). Hence, the EEG really does contribute to reducing emissions. Secondly, there is no “fair” competition between renewable and non-renewable energy sources which leads to distortions of technology

choice (Lehmann and Gawel 2012). The energy system has been optimized for fossil-nuclear power generation and a variety of relevant subsidies is still in place (Ellis 2010; UBA 2010). Renewable energies face a systematic comparative disadvantage when competing with conventional energies. In other words, there are path dependencies to the benefit of the old fossil-nuclear technologies. Therefore, the ETS does not suffice to promote fundamental technological path changes (Unruh 2000; Neuhoff 2005; Lehmann et al. 2012). Additional RES support policies are warranted to create a level playing field where renewables are not restrained by structural obstacles. This rationale for RES support becomes even more important in cases of market failure in the technology sector. If knowledge spillovers create benefits beyond an individual company's calculation, RES support is necessary to guarantee the optimal level of investment and deployment of new technologies (Fischer and Newell 2008; Kalkuhl et al. 2012). Thirdly, policy failures cast doubt on the claim that the ETS constitutes the only legitimate instrument of climate policy (Matthes 2010). In particular, politically induced uncertainty over the long-term emissions reduction path justifies additional RES support (Ulph and Ulph 2010). Fourthly, on a very general level, the existence of multiple objectives (such as technology change, security of supply, sustainability etc.) requires an equal amount of policy instruments to reach these objectives (Tinbergen 1952). Accordingly, it has been shown for the case of climate and energy policy, that a single policy instrument is not sufficient to attain a multiplicity of policy goals (Pethig and Wittlich 2009; Jensen and Skytte 2003).

A fundamental disagreement regards the role of the state in the energy transition. By using a feed-in tariff to support renewables, critics complain, the state is "picking winners", which only the market should do (Weimann 2008). The long-run targets of the energy concept and the complex support scheme of the EEG are characterized as instances of governmental hu-

bris, typical of a command economy (Lambertz and Steiger 2011; Mihm 2011). However, the energy system has never been and never will be free of governmental intervention (Gawel et al. 2012). A large-scale project such as the energy transition is hardly conceivable without the state playing a substantial role. In particular, RES support policies are required to facilitate fundamental technological path changes (Unruh 2000; Neuhoff 2005; Lehmann et al. 2012). Also, the narrative of essentially command economy-oriented energy policies that inhibit competition in the energy market is not convincing. It can be answered with a counter-narrative: rather, the sluggish liberalization of the electricity market will be completed via the transition to a decentralized system. Hitherto, the German electricity market has effectively been an oligopoly of four big power companies. A decentralized system where municipal suppliers and individual households produce a substantial part of the energy promises an open and competitive market structure.

Another argument which is brought forward against *Energiewende* policies addresses the distributional effects of the energy transition. Rising energy prices due to the EEG are said to be unjust because poorer households have to spend a larger share of their income on energy (INSM 2012). Accordingly, the costs of promoting renewables and the speed of the energy transition are called into question with reference to their social repercussions. Yet, the regressive income effect of goods with low income elasticity is well known and does not hold as an argument for direct intervention in commodity prices: energy policy is a bad substitute for social policy. That is, organizing the energy system in a sustainable and efficient way benefits everyone; the affordability of energy should, of course, be addressed, but preferably via social policy, not via distorting energy policy. In economic textbook parlance, the size of the whole cake is in everyone's interest, so better not disturb the making of the cake with the question of how to partition the individual slices.

If we sum up at this point there is definitely an economic rationale for both energy transition in general and using complementary RES supporting instruments such as feed-in tariffs. Yet, what drives the harshness of the critique against this background? And how should the *Energiewende* be governed accordingly? The next section tries to shed some light on the motivations for the attacks on the energy transition and discusses the suggested policy alternatives.

Motives behind the critique and possible alternatives

Representatives of the “ancien régime” (that is, the oligopoly comprising the big four German power companies as well as the industrial beneficiaries of the former market structure) have little interest in supporting the transition to a RES-based system because this transition steadily dissolves the old, centralized market structure, thereby eroding the oligopoly’s hitherto privileged status and, at the same time, revealing the social cost of fossil-nuclear energy provision. Consequently, dominant firms tend to invest in incremental improvements of existing technologies (or even mere rent-seeking) rather than fundamental technological change (Grubb 1997). Discrediting attacks on the RES-policy regime from the “ancien régime” might be interpreted as defense actions. Yet, the drastic critique of the RES support policies from some liberal economists remains puzzling. The very same economists that tend to pride themselves on their “positive analysis” from an impartial perspective seem to disrespect some of their core tenets.

First, economists generally point out that discussions about allocative efficiency should be separated from arguments about distributive justice. Therefore, the emphasis on the EEG’s regressive income effect is surprising. Second, economists differentiate between prices ob-

served on real markets and “shadow prices”, which comprise full information on social value and indicate theoretically optimal prices. Spot market prices should not be mistaken for full-information shadow prices – unless the market price is corrected for all externalities. Apparently, some economists ignore this fundamental tenet as they do not try too hard to “get the prices right”. For example, to a large extent carbon externalities are considered to be the only relevant social cost of energy supply neglecting other energy-related externalities such as oil spills or radiation risks. Third, economists take individual preferences and normative ends as given. They present economics as the discipline that, by analyzing trade-offs and means-ends relationships, prepares rational ordering of policies following individuals’ preferences. In this view, democratic decision-making may build on value-free economic decision support. However, the terminology used by several economists when criticizing RES support refutes their claim of impartially observing politics. Attacking the RES-policy regime as a gateway to a command economy or as giving rise to a cost-tsunami contradicts the self-description of economics as an empirical-analytical science. Fourth, economists differentiate between dynamic processes and static settings. The energy transition is obviously a dynamic problem, so it should be discussed with arguments from a static perspective. Still, as shown in the preceding section, some of the critiques brought forward against the EEG stem from static considerations.

How to make sense of this pattern – why do liberal economists neglect some of their core tenets when discussing the energy transition? One reason might be the deep skepticism of liberal economists regarding large-scale government interventions and their related belief in market virtues. Governments fail and so do markets. To which degree, however, is a matter of debate, which leaves space for ideological reasoning. As a large-scale project relying on state interventions, the energy transition serves as a prime target: an idealized, unfettered

energy market may be positioned against an excessively regulated renewable energy market. Another reason seems to lie in a misperception about the role of scientists in public debates. Apparently, some liberal economists confuse their twofold roles as citizens and scientists. As citizens, they are entitled to bring their own normative views forward. As scientists, they should distinguish their own preferences from analytically obtained results. In particular, scientists should be as explicit as possible about their normative background and their personal opinions (Weber 1972 [1917]). Yet the tendency to scandalize *Energiewende* policies clearly exposes a mix of individual normative views and scientific reasoning. Thus, the harsh tone of the critiques may be traced back to a conflation of perspectives.

Which conclusions should be drawn from the assessment of the critiques? The main accusations can and should be rebutted. First, liberals' proposed alternatives for the criticized feed-in tariff system are not convincing. In particular, quantity instruments cannot fulfill the same function as feed-in tariffs: while the latter support a whole spectrum of technologies, quantity instruments only promote the technologies that are cheapest at a given point in time. That is, quantity instruments would currently only induce more on-shore wind and more biomass capacities. Yet, the EEG's aim is precisely to provide a diverse portfolio of renewables, including photovoltaic power and off-shore wind. Moreover, feed-in tariffs actually turned out to be more effective than quantity instruments in increasing installed capacities of renewables (Lipp 2007; Mitchell et al. 2006). Second, RES support is neither "unjust" nor "useless", if appropriately integrated in the overall policy mix. Justifiable critique of specific regulation aspects does, therefore, not question the *Energiewende* as such. Evidently, the RES support policy system is not perfect. For instance, the EEG will have to be adjusted to guarantee market integration of renewables in the long run. Here, a careful balance must be struck between reducing investment risks and exposure to market pressure. The necessary

shift from a system of guaranteed technology support to a competitive market structure needs to be smooth and transparent because regulatory uncertainty is the biggest obstacle to investments in new technologies. Hence, a sudden and complete overhaul of the RES support scheme, as called for by Frondel et al. (2010), would severely disrupt the progress of renewables.

Conclusion

In sum, Germany has not embarked upon an irrational *Sonderweg*. Rather, it has chosen a particularly forceful approach to securing sustainable energy supply in a likely future of rising prices for fossil fuels – supported by a broad societal consensus. Large investments in the transformation of the energy system will probably prove to be beneficial in the long run. Sure enough, the *Energiewende* is an ambitious and challenging endeavor, which needs to be governed in an effective way. To that end, economic vigilance is warranted; alarmist warnings of economic catastrophes, however, are certainly misleading.

References

- Birnbaum, Michael. 2012. "Germany faces energy balancing act." Washington Post. 23. August 2012. www.washingtonpost.com/world/europe/germany-faces-energy-balancing-act/2012/08/23/d3b82ddc-e979-11e1-936a-b801f1abab19_story.html
- Boutelet, Cécile. 2011. "Sortir du nucléaire - Une stratégie allemande." Le monde. 7. June 2011. <http://lemonde-emploi.blog.lemonde.fr/2011/06/07/sortir-du-nucleaire-une-strategie-allemande-dans-le-monde-economie-du-7-juin/>
- Buchan, David. 2012. "The Energiewende - Germany's gamble." The Oxford Institute for Energy Studies - Working Papers. <http://www.oxfordenergy.org/wpcms/wp-content/uploads/2012/07/SP-26.pdf>
- Ellis, Jennifer. 2010. "The Effects of Fossil-Fuel Subsidy Reform: A review of modelling and empirical studies." in Untold billions: fossil-fuel subsidies, their impacts and the path to reform.

- Winnipeg: International Institute for Sustainable Development (IISD).
http://www.iisd.org/gsi/sites/default/files/effects_ffs.pdf
- Fischer, Carolyn, and Richard G. Newell. 2008. "Environmental and Technology Policies for Climate Change Mitigation." *Journal of Environmental Economics and Management* 55 (2): 142-162.
- Frondel, Manuel, Nolan Ritter, and Christoph M. Schmidt. 2008. "Germany's solar cell promotion: Dark clouds on the horizon." *Energy Policy* 36 (11): 4198-4204.
- Frondel, Manuel, Nolan Ritter, and Christoph M. Schmidt. 2010. "Die Förderung der Photovoltaik - ein Kosten-Tsunami." *Energiewirtschaftliche Tagesfragen* 60 (12): 36-44.
- Frondel, Manuel. 2010. Energie-Streitgespräch „Rückkehr zur rationalen Energiepolitik“. *Wirtschaftswoche*. www.wiwo.de/technologie/umwelt/energie-streitgesprach-rueckkehr-zur-rationalen-energiepolitik/5144218.html.
- Gawel, Erik, Paul Lehmann, Sebastian Strunz, and Klaas Korte. 2012. "The German energy transition - a scandalon?" *GAIA* 21 (4) forthcoming.
- Grubb, Michael. 1997. "Technologies, Energy Systems and the Timing of CO2 Emissions Abatement: An Overview of Economic Issues." *Energy Policy* 25 (2): 159-172.
- Hockenos, Paul. 2012a. "Angst or arithmetic? Why Germans are so skeptical about nuclear energy." in Heinrich Böll Stiftung - Series on the German Energy Transition. boell.org/downloads/Hockenos_Angst_or_Arithmetic.pdf
- Hockenos, Paul. 2012b. "Ein deutscher Sonderweg." *die tageszeitung*, 20 August. www.taz.de/!99926/
- Initiative Neue Soziale Marktwirtschaft (INSM). 2012. Das EEG belastet vor allem Geringverdiener. 23 April. www.insm.de/insm/dms/insm/text/presse/pressemitteilungen/pressemitteilung-EEG-studie/Pressemeldung%20EEG-Studie.pdf
- Jensen, Stine Grenaa, and Klaus Skytte. 2003. "Simultaneous attainment of energy goals by means of green certificates and emission permits." *Energy Policy* 31: 63-71.
- Kalkuhl, Matthias, Ottmar Edenhofer, and Kai Lessmann. 2012. "Learning or Lock-in: Optimal Technology Policies to Support Mitigation." *Resource and Energy Economics* 34 (1): 1-23.
- Krause, Florentin, Hartmut Bossel, and Karl-Friedrich Müller-Reißmann. 1980. *Energiewende - Wachstum und Wohlstand ohne Erdöl und Uran*. Frankfurt am Main: Fischer.
- Lambertz, Johannes, and Wolfgang Steiger. 2011. "Wirtschaftlicher Sachverstand statt Planwirtschaft: Programm für eine realistische Energiewende." *Energiewirtschaftliche Tagesfragen* 61 (9): 33-35.
- Lehmann, Paul, Felix Creutzig, Melf-Hinrich Ehlers, Nele Friedrichsen, Clemens Heuson, Lion Hirth, and Robert Pietzcker. 2012. "Carbon Lock-Out: Advancing Renewable Energy Policy in Europe." *Energies* 5 (2): 323-354.
- Lehmann, Paul, and Erik Gawel. 2012. "Why Should Support Schemes for Renewable Electricity Complement the EU Emissions Trading Scheme?" *Energy Policy*, in press.
- Lipp, Judith 2007. "Lessons for effective renewable electricity policy from Denmark, Germany and the United Kingdom." *Energy Policy* 35: 5481-5495.

- Matthes, Felix Chr. 2010. Greenhouse gas emissions trading and complementary policies. Developing a smart mix for ambitious climate policies. Berlin: Öko-Institut e. V. www.oeko.de/oekodoc/1068/2010-114-en.pdf
- Mihm, Andreas. 2011. "Planwirtschaft in der Energiewirtschaft." Frankfurter Allgemeine Zeitung. 6 June. www.faz.net/aktuell/wirtschaft/wirtschaftspolitik/energiepolitik/atomausstieg-planwirtschaft-in-der-energiewirtschaft-1655170.html
- Mitchell, Catherine, Dierk Bauknecht, and Peter M. Connor. 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: 297-305.
- Mundt, Andreas. 2012. "Wettbewerb im Strommarkt oder Planwirtschaft erneuerbarer Energien." Speech delivered at the fourth Speyerer Energieforum. 22 March. Berlin. www.bundeskartellamt.de/wDeutsch/download/pdf/Stellungnahmen/Rede_Andreas_Mundt_Speyerer_Energieforum.pdf
- Neuhoff, Karsten. 2005. "Large-scale deployment of renewables for electricity generation." *Oxford Review of Economic Policy* 21 (1): 88-110.
- Nitsch, Joachim, Thomas Pregger, and Tobias Naegler. 2012. "Erneuerbare in der zukünftigen Energieversorgung - wie sind die Ziele der Energiewende erreichbar?" *energiewirtschaftliche Tagesfragen* 62 (5): 30-37.
- Pethig, Rüdiger, and Christian Wittlich. 2009. "Interaction of Carbon Reduction and Green Energy Promotion in a Small Fossil-Fuel Importing Economy". CESifo Working Paper. www.cesifo-group.de/portal/pls/portal/docs/1/1186082.PDF
- Sinn, Hans-Werner. 2011. *The Green Paradox*. Cambridge, MA: MIT Press.
- Tinbergen, Jan. 1952. *On the Theory of Economic Policy*. Amsterdam: North-Holland.
- UBA. 2010. *Umweltschädliche Subventionen in Deutschland - Aktualisierung für das Jahr 2008*. Dessau: Umweltbundesamt (UBA).
- Ulph, Alistair, and David Ulph. 2010. "Optimal Climate Change Policies When Governments Cannot Commit." The University of Manchester Sustainable Consumption Institute Discussion Papers. <http://www.sci.manchester.ac.uk/uploads/no4ulphandulph.pdf>
- Unruh, Gregory. 2000. "Understanding Carbon Lock-in." *Energy Policy* 28 (12): 817-830.
- Warner, Mary B. 2012. "Solar energy row is an 'undignified spectacle'." *Der Spiegel*. 20 January 2012. www.spiegel.de/international/germany/the-world-from-berlin-solar-energy-row-is-an-undignified-spectacle-a-810370.html
- Weber, Max. 1972 [1917]. "Wissenschaft als Beruf." in *Schriften zur Wissenschaftslehre*, ed. Max Weber, pp. 582-592. Tübingen: Mohr.
- Weimann, Joachim. 2008. *Die Klimapolitik-Katastrophe*. Marburg: Metropolis.
- Weimann, Joachim. 2009. "Königswege und Sackgassen der Klimapolitik." in *Jahrbuch Ökologische Ökonomik: Diskurs Klimapolitik*, ed. Frank Beckenbach et al.. Marburg: Metropolis, 213-237 and 254-259.