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Policy path dependency and the governance of transitions – explaining a policy's stickiness through its design (Paper ID 217)

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Abstract:

Socio-technical transitions often require strong policy intervention, particularly in sectors that involve public good and/or infrastructure, such as energy, transport, water, or health. Often, policies that aim at catalyzing transitions are dismantled quickly, amongst others, due to pressure from incumbents. In other words, the everyday politics of (transitions) policymaking come into play. One important question relates to how policies can be intentionally designed to become sticky, i.e. less likely to be dismantled quickly. However, predicting future policy *output* has not been a focus of research so far, with researchers primarily engaging with the prediction of policy *outcomes* (e.g. in the form of new knowledge or technology diffusion). In this paper, we bring together two different strands of literature, path-dependency literature and policy design studies, that allow for theorizing the linkage between the existence and strength of policy design characteristics and the strength and stability (or 'stickiness') of policy instruments in subsequent time periods. It is theorized that certain design elements can increase (or decrease) the stickiness of a policy through positive or negative feedback mechanisms.

We test our theory in panel regression analyses using a detailed and comparable dataset of policy output across nine countries and covering seventeen years (1998-2014). We focus on the policy field of renewable energy production and base our empirical assessment of policy design (i.e., the explanatory variable in our study) on the *Index of Policy Activity* (IPA). By systematically analyzing which policy design characteristics drive the future outlook of policies, we contribute both to empirical, quantitative and comparative policy analysis as well as, potentially, to the theorization of temporal relationships between current policy choices and future policy output. In the conclusion, we discuss how policy could be intentionally designed in order to stick and thereby enable major socio-technical transitions.

Keywords: policy feedback; socio-technical transitions technology policy; policy design; Index of Policy Activity IPA; renewable energy; path-dependency; policy effectiveness

1. Introduction

Prediction has long been described as an important goal of quantitative policy analysis (Breunig and Ahlquist 2014). Socio-technical transitions often require strong policy intervention, particularly in sectors that involve public good and/or infrastructure, such as energy, transport, water, or health (Geels et al. 2017; Smith, Stirling, and Berkhout 2005). However, often policies that aim at catalyzing transitions are dismantled quickly, amongst others, due to pressure from incumbents. In other words, the everyday politics of (transitions) policymaking come into play (Kern and Rogge 2017). However, predicting future policy output has not been a focus of research so far, with researchers primarily engaging with the prediction of policy outcomes (e.g. in the form of new knowledge – often measured in patents – or technology diffusion). As output prediction is closely related to understanding policy change as such, a plethora of literatures potentially contributes relevant research perspectives to the debate – making the integration of these perspectives a key task for researchers (Kern and Rogge 2017).). In this paper, we bring together two different strands of literature, path-dependency literature and policy design studies, that allow for theorizing the linkage between the existence and strength of policy design characteristics and the strength and stability (or 'stickiness') of policy instruments in subsequent time periods.

One recent development in the public policy literature is the debate that emerged around policy stickiness. Among others, Cashore and Howlett (2007) opened the debate by conceptualizing different policy trajectories and asking how such trajectories, e.g. a trajectory of progressive incremental changes, could be created. In their more recent agenda-setting article, Jordan and Matt (2014) put the question forward how policies can be intentionally designed to become sticky, i.e. resilient to efforts of revoking or dismantling them. Their contribution is part of the so-called 'new' policy design literature (Howlett 2014) striving to revisit the question of intentional policy design that has been pushed aside by the 'government to governance' debate. In related policy fields, such as innovation studies, there is a similar renewed interest in questions of policy design. Among others, Kemp and Pontoglio (2011) have argued to shift attention from the perceived merits and pitfalls of specific policy instrument types to the design of specific instruments. An important reference point for these research endeavors are policy feedback effects. The policy feedback literature, on the other hand, is only just beginning to turn attention to policy design instead of continuing to focus on broad conceptualizations of policy regimes (e.g. May and Jochim 2013; Weaver 2010). Crucially, this established focus on the macro-level of policy leaves issues of instrumentation in shadow (Jordan and Matt 2014). In addition, the study of long-term feedback loops, where the focus is on the impact of feedback on policy rather than actors, is seldom tackled in the literature (ibid., 231). The question of how real-world policy outcomes impact on subsequent

policy dynamics also remains underexplored (Tobias S. Schmidt and Sewerin 2017). Thus, both theoretical assumptions regarding feedback induced by policy design and related conceptualisations are thus missing in the literature.

In this paper, we contribute to advancing the debate about the effect of feedback on policy stability and change by analysing the impact of policy design on policy persistence and on policy supersession. By addressing a broad research question – *Do policy design features affect subsequent policy dynamics and thus a policy's stickiness?* – we aim to bridge the literatures on policy feedback and policy design. We contribute to overcoming two crucial bottlenecks in research, namely (1) the absence of quantitative policy-design focused feedback analyses, (2) the scarcity of explicitly conceptualized and empirically tested feedback loops between policy-induced outcomes and subsequent policy dynamics and stickiness, and (3) the shortage of long-term feedback studies in policy fields outside social security. The former is achieved by building on a systematic and comparable assessment of policy output and policy design features based on Schaffrin et al.'s (2014, 2015) approach in order to conduct a panel data regression. The latter by focusing on the very dynamic policy field of low-carbon energy.

The paper is structured as follow. Section 2introduces the relevant literatures on policy feedback (2.1) and policy design (2.2) and bridges them in our research framework (2.3). Based on this framework, we derive a set of three hypotheses. Section 3 introduces the empirical application, i.e. the case we analyze (3.1) and the statistical model including the data used (3.2). We present our results in Section 4 and discuss their strategic policy implications in Section 5. The paper concludes by summarizing key contributions and mapping suggestions for future research (Section 6).

2. Theory

2.1 How policy feedbacks explain policy stability and change

Policy feedback and its role as explanatory factor for policy stability and change is a long-standing topic in public policy research. Particularly scholars in the tradition of historical institutionalism have long been interested in the trajectories of policy stability and change over time (for a review see Beland 2010). Earlier literature focused almost exclusively on how positive feedbacks from past policy choices lock-in policies in a country, resulting in stable policy regimes. Most prominently, Pierson (1993, 2000) argued that stability in policy regimes results from feedback mechanisms that create path-dependence in policy choices. Frequently discussed feedbacks are the resource and interpretive effects of policies, with the former focusing on sunk costs, the latter

on actors' adaptive behavior. Feedback is conceived as a process that leads, over time, to a progressively narrowing down of the range of policy options available to decision-makers as the (economic and the) political costs of changing the status quo become too high. As Pierson (2000, p. 10-11) puts it: "Once actors have ventured far down a particular path, they may find it very difficult to reverse course. Political alternatives that were once quite plausible become irretrievably lost." In short, this older literature argues that positive feedback mechanisms are associated with policy stability whereas negative feedback mechanisms are associated with policy change.

This assumption has been criticized by, among others, Jacobs and Weaver (2015), who argue that there is little conceptual justification for associating positive feedback mechanisms with the outcome of policy stability, or negative feedback mechanisms with policy change. Instead, positive feedback can be a key driver of change, while negative feedback can be a powerful stabilizing force. Putting it In a more formal way, they assert that policy choices at t_0 have social consequences that reshape actors' preferences or capacities at t_1 in ways that diminish those policies' bases of political support and expand the opposing coalition (p. 444). Other researchers, e.g. Jordan and Matt (2014), presume that the most politically consequential feedbacks may not necessarily be positive. Similarly, this newer research is critical of the notion that feedbacks over time narrow down the range of policy options. Instead, researcher stress that over time policy innovations expand the menu of policy options available to policy-makers. According to Weaver (2010), these new options are an important factor for determining the trajectory of policy change, working in combination with positive and negative feedbacks. There is, however, no systematic discussion about the conditions under which new policy options are invented, they are simply assumed to be either conceived domestically or imported from other countries (p. 143). Building on this, Jacobs and Weaver (2015) engage more with this search for alternative policy options and also consider the side-effects, stating that searches for new policy alternatives are not only about simply adding options to the menu, they can also impact the actor coalitions striving for or against policy change. This emerging perspective on policy options challenges the argument from older research that due to positive feedback the range of options available to decision-makers is narrowing down.

It can thus be argued that the focus of feedback research begins to shift, resulting in an expansion of the theoretical toolkit for explaining policy change via feedback. While new contributions to feedback research are very promising, the level of analysis primarily remains at the macro-level of policy regimes, leading Jordan and Matt (2014, p. 235) to conclude that "to [Pierson's] evident frustration […], the policy feedback literature has continued to focus on rather broad elements of policy such as programmes and policy regimes […], leaving instrumentation issues in shadow". In other words, there still is a(n) (in)dependent variable problem in policy feedback research. Also,

systematic and quantitative analyses of feedback on policy stability and change is sparse, as is thinking about long-term feedback loops instead of short-term feedback effects.

Still, there have been important recent conceptual and theoretical contributions to feedback research. In addition to questioning the basic assumptions about feedback effects and policy stability and change, newer contributions have engaged with two important question: (1) the time dimension of feedback and (2) the interplay of endogenous feedback effects and exogenous factors. Regarding the former, researcher have argued for distinguishing between pre- and post-enactment feedback processes since actors' positions can change post-enactment (Burroughs 2017; Patashnik and Zelizer 2013). Regarding the latter, researcher have begun tackling the conditionality of feedback effects, i.e. how endogenous feedback processes and exogenous factors work in combination to determine policy change (e.g. Skogstad 2017). Primarily, scholars have focused on the question of how policy feedback processes interact with and are shaped by the institutional context (see Figure 1 for a visualization; blue arrows), also taking exogenous shocks under consideration (see Figure 1; green arrow).

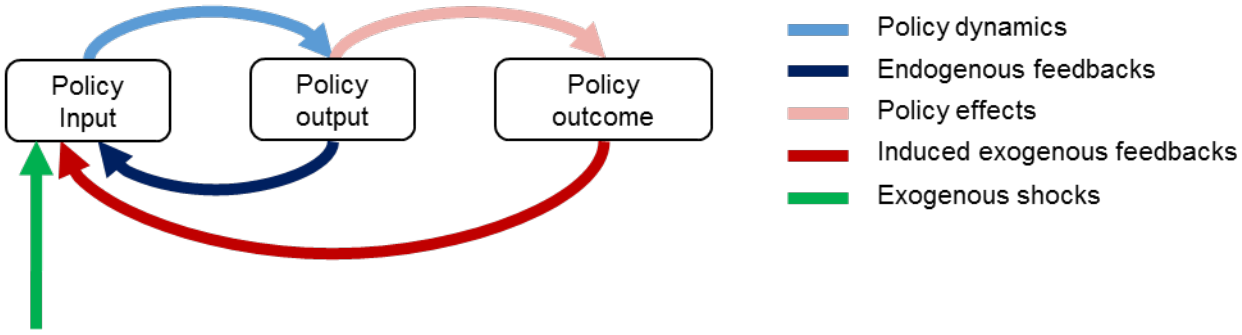

Figure 1: Conceptualizing different types of policy feedbacks

However, systematic research on one important aspect remains sparse: the feedback effects of policy-induced real-world changes in socio-economic systems (see Figure 1; red arrow). One prime example of these changes in socio-economic systems is technological innovation. Interestingly, and perhaps because most feedback-centered research is done in the field of social policy, technological change as driver of politics is rarely considered systematically (see Schmidt and Sewerin 2017). This is remarkable since some researchers (e.g. Jacobs and Weaver 2015) have maintained that technological change can potentially contribute to expanding the menu of policy options by making new tools available. Quite how this mechanism works is not spelled out in detail, however.

Engaging more systematically with the potential feedback effects of technological change thus seems highly relevant: Technological change has a huge influence on creating socio-economic

winners and losers, which, again, relates back to more established arguments in the policy feedback literature (cp. Beland 2010). Jacobs and Weaver (2015), for example, focus on the effects of unanticipated losses for powerful actors, i.e. "adverse consequences that were not predicted or taken into account by political actors at the moment of policy enactment." (p. 445). In other words, occasionally policies will work out badly even for actors with substantial political resources. These emergent losses are described as one key mechanism of self-undermining feedback and as being common in compromise-prone policymaking in democracies. Also, the gradual accretion of policy complexity and frequently foreshortened time horizons contribute to long-term policy outcomes that are both unexpected and unwanted by members of a policy's original enacting coalition. Thus, self-undermining feedback effects can expand, over time, the interest groups and coalitions pushing to dismantle or substantially reform certain policies. Also, Jacobs and Weaver (2015) argue, losers do not simply disappear and new losers can enter the stage as well. On the other hand, recent contributions have argued that the political (and organizational) power of losers can change dramatically (Matsuo and Schmidt 2017; Meckling et al. 2015; Tobias S. Schmidt, Matsuo, and Michaelowa 2017; Tobias S. Schmidt and Sewerin 2017), with consequences for their ability to influence further policy-making.

Taking policy-induced exogenous feedback explicitly into account thus broadens the scope of these arguments and shifts attention to two further determinants of feedback: (1) the height of wins or losses for socio-economic actors is determined by the effects of policy that cause real-world changes (see Figure 1; pink arrow); (2) the strength of the resulting policy-induced exogenous feedback (see Figure 1; red arrow) then is contingent on the political (and organizational) power of the respective winners or losers.

Thus, there are strong arguments for investigating the feedback induced by policies creating winners and losers in the wider socio-economic context. As the extent of these feedbacks strongly depends on policy outcomes, we now turn to the literature on policy effects.

2.2 The role of design features for explaining policy outcomes

There is a relatively large body of literature on the determinants of policies' outcomes (Ashford, Ayers, and Stone 1985; T.S. Schmidt et al. 2012; Zhang and Wei 2010). One of the key insights of this literature is that often policy design is more important than policy instrument types (Hoppmann et al. 2011; Kemp and Pontoglio 2011; Sandén and Azar 2005; T.S. Schmidt et al. 2016). Policy design can be defined as the intentional development of micro-level policy elements consisting of, amongst others, settings (i.e. specific on-the-ground requirements) and instrument calibrations (i.e. the specific way in which the instruments are used) (Howlett and Cashore 2009). While there are general policy design features that matter in any policy field (Schaffrin et al. 2015),

certain policy design features are relevant for specific policy fields only (Tobias S. Schmidt and Sewerin 2018). In this study, we focus on one general and one specific design feature: policy intensity as general and technology-specificity as specific policy design feature.

Policy intensity

Systematically measuring and comparing policy output is a long-standing challenge of policy research (Howlett and Cashore 2009). In order to facilitate the academic discussion about comparable assessment of policy output, Knill et al. (2012) have highlighted the relevance of the conceptual distinction between policy 'density' and policy 'intensity'. While the former relates to the number of policies applied in a policy field, the latter focuses on a policy's content. As a conceptualization of intensity, they suggest assessing a policy's scope, i.e. the number of cases or addressees covered by a specific policy instrument. Schaffrin et al. (2014, 2015) go beyond this approach and propose to focus on more general policy dimensions that allow measuring intensity in a broader sense. Schaffrin et al. (2015) define intensity as "amount of resources, effort and political activity that is invested in or allocated to a specific policy instrument" (p. 261). They propose six intensity indicators – objectives, scope, integration, budget, implementation, and monitoring – that any policy comprises with varying degree of distinctiveness. Taken together, these indicators reveal the amount of resources, effort and political activity that is invested in or allocated to the policy under investigation. The underlying assumption is that the more resources, effort and political activity is invested, the greater a policy's effect. In terms of measurement, these indicators inform a content-based coding procedure that allows for the production of a comparable dataset of policy's design features which can also be aggregated to an equally weighted measure of a policy's intensity: the Index of Policy Activity (IPA). This comprehensive measure of policy intensity can then be compared across cases and over time. Schmidt and Sewerin (2018) recently showed that – as expected – higher intensity of policies increases the outcomes of policy.

Technology-Specificity

According to Howlett and Cashore (2009), policy design includes the specifications, i.e., which groups are targeted by a policy. In the case of social policy, this could refer to the working population versus the retired population. In the case of technology-oriented policy, it refers to the technologies that are targeted. In this paper, we apply focus on technology-oriented policies and thus describe the design feature that determines the target group in the following. Technology- and innovation-policy literature shows that technology-specificity is the key design feature in determining the target group of the actor. Technology-specificity describes whether a policy is

technology neutral, targets a specific group of technologies, a specific technology, or even a sub-technologies (Azar and Sandén 2011; Tobias S Schmidt et al. 2016). The importance of this design feature stems from the fact that the level of technology-specificity of an instrument can determine which technologies markets pick, i.e., which technology profits from increased investments into R&D and technology diffusion (Azar and Sandén, 2011). As markets pick on short-term basis, less specific instrument are more likely to result in incremental improvements of existing technologies (Hoppmann et al. 2011; del Río González 2008; T.S. Schmidt et al. 2016).

To conclude, literature focusing on the determinants of policy outcomes highlights the role of policy design. As stated above, differing outcomes should then result in differing (policy-induced) exogenous feedback.

2.3 The role of design features in explaining policy stickiness

In this section, we aim at bringing together the two strands of literature discussed so far. We draw together theoretical and conceptual insights that have been scattered in the literature in order to frame new questions about the impact of policy design on policy stickiness (see Figure 2 – the blue boxes indicate where the two relevant literatures contribute). We argue that this feedback effect is contingent on the question of how policy design affects socio-economic actors and how changes in the socio-economic system then affect the political power and organizational capacities of incumbent or emerging actors. More specifically, we are interested in the impact of two policy design features, intensity and specificity, on the persistence and supersession of policies. The persistence describes the duration of a policy, which is a very straightforward measure for stickiness. By simply focusing on persistence, one would however, overlook the fact that policies are often directly replaced by new policies with similar intentions and logics. We consider these supersessions as an indirect form of stickiness. We therefore split our research question and analyze policy design effects on persistence and supersession independently. This section serves to synthesize insights from the above-discussed literatures in order to develop a set of hypotheses that will be tested in the subsequent sections of this paper. Note that we treat effects on the socio-economic system as a black box (see Figure 2).

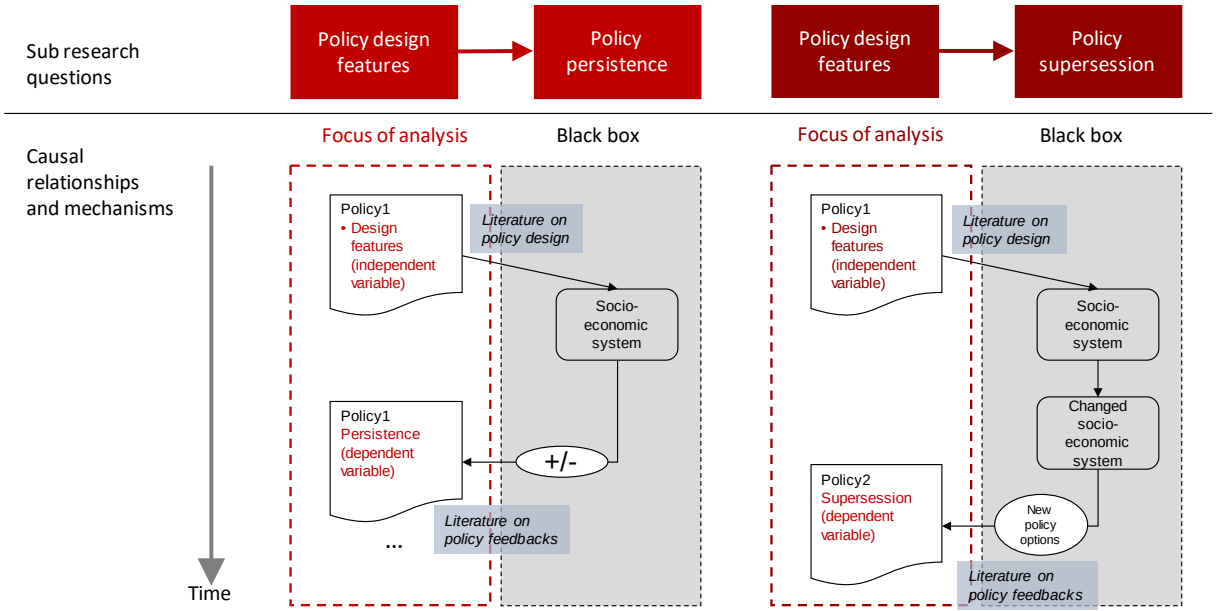

Figure 2: Research questions and focus of analysis

Conceptualizing feedback loops

To explain the role of policy design on policy stickiness, we conceive three types of policy feedback loops (cf. Figure 3). In this paper, we are concerned with post-enactment feedback, only, i.e. we do not consider the endogenous policy cycle that has resulted in the adoption and design of a policy in the first place. The left hand loop in Figure 3 is a vicious feedback loop that hinges on negative induced exogenous feedback. Policy 1's design features (t_0) affect the socio-economic system in a way that important actors perceive themselves as losers. If these actors are politically powerful, their strong opposition (i.e., negative feedback) will affect the subsequent policy dynamics and thereby results in weakening or termination of Policy 1 in t_1. The center part of Figure 3 describes a virtuous induced exogenous feedback loop. Policy 2's design features creates (perceived) winners (t_0), while avoiding perceived losses or only creating politically powerless losers. In case these winners are politically powerful, this will result in strong support for Policy 2 in t_1 and thus might increase the likelihood of this policy persisting longer (t_2, t_3, …). Note that Policy 2 can also result in the creation of new actor groups that have a strong stake in the policy. These actors can form advocacy coalitions with winners, amplifying positive feedback. In case of very strong feedbacks, the policy's design might even be adjusted, e.g., through increased intensity (compare the more intense colors of Policy 2 in Figure 3). This might create effects that are even more positive and thus further increase the likelihood of persistence. On the right hand side of Figure 3 we conceive an induced exogenous feedback loop that goes beyond policy persistence.

The design features of Policy 3 in t_0 have such strong effects on the socio-economic system that the system changes in a substantive way (t_1). These changes result in the creation of new policy options. For instance, innovation induced by Policy 3 can make a niche technology much more competitive, resulting in less need for policy support (e.g., lower policy intensity or lower technology-specificity). Note that in many sectors (technology-related or not) changes in the socio-economic system take time, hence, the option-creating feedback loops is dependent on the persistence of the initial policy (in Figure 3, Policy 3 lasts from t_0 to t_2,when it is replaced). Note that alternatively, external shocks (e.g., innovation which is not policy induced or induced by a different policy, e.g., in a different country) can lead to changes in the socio-economic system that create new policy options (compare Tobias S. Schmidt and Sewerin 2017). Based on these three types of feedback loops, in the following, we formulate hypotheses focusing on the role of design features.

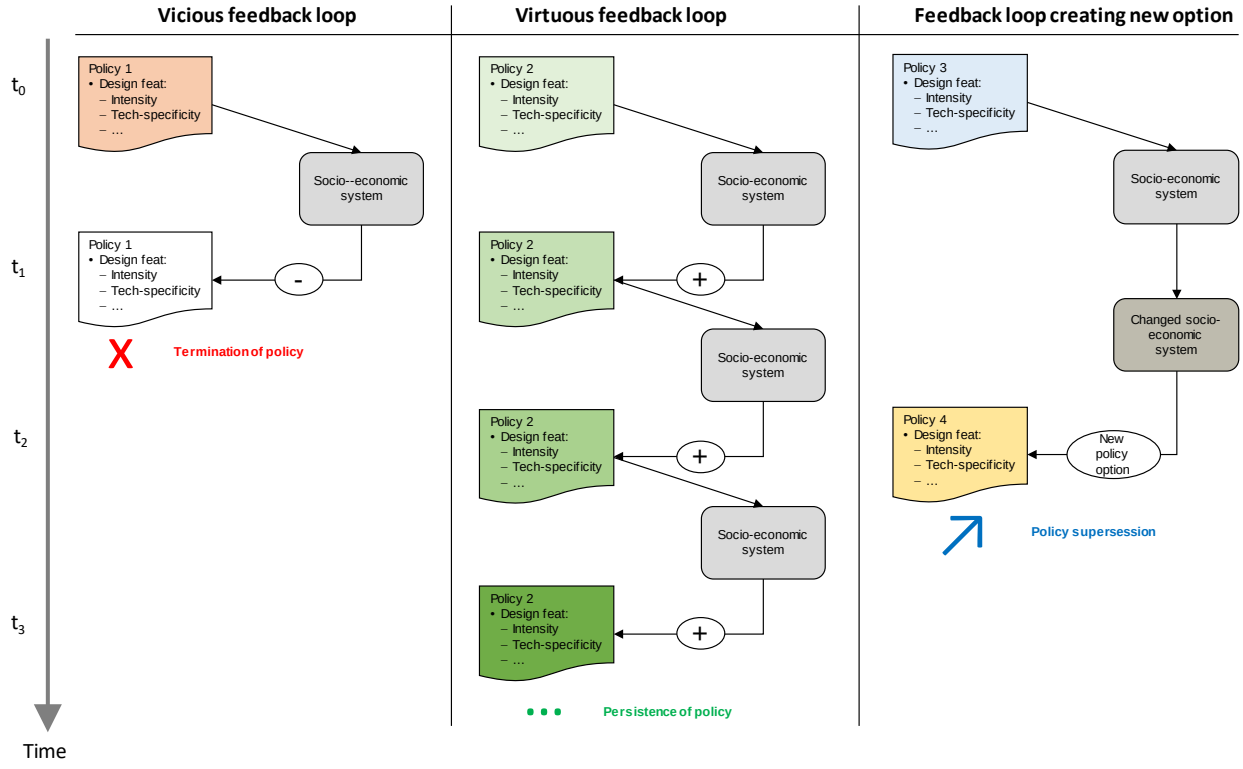

Figure 3: Conceptualization of different induced exogenous feedback-loops

Hypotheses regarding persistence and policy intensity

Higher policy intensity results in stronger effects on the socio-economic system (Kemp and Pontoglio 2011; Tobias S. Schmidt and Sewerin 2018). This can result in the creation of winners and thus strong support for this policy (see above). We therefore hypothesize:

- *(H1a) The higher a policy's intensity, the higher its persistence.*

On the other hand, strong effects might mean that incumbent actors might turn out as (perceived) losers and thus oppose such policies (see above and Jacobs and Weaver (2015)), resulting in the following conflicting hypothesis:

- *(H1b) The higher a policy's intensity, the lower its persistence.*

In case both hypotheses hold, we might observe overlapping effects, that result in the following combined hypothesis:

- *(H1c) There's a U-shaped relationship between a policy's intensity and its persistence.*

Hypotheses regarding persistence and technology-specificity

Technology-specificity typically determines, which technologies (i.e., which winners) are picked by markets (Sandén and Azar 2005). As markets pick based on short-term efficiency, less specific policies typically result in more mature technologies being picked (i.e., incremental change) (Aghion, David, and Foray 2009; Hoppmann et al. 2013; T.S. Schmidt et al. 2016). Therefore, more specific policies are more likely to create new winners (e.g., new users and producers of new, more radical technologies), and to open up new opportunities (by growing niches for these radical technologies) (Azar and Sandén 2011). This means, positive feedback from these winners is likely. We therefore hypothesize:

- *(H2a) The higher a policy's technology specificity, the higher its persistence.*

On the other hand, less technology-specific policies (such as a carbon tax) are less likely to hurt incumbent, often politically powerful firms (e.g., electricity utilities). Vice versa, more technology-specific policies are more likely to hurt these incumbents and create negative feedback. This means, there is a conflicting hypothesis, stating:

- *(H2b) The higher a policy's technology specificity, the lower its persistence.*

In case these effects overlap, one can expect a relationship expressed in the following hypothesis:

- *(H2c) There's a U-shaped relationship between a policy's technology-specificity and its persistence.*

Hypotheses regarding policy supersession

Inducing substantial changes in socio-economic systems requires strong, i.e. intensive, policy (Ashford, Ayers, and Stone 1985; Tobias S. Schmidt et al. 2012). Therefore, a higher intensity of a policy is more likely to result in the creation of future policy options through change in the socio-eocnomic system. We thus hypothesize:

- *(H3a) The higher a policy's intensity, the higher the likeliness of it being superseded.*

As stated above, policies with a low technology-specificity typically result in more incremental socio-economic change (del Río González 2008). They are thus less likely to create new policy

options. On the other hand, more technology-specific policies can result in the creation and nurturing of new niches which can fundamentally change the socio-economic system, resulting in new policy options. We therefore hypothesize:

- *(H3b) The higher a policy's technology specificity, the higher the likeliness of it being superseded.*

In the following, we test these hypotheses in a regression model.

3. Empirical application

3.1 Case selection

We choose the field of low-carbon energy (LEC) policy (i.e., renewable energy and energy efficiency enhancing policies) as the case for our analysis, based on a theoretical and relevance-driven case-selection logic. LEC policies encompass different instrument types, but all have the goal to induce technological change in the power sector towards are more RE-based power generation and increased efficiency throughout the sector. Five factors make this policy field a good case: First, innovation literature has shown that the role of policy design in inducing policy outcomes is particularly important for LEC policy (Azar and Sandén 2011; Sandén and Azar 2005; T.S. Schmidt et al. 2016; Tobias S Schmidt, Schneider, and Hoffmann 2012). Second, the energy sector is characterized by conventional (fossil and nuclear fuel-fed) technologies (and respective user- und producer constituencies). Hence, LEC policies can create major shifts in the socio-techno-economic system, resulting in major wins and losses for particular groups. Third, due to the fact that most renewable energy and energy efficiency technologies[1] are in rather early stage of their life-cycle (compared to conventional energy technologies), policies can have major innovation effects, resulting in the creation of shifts in economic and political costs as well as new opportunities (affecting the likelihood of policy supersession). Fourth, both renewable energy and energy efficiency are two of the most important levers to address climate change (Edenhofer et al. 2011; IEA 2015). Finally, and related to this, many countries have enacted LEC policies. Interestingly, however, there is a very high variation in policy designs (REN21 2016).

We focus on national-level policies. In terms of countries, we follow a diverse-case selection strategy (Gerring 2007; Rohlfing 2012; Seawright and Gerring 2008) that increases variance across policy designs as well as incumbent power sector structures. The former affects the policy effect, whereas the latter affects to which extent incumbents are winners or losers and whether they are politically powerful or not. The nine countries analyzed in this paper are Australia, Austria, Canada, Germany, Ireland, New Zealand, Spain, Switzerland and the United Kingdom (UK). While all these countries have multiple energy policies with varying designs in place, the diffusion of LCE policy differs strongly across countries. This is a very strong indicator for the variance in policy

[1] RE technologies include solar photovoltaics, wind (on- and off-shore), geothermal power, biomass-based power, as well as hydro (the latter being significantly more mature, but less relevant for RE polices, due to the limited remaining technical potentials of hydro). Energy efficiency policies aim at inducing energy efficiency throughout the entire energy supply chain, from production, conversion, transmission and distribution to end-use of energy.

effectiveness of these different designs (Tobias S. Schmidt and Sewerin 2018). Also, the key LEC policies are enacted at the national level.

3.2 Method

We test our hypothesis through panel-data regression, covering the period of 1998 to 2014 (the period since the adoption of the Kyoto Protocol).[2] The total number of RE policies in the dataset is 684. Data on policy instruments was collected from the following publicly available sources: the Policies and Measures Databases of the International Energy Agency and the Climate Policies and Measures in Europe Database of the European Energy Agency. We also consulted UNFCCC National Communications and other documents on the national level, such as governmental reports.[3] This dataset is only used in full for the third set of hypotheses. The model for the first and second set of hypotheses only covers 435 policies, as it excludes policies that are superseded: a policy that is superseded quickly, has a short persistence, but it might be due to positive feedback. We code each of these policies along their design features, instrument types, as well as persistence and supersession (see below).

Dependent variable of Hypotheses 1 and 2: policy persistence

The dependent variable of the first and second hypothesis is policy persistence. In order to avoid a bias towards older policies that have a higher chance to be enacted for a longer period, we define policy persistence as the ratio of the number of years a policy has persisted (up to today) to the average persistence of policies with the same start year.[4]

Dependent variable of Hypothethsis 3: supersession

In hypothesis 3, we test the likelihood of whether a policy is superseded. Policy supersession is a binary variable, that can either be one or zero. For each policy in our sample, we coded supersession by checkeing whether it was superseded according to the information by the IEA database, complemented by a cross-check of the national databases.

Independent variable of Hypothesis 1 and 3: policy intensity

To measure policy intensity, we apply the measurement approach introduced by Schaffrin et al. (2014, 2015), the Index of Policy Activity (IPA). This approach is based on a content-based coding procedure to be applied to each policy under investigation. The approach allows for the

[2] Countries only started developing climate policy in earnest after 1998. Relevant policies enacted before 1998 that were still in force during the period of analysis are incorporated as appropriate.

[3] This was done to add further policy instruments not listed in the public datasets or complement information on policy instruments' characteristics.

[4] For example, a policy that persisted for six years when the average policy from the same year lasted four years would get a score of 6/4=1.5.

aggregation of a score (weighted number) of a policy instrument's intensity. More details on the coding scheme can be found in Annex A. The coding of policy instruments was carried out by two coders and checked by the authors of this study to increase the validity of assessment.[5] The IPA of a policy instrument can go from zero to one.

Independent variable of Hypothesis 2 and 3: technology specificity

To measure technology-specificity, we follow Schmidt and Sewerin (2018) and differentiate four levels: (1) economy, (2) sector, (3) technology field, (4) technology. Appendix B describes each of these levels. Each policy is coded along these levels and receives a respective value.

Control variables

We control for the instrument type of each policy, as certain types can be more likely to persist longer or to be superseded than others. Jordan and Matt (2014, p. 235), for example, suggest that regulatory policies are more likely to persist since target groups are prone to becoming clienteles with a strong stake in the policies' continuation. Voluntary instruments, on the other hand, are more likely to be abandoned quicker. There are nine different policy types included in the dataset: Education, Financial, Incentive, Public Investment, Research, Development & Deployment (RD&D), Regulatory, Tradable, Permits, Voluntary and Framework. Each policy instrument is coded as zero or one for each policy type; it is possible for one instrument to have several different types. We furthermore control for the start year of a policy. We expect newer policies to persist shorter in comparison to policies from the same year. The influence of institutional variables that do not change over time is mostly covered by country-fixed effects (country dummies). However, there are some institutional variables that vary over time, and so specific controls are needed in the model. The first of these is a veto player index based on the theory developed by Tsebelis (2002). This theory proposes that cross-national differences in policy output can be explained by the number of decision-makers. The index created by Henisz (2000) is used here as a control variable. The second is the presence of green parties in the legislature. Their presence may affect environmental policy intensity, and although their presence or absence depends largely on the electoral system, there is obviously variation over time as well, caused by elections and other changes in government. Third, governmental change in itself is also important to control for. If there are many changes in government, less persistence and less supersession can be expected. The data for both governmental change and green parties is extracted from the Comparative Politics Dataset (Armingeon et al. 2016a, 2016b). Finally, economic factors are important, as they can create exogenous shocks (compare Figure 1) that lead to policy change. In addition, richer

[5] If differences in the assessment of a policy instrument arose between the coders, the value of the debated intensity measure was set in a group discussion.

countries may have more stable policy environments and may be more willing to pay for environmental quality (Dasgupta, Laplante, and Wang 2002). The rate of change is also important; rapidly changing economies likely motivate rapid changes in policy. Therefore, per-capita GDP and GDP growth are included as control variables in the analysis. The data for these variables is sourced from the International Monetary Fund.[6]

Model specifications

We use a cross-sectional time series analysis (panel data) to test our hypotheses. As the sample includes seventeen time intervals (1998-2014) for nine countries, and there is most likely correlation between the independent variables and the country units, the work done by Clark and Linzer (2015) suggests that a fixed effects model is preferable in terms of Root Mean Squared Error.

The general specification of the model used to test Hypotheses 1 and 2 is as follows:

$$\text{Persistence} = b1*\text{intensity} + b2*(\text{intensity})2 + b3*\text{technologyspecificity} + b4*(\text{technologyspecificity})2 + \Sigma\, bi*\text{controls} + \Sigma\, bj*\text{countrydummies} + \text{error term}$$

In this specification, Yt is the dependent variable, X1 to Xb are the independent and control variables and Z1 to Zc are the country intercepts in the fixed effects model. B1 to B(a+c) are the coefficients of interest and et is the residual error term.

To test Hypothesis 3, where the dependent variable is binary (supersession or non-supersession), we use a logistic regression (logit) model. The specification is as follows:

$$P(\text{supersession}) = f(\text{intensity, technology specificity, controls, countrydummies})$$

In both models, the dependent variables are lagged by one year to avoid endogeneity. Due to the nature of the data, non-stationarity is not an issue. Therefore, the possible concerns are primarily heteroscedasticity and multicollinearity, which are tested for through a robustness check and descriptive statistics, respectively. Please find the descriptive and correlation statistics for both samples in Appendix C.

4. Results

Here we present the results of our regression analysis, which are summarized in Table 1. Model I shows the effects on persistence without squared terms on intensity and technology-specificity, whereas in model II, the squared terms are added. Model III refers to Hypothesis 3, analyzing the

[6] Online at: http://data.imf.org/?sk=5DABAFF2-C5AD-4D27-A175-1253419C02D1

determinants of the likelihood of a policy being superseded. We will discuss these results along our three hypotheses.

Table 1: Results of regression analyses

	Dependent variable		**Dependent variable**		**Dependent variable**	
	Relative Policy Persistence		Relative Policy Persistence		Likelihood of Supersession	
	I		**II**		**III**	
	coeff.	(Std. Error)		(Std. Error)		(Std. Error)
Intensity	-0.558**	(0.228)	-1.011	(0.646)	3.063***	(0.606)
Intensity squared	-	-	0.758	(1.030)	-	-
Technology Specificity	-0.111	(0.112)	-1.279***	(0.414)	0.769**	(0.333)
Technology Specificity squared	-	-	1.099***	(0.374)	-	-
Incentives	0.033	(0.081)	0.029	(0.080)	0.463**	(0.225)
Public Investment	-0.099	(0.152)	-0.074	(0.151)	-0.368	(0.427)
Tradable	0.071	(0.172)	0.154	(0.172)	1.007***	(0.384)
Voluntary	-0.003	(0.102)	0.008	(0.102)	-0.26	(0.284)
Education	0.007	(0.086)	0.001	(0.085)	-0.143	(0.249)
Financial	-0.098	(0.084)	-0.063	(0.085)	-0.436*	(0.241)
R&D	-0.063	(0.085)	-0.049	(0.085)	-0.289	(0.250)
Regulatory	0.093	(0.084)	0.11	(0.084)	-0.005	(0.226)
Framework	0.246***	(0.084)	0.231***	(0.084)	0.233	(0.226)
Start Year	-0.093***	(0.013)	-0.095***	(0.013)	-0.037	(0.032)
Change in Govt Average	-0.972***	(0.24)	-1.021***	(0.240)	1.025*	(0.566)
Avg GDP Per Capita	0.0001***	(0.00001)	0.0001***	(0.00001)	-0.0001***	(0.00002)
Avg Veto Player Inde	3.207***	(1.051)	3.197***	(1.043)	-9.452***	(2.433)
Avg Green Party Seat Share	0.131***	(0.046)	0.149***	(0.046)	0.036	(0.110)
Avg GDP Growth	-0.047	(0.039)	-0.042	(0.039)	0.353***	(0.092)
dummy Australia	183.438***	(24.943)	188.127***	(24.833)	78.021	(63.634)
dummy Austria	182.074***	(24.889)	186.629***	(24.778)	77.482	(63.426)
dummy Canada	183.927***	(24.953)	188.629***	(24.843)	77.541	(63.652)
dummy Germany	182.723***	(24.909)	187.208***	(24.795)	77.597	(63.478)
dummy Ireland	183.235***	(24.889)	187.905***	(24.778)	78.311	(63.509)
dummy New Zealand	183.261***	(25.005)	187.768***	(24.892)	76.509	(63.682)
dummy Spain	184.688***	(25.047)	189.406***	(24.937)	76.988	(63.801)
dummy Switzerland	181.410***	(24.774)	185.976***	(24.660)	79.687	(63.180)
dummy UK	183.726***	(24.970)	188.382***	(24.859)	77.749	(63.666)
Oberservations	435		435		684	
R2	0.768		0.773			
Adjusted R2	0.753		0.757			
Residual Std. Error	0.690 (df = 409)		0.683 (df = 407)			
F Statistic	51.9*** (df = 26; 409)		49.5*** (df = 28; 407)			
Log Likelihood					-361.342	
Akaike Inf. Crit.					774.683	

Note: *p<0.1; **p<0.05; ***p<0.01

Hypothesis 1: The role of policy intensity for stickiness

The results of model I indicate that there is a negative linear effect of a policy's intensity on its stickiness (at the $p<0.05$ level). This would mean that policies that are more intensive trigger more negative feedback from the socio-economic sector. When the squared term is included (Model II), the effect disappears. Given the high correlation between the intensity and its squared term, this is likely due to multicollinearity.

Hypothesis 2: The role of technology-specificity for stickiness

When only analyzing the linear term, we find no effect of technology-specificity (Model I). However, by adding the squared term, we detect a strong u-shaped relationship. At the same time, the linear term becomes negative (with both effects at the $p<0.01$ level). An analysis of the combined effect reveals that the quadratic effect outweighs the linear effect. This means, very unspecific and very specific policies persist longer than medium-specific policies. This means, our data confirms hypothesis 2c, which could be explained by the overlapping effects of H2a and H2b.

Hypothesis 3: The role of intensity and technology-specificity for supersession

Model III shows that both higher intensity (at the $p<0.01$ level) and technology-specificity (at the $p<0.05$ level) increase the likelihood of a policy being superseded. This seems to confirm that policies that have a more "radical" outcome, are more likely to stick, but in different form.

Interestingly, only few instrument types seem to have an effect on policy stickiness: Framework policies have a higher persistence, which is in line with expectations. They are designed to cover longer periods and also typically do not create direct (positive or negative incentives) and thus are less likely to trigger opposition by powerful actors. For supersession it incentives (i.e., strong investment incentives) seem to results in a higher likelihood of policy supersession. This is also in line with the expectations as these policies are more likely to induce actual socio-economic change (Tobias S. Schmidt et al. 2012). Similarly, tradable policies are more likely to be superseded.

If significant, the control variables all point in the expected direction: younger policies persist shorter; government changes reduce stickiness (but might increase supersession likelihood); richer countries have more sticky policies, but feature lower supersession likelihood; the number of veto players increases persistence but decreases supersession likelihood; higher green party shares result in more sticky policies; and economic growth increases the likelihood of policy supersession.

5 Discussion: Strategic policy design to increase stickiness

Our analysis shows that policy design features can strongly affect policy dynamics and thus the stickiness of a policy. Based on our results, it is possible to derive policy design strategies, that increase the likelihood of policy stickiness and reduce the likelihood of dismantling or termination. In the following we derive such strategy based on our findings for the two key design features *intensity* and *technology-specificity*.

Our results suggest that more intense policies are more likely to be superseded but at the same time less sticky. This is problematic as typically change in socio-economic systems, such as the energy sector, takes time to unfold and thereby create new policy options that can result in policy supersession. Hence, a policy needs to be sticky in the first place in order to induce lasting change. One option to address this dilemma is to start policies with not too high levels of intensity to avoid instant negative feedback by (perceived) losers. However, in order to have substantial effects, policy intensity should be increased over time. Self-adjusting (or 'thermostatic') policies that have a built-in ramp up of intensity, can be an option (Cashore and Howlett 2007). Alternatively, policy mixes that make losses less obvious are a potential solution to the dilemma. However, consistency issues are likely to play an increasing role (Kern and Howlett 2009).

Further, our results show that more technology-specific policies are more likely to result in supersession. At the same time, we observe a u-shaped effect of technology-specificity on stickiness. This means, technology-specificity does not face the above-described dilemma. Therefore, from the perspective of a 'stickiness-increasing strategy' policies with a very high technology-specific are a no-regret design option.

Using the graphical language of Figure 3, we here suggest a 'stickiness-maximizing' pattern of induced exogenous feedback (shown in Figure 4). Policymakers aiming to induce this pattern can try to employ a respective strategy: here, one would design and enact a medium intense but highly technology-specific $Policy_i$ in t_0, which avoids negative feedbacks from the socio-economic system. At the same time the policy creates some winners as well as entirely new actors, which together provide enough positive feedbacks to result in increased intensity in t_1 (this could also be achieved by a thermostatic mechanism mentioned above). This more intensive policy then results in more substantive changes of the socio-economic system (by the time t_2) and thereby creates new policy options. These options, in turn, result in $Policy_i$ being superseded by $Policy_j$, which in turn creates more positive feedbacks from the socio-economic system and thus is further increased in terms of its intensity at t_4.

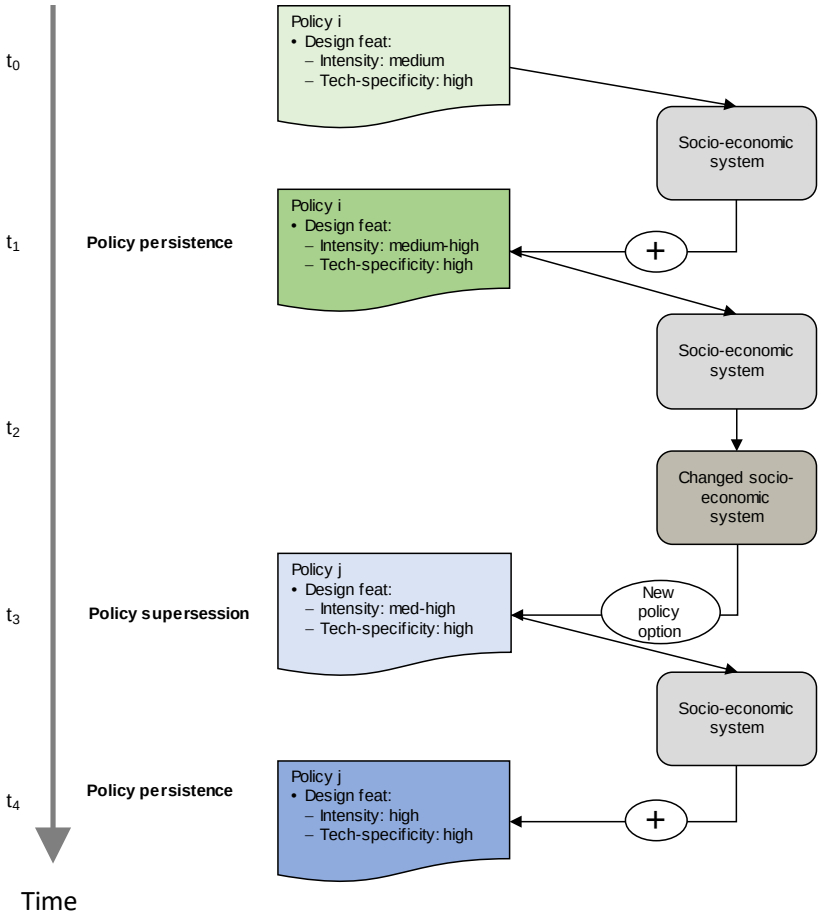

Figure 4: A stickiness-maximizing feedback pattern

In the field of renewable energy, Germany's support for solar photovoltaic power serves as prime example for policy stickiness (Jacobsson and Lauber 2006). Several elements of the history of the Germany solar policy resemble the described pattern. For instance, the German solar support started with a very modest (i.e. non-intensive) but highly technology-specific policy: the "1000-roof program" aiming at the installation of solar panels on 1000 roofs. This policy created several winners and the thereby induced exogenous feedback led to the policy being intensified later on: the target moved to 100'000-roofs. This "drew in yet new actors", creating even more positive feedback, which eventually was important in creating the solar PV feed-in tariff (Jacobsson and Lauber 2006). The intensity of which also increased over time. Importantly, negative feedback from politically powerful incumbents, namely the big utilities, was avoided because they did not perceive the policy as very threatening and underestimated the effects on the socio-economic system, that were driven by policy-induced innovation in solar technology (Ossenbrink 2017). Once they realized these effects, the policy was locked-in, supported by a strong coalition of actors while the utilities' political power had been eroded. Importantly and despite its modest start, many see the German solar feed-in tariff as one of the most important policies that enables the ongoing technological transition towards low-carbon energy systems (Tobias S. Schmidt and Sewerin 2017; Trancik et al. 2015). Of course, other aspects (like

continuity in government composition) played an important role (which are also highly significant variables in our regression analyses). However, from their own account (Scheer 2005) it appears that the "fathers" of the German feed-in tariff were very strategic in their policy design decisions.

6 Conclusion and future research

This paper is a first attempt to conceptually and empirically address the research question of whether and how policy design features affect the stickiness of policies. We find that policy design features have important effects on stickiness. Besides this main finding, our paper makes several contributions: First, it bridges the literature on policy designs – which is primarily focusing on the role of policy design in explaining policy outcomes – with the literature on policy feedbacks (as well as the related political economy literature). Second, it stresses the role of post-enactment feedbacks from non-political actors that are induced by the policy itself – we coin these induced exogenous feedbacks. Third, we provide an empirical case that goes beyond social policy, still the dominating policy sector in feedback analyses.

Our paper is of course not free of limitations. We only focus on LCE policies, hence future research should analyze policies that affect other dynamic socio-economic systems (such as transport, health, or food). Of course, our analysis is also limited by the size and composition of our sample. Future analyses should go beyond the nine industrialized countries covered by this paper. Also, our analysis does not cover spillovers: Policies do not exist in vacuum but are part of increasingly complex policy mixes. Therefore policies can be affected by effects that are induced by other policies in the mix. Furthermore, policies in one country, can induce changes in socio-economic systems that then spill over to other countries. For example, cost reductions in solar PV, strongly induced by the German feed-in tariff policy, created feedback spillovers in other countries, potentially contributing to the intensification or even supersession of their renewable energy policies). Finally, we do not control for interaction effects of design features. Interaction terms of intensity and technology-specificity could provide even more fine-grained results and inform stickiness-maximizing policy design strategies.

Despite these limitations, our results highlight the importance of directing more attention towards post-enactment induced exogenous policy feedback patterns. We believe this can help advancing the 'new' policy design literature (e.g. Howlett 2014) revisiting intentional policy designs and ultimately provide recommendations for strategic long-term-oriented policy design that go beyond tactical recommendations.

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Appendix

Appendix A

Coding scheme for calculating the Index of Policy Activity (IPA) (Tobias S. Schmidt and Sewerin 2018):

Intensity measure	Coding question	Coding values	Specific aggregation to final value	Range
Integration	Is the policy instrument integrated in a package or closely related to other policy instrument(s)? Is a framework policy included?	0=no 0.5=yes 1=yes, including framework policy	additive aggregation	0, 0.5, 1
Scope	Does the policy include branches of both supply and demand side? Are all mitigation actions targeted?	0=only one target group included 0.16=for each target group households/ companies demand/ supply 0.5=all groups targeted 0.15=energy efficiency targeted 0=only one mitigation action targeted 0.05=for each additional action out of oil, gas, coal/CCS, wind, solar, biomass, hydro/ocean, and combined heat and power	additive aggregation	0-1
Objectives	What is the policy objective with respect to policy performance?	0=no specific target given CALCULATION: objective for absolute emission reduction CALCULATION: objective for energy efficiency increase CALCULATION: objective for absolute increase in energy production from renewable sources CALCULATION: objective for absolute decrease in energy production from non-renewable sources *Note:* *Any targets that don't fall into categorization of emissions reduction, renewables or efficiency are coded as 0, as are any targets that are too specific to be meaningfully coded (example: reduce emissions from heavy oil extraction by 80%).* *Energy efficiency targets are coded based on the assumption that 1% efficiency improvement equals 1% reduction in GHG emissions.* *Targets on the reduction of the use of fossil energy can be treated like emission reduction targets under the assumption, that 1% reduction of the use of fossil energy equals 1% reduction in GHG emissions*	We calculate the share of the policy instruments' objective for absolute emission reduction or absolute increase in energy production from renewable energy sources against the benchmark of 80% emission reduction against 1990 levels or 100% energy production from renewable energy sources in 2050. *Note:* *Maximum value for this is assumed to be 1, although calculation allows values >1.* *If multiple targets coded, only the most aggressive one is used for the final value* *For the calculation of the share of energy production from renewable energy it can be assumed that energy production equals energy consumption. If there is no energy data available it can be calculated as the sum of electricity and heat production resp. consumption.*	0-1
Budget	What are the set expenditures/impositions of the policy instrument?	0=no fixed expenditures/impositions CALCULATION: absolute annual expenditure/imposition of policy instrument *Note:* *For multiyear spend, calculated as average of total expenditure over the time period.* *Funding coming from the revenues from European emissions trading only coded as budget=0.*	We calculate the share of public expenditure or imposition for the policy instrument against total public expenditure for energy and fuels or direct public revenue (in the form of the value added tax). *Note:* *Where both expenditure and imposition are specified, only the higher one is used for the calculation.*	0-1
Implementation	Is there a statement about implementation procedures specifically allocating actors and rules? How is this implementation planned and is there sanctioning?	0=no statement about implementation procedures found 0.25=implementation is specifically allocated to actors and rules 0.25=only one specific actor coordinated implementation 0.25=implementation procedure is strict in the sense that it does not allow a range or change in standards or rules 0.25=there is sanctioning for actors not complying to the implementation procedure	additive aggregation	0-1
Monitoring	Is there a specific monitoring process for the policy instrument and by whom?	0=no monitoring 0.5=monitoring by the implementing agency or other existing agency 1=a special group/institution is established for monitoring	additive aggregation	0-1

Appendix B

The four technology-spcificity levels can be described as follows (Tobias S. Schmidt and Sewerin 2018):

- An *economy-level* policy is one that (potentially) affects all sectors and their technologies. Examples of this kind of policy are informational campaigns to increase climate awareness and broad carbon taxes that treat all marginal changes in emissions equally.
- *Sector-level* policies are those policies that target climate-relevant technologies associated with a particular sector of the economy. The classic example of this level of specificity is a policy that targets all forms of power generation, transmission and distribution, but does not extend to other sectors such as industrial emissions or energy efficiency in buildings. Here we focus on the power sector.
- *Field-level* technology-specificity encompasses policies that target or apply to particular categories of technologies within a sector. An example of field-level policies within the power sector include those that specifically seek to promote renewable power generation (focus of this paper), such as renewable portfolio standards.
- Once policies become focused on a single technology, they are coded at the *technology-level* of specificity. Many feed-in tariffs fall into this category, as they pay different premiums for different renewable energy technologies, such as wind, solar or biomass.

In order to systematically differentiate between energy technologies at the technology level, Schmidt and Sewerin (2018) follow the definition provided by the European Patent Office.[7]

[7] More details can be found at: http://www.epo.org/news-issues/issues/classification/classification.html

Appendix C

Descriptive and correlation statistics of subset used to test Hypotheses 1 & 2:

		Mean	Min	Max	Std Dev	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Persistence	1.15	0.00	8.08	0.78	1.00	-0.06	-0.04	-0.08	-0.05	-0.06	-0.05	0.02	-0.06	-0.01	-0.14	0.02	-0.03	0.14	-0.10	-0.06	0.02	0.14	0.11	0.15
2	IPA	0.25	0.00	0.75	0.17		1.00	0.95	0.09	0.11	0.04	0.06	0.10	-0.07	-0.03	-0.02	-0.08	0.21	0.23	0.31	0.00	-0.25	0.08	0.20	0.07
3	IPA^2	0.09	0.00	0.56	0.11			1.00	0.07	0.09	0.03	0.06	0.07	-0.06	-0.03	-0.05	-0.06	0.17	0.22	0.27	0.02	-0.23	0.06	0.22	0.09
4	Technology Specificity	0.63	0.00	1.00	0.31				1.00	0.96	0.19	0.02	-0.07	0.00	0.00	0.09	0.10	-0.01	-0.06	0.17	-0.02	-0.11	0.11	0.03	-0.05
5	Tech Spec ^2	0.50	0.00	1.00	0.35					1.00	0.16	0.01	-0.11	-0.01	0.00	0.05	0.08	-0.02	-0.02	0.18	-0.03	-0.12	0.11	0.02	-0.05
6	Incentives	0.34	0.00	1.00	0.48						1.00	0.06	-0.06	-0.05	0.05	0.33	0.06	-0.15	-0.12	0.10	0.15	-0.02	0.18	0.07	0.02
7	Public Investment	0.06	0.00	1.00	0.23							1.00	-0.05	-0.04	0.12	0.02	0.06	-0.08	0.07	-0.01	0.04	-0.01	0.06	-0.02	-0.11
8	Tradable	0.04	0.00	1.00	0.20								1.00	-0.02	-0.08	-0.04	-0.06	0.25	0.03	0.04	-0.04	-0.05	0.00	0.04	0.05
9	Voluntary	0.14	0.00	1.00	0.34									1.00	0.11	-0.09	-0.01	-0.02	-0.08	0.01	0.09	0.15	0.03	-0.05	-0.01
10	Education	0.21	0.00	1.00	0.41										1.00	-0.06	0.16	-0.14	0.04	0.01	0.05	-0.05	0.07	0.00	-0.15
11	Financial	0.30	0.00	1.00	0.46											1.00	-0.04	-0.03	-0.23	-0.11	0.12	0.05	0.02	-0.12	-0.17
12	R&D	0.23	0.00	1.00	0.42												1.00	-0.24	0.02	-0.03	0.02	0.01	0.11	0.00	-0.06
13	Regulatory	0.31	0.00	1.00	0.46													1.00	-0.12	0.17	-0.08	-0.10	-0.09	0.00	-0.10
14	Framework	0.25	0.00	1.00	0.44														1.00	0.10	-0.02	-0.08	0.05	0.14	0.07
15	Start Year	2007	1977	2014	5															1.00	-0.07	-0.31	0.41	0.15	-0.24
16	Change in Govt (Average)	0.35	0.00	1.00	0.22																1.00	-0.09	0.40	0.35	0.05
17	Avg GDP Growth	1.75	-3.90	7.13	1.29																	1.00	0.06	-0.22	0.03
18	Avg GDP Per Capita	44901	14396	85617	12227																		1.00	0.17	-0.09
19	Avg Green Party Seat Share	3.84	0.00	13.50	4.82																			1.00	0.36
20	Avg Veto Player Index	0.41	0.17	0.62	0.06																				1.00

Descriptive and correlation statistics of full dataset (used to test Hypothesis 3):

		Mean	Min	Max	Std Dev	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Superseeded	0.36	0.00	1.00	0.48	1.00	0.18	0.04	0.02	0.00	0.12	-0.02	-0.07	0.02	-0.08	0.05	0.06	-0.26	0.02	0.21	-0.26	-0.07	-0.05
2	IPA	0.28	0.00	0.82	0.19		1.00	0.11	-0.03	0.09	0.13	-0.03	-0.07	-0.04	-0.05	0.22	0.24	0.18	-0.01	-0.17	0.01	0.25	0.07
3	Technology Specificity	0.64	0.00	1.00	0.31			1.00	0.20	0.05	-0.10	-0.05	-0.03	0.11	0.10	0.00	-0.06	0.14	-0.04	-0.10	0.11	0.03	0.04
4	Incentives	0.35	0.00	1.00	0.48				1.00	0.08	-0.14	-0.02	0.03	0.41	0.04	-0.15	-0.15	0.04	0.16	-0.03	0.11	0.04	0.06
5	Public Investment	0.06	0.00	1.00	0.23					1.00	-0.07	0.00	0.08	0.07	0.07	-0.09	0.02	-0.01	0.02	0.06	0.03	-0.02	-0.07
6	Tradable	0.07	0.00	1.00	0.25						1.00	-0.02	-0.10	-0.07	-0.11	0.27	0.04	0.04	-0.06	-0.05	-0.05	-0.03	-0.08
7	Voluntary	0.13	0.00	1.00	0.34							1.00	0.17	0.00	0.00	-0.05	0.00	0.01	0.11	0.05	0.05	-0.03	-0.04
8	Education	0.19	0.00	1.00	0.39								1.00	-0.03	0.13	-0.11	0.05	0.02	0.07	-0.02	0.10	-0.02	-0.09
9	Financial	0.31	0.00	1.00	0.46									1.00	-0.07	-0.08	-0.20	-0.10	0.12	0.02	-0.03	-0.11	-0.14
10	R&D	0.20	0.00	1.00	0.40										1.00	-0.21	0.02	0.02	0.06	-0.01	0.16	0.05	-0.01
11	Regulatory	0.33	0.00	1.00	0.47											1.00	-0.13	0.14	-0.06	-0.14	-0.11	0.01	-0.11
12	Framework	0.27	0.00	1.00	0.45												1.00	0.07	0.02	-0.06	0.06	0.09	0.00
13	Start Year	2005	1977	2014	5													1.00	-0.10	-0.40	0.46	0.15	-0.22
14	Change in Govt (Average)	0.35	0.00	1.00	0.23														1.00	-0.11	0.34	0.25	0.08
15	Avg GDP Growth	2	-4	10	2															1.00	-0.08	-0.22	0.06
16	Avg GDP Per Capita	42437	13762	85617	12515																1.00	0.18	0.00
17	Avg Green Party Seat Share	3.62	0.00	13.50	4.57																	1.00	0.30
18	Avg Veto Player Index	0	0	1	0																		1.00