Policy feedback and institutional context in energy transitions

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Abstract
Interest in policy feedback processes in energy transitions has grown rapidly in recent years. However, while it has provided interesting accounts of the mechanisms of stability or change, the policy feedback framework begs the question of why policy feedback dynamics vary so widely across cases. Existing accounts have tended to focus on the influence of ideas on policy design and on the role of interest groups. By contrast, the role of background institutional context in shaping policy feedback processes has been understudied. In this article, I develop a framework for identifying relevant types of institution that potentially shape policy feedback across different analytical stages of the feedback cycle. This approach is illustrated through the example of support policies for solar PV, where it is argued that a relatively small set of political, political economy and social institutions are likely to be important. The argument is then applied through a comparison of the evolution of solar PV policy in the UK and Germany, and the role of institutional context in explaining divergent policy pathways.

Keywords Policy feedback · Institutions · Energy transitions · Renewable energy

Introduction
Policy feedback, i.e. the idea that the implementation of a policy in an issue area can transform the politics associated with that issue (Pierson, 1993), has come to play a major role in the understanding of post-implementation policy dynamics, in a wide variety of areas. Early empirical research focused on issues such as welfare state dynamics, social policy, and tax and regulatory reforms, with an empirical bias towards the USA. With the emergence of climate change as a public policy problem, there has been increasing interest in the application of policy feedback to climate and low-carbon energy policy, especially renewable energy policy, much of which has been European or comparative in geographical scope.

In early work on renewables, much of which was on wind energy, use of the policy feedback approach was implicit rather than explicit (e.g. Toke, 2002; Strachan & Lal, 2004;
However, over the following decade policy feedback has been adopted explicitly and much more widely. The framework has been used in the analysis of persistence and retrenchment of renewable energy support in different countries (Laird & Stefes, 2009; Lockwood, 2015; Stefes, 2016; Aklin & Urpelainen, 2018; Stokes, 2020), with Schmidt and Sewerin (2017) arguing for its extension to incorporate feedback loops via technological change. It has similarly been used to explore broader climate policy dynamics (Lockwood, 2013), and implications for policy design (Jordan & Moore, 2020) and phasing (Meckling et al., 2015). Policy feedback has also appeared as an important element in wider theoretical syntheses for understanding and attempting to accelerate climate policy and sustainable energy transitions (Breetz et al., 2018; Roberts et al., 2018; Edmondson et al., 2019; Rosenbloom, Meadowcraft and Cashore, 2019; Sewerin et al., 2020; Schmid et al., 2020). This work has come both from energy transitions scholars adopting policy feedback tools and from researchers in other areas of policy studies shifting their focus to energy and climate policy.

Many early studies in the original policy feedback literature emphasised positive feedback effects, whereby policies create new constituencies and institutions, strengthen existing supporters and weaken the power of opponents, leading to lock-in in areas such as pension systems. Since renewable energy and climate policies have both had less unequivocal success, the analysis of these has especially benefitted from the interest in negative feedback effects pioneered by Weaver (2010) and others. Studies have also drawn on other developments in the broader policy feedback literature, such as the disaggregation of the feedback cycle (Schneider, 2012; Oberlander & Weaver, 2015).

Policy feedback has provided important tools for thinking about post-implementation dynamics in areas such as renewable energy. However, while it has provided interesting accounts of the mechanisms of stability or change, the framework begs the question of why policy dynamics have varied so widely across countries and types of renewable energy. Some kinds of explanation suggest themselves fairly easily from within the framework itself. Because of the ability of interest groups to mobilise both resources and ideas, it is not surprising that many accounts draw on differences in interest group power (see for example Stokes, 2020: 236). Equally, as identified by (Pierson, 1993), differences in policy design are an obvious proximate cause of variation in feedback paths (see, for example, Stenzel and Frenzel (2008) on wind power).

Here, however, I argue that the study of policy feedback in the area of energy transitions has paid insufficient attention to another kind of explanation—differences in the wider institutional contexts in which policies are implemented and in which interests are shaped and operate. Institutional context matters because it can influence policy feedback throughout all stages of the cycle. The types of institutions that are relevant will depend on the particular policy area involved. Here I draw on Hochstetler’s (2020) argument that for renewable energy policy the key arenas of politics include electricity service provision (including the distribution of subsidy costs and benefits), siting and industrial policy.

This approach is illustrated in the case of the dynamics of support policies for solar photovoltaics (PV). I identify a limited number of political, political economy and social institutions that are likely to shape policy feedback. I then illustrate how these contextual factors have affected policy feedback and resulting pathways in the UK and Germany over the 2010s, which ended in reversal in the former case but not the latter. I argue that the distributional impacts of support policies have been particularly important, but that these have been conditioned by a set of political, social and political economy institutions. These institutions have also conditioned how far these impacts have created political pressure, and how far such pressure has been converted into actual policy retrenchment.
The article builds on and adds to the existing literature both on policy feedback and on comparative renewable energy policy. It revisits themes from earlier work in the importance of institutional context for understanding outcomes in renewable policy (e.g. Toke et al., 2008), but locates these themes more explicitly in the policy feedback framework. More recent work has sought to explain different energy transition outcomes by contrasts in political economy and political institutions (Četković & Buzogány, 2016; Gürtler et al., 2019). This article again links these approaches to a policy feedback framework for understanding dynamics, whilst also taking a broader view of the range of institutions likely to be relevant. Equally, while existing research on contrasts in renewable energy policy outcomes in Germany and the UK has emphasised the roles of interest groups and ideas in shaping different policy feedback pathways in the two countries (Geels et al., 2016; Jacobsson & Lauber, 2006; Laird & Stefes, 2009; Toke & Lauber, 2007), by bringing in institutions this article builds on these analyses and addresses questions otherwise unanswered, such as why it was that while the costs to consumers of solar PV support in Germany was of the order of five times higher than in the UK, it was the latter not the former that saw policy reversal.

In Sect. 2, I review the literature on policy feedback, with a particular focus on contributions that distinguish different elements of phases of the policy feedback loop. Section 3 lays out the key arguments for the importance of institutional context, and proposes a framework for assessing how this context shapes policy feedback processes. This framework is then applied to the case of solar PV and is illustrated through a comparison of solar PV support policy dynamics in the UK and Germany in Sect. 4. Section 5 concludes with some discussion of how the framework may also be used to predict future feedback pathways and implications for using the framework to inform policy design.

**Evolution of the policy feedback framework**

Policy feedback refers to the concept that ‘new policies create a new politics’ (Schattschneider, quoted in Pierson, 1993), or as expressed more fully in Theda Skocpol’s landmark work on the development of the welfare state in the USA: ‘Policies not only flow from prior institutions and politics; they also reshape institutions and politics...’ (Skocpol, 1992: 531). Much of the literature takes as its starting point Paul Pierson’s, 1993 essay (Pierson, 1993) which seeks to provide a typology of feedback effects divided into two broad categories, resource effects and interpretive effects.

Policies typically distribute resources and thereby create material incentives for beneficiaries to maintain the flow of resources or lobby to increase these. These effects can work through the creation or strengthening of organised interest groups or amongst policy elites, but are especially powerful where they induce widespread investments by mass publics which then make it virtually impossible for such policies to be reversed. Secondly, policies can also change politics by producing ‘cues’ for mass publics that cut through the complexity of modern life and sporadic attention paid to politics, generating ‘focusing events’, becoming iconic of particular political identities and helping to mobilise support or opposition.

Pierson’s model has been explicated in a number of ways. A basic point is what ‘policy’ actually means. While analysis of feedback can be applied to single policy instruments (Jordan & Matt, 2014), in most cases what will be involved will actually be a set or package
of policies; Weaver (2010) uses the term ‘policy regime’, while (Schmidt & Sewerin, 2019) and (Edmondson et al., 2019) refer to the ‘policy mix’.

Secondly, early research tended to focus on cases of policy durability or lock-in (Pierson, 2000) resulting from positive policy feedback effects, and neglected the possibility and importance of negative feedback effects leading to the undermining and reversal of policies (Béland, 2010; Jacobs & Weaver, 2015; Patashnik & Zelizer, 2009; Weaver, 2010). Within Pierson’s typology described above, such effects could arise through creating incentives for interest groups, policy elites and mass publics to oppose policies because of the way that they distribute costs and benefits, or through creating interpretive effects in which cues for opposition end up being stronger than those for support. Weaver (2010) argues that both positive and negative feedbacks are often present and that it is the combination of such effects that determines the evolution of policy regimes.

Another important development in the literature has been the analytical disaggregation of the overall feedback process into different phases. The first comprises the immediate post-enactment effects of policy; what (Jordan & Moore, 2020) call ‘first-order effects’. While such first-order effects are essentially technological, economic or organisational in nature, a second element in the overall loop is then the resulting political pressure for strengthening, weakening, reversal or transformation of the original policy created by the first-order effects (Campbell, 2012; Sewerin et al., 2020). It is from such political effects that moments of crisis often occur that test the durability of policy (Jordan & Matt, 2014). Some scholars use the term ‘feedback effects’ to refer to this phase (Oberlander & Weaver, 2015). However, even quite powerful feedback effects may not in the end lead to an actual shift in policy design. In order for such outcomes to be realised, pressures will have to work through informal and formal mechanisms for policy change including party political, legislative and bureaucratic mechanisms, part of what Edmondson et al. (2019) call the ‘policy sub-system’.

The importance of institutional context for policy feedback patterns

Policy feedback does not necessarily provide a comprehensive account of all post-implementation policy dynamics (Jordan & Moore, 2020; Patashnik & Zelizer, 2013: 1083), but the framework has nevertheless proven to be valuable in the study of energy transitions. This is especially the case for renewable energy policy where it is clear that feedback effects of various kinds have played a significant role (Aklin & Urpelainen, 2018). However, as Pierson notes (1993: 602), identifying and describing feedback effects is merely illustrative; what we want to know are the circumstances under they occur. In an immediate sense, lock-in or retrenchment are determined by the balance of negative and positive feedback effects, but which factors determine this balance and why does it differ across countries and sometimes renewable technologies?

Since policy feedback is concerned with the consequences of resource and interpretative effects for interests, an obvious starting point for answers might be differences in the nature and strength of interest groups. Stokes (2020: 236), for example, argues that variation in renewable energy policy dynamics across US states is ‘a function of interest group political power.’ A second obvious source of variation in policy feedback is policy design (Pierson,
1993: 599) or what (Pierson, 1994: 166) calls programmatic characteristics. First-order effects of policies may be shaped strongly by their design. Indeed, policy feedback scholars are increasingly interested in the possibility of consciously designing policy for lock-in, or at least durability (Jordan & Moore, 2020; Roberts et al., 2018; Rosenbloom et al., 2019).

However, interests and ideas are not sufficient in themselves to fully explain variation in policy feedback patterns. They are both importantly conditioned by the nature of institutions (Steinmo & Thelen, 1992: 2), especially those in what Pierson (1993: 621) calls the ‘broader political environment’. Interests, even the material interests of companies, are not fixed but are socially constructed and therefore in part shaped by institutional context (e.g. Martin & Swank, 2012). Moreover, interests, even once well defined, cannot generate outcomes by themselves; rather they must be articulated and organised, and the institutional context will often play a role in whether and how this happens.

Equally, while policy design is clearly relevant for potential first-order effects, but what these actually are will also be conditioned by the institutional context. The relationship between policy design and institutions is complex. Discursive institutionalists argue that policy design choice is significantly shaped and constrained by underlying ideas in policy communities that can be identified as policy paradigms (Campbell, 1998; Hall, 1993), which in turn are often associated with macro-institutional systems (Schmidt, 2002). However, paradigms do not completely determine design, and designs originally generated in one discursive context are often adopted in another. For example, as described in the case study of solar PV policy below, the UK adopted a feed-in tariff policy design from Germany that was very much against the grain of the dominant market-led policy paradigm. But the impacts of similar policies in different contexts may well differ because of contrasts in the wider institutional contexts in which they operate, as well as differing constellations of interests. The approach taken here is to focus less on the policy paradigms underlying policy design choices, and more on wider institutions that condition impacts for a given policy design, once adopted.

With a few exceptions—such as Pierson’s (1994) study of the dismantling of the welfare state in the USA and the UK in the 1980s, which included an examination of how the nature of political institutions conditioned policy feedback in welfare, housing and pensions differently in the two countries—the role of institutional context in policy feedback has remained a gap in the literature. As Béland and Schlager (2019, 197) note: ‘Examining the context and conditions that limit or suppress feedback effects is an important and under-studied aspect of policy feedback studies’. Stated in this broad way, an argument for consideration of institutions alongside ideas and interests in policy feedback is uncontroversial. But it immediately begs the question of what types of institutions are relevant, and how they might be expected to interact with interests and ideas in shaping feedback processes. A first point to make is that the focus here is on ‘background’ institutions that shape the context into which policy emerges but do not change in response to that policy. This is in distinction from the role of institutional change in the sense of a specific mechanism within policy feedback, for example in the work of Patashnik who showed that new policies are more likely to remain in place if they introduce new institutional arrangements that displace those that underpinned old policies (Patashnik, 2014).

Within this general approach, the types of institution that will be relevant for understanding policy feedback depend on the policy area being analysed, and associated arenas of political contention and consensus. For the focus of this paper, i.e. renewable energy policy, a useful approach is that of Hochstelter (2020) who argues that beyond the initial climate change driver there are three key arenas of political economy. One of these is what she calls ‘service provision’, which captures policy costs (i.e. deployment subsidies)
to consumers or taxpayers and benefits to the owners of renewables. Here we will be interested primarily in those background institutions that condition the distribution of subsidy costs and benefits amongst interest groups and across voters. Also relevant will be those institutions that condition the opportunities for organising any consequent political effects in ways that can feedback to policy reform. A second arena is that of industrial policy, i.e. jobs and investment in renewable energy supply chains. The degree to which governments attempt to link renewables policy to industrial policy varies (Aklin & Urpelainen, 2018; Meckling et al., 2017), often because of differing policy paradigms. But where there are attempts to develop supply industries the success of this in producing first-order effects will depend in part on how supportive background political economy institutions are for such development. The feedback effects of any resulting industry will also depend on institutions shaping relationships between industry and the state.

Hochstetler’s third arena is the politics of siting, i.e. where and on whose land renewable energy technologies are located. Here, background institutions of land ownership are likely to be relevant in shaping first-order effects, alongside social institutions relating to perceptions of landscape. Again, how far local opposition to or support for specific renewables projects, where they occur, are translated into political pressures and consequent policy reform will be shaped by institutions such as planning, and the articulation of local planning systems with national level or sub-national renewable energy policy making.

Even within renewable energy policy areas of contestation, and therefore which aspects of institutional context are relevant, will vary. For example, the landscape effects of solar PV are of much less importance than those of wind power, where the visual impact of turbines is more significant. To illustrate the kinds of institutions that may be relevant in more depth, I focus here on the particular example of policy feedback for solar PV (Table 1). I therefore focus here on a limited number of dimensions of the political, political economy and social institutional context relevant for policy feedback, working through costs to consumers, and benefits to owners and industries and workers in the supply chain for solar PV.

Taking the costs of subsidy first, we can expect the distribution of these costs and therefore first-order effects of policy, to be shaped by a cluster of inter-related political economy institutions. One of these is interest intermediation, specifically of business interests, as this can be expected to shape the distribution of policy costs between businesses and households more widely. A number of studies argue that households will bear relatively higher climate policy costs in countries with corporatist institutions compared with those with pluralist ones (Finnegan, 2019; Svendsen et al., 2001; Mildenberger 2020). This is

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**Table 1** Types of conditioning institutions and phase of policy feedback for solar PV policy

| Political institutions | Political economy institutions | Social institutions |
|------------------------|--------------------------------|---------------------|
| First-order effects    | Electoral systems              | Interest group intermediation | Forms of cooperatives and community organisation |
|                        |                                | Varieties of capitalism   |                                      |
|                        |                                | • Labour market and welfare institutions |                                      |
|                        |                                | • Financial institutions |                                      |
|                        |                                | • Relationships between firms and workers |                                      |
| Feedback effects       | Electoral systems              | Interest group intermediation | Forms of cooperatives and community organisation |
|                        | Vertical and horizontal        |                                |                                      |
|                        | concentration (e.g. federalism)|                                |                                      |
because business interests in corporatist contexts are more organised and have better access to policy making, and so are able to obtain exemptions from or compensation for policy costs.2

Second are labour market and welfare institutions that have consequences for the distribution of income, and therefore the relative burden of policy costs amongst households. These institutions, and how far they deliver degrees of equality in market and post-transfer income and protection from economic insecurity, vary substantially across countries. This variation is in part related to how far interactions between workers and businesses are mediated through markets as opposed to non-market relationships, i.e. ‘varieties of capitalism’ (Hall & Soskice, 2001, Thelen 2014), with lower wages and higher economic insecurity more common in liberal market economies (LMEs) as opposed to coordinated market economies (CMEs). It is also related, at least in Europe, to the institutional roots of welfare systems in markets, family structures or strong cross-class solidarity, with more generous and stable welfare provision historically in countries with the latter two traditions (Esping-Anderson, 1990). These macro-political economy institutions are in turn associated with each other and linked to electoral institutions, since countries with majoritarian electoral systems tend to redistribute less and have labour markets with higher levels of economic insecurity than those with proportional representation (PR) (Iversen and Soskice 2006) and also tend to have pluralist systems of interest representation, whereas PR has co-evolved with corporatism (Cusack et al., 2007).

Turning to the benefits of solar PV policy, in terms of ownership of assets and receipt of subsidy, one factor shaping patterns of ownership and therefore first-order effects, will be the range of actors, i.e. commercial or social, large or small, etc., investing in solar PV. The relative strength or weakness of existing social institutions, such as cooperative or community organisation, is likely to be particularly important for shaping which kinds of social actors can benefit from investments in solar PV. These forms of organisation, and associated legal forms of property ownership, vary significantly in strength across countries. Where they are weak or absent, investors will tend to be individual households rather than collective social actors.

Moreover, the ability of actors to invest, especially smaller actors both commercial and social, also depends on access to finance, and therefore the nature of financial institutions. The nature of finance is in turn closely linked to the deeper political economy and social institutions discussed above. In a few cases (e.g. Denmark), cooperative organisations have developed their own financial institutions. More widely, within the varieties of capitalism framework, financial institutions in CMEs are seen as incorporating a wider range of social goals alongside short term returns (Hall & Soskice, 2001). It may also be that the lower levels of political concentration, seen, for example, in federalist systems, encourages the strength of more regional and local banking systems. All of these factors imply variation in the availability of finance for solar PV investments for smaller commercial actors, but especially cooperative or community groups, with such availability better in countries with strong social institutions, coordinated market economies or federal systems.

The third arena of politics in solar PV policy is industrial policy and the development of jobs and investments in the supply chain, especially in the manufacture of cells and panels, potentially creating new interest groups. As a paradigmatic form of state intervention, the strength and design of such industrial policies can be expected to be

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2 This is a distinct argument from those that corporatist interest representation institutions will work for (Mikler and Harrison, 2012) or against (Meckling and Nahm, 2018) the original adoption of energy transition policies.
strongly influenced by ideas, in the form of policy paradigms, as noted above. However, once in place, the first-order effects of such policies in any particular case, i.e. how many jobs and how much investment are created in supply chains, will also depend on the capacity of the manufacturing sector to respond, which in turn will be shaped by the wider institutional context. The varieties of capitalism framework are again relevant here (Ćetković & Buzogány, 2016); extra-market coordination between firms and unions in CMEs with manufacturing sectors has tended to constrain deindustrialisation, and produce strong training institutions and negotiated incremental innovations that increase productivity (Hall & Soskice, 2001). Such countries maintain a growth model based on manufacturing exports, compared with LMEs that have embraced globalisation and deindustrialisation more fully (Hall, 2019), and it is therefore in CMEs that we can expect to see larger first-order effects.

Some of the same institutional factors are also likely to be important for how the first-order effects of solar PV policy are translated into feedback effects in the form of political pressure to change, maintain or expand policy, and for how this pressure then results in actual policy outcomes. Electoral systems are likely to be relevant for how the burden of subsidy costs for households (and therefore voters) are translated into political pressure. In Lijphart’s (2012) formulation, majoritarian politics produces a competitive, adversarial political culture, typically with two main parties competing for swing voters to form single party governments with clear lines of responsibility. By contrast, in countries with PR systems, and therefore more frequent coalition governments, greater costs can be placed on voters without fear of political backlash. In such contexts, blame is more diffuse, political competition and the probability of loss of office is lower, so there is less focus on demands of voters in marginal constituencies and more attention to public goods. This argument is supported by evidence from Chang et al. (2011).

The strength or weakness of cooperative or community forms of social organisation also arguably has implications for feedback effects, since these help solve coordination problems in organising what would otherwise be diffuse groups of individuals in representing their interests.

A more general factor will be the number of vertical and horizontal veto players or points involved in in policy reform (Tsebelis 2002; Immergut, 1990), directly related to the degree of centralisation in political systems (e.g. control of leaders over parties, majority vs coalition government) and in constitutions (e.g. federalism vs centralised states). A simple approach would be to hypothesise that the more veto players there are, the harder it is to retrench or reverse policy. However, it is also the case that while those with centralised power can more easily reverse policy under political pressure, they can also more immediately be blamed by policy supporters (Pierson, 1994), so in conditions of mixed positive and negative feedback the effects of centralisation may be more complex. More widely, in shared power systems, the opposition of veto players to policy reform may be overcome through forms of compensation (Lindvall, 2017). The overall influence of the veto players structure will therefore depend on the particularities of the case involved.
Policy feedback and institutional context in solar PV in Germany and the UK

To illustrate the arguments made above, in this section I compare German and UK solar PV policy over the 2010s. Policy was similar in both cases, but feedback dynamics were quite different. Both countries experienced a boom in solar PV installations as module costs declined sharply from the end of the 2000s onwards. However, while the boom in the UK led to policy reversal and the withdrawal of support mechanisms, in Germany commitment to further deployment was ultimately maintained and expanded.

The choice of comparison between the UK and Germany was driven by both countries having a support policy of similar design, i.e. a fixed feed-in tariff, in place from 2010 through to the late 2010s. As a technology-specific support mechanism, the feed-in tariff policy ran against the grain of the dominant policy paradigm in the UK, but it was adopted nevertheless because of a coordinated campaign by environmental NGOs influenced by the German experience and by renewables lobbies effectively excluded from benefitting from the existing support policy, the Renewables Obligation (Toke, 2010). At the same time, while EU directives formed a common background for overall renewable energy policy goals in both countries, support for solar PV specifically was far more a domestic policy choice, and so is more amenable to an analysis of the role of institutional contrasts in policy feedback. Here, the strong, almost paradigmatic, political economy and political institutional contrasts between the two countries are also a reason why this comparison is appropriate here.

Accounts of German renewable policy have often emphasised the importance of positive policy feedback effects through broad-based ownership (Laird & Stefes, 2009; Morris and Jungjohann, 2016), sometimes linked to differences in policy design driven by ideas (Mitchell et al., 2006; Toke & Lauber, 2007), and a strong renewables industry lobby (Jacobsson & Lauber, 2006). While not adopting an explicit policy feedback approach, (Geels et al., 2016) explain a divergent pathway for the UK partly in terms of the absence of these effects. Such accounts rely on plausible policy feedback arguments. However, they also raise puzzles that cannot be explained simply by reference to interest groups and ideas alone. For example, solar PV ownership in the UK, unlike wind ownership, is relatively broad, involving around a million households and many businesses. Yet this broad-based ownership produced only weak positive feedback effects compared with that in Germany. Even more striking, the costs to consumers of solar PV support in Germany was of the order of five times higher than in the UK (see below), yet it was the latter not the former that saw policy reversal. Here I seek to account for these puzzles with reference to the different institutional contexts in the two countries.

This section is based on official data on solar PV deployment, government documents, and existing published studies. It draws on analysis on solar PV policies and investment trends, accounts of the politics of policy dynamics, and wider literatures on political, political economy and social institutions in the UK and Germany. Its contribution lies in its novel interpretation of this existing evidence base.

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3 This development can be seen as a form of ‘spillover’ policy feedback effect (Skocpol, 1992).
Fig. 1 Additions to solar PV installed capacity under the SSFiT and RO, UK Source: https://www.gov.uk/government/statistics/solar-photovoltaics-deployment

Fig. 2 Additions to solar PV installed capacity under EEG, Germany Source: https://www.erneuerbare-energien.de/EE/Navigation/DE/Service/Erneuerbare_Energien_in_Zahlen/Zeitreihen/zeitreihen.html
The evolution of solar PV policy in the UK and Germany

An initial step is to define the dependent variable, i.e. what ‘solar PV policy’ is taken to mean in this context. The main focus here is on the deployment support policy elements within the policy regime, along with complementary industrial policies. Planning and siting policies are not discussed, because as noted above local acceptance or opposition has not played a major role in solar PV policy dynamics in either country. Within support policy all levels are considered from the overall design of policy, to instruments (e.g. degression, caps/ceilings, corridors) and settings (e.g. tariff rates, degression rates etc.).

Figures 1 and 2 show the evolution of growth in solar PV deployment and key points of policy evolution for the two countries. Solar PV deployment in the UK was negligible before 2010. The situation changed with the launch of a small-scale feed-in tariff (SSFiT) scheme. The scheme offered 25 year contracts and an initial tariff of 41.3 p/kWh. The tariff rate was subject to a degression mechanism, but early reductions in rates were in practice driven initially by unscheduled reviews in light of much faster than expected growth in deployment (Muhammad-Sukki et al., 2013). In the summer of 2015, the government embarked on a review of renewables policy that led to large cuts in tariff rates for solar PV of between 64 and 85% in February 2016 (Lockwood, 2016). Deployment under the SSFiT collapsed to 2010 levels and did not rise again before the scheme was closed to new applicants in April 2019.

The falling costs of solar PV panels also meant that commercial investments became viable from 2011 onwards under the main existing renewables scheme, the Renewables Obligation (RO). Levels of support for solar PV under the RO were reduced in 2013, but despite this installations growth continued. However, the 2015 review led to the closure of the RO to solar PV projects above 5 MW in early 2016, and by 2018 growth had virtually halted. At the same time, the government decided that solar PV would not be eligible for support under a new auction-based policy. This decision was reversed only in 2020, with solar PV entering an auction for the first time in December 2021.

Significant support to solar PV in Germany started with the EEG law in 2000, amended on a regular basis every 3–5 years since (e.g. Hoppmann et al., 2014; Leiren & Reimer, 2018). The initial tariff was around 0.5 €/kWh for a contract period of 20 years, with an annual degression rate of 5%. Support for renewables was reaffirmed by a new government in 2005 with more ambitious targets for 2010 and 2020. As PV technology costs came down, deployment began to take off, especially from 2008. From 2009, a new EEG amendment brought in the concept of linking the tariff rate to a deployment growth ‘corridor’, initially set at 1–1.5 GW a year (Grau, 2014). Over the next three years, deployment continued to grow rapidly despite further cuts to support, with over 7GW of installed capacity growth in the period 2010–2012.

The solar PV boom started to drive debates on the future of Germany’s renewables policy. A draft law proposed by the centre-right coalition government with dramatic cuts to tariffs was blocked in March 2012, but an amended law was passed in June, still with cuts of 20–29%. In 2013 an overall cap of 52GW on deployment was adopted. Under pressure from the EU, the 2014 EEG amendment saw a shift in policy towards auctions (Leiren & Reimer, 2018) and a new corridor and cap. The move to auctioning was complete by 2016, with the exception of small-scale projects which continued to receive the FiT. Unlike in the UK, the government adopted a managed deployment growth approach and committed to an advance timetable for auctions, and deployment...
rates started to rise again. The deployment cap was removed in 2020, and the 2021 EEG has a new overall target of 100GW by 2030, biannual targets for deployment growth and a timetable of PV auctions twice a year.

Institutional context and negative feedback via policy costs

Why was it that support policy for solar PV was reversed in the UK in 2016, whereas German support policy survived challenge in 2013–14? The proximate cause of reversal in the UK was a mechanism called the Levy Control Framework (LCF) originally set up by the Treasury in 2011 (Lockwood, 2016). The framework set a cap on the estimated gross costs of a number of policies, including support for renewable energy, which were passed through to consumer energy bills. Initially, policy costs were well within the LCF envelope of rising annual caps, but in the summer of 2015 it became clear that these would be breached, mainly because of the surge in growth of onshore wind and solar PV over the first half of the 2010s. The costs of support to solar PV were of the order of £1 billion a year. The LCF rules required the Department for Energy and Climate Change to reduce policy costs immediately, which led directly to the cuts described above.

The gross costs of support for solar PV were also an issue in Germany, as they played an increasingly central role in the growth of renewables support costs overall. Even taking into account Germany’s larger economy they were also much higher, reaching over €7 billion per year by 2012 (Pegels & Lütkenhorst, 2014). But while there were significant debates about these costs, most notably in the 2013 federal elections, and reforms continually reduced the tariff rate over time, cost concerns did not lead to policy reversal (Hoppmann et al., 2014; Lauber & Jacobsson, 2016; Leiren & Reimer, 2018).

In accounting for why the UK experienced much stronger negative feedback through support costs than Germany, despite much smaller gross costs, a first step is to examine the incidence of gross policy costs as a key first-order effect. In both countries, policy costs were passed through to electricity consumers. However, in Germany from early on costs fell much more on households rather than businesses. Energy-intensive industries negotiated an exemption from the surcharge that paid for the EEG in 2003 (Leiren & Reimer, 2018) which over time was expanded to a growing share of businesses (Lauber & Jacobsson, 2016). In the UK, energy-intensive companies also negotiated exemption from support costs, but only from 2015 and covering a much narrower set of industries (BEIS 2020). As discussed above, this contrast is directly related to differences in corporate interest representation, as Germany has strong corporatist institutions, while the UK is more characterised by pluralism (Iversen & Soskice, 2009; Martin & Swank, 2012).

4 The contrast in interest representation raises the question of why incumbent energy utilities did not also benefit from corporatism and close down renewable energy policy in Germany. Early in the adoption of the policy, the existing energy sector was relatively fragmented (Stenzel and Frenzel, 2008) and paid little attention to the renewable energy sector, being more focused on opportunities arising out of reunification (Jacobsson and Lauber, 2006). As renewables grew, policies began to impact on utilities and mergers over the 1990s following liberalisation began to create a consolidated industry comprising the ‘Big Four’ utilities. These companies have indeed enjoyed good access to ministers (Leiren and Reimer, 2018; Sültsen and Hischemüller, 2014), and there was in fact increased lobbying against renewables support by the industry association (the VDEW), leading to proposed legislation in 1997. However, this threat was seen off by a broad coalition of environmental NGOs, municipalities, students, unions and industrial companies described in (Jacobsson and Lauber, 2006). By 2000, the coming to power of a Green-Social Democrat coalition government and the emerging technological possibility of utility scale offshore wind led the utilities to pivot away from trying to stop the policy towards shaping it in such a way as to gain benefit from it (Stenzel and Frenzel, 2008).
The burden of costs amongst households themselves was also shaped by institutions. In both countries, the distributional effects of support costs on bills were regressive (e.g. Chawla and Pollitt, 2013; Neuhoff et al., 2013). However, these effects have been mitigated to a greater extent in Germany than in the UK because of differences in labour market and welfare institutions. While median incomes are similar in the two countries, pre-transfer and post-transfer income inequality and poverty have all consistently been lower in Germany than in the UK since the 1980s (Wang et al., 2014). As a result, while in 2010 Germany was spending around four times as much as a percentage of GDP on support to renewables than the UK (OECD 2013), the costs of renewable support as a percentage of disposable income for the poorest 10% of households was only roughly twice as large in Germany (Neuhoff et al., 2013; Chawla & Pollitt, 2013).

Institutional context also shaped feedback effects, through the politics of policy costs for households. As noted, despite the effects of redistribution, gross support costs in Germany were still were around twice those in the UK. Nevertheless, even when costs were rising sharply in the period 2010–2013, debates and consequent reforms in the former were driven less by costs for households and more by issues of competitiveness, lobbying by near-bankrupt utilities and ideological opposition from the economically liberal FDP (Lauber & Jacobsson, 2016; Leiren & Reimer, 2018). This contrasts strongly with the UK, where there was critical attention to costs for households through the late 2000s and the early 2010s, not least through a hostile print media that used a ‘green stealth taxes’ framing (Lockwood, 2016).

An explanation for why negative feedback was so muted in Germany compared with the UK partly lies in the ability of German governments to impose larger costs on consumers within the politics created by its PR electoral system, in contrast to UK governments which faced sharper political competition in its first-part-the-post system. Coalition government is the norm in Germany, and much of the period since 2000 has involved ‘grand’ coalitions involving the main centre-right and centre-left parties, both of which have maintained broad support for solar PV. By comparison, majority governments with clear lines of responsibility for policies are the norm in the UK. The UK did have a (rare) coalition government from 2010 to 2015, but the reversals to solar PV support were brought in by a majority Conservative government in the wake of sharp debates on the costs of energy with the main opposition party in 2013.

The main challenge to solar PV support in Germany came from the position of the European Commission that the extensive exemptions from renewable policy costs for businesses were against State Aid rules. Ending these had implications for competitiveness, particularly important in the context of Germany’s manufacturing export-based growth model. Incumbent utilities, which were in financial trouble due to taking on excessive debt, were also lobbying for support to be switched away from solar to offshore wind, which better suited their scale of investment (Leiren & Reimer, 2018). The economically liberal FDP, in the coalition government, pressed for legislation to scale back targets and radically cut feed-in tariff rates for solar PV. A draft Bill entered the parliament in 2012, but feedback effects were again shaped by institutional context. The legislation had the support of the parties in the governing coalition in the lower house. However, Germany’s federal constitution gives Länder (states) representation in national decision making through the Bundesrat, the upper house of the German legislature, and they vetoed the draft Bill (Lauber & Jacobsson, 2016; Stefes, 2016). While there is some variation, Länder governments have generally been strong and consistent supporters of the expansion of renewables and the maintenance of supportive policy frameworks (Schönbergerand & Reiche, 2016). These institutional arrangements contrast with the UK system, in which political power
is concentrated horizontally and vertically, enabling the governing party to impose major policy retrenchment without facing any veto players.

**Institutional context and positive policy feedback via ownership**

By contrast with the potential negative feedback created by the costs of policy, the beneficiaries of policy in the form of owners of solar PV enjoying subsidies potentially create a source of positive feedback for the maintenance and expansion of policy. In the case of Germany, it is well known that the ownership pattern of renewable energy is relatively widely distributed (Morris & Jungjohann, 2016). The dominance of smaller actors in renewables ownership was partly due to the nature of the simple and risk-minimising FiT as the key support mechanism up to 2015 (Mitchell et al., 2006), and partly due to the deliberate exclusion of large utilities (Stenzel & Frenzel, 2008). However, as noted above, policy design does not in itself determine first-order effects, as these will also be shaped by the institutional context into which the policy enters. In the case of Germany, a number of features of this context supported dispersed ownership (Oteman, Wiering and Gelderman, 2014). These include: the existence of legal forms of ownership that facilitated citizen and cooperative ownership (Yildiz et al., 2015); a supportive finance sector built on Germany’s traditionally strong local banking sector (Hall et al., 2016); the relative strength of the cooperative movement in Germany (Punt et al., 2021; Wierling et al., 2018), and finally the supportive role of municipalities and regional (Länder) governments (Schönberger and Reiche, 2016; Nolden, 2013; Jacobsson & Lauber, 2006), made possible by Germany’s post-war federal constitution and enduring municipal institutions of public utilities (Stadtwerke). These institutional factors have meant that ownership of solar PV is dispersed not just across individuals, but also across a range of actors (cooperatives, citizen groups, municipally owned energy companies, etc.) for whom collective action is easier to achieve.

While comparative figures for the UK are harder to come by, it is clear that ownership structures of renewables, but especially wind, is much more concentrated in commercial hands (Hall et al., 2016; Nolden, 2013). The SSFiT did extend renewables ownership to a greater range of actors from 2010 onwards, including to around a million households by 2020, but these remained isolated and unorganised as a political force. The cooperative energy sector meanwhile was relatively weak (Mirzania et al., 2019; Wierling et al., 2018), hampered by an unsupportive financial environment due in turn to a concentrated banking sector with little interest in lending to small-scale social enterprises (Hall et al., 2016; Nolden, 2013; Willis & Simcock, 2019).

At the same time, commercial developers also moved into solar PV in the UK from the early days of the FiT, making use of the relatively high 5 MW maximum plant size. These companies also dominated investment under the RO from 2011 onwards in the shape of solar farms, many in the south of England. Larger-scale ownership, including by venture capital funds, began to overtake rooftop solar. Politicians became increasingly uneasy about the involvement of these companies, and there were perceptions that solar PV had become a ‘gold rush’ attracting ‘fat cats’ (Smith et al., 2014), all of which undermined the legitimacy of the policy.

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5 https://www.cleanenergywire.org/factsheets/citizens-participation-energiewende
Institutional context and positive policy feedback via jobs and investment

The other potentially important area of policy feedback for solar PV is in the formation of new interests through the creation of jobs and investment in supply chains, e.g. the manufacturing of solar PV cells, supported by industrial policy. Both the UK and Germany had forms of support for investment, but support in Germany was undoubtedly stronger and more focused. The UK had a general tax allowance for investment from 2008, but Germany used a greater range of mechanisms at both federal and Länder levels to support the development of renewables industries (Jacobsson & Lauber, 2006; Lewis & Wiser, 2007). Solar benefited especially from a set of policies aimed at encouraging investment in the politically important former East Germany. By 2012 there were around 70 manufacturers and industry sales of around €12 billion (Grau et al., 2012). Over 110,000 people were employed in the sector in 2011 (Dewald & Truffer, 2012; Pegels & Lütkenhorst, 2014). By contrast, the UK never had a large PV manufacturing industry, with just two factories, one of which had closed at the end of 2013. Estimates of employment in solar PV were only around 10,000 people in 2015, the vast majority in module installation (Office for National Statistics, 2019). Turnover for the sector peaked at £2.7 billion in 2015.

Differences in solar PV industry outcomes were in part due to different industrial policy designs. However, contrasts in the development of solar PV manufacturing industries up to the early 2010s also arose from other sources. One is simply the size of the domestic market, which is strongly correlated to manufacturing (Nemet 2019). But another is a set of institutional factors that supported the capacity of high-skilled manufacturing to a greater extent in Germany than in the UK. Germany’s post-war growth model has been based on manufacturing exports, while that of the UK has become far more service oriented (Hall, 2019), in part because the institutional strength of manufacturing unions in the former has constrained the degree of deindustrialisation. Coordinated market economy institutions between firms encouraged greater networking amongst emerging solar PV industries (Jacobsson & Lauber, 2006), which also benefited from Germany’s strong state-supported network of independent research institutes. Germany also has a history of stronger institutions for vocational skills and training in manufacturing, organised by firms themselves, and of a financial sector more supportive of smaller firms (Hall and Soskice, 2001).

The strength of the German solar PV industry, mediated through corporatist institutions, had important consequences for policy feedback early on. Peak associations for workers and the manufacturing industry played an important role in defending early renewables policy from attacks by opponents at the end of the 1990s (Jacobsson & Lauber, 2006). However, by the 2010s, this had begun to change as the solar PV industry was progressively undercut by China (Pegels & Lütkenhorst, 2014), and even the German growth model could not save it. Germany’s share of global in wafer and cell production peaked in 2008, manufacturing contracted sharply and by the time of the key debates of 2013–2014 employment in solar PV had fallen back to 2007 levels. The record of solar PV on jobs and investment had if anything become a liability (Brock et al., 2021).

By contrast, in the UK the solar industry lobby was always relatively weak. Together with environmental NGOs this lobby pressed for more gradual reductions in tariffs in 2015–2016 and drew attention to likely bankruptcies and job losses, but it was largely ignored by the government (Lockwood, 2016).
Discussion and conclusions

The adoption of policy feedback in analysis of energy transition dynamics been important and has re-energised the theoretical field, while empirical applications have engaged with different aspects of the framework such as negative feedback and the disaggregation of the policy feedback cycle. However, a limitation of policy feedback is that it does not in itself explain why different patterns of negative and positive feedback are seen in different contexts, even where policies are similar. The role of interests in explaining such differences is clear and has been explored in the literature, but less attention has been paid to the role of institutional context in shaping policy feedback processes and explaining differences across cases.

Here I have developed a framework for examining the potential roles of different types of institutions in influencing solar PV policy dynamics in particular, across different analytical stages of the policy feedback process. These include institutions that shape the incidence of deployment subsidy costs and benefits, such as interest representation institutions, welfare policy and labour markets, alongside legal and social institutions affecting forms of ownership, and electoral and political institutions that partly shape the incentives and opportunities for constituencies to organise and effect policy reform. They also include political economy institutions governing relationships between firms and workers in influencing first-order effects of industrial policy for renewable supply chains.

To illustrate how such a framework might be applied, a comparison of potential institutional factors shaping solar PV support policy dynamics in the UK and Germany was explored. The two countries have contrasting institutions but over the 2010s had a similar solar PV support policy. It was argued that the effects of costs for household consumers, which played a more negative role in the UK than in Germany despite being smaller, were shaped by corporate interest representation and labour market and welfare institutions, with these also closely associated with electoral institutions. Ownership patterns, which have been argued to play a positive feedback role especially for Germany, were argued to be shaped by contrasts in social institutions, especially the relative strength or weaknesses of cooperative and community forms of social organisation. The role of regional veto players within German federalist institutions also prevented in blocking political pressure from a national level coalition leading to policy retrenchment.

This framework can applied in other comparisons, for example across different sectors in a single country. For example, the durability of renewables policy in the UK electricity sector and the transformation of the interests of the key incumbent actors (Kattirtzi et al., 2021) contrasts with attempts to decarbonise new build housing, killed off by incumbents who remained opposed to the policy (Edmondson et al., 2019). In this type of comparison, background political economy and constitutional institutions are the same, and the key to understanding different feedback pathways will lie in part with how interests interact with sectoral–level institutional contexts.

The framework presented here could also be used in more forward-looking analysis, and by extension the construction of policy. Lockwood (2015) uses a consideration of institutional context to predict points at which negative policy feedback for renewable energy are likely to arise in future in India and China. Thinking explicitly about policy feedback processes—effectively anticipating especially the politics of policies—can in principle increase the chances of success (Roberts et al., 2018). Advocates of the feed-in tariff in the UK were inspired partly by diverse forms of ownership of renewables in Germany, but what seemed less apparent to them at the time was that legal, financial and social
Institutions were more supportive of cooperative and communal forms of ownership than those in the UK.

In such cases, it may be possible to design in complementary policies or institutional changes. More challenging to manage are effects caused by more deep-seated macro-institutions or systems of institutions, as these are far more difficult to change, and are less amenable to partial reform or tinkering. For example, policies with high costs for consumers, such as growing a domestic market in new technologies, that are feasible in some contexts, such as northern European countries with PR and strong welfare institutions, may well be politically infeasible when transferred to countries with majoritarian institutions and more acute political competition. But it is not realistic to change such institutions, at least not quickly, and a more fruitful approach will be to amend policy design to compensate. In this context, it is worth noting that the UK’s successful decision to go for leadership in offshore wind was strongly conditional on industry achieving rapidly falling costs.

The limitations of the analysis presented here are readily acknowledged. I have focused on and singled out institutional context as distinct from interests for purposes of analytical argument. In fully explaining feedback pathways, institutions do not replace interests, but rather it is the interaction of interests and institutions that matters (Patashnik & Zelizer, 2013: 1083). At the same time, the account given here is preliminary and is presented as a starting point for a wider research agenda. The typology of institutions relevant for policy feedback in renewable energy may well include other institutions not included here. The empirical comparison is illustrative; more definitive research to isolate the effects of particular institutions requires more cases. Better identification of boundary conditions of what constitutes institutional context may be needed. Other aspects of energy transitions, such as the decarbonisation of mobility, are likely to involve institutions in different arenas of politics.

But the general principle remains that explaining why feedback processes take the form they do in specific cases is not complete without consideration of institutional contexts and that a more systematic approach to such consideration will strengthen our understanding of why renewable energy transitions have sometimes stalled and sometimes accelerated.

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References

Aklin, M., & Urpelainen, J. (2018). *Renewables: The politics of a global energy transition*. Cambridge: MIT Press.

Bélard, D. (2010). Reconsidering policy feedback: How policies affect politics. *Administration & Society, 42*, 568–590. https://doi.org/10.1177/0095399710377444

Bélard, D., & Schlager, E. (2019). Varieties of policy feedback research: Looking backward, moving forward. *Policy Studies Journal, 47*, 184–205. https://doi.org/10.1177/0095399718810130

Breetz, H., Mildenberger, M., & Stokes, L. (2018). The political logics of clean energy transitions. *Business and Politics, 20*, 492–522. https://doi.org/10.1017/bap.2018.14

Brock, A., Sovacool, B. K., & Hook, A. (2021). Volatile photovoltaics: Green industrialization, sacrifice zones, and the political ecology of solar energy in Germany. *Annals of the American Association of Geographers*. https://doi.org/10.1080/24694452.2020.1856638

Campbell, A. L. (2012). Policy makes mass politics. *Annual review of political science, 15*, 333–351. https://doi.org/10.1146/annurev-polisci-012610-135202

Campbell, J. L. (1998). Institutional analysis and the role of ideas in political economy. *Theory and Society, 27*, 377–409.

Četković, S., & Buzogány, Á. (2016). Varieties of capitalism and clean energy transitions in the European union: When renewable energy hits different economic logics. *Climate Policy, 16*, 642–657. https://doi.org/10.1080/14693062.2015.1135778

Chawla, M., & Pollitt, M. G. (2013). Energy-efficiency and environmental policies & income supplements in the UK: Evolution and distributional impacts on domestic energy bills. *Economics of Energy & Environmental Policy, 2*(1), 21–40.

Cusack, T. R., Iversen, T., & Soskice, D. (2007). Economic interests and the origins of electoral systems. *American Political Science Review, 101*, 373–391. https://doi.org/10.1017/S0003055407070384

Dewald, U., & Truffer, B. (2012). The local sources of market formation: explaining regional growth differentials in German photovoltaic markets. *European Planning Studies, 20*, 397–420. https://doi.org/10.1080/09654313.2012.651803

Edmondson, D. L., Kern, F., & Rogge, K. S. (2019). The co-evolution of policy mixes and socio technical systems: Towards a conceptual framework of policy mix feedback in sustainability transitions. *Research Policy, Policy Mixes for Sustainability Transitions: New Approaches and Insights through Bridging Innovation and Policy Studies, 48*, 103555. https://doi.org/10.1016/j.respol.2018.03.010

Esping-Anderson, G., (1990). The three worlds of welfare capitalism. *Finnegan, J. J., (2019). Institutions, climate change, and the foundations of long-term policymaking. https://doi.org/10.33777/apsa-2019-6ft75

Geels, F. W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J., Neukirch, M., & Wassermann, S. (2016). The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014). *Research Policy, 45*, 896–913. https://doi.org/10.1016/j.respol.2016.01.015

Grau, T. (2014). Responsive feed-in tariff adjustment to dynamic technology development. *Energy Economics, 44*, 36–46. https://doi.org/10.1016/j.eneco.2014.03.015

Grau, T., Huo, M., & Neuhoff, K. (2012). Survey of photovoltaic industry and policy in Germany and China. *Energy Policy, Renewable Energy in China, 51*, 20–37. https://doi.org/10.1016/j.enpol.2012.03.082

Gürtler, K., Postpischl, R., & Quitzow, R. (2019). The dismantling of renewable energy policies: The cases of Spain and the Czech Republic. *Energy Policy, 133*, 110881. https://doi.org/10.1016/j.enpol.2019.110881

Hall, P. A. (1993). Policy paradigms, social learning, and the State: the case of economic policymaking in Britain. *Comparative Politics, 25*, 275–296. https://doi.org/10.2307/422246

Hall, P. A. (2019). From Keynesianism to the knowledge economy: The rise and fall of growth regimes. *Business Economics, 54*, 122–126. https://doi.org/10.1057/s11369-018-00107-2

Hall, S., Foxon, T. J., & Bolton, R. (2016). Financing the civic energy sector: How financial institutions affect ownership models in Germany and the United Kingdom. *Energy Research & Social Science, 12*, 5–15. https://doi.org/10.1016/j.erss.2015.11.004

Hall, P. A., & Soskice, D. (2001). An introduction to varieties of capitalism. In P. A. Hall & D. Soskice (Eds.), *Varieties of capitalism: The institutional foundations of comparative advantage* (pp. 1–68). Oxford: Oxford University Press.

Hochstetler, K. (2020). *Political economies of energy transition: wind and solar power in Brazil and South Africa*. Cambridge: Cambridge University Press.
Hoppmann, J., Huenteler, J., & Girod, B. (2014). Compulsive policy-making—The evolution of the German feed-in tariff system for solar photovoltaic power. *Research Policy, 43*, 1422–1441. [https://doi.org/10.1016/j.ressp.2014.01.014](https://doi.org/10.1016/j.ressp.2014.01.014)

Immergut, E. M. (1990). Institutions, Veto Points, and policy results: A comparative analysis of health care. *Journal of Public Policy, 10*, 391–416. [https://doi.org/10.1017/S0143814X00006061](https://doi.org/10.1017/S0143814X00006061)

Iversen, T., & Soskice, D. (2009). Distribution and redistribution: The shadow of the nineteenth century. *World Politics, 61*, 438–486. [https://doi.org/10.1017/S004381710900015X](https://doi.org/10.1017/S004381710900015X)

Jacobs, A. M., & Weaver, R. K. (2015). When policies undo themselves: Self-undermining feedback as a source of policy change. *Governance, 28*, 441–457. [https://doi.org/10.1111/gove.12101](https://doi.org/10.1111/gove.12101)

Jacobsson, S., & Lauber, V. (2006). The politics and policy of energy system transformation—explaining the German diffusion of renewable energy technology. *Energy Policy, Renewable Energy Policies in the European Union, 34*, 256–276. [https://doi.org/10.1016/j.enpol.2006.12.005](https://doi.org/10.1016/j.enpol.2006.12.005)

Jordan, A., & Matt, E. (2014). Designing policies that intentionally stick: Policy feedback in a changing climate. *Policy Sciences, 47*, 227–247. [https://doi.org/10.1007/s11077-014-9201-x](https://doi.org/10.1007/s11077-014-9201-x)

Jordan, A., & Moore, B. (2020). *Durable by design? Policy feedback in a changing climate*. Cambridge University Press.

Kattirtzi, M., Ketsopoulou, I., & Watson, J. (2021). Incumbents in transition? The role of the ‘Big Six’ energy companies in the UK. *Energy Policy, 148*, 111927. [https://doi.org/10.1016/j.enpol.2020.111927](https://doi.org/10.1016/j.enpol.2020.111927)

Laird, F. N., & Stefes, C. (2009). The diverging paths of German and United States policies for renewable energy: Sources of difference. *Energy Policy, 37*, 2619–2629. [https://doi.org/10.1016/j.enpol.2009.02.027](https://doi.org/10.1016/j.enpol.2009.02.027)

Lauber, V., & Jacobsson, S. (2016). The politics and economics of constructing, contesting and restricting socio-political space for renewables – The German Renewable Energy Act. *Environmental Innovation and Societal Transitions, 18*, 147–163. [https://doi.org/10.1016/j.eist.2015.06.005](https://doi.org/10.1016/j.eist.2015.06.005)

Leiren, M. D., & Reimer, I. (2018). Historical institutionalist perspective on the shift from feed-in tariffs towards auctioning in German renewable energy policy. *Energy Research & Social Science, Sustainable Energy Transformations in an Age of Populism, Post-Truth Politics, and Local Resistance, 43*, 33–40. [https://doi.org/10.1016/j.erss.2018.05.022](https://doi.org/10.1016/j.erss.2018.05.022)

Lewis, J. I., & Wiser, R. H. (2007). Fostering a renewable energy technology industry: An international comparison of wind industry policy support mechanisms. *Energy Policy, 35*, 1844–1857. [https://doi.org/10.1016/j.enpol.2006.06.005](https://doi.org/10.1016/j.enpol.2006.06.005)

Lindvall, J. (2017). *Reform capacity*. Oxford: Oxford University Press.

Lockwood, M. (2013). The political sustainability of climate policy: The case of the UK climate change act. *Global Environmental Change, 23*, 1339–1348. [https://doi.org/10.1016/j.gloenvcha.2013.07.001](https://doi.org/10.1016/j.gloenvcha.2013.07.001)

Lockwood, M. (2015). The political dynamics of green transformations: The roles of policy feedback and institutional context. In M. Leach, P. Newell & I. Scoones (Eds.), *The politics of green transformations* (pp. 86–101). London: Earthscan.

Lockwood, M. (2016). The UK’s Levy Control Framework for renewable electricity support: Effects and significance. *Energy Policy, 97*, 193–201. [https://doi.org/10.1016/j.enpol.2016.07.026](https://doi.org/10.1016/j.enpol.2016.07.026)

Martin, C. J., & Swank, D. (2012). *The political construction of business interests: Coordination, growth, and equality*. Cambridge University Press.

Meckling, J., Kelsey, N., Biber, E., & Zysman, J. (2015). Winning coalitions for climate policy. *Science, 349*, 1170–1171. [https://doi.org/10.1126/science.aab1336](https://doi.org/10.1126/science.aab1336)

Meckling, J., & Nahm, J. (2018). When do states disrupt industries? Electric cars and the politics of innovation. *Review of International Political Economy, 25*, 505–529. [https://doi.org/10.1080/09692290.2018.1434810](https://doi.org/10.1080/09692290.2018.1434810)

Meckling, J., Sterner, T., & Wagner, G. (2017). Policy sequencing toward decarbonization. *Nature, 2*, 918–922. [https://doi.org/10.1038/s41560-017-0025-8](https://doi.org/10.1038/s41560-017-0025-8)

Meyer, N. I. (2007). Learning from wind energy policy in the EU: Lessons from Denmark, Sweden and Spain. *European Environment, 17*, 347–362. [https://doi.org/10.1002/eeet.463](https://doi.org/10.1002/eeet.463)

Mikler, J., & Harrison, N. E. (2012). Varieties of Capitalism and Technological Innovation for Climate Change Mitigation. *New Political Economy, 17*, 179–208. [https://doi.org/10.1080/13563467.2011.552106](https://doi.org/10.1080/13563467.2011.552106)

Mirzania, P., Ford, A., Andrews, D., Ofori, G., & Maidment, G. (2019). The impact of policy changes: The opportunities of community renewable energy projects in the UK and the barriers they face. *Energy Policy, 129*, 1282–1296. [https://doi.org/10.1016/j.enpol.2019.02.066](https://doi.org/10.1016/j.enpol.2019.02.066)

Mitchell, C., Bauknecht, D., & Connor, P. M. (2006). Effectiveness through risk reduction: A comparison of the renewable obligation in England and Wales and the feed-in system in Germany. *Energy Policy, Renewable Energy Policies in the European Union, 34*, 297–305. [https://doi.org/10.1016/j.enpol.2004.08.004](https://doi.org/10.1016/j.enpol.2004.08.004)
Morris, C., & Jungjohann, A. (2016). Energy democracy: Germany’s energiewende to renewables. Basingstoke: Palgrave Macmillan.

Muhammad-Sukki, F., Ramirez-Iniguez, R., Munir, A. B., Mohd Yassin, S. H., Abu-Bakar, S. H., McMeekin, S. G., & Stewart, B. G. (2013). Revised feed-in tariff for solar photovoltaic in the United Kingdom: A cloudy future ahead? Energy Policy, Special Section: Transition Pathways to a Low Carbon Economy, 52, 832–838. https://doi.org/10.1016/j.enpol.2012.09.062

Neuhoff, K., Bach, S., Diekmann, J., Beznoska, M., & El-Laboudy, T. (2013). Distributional effects of energy transition: Impacts of renewable electricity support in Germany. Economics of Energy & Environmental Policy, 2, 41–54.

Nolden, C. (2013). Governing community energy—Feed-in tariffs and the development of community wind energy schemes in the United Kingdom and Germany. Energy Policy, 63, 543–552. https://doi.org/10.1016/j.enpol.2013.08.050

Oberlander, J., & Weaver, R. K. (2015). Unraveling from within? The affordable care act and self-undermining policy feedbacks. The Forum, 13, 37–62. https://doi.org/10.1515/for-2015-0010

Office for National Statistics, (2019). Low carbon and renewable energy economy, UK [WWW Document]. URL https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/latest#the-low-carbon-and-renewable-energy-economy-over-time. Accessed 29 June 2021.

Oteman, M., Wiering, M., & Helderman, J.-K. (2014). The institutional space of community initiatives for renewable energy: a comparative case study of the Netherlands, Germany and Denmark. Energy, Sustainability and Society | Full Text [WWW Document]. https://energsustainssoc.biomedcentral.com/articles/doi.org/10.1186/2192-0567-4-11. Accessed 22 Apr 2021.

Patashnik, E., & Zelizer, J.E. (2009). When Policy Does Not Remake Politics: The Limits of Policy Feedback (SSRN Scholarly Paper No. ID 1449996). Social Science Research Network.

Patashnik, E. M. (2014). Reforms at risk: What happens after major policy changes are enacted. Princeton University Press.

Patashnik, E. M., & Zelizer, J. E. (2013). The struggle to remake politics: Liberal reform and the limits of policy feedback in the contemporary American state. Perspectives on Politics, 11, 1071–1087. https://doi.org/10.1017/S1537592713002831

Pegels, A., & Lütkenhorst, W. (2014). Is Germany’s cloudy future ahead? Energy Policy, Special Section: Transition Pathways to a Low Carbon Economy, 52, 543–552. https://doi.org/10.1016/j.enpol.2012.09.062

Pierson, P. (1994). Dismantling the welfare state?: Reagan. Cambridge University Press.

Pierson, P. (2000). Increasing returns, path dependence, and the study of politics. The American Political Science Review, 94, 251–267. https://doi.org/10.2307/2586011

Punt, M. B., Bauwens, T., Frenken, K., & Holstenkamp, L. (2021). Institutional relatedness and the institutional space of community initiatives for renewable energy: a comparative case study of the Netherlands, Germany and Denmark. Energy, Sustainability and Society | Full Text [WWW Document]. https://energsustainssoc.biomedcentral.com/articles/doi.org/10.1186/2192-0567-4-11. Accessed 22 Apr 2021.

Rosenbloom, D., Meadowcroft, J., & Cashore, B. (2019). Stability and climate policy? Harnessing insights on path dependence, policy feedback, and transition pathways. Energy Research & Social Science, 50, 168–178. https://doi.org/10.1016/j.erss.2018.06.001

Robert, C., Geels, F. W., Lockwood, M., Newell, P., Schmitz, H., Turnheim, B., & Jordan, A. (2018). The politics of accelerating low-carbon transitions: Towards a new research agenda. Energy Research & Social Science, 44, 304–311. https://doi.org/10.1016/j.erss.2018.06.001

Schmid, N., Sewerin, S., & Schmidt, T. S. (2020). Explaining advocacy coalition change with policy feedback. Policy Studies Journal, 48, 1109–1134. https://doi.org/10.1111/psj.12365

Schmidt, V.A., (2002). The futures of European capitalism. OUP Oxford.

Schmidt, T. S., & Sewerin, S. (2017). Technology as a driver of climate and energy politics. Nature Energy, 2, 1–3. https://doi.org/10.1038/s41560-017-0023-3

Schmidt, T. S., & Sewerin, S. (2019). Measuring the temporal dynamics of policy mixes – An empirical analysis of renewable energy policy mixes’ balance and design features in nine countries. Research Policy, Policy Mixes for Sustainability Transitions: New Approaches and Insights through Bridging Innovation and Policy Studies, 48, 103557. https://doi.org/10.1016/j.respol.2018.03.012

Schneider, A. L. (2012). Punishment policy in the american states from 1890 to 2008: convergence divergence synchronous change and feed-forward effects. Policy Studies Journal, 40(2) 193–210. https://doi.org/10.10111/j.1541-0072.2012.00449.x.

Schönbergerand, P., & Reiche, D. (2016). Why subnational actors matter: The role of Länder and municipalities in the German energy transition. In C. Hager & C. H. Stefes (Eds.), Germany’s energy transitions: A comparative perspective (pp. 27–62). Basingstoke: Palgrave Macmillan.
Sewerin, S., Béland, D., & Cashore, B. (2020). Designing policy for the long term: Agency, policy feedback and policy change. *Policy Sciences, 53*, 243–252. https://doi.org/10.1007/s11177-020-09391-2

Skocpol, T. (1992). State formation and social policy in the united states. *American Behavioral Scientist, 35*(4–5), 559–584. https://doi.org/10.1177/000276429203500412

Smith, A., Kern, F., Raven, R., & Verhees, B. (2014). Spaces for sustainable innovation: Solar photovoltaic electricity in the UK. *Technological Forecasting and Social Change, 81*, 115–130. https://doi.org/10.1016/j.techfore.2013.02.001

Stefes, C. H. (2016). Critical Junctures and the German Energiewende. In C. H. H. Stefes (Eds.), *Germany’s energy transition a comparative perspective* (pp. 63–90). Basingstoke: Palgrave Macmillan.

Steinmo, S., & Thelen, K. (1992). Historical institutionalism in comparative politics. In S. Steinmo, K. Thelen & F. Longstreth (Eds.), *Historical institutionalism in comparative politics* (pp. 1–32). Cambridge University Press.

Stenzel, T., & Frenzel, A. (2008). Regulating technological change—The strategic reactions of utility companies towards subsidy policies in the German, Spanish and UK electricity markets. *Energy Policy, 36*, 2645–2657. https://doi.org/10.1016/j.enpol.2008.03.007

Stokes, L., C., (2020). Short circuiting policy: Interest groups and the battle over clean energy and Climate Policy in the American States. Oxford University Press.

Strachan, P. A., & Lal, D. (2004). Wind energy policy, planning and management practice in the UK: Hot air or a gathering storm? *Regional Studies, 38*, 549–569. https://doi.org/10.1080/0143116042000229311

Sühlsen, K., & Hisschemöller, M. (2014). Lobbying the ‘Energiewende’. Assessing the effectiveness of strategies to promote the renewable energy business in Germany. *Energy Policy, 69*, 316–325. https://doi.org/10.1016/j.enpol.2014.02.018

Svendsen, G. T., Daugbjerg, C., Hjøllund, L., & Pedersen, A. B. (2001). Consumers, industrialists and the political economy of green taxation: CO2 taxation in OECD. *Energy Policy, 29*, 489–497. https://doi.org/10.1016/S0301-4215(00)00145-2

Szarka, J. (2006). Wind power, policy learning and paradigm change. *Energy Policy, 34*, 3041–3048. https://doi.org/10.1016/j.enpol.2005.05.011

Toke, D. (2002). Wind power in UK and Denmark: Can rational choice help explain different outcomes? *Environmental Politics, 11*(4), 83–100. https://doi.org/10.1080/714000647.

Toke, D. (2010). Politics by Heuristics: Policy networks with a focus on actor resources, as illustrated by the case of renewable energy policy under new labour. *Public Administration, 88*, 764–781. https://doi.org/10.1111/j.1467-9299.2010.01839.x

Toke, D., Breukers, S., & Wolsink, M. (2008). Wind power deployment outcomes: How can we account for the differences? *Renewable and Sustainable Energy Reviews, 12*, 1129–1147. https://doi.org/10.1016/j.rser.2006.10.021

Toke, D., & Lauber, V. (2007). Anglo-Saxon and German approaches to neoliberalism and environmental policy: The case of financing renewable energy. *Geoforum, 38*, 677–687. https://doi.org/10.1016/j.geoforum.2006.11.016

Wang, C., Caminada, K., & Goudswaard, K. (2014). Income redistribution in 20 countries over time. *International Journal of Social Welfare, 23*, 262–275. https://doi.org/10.1111/ijsw.12061

Weaver, R. K. (2010). Paths and forks or chutes and ladders?: Negative feedbacks and policy regime change. *Journal of Public Policy, 30*, 137–162.

Wierling, A., Schwantz, V. J., Zeiß, J. P., Bout, C., Candelise, C., Gilcrease, W., & Gregg, J. S. (2018). Statistical evidence on the role of energy cooperatives for the energy transition in European countries. *Sustainability, 10*, 3339. https://doi.org/10.3390/su10093339

Willis, R., Simcock, N., (2019). Consumer (Co-)Ownership of renewables in England and Wales (UK), In: Lowitzsch, J. (Ed.), Energy Transition: Financing Consumer Co-Ownership in Renewables. Springer International Publishing, Cham, pp. 369–394. https://doi.org/10.1007/978-3-319-93518-8_17

Yildiz, Ö., Rommel, J., Debor, S., Holstenkamp, L., Mey, F., Müller, J. R., Radtke, J., & Rognli, J. (2015). Renewable energy cooperatives as gatekeepers or facilitators? Recent developments in Germany and a multidisciplinary research agenda. *Energy Research & Social Science, 6*, 59–73. https://doi.org/10.1016/j.erss.2014.12.001

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