Anna Leipprand, Christian Flachsland, Michael Pahle

Starting low, reaching high? Sequencing in EU climate and energy policies

Originally published in:
Environmental Innovation and Societal Transitions
37 (2020), 140-155
DOI: 10.1016/j.eist.2020.08.006

Wuppertal Institut

Starting low, reaching high? Sequencing in EU climate and energy policies

Author's Accepted Manuscript

Citation: Leipprand, Anna, Flachsland, Christian, Pahle, Michael 2020. "Starting low, reaching high? Sequencing in EU climate and energy policies." *Environmental Innovation and Societal Transitions* 37, 140-155.

doi: https://doi.org/10.1016/j.eist.2020.08.006
URL: https://www.sciencedirect.com/science/article/abs/pii/S2210422420301106

Anna Leipprand[a,*], Christian Flachsland[b,c], Michael Pahle[d]

[a]Wuppertal Institute for Climate, Environment and Energy, Döppersberg 19, 42103 Wuppertal, Germany
[b]Hertie School of Governance, Friedrichstraße 180, 10117 Berlin, Germany
[c]Mercator Research Institute on Global Commons and Climate Change, Torgauer Str. 12-15, 10829 Berlin, Germany
[d]Potsdam Institute for Climate Impact Research, Telegrafenberg A31, 14473 Potsdam, Germany

* corresponding author, email: anna.leipprand@wupperinst.org

Abstract

In order to achieve the UNFCCC Paris Agreement goals, climate policies worldwide require considerable ratcheting-up. Policy sequencing provides a framework for analysing policy process dynamics that facilitate ratcheting-up. We apply a sequencing perspective to two key EU climate and energy policies, the Emissions Trading Scheme (ETS) and the Renewable Energy Directive (RED), to comparatively test the empirical relevance of sequencing for single policies – in addition to sequencing across policies, which has been the focus of sequencing theory so far – and to uncover specific mechanisms. Our results confirm that sequencing, based on triggering positive and controlling negative feedback, is relevant both within and across policies. Policy choices that may facilitate ratcheting-up include tools to control costs, the possibility to centralise and harmonise in a multi-level governance context, options for compensation of reluctant actors, and the encouragement of learning processes.

Keywords: Policy sequencing, policy feedback, energy policy, climate policy, emissions trading, renewable energy

1 Introduction

In order to achieve the UNFCCC Paris Agreement goals, global greenhouse gas emissions will have to be reduced dramatically over the coming decades (IPCC 2018). To incentivise the decarbonisation of economic systems and energy supply structures at the required scale and speed, a considerable ratcheting-up of policies for low-carbon transformations is necessary (UNEP 2018). Recent research on climate policy sequencing (Meckling et al. 2015; Meckling et al. 2017; Pahle et al. 2018) provides a framework for analysing mechanisms and processes that support such ratcheting-up. The framework is interested in pathways of stepwise policy development where 'each stage is conducive to achieving the subsequent, more stringent one' (Pahle et al. 2018, p. 861). This happens as barriers that restrict the stringency of climate policies are removed or relaxed through sequential policy-making.

Building on path dependency and policy feedback theory, the sequencing framework investigates how policies themselves work back on their context's political economy, affecting actors, institutions and coalitions. While in the analytical perspective sequencing is not necessarily intentional, the framework can be used to identify tools that allow for strategic policy sequencing through anticipating and possibly channelling feedback effects of policies into the desired direction. As a novel analytical framework, climate policy sequencing yet has to be tested in case study research.

This paper contributes to closing this gap by investigating sequencing dynamics in two key European Union energy and climate policies: The Renewable Energy Directive (RED) and the European Union's Emissions Trading Scheme (EU ETS). The EU has been playing a leading role in international climate policy since the early 1990s (Oberthür and Pallemaerts 2010). It adopted an emissions reduction target of minus 8 percent for 2010 relative to 1990 levels under the Kyoto Protocol 1997, which was increased to 20 percent with the 2020 climate and energy package. The 2030 climate and energy framework adopted in 2014 set a minus 40 percent reduction target for 2030; this target may be made more ambitious in autumn 2020. The RED and the EU ETS both have been central instruments in the EUs climate and energy strategy, evolving in the same context but exhibiting very different process dynamics.

The questions we address in this research are 1) whether sequencing was relevant in the development of the two policy instruments over time, both within each policy process and across the two; 2) through which mechanisms (within and across policy processes) sequencing affected existing barriers and thus shaped process dynamics; and 3) what can be learned from the two cases about conditions that facilitate ratcheting-up climate policy stringency. The following Section 2 presents the relevant literature, the analytical framework, the methodology, and the case study. Section 3 traces the dynamics of the two

policy processes. In Section 4 we discuss our findings' relevance for refining the sequencing framework and present key conclusions.

2 Research design

2.1 Theoretical embedding and related work

The core hypothesis of climate policy sequencing is that policies at an early stage can be conducive to implementing more stringent policies at a later stage. Meckling et al. (2015; 2017) argue that green industrial policies have paved the way for carbon pricing in many jurisdictions, primarily by building a so called "winning climate coalitions". Here, policy sequencing is primarily understood in terms of a sequential succession of different policies. Pahle et al. (2018) have proposed a broader sequencing framework aimed at ratcheting-up the stringency of climate policies that goes beyond the focus on building political coalitions. It asserts that initially barriers to more stringent policies exist, which can be relaxed through sequencing options relying on different underlying mechanisms. Pahle et al. (2018) identify four key types of economic, political and legal barriers: 1) **economic cost** (technology cost and lack of policy cost-effectiveness), 2) **distributional dynamics** (interest group opposition, lack of supporting coalition), 3) **institutions and governance** (lack of expertise and capacity, veto power of opposing units in government), and 4) **free riding** (free riding and heterogeneous preferences). For each of these barriers several policy choices and design options are identified by which they can be reduced over time (sequencing options).

The sequencing framework is rooted in the classical theoretical literature on policy feedback, path dependency and policy sequences (Pierson 1993, Pierson 2000, Mahoney 2000, Howlett 2009). Sequencing options for the most part work through triggering policy feedback, which can be defined as 'the impact of existing policies on politics and policy development' (Béland 2010, p. 569). Positive feedback occurs, for example, if self-reinforcing process dynamics such as increasing returns increase the costs of switching to alternative solutions (Pierson 1993; Pierson 2000; Skocpol 1992). Correspondingly, positive policy feedback can help overcoming or reducing barriers to higher stringency. In contrast, negative feedback may strengthen rather than relax barriers to stringency which may undermine the stability of a (climate) policy regime (Jacobs and Weaver 2015; Oberlander and Weaver 2015; Weaver 2010).

The sequencing framework resonates with several other theoretical approaches to studying policy change in sustainability transitions based on feedback that were put forward in recent years. Roberts et al. (2018) develop a research agenda for studying the politics of accelerating low-carbon transitions. They point to the need to close knowledge gaps for

instance regarding how transition policies can encourage positive feedbacks over the long term, and how the effects and mechanisms of policy feedbacks can be distinguished. Schmidt and Sewerin (2017) diagnose a "paradigm shift from cost-minimizing to opportunity-seizing" in climate politics, and highlight the need to better understand feedback links between technology, politics and policy change by integrating research from different academic disciplines. Edmondson et al. (2018) propose a framework that accounts for the co-evolution of policy mixes and socio-technical systems, showing that individual policies can produce wider feedback effects that also influence the development of other policies.

To the best of our knowledge, these novel frameworks are still in need of empirical validation of the suggested mechanisms. A notable exception is the co-evolution framework by Edmondson et al. (2018), which is applied to the case of zero-carbon homes in the UK by Edmondson et al. (2020). The broader questions we ask here are: Do the mechanisms actually work out in different practical cases as theorized? How do feedback links work out across or within specific policy processes? While the present study starts from the sequencing framework and its focus on barriers, its results can also be used in the context of related frameworks and thus contribute to the broader literature on socio-technical transitions.

2.2 Analytical framework

Since the sequencing framework remains relatively broad and not all concepts have been operationalized for use in empirical studies, some refinement is required. We add to the development of the framework by (1) applying it explicitly both with regard to process-internal and cross-policy mechanisms, (2) operationalizing the key concept of stringency and (3) providing insights on specific mechanisms.

Figure 1 presents an updated version of the sequencing framework, building on Pahle et al. (2018). The increase in *stringency* (S) of a policy is the key dependent variable in the framework, but not explicitly defined in Pahle et al. (2018). Drawing on Oberthür (2019) and Schaffrin et al. (2014), we propose that the assessment of (change in) policy stringency should be based on the following three indicators:

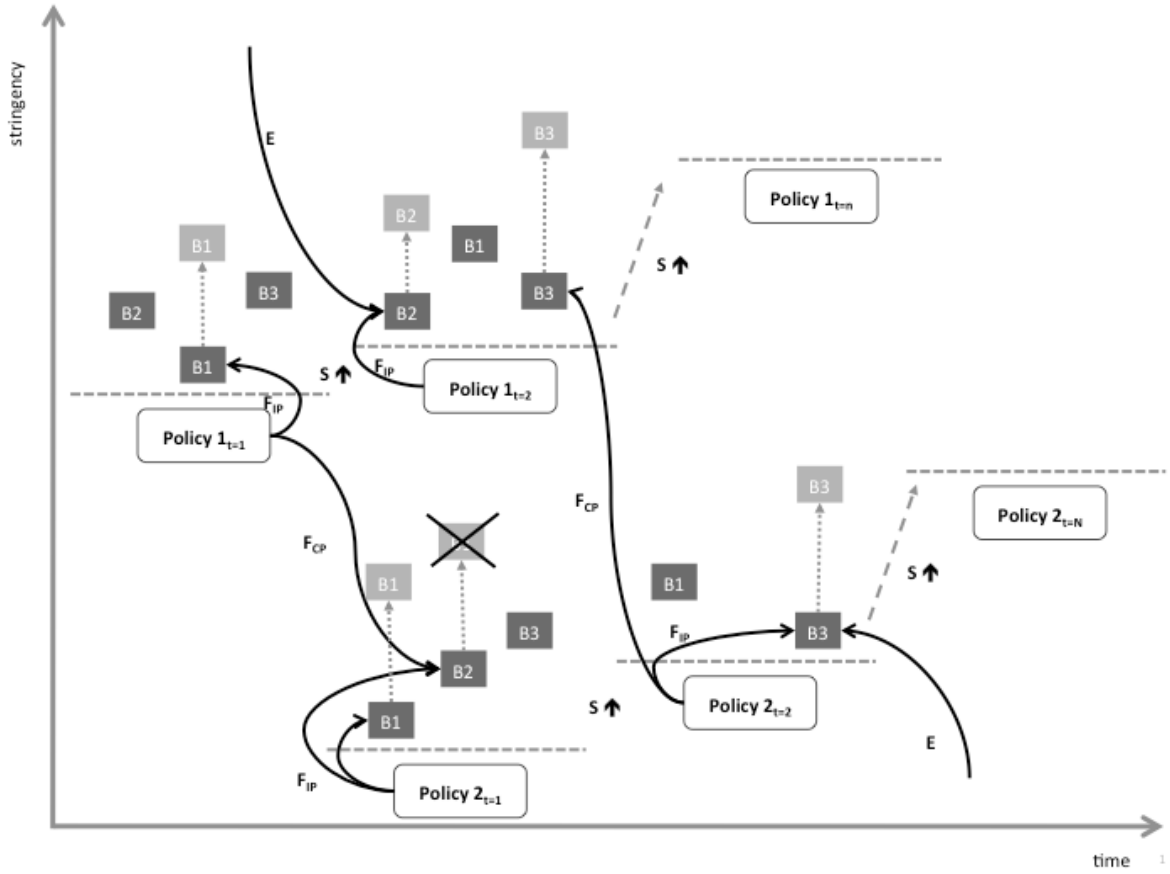

Figure 1. Ratcheting-up in two related policy processes. The figure develops the sequencing framework proposed by Pahle et al. 2018, broadening the perspective to two related policy processes and feedback effects between them. B – barrier, S ↑– stringency increase, F_{IP} – internal policy feedback, F_{CP} – cross-policy feedback, E – external factor influencing barrier. Through feedback and external factors, barriers are relaxed or removed.

1. Policy *ambition*: are the targets of the policy becoming increasingly ambitious?
2. Policy *scope*: is the policy expanding in scope, e.g. coverage of greenhouse gas emissions, sectors and countries? (Defined as "ratcheting out" by Pahle et al. 2018)
3. Policy *design*: is the design of the policy becoming increasingly suitable to ensure target achievement? This includes a consideration of the level of bindingness, enforceability, and monitoring and review provisions.

Stringency is restricted by *barriers*, and it can increase (S ↑) as barriers are relaxed or removed. We concentrate on barriers related to costs (B_C), to politics (B_P) and to institutions and governance (B_{IG}) (Table 1). *Ratcheting-up* of a policy occurs if stringency is increased over time. *Sequencing*, finally, refers to the adoption of policy design choices that – intentionally or not – enable ratcheting-up by relaxing or removing barriers via specific mechanisms.

Table 1. Barrier types

Category	Specific barrier
Cost (B_C)	High (technology) costs
	Lack of policy cost-effectiveness
Politics (B_P)	Interest group opposition
	Lack of supporting coalition
Institutions & Governance (B_{IG})	Lack of expertise and capacity

Adapted from Pahle et al. (2018)

In our analysis, we are particularly interested in mechanisms describing how barriers can be altered through feedback effects from the policy itself (internal feedback F_{IP}) or feedback caused by the effects of other policies (cross-policy feedback: F_{CP}). We recognize barriers might not only be relaxed, but could also increase due to negative feedback mechanisms.

Sequencing theory thus builds on mechanisms that have been demonstrated or proposed in the feedback literature. For instance, policies may reduce the costs of technologies for emission reductions and thus lower or eliminate the **cost barrier**. As policies are successful in making low-carbon technologies more competitive, policy-makers increasingly perceive economic opportunities and are incentivized to implement more ambitious national or subnational policies (Schmidt and Sewerin 2017). Negative feedback reinforcing the cost barrier, by contrast, may come from mounting fiscal pressures or societal costs caused by policies (Weaver 2010).

Policy feedback research has created deep insights on the influence of policies on **politics**. If policies create benefits for powerful clienteles or incentivise actors to make high up-front investments in abatement technologies, attempts to dismantle them later will be met by strong resistance (Béland 2010; Jordan and Matt 2014; Pierson 1993; Skocpol 1992). Building winning coalitions can stabilise a policy (Meckling et al. 2015). Policies that generate fiscal revenue are likely to benefit from the support of the treasury (Edmondson et al. 2018). By contrast, a policy that creates concentrated costs for powerful actors may cause them to intensify their resistance (Jordan and Matt 2014; Meckling et al. 2017; Oberlander and Weaver 2015). Negative feedback from the resistance of affected actors may be mitigated through strategic transfers and compensation measures (Dorsch et al. 2019).

The build-up of 'bureaucratic constituencies' (Béland 2010: 571; Skocpol 1992) is a positive feedback effect that might work back on the **institutions and governance** barrier. We expect policy learning to be a relevant feedback effect in institutions and governance (Daugbjerg 2009), as policy-makers develop new strategies or policies from experience with existing policies (Dunlop and Radaelli 2016; Heikkila and Gerlak 2013). Policies may encourage

learning if they include monitoring and review systems that reveal deficiencies in performance (Jordan and Matt 2014, p. 234).

Finally, we acknowledge that barriers and more broadly policy changes may also be caused by *external effects* (E) and by conditions that are not affected by the policy itself. While external factors may be used as alternative explanations for policy changes, following Mahoney's (2000) conceptualization of conjunctures among otherwise distinct causal chains of events we assume that outcomes are determined by the interaction of external pressures *and* feedback effects. Feedback scholars have pointed to the relevance of external processes and conditions such as the availability of policy alternatives, pressures from international environmental regimes, the role of policy entrepreneurs, the complexity and consistency of policies within policy mixes, and the degree of partisan polarisation (Edmondson et al. 2018; Jacobs and Weaver 2015; Jordan and Matt 2014; Oberlander and Weaver 2015; Weaver 2010).

The EU's multi-level governance context creates specific conditions that influence the structure of barriers and feedback effects. Compromise solutions need to be created that are acceptable to 28 Member States with different national climate policy preferences. While decisions on high-level targets are taken by the European Council in unanimous voting, a strong pressure to achieve consensus is also present in energy and climate legislative processes without formal unanimity requirements (Fischer 2014). While outcomes determined by the lowest common denominator may be expected under these circumstances, the EU has in fact been able to take on an international leadership role on climate change mitigation. This implies that its complex decision-making processes also hold multiple options for actors willing to enact leadership (Schreurs and Tiberghien 2007, p. 41).

2.3 Methods

We perform process tracing to reconstruct the temporal sequence of policy choices with the aim to understand causal dynamics. Following Beach (2017) we understand process tracing as a research method that uses within-case empirical analysis to establish how causal processes play out in actual cases, and thus to gain better understanding of the causal dynamics that produced the outcome of a particular historical case. Such studies can be a basis for comparative analyses, which then allow inferring generalizable causal mechanisms. Starting from the theorizing about causal processes provided e.g. by Pahle et al. (2018), we aim to go further in empirically unpacking the constituent parts of the processes that occur between causes and outcomes, and in disentangling the role of actors, organizations and structures in these processes (Beach 2017). Where, as in our cases, political processes at high levels of government are in the focus, elite interviews can be critical sources of information in process tracing, since they allow to cross-check information about causal

mechanisms from the literature, and possibly to identify additional mechanisms by probing beyond official accounts (Tansey 2007).

We therefore combine a desk analysis of written material with expert interviews. Key written data sources are the official documentation of EU policy-making, and scientific studies that analyse specific episodes or aspects of the policy processes. We evaluated this material first, synthesizing relevant insights on policy processes, barriers to stringency, occurrences of increases in policy stringency, and the underlying mechanisms. We then conducted interviews with 19 experts on ETS and RED policy processes at both EU and Member State level to complement and cross-check information from the desk research. We focused on policy-makers but also included experts from science. A list of interviewees is provided in Annex I. The list shows that while the range of experts provides good coverage of both policy processes and of governance levels, there is a bias towards experts of German nationality even though we approached experts from a range of EU countries. This is mainly driven by a particularly high response rate from German experts, very likely due to pre-existing personal contacts between some of them and the authors.

For the semi-structured interviews we used the guideline provided in Annex II. Interviews had a duration of between 35 and 60 minutes. Nine were conducted face-to-face, the others per Skype or telephone (see Annex I).

The transcribed data from interviews were analysed in a step-wise process. First, we extracted the key information on the guideline questions for each individual interview from the transcript. Second, we synthesized this information from all interviews in a table, assigning statements about barriers and feedbacks or other external mechanisms that helped overcome them to the respective categories of the sequencing framework, and in the process of doing so pooling similar arguments. Many aspects were mentioned by more than one interviewee; where applicable this is indicated in the results section. While interview partners highlighted different aspects of policy sequencing, there were few cases where statements from different interviews disagreed, and only one instance where this affected a relevant feedback mechanism (conflicting evidence on role of revenues, see section 3.1).

2.4 Case selection

Our cases are two flagship EU climate and energy policies, the European Emissions Trading System (ETS) and the EU's Renewable Energy Directive (RED). We choose them for two reasons: First, the dual case study helps ensure that our conceptual framework is not too narrowly based on the characteristics of just one policy, and allows us to learn about within-policy sequencing from comparison of the two cases. Second, using the two cases enables us to identify potential cross-policy feedback effects. Overall, the study design was chosen to

refine our understanding of sequencing both within and across individual policies' evolution processes.

Both policies can be considered 'most likely' cases (Flyvbjerg 2006). As the EU's climate targets are ambitious in global comparison and have been continuously raised over time, there is reason to expect that a ratcheting-up of the corresponding policies can be observed. The two policies were implemented in the 2000s, unfolded in the EU's multi-level governance under the same basic decision-making structures, and underwent two major reforms with the EU's 2020 and 2030 climate and energy packages. Impact assessments for both instruments suggested that compliance costs in terms of GDP losses would be moderate not exceeding 0.5 percent (Capros et al. 2011; European Commission 2000; European Commission 2006).

As the two policies evolved in the same context and as they were reformed simultaneously in policy packages, they are clearly not independent from each other. Thus, the comparison of the two cases constitutes an exploratory analysis of sequencing in different policy environments, but cannot fully isolate causal effects. On the other hand, the interdependence of the policies is a prerequisite for the investigation of cross-policy feedback effects, which further warrants the choice of the two cases.

The two cases differ in policy type and design, with the RED being a regulation encouraging Member States to implement policies subsidising renewables via national support schemes, and the ETS being a market-based instrument directly imposing a cap-and-trade system at installation level for GHG emissions. Both the type of policy instrument and its specific design features influence policy process outcomes (Carley et al. 2018; Schmidt and Sewerin 2018). In Section 4 we discuss how the differences in sequencing dynamics that we observe may relate to these different policy characteristics and conditions. In the following, we describe each policy's evolution since its first introduction and discuss whether it exhibits indicators for ratcheting-up.

2.4.1 EU ETS policy development

As introduced in 2003 (Directive 2003/87/EC), the EU ETS essentially was a system of linked national trading schemes intended to achieve the relatively moderate 2012 Kyoto targets. Member States set individual caps and determined rules for the allocation of allowances to the regulated facilities in their national allocation plans (NAPs) – subject to review by the EU Commission (Ellerman et al. 2016). The 2003 ETS Directive required that almost all allowances were allocated free of charge. The Linking Directive (2004/101/EC) adopted in 2004 allowed the use of emission reduction credits generated under the Kyoto Protocol's Clean Development Mechanism (CDM) and Joint Implementation (JI) within the EU ETS. The

ETS started with a pilot phase in 2005. In the second trading period (2008 – 2012), the policy's scope was extended as a number of countries included nitrous oxide emissions, Iceland, Liechtenstein and Norway joined the system, and the domestic aviation sector was added to the system (from 2012 onwards).

The reform of the ETS in 2009 (Directive 2009/29/EC) brought a strengthening of ambition and a centralisation of the system for the third phase starting 2013. It introduced a single EU-wide cap that was to decline according to a linear reduction factor (LRF) of 1.74 percent per annum to arrive at the 20 percent emissions cut envisaged for 2020. Auctioning became the basic principle for allocating allowances that would apply to the power sector in 2013 and be phased in to the industrial sector more slowly. The remaining free allocation was based on centrally determined benchmarks. Rules for the import of third country credits became stricter. The ETS now also included the 10 new Member States who had joined the EU in 2004 (Ellerman et al. 2016; Skjærseth and Wettestad 2009).

A low allowance price and a growing surplus of allowances in the EU ETS that emerged from the economic crisis but also from the use of external CDM and JI credits gave rise to new ETS reform debates. In 2013, the auctioning of 900 million allowances was postponed until 2019/2020 ('backloading'). A Market Stability Reserve (MSR) was implemented through Decision (EU) 2015/1814 to start operation in 2019. If the total number of allowances in circulation exceeded a certain threshold (833 million), the MSR was to take away allowances from the market at a rate of 12 percent. It was to release additional allowances if the total number in circulation fell below 400 million.

While the initial MSR reform arguably increased stringency only to a relatively small extent (Perino et al. 2017), it paved the way for a more significant change with the 2018 ETS reform that regulates the fourth trading period starting in 2021. The 2018 ETS Directive doubles the rate at which the MSR absorbs surplus allowances to 24 percent between 2019 and 2023. Furthermore, from 2023 the reserve will be limited in size to the number of allowances auctioned during the previous year; all allowances above that number in the reserve will be cancelled (Art. 2 of Directive 2018/410). The 2018 Directive also implements the key decisions adopted by the European Council in 2014, setting the emissions reduction to be achieved by the ETS to 43 percent by 2030 and tightening the LRF to 2.2 percent from 2021 onwards (Directive (EU) 2018/410). The reformed EU ETS continues free allocation for industries with high carbon leakage risk and exemptions for Eastern European countries. After the 2015-2018 reform allowance prices increased considerably; they have been moving around 20 to 30 Euro since summer 2018 (as of December 2019).

In summary, the *ambition* of the policy's targets, that is, the cap and the rate of decrease of the annual quantity of allowances, were made more stringent over the subsequent steps of policy reform. *Policy scope* was expanded in terms of adding greenhouse gases, sectors and

countries. *Policy design* also was continuously strengthened. Reviews were built into the policy from the beginning. Reforms enhanced not only static environmental effectiveness (that is, compliance with the cap), but also the instrument's dynamic efficiency (Knopf et al. 2014), as they increasingly aimed at incentivising investments that would allow achieving the long-term cumulative cap at low cost. While the MSR has been critically reviewed and other design features such as a minimum price have been proposed as more effective (Edenhofer et al. 2017; Ellerman et al. 2016, p. 103), the reforms do address major deficits and constitute improvements vis-à-vis the previous situation (Carlén et al. 2018; Flachsland et al. 2018). This general assessment is shared by the experts we interviewed on the ETS. Overall, we argue that in the case of the ETS we observe clear indications of ratcheting-up in several dimensions and over several successive steps of policy evolution.

2.4.2 EU renewable energy policy development

The first European Directive on the promotion of renewable energy (Directive 2001/77/EC; 'RED 0') set an indicative target of 22 percent renewables in EU electricity consumption to be reached by the year 2010. Member States were required to set national indicative targets and to regularly report on their targets and measures. The European Commission was to monitor whether national indicative targets were consistent with the overall EU 22 percent target. Member States did not support proposals by the European Commission to introduce a pan-European tradable certificate scheme (Wettestad et al. 2012, p. 71).

With the EU's 2020 climate and energy package and the revised Renewable Energy Directive 2009/28/EC ('RED I'), the Directive's scope was expanded to include heating/cooling and transport. A share of 20% renewables in the EU's energy consumption was to be reached by 2020, with a specific target of 10% of renewable energy in transport. The Directive set national targets for Member States and made them legally binding. Member States were required to adopt national renewable energy action plans that set out their targets for transport, electricity and heating and cooling, with biannual progress reporting. The Directive described an indicative trajectory that Member States should follow to reach the targets. With an increasing slope, the trajectory allowed postponing action to relatively late points in time. The European Commission could require Member States who were not on track to submit revised national action plans.

The Commission made another attempt to introduce a mandatory scheme for trading RE certificates with the RED I, but again failed to gain the necessary support from Member States (Skjærseth et al. 2016, p. 65). However, mechanisms were introduced to provide Member States with additional flexibility in reaching their national targets, including a voluntary statistical transfer scheme for renewable energy at the Member State level.

The Directive was again recast with the adoption of the EU 2030 climate policy framework. The 2014 European Council Conclusions removed the nationally binding targets (while the aggregate EU-level target is still binding), and streamlined the monitoring, reporting and compliance control mechanisms with other energy and climate legislation in the Governance Regulation (GovR). The new Directive agreed in 2018 (”RED II”) sets the European RE target at 32 percent for 2030, stepped up from the 2014 European Council's 'at least 27%', and at 14 percent in transport. Member States must publish integrated National Energy and Climate Plans by 2019 where they set their national contributions to the EU target and describe measures planned to attain them. The Directive sets an indicative trajectory that is steeper than that of RED I, so substantial action for reaching the targets will have to be taken earlier in the process. While support schemes continue to be designed at national level, the RED II requires that they incentivise integration into the electricity market and that market premiums shall be used in direct support schemes. The RED II maintains the intergovernmental flexibility mechanisms.

Without binding national targets under RED II, Member States in case of non-compliance will not face an infringement procedure as under the RED I. However, the GovR provides the European Commission with tools to put pressure on Member States, pinpoint national targets and intervene early in the process. For instance, when in assessing progress (Art. 25) the Commission finds a gap between the collective contributions of Member States and the EU target, it can determine appropriate national targets based on a formula in Annex IA of the GovR. Member States not on track with respect to the indicative trajectory must take additional action with the possibility to choose from different options.

In summary, the reform in 2009 brought a broadening of *scope* and with the stepped-up level of bindingness also an improvement in policy *design*. With RE shares in Europe at 17.4% in 2017, the EU as a whole is currently on track to achieve the 2020 target, although some Member States are not, and although progress towards the specific 10% target for the transport sector is insufficient (EEA 2018). The 2018 reform again increased the *ambition* of the EU target; and national efforts will have to be stepped up to achieve it (ibid). However, it is less clear what the effects of the changes in policy *design* will be. The loss of binding national targets is considered a serious risk for target achievement by some (3 interviews, Bausch et al. 2017; Knodt 2018). Others argue that the strengthening of the monitoring and control mechanisms in the GovR may counterbalance this (3 interviews, Oberthür 2019). Overall, while targets have been made more ambitious, not all indicators unambiguously signal an increase of policy stringency.

3 Empirical analysis: Tracing policy development of ETS and RED

3.1 EU ETS

The external processes and conditions (E) that influenced the ETS policy process have been analysed elsewhere in detail (e.g. Convery 2009; Fitch-Roy et al. 2019; Jevnaker and Wettestad 2017; Skjærseth et al. 2016; Skjærseth 2017; Skjærseth and Wettestad 2009; Skjærseth and Wettestad 2010). They prominently include leadership from individuals and institutions, with a strong role of the European Commission as policy entrepreneur supported by an associated network of actors across institutions and governance levels; a push from European governments in key phases of reform, and pressure from the European Parliament. Also, developments in international climate negotiations such as the withdrawal of the US from the Kyoto Protocol, and the degree to which climate change was a priority for European citizens and policy-makers, strongly influenced the process. Interviews highlighted the direct link of the EU ETS to the EU's international emission reduction commitments as another key factor. As the emissions cap and LRF are almost directly translated from the EU's international obligations, and loosening them would imply increasing the burden on the non-ETS sectors, two interviewees argued that the ETS has a 'built-in ratcheting-up dynamic'.

Our research shows, however, that internal policy sequencing also strongly shaped the process, as policy design caused feedback effects (F_{IP}) that relaxed barriers (Figure 2). In addition, cross-policy feedback (F_{CP}) from the renewable energy policy process was relevant (see Section 3.3).

3.1.1 Cost

Concerns about the economic costs to be expected from the EU ETS have featured centrally in arguments of opponents and initially constituted a barrier to its introduction (B_C). Cost issues have been closely interlinked with free-riding concerns, with affected industries claiming the ETS would negatively affect their competitiveness vis-à-vis international competitors not subjected to comparable regulation. At the same time, however, the ETS was advocated by its proponents as a gain in efficiency that allowed reaching climate targets at *lower* costs than with national instruments and no possibility to trade emissions (European Commission 2000). Anticipated effects of ETS reforms on EU GDP were moderate (European Commission 2008a), and due to early overallocation the instrument in fact started at an even lower level of ambition. Resulting low allowances prices, however, facilitated increasing the stringency of the ETS later-on (4 interviews, F_{IP}). On the one hand, they signalled that the costs of the system were manageable and clearly contradicted more

alarmist claims. On the other hand, indicating a lack of instrument performance, the low allowance prices also provided a strong argument for reform.

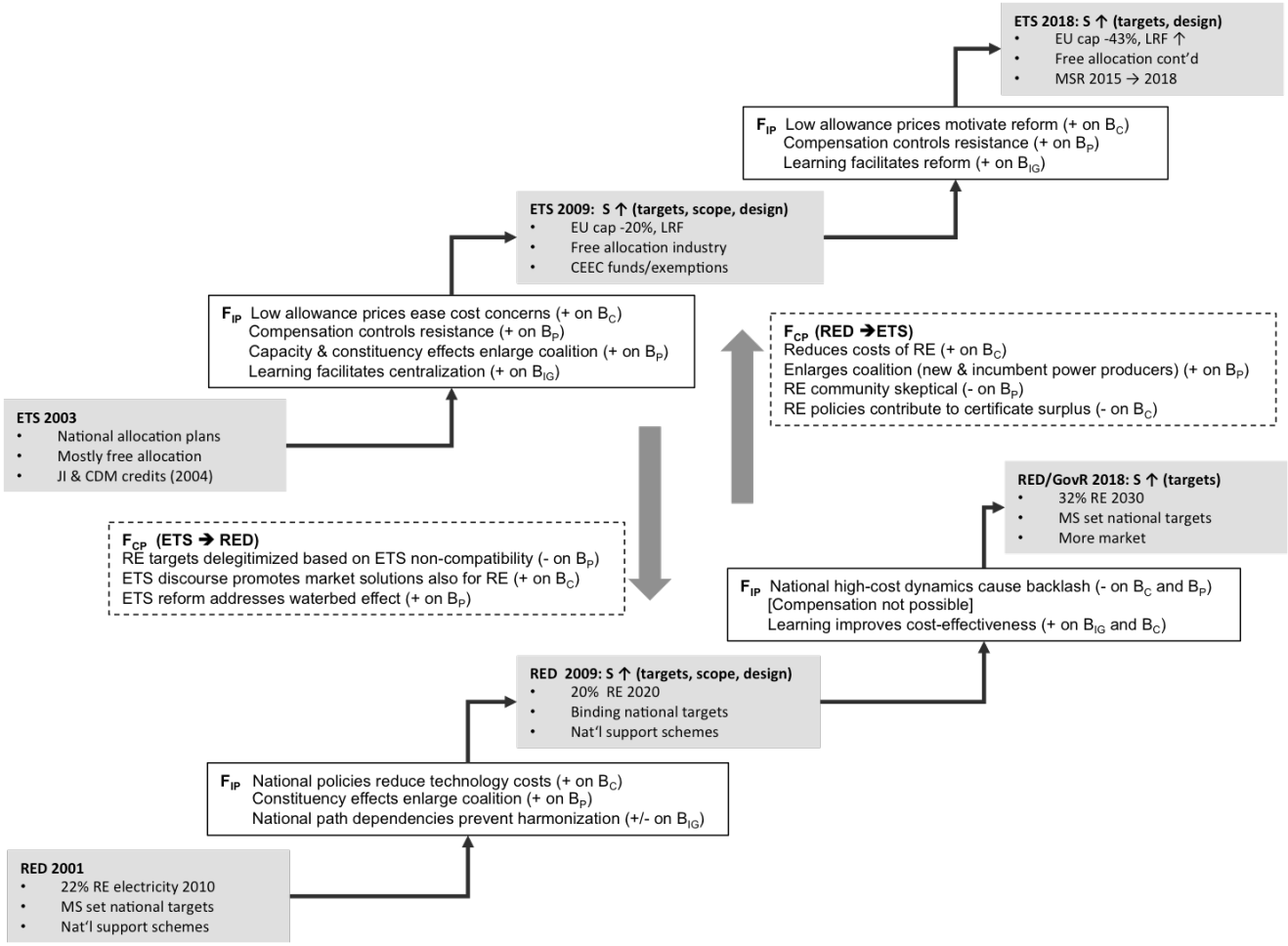

Figure 2. Dynamics of the EU ETS and RED policy processes. Grey boxes represent the policies in their different versions after key reforms. Process-internal feedbacks (F_{IP}) are shown for both policy processes (black arrows), as well as cross-policy feedback between them (F_{CP}), grey arrows. Feedbacks work on barriers related to costs B_C, to politics B_P and to institutions and governance B_{IG}. Positive signs indicate a barrier is relaxed, negative signs indicate it is increased. Feedback mechanisms enable stringency increases S . External factors influencing the processes are not shown.

3.1.2 Politics

Opposition from industry stakeholders and from European Member States has been a persistent and strong barrier to increasing the stringency of the ETS (B_P). Non-power industry has been the strongest opposing interest group, being more exposed to international competition than the power sector and less able to pass on costs to consumers. At the time of introduction of the ETS, there was little enthusiasm among the then 15 EU Member State governments (Skjærseth and Wettestad 2010). Later, resistance came mostly from Central and Eastern European Countries (CEECs) with a strong reliance on fossil fuels and a desire to

keep electricity prices low. The 'green' constituency (environmental NGOs, Green Parties, RE industry associations) did not support the ETS initially, expecting a lack of environmental effectiveness, but also threats to renewables support policies (2 interviews).

Compensation measures that moderated the distributional impacts of the ETS have been key to overcome the resistance barrier and to control the potential for negative feedback from affected actors (Dorsch et al. 2019). The free allocation of allowances to industry has played a very important role in this context (4 interviews). The continuity of compensation measures eased individual actors' cost concerns and created trust among industry stakeholders that policy-makers would continue to be responsive to their concerns. It also had the effect of channelling lobbying activities into securing compensation and away from opposition against the instrument more generally (4 interviews, Jevnaker and Wettestad 2017). As one interviewee put it, 'all they would ask for in meetings was higher shares of free allocation". Compensation measures also helped to win support from reluctant Member States. For instance, the CEECs were beneficiaries of several compensation measures introduced in 2009. A blocking minority on the MSR could be broken by the concession that the CEECs would contribute less to feeding the MSR than the Western Member States (interview, Jevnaker and Wettestad 2017). While compensation eased resistance at each single reform step, it did not lead to dynamic effects itself, but rather served to prevent negative politics feedback, thus allowing for other self-reinforcing processes to unfold over time.

Positive dynamic feedback strengthening the supporting coalition came from constituency building effects that spanned different actor groups (F_{IP}). In the EU institutions, national governments and government agencies, but also in the regulated firms, business associations, research, think tanks and NGOs, a community of experts emerged who developed ownership of the instrument and who were interested in improving its functioning – even if their specific interests differed. Five interviewees argued that with an increase in the generation of revenues from auctioning that accrue to Member State governments, finance ministers also become more likely to join the ETS-supporting constituency, although six others considered the size of this effect to be limited, given the relatively small volume of revenues. Some power sector companies are perceived to be increasingly active in pushing ambitious ETS reform (3 interviews). The increased commitment of the power sector to the ETS likely is an effect from both renewables policies and the ETS itself (F_{IP} and F_{CP}, see Section 3.3).

3.1.3 Institutions and governance

Limitations in expertise and capacity, in particular the lack of data on firm level emissions, a lack of experience with emissions registries, and the allocation of responsibilities for

implementation and monitoring in the Member States, was a major challenge when the ETS was introduced (B_{IG}). At the beginning there also was resistance in Member State administrations from individuals who would have preferred to hold on to traditional command and control instruments (3 interviews). However, with the implementation of the system and during the first pilot phase, technical and administrative capacity was quickly built up (positive feedback F_{IP}).

In the reform processes that followed, the community of experts and stakeholders engaged in ETS policy-making went through learning processes, where experiences made with earlier versions of the instrument informed reform processes in a positive feedback loop (F_{IP}). Notably, learning from experience paved the way for centralisation. The decentralised structure of the early ETS system created incentives for all Member States to treat their own industries favourably, causing a 'race-to-the-bottom dynamic' (Wettestad et al. 2012, p. 76) and competitive distortions. The NAP process was experienced as cumbersome and frustrating (Ellerman et al. 2016, p. 92; Matthes and Schafhausen 2007; Skjærseth and Wettestad 2009), while overallocation threatened the environmental effectiveness of the whole system (Skjærseth and Wettestad 2010). Against this background, Member States were arguably relieved to get rid of the task of negotiating with domestic industry (interview: 'no-one wanted to continue with national allocation') and did not oppose the EU-wide cap and the harmonisation of allocation rules in 2008 (7 interviews). The fact that Member States actually welcomed centralisation and harmonisation, a rare condition in EU policy-making, suggests that Member States had a basic interest in a functioning ETS, and that a learning process led them to accept the reforms which the logic of the instrument required (Neuser 2014). Centralisation increased policy stability, as lobbying directed at national governments became less effective (interview) and the European Commission's information advantage increased (interview). It also reduced vulnerability to national rollbacks due to government changes (interview).

The reforms implemented between 2012 and 2018 also were the result of learning processes, as the ETS expert community observed the deficits of the existing system and developed solutions to improve – or rather restore – its functioning. While CO_2 emissions in EU ETS sectors were somewhat decoupled from GDP growth in Europe between 2004 and 2014 (Ellerman et al. 2016, p. 96), prices in the third trading period remained low and a surplus of 2 billion allowances was diagnosed (European Commission 2014, p. 8). Concerns about the resulting lack of dynamic efficiency of the instrument were a key motivation for the reforms for the fourth trading period (6 interviews). The experience of the economic crisis' effects facilitated arguing for an ex-post regulation of allowance volumes as performed by the MSR (2 interviews).

3.2 EU renewable energy policy

As in the ETS case, external factors (E) played a strong role in shaping the process. Changing degrees of leadership by the European Commission and individual Member States, pressure from the European Parliament, and the role of 'entrepreneurial networks' of actors across institutions and governance levels are highlighted in the literature (Boasson and Wettestad 2013; Bürgin 2015) and by interviewees. The agreement on national binding targets by the European Council in 2007 is widely interpreted as being the result of surprising and only temporary support from the UK government under Tony Blair to the German initiative, with the UK afterwards quickly re-adopting its traditional 'CO_2-target only' stance (Bausch et al. 2017; Bürgin 2015). The economic crisis increased cost sensitivity among governments and may have contributed to a generally less favourable spirit towards ambitious renewable policies (3 interviews). Also, the rise of EU-critical movements across Europe and re-nationalisation tendencies may have affected the process (Bausch et al. 2017; Skjærseth et al. 2016; Wettestad et al. 2012).

At the same time, we find a number of feedback mechanisms from the policy that influenced barriers.

3.2.1 Costs

In general, renewable support policies have reduced the costs of these technologies (IRENA 2018), to a point where today new renewable energy installations start becoming financially viable without support. Thus, the RED and national policies contributed to a positive feedback that significantly lowered the technology cost barrier (F_{IP}).

At the same time, design deficits in national policies reinforced the policy cost barrier (negative F_{IP}). Just as technology costs decreased, many national support schemes generated highly problematic distributional effects. Policies provided overly generous support to certain technologies or were not flexible enough to adjust tariffs to sinking technology costs, so that profits of investors became disproportionately high and costs to rate-payers skyrocketed (Bürgin 2015; Kampman et al. 2015; Skjærseth 2017, p. 94–95). The financial crisis that struck around the same time interacted with the policy feedback effects and considerably reinforced them in many countries. National policy-makers, aiming to mitigate the cost problems, responded by dramatically cutting subsidies, putting support schemes on hold or abandoning them, and in some cases introducing measures that retroactively affected the financial viability of existing installations. The measures taken to limit the costs to public budgets came at the price of severe damages to renewables industry with massive loss of jobs, unstable investment environments, and dropping rates of installation of new renewable capacity. Spain was the first country to experience this dynamic around 2007-

2008, with similar processes occurring in the following years for instance in the Czech Republic, Italy, and Bulgaria (Antonelli and Desideri 2014; del Rio and Mir-Artigues 2014; Gürtler et al. 2019; Kampman et al. 2015).

In other cases, policy reactions to rising costs had less disruptive effects, and reforms reduced policy costs. In Germany, policies were reformed to increase their flexibility in dynamically responding to technology cost reduction (Pahle et al. 2018). The UK government, in an attempt to avoid boom-and-bust dynamics, introduced measures to contain policy costs, albeit with the side-effect of creating new uncertainty (Lockwood 2016). Reforms for more market orientation and cost-effectiveness were also pushed by the European Commission (see below).

3.2.2 Politics

Interest group opposition (B_P) from fossil-nuclear electricity producers and from energy-intensive industry was present in the national policy processes (e.g. Gürtler et al. 2019; Lauber and Jacobsson 2016) and at European level (Boasson and Wettestad 2013). In policy debates, opponents of the RED often claimed a lack of compatibility with the ETS (3 interviews, Markard and Rosenbloom 2018) (negative cross-policy feedback F_{CP} from ETS process, see Section 3.3).

For the European policy process, resistance from Member State governments was emphasised by interviewees as the decisive barrier. First, there was resistance from Member States against the harmonisation of renewables support policies proposed by the Commission. Member States with advanced national RE policies have tended to support ambitious targets but block harmonisation because they wanted to safeguard regulatory traditions and protect national renewables industry (Boasson and Wettestad 2013; Klessmann 2009; Rowlands 2005). While the Commission argued that a greater centralisation and harmonisation of RE support would reduce overall costs (European Commission 2008b, p. 98), there were also arguments for maintaining some degree of heterogeneity, including the need for policies to reflect inhomogeneous technology-specific externalities and to prevent high producer surpluses for low-cost installations (Klessmann 2009; Strunz et al. 2014). In contrast to the ETS case, there was no unambiguous logic that warranted centralisation and harmonisation. Thus, there were feedback effects in the multi-level RED governance with ambiguous impact on the European-level policy (F_{IP}).

Second, there was resistance from Member States against the setting of ambitious and, after 2009, nationally binding targets (B_P). This was partly due to divergent climate policy preferences. The UK and the Netherlands supported ambitious climate targets but did not want the EU to impose additional renewables targets (Fischer 2014). CEEC countries rejected

national targets for different reasons, focused on protecting coal and not interested in promoting renewables (Skjærseth 2018). In addition, the high-cost experience in national support regimes with in some cases extreme negative policy feedback and backlash (see above) translated into a lack of support from Member State governments for increasing the stringency of the European policy (7 interviews).

Sequencing helped to mitigate barriers in politics based on the generation of positive and the control of negative feedback (F_{IP}). First, in countries with ambitious national renewables support policies, powerful renewable industry lobbies and supporting coalitions emerged (Sühlsen and Hisschemöller 2014), who formed networks active also at European level. The renewable energy constituency was able to significantly influence the ambition and design of the RED I (Boasson and Wettestad 2013). National renewables support policies have also contributed to making reluctant incumbent power producers eventually change their business models and reorient towards renewable energy (Kungl 2015). Thus, the combined national and EU policies created positive feedback through constituency building effects, albeit to varying degrees in the different Member States.

Policy design also to some extent allowed for the control of negative feedback (F_{IP}) through compensation. However, options for compensation were limited given the instrument logic of renewables support policies and the decentralised structure of the RED. At national level, industry consumers strongly affected by rising electricity costs could be compensated through exemptions, and case study research suggests that this type of compensation did stabilise support policies by mitigating resistance. In the Czech Republic, where policies did not include exemptions to energy-intensive industry, cost increases hit powerful players that went on to lobby strongly against the policy (Gürtler et al. 2019). However, compensation also raises additional distributional concerns, and if the relation between investors' profits and overall public costs becomes disproportionate, compensation measures that place an additional burden on rate-payers also become harder to justify.

At EU level the RED process provided only limited room for compensation across Member States, and no leverage for mitigating shocks experienced in individual countries. Side-payments to poorer Member States were made when the national targets of RED I were determined, as a formula was used that considered national GDP and thus reduced the relative ambition of targets for the less wealthy Member States (European Commission 2008b, p. 85; Skjærseth et al. 2016, p. 74). This facilitated agreement among Member States on the RED I (interview), but it did not provide tools to address uneven cost developments in Member States later on. The RED's flexibility mechanisms might lead to some transfer from more to less wealthy Member States, and Member States may come under pressure to use them more intensely as the RED I's 2020 deadline approaches (3 interviews). However, the

design of targeted compensation measures that would effectively secure the support of hesitant Member States was not possible for EU policy-making.

3.2.3 Institutions and governance

Positive feedback on institutional set-up and governance emerged from learning process among experts in the European Commission and in Member State governments (F_{IP}). The European Commission accepted that top-down harmonisation was politically not feasible and might in fact have undesired consequences, and used state aid governance instead to push for a stronger market orientation of national support schemes from outside the RED policy process. The 2014 State Aid Guidelines, which require the use of market instruments such as auctioning for the allocation of subsidies, put significant pressure on Member States and for instance nudged the German government toward reform already during the drafting process (Boasson 2019, 2 interviews). In parallel, Member State governments themselves became more open towards reforming support schemes, as confidence in RE technologies and regulatory institutions increased, and in response to the experience of rising costs of Feed-in Tariff systems (interview). The reforms reduced policy costs and may to some degree lead to a bottom-up convergence of Member State policies (Strunz et al. 2015).

3.3 Cross-policy feedback

Meckling et al. (2015; 2017) suggest that cross-policy feedback from RE policy may eventually lead to ambitious carbon pricing by (1) reducing costs of clean technologies and thus also the policy costs of carbon pricing, and (2) building a constituency that supports more encompassing and cost-efficient carbon pricing policies. The results from our research confirm the existence of cross-policy feedback between renewables support and carbon pricing, but suggest that the interaction is not straightforward (see Figure 2). While significant synergetic effects can be identified, persistent conflict between proponents of the two instruments has characterized the policy debate.

RE policies caused positive cross-policy feedback (F_{CP}) on the ETS, reducing the costs of renewable energy technologies and generating business models for renewable energy also for incumbent power producers. The power sector, as a consequence of synergetic effects from RE policies (pull) and ETS (push), across most of Europe appears to have settled onto a decarbonization pathway and today supports stringent carbon pricing (see Section 3.1). Thus, RE policies reduced barriers of the ETS process in the cost and politics domain.

At the same time, interviewees describe the relationship between the actor communities concerned with the ETS and the RED as mostly conflictual. Seven interviewees describe a strong rivalry between the stakeholder communities, a lack of cooperation, and a general

perception that “more ETS is bad for renewables or the other way round” (interview). Although both instruments aim at protecting the climate, over long stretches of time their policy communities did not join forces. This partly reflects the academic and expert discussion where the two policy instruments often feature as competitors that are to a large extent non-compatible with each other. When co-existing with an emissions trading regime, renewables policies may lower the CO_2 price while only shifting emissions to other locations (‘waterbed effect’, Fankhauser et al. 2010). While there is no conclusive empirical evidence so far on the size of this effect (Ellerman et al. 2016; Koch et al. 2014), it has been exploited heavily by political actors and lobby groups to delegitimise RE support policies (Markard and Rosenbloom 2018). For instance, the UK and other countries supported by EU-level industry lobby groups around 2014 attempted to trade a strong CO_2 target against the abandonment of the European RE target (3 interviews).

At the same time, the RE community has not been a strong supporter of the ETS for most of the time. They did not support the introduction of the ETS, perceiving it as a threat to RE support programs (2 interviews). As the carbon price for long periods did not reach levels that could make renewable technologies competitive with conventional technologies (Gavard 2012) and incentivize the investments necessary to enable comprehensive decarbonization in the longer term (Edenhofer et al. 2017), environmental NGOs maintained their preference for renewables support policies (WWF 2016).

However, the competition between the communities more recently brought some more productive developments. With the MSR and the possibility for Member States to unilaterally cancel allowances, the waterbed effect has been at least partly addressed, so that a core argument claiming incompatibility between the two instruments has been weakened. The ETS discourse brought a debate about more market-oriented solutions also for RE policies around 2009 (interview, Boasson and Wettestad 2013, p. 88). More recently, renewables policies have been reformed to become more market-oriented, changing in character from guaranteeing income to investors to a risk buffering instrument. Environmentalists and business actors have formed coalitions that helped find compromise solutions in the most recent ETS reform (Fitch-Roy et al. 2019), and the renewables industry today pushes ambitious carbon pricing solutions to improve market conditions, realizing that high carbon prices help reduce the costs of RE support and thus help relax this barrier to stringency (Fernahl et al. 2017, BEE 2019). At the same time, as ETS allowances prices have been increasing as a result of recent reforms and as the costs of renewables decrease further, the ETS moves closer to being able to trigger investments into renewable energy generation.

In summary, our results are compatible with the hypothesis that a cross-policy sequencing process is taking place that entails a transition towards a more dominant role of carbon

pricing. However, this process seems to be driven not so much by a synergetic constituency effect than by RE cost reductions and a policy learning process that responds to emergence of compatibility problems between the two instruments, and that slowly helps to overcome the politics barrier of conflictual relationships between policy communities.

4 Discussion and conclusion

This paper investigates the dynamics of the ETS and RED policy processes with the aim of identifying feedback mechanisms that facilitated ratcheting-up. From the analysis we draw four key conclusions:

1) Sequencing relies on feedback that occurs both within and across policy processes. In both cases policies created feedback effects that worked back on their own and on each other's barriers, in addition to external factors. Our results refine the understanding of these effects.

2) Successful ratcheting-up via sequencing is mainly based both on positive feedback and the control of negative feedback. Positive feedback effects both within and across policy processes provided a basis for successive increases of stringency. However, while the sequencing framework is primarily interested in effects that relax barriers, our results highlight that feedback effects can also strengthen them (e.g. cost increases from inefficient policy design).

3) The conditions for sequencing depend on available policy design options. From the comparison of the two case studies we conclude that the conditions for process-internal sequencing depend on the choice of policy instrument and the design options it offers. Our results point to four relevant design characteristics.

- ***Availability of tools to control costs and to avoid sudden and extreme developments***. The ETS process started with a low-ambition but politically feasible policy design, which initially caused neither large environmental benefits nor considerable economic costs, but which created a path dependency and a basis for increasing stringency later-on. In the RED process, by contrast, positive feedback from reduced technology cost was overshadowed by backlash from high-cost crises in several Member States. As in other cases, renewables support policies not only built constituencies, but also triggered strong resistance (Stokes 2020).
- ***The possibility to harmonise and centralise in a multi-level governance context***. While the degree of centralisation and the level of policy ambition do not necessarily correlate, centralisation is likely to make policies more stable and to facilitate the control of target achievement (Bausch et al. 2017). Centralisation contributed to stabilising the ETS, while the lack of centralisation had ambiguous effects for the stringency of the RED. The RED was faced with strong and persistent barriers to

harmonisation and centralisation, while the evolution of the ETS was driven towards centralisation by the intrinsic incentive structure of the instrument.

- ***The possibility of strategic compensation of resistant actors***. In the ETS process, the potential for negative feedback from industry and reluctant Member States could be kept under control through targeted compensation measures as part of the policy's design. By contrast, the lack of options for compensation across Member States in the RED's decentralised system made it impossible for EU-level policy-makers to prevent negative cost feedback at national level from becoming destructive. Although compensation may cause problematic lock-in effects (Pahle et al. 2018), our results suggest that the presence of compensation options is a key prerequisite for successful sequencing towards ratcheting-up.
- ***The facilitation of learning processes***. We find in both policy cases that constituency effects are important not only in the business sector, but also through the creation of ownership in administration. For policy development, learning from experience among these emerging expert communities appears to have played a strong role. In particular, high policy costs and transaction costs triggered learning and subsequent reform, thus turning from a barrier to a driver of improvements.

4) *The interaction between renewables policies and carbon pricing is more complex than previously assumed.* The sequencing literature suggests that green industrial policies are likely to produce positive feedback from reduced technology costs and constituency building, and that they may thus pave the way for carbon pricing at later stages (Meckling et al. 2015; 2017). Our results do not fully support this hypothesis. While renewables policies certainly reduced the policy costs also of the ETS and accelerated transformation in the power sector, the joining-forces effect among constituencies postulated by Meckling et al. for a long time did not materialize, as two largely separate actor communities engaged in antagonistic competition.

Nevertheless, we do observe a gradual shift of balance between the two instruments more recently. While renewables support policies provided early incentives for deep decarbonisation, the ETS has been moving closer to being able to trigger investments into renewable energy generation over time. Increasing stringency of renewables policies in the future will likely be reflected by higher targets but by *lower* financial support rates, while carbon pricing might become an increasingly strong driver for long-term decarbonisation.

Our analysis is a first attempt to systematically apply the sequencing framework to individual policy processes. Limitations to our data and analytic methods may be overcome by further research in several directions. First, additional comparative case studies across different contexts to test and possibly identify various sequencing options within and across policies are needed. Second, while we suggest an explicit conceptualization of process-internal and

cross-policy feedback in sequencing research, and while we consider cross-policy feedback in the empirical analysis, analysis of complex interactions in a broader policy mix perspective would be helpful. Third, the role of changing external circumstances including for instance the evolution of societal discourses and their interaction with policy sequencing should be investigated further.

Acknowledgements and funding information

The research for this paper by Anna Leipprand and Christian Flachsland was performed at Mercator Research Institute on Global Commons and Climate Change (MCC) between December 2017 and March 2019. We gratefully acknowledge the funding by the German Ministry of Education and Research under the research project START (Strategic Scenario Analysis – A first German Australian focus project, grant number 833/03EK3 04 6B START). Michael Pahle's contribution was funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 642147 (CD-LINKS) and by Stiftung Mercator and ClimateWorks Foundation under the research project AHEAD. We are very grateful to our interview partners for sharing their knowledge and insights. We also wish to thank the participants of the workshop "The co-evolution of politics and technology: The role of feedback effects", convened by ETH Zurich, 16-18 January 2019 in Lucerne, for valuable feedback on an earlier draft of the paper, and two anonymous reviewers for deeply thoughtful, detailed and constructive comments.

Disclosure statement

The authors declare no conflicts of interest.

Annex I: Interviews

	Name	Institution	Policy focus	Nationality	Location of institution	Date
1	**Buck, Matthias**	Agora Energiewende, Germany	RED	DE	DE (previously also EU)	11.09.2018, Telephone
2	**Boasson, Elin Lerum**	Cicero (Center for International Climate Research), Norway	RED	NO	NO	05.07.2018, Skype
3	**Caekelbergh, Stijn**	Climate Policy Advisor to the Flemish Government, Belgium	ETS	BE	BE	13.09.2018, Telephone
4	**Dong, Yue**	Ministry of Environment, France	ETS	FR	FR	30.08.2018, Skype
5	**Goeke, Berthold**	Ministry of Environment, Germany	ETS & RED	DE	DE	04.10.2018, Berlin
6	**Heer, Katrin**	Ministry of Economic Affairs, Germany	RED	DE	DE	21.09.2018, Berlin
7	**Karcher, Silke**	Ministry of Environment, Germany	ETS & RED	DE	DE	19.07.2018, Berlin
8	**Klessmann, Corinna**	Ecofys, Germany	RED	DE	DE	12.09.2018, Berlin
9	**Neuser, Uwe (together with Dirk Weinreich)**	Ministry of Environment, Germany	ETS	DE	DE	26.07.2018, Berlin
10	**Oberthür, Sebastian**	Vrije Universiteit Brussels, Institute for European Studies IES, Belgium	RED	DE	BE	23.08.2018, Hamburg
11	**Runge-Metzger, Artur**	European Commission, DG Climate Action, Belgium	ETS and RED	DE	EU	25.07.2018, Skype
12	**Sánchez García, Ignacio Ángel**	Ministry for the Ecological Transition, Spain	ETS & RED	ES	ES	18.09.2018, Telephone
13	**Schafhausen, Franz-Josef**	Institute of Energy Economics (EWI), University of Köln, Germany	ETS	DE	DE	09.05.2018, Berlin 05.06.2018, Köln
14	**Tuma, Jan**	Ministry of Environment, Czech Republic	ETS	CZ	CZ	05.09.2018, Telephone
15	**Vis, Peter**	European Commission, European Political Strategy Centre (EPSC), Belgium	RED and ETS	UK	EU	19.06.2018, Skype
16	**von Meyerinck, Lutz**	Outrage Management, Germany	ETS	DE	DE	04.07.2018, Skype
17	**Weinreich, Dirk (together with Uwe Neuser)**	Ministry of Environment, Germany	ETS	DE	DE	26.07.2018, Berlin
18	**Wettestad, Jørgen**	Fridtjof Nansen Institute, Norway	ETS	NO	NO	20.06.2018, Skype
19	**Zapfel, Peter**	European Commission, DG Climate Action, Belgium	ETS	AT	EU	19.09.2018, Brussels

Annex II: Consolidated version of interview guideline, October 2018

Introduction

- Brief presentation of research aim and context, clarification of formal issues
- Brief introduction of key concepts

EU ETS

Teaser: a possible ETS story

ETS was introduced as decentralized instrument, with national allocation plans, with relatively low ambition in the beginning. However this established a system and created a strong path dependency. This was the basis for stepwise ratcheting-up. → Would you agree with this story? (possibly compare to RED process)

Introduction ETS 2003

- What were the greatest **barriers** at the time (e.g.: cost & competitiveness aspects, free riding; actor coalitions, administrative barriers)?

- **Sequencing measures/facilitating factors**: What were decisive factors that enabled the introduction of the ETS? (e.g. actor networks, policy entrepreneurs, support from industry; cross-policy feedback from RED/RE policies?)

Reform ETS 2008

- What were the most **conflictual issues and greatest barriers** to reform at the time?
    - E.g.: positions vis-á-vis **centralization of the cap and introduction of the LRF**?
    - E.g.: positions of key stakeholders?
- **Sequencing measures/facilitating factors**: what were decisive factors that enabled reform?
- **Were feedback processes relevant?**
    - Were conditions different than in 2003? Had the policy itself changed things?
    - Could things have worked out without **compensation measures**?
    - Cross-policy feedback from RED?

ETS reform and MSR introduction 2014-2018

- What were the most **conflictual issues and greatest barriers** to reform at the time?
    - E.g.: role of level of allowance prices?
    - E.g.: coalitions and actors?
- **Sequencing measures/facilitating factors**: what were decisive factors that enabled reform?
- **Were feedback processes relevant?**
    - Were the more recent reforms triggered by experiences with the previous Directive?
    - Had the previous Directive changed conditions in ways that supported or hampered further reform?
    - E.g. role of compensation, no expiry date for free allocation, creation of revenues?
    - Cross-policy feedback from RED?

RED

Teaser: a possible RED story

There was clear increase of policy stringency in 2009 vis-á-vis the 2001 Directive as RED now covered all energy and included binding national targets. The latest reform completed in 2018, however, can be considered as stringency decrease, as the binding targets were abandoned, which weakens the Directive and threatens the achievement of the (now more ambitious) targets. No resilient and stable instrument could be established at EU level, no clear ratcheting-up. → Would you agree with the story? (possibly compare to ETS process)

RED 2001

- What were the most **conflictual issues and greatest barriers** at the time of first introduction of the RED? (e.g.: positions on indicative targets)?
- **Sequencing measures/facilitating factors**: What were the decisive factors that enabled the introduction of the RED? (e.g. existence of national RE policies, actor networks, policy entrepreneurs)?

RED 2009

- What were the most **conflictual issues and greatest barriers** to reform at the time?
    - Positions of key stakeholders (e.g. incumbent energy, RE industry)?
- **Sequencing measures/facilitating factors**: what were decisive factors that enabled reform?
    - What enabled the introduction of binding national targets?
    - Why was it not possible to introduce **green certificate trading**?
- **Were feedback processes relevant?**
    - E.g.: what were the experiences from the RED 2001?
    - Were conditions different than in 2001? Had the policy itself changed things?
    - Feedback from national RE policies?
    - Cross-policy feedback from ETS?

RED 2018

- What were the most **conflictual issues and greatest barriers** to reform at the time?
    - Concerns and positions of key stakeholders?
- **Sequencing measures/facilitating factors**: what were decisive factors that influenced the outcome of the reform?
    - What stood in the way of binding targets in the years up to 2018?
    - What were factors that shaped the new governance?
- **Were feedback processes relevant?**
    - Role of experiences with RED 2009/national level implementation?
    - Role of changes in conditions caused by the RED 2009 (and national RE policies)?
    - Cross-policy feedback from ETS?

References

Antonelli, M. and Desideri, U. (2014) 'The doping effect of Italian feed-in tariffs on the PV market', *Energy Policy* 67: 583–594, doi:https://doi.org/10.1016/j.enpol.2013.12.025.

Bausch, C., Görlach, B. and Mehling, M. (2017) 'Ambitious climate policy through centralization? Evidence from the European Union', *Climate Policy* 17(sup1): S32–S50, doi:10.1080/14693062.2016.1259100.

Beach, D. (2017) 'Process-Tracing Methods in Social Science', *Oxford Research Encyclopedia of Politics* 1(November 2018): 1–31, doi:10.1093/acrefore/9780190228637.013.176.

BEE (Bundesverband Erneuerbare Energien) (2019) *BEE-Konzeptpapier zur CO2 -Bepreisung.* Berlin. Available at: https://www.bee-ev.de/fileadmin/Publikationen/Positionspapiere_Stellungnahmen/BEE/201907_BEE-Konzeptpapier_CO2-Bepreisung.pdf (accessed March 2020).

Béland, D. (2010) 'Reconsidering policy feedback: How policies affect politics', *Administration and Society* 42(5): 568–590.

Boasson, E. L. (2019) 'Constitutionalization and Entrepreneurship: Explaining Increased EU Steering of Renewables Support Schemes', *Politics and Governance* 7(1), in press.

Boasson, E. L. and Wettestad, J. (2013) *EU Climate Policy: Industry, Policy Interaction and External Environment*, Farnham: Ashgate.

Bürgin, A. (2015) 'National binding renewable energy targets for 2020, but not for 2030 anymore: why the European Commission developed from a supporter to a brakeman', *Journal of European Public Policy* 22(5): 690–707, doi:10.1080/13501763.2014.984747.

Capros, P. et al. (2011) 'Analysis of the EU policy package on climate change and renewables', *Energy Policy* 39(3): 1476–1485, doi:10.1016/j.enpol.2010.12.020.

Carlén, B., Dahlqvist, A., Mandell, S. and Marklund, P. (2018) *EU ETS emissions under the cancellation mechanism: Effects of national measures. Working Paper No. 151*, available at https://www.konj.se/download/18.6c28ad341641996809a1b84a/1529484872828/Working paper 151_Effects_of_the_cancellation_mechanism.pdf (accessed March 2019).

Carley, S., Davies, L. L., Spence, D. B. and Zirogiannis, N. (2018) 'Empirical evaluation of the stringency and design of renewable portfolio standards', *Nature Energy* 3: 754–763, doi:10.1038/s41560-018-0202-4.

Convery, F. J. (2009) 'Origins and development of the EU ETS', *Environmental and Resource Economics* 43(3): 391–412.

Daugbjerg, C. (2009) 'Sequencing in public policy: the evolution of the CAP over a decade', *Journal of European Public Policy* 16(3): 395–411, doi:10.1080/13501760802662698.

Dechezleprêtre, A., Nachtigall, D. and Venmans, F. (2018) *The joint impact of the European Union emissions trading system on carbon emissions and economic performance*, Paris: OECD Publishing.

del Rio, P. and Mir-Artigues, P. (2014) *A Cautionary Tale: Spain's solar PV investment bubble*, Winnipeg, Canada and Geneva: GSI and IISD.

Dorsch, M. J., Flachsland, C., and Kornek, U. (2019) ,Building and enhancing climate policy ambition with transfers: allowance allocation and revenue spending in the EU ETS', *Environmental Politics*, 1–23. https://doi.org/10.1080/09644016.2019.1659576

Dunlop, C. A. and Radaelli, C. M. (2016) 'Policy learning in the Eurozone crisis: modes, power and functionality', *Policy Sciences* 49(2): 107–124.

Edenhofer, O. et al. (2017) *Decarbonization and EU ETS Reform: Introducing a price floor to drive low-carbon investments*. MCC Policy Paper, Berlin: MC, available at https://www.mcc-berlin.net/fileadmin/data/C18_MCC_Publications/Decarbonization_EU_ETS_Reform_Policy_Pa

per.pdf (accessed June 2020)

Edmondson, D. L., Kern, F. and Rogge, K. S. (2018) 'The co-evolution of policy mixes and socio-technical systems: Towards a conceptual framework of policy mix feedback in sustainability transitions', *Research Policy* Online, doi:10.1016/j.respol.2018.03.010.

Edmondson, D. L., Rogge, K. S. and Kern, F. (2020) 'Zero carbon homes in the UK? Analysing the co-evolution of policy mix and socio-technical system', *Environmental Innovation and Societal Transitions* 35: 135–161. doi: https://doi.org/10.1016/j.eist.2020.02.005.

EEA (European Environment Agency) (2018) *Trends and projections in Europe 2018. Tracking progress towards Europe's climate and energy targets. EEA Report No 16/2018*, Luxembourg: Publications Office of the European Union.

Ellerman, A. D., Marcantonini, C. and Zaklan, A. (2016) 'The european union emissions trading system: Ten years and counting', *Review of Environmental Economics and Policy* 10(1): 89–107.

European Commission (2000) *Green Paper on greenhouse gas emissions trading within the European Union*, COM(2000) 87 final.

European Commission (2006) *Impact assessment on the Renewable Energy Road Map*, SEC/2006/1719 final.

European Commission (2008a) *Impact Assessment on the ETS Directive proposal*, SEC(2008) 52.

European Commission (2008b) *Impact Assessment on the Package of Implementation measures for the EU's objectives on climate change and renewable energy for 2020. SEC(2008) 85*.

European Commission (2014) *Impact Assessment on the establishment and operation of a market stability reserve. SWD(2014) 17 final*.

Fankhauser, S., Hepburn, C. and Park, J. (2010) 'Combining multiple climate policy instruments: how not to do it', *Climate change economics* 1(3): 209–225, doi:10.1142/S2010007810000169.

Fernahl, A., Perez-Linkenheil, C., Huneke, F. and Küchle, I. (2017) *Wirkungsweise einer CO_2-Steuer im Strommarkt*, Berlin: Energy Brainpool commissioned by BEE (Bundesverband Erneuerbare Energie).

Fischer, S. (2014) *The EU's New Energy and Climate Policy Framework for 2030. Implications for the German Energy Transition. SWP Comments 55*, Berlin: Stiftung Wissenschaft und Politik.

Fitch-Roy, O., Fairbrass, J. and Benson, D. (2019) 'Ideas, coalitions and compromise: reinterpreting EU-ETS lobbying through discursive institutionalism', *Journal of European Public Policy Online*, doi:10.1080/13501763.2019.1567573.

Flachsland, C. et al. (2018) *Five myths about an EU ETS carbon price floor*, Policy Brief, available at https://www.mcc-berlin.net/fileadmin/data/C18_MCC_Publications/181009_EU_ETS_Carbon_Price_Floor_Myths_and_enlightenment_Policy_Brief.pdf (accessed June 2020).

Flyvbjerg, B. (2006) 'Five Misunderstandings About Case-Study Research', *Qualitative Inquiry* 12(2): 219–245, doi:10.1177/1077800405284363.

Gavard, C. (2012) *Carbon price as renewable energy support? Empirical analysis on wind power in denmark*. EUI Working Papers RSCAS 2012/19. Florence. doi:10.2139/ssrn.2481918.

Gürtler, K., Postpischil, R. and Quitzow, R. (2019) 'The Dismantling of Renewable Energy Policies: the Cases of Spain and the Czech Republic', *Energy Policy*, 133. doi:10.1016/j.enpol.2019.110881.

Heikkila, T. and Gerlak, A. K. (2013) 'Building a conceptual approach to collective learning: Lessons for public policy scholars', *Policy Studies Journal* 41(3): 484–512.

Howlett, M. (2009) 'Process sequencing policy dynamics: Beyond homeostasis and path dependency', *Journal of Public Policy* 29(3): 241–262.

IPCC (Intergovernmental Panel on Climate Change) (2018) *Global warming of 1.5°C. IPCC Special report, Summary for Policymakers*, available at http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf (accessed March 2019).

IRENA (International Renewable Energy Agency) (2018) *Power Generation Costs in 2017*, Abu Dhabi: IRENA.

Jacobs, A. M. and Weaver, R. K. (2015) 'When Policies Undo Themselves: Self-Undermining Feedback as a Source of Policy Change', *Governance* 28(4): 441–457.

Jevnaker, T. and Wettestad, J. (2017) 'Ratcheting Up Carbon Trade: The Politics of Reforming EU Emissions Trading', *Global Environmental Politics* 17(2): 105–124, doi:10.1162/GLEP_a_00403.

Jordan, A. and Matt, E. (2014) 'Designing policies that intentionally stick: Policy feedback in a changing climate', *Policy Sciences* 47(3): 227–247.

Kampman, B. et al. (2015) *Mid-term evaluation of the Renewable Energy Directive. A study in the context of the REFIT programme*, Delft: CE Delft, available at https://ec.europa.eu/energy/sites/ener/files/documents/CE_Delft_3D59_Mid_term_evaluation_of_The_RED_DEF.PDF (accessed March 2019).

Klessmann, C. (2009) 'The evolution of flexibility mechanisms for achieving European renewable energy targets 2020-ex-ante evaluation of the principle mechanisms', *Energy Policy* 37(11): 4966–4979, doi:10.1016/j.enpol.2009.06.065.

Knodt, M. (2018) 'Genaues Monitoring, kaum Sanktionen: Die EU-Governance', *Tagesspiegel Background, Standpunkt 12. July 2018*.

Knopf, B. et al. (2014) *The EU ETS: ex-post analysis, the market stability reserve and options for a comprehensive reform*. FEEM Working Paper No. 79.2014. Milano: Fondazione Eni Enrico Mattei, available at SSRN: https://ssrn.com/abstract=2499457 (accessed March 2019).

Koch, N., Fuss, S., Grosjean, G. and Edenhofer, O. (2014) 'Causes of the EU ETS price drop: Recession, CDM, renewable policies or a bit of everything?-New evidence', *Energy Policy* 73: 676–685.

Kungl, G. (2015) 'Stewards or sticklers for change? Incumbent energy providers and the politics of the German energy transition', *Energy Research and Social Science* 8: 13–23, doi:10.1016/j.erss.2015.04.009.

Lauber, V. and 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, doi:10.1016/j.eist.2015.06.005.

Lockwood, M. (2016) ‚The UK' s Levy Control Framework for renewable electricity support: Effects and significance', *Energy Policy* 97: 193–201.

Mahoney, J. (2000) 'Path dependence in historical sociology', *Theory and Society* 29(4): 507–548.

Markard, J. and Rosenbloom, D. (2018) 'Politics of climate change: ETS as a Trojan horse ?', *Paper presented at the 9th International Sustainability Transitions Conference (IST), Manchester, June 12-14, 2018* 24, available at http://documents.manchester.ac.uk/display.aspx?DocID=37385 (accessed March 2019).

Matthes, F. C. and Schafhausen, F. (2007) 'Experiences from Member States in allocating allowances: Germany', in A. D. Ellerman, B. K. Buchner, and C. Carraro (eds). *Allocation in the European Emissions Trading Scheme - Rights, Rents and Fairness*. Cambridge: Cambridge University Press, pp. 72–105.

Meckling, J., Kelsey, N., Biber, E. and Zysman, J. (2015) 'Winning coalitions for climate policy', *Science* 349 (6253): 1170–1171.

Meckling, J., Sterner, T. and Wagner, G. (2017) 'Policy sequencing toward decarbonization', *Nature Energy* 1–5, doi:10.1038/s41560-017-0025-8.

Neuser, U. (2014) 'Die Lernkurven beim EU-Emissionshandel', in R. Brinktrine, M. Ludwigs, and W. Seidel (eds). *Energieumweltrecht in Zeiten von Europäisierung und Energiewende*. Berlin: Duncker & Humblot, pp. 95–111.

Oberlander, J. and Weaver, R. K. (2015) 'Unraveling from within? The affordable care act and self-undermining policy feedbacks', *Forum (Germany)* 13(1): 37–62.

Oberthür, S. (2019) ‚Hard or Soft Governance? The EU' s Climate and Energy Policy Framework for 2030, *Politics and Governance* 7(1), in press.

Oberthür, S. and Pallemaerts, M. (2010) 'The EU's Internal and External Climate Policies: an Historical Overview', in *The New Climate Policies of the European Union*. Brussels: Brussels University Press, pp. 27–63.

Pahle, M. et al. (2018) 'Sequencing to ratchet up climate policy stringency', *Nature Climate Change* 8(10): 861–867, doi:10.1038/s41558-018-0287-6.

Perino, G., Willner, M. and Willner, M. (2017) 'EU-ETS Phase IV: allowance prices, design choices and the market stability reserve', *Climate Policy* 17(7): 936–946, doi:10.1080/14693062.2017.1360173.

Pierson, P. (1993) 'When Effect Becomes Cause: Policy Feedback and Political Change', *World Politics* 45(4): 595–628, doi:DOI: 10.2307/2950710.

Pierson, P. (2000) 'Increasing returns, path dependence, and the study of politics', *The American Political Science Review* 94(2): 251–267.

Ringel, M. and Knodt, M. (2018) 'The governance of the European Energy Union: Efficiency, effectiveness and acceptance of the Winter Package 2016', *Energy Policy* 112: 209–220.

Roberts, C., Geels, F. W., Lockwood, M., Newell, P., Schmitz, H., Turnheim, B. and Jordan, A. (2018) ' The politics of accelerating low-carbon transitions: Towards a new research agenda', *Energy Research and Social Science* 44: 304-311.

Rowlands, I. H. (2005) 'The European directive on renewable electricity: Conflicts and compromises', *Energy Policy* 33(8): 965–974.

Schaffrin, A., Sewerin, S. and Seubert, S. (2014) 'The innovativeness of national policy portfolios – climate policy change in Austria, Germany, and the UK', *Environmental Politics* 23(5): 860–883, doi:10.1080/09644016.2014.924206.

Schmidt and Sewerin 2017: Technology as a driver of climate and energy politics. *Nature Energy 2, 17084 (2017*). doi: 10.1038/nenergy.2017.84.

Schmidt, T. S. and Sewerin, S. (2018) 'Measuring the temporal dynamics of policy mixes – An empirical analysis of renewable energy policy mixes' balance and design features in nine countries', *Research Policy* Online, doi:10.1016/j.respol.2018.03.012.

Schreurs, M. A. and Tiberghien, Y. (2007) 'Multi-Level Reinforcement: Explaining European Union Leadership in Climate Change Mitigation', *Global Environmental Politics* 7(4): 19–46, doi:10.1162/glep.2007.7.4.19.

Skjærseth, J. B. (2017) 'The European Commission's Shifting Climate Leadership', *Global Environmental Politics* 17(2): 84–104.

Skjærseth, J. B., Eikeland, P. O., Gulbrandsen, L. H. and Jevnaker, T. (2016) *Linking EU Climate and Energy Policies*, Cheltenham, Northampton, Mass.: Edward Elgar Publishing.

Skjærseth, J. B. and Wettestad, J. (2009) ‚Explaining the significant 2008 changes in EU emissions trading. Paper prepared for *International Studies Association 50th Annual Convention*, New York, U.S., February 15-18, 2009.

Skjærseth, J. B. and Wettestad, J. (2010) 'Making the EU Emissions Trading System: The European Commission as an entrepreneurial epistemic leader', *Global Environmental Change* 20(2): 314–321.

Skocpol, T. (1992) *Protecting soldiers and mothers*, Cambridge Mass.: Harvard University Press.

Stokes, L. (2020) *Short Circuiting Policy: Interest Groups and the Battle Over Clean Energy and Climate Policy in the American States.* New York: Oxford University Press.

Strunz, S., Gawel, E. and Lehmann, P. (2014) 'Towards a general "Europeanization" of EU Member States' energy policies?', *UFZ Discussion Paper 17/2014*, Leipzig: Helmholtz Centre for Environmental Research, available at https://econpapers.repec.org/article/aeneeepjl/eeep4-2-

strunz.htm (accessed March 2019).

Sühlsen, K. and Hisschemöller, M. (2014) 'Lobbying the "Energiewende". Assessing the effectiveness of strategies to promote the renewable energy business in Germany', *Energy Policy* 1–10, doi:10.1016/j.enpol.2014.02.018.

Tansey, O. (2007) 'Process Tracing and Elite Interviewing: A Case for Non-probability Sampling', *PS Political Science and Politics* 40, 765–772. doi:10.1017/Si049096507071211.

UNEP (United Nations Environment Programme) (2018) *Emissions Gap Report*, Nairobi: United Nations Environment Programme, doi:10.1016/S0264-410X(12)01439-9.

Weaver, K. (2010) 'Paths and Forks or Chutes and Ladders?: Negative Feedbacks and Policy Regime Change', *Journal of Public Policy* 30(2): 137–162, doi:DOI: 10.1017/S0143814X10000061.

Wettestad, J., Eikeland, P. O. and Nilsson, M. (2012) 'EU Climate and Energy Policy: A Hesitant Supranational Turn?', *Global Environmental Politics* 12(2): 67–86, doi:10.1162/GLEP_a_00109.

WWF (2016) *Briefing Paper: Revising the EU's Renewable Energy Directive*. Brussels: WWF European Policy Office.