3rd International Conference on Public Policy (ICPP3)
June 28-30, 2017 – Singapore

Panel T16P02 Session

The Future of Environmental Policy in a Time of Global Crisis

The Economic Crisis and Policy Dynamics in the Field of Renewable Energy

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Date of presentation

June 30th 08:15 to 10:15

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Abstract

Renewable energy policy is a distinct policy field as it encompasses both economic (job creation/industry policy) and environmental considerations (climate mitigation). How these two competing arguments are balanced in the face of the crisis is an important questions relating to the general stickiness of environmental policies. In this paper, we investigate long-term policy dynamics across both EU and non-EU countries and across three levels of policy change. Based on an IPA dataset consisting of 562 policies, we analyse the general direction of overall change in policy mixes (macro level), the dynamics of policy instrument type use (meso level), and the micro-dynamics of change on the policy design (micro) level. We find that even though the crisis marks a turning point in the overall speed of policy change, the overall direction of policy change only changes in Ireland and the UK, namely towards policy dismantling. However, we show that how both dismantling and expansion plays out at the policy meso- and micro-level is very different across cases.

Introduction

Renewable energy policy is particularly interesting and important when analysing the impact of the economic crisis on environmental policy dynamics for two reasons. First, the support of low-carbon electricity production has become almost a mainstream environment-related policy objective. At least in some countries, the ubiquity of energy-related challenges and the sheer amount of public and private resources spent on renewable energy (e.g. €10.8 billion on solar PV and €6.8 billion on onshore wind in Germany in 2015 alone; see BMWi 2016) have secured renewable energy a prominent place on the legislative and political agenda. Thus, renewable energy is different from other, less prominent environmental issues, which during times of economic crisis are at risk of moving even further down voters' and governments' priorities. Second, renewable energy is located at the intersection of environmental and industry policy, with many governments aiming to nurture new local industries around renewable energy technologies (Schmidt & Huenteler 2016). These governments aim to contribute to decarbonisation of the economy while simultaneously pursuing an industrial policy strategy.

Therefore, in distinction to other environmental policy areas, renewable energy policy encompasses economic considerations, such as jobs, which also come into play during times of economic crises, therefore potentially balancing arguments to "get rid of all the green crap" that resurface in economically trying times (Carter & Clements 2015).

Importantly, as a result, we can expect a wide variety of policy dynamics including: Firstly, dismantling when environmental policy interventions involve either significant public expenditure or are perceived to negatively affect the economy's competitiveness. Secondly, stasis when existing policy interventions have already led to the creation of new actor constellations that are powerful enough to resist dismantling efforts (see Schmidt & Sewerin 2016b). Thirdly, policy expansion when governments aim to create economic stimuli following a green growth or pragmatic approach aiming at boosting local job creation (for example, for photovoltaic installers) or supporting existing low-carbon industries (for example, via more effective or generous financial support for renewable energy technology manufactured locally).

Research on the economic crisis and green growth strategies in general are abundant (see Bowen and Fankhauser 2011; Fankhauser et al. 2013; Schmidt and Huenteler 2016). However, analyses of the impact of the economic crisis on renewable energy policy mixes are either notably absent or only tentatively included in comparative analyses of EU countries (for example, Jacobs 2012; Kitzing, Mitchell, and Erik 2012; Mir-Artigues and del Rio 2014). Similarly, single-case studies focus more on the politics of policy change in the field of renewable energy (for example, Martínez et al. 2016) or the larger field of environmental policies (for example, Carter and Clements 2015) than on renewable energy policy mixes themselves. This situation has led to somewhat atomistic conclusions that are hard to synthesize. This paper seeks to complement and contribute to these extant but rather piecemeal analyses by providing a more comprehensive assessment that encompasses both single and cross-national comparative analyses.

In our view, the main reason for the absence of systematic and comparative studies of policy patterns is a lack of comparative policy data. Most research of renewable energy policy evolves around the effectiveness of policy instrument choices or specific policy designs thus focusing more on the *what* (is best) (see for example, Schmidt et al. 2016) than the *how* (things actually change). Thus, a clear research gap exists: we lack systematic analyses of how instrument choice and policy design decisions are affected across a complex policy mix against the background of the economic crisis. So far, the effect of the economic crisis has been primarily analysed at EU

level (for example, Falkner 2016; Slominski 2016), leaving unanswered the question of the crisis' effect on national level policy. By studying policy change across cases, we also contribute to opening up the primarily case-study based climate and energy policy literature (for example, Carter and Jacobs 2014; Kern, Kuzemko, and Mitchell 2014) to quantifiable policy data. Also, by taking a policy mix perspective (Flanagan et al. 2011; Howlett & del Rio 2015; Schmidt & Sewerin 2016a), we go beyond existing single-case studies focusing on policy dynamics in the context of single policy instruments (for example, Korte and Jörgens 2012).

To address this gap, this paper analyses three research questions, covering three policy levels, the overall policy mix, individual policy instruments, and policy instrument designs:

(i) Which type of policy dynamics can be observed before and since the start of the economic crisis in complex policy mixes?

(ii) How do these dynamics differ between the various policy instrument types constituting these mixes and applied across countries?

(iii) For specific instrument types, which policy design changes can be observed?

The first question investigates the general direction of overall policy mixes in the form of dismantling, stasis and expansion. The second question aims at uncovering specific trends in the dynamics of policy instrument types. The third question aims at shedding light on the micro-dynamics of dismantling and expansion on the policy design level that drive the overall dynamics at the instrument and mix level. Answering these questions requires an encompassing, systematic and comparative dataset of countries' renewable energy policy mixes – something that is missing so far. The policy measurement approach applied in this paper, the Index of Policy Activity (Schaffrin et al. 2014; 2015), is conducive for such an exploratory endeavour and we will describe in more detail later how we make use of an IPA dataset to answer these research questions. Regarding the country cases covered by this paper, we provide a broad, diverse case investigation, including nine EU and non-EU countries: Australia, Austria, Canada, Germany, Ireland, New Zealand, Spain, Switzerland and the UK. By assessing renewable energy policy mixes in these countries over 17 years (1998-2014), our empirical basis is very broad. The analytical focus is on establishing patterns across cases and over time, not on causal analysis.

The remainder of the paper is structured as follows: First, we discuss our case selection rationale, explain how we apply the IPA approach, and describe our database. In a second step, we present our empirical findings, moving down from the macro-level (policy mixes) to the meso-level (policy instrument types) and then to the micro-level (policy design characteristics). In a third

step, we discuss the relevance and implications of our findings before concluding the paper with an outlook on the implications of our methodological approach for the comparative study of long-term policy dynamics.

Case selection, method, and data

Case selection

This paper's main contribution to the emergent literature on the effect of the economic crisis is to provide a comparative perspective, across a selection of EU member states as well as beyond the EU. While our principal focus is on the former, by including non-EU countries we can highlight differences and similarities across geographical areas and thus contextualise EU policy dynamics. This paper also provides a comparative perspective of a different kind, namely between policy dynamics at the macro- (namely the policy mix), meso- (policy instruments) and micro-level (policy design).

As this paper's main motivation is providing an empirical overview rather than a causal analysis, 'hard' case selection rationales building on theoretical arguments or expectations (Van der Heijden 2014; Seawright & Gerring 2008) cannot be applied in a meaningful way. Since empirical assessments of how the economic crisis affected renewable energy policy mixes are lacking, our aim is to include as diverse a sample of countries as possible. As such, we employ a form of diverse-case selection strategy (Rohlfing 2012), which maximises variance across a dimension (or dimensions) of interest, albeit informed by a number of practical considerations. We include (i) countries seen as renewable energy policy leaders and laggards, (ii) countries that were hit hard by the economic crisis as well as countries that were affected to a lesser degree, (iii) small and large countries, and (iv) both EU and non-EU countries.

Against this background, we decided to investigate policy dynamics in five EU Member states, namely Austria, Germany, Ireland, Spain, and the UK; and four non-EU countries, specifically Australia, Canada, New Zealand, and Switzerland. The Austrian renewable energy policy mix has been characterised as being troubled with symbolic policy innovations and lacking co-ordination between the federal and sub-federal level (Schaffrin et al. 2014; Steurer & Clar 2015) – on the other hand, overall the share of renewable electricity generation capacity installed is high. Germany is a leader in renewable energy policy, demonstrated by its 'energy transition', or *Energiewende*, policies, and its share of installed renewable electricity capacity is very high, with

38% in 2013. The share of renewables installed in Ireland is very low in comparison, and the country is thus a renewable energy policy laggard. Spain is a leader in renewable energy policy and its share of renewable electricity capacity installed is very high with 28% in 2013; however, the economic crisis is blamed for Spain losing track in recent years. The UK has also been described as a leader in climate and renewable energy policies during the late 2000s (Carter & Jacobs 2014) but faced more critical assessments during more recent years (Lockwood 2013) and has lagged behind in its share of installed renewable electricity capacity, with 15% in 2013.

Regarding non-EU states, Australia and Canada are notorious laggards in terms of renewable energy policy and have not been very successful in the deployment of renewable energy technology. New Zealand, on the other hand, is a very green country with a high share of renewable energy. However, this strong performance can be attributed mainly to the dominance of hydropower; in terms of capacity additions of other renewables, the country is lagging far behind (6.5% in 2013). Finally, Switzerland is a latecomer in terms of renewable energy policy, which is related to the country's already low-carbon technology (especially hydro and nuclear) dominated electricity generation fleet (IEA 2012) and to the lacking public acceptance of renewable energy technologies (Walter 2014).

Crucially, these countries were affected differently by the economic crisis, with Ireland, Spain and the UK being hit hard; Austria, Canada, New Zealand and Switzerland affected slightly higher than the OECD average; and Australia and Germany quickly recovering and resuming on a path of economic growth (Ollivaud & Turner 2014). The time-frame under investigation, seventeen years (1998-2014), is intentionally long, in order to provide information on policy dynamics in the field of renewable energy from the very early phase when the field was established to a more mature phase, and then on to the period in which policies may have been affected by the economic crisis since 2008. Also, this long time-frame satisfies the minimum time period of ten years that Sabatier and Jenkins-Smith (1999) stipulated for a meaningful study of policy change.

In combination, the broad geographical coverage and the long time-frame enable a broad comparison of policy dynamics over both time and space (Howlett & Cashore 2009; Schaffrin et al. 2014). As a result, we can inform future theorizing about the impact of the economic crisis since 2008 (or economic crises as such) even without engaging in causal analysis (Howlett & Cashore 2014; Howlett & Rayner 2006).

IPA Approach and Data Sources

To establish our database, we apply the standard IPA approach. We use the resulting dataset to give an overview, over time, of the overall intensity of renewable energy policy mixes, the use of policy instrument types, and the specific development of policy design variables as captured by the six intensity indicators of IPA. In addition, in order to answer the research questions set out above, we apply an innovative way of processing and presenting standard IPA data: we calculate average annual growth rates over all three levels considered, namely the macro- (policy mix), meso- (policy instruments) and micro- (policy design) levels. We divide our dataset into two periods, namely the pre- (1998-2009) and post-crisis (2010-2014) years.[1] Through such division, we can discern the differences in policy dynamics that might be attributed to the impact (direct or indirect) of the economic crisis. More specifically, to investigate the first research question – regarding the general direction of overall policy mixes – we calculate the annual IPA of all renewable energy policies in a given country. The annual growth rates of this IPA at the policy mix level are then used to calculate the mean growth rates over each of the two time-periods. In the same vein, we also provide the figures for mean growth rates of overall policy intensity (the number of policies employed) across the periods. This approach thus provides a straightforward means of discerning the direction of policy change, ranging from expansion to dismantling, via stasis. We do not predefine ranges of percentage changes that distinguish expansion from stasis and stasis from dismantling. Given that these concepts have so far been discussed primarily in a qualitative way, we employ the pragmatic assumption that a clearly positive growth rate constitutes an instance of expansion, a growth rate close to zero an instance of stasis, and a negative rate an instance of dismantling. Our empirical results, discussed later in this paper (see Table 1 below), point towards the existence of many grey areas in between expansion and dismantling that are difficult to discern from a large(r)-*n* perspective. For illustrative reasons we also calculate and report the mean growth rates of the policy density in the same two periods.

To investigate the second research question – regarding dynamics at the policy instrument type level – we calculate mean IPA growth rates across nine policy instrument types as established by Schaffrin et al. (2014), namely education, financial, framework, incentive, regulatory, RD&D, public investment, tradable, voluntary (see Appendix 1 for a description). This division allows us

[1] Given the long time frame of legislative processes we include a one-year time-lag as we assume that the financial crisis of late 2008 impacted new or updated policies coming into force from 2010 onwards.

to investigate the relative importance of policy instrument type changes across time-periods, for example, whether voluntary instruments show a higher or lower growth rate than other instrument types and thus become more or less prominent in the overall policy mix. We are thus able to provide a relational take on patterns of expansion, stasis and dismantling on the policy instrument level.

Finally, to investigate the third research question – regarding the micro-dynamics of dismantling, stasis and expansion on the policy design level – we make use of IPA's six policy intensity indicators to distinguish between different policy design features. We calculate the mean values for these design features across policy instrument types – that is to say the mean integration, scope etc. of financial policies etc. – to investigate differences between the two time-periods pre- and post-crisis. This innovative approach allows for a better understanding of what drives, in terms of policy design, overall policy dynamics. For example, policy dismantling could be driven either by a uniform decrease in all policy intensity indicators or by a decrease in one, two or three indicators while the others remain stable or even increase. Thus, we add empirical information about patterns of policy dynamics that can provide precise information about how policy change occurs at the micro-level.

It is important to note that even though a policy density perspective has its merits, only a systematic approach to measure policy intensity allows answering all three research questions. While a density perspective could provide an assessment of the overall direction of countries' policy mixes (RQ1) and give an idea of policy dynamics on the policy instrument level (RQ2), tackling the question which policy design (non-)changes actually drive these dynamics (RQ3) is only possible with a systematic and comparable measure of policy intensity indicators. The advantages of applying the IPA approach are particularly applicable for a large(r)-n research project such as this.

Policy data were compiled by collecting information on policy instruments from public sources, the *Policies and Measures Databases* of the International Energy Agency and the *Climate Policies and Measures in Europe* Database of the European Energy Agency. We also used UNFCCC National Communications and other national documents such as governmental reports to complement additional policy instruments not listed in the public datasets or complement information on policy instruments' characteristics. In total, 562 policy instruments were analysed, with varying numbers of instruments per country and per year; 292 policies were enacted in EU Member states, 270 in the four non-EU countries. The coding of policy instruments

was done according to the original IPA scheme by two coders and checked by the authors of this study to increase the validity of assessment. If differences in the assessment of a policy instrument arose between the coders, the value of the debated intensity measure was set in a group discussion. By applying the IPA approach across a larger number of cases, we highlight the added value of the approach in producing comparative and systematic datasets, which are very much in need in the comparative study of public policy (Howlett & Cashore 2009).

Findings

Now, we turn to the main contribution of this paper, which is an exploratory analysis of patterns of policy dynamics in the field of renewable energy before and after the economic crisis. As a first step, we investigate the general direction overall policy mixes have taken in the pre-crisis period from 1998 to 2009 and compare these dynamics with those of the post-crisis period from 2010 to 2014. As a second step, we investigate how these dynamics differ between policy instrument types. Finally, as a third step, we analyse the micro-dynamics at the policy design level.

The general direction of policy change

We begin by comparing the mean changes in countries' renewable energy policy density, that is to say the number of policies employed, and intensity, the strength of these policies measured via the IPA approach, both pre-and post-crisis. At this macro-level of policy dynamics, we also consider EU and non-EU countries. Table 1 reveals very diverse patterns across our sample.

Table 1: Mean annual rate of increase in policy density and intensity

			1999-2009	2010-14
EU	Austria	*Density*	32%	6%
		Intensity	86%	7%
	Germany	*Density*	40%	3%
		Intensity	94%	1%
	Ireland	*Density*	34%	0%
		Intensity	79%	-1%
	Spain	*Density*	27%	6%
		Intensity	26%	5%
	UK	*Density*	32%	-2%
		Intensity	41%	-1%
non-EU	Australia	*Density*	45%	-1%
		Intensity	40%	7%
	Canada	*Density*	46%	-1%
		Intensity	69%	-1%
	New Zealand	*Density*	32%	-8%
		Intensity	32%	0%
	Switzerland	*Density*	26%	6%
		Intensity	25%	5%

In the pre-crisis period, renewable energy policy density increases at a fast pace: mean changes in density range from 26% in Switzerland to 46%in Canada, a clear indication that renewable energy policy during this time becomes an established policy field that witnesses a high degree of political activity. Interestingly, Germany, which generally is seen as a front-runner in renewable energy policy and where on average policy density increases by 40%, is outperformed by Australia and Canada, two countries with a reputation as laggards in the policy field, where the mean increase per year is 45 and 46%, respectively. Four countries – Austria, Ireland, New Zealand and the UK – show a very similar pattern with mean increases between 32 and 34% per year. Spain and Switzerland form the bottom group with 27 and 26% increases, respectively.

Turning to policy intensity, patterns of policy dynamics become even more diverse. Here, three countries, namely Austria, Germany and Ireland, reveal a mean increase in intensity, by 86, 94 and 79% per year. In all of these cases, the difference between increase in mean density and intensity is high: in Germany, policy density increases by 40 % while policy intensity increases by 94%. This variation highlights that these countries not only adopted more policies during this time-period, they adopted stronger or better ones. Australia, despite being in the top group in terms of density increase (45%), reveals an intensity increase that is at a lower level (40%), indicating that while the country adopted a huge number of policies, the intensity or strength of these policies decreases. With Spain and Switzerland, two other countries show a similar

negative pattern, albeit less pronounced (27 to 26%.and 26 to 25%). This finding points towards the importance of studying both policy density and intensity to get a better understanding of different patterns across cases. Apart from the top group with Austria, Germany and Ireland, mean intensity in the other countries increases between 25 and 41%. This time-period thus can clearly be characterised as a period of policy expansion, albeit with diverse patterns between countries, with no systematic difference between EU and non-EU countries.

The post-crisis period reveals a clear trend of slowing down of further increase in policy density and intensity across our sample. Some countries, Austria, Spain and Switzerland, still feature mean growth of policy density between 5 and 7% per year, followed by Germany with a mean increase of 3%. On the other hand, four countries, Australia, Canada, New Zealand, and the UK, exhibit a mean decline of policy density between one and eight percent each year. Mean policy density in Ireland does not change. Our sample thus shows two distinct policy dynamics: continued policy expansion (albeit on a lower level compared to the pre-crisis period) in one group and policy dismantling in the other. Turning to post-crisis policy intensity, our data reveal more nuanced patterns: on this dimension, only three countries, Canada, Ireland and the UK, show a trend of slow dismantling, with a mean decrease in policy intensity by one percent per year. Five countries, Australia, Austria, Germany, Spain and Switzerland, continue to increase the mean intensity of their policy mixes, with annual increases between 7 (Australia and Austria) and 1% (Germany). New Zealand, in contrast to the policy density dimension, reveals a pattern of policy stasis with no change in mean intensity. Since we do not observe clear-cut differences in overall policy dynamics between EU and non-EU countries – we observe patterns of expansion, stasis and dismantling in both country groups across both time-periods – the remainder of this paper focuses on the EU countries in our sample.

To complement the already complex picture of policy dynamics described above, we include the absolute height of policy density and intensity (see Figure 1) in order to work out more clearly different patterns across the EU countries under investigation. This perspective reveals that renewable energy policy mixes in Germany and the UK are much more advanced than those in Austria, Ireland and Spain. Policy intensity in 2009, measured as absolute IPA value (the sum of all renewable energy policies in force in a given year), reaches 13.53 (Germany) and 11.15 (UK), compared to 6.77 (Ireland), 5.58 (Spain), and 5.31 (Austria). In the post-crisis period, the gap between Germany with an IPA value of 14.35 in 2014 and the other countries increases

noticeably, with the UK dropping to 9.96, Spain and Austria rising to 6.96 and 6.35 respectively, and Ireland dropping to 5.70. Within this group of countries, Ireland thus turned from mid-field leader to laggard since 2010.

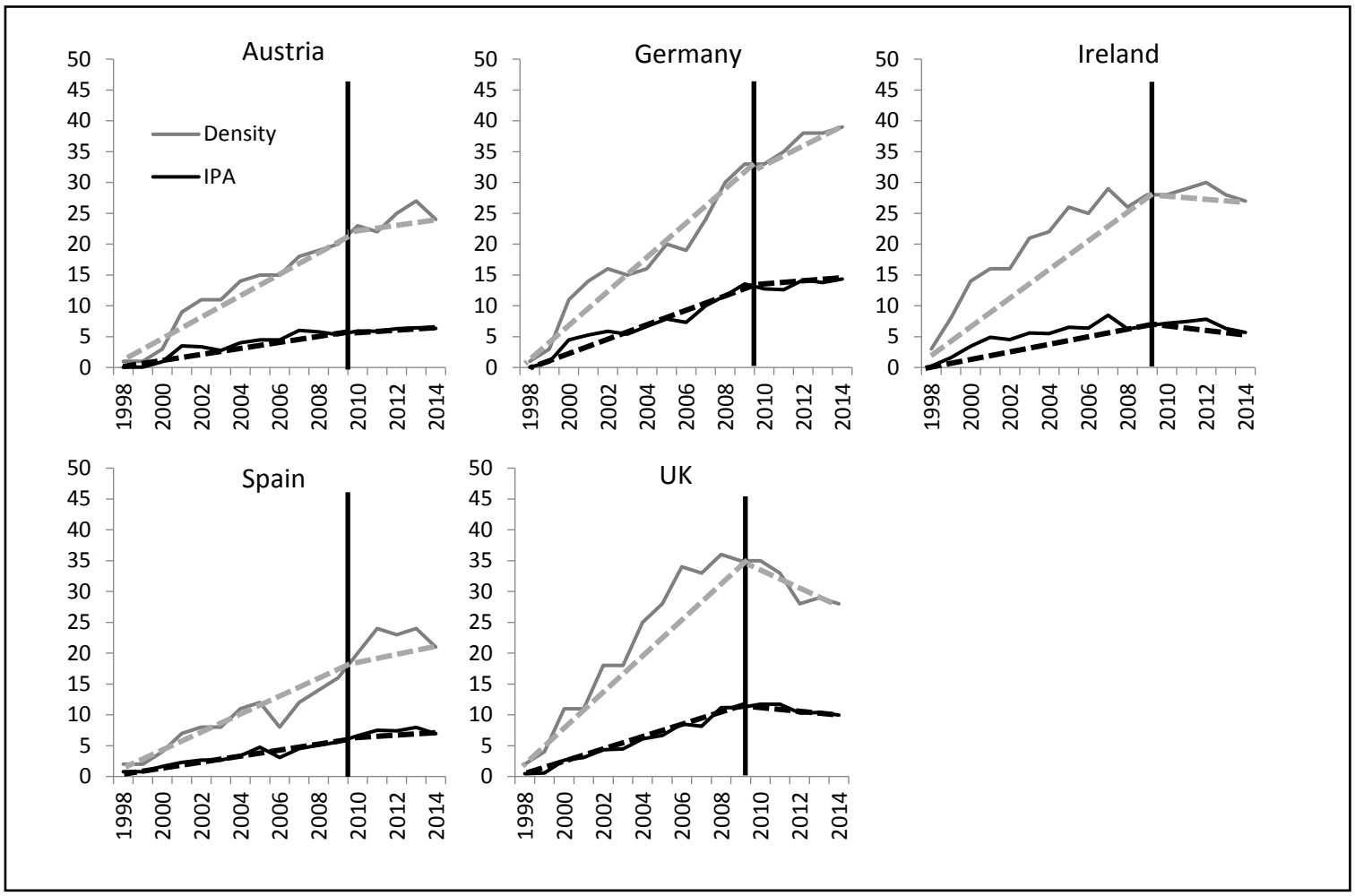

Figure 1: Policy dynamics in EU countries, measured in absolute policy density (number of policy instruments and policy intensity (IPA).

Policy dynamics at the meso-level: policy instruments and the overall policy mix

To answer our second research question – how policy dynamics differ between policy instrument types constituting renewable energy policy mixes – we differentiate between nine instrument types: education, financial, framework, incentives, investment, RD&D, regulatory, tradable and voluntary (see Appendix 1). Accordingly, Figure 2 presents mean annual policy intensity (IPA) growth rates for these instrument types in both the pre-crisis (1998 to 2009) and post-crisis (2010 to 2014) period. Apart from the marked slowing down in policy activity between the two

periods, no clear patterns across all countries emerge; rather, post-crisis patterns seem to be country-specific.

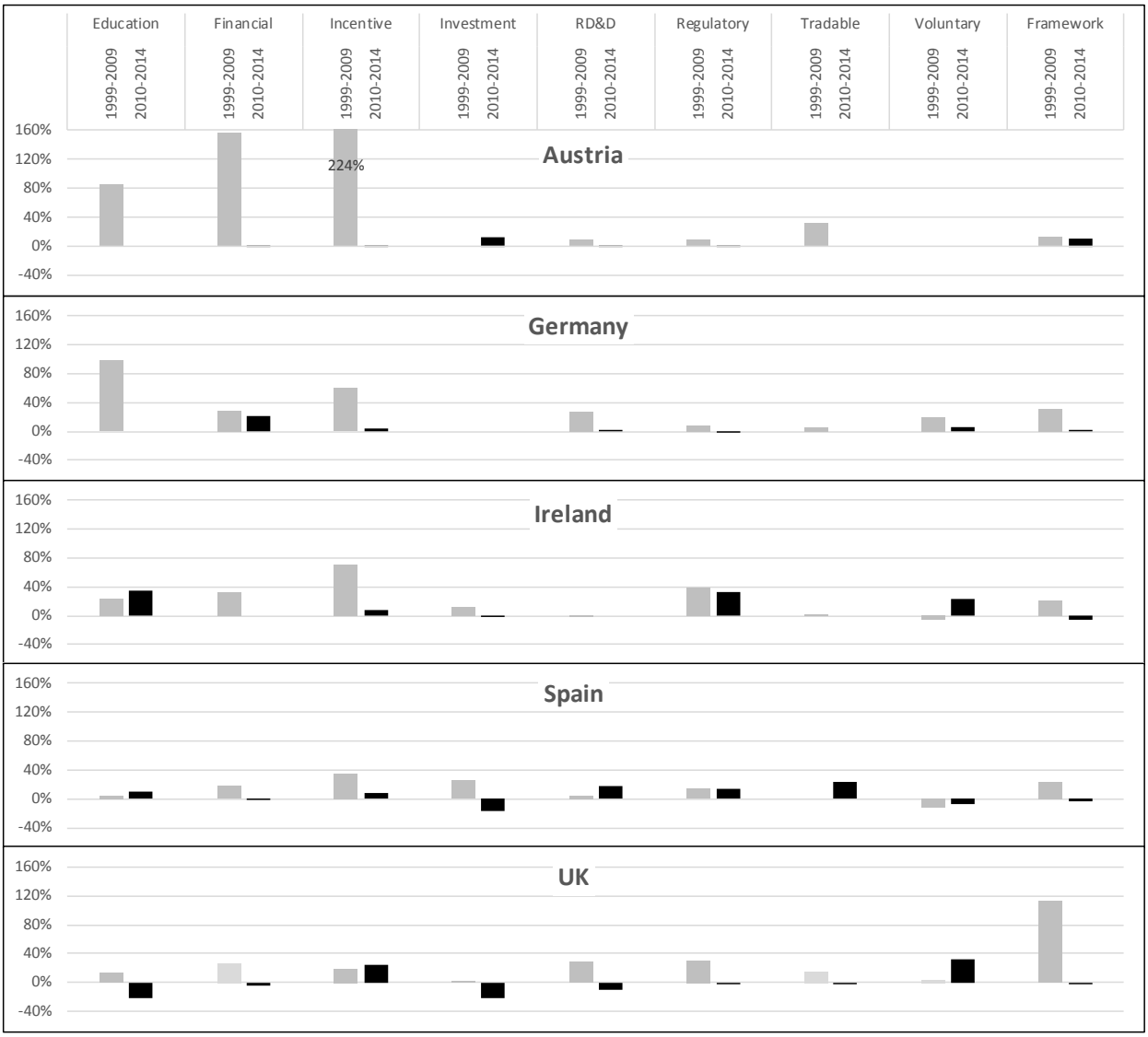

Figure 2: Mean annual changes in policy intensity (IPA) across policy instrument types

While policy expansion in the pre-crisis period in Austria was primarily driven by increases of policy intensity in incentives (mean growth of 224%), financial instruments (155%), and education (85%), these instrument types remain stable in the post-crisis period. Post-crisis, overall intensity increase in Austria is mainly driven by public investment instruments (12%). In Germany, pre-crisis increase in policy intensity is driven by a broad set of instrument types, with only education (99%) and incentives (60%) exhibiting more prominent increases than the other. Post-crisis, policy expansion is driven by financial (21%) and, to a lesser degree, voluntary instruments (7%) and incentives (4%). In Ireland, pre-crisis expansion is also driven by a broad

set of instrument types, with incentives sticking out with 72% mean annual increase. Post-crisis, however, expansion shifts to education (34%), regulation (33%) and voluntary instruments (24%) while framework policies are dismantled (6% mean decrease). In Spain, pre-crisis policy expansion is driven by incentives (36%), public investment (25%), framework (23%) and financial instruments (18%). Post-crisis, also here the locus of policy expansion shifts, namely towards RD&D (18%), education (10%) and regulatory instruments (13%), with mean increase in incentives dropping to 9%. Instrument types that reveal a clear dismantling pattern are public investment (minus 18%) and voluntary instruments (minus 7%); financial and framework instruments also decrease at a slow pace (minus 2 and 4%). Finally, pre-crisis policy expansion in the UK is driven by a broad set of instrument types with only framework instruments revealing markedly higher annual increases in intensity (113%). Post-crisis policy dismantling takes place in seven instrument types: public investment (minus 22%), education (minus 21%), and RD&D (minus 10%) are dismantled at a high rate, financial, regulatory, tradable and framework instruments at a lower rate (minus 5, 3, 3 and 2%). Interestingly, two instrument types, namely incentives and voluntary instruments, show higher degrees of expansion in the post- than in the pre-crisis period (24 vs 18% and 32 vs 4%).

These very distinct patterns reveal that both post-crisis policy expansion (as in Austria, Germany and Spain) and policy dismantling (as in Ireland and the UK) are country-specific and do not represent clear shifts towards or away from specific policy instrument types. Perhaps the only overall observation to be made is that instrument types requiring either spending public (public investment, RD&D, financial instruments) or private (via feed-in tariffs as incentives) money have become less prominent in the post-crisis period, both in those countries that still exhibit overall policy expansion and those that experience dismantling. Prime examples for this general trend are the marked decrease in public investment in Spain and the UK, as well as the decrease in RD&D in the UK. There are, however, exceptions to this general trend, for example, in Austria, where public investment becomes more important for the policy mix post-crisis, in Germany, where financial instruments continue to show similar growth patterns post-crisis, in Spain, where RD&D increases more strongly than pre-crisis, and in the UK, where incentives also increase in relative prominence compared to the pre-crisis period. On the other hand, policy instrument types that do not require (as much) public or private money, such as education and voluntary instruments, increase their relative importance to the policy mixes in our sample post-crisis. Again, there is an interesting exception, namely a decrease in education instruments by

21% in the UK's policy mix. Finally, there is at least an indication of an instrument shift in the two countries exhibiting overall dismantling dynamics, Ireland and the UK: Post-crisis, Ireland shifts focus towards education and voluntary instruments, instrument types not requiring much public funding. Similarly, in the UK the focus shifts away from public investment and RD&D towards voluntary instruments. A further analysis of these patterns, however, would require a more detailed database (see discussion below).

Policy Dynamics at the Micro-Level: Policy Design Indicators

As a final step in our exploratory investigation of post-crisis policy dynamics, we move down one level further to the micro-level. To address our third research question – which policy design changes can be observed – we turn to changes in policy intensity indicators as established by the IPA approach. The aim is to shed light on the micro-dynamics of policy dismantling and policy expansion that drive changes in the overall policy dynamics at the macro- (policy mix) and meso- (instrument type) level. Having discussed that post-crisis policy instrument use across all five EU-member countries in our sample seems to shift away from resource-intensive to less costly policy instrument types, we investigate changes in policy design indicators in financial and voluntary policy instruments. While voluntary policy instruments' importance for overall policy mixes increases in Germany, Ireland and the UK, they remain stable in Austria and only decrease in Spain, financial policy instruments' relative importance only increase in post-crisis Germany. Figure 3a depicts mean annual changes in policy intensity of *financial* policies differentiated between the six intensity indicators established by IPA, namely integration, scope, target, budget, implementation, and monitoring. We focus on Germany, the case where relative importance of financial instruments increases post-crisis, Ireland, where it remains stable, and Spain where relative importance decreases. Again, our findings indicate very specific patterns in each country: In Germany, pre-crisis policy expansion is primarily driven by increases in the budget, target and, to a lesser extent, scope and implementation indicators. Interestingly, the post-crisis period reveals a shift of focus towards increase in scope and targets and away from budget. This shift can be interpreted as German policy-makers intentionally choosing not to increase the amount of resources invested but instead to focus on increasing the scope of these financial policies. In Ireland, pre-crisis expansion is driven by increases in the scope and implementation indicators whereas the post-crisis period reveals stability across all indicators. Finally, the pre-crisis expansion of financial instruments in Spain was driven almost equally by all

intensity indicators, except for budget, which remained stable. Post-crisis dismantling, on the other hand, is driven by a sharp decrease of the budget indicator (minus 44%).

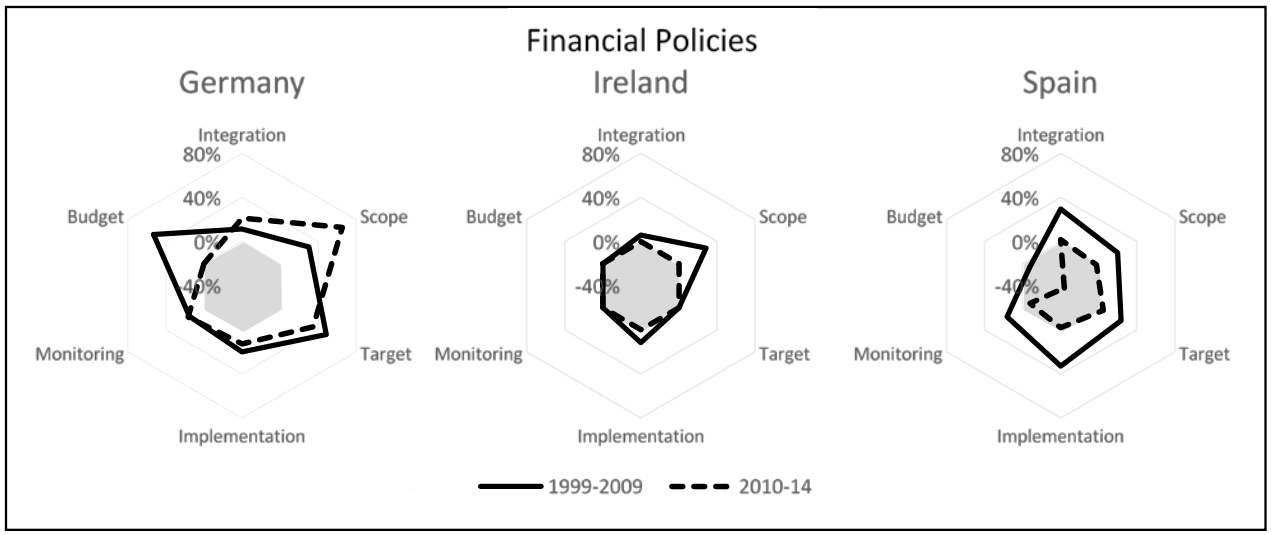

Figure 3a: Policy design indicators, pre- and post-crisis, for financial policy instruments in Germany, Ireland and Spain. The percentages show the mean annual changes in the six IPA intensity indicators compared between the two time periods (pre-crisis depicted in solid lines, post-crisis period in dotted lines). The grey area in the middle of the spider graphs marks negative changes. The graphs should be read like this: the budget indicator for German financial policies in the pre-crisis period increased on average by 53% per year while it remained stable (0% change) in the post-crisis period.

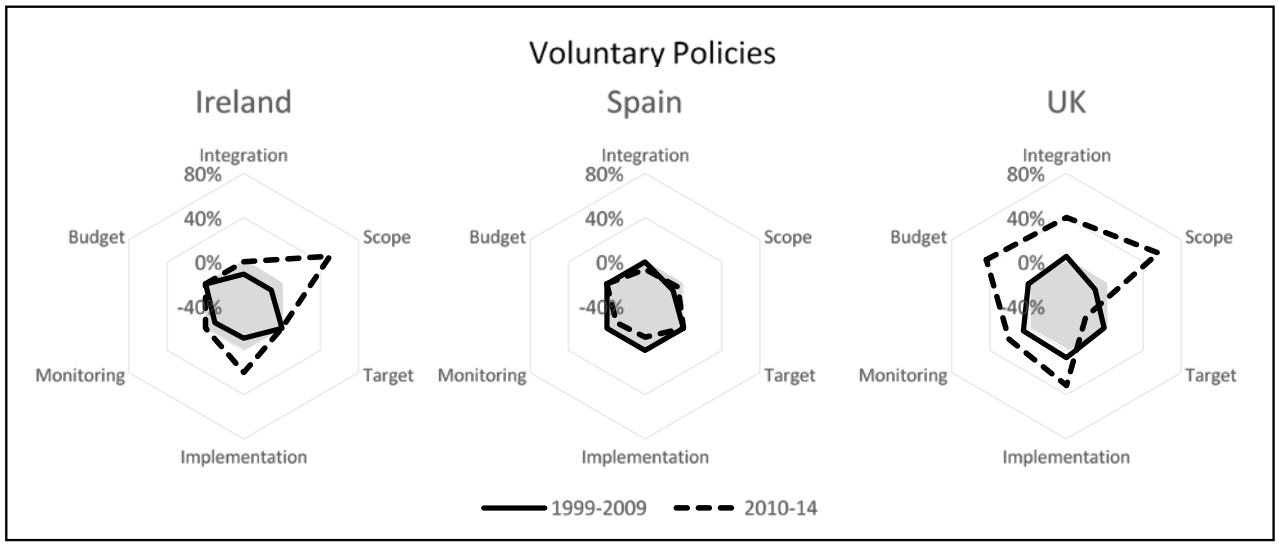

Figure 3b: Policy design indicators, pre- and post-crisis, for voluntary policy instruments in Ireland, Spain, and the UK.

Lastly, we turn to the micro-dynamics in *voluntary* policy instruments (see Figure 3b), the instrument type that seems to gain more relative importance for overall post-crisis policy mixes. With Ireland, Spain and the UK, we probe into three cases that experience either a sharp increase

in the relevance of voluntary policies (plus 24 and 32% in Ireland and the UK, respectively), or a noticeable decrease in relevance (minus 7% in Spain) in the post-crisis time-period. The decrease in Spain is driven by negative changes of the monitoring and implementation indicators. Interestingly, Ireland and the UK reveal very different patterns in terms of indicators that increase their relative importance: while the scope and implementation indicators drive the increase in Ireland, the full set of indicators (except target) drive the post-crisis increase in the UK. Thus, also at this micro-level of policy dynamics, our exploratory investigation reveals very distinct national patterns of policy expansion, stasis and dismantling.

Considering the findings across the three levels of policy dynamics we are interested in – the macro- (policy mix), meso- (policy instruments) and micro-level (policy design indicators) – we do find only one trend common to all EU countries in our sample, namely that the financial crisis marks a turning point in the development of renewable energy policy mixes. While the pace of policy expansion becomes notably slower in Austria, Germany and Spain, Ireland falls into stasis turning into dismantling, while the UK clearly goes through a period of sharp policy dismantling after the economic crisis.

Discussion

In the remainder of this paper, we briefly discuss relevant empirical findings before addressing methodological and conceptual implications of our approach to investigate policy dynamics in complex policy mixes. Our empirical findings reveal policy dynamics that put some common preconceptions in perspective. First, even though the economic crisis certainly marks a turning point in the overall speed of policy change, the overall direction of policy change only changes in Ireland and the UK. Both countries reveal clear patterns of policy dismantling after the economic crisis. However, how dismantling plays out at the meso- (policy instrument) and micro-level (policy design indicators) is very different in both cases. The same holds true for the inverse dynamics of slowed down policy expansion in Austria, Germany and Spain. In terms of policy instrument use, our findings suggest an overall trend away from resource-intensive instrument types like public investment, financial instruments and incentives, towards less resource-intensive instrument types like education and voluntary instruments. Yet, there are some interesting exceptions to this trend, as, for example, the increasing relevance of financial instruments in post-crisis Germany or the increase in RD&D in Spain. Interestingly, the post-crisis

UK shows some developments contrary to this trend, namely the relative shift towards incentives and the equally strong shift away from education.

While explaining these empirical patterns is not the primary intention of this paper, we venture one possible explanation that builds on the unique characteristic of renewable energy as a policy field being on the intersection of environmental and industry policy. It is striking that those countries that were successful in nurturing a relevant national industry around specific renewable energy technologies – wind and for a time solar PV in Germany and Spain, biomass in Austria – did not turn onto a path of policy dismantling after the economic crisis. By contrast, Ireland and the UK possessed either no or only a small relevant national industry, and did turn onto a path of policy dismantling. These different patterns could potentially be linked to the importance of positive policy feedback and path dependency in long-term policy dynamics (Schmidt & Sewerin 2016b). In any case, further qualitative studies are needed to investigate the causal mechanisms behind the overall trends of policy expansion, stasis and dismantling we reveal with our layered quantitative approach.

Being a first example of a systematic, large(r)-*n* comparison of policy dynamics across three levels of policy (policy mix, policy instruments, policy design indicators), our study also highlights a blind spot in existing comparative research. Dynamics that seem similar at a higher level, such as dismantling at the policy mix (macro-) level or expansion at the policy instrument type (meso-) level, can be driven by rather different dynamics on the level below. For example, while Ireland and the UK reveal a similar development at the policy mix level with annual mean decreases of one percent to post-crisis policy intensity, the dynamics on the policy instrument level below are very different. At this meso-level, the UK exhibits a sharp dismantling of three instrument types (public investment, education and RD&D) while simultaneously expanding the relative importance of incentives for the overall policy mix. Dismantling in Ireland, on the other hand, is not focused on specific instrument types. This distinction is a very important contribution to the literature on policy dismantling where these kind of comparative analyses are rarely conducted. Similarly, delving into the micro-level of policy dynamics at the policy design level points towards a potentially weak spot in the conceptual literature on policy dismantling. Bauer and Knill (2012) distinguish between four types of policy dismantling strategies. They posit ‘dismantling by arena shifting’ as a primary strategy in the active decision/low visibility corner of their four-field matrix. However, at the policy design level, another potential strategy of this type could also be the dismantling of low-visibility indicators, such as implementation, monitoring and integration or

less-visible indicators like scope and target. In addition, depending on the circumstances, the dismantling of the budget dimension of financial instruments in post-crisis financial instruments may fall into this category of dismantling strategies with reduced visibility.

Our investigation also points towards challenges facing quantitative comparative analyses of policy dynamics. The main challenge is how to define borders between the conceptually distinct categories of policy expansion, stasis and dismantling. While it seems obvious that positive changes in policy intensity can be seen as expansion and, in turn, negative changes as dismantling, stasis is much harder to define. In our sample, only New Zealand fits neatly into the zero percent change in policy intensity category. On the other hand, four countries exhibit a mean expansion (Germany) or dismantling (Canada, Ireland and the UK) rate of just 1%. Finally, our findings make a clear case for basing comparative studies of policy dynamics on policy intensity rather than on density. Only focusing on the latter would have categorised Australia and New Zealand as cases of policy dismantling, on the basis of their mean annual post-crisis decrease of one and eight percent, respectively. Our focus on policy intensity, however, reveals that by that measure, Australia is on a path of expansion and New Zealand's policy mix remains stable. Again, these complex patterns of policy dynamics across countries point toward the need to study both density and intensity as applying only one perspective would have missed important pieces of information.

Regarding the UK and the potential consequences of Brexit, our findings indicate that the country already has shifted towards a dismantling path in the policy field of renewable energy that could be hard to reverse again at a later point. As noted by Carter and Jacobs (2014), climate policy, and therefore by extension renewable energy policy, have become partisan issues since 2012 with policy preferences clearly differing between the two main political parties. Moreover, as Carter and Clements (2015) have pointed out, the economic crisis has been used to justify a reframing of environmental policy as involving a contradiction between environmental protection and economic competitiveness. Also, Brexit-related law-making will dominate in the years to come, potentially moving renewable energy policy way down on the legislative agenda. Against this background, the UK already seems to be on a trajectory of becoming a laggard in renewable energy policy. Our findings indicate that the post-crisis time-period is marked by seemingly unsystematic changes in policy instrument use pointing to the general propensity of the UK to shift sharply between policy options. This trait can be attributed to the UK's institutional setup as a majoritarian democracy with few veto points that allows for swift and

radical changes in public policy (Lijphart 2012; Tsebelis 1995; 1999). Finally, the volatility of the UK's renewable energy policy mix can also be attributed to lacking path creation (Garud & Karnøe 2003), as it did not nurture a national industry around specific renewable energy technologies (see above).

Conclusion

This paper serves as a blueprint for the comparative study of complex policy mixes and the effect of the economic crisis on them by providing an overview of empirical policy patterns in a very important environmental policy field, renewable energy, across a larger number of cases. The focus is on highlighting differences between cases and over time, not on causal analysis. As such, this paper provides a means of considering the bigger picture of long-term policy dynamics across a set of nine EU and non-EU countries. It thus contributes to a better understanding of both macro- and micro policy dynamics over a long time frame, covering both pre- and post-crisis periods. Future research should provide more details about individual cases and other policy fields as well as conduct analyses of causal mechanisms behind policy dynamics.

In methodological terms, our analysis clearly highlights the added value of a systematic measurement approach, such as IPA, for studying policy dynamics: we use an IPA dataset to assess both general policy mix dynamics (overall intensity, use of instruments) and policy dynamics at the more concrete design level (measured by the six IPA indicators). Other approaches, such as focusing on policy density or applying more qualitative policy assessments, could not provide such systematic and comparable data.

Since we study policy dynamics from a policy mix perspective (Flanagan et al. 2011; Howlett & del Rio 2015), we contribute to the evolving field of policy dismantling studies that until now predominantly focuses on policy dismantling processes in single policy instruments (for example, Korte and Jörgens 2012). As has been pointed out above, the advantage of the IPA approach is that it enables the production of a dataset that provides systematic information over all three levels investigated in this paper, from the macro-level of policy mixes, to the meso-level of policy instruments, to the micro-level of policy design. Thus, without engaging in causal analysis ourselves, it is important to stress that this unique empirical approach enables future research to recognize and disentangle the multidimensionality of policy change (Pierson 2001) by

assuming that different levels of policy may change (or remain stable) due to different causal processes (Cashore & Howlett 2007; Levin et al. 2012).

Finally, our empirical findings answers a call in public policy literature for more systematic comparative studies of policy change (for example, Howlett and Cashore 2014). We thus contribute to expanding the toolbox of research interested in long-term policy change and argue that our concrete approach could act as a blue print for future large(r)-*n* investigations of dynamics across three policy levels (macro/meso/micro) or for more focused (qualitative) investigations of dynamics on one policy level.

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Appendix 1: Description of policy instrument types (based on Schaffrin et al. 2014).

Policy type	Description
Education and outreach	Policies designed to increase knowledge, awareness, and training among relevant stakeholders or users, including information campaigns, training programs, labeling schemes.
Incentives and subsidies	Policies to stimulate certain activities, behaviors or investments. These include feed-in tariffs for renewable energy, rebates for the purchase of energy-efficient appliances, grants, and preferential loans and third-party financing.
Financial	Policies to encourage or stimulate certain activities or behaviors. These include tax incentives, such as tax exemptions, reductions or credits on the purchase or installation of certain goods and services.
Framework policy	Refers to the processes undertaken to develop and implement policies. This generally covers strategic planning documents and strategies that guide policy development. It can also include the creation of specific bodies to further policy aims, making strategic modifications, or developing specific programs.
Public investment	Policies guiding investment by public bodies. These include government procurement programs (e.g. requirement to purchase energy efficient equipment and vehicles) and infrastructure investment (e.g. urban planning).
RD&D	Policies and measures for the government to invest directly in or facilitate investment in technology research, development, demonstration and deployment activities.
Regulatory instruments	Covers a wide range of instruments by which a government will oblige actors to undertake specific measures and/or report on specific information. Examples include energy performance standards for appliances, equipment, and buildings; obligations on companies to reduce energy consumption, produce or purchase a certain amount of renewable energy; mandatory energy audits of industrial facilities; requirements to report on GHG emissions or energy use.
Tradable permits	Refers to three kinds of systems – GHG emissions trading schemes, white certificate systems stemming from energy efficiency or energy savings obligations, and green certificate systems based on obligations to produce or purchase renewable energy-sourced power (generally electricity). In GHG trading schemes, industries must hold permits to cover their GHG emissions; if they emit more than the amount of permits they hold, they must purchase permits to make up the shortfall. If they emit less, they may sell these. White certificate schemes create certificates for a certain quantity of energy saved, for example one MWh; regulated entities must submit enough certificates to show they have met energy saving obligations. Again, if they are short, this must be made-up through measures that reduce energy use, or through purchase of certificates. Green certificates refer to renewable energy certificates that represent the certified generation of one unit of renewable energy, generally one megawatt-hour. Certificates can be traded among consumers and/or producers and used to meet renewable energy obligations.
Voluntary agreements	Refers to measures that are undertaking voluntarily by government agencies or industry bodies, based on a formalized agreement. There are incentives and benefits to undertaking the action, but generally few legal penalties in case of non-compliance. The scope of the action tends to be agreed upon in concert with the relevant actors. These are often agreed to between a government and an industry body, with the latter agreeing to certain measures; for example, reporting information on energy use to the government, being subject to audits, and undertaking measures to reduce energy use