Energy Research & Social Science xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

# The need for comprehensive and well targeted instrument mixes to stimulate energy transitions: The case of energy efficiency policy

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ARTICLE INFO

*Keywords:*
Policy mix
Innovation
Technology
Energy efficiency

ABSTRACT

To meet global climate goals an energy transition is needed. However, energy transitions are complex and long-term processes and require a variety of public policy interventions to steer their direction and speed to achieve global climate change mitigation targets. One area where policy support is required is energy efficiency, which offers a high potential for carbon savings. It is widely acknowledged that energy efficiency improvements will need to be faster and deeper than is currently the case and this requires policy instrument mixes to support both those energy efficiency measures that are simple and cost-effective as well as more complex and costly technologies. In other words, policy mixes need to be well-targeted and comprehensive. In this paper, we address the issue of comprehensiveness in terms of technology-specificity and the level of complexity and costliness of energy efficiency measures. We use an existing dataset produced as part of a pan-European effort to understand instrument mixes in 14 EU Member States in the area of energy efficiency. Based on the empirical analysis and our segmentation of instrument types and their role in the overall mix, we illustrate the need for using a comprehensive instrument mix rather than single instruments.

## 1. Introduction

In order to reach the pledges made under the Paris Agreement on climate change it is clear that we need an ambitious energy transition towards low-carbon solutions involving every part of the economy [1]. Energy transitions, defined as structural change in the way energy services are delivered and used, are inherently complex, uncertain and difficult to govern, and there is wide ranging agreement that a variety of different policy instruments are needed to foster such transitions [2,3]. In this context, it is increasingly acknowledged that policy mixes are required to address the various market and system failures associated with sustainability transitions [4,5] (Jacobsson et al. this issue). However, most policy mix studies only cover a discussion of different instruments and their interactions, whereas a broader perspective would also include policy processes and policy mix characteristics [6,4]. In this paper, we focus on comprehensiveness as one key policy mix characteristics, but to analyse this in sufficient detail we limit our discussion to instrument mixes for which we propose a novel operationalisation of comprehensiveness. That is, while we recognize that the politics of policy making and implementation are a key factor in understanding the characteristics of real-world policy mixes, such a broader policy mix perspective is outside the scope of our study.

The emerging literature on the importance of policy mixes to tackle the decarbonisation of the energy system draws on different bodies of literature. These range from policy studies [7–9] to environmental economics [10] [55] and innovation and transition studies [2,4,11]. One focal area of such studies has been the interactions of different policy instruments, both between policy instruments in specific policy sub-domains, such as energy efficiency policy (e.g. [12]), and between sub-domains, such renewable energy policy and climate policy [54]. In contrast, studies in the policy design field have traced the development of policy mixes over time (e.g. [13] for building efficiency in the UK and Finland). Finally, transition studies have started to pay greater attention to the co-evolution of policy mixes and system innovation, such as for the case of technological innovation systems (e.g. [14] for offshore wind in Germany).

Research on policy mixes is also increasingly paying attention to the characteristics of policy mixes, although following different literatures with differences in terminology [15]. For example, policy design scholars have been using consistency, coherence and congruence as criteria to assess policy mixes in terms of the alignment of instruments and goals [9]. Drawing on contributions from different bodies of

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http://dx.doi.org/10.1016/j.erss.2017.09.013
Received 3 March 2017; Received in revised form 6 September 2017; Accepted 8 September 2017

literature based in environmental economics, innovation and policy studies, Rogge and Reichardt [4] have proposed an initial set of core policy mix characteristics which include the consistency of instrument mixes and policy strategies, the coherence of policy making and implementation processes, as well as the credibility and comprehensiveness of policy mixes. Initial qualitative evidence for offshore wind in Germany suggests that these policy mix characteristics play a key role for corporate innovation activities [16].

In this paper, we focus on the comprehensiveness of instrument mixes, thereby analysing how extensive and exhaustive a mix is [36; p. 1627]. One way of operationalising the idea of comprehensiveness is by determining if the instrument mix includes technology push, demand pull and systemic instruments [17,18]. It has also been suggested that comprehensiveness could be assessed according to the degree to which it addresses relevant failures and barriers [4,5] ([57,59]). Here, we contribute to this literature by proposing a novel way of operationalising the comprehensiveness of instrument mixes, specifically in the context of energy transitions. More specifically, and following earlier suggestions by Rogge and Reichardt [15], we argue that comprehensiveness of instrument mixes within specific policy sub-domains should also be assessed regarding technology/technological specificity, instrument types covered, and sector(s) addressed. We argue that especially understanding the technological specificity of instruments in the mix is a precondition for designing effective instrument mixes that support the full range of low-carbon solutions needed to achieve an ambitious energy transition, including low-cost and simple energy efficiency measures as well as high-cost and complex options. Against this background, in this paper we investigate how certain instruments within the mix consider complexity and technology cost.

Empirically, our paper focuses on energy efficiency policy because a key part of the energy transition will need to be delivered by improvements in energy efficiency, as acknowledged in decarbonisation scenarios by the International Energy Agency [1]. However, it has long been established that even cost-effective energy efficiency measures are often not taken up by consumers or businesses (the so-called 'energy efficiency gap'), and that therefore policy is needed to support their delivery [19–21]. In order to achieve the low-carbon pathways set out by the Paris Agreement and also at European and national level, the current uptake and ambition of energy efficiency improvements needs to improve significantly and much deeper and rapid decrease in energy use than is currently the case is required. A good example are buildings where current levels of low-carbon retrofits are far behind of what they need to be [22]. This means that policy needs to avoid just focusing on the easiest energy efficiency improvements (typically those with the lowest cost and easy to implement, e.g. loft insulation and energy efficient appliances and lighting) but also support more complex and costly solutions (such as industrial process optimisation and whole-house retrofits). We argue that such a step-change in a wide range of energy efficiency measures cannot be achieved through a single policy instrument. Instead, we argue that a well-targeted and comprehensive instrument mix is needed – something that so far has been neglected in existing studies on energy efficiency policy mixes (e.g. [13,12]).

In the remainder of the paper we first discuss the need for instrument mix analyses looking at technology specificity within the context of energy transitions and develop our analytical approach to assess comprehensiveness (Section 2). We then present the methodology employed to empirically investigate the variation within instrument mixes regarding the technological focus of instruments (Section 2). This is followed by a short overview of European energy efficiency policy provided in Section 4. In our results Section 5 we demonstrate empirically that different instrument types support quite different technologies with some variation across the different sectors (such as residential, service (including public), industry, and transport). We close the paper by providing concluding comments in Section 6.

## 2. Assessing energy efficiency instrument mixes: the importance of comprehensiveness

### 2.1. Existing strands of literature on policy mixes

So far, the majority of studies looking at the role of EU policy for innovation and energy efficiency have focused on single policy instruments and their role in achieving a greater uptake of energy efficient technologies. In reality, the EU itself and also most EU Member States employ a set of different energy efficiency policies rather than just one single instrument [13,12,23]. The idea that one policy instrument is used to address one particular policy goal (known as the Tinbergen rule) has long been discredited. Instead it is increasingly accepted in the academic literature that "[p]olicies increasingly come in complex packages and understanding the nature of design criteria for such portfolios of policies and instruments is increasingly important" [22; p. 1]. Energy policy is probably the domain most studied from a policy mix perspective [53], with a main focus on emissions trading schemes and renewable energy policies (e.g. [24,25,54]) and, to a lesser extent, energy efficiency [13,12]. However, even within this policy domain, papers analysing the instrument mix rather than individual instruments are scarce.

One strand of this policy mix research (mainly within economics) has focussed on interactions between two or more instruments. The main concern in this literature is that using several instruments to achieve the same policy objective, these instruments should be mutually supportive rather than undermining each other. Especially for targeting environmental problems it has been pointed out early on that a better approach than focussing on single instruments is to use combinations of instruments because no single instrument is "sufficiently flexible and resilient to be able to successfully address all environmental problems in all contexts" [19; p. 49]. Instead, good policy making will "seek to harness the strengths of individual mechanisms while compensating for their weaknesses by the use of additional instruments" [19; p. 49]. In their seminal work, these authors have developed typologies of different kinds of instrument mixes: (1) mixes that are inherently complementary; (2) mixes that are inherently incompatible; (3) mixes that are complementary if sequenced; and (4) mixes whose complementarity or otherwise is essentially context specific. Which instrument types can be used together and are seen inherently compatible or incompatible depends of the types of policy instruments, but its ex ante assessment needs to be interpreted with caution due to the context specificity of instrument interactions. Empirical analyses of the combined effects of policy instruments often focus on a small number of instruments or commonly just two instruments (e.g. [27,12,28]). However, most of these analyses are static and focus on interactions at one point in time, thereby making them less relevant when thinking about policy mixes for long term transformative change in the context of energy transitions.

Another strand of policy mix research focuses on the temporal dynamics of policy mixes. In the policy studies literature, the understanding of policy mixes goes beyond instrument interactions and has been defined as "complex arrangements of multiple goals and means which, in many cases, have developed incrementally over many years" [28; p. 395]. This literature starts from the observation that in most cases policy makers do not start with a 'blank slate' when developing policy but that any new policy goal or instrument introduced normally joins a patchwork of existing policy goals and instruments. This literature takes into account the empirical fact that most policy mixes evolve in a rather haphazard way rather than being consciously 'designed' by policy makers [8]. Of course, policy making processes are majorly influenced by politics, which also means that a priori there are no unambiguously 'good' mixes and that analysis should focus on the actors, instruments, institutions and interactions which shape public policy [6]. Nevertheless, research has analytically distinguished between different kinds of processes through which additional goals and