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Policy packaging or policy patching? The development of complex energy efficiency policy mixes

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ABSTRACT

The ambition of energy policy has long been to reduce carbon emissions, secure energy supply and provide affordable energy services. In recent years an increasing number of policy instruments have been introduced to promote energy efficiency in different sectors across the EU. While previous research has largely analysed the effectiveness of individual policy instruments and their impact on the diffusion of particular energy efficient technologies or practices, our analysis takes a broader view and examines the mix of existing policies aimed at stimulating reductions in energy use. The empirical focus of the paper is on policy goals and instruments aimed at stimulating energy efficiency in buildings in Finland and the United Kingdom (UK). We trace the development of the policy mixes during 2000–2014 and analyse their emerging overall characteristics. The analysis is based on a mapping of policy goals and instruments, documentary analysis and semi-structured interviews with stakeholders. We find that both countries have increasingly complex policy mixes, encompassing a variety of goals and instruments and make use of a range of different instrument types to encourage users to reduce their energy consumption. Despite the shared EU influence, the way in which the policy mixes have evolved in both countries were found to be quite different.

1. Introduction

Stimulating energy efficiency is an important part of many policy strategies aimed at addressing energy and climate policy objectives. The relative focus on energy efficiency has recently increased in many countries across Europe following EU initiatives [1]. According to the International Energy Agency (IEA), stimulating energy efficiency of buildings has a number of potential benefits which include public expenditure savings of around €30-40b across Europe as well as improved occupant health and well-being [2]. As buildings account for a 40% share of energy use in Europe, there is much potential for reducing their energy use. For example a study of the Swedish residential building stock found a maximum technical reduction potential in energy demand of 53% [3]. Similarly a study in Italy found that due to the poor quality of existing housing in the Piedmont region, potential energy savings of 77% could be achieved [4]. However, even cost effective solutions are often not taken up [5,6]. Thus, scholars have started to pay more attention to notions of a social potential for reducing energy use [7] and the limitations of the conventional physical-technical-economic model [8]. Given the identified energy efficiency gap, a range of policy instruments have been introduced in many countries to help increase energy efficiency [9].

Much existing energy policy research analyses the effectiveness of the different types of policy instruments [10], often focused on the impacts of selected instruments. We argue that less attention has been paid to the mixes of policies influencing building energy efficiency, which is an important gap given the high share of energy use in buildings. Murphy et al. [11] found that while policy instrument combinations addressing the energy performance of buildings exist, they appear rather ad hoc, often resulting from EU legislation and overlapping policy aims. This indicates that from an impacts perspective, studying real-life (rather than intended) policy mixes, including their evolution over time, is of importance [12,13]. Examples of previous studies include an analysis of EU countries' National Energy Efficiency Action Plans [14], a study of interaction effects across Dutch policy measures on household energy efficiency [15], and a study of interactions in building energy efficiency policy in 14 European countries [16]. These studies focus on the current state of policies. The literature has largely focused on the analysis of single policy instruments, pairwise instrument interactions or on deliberately designed mixes, and often only capture

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snap-shots in time. Therefore, we argue that further complementary analysis is needed to shed light on the complex, real world policy mixes, how they develop over time and their emerging characteristics such as consistency and coherence. This is important as it influences their potential performance. We also argue that our paper adds value to the existing literature by providing a comprehensive analysis of building energy efficiency policy mixes in two countries and by examining how they develop over time, rather than contributing to discussions trying to identify 'ideal' policy packages (cf [17]). In doing so, we agree with Flanagan et al. [18] that there are no unambiguously 'good' mixes.

Policy mixes are "*complex arrangements of multiple goals and means which, in many cases, have developed incrementally over many years*" [19]: 395. Policy goals can be defined as the "*strategic targets defined by poli*cy actors" [20]: 397, which are not static, coherent or always even hierarchical, but often a range of goals exist that can change over time and be in conflict [18]. Policy means or instruments are the concrete tools to achieve policy goals [21]. Drawing on previous literature on policy mixes within the field of policy design, this article examines the development of policy mixes relating to energy efficiency in buildings in Finland and the UK between 2000 and 2014. The aims of the article are: (1) to describe the development of the policy mixes in the two countries over time and (2) to analyse their emerging characteristics. Our novel insights relate to introducing a conceptual perspective on the evolution of policy mixes into energy policy debates and new empirical analysis regarding building energy efficiency policies in Finland and the United Kingdom (UK).

The remainder of the paper is organised as follows: Section 2 discusses the existing literature on policy mixes and energy efficiency policy and elaborates the conceptual framework. Section 3 details the methodology. Section 4 contains the empirical analysis. Section 5 discusses the main findings. Section 6 concludes.

2. Theoretical approach to policy mixes

2.1. Energy efficiency policies and policy mixes

Many existing studies on energy efficiency policy focus on the effectiveness of individual policy instruments (or a few instruments) such as energy audit programmes [22], energy performance certificates [23], energy performance regulation [24] or market based instruments such as the UK's Green Deal [25–27]. Furthermore, previous studies have often looked at energy efficiency policies' impact on the diffusion of particular technologies or consumer practices (e.g. [28,7]) or the effects of policies on technological innovation [29]. While studies on single instruments are valuable, it is also important to consider the wider context in which instruments are designed and implemented. In order to promote energy efficiency, a whole range of instruments is required which need to be implemented comprehensively [9]. For example, complementary policy instruments are required to create a structural market for energy saving [30], while evaluations of policy instruments should take into account that "*several different measures are usually required for an effective policy mix*" [31]: 75.

Over the last decade a small but growing literature on policy mixes or interactions between different energy efficiency instruments has emerged (e.g. see [15,17,32,13,33,16]). Boonekamp [15], for example, developed a qualitative matrix for assessing the interaction effects between 15 energy efficiency instruments. A European project looked at a range of policy instruments influencing energy efficiency in the industrial, transport and building sectors [34]. Recent work has examined the coherence of the EU's energy security and climate mitigation policies including energy efficiency [33]. Rosenow et al. [16] provide an analysis of selected building energy efficiency instruments in 14 European countries focussing on pairwise interactions of instruments at one point in time. They do not study the evolution of the overall policy mixes over time. In this literature, analysis of pairwise interactions often takes place through theoretical considerations (e.g. [32,16]), expert judgement or both (e.g. [17]). Costantini et al. [13] analyse the effects of energy efficiency policy mixes for the residential sector on patent applications and find a positive inducement effect. A good review of the literature on qualitative and quantitative methodologies employed for the appraisal of interacting energy and climate policies is provided by Spyridaki and Flamos [35].

Existing research shows that there are many problems associated with energy efficiency policy mixes. First, they are often an uncoordinated outcome of instruments stipulated by the EU and overlapping policy aims [11]. Second, the design of comprehensive energy efficiency policy mixes is complicated by the variety and complexity of end-users [1]. Third, policy mixes evolve, and there is an emerging literature on how policy mixes change over time and with what consequences for their potential effectiveness [18,19,36]. It is the latter challenge which the analysis in this article is contributing to (how mixes emerge and change over time), while others have recently contributed to an emerging literature on how to design an effective policy mix (e.g. [16]).

2.2. Conceptualising the development of policy mixes: policy packaging and policy patching

The existing literature on energy efficiency policy mixes focuses mainly on the ex-post evaluation of policy interactions. In contrast, the approach taken in this article is interested in an ex-ante assessment of policy mixes. This approach builds on the policy design literature which judges the potential effects of policy mixes on the basis of criteria such as consistency and coherence, and analyses why many existing policy mixes are sub-optional. Howlett and Rayner understand policy design as follows: "*how specific types of policy tools or instruments are bundled or combined in a principled manner into policy 'portfolios' or 'mixes' in an effort to attain policy goals*" ([37]: 172). We draw on Howlett and Rayner [37] who define consistency as "*the ability of multiple policy tools to reinforce rather than undermine each other in the pursuit of policy goals*" ([37]: 174). Coherence is the "*ability of multiple policy goals to co-exist with each other and with instrument norms in a logical fashion*" ([37]: 174). However, goals and instruments are added to and subtracted from the mix over time. Policy makers are not completely free in their choices as policy mixes are path-dependent and typically evolve through four processes: *layering*, *drift*, *conversion* and *replacement* [36,37,19].

Layering refers to the process of adding new policy goals and instruments to existing policy mixes without discarding previous measures [37]. Howlett and Rayner [36] argue that this often results in incoherence among goals and inconsistency of instruments. In turn, "*drift occurs when new goals replace old ones without changing the instruments used to implement them. These instruments then can become inconsistent with the new goals and most likely ineffective in achieving them*" [19]: 395. Third, "*[c]onversion involves the reverse situation whereby new instrument mixes evolve while holding old goals constant. If the old goals lack coherence, then changes in policy instruments may either reduce levels of implementation conflicts or enhance them, but are unlikely to succeed in matching means and ends of policy*" [19]: 395. Finally, *replacement* describes a process in which a conscious effort is made to fundamentally restructure both goals and instruments in a coherent and consistent manner by sweeping aside old elements and designing a new mix de novo [19,36]. However, Howlett and Rayner [37] note that empirically most existing policy mixes have developed through *layering, conversion* or *drift*, often resulting in inconsistent and incoherent policy mixes. Situa-

Table 1
Relationship between policy development processes and the expected coherence and consistency of a policy mix.

Goals	Instruments	
	Consistent	Inconsistent
Coherent	Replacement	Conversion
Incoherent	Drift	Layering

Source:Kern and Howlett [19]: 396.

Table 2
Components of a policy mix.

		High Level Abstraction	Programme Level Operationalisation
Policy Focus	Policy Aims	**Goals** *What general types of ideas govern policy development?* (e.g. environmental protection, economic development)	**Objectives** *What does policy formally aim to address?* (e.g. saving wilderness or species habitat, increasing harvesting levels to create processing jobs)
	Policy Instruments	**Instrument Logic** *What general norms guide implementation preferences?* (e.g. preferences for the use of coercive instruments, or moral suasion)	**Mechanisms** *What specific types of instruments are utilised?* (e.g. the use of different tools such as tax incentives, or public enterprises)

Source: Howlett and Rayner [37]: 176.

tions where new policy mixes are developed 'from scratch' are rare. Table 1 below summarises the relationship between policy development processes and the expected coherence and consistency of a policy mix.

Howlett and Rayner argue that policy (re-)design can thus be understood as two different types of processes: *policy packaging* or *policy patching*. *Policy packaging* refers to a policy design process in which previous policies are discarded and a new policy package is introduced (*replacement*) [37]. While many early policy design studies have a preference for this approach, Howlett and Rayner argue that processes of *layering*, *drift* and *conversion* can also be intentionally designed as a form of *policy patching*, "*much in the same way as software designers issue 'patches' for their operating systems and programmes in order to correct flaws or allow them to adapt to changing circumstances*" [37]: 177. The aim of both types of processes is the increased coherence of goals and consistency of instruments. Policy makers are also encouraged to use the full range of possible instruments "*rather than assuming that a choice must be made between only a few alternatives such as regulation versus market tools*" [37]: 175. We argue that where this is not the case, policy mixes are unlikely to be effective in meeting their goals. Studying the processes of how policy mixes evolve over time and the emerging overall policy mix characteristics in terms of their consistency and coherence can therefore be used as a proxy to assess likely policy outcomes ex ante. Table 2 summarises the different components of a policy mix.

3. Methodology

This article examines the development of building energy efficiency policy in Finland and the UK during 2000–2014. Analysing multiple cases is argued to provide a better test of the proposed framework than a single case study [38]. Finland and the UK were chosen as contrasting cases as they differ in a number of respects:

(1) While the UK was found to have a clear strategy for improving energy efficiency, policy progress between 2010 and 2013 was ranked from low to moderate; in contrast, Finland was ranked among the top three countries in terms of progress in energy efficiency policy [14].
(2) The countries also differ in energy consumption profiles, with the UK having one of the lowest energy consumptions per GDP among IEA countries [39] with Finland having one of the highest [40]. In Finland manufacturing is the largest energy consumer accounting for 47% of total consumption in 2015 while space heating of buildings accounts for 25% of the final consumption of energy [41], while in the UK domestic and non-domestic buildings together account for 49% of energy consumption [42]. The UK has one of the oldest building stocks in Europe, with 20% of its 26 million dwellings being over 100 years old and nearly 70% being built before 1946; in contrast, 60% of Finland's 2.5 million dwellings have been built since the 1970s and 90% since 1946 [43].

The countries differ in terms of population size and density, and climatic conditions. Thus, the two countries provide contrasting settings for the analysis of energy efficiency policy while both being EU members. A shortcoming of this selection rationale, based on contrasts, is that testing the role that national institutional contexts play in shaping policy is more difficult, because the cases differ in many aspects in addition to their institutional contexts. However, this is not the primary motivation of this article.

The data on which our analysis is based was collected from a number of sources outlined below.

1. A systematic review of national energy policy documents, reports, IEA documents, and databases was used to identify building-related policy goals and instruments. These included the IEA policies and measures databases on energy efficiency[1]; IEA country reviews [44–47,39,40], the European Environmental Agency's database on climate change mitigation policies and measures in Europe[2]; the IEA Sustainable Buildings Centre's Building Energy Efficiency Policies database[3] and the ODYSSEE-MURE database.[4]
2. An Excel spreadsheet and a timeline of policy instruments in place in late 2014 in each country was used to analyse the overall characteristics of the policy mixes. In addition, policy instruments removed since 2000 were identified from IEA country reviews and the ODYSEEE-MURE database, while research programmes ended since 2000 in Finland were identified from information on the website of the Finnish Funding Agency for Innovation Tekes.[5] The collected information was used to trace policy developments over time.
3. Stakeholder interviews were used to cross-check the list of policy instruments and elicit information about the development of the policy mixes. A total of 19 semi-structured interviews were conducted with stakeholders who have expertise in energy efficiency in buildings, including representatives of the building industry, technical experts, energy agencies, civil servants and NGOs (see Appendix A). Interviewees were asked about their views on the respective country's building energy efficiency policies. All interviews were recorded, transcribed and coded using NVivo software. Data analysis was conducted using an open coding process based on the analytical framework with triangulation

[1] http://www.iea.org/policiesandmeasures/.
[2] http://www.eea.europa.eu/data-and-maps/pam/.
[3] http://www.iea.org/beep/.
[4] http://www.measures-odyssee-mure.eu/topics-energy-efficiency-policy.asp.
[5] http://www.tekes.fi/en/programmes-and-services/tekes-programmes/.

Table 3
Development of Finnish energy efficiency goals in buildings.

	Policy content	
	High Level Abstraction Goals *What general types of ideas govern policy development?*	Programme Level Operationalisation Objectives *What does policy formally aim to address?*
2000–2002	Climate change mitigation (for the first time) as an energy policy goal co-exist with economic and employment goals [52]	"Building requirements will be tightened so that the heat energy consumption of new buildings is approximately 30 percent lower than the current level of requirements" [48].
2003–2006	Development of energy and environmental taxation, principle of 'ecological tax renewal' [53] To secure the supply of competitive energy and at the same time fulfil the requirements set by international environmental commitments [53]	"The long term objective of energy saving measures is to halt growth in the total consumption of primary energy and turn it to decline" "Energy efficient and low energy building will be promoted" [54]
2007–2010	Climate change mitigation as a prominent goal (first of the list) in energy policy [55]. Emphasis on bioenergy as a principal solution to energy and climate problems [55].	"To save energy and improve efficiency it is important to draft a tightened energy saving programme by end of 2008. As part of that, e.g., building energy efficiency, energy saving agreement procedures... must be developed. Additional funding for energy saving is safeguarded." ([55]: 44) "The Council of State sets as the strategic objective of Finland to halt growth in the total consumption of primary energy and turn it to decline so that the primary energy consumption in year 2020 would be circa 310 TWH i.e. more than 10% smaller than in business as usual." "Building energy-efficiency requirements will be tightened circa 30% in 2010 compared to the current level or requirements"
2011–2013	Energy tax renewal, lowering industrial energy tax rates to boost employment and competitiveness; focus on innovation and clean tech [51] Carbon-neutral society as a long term goal	"To improve building energy efficiency through regulation and other steering and by creating incentives. To draft a road map for building energy efficiency regulation with an aim of near zero energy building by 2020. The roadmap aims for enforcement of regulation as larger mixes." "To increase education and research in energy efficient building and renovation" ([51]: 71) "An overarching goal to halt, and reverse, growth in final energy consumption... an ambitious target to limit final energy consumption to 310 TWh in 2020." ([40]: 44)

from different sources of evidence. One of the limitations of the analysis is that it only covers national level policies (i.e. the horizontal policy mix), while European or local policies are not covered (i.e. the analysis of the vertical policy mix is beyond the scope of the analysis), unless they directly drive the development of national policy schemes (as is the case with several EU directives).

4. Building-related energy efficiency policy mixes in Finland and the United Kingdom: analysis

4.1. Finland

4.1.1. Background

At present, "*Finland's building stock is relatively energy-efficient as the cold climate has naturally encouraged the adoption of energy-efficient technologies...guided by national legislation since 1976*" [40]: 50. Typical measures include triple glazing, minimum efficiency performance standards for building components, and use of fuel-efficient district heating. However, the sector is faced with challenges from "*high-carbon heating fuels in non-district heated properties*" [40]: 35. The responsibility for climate and energy policy is distributed across several ministries. The Ministry of Employment and Economy (MEE) oversees energy policy, including energy efficiency. The Ministry of the Environment (MOE) has responsibility for building regulations and renovation grants, while the administration of grants is under the Housing Finance and Development Centre (ARA). The Energy Authority is responsible for the implementation of energy efficiency agreements, energy audits, design and labelling of products, as well as providing guidance on energy related issues. In addition Motiva, a government-owned company, promotes energy saving to consumers and businesses.

4.1.2. Development of building-related energy efficiency policy goals

The policy goal development during 2000–2014 can be described as incremental improvement towards increased energy efficiency and zero carbon buildings. The policy objectives of reducing energy demand relate to two overarching energy policy goals: maintaining security of energy supply and mitigating climate change. Aside from diversifying the energy supply mix, reducing energy use has been the way to avoid dependence on energy imports in a country with limited indigenous resources [40].

Policy goals and objectives have been described in a number of climate (and energy) strategies since 2001 [48–50] and in specific energy efficiency action plans and decisions in 2000 and 2010. Government programmes published by each new government have been crucial in setting goals and objectives. A long term, non-quantitative and rather unspecific objective of halting and reversing growth in energy consumption has prevailed since the early 2000s. In terms of new buildings, a target of an additional 30% improvement in energy efficiency has been set four times in 2003, 2008, 2010 and 2012. In 2011 Finland adopted the objectives of improving the existing building stock and introducing near zero carbon new buildings by 2020 [51].

The latest Climate and Energy Strategy of 2013 highlighted, one, the development of a long-term plan for building energy efficiency and, two, addressing the energy efficiency of government buildings [50]. The new Energy Efficiency Act (HE 182/2014) set general targets to improve energy efficiency by 9% by 2016 and 20% by 2020. The 2016 target has already been met in 2013 and the achievement of the 2020 target has been estimated to be very likely [50].

Apart from the above objectives, the government programmes and strategies set long lists of specific policy instruments to be implemented rather than presenting more general objectives. This means that the overall goals have remained rather similar over the studied period. For details on the development of Finnish energy

Table 4
Development of Finnish policy instruments.

Policy Instruments	Instrument Logic	Mechanisms
	What general norms guide implementation preferences? (e.g. preferences for the use of coercive instruments, or moral suasion)	*What specific types of instruments are utilized?* (e.g. the use of different tools such as tax incentives, or public enterprises)
Changes between 2000 and 2014	Coercive instruments as principal means have played a key role (in new build) while at the same time voluntary measures have received particular attention in Finland (existing buildings). Very recently government preference changed towards additional coercive measures for both new and existing buildings largely due to EU pressure.	Mix of regulatory, economic and voluntary measures has been a key strategy. However, due to economic pressure on the government the role of subsidies has weakened over the timeframe of the analysis.

efficiency goals and objectives related to buildings, please see Table 3.

The two overarching goals of climate change mitigation and reducing dependence on energy imports are seen as complementary from the perspective of building energy efficiency. The change in the specific building energy efficiency objectives towards the end of the studied period highlights an improved *coherence* between tightened energy efficiency requirements for new buildings and the aspirations to improve existing building stock by encouraging the use of alternatives to fossil-fuel based heating. This has also been reflected in a change in overall policy goals, which recognise that climate change and the requirements to reduce emissions are integral rather than something to be questioned (interviewee FIN4), visible also in the integration of energy efficiency into the Strategy for Renovation in 2007 [56]. However, concerns have also been raised by some interviewees about the incoherence of goals towards highly energy efficient buildings and healthy living due to potential indoor air quality implications of improved energy efficiency if not properly carried out or combined with effective ventilation (FIN5, FIN7). Besides this, no significant incoherence of goals was identified. Cross-departmental working groups are used by the government administration as means to maintain coherence [39].

4.1.3. Development of building-related energy efficiency policy instruments

We identified a total of 36 policy instruments, which were in force to influence building energy efficiency in 2014: heating specific (9), electricity specific (4), covering electricity and heating (8), and cross-sectoral (15) policy instruments. Fig. 1 illustrates changes in policy instruments regarding building energy efficiency between 2000 and 2014.

Finland uses a mix of different types of policy instruments to address building energy efficiency, including economic (subsidies, public procurement, research & development (R&D) support and taxation), regulatory and 'soft' instruments (information and voluntary measures). Key trends are summarised in Table 4.

While some more traditional instruments, such as building regulations and energy conservation agreements have been updated, also new types of policy instruments have been added, including various innovation and advice focused instruments, as well as subsidies.

For addressing existing buildings, subsidies to encourage renovation have been important (FIN6). The government has also encouraged the switching to low carbon heating fuels such as biomass wood fuels, ground source heat pumps and solar heating (e.g. 2003 subsidy for replacing oil-based heating systems and 2011 subsidy for efficient wood-fuelled heating systems), while at the same time discouraging the use of fossil fuel based heating fuels through taxation (the 1996 electricity tax also addresses heating fuels). One key feature of the policy mix since the late 1990s has been the use of voluntary agreements to encourage the uptake of energy efficiency measures in different sectors. While not solely limited to existing buildings, the agreements have mainly addressed renovation of existing buildings (FIN8). By 2010, 80% of Finland's total energy consumption was covered by the agreements [40]. A regulatory approach to address energy efficiency in the renovation of existing buildings was added to the mix as late as 2013.

New buildings have been addressed through regulatory instruments, predominantly the National Building Code, introduced in 1975 and the Land Use and Building Act of 1999. The Building Code has been tightened several times, with additional 30% increases in energy efficiency requirements added in 2003, 2008, 2010 and 2012 respectively. Tightening building regulations have marked a clear downward trend in the energy consumption of new buildings since 2000 [57]. The 2012 update also included a requirement that the calculation of building energy use is to be based on total primary energy use, with house builders able to choose the measures to meet those criteria, including renewable energy generation. This change in building regulations was significant according to interviewees (FIN3, FIN4, FIN8, FIN9), as the Building Code is now also used to encourage renewable energy.

In addition, various information instruments have been developed by different actors, including MEE, MOE and Motiva addressing both existing and new buildings. These have spanned different sectors including government departments, small to medium size enterprises and householders. Sitra, the Finnish Innovation Fund established a National Consumers Energy Advice Network & Architecture in 2010. The information and advice aimed at households has focused on aiding renovation designs to ensure that households can find best options before undertaking projects, rather than having to change installations retrospectively (FIN8).

The significant increases in regulatory demands since 2000 were driven by EU policy (e.g. through the 2007 Act on Building Energy Certification) and domestic objectives (e.g. those stated in the 2010 Government decision on energy efficiency), indicating a trend towards an increased role of regulation in the overall policy mix. The process of introducing new measures and specifications has been relatively fast-paced, especially since 2008, with the increased focus on the importance of tackling climate change as well as regulation coming from the EU (FIN4). This is confirmed by Fig. 1 and Table 5.

Our data (summarised in Table 5) shows that Finland introduced 31 new policy instruments between 2000 and 2014, while 11 instruments were removed. Instruments no longer in place include mainly fixed-term R&D programmes (5), information provision (3) and some grant schemes (2). New R&D programmes have also been introduced, such as the Built Environment SHOK in 2009, the Future of Living and Housing Programme and the Green Growth Programme in 2011. For information provision, there has been a reducing trend (FIN5, FIN8). Despite the establishment of the Consumer Energy Advice Network & Architecture in 2010, the funding available for energy efficiency advice on the ground remained the same during 2012 and 2014, and further cuts were proposed (FIN5), undoing some of the long term information provision that Finnish policy making had advocated in the past. Interviewees considered the incorporation of advice as a crucial part of the overall mix complementing regulatory and economic instruments (FIN7, FIN9).

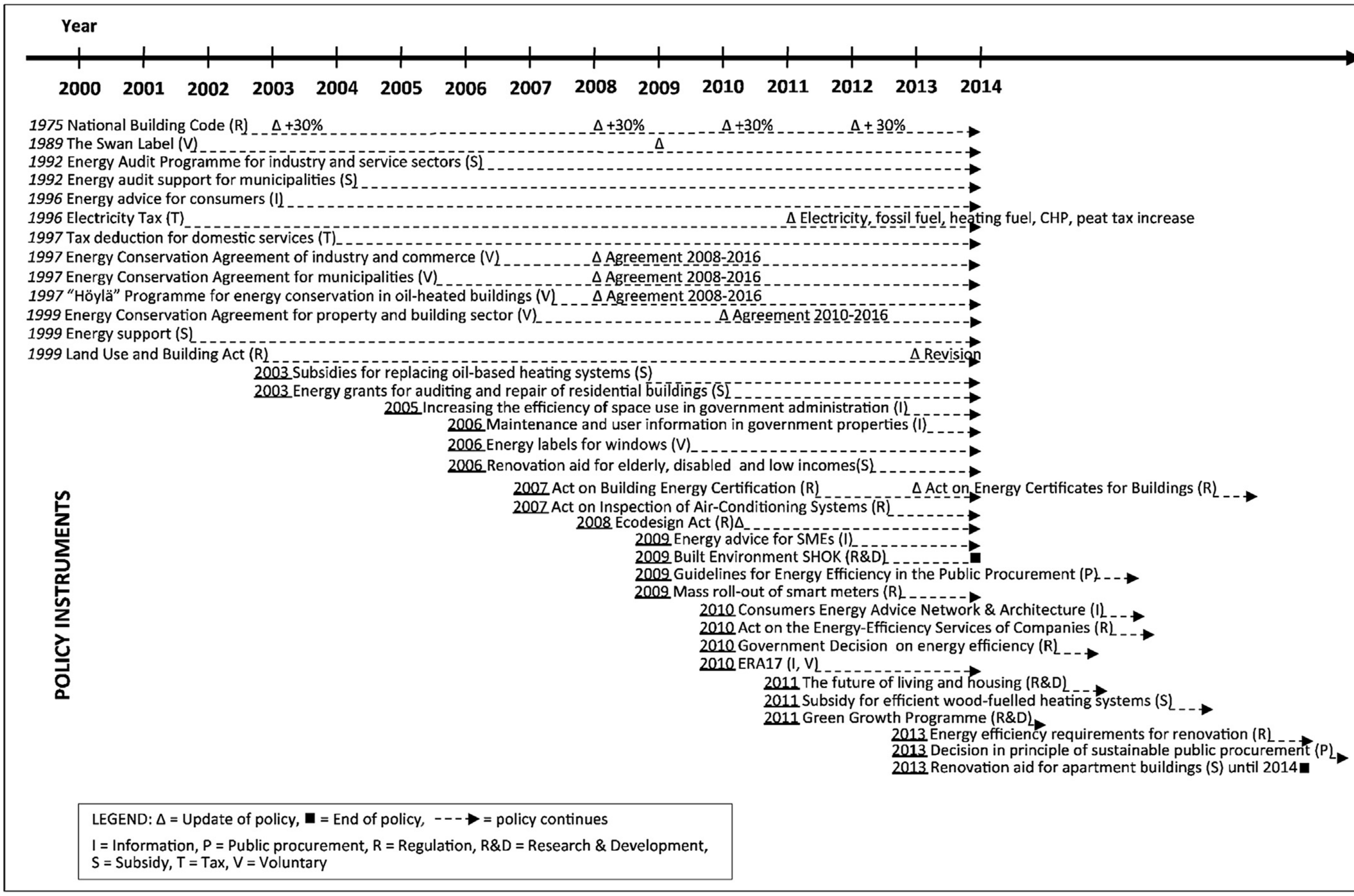

Fig. 1. The development of the Finnish policy instruments for building energy efficiency, 2000–2014.

Several energy subsidies have been cut following pressures on public finances and reduction of government spending on energy efficiency (FIN3). For example, energy grants for energy efficiency improvements were available to all households in 2011 but they were reduced and are now only available to those on low incomes, the elderly and disabled (FIN6). This was possibly due to the government wanting to support only those who cannot otherwise afford energy efficiency measures (FIN6). The remaining subsidies relate to fuel poverty[6] mitigation objective, while this is not typically explicitly voiced in Finnish policy dialogue.

The development of instruments has largely been *consistent*, benefitting from cross-ministry coordination [39] and the creation of the ERA17 Action Programme on Energy Smart Built Environment that was launched in 2010 by the Ministry of the Environment jointly with Sitra and the Finnish Funding Agency for Technology and Innovation, Tekes. The programme has effectively brought together 31 different policy instruments – some already in place and some proposed – and actors around building energy efficiency aiming to create a coordinated policy mix to advance energy efficiency. It has benefitted from the longer term focus over three government periods due to the involvement of Sitra and Tekes and is seen as an action that is intended to create synergies between the various policy instruments influencing energy efficiency in the built environment. Besides ERA17, particularly the combination of subsidies and regulations with advice and other informational instruments has been perceived as being supportive of consistency (FIN7).

4.1.4. Characteristics of the developing Finnish policy mix, 2000–2014

Our analysis shows that the development of the policy mix tended to follow a *replacement* process in the form of coherent long-term policy goals and (increasing) consistency of the instrument mix used to implement them. However, the findings do not chime completely with Howlett and Rayner's conceptualisation of *replacement* through *policy packaging*: instead of a complete overhaul of the mix, the development resembles *policy patching* by adopting mechanisms to create synergistic mixes of both existing and new policies (such as the ERA17 Programme). This seems to have led to a policy mix with some promise of effectiveness – at least from an ex-ante perspective. However, an element of *layering* still exists as many more instruments have been added than removed (see Table 5).

Howlett and Rayner [36,37] argue that *policy patching* can lead to incoherent policy mixes. Despite evidence of *policy patching* in the Finnish policy mix, interviewees felt that the building energy efficiency policy mix in Finland has worked relatively well, especially in terms of requirements for new buildings (FIN1), though there has also been much undoing of efforts, especially in terms of removing instruments, such as information provision (FIN5). The need for consistent information and advice has also been newly recognised by the Finnish government, as highlighted in the Energy

[6] Fuel poverty is generally understood as a household having to spend >10% of their income to keep their home adequately heated (21 °C in living rooms, 18 °C in other rooms). Since 2013, fuel poverty in England has been measured by the Low Income High Costs definition. Under this definition a household is fuel poor if they have required fuel costs that are above average (the national median level), and were they to spend that amount, they would be left with a residual income below the official poverty line [76].

Table 5
Trends in Finnish policy instruments.

Year	Instruments introduced since 2000	Instruments removed since 2000
2001		1997–2001 Research Programme on Energy Conservation Decisions and Behaviour (LINKKI 2), Ministry for Trade and Industry, €0.7 million (R&D)
2002	TEKES Building Services Technology Programme (CUBE) to improve energy performance and comfort for residential and non-residential buildings (R&D) Climate Change Communications Programme, Motiva (I) Voluntary Energy Conservation Agreement of Municipal and Non-profit Housing Properties of ASRA (V)	
2003	Subsidies for replacing oil-based heating systems (S) Energy grants for auditing and repair of residential buildings, ARA (S) Energy Grants by ARA for the uptake of renewable energy (S)	
2005	Increasing the efficiency of space use in government administration (I) Energy-Efficient Home campaign, Motiva (I)	1996–2005 Energy Experts training programme, Motiva (I) 2003–2005 Energy grants by ARA, for up to 40% of energy audits and up to 10–15% of investments related to energy efficiency (e.g. insulation, windows, ventilation, heating systems incl. renewables, connection to district heating, boilers, heat pumps; for residential buildings with minimum of three flat (S)
2006	Maintenance and user information in government properties (I) Energy labels for windows (V) Renovation aid for elderly and disabled (S)	2002–2006 TEKES Building Services Technology Programme (CUBE) to improve energy performance and comfort for residential and non-residential buildings (R&D)
2007	Act on Building Energy Certification (R) Act on Inspection of Air-Conditioning Systems (R) TEKES Sustainable Community programme (R&D) TEKES Functional Materials programme (R&D)	2002–2007 Climate Change Communications Programme, Motiva (I)
2008	Ecodesign Act (R) Sitra Energy Programme (R&D)	2005–2008 Energy-Efficient Home campaign, Motiva (I)
2009	Energy advice for SMEs (I) Built Environment SHOK (R&D) Guidelines for Energy Efficiency in the Public Procurement (P) Mass roll-out of smart meters (R)	
2010	Consumers Energy Advice Network & Architecture (I) Act on the Energy-Efficiency Services of Companies (R) Government Decision on energy efficiency (R) ERA17 (I, V)	
2011	The future of living and housing (R&D) Subsidy for efficient wood-fuelled heating systems (S) Green Growth Programme (R&D)	
2012		2002–2012 Voluntary Energy Conservation Agreement of Municipal and Non-profit Housing Properties of ASRA (V) 2007–2012 Tekes Sustainable Community programme (R&D) 2008–2012 Sitra Energy Programme (R&D)
2013	Energy efficiency requirements for renovation (R) Decision in principle of sustainable public procurement (P) Renovation aid for apartment buildings (S)	2007–2013 TEKES Functional Materials programme (R&D) 2003–2013 Energy Grants by ARA for the uptake of renewable energy (S)
Total	31 new instruments	11 instruments removed

Legend: I = Information, P = Public Procurement, R = Regulation, R&D = Research&Development, S = Subsidy, T = Tax, V = Voluntary.

and Climate Roadmap, published in 2014 [58]. Overall the findings indicate that *policy patching* can be an equally – if not more – promising strategy, as it provides some long term policy continuity that is important, for example, for innovation. However, the recent removal of instruments related to both advice and funding for building energy efficiency, creates gaps and reduces existing synergies in the policy mix.

4.2. UK

4.2.1. Background

While the UK has one of the lowest energy use per unit of GDP among IEA countries, there "*is significant potential for higher efficiency, in particular in the building sector*" [36][36]: 15. Given that two thirds of the existing building stock is estimated to still be in existence in 2050 [59], improving the energy efficiency of existing buildings is an important task. Several departments have responsibility for building energy efficiency [42]. Overall responsibility for energy efficiency has been with the Department of Energy and Climate Change (DECC).[7] The Department for Communities and Local Government (DCLG) is responsible for minimum energy performance requirements for new buildings. The energy sector regulator Ofgem is responsible for the administration of household energy efficiency schemes. Some programmes were delivered by the Carbon Trust (business energy efficiency) or the Energy Saving Trust (domestic energy efficiency).

4.2.2. Development of building-related energy efficiency policy goals

Over the period 2000–2014 the government introduced a range of goals and objectives, but primarily building energy efficiency was seen as important for tackling fuel poverty and contributing to carbon reduction targets (see Table 6). Since 2000, several policy strategies have highlighted the importance of energy efficiency, including the 2003 Energy White Paper and the 2008 Climate Change Act which set a legally binding target to reduce emissions

[7] Now it is with the new Department for Business, Energy and Industrial Strategy.

Table 6
Development of UK building-related energy efficiency policy goals and objectives.

	Policy content	
	High Level Abstraction Goals *What general types of ideas govern policy development?*	Programme Level Operationalisation Objectives *What does policy formally aim to address?*
2000–2001	A mix of instruments including regulation, sector-specific voluntary agreements, information/advice and economic instruments as well as action in public sector buildings is required [60].	All social housing should meet established standards of decency by 2010 ([60]; [46]: 73) Reducing greenhouse gas emissions from public sector buildings by 1% per annum compared against 1999–2000 levels [44] 2001: Target to eradicate fuel poverty in vulnerable households in England by 2010 [46]: 76
2001–2005	Energy efficiency in buildings is important in order to reduce carbon emissions and fuel poverty [44]: 7. "the cheapest, cleanest and safest way of addressing our energy policy objectives is to use less energy" [61]. 'Value for tax payers' money' is important for energy efficiency programmes (e.g. [44]: 60). Building regulations are important for new built, but other instruments are needed to tackle existing buildings, such as incentivising insulation [62] Commitment to tightening building standards every five years [62]	Progressively improve building standards, increase insulation, increase the use of energy efficient lighting [61]. Half of the expected emissions reductions through to 2020 should come from improved efficiency [61]. Eradicate all fuel poverty by 2016–2018 [61]. "A new aim to secure annual carbon savings from the household sector in the UK of around 4.2 million tonnes by 2010" [62]. Energy efficiency can achieve carbon savings of around 10 MtC by 2020, beyond those delivered by 2010. This could be split roughly equally between households (4–6 MtC) and the business and public sectors (4–6 MtC) [62]. Cutting carbon emissions of central government estate by some 29% between 1990 and 2011 [62].
2005–2007	long-term ambition of making all new developments carbon neutral [63] Government needs to respond to different market failures in different ways. A package of measures will be the most effective approach [63]	2006: any new domestic buildings needs to be zero carbon from 2016 onwards [64]
2007–2010	2009: Increasing recognition that a 'whole house' approach is required to make homes zero carbon	2009: Any new non-domestic building needs to be zero carbon from 2019 onwards [65] 2009: new public sector buildings to be zero carbon from 2018 and for all schools to be zero carbon by 2016 [65] 2009: cut emissions from homes by 29% on 2008 levels by 2020, by 2050 emissions from homes need to be almost zero [65] 2009: by 2030 all homes will have undergone a 'whole house' package including all cost-effective energy saving measures, plus renewable and low-carbon heat and electricity measures as appropriate [65]
2010–2014	2014: Bringing as many residential and commercial buildings as possible up to a high level of energy performance is a priority DECC, 2014	2011: By 2027, based on the scenarios set out in this plan, emissions from buildings should be between 24% and 39% lower than 2009 levels. ([59]: 6) 2012: 18% reduction in final energy consumption across all sectors, relative to the 2007 business-as-usual projection ([42]: 5) 2014: government introduced the objective of ensuring that as many as is reasonably practicable of the homes of persons in England living in fuel poverty have an energy efficiency rating of Band C by 2030 [66]

by 80% by 2050 [59]. The 2006 Energy Challenge report added the objective to introduce zero carbon new domestic buildings from 2016 onwards, providing a long-term vision for policy and the building industry (UK2) in response to which, designers started to explore how to improve fabric insulation, reduce the need for space heating, and incorporate renewable energy technologies into building design and operation (UK10). In 2009 the government announced that by 2019 also all new non-domestic buildings would be zero carbon [65]. Since then a variety of policy documents, such as the 2011 Carbon Plan, have stressed the importance of energy efficiency in meeting the UK's emission reduction targets [59].

Alongside the commitment to carbon reductions, the government also sees building energy efficiency as key to tackling fuel poverty. The 2001 UK Fuel Poverty Strategy set the goal to eradicate fuel poverty in vulnerable households[8] in England by 2010 [67], while the 2003 Energy Review aimed to help eradicate fuel poverty altogether by 2016–2018 [61].

The government's approach to building energy efficiency has been guided by ideas around the need for a mix of instruments (see Table 6) and sees energy efficiency as one of the most cost effective ways of meeting energy policy goals (e.g. [62].

[8] Vulnerable households are defined as older households, families with children and householders who are disabled or have a long-term illness.

In terms of the *coherence* of policy goals, one of the issues is whether it is possible to address climate change concerns in a cost effective way while also ensuring the affordability of energy bills. Both goals inform policy but the IEA has criticised that mixing social goals into energy efficiency policy is at odds with designing cost effective carbon reduction policies [46]: 16–17. Similarly, there is an incoherence between the goal of tackling fuel poverty and stimulating energy efficiency in the residential sector by internalising external costs. For social policy reasons, the government has been reluctant to introduce policies that raise fuel bills and so the use of economic instruments in the domestic sector is largely ruled out (e.g. see [60]). For example the domestic sector was explicitly exempted from the 2001 Climate Change Levy because it was seen to be counterproductive to achieving the goals of the fuel poverty strategy [44]. The 2009 Transition Plan changed this focus and acknowledged that the policies in the plan will contribute to household bill increases. More recently however, energy efficiency instruments were cut because they were argued to add to consumer energy bills (UK1, UK5, UK7), which became a contentious political issue in 2013 [68]. In addition, the IEA has repeatedly criticised that UK energy efficiency policy has been pursued too much from a climate change perspective, rather than from a broader perspective including security of supply concerns [46,39]. Interview evidence confirmed that whereas energy security has been one of the overarching goals of UK energy policy, it has not featured prominently in building energy efficiency policy (UK1, UK2, UK3). There is also a tension between the ambition of the government to significantly increase the number of new homes being built, given the increase in house prices in the UK, and stringent zero carbon homes targets that increase the price of new built homes (UK10). Similar to the Finnish case there was also a concern raised that high insulation standards can lead to air quality deterioration in cases of ineffective ventilation and to summertime overheating of buildings through unwanted solar gain (UK10).

Overall, it seems that at least some of the goals of UK building energy efficiency policy are difficult to achieve simultaneously and are therefore argued to be *incoherent*. Policy ambitions increased over time for example with the introduction of the zero carbon buildings objectives.[9] Some objectives were also 'downgraded', such as the commitment to eradicate fuel poverty, which was reformulated as homes of people living in fuel poverty achieving at least a Band C energy efficiency rating by 2030 [66]. The latest progress report by the Climate Change Committee pointed out that there has been very limited progress in reducing emissions from buildings because of a slow uptake of low carbon technologies and behaviours [69]: 13.

4.2.3. Development of building-related energy efficiency policy instruments

In total 38 policy instruments to influence building energy efficiency, in force at the end of 2014, were identified in our review: heating specific instruments (12), electricity-specific instruments (5), instruments covering both electricity and heating (14), and cross-sectoral policy instruments (7). Fig. 2 summarises developments between 2000 and 2014.

Our analysis shows that there is a high level of awareness amongst policy makers that a policy mix (e.g. [62,63]), or a package of policies (e.g. [70]), is needed: this mix is mainly thought of in terms of: instruments targeted a) at different domains such as electricity use or heating, b) at different groups (households, industry or public sector), c) at either new or existing buildings and d) using different types of instruments. Types of policy instruments to improve building energy efficiency include funding, information, loans, public procurement, regulation, subsidies, taxation and voluntary instruments. An initial emphasis on voluntary measures (such as the Climate Change Agreements or the Code for Sustainable Homes) has given way to a more regulatory approach (with a focus on supplier obligations and strengthened building regulations) as well as market-based instruments such as the Green Deal[10] offering loans for energy efficiency measures (see Table 7 and Fig. 2). According to interviewees these shifts have been driven by the Conservative party ideology that markets, not government or the tax payer, should pay for energy efficiency measures (UK4, UK6) and that deregulation is necessary (UK10). Analysts have argued that for the first time the government placed more weight on markets to deliver energy efficiency measures based on voluntary action by the consumer, rather than on an energy supplier obligation [72].

Existing domestic buildings form the bulk of the UK's housing stock and many types of instruments have been introduced to improve the insulation of those properties, including regulation, subsidies and loans. However, retrofitting is challenging as, for example, homeowners are often faced with balancing improvements in the building fabric with a range of heritage and aesthetic concerns [73]. Both the 2004 and 2007 Energy Efficiency Action Plans highlight supplier obligations as the principal policy mechanism to deliver energy savings in the domestic sector [71]. The government implemented a succession of these schemes including the Energy Efficiency Standards of Performance (EESoP), the Energy Efficiency Commitment (EEC1 and EEC2), the Carbon Emission Reduction Commitment (CERT), and the Energy Companies Obligation (ECO). EEC mandated that at least 50% of the savings had to come from priority groups, mainly from low-income households. In CERT, the low-income group requirement was reduced to 40% [74]. ECO has been largely aimed at those on low incomes, while people more able to pay had access to loans through the Green Deal. Funding for domestic energy efficiency measures has also been available through programmes targeted at fuel poverty (e.g. Decent Homes and Warm Front).

Table 7
Changes in instrument logic and mechanisms between 2000 and 2014.

Policy Instruments	Instrument Logic	Mechanisms
	What general norms guide implementation preferences? (e.g. preferences for the use of coercive instruments, or moral suasion)	*What specific types of instruments are utilized?* (e.g. the use of different tools such as tax incentives, or public enterprises)
Changes between 2000 and 2014	Use of a range of instruments incl. financial incentives and minimum standards through building regulations in residential and commercial sector [44]. Use of both mandatory and voluntary approaches but with an emphasis on voluntary ones [44]:70. This focus has changed later with a series of supplier obligations (EEC1-2, CERT, ECO) becoming the principle policy driver in the household sector [71]. Most recently focus has changed to market-instruments such as Green Deal [72].	Both the 2004 and 2007 Energy Efficiency Action Plan highlight supplier obligations (EEC, CERT, ECO) as the principal policy mechanism to deliver energy savings in existing buildings in the domestic sector [62,71,46]. The warm front scheme is considered the "key tool for tackling fuel poverty in the private sector" [46]: 76.

In terms of new buildings, energy efficiency has mainly been addressed by regulatory instruments (UK10), e.g. through updating building regulations, which have been tightened several times (in 2000, 2005, 2006, 2010 and 2013). Informational and voluntary instruments have been used in a relatively limited way. Examples of informational instruments include the Climate Change Communications Initiative (2005) and the 'Act on CO_2' campaign (2007).

Table 8 summarises which instruments were added to and removed from the building related energy efficiency policy mix between 2000 and 2014. 50 instruments were added during this time, while 22 instruments were removed.

Our analysis shows, first, the increased importance of energy efficiency over time with a variety of new instruments introduced which can be seen as evidence of a targeted and increasingly comprehensive policy mix. Second, it also shows that there is quite a lot of 'churn', with many instruments coming to an end, then being extended (e.g. EEC 1 and 2), or being replaced by similar schemes (e.g. Warm Front replaced by ECO; EEC being replaced by CERT) increasing uncertainty for stakeholders and households. Third, the addition of more and more instruments also increases the challenge of ensuring consistency. In 2002 the IEA already warned that the variety of energy efficiency programmes needs to be well coordinated to be effective ([46]: 70). In its 2006 report the IEA again picked up on this tension but concluded: "*While such a wide range*

[9] The analysis covers the time period 2000–2014. Since then, in July 2015, the zero carbon buildings objectives have been abandoned.

[10] It should be noted that the analysis covers the time period 2000–2014. The Green Deal was removed in July 2015.

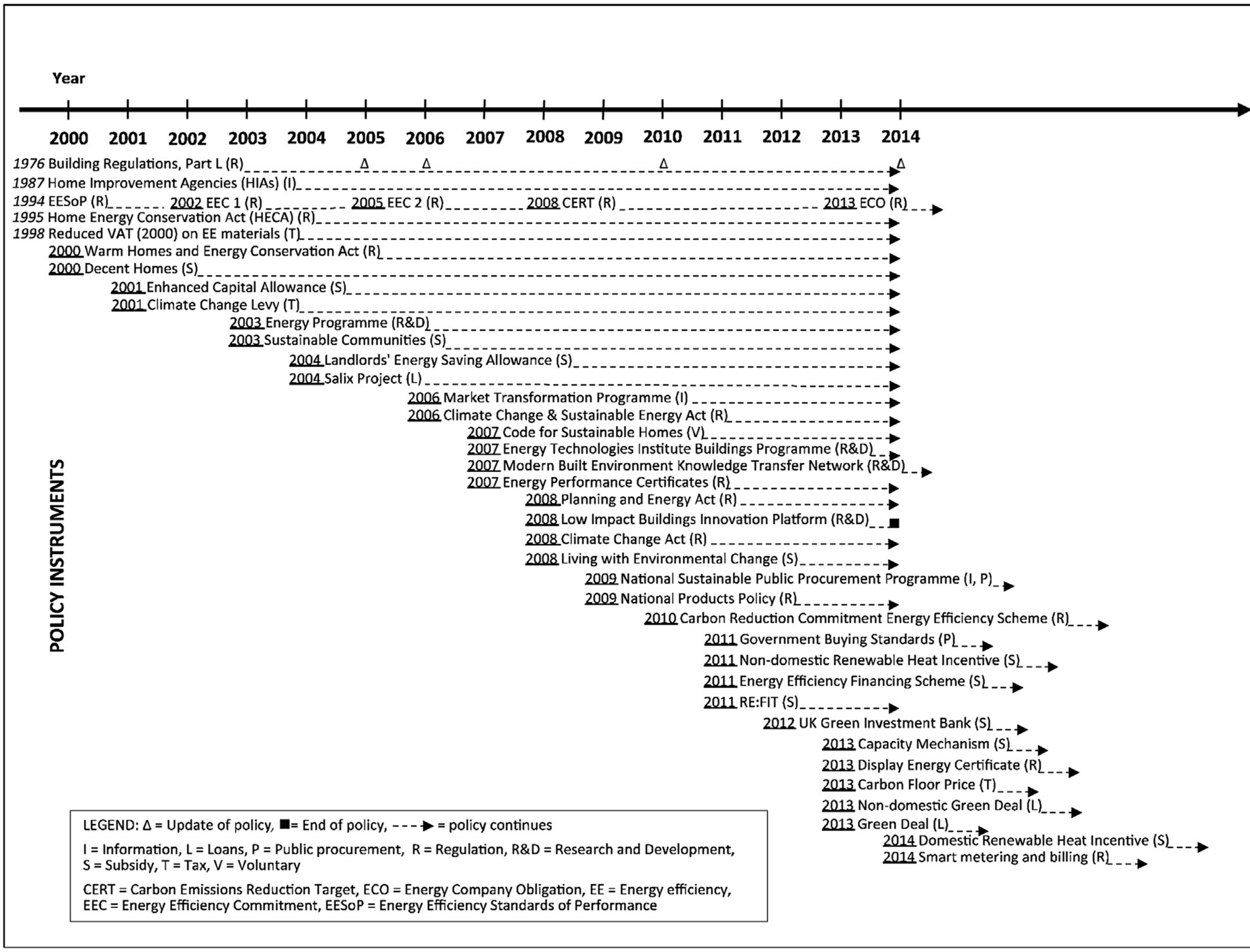

Fig. 2. The development of the UK policy instruments for building energy efficiency, 2000–2014.

of measures and programmes may lead to complications, dispersion of resources and occasional bureaucratic infighting, it also allows each programme to specialise in a particular area and to operate more independently and, ideally, more effectively. The UK government manages this inherent tension well" [46]: 87. Since then the government has cut funding to a number of organisations (Energy Saving Trust, Carbon Trust.[11]), which has reduced the number of involved parties, and has made efforts to coordinate policy through the establishment of an Energy Efficiency Deployment Office in 2012[12]

Our interviewees noted that despite the range of instruments used in the policy mix, building energy efficiency has not improved as fast as is necessary to meet targets (UK4, UK6), and especially falling short with regards to the existing building stock (UK1). For example annual rates of cavity wall and loft insulation in 2013–2015 were 60% down and 90% down respectively on annual rates in 2008–2012 [69]: 13). This was largely attributed to the fact that the government had not succeeded in raising demand drivers (UK2) and awareness of the importance of energy efficiency by consumers (UK1, UK2, UK4, UK8), which has been further jeopardised by cuts in funding to key information providers such as the Energy Saving Trust or the Carbon Trust (UK3). While there is knowledge and understanding of building energy efficiency being generated by actors such as universities and research institutes, this knowledge is still not being employed by the mass consumer market (UK10). Without consumer understanding of energy efficiency, even well designed policy instruments will suffer from a lack of demand (UK2). Also the CCC advocated that there is a need for "clear, consistent and credible policies [...] that are attractive to owners and landlords of both homes and workplaces, that overcome behavioural barriers and that can build up skills and supply chains" [69]: 13. While the policy mix overall seems well targeted and our analysis did not identify any significant inconsistencies across instruments, there are gaps especially in terms of reduction of information provision and instruments aimed at building energy use (rather than building fabric) as well as issues with 'churn'.

4.2.4. Characteristics of the developing UK policy mix, 2000–2014

Our analysis shows that the development of the UK policy mix tended to follow what [19] described as a *drift* process which occurs when there are at least partly incoherent policy goal developments combined with a relatively consistent instrument mix, according to the logic of Table 2 in Section 2.2. However, this empirical finding is slightly at odds with the definition of *drift* "*to occur when new goals replace old ones without changing the instruments used to implement them. These instruments then can become inconsistent with the new*

[11] This has meant that some of the information provision services that the Carbon Trust provided have not been continued, meaning that some of the valuable energy efficiency information for the non-domestic sector has been lost (UK3).

[12] This office was however subsequently abolished in May 2015.

Table 8
Developments in UK building-related energy efficiency policy instruments (2000–2014).

Year	Instruments introduced since 2000	Instruments removed since 2000
2000	Decent Homes (S) Warm Front (S)	1991–2000 Home Energy Efficiency Scheme (HEES) (S)
2001	Enhanced Capital Allowance (S) Climate Change Levy (T) The Carbon Trust (S, R&D)	
2002	EEC1(R) Community Energy (S)	1994–2002 Energy Efficiency Standards of Performance (EESoP) (R) 1989–2002 Energy Efficiency Best Practice Programme (EEBPp) (I, R&D)
2003	Energy Programme (R&D) Sustainable Communities (S) Building Schools for the Future (S)	1997–2003 New Deal for Schools (S)
2004	Landlords' Energy Saving Allowance (S) Salix Project (L)	
2005	EEC2 (R) Climate Change Communications Initiative (I)	2002–2005 EEC 1 (R)
2006	Market Transformation Programme (I) Low Carbon Building Programme (S) Sustainable Operations on the Government Estate (SOGE) (P)	
2007	Code for Sustainable Homes (V) Energy Technologies Institute Buildings Programme (R&D) Modern Built Environment Knowledge Transfer Network (R&D) Energy Performance Certificates (R) "Act on CO2" climate campaign (I) Stamp duty relief for zero-carbon homes costing more than £500,000 (T) Energy Efficiency Loans for Small or Medium sized Enterprises (SMEs) (L) Voluntary Agreement on the Phase Out of Incandescent Light Bulbs (V) Home Information Pack (HIP) (R)	
2008	CERT (R) Planning and Energy Act (R) Low Impact Buildings Innovation Platform (R&D) Climate Change Act (R) Living with Environmental Change (S)	2002–2008 Community Energy (S) 2005–2008 EEC2 (R) 2007–2008 "Act on CO2" climate campaign (I) 2005–2008 Climate Change Communications Initiative (I)
2009	National Sustainable Public Procurement Programme (I, P) National Products Policy (R) Community Energy Savings Programme for low income communities (S) Low Carbon Technology Programme (S)	2007–2009 Voluntary Agreement on the Phase Out of Incandescent Light Bulbs (V)
2010	Carbon Reduction Commitment Energy Efficiency Scheme (R) Boiler Scrappage Scheme (S)	2007–2010 Home Information Pack (HIP) (R) 2010 Boiler Scrappage Scheme (S) 2003–2010 Building Schools for the Future (S)
2011	Government Buying Standards (P) Non-domestic Renewable Heat Incentive (L) Energy Efficiency Financing Scheme (S) RE:FIT (S)	2008–2011 CERT (R) 2006–2011 Low Carbon Building Programme (S) 2006–2011 Sustainable Operations on the Government Estate (SOGE) (P) 2009–2011 Central Government Low Carbon Technology Programme (S)
2012	UK Green Investment Bank (L)	2001–2012 The Carbon Trust was funded by government until March 2012 (S, R&D) 1992–2012 Energy Saving Trust was funded by government until March 2012 (S, R&D) 2007–2012 Stamp duty relief for zero-carbon homes costing more than £500,000 (T) 2009–2012 Community Energy Savings Programme for low income communities (S)
2013	Energy Company Obligation (R) Capacity Mechanism (S) Display Energy Certificate (R) Carbon Floor Price (T) Non-domestic Green Deal (L) Green Deal (L)	2000–2013 Warm Front Scheme (S)
2014	Domestic Renewable Heat Incentive (S) Smart metering and billing (R) Total added: 50	Total removed: 22

Legend: I = Information, P = Public Procurement, R = Regulation, R&D = Research&Development, S = Subsidy, T = Tax, V = Voluntary.

goals and most likely ineffective in achieving them" [41][41]: 395. In this case *drift* has occurred through the introduction of social and carbon reduction ambitions into energy efficiency policy which led to a set of partly incoherent goals, making it very difficult for a set of instruments to achieve both the carbon reduction and the fuel poverty objectives in a cost effective way. This struggle can clearly be seen in the design of the various supplier obligation schemes which tried to strike a balance between enabling the suppliers to meet the obligations at lowest cost and to also meet social objectives. There is also some *layering* in which more and more goals and instruments are added to the mix, although some goals and instruments have also since been abandoned. The process of

Table 9
Summary of types of instruments in Finland and the UK in place in 2014.

Types of instruments		Finland	UK
Economic instruments	Subsidy	8	11
	Loans	0	3
	Taxation	2	3
	Public procurement	2	2
	Research & Development	3	4
Regulatory instruments	Regulation	9	12
Soft instruments	Voluntary measures	7	1
	Information	6	3
	Total	*37*	*39*

NB: Because some instruments are classed under more than one type, the overall number does not match with the ones in Section 4.

implementing national energy efficiency action plans (required by the EU) can also partly be interpreted as containing an element of *policy packaging* with some new instruments having been designed and implemented as part of a package and replacing a set of previously existing instruments. DECC has also started to think about the consistency of various demand side instruments and commissioned a report on this issue [75]. Overall, however, there is a high risk that the policy mix will not be successful in achieving the ambitious energy and climate policy targets cf. [69].

5. Discussion

The analysis of building related energy efficiency policy in Finland and the UK showed that a variety of goals and instruments have accumulated during 2000–2014 in both countries and that as a consequence building-related energy efficiency policy has become a crowded field. The analysis can be summarised in a number of key points:

First, both countries have an increasingly complex policy mix, encompassing a variety of goals and instruments. In both cases more new goals and instruments have been added over time than have been removed. This poses challenges in terms of policy coordination as well as evaluating the policy mix. Both countries should make an effort to start evaluating the overall impact of their policy mixes rather than evaluating individual instruments or selected bundles of instruments as is common practice. A first attempt of doing this has been a UK DECC commissioned report on 'D3: Opportunities for integrating demand side energy policies' which argued that there is a wide range of government programmes supporting energy efficiency and distributed energy solutions but that a lack of integration could cause policies to compete or undermine each other's effectiveness [75].

Second, in terms of the types of instruments being used, Table 9 shows that both countries make use of the 'full toolbox' of available instruments, including financial, regulatory as well as 'soft' instruments in a reasonably balanced way. This is important since in early policy design studies analysts often argued for implementing the least intrusive measures first and then ratcheting up the level of coercion. In contrast, Howlett and Rayner argue that "*rather than assuming that a choice must be made between only a few alternatives such as regulation versus market tools*" [37]: 175, policy makers are encouraged to use the full range of possible instruments. Interestingly, during the early 2000s, the UK government was criticised for putting a focus on voluntary energy efficiency measures (e.g. [44]). However, now there is very little use of voluntary measures in the UK (1) compared to Finland (7) where voluntary measures – in particular energy saving agreements and associated audit Schemes – have been successful [40]. UK policy makers should be encouraged to draw on experiences from elsewhere (e.g. Finland) to see whether such instruments could be used to a greater extent to meet goals. Conversely, Finland does not have any loan schemes for energy efficiency improvements which is an area where the Finnish government could potentially learn from the UK. Surprisingly, given the pressure on public finances in both countries, there have been several subsidy schemes in place, although simply counting the instruments does not say anything about their budgets and how they have changed over time.

Third, much of the policy action in both countries has been stimulated by the EU's drive towards increasing energy efficiency, particularly through the 2012 Energy Efficiency Directive, the 2002 European Building Energy Performance Directive [29], and the recast Directive 2010/31/EU on the Energy Performance of Buildings. However, despite this EU influence, the countries have rather different policy mixes for building energy efficiency which shows the flexibility member states have in choosing how to meet the objectives set out in EU directives. While reducing fuel poverty has been a key energy policy goal in the UK, this is rather implicit in the Finnish policy mix.

Forth, while in the UK there has also been a lot of 'churn' in policy instruments, Finland has had a somewhat more stable policy environment, where the added policies have not as radically altered the mix. According to previous research, a rapidly fluctuating policy environment can slow innovation down as companies generally prefer stability for their investment decisions, particularly given that innovation processes can take decades (see [77] for a review of this research). This means that the UK policy context may in effect deter low energy innovations and their diffusion. In contrast, while the more stable Finnish approach is likely to support innovation and diffusion of building innovations such as heat pumps cf. [78], insulation and ventilation systems, it is unlikely to lead to radical system innovation in zero carbon or passive houses cf. [79,80].

6. Conclusion

In energy policy discussions amongst both policy makers and academics, there is an increasing interest in the effects of combinations of goals and instruments (i.e. policy mixes) and how they evolve over time. This article draws on the policy design literature to introduce a conceptual framework to study policy mixes and their evolution in order to provide an ex ante assessment of their potential implications. This framework was applied to study building energy efficiency policies in Finland and the UK between 2000 and 2014. The specific aims of this article were to describe (1) the development of the policy mixes over time in the two countries and to (2) analyse their emerging overall characteristics. Our analysis is novel compared to the existing energy efficiency policy literature which predominantly focusses on single instruments or, if interested in mixes, focusses on pairwise instrument interactions or selected bundles of instruments at one point in time rather than comprehensively analysing the development of policy goals and instruments over time to assess the overall characteristics of the mix.

Our analysis found that both countries have increasingly complex policy mixes, encompassing a variety of goals and instruments and making use of a variety of different types of instruments – creating challenges for both the design and evaluation of the policy mixes. This confirms the finding that, in order to meet EU targets, many member states are introducing additional policies into an already crowded space Rosenow, 2016. Interestingly, the way in which the policy mixes evolved during 2000–2014, despite the shared EU policy influence, were quite different in the two countries. While the Finnish mix evolution showed characteristics of a *replacement* process, it also displayed a degree of *layering* of new instruments and an approach of *policy patching* rather than a complete re-packaging that the literature associates with *replacement*.

Nevertheless, the policy mix is seen to function relatively well and is likely to lead to positive outcomes at least in terms of incremental innovation. For example, the energy performance of residential building of the capital city Helsinki shows a clear downward trend in response to policy Lemstrom, 2015.

In contrast, the UK case is predominantly characterised by *drift* as partly incoherent policy goals have been combined with a relatively consistent and largely well targeted instrument mix with some gaps, which may undermine progress towards achieving the goals. Especially with regard to the existing building stock, energy efficiency has not improved as fast as is necessary to meet targets. Unlike in Finland, progress in improving the energy performance of residential buildings has stalled since 2012, following good progress during 2008–12 [69]. Conceptually, the UK case shows a different pattern compared to the way *drift* has previously been defined as occurring when new goals replace old ones while keeping the instruments similar [19]. Instead in this case *drift* has occurred through the introduction of social and carbon reduction goals into traditional energy efficiency ambitions which led to a set of partly incoherent goals. The definition of *drift* should be extended in line with this finding and other studies should be used to corroborate whether this is a more common finding. Until 2014, the UK also showed a rapid accumulation of new instruments (*layering*) combined with a degree of *policy packaging*.

What may be some of the reasons to explain the different ways in which the policy mixes have involved in the two countries? We argue that a number of factors may explain the two trajectories: The UK has a parliamentary system which favours single party governments because of the first-past-the-post electoral system.[13] Ideological contrasts between the two major parties (Labour and Conservatives) about the appropriate role of the state in stimulating energy efficiency, thus, can mean significant changes in policy goals and instruments following a change of government, potentially explaining why there is more 'churn' in the UK. Frequent changes in who was responsible for energy efficiency policy (DETR, DEFRA, DECC, DCLG) and who is implementing core programmes (e.g. DEFRA, Carbon Trust, Energy Saving Trust) may have also contributed. In contrast, the Finnish political system is much more consensual and frequently has coalition governments, leading to more policy stability that has helped maintain focus over three government periods. However, this also reduces the opportunities for *policy packaging*. The Finnish government has also achieved better coordination of policies through setting up cross-departmental working groups and creating the ERA17 Action Programme on Energy Smart Built Environment, while such coordination mechanisms are less well developed in the UK.

Our results support the claim by Howlett and Rayner [37] that strategic *policy patching* may be a more promising approach for policymakers than the creation of completely new *policy packages* from the perspective of achieving a coherent and consistent policy mix. We argue that the concept of *patching* is useful for policymakers as it chimes better with the reality of 'messy, real-world' policy making. Our analysis has identified ways in which such *patching* can be strategically used by policymakers in both countries to increase the chances of significant improvements in building energy efficiency. Finland has achieved coherence through *policy patching* by improving not only inter-departmental coordination but by creating a dialogue between a range of stakeholders regarding policy mix design, illustrated by the ERA17 programme. In the UK, policy makers have started to work on *policy patching* through the national energy efficiency action plans and through considering the portfolio of goals and instruments in the context of the D3 strategy. Our findings show that there is much potential for learning between the different country approaches, not only about the respective toolboxes applied but also about how to carry out successful *policy patching*.

[13] This is an voting system in which the candidate attracting the most votes in a constituency is elected to parliament, which means predominantly candidates from large parties are elected. This is on contrast to a representative voting system which allows smaller parties to enter into parliament which makes it more difficult to create an overall majority for any party to govern.

Data access statement

Most of the analysis in this manuscript was based on secondary data which is available publicly through the sources cited in the methodology section. However, the interview data is not available since due to the politically sensitive nature of the research, no interviewees consented to their data being retained or shared.

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Appendix A. List of interviewed organisations

List of organisations interviewed in Finland

FIN1: Rakennusteollisuus ry (Conferederation of Finnish Construction Industries)
FIN2: RAKLI – The Finnish Association of Building Owners and Construction Clients
FIN3: VTT Technical Research Centre of Finland
FIN4: Demos Helsinki
FIN5: Kuntaliitto (Association of Finnish Local and Regional Authorities)
FIN6: ARA (the Housing Finance and Development Centre)
FIN7: Kiinteistöliitto (Finnish Real Estate Federation)
FIN8: Motiva
FIN9: Ympäristöministeriö (Ministry of the Environment)

List of organisations interviewed in the UK

UK1: UK environmental think tank
UK2: UK Green Buildings Council (UKGBC)
UK3: National Energy Foundation (NEF)
UK4: Building Research Establishment (BRE)
UK5: former employee Energy Saving Trust (EST)
UK6: Energy Bill Revolution
UK7: WWF-UK
UK8: chairman of the British Energy Efficiency Federation
UK9: Zero Carbon Hub
UK10: former senior civil servant involved in energy efficiency policy (DEFRA) and former employee Carbon Trust (CT)

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