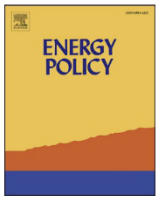
Energy Policy 171 (2022) 113225

Contents lists available at ScienceDirect

Energy Policy

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



Strategic energy and climate policy planning: Lessons learned from European energy efficiency policies

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ARTICLE INFO

Keywords:
Energy efficiency
National strategies
EU policy
Energy and climate plans
Targets
Policies and measures

ABSTRACT

Strategic policy planning has gained increasing importance in international energy and climate policy. This paper aims to contribute to the debate on stringent policy planning by drawing lessons learned from two decades of strategy development in the field of European energy efficiency policy. Since the inception of the first national energy efficiency action plans under the Energy Services Directive (2006/32/EC), the European Commission and the Member States have had a long experience in planning national strategies. This paper analyses the lessons learned in setting up national energy efficiency strategies and traces the progress made in 2007–2020. Our findings show that major improvements are attained in the latest national energy and climate plans through the adoption of harmonised reporting approaches, evidence-based target setting methods, establishment of better monitoring systems and broader consideration of policy packages. Various areas with a significant potential for further improvements are also identified, ranging from more coherent reporting framework for policies and measures to the need of setting up systems that encourage the adoption of targets in line with a country's cost-effective energy efficiency potential. Embedding energy efficiency in the larger climate policy framework, considering how it can support pressing socioeconomic challenges, is also of pivotal importance.

1. Introduction

Structured policy planning based on clear objectives has a vital role to play in international energy and climate policy (Rocha and Ellis, 2020). With the COP26 agreement on a finalized "Paris Agreement Rulebook" (UNFCCC, 2021), laying out how countries are held accountable for delivering on their climate action promises and self-set targets under their Nationally Determined Contributions (Català and Wyns, 2022; Huang, 2019) the question arises how to support these national strategies by suitable monitoring tools and processes.

Strategic planning has developed in both private and public sectors. Strategic planning has strong positive impact on successful implementation (Elbanna et al., 2016). There is quite a robust literature on various aspects of strategic planning (Ferlie and Ongaro, 2015). However, as Bryson et al. (2018) point out, "much more knowledge is needed about the actual process design features that lead to strategic planning success (or not)". Insight into what works best, in which situations, and why, can be helpful for promoting and implementing the policy goals.

This paper argues that many lessons can be drawn from analysing existing planning exercises, notably in the European Union. Here, energy efficiency policy coordination draws on an almost two-decade process of developing planning and monitoring tools. Given the recognised role of energy efficiency in the transition to a clean and sustainable energy system (Hilke and Ryan, 2012; Kerr et al., 2017: IEA, 2018), the development of ambitious national energy efficiency strategies has been of high political priority.

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https://doi.org/10.1016/j.enpol.2022.113225
Received 7 December 2021; Received in revised form 13 July 2022; Accepted 25 August 2022
Available online 14 October 2022

In the European context, the requirement of drafting national strategies on energy efficiency dates back to the adoption of the Energy Services Directive, ESD (European Parliament and the Council, 2006).[2] Under the ESD, Member States were required to reach an indicative end-use energy saving target of 9% by 2016 underpinned by a National Energy Efficiency Action Plan (NEEAP), which "provides an overview of its strategy for the achievement of the intermediate and overall targets". The NEEAPs, which were due every 3 years, included information on the indicative national targets as well as details on the incentives and the regulatory, institutional, financial and legal frameworks set in each Member State to eliminate barriers preventing efficient end use of energy. The ESD focused on tracking energy efficiency impacts, i.e. detailed monitoring of (policy-induced) energy savings. As the target was based on measured energy savings which had to be established on policy-by-policy basis and could not directly be derived from existing energy statistics, dedicated calculation methodologies had to be developed.[3] Before the proposal of harmonised calculation methods, this led to a variety of different approaches across EU Member States that were difficult to compare.

With the introduction of the Energy Efficiency Directive, EED (Directive 2012/27/EU, 2012) in 2012, the foundation for more actions was put in place with a view of enhancing national efforts in the area of energy efficiency. The Directive, a key part of the EU's 2020 climate and energy legislative package, required EU Member States to set indicative national energy efficiency targets and legally binding measures to help the EU reach its 20% energy efficiency target by 2020. As such, this simplified monitoring of the targets, as it could be reformulated as a gap in energy reduction efforts. However, this simplification came at the price of counting in other effects (e.g. structural changes, impacts of non energy-efficiency-policies on energy consumption, economic fluctations such as boom or recession effects, COVID effect). While the preceding ESD aimed at measuring policy induced savings, the EED simplification meant that all types of savings were covered. To safeguard policy engagement, all EU Member States were required to implement policy measures that improved energy efficiency at all stages of the energy chain from production to final consumption. In compliance with the EED requirements, Member States were required to continue reporting on the progress and efforts made in their triennial NEEAPs, starting from 2014. The previous experience gained through the submission of NEEAPs under the ESD provided a strong foundation upon which Member States continued to develop and strengthen their energy efficiency policy strategies (Economidou et al., 2018). In addition to the NEEAPs, the annual reports referred to in Article 24(1) of the EED provided a basis for the monitoring of the progress towards national 2020 targets (Tsemekidi-Tzeiranaki et al., 2019).

In view of extending the climate and energy package beyond 2020, the European Commission took new collective steps to secure sustainable, competitive and affordable energy to EU consumers, households, and businesses after the adoption of the EED. Central to these steps was the publication of the Energy Union strategy (COM/2015/080), with the aim to integrate Europe's energy markets, ensure energy security, improve energy efficiency, decarbonising the economy and prioritise research and innovation on the energy transition by 2030 (European Commission, 2015a). The 2030 climate and energy framework set targets for cutting greenhouse gas emissions and increasing the share of renewable energy and energy efficiency.

Since the launch of the Energy Union strategy in 2015, the European Commission published several packages of measures and initiatives to ensure the effective implementation of policies to reach the 2020 and 2030 EU targets. To streamline processes and facilitate the implementation of the Energy Union, it adopted the Regulation on the Governance of the Energy Union and Climate Action, EUGR (Regulation (EU) 2018/1999, 2018) in the framework of the Clean Energy for all Europeans package, which entered into force on 24 December 2018. The regulation aimed to develop a transparent and dynamic governance process and help deliver on the new 2030 climate and energy targets in an efficient and coherent manner. Under the EUGR, Member States were requested to develop integrated National Energy and Climate Plans (NECPs), covering the five dimensions of the Energy Union based on a common template. With energy efficiency being one of the five dimensions, the integrated NECPs replaced the preceding NEEAPs under the EED. The new plans, with a 10-year validity for the period 2021–2030, were due as draft plans by the end 2018 and as final plans by the end of 2019.

As part of the European Green Deal, the Commission proposed under the new Climate Law to raise the 2030 greenhouse gas emission reduction target in September 2020, from the previously agreed 40% greenhouse gas emissions reduction to at least 55% compared to 1990 (European Commission, 2021; Fleming and Mauger, 2021; Samper et al., 2021). The so-called "Fit for 55" legislative package adopted in July 2021 cemented the new ambition through a set of interconnected policy proposals that combine pricing, targets, rules and support measures (European Commission, 2021). This new ambition requires intensified actions across all sectors, including increased energy efficiency and renewable energy, highlighting the strategic role of NECPs and their updates due in 2024 in monitoring how EU countries plan to translate the increased ambition in their national context and comply with updated EU legal provisions.

Collating the experience gained in assessing national energy efficiency plans from 2007 to 2020, this paper addresses the evolution of energy efficiency strategic planning from the introduction of the first EU reporting obligations until now. The paper traces the progress made in drafting these strategies and provides insights in what constitutes a good strategy for setting an ambitious long-term vision in energy efficiency supported by concrete policy actions and targets. Against this background, the paper addresses the following research question:

RQ: What lessons can be drawn from the continuous strategy planning exercises in European energy efficiency policies?

To answer this question, we will address two main sub-questions:

SRQ1: Can a process of continuous alignment be witnessed in energy efficiency policy planning in the EU?

SRQ2: Which factors supported or impeded policy planning and monitoring?

The paper is outlined as follows. Section 2 describes the methodology used to assess strategic plans on energy efficiency based on five areas ranging from compliance to targets, policy measures and general issues. Section 3 shortly presents the evolution of the legal framework and reporting requirements on energy efficiency since the adoption of the EED in 2006 to the current integrated approach under the EUGR in 2018. The assessment of national energy efficiency plans over the examined period is discussed in Section 4, highlighting key achievements, shortcomings and success factors. Conclusions and policy recommendations are drawn in Section 5.

2. Methodology

This research provides insights on the evolution of strategic planning in the EU since the introduction of reporting obligations on energy efficiency in 2006. Three phases are identified: Phase I (NEEAPs 2007–2011 under the ESD), Phase II (NEEAPs 2014 & 2017 under the EED) and Phase III (NECPs under the EUGR). To assess the evolution of the plans, we use qualitative assessment (Ferlie and Ongaro, 2015) with a set of predefined areas which are key for strategic planning.

[2] A few countries had national energy efficiency action plans prior to the ESD adoption; e.g. the UK plan "Energy efficiency: The government's plan for action" by the Department of the Environment, Food and Rural Affairs (2004) (Mallaburn and Eyre, 2014)).

[3] https://www.motiva.fi/files/4594/ESD_Recommended_measurement_and_verification_methods_draft_www.pdf.

Table 1
Criteria used to track the evolution of energy efficiency plans in the EU.

Area/theme	Assessment questions	Relevant literature
Compliance with reporting obligations	• Does the plan fulfil the reporting obligations stipulated in the legal text? • Does it adhere to the template(s) provisions (if any)?	(Economidou et al., 2016, 2018)
Target definition, coherency and monitoring	• Does the plan define a clear target and does it provide enough details on how it is set? • Is the target ambitious, yet achievable in line with the overall cost-effective potential? • Does the plan adequately describe the calculation methodology used to set the target? • Is there a framework allowing the monitoring of the progress towards the target? • Is there coherence with other targets?	(Harmsen et al., 2011; Harmsen et al., 2014; Schlomann and Eichhammer, 2014)
Package of policies and measures	• Does the plan present a wide range of policy measures covering all sectors of economy in line with their energy efficiency potential? • Is there a thorough description of each measure? Does the description cover information such as timeline, funding, targeted sectors/beneficiaries, expected/achieved impact, calculation methodology and responsible implementation bodies? • Are the measures linked to a specific target? Is their impact quantified against the target? How is the impact calculated and does it take into consideration double counting, additionality and other factors? • Is there a clear distinction between new and existing measures?	(Schlomann et al., 2012; Thomas et al., 2012a,b; Bertoldi and Cahill, 2013; Tholen et al., 2013; Kern et al., 2017; Moyson et al., 2017)
Governance & institutional capacity	• Is there appropriate governance in place to execute the plan? • Does the plan foresee capacity-building activities to meet the ambition of the plan? • Does the plan provide clear information on investment needs and budgetary commitments and sources towards the implementation of the overall plan and the implementation of PAMs?	(Höfele et al., 2012; Pereira and da Silva, 2017; Cabeça et al., 2021)
General	• Does the plan identify key priorities in the country? • Does it make a link to current economic and social challenges with a view of addressing these challenges through energy efficiency? • Is the plan used as a tool to take stock, evaluate and improve policies? • Is the plan a tool to track the compliance with other? Energy related? EU legal provisions?	(Hilke and Ryan, 2012; Fawcett and Killip, 2019)

2.1. Evaluation criteria

Based on the literature and experience gained in assessing the national energy efficiency plans from 2007 to 2020, we identified 5 areas through which we trace this evolution. The areas are summarised in Table 1. They cover: 1. compliance with reporting obligations, 2. target definition, coherency and monitoring, 3. policies and measures, 4. governance and institutional capacity, and 5. general issues. In Section 4, we assess the progress made[4] according to these areas. We pinpoint key success factors and challenges and illustrate some key general trends together with specific examples from concrete plans.

Reporting obligations, which may cover specific requirements such as structure of plans, content and reporting frequency, are of pivotal importance in ensuring completeness of plans and consistency across countries. There have been significant developments towards more streamlined and comprehensive reporting approaches in the EU over the years. For example, the use of NEEAPs was originally envisaged under the ESD as a tool to track both strategic planning and achieved progress, but planning and progress were viewed separately under the EED, with several implementation progress aspects being streamlined through the so-called annual reports (Zangheri et al., 2019).[5] The distinction between strategic planning and progress reporting was made stronger with the EUGR through the introduction of annual and biennial progress reports which focus exclusively on implementation and progress monitoring aspects, mirroring the NECP template elements. Another key element is the establishment of templates to guide reporting; these were formally introduced in the EED and elaborated further under the EUGR.

The second area relates to target definition, coherency and monitoring. A comprehensive energy efficiency strategy must be underpinned by a well-defined, easy-to-monitor and ambitious target that takes into account the remaining cost-effective energy-saving potential in the country and ability to pay for future investments (Broc et al., 2019). stressed the need for thorough calculation methodologies together with underlying assumptions and baseline scenarios. Exploring interactions with and contributions to other climate-related targets is an issue flagged by several researchers (Harmsen et al., 2011; Schlomann and Eichhammer, 2014). Furthermore, the type of target may have important implications in terms of target monitoring and this is the case for the ESD and EED targets (Harmsen et al., 2014).

Thirdly, pivotal to reaching the targets is the implementation of accompanying policies and measures in view of exploiting the identified energy saving potential. A far-reaching package of policies and measures, consisting of a balanced mix of financial, fiscal, regulatory, voluntary, information-awareness, supportive and other measures in all major energy-consuming sectors, is a prerequisite for a complete strategy. Each measure must be described thoroughly with complete information on policy objectives, responsible implementation authorities, targeted sectors, beneficiaries, implementation status, timeline, budgetary needs and sources, expected impacts and calculation methodologies (Economidou et al., 2018; Jamek and Suomi, 2012; Schüle et al., 2013). Whilst a minimum level of information on policies and measures has not been mandated by the respective EU legislation, the EUGR encouraged the provision of this information through a voluntary template (Kern et al., 2017). stressed that the development of increasingly complex policy packages posed new challenges in terms of policy coordination and evaluation. Therefore, the more is not necessarily the better in this case. A coherent reporting approach, however, demonstrates how policy measures may complement each other and how adjustments for additionality, potential double-counting, multiplier and "free rider" effects must be made (Thomas et al., 2012a,b).

Beyond comprehensive reporting, targets and policies, a strategic plan must include a credible framework on how to establish appropriate governance and institutional capacity. This can ensure effective design, implementation and evaluation of policies and it often may require strengthening existing institutional capacity or developing new administrative infrastructure and funding structures (Pereira and da Silva,

[4] We only analysed the plans, not the annual progress reports.
[5] Despite this, the NEEAPs under the EED continued to include several progress-reporting elements including achieved final energy savings under ESD Article 3(1)–(2) and EED Article 7 (Economidou et al., 2016).

2017). More attention towards coherent governance of energy efficiency institutions and the way these institutions are designed was suggested by Delina (2012) while Cabeça et al. (2021) showed that there is still room for improvement in terms of compliance with the European regulation by Member States, hence the need to make the current governance framework more severe in the future. Strategies should also provide information on investment needs and respective private and public budgetary sources and commitments towards implementation.

Finally, a coherent plan should identify key priorities in connection to current political, economic, and social challenges with a view of expanding the impact of energy efficiency beyond energy and cost savings. With important contributions in economic growth, social development, energy security, industrial productivity, poverty alleviation and job creation, the role of energy efficiency should be reflected under a broader framework (Fawcett and Killip, 2019; Ryan and Campbell, 2012). For example, alleviation of energy poverty is highlighted a key EU policy priority in the Clean Energy for all Europeans Package and included as reporting obligation in the EUGR (European Commission, 2016a), and energy renovation of buildings is regarded as a measure to reverse the economic impact of the Covid-19 pandemic (European Commission, 2020a).

2.2. Evaluation of plans

First, all energy efficiency plans of individual Member States were evaluated against each of the five identified areas above. Following the methodology used by e.g. (Castellazzi et al., 2019) qualitative scoring was used to assign scores to various levels of quality addressing the given point (Table 2).

Secondly, the results for each of the areas were summed into an overall assessment of the progress across all EU, in which a score was allocated to each areas/question as follows: 0 – Not applicable, not existing; 1 – Considered voluntarily on ad-hoc basis by some Member States (<10%); 2 – Implemented by minority of Member States (<25%); 3 – Implemented by some Member States (<50%); 4 – Implemented by majority of Member States (>50%); 5 – Implemented by (almost) all Member States (>90%). These are then summed up to derive a total score that tracks progress over time and derive the success stories and remaining challenges of the strategic planning.

3. Evolution of the legal framework and reporting requirements on energy efficiency

This section summarizes the main reporting requirements introduced by the ESD, EED and EUGR and the implementation of the plans in compliance with each legislation under Phases I-III.

The legal context on energy efficiency and, by extension, reporting obligations have changed over time. As the EU policy framework continued to develop in the 2000s to late 2010s —by expanding the scope of targets or measures, introducing new policies and addressing new sectors— so did the requirements on the plans. The first National Energy Efficiency Action Plans under the Energy Services Directive (Phase I) paved the way towards the development of more comprehensive National Energy Efficiency Action Plans under Energy Efficiency Directive (Phase II), which were then eventually replaced by the integrated National Energy and Climate Plans under the Regulation on the Governance of the Energy Union in Phase III (Fig. 1).

As illustrated in Table 3, each phase was marked by a deepening of the planning requirements. The Member States were given a growing number of supporting templates and guidelines and specifics on the analytical basis and assessment required under the respective legislation. Full details on the legislative and implementation process in the three phases of energy efficiency planning are provided in the Annex I to this article.

Table 2
Reporting obligations on energy efficiency plans under the ESD, EED and Energy Union Governance.

Score	Description
0	MISSING – the item is missing or not covered at all
1	UNSATISFACTORY – only the most cursory coverage of the item
2	INADEQUATE or PARTIALLY ADDRESSED– item addressed poorly, with insufficient detail, or with important aspects missing
3	ADEQUATE – meets the basic minimum requirements
4	GOOD – item is described in some detail
5	EXCELLENT – exemplary coverage of the item

4. Results & discussion

4.1. Summary of results

Applying the methodology presented in section 2 yielded a detailed evaluation of each round of energy efficiency plans (2007, 2011, 2014, 2017, 2020) for the (then) 28 EU Member States. Aggregating results for the three phases described in section 3 yields a radar chart overview per Member State, which is presented in Annex II. For almost all Member States, a clear evolution towards more comprehensive planning can be witnessed. In a first phase, results per Member State show a clear focus on complying with reporting obligations, in line with the ESD. Target setting emerges stronger over time, related to the common agreement to turn the NEEAPs into policy planning tools rather than simple monitoring instruments. As per EED provisions, the NEEAPs therefore constituted the key planning instrument. Finally, the implementation of the EED shows a stronger consideration of governance and institutional aspects as well as general transparency aspects (category "other"). Along with a stronger coordination of policy planning, the results per Member State also show a strong potential for mutual learning, with best practices across Member States in the different categories.

To achieve a more aggregated picture, the results of the assessment of national strategies on energy efficiency were scored based on the criteria identified in the methods section. The aggregated results of this scoring are presented in Table 4. As shown from the aggregated results, a steady improvement over time has been attained in all examined areas. Important findings and lessons learned in each of the five areas are identified and discussed below.

4.2. Compliance with reporting obligations

The **reporting obligations** stipulated in the legal text were largely met in Phase I. In general, the requirement related to the calculation methodology was satisfied, and most Member States introduced a range of measures. With the second NEEAPs in 2011, Member States presented a thorough analysis and evaluation of the preceding NEEAPs, including results on the fulfilment of targets and planned additional measures for addressing any existing or expected shortfalls. Only half of the Member States[6] demonstrated fulfilment of the requirements on the exemplary role of the public sector and most Member States did not include inputs from assessments of saving potentials in buildings. Furthermore, none of them referred to any kind of potentials when presenting objectives or results (European Commission, 2014).

The key reporting obligations of the NEEAPs under Phase II, namely to provide indicative national 2020 targets and inform on adopted and planned measures and energy savings, were mostly met (Table 4). All Member States disclosed their targets (even though approaches to target setting differed as discussed below). The comprehensiveness and detail on policies and measures improved despite some prevailing shortcomings stemming from missing estimates of energy savings or other impacts

[6] Austria, Belgium, Cyprus, Denmark, Finland, Germany and Sweden went beyond the minimum requirements. Estonia, France, Greece, Latvia, Italy and Lithuania presented their measures with sufficient detail.

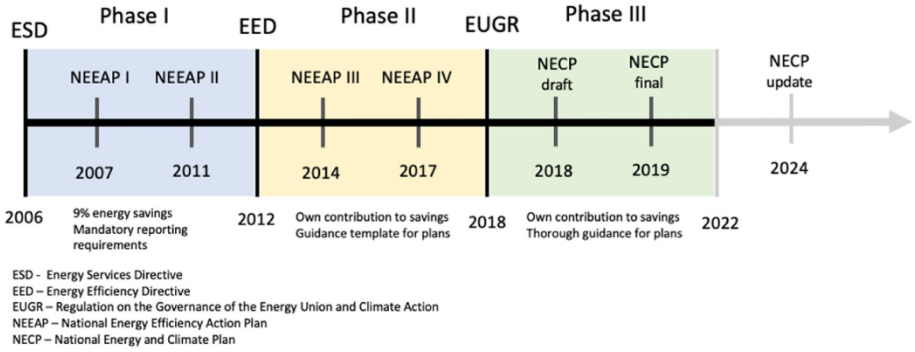


Fig. 1. Timeline of the mandatory plans related to energy efficiency in the EU.

of measures and their contribution to the overall targets (Economidou et al., 2016, 2018). As the minimum set of reporting data for each measure was not prescribed, the level of detail differed significantly across NEEAPs, both in 2014 and 2017, with typically higher completeness for financial measures as opposed to e.g., information and education measures (Economidou et al., 2016, 2018).

With regards to NECPs, while a few countries did not submit their national contributions[7] in the draft plans (European Commission, 2019a), no one omitted this information in their final plans and some Member States notified revisions to their expected 2030 contributions (Economidou et al., 2020). Consequently, the key reporting obligations under Phase III, namely to notify the expected contributions to the EU energy efficiency target by 2030 (under different scenarios) and implementation details about policies and measures, were mostly met (Table 4).

In terms of **compliance with template provisions**, the ESD provisions did not foresee any guiding template. The scarce and sporadic information on measures identified in the assessment of the first NEEAPs in various countries in terms of reporting format and level of detail raised the need for harmonisation. For this reason, the Commission made available a non-compulsory guide and template to assist Member States before the NEEAP 2011 submissions, which led to notable improvements between the first and second round. On the other hand, Phase II was formally supported by a guiding template, as previously discussed, which was overall positively perceived, and resulted in more homogeneous reporting. All but three countries[8] followed the proposed template structure. The template therefore clearly provided the much-needed enhancement both in terms of guidance for Member States and a meaningful comparison and evaluation by the Commission. However, the guiding template did not fully specify the minimum information for measures. While several countries[9] already used a more harmonised way of reporting their measures (Economidou et al., 2016), lack of clear guidance resulted in a high discrepancy in the amount of information describing individual measures. This discrepancy prevailed also in 2017, resulting in a call for template on how to report on both targets and especially measures (Economidou et al., 2018).

The mandatory NECP template ensured that all national plans were sufficiently comprehensive, thereby facilitating comparison and aggregation of national plans (European Commission, 2020b). It provided sufficient flexibility for Member States to set out the details of national plans reflecting national preferences and peculiarities. All followed the suggested structure and some improvements passed from the draft to the final plans. The Commission's voluntary template on policies and measures encouraged Member States to adopt a more harmonised way for reporting this information but just over half of them made use of it (Economidou et al., 2020).

4.3. Target definition, coherence, and monitoring

There is a clear learning curve on the target setting in the plans (Table 4). The following subchapter gives a more granular view of the assessment provided in Table 4 and Annex II. On **target definition**, consistent reporting was noted throughout the entire period. Nearly all Member States established their 2016 target in line with the ESD Annex I methodology (European Commission, 2009). In Phase II, Member States used different approaches to set their targets, but in line with the general requirements, i.e. mostly in primary energy consumption, but less so in primary energy savings. Most countries also reported their targets in terms of final energy consumption and/or final energy savings in line with the EED provisions and adapted the targets to factors influencing national primary energy consumption, GDP development and energy production (Suomi, 2017). While this level of flexibility continued in the NECPs, the EUGR prescribed fairly in detail on how the underlying scenarios should be set up, therefore, decreasing the degree of freedom for individual Member States. Nevertheless, similar conclusions to Phase II apply.

Concerning **target ambition**, there are notable differences over time (Table 4). In Phase I, the level of ambition was mainly assessed based on whether Member States had set a higher target than 9%. More specifically, 4 Member States[10] set a more ambitious target in 2009, while others stated that they expected final energy savings to be higher than 9% even though they did not commit to a higher ambition. The EC assessment noted, "statements of ambition are welcome, (..) the lack of formal commitment may not convey the right signal (..-.) about the actual political will to act on energy efficiency" (European Commission, 2009). In the second NEEAPs, at least half of the Member States indicated increased forecasts of energy savings due to either higher policy activity or re-evaluation of existing policies. However, the EC assessment stated that this may have been mainly due to methodical inconsistencies and the use of top-down techniques in the time of "economic turbulences" (European Commission, 2014).

When projected against the PRIMES 2007 baseline (Capros et al., 2008), most countries in Phase II stayed below the 20% target level in primary energy consumption[11] and to a large extent in final energy consumption as well, and therefore, arguably, below their cost-effective potential. In addition, energy consumption in most countries was still affected by the impacts of economic crisis (bringing them closer to reaching their 2020 targets, but with lower effects from energy efficiency as such).[12] Nearly half of all Member States set targets using an energy efficiency scenario, computed based on cost-effective potentials or impacts of additional policy measures. While the underlying

[7] Estonia, Germany, Hungary, Lithuania, the Netherlands.
[8] Germany, France and Portugal opted for a different reporting structure.
[9] E.g. Finland, Austria, the Netherlands, Czech Republic, Cyprus, Greece, Ireland.
[10] Italy, Cyprus, Lithuania, and Romania.
[11] With the exception of Bulgaria, Greece, Spain, Ireland, Italia, Lithuania, Latvia, Portugal, and Sweden (Economidou et al., 2016).
[12] The PRIMES model has been recalculated in 2013 to reflect, among others, the effects of economic crisis (Capros et al., 2013).

Table 3
Reporting obligations on energy efficiency plans under the ESD, EED and Energy Union Governance.

	Phase I: NEEAPs 2007 & 2011	Phase II: NEEAPs 2014 & 2017	Phase III: Draft/Final NECPs 2020
Legal basis	Directive 2006/32/EC (ESD) - Article 14(2)	Directive 2012/27/EU (EED) - Article 24(2) & Annex XIV Part 2	Regulation (EU) 2018/1999 (EUGR) – Articles 3, 4(b), 6, 7, 8, 9, 14, & Annex I
Requested content	*ESD Article 14 (2)* - Measures to reach targets (ESD Art. 4(1)–(2)) and their end energy saving impact - Measures on exemplary role of public sector (ESD Art. 5(1)) - Measures on information and advice to final customers (ESD Art. 7(2)) - Evaluation of preceding NEEAP (s) - Results on fulfilment of targets - Additional measures and their effect on existing or expected shortfall vis-à-vis targets	*EED Article 24 (2)* - Measures and expected/achieved energy savings, including those in energy supply, transmission and distribution as well as end-use, in view of achieving EED Art. 3(1) targets - Estimates of expected overall and sectoral primary energy consumption in 2020 *EED Annex XIV Part 2* 1. Targets & strategies: EED Art.3(1) targets, ESD Art.4(1) targets & other energy efficiency targets 2. Measures & savings - List of measures with estimated achieved and expected primary energy savings by 2020 as well as other impacts/benefits and budget where available - Results on ESD Art. 4(1)–(2) target fulfilment and information on measurement and/or methodology used for calculating energy savings 3. Specific information on EED Art. 5, 7, 8, 14, 15, 16, 18 and 19	*EUGR Article 4(b)* - Indicative national energy efficiency contribution to EED Art. 3 in 2030, with indicative trajectory from 2021 onwards; Underlying methodology and used conversion factors - EED Art. 7 end-use energy savings in 2021–2030 - Indicative renovation milestones of building stock under Directive 2010/31/EU Art. 2a and contributions to EED Art. 3 target - Floor area to be renovated or equivalent annual energy savings from 2021 to 2030 under EED Art. 5
Template	No	SWD(2013) 180 final (European Commission, 2013)	- EUGR Annex I - Policy and measures template (voluntary)
Reporting frequency	Every 3 years	Every 3 years	Every 10 years with an update due in 2024
Other relevant reporting	No	Annual reports (EED Art. 24(1) & Annex XIV Part 1)	Biennial progress reports
Implementation period	2007–2016	2014–2020	2021–2030

approaches to setting these scenarios may have differed, this approach provided a good practice basis, which was then enhanced in the NECPs through the concepts of the 'WEM' (With Existing Measures) and 'WAM' (With Additional Measures) scenarios. Such an approach theoretically offers a better basis for target evaluation.[13]

In Phase III, nearly all countries matched (or exceeded) their ambitions with the WAM scenarios. There was a clear upward ambition shift in many Member States after the draft NECPs, but when compared to PRIMES 2007 baseline projections to the 2030 target, 5 Member States fell short of the EU-wide ambition in both primary and final energy,[14] and another 11 countries[15] in primary energy only. On the other hand, 21 countries had a matching or higher ambition than PRIMES 2007 in final energy. Only a few countries matched both final and primary energy ambition, which may suggest a remaining gap to reach the cost-effective potential (Economidou et al., 2020).

In terms of **calculation methodology**, a clear trade-off between the stringency of monitoring and the complexity of applying the monitoring methods can be witnessed. Establishing a set of harmonised energy-saving measures proved politically difficult and led to complex and sometimes "messy" political compromises such as wide ranges of saving calculations and differing national approaches. This underlines that many "technical" aspects were in fact strongly influenced by political aspects such as political reticence to showcase missing ambition by applying too stringent monitoring of a given sector or policy. That said, a slow, but gradual alignment of Member States in terms of applying calculation methods can be witnessed.

Targets under Phase I were set as a percentage of historical energy consumption based on a straightforward approach (as opposed to Phases II-III discussed below). Overall, 8 Member States[16] did not calculate the target fully in line with the ESD requirements, mainly due to a different timeframe than the one required or by not excluding energy consumption from prescribed relevant undertakings.[17] The NEEAPs differed in the quantification of savings and progress towards the 2016 targets, as well as how the economic crisis effects were taken into account (European Commission, 2014). The ESD scenario development was rather vague and the EC assessment further emphasized the need to set up more transparent target calculation methods.[18]

Given the EED flexibility provided in Phase II, Member States followed various calculation approaches: the general PRIMES model, own national models and other methods. The modelling year differed significantly ranging from 2007 to 2015. As mentioned above, most countries set their 2020 targets using an energy efficiency scenario, while some other countries merely applied a fixed percentage reduction and others related their target to historical energy consumption or energy intensity. This heterogeneity did not allow for a direct meaningful comparison. On the other hand, the NECPs (Phase III) were generally more detailed in describing the methodology behind the calculation of the targets, stemming, among others, from the more detailed requirements set out in the EUGR. Member States were required to describe both WAM and WEM scenarios underpinning their targets. The methods to develop the scenarios differed based on national modelling customs. The level of detail improved from the draft to the final NECPs for about one third of the countries, but remained inadequate for another third (either missing WAM or WEM scenario, or missing the attribution of WAM measures). Overall, 20 countries provided a more

[13] However, as we show further, the monitoring of the targets has rarely been clearly set in the Member States.
[14] Belgium, Denmark, Cyprus, Malta and Finland.
[15] Bulgaria, Czechia, Estonia, Ireland, France, Sweden, Germany, Hungary, Poland, Slovenia, Slovakia.
[16] Belgium, Denmark, Estonia, France, Germany, Portugal, Slovakia, Spain.
[17] The assessment of the plans by the EC further stressed that there were ambiguities as to the "definition of undertakings" and historical data to enable excluding the energy consumption from such undertakings may have not been available in some Member States.
[18] Ibid.

Table 4
Assessment of strategies on energy efficiency based on the criteria identified in this analysis.

Criterion	Sub-criteria	Phase I NEEAPs under ESD		Phase II NEEAPs under EED		Phase III NECPs under EUGR	
		2007	2011	2014	2017	2019	2020
Compliance with reporting obligations	*Fulfilment with legal reporting obligations*	4	3	4	5	4	5
	Adherence to template provisions	–	0	4	4	4	5
Target definition, coherency and monitoring	*Clear target definition*	5	5	5	5	5	5
	Target ambition in line with cost-effective potential	1	4[a]	2	3	3	3
	Description of calculation methodology to set target	4	4	2	5	3	4
	Framework to monitor target progress	2	2	5	5	2	2
	Coherence with other targets	–	–	3	3	4	4
Package of policies and measures	*Coverage and range of policy measures*	2	3	3	4	4	5
	Detailed description of policies and measures	2	3	4	4	4	4
	Impact of measures towards target and calculation approach	1	2	2	3	3	3
	Distinction between new and existing measures	1	2	3	3	4	4
Governance and institutional capacity	*Appropriate governance to execute the plan*	3	4	4	4	5	5
	Capacity-building activities to meet ambition of plan	2	3	3	3	4	5
	Information on investment needs, budgetary commitments and sources towards implementation	2	3	3	3	4	5
General	*Identification of key national priorities*	0	3	3	4	5	5
	Link to current economic and social challenges with view of addressing them through energy efficiency	0	1	1	1	5	5
	Use of plan as a tool to take stock, evaluate and improve policies	0	2	4	5	5	5
	Tool to track compliance with other legal provisions	0	2	4	4	5	5
Total score		29/80	46/85	59/90	68/90	73/90	79/90

Score guide.
0 – Not applicable, not existing; 1 – Considered voluntarily on ad-hoc basis by some Member States (<10%); 2 – Implemented by minority of Member States (<25%); 3 – Implemented by some Member States (<50%); 4 – Implemented by majority of Member States (>50%); 5 – Implemented by (almost) all Member States (>90%).
[a] Indication of higher energy savings **forecast** than the required 9% by 2016.

complete information on the calculation of their WAM and/or WEM projections in the final NECPs.

In terms of **progress monitoring**, the 2011 plans were marked by a significant diversity in the top-down and bottom-up methods used to assess progress at the sector or policy measure level. The so-called "early actions", i.e. measures undertaken before the ESD,[19] accounted for large portions of the reported savings in many NEEAPs. In Phase II, the plans contained little information on the contribution of individual measures (or group of measures) to reaching the overall targets, which renders the monitoring of the progress towards the target more challenging. Nevertheless, the EED obligation to submit annual progress reports did not require the contribution of the measures apart from the measures under the EED Article 7. This is due to the lack of establishment of continuous updates of baselines and projections, and lack of assessment and updates on implementation of policies and especially their contribution to reaching the overall target. Monitoring methods were met by large heterogeneity and barriers included advanced data collection, definition of baselines and sampling (Suomi, 2017). Finally, only a handful of Member States[20] in Phase III provided details on monitoring and verification systems. Given the EUGR requirement to establish biennial progress reports and to submit two updates of the NECPs by 2030, a more robust progress-monitoring framework is, nevertheless, expected.

On **coherence with other targets**, the NEEAPs under Phase I were not embedded in the larger climate policy framework and were thus not cross-connected with other targets. Most of the NEEAPs referenced the contribution to the EU level 2020 target (of 20% savings from baseline), but a common method and approach (or requirement for that matter) was not been established. In the EED, only a limited number of Member States set additional energy efficiency (or more general climate) targets in both 2014 and 2017 plans. They mainly entailed reduction of GHG emissions above the EU-level targets, decarbonisation of residential heating and transport or targets for energy efficiency in buildings above EPBD requirements. The EUGR explicitly introduced the need for coherence and cross-connection of energy efficiency with (other) climate and energy related targets, the majority of which entailed decarbonisation and electrification of transport, reduction of energy poverty, decarbonisation of heating, and climate neutrality.

4.4. Package of policies and measures

Policy measure coverage has notably improved over the years (Table 4). As previously discussed, the first NEEAPs in Phase I included scattered and fragmented measures in spite of the overall good sectoral coverage. In Phase II, measures targeted all sectors and policy types, with residential measures and measures of financial or fiscal nature of particularly dominance (Bertoldi and Economidou, 2016). Whilst not an EED requirement, 10 countries also covered the agricultural sector[21] in their policy mix (Economidou et al., 2018). The trend of more comprehensive policy coverage continued with the NECPs (Phase III), where around two thirds of reported measures were found to have no direct link to previous NEEAP measures, suggesting thus the novelty of many of these measures (Economidou et al., 2020).

Despite the template provided to support the drafting of the 2011 plans (as discussed in Section 4.1), Member States adopted Commission guidelines to different extents, resulting in **descriptions of policies and measures** of diverse quality and depth. In certain cases, it failed to push Member States to disclose sufficient proof on whether and how some Member States were to reach their energy savings target (Schüle et al., 2013). With Phase II, more detailed descriptions of the overall strategies

[19] Directive 2006/32/EC: "Energy savings in a particular year following the entry into force of this Directive that result from energy efficiency improvement measures initiated in a previous year not earlier than 1995 and that have a lasting effect may be taken into account in the calculation of the annual energy savings. In certain cases, where circumstances can justify it, measures initiated before 1995 but not earlier than 1991 may be taken into account".
[20] Croatia, Latvia, the Netherlands, Slovakia.
[21] Netherlands, Finland, Czechia, Denmark, Bulgaria, Hungary, Sweden, France, Spain and Belgium.

and individual measures were given with good examples categorising information according to policy type, timeframe, target groups, budget and financial resources, impact and assumptions underlying savings estimates (Economidou et al., 2016). Given the lack of a mandatory template on policy measures, Economidou et al. (2018) stressed the issues rising from heterogeneous reporting. In particular, some countries continued to include only lists of measures, without necessarily demonstrating consistency or comprehensiveness. With the addition of new reporting requirements under Phase III, a more harmonised approach was adopted and the intermediate recommendations issued by the EC on the draft plans served as a quality control check before the final submissions by Member States. The EC assessment noted that most countries provided more information on their policies and measures in their final plans compared to the draft ones, including higher ambition of reported measures, more details about their implementation and design features or a larger set of measures (European Commission, 2020b). On the other hand, no significant changes were notified in terms of quantified impact of policies and measures.

In addition to the absent or sporadic indication of saving estimates discussed above, a considerable gap between the political commitment to energy efficiency and adopted or planned measures was identified in Phase I. A **link between measures and targets** was therefore missing. Only Hungary, Ireland, Italy, Luxembourg, Portugal, Spain and the UK included saving estimates for all or almost all measures and only a few countries presented underlying assumptions, with Finland, Italy, Luxembourg, Portugal and Slovenia standing out as good examples (European Commission, 2009). The situation improved in Phase II, albeit in a modest way. In total, 12 Member States[22] reported partial or full information on savings of measures under Article 3 and 20 countries[23] under Article 7 (Economidou et al., 2016). The evaluation of the ambition of the overall national policy framework against the targets remained an important hurdle in conducting a full assessment of the plans, especially in relation to the achievement of the overarching targets under Article 3. For certain countries, the share of the savings to be achieved in 2020 by each sector was presented, demonstrating how each sector was expected to contribute towards the targets. For Phase III, the requirement of disclosing the WEM and WAM scenario projections covering the five dimensions meant that more concrete evidence on the contribution of measures towards the targets was to be expected. However, only a few countries specified which measures fell under the WAM and WEM scenarios even though the majority of the reported measures indirectly supported the energy efficiency targets. Linking the ambition of national policy frameworks to targets in a quantitative way therefore remained a weakness in Phase III. Economidou et al. (2020) pointed to the need of a robust reporting framework which would require the calculation of energy savings of measures –considering double counting, additionality and other elements as in the case of EED Article 7– allowing thus a comparison of the ambition of the proposed policies against the national contributions towards the EU target.

The EED NEEAPs included a mixture of "old" measures reported in Phase I under the ESD and new measures, thus making a **distinction between new and existing measures**. Specifically, around 60% of the Phase II measures represented measures previously notified in Phase I (Bertoldi and Economidou, 2016; European Commission, 2009, 2014). In Phase III, over a third (35%) of all measures by the EU27 Member States in their NECPs were specified as "planned", confirming the existence of several new efforts, possibly pointing to national intentions of stepping up efforts to meet the new ambitions set in the 2030 framework (Economidou et al., 2020). In addition, two thirds of the NECP measures had no direct link with the NEEAPs as previously mentioned.

[22] Belgium, Bulgaria, Cyprus, Finland, France, Croatia, Ireland, Italy, Luxembourg, Malta, Portugal, UK.

[23] All except Czechia, Spain, Hungary, Luxembourg, Netherlands, Poland, Slovenia, Slovakia.

4.5. Governance and institutional capacity

Concerning "Governance and Institutional Capacity", a linear improvement in the governance to execute and monitoring the plan, the capacity building activities and the forecasted investment needs and budgetary commitment to implement the PAMs, can be noted across Member States (Table 4).

While the majority of the NEEAPs under the ESD lacked a robust **governance structure** to effectively implement the plan, the introduction of the Energy Union Package in 2015 aimed to establish goals for the coming decades and set a governance framework thus pushing Member States in the direction of more ambitious and better coordinated climate and energy policies (Ringel, 2018). With the introduction of EUGR, all Member States were therefore required to provide an overview of the process under which the NECPs were adopted, including a mandatory consultation of national and sub-national stakeholders. As a result, all Member States submitted final plans of good quality supported by a clear and solid governance (European Commission, 2020b).

In what concerns **capacity building**, in the first NEEAP only a minority of Member States foresaw activities to meet the ambition of the plan. This aspect however, gradually improved over the years, which resulted in almost all Member States enhancing the capacity of public authorities to plan and implement sustainable energy policies and measures[24] and reporting such activities in their final NECPs.

Further, the first NEEAP assessment highlighted that only very few Member States provided information on **budgetary resources, commitments and investment needs** to implement the adopted measures. Following the Commission's observations and further mandatory requirements indicated in the EED, 12 Member States[25] improved the level of information regarding investment needs and funding sources necessary to mobilise investments and implement their PAMs which was subsequently reflected in the final NECPs. This can be attributed to:

- EED mandatory requirements regarding the inclusion of investment needs and necessary budgetary commitment to implement the actions
- The introduction of new EU financing mechanisms for Energy Efficiency,[26] subsidies and grants mainly (but not only) in the Building sector
- Access to the European Regional Development Fund and Cohesion Fund to implement NECPs PAMs (energy efficiency and renewable energy)
- Increased use of EU ETS auction revenues for funding investments in emission reductions and removals, renewable energy, energy efficiency, research and innovation for clean energy and industry technologies.

Although, with the introduction of EUGR almost all Member States have identified their investment needs to implement their NECP, in order to deliver additional investment of around EUR 260 billion[27] per year to achieve the EU's climate and energy targets by 2030, a considerable extra effort should be made by Member States to meet this target (European Commission, 2020b).

[24] For instance under the Covenant of Mayors initiative.

[25] Croatia, Cyprus, Czechia, Finland, Ireland, Italy, Lithuania, Netherlands Romania, Slovakia, Slovenia, Spain.

[26] The European Fund for Strategic Investments, the Connecting Europe Facility, the European Structural and Investment Funds and other existing initiatives have been successful in supporting investments in renewable energy and energy efficiency.

[27] See EUCO32–32.5 scenario https://ec.europa.eu/energy/en/data-analysis/energy-modelling/euco-scenarios.

4.6. General issues

Regarding the overall aspect of "general criteria", a clear learning curve over the various rounds of plans is visible (Table 4). As the first NEEAPs of 2007 were largely seen as a reporting tool of policies and measures that achieve the overall 9% end energy target of the ESD (Bertoldi and Cahill, 2013; Schüle et al., 2013; Suomi, 2017), almost no reporting on the sub-criteria of this category took place. Following discussions in the Concerted Action and overall agreement that the NEEAPs can and should be used as a "policy tool", a much larger share of countries reported on **key priorities** (often: developing energy service markets and addressing energy efficiency improvement with buildings). To a lesser extent, overall linking to economic and social challenges was addressed, with the notable exception of addressing energy poverty. In terms of using the plans as a **tool to take stock, evaluate and improve policies**, as clear shift can be witnessed between the first and second phase of NEEAPs. Whereas the focus in Phase I largely concentrated on measurement and verification of measures (Thomas et al., 2012a,b), the Phase II saw a much broader stock-take of political options and measures (Suomi, 2017). To a certain extent this can be attributed to:

(1) The issuing of a Commission template as guideline for the NEEAPs;
(2) the alignment of the energy efficiency reporting with the overall reporting of the Member States for the clean energy targets under the European Semester; and
(3) a continuous exchange of good practices between Member States (Federici et al., 2016). This largely explains a similar shift witnessed in the sub-category of "tracking compliance with other/all energy-related EU legal provisions". Under this aspect, the compliance and reporting of building-related energy efficiency to show proper implementation of the Energy Performance of Buildings Directive (EPBD) stands out in terms of mentions in the NEEAPs (Economidou et al., 2018).

As with the second phase of NEEAPs, a clear "change in gear" can be witnessed with the reporting in the NECPs. As the EUGR explicitly demands including all sub-categories in the reporting, the EUGR manages the full shift from the early impact-of-measures-reporting to a full-fledges screening of the potential and prospects of energy efficiency policies. With the draft NECPs handed in relatively shortly after the negotiations of the EUGR, it is not surprising that Member States had a clear understanding of the more **policy-oriented approach towards policy planning** that was implemented already at the stage of the draft plans and confirmed later with the final NECPs. As this understanding is also the outcome of a process that was supported by several formal and informal workshops with the European Commission and between Member States, it can be argued that the present form of comprehensive and policy-oriented reporting is a clear case of "policy learning"[28] (Easterby-Smith et al., 2008; Moyson et al., 2017) over time.

5. Conclusions and policy implications

The objective of this paper was to take stock of the strategy planning exercises in European energy efficiency policies, so as to draw overall conclusions for similar international energy and climate policy planning. Our assessment has revealed a clear learning curve over time both in terms of developing and detailing the legal requirements and in expanding and advancing the strategies. Since the inception of the first NEEAPs under the ESD more than 10 years ago, the European Commission and the Member States have had multiple opportunities to draw lessons from past experiences and incorporate steady improvements on how to set EU-wide requirements and how to plan effective strategies on energy efficiency at national level. Our findings show that these improvements are, to a large extent, reflected in the latest NECPs through the adoption of more harmonised reporting approaches, more evidence-based target setting methods, the establishment of better monitoring systems and broader consideration of policy measures and packages. Parallel to this, econometric modelling provides suggestive evidence of the encouraging effect of energy efficiency policies on energy consumption in the EU. Bertoldi and Mosconi (2020) showed that energy consumption would have been 11% higher in the absence of energy policies in the period 1990–2013. More recent findings using index decomposition analysis techniques also confirm the positive role of energy efficiency gains in the EU (Román-Collado and Economidou, 2021). These encouraging results can be largely backed by comprehensive energy efficiency strategies comprising a wide range of policies and measures.

Derived from the analysis above, several implications can be drawn at general level from our stock-taking exercise of national energy efficiency policy planning:

- Overall planning should not limit itself to formulating target commitments, such as the NDCs or energy efficiency targets. To be fully effective, these commitments should be underpinned and monitored by related policies and measures, including assessments of their energy and climate impacts.
- Specific guidelines and templates are clearly beneficial. In energy efficiency planning, they have demonstrably helped enhance the thoroughness and credibility of the strategies, as well as enable more meaningful cross-evaluation. In the EU, templates have nudged Member States to better describe (nearly) all the necessary features, such as timeframe, target groups, budget and financial resources, as well as impacts.
- Strategy planning is not a one-off exercise, but rather a continuous dialogue. The two-step submission procedure under EU Governance Regulation can be considered a workable practice. The review process in which EC provided comments to the draft versions of the NECPs clearly led to improved strategies for most Member States. Considering a similar policy dialogue under the UNFCCC and the Paris Agreement rulebook might prove beneficial.
- Linking planning exercises to scenario analysis in order to underpin future developments while considering socio-demographic and economic factors can provide a solid foundation for deriving suitable policies and measures.
- Accurate monitoring and verification is needed, but far from only being a "technical" exercise. This needs to check actual progress in energy efficiency and effectiveness of national policies and measures. Monitoring of the impact and progress of the strategies remains a weak point that requires more attention than it received in most of the assessed strategies throughout the whole assessed period. The strategies should ideally provide a clear approach to continuous update of both the scenarios behind the targets and the verification and evaluation of the policies and measures to enable adapting the pathways to reaching the overall target. With this respect, the advanced data availability remains at present one of the challenges and points of further focus.

Considering these lessons learnt seems beneficial to craft effective and (politically) working energy and climate planning at national and international level. With the COP26 agreement on the rulebook of the Paris Agreement and the 2023 global stock-take exercise ahead, these insights should be considered when putting the rulebook into practice.

CRediT authorship contribution statement

M. Economidou: Conceptualization, Methodology, Formal analysis, Visualization, Writing – original draft, Writing – review & editing. **M.**

[28] Policy learning as a concept describes a situation where policies or positions are adapted over time based on feedback from other stakeholders (inter-organizational knowledge transfer) or feedback on the successes or failures of earlier positions (organizational policy learning).

Ringel: Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **M. Valentova:** Methodology, Formal analysis, Visualization, Writing – original draft, Writing – review & editing. **L. Castellazzi:** Methodology, Formal analysis, Visualization, Writing – original draft. **P. Zancanella:** Formal analysis, Writing – original draft. **P. Zangheri:** Formal analysis, Writing – original draft. **T. Serrenho:** Formal analysis, Writing – original draft. **D. Paci:** Formal analysis, Writing – original draft. **P. Bertoldi:** Methodology, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

Annex I

Legal framework and reporting requirements on energy efficiency in the European Union

Main reporting requirements set by the ESD (Phase I)

The ESD aimed to enhance cost-effective energy efficiency improvements at end-use level in the Member States by establishing indicative targets, incentives and setting the institutional, financial and legal frameworks to remove existing market barriers that hampered efficiency. It also introduced a clear methodology to calculate target savings in relation to a baseline based on average past consumption (Horowitz and Bertoldi, 2015; Thomas et al., 2012a,b). In line with the main ESD objectives, it set out two key conditions: to develop and promote a market for energy services and to deliver energy-saving programmes and other relevant measures.

Within its legal framework, one of the most significant aspects brought in by the ESD was **the mandatory reporting** introduced by Article 14(2). According to this, Member States were required to submit their first NEEAPs by June 2007 and a second one no later than June 2011. Further, Article 4 required Member States to adopt an overall national indicative savings target of 9% or higher, to be achieved and measured in 2016, and an intermediate national indicative savings target to be achieved in 2010.[29] This had to be supported by a description of national energy efficiency measures put in place to comply with other EED provisions, including the exemplary role of the public sector (Article 5).

New planning and reporting requirements by the EED (Phase II)

The EED, adopted in October 2012 as part of the EU climate and energy legislative package, set an ambitious EU energy efficiency target by 2020 but did not prescribe a specific methodology in defining national targets. Member States were free to determine their own national contributions, based on either primary or final energy consumption, primary or final energy savings, or energy intensity (European Commission, 2013). Nevertheless, it brought forward a set of legally binding measures at the level of energy transformation, distribution, and final consumption, such as the requirements to establish energy efficiency obligations schemes (or equivalent alternative measures), renovate the 3% of central government buildings annually, promote energy audits and energy management systems and set up building long-term renovation strategies.[30]

The relevant EED article to planning was Article 24 on review and monitoring of implementation which set out the main reporting elements, with the first NEEAPs under the EED due in 2014 and every three years thereafter. In an effort to improve the quality of Phase I NEEAPs, the EED became much more specific and instrumental in putting down requirements for both the plans and reporting (European Commission, 2010). Annex XIV of the EED provided the general framework for reporting, divided into two parts. Part 1 of Annex XIV formalised requirements such as key energy and economic indicators related to the energy efficiency targets, energy savings achieved under the EED Article 7 (in relation to the national energy efficiency obligation schemes, EEOS), and updates of major legislative and non-legislative measures. Part 2 provided the NEEAP framework with a list of minimum reporting requirements. This included, among others, the indicative 2020 targets, information on adopted and planned measures and their related energy savings (achieved by the reporting period and expected for 2020), and description of the energy efficiency obligation scheme (or alternative measures). The European Commission also issued a thorough guidance template accompanying the EED (European Commission, 2013), listing all mandatory NEEAP reporting elements with explanations including suggestions for additional information to be considered. The actual format of the reporting remained non-binding.

Energy efficiency as one of the five dimensions of the EUGR (Phase III)

The EUGR aligned the post-2020 energy and climate change monitoring and reporting across all five dimensions of the Energy Union: energy security, internal energy market, energy efficiency, decarbonisation, research, competitiveness and innovation (European Commission, 2018; Karakas, 2015). The regulation streamlined some 50 individual planning, reporting or monitoring obligations (European Commission, 2016b). It synchronised the energy governance process with the macroeconomic coordination of the European Semester and the stocktaking exercises under the Paris Agreement (Slingerland et al., 2015; Stuchlik, 2017; Turner, 2015; Turner et al., 2015; Umpfenbach, 2015). A structured dialogue was set up between the Commission and Member States through the means of planning and reporting obligations. The coordination follows: (1) strategic long-term energy and climate policy planning and (2) short-term reporting by means of (a) biennial progress reports and (b) annual reporting (see (Knodt and Ringel, 2019; Ringel and Knodt, 2018), Knodt and Ringel (2019) and (Gkonis et al., 2020) for details).

Cornerstone of the long-term planning are the NECPs with a ten-year perspective, covering national objectives, strategies and policies in the clean

[29] According to Annex 1 of the Directive, the national indicative savings target should be calculated using the annual *final inland energy consumption* of all energy users within the scope of the Directive, except for activities included in the ETS (Emissions Trading Scheme) sector. Also, according to paragraph 2 of Article 4 ESD, the national energy savings in relation to the national indicative energy savings target shall be measured as from 1 January 2008.

[30] The requirement to draw these long-term renovation strategies was moved to the Energy Performance of Buildings Directive as part of the revision of the revision of the directive adopted in 2018 (2018/844/EU).

energy and climate fields, notably energy efficiency. As a learning exercise from earlier experiences with the NEEAPs and the National Renewable Energy Action Plans (NREAPs), the Commission provided Member States with a clear template and guidance documents, inter-alia for the reporting of policy measures[31]. The first draft plans for the period 2021 to 2030 were due at the end of 2018. Following feedback from the European Commission (European Commission, 2019a, 2019b), Member States adapted their plans, which they had to submit as final version by the end of 2019. By 30 June 2024 the Member States shall provide updates of the plans, in line with the 5-yearly ambition cycle of the Paris climate agreement (Bertoldi, 2018; United Nations, 2015). The long-term planning is complemented by periodically updated national Low Emissions Strategies. These strategies cover a fifty-year perspective and strongly focus on climate policy-related issues.

Regarding energy efficiency, Article 4 of the EUGR and its Annex I A, points 2.2 and 3.2 list reporting obligations. These comprise national objectives and targets (national targets and their contribution to the EU energy efficiency target, milestones for building renovation, other objectives) and relate to the reporting of policies and measures (eight areas that need to be covered in the NECPs, including notably the impact of energy efficiency obligation schemes and alternative policy measures under Articles 7a and 7b). Section A presents the national plan and Section B provides the analytical basis. Under each dimension, Member States are required to cover 4 key areas: a) national objective and targets, b) policies and measures, c) current situation and reference projections, d) impact assessment of policies and measures. In reporting reference projections, Member States must set their WEM (with existing measures) and WAM (with additional measures) scenarios, where the former scenario reflects existing policies and measures and the latter takes into account the additional effects of planned measures reported by Member States.

Implementation by Member States

NEEAPs 2008 & 2011 (Phase I)

The first NEEAPs, synthesized by the Commission in the Staff Working Document SEC (2009)889 (European Commission, 2009), cemented the national 2016 targets and intermediate 2010 targets (the latter ranged between 1.5% and 9%). Some opted for a higher 2016 ambition, while others indicated that the NEEAPs formed part of their strategy to reach a 20% energy demand reduction by 2020 and proposed a wide variety of policy measures targeting different end-use sectors. For the most part, “early actions” or ongoing measures dominated many NEEAPs, even if new measures were prominent for some late EU-arriving Member States.

Sector-wise, measures in the building sector, especially residential buildings, were at the heart of these plans, with special focus on refurbishment of existing buildings. Some Member States declared ambitious strengthening of building codes and supported passive or low-energy house buildings. With varying degrees of detail, almost all NEEAPs included measures in the tertiary, transport and industrial sectors. In addition, many NEEAPs included a number of promising horizontal measures and others proposed a range of measures to fulfil the provisions regarding the exemplary role of the public sector (European Commission, 2009). In spite of this, the information reported by most Member States in this first round failed to provide a clear demonstration of the final energy savings to be generated by the proposed measures (European Commission, 2011).

The second NEEAPs showcased significant progress in energy saving efforts, with more information disclosed on medium-term strategies, policy measures and evaluation methodologies. While many Member States retained their previous 2016 energy saving targets, some indicated higher levels of forecast savings, either due to increased policy activity or due to a re-evaluation of the effectiveness of existing policies (European Commission, 2014). Taking into account their comprehensiveness, level of description of national policy measures and coverage of key sectors, the overall quality of the second NEEAPs was higher than that of the first NEEAPs (Broc et al., 2013; Thomas et al., 2016). This was also reflected in the energy savings expected to be achieved due to the implementation of new measures included in this round of NEEAPs (European Commission, 2011). All Member States listed some supply side energy efficiency measures, even though the principal focus remained on end-use efficiency measures (European Commission, 2014).

As buildings were associated with the largest energy savings potential in the EU, achieving energy efficiency improvements in this sector continued to be priority for many Member States (Thomas et al., 2016). Inputs from assessments of saving potentials in buildings were, however, missing. The large reported increase in savings between 2010 and 2016 often led to a 5-to-10-fold increase in annual rate of actions or savings. The novel introduction of nearly-zero energy building levels in new constructions was taken into consideration, although most countries opted to develop their building initiatives in more detail within the reporting framework of the Energy Performance of Buildings Directive, EPBD (Directive 2010/31/EU, 2010). The introduction of many promising financing tools to support energy efficiency programmes were identified, mainly through the aid of the EU Structural Funds, mechanisms such as public-private partnerships or energy performance contracting. In the public sector, Member States outlined the exemplary role of the sector, including the set-up of quantified energy savings targets and implementation of energy management systems and voluntary agreements in public authorities (European Commission, 2014).

NEEAPs 2014 & 2017 (Phase II)

In compliance with the EED Article 24(2) reporting obligations, Member States set their energy efficiency targets of 2020, and presented a variety of existing and planned measures including monitored energy savings in the NEEAPs submitted in 2014. Several Member States increased the level of ambition of their national targets as regards primary and/or final energy consumption compared to earlier communications in 2013. Nevertheless, the sum of national indicative targets fell short, corresponding to 16.8% primary energy savings compared to the 2007 PRIMES projections for 2020 (European Commission, 2015b).

A large majority of the 2014 plans reported on the progress towards the ESD targets and established a general continuation of energy efficiency policies at national level. Many of the notified measures were also found in the previous 2007 and 2011 plans, although, in several cases, these were reinforced and complemented with new measures. New measures included energy efficiency obligation schemes, energy audits for large enterprises, 3% renovation of central government building stock and long term renovation strategies. In relation to Article 7, only 4 Member States planned to rely exclusively on EEOSs, 10 only on alternative measures and twelve through a mixture of EEOSs and alternative measures (Bertoldi et al., 2015; Fawcett et al., 2019). For 12 Member States, the obligation scheme was a new measure in their national policy mix, confirming the important role of the EED as a driver of new measures.

[31] For the first time, the European Commission provide a non-binding template for reporting policy measures.

On the long-term renovation strategies, most Member States achieved high compliance with the Article 4 requirements, but the level of ambition, details, scope and depth of analysis varied significantly between countries (Castellazzi et al., 2016). Main issues included data gaps in the non-residential sector, lack of modelling evidence, absence of specific monitoring indicators and unclear targets (M. Economidou et al., 2020).[32]

The fourth NEEAPs submitted in 2017 continued to have a central role in energy policy. As in the case of 2014, the EU Member States outlined updates in their 2020 energy efficiency targets, with 10 Member States disclosing target updates as a result of changes in macro-economic parameters, statistical reporting or other baseline conditions (Economidou et al., 2018).[33] The gap between the collective national contributions and EU primary energy target grew further but the contributions in terms of final energy remained below the EU target (European Commission, 2017). Nevertheless, the European Commission confirmed the full transposition of the EED in all Member States and closure of all infringement proceedings, despite various implementation delays and pending conformity checks (European Commission, 2017).

On energy efficiency obligations (EED Article 7), implementation changes were reported by Bulgaria, which opted to use alternative policy measures, and Greece, which introduced an EEOS alongside alternative measures. In addition, six countries notified updates to their energy saving requirements due to energy statistics updates affecting baseline calculations (Economidou et al., 2018). Measures of financial and fiscal nature were the most commonly reported measure, which predominantly targeted the residential sector, followed by services, industry, transport and agriculture (Zangheri et al., 2019). These often took the form of subsidies and grants for energy efficiency investments, tax credits, low-interest loans for building renovations and incentives for electric vehicles (Bertoldi et al., 2021; Castellazzi et al., 2019; Economidou et al., 2019). Taxation measures were also reported in several countries including Austria, Denmark, Estonia, Germany, the Netherlands, Ireland, Finland, France and Sweden (Economidou et al., 2018). Regulatory measures were mostly composed of EPBD and Eco-design requirements as well as mandatory energy audits in large enterprises in line with the EED Article 8 provisions and central government building renovations mandated by the EED Article 5. Other measures focused on the provision of information and advice as well as education and qualification courses on energy advisers, building professionals and auditors. On industry, voluntary agreements were highlighted as a common policy instrument often coupled with fiscal incentive measures (Bertoldi and Economidou, 2018).

NECPs (drafts 2019 and final 2020)

As previously discussed, the preparation of NECPs followed a staged approach, where the draft NECPs anticipated the formal submission of the final plans. This consisted of an extensive process of coordination at national level[34] and constant dialogue and collaboration between Member States, the Commission and other EU institutions (European Commission, 2020b). Their integrated nature, which required the definition of national contributions to the EU targets and accompanying policies and measures in the five areas, aimed to break silos across sectors, policies, government departments with stakeholders and the public.

The assessment of the national contributions in the draft NECPs, made by the Commission in June 2019, showed that only a few Member States indicated a sufficient level of contributions for 2030. On aggregate, the gap with the EU target on primary and final energy consumption was substantially high.[35] The Commission provided individual feedback to Member States[36] and asked to review the level of ambition in the final NECPs in cases where contributions were deemed as insufficient (European Commission, 2019a). Member States took into account most recommendations in their final NECPs. The assessment of the final plans showed that the revised energy efficiency ambition would amount to a reduction of 29.7% for primary energy consumption and 29.4% for final energy consumption, reaching 1,176 Mtoe and 885 Mtoe respectively in 2030 (European Commission, 2020b).[37]

The NECPs provided information on a number of policies and measures, with nearly 1,400 policy and measures on energy efficiency (M. Economidou et al., 2020). Many countries tended to concentrate and intensify their efforts especially in the transport and building sectors (with nearly 670 measures in total), also in terms of ambitions and details, setting specific targets or milestones. While some of the measures were a continuation of longstanding existing measures, a significant number of new or updated policy measures of various types (financing, information, education, planning and regulations) were reported in the NECPs.

Regarding building renovations (EPBD Article 2a), only a few countries notified their ambition to set indicative milestones expressed as a share or number of buildings to be renovated or to meet a certain energy class, energy savings, CO_2 or GHG emission reduction, absolute energy consumption, and renovation rates. In the context of the EED Article 7, the NECPs reported a few important differences in the implementation period 2021–2030 with respect to the preceding one (2014–2020). New obligation schemes were recently set up (or planned to be set up) in Croatia, Cyprus and Hungary, while others were stopped or terminated. As in the previous period, the policy mix adopted by countries with alternative measures in 2021–2030 is quite diverse. Eight Member States did not report the expected impact of the Article 7 measures in energy savings and only 13 Member States notified cumulative impact of measures to be sufficient to meet the EED Article 7 requirement (M. Economidou et al., 2020). On the central government renovation requirement (EED Article 5), no major changes were identified in the chosen implementation approach, compared to the previous reporting period (2014–2020). Countries opting for the alternative approach in 2021–2030 presented a mixture of regulatory, economic and information measures.

Recognising the prominent role of energy efficiency, the Energy Union enshrined the guiding "Energy Efficiency First" principle into legislation.[38]

[32] These shortcomings were partially solved in the updated 2017 and 2020 strategies that that included an improved description of the national building stock and were supported by more robust data analysis (Castellazzi et al., 2019).

[33] These resulted in minor upward revisions in the collective contribution towards the EU target corresponding to 0.1% in final energy and 0.2% in primary energy consumption compared to previous notifications reported up until 2016.

[34] The plans have been subject to extensive consultation with stakeholders, civil society and citizens to ensure ownership and wide public support.

[35] For primary energy consumption, the gap ranged from 118 to 43 Mtoe (the considerable range depends on whether more conservative or more ambitious assumptions are made for countries without a national contribution), corresponding to 26.3% to 30.2%. The final energy consumption gap ranged from 85 to 26 Mtoe (i.e. 26.5%–30.7%).

[36] Commission Recommendations of 18 June 2019 on the draft integrated National Energy and Climate Plan of each Member State covering the period 2021–2030, C/2019/4401 to C/2019/4428.

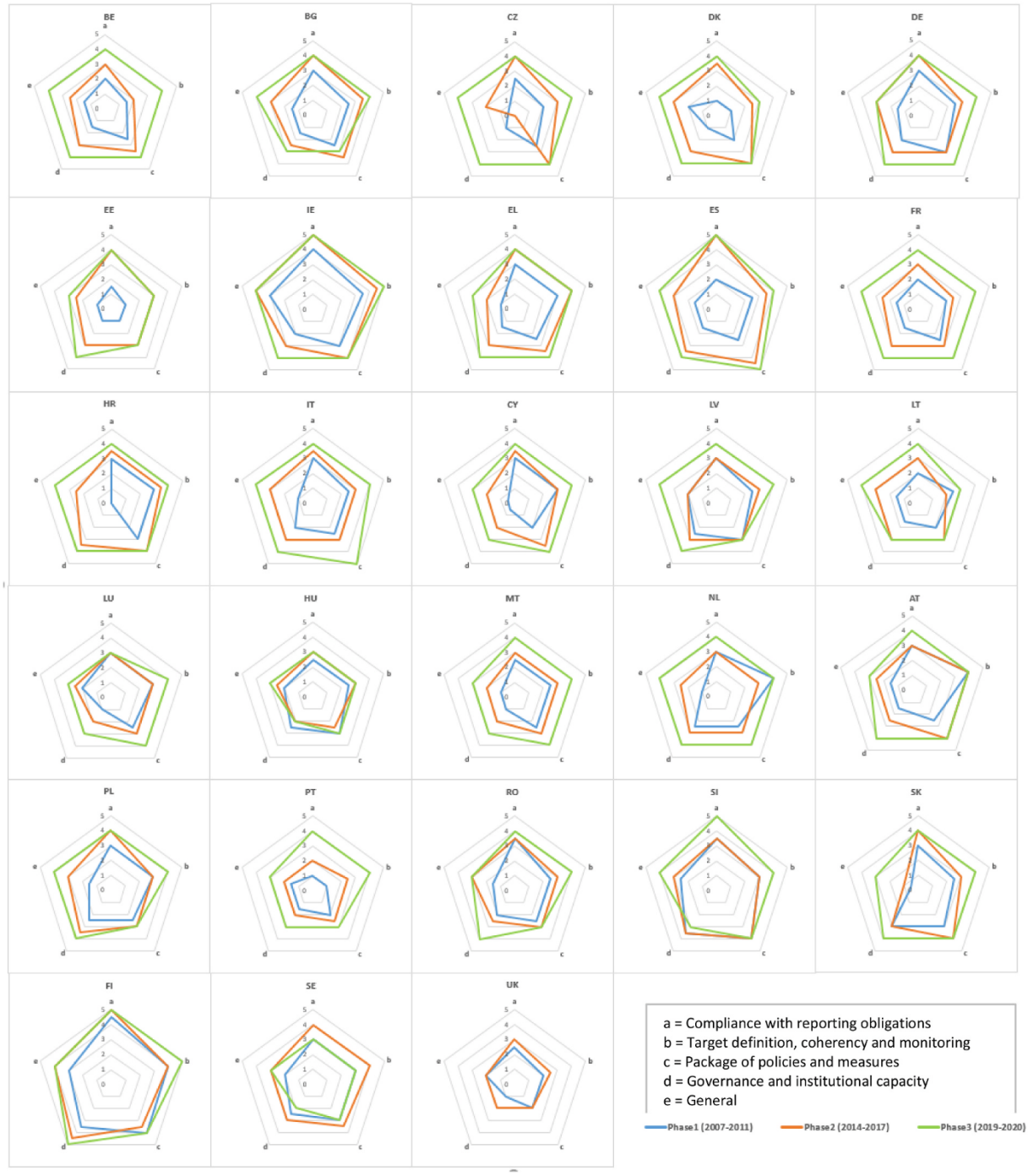
[37] This represented an increased ambition compared to the draft NECPs even though there was still a gap of 2.8% for primary energy consumption and of 3.1% final energy consumption compared to the EU 32.5% target.

[38] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action.

Most final NECPs only set out limited details on the application of this principle (European Commission, 2020b). In general, the NECPs did not sufficiently identify or quantify wider benefits of energy efficiency measures (economic, environmental and societal), which remain to be addressed in the future, despite growing scientific literature on the topic (Shnapp et al., 2020). Finally, the NECPs did not consider any COVID-19 crisis implications as they were submitted before the pandemic.

Annex II

Evaluation of energy efficiency plans in individual Member States.



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