Title: How first comes energy efficiency? Assessing the Energy Efficiency First Principle in the EU using a comprehensive indicator approach

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Abstract

The energy efficiency first (EE1) principle was defined and established as a leading principle with the Clean Energy for All Europeans package in 2016. The principle requires demand resources to be considered on par with supply-side solutions and prioritized whenever they are less costly or deliver more value than alternative options. This approach should be applied in every planning process, decision-making and investment regarding the energy sector. In order to examine to which degree, the EE1 principle is actually implemented by the Member States, we developed a composite indicator, which consists of 13 criteria. These criteria capture the multiple facets of the EE1 principle and thus, can also be used as a guide for the Member States in their operationalization of the EE1 principle. In this paper, the indicator approach was deployed to assess the implementation of the EE1 principle in the national energy and climate plans of 14 Member States, which demonstrated its applicability as an assessment tool across different countries in the EU. The results imply that the fundamentals of the principle are understood and realized, but in regard to details and the degree of compliance, improvements can be made.

Keywords: Energy Efficiency First, Composite indicator, Energy Policy, European Union, Energy poverty, Sufficiency

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1. Introduction

The relevance of energy efficiency (EE) in building a secure, sustainable, and affordable energy system has been recognized both on the international as well as the European level. In 2013 the International Energy Agency coined EE as “the first fuel” (IEA 2013), which was then adapted by the European Union (EU) in the EU 2030 climate and energy policy framework (EC 2015). EE constitutes one of the five pillars of the Energy Union, which further include energy security, solidarity, and trust; the internal energy market; decarbonization of the economy; and research, innovation, and competitiveness. In this context, EE takes on an overarching role, as it presents a cost-effective option to reach a variety of goals due to the fact that “*the cheapest and cleanest source of energy is the energy that does not need to be produced or used”* (EC 2016).

Despite this, the progress in EE has slowed down over the last decade across the EU. While EE improvements in final energy consumption grew by 1.4 percent annually between 2000 and 2007, the progress decreased to an annual growth rate of 1.1 percent afterwards (ODYSSEE-MURE 2020). Because the Member States (MS) across the EU continue to underinvest in energy efficient opportunities and demand-side measures, a significant share of economic EE potentials remains untapped (Economidou et al. 2011). As a consequence of this gap, the Energy Union agreed on the necessity for an overarching mandate to ensure the exploitation of the economic EE potentials. For this purpose, the energy efficiency first (EE1) principle was defined and established as a leading principle with the Clean Energy for All Europeans package in 2016 (EU 2018).

In short, the principle requires demand-side options to be considered on par with supply-side solutions in energy policy and prioritized whenever they are less costly or deliver more value than alternative options. The ubiquity of EE1 further demands its application in every planning process, decision-making and investment regarding the energy market. While the preferential treatment of less costly demand-side solutions seems like a logical and common-sense approach to policymaking, the insufficient EE investments and measures show that this is not the standard in EU policymaking. The uptake of cost-efficient and energy efficient technologies are impeded by a variety of market barriers like limited access to capital, information, or behavioral issues (Thollander and Palm 2013). Furthermore, the traditional prioritization of supply-side solutions on the political sphere as well as in business decisions, still prevails today and may cause policymakers and investors to overlook cost-efficient EE opportunities. Therefore, the EE1 principle represents a change to the paradigm of the energy system, by moving EE on the top of the agenda and demanding it to be treated as the first fuel.

Because EE1 goes beyond the implementation of EE measures and the introduction of specific targets, the extent to which the EE1 principle has been incorporated by the MS cannot be assessed by common EE indicators like final energy consumption and energy intensity. Instead, the indicator needs to contain information about the treatment of supply- and demand-side options in the policymaking process and decision making as well as on the management of obstacles and challenges to the uptake of EE improvements. The objective of this paper is to assess the current state of the EE1 principle at the national level across the EU as well as to provide the MS with guidance for the implementation of the EE1 principle. The aim is to develop criteria, on how to assess the EE1 principle in policymaking, and aggregate those to a single indicator. The set of criteria should reflect the different aspects of the EE1, be comparable across countries and straightforward, so that national policymakers can use them as a guideline or checklist for operationalizing the EE1 principle.

For this purpose, section 2 of this paper provides a detailed definition of the EE1 principle and explores the necessary steps for it to be operational. Based on this, a total of 13 criteria are developed, which are presented in section 3. Depending on the relevance of the criteria different weights are assigned to them, which are then aggregated to a single indicator. The application of the indicator follows in section 4, in which the integration of the EE1 principle in national policymaking is assessed. The assessment is based on the National Energy and Climate Plans (NECPs) and interviews with stakeholders of 14 MS. After the results are presented, conclusions are drawn in section 5, as well as the limitations and future application of the indicator discussed.

2. Defining the EE1 principle

The origin of EE1 principle can be traced back to the 1970s, where rising electricity prices caused by the oil shocks forced the United States to explore the potential of demand-side resources. In this context, concepts such as integrated resources planning, or least-cost planning emerged. At the EU level, the principle first gained attention with the launch of the Energy Union in 2015 and entered the political and policy sphere with the Clean Energy for All Europeans package (ENEFIRST 2019). The principle has further been included in subsequent regulations and amendments of a variety of directives. For instance, in the amendment to the Governance Regulation (EU, 2018/1999) the EE1 principle is defined as the following in Article 2(18):

„`*energy efficiency first' means taking utmost account in energy planning, and in policy and investment decisions, of alternative cost-efficient energy efficiency measures to make energy demand and energy supply more efficient,*

in particular by means of cost-effective end-use energy savings, demand response initiatives and more efficient conversion, transmission and distribution of energy, whilst still achieving the objectives of those decision" (EU 2018, Article 2, 18).

Further interpretations of the EE1 principle are given on the European level (EC 2016, 2019), by the German government (BMWI 2016) as well as by numerous NGOs and European think tanks (Bayer 2015; Coalition for Energy Savings 2015; Cowart 2014; Cowart et al. 2015). While they slightly differ in terms of details and formulation, they all contain common elements. In the following, these core elements of the EE1 principle are summarized in three statements, which together provide an overview of meaning behind the principle.

Statement 1: Energy demand is not fixed

The EE1 principle moves away from the traditional approach of considering energy demand solely as a fixed variable in the energy equation to presenting it as an input variable, which can be altered. Hence, additionally to supply options - like grid expansion - demand-side management should be taken into account (Gellings 2017).

Statement 2: Equality of supply and demand resources

The principle neither equals a specific level of EE nor does it promote a general superiority of demand side solutions. Instead, EE1 requires demand resources to be considered on par with other options and only prioritized whenever they are less costly or deliver more value than alternative options. Thereby, the principle acknowledges that both costs and benefits go beyond economic aspects and additionally include social and environmental benefits. The results of the CBA and thus, also the assessment of the economic EE potentials, depend on the definitions applied in this context as well as the assessment methodology (ENEFIRST 2019).

Statement 3: Ubiquity in all energy policies and strategies at any level

As noted previously, according to the EE1 principle, EE is more than a tool to achieve a final target like energy savings. It rather transfers EE to a higher level by integrating it in energy policies and strategies. As a resource on its own or as a first fuel, EE contributes to all five pillars of the Energy Union. Consequently, policymakers on the national, regional, and local level are supposed to apply the principle in all energy planning, policy, and investment decisions in order to optimize the energy system. Furthermore, the respective governments are urged to involve private and business entities, so that the EE1 principle is also embedded in their investment decisions (EU 2018).

2.1. Implementation of the EE1 principle

In order to meet the EU climate and energy targets for 2030, the MS are required to submit an integrated national energy and climate plan (NECP) for the period from 2021 to 2030 (EU 2018). In this process, they are supposed to "*take into account the interlinkages between the five dimensions of the Energy Union, in particular the energy efficiency first principle*" (EU 2018) .

The implementation of the EE1 principle and thus, the exploitation of economic energy saving potentials is associated with multiple benefits (MBs) for the society. These benefits go beyond energy savings and further include environmental, economic as well as social improvements (IEA 2014; Reuter et al. 2020). The application of cost-effective demand-side solutions to meet energy demand instead of investing in costly energy infrastructure and fuel, has wide-ranging impacts, e.g., increasing energy security, reducing greenhouse gas (GHG) emissions or

health benefits by improved the air quality due to avoided local emissions. While this impact might be more obvious when energy efficient technologies replace fossil fuel consumption, an in-efficient use of renewables should also be avoided. A wasteful consumption of renewable energy sources may slow the process of decarbonization and put a burden on the environment due to excessive land-use, habitat loss or disruptions to natural river flows (Rosenow and Cowart 2019).

For the purpose of exploiting the economic EE potentials and thus, to reach those benefits, the EE1 principle needs to be more than a slogan or a simple declaration in the NECP. As the EE1 can be considered as a compass to guide policy and decision making, its implementation resembles more a step-by-step approach rather than as specific action (Coalition for Energy Savings 2015; ENEFIRST 2019). This approach includes the following steps:

1. Systematic identification of policies and decision points, where efficiency measures and demand resources offer potential, but are often overlooked or undervalued.
2. A cost-benefit assessment of the different supply- and demand-side options
3. The removal of market barriers to EE investments

Identification of relevant policy areas

The EE1 principle is an overarching concept, which should be applied in every policy and decision process related to the energy system. However, in order to make the EE1 principle operational it is essential to move away from a general level and instead identify its applicability in relevant policy areas and decision points concerning the energy system, where energy savings solutions might otherwise be overlooked or undervalued. As a result, all provisions, and policies, which reflect overall political targets and are instrumental for future development, should also incorporate and promote EE as the first fuel. For instance, in the EU among the most relevant policy areas are power market rules, climate, building and renewable policies as well as EE measures (ENEFIRST 2019).

A cost-benefits assessment of the different supply- and demand-side options

The application of a cost-benefit analysis (CBA) in the appraisal phase of policy development, allows policymakers to make decisions based on the best value for the whole society. In contrast to other approaches like the least-cost analysis, CBAs systematically compares both total cost and benefits. They go beyond a pure financial analysis as additionally to financial aspects, CBAs cover costs and benefits, which are not traded or cannot necessarily be monetised. This is particularly relevant in the case of EE due to the MBs, which are associated with improvements in this regard (Kavvadias 2015). The failure to take the economic, social, and environmental benefits of EE into account, might lead to undervaluation of EE opportunities and thus, contribute to the underinvestment in EE technologies. Besides, a neglect or only a selective inclusion of benefits in the CBA, overestimating the cost through inflated discount rates may also result in a bias against EE (Scheuer et al. 2016). Discount rates play a crucial role in the cost assessment of different policy options and EE opportunities. EE investments generally require high upfront cost and long payback periods, which makes discount rates highly influential in the determination of their net present value. In general, the social discount rate should be applied as it considers costs and benefits from the point of view of the society as a whole and not from the point of view of a single stakeholder. The recommended social discount rate for the MS ranges between 1 and 7 percent (Steinbach and Staniaszek 2015). While the discount rates can be assumed to differ across sectors and vary within household by socioeconomic parameters like income, they should not depend on the applied technology. Furthermore, to map non-economic and behavioural barriers the use of behaviour model presents a more suitable tool compared to

simply increase the discount rates. Therefore, to avoid biases and to ensure that EE competes on equal terms with supply-side alternatives, the discount rates are allowed differ by sector and socio-economic attributes, but not between different technologies (Steinbach and Staniaszek 2015).

The removal of market barriers to EE investments

A combination of deep-seated market barriers to end-use EE investments and historic preferences for supply-side investments across the policy landscape, contribute to a market imbalance in favor of supply-side solutions. The EE1 principle means recognizing the different barriers that prevent the uptake of EE investments and the necessity to overcome those. Hence, both reversing past policies as well as implementing new measures to overcome market barriers are part of guaranteeing a level-playing field (Rosenow and Cowart 2019). The degree to which market barriers are considered in energy scenarios also influences the results and thus, also what is considered to be an optimal EE target. If market barriers are not removed beyond the extent of existing policies, the projections ignore the possible impact of any additional policies. As a consequence, this scenario delivers rather a 'worst case' assessment of EE targets, instead of an optimal target level with policies and measures, which promote the realization of cost-efficient EE investments (Coalition for Energy Savings 2015).

3. Methodology

3.1. Development of Criteria to Assess the EE1 Principle

For our approach, we developed a set consisting of 13 criteria. The selection of those criteria is based on the definitions and conceptualizations given on the EE1 principle as listed in section 2. Thereby, we mainly focused on the three main steps, which are necessary for the implementation of the EE1 principle. Against the background of extensive literature review, we elaborated a set of criteria necessary to fulfill those requirements. They are chosen in such a way that they capture the core elements of the principle, while at the same time offer the MS the flexibility to apply the EE1 principle to country specific circumstances. An emphasis was set on keeping the criteria simple, so that besides presenting an assessment tool they can easily be used as a guideline or checklist by the MS to facilitate the operationalization of the EE1 principle. The criteria can be divided into the following five categories:

- The EE1 principle in the policymaking process
- The removal of market barriers to EE investments
- Challenges to EE
- Regional and local adaptation of the EE1 principle
- Monitoring and verification process

The rating of the criteria follows a simple semi-quantitative scoring system, which ranges from 0 to 2. Thereby a score of 0 reflects no or a minimal compliance, while a score of 2 is assigned to MS, which fully meet the requirements and show a high degree of compliance with the criterion. The following sections, describe the five categories and the criteria associated with them. Thereby, tables 1-5 give an overview of the criteria and the corresponding scoring system.

3.1.1. Policymaking process

The demand for the EE1 principle emerged from the failure of MS to exploit the economic EE potentials. For this purpose, one main aspect of the EE1 principle is to remind policy makers that energy demand is not fixed and should rather be considered next to supply solutions in every decision related to the energy system. Therefore**,** an *approach to compare different supply and demand-side solutions* during the policymaking process and target setting, presents the first criterion. However, just considering both options in the policy-making process is not sufficient to achieve EE1. In order to "ensure that EE and demand side response can compete on equal terms with generation capacity" (EC 2015), two further requirements have to be fulfilled. Firstly, the application of a *CBA* as the decisive tool for comparing different policy options and measures and secondly, the establishment of a level-playing field (Coalition for Energy Savings 2015). Section 2 outlines the advantages of conducting a CBA to assess the solution with the most benefits to the society. If policymakers aim to compare supply-side and demand-side solutions on equal terms, it is necessary for all cost and benefits associated with those solutions to be included in the calculation. Therefore, the *MBs* of EE should not only be acknowledged, but also quantified so that they can be taken into account during the CBA. Regarding the cost assessment in the CBA, the EE1 principle requires the application of similar or the same *discount rates* for both supply and demand- solutions, to avoid biases through overestimating the cost of certain technologies. The discount rates also influence the assessment of *economic EE potentials*, which have two relevant functions under the EE1 principle. Firstly, a guiding function to help policymakers to identify potential end-users and to implement measures accordingly. And secondly, a verification mechanism to check if the planned and implemented measures achieve to exploit the existing cost-effective EE potentials.

Table 1: Overview of the criteria for the policymaking process

Criteria	Score	Description
Screening process, in which both supply and demand-options are compared with each other	0	Demand is considered as a fixed variable
	1	Both supply and demand-side solutions are considered but separate from each other.
	2	Both demand and supply-side solutions are compared in the modeling process.
Comparison between different solutions via cost-benefit analysis (CBA)	0	No CBAs are not conducted
	1	CBAs are conducted; however, these do not have an impact on policy decisions.
	2	CBAs are conducted and serve as a decision tool between different measures and policies.
Discount rates	0	The discount rates differ between supply and demand.
	1	The discount rates are similar or the same, but only in a few sectors.
	2	Across all sectors the discount rates are the same or differ slightly.
Multiple benefits (MBs)	0	The MBs are neither fully recognized nor quantified or included in the decision-making process.

	1	It is recognized that EE has positive impacts including social, economic, and environmental aspects. Furthermore, some of those benefits are quantified and incorporated in the decision-making process.
	2	The MBs are recognized as well as quantified and included in the modeling approach.
Economic efficiency potentials as a guiding principle	0	While economic EE measures might be calculated, they have no significant role during the policymaking-process.
	1	Economic EE potentials have a guiding function. They are used to identify end-user and sector/areas with large potential as well as support the targets setting.
	2	EE potentials are used to guide policy makers in their decision process. Additionally, the impact of the chosen policies is compared to the economic EE potential, to ensure that the existing and planned policies are sufficiency to exploit the economic potential of EE.

3.1.2. Removal of market barriers

Previous trends in policymaking often prioritized supply-side resources over demand-side solutions. This can result in an unbalanced and unequal treatment of those resources on the market. To review past policies and measures based on the criteria of equal treatment as well as to reverse those preferential measures is therefore critical to avoid *market distortions* (Rosenow and Cowart 2019). Apart from market imbalances, a significant share of EE potentials remains unrealized due to a range of deep-seated market barriers. Part of reaching EE1 is to detect and to overcome those barriers through the implementation of standards and measures. *Imperfect information* has been identified as a potential market failure, which includes a lack of information, but also deficiencies regarding the quality, trustworthiness, and amount of targeted information. Furthermore, limited *access to capital* may deter end-users from investing in EE improving technologies, especially if they rely on external capital for the investment. Tax incentives and low-interest loans are considered to be important factors to overcome this barrier (UN). While every investment decision is associated with certain risks, the high implicit discount rate for investments related to EE indicates a particularly high-perceived risk in this regard. If this is due to uncertainties about future regulations or misperceived technical risk, policymakers can reduce this *risk* through policy interventions (Schleich 2009).

Table 2: Overview of the criteria regarding the removal of barriers

Criteria	Score	Description
Prevention of distorted markets	0	No concern is given to this issue
	1	Distorted markets are recognized as a concern and current as well as planned policies aim to prevent any market imbalances. However, past policies and measures are not actively revised for this purpose.
	2	Distorted markets are recognized, and past policies/ measure are actively reversed in order to correct those imbalances.
Access to information	0	A lack information recognized as a barrier and thus, no specific measures regarding information, training or education campaigns are implemented.

	1	While information exists, it is kept in a general format, e.g., on a website.
	2	Besides the provision of general information, specific information and awareness campaigns are conducted. Furthermore, more targeted campaigns in form of seminar and trainings offered to a diverse group of actors.
Access to capital	0	No concrete measures offer financial support to incentive EE investments.
	1	Financial incentives are in place but limited to certain sectors and instruments.
	2	Financial incentives are offered across different sectors and available in form of different instruments, so that a diverse group of recipients can profit from them.
Reduction of risk and uncertainty	0	No measures to mitigate the risk for individuals or companies are implemented.
	1	The introduction of measures to mitigate the risk for businesses or in the residential sector.
	2	The introduction of measures to reduce risk for both businesses and in the residential sector.

3.1.3. Challenges to EE

The challenges to EE encompass societal issues and trends, which impede the realization of the cost-effective EE potentials, if policymakers fail to address them. The first obstacle constitutes *energy poverty***.** Many of the general market barriers to EE affect energy poor household to greater extent (EP 2016). Furthermore, those households face additional barriers, which present no obstacle for the wealthier parts of the population. For instance, informational barriers like a lack of awareness and knowledge on the own energy consumption, on energy saving potentials in their dwelling as well as on the MBs associated with efficiency improvements is likely be more prevalent in energy poor households. In a similar manner, energy poor households are confronted with aggravated economic barriers like higher risk and greater financial barriers (EP 2016; Ordonez et al. 2017). While social policies like energy payment assistance for low income housholds (e.g., Chèque énergie in France), alleviate the costs burden, those policies might even disincentive energy efficient behaviour (EP 2016). Therefore, targeted EE measures are necessary to reach the full potential of EE and thus, comply with the EE1 principle. The second challenge concerns *energy sufficiency*, which can be defined as a state in which peoples basic needs for energy services are met equitably and ecological limits are respected (ECEEE 2018). While some societal trends contribute to energy sufficiency like an increasing awareness of environmental impacts, other developments like larger homes or a raising number of appliances per dwelling, increases energy consumption and thus, counteracts EE improvements . The failure to implement measures addressing energy sufficiency, allows the societal trends to unfold in an unmanaged manner and thus, create new inefficiencies in the energy use. For instance, implementing policies and measures across the EU to guarantee an efficient development of the new trend can lead to energy savings of 376 Mtoe by 2050 (Brugger et al. 2019). As the discussion around sufficiency is still in its early stages and energy poverty already an established issue, the requirements of the scoring system are less demanding for suffciency.

Table 3: Overview of criteria regarding the challenges to EE

Criteria	Score	Description
Energy Poverty	0	While energy poverty might be recognized as an issue, the measures in place belong to the category of social policies.
	1	The relevance of the relationship between EE and energy poverty is acknowledged. However, Energy poverty is only mentioned in context of EE measures, but not specifically targeted by an of the EE measures.
	2	Energy poverty is incorporated in EE policies, which means that vulnerable households are targeted by the EE measures.
Sufficiency	0	No attention is given this issue
	1	Sufficiency is acknowledged as challenge to EE.
	2	Concrete measures are in place to address sufficiency trends.

3.1.4. Integration of EE1 on different levels

One key element the EE1 principle is its ubiquity. To guarantee an equal treatment of supply and demand throughout the whole energy system, the MS are encouraged to promote its implementation by *regional and local governments*, as well as by the private sector (EU 2018). The exact role and competences of the regional and local governments differ across the MS. However, with remits like spatial planning, overseeing the heating infrastructure or individual target setting, the decisions of those entities have a great impact on the energy system. Furthermore, private entities like banks play an essential role in financing EE investments. In particular, "*a historic level of public-private collaboration is required to deliver multiples of existing energy efficiency investment flows by 2030*" (EEFIG 2015).

Table 4: Overview of the criteria regarding the local and regional incorporation

Criteria	Score	Description
EE1 principle on regional and local level	0	The EE1 principle is not incorporated or not wanted on the local and regional level.
	1	The status of the EE1 principle is unknown.
	2	The EE1 principle in incorporated on the local / regional level.

3.1.5. Monitoring and Verification Process

Part of the EE1 principle is the establishment of clear *monitoring and verification standards*. Access to data and information on the progress of energy savings and the success of EE measures, allows the MS to review their strategies continuously and adjust the design of their measures. For instance, the detection of unsuccessful information campaigns or a slow uptake of loans, gives policymakers the opportunities to adapt their measures early on. This in accordance with global experiences, which imply that active oversight and continuous programme improvements are needed to uncover and deliver on demand-side potentials in almost every market (Rosenow and Cowart 2019). Furthermore, the aggregation of data supports the evaluation of long-term economic, environmental, and social costs and benefits of EE solutions and therefore, improves the CBA and the exploration of the economic EE potentials (Coalition for Energy Savings 2015).

Table 5: Overview of the criteria regarding monitoring process

Criteria	Score	Description
Monitoring	0	There are no official guidelines in place. The monitoring occurs unregularly and differs in intensity across sectors.
	1	While there are monitoring guidelines in place, they fail to cover all sectors and no regular reports are submitted. Furthermore, the type of monitoring is simplified, for example by only applying a top-down approach to evaluate the development in EE.
	2	Official guidelines are in place. They cover all sectors and require the application of more complex measuring tools, e.g., the use of both top-down and bottom-up approaches; both ex-ante and ex-post evaluations are used to assess the success the measures

3.2. Methodology of the composite indicator

To assess the EE1 principle across the EU in our approach we chose a composite indicator. This is an established tool for assessing and ranking countries in terms of sustainability, human development, competitiveness, or other complex phenomena, which are not easily measurable and uniquely defined (Becker et al. 2017). The approach provides the simplicity required to facilitate the evaluation and comparison of the multiple aspects of EE1 principle. The performance of countries regarding the EE1 principle is calculated by aggregating the 13 criteria with different weights assigned to each of them.

$$y_j = \sum_{i=1}^{d} w_i x_{ji} \qquad j = 1,2,\dots,13$$

The weights differ between 1, 1.5 and 2 and reflect the degree of priority, which is assigned to each criterion. Table 6 displays all 13 criteria including their weights.

Table 6: Weighting scheme of the Indicator

Category		**Criteria**	**Weight**
Policy-making process	1	Comparison of supply and demand	High
	2	Cost-benefit analysis	High
	3	Discount rates	High
	4	Multiple Benefits	High
	5	Economic efficiency potentials	Medium
Market Barriers	6	Prevention of distorted markets	Medium
	7	Access to information	High
	8	Access to capital	High
	9	Risk and certainty	Low
Challenges	10	Energy poverty	Medium
	11	Sufficiency	Low
Regional and local level	12	Region and local level	Low
Monitoring	13	Monitoring	Medium

Although all criteria are relevant, we consider some of them to be fundamental to the realization of the EE1 principle and for this reason, assigned a high priority to those criteria. Firstly, the criterion about the comparison of supply- and demand-side resources addresses the core idea of the EE1 principle, which is to encourage policymakers to consider EE resources next to supply-side alternatives in their decisions related to the energy market. To guarantee an equal treatment and thus, ensure the quality of the comparison, the fulfilment of three further criteria is necessary. Therefore, we also assigned a high value to CBAs, discount rates and the MBs as these factors influence the attractiveness of EE investments, the necessity of EE measures as well as the overall target setting. As the exploitation of the EE potentials requires the removal of barriers, both the provision of capital and information also belong to the group of high priority criteria.

In total three criteria are considered to be of lower priority due to different underlying reasons. Although the EE1 principle requires its implementation on all levels, we assigned a lower value to the regional and local integration. This is due to fact, that the EE1 principle is still a relatively new concept and hence, for now the focus lies on its operationalization on the national level. Similar reasons are behind the low priority associated with sufficiency. As this still presents an emerging topic, we do not expect policy makers to have fully incorporated the concept in their decision-making processes at this point in time. The weighting of these criteria might be adapted over time as the adaption of the EE1 principle increases in the MS. The third criterion, which we assigned with a low priority, involve the implementation of measures to target the reduction of risk and uncertainty surrounding EE investments. This decision is based on its overlap with the criterion of access to finance as financial support can also present a form of risk reduction.

3.3. Data sources

In this paper, the composite indicator approach is applied to assess the extent to which the EE1 principle is incorporated in the NECP of the MS. For this purpose, two main sources of data are used. The first part of the evaluation consists of semi-structured interviews, which we conducted with stakeholders that were involved in the preparation of the NECP or have special insight into the overall policymaking process in a MS. As the interviews are necessary to get an understanding of the decision- and policymaking process during the preparation of the NECPs, the application of the EE1 indicator is limited to number of MS, who we were able to interview. Table 1 provides an overview of those MS and shows the number of stakeholders per country. Since our criteria refer to various areas of the policymaking process and the NECP, in some cases we reached out to more than one stakeholder per country in order to get information on all categories. For this purpose, we conducted both virtual interviews and used questionnaires. In addition to that, we examined the NECPs, and used the ODYSSEE-MURE (ODYSSEE-MURE 2020) data base as supporting data sources.

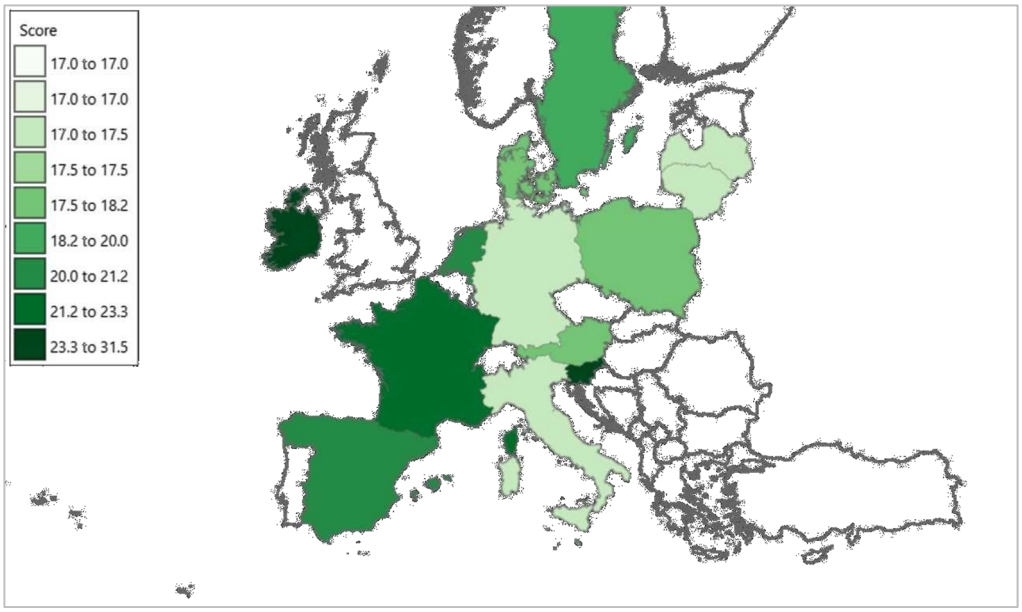
Table 7: Overview of stakeholders

	AT	DE	DK	ES	FR	IE	IT	LT	LV	MT	NL	PL	SE	SI
Questionnaire					x		x			X				
Interview	x	x	x	x		x	x	x	x		x	x	x	x
No. of stakeholder	1	1	1	4	1	1	2	2	2	1	1	2	1	2

4. Results

This section provides an overview of the state to which extent the EE1 principle is implemented by the MS. In Figure 1, the 14 MS examined in this paper are highlighted in colour and provide a first impression of the degree of operationalisation of the EE1 principle.

Figure 1: Compliance with EE1 principle across the EU

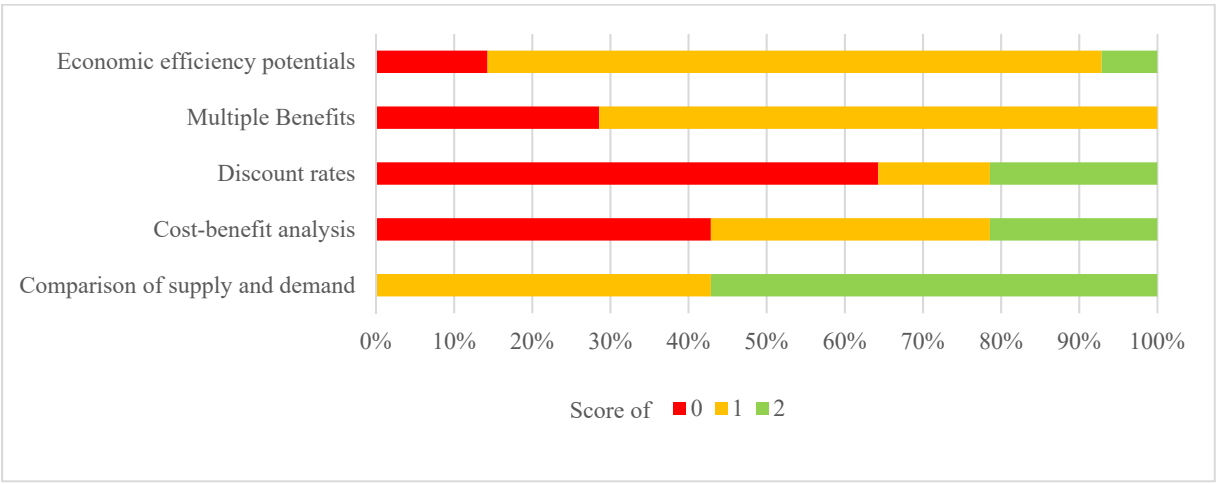


The highest total score reaches Ireland with 31.5 points out of 42, which means that Ireland fulfills 75 percent of the requirements necessary for fully operationalizing the EE1 principle. Further four countries – Spain, Malta, the Netherlands, and France – have a score above 20 and the remaining countries range between 17 and 19 points.

4.1. EE1 principle in the policymaking- process

To assess the EE1 principle in the policy and decision-making process on the national level, we developed five criteria, whereby four of those are considered to be of high priority. Figure 2 lists those five criteria and illustrates the extent to which the MS comply with each of them in the NECP.

Figure 2: The EE1 principle in the policymaking-process



The criteria, in which the MS show the greatest deficiencies are the *discount rates*. Around 64 percent of the interviewed MS received the lowest score for their use of the discount rates. The low score either reflects the application of significantly different discount rates for supply-side and demand-side investments or a lack of including them in general. Although Latvia also applied different discount rates in the development of their NECP, they reached a score of 1 as the deviation between the resources is less than 5 percentage points. A score of 2 was assigned to Ireland, the Netherlands and Austria as they applied the same discount rates irrespective of the program, resource or sector.

Among the MS, only Ireland, Slovenia and Sweden conducted *CBA***s** to compare different measures with each other, in particular supply-side and demand-side solutions. This means that 21 percent of the interviewed MS successfully incorporated this aspect of the EE1 principle in their policymaking process. However, with 42 percent most of the MS received a score of 0 as they use other methods to compare the different alternatives with each other. The minimization of costs guided the development of the NECP in Spain, Latvia, and Denmark. In Germany and Austria neither the costs nor the benefits determined the selection of measures. Instead, political factors, federal competencies, and the ability to promote certain measures influenced the comparison. In Germany CBAs were still conducted, however not for the purpose of comparison, but rather to assess the impact of the selected measures afterwards. The MS, which received a score of 1, applied a CBA to some extent, but not in every comparison. For instance, Lithuania uses CBAs to directly compare measures, but within their forecasting models the least cost-principle dominates.

Regarding the recognition and quantification of the *MBs* of EE in the NECP, with 71 percent most countries received a score of 1. While these countries recognized that the benefits include environmental, economic as well as social benefits, they limited the quantification to the reduction of emissions and economic aspects like GDP growth and job creation. Latvia and Spain additionally include air pollution and quality as possible benefits in their calculation. Overall, no MS included and quantified the complete range of MBs. A score of 0 was assigned to the Netherlands, Slovenia, Germany and to Austria. The Netherlands exclusively looked at environmental benefits in form of lower emissions, which is in accordance with their political focus on the reduction of GHG emissions. Furthermore, in Germany and Austria, the MBs the MBs are solely taken into accounted in qualitive manner within discussions.

Regarding the equal treatment of *supply and demand-side solutions in the screening process* for policies and measures, the MS on average performed the best. Each MS at least considers EE as viable resource to meet a range of targets and requirements. For the development of the NECP 64 percent of the MS based their decisions on energy models, which consider both supply- and demand-side options across all sectors and target areas. While Denmark also treats EE as a resource on its own, it evaluates EE and renewables or other supply-side options separately from each other. A similar approach is taken by Malta, who treat EE as a priority in a variety of areas but assess supply- and demand-side alternatives in a separate manner. Therefore, both Denmark and Malta as well as Sweden, Germany and Lithuania receive a score of 1 in this criterion.

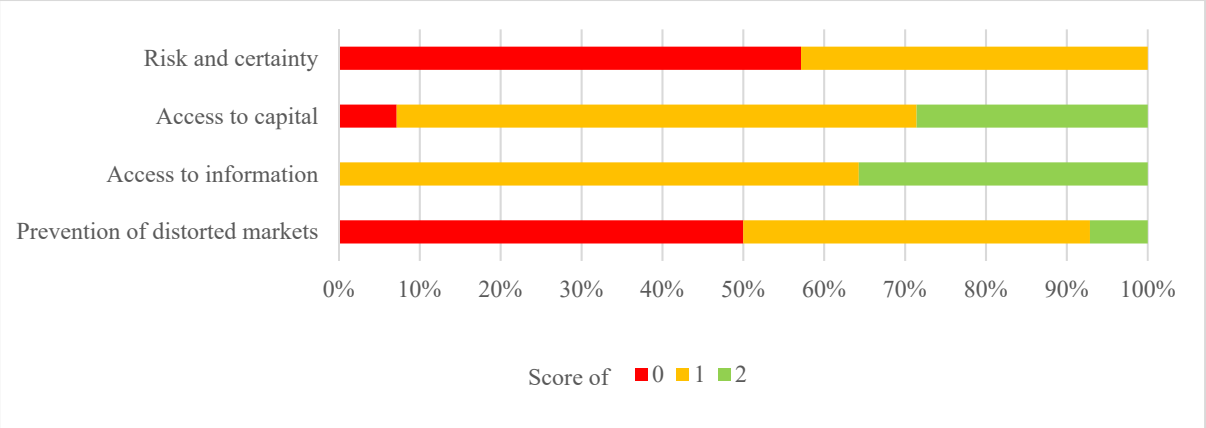
Economic EE potentials present the last criterion of this category. As described in chapter 3, the economic EE potentials function as a guide as well as a benchmark under the EE1 principle. Figure 2 demonstrates that the majority of interviewed MS reached a score of 1 and thus, solely made use of one of the functions. These countries used the economic EE potentials as a base of the energy models and scenarios and used them for identification

purposes. However, a direct comparison with the impact of existing and planned measures is solely carried out by Ireland and Malta.

4.2. Removal of barriers to EE investments

This category contains four criteria, whereby two of them are of high priority and one of low priority. Figure 4 provides an overview on how the countries in total performed in each category. Overall, the majority of MS received a score of 2 in this category, which implies that across the EU the requirements of those categories are mostly met at a moderate level.

Figure 3: Removal of barriers to EE investments



In regard to the prevention of **distorted markets**, only France systematically reviews existing imbalances and corrects those by adjusting or reversing past policies and measures. Another 42 percent of the MS commit to avoid possible imbalances through present and future policy decisions. In total, half of the interviewed countries fail to address this concern. Denmark recognizes imbalances, in particular between renewables and EE, but does not consider it to be an issue as the GHG emissions are not affected by this. Further countries with no systematic approach to market distortions are Poland, Spain, Germany, Malta, and Ireland.

Another obstacle to investments in EE presents a *lack of information***.** All interviewed MS acknowledge the relevance of information and include at least general measures to provide information to consumers and investors. Thereby Ireland, Spain, Denmark, Germany, and Malta reached a score of 2 for this criterion as they differ from the other countries in terms of the degree of targeted information, the sectors covered by information programs as well as the variety of measures offered. This contrasts with the remaining 64 percent of MS covered by this paper, who have implemented some information programs like general awareness campaigns and the provision of free or subsidies energy counseling services in the NECP but keep them in a general format and cover a limited number of consumers.

Access to capital is an essential criterion to facilitate the necessary investments in EE. Similar to the informational barrier, with 64 percent the majority of countries show a moderate effort to overcome this barrier and thus, receive a score of 1. One these countries is Denmark, whose NECP contains subsidy schemes for the residential sector and grants aimed at private enterprises but exclude the transport and service sector from any financial support regarding EE investments. Further countries with a score of 1 are Poland, Italy, Slovenia, Latvia, Lithuania, and Austria. A score of 0 was assigned to Malta as the financial support is limited to low-income households and the promotion

of electric and hybrid vehicle through grants, which have experienced low uptake. The remaining MS Germany, Slovenia, Ireland, and the Netherlands reached a score of 2 due to the variety of financial instruments in the different sectors.

With 57 percent, the majority of interviewed MS relies on loans and grants to reduce the *risk and uncertainty* related to EE. While financial measures constitute as instruments to reduce economic risk associated with EE investments, within the scope of this indicator, they are counted under the previous criterion. This is due to the fact that risk as a relevant barrier, which merits policy intervention, rather refers to regulatory and misperceived technical risk instead of business and financial risks, which are part of economic efficient behaviour and present a general issue in regard to investments. Therefore, those eight countries received a score of 0 for their performance and the remaining six MS a rating of 1. Although Slovenian and Latvia also focus on financial aspects, they go beyond loans and grants and introduce guarantee schemes to reduce the risk for EE investments. Furthermore, Slovenia establishes a shared-incentive scheme between owners and tenants in the residential sector and actively promotes new EE technologies to avoid the overestimation of the technological risks associated with EE improvements. In Ireland, the creation of learning networks and cooperation between the largest industries proofed to be an effective way to reduce the risk perception of the quality and reliability of different energy efficient technologies.

4.3 Challenges to EE

Figure 4: Challenges to the EE1 principle

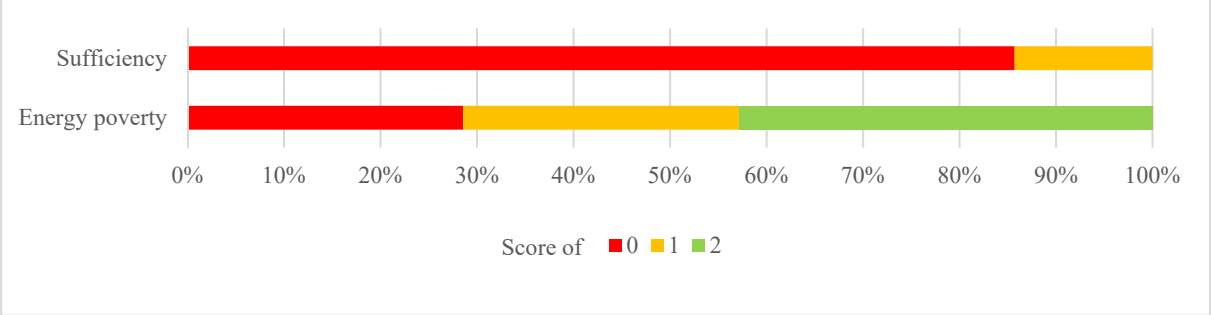


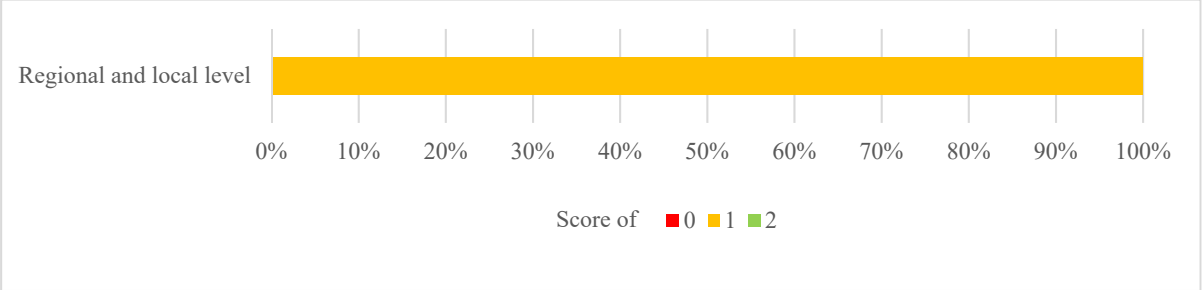
Figure 5 illustrates that *sufficiency* is not yet addressed by specific measures and represented in the NECP. The MS predominantly acknowledge the relevance of sufficiency and include it in internal discussion; however, this has not manifested into concrete measures and policies. Malta and Denmark received a score of 1 in the evaluation as they at least address the topic in the NECP, even though it is only in an indirect manner. Denmark recognizes behavioural aspects as obstacle to EE but has not included any concrete measures. Malta does not directly mention sufficiency, but addresses lifestyle changes like carsharing, which lower the energy consumption.

Compared to sufficiency, the challenge of *energy poverty* receives more attention across the EU. However, not every country, which recognizes energy poverty as a concern, addresses this topic in form of EE policies. Denmark, Germany, and Malta treat energy poverty in the scope of social policies, which rather focus on financial support for energy bills and heating than reducing the bill through EE improvements. Other countries incorporate energy poverty in their energy policies, but do not necessarily target vulnerable or low-income households in this context. For instance, Lithuania, lists three different EE measures to reduce energy poverty, but none of them are targeted measures. Latvia also follows this approach of general EE policies to combat energy poverty, which resembles a

score of 1. The countries with a score of 2 are Spain, France the Netherlands, Austria, Ireland, and Slovenia. In those countries, the EE measures in the residential sector contain higher aid intensities for vulnerable or low-income households and thus, target energy poverty specifically.

4.4. The implementation of EE1 principle on the regional level

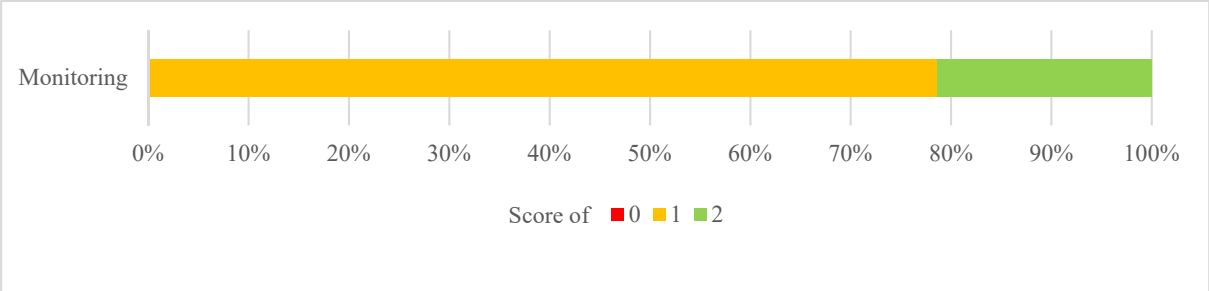
Figure 5: Regional and local level implementation of the EE1 principle



Regarding the implementation of the EE1 principle on the *regional and local level***,** the performance of all 14 MS rank at a score of 1 as illustrated by Figure 6. All countries support the operationalization of the EE1 principle on all levels of the society, however no official documents or statements commit to this plan. While through top-down mechanisms national targets demand certain actions on the local level and through the participation in national funding-programs, municipalities and regional entities are obliged to follow certain EE requirements, no clear guidelines for the EE1 principle on the regional and local levels are established.

4.5. Monitoring and verification

Figure 6: Monitoring of EE



Similar to the previous criterion, the majority of MS received a score of 1 for their *monitoring and verification* approach. The MS have in common, that the monitoring of measures is an obligation and strictly regulated. The monitoring process and methods usually vary across sectors and program. The deficiencies in the criterion are related to an insufficient coverage of all sectors and the application of simplified methods such as a sole reliance on top-down monitoring to track energy savings across the economy. Denmark, Latvia, and the Netherlands achieve a score of 2 by combining different measurement approaches and prescribing their application across sectors and programs. The monitoring of policy programmes and their performance is integrated in the national reporting and reviewed on an annual basis. Both bottom-up and top-down approaches are applied across the economy and in combination with historical data, the changes and trends in the different sector are closely monitored.

5. Discussion

Table 7 summarizes the results of the previous chapter including the specific scores, which were assigned to the MS for each criterion. According to the indicator, on average around 47 percent of the aspects regarding the EE1 principle were considered and applied in the NECPs by the MS. The discrepancies between the countries are limited to 35 percentage points, with the best performance at 75 precent and the lowest one at 40 percent. Regarding the compliance with single criteria, the figures 2-6 of the previous section illustrate that the extent to which the MS fulfill the requirements differ significantly across categories and criteria.

Table 8: An assessment of the EE1 principle across the NECPs.

Category	**Criteria**	AT	DE	DK	ES	FR	IE	IT	LT	LV	MT	NL	PL	SE	SI
Policymaking-process	Comparison of supply and demand	2	2	1	2	2	2	2	1	1	2	1	2	1	2
	Cost-benefit analysis	0	0	0	0	1	2	0	1	0	1	1	1	2	2
	Discount rates	2	1	1	0	1	2	0	0	1	0	2	0	1	1
	MBs	0	1	1	1	1	1	1	1	1	1	0	1	1	0
	Economic efficiency potentials	0	1	1	1	1	2	1	1	0	1	1	1	1	1
Removal of barriers	Prevention of distorted markets	0	0	0	1	2	0	1	1	1	0	1	0	0	1
	Access to information	1	2	1	2	1	2	1	1	1	2	1	1	1	1
	Access to capital	1	2	1	1	1	1	1	1	1	1	1	1	1	2
	Risk and certainty	0	1	1	0	1	1	1	1	1	0	0	0	1	1
Challenges	Energy poverty	2	0	0	2	2	2	1	1	1	2	0	1	0	2
	Sufficiency	1	0	1	1	0	1	0	0	0	1	0	0	1	0
Regional and local level	Region and local level	1	1	1	1	1	1	1	2	1	1	2	1	1	1
Monitoring	Monitoring	1	1	2	1	1	1	1	1	2	1	2	2	1	1

The first category about the integration of the EE1 principle in the policy-making process consists of four criteria with high priority and therefore, has much weight in the overall assessment. The fact, that all MS consider EE as a resource on its own and not as a fixed variable in the energy equation, means that the most fundamental element of the EE1 principle is understood and implemented by all MS. The fact that the consideration of energy demand as a variable parameter is not self-evident and is partly the result of recent developments, is reflected by the energy policy of Poland. Around five years ago Poland still considered energy demand as given and the aim of their energy models was to find supply-side solutions to satisfy the demand. After making EE part of the equation, the second cornerstone of the EE1 principle is to treat EE on par with other resources. According to the results, the majority of MS fail to compare the different options on equal terms with each other. This becomes apparent with respect to the low performance in the three categories CBA, MBs, and discount rates. Some countries do not perceive CBAs to be necessary as they intent to achieve certain targets with minimal costs and without taking any further benefits into account. While this approach helps to ease the strain on the public budget at least in the short term, e.g., through lower subsidies, it may lead to countries to neglect solutions, which in the mid- and long-term present the least costs to the society due to the range of benefits associated with them. Nevertheless, the interviews suggest that the majority acknowledge the relevance of CBAs but are confronted with obstacles regarding the execution. The complexity and difficulty to quantify the benefits, was stated as a common challenge by the MS. In particular,

social benefits like improved living comfort, health benefits, and the alleviation of energy poverty are hardly mentioned and quantified in the NECPs. Only four countries - Spain, Ireland, Poland, and Latvia- actually recognized health benefits related to EE and the intention to quantify improvements in living comfort was only declared by Ireland. Regarding health benefits, Ireland, specifically noted the inability to quantify and thus, provide solid evidence on them, impeded them to fully incorporate health aspects in the policy-making process. In order to solve this issue, they aim to generate more data and evidence on this relationship through a range of pilot projects. On the EU level, the MICAT project exactly addresses this issue through the development of a calculation tool, which provides the MS with a comprehensive approach to estimate the MBs of EE (EC 2020). Overall, the collection and availability of data on EE as well as on the wide-ranging impacts will be the key when it comes to ensuring the quality of the CBA and the inclusion the MBs in the future comparisons.

A condition for the EE1 principle to prosper and reach its full effect, is the removal of any barriers and hurdles to EE investments. Among the four criteria developed for this purpose, a special weight is put on the support to overcome informational and financial barriers. The results imply that the MS share this sense of priority as they have all implemented information programs and financial support measures to incentivise EE investments. However, in the matter of information, improvements can still be made in terms of more targeted information and regular evaluation of the programs, to ensure that the information campaigns are effective and reach the intended cohorts. This in accordance with experiences in Ireland, where the evaluation of national information and awareness campaigns indicated a low effect of general campaigns. As a consequence, they are currently developing more targeted information programs to better reach potential investors and consumers. While few MS are cautious of avoiding imbalances between supply and demand-side resources in their current policymaking, no concern is given to the review and adjustment of past regulations and systems across the national policy landscape. The underlying reason for this neglect varies across countries. For instance, in Austria the spread of competencies across different departments and institutions as well as the federal structure impede the detection of imbalances. Denmark recognizes imbalances, in particular between renewables and EE, but does not consider it to be an issue as the reduction of GHG emissions is not affected by this. In a study about the EE1 principle in the UK, Rosenow et al. (2017) outline the importance of actively reversing historic preferences in the policymaking. They demonstrate this through concrete examples like the National Infrastructure Plan, in course of which 256 billion £ were spent. However, none of the fund was allocated towards efficiency projects due to the neglect of considering buildings as part of infrastructure and EE as an infrastructure priority. This shows that even though this might present a complex task, which is aggravated in case of shared responsibilities and competencies across different institutions and federal entities, the review and adjustment of past measures is nevertheless a necessary step for the creation of a level-playing field.

Besides the removal of barriers, the EE1 principle also requires policymakers to engage with societal trends and other factors, which might counteract the EE endeavours. Within the scope of the indicator, we identified energy poverty and sufficiency as relevant challenges to the success of the EE1 principle. Around one quarter of the MS focus on social policies to combat energy poverty. While income assistance or direct support via payments of energy bills, has the potential to deliver short-term relief, it cannot solve energy poverty in the long-term and simultaneously, presents a great financial burden to the public budget. In contrast, targeted EE policies directly address the root cause of energy poverty and therefore, can alleviate it in the long-term. (Ordonez et al. 2017) Furthermore, governmental payments of the energy bill might even counteract the ambitions of EE since they

reduce the incentive for the consumer to reduce the energy bill with EE measures. Besides those few exceptions, the results show that energy poverty is considered by the majority of policymakers in the context of EE policies and merely needs more targeted polices at low-income and vulnerable households for all countries to fully address this issue. This is not the case for sufficiency, which is not mentioned formally in any NECP. The interviews indicated that the concept of sufficiency has not fully reached the political sphere and has to be further developed and disseminated, in order for a serious discussions and concrete measures to emerge around this issue.

In order for the EE1 principle to be reflected in all policymaking and investment decisions across the energy system, a criterion regarding its incorporation on the regional and local level was included in the indicator. The interviews delivered two important insights on this issue. Firstly, there is general challenge of forwarding requirements to a subordinate level due to the degree of independence, which the federal states and municipalities enjoy. Furthermore, the energy policies and strategies partly differ between the federal states or municipalities and thus, it is difficult to get them to agree on a uniform adaption of the principle. Secondly, the lack of a clear understanding and guidelines on the EE1 principle on the national level hinders the transmission of the principle to other entities. This is in support with the efforts of this paper to provide the MS with an indicator, which can be used as a guideline for the operationalization of the EE1 principle.

While all the interviewed MS provide a minimum standard of monitoring and verification process in the context of EE, there are still deficiencies in respect to quality of the monitoring method and the coverage of sectors and programs. The failure of only doing ex-ante assessment and not to continuously monitor the progress of measures and programs, prevents governments from improving programs and making course corrections, which are necessary for the demand-side potential to be exploited (Rosenow et al. 2017). Furthermore, as stated previously, the collection and aggregation of data on EE is essential for the understanding and quantification of the MBs and thus, the quality of the CBA.

Before drawing an overall conclusion on the application of the EE1 principle in the NECPs, the framework of our indicator approach should be taken into account as it comes with some limitations. The first possible shortcoming stems from the weighting scheme of the individual indicators. Although we have allocated the weights to the best of our knowledge and the resources available, some assumptions may be affected by subjective judgement. Second of all, our data sources were limited to the NECPs, the ODYSSEE-MURE database as well as interviews, which were conducted with 1 to 4 stakeholders per country. These sources can be considered to be sufficient for the acquirement of necessary information about the policies and measures, which are in place to remove market barriers and combat the challenges to EE. Since this information is formally documented, subjectivity presents no concern in this context. In contrast, the assessment of the EE1 principle in general policy- and decision making requires insights about the policy-making process, which are not necessarily formally and publicly documented. While we chose interview partner with a comprehensive understanding of the policy-making processes in the respective countries, the small number of interview partners per country might introduce some subjectivity to the assessment.

However, those potential shortcomings do not interfere with the purpose of this paper. The aim was to develop an indicator based on a set of criteria, which can support the MS in making the EE1 principle operational. The 13 criteria capture the relevant elements of the EE1 principle and provide a comprehensive picture on how the MS treat EE in their policymaking and target setting. The comparability and straightforwardness of the single criteria

make it possible for the indicator to be easily applied as a checklist by the MS without complex intermediary steps. The interviews were used to review the applicability of the indicator in this context. During the interviews, our questions were easily understood and answered by all MS. And although the assessment of the MS regarding the implementation of the EE1 principle, might include some degree of subjectivity, the overall results give a comprehensive overview on the dissemination and implementation of the EE1 principle across the EU. They reveal a general pattern of the areas, where on average the MS show a high degree of compliance and help to detect the aspects of the EE1 principle, which receive less attention in the policymaking and where improvements are necessary.

The utilization of the indicator as an assessment tool is planned through its incorporation to the ODYSSEE-MURE database. This will enable policymakers and researchers to get an insight into the current state of the EE1 principle across the EU and within the MS. Additionally, it will support them in detecting existing weaknesses regarding national EE policymaking and point them towards areas, which still require more political attention and improvements to realize the full potential of EE. Regarding the application of the indicator as a guide in the operationalization of the EE1 principle, the 13 criteria illustrate the multiple aspects of the principle and can be utilized by the MS as a checklist to support them in their realization of the EE1 principle. For validity reasons, we recommend updating and slightly adjust the weighting scheme of the criteria depending on the time periods, which present the focus of the assessment. For, instance for the assessment of the EE1 principle until 2030, we assigned less relevance and thus, a lower weight to sufficiency. However, the consideration of sufficiency will become more important in policy plans, which extend until 2050. Therefore, in future application of the indicator and future research this aspect should be taken into account.

6. Conclusions

The EE1 principle is a multifaceted concept, which requires the consideration of a range of aspects to make it fully operational. One aim of this paper is to shed a light on the multiple aspects and steps necessary to make the EE1 principle fully operational. The second aim is to create a tool, which facilitates the assessment of the operationalization of the EE1 principle across the EU. The 13 criteria of the indicator reflect those multiple steps and the scoring system allows its quantification. The result is a multidimensional indicator approach with the capacity to deliver information about the overall performance of countries and to highlight deficiency and areas, which still need to be incorporated by the MS.

Our indicator approach fills the existing gap of a step-by-step guideline, which supports the MS in making the EE1 principle operational. Policymakers can utilize our indicator early in the policymaking process to ensure that the various aspects of the principle are considered in every stage of the process. The compliance with the criteria can help them to identify the economic EE potentials and thus, support the promotion of EE policies. Furthermore, the approach can be used to assess the current state of the EE1 principle across the EU and allows to compare the performances of the MS. The additional information on the single criteria makes it possible for countries to exchange knowledge and learn from the best performing countries in each category. While the indicators already deliver significant insights on the application of the EE1 principle, further improvements, e.g., in form of more elaborated data collection, can enhance the quality of the indicator.

The operationality of the indicator was demonstrated by its application to 14 MS. The results suggest that on average the MS fulfill 47 percent of the requirements for the full realization of the EE1 principle. The main deficiencies lie in the failure to compare demand-side and supply-side options on equal terms with each other. Overall, only 21 percent compare both the costs and benefits, while in remaining MS the decision-making is driven by cost-minimization or political influence. In addition, most countries neglect the range of MBs associated with EE improvements and apply higher discount rates for EE solutions. As a result, the benefits of EE investments are often undervalued, and the costs are overestimated, which in turn reduces the number of cost-efficient EE opportunities in impact assessments. While 90 percent of the MS provide measures to overcome financial and informational barrier, over 50 percent fail to include any provisions to reduce regulatory and non-technological risks related to EE investments. Furthermore, the review of historic preferences for supply-side resources as well as the reversal of biased measures because of those historic trends, do not seem to present a concern to MS. In conclusion, it could be assessed that the MS have mainly understood and implemented the fundamental idea of the EE1 principle, but progress has still to be made regarding the more detailed aspects of the principle.

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