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Report on barriers to implementing E1st in the EU-28

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

This report is focused on barriers to implementing "Efficiency First" (E1st) in the EU in several policy areas that are linked to energy use in the buildings sector (such as network codes, renewable energy policy, building regulations and others). These range from legal and regulatory, institutional and organizational capacity-related barriers, which consider the way that energy planning and policy operate including multilevel governance, to economic and social/cultural barriers (in relation to buildings, heating systems, etc.). The scope is deliberately wider than just buildings policy; for example, deciding whether to invest in energy network upgrades or demand-side responses is an application of the E1st principle that also relates to the building sector.

The E1st concept is still recent, so there is not yet a developed literature that specifically analyses the related barriers. This report thus begins by considering underlying barriers related to the key components that form the E1st principle: barriers to demand-side resources (end-use energy efficiency in buildings and demand-response) and barriers to decision or planning frameworks (IRP – Integrated Resource Planning, or LCP – Least Cost Planning) that can ensure a level playing field for the comparison of demand-side and supply-side resources. These targeted literature reviews were used to draw a typology of barriers to prepare an online survey and structure the analysis of the 45 answers received from various stakeholders, with a larger representation from demand-side experts (energy efficiency or building experts) as this is the focus of the project.

The main messages from this survey are that:

- Political barriers are the category most frequently mentioned by respondents, suggesting that implementing the E1st principle would be first and foremost a political decision.
- A majority of respondents stressed the lack of expertise, knowledge, awareness or understanding, which suggests that a proactive dissemination of good practices and case studies is important.
- Implementing E1st can work only if every actor understands what it means for them: making E1st a common practice implies making E1st part of everyone's work.
- Multiple benefits of E1st need to be considered and communicated more effectively among stakeholders, in line with one key element of the E1st principle: using a broader scope in cost-benefit analysis.
- Making E1st a common practice would require a cultural change along the whole chain of actors.
- Cultural barriers are related to actors' own habits and practices as well as about breaking silo thinking.
- Other barriers specific to E1st relate to possible reasons why supply-side options might be given priority, disregarding demand-side options: these aspects are at the core of the E1st principle and complement the analyses done earlier on the background and definitions of E1st (see ENEFIRST 2020a) by emphasising why we need to think beyond existing energy efficiency policies.

1 INTRODUCTION

ENEFIRST is a three-year project funded under the Horizon 2020 programme, which gathers a consortium of partners from across sectors and regions: IEECP, BPIE, Fraunhofer ISI, CEU, RAP, IREES, TU Wien.

From definition to implementation, ENEFIRST aims to make the "Efficiency First" (E1st) principle more concrete and operational. It seeks to improve understanding of the relevance of the E1st principle for decision processes related to energy demand and supply, and its broader impacts across sectors and markets, focusing on the building sector and related energy systems in EU Member States.

E1st gives priority to demand-side resources for meeting policy objectives whenever they are more cost-effective from a societal perspective than investments in energy infrastructure. It is a principle that is applied systematically at any level to energy-related investment planning and is enabled by an "equal opportunity" policy design, i.e. that treats demand resources as equal alternatives to supply options.

ENEFIRST combines policy analysis and quantitative assessments of E1st impacts to develop policy guidelines and recommendations, following a process of continuous exchanges with stakeholders.

This report is focused on barriers to implementing E1st in the EU in several policy areas that are linked to energy use in the buildings sector (such as network codes, renewable energy policy, building regulations and others). These range from legal and regulatory, institutional and organizational capacity-related barriers, considering the way that energy planning and policy operate including multilevel governance, to economic and social/cultural barriers (in relation to buildings, heating systems, etc.).

The scope is deliberately wider than just buildings policies; for example, deciding whether to invest in energy network upgrades or demand-side responses is an application of the E1st principle that also relates to the building sector.

Two previous project reports provide a basis for the analysis on barriers, with a background analysis of the context and definition of the E1st principle (ENEFIRST 2020a) and a set of 16 "real world" examples where the E1st principle has been implemented (ENEFIRST 2020b).

2 METHODOLOGICAL APPROACH

The first step of this task was to look at the existing literature on barriers to the implementation of the E1st principle. The literature covered different policy areas, countries and the EU level as well as overall barriers.

In a second step a survey was conducted among European experts in energy and/or building policies in order to identify barriers to the implementation of the E1st principle, i.e. to the use of demand-side resources (end-use energy efficiency and demand-response) in the building sector, as alternatives to investments in energy infrastructures. The full questionnaire can be found in Annex I.

In parallel, barriers identified in a selection of practical examples (e.g. existing policies and legislation, utility programmes; see ENEFIRST 2020b) were added to the survey results to yield a wider pool of barriers.

The barriers identified from existing cases and by experts show a larger picture of which issues are perceived as barriers in general, and which have already been identified and sometimes overcome in practical cases. This will be carefully examined both for policy-makers and regulators. In the course of the Enefirst project they will inform the development of case studies as well.

2.1 Categories of barriers

The underlying literature review presented in chapter three covers a large scope of policy areas. Based on this, we have identified 10 general categories, shown in Table 1, to structure the analysis presented further in this report, as well as in the survey.

This typology is a balance between distinguishing the main categories found in the literature and keeping the categories general enough for respondents to easily chose. More detailed typologies will be developed later on in the project, when focusing on given policy areas.

The categories we use here are not exclusive, as explained for example regarding the regulatory barriers in Table 1: in practice, a given barrier can be related to several categories of barriers.

Table 1: Categories of barriers to end-use energy efficiency and how they can hinder the E1st process

Category of barrier	How it can hinder E1st implementation
Political barriers	Barriers might be inherent in the policy design, caused by political decision-makers or lie in the political system in general. For example, a policy might limit the scope of options considered or create a bias in the decision-making when the eligibility criteria favour specific options, or when there is a political decision to support fossil fuel infrastructure instead of implementing efficiency measures first.
Regulatory barriers	Regulatory barriers can refer to energy system barriers, network barriers or barriers within regulation in general. Such barriers occur for example when current regulations impede the choice of demand-side resources as alternatives to supply-side resources, or when current regulations create a bias in favour of supply-side resources. For example, a building code might create a bias in the decision-making in favour of renewable energy supply over end-

	use energy efficiency. Regulatory barriers can result from political decisions (linked to political barriers) or because E1st was not considered properly when designing the regulation (linked to lack of knowledge or expertise).
Financial barriers	These barriers can point to either lack of money available or lack of returns when implementing E1st, lack of subsidies directed at E1st or financial emphasis on other priorities which do not support E1st implementation. The barriers can for example materialise in the absence of financial aid that would value the positive impacts of E1st at societal level. The (non-)availability of financial subsidies might then create a bias in the way the demand-side options are assessed and valued, thereby creating a bias in the decision-making.
Technical barriers	These barriers cover the technical issues of implementing E1st, e.g. it might be technically easier to implement other measures, or modelling software that cannot simulate all possible options limits the scope of options considered.
Cultural barriers	Cultural habits of professionals might limit the scope of options considered (e.g. installers suggesting only options they are used to), or tend to favour some options, creating a bias in the decision-making.
Communication/awareness barriers	Lack of awareness about energy efficiency options limits the scope of options considered. Bad communication on how E1st works and what it is can cause it not to be considered in decision-making.
Lack of expertise or knowledge	Lack of expertise and knowledge can create bias in the way various options are assessed and policies are designed.
Weight of the supply-side stakeholders in policy- or decision-making	These can be seen as a sub-group of cultural barriers. Supply-side stakeholders are often more centralised or have long-lasting and well-established contacts with policy-makers, while stakeholders of demand-side resources are more diverse and not always well identified in consultation or decision-making processes. This can result in an imbalance in the policy- or decision-making process, and a bias in favour of supply-side investments.
Supply chain barriers	Mostly, the energy supply chain is in place already. For example, energy markets were designed from a supply-side point of view. Supply-side stakeholders have no natural incentive to support E1st, and may even have incentives to hinder its implementation, for example if a certain amount of energy has to be produced to keep prices stable.
Policy interaction barriers (e.g. conflicting objectives or priorities)	Most policy areas are closely interlinked, though the decision-makers often look only at their policy area. In some cases, this can lead to conflicting objectives of for example renewable energy policy and E1st. Another common example is the possibility of conflicts between implementing E1st and energy security objectives, especially when decision-makers think demand-side resources are not reliable enough.

3 LITERATURE REVIEW

The concept and terminology of "Efficiency First" or "Energy Efficiency First" is still recent (for more details on the concept and definition see ENEFIRST 2020a). Therefore, there is not yet a developed literature that analyses specifically the barriers to the implementation of the E1st principle. Our approach was thus to consider underlying barriers related to the key components that form the E1st principle: barriers to demand-side resources (end-use energy efficiency in buildings and demand-response) and barriers to decision or planning frameworks (IRP – Integrated Resource Planning, or LCP – Least Cost Planning) that can ensure a level playing field for the comparison of demand-side and supply-side resources.

3.1 Barriers to end-use energy efficiency in buildings

End-use energy efficiency in buildings is closely linked to building policy and increasingly linked to renewable energy policy and network policy. This is because buildings are becoming increasingly integrated into the energy systems as not only end users of energy but also energy storage points and energy producers. This makes it even more important to ensure that energy use in buildings puts the E1st principle in the centre of new and revised policies in a way which ensures that building occupants have comfortable and healthy living or working spaces (regarding heating and cooling) and at the same time don't use more energy than necessary (e.g. tackling the issue of building envelopes with poor energy performance).

There is already a lot of literature on energy efficiency in buildings, the barriers to the related energy efficiency actions and how to overcome them. But this is a different concept from implementing E1st as a principle: the E1st principle wants to make sure that in all decisions taken, there is a systematic check on whether or not efficiency is being put first when it is more cost effective and has societal benefits in comparison to investments related to energy supply.

Literature on barriers to implementing efficiency first is not available for overall building policies. As a first step, we summarise the main barriers to end-use energy efficiency. Then, we highlight the difference between those barriers and the barriers to E1st.

In a previous survey conducted in selected European countries, BPIE identified barriers to deep building renovation at national level (BPIE 2017). The main barriers were identified as:

- **Access to finance** and **high transaction costs**
- **Split incentive** dilemma keeping landlords from implementing efficiency measures (in the rental sector)
- **Complexity and hassle** of renovation measures
- **Lack of skills** in the supply chain of renovation works
- **Institutional and legal framework**.

The results of this survey are in line with the general typology of barriers to energy efficiency (see e.g. Hirst and Brown 1990), and more specifically to energy efficiency in buildings. Palm and Reindl (2018), from a

literature review, provide a broader view of barriers, considering in particular the supply chain of renovation works:

- **Financial barriers**, such as high investment costs and long payback time combined with a lack of an LCC (Life Cycle Cost) perspective; energy performance less valued than the related investment costs; insufficient financial incentives; external risks (e.g. volatility in energy prices).
- **Informational barriers**, such as imperfect information: for example, lack of information and knowledge about energy-efficient and sustainable materials and products (see more details about informational barriers below, based on Giraudet 2018).[1]
- **Behavioural barriers**, such as lack of shared objectives, other priorities, inertia (e.g. conservatism in the building industry, aversion to change), bounded rationality.
- **Technical barriers**, such as discrepancies between predicted and actual savings.
- Barriers related to the **organisation of the market**:
  - **Fragmented market**: e.g. fragmented building trades, issues with subcontracting, lack of project integration and communication between actors.
  - **Split incentives**: e.g. diverse stakeholders with varied interests, incentive for contractors to oversize equipment.
  - **Lack of time**: e.g., reuse of former bids, little time dedicated to creativity, tendency to maintain current practices.

The barriers to energy efficiency investments in buildings therefore form a vast topic that can be investigated in more detail by looking more specifically at some types of barriers or particular segments of the building stock.

For example, Giraudet (2018) reviewed the informational barriers to energy efficiency in buildings from a 'credence goods'[2] perspective, providing a detailed analysis of the difficulties that owners, investors or funders might encounter in assessing the opportunities, costs and benefits of energy efficiency work. These issues can have strong links with the E1st principle, as implementing E1st implies being able to assess what options are available and relevant, and accordingly their costs and benefits. Giraudet summarises the literature review through a detailed typology. In the present report, the objective was to identify general categories of barriers and how they are interpreted by stakeholders when considering barriers to the implementation of the E1st principle. More detailed typologies like the one presented in Annex III.

will be taken into account in the next steps of the project, when prioritising the analyses on a selection of promising policy areas to develop practical policy guidelines.

Regarding a particular segment of the building stock, a study (U-Sentric and TU Delft 2016) on **social housing** and building renovation identified the following main barriers on political, financial cultural and technical levels:

[1] The link in the text is to a publicly available working paper. This has since been published in *Energy Economics* (subscription only): Giraudet, L.-G. (2020). Energy efficiency as a credence good: A review of informational barriers to energy savings in the building sector. *Energy Economics*, 87, 104698.

[2] A credence good is a type of good with qualities that cannot be observed by the consumer after purchase, making it difficult to assess its utility. Typical examples of credence goods include expert services such as medical procedures, automobile repairs, and dietary supplements.

- **Barriers related to policies**, such as building regulations which do not support efficiency measures
- **Financial barriers**, such as the lack of government funding
- **Cultural barriers**, such as tenants who do not support renovation measures
- **Technical barriers**, such as energy performance calculation software which doesn't give an appropriate picture of efficiency levels of the building.

A study by Schleich (2009) provides another example of analysis for a specific segment of the building stock, looking at barriers to energy efficiency in the **commercial and services sector** in Germany. This showed the **lack of information** as the main problem, followed by **priority setting** within organisations, the **investor/user dilemma** and public administrations' **lack of commitment** to implementing efficiency measures. This is interesting as it shows that some types of barriers are similar to those recognised in the residential sector – lack of information and political will. However, in detail the barriers will be different as companies and households often have different needs regarding efficiency legislation and information, and consider investments in different ways.

In principle, all the barriers to energy efficiency in buildings are also barriers to the implementation of E1st, as they can impede the likelihood of energy efficiency actions being considered, assessed and finally decided and implemented. Therefore, all energy efficiency policies that contribute to overcoming these barriers also contribute to creating more favourable conditions for the implementation of E1st.

However, in this report, and more generally in the ENEFIRST project, we **focus on the barriers that might intervene in the process of implementing the E1st principle**. This means that we focus on the barriers that might:

- **Limit the scope of options considered** when planning actions or investments related to energy use in buildings
- **Create bias in the way the energy efficiency options are assessed and valued** (compared to other options)
- **Create bias in the decision-making.**

The general categories selected to structure the analyses presented further in this report are shown in section 2.1, merging the categories identified from the three underlying targeted literature reviews (about barriers to energy efficiency, Demand Response and Integrated Resource Planning).

3.2 Barriers to demand response

The aim of end-user energy efficiency measures is to reduce overall consumption on a permanent basis. Demand response, however, means action that alters the consumption pattern over time, not necessarily resulting in overall demand reduction. Concerning electricity, this means changing the daily load pattern e.g. to reduce peak demand. The importance of peak demand the sizing of the energy infrastructures (generation capacities, transmission and distribution networks, storage facilities) is also important for gas and heat, acknowledging that currently they have cheaper storage options to adjust to demand. Flattening the demand curve and using the existing network more efficiently in the context of growing overall electricity demand due to the electrification of transport (electric vehicles) and heating (heat pumps) is crucial for electricity systems. Well-designed demand response programmes can defer network or capacity investments.

The most cited barriers to using the demand-response potential of buildings (residential, public or commercial) are:

- **Insufficient wholesale price volatility to reward elastic demand** (market barrier/supply chain barrier)

Price caps, over-procurement of supply resources in power markets (including the use of capacity mechanisms) and other distortions to price formation and volatility associated with the increasing share of intermittent renewables limit the business case for demand response.

- **Tariff structures providing no incentive to shift demand (and reduce energy use)** (market and regulatory barrier/policy interaction barrier)

Energy and network tariff structures that are non-time differentiated (time-of-use or even more dynamic) volumetric, capacity-based or fixed make the consumers indifferent to the level and pattern of energy use. Reforming tariff structures is an essential element of integrating electrified transport and heat in power networks (Kolokathis et al., 2018).

- **Distribution System Operators (DSO) remuneration schemes incentivising for wires-only solutions** (regulatory barrier/policy interaction barrier)

Network companies (both power and gas) sometimes receive their revenue based on throughput, but even if their revenue is decoupled from the energy volume distributed, they earn a return on invested assets ('wires and poles') (CAPEX-based approach). This creates a bias against upgrading to smart grids or investing into demand resources instead of network capacity development, the so called non-wires solutions (Pató et al, 2019).

- **Access of third-party actors to pool demand resources to organised markets** (market and regulatory barrier/supply chain barrier, and weight of the supply-side stakeholders in policy- or decision-making).

The pooling of small residential demand requires both aggregators that are free to recruit households and other consumers as well as energy market access rules that enable these pooled resources to compete with supply options (SmartEn and Delta EE 2018).

The common barriers to demand response are therefore mostly related to regulatory or market barriers. In the perspective of the E1st principle, these barriers can also be analysed as:

- Weight of the supply-side stakeholders in policy- or decision-making
- Supply chain barriers
- Policy interaction barrier (e.g. conflicting objectives or priorities)

These three categories of barriers were added to the barriers to energy efficiency to structure the survey (see full list in section 2.1).

3.3 Barriers to Integrated Resource Planning (IRP) or Least Cost Planning (LCP)

Swisher et al. (1997) provided definitions for Least Cost Planning (LCP) and Integrated Resource Planning (IRP):

- LCP: "*Utility planning method whereby alternative resource mixes, including demand-side options such as conservation and load management, are evaluated along with traditional supply-side options to determine which of them minimizes the overall cost of service. Cost management is used as the criterion for selecting the resource plan for the utility company*"
- IRP: "*Combined development of electricity supplies and demand-side management (DSM) options to provide energy services at minimum cost, including environmental and social costs*"

Both concepts, LCP and IRP, are relevant when considering the E1st principle, as they are similar in the way they take into account demand-side resources when planning investments in energy systems. The main difference is that LCP and IRP have mostly been applied to electricity systems, while E1st is not limited to considering a particular energy carrier. Moreover, E1st aims to take into account a wider scope of costs and benefits (for more details about the history of LCP and IRP, and the links with E1st, see ENEFIRST 2020a).

A non-exhaustive literature review on LCP and/or IRP sheds light on the main barriers to the implementation of such approaches in Europe (see Annex IV), summarised in Table 2 below. It should be noted that many of the references used for this synthesis are papers published in the 1990s, at a time when several European countries, researchers and stakeholders investigated the interest and feasibility of implementing IRP, while the liberalisation of the energy markets took place from the early 2000s. However, the types of barriers are likely to be relevant for the current context when considering the implementation of the E1st principle.

Table 2: Overview of barriers to the implementation of IRP or LCP

Aspect (and related barrier categories)	**Related barrier(s) to the implementation of IRP or LCP**	**References**
Energy market (Political barriers/ Regulatory barriers / Supply chain barriers / Policy interaction barriers)	**Liberalisation → unbundling and competition** • "*Liberalisation of energy markets, in addition to **unbundling**, opens them up to **competition** from a greater number of players (…) IRP becomes increasingly driven by diverging and decentralised business interests*". This implies that "*IRP also becomes less likely and able to deliver public policy objectives*" (Guertler, 2011) • EU regulations on energy markets have put a priority on separating the transmission networks from generation and retail, which creates a barrier to the cooperation of the various energy stakeholders (Didden and D'haeseleer, 2003).	Guertler (2011) Didden and D'haeseleer (2003) Thomas et al. (1999) York (1993)
	Separate costs and benefits by each player	Guertler (2011)

Aspect (and related barrier categories)	**Related barrier(s) to the implementation of IRP or LCP**	**References**
	No clear responsibility allocation • "*Requiring an IRP-strategy from the generators is not feasible in an open market. Especially in a power pool, it is not known which generator is covering which part of the load-flow*." (Didden and D'haeseleer, 2003)	Didden and D'haeseleer (2003)

Regulatory framework (Regulatory barriers / Policy interaction barriers)	**Lack of incentives**
	• "*There is little incentive for production utilities to sell less of their 'product' by investing in DSM*" (York, 1993)
	• "*Unsurprisingly, two perverse incentives undermining LCP generally hold true in Europe's regulatory frameworks today:*
	  • *Each kWh sold by a utility adds to its earnings and profits*
	  • *Each kWh saved or provided by DSM programmes reduces its profits*" (Moskovitz, 1989; RAP, 2005 *in* Guertler, 2011)
		Guertler (2011)
		Leprich and Schulte-Janson (1995)
		Wolcott et al. (1993)
		York (1993)

LCP/IRP characteristics (Cultural barrier / Weight of the supply-side stakeholders in policy- or decision-making / Supply chain barriers / Policy interaction barriers / Technical barriers)	**Need to adopt a long-term perspective** • "*If the electricity market would be fully unbundled it is for many reasons very unlikely that the retailers would be submitted to governmental restrictions such as IRP. One important reason lies in the fact that IRP requires a long-term planning vision, which is very hard if customers can switch any time*" (Didden and D'haeseleer, 2003)	Guertler (2011) Didden and D'haeseleer (2003) Thomas et al. (1999) York (1993)
	Rise in unitary energy costs • "*If a utility makes any investments that cause its rates to increase, it can lose customers to a competing utility, which can cause further increase in rates for remaining customers*" York (1993)	Leprich and Schulte-Janson (1995) Thomas et al. (1999) York (1993)
	Measurement and evaluation costs • "*Upholding IRP would also require a considerable amount of measurement and evaluation costs*" (Didden and D'haeseleer, 2003)	Didden and D'haeseleer (2003)
Governance (Cultural barriers / Communication and awareness barriers / Weight of the supply-side stakeholders in policy- or decision-making)	**Information exchange** • "*The first difficulty is where the grid owner and/or operator should obtain demand side information?*" • German utilities are concerned that LCP/DSM activities might encourage a closer relationship with the price authority, resulting in a more detailed evaluation of costs and revenues not associated with LCP, which could impact their profits (Leprich and Schulte-Janson, 1995).	Didden and D'haeseleer (2003) van der Berg and Welling (1993) Leprich and Schulte-Janson (1995)
	Lack of effective communication • "*Due to its reliance on **effective communication** between unbundled entities, and due to separate costs and benefits faced by each functionally different player*" (Guertler, 2011)	Guertler (2011) van der Berg and Welling (1993)

Aspect (and related barrier categories)	**Related barrier(s) to the implementation of IRP or LCP**	**References**
Utilities' capacity (Communication and awareness barriers / Lack of expertise or knowledge**)**	**Lack of knowledge about LCP and/or capacity (information, staff, etc.)** • "*LCP/DSM activities are new for most of the utilities. The German utilities lack knowhow, reliable data, and qualified staff for the implementation of successful programmes*" (Leprich and Schulte-Janson, 1995)	Leprich and Schulte-Janson (1995)
Compatibility of agendas (Political barriers / Policy interaction barriers)	**Conflict of government agendas** • In Denmark, "*a conflict may arise between IRP, fulfilment of the environmental objectives adopted by the Danish parliament and introduction of an EU electricity market characterized by competition*." (Sandholt and Nielsen, 1995) • In Poland, there was the perception that DSM can contribute to unemployment, especially in the utility and mining industries (Wolcott et al., 1993)	Sandholt and Nielsen (1995) Wolcott et al. (1993)

Most of the barriers to IRP and LCP fit in the categories defined earlier in the analysis of barriers to end-use energy efficiency and demand response, so do not add to the typology used in this report. However, the analyses of barriers to IRP and LCP show the importance of barriers specific to long-term planning and to comparing demand-side and supply-side options from the perspective of the energy companies.

One key aspect in the EU context is that the liberalisation of the energy markets has made it more difficult or complex for public authorities to intervene in the planning and investments of energy companies, especially producers and suppliers. In most cases, network companies are still regulated monopolies. Moreover, at EU level, another key issue is the coordination or cooperation between countries, emphasised in the Governance Regulation ((EU) 2018/1999) adopted late 2018.

4 ANALYSIS OF EXISTING CASES

A review of 16 examples of policies, regulatory frameworks, energy company programmes and other initiatives that have implemented the E1st principle in practice (ENEFIRST 2020b) has helped identify barriers that can be directly related to implementing E1st.

The case studies cover examples from Europe and the US, and all demonstrate a policy approach in line with E1st – even if the "efficiency first" concept is not explicitly mentioned. The examples have been identified through literature review, personal communication and desk research but do not represent an exhaustive analysis. The objective of the review was to analyse why and how the E1st principle has been applied in practice, and what experiences can be drawn from it. The examples have been analysed in terms of their impacts, their development over time, and their replicability and scalability potential. Barriers and success factors were identified where feasible.

The identified barriers were analysed taking into account the categories presented in section 2.1. As they are connected to a limited number of specific cases, they should be seen as practical illustrations, not as a

representative sample. Due to the nature of the examples, which have been analysed on a more technical and specific level, the barriers identified are less political and more practical (e.g. technical or regulatory) than those identified in the expert survey (see results in part 5).

Table 3: Barriers to implementing E1st identified in a review of 16 examples

Example of implementing E1st and barriers identified in the example	**Category of barriers**[3]
1) Time-of-use tariffs in Europe	
Lack of awareness and consumer motivation	Communication / awareness barrier
Limited monetary savings on the consumer side because of weak price signals	Financial barrier
Limited availability and high costs of enabling technologies (smart meters, controlling devices, electricity price communicators)	Technical barrier / financial barrier
2) Social constraint management zones in the UK	
Low market maturity (high associated costs for the support of communities)	Technical barrier / supply chain barrier
3) Demand flexibility in DH networks	
Importance of taking consumer requirements for comfort into account (difficult to define and measure)	Lack of expertise or knowledge / technical barrier
4) Demand response in French wholesale electricity market	
Low market maturity	Technical barrier / supply chain barrier
5) Enabling rules for demand response aggregators in Germany	
Regulatory barriers hinder market growth (lack of clarity regarding market roles and responsibilities)	Regulatory barrier
Lack of standardised processes and contracts for collaboration between aggregators, balancing group managers and suppliers	Regulatory barrier / weight of the supply-side stakeholders in policy- or decision-making
6) Decoupling utility sales and revenues in the US	
Encouraging utilities to take cost-cutting steps that might hurt system reliability and customer satisfaction	Regulatory barrier / policy interaction barrier
7) Replacing a polluting power plant with behind-the-meter resources	
Difficulty to ensure the reliability of the demand-side resources for a capacity equivalent to a power plant	Technical barrier
Possible conflicts in priorities between security of supply (also taking into account interconnections of networks/areas) and environmental objectives	Policy interaction barrier
8) Distribution system planning in the US	

[3] When more than one category is mentioned, the first is the main category.

Example of implementing E1st and barriers identified in the example	**Category of barriers[3]**
Market acceptance constraints, upstream capacity for product development and knowhow; possibility to adapt the utility business model	Lack of expertise or knowledge /cultural barrier /weight of the supply-side stakeholders in policy- or decision-making
EU regulatory framework does not incentivise distribution network operators to actively manage the electricity flows in their networks, nor to provide incentives to customers connected to distribution grids to use the network more efficiently.	Regulatory barrier
9) Assessing the value of demand side resources in the US (Barriers to a widespread use of non-wire solutions)	
Ill-designed regulations (e.g., the lack of incentives for utilities to use these solutions).	Regulatory barrier
Utility standard procedures that neglect NWSs (e.g., internal corporate professional structure able to deal with both supply and demand issues).	Cultural barrier /supply chain barriers
Difficulties related to the procurement of these resources.	Lack of expertise or knowledge
10) Water heaters as multiple grid resources	
Lack of availability of a control device easy and quick to install	Technical barrier
Regulatory environment that may impede third-party aggregators or solution providers in developing attractive offers to final customers	Regulatory barrier
11) Building logbook (digital building file to exploit efficiency potentials in buildings)	
Difficulty of making building owners consider their investments from a long-term perspective	Cultural barrier
Difficulty of providing information in a way that can be easily and effectively used by building owners	Communication/awareness barrier
12) Optimising building energy demand by passive-level building code in Brussels, Belgium	
Compliance levels of passive-level building codes were criticised in the beginning	Political barrier
Specific building structures (historic buildings, tower buildings) need specific targeted legal, informational and institutional provisions	Political barrier /technical barrier
13) Deferring transmission and distribution infrastructure investments through local end-use efficiency measures	

Example of implementing E1st and barriers identified in the example	**Category of barriers[3]**
To ensure the reliability of the demand-side resources, this approach needs to focus on solutions that are well-developed, commercially viable, readily available in terms of timing and quantity, and priced reasonably to enable straightforward implementation	Technical barrier /lack of expertise or knowledge
Difference in the timeframe needed to develop end-use measures and the timeframe to decide on reinforcements of the network (need for anticipation)	Technical barrier /supply chain barrier
Differences in technical cultures between the units in charge of supply and the units in charge of energy efficiency programmes	Communication/awareness barrier /cultural barrier
14) Building energy performance requirements of the Irish heat pump system grant	
Limited capacity of qualified and certified contractors (for the energy performance assessment)	Lack of expertise or knowledge
Comprehensive pre-assessment prior to renewable energy installation increases costs and requires a shift in mindset of installers (heat pump grant)	Financial barrier /cultural barrier
15) Fabric First approach under the Irish Better Energy Communities grant scheme	
Energy efficiency measures are more complex and cost-intensive than a single replacement of a heating system which results in decreasing project applications (total volume decreases)	Financial barrier /technical barrier
Lack of a credible, easy-to-acquire energy performance certification scheme with an accessible online registry	Technical barrier /lack of expertise or knowledge
16) Linking renewable support to building energy performance	
Lack of reliability or credibility of energy performance certificates	Political barrier /technical barrier
Possible conflicts between the objectives to promote renewable energy sources and to promote energy efficiency	Policy interaction barrier

(Source: based on the examples included in ENERFIRST 2020b).

5 RESULTS: BARRIERS IDENTIFIED IN THE ENEFIRST SURVEY

5.1 Survey design

The aim of the survey was to establish a list of barriers to realising E1st in the EU in several policy areas that are linked to energy efficiency in the buildings sector (for instance policies such as network codes, renewable energy targets, building regulations and others). The scope is deliberately wider than just buildings policies as, for example, deciding whether to invest in network upgrades or end-use energy efficiency has a direct impact on energy efficiency in buildings. These barriers are distinct from consumer-facing barriers to adopting more energy-efficient technologies and behaviours. They can be classified as implementation barriers of the E1st principle.

The survey was conducted as an online questionnaire sent directly to stakeholders in the field of energy efficiency, energy markets, energy policies and building policies. These contacts were identified by the project partners. The survey was additionally disseminated through the partners' social media channels and newsletters. The survey lasted 10 weeks from 27 February to 8 May 2020. In total, 45 responses were collected from a wide range of stakeholders across Europe, working on EU, national and regional level. Where there was a significant output from one specific country or policy area, the results are presented separately.

As the project has a focus on buildings, there was an emphasis on finding stakeholders from the buildings sector, which is reflected in the results. As buildings are part of the energy system, a lot of the answers are applicable to other policy areas as well.

The online survey focused on the following questions (see the full questionnaire in Annex I):

1. **Please select the policy areas you work on or you have expertise in** (multiple answers possible)
2. **According to your experience, which barrier(s) impede the implementation of E1st in the policy areas you know?**
3. **How would you categorise this (or these) barrier(s)?** (multiple choices possible)
4. **According to your experience, which barrier(s) create the biggest problem to the implementation of E1st? (and why?)**
5. **Do you have any suggestions or examples on overcoming implementation barrier(s)?**
6. **Please select the most relevant type of organisation you are working for/affiliated to**
7. **Do you work at European, national or local/regional level?** (multiple choices possible)
8. **Which country do you work in?**

Questions 1 and 6 to 8 were asked to allow for an analysis of whether or not the background of the respondents have an influence on their answers to questions 2 to 5. The objective was not to perform detailed statistical analysis nor to identify possible correlations, as the number of respondents would not provide statistically significant results. Rather, the relation was qualitatively assessed to see if there could be some bias in the answers in case some of the sub-groups of participants represented a large share of the whole respondents.

Question 2 was an open question asked first, so that answers to question 2 could be considered 'spontaneous' and not guided or biased by the categories presented in question 3. Question 3 was meant to help to structure the answers according to the categories of barriers presented in section 2.1. Question 4 was to draw a kind of hierarchy in the categories of barriers, with caution in the analysis due to the subjectivity of the answers. As it was an open question, the answers have fed into the analysis.

Question 5 was meant to collect inputs for the next step of the project that will investigate how to overcome the barriers identified in this first step.

The following chapters summarise the main findings from the survey and the examples presented in ENEFIRST 2020b.

5.2 Profiles of the respondents

The survey was sent personally to 170 experts, 76 people looked at the corresponding page on the website and 47 people interacted with the post on Twitter, of which 5 clicked on the link for the survey. Overall, we received **45 answers**. The answer rate of about 26% also takes into account answers from contacts reached through social media channels and newsletters, which was lower than from personal contacts.

Several contacts who did not answer the survey told us this was because there has already been a lot of research into barriers to energy efficiency. This shows that, despite the introduction to the survey that highlighted that it was focused on E1st, several experts conflated barriers to energy efficiency and barriers to the implementation of the E1st principle. It is difficult to estimate to what extent this could have been a reason for not answering the survey, as we had the chance to discuss this with only a few contacts. However, this shows clearly the need to analyse the specificities of the barriers to the implementation of the E1st principle compared to general barriers to energy efficiency.

Question 1 asked about the **working area of the respondents**, to give a quick idea where the barriers are specifically relevant. A deeper analysis of policy areas will be done at a later stage of this project. The following policy areas could be chosen (multiple answers possible):

- Power market and regulation
- Gas market and regulation
- District heating market and regulation
- Renewable energy policy/market
- Energy efficiency policy/market
- Building policy/market
- Climate policy
- Industrial policy
- Energy planning
- Urban planning
- Public procurement
- Social policy
- Other(s), please indicate below

Respondents often chose more than one policy area. Figure 1 shows the distribution across policy areas. A quarter of respondents work in energy efficiency policy/markets, followed by climate policy (14%), building policy/market (13%) and energy planning (13%).

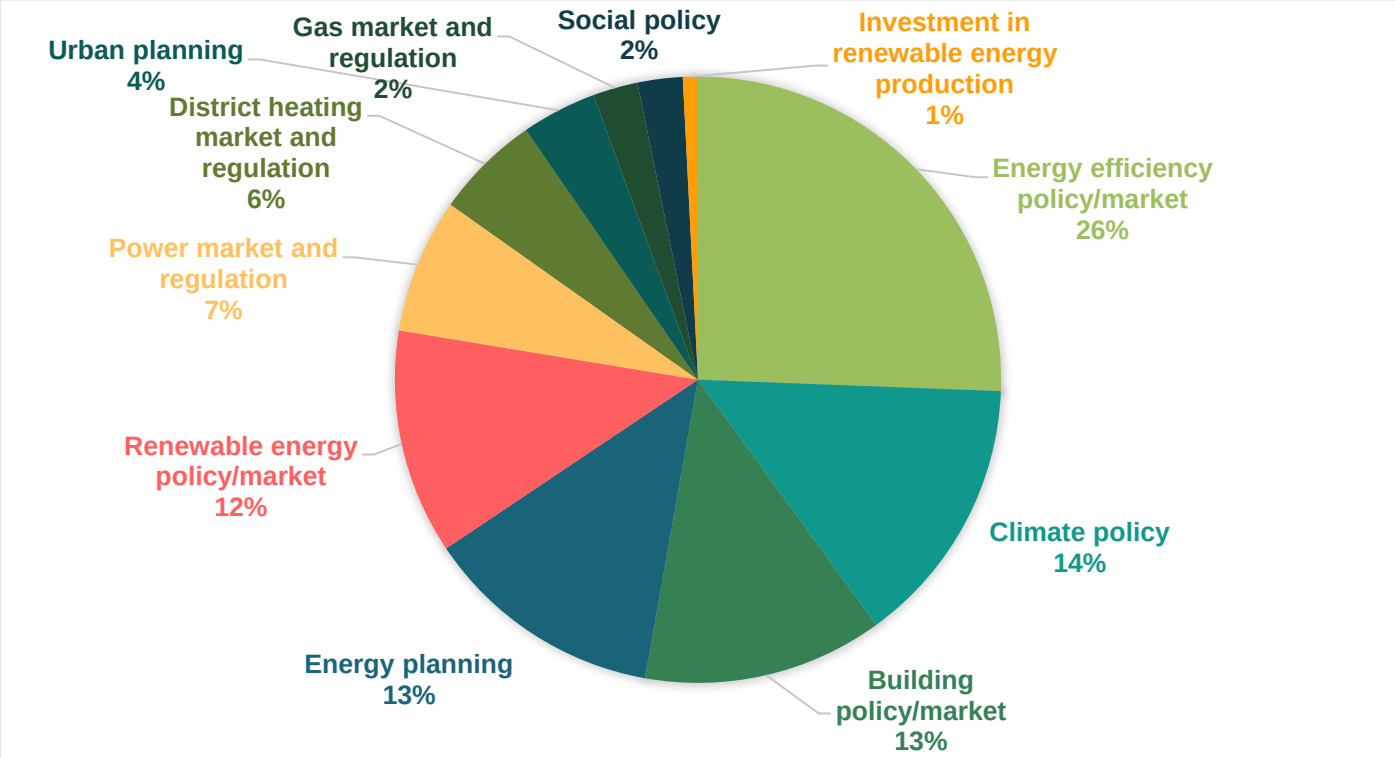

Figure 1: Respondents per policy area

We also asked respondents to let us know at which **governance level** they work (question 7). As seen in **Figure 2**, most respondents work mainly at the national level, followed by those working at the local/regional level and the European/national level.

Question 6 referred to the **type of organisation** the respondents are affiliated to. Figure 3 shows that most answers come from an expert working at an energy agency, a consultancy/engineering company, or a research organisation (public research body or university).

Question 8 asked participants about the **country** they work in. Overall, country sub-groups are very small. The largest (six) is Belgium, but these work at EU level rather than Belgian national policies. Five respondents each work in Spain and Germany while four work in European countries outside the EU. Three respondents work in Croatia and the rest work in Austria, Bulgaria, Denmark, Greece, Sweden, UK[4], Finland, France, Hungary, Italy, Lithuania, Netherlands and internationally (one or two respondents each).

[4] Although the UK has left the EU, at the time of the survey design it was still in the EU and therefore counted as an EU country.

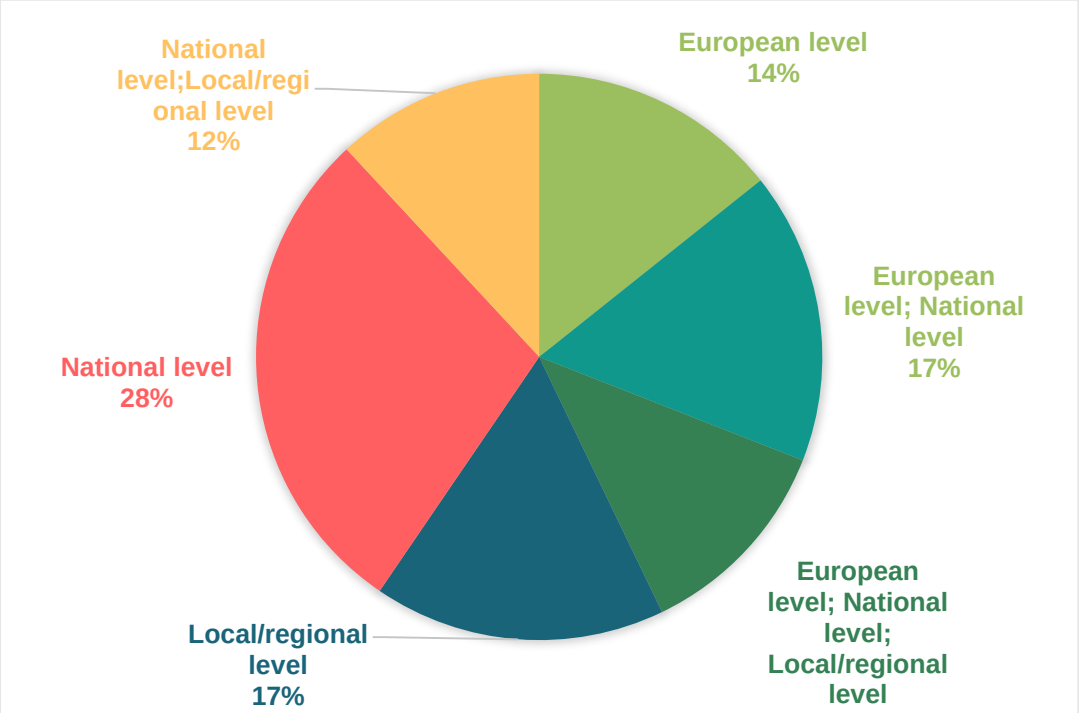

Figure 2: Working level of respondents

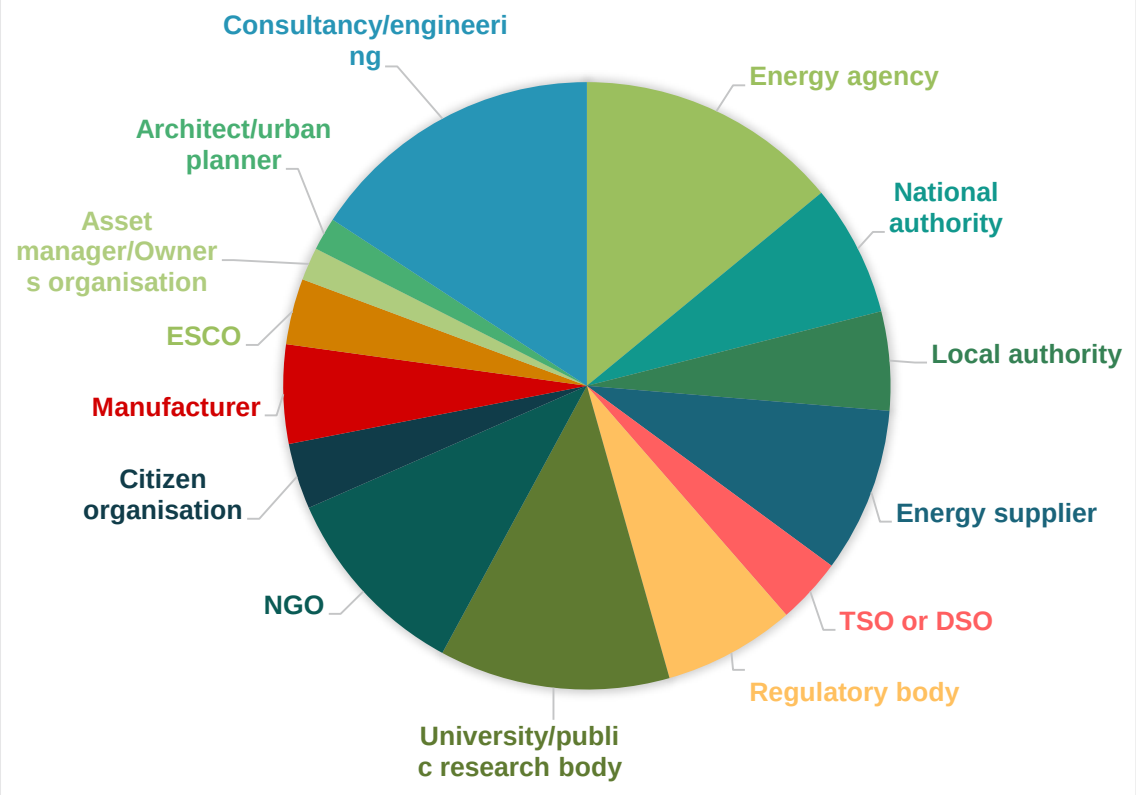

Figure 3: Type of organisation respondents work for

This variety in policy areas, working levels and working countries ensures that the answers reflect different national areas and policy approaches and give a diverse set of answers which can be applied to a general approach to E1st.

5.3 Overview

The survey covered a variety of policy areas, countries, geographical areas and types of barriers. It gives a general overview of barriers to the implementation of the E1st principle. This overview does not aim to be exhaustive or representative but gives an insight into which barriers experts in different policy areas see as most challenging.

This report should be seen as the start of a series of activities which we will perform to identify more barriers, group them by policy areas and deepen the knowledge on how they intervene and how they can be overcome through interviews with experts. Some of the survey questions are not covered in this report in detail but will feed into the further work of the project (for the full set of questions see Annex I).

Question 2 was an open question to get answers that were not biased from the typology suggested in question 3 (categories of barriers). It was seen as important to start the analysis of barriers by summarising what the respondents mentioned spontaneously, looking at whether their background has an influence on their views (crossing with answers to question 1 on respondents' working field, and possibly question 6 on their affiliation).

Most answers to question 2 related to a lack of knowledge, understanding or awareness of the concept and the benefits of E1st and financial barriers, notably high investment costs and the split-incentive dilemma in the building sector. Answers also related to a lack of political will, political priorities and cultural barriers. The full list of answers to question is available in Annex II (together with the answers to the other open question, question 4).

In order to analyse all the answers to the open question 2 in a structured and systematic way, a typology of barriers was used from the literature review (see typology in section 2.1 and literature review in part 3). In question 3, the respondents could therefore choose among the following categories of barriers, as presented in section 2.1 (multiple answers being allowed):

- Political barriers
- Regulatory barriers
- Financial barriers
- Technical barriers
- Cultural barriers (related to professional cultures, habits and practices)
- Communication/awareness barriers
- Lack of expertise or knowledge
- Weight of the supply-side stakeholders in policy- or decision-making
- Supply chain barriers
- Policy interaction barriers (e.g. conflicting objectives or priorities)

Since the open answers to question 2 were not directly linked to the closed question of identifying categories in question 3, we had to categorise these answers ourselves. This was a difficult task, as of course many of the barriers mentioned spontaneously by the respondents can be categorised in more than

one category (e.g. political and regulatory). The answers to question 2 were thus grouped taking into account the categories selected by the respondents in question 3, as well as trying to group similar barriers in the same category (even if barriers could have been included in several categories). One of the next steps in the project will be to analyse barriers for different policy areas in detail.

In practice, the different categories of barriers do not apply in the same way to all policy areas. To put the answers given in context to the working area of the respondents, the relationship of question 1 and 3 was analysed. Figure 4 displays the share of categories of barriers identified by experts from the respective policy area and professional background. Although the answers across the policy areas are generally balanced, experts working in the gas market and regulation area did not see any regulatory barriers and experts working in social policy and urban planning did not identify any technical barriers. Political barriers were identified most by social policy, urban planning and energy planning experts, while just two respondents with expertise in the power market and regulation area named political barriers. The latter mostly identified barriers connected to culture and lack of expertise and knowledge. District heating and building policy experts named few technical barriers, but rather financial and lack of expertise barriers and political and communication barriers respectively. These results should be taken with caution due to the small size of the sub-groups per policy area, as well as because respondents could select several policy areas. Energy efficiency experts, who make up the largest group of respondents, mostly identified political, cultural and communication barriers as well as a lack of expertise.

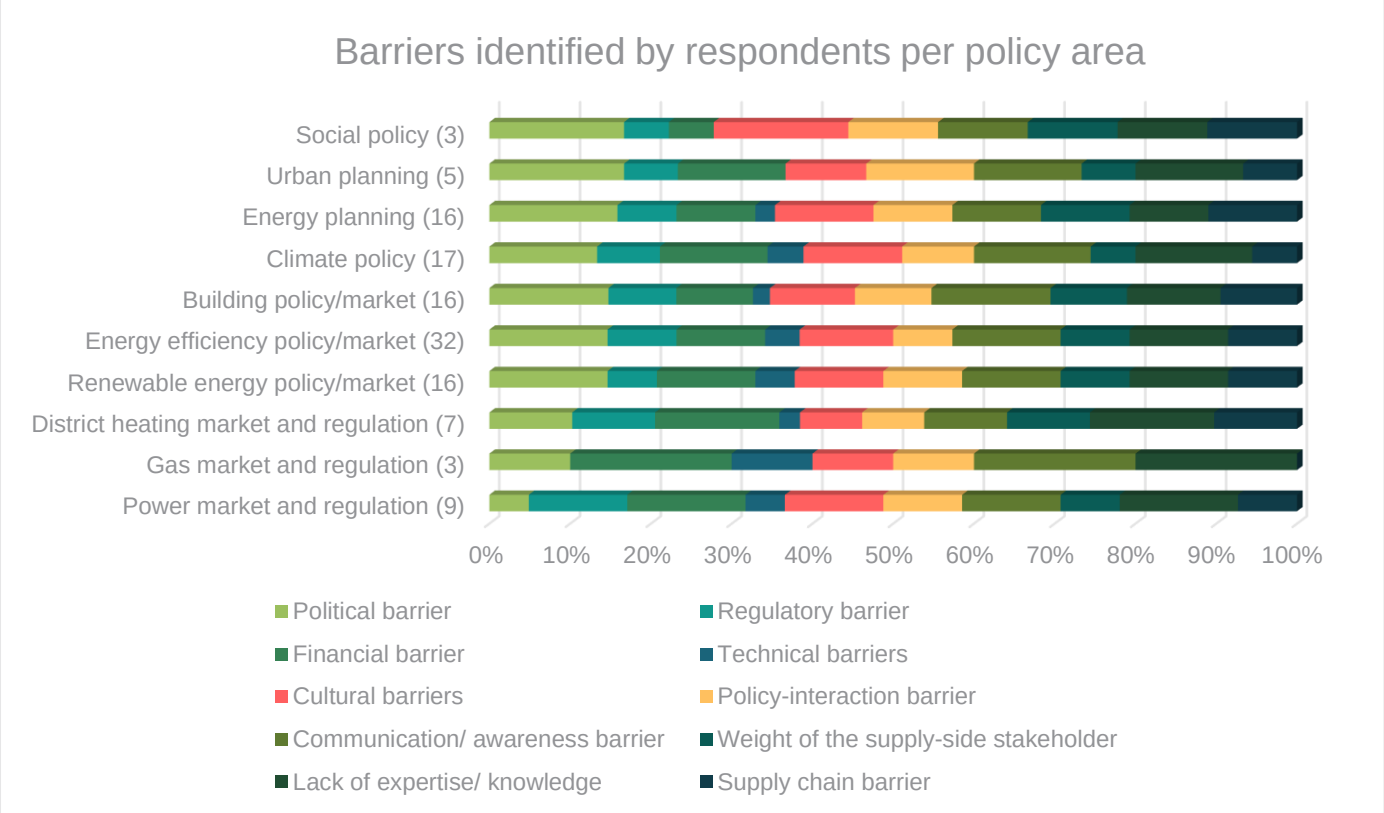

Figure 4: Barriers identified by respondents and policy area

The details of each of the categories will be discussed and presented below. The barriers identified in the examples were categorised after the survey results were finalised according to the set categories and included in the analysis.

5.4 Results by category

From the ten predefined barrier types, the five most frequently selected by the respondents are discussed below in further detail. These are political barriers, lack of expertise, cultural barriers, communication/awareness barriers and financial barriers. Multiple answers for each barrier were possible since barriers often apply to different categories and policy areas. As the barriers and the categories were not tied to each other in the survey there are many answers which may fall under more than one category. Many respondents for example mentioned regulatory barriers as a category, but did not give many specific examples of barriers which can be pinned to this category only.

Respondents had the chance to offer solutions to the barriers they named. Where solutions were mentioned in the survey they have been included in this report under each category.

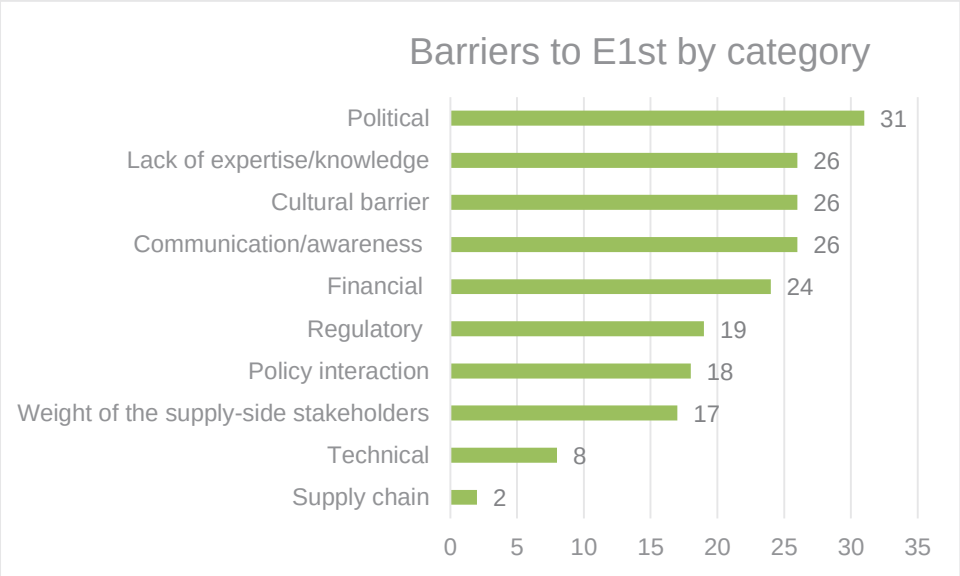

Figure 5: Number of respondents who selected each category of barriers to E1st (Question 3 of the survey)

Question 4 allowed respondents to highlight what barriers they saw as the most important. This was an open question to let respondents mention a barrier more precisely than the general categories used in question 3 and shown in Figure 5 above. These open answers are taken into account in the analyses per category in the next sections.

5.4.1 Political barriers

Political barriers (selected by 31 respondents) were identified as key, which is not surprising as it is at the political level that umbrella decisions on implementing E1st are made. Implementing the E1st principle in setting the investment context is a clear decision for governments/regulators which is not always easy to follow through given the different parties and interests involved and the difficulties of practical implementation.

The specific political barrier mentioned by the most respondents was the lack of political will to implement the E1st principle. This very general description includes the lack of implementation and enforcement through political institutions and decision-makers, and the lack of financial incentives provided by governments to push E1st, for example in the building sector.

Financial incentives are not a prerequisite for implementing E1st. However, if other areas such as development of generation capacities (fossil fuels or renewable energies) or other energy infrastructures (e.g. energy networks) are receiving more public funding (including tax exemptions) compared to efficiency measures this turns into a barrier to E1st, as it creates a bias in the way investors will assess and value the different options.

> "Implementation of the principle cannot be done if it is not included in 'hard law' and operationalised. It is also difficult to overcome decades of supply side thinking notably in energy planning"
>
> *- Manufacturer from Belgium*

For example, the balance between the financial aid for installing renewable energies and for efficiency measures is often unfair (e.g. on a cost/kWh basis), giving an economic advantage to investments in renewable energy. In this case, the political decision then creates a financial barrier (see section 5.4.5). This same issue of possible conflicts between policy objectives related to renewable energy and energy efficiency touches upon other categories such as supply side barriers or regulatory barriers: several respondents said political support for renewables can hinder the implementation of E1st (especially in the building sector).

> "The commitment of governments has to be increased. The E1st principle has to be implemented in all relevant policies and regulations and conflicts of goals in case of renewables have to be solved."
>
> *- Energy efficiency expert from Austria*

A lack of knowledge was identified on all levels, not only the political level (see section 5.4.2 below). However, the political level is important as this is where decisions are made that pave the way for companies and building owners in the future. If political decision-makers do not understand the E1st principle, policies and subsidy schemes will be badly designed to implement E1st.

Respondents also commented on the fact that existing regulations and legislation are not going far enough because they often do not follow a strategic E1st approach and fail to encompass enforcement, which would be important to ensure the implementation of E1st.

Table 4: Summary of open answers (to Question 2) related to political barriers to E1st implementation

Lack of understanding and political will, including lack of political will to actually apply the E1st principle to strategic planning, and lack of political will to put in place measures to tap the energy savings potential (*merged answers from five respondents*)
Lack of implementation and enforcement of existing legislation (e.g. Energy Performance of Buildings Directive (EPBD), Ecodesign Directive, building regulations) (*merged answers from three respondents*)
Badly designed subsidy schemes, or governments that do not promote energy efficiency enough (assuming financial incentives will be sufficient, they do not offer sufficiently attractive subsidies), insufficient incentives and regulations from governments (*merged answers from three respondents*)
National regulations
E1st has not been fully implemented. The focus for E1st principles has not been implemented so far in the

different policies
The focus is given to renewables first. In case of biomass applications, these systems have lower efficiencies than fossil fuelled systems
(Grid) tariffs
Other policy objectives, most importantly financial and economic policies
Cultural and policy focus on supply-side
Political reticence to deploy E1st due to fear of strong interference in energy system
Ignorance of public administrations

Since governance of E1st and its implementation are under the leadership of policymakers it is no surprise that this barrier has attracted a lot of attention. The answers to the survey highlighted that if the governance and public policy structure is not set right and adjusted to meet the goals of E1st, then it cannot be implemented.

Interestingly, in the examples analysed in ENEFIRST 2020b, the political barriers were not in the foreground and were only identified in the buildings-related examples. The reason behind this could be that in building policy, which is often meant to work in the long term, political barriers are more prominent and seen as more obstructive than in other policy areas. It could also be because in the survey there were a larger number of respondents who work on buildings and energy efficiency, while the examples included three from the buildings sector. Moreover, the examples are about cases where E1st (or similar approaches) could be implemented, which often means that the policy background was already favourable.

The answers to the survey stressed that a concern regarding possible political barriers is shared by a majority of the respondents (19 spontaneous open answers related to political barriers from question 2; 31 out of 45 from question 3). It will be interesting to explore more in detail how political barriers might occur and how they can be overcome.

5.4.2 Lack of expertise or knowledge

The lack of expertise or knowledge (selected by 26 respondents) is closely connected to the communication/awareness barrier. If authorities and building installers lack the expertise and knowledge on how to implement E1st and the benefits it offers, then it is also difficult for them to communicate this properly and in an understandable way for the average citizen and user.

One answer mentioned the lack of in-house knowledge within companies in the manufacturing sector. This is an interesting aspect, as companies could be important players in implementing E1st due to financial and other non-energy benefits – but this will not happen if companies are not aware of these

"More information is needed on what E1st in everyday decision-making can mean and how it works and how to apply it in practice. There is also a need for information on concrete and workable implemented case examples and tools for many kind of case examples - to be able to be used by all; meaning not tools for scientists and/or some few (often same EU level) consultants."

- Energy expert from Finland

benefits. The same goes for building owners. Without knowledgeable and committed construction companies and contractors, it is often not clear to the building owners why they should invest in efficiency measures if they can just simply change their heating system at a lower price.

Table 5: Lack of expertise or knowledge barriers to implementation of E1st

Lack of expertise of majority of tradespeople and at installer level in particular
A lack of qualified workforce to implement measures
Lack of in-house and third-party expertise in assessing, identifying, recommending and executing energy efficiency projects for the manufacturing sector
Challenges to make sure contractors have the latest training regarding energy efficiency measures in maintenance, design sizing, etc.
Unclarity how to take E1st into account in general in all cases and especially in a reasonable and practical way which does not make the decision-making and investment process too complicated and time consuming
Lack of knowledge of the exact definition of the principle
Incomplete knowledge of multiple benefits

The lack of expertise and knowledge proves the need to establish a common understanding of what it means to put efficiency first and how it can be implemented. Both in the survey and the examples shown in part 4, this barrier has been further narrowed down to a lack of knowledge on how the implementation of E1st works in practice.

There is a natural link between the lack of stakeholder knowledge and expertise to implement the principle and the political barriers described above. Therefore, serious commitment needs to be put into better defining, explaining and researching the implementation of E1st in all sectors. This is a prerequisite for the greening of the European energy system and sector integration.

The open answers from the respondents also show that the lack of expertise or knowledge, and the related need for technical support or tools, apply to various categories of actors: tradespeople, manufacturers, decision-makers. This means that communications on E1st should take into account that various types of stakeholders need to be reached. Understanding what implementing E1st means should not be restricted to a limited number of experts.

5.4.3 Cultural barriers

Cultural barriers (selected by 26 respondents) are first and foremost a barrier to the mindset and thinking of the relevant actors. The respondents believed that energy sector actors find renewable energies more interesting, more valuable and more important to receive funding. To many this is intrinsic within our energy system and difficult to overcome.

"The basis of the problem probably would be a cultural one. E1st principle is not understood as the most effective measure. Just an example, companies use marketing strategies of having a high percentage of renewable energy, but rarely E1st is showcased."

- Efficiency expert from Spain

These cultural barriers include the traditionally strong influence of utilities which promote fossil fuels. They have a lower interest in raising efficiency because that goes against their main selling point, as some of them already have oversized supply infrastructure.

Cultural barriers can also be bureaucratic barriers; for example, older people can be put off implementing efficiency measures in their home due to the bureaucracy involved, or utilities may choose to build new power stations instead of investing in efficiency measures on the demand side because "this is how it is done" and stakeholders are slow to change existing paths.

Table 6: Cultural barriers to E1st implementation

Retrofitting for energy efficiency may require more disruption e.g. floor insulation.
Implementing an energy efficient refurbishment is an enormous organisational task, requiring many skills
Increased consumption gives people more satisfaction and is simpler than carefully reducing energy needs
Too little willingness of building owners to implement efficiency measures
Misconception about consumption being a sign of status and wealth - of individuals and nations
Difficulties to identify the problem, to contract, to get administrative permission
Inconvenience caused by building renovation
Disregard of energy efficiency as a criterion for buying a dwelling
Opposition to building renovation from residents
Supposed uncertainty of demand-side measures compared to the reliability of energy generation, easier to control
The culture in grid companies is often focused on investments
E1st is not top corporate priority
Technological mentality, whereby efficiency stands for demand reduction and renewable energy for sustainability

The answers related to cultural barriers show that they can occur among most types of actors: building professionals, building owners and end-users. While some of the examples mentioned are clearly related to the E1st principle, others are general barriers to energy efficiency in buildings that are related to considering energy efficiency options, but not directly related to the E1st process described in section 3.1 (selecting the options to be considered, assessing them and making a decision). These general barriers intervene ahead of this process, about whether or not to take an action (e.g. doing renovation works). These barriers have been extensively discussed in the literature, and are addressed by energy efficiency policies, independently of the E1st approach.

"Silo thinking between demand and supply side is a problem. Energy suppliers benefit from E1st in terms of infrastructure requirements and peak demand, but this link is nearly never made"

- Manufacturer from Belgium

5.4.4 Communication/awareness barriers

Communication and awareness (selected by 26 respondents) are closely linked and are a significant barrier to E1st implementation. This barrier blends into the political barriers and is connected to the lack of knowledge and expertise which was identified among political decision-makers, as well as other actors. While communication and awareness is more of a soft barrier related to the lack of bringing information to stakeholders and decision-makers, the lack of knowledge and expertise refers directly to the fact that many stakeholders do not know what the E1st principle means and how it can be implemented technically. Specifically, for buildings there is a lack of communication of the benefits of putting energy efficiency first, not only for society as a whole (by meeting climate targets and avoiding stranded assets) but also for the individual building owner and occupant (by generating multiple benefits on both sides).

> "There is a need for information on concrete and workable implemented case examples and tools for many kinds of case examples in practice - to be able to be used by all; meaning not tools for scientists and/or some few (often same EU level) consultants"
>
> *- Efficiency expert from Germany*

A major problem specifically in building policy is that the actors who are responsible for making decisions on improvements and renovations of buildings are too often not aware of the benefits of energy efficiency measures compared to renewable energy installations or business-as-usual work. An important barrier was identified as lack of awareness at owner, installer and political level, which is difficult to overcome because it involves a certain mindset among these actors (linking with the cultural barriers mentioned in the previous section).

Table 7: Communication barriers to E1st implementation

Low awareness on wider societal benefits
Lack of knowledge and understanding
Lack of awareness among key decision-makers
Lack of understanding of the potential of energy efficiency
Lack of awareness of benefits of E1st at consumer, installer and political level
Public behaviour
Benefits of E1st may not be sufficiently understood
E1st measures may not be perceived to be as "low carbon" as renewables
Lack of interest from companies and relevant professionals (e.g. installers, architects)
Too little public awareness of the importance of efficiency
Lack of campaigns for consumers to reduce energy demand
Dispersed information on building renovation and related support programmes
E1st principle is not understood as the most effective measure
Customers are not aware of efficiency implications

Communication and awareness barriers are difficult to grasp and also to overcome as they need to target different stakeholders, with different background knowledge and expectations. Therefore, these barriers should always be taken into account when discussing E1st implementation barriers.

5.4.5 Financial barriers

Financial barriers were the next most frequently mentioned category (selected by 24 respondents). This includes the lack of funding for efficiency measures, the missing link between E1st and financial support and high upfront investment costs.

On another level, financial barriers were identified related to demand and supply issues. These included a bias in public funding which puts supply-side investments before demand-side investments, financial subsidies for fossil energy which block investment in efficiency measures, and the capital allocation of businesses which often ignores the potential of E1st.

Table 8: Financial barriers to E1st implementation

Lack of financing mechanisms
High upfront investment costs and long periods of return on investment, especially for high efficiency solutions
Complicated procedures and administrative process to apply for financial support
Financial obstacles
Cost of debt to renovation as a mortgage cost are expensive for 40k investment and personal loans have huge interest rates
Internal capital allocation by businesses typically does not include money for E1st
Lack of financing for nearly zero-energy buildings
Lack of funding for public building renovation
Not high enough price on carbon-intensive energy
High age of the population who rightly do not want to take out mortgages to pay for the rest of their few remaining years of life

Financial barriers can weigh strongly when trying to change a running system and especially when trying to improve and upgrade the infrastructure. This is an especially significant barrier in buildings because they are owned not only by companies (which can be expected to have larger financial resources) but to a large extent by private owners. The latter may not have the means or be willing to use savings to renovate their building and lack knowledge of how E1st works to their advantage.

Funding and financial support for buildings has been identified as one of the key pillars to improve the efficiency of buildings across Europe. This is reflected in the Covid19 recovery plan and in the European Green Deal (European Commission 2019).

As with cultural barriers, several of the examples mentioned above about financial barriers are related to general barriers to energy efficiency (e.g. high upfront cost) that are not directly related to the E1st process. The high upfront cost will likely come into play at the time of deciding whether or not to act. It might, however, also be relevant when comparing different options if the comparison does not include the entire

societal or life-cycle costs. However, in this case the barrier is not the high upfront cost per se, but rather the bias in the method used to compare the costs of different options.

The difference between a general energy efficiency policy and an E1st policy or approach is that the energy efficiency policy will focus on helping to overcome the high upfront cost (e.g. with loans or other financial aids); the E1st approach will promote an assessment looking at the building in the entire energy system and including life-cycle costs, taking into account a broader scope of costs and benefits. This broader analysis might reveal societal benefits that would not be taken into account by the individual investor, arguing in favour of financial aids to internalise these benefits.

Likewise, promoting the renovation wave is first an energy efficiency policy. Making the renovation wave an E1st policy would mean considering how it would interact with decisions on energy systems and taking into account demand and supply options in the same way.

5.4.6 Relevant findings in other categories

The five most frequently mentioned categories presented above give a good overview of the main barriers which E1st is facing, as perceived by stakeholders. Other barriers are nonetheless important and can cause disruption to implement the principle. They are discussed here in an overview.

> *"The perspective in the policy debate is on the strategic choice of a certain supply-side technology or changes in the energy mix. In many cases, this is also reflected at individual building design level, where measures limiting the energy demand are underestimated at the expense of fuel switch measures."*
>
> *- Efficiency expert from Bulgaria*

Most barriers which do not apply directly to one of the categories discussed above are related to supply- and demand-side interactions. These are badly designed tariff policies, subsidies for energy instead of efficiency and an already oversized energy infrastructure which has no direct or clearly attributable benefit from increasing efficiency. The latter can also be seen as a technical barrier. Other technical barriers mentioned are that efficiency measures are the sum of small parts which need to be coordinated and include high upfront investments before they take effect, and that E1st options are not stand-alone options but need to be embedded into the entire energy system. This requires different policy areas to work together, making it also a policy interaction barrier (e.g. possible conflict between distinct policy objectives) and a cultural barrier (e.g. to make professionals from different fields work together).

Policy interaction barriers cover the whole topic of renewable and efficiency policy as well as the energy system and infrastructure. Since the E1st principle involves many different policy areas, this barrier is important, though it is more of an umbrella for the political, regulatory, cultural, supply-side and technical barriers.

Table 9: Other barriers to E1st implementation

Answers to question 2	Main related barrier category
Unbalanced tariff policy and subsidy policy for energy	Policy interaction

Renewable energy can mean some fiscal advantages in some municipalities, but E1st not	Policy interaction
Price of energy	Policy interaction
Political barrier forcing cap on end-user price/tariff level	Policy interaction
Lack of housing	Policy interaction
Complicated and volatile legal and regulatory environment	Regulatory
Market rules	Regulatory
Existing regulation for cross-border infrastructure planning is mostly focused on supply-side solutions	Supply chain / Regulatory
Already oversized energy infrastructure, e.g. for gas storage	Supply chain
Lack of clear picture of how to weigh the supply and demand side, renewable energy and E1st	Technical
Efficiency first/energy usage reduction is usually the sum of multiple small parts	Technical
Focus on intermediate solutions that are not preferable long-term, e.g. incentives for gas	Technical
Inadequate energy performance certificates	Technical
Dominant perceptions among energy sector professionals	Weight of the supply-side stakeholders in policy- or decision-making
Long-term tradition of expansive growth of energy production facilities	Weight of the supply-side stakeholders in policy- or decision-making
Supply-side objectives much higher placed than demand-side objectives	Weight of the supply-side stakeholders in policy- or decision-making
Powerful incumbents in the energy markets which distort competition with demand side	Weight of the supply-side stakeholders in policy- or decision-making
Public financing (distorted market due to ongoing subsidies for fossil fuel-based solutions)	Weight of the supply-side stakeholders in policy- or decision-making
Large influence of traditional utilities (with interest in fossil fuels) - state capture / Fossil fuel lobbies (*merged from two respondents*)	Weight of the supply-side stakeholders in policy- or decision-making
Bias on supply-side considerations among policy-makers	Weight of the supply-side stakeholders in policy- or decision-making

The list of other barriers is of course non-exhaustive. It is important not to forget these many other barriers beyond the most chosen categories. This goes especially for the regulatory and supply-side barriers, which often work together hindering the implementation of E1st. These other barriers also require particular attention as many of them are related to the interactions between the supply and demand sides, either from a technical or a decision-making point of view. These issues are at the core of the E1st principle.

Different policy areas particularly relevant to the implementation of E1st will be selected and further explored in the next steps of the project. Focusing the scope of analysis will then make it possible to enter into more targeted and detailed analyses about how barriers might occur and intervene in practice, and

how they can be overcome in view of developing policy guidelines. It will be especially interesting to see how the results from this survey will be seen in personal interviews when looking more closely at different policy areas.

6 CONCLUSIONS

E1st seems like a clear principle and the term has already been incorporated in many national and sub-national policy strategies. Nevertheless, knowledge of the principle and awareness of how to make it work in practice seem still to be limited across all sectors and levels.

The barriers discussed in this report show that the work of this project is essential. A clear differentiation between barriers to energy efficiency and barriers to an integrated implementation of the holistic E1st principle is important to address the latter effectively. Describing exactly what E1st is and how it can be implemented as well as providing practical examples and guidance to policy-makers, are the key to introducing this principle across the EU. In order to make the strategic principle operational, its benefits to the energy system, consumers, residents and society as a whole need to be analysed and communicated to decision-makers.

From the survey presented in this report, we learn that:

- Political barriers are the category most frequently mentioned by respondents, suggesting that implementing the E1st principle would be first and foremost a political decision, including political will and commitment to policy implementation and enforcement of regulations.
- A majority of respondents also stressed the lack of expertise, knowledge, awareness or understanding, which suggests that a proactive dissemination of good practices and case studies is important.
- Financial barriers are significant, and when linked to political barriers can be a major obstacle to E1st implementation.
- Implementing E1st can work only if every actor understands what it means for them: making E1st a common practice implies making E1st part of everyone's language.
- There is a lack of knowledge on multiple benefits of E1st beyond its impact on energy consumption and these need to be communicated more effectively among stakeholders: this is indeed one of the major elements of the E1st principle, which uses a broader scope in cost-benefit analysis or similar assessment.
- The answers show a variety of points of view, emphasising that barriers related to lack of knowledge and awareness, as well as cultural barriers, are not limited to a particular type of actor, but can be seen everywhere: making E1st a common practice would require a cultural change along the whole chain of actors.
- Some cultural barriers are related to actors' own habits and practices, but others that are more specific to E1st are about breaking silos (e.g. between supply-side and demand-side experts in energy companies, between craftsmen of various building trades).

Some of the barriers mentioned by the respondents are already well identified as general barriers to energy efficiency and tackled as such by energy efficiency policies. These barriers should not be neglected: they often deal with pre-requisites to E1st, i.e. whether an action will be taken or not. By their essence, energy efficiency policies that contribute to overcoming these general barriers also contribute to creating more favourable conditions for the implementation of E1st.

However, dealing with the dimensions or elements specific to E1st implies focusing on barriers that might:

- Limit the scope of options considered when planning actions or investments related to energy use in buildings.
- Create bias in the way the energy efficiency options are assessed and valued (compared to other options).
- Create bias in decision-making.

We see from the survey, barriers or perceived barriers can be found at all levels and points of decision making and have a lot to do with information and financial interests. Taking a step back and looking at the the wider energy system, we see that we need a cross-sectoral approach which puts E1st at the very basis of all decision making – it should be inherent in all decisions regarding the energy system and not be an optional decision which can be made or not.

The principle of E1st has found its place in the European policy debate and is an essential part of European strategies on energy policy as well as numerous national strategies. Nevertheless, as with many other inherent principles, it is not always clear why efficiency is not always put first when it actually should be. This report gives a first overview of what experts think and what we can learn from case studies on how barriers work against the implementation of E1st. This is the start of a wider analysis of different policy areas, for which we will identify barriers, best practice examples and of course solutions on how to overcome barriers and better integrate the E1st principle into decision making.

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ANNEX I: QUESTIONNAIRE OF THE ONLINE SURVEY

Identifying barriers to policy implementation of the energy efficiency first principle

PLEASE NOTE: This survey is done for the sole purpose of the Horizon 2020 ENEFIRST project. Answers will be used as input for a report on barriers to the implementation of the energy efficiency first principle. No personal data is collected for this survey. Answers will be analysed in an anonymized way and only aggregated data or anonymised quotes will be published.

The individual and anonymized answers will only be used by the ENEFIRST partners, with the objective to identify barriers to implementing the Efficiency First (E1st) principle. The data will be stored on by BPIE only for statistical purposes and ensuring GDPR conformity. Find more information, see the privacy policy.

You can contact us at info@bpie.eu indicating the project ENEFIRST at any time, if you wish to change or remove your answers.

Introduction to the project and explanation of E1st principle.

Efficiency First (E1st) gives priority to *demand-side resources* whenever they are more *cost effective* from a societal perspective than investments in energy infrastructure in meeting policy objectives. It is a decision principle that is applied systematically at any level to energy-related investment planning and enabled by an 'equal opportunity' policy design.

Please keep this definition in mind when answering the questions of the survey.

If you are interested to know more regarding the E1st principle, you can find our background analysis here.

Examples of E1st application:

Grid expansion: in the planning process, a cost-benefit analysis is included, taking into account all demand side options and their benefits compared to a further expansion of the energy grid.

Buildings: Inclusion of minimum energy performance of the building envelope as prerequisite to funding for on-site renewables/heat pumps.

1. **Please select the policy areas you work on or you have expertise in?** (multiple answers possible)

⊗ Power market and regulation
⊗ Gas market and regulation
⊗ District heating market and regulation
⊗ Renewable energy policy/market
⊗ Energy efficiency policy/market
⊗ Building policy/market
⊗ Climate policy
⊗ Industrial policy
⊗ Energy planning

- ⊗ Urban planning
- ⊗ Public procurement
- ⊗ Social policy
- ⊗ Other(s), please indicate below

Other policy area(s):

The next questions deal with barriers to the implementation of E1st, i.e. conditions or factors that make it difficult or even impossible to implement E1st, or reasons why E1st is not already implemented. (e.g. with regard to existing regulatory provisions, level of awareness, existing business cases, etc.)

2. **According to your experience, which barrier(s) impede the implementation of E1st in the policy areas you know?**

Please indicate here these barriers (and feel free to add explanations):

3. **How would you categorize this (or these) barrier(s)? (multiple choices possible)**
   - ⊗ Political barrier
   - ⊗ Regulatory barrier
   - ⊗ Financial barrier
   - ⊗ Technical barrier
   - ⊗ Cultural barrier (related to professional cultures, habits and practices)
   - ⊗ Communication/ Awareness barrier
   - ⊗ Lack of expertise or knowledge
   - ⊗ Weight of the supply-side stakeholders in policy- or decision-making
   - ⊗ Supply chain barriers
   - ⊗ Policy interaction barrier (e.g. conflicting objectives or priorities)
   - ⊗ Other, please indicate:

4. **According to your experience, which barrier(s) create the biggest problem to the implementation of E1st? (and why?)**

5. **Do you have any suggestions or example on overcoming implementation barrier(s)?**

Please give examples

The next questions help us analyse the answers to the survey. This data will only be used in an aggregated and anonymised way.

6. **Please select the most relevant type of organisation you are working for/affiliated to:**

⊗ Energy agency
⊗ National authority
⊗ Local authority
⊗ Energy supplier
⊗ TSO or DSO
⊗ Regulatory body
⊗ University/public research body
⊗ NGO
⊗ Other professional organisation
⊗ Citizen organisation
⊗ Manufacturer
⊗ ESCO
⊗ Asset manager/Owners organisation
⊗ Building company
⊗ Architect/urban planner
⊗ Consultancy/engineering
⊗ Other, please specify:

7. **Do you work at …? (multiple choices possible):**

⊗ European level
⊗ National level
⊗ Local level

8. **Which country do you work in?**

⊗ Dropdown list of countries
⊗ EU countries
⊗ Outside EU in Europe
⊗ International

Please leave your email for further information or contact. You will not be contacted unless you tick one of the boxes below and your email address will not be stored after the conclusion of the survey.

- tick this box if you want to receive the newsletter with updates on the report
- tick this box if you agree to be contacted for an interview for further exchanges on this topic:

More on the project can be found on our website www.enefirst.eu or in our brochure.

ANNEX II: LIST OF OPEN ANSWERS

Note: the table below shows the answers to open questions number 2 and 4. The answers have been anonymized. Answers on the same line come from the same respondent.

Question 2 **According to your experience, which barrier(s) impede the implementation of E1st in the policy areas you know?**	Question 4 **According to your experience, which barrier(s) create the biggest problem to the implementation of E1st? (and why?)**
Lack of political will,	Slow progress, low finances
Low awareness on wider societal benefits	Lack of knowledge and understanding hinders the decision making Lack of housing is used as an excuse for poorer energy performance in new buildings Lack of financing mechanisms (or incorrect mechanisms) makes it difficult to take a life cycle approach on e-eff measures
Lack of knowledge and understanding	Only wealthy and enthusiastic persons are going for it. Need of self-initiative and time to get craftsman knowledgeable and enthusiastic on these topics.
Lack of housing	complicated or unreliable subsidy schemes produce waiting times and/or market-unfriendly waves of implementation
Lack of financing mechanisms	the perspective in the policy debate is on the strategic choice of a certain supply-side technology or changes in the energy mix. In many cases, this is also reflected at individual building design level, where measures limiting the energy demand are underestimated at the expense of fuel switch measures
Lack of enforcement of legislation	Policy interaction, we already have to meet several numerical targets, which at national level create problems with priorities. Political, limited resources go where mostly needed to meet the national targets. Financial and regulatory, in the liberalized energy markets it is very difficult to establish regulatory frameworks where companies are forced to put their money into something they independently would not see profitable. Technical, the situations are getting more complicated, optimal solutions may not be "stand-alone-ee" but combination of ee-res-ems with the help of digitalization and electrification. Could also be my total lack of knowledge with this topic, with energy efficiency I have been working with full time since October 1986.
Lack of political prioritization	Separate barriers may form very strong multiple

	barriers. Public/behaviour/awareness barriers may block any very good initiative or solution.
Lack of awareness of key decision-makers	Realistic demo flagship projects that are kept up-to-date
Supply side objectives much higher placed than demand-side objectives	Politicians will prefer industrial solutions with large companies, easier do regulate compared to individual actions.
High upfront investment costs and long periods of return of investment, especially when seen in comparison with low conventional energy prices.	Policy makers does not support energy saving (energy efficiency) measures at poor households. Household end user price/tariff cap does not allow acceptance of energy efficiency related expenditures of obligated energy companies under the energy efficiency obligation scheme.
Lack of expertise of majority of craftsmen (at least in Belgium).	EE measures are more difficult to implement, so necessarily will not then be implemented first. By definition, to be first, they need to be more attractive than the alternative for the relevant decision makers.
Complicated procedures and administrative process to apply for financial support.	Financial barriers are obviously visible to increase energy efficiency to a higher level (only minimum requirements are implemented, f.ex. cost optimal levels in the building sector). In the public sector, budgets limit the E1st principle in the refurbishment efforts.
incentives which are not reliable or too complicated like very limited subsidies or compulsive co-measures	Implementation of the principle cannot be done if it is not included in 'hard law' and operationalised It is also difficult to overcome decades of supply side thinking notably in energy planning Maybe if decision making would be less at national/central level and more at local level, it would be easier to implement the principle
dominant perceptions among energy sector professionals,	Towards a level playing field: Ideally, price signals show system requirements for efficiency and flexibility The effect of the price signal is limited because the price signal from the wholesale market is only indirectly passed on to consumers because deficits exists in the design of flexibility markets because the structure of grid charges creates false incentives because duties, surcharges, and other fees create additional false incentives Improve price signals, improve design of flexibility markets, review grid charges and other duties and surcharges …

	Further obstacles exist (market imperfections) that impede economically sensible investments in efficiency such as disincentives to energy efficiency in current regulations, leading to distorted economic rationality investor/user dilemma (especially for efficiency in residential buildings) lack of information and uncertainty about future developments Identify/remove existing disincentives, e.g. concession law reform (decoupling)*, modify market rules, (grid) tariffs, reduce information gaps and uncertainties, amend ISO 5000
Lack of understanding of the potential of energy efficiency,	E1st is not a mandatory element to include nor in the scenario building nor in the Cost-Benefit Analysis. This implies that demand-side solutions are disregarded from the range of options to tackle infrastructure gaps. The "cross-benefit" criterion is also challenging the implementation of demand-side solutions - but this could change by widening up the interpretation of cross-border to the effects (rather than only the geographical position of a project)
long-term tradition of expansive growth of energy production facilities	Too long to explain in a questionnaire
lack of awareness of benefits of EE1 at consumer, installer and political level	Makes the return too expensive as renovation needs large periods
lack of implementation and enforcement of existing legislation (EPBD, Ecodesign...)	Seems obvious (actually, it is not barriers, but lack of drivers).
high upfront investment cost for high efficiency solutions	People prefers to buy energy when they needs respect to organize themselves before and spent time and efforts for reduce consumption. Core business of people are production and amusement not to control themselves for maintain an efficient behaviour.
public financing (distorted market due to ongoing subsidies for fossil fuel based solutions)	Other corporate priorities: revenues, health & safety, manpower, before energy efficiency
silo thinking btw demand and supply side: energy suppliers benefit from EE1 in terms of infrastructure requirements and peak demand but this link is nearly never made	building owner associations and renewable energy stakeholders affect political decision makers to loosen efficiency targets
lack of skills at installer level	Energy efficiency in Spain is starting as a serious issue during last few years but the economic situation has stopped many projects to be done. The policy situation: the last years the public financing has been focused mainly for transport sector: private replacement of cars buses more efficient with direct

	money for the users. Also many municipalities had the opportunity to buy bicycles and electric cars for the people who works in public sector and for citizens who hire the bikes and then avoiding using cars that pollute more... About buildings the increasement in the price of the kWh made to reduce some uses of electricity Renewables starting again to be promoted mainly the solar photovoltaics last year after 6 years of stopping due to internal national policies
split incentives tenants / landlords	They counter the policy and everyday adoption of significant transformation in energy consumption and uses.
National regulations;	Decisions on investment focus on short term only, not life cycle
public behaviour;	- Political reticence to deploy EE1st due to fear of strong interference in energy system - Information barrier/financial barrier: Dispersed information on building renovation and related support programmes
financial obstacles	- Not high enough price on carbon-intensive energy - Market surveillance is not implemented - Not enough focus on low GWP refrigerants in buildings - Awareness issues around BAT - Training challenges around maintenance, design sizing, etc.
Complicated and volatile legal and regulatory environment	Subsidizing of the population at payment of energy resources is the political decision of the country leaders. The population at the low cost of energy has no motives for its economy at operation of residential buildings. Situation is aggravated with lack of knowledge of the population of the principles of economy of energy and the positive moments of this process. Process of economy of energy is slowed down also by the companies making and delivering energy.
the supposed uncertainty of DSM measures compared to the reliability of Energy generation, easier to control.	Hinder the systematic favouring of energy efficiency in policy decisions. Energy efficiency is not a widespread horizontal principle of policy decisions.
Political barrier forcing cap on end-user price/tariff level	Lack of political will to put actually apply the E1st principle to strategic planning Lack of political will to put in place measures to tap the energy savings potentials
Benefits of EE may not be sufficiently understood	The main barriers are financial : retrofits allowing a substantial efficiency gain are costly and have a

	very long payback period (several decades) while a family will occupy a house/apartment for 7 years in average (average including all types of household, from the student renting a room for 1 year to the family staying in the same house for decades). The second type of barrier that I categorize as "cultural barrier" is the inconvenience caused by such retrofits (having to be out of the house, etc.) The third type of barrier is awareness : customers are not necessarily aware of the efficiency implications The fourth type of barrier is awareness among the contractors who are in charge of the retrofits/heating system installation : they do not always have the training for the latest energy efficiency actions (right parametrization of a new heat pump, right dimensioning etc.) and may privilege the techniques or systems they are familiar with.
EE measures may not be perceived to be as "low carbon" as renewables	The regulation of grid companies is often related to "as-is". There is little incentive for new initiatives that are not investments. The culture in grid companies is often focused on investments. "That's how we've always built our grid". People don't trust new solutions, especially when status quo works very well.
Retrofitting EE may require more disruption e.g. floor insulation.	Buildings with multiple dwellings and decision makers. => In buildings with many apartments it is difficult to renovate the apartment's insulation or stop using the central heating system, or even install solar heater due to opposition from other residents. Also, there is no incentive in installing thermal insulation, since you will still pay for the operation and/or maintenance of the central heating system. Inadequate issuing of energy efficiency certificates. => Most building owners see the certificates as an unwanted/unnecessary cost so they choose the most cheap ones (rates of 50 or even 30 Euros) so many of the EECs are issued without proper work or even without on-site inspection of the building. Moreover, the regulatory authorities have not checked the work done by inspectors and/or revoked the licenses of inspectors who do careless work. Apartment renting. => Apartment's owner just wants to have an income for paying taxes, or maintaining the apartment, or just an extra income, and overlooks the energy efficiency increase. And apartment's resident does not want to invest money by making high cost renovations that will stay at the

	apartment, so he/she chooses less costly (and efficient) actions, such as sealing the crevices of windows and doors, etc). Also, renters prefer to rent a less energy efficient apartment closer to a subway/bus station rather than a more energy efficient which is farther. Lack of buildings'/apartments' energy efficiency amelioration planning / Other priorities from the owner. => An owner who has inherited the apartment or is leaving in it for long usually has other economic priorities and disregards the energy efficiency increase of its apartment. Disregard of energy efficiency as a criterion for buying a dwelling. => Most buyers overlook the energy efficiency of a building/apartment either because they are not well informed or because the placement is more important.
Government does not promote EE (assumes financial incentives will be sufficient so doesn't offer sufficiently attractive subsidies)	Energy efficiency targets are postponed. There is not enough communication and promotion about energy efficiency.
E1st has not been fully implemented. The focus for E1st principles have not been implemented so far in the different policies.	Supply side projects usually have higher political and policy priorities
Moreover, the focus is given to renewables first. In case of biomass applications, these systems have lower efficiencies than fossil fuelled systems.	Different stakeholders' interest
Lack of knowledge of the exact definition of the principle	- fossil fuel lobbies - ignorance of public administrations - high age of the population who rightly do not want to take out mortgages to pay for the rest of their few remaining years of life
Powerful incumbents on the energy markets which distort competition with demand side	
market rules	
(grid) tariffs	
public support schemes	
investment plans/ infrastructure investments	
Lack of political will,	
low awareness on wider societal benefits	
Lack of knowledge and understanding	
lack of housing	
lack of financing mechanisms	
Lack of enforcement of legislation	

Lack of political prioritization	
Lack of awareness of key decision-makers	
Supply side objectives much higher placed than demand-side objectives	
High upfront investment costs and long periods of return of investment, especially when seen in comparison with low conventional energy prices.	
Lack of expertise of majority of craftsmen (at least in Belgium).	
Complicated procedures and administrative process to apply for financial support.	
incentives which are not reliable or too complicated like very limited subsidies or compulsive co-measures	
dominant perceptions among energy sector professionals,	
lack of understanding of the potential of energy efficiency,	
long-term tradition of expansive growth of energy production facilities	
lack of awareness of benefits of EE1 at consumer, installer and political level	
lack of implementation and enforcement of existing legislation (EPBD, Ecodesign...)	
high upfront investment cost for high efficiency solutions	
public financing (distorted market due to ongoing subsidies for fossil fuel based solutions)	
silo thinking btw demand and supply side: energy suppliers benefit from EE1 in terms of infrastructure requirements and peak demand but this link is nearly never made	
lack of skills at installer level	
split incentives tenants / landlords	
National regulations	
public behaviour	
financial obstacles	
Complicated and volatile legal and regulatory environment	
the supposed uncertainty of DSM measures	

compared to the reliability of Energy generation, easier to control.	
Political barrier forcing cap on end-user price/tariff level	
Benefits of EE may not be sufficiently understood	
EE measures may not be perceived to be as "low carbon" as renewables	

ANNEX III: ANALYSIS OF INFORMATION BARRIERS TO ENERGY EFFICIENCY INVESTMENTS

This annex provides an example of more detailed analyses of barriers to energy efficiency investments available from the literature. This example is based on the review by Giraudet (2018) on a particular type of barrier: **informational barriers** to energy efficiency works in buildings.

Giraudet made a literature review from a 'credence goods' perspective, providing a detailed analysis of the difficulties that owners, investors or funders might encounter in assessing the opportunities, costs and benefits of energy efficiency works.

These issues can have strong links with the E1st principle, as implementing E1st implies being able to assess what options are available and relevant, and accordingly their costs and benefits.

Giraudet structured his analysis along the following categories of informational barriers:

- **Symmetric-information problems** (i.e. "*information imperfections or gaps identically faced by contracting parties*"):
    - **Incomplete information** (e.g. about energy operating costs, about the energy performance of products, about the possible actions, about possible differences between expected and actual energy savings)
    - **Imperfect information** (e.g. due to volatility in energy prices, random factors such as weather conditions)

- **Asymmetric information** (i.e. market failures requiring public intervention):
    - **Adverse selection** (i.e. "when part of the relevant information is hidden to one party"):
        - **Screening issues** (i.e. when a seller has no overview over the types of buyers), for example related to utility-included rent contracts[5] or energy efficiency loans[6]
        - **Signalling issues** (i.e. when a building owner is unable to convey the energy performance of the building to prospective buyers) related to building sales or rental (as investigated for example by looking at the influence of energy performance certificates on building prices or rents)

[5] In this case, the seller is the building owner, offering a dwelling for rent; and the buyer is the tenant, looking for a dwelling to rent. The screening issue is then due to the fact that the building owner cannot know how the tenant will behave in terms of energy usage, which "hides" part of the information needed to assess the cost-effectiveness of an energy efficiency action (for example if there can be a risk of rebound effect).

[6] In this case, the seller is the bank, offering loans; and the buyer is the building owner or occupant, looking for loans to finance their renovation works. The screening issue is then due to the fact that the bank cannot know how the occupant will use energy after doing the energy efficiency actions for which the loan is asked (for example, there can also be a risk of rebound effect here), which may affect the capacity of the customer to reimburse the loan.

- **Principal-agent problems** (i.e. "situations in which a principal hires an agent to perform a task" that "produce[s] undesirable behaviours (…) likely to affect the markets for energy efficiency"):
  - **Moral hazard** (i.e. "*if the principal cannot observe the agent's ex post actions*"), for example related to utility-included rental contracts (as the energy user does not face the marginal cost of energy and might thus over-use energy), quality of building retrofits (as this quality is difficult to verify by non-experts) or energy efficiency loans (difficulties for the lenders to assess the default risk for a credit related to energy retrofits)
  - **Price discrimination** (i.e. "*if a multiproduct monopolist cannot observe the agents' types ex ante*"), for example related to imperfect competition and adverse selection (e.g. difficulties for sellers of renovation works to assess customers' profiles, and for buyers of renovation works to compare various offers)

While such detailed analyses are very useful when focusing on a given type of policy measure and sector (here policies promoting renovation works for buildings), it would not be possible to use a typology with so many sub-categories of barriers at this stage of our exploration of barriers to implementing E1st.

In the present report, the objective was to identify general categories of barriers and how they are interpreted by stakeholders when considering barriers to the implementation of the E1st principle.

More detailed typologies like the one presented in this annex will be taken into account in the next steps of the project, when prioritising the analyses on a selection of promising policy areas to develop practical policy guidelines.

ANNEX IV: A BRIEF HISTORY OF THE BARRIERS TO INTEGRATED RESOURCE PLANNING AND LEAST COST PLANNING

Swisher et al. (1997) provided definitions for Least Cost Planning (LCP) and Integrated Resource Planning (IRP):

- LCP: "*Utility planning method whereby alternative resource mixes, including demand-side options such as conservation and load management, are evaluated along with traditional supply-side options to determine which of them minimizes the overall cost of service. Cost management is used as the criterion for selecting the resource plan for the utility company*"
- IRP: "*Combined development of electricity supplies and demand-side management (DSM) options to provide energy services at minimum cost, including environmental and social costs*"

This annex is based on a non-exhaustive literature review on LCP and/or IRP with the aim to shed light on the main barriers to the implementation of such approaches in Europe. The papers reviewed comprise an analysis of the general European context as well as studies related to application of LCP/IRP in specific countries (namely, the Netherlands, Germany, Norway, Poland and Denmark). Some papers also refer to Demand-Side Management (DSM). Most of these papers related to analyses done in the 1990s or early 2000s. While the context has changed (e.g. successive revisions of the European directives related to electricity and gas markets, distinct approaches used by Member States to liberalise their energy markets), the analyses summarised below are still relevant when considering what can be learnt about possible barriers to the implementation of the E1st principle.

The different barriers to the implementation of LCP/IRP are mainly related to the following three aspects:

1) **Liberalisation of the energy market**, characterised by:
    a) Unbundled entities (e.g., transmission network separated from generation and retail)
        i. Separate costs and benefits by each player
        ii. No clear responsibility allocation
    b) Competition
        i. Energy prices depending on market mechanisms
        ii. Lack of effective communication between actors
        iii. Lack of cooperation
2) **Regulatory framework**, which lacked incentives for investing in IRP
3) **Technical characteristics of LCP/IRP**, characterised by:
    a) Long-term planning
    b) Rise in costs of energy

The combination of and interaction between these main aspects resulted in several issues that constrained the adoption of LCP/IRP. **Liberalising the markets for electricity and gas** created **competition** for

generation and supply. This competition made **IRP's long-term planning more difficult to be implemented** by energy companies because an open market is less predictable than a monopoly when forecasting the demand to plan the investments needed (Thomas et al., 1999). In Norway, the decentralised structure of separated production and distribution utilities limited integrated, long-term energy planning by the utilities (York, 1993). Likewise, van der Berg and Welling (1993) argued that in the Netherlands, where the generation and distribution of energy was the responsibility of different actors with limited understanding of each other's practices, the poor information exchange and competition could inhibit the implementation of IRP.

Furthermore, the **competitive market** made the supplier's primary goal to offer electricity at competitive prices, which hinders **investment decisions that can increase rates** (York, 1993; Thomas et al., 1999; Guertler, 2011). As argued by York (1993, p. 242), a "*distribution utility, unlike a vertically integrated utility, has limited means to weigh the costs of new generation against other alternatives, including DSM*" and IRP. It is a challenge to apply long-term vision when customers can switch to a retailer that offers a better price at any time, making it unlikely that retailers submit to governmental restrictions such as IRP (Didden and D'haeseleer, 2003; York, 1993). Price rises can also provoke political and economic controversy, "*especially if the prices of the neighbouring countries' utilities are already lower*" (Leprich and Schulte-Janson, 1995, p. 46), which can make IRP less likely to deliver public policy objectives (Guertler, 2011). The price increase can also encourage self-generation in electricity-intensive industries (Leprich and Schulte-Janson, 1995).

Regarding the overall European **regulatory framework**, another "*two perverse incentives undermining LCP generally hold true*" (Moskovitz, 1989, and RAP, 2005 *in* Guertler, 2011, p. 81):

- Each kWh sold by a utility adds to its earnings and profits
- Each kWh saved or provided by DSM programmes reduces its profits

Guertler (2011) argues that Europe's **lack of experience on IRP** and the fact that **LCP's incentives were not aligned with the energy supply market framework** of the time contributed to constraining their adoption. In Poland, the lack of regulatory framework and the existing decision-making structures could constrain the implementation of changes required by IRP. One solution suggested by Wolcott et al. (1993) was to change the rules promulgated by the Energy Regulatory Agency. In Norway, structural factors and market conditions led to a lack of incentives for customers and utilities to invest in DSM as there were not enough incentives for production utilities to reduce their sales by investing in DSM (York, 1993).

On the other hand, the regulatory practice in Germany encouraged utilities to increase their rate bases without any considerable risk (since the real and the forecasted sales were not compared at the end of the tariff authorisation period). However, German utilities were concerned that LCP activities could encourage a closer relationship with the price authority, resulting in a more detailed evaluation of costs and revenues not associated with LCP, which could impact their profits (Leprich and Schulte-Janson, 1995).

In addition, Guertler (2011, p. 81) highlights that European policies focused on "*imposing obligations on utilities to help deliver public policy objectives via DSM without integrated assessments*". The Energy Services Directive in 2006 and then the Energy Efficiency Directive (EED) in 2012 have encouraged Member States to implement Energy Efficiency Obligation Schemes (EEOS). According to Eyre et al. (2009 *in* Guertler, 2011), these obligations resulted in substantial energy savings at net benefit to society in France, Italy and the UK, regardless of their uneven distributional impacts. The EEOS have indeed been

developed in European countries mostly as a way to contribute to energy savings targets or objectives, but without explicit links with energy planning or interactions with the supply side (other than involving energy companies in energy efficiency programmes) (for an overview of EEOS in Europe, see for example ENSMOV 2020). However, the fact that EEOS set clear energy savings targets provides de facto an input to the forecast of the energy demand over the obligation period. This applies even more since the entry into force of the EED, as the EED has defined obligation periods (first 2014-2020 and now 2021-2020). This gives a longer time horizon, compared to the national obligation periods of the EEOS, which are usually specified for up to three or four years. The importance of long-term planning is also stressed in the Governance Regulation ((EU) 2018/1999), especially as part of the preparation of the National Energy and Climate Plans (NECPs).