Analysis of transferability of global experience to the EU

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EXECUTIVE SUMMARY

The concept of Efficiency First (E1st) applies across various areas of energy policymaking, planning, and investment. While the concept itself is recent, there are various international examples of policies measures, regulatory frameworks, utility programmes or other initiatives that exhibit the underlying idea of prioritizing demand side resources whenever they are more cost-effective than equivalent supply side assets. In a previous report (Pató et al. 2020b), the ENEFIRST project compiled and characterized a set of **16 case studies about international experiences** with the E1st principle. A next step is to explore if the merits of these experiences can be replicated in the jurisdiction of the EU, to drive the implementation of the E1st principle in EU policymaking. Against this backdrop, **the objective of this report is to systematically assess to what extent the previously international experiences identified are transferable to the political and legal system of the European Union and its Member States**.

The theoretical literature on policy transfer generally recognises the significance of contextual factors for policies to replicate the achievements from a primary context in a target context. Contextual factors are manifold, covering the institutional and structural setting, socio-cultural concerns, and the administrative capacity of the target country. The more the contextual factors in the target context match the ones in the primary context, the more likely it is that the policy will yield similar outcomes and achievements. In accordance with these theoretical considerations, the methodology applied uses a consistent framework to assess the transferability of the 16 international experiences.

The transferability frameworks suggest that **eight of the international experiences feature a high level of transferability**, meaning that they are either readily transferable or already have been adopted in EU or MS legislation. However, the high transferability level does not mean that implementation in the EU is fully completed. Instead, it suggests that there remain minor contextual factors that need to be considered when attempting to augment the measure's effectiveness as well as to expand it to all 27 Member States. **Seven international experiences are found to feature a medium transferability** to the target context of the EU and its Member States. This means that there exist significant contextual factors that impede a direct transfer to the EU context and that are expected to result in less successful policy outcomes than in the primary context. Finally, this report identifies **one international experience with E1st that, given its present regulatory standing in EU legislation, is assigned a low level of transferability**.

In conclusion, policymakers in the EU and its Member States can certainly learn from their counterparts to establish a level playing field between demand and supply side resources and thus help embed the E1st principle. However, this reports also points out that the political and legal system of the EU features particularities in terms of institutional, socio-cultural, and administrative aspects that, ultimately, do not allow for direct replication of existing practices from abroad. Instead, embedding the E1st principle in the EU, and truly putting demand side resources on equal footing with supply side infrastructures in all relevant instances, will require a custom set of policy and regulatory instruments that go beyond fragmented international practices. The topic of effective policy design for implementing the E1st principle will be further investigated in upcoming reports of the ENEFIRST project:

- Several upcoming reports use energy systems modelling to quantify the possible long-term effects of embedding the E1st principle in the EU building sector.
- A parallel series of reports is dedicated to exploring possibilities for introducing E1st in relevant policy areas and to assessing the replicability in specific national contexts.

1 INTRODUCTION

Efficiency First (E1st) is a concept that concerns various areas of energy policymaking, planning, and investment. As such, there is not one single policy lever to put the principle in practice. Rather, it requires a comprehensive set of policy and regulatory approaches to ensure that investments in the EU are made wherever demand-side resources are more cost-effective or valuable than equivalent supply-side resources. A previous report of the project (Pató et al. 2020b) set out to collect **international experiences** and to compile a total of **16 case studies**. The focus of these case studies was on policies, regulatory frameworks, utility programmes or other initiatives that establish a level playing field between demand- and supply-side resources and thereby effectively put the Efficiency First principle in practice. **Table 1** provides an overview of these case studies, along with their country or region of origin.

Table 1. Overview of case studies on international experiences on E1st analysed in the ENEFIRST project.

No.	Case study	Country/region
1	Assessing the value of demand-side resources	United States
2	Building energy performance requirements of the Irish Heat Pump System grant	Ireland
3	Building Logbook – Woningpas: Exploiting efficiency potentials in buildings through a digital building file	Belgium
4	Decoupling utility sales and revenues	United States
5	Deferring T&D (Transmission & Distribution) infrastructure investments through local end-use efficiency measures	United States
6	Demand flexibility in District Heating networks	European Union
7	Enabling rules for demand response aggregators	European Union
8	Fabric First approach under the Better Energy Communities grant scheme in Ireland	Ireland
9	Linking renewable support to building energy performance	United Kingdom
10	Optimising building energy demand by passive-level building code	Belgium
11	Participation of demand response in French wholesale electricity market	France
12	Replacing a polluting power plant with behind-the-meter resources	United States
13	Social Constraint Management Zones to harvest demand flexibility	United Kingdom
14	Updating distribution system planning rules in Colorado and Nevada	United States
15	Using Time-of-Use tariffs to engage customers and benefit the power system	European Union
16	Water heaters as multiple grid resources	United States

These case studies have been identified through a review of scientific and grey literature, accompanied by personal communications. Note that this list of case studies is not meant to be exhaustive with regard to the multitude of existing international experiences with the E1st principle. Instead, the objective of this overview was to cover a diversity of situations and approaches, in terms of policy type, framework or initiative, and types of energy carrier targeted. Overall, these case studies represent a sample of regulatory and policy approaches that can be applied to put E1st (or similar concepts) in practice, ranging from strict regulatory provisions to energy utilities' own initiatives.

Policymakers closely monitor and examine how policy and regulatory approaches designed and implemented in other countries or regions perform in terms of their stated objectives. In case of success, it is obvious for policymakers to consider whether these approaches from abroad can be replicated in their domestic political and legal system.

An illustrative example of such **policy transfer** in the context of the E1st principle is the adoption of utility obligations across Europe (Warren 2017). Utility obligations – referred to as Energy Efficiency Obligation Schemes (EEOS) in the EU – are mandatory quotas that energy suppliers and/or distribution companies must meet with demand-side measures of their choice to achieve a predefined level of energy or carbon savings over a given time period. The implementation of EEOS across Europe has been inspired by successful experiences in the UK and Denmark in the 1990's as well as by similar approaches in place in the U.S., particularly in the state of California. Implementation across Europe was further driven by the liberalization of the energy markets as well as a general policy trend towards market-based instruments (e.g. in Denmark) as alternatives to publicly funded measures (Bertoldi et al. 2010). Either way, France and Italy turned out as supporters of EEOS – adapting the approach to their policy framework and developing new aspects, such as trading, and thus upscaling to white certificates, which again might have been inspired by the experience of New South Wales in Australia in the early 2000s. Ultimately, the concept of EEOS found its way into the supranational EU legislation of Energy Services Directive (2006/32/EC). Followed by the Energy Efficiency Directive (2012/27/EU, EED), Member States are now required by its Article 7 to implement an EEOS, or alternative measures, in order to achieve a required amount of energy savings set per obligation period (first 2014-2020, and now 2021-2030). Overall, the number of EEOS across Europe have increased from four in 2006 to sixteen in the year 2020 (Broc et al. 2020).

This example illustrates the intuitive benefits of policy transfer: borrowing successful policies from other countries and regions and transferring them to the own political and legal system can potentially accelerate policy development and contribute to meeting political and societal objectives (Swainson and Loe 2011) – such as the EU's targets for market integration, security of supply, competitiveness, and sustainability. However, an essential question is *if* and *under what conditions* policies, regulatory frameworks and other initiatives developed in one context (hereinafter referred to as '**primary context**') are practically transferable to another jurisdiction ('**target context**').

To address this question, a large amount of literature and research has been devoted to the field of policy transferability in recent years, nested in the academic disciplines of political science and legal studies. The **transferability of policies** from a primary context to a target context is generally understood to depend on a multitude of **contextual factors**, including the institutional and structural setting, socio-cultural concerns, and the administrative capacity of the target country (Swainson and Loe 2011; Warren 2017). Other studies have shown that the less complex a policy and the better theorized it is, the easier it will be to transfer to a new context (Dolowitz and Marsh 1996; Rose 1991). Similarly, solutions to ubiquitous policy problems tend to be more transferable than solutions to rare problems (Swainson and Loe 2011). Another important factor is path dependency – new polices cannot be introduced without consideration of the policy environment related to past commitments (Dolowitz and Marsh 1996).

In the particular field of energy and climate policy, research on policy transferability is scarce. For instance, Steinbacher (2015) uses semi-structured interviews to assess renewable energy policy transfer from Germany to Morocco, highlighting the importance of similar policy objectives (e.g. energy security) for transfer to happen. Dastan (2011) uses a literature review to analyse the transfer of energy market regulation between the UK and Turkey, emphasizing effective regulatory design as well as external pressure to have a decisive role in the given case of policy transfer. Warren (2017) introduces a methodological framework to determine the transferability of policies in the energy policy field and tests the framework across 30 countries and 36 sub-national states.

Against this background, it can be presumed that the 16 international experiences listed above will not automatically yield the same outcomes and success as in their country or region of origin (**primary context**) when being transferred to the EU jurisdiction and its Member States (**target context**). Instead, determining the transferability of these experiences and the likelihood of producing similar outcomes requires scrutiny in terms of applying established methodological approaches and performing in-depth analysis on the context that each of these experiences is nested in. **The major objective of this report is to determine to what extent the previously identified international experiences on E1st are transferable to the political system of the European Union and its Member States**. Figure 1 provides an illustration of this objective.

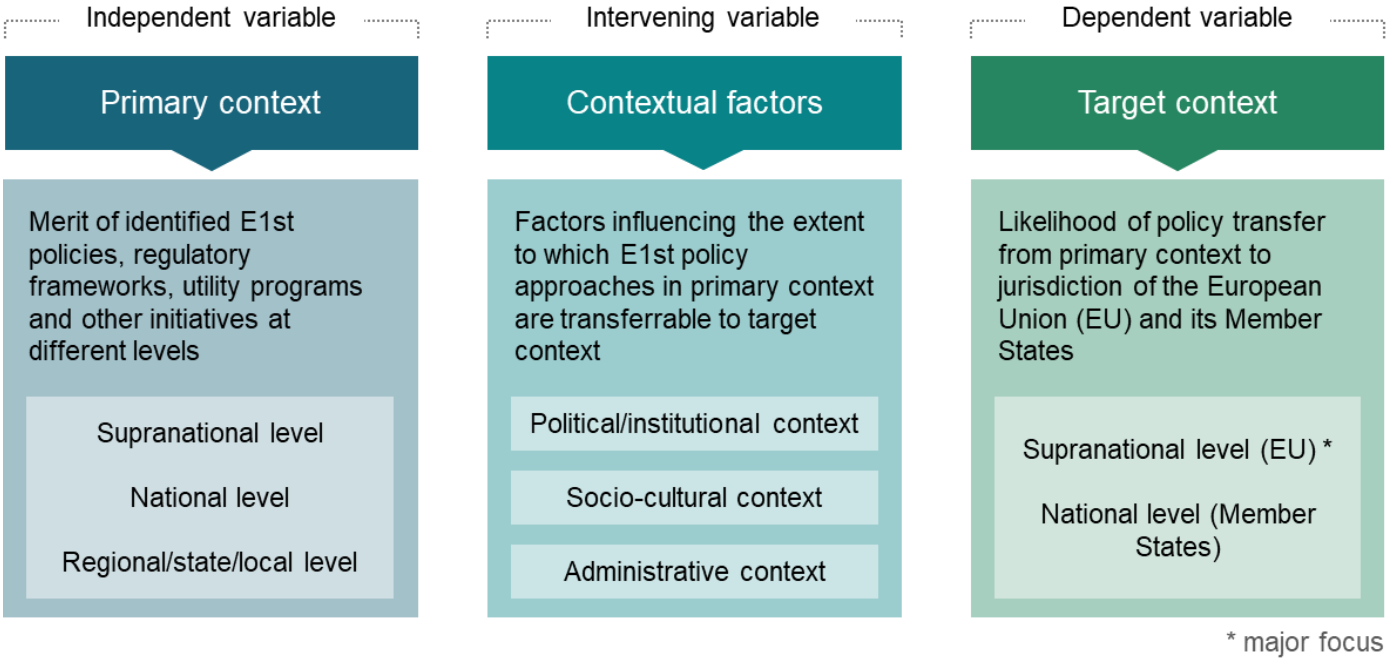

Figure 1. Outline of research objective.

The *independent variable* is the overall merit of the international experiences on E1st[1], which have been implemented at different levels, including the supranational level (e.g. EU Directives/Regulation), the national level (e.g. U.S.) and subordinate levels (e.g. U.S. State).

The *intervening variable* are contextual factors, determining the possibility and likelihood of policy transfer from a primary context to a target context. These contextual factors are characterized and elaborated on in the following chapters.

Finally, the *dependent variable* is the actual likelihood of policy transfer from the primary context to the target context. To specify, the major scope for the target context is the supranational legislation of the European Union.[2]

Where relevant, the scope is broadened to include contextual factors that are characteristic to specific Member States.[3] Note that overall, this report takes a cross-level perspective – ranging from the transfer of

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[1] This report acknowledges that policy outcomes are often somewhere in between the extremes of success and failure, with benefits occurring in some respects but not in others, according to facts and their interpretation (McConnell 2010). As further described in Chapter 3, the primary context is thus characterised mainly by its merits and achievements stated in scientific literature, evaluation reports, and other relevant documents.

[2] With 'supranational legislation' we essentially refer to EU Directive and Regulations. Directives require Member States to achieve a particular outcome without dictating the measures of achieving that result, i.e. leaving Member States some leeway to devise their own laws on how to reach these outcomes. Regulations, on the contrary, are self-executing and must be applied in their entirety across the EU (European Union 2020).

local experiences on E1st (e.g. *Demand flexibility in district heating networks*) to the supranational EU level, but also from existing policies at the EU level to the Member State level (e.g. *Using Time-of-Use tariffs to engage customers and benefit the power system*). In the latter case, the analysis sets out to determine what factors currently counteract greater effectiveness; i.e., what political/institutional, socio-cultural and administrative factors would need to be addressed to strengthen the level playing-field between demand- and supply-side resources in line with the E1st principle.

The report is structured as follows. It begins by giving an overview of the recent theoretical discussion on the topic of policy transferability, highlighting the factors that influence the transferability of successful regulatory and policy approaches between countries and regions (**Chapter 2**). Based on these theoretical considerations, it presents a methodological framework for assessing the transferability of the international experiences identified (**Chapter 3**). This methodological framework is applied to assess the transferability of the 16 case studies to the jurisdiction of the EU (**Chapter 4**). Finally, the conclusion provides a brief summary along with major policy implications (**Chapter 5**).

[3] For example, the socio-cultural context can be assumed to feature particularities in terms of values, beliefs and ideas that are characteristic of single Member States instead of the EU as an overall union of states. In turn, institutional design of power and gas markets is largely determined by EU Directives and Regulations, which suggests to consider the political/institutional context primarily at the supranational level.

2 THEORETICAL BACKGROUND: TRANSFERABILITY OF POLICIES

This chapter provides a theoretical discussion on the topic of policy transferability. These considerations are based on a review of literature from the field of political science and related disciplines. In general, a large and growing body of literature has investigated the question how and under what circumstances policy measures are transferable between countries or political systems.

In general, **policy transfer** is understood as the "*process in which knowledge about policies, administrative arrangements, institutions etc. in one time and/or place is used in the development of policies, administrative arrangements and institutions in another time and/or place*" (Dolowitz and Marsh 1996). As indicated in this definition, **objects of the transferability process** are not only specific policies, but can also be more abstract concepts, including administrative techniques, institutions, ideology, as well as overall ideas, attitudes and concepts (Dolowitz and Marsh 1996). **Actors involved in policy transfer** are manifold. Although in any specific case of transfer more than one category of actor is likely to be involved, the following ones can be identified: elected officials; political parties; bureaucrats/civil servants; advocacy groups (e.g. trade associations, NGOs, citizen organisations); policy entrepreneurs/experts; supra-national institutions (e.g. OECD, EU, World Bank, United Nations) (Dolowitz and Marsh 1996).

Moreover, different **degrees of policy transfer** have been theorized – ranging from direct copying of legislation, regulatory frameworks, policy design and implementation processes, to simply taking inspiration from successful policies in other countries and transferring general ideas (Warren 2017). Rose (1991), one of the seminal pieces of literature in the field, identifies five categories of policy transferability:

- ***'Copying'*** means adopting more or less intact of a policy already in effect in another jurisdiction;
- ***'Emulation'*** accepts that a particular policy elsewhere provides a best practice for designing legislation in the domestic context, while requiring transfer to take national particularities into account;
- ***'Hybridisation'*** combines elements of policies from two different primary contexts;
- ***'Synthesis'*** combines familiar elements from policies in effect in three or more different contexts;
- ***'Inspiration'*** means using policies elsewhere as intellectual stimulus for developing a novel policy without an analogue elsewhere.

Much of the recent literature on policy transferability places emphasis on the definition of **policy success** as a pre-requisite for the analysis of policy transferability. McConnell (2010) argues that policy outcomes are often somewhere in between the extremes of success and failure, with benefits occurring in some respects but not in others, according to facts and their interpretation. In this context, Warren (2017) defines a set of possible success evaluation criteria, including, inter alia, *performance criteria* (quantitative impacts, e.g. energy and carbon savings) and the *stated success* (qualitative judgements of policy evaluators).

Policy transfer has also been found to follow different **pathways** (Newmark 2002; Dolowitz and Marsh 2000), for example, within international organisations; from nation to nation; from region to region; from state to state; from locality to locality; or in any combination of these pathways. As pointed out in Chapter 1, the EU's political hybrid system of intergovernmentalism and supranationalism provides a multitude of opportunities for policy transfer, occurring both horizontally between countries and vertically between different institutional levels (EU; national; provincial and local).

Perhaps the theoretical concept most significant to the research of policy transferability are the aforementioned **contextual factors** (Rose 1991; Swainson and Loe 2011). This literature generally recognises that policy transfer processes and outcomes are shaped by the setting or context in which they take place. In turn, inappropriate transfer occurs when insufficient attention is paid to the differences between economic, social, political and ideological contexts in the transferring and of policies. Providing categories of contextual factors, Swainson and Loe (2011) make a conceptual distinction between (i) *political and institutional context*; (ii) *socio-cultural context*; and (iii) *administrative context*.

The **political and institutional context** of a policy strongly influences its transferability to another context (Dolowitz 2003). Wolman (Wolman 1992) identifies a number of aspects of a policy's context that must be considered for effective transfer – including its institutional and structural setting, the national political structure in which it is embedded, relationships to other policies, and the economic structure of the jurisdiction. In the sphere of energy policy, Warren (2017) identifies market structure as the key contextual factor for the transferability of energy efficiency policies, i.e. the degree of liberalization in the markets for electricity, gas and heating. Other sub-factors identified in (Warren 2017) that could affect transferability are the presence of regulatory frameworks to allow demand-side resources to participate in balancing, reserve or capacity markets; as well as the utility structure – differentiating vertically integrated utilities from horizontal ones.

It is also critical to consider the **socio-cultural context** in relation to policy transfer. This means the extent to which policy measures are compatible with the socio-cultural norms and values of a target context. For example, Wolman (1992) identifies public opinion as an important factor influencing transferability, which reduces when policy measures conflict with public opinion or cultural beliefs. Traditions also influence the acceptance of new measures, and therefore the set of barriers and success factors that emulate a new policy will potentially differ from one location to the other (Wilhite et al. 1996).

Successful transfer of energy policies and measures also requires administrative and organizational capability, referred to as the **administrative context** (Swainson and Loe 2011). This includes the capacity and experience of authorities and agencies responsible for implementing and administering policies as well as their financial, technical and administrative resources, altogether influencing how a given policy measure will fit in a particular target context. For example, Rose (1993) describes how bureaucratic size and efficiency of the primary and target jurisdictions can influence policy transfer.

To conclude this chapter, research has investigated the matter of policy transferability from various perspectives. Commonly recognised is the idea that the extent to which a policy can be transferred to a target context, and replicate the achievements from its primary context, is largely determined by the contextual factors in which they take place. In other words, policymakers might easily copy legislation from successful primary context to their own jurisdiction. However, if different contextual factors (political/institutional, socio-cultural, administrative) are not adequately considered in this transfer process, the policy is unlikely to yield the same outcomes and achievements as in its primary context. Referring back to the objective of this report, the question arises what specific contextual factors are most relevant to consider for evaluating the transferability of the 16 case studies identified to the EU context. Moreover, the question remains how the theoretical considerations outlined here can be turned into a methodological approach to actually assess the transferability of a given case study. These issues are addressed in the following chapter.

3 METHODOLOGY: POLICY TRANSFERABILITY FRAMEWORK

This chapter presents the methodological approach taken to assess the extent to which the previously identified case studies on E1st (Pató et al. 2020b) are transferable to the political system of the European Union and its Member States. The methodology involves the following steps:

- First, the international experiences are categorized and characterized in terms of **'policy types**';
- Second, the general theoretical considerations from Chapter 2 are substantiated by identifying **contextual factors** relevant for particular policy types, allowing for a nuanced appraisal of factors relevant for determining the transferability of a given international policy approach to the EU context;
- Finally, a **policy transferability framework** is designed, providing a practical heuristic for the structured analysis of contextual factors and overall transferability of the 16 case studies.

3.1 Categorization of existing best practices

In a first step, the identified initiatives and policies associated with the E1st principle are categorized into different **policy groups** and **policy types**. In general, energy policies can be categorized in different forms. The overarching literature on energy policy instruments typically suggest a distinction into communication/information instruments, economic/financial instruments, and normative/regulatory instruments (Blok and Nieuwlaar 2016). A more nuanced categorization is provided in (Warren 2015), differentiating five groups of instruments: market, regulatory, fiscal, information, and voluntary instruments. The International Energy Agency's (IEA) Energy Efficiency Database (IEA 2015) distinguishes seven policy groups with more than 20 policy types attached to these groups. In the following, we adopt a merged set of four policy groups and seven policy types that are assigned to the identified initiatives and policies associated with the E1st principle. This overview is informed by additional reports and studies (SEDC 2016; Warren 2015; Boza-Kiss et al. 2013; Blok and Nieuwlaar 2016).

Policy group 1: Economic instruments

Economic instruments are understood as mechanisms providing financial incentives to stimulate desired behaviour or financial penalties to discourage undesired behaviour. In terms of policy types, a distinction is made between *fiscal/financial incentives* and *utility remuneration schemes*.

Fiscal/financial incentives refer to public financial assistance in the form feed-in tariffs/premiums, grants and subsidies, loans, and tax reliefs provided to companies or individuals, in order to support particular investments and projects. These incentives can be coupled to other regulation and eligibility criteria. The following E1st case studies are examined under this policy type:

- Building energy performance requirements of the Irish Heat Pump System grant (Ireland)
- Fabric First approach under the Better Energy Communities grant scheme (Ireland)
- Linking renewable support to building energy performance (United Kingdom)

Utility remuneration schemes refer to business models for energy utilities prescribed by their regulatory authorities. These may take the form of decoupling policies (such as cost-recovery mechanisms) or resource standards (such as performance targets) in order to put demand-side options on an equal basis with supply-side options. This policy type comprises the following E1st case study:

- Decoupling utility sales and revenues (USA)

Policy group 2: Information and education

Information and training policies are mechanisms for transferring information and providing knowledge. This policy group is represented by the single policy type *information provision*.

Information provision refers to marketing and education measures that aim to induce voluntary behaviour change by in influencing individual and organizational perceptions, preferences and abilities. This may also include advice and aid in implementation. The following E1st case study is considered here:

- Building Logbook – Woningpas: Exploiting efficiency potentials in buildings through a digital building file (Belgium)

Policy group 3: Market structure and design

Market structure and design policies are understood as rules that structure the functioning of markets as well as the access of actors in the markets for electricity, gas, district heating, and other commodities. Contrary to the policy groups 'economic instruments' and 'regulatory instruments', this policy group is meant to address the interface of generators, consumers and supply/retail companies in competitive markets, rather than a single one of these market actors. The policy area is further distinguished into *demand response* and *market access regulation*.

Demand response refers to market-based incentives for consumers to shift their use of electricity and other commodities over time. In practice, demand response typically comes in either of two forms. Incentive-based demand response (also referred to as *explicit demand response)*, refers to trading committed and dispatchable flexibility in energy markets, either through single consumers or through aggregators. Price-based demand response, also known as implicit demand response, refers to the use of time-varying tariffs for electricity, gas and other commodities that reflect their marginal network and/or generation costs to incentivize customers to shift or reduce their energy use. Price-based demand response is thus based on time-varying tariffs, whereas incentive payment-based demand response reduces or shifts load in response to direct financial payments. Under this policy type, the following E1st case studies are analysed:

- Demand flexibility in District Heating networks (Italy)
- Water heaters as multiple grid resources (USA)
- Using Time-of-Use tariffs to engage customers and benefit the power system (European Union)

Market access rules refers to legal conditions that determine the possibility of actors and service providers to provide their services in various markets for power, gas, and district heat. Gaining market access is an indispensable step for demand response and energy efficiency as demand side resources to compete on an equal footing with generation. Based on economic theory, expanding market access contributes to achieving free markets in which prices are established by the forces of supply and demand and are allowed to reach their point of equilibrium. Under this policy type, we consider the following E1st case studies:

- Participation of demand response in French wholesale electricity market (France)
- Enabling rules for demand response aggregators (European Union)

Policy group 4: Regulatory instruments

Regulatory policies mean standards for what actors and corporations are obliged to do or for forbidding certain behaviour, including possible penalties for non-compliance as well opportunities for own initiatives nested in the regulatory framework. This policy group is differentiated into *end-use performance standards* and *utility provisions and guidelines*.

End-use performance standards refer to mandatory or voluntary policies that seek to improve the efficiency of appliances, equipment and buildings in the manufacturing and construction process that are backed by legislation and regulations requiring these technologies to meet at least some minimum energy performance standards. The following E1st policies are considered under this policy type:

- Optimizing building energy demand by passive-level building code (Belgium)

Utility provisions and guidelines refers to legal acts enacted by regulatory authorities to influence business operations of energy utilities, i.e. supply-side companies in both a regulated (usually vertically integrated) and a liberalized context (generation, transmission, distribution, retail). These acts are understood to comprise both legal provisions to drive systematic consideration of demand side resources, as well guidelines that utilities can adopt on a voluntary basis in the context of own initiatives. Note that financial incentive structures to encourage investments in demand-side resources (utility remuneration) are accounted under policy group 1. The following E1st case studies are considered here:

- Assessing the value of demand-side resources (USA)
- Deferring T&D (Transmission & Distribution) infrastructure investments through local end-use efficiency measures (USA)
- Replacing a polluting power plant with behind-the-meter resources (USA)
- Social Constraint Management Zones to harvest demand flexibility (United Kingdom)
- Updating distribution system planning rules in Colorado and Nevada (USA)

Overall, the categorization of E1st policy initiatives into *policy groups* and *policy types* introduced in this section allows for a detailed screening of the scientific evidence base on relevant contextual factors. This methodological step is described in the following section.

3.2 Identification of contextual factors per policy type

As elaborated on in Chapter 2, the extent to which a policy measure is potentially transferable from one context to another is largely determined by the political/institutional, socio-cultural and administrative setting in which they take place – referred as contextual factors. The purpose of this section is to complement the overall theoretical understanding gained in Chapter 2 by identifying contextual factors relevant for the particular policy types identified above in Section 3.1. This is to take account of the fact that contextual factors affecting policy transferability depend on the policy type under consideration.

For example, the transferability of utility remuneration schemes may be primarily driven by the political/institutional context in a target context and less by socio-cultural concerns. In turn, the transferability of an information measure can be supposed to be less determined by the institutional setting and more by the administrative capacity and socio-cultural awareness. Overall, the contextual factors identified in the following for single policy types are used to guide the analysis on the transferability of the 16 E1st case studies to the EU context.

The identification of relevant contextual factors for single policy types is performed by screening relevant academic literature on these subjects. This results in a set of key contextual factors for each of the eight policy types described in Section 3.1 (fiscal/financial incentives; utility remuneration schemes; information provision; demand response; market access rules; end-use performance standards; utility provisions and guidelines). To maintain coherence in the set of contextual factors identified, reference is made to the distinction into *political/institutional, socio-cultural* and *administrative* factors. In the following, the seven policy types are listed along with their individual contextual factors identified in the literature. **Figure 2** below provides a summarizing overview of these factors.

	Policy type	Political and institutional context	Socio-cultural context	Administrative context
ECONOMIC INSTRUMENTS	Fiscal/financial incentives	▪ Availability of dedicated public funds	▪ Credibility of implementing bodies	▪ Trained staff in implementing authorities/agencies
	Utility remuneration schemes	▪ Suitability of market structure ▪ Frequency of rate proceedings	▪ Previous experience of utility planners with demand side resources	▪ Trained staff in regulatory authorities
INFORMATION AND EDUCATION	Information provision	▪ Existence of dissemination networks	▪ Credibility of implementing bodies ▪ Existing level of awareness	▪ Adequate impact monitoring ▪ Sufficient public funding
MARKET STRUCTURE & DESIGN	Demand response	▪ Enabling regulatory framework ▪ Existence of dynamic tariffs	▪ Consumer commitment to load shifting	▪ Deployment of advanced metering infrastructure
	Market access rules	▪ Enabling regulatory framework ▪ Effective price incentives	-	▪ Administrative capacity for market surveillance and transposition of supranational legislation
REGULATORY INSTRUMENTS	End-use performance standards	▪ Enabling regulatory framework	▪ Tradition of compliance with regulatory instruments ▪ Consumer awareness	▪ Technical capacity in monitoring bodies
	Utility provisions and guidelines	▪ Suitability of market structure	▪ Consumer response to procurement of demand side resources	▪ Trained staff in regulatory authorities for enforcement and monitoring

Figure 2. Contextual factors per policy type identified in literature.

Fiscal and financial incentives have been associated less with political/institutional, but more with socio-cultural and administrative factors. Concerning the former, attitudes towards fiscal and financial incentives have been shown to matter in a way that borrowing money is not perceived in the same way from one country to the other. In some countries, people are reluctant to borrow, while in others this is a more frequent and established practice. In terms of administrative factors, fiscal and financial incentives require sufficient public funding to effectively stimulate consumer behaviour. Moreover, depending on the complexity of the incentive measure, implementing agencies need to have sufficient staff and personnel to administer application and to evaluate eligibility criteria and other requirements (Boza-Kiss et al. 2013).

Utility remuneration schemes feature various factors determining transferability. Of major significance is the political/institutional context in terms of the general market structure applied to utilities, i.e. the question which market activities (generation, transmission, distribution, retail) are unbundled from the other ones and which activities are conducted on a competitive basis or remain monopoly businesses (Batlle and Ocaña 2016). Utility remuneration schemes (e.g. cost-of-service regulation, incentive-based regulation, performance-based regulation) are instruments by regulatory authorities designed for monopolistic market activities to prevent these utilities from overarching customers or delivering a service of unacceptable quality. Vertically-integrated utilities (in which none of the market activities are unbundled or open to competition) are the historic archetype of monopolistic energy markets and still predominant in many parts of the world. In liberalized markets – including the EU, ever since market reform started during the mid-1990s with the First Energy Package – market activities are unbundled and competition is introduced to the activities of generation and retail. However, energy transmission and distribution (T&D) remain monopoly businesses.[4] Utility remuneration schemes imposed by regulatory authorities thus remain relevant in a liberalized market setting, however, with less leverage points (i.e. market activities) than in traditional vertically-integrated utility regulation. For the market activities of generation and retail, utility remuneration schemes are obsolete because it is up to market forces to establish prices and thus incentives, with the regulators job to ensure fair competition and market access. Overall, the market structure in a target context thus clearly affects the transferability of utility remuneration schemes in terms of the political/institutional context.

The socio-cultural context has relevance in a way that utility planners and engineers can be sceptical of the potential for end-use efficiency and demand response to reliably substitute for supply-side infrastructures (Schmatzberger and Boll 2020). In turn, policymakers and regulatory staff typically do not fully understand the complexities of the reliability issues faced by utility planners, overall raising the need for interdisciplinary working groups to develop the confidence necessary for implementers and engineers to account for demand-side resources in utility planning (Neme and Grevatt 2015). Regarding the administrative context, trained staff is necessary for enforcing regulatory provisions, taking legal actions and penalizing the infringement of rules, as well as permanently reviewing the effectiveness to achieve the objectives sought (Neme and Grevatt 2015; Batlle and Ocaña 2016).

For **information provision measures**, different contextual factors have been identified in literature. Concerning institutional/political factors, the existence of networks of local energy agencies or other dissemination networks has been shown to facilitate the promotion of the measure as well as acceptance from the side of consumers. In terms of socio-cultural aspects, the government or implementing body of the information measure have been shown to require credibility in the eyes of the target groups. Moreover, the success of awareness raising, education and information campaigns in general has been largely associated to current awareness and information levels, which, in turn, are linked to the impacts of previous campaigns (Boza-Kiss et al. 2013). Concerning administrative factors, information measures require top-level support from government officials that believe in the capacity of such measures and that introduce adequate monitoring efforts to be able to demonstrate the potential and actual impacts of the measure (Boza-Kiss et al. 2013). Moreover, implementing bodies require sufficient funding to reach the measure's target groups in various channels (e.g. print, online).

The transferability of **demand response** schemes (both *explicit* and *implicit* demand response) has been related to regulatory frameworks as a major success factor. This includes the establishment of competitive balancing or capacity markets with explicit market access for demand response and its aggregators, eventually affecting the economic viability of demand response programs. Specifically for price-based demand response (implicit demand response), literature emphasizes the importance of a political framework in support of dynamic pricing (Warren 2015). In terms of socio-cultural factors, the literature highlights consumers' willingness to commit to remotely controlled load shifting in return for the financial incentive received as well as the extent to which they perceive benefits from participating in these programs (ACER/CEER 2016). From the administrative/implementing side, demand response has been shown to require enabling technologies in terms of advanced metering infrastructure for the two-way communication between suppliers and consumers (IRENA 2019b). In addition, particularly implicit demand response is considered to be challenging to administer compared to the typically direct contracts between large consumers and system operators in explicit demand response (Warren 2015).

[4] T&D networks are characterized as natural monopolies because they are bound to the physical space where they are located. Introducing competition in this type of activities is inefficient as it would duplicate expense involved in two competing electricity network companies building the same type of infrastructure in the same area to provide the same service. These duplicate networks would be redundant and users would end up paying roughly double the price for the same service (Gómez 2016).

The transferability of **market access rules** has been largely associated with political and institutional factors. In essence, the participation of demand response and other demand-side resources in power, gas, and heat markets requires unbundled and competitive market design with high degrees of accessibility and openness to value streams for these resources. Also important are effective price incentives for businesses and customers to engage in providing demand-side resources as well as for aggregators to procure and bundle these resources (smartEn 2019). While the significance of socio-cultural factors is less pronounced in literature (Warren 2015), administrative capacity is considered crucial to transpose comprehensive supranational EU legislation into national jurisdiction.

End-use performance standards have been shown to require the existence of a regulatory framework with long time horizons to ensure reliability and cost recovery for private and commercial investors, as well as for banks providing capital. Regarding socio-cultural aspects, a tradition of compliance with regulatory instruments as well as a successful collaborative record between public authorities and the building industry and/or building owners is mentioned in literature. Further, consumers need to be aware of the implications of performance standards, heightening the need for complementary information measures (e.g. public campaigns). In terms of administrative factors, performance standards require the availability of technical capacity as well as monitoring bodies able to verify compliance and to control and secure the enforcement of the standards (cf. market surveillance) (Warren 2015; Boza-Kiss et al. 2013).

The transferability of **utility provisions and guidelines** has been related to the overall market structure in terms of the institutional/political context, i.e. the question whether regulation from a primary context is designed for vertically-integrated utilities and regulated monopolies (typically transmission and distribution) or for competitive market segments (typically generation and supply/retail) (see *Utility remuneration schemes*). In terms of socio-cultural aspects, consumers' willingness to participate in demand-side actions in response to incentives provided by the utilities or energy service companies is considered important (GridLab 2019). Regarding administrative aspects, the regulatory authorities administering any form of utility obligations require trained staff to enforce regulatory provisions, as well as to monitor and review the effectiveness of these provisions on a periodical basis.

To conclude, the scientific literature presents a broad range of relevant contextual factors for each policy type. This generally suggests that none of the 16 case studies for Efficiency First can be transferred to the target context of the EU and its Member States without thorough consideration of their individual contextual factors in terms of political/institutional, socio-cultural and administrative constraints. Note that this screening of relevant contextual factors is limited to aggregate *policy types*, without claiming to be exhaustive. The actual analyses per *case study* in Chapter 4 are guided by this screening while taking into account the particularities associated with each of the 16 case studies in terms of contextual factors and transferability. For this purpose, the next and final methodological step, described in the following section, is to compose a framework that allows for a structured analysis per case study.

3.3 Composition of policy transferability framework

After having performed a literature-based review of relevant contextual factors per policy type, this section presents a practical scheme for the detailed and structured analysis of contextual factors and overall transferability of the 16 international experiences with E1st. **Figure 3** illustrates the outline of the framework to be applied to each of the 16 experiences individually.

<table>
<tr><th colspan="5">Case study title</th></tr>
<tr><th colspan="5">Outline of primary context</th></tr>
<tr><td colspan="2">Policy type: [...]</td><td colspan="2">Country/province: [...]</td><td>Duration: YYYY – YYYY</td></tr>
<tr><td colspan="5">Merit in primary context: [...]</td></tr>
<tr><th colspan="5">Transferability to target context</th></tr>
<tr><td>Context</td><td colspan="4">Contextual factor</td></tr>
<tr><td rowspan="2">Political/ institutional context</td><td colspan="4">Factor: [...]</td></tr>
<tr><td colspan="4">Factor: [...]</td></tr>
<tr><td rowspan="2">Socio-cultural context</td><td colspan="4">Factor: [...]</td></tr>
<tr><td colspan="4">Factor: [...]</td></tr>
<tr><td rowspan="2">Administrative context</td><td colspan="4">Factor: [...]</td></tr>
<tr><td colspan="4">Factor: [...]</td></tr>
<tr><th colspan="5">Conclusion on transferability to target context</th></tr>
<tr><td colspan="5">[...]</td></tr>
<tr><td>Key EU legislations</td><td colspan="4">[...]</td></tr>
<tr><td>Current status of implementation</td><td>Full</td><td>Partly</td><td>Planned</td><td>Not considered</td></tr>
<tr><td>Current level of implementation</td><td>Supranational
(European Union)</td><td>National
(Member States)</td><td>Regional/province</td><td>None</td></tr>
<tr><td>Transferability level</td><td>High</td><td>Medium</td><td>Low</td><td>None</td></tr>
</table>

Figure 3. Composition of policy transferability framework.

The top section **outline of primary context** features an overview of the country, state or province in which the E1st measure was implemented and characterized in the reference report (Pató et al. 2020b). It lists the country/province, the duration of the E1st measure, as well as its merits in the primary context. We hereby refer to the *stated success* of a measure, i.e. general statements on whether data speak for its effectiveness as well as discussions of whether or not the policy met its original overall objectives. The field thus outlines what benefits can potentially be achieved in the target context when implementing the E1st measure in question.

The subsequent section **transferability to target context** elaborates on the transferability of the E1st ca to the target context – i.e., as stated as the primary objective of this report in Chapter 1 – the political system of European Union and, where relevant, its single Member States. The central element of this section is an analysis of the contextual factors determining the transferability of the given E1st measure to the target context of the EU and its Member States. This analysis draws upon the general findings per policy type from Section 3.2 and substantiates these with a description of case-specific contextual factors. Again, for the sake of coherence and to structure the analyses, a distinction is made between political/institutional, socio-cultural, and administrative factors.

Finally, the bottom section provides an overall **conclusion on the transferability** of the given E1st measure to the EU context and its Member States. To complement the conclusion, the section also lists:

- the range of existing **key EU legislations** (Regulations and Directives) that would be concerned when attempting to transfer the E1st measure in question to the EU context;
- the **current status of implementation**, i.e. the question to what extent the measure in question has already been considered in the EU context as well as in its Member States. The fields range from *full* (i.e. explicitly referred to in established directives, regulations and other legislations), to *partly* (i.e. adopting certain elements of the measure from the primary context, but neglecting others), *planned* (i.e. demonstrable efforts and discussions to implement measure), to *not considered* (i.e. implementation of measure discarded or put on hold for an indefinite period);
- the **current level of implementation**, i.e. the legislative level which has already been concerned in a form of policy transfer, ranging from *supranational* (i.e. the EU as a whole in terms of supranational directives and regulation), *national* (i.e. level of Member State legislation), *regional/province* (i.e. any sub-national level), and *none* (i.e. transfer of measure not considered at any of the levels indicated);
- a **transferability level** provides a rough qualitative appraisal of the degree of transferability, ranging from 'low' (no to low prospects for transferability of the E1st measure) to 'high' (no major contextual factors that speak against an implementation of the E1st measure to the EU context).

To summarize, this chapter introduced the three-step methodological approach applied to analyse the transferability of 16 international experiences with the E1st principle to the target context of the EU and its Member States. The following chapter applies the developed policy transferability framework to each of the 16 case studies and provides insights on their transferability.

4 RESULTS: TRANSFERABILITY ASSESSMENT FOR EU

This chapter presents the findings of this report. For each of the previously characterized E1st case studies (Pató et al. 2020b) (Chapter 1), transferability is assessed from the respective primary context to the target context of the European Union and its Member States. As introduced in Chapters 2 and 3, political/institutional, socio-cultural, and administrative factors are the major explaining variables for this assessment. In the following, **Section 4.1** outlines the findings in a transferability matrix, listing key contextual factors along with the overall level of transferability. **Sections 4.2–4.5** apply the policy transferability framework to each of the 16 international cases and provide in-depth analyses and results, structured by policy type (Economic instruments, Information and education, Market structure and design, Regulatory instruments).

Key results of the analysis include:

- **8 of the international experiences identified feature a *high* transferability level**. This means that these experiences are either readily transferable or already have been adopted to a large extent in EU legislation. For example, time-of-use tariffs (see case *Using Time-of-Use tariffs to engage customers and benefit the power system*) are already in place in many parts of the EU, with the Electricity Market Directive and Regulation providing a fundamental regulatory framework. However, the high level of transferability is not meant to indicate that implementation in the EU is fully completed. Instead, it suggests that there remain factors that need to be considered to augment the measure's effectiveness as well as to expand it to all 27 Member States and all relevant market segments (e.g. applying time-of-use schemes to network tariffs).

- **7 out of 16 international experiences are found to have a *medium* transferability to the target context of the EU and its Member States.** This indicates that there exist significant contextual factors that impede a direct transfer to the EU context and that are expected to result in less successful policy outcomes than in the primary context. From the transferability matrix, it becomes apparent that these are mostly experiences from the U.S. context and, more specifically, closely associated with the tradition of Least-Cost Planning (LCP) – i.e., the practice of encouraging or requiring utilities to consider demand side resources alongside supply side assets in their planning processes by virtue of regulatory control. As elaborated on in the transferability assessments, the difference in market structure between the U.S. and the EU is a key factor, overall reducing the leverage points for energy efficiency and demand response to defer supply side infrastructures.

- **Finally, one international experience with E1st is identified that, in its present state, is assigned a *low* level of transferability.** This is the case of *Demand flexibility in district heating networks* which is currently limited to pilot implementations and yet to be deployed in commercial settings. Besides its overall market prospects being uncertain, there hardly is an enabling regulatory framework for district heating and cooling at the EU level that would encourage such initiatives. It is thus concluded that in this particular case, primary stimuli for its future deployment need to come from the Member States as well as local authorities as the major decision-makers in district heating and cooling policy and planning.

4.1 Synthesis: Transferability matrix

Policy group	Policy type	Case study	Political/institutional context	Socio.-cultural context	Administrative context	Transferability level
Economic instruments	Fiscal / financial incentives	Building energy performance requirements of the Irish Heat Pump System grant	▪ Existence of renewable energy targets ▪ Market activity	▪ Willingness to invest of building owners ▪ Technical knowledge and awareness	▪ Sufficient public funding ▪ Capacities in implementing authority	HIGH
Economic instruments	Fiscal / financial incentives	Fabric First approach under the Better Energy Communities grant scheme in Ireland	▪ Climate policy framework	▪ Commitment of building owner ▪ Acceptance of market actors	▪ Capacities in implementing authority ▪ Financial and administrative resources	HIGH
Economic instruments	Fiscal / financial incentives	Linking renewable support to building energy performance	▪ Type of building integrated RES support ▪ Purely market-based RES uptake:	▪ Credibility of building performance standards	-	MEDIUM
Economic instruments	Utility remuneration schemes	Decoupling utility sales and revenues	▪ Market structure ▪ Market prospects for utilities	▪ Public acceptance & consumer protection	▪ Financial endowment of regulatory authorities ▪ Trained staff in regulatory authorities	HIGH
Information and education	Information provision	Building Logbook – Woningpas: Exploiting efficiency potentials in buildings through a digital building file	▪ Data availability ▪ Interplay with other policy areas ▪ Market status	▪ Consumer awareness and trust ▪ Political culture	▪ Administrative experience ▪ Financial support	HIGH
Market structure and design	Demand response	Demand flexibility in District Heating networks	▪ Enabling regulatory framework ▪ Upscaling of pilot implementations	▪ Consumer involvement	▪ Deployment of automation equipment	LOW
Market structure and design	Demand response	Water heaters as multiple grid resources	▪ Market structure ▪ Third-party access to markets ▪ Procurement requirement from the regulator	▪ Consumer involvement ▪ Consumer hassle and risk	-	MEDIUM
Market structure and design	Demand response	Using Time-of-Use tariffs to engage customers and benefit the power system	▪ Regulatory framework for diffusion of time-of-use tariffs	▪ Consumer involvement ▪ Value proposition for consumers	▪ Deployment of smart metering equipment	HIGH

	Market access rules	Enabling rules for demand response aggregators	▪ Accessibility of multiple value streams ▪ Availability of diverse customer segments and assets	▪ Consumer involvement	▪ Communication infrastructure & automation equipment	HIGH
	Market access rules	Participation of demand response in French wholesale electricity market	▪ National flexibility target ▪ Experience with demand integration ▪ Availability of diverse customer segments and assets	▪ Consumer involvement	▪ System operator experience and trust	HIGH
Regulatory instruments	End-use performance standards	Optimising building energy demand by passive-level building code	▪ Preceding measures ▪ Long-term climate targets	▪ Lead by example ▪ Provider side	▪ Financial support to kick-start ▪ One-stop shop ▪ Legal grounding	MEDIUM
Regulatory instruments	Utility provisions and guidelines	Assessing the value of demand-side resources	▪ Market structure ▪ Utility incentive structure ▪ Informational asymmetry ▪ Regulatory guidance	▪ Transparency of planning process	▪ Organizational & human capacities	MEDIUM
Regulatory instruments	Utility provisions and guidelines	Updating distribution system planning rules in Colorado and Nevada	▪ Market structure ▪ DSO planning scope ▪ Regulatory mandate	▪ Transparency of planning process	▪ Organizational & human capacities	MEDIUM
Regulatory instruments	Utility provisions and guidelines	Deferring T&D infrastructure investments through local end-use efficiency measures	▪ Enabling regulatory framework ▪ Utility incentive structure	▪ Transparency of planning process	▪ Organizational & human capacities	MEDIUM
Regulatory instruments	Utility provisions and guidelines	Replacing a polluting power plant with behind-the-meter resources	▪ Enabling regulatory framework ▪ Enabling policy of the system operator ▪ CAPEX bias ▪ Transparency of grid needs	▪ Cooperation with a local energy actor	▪ Human capacity ▪ Air quality standards	HIGH
Regulatory instruments	Utility provisions and guidelines	Social Constraint Management Zones to harvest demand flexibility	▪ Additional funding/regulatory incentive ▪ Solution-neutral DNO regulation ▪ Political will of the local authorities ▪ Heat decarbonisation policy	▪ Community outreach ▪ Will of the DNO to try alternative solutions ▪ Stakeholders developing/aggregating demand-side resources	▪ Deployment of smart meters	MEDIUM

4.2 Economic instruments

Building energy performance requirements of the Irish Heat Pump System grant
Outline of primary context
Policy type: Fiscal/financial incentive **Country/province:** Ireland **Duration:** 2018 – ongoing
Merit in primary context: The Heat Pump System Grant is a fiscal policy initiated by the Irish government and administered by the national energy authority (SEAI) with the objective to meet renewable energy targets in the residential heating sector. The prerequisite of decreasing a building's heat loss before granting financial support for installing a heat pump system gives priority to an improved energy performance of the building/ dwelling and the efficient use of the heating installation.

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Existence of renewable energy targets:** The Heat Pump system grant is embedded in a policy framework to reach the Irish renewable heat target of 12% (and the renewable target of 16%). To increase the use of renewable heat, the subsidy scheme has supported the market and technological development of heat pump systems since 2018. All European MS are subject to a binding 2020 renewable energy target (EU/2009/28) and to an indicative increasing annual average of 1.3% percentage points in heating and cooling from 2021 (recast of the Renewable Energy Directive, EU (2018/2001)) which might increase the demand for renewable heating systems, including heat pumps.
	Market activity: The European heat pump market grew extensively over the past decade, with 1.3 million installed heat pumps in 2018 (compared to 734,000 in 2009) and its increasingly recognised across Europe (Andreu et al., 2020). Energy is used efficiently as heating and cooling can be provided with the same technology and the thermal efficiency of a heat pump can be increased with a better building energy performance. The biggest markets are France, Italy and Spain where air-sourced heat pumps are dominant (EHPA 2020). The open, growing market leaves room to apply the requirements of the Heat Pump grant to other EU countries to ensure an efficient application of the heating systems.
Socio-cultural context	**Willingness to invest of building owners:** The transferability of the Heat Pump grant depends highly on the financial capacity of the building owners who are investing in a new heating system and energy efficiency measures. As the Irish Heat Pump grant does not cover the full costs of the system replacement (up to €3,500 for a heat pump plus €200 for technical assessment) and might require additional expenses for works on the building envelope, owners have to be able and willing to invest. The transfer of this grant scheme thus depends on the socio-economic situation of residential owners in the respective country and the cultural context of investing/ lending a lot of money for their buildings' energy consumption. The transferability level might be higher to countries with high shares of owner-occupied detached houses (e.g. in Scandinavia) then to MS with a majority of co-owned multi-family buildings, such as Bulgaria or Lithuania where the financial resources are limited and mixed-ownership slows down renovation projects (Hegedüs et al. 2017).
	Technical knowledge and awareness: The transferability and exploitation of the Irish heat pump grant in other EU countries depends on the awareness about the technical specifications on the efficient functioning of heat pump systems. Responsible authorities and implementing organisations have to be aware and supportive of the minimum performance level as prerequisite of the grant to implement this aspect into their grant schemes. With a predicted growing demand of heat pump systems across Europe (EHPA 2020), a similar grant scheme in several EU Member States could increase the awareness about the importance of adapting the respective building envelope prior to any new heat pump installation.
Administrative context	**Sufficient public funding:** The government has to provide enough public funding to provide a long-term financial incentive for a certain renewable heat technology. This depends on the government's climate policy agenda, the European requirements (renewable energy targets) and a political decision which support programmes to implement. Fiscal incentives could, apart from a grant, be implemented as loans, tax rebates, de-risking initiatives or in form of CO_2 prices some of which might mobilise more private financing A sufficient amount of the grant to stimulate the heat pump market would be especially important in low-income countries.
	Capacities in implementing authority: The implementing authority needs sufficient technical and administrative staff and digital capacities to manage the application process efficiently. High numbers of applications need to be checked for compliance and the pre-assessment of the building envelope requires a large number of certified (SEAI) contractors and Building Energy Rating (BER) assessors. This capacity is often lacking in South-Eastern European countries, such as Bulgaria and Romania where EU-funded technical assistance facilities can support (e.g. ELENA) (Boll et al. 2019).

Conclusion on transferability to target context

Subsidies for heat pump systems already exist in other European MS but without the prior energy performance requirement (e.g. Germany, France). Transferability potential is high depending on the energy saving objectives and renewable targets in a country. Prerequisites are the existence of an EPC registry to identify eligible homes, enough skilled workers to carry out the pre-assessment and sufficient awareness of the benefits of a high building energy performance for the heat pump's efficiency. The requirement of a certain energy performance of the building envelope prior to a heat pump installation could be implemented in the Renewable energy directive (RED) on EU level.

Key EU legislations	Energy Performance of Buildings Directive, Renewable Energy Directive			
Current status of implementation	Full	Partly	Planned	**Not considered**
Current level of implementation	Supranational (European Union)	**National (Member States)**	Regional/province	Local
Transferability level	**High**	Medium	Low	**None**

Fabric First approach under the Better Energy Communities grant scheme in Ireland

Outline of primary context

Policy type: Fiscal/financial incentive **Country/province:** Ireland **Duration:** 2015 – ongoing

Merit in primary context: The Better Energy Communities (BEC) scheme supports community-oriented innovative projects from various sectors, including residential and non-residential building energy efficiency upgrades. It is one of the main grant schemes in Ireland, administered by the Sustainable Energy Authority Ireland (SEAI). Eligible projects are required to follow a *Fabric first* approach since 2017 - meaning to achieve an energy performance level of a B2 (minimum C1 to receive funding) and prioritizing works on the building envelope. The grant scheme helped implement energy efficiency measures in over 18,500 homes and 2800 non-residential buildings by 2020 (€ 165 million total grants) by providing 35% to up to 80% (for energy poor households) of the costs.

Transferability to target context

Context	*Contextual factor*
Political/ institutional context	**Climate policy framework:** The driver behind the subsidy scheme to improve the energy performance of community/ residential buildings is the national/ regional climate policy framework. Ireland is, just like all EU Member States, subject to a binding EU energy efficiency target (32.5%) and a renewable energy target (30%) by 2030. With the residential and services sector representing 35% of Ireland's final energy consumption (SEAI 2019), high building renovations targets are introduced with the 2019 Climate Action Plan (SEAI 2019). As the building stock is responsible for 40% of the EU's final energy consumption the political driver to implement subsidy schemes to increase the buildings' energy performance is high across Europe but would have to be implemented by each Member State in their national support schemes. On EU level, a requirement to issue post-works Energy Performance Certificate (EPC) could improve the quality and in-use transparency of renovation measures
Socio-cultural context	**Commitment of building owner:** Since 2015 the BEC scheme requires minimum building energy ratings (Building Energy Rating (BER) referring to the Irish Energy Performance Certificate system) after the completion of energy efficiency works. Contrary to pre-2015 applications that were led by manufacturers (product led), the change requires more holistic deep renovation measures that lead to higher costs and therefore require more commitment and financial capacity from the building owner. The *Fabric first* approach increased the investment spent per home which makes it harder to find committed homeowners. Transferring the grant scheme to other EU MS would require higher shares of grant contribution in some countries as the disposable income is lower in many Eastern European countries, like Hungary, Croatia and Bulgaria (Eurostat 2020). Renovation grants in Bulgaria often provide 100% of the costs (BPIE 2018).
	Acceptance of market actors: In Ireland, the introduction of a minimum energy performance obligation to access the grant scheme resulted in a strong decrease of applications from manufacturers and contractors. It took some time for contractors to adapt to the new requirements and allow them to develop more comprehensive, deep renovation measures. The application evaluation is since 2017 based on the energy rating which requires contractors and owners to change their planned measures.
Administrative context	**Capacities in implementing authority:** Prerequisite for an implementation of the grant scheme in other EU countries is a transparent Energy Performance Certificate system and transparent online registry as well as enough qualified (and certified) workers to carry out the post work building energy rating assessment. Although, all EU MS have implemented an EPC system, the uptake of EPCs is still low in some countries (e.g. Latvia, Bulgaria). As the methodology and quality assurance differs between MS, an EU-wide implementation of an energy-rating based grant scheme might lead to different performance levels (Volt et al. 2020).
	Financial and administrative resources: The government needs to provide enough public funding for the volume of the grant scheme as well as the suitable administrative capacities in the implementing organisation. If the grant depends on EU-funding, an early effort to secure follow-up funding is necessary to guarantee a sustainable fund. The technical requirements of the grant programme are rather complex which demands enough qualified administrative staff to assess the applications and check for compliance before and after completion of the energy saving works which varies between European Member States Local authorities in South-Eastern European countries often lack the financial and technical capacity to develop project pipelines and apply for funding (Boll et al. 2019).

Conclusion on transferability to target context

The transferability level to other European Member States is high given the high energy consumption of the EU building stock and the related energy saving objectives. Many European countries have implemented subsidy schemes for energy efficiency improvement measures in residential and non-residential buildings, but few require a post-works energy audit/ a certain EPC level to be achieved (e.g. Portugal). A requirement for an EPC after renovation works could be implemented with the revision of the EPBD in 2021**.** The *Fabric first* approach could be transferred to different buildings or renewable energy grant schemes given a transparent and widespread EPC scheme, enough certified energy auditors and a sufficient funding level depending on the income levels and distributed wealth in the respective country.

Key EU legislations	Energy Performance of Buildings Directive			
Current status of implementation	Full	Partly	Planned	**Not considered**
Current level of implementation	Supranational (European Union)	**National (Member States)**	Regional/province	Local
Transferability level	**High**	Medium	Low	None

Linking renewable support to building energy performance

Outline of primary context

Policy type: Fiscal/financial incentive **Country/province:** United Kingdom **Duration:** 2012 – 2019

Merit in primary context: Improving the energy performance of a building before investing into supply options is a clear example for applying the principle of Efficiency First at the building level. Many countries provide some form of public support for building integrated PV installations. Conditioning public support for distributed energy supply on a predefined minimum level building energy performance is a straightforward policy tool. This case is about linking feed-in tariff in the UK to minimum building standard.

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Type of building integrated RES support:** There are three dominant forms of support: support related to the export of power to the grid (FIT), investment support and eligibility for net metering. The UK scheme stopped as FIT scheme for rooftop PV stopped in the UK in 2019. The way to condition RES support to building energy performance depends on the type of support. Eligibility for preferential feed in price (FIT) or upfront investment cost is relatively straightforward. In these cases either the eligibility or the level of the FIT or the investment support (discounted) can be linked to energy performance. Conditioning eligibility for net metering that is usually an automatic right not requiring support decisions is less clearcut. As the net metering regimes – that are mainstream form of building integrated RES support - are likely to be phased out in Europe, the question remains whether other form of support remains in place for a considerable future. CEER – the association of energy regulatory agencies – advised to avoid net-metering as it implies that the system acts as a virtual free storage (CEER 2016): prosumers only pay network fee and levies after the netted-out amount, usually negligible as the business case in avoidance of network fees and taxes.
	Purely market-based RES uptake: If retailers buy off the electricity injected to the grid on a purely market basis then the state has less leverage on placing conditionality on PV investments. This has ended the scheme that linked FIT level to building energy performance in the UK. Same phaseout is planned in other MSs as well. E.g. Belgium/Flanders. With rooftop PV approaching socket parity, this is an effective barrier to the implementation of E1st in this context.
Socio-cultural context	**Credibility of building performance standards:** For the efficient linking of any RES support with building energy efficiency, the rating methodology needs to be robust and trusted and the certificate need to be easily obtainable. The compliance with EPCs regulation across the Member States varies considerably (Jamieson et al. 2015).

Conclusion on transferability to target context

Supporting renewable units integrated to buildings is a national mandate. The conditionality options depend on the type of support. applicability is limited by the gradual phasing out of such support.

Key EU legislations	Renewable Energy Directive			
Current status of implementation	Full	**Partly**	Planned	Not considered
Current level of implementation	Supranational (European Union)	**National (Member States)**	Regional/province	Local
Transferability level	High	**Medium**	Low	None

Decoupling utility sales and revenues

Outline of primary context

Policy type: Utility remuneration schemes **Country/province:** United States **Duration:** 1982 – ongoing

Merit in primary context: Decoupling is a form of regulation-induced utility remuneration that removes the disincentive for utilities to invest or engage in demand-side activities, including end-use efficiency and demand response. In practice, decoupling mechanisms implemented in the U.S. have successfully induced utilities to no longer take actions against energy efficiency as an activity that decreases sales whilst maintaining the financial viability of utilities (Lazar 2014; Sullivan et al. 2011).

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Market structure:** Utility remuneration schemes, including decoupling, are imposed by regulatory authorities to control and drive the business operations of monopolistic market activities, which traditionally have been vertically-integrated utilities. It is a regulatory model that stands in contrast to market-based competition, in which prices and thus incentives are established through the market forces demand and supply, rather than by virtue of regulatory control. Starting with the First Energy Package in 1996 and consolidated in the 2018 Clean Energy for All Europeans Package, the EU has gradually liberalized its power and gas markets in terms of unbundling the formerly vertically-integrated monopoly structures and introducing competition to the market activities of generation and retail. In this setting, transmission and distribution remain as regulated monopolies and, as such, are suitable for decoupling or alternative forms of utility remuneration (e.g. performance-based regulation) (Lazar 2014). Aside from the liberalized markets for power and gas, decoupling is also applicable to the EU district heating sector, which is characterized by vertically-integrated utilities responsible for heat generation, network operation and heat supply, subject to regulatory oversight (Wissner 2014).
	Market prospects for utilities: Replacing traditional rate-of-return regulation by decoupling marks a deep change in utilities' business models. It requires cooperation of utility stakeholders, which are more likely to comply with decoupling mechanisms and investments in demand-side resources if it favours their market prospects. In the EU, particularly the gas sector tends to face declining average revenues per customer over time, leading to long-term revenue and profit erosion between tariff proceedings in traditional cost-of-service regulation (NARUC 2007). As such, applying decoupling schemes for gas network operators can be considered attractive for these businesses because it ensures a stable revenue stream between tariff proceedings. In turn, considering the ongoing electrification of the EU energy system (Guelpa et al. 2019a), power network operators would certainly prefer traditional cost-of-service regulation as it rewards capital expenditures.
Socio-cultural context	**Public acceptance & consumer protection:** Implementing decoupling mechanisms can impact consumer acceptance in two ways. First, experience shows that in the short run, tariffs for all customers under decoupling may increase when energy efficiency reduces sales because the utilities have to cover their costs and necessary returns on investment. Second, decoupling may impact service quality because it incentivises utilities to take cost-cutting steps in the form of reducing expenses as the only way to increase earnings (since revenues will not be affected by sales). As such, it might hurt system reliability, safety and thus customer satisfaction. For this reason, decoupling is generally paired with a service quality index mechanism so that any diminishment in the quality of service will be penalised (Lazar 2014). Successful transfer to the EU thus requires institutional capacities in terms of consumer centres to bundle customer concerns as well as prudent regulatory authorities that closely monitor system reliability.
Administrative context	**Financial endowment of regulatory authorities:** Decoupling is related to traditional cost-of-service regulation in way that it requires periodical tariff proceedings in which the utility's revenue requirement and rate of return are negotiated with the regulatory authorities. In this setting, the regulator requires sufficient financial endowment for specialised personnel and sophisticated analytical tools to accurately calculate the utility's real revenue requirement and thus overcome information asymmetries against the utility (Gómez 2016). The 27 EU national regulatory authorities (NRAs) are assumed to have ample experience with and institutional capacity for managing such tariff proceedings.
	Trained staff in regulatory authorities: Decoupling requires trained staff for enforcing regulatory provisions, taking legal actions and penalizing the infringement of rules, as well as permanently reviewing the effectiveness to achieve its effectiveness (Batlle and Ocaña 2016). However, compared to traditional cost-of-service / rate-of-return regulation, decoupling is less complex to administer by the authorities, requiring minimal action to perform a simple true-up comparison of actual revenues to the allowed revenues and adjusting tariffs to return or recover any over- or under-collection the following period (Sullivan et al. 2011).

Conclusion on transferability to target context

Originating from the U.S., decoupling has been applied to the EU context and its Member States as one form of incentive regulation for electricity and gas TSOs and DSOs. Commonly referred to as 'revenue-cap regulation' in the EU context, different variations of decoupling are currently used by at least 12 NRAs for power T&D, and at least 14 NRAs in gas T&D (CEER 2020)**.** Overall, the different contexts constitute no major obstacle to expand the share of NRAs adopting decoupling / revenue cap mechanisms.

Key EU legislations	Energy Efficiency Directive, Electricity Market Regulation, Gas Directive			
Current status of implementation	Full	**Partly**	Planned	Not considered
Current level of implementation	**Supranational (European Union)**	**National (Member States)**	Regional/province	Local
Transferability level	**High**	Medium	Low	None

4.3 Information and education

Building Logbook (Woningpas)				
Outline of primary context				
Policy type: Information provision	**Country/province:** Belgium	**Duration:** 2018 – ongoing		

Merit in primary context: The building logbook is an innovative tool used in many countries (including USA and EU) with the goal of better buildings management including data management and information for improving the efficiency of buildings. The Woningpas from Flanders is one of the most mature concepts and features energy performance, renovation advice, the housing quality (such as stability, humidity, safety) and data on the environment. In practice it can be used to identify where E1st can be implemented in a building context by providing all the necessary information on the building for an informed decision.

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Data availability:** The availability of data is key to delivering efficiency in buildings and even more so when looking at implementing efficiency first. At the building level a sound data basis for each individual building and the supply system it is connected to is necessary to ensure that the cost-optimal solution is chosen and multiple impacts of building renovation are integrated in the calculation. The EPBD (Art. 10) allows Member States to use aggregated and anonymised data on buildings for statistical and research purposes, Member States have a lot of leeway regarding which data is collected and made available though and this is closely connected to a culture and habits of data sharing.
	Interplay with other policy areas: Buildings as part of the energy system are closely linked to regulatory, renewable energy and financial policies which can have an impact on the effectiveness of measures and policies on building level. While there are certain overall requirements stemming from EU legislation, their design is different regarding for example subsidies for building renovation or renewable energy quotas for buildings. For the implementation of E1st it is important how these policies support or hinder the implementation in the target country.
	Market status: The market for building renovation is very large and has different interest groups involved, depending on their product pallet. Therefore, the building can be improved in different ways, achieving different levels of energy reduction in different ways. For E1st to be implemented, a level playing field needs to be supported through policies which help building owners understand the effects of different measures on their buildings and shows them benefits of implementing E1st, which is what the Woningpass does – this could be copied by other EU governments.
Socio-cultural context	**Consumer awareness and trust:** Consumers are key actors in the implementation of E1st in buildings policy, as they make final decisions in the residential building sector. Depending on the regions implementation design of the EU legislative framework and previous experience with building documentation such as Energy Performance Certificates (EPCs), the trust consumers have in EPC data, in energy advisors and generally government programmes can differ.
	Political Culture: For new instruments and tools to be successful and for the building logbook to support the implementation of the E1st principle, the support through political and administrative/bureaucratic support. This can be shown through proactive communication, through the exact formulation of how the tool will work and through policy implementation including financial subsidies which support the implementation of measures which put efficiency measures first.
Administrative context	**Administrative experience:** Issues regarding building renovation and moreover efficiency measures tend to be very conventional and not change quickly. Using the building logbook for implementing the efficiency first principle can prove to be difficult when administrative experience on newly developed tools is missing and cannot be developed sustainably because of changing staff or changing administrative processes.
	Financial support: Administrations can provide a framework and guidelines for new formats such as the building logbook. In order to implement such a tool on a wider basis and urge building owners to voluntarily adopt it, a certain amount of funding needs to be made available- on the one hand for enough qualified staff in the authorities responsible for implementation and quality control and on the other hand financial subsidies for building owners to kick-start the logbook. Therefore existing financial support schemes need to be extended to support the above.

Conclusion on transferability to target context

Overall, the transferability of the building logbook across Europe is very high. For one this is based on the fact that there is already an existing EPC scheme, which building logbooks build on and also give consumers trust in it. Moreover, through a European framework regulation on building logbooks the main criteria could be established and then building logbooks introduced based on country specific contexts.

Key EU legislations	Energy Performance of Buildings Directive, Energy Efficiency Directive			
Current status of implementation	Full	Partly	**Planned**	Not considered
Current level of implementation	Supranational (European Union)	**National (Member States)**	Regional/province	Local
Transferability level	**High**	Medium	Low	None

4.4 Market structure and design

Demand flexibility in district heating networks

Outline of primary context

Policy type: Demand response **Country/province:** UK, Italy, Finland **Duration:** 2016 – ongoing

Merit in primary context: Demand response (DR) and flexibility schemes in district heating (DH) systems make use of buildings' thermal inertia and automation equipment to reduce peaks in heat load. This allows for downsizing of heat supply plants, pumps, and the network infrastructure. Compared with conventional thermal storage, DR avoids substantial investment costs and space requirements. As demonstrated in multiple trial implementations, such schemes can thus reduce a DH system's primary energy consumption, its environmental impact, as well as its capital costs.

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Enabling regulatory framework:** As natural monopolies, DH utilities are typically reluctant to embark on innovative activities and to significantly alter their established business model of selling kilowatt-hours of heat without an incentive to do so. To promote DR use in DH networks, it needs to be financially attractive to the utilities and predictable concerning the regulatory framework prescribed by legislators and regulatory authorities (Colmenar-Santos et al. 2015). The current institutional and legal framework for DH at the supranational EU level generally provides little impetus on the efficient operation of DH systems. In essence, the Energy Efficiency Directive (2012/27/EU; (EU) 2018/2002) requires MSs to carry out cost-benefit analyses (CBAs) for the application of efficient district heating in their territory (Art. 14.1) as well as for the construction of new as well as the major refurbishment of existing DH networks (Art. 14.5). However, the calculation principles provided in the Directive (Annex IX) are limited with regard to the investment options, focusing on heat supply resources while not explicitly referring to demand response, energy efficiency and other demand-side resources. An amendment of these provisions could enhance the consideration of DR as a potentially cost-effective resource in DH systems. More promising is the amended Energy Performance of Buildings Directive ((EU) 2018/844), supporting automation and control systems to make buildings operate more efficiently (Art. 14.4), which is a practical prerequisite for the operation of DR schemes. Moreover, a smart readiness indicator is to measure a building's capacity to use new technologies and electronic systems to adapt to the needs of the consumer, optimise its operation and interact with the grid (Art. 8.10). Ultimately, in the present legal framework, it is for the MSs and local authorities to define conditions and incentives for the use of DR in DH networks, making its future adoption uncertain.
	Upscaling of pilot implementations: Practical applications of DR schemes in DH systems are currently limited to single pilot projects (Sweetnam et al. 2018; Guelpa et al. 2019b; Mishra et al. 2019), with commercial deployments being outstanding. These pilots reflect small trial populations that do not provide generalized results. An upscaling of these initiatives would benefit from public support (e.g. low-interest loans) to demonstrate their feasibility in different DH systems. Major stakeholders are local authorities, which typically have the ultimate responsibility for the final push of the development and design of DH systems (Colmenar-Santos et al. 2015).
Socio-cultural context	**Consumer involvement:** Commercial deployments of DR schemes in DH systems should attain their load shifting objectives without adversely affecting occupants' thermal comfort. In a trial implementation in England, some participants noted the altered operation of their heating systems and expressed concern (Sweetnam et al. 2018). Another trial study notes that overall satisfaction levels were not significantly affected by the load shifting (Mishra et al. 2019). In either case, DR schemes should be accompanied by explanations about how the system operates, how this may differ from their expectations, what the can do to ensure their comfort requirements are met and, significantly, the benefits that their participation bring both to the overall network and to them as individuals should be provided to avoid raising concerns and reducing participation. Commercial applications would also need to design financial rewards or other incentives for consumers participating in the scheme – an issue that so far has not been addressed in trials (Sweetnam et al. 2018).
Administr. context	**Deployment of automation equipment:** ICT automation equipment is required to provide demand-side flexibility in DH systems. For example, Ahn and Cho (2017) demonstrate an artificial intelligence based system with temperature detectors and user interfaces to reduce peak loads in DH systems. Similar to the electric smart meters, public commitment could boost the deployment of such equipment. The aforementioned provisions in the EPBD on automation and control systems provide a potential starting point for more explicit supranational legislation.

Conclusion on transferability to target context

While DH systems serve large shares of space and water heating demand in many MS, the use of demand response to avoid peak loads is limited to pilot implementations and yet to be deployed in commercial settings. In consideration of the overall fragmented legal framework for DH at the EU level, the primary stimuli for the deployment of such innovative approaches need to come from MS as well as local authorities. Transferability then is likely to increase with the number of successful commercial applications as well as cost savings achieved for DH utilities.

Key EU legislations	Energy Efficiency Directive, Energy Performance of Buildings Directive			
Current status of implementation	Full	Partly	Planned	**Not considered**
Current level of implementation	Supranational (European Union)	National (Member States)	Regional/province	**Local**
Transferability level	High	Medium	**Low**	None

Water heaters as multiple grid resources

Outline of primary context

Policy type: Demand response **Country/province:** United States **Duration:** 2018 – ongoing

Merit in primary context: Hot water heaters are widely used domestic appliances. Traditionally they are used as thermal storage devices by delinking the time of demand for and generation of hot water: heating up water in the tank in periods of low overall power demand (e.g. at night). However, with a minor upgrade, these appliances can provide further grid services as well as saving money for consumers.

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Market structure:** Integrated utilities prevalent in the US are grid companies and retail suppliers – in the European terminology - at the same time. Hence, they are aware both the signals that trigger demand response: high (wholesale) price) and network constraints. In Europe, grid services, such as frequency control could be purchased by the DSO, whereas the thermal storage function of water heaters can be activated either by the supplier (ToU energy tariffs) or the grid company (ToU network tariffs).
	Third-party access to markets: The Hawaiian example is built on the assumption that third-party service providers can enter the markets as intermediaries and/or aggregator of loads. Both OATI (the winner of the utility procurement tender) and Shifted Energy managing the water heater segment are such independent actors. The European legislation guarantees the access of aggregators and other third-party actors to the various markets. The national implementation, however, is still in progress in many Member States. The formal recognition of aggregators does not guarantee their effective operation. Technical rules such as on contracting or on baseline calculation methodology can act as barriers.
	Procurement requirement from the regulator: The program is borne out of the request of the Hawaii Public Utilities Commission that mandated the utility, Hawaiian Electric to launch its Grid Services Purchase Agreement (GSPA) in 2018 to competitively procure approximately 16 MW of capacity. This is the framework in which Shifted Energy - partnering with Open Access Technology International (OATI) – committed to deliver 2.5 MW of grid-integrated water heaters (GIWH). The 2018 GSPA contract was awarded to OATI to deliver aggregated capacity from a combination of residential, commercial, and industrial customer-sited assets, including the 2.5 MW of GIWH from Shifted Energy. OATI aggregates these resources to provide capacity and fast frequency response services to Hawaiian Electric. The Electricity Market Directive requires that DSOs "procure such services from providers of distributed generation, demand response or energy storage and shall promote the uptake of energy efficiency measures, where such services cost-effectively alleviate the need to upgrade or replace electricity capacity and support the efficient and secure operation of the distribution system. " (Art. 32.1).
Socio-cultural context	**Consumer involvement:** As Hawaii's major utility 'Hawaiian Electric' had a water heater programme before its current program, consumers already experienced that the utility using their device does not results in lower comfort. The utility has relied on electric water heaters as demand response devices for years. Its EnergyScout program uses a one-way paging network to control about 34,000 water heaters, which deliver approximately 10 MW of controllable peak demand. The installed device turns off the water heaters during system peak usage, typically for no more than one hour at a time. In Europe water heaters are used for load shifting for decades in many Member States predominantly based on day versus night tariffs. Even though the idea of experiencing load curtailment any hour during the day is different, European consumers probably would accept such a limitation if they are made aware that their convenience of energy service use is not to deteriorate.
	Consumer hassle and risk: The off-tank controller requires a maximum 20-minutes installation anywhere on the electric line between the breaker panel and water heater. As no sensors touch the tank, it does not affect warranties of the device. The installation of the controller requires no plumbing. This is likely to be an important consumer aspect and as such any similar programs in Europe need to consider it and survey potential consumer on their willingness to risk warranty and time needed for the installation.

Conclusion on transferability to target context

Despite the market structure disparities between the US and Europe, water heaters can be used for system services, such as frequency control that goes beyond peak shaving as thermal storages. This is especially relevant resource in European countries with high water heater penetration (high share of electricity based hot water supply) and increasing share of variable renewable generation.

Key EU legislations	Electricity Market Directive, Electricity Market Regulation			
Current status of implementation	Full	**Partly**	Planned	Not considered
Current level of implementation	**Supranational (European Union)**	**National (Member States)**	Regional/province	Local
Transferability level	High	**Medium**	Low	None

Using Time-of-Use tariffs to engage customers and benefit the power system

Outline of primary context

Policy type: Demand response **Country/province:** EU (various MS) **Duration:** 1960s – ongoing

Merit in primary context: Time-of-use (ToU) tariffs in the EU have been an important enabler of demand response (DR) by incentivizing customers to shift their electricity use from high to low demand periods, allowing them to save on electricity expenses. DR thus contributes to the integration of high shares of renewables and to saving investments in generation capacities and network upgrades by shifting demand to off-peak time periods. For example, the French *Tempo* tariff – a critical peak pricing tariff – has been shown to have reduced national peak load by about 4%, with households shifting about 6 GW of load daily (Rosenow et al. 2016).

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Regulatory framework for diffusion of ToU tariffs:** Regulatory frameworks are essential for ToU tariffs to be taken up by consumers and for price signals to deliver effective incentives for DR. Ever since the attempts to promote electronic metering and informative billing in the Energy Services Directive (2006/32/EC), the EU and its MSs have gradually increased efforts towards the support of ToU tariffs. In essence, the recast Electricity Market Directive ((EU) 2019/944) provides that – inter alia – final customers who have a smart meter installed can request to conclude a ToU electricity tariff contract with at least one supplier (Art 11.1), and that MSs shall ensure expedited supplier switching (Art. 12.1). In turn, the recent provisions fall short in strengthening ToU *network* tariffs, which national regulators are only asked to consider in a "foreseeable way" (Art. 18.7, Electricity Market Regulation, (EU) 2019/943) (Pató et al. 2019b). Overall, the diffusion of ToU tariffs across MSs is still limited. As of 2019, electricity consumers in 16 MSs could sign up to ToU contracts with intra-day, weekdays or weekend energy price differentiation. In only eight MSs, electricity consumers can choose real-time or hourly energy pricing (ACER/CEER 2019a).
Socio.-cultural context	**Consumer involvement:** ToU tariffs do not require firm commitment by consumers who are left to decide how and when to react to price signals given. Especially residential consumers have been shown to exhibit preferences for conventional fixed contracts even though they could save money within ToU schemes (ACER/CEER 2016). To increase the responsiveness of consumers to price signals, automation control using smart appliances based on pre-set criteria according to consumers' preferences has proved successful (Fell et al. 2015). Consumers also should be adequately informed about the opportunities and risks of ToU pricing contracts, such as uncertainty about the actual bill level and potentially high price fluctuations over short periods of time (ACER/CEER 2019a).
	Value proposition for consumers: The extent to which consumers anticipate monetary savings from the participation in ToU and DR schemes has been shown to pose a critical barrier to its diffusion (ACER/CEER 2016). This is associated with the typical structure of electricity bills in the EU, consisting of approx. 38% static components (VAT, other taxes, RES charges) and of 25% network charges (ACER/CEER 2019b) for which availability of ToU tariffs is limited. As such, only 37% of the tariff relate to wholesale market dynamics which established ToU schemes primarily account for. Increasing the share of dynamic components is argued to significantly support the uptake of ToU tariffs (EURELECTRIC 2017).
Administrative context	**Deployment of smart metering equipment:** Smart metering equipment is a prerequisite for consumers to be able to opt into ToU schemes. The deployment or "rollout" of smart meters requires appropriate legislation and administrative capacity to ensure that rules are adhered to – such as smart meter design, ensuring data privacy, detailing the timeline for the rollout, assessing costs and likely impacts, and clearly stating which parties (usually suppliers) will undertake the rollout (Warren 2015). Smart meter rollouts in MS are subject to cost-benefit analyses (CBA) (Electricity Market Directive, Art. 19; in accordance with Commission Recommendation 2012/148/EU). When the CBA results in a positive outcome, at least 80 % of final customers shall be equipped with smart meters either within seven years of the date of the positive assessment. When the outcome is negative, Member States shall revise their CBA at least every four years. According to a report from the European Commission, in 2018, (European Commission 2019) there were approx. 99 million smart electricity meters or 34% of electricity metering points (households and small/medium enterprises) installed. However, in seven MSs there are decisions not to implement the roll-out of smart meters based on a CBA, or no decision about a roll-out at all: Bulgaria, Croatia, the Czech Republic, Germany, Hungary, Poland and Slovakia (ACER/CEER 2019a).

Conclusion on transferability to target context

ToU tariffs are in place in many parts of the EU, with hourly real time pricing becoming more commonplace and expected to gradually replace static pricing arrangements. While the Electricity Market Directive and Regulation provide a fundamental regulatory framework, more efforts towards the diffusion of ToU network tariffs are needed. An ongoing challenge is consumer engagement which can be promoted by informing the consumers, and designing the dynamic pricing easily usable.

Key EU legislations	Electricity Market Directive, Electricity Market Regulation, Energy Efficiency Directive			
Current status of implementation	Full	**Partly**	Planned	Not considered
Current level of implementation	**Supranational (European Union)**	**National (Member States)**	Regional/province	Local
Transferability level	**High**	Medium	Low	None

Enabling rules for demand response aggregators

Outline of primary context

Policy type: Market access rules **Country/province:** EU (various MS) **Duration:** 2010s – ongoing

Merit in primary context: Aggregators are emerging market players in the EU that are critical to bundle small and medium-scaled demand-side resources connected to the distribution network to engage as a single entity in power or service markets. Benefits that aggregators have been providing include load shifting, balancing and ancillary services, and local flexibility for DSOs. These services help in avoiding investments in peak generating capacity, deferring investments in transmission and distribution infrastructure, and ultimately, reducing environmental risks (IRENA 2019a).

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Accessibility of multiple value streams:** Aggregators require multiple value streams to operate profitably, covering ancillary services, interruptible loads, capacity mechanisms, TSO/DSO network charges, day ahead and intraday markets, and DSO specific products. At present, in the EU, ancillary services are primarily used for monetising aggregator services (smartEn 2019). France, Ireland and Belgium are considered having the most open and accessible value streams, including capacity mechanisms and wholesale markets. Across these value streams, regulatory frameworks should remove the most undue barriers for aggregators' market entry with the objective to create a level playing field with traditional methods of flexibility (i.e. generation assets) and incumbent players. With the recast Electricity Market Directive (EU)) 2019/944), aggregators are not only granted market access without consent from the suppliers and the balancing party of the consumer, also does it set fundamental rules on data exchange between market participants engaged in aggregation, overall significantly improving the regulatory status of aggregators (Pató et al. 2019b).
	Availability of diverse customer segments and assets: Profitable aggregation requires a diversity of customer segments (industrial, commercial, residential) and technologies with load shifting potential (e.g. HVAC, electric vehicles). Many EU countries have evidence of aggregator activity across all segments and asset types. For example, Denmark employs approx. 100 MW of flexible electric boilers and CHP units in district heating systems, optimised for ancillary services and day ahead markets. In the Netherlands, their activity concentrates to the residential sector, including the integration of electric vehicle chargers, batteries, and electric heating loads (smartEn 2019). Some of these activities are still limited to trials, yet offering significant prospects for monetisation.
Socio-cultural context	**Consumer involvement:** Consumers have different preferences and abilities that aggregators need to respond to. The established business case of aggregators in the EU is explicit demand response, i.e. offering financial incentives for consumers in return for committed and dispatchable flexibility that can then be traded on the different energy markets (wholesale, balancing, reserves markets). This is particularly suitable for larger businesses and industrial sites that have suitable (dispatchable) appliances and processes and that prefer to rely on a stable retail price. In addition, aggregators in the EU, for example *Next Kraftwerke* in Germany, increasingly engage in implicit demand response, i.e. consumers adapting their behaviour (through automation or personal choices) in response to hourly or shorter-term market pricing. While implicit demand response offers new customer segments, the challenge for aggregators is that is does not require a firm commitment by the consumer to adjust consumption at specific times, but leaves it to the consumer's discretion how and when to react to price signals given (SEDC 2016). Automation processes along with an increasingly wide consumer participation can be a way for aggregators in the EU to enhance the predictability and reliability of implicit demand response schemes. Overall, aggregators need to enable both types of demand response to accommodate different consumer preferences and to exploit the full spectrum of consumer- and system benefits from demand response.
Administrative context	**Smart meters & communication structure:** To send optimised dispatch schedules, aggregators require central information technology and automation where data related to weather forecasts, electricity in markets, and the overall power supply and consumption trends are processed (IRENA 2019a). Another key asset are advanced meters to provide real-time price signals to customers engaging with implicit demand response. The Electricity Market Directive supports these aspects by defining a new rollout schedule for smart meters (Art. 19 and Annex III). Member States are allowed a period of 12 years to upgrade their existing metering fleet and must reach the 80 percent deployment target within seven years after the conclusion of a positive cost-benefit analysis. In addition, individual consumers are entitled to a smart meter even in the absence of a national rollout (Art. 22) (Pató et al. 2019b).

Conclusion on transferability to target context

The EU is an active market undergoing development to open more fully to aggregators. In its Member States there are diverse aggregator activities across different value streams, customer segments and asset types, with many nuances to each individual market. With the ongoing transposition of supranational EU legislation (Electricity Market Directive) into national law, the standing of aggregators is further improved compared to incumbent market players.

Key EU legislations	Electricity Market Directive, Electricity Market Regulation			
Current status of implementation	Full	**Partly**	Planned	Not considered
Current level of implementation	**Supranational (European Union)**	**National (Member States)**	Regional/province	Local
Transferability level	**High**	Medium	Low	None

Participation of demand response in French wholesale electricity market

Outline of primary context

Policy type: Market access rules **Country/province:** France **Duration:** 2014 – ongoing

Merit in primary context: The participation of demand response in the various energy market is key for their widespread utilisation. Market access rules in France are probably the most well developed within the EU and hence can serve – despite its deficiencies – as an example for the other Member States.

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**National flexibility target**: Flexibility targets are set in France's multi-year energy planning (PPE – "*Programmation Pluriannuelle de l'Energie*" currently under revision) (MTES 2020). The government is committed to organise additional tenders for demand response in case objectives defined in the energy plan are not achieved. Even if French authorities have proposed to adjust the 2023 flexibility objective downwards and provided a number of reasons for missing the target which was originally set, including a lack of maturity of the sector, having a target reduces the business risk of all parties Involved in demand response. There is no legal requirement for Member States to define their flexibility target even though the some NECPs contain the expected need for flexibility by 2030. Having a target only supports demand resources insofar not meeting them triggers some regulatory change. This is an enabling but not necessary condition for using demand resources in power markets.
	Experience with demand integration: Balancing market started to open up to demand resources as early as 2003. Since then the regulation opened up the rest of the markets, i.e. reserves, capacity and wholesale. This latter is not very widespread in the rest of Europe and even in France it is responsible for only a minor share of the revenue earned by demand resources. There are still some regulatory barriers in France but its power markets can be considered fully open to demand. The rest of Member States (smartEn 2019) lags behind and consumers and aggregators have less experience on how to enter these markets.
	Availability of diverse customer segments and assets: The demand response potential of the French residential sector is higher than the European average due to the substantial electrification of space and water heating. This results in large seasonal load variation and high winter peak. The need for flexibility will increase with further as more to heat pumps (switch from fuel oil) receives financial support and the share of electric vehicles is growing steadily. France is a good showcase for other member states that are ahead of building electrification.
Socio-cultural context	**Consumer involvement:** French consumers have a long experience in participating in power system management through dedicated tariffs. Since the 1960's, EDF has been moving gradually towards real time tariff linked to the marginal costs. They introduced Tempo tariff (mixture of time-of-use and critical peak pricing) in 1993. Additionally, probably the largest residential aggregation project (by Voltalis, an independent aggregator) has been implemented in France as well. The mobilisation of consumers in other Member States would require the education of consumers on the value of demand response and the benefits for them. The automation of demand response is likely to be crucial in mitigating both the hassle of manual response but also the bill risk associated with inaction. Intelligent meters and submeters per equipment, like in the case of Voltalis, can optimise all behind-the-meter operations for the benefit of the consumer and the power system as a whole.
Administrative context	**System operator experience and trust**: The French TSO has already a substantial experience with integrating demand to markets, including the prequalification and baseline methodology. The reliability of demand resources is already established in the French power market. It is the TSO that defines the tender product, that bears responsibility for the reliable operation of the power system and if it is not comfortable with the integration of demand resources and set conditions that are conducive for them than their uptake is likely to remain low.

Conclusion on transferability to target context

Opening up all power markets for demand resources is already an EU requirement (Electricity Regulation Art. 12). There is no real barrier to comply with these legal requirements even though it requires regulatory resources to develop national rules. The business case of demand response and aggregation, however, is a derivative of other power market rules such as moving away from capacity markets and clearing other distortions to energy-only markets.

Key EU legislations	Electricity Market Directive, Electricity Market Regulation			
Current status of implementation	Full	**Partly**	Planned	Not considered
Current level of implementation	Supranational (European Union)	**National (Member States)**	Regional/province	Local
Transferability level	**High**	Medium	Low	None

4.5 Regulatory instruments

Optimising building energy demand by passive-level building code

Outline of primary context

Policy type: End-use performance standards **Country/province:** Belgium **Duration:** 2015 – ongoing

Merit in primary context: Construction and renovation of buildings to passive-house level requires a systems perspective, where the balance between significant demand reduction is met with sustainable and ideally decarbonised fuel supply. However, complex building solutions are reaching a tipping point only very slowly, because of the numerous financial, regulatory and informational barriers. Stepping up from single projects to a wide-scale roll-out has been forecast by experts for a few years, but could happen only in a handful of cases, for example in the Brussels Capital Region. The local building code and its accompanying policies have contributed to a significant improvement of the carbon intensity of Brussels' building sector, with 243 energy performance projects of over 621,000 m² having been awarded financial support between 2007 and 2013 under the so-called BatEx law. Beyond the subsidized projects, ca. 3000 building projects followed the example and were constructed or reconstructed to passive level by 2019.

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Preceding measures that prepared the market:** The introduction of the strict building standards was preceded by a package of voluntary and mandatory policy measures between 2002 and 2014. Key pieces of the policy package were the first thermal requirements in 2002 (K55), which required minimum insulation of new buildings across Belgium from 2002 (IEA 2017), followed by the competitive Exemplary Buildings program, or BatEx from 2007 – 2013, and the Air-Climate-Energy Code (known as COBRACE) in 2013.
	Long-term climate targets: There was a commitment at the federal level (Brussels Capital Region) to ensure compliance with the EPBD, and to achieve reductions of CO_2 emissions of 80% savings in 2050. In addition, improvement of the buildings' energy performance was not seen in isolation, but as a complex solution for costs savings, for the improvement of indoor air quality, for improvement of health, as well as part of urban planning.
Socio-cultural context	**Lead by example:** In 2006, a few public buildings were renovated to passive house level in order to serve as demonstration sites. These proved that construction in an urban setting was technically possible, even with the integration of more complex elements, such as the integration of ecoconstruction elements (such as green roofs). This has kick-started the technology supply market, which was critical, because high-end efficiency and integrated RES technologies were not fully available beforehand.
	Provider side: When started in 2004, efficient equipment and efficient supply solutions were not widely available for passive-house interventions. The program started as a voluntary buildings program without predefining the energy demand improvement level. Instead, the level of the building standard was based on the energy performance levels set by the participants in this competitive setting. Due to the competition, the best and most cost-effective building solutions were implemented, with a constant improvement over the years. This has built up a strong provider side.
Administrative context	**Financial support to kick-start:** The funding was used to boost the market, both on the supply side and the demand side. Financial instruments such as green loans, subsidies and innovative energy performance solutions were combined.
	One-stop shop: As of 2020, another element was added to further increase the success of the implementation of the ambitious building code. A special administrative unit of was established as part of the regional government. The one-stop shop provides technical assistance for free, and manages financial support if needed and granted. Furthermore, the OSS carries out general awareness raising, promotes the buildings built or renovated under the new law, and communicates the successes and challenges of passive-house projects
	Legal grounding: On 2 May 2013, the Brussels Capital Region adopted its Air-Climate-Energy Code (known as COBRACE 90). It served as a legal basis for its Integrated Air-Climate-Energy Plan, which was adopted on 2 June 2016. The "passive house law" (or Energy Performance of Buildings Regulation) was agreed in 2011, requiring the standard for all new construction as of 2015, most renovation from 2017, and further revised in 2019

Conclusion on transferability to target context

The example of the stringent building standard is often referred to as exemplary and other cities and regions learn from successes, as well as from the barriers. There are a few transfer examples. The most evident learning has taken place across Europe, where nearly-zero energy requirements have been adopted as a response to EPBD. Furthermore, New York City has followed the pathways of Brussels in order to contribute to the overall city target of an 80% reduction of carbon emissions by 2050 (Yancey et al. 2016).

Key EU legislations	Energy Performance of Buildings Directive, Energy Efficiency Directive			
Current status of implementation	**Full**	Partly	Planned	Not considered
Current Level of implementation	Supranational (European Union)	National (Member States)	**Regional/province**	Local
Transferability level	High	**Medium**	Low	None

Assessing the value of demand-side resources

Outline of primary context

Policy type: Utility provisions and guidelines **Country/province:** United States **Duration:** 2016 – ongoing

Merit in primary context: US utilities are required to develop appropriate methodologies for evaluating non-wire solutions (NWSs). Designing appropriate methodologies - that consider the societal perspective - is essential for the integration of NWS. NWSs means the use of distributed energy resources (DERs) that includes demand response, energy efficiency but also storage and distributed generation. US utility Con Edison's cost-benefit analysis (CBA) Handbook includes many critical elements required for the fair assessment of demand-side resources.

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Market structure:** US utilities – like Con Edison (ConEd) – are vertically integrated companies involved both in generation, retail and network operations. When comparing demand and supply resources, the scope of benefits and cost pertaining to the utility itself is much wider than it would be in Europe. In Europe the network development plan of a DSO (required by the Electricity Regulation) would need to consider NWSs but would consider only the benefits and costs directly linked to network operation and not including generation that belongs to the competitive segment.
	Utility incentive structure: Legal provisions on CBA methodologies will remain ineffective if there's no parallel incentive structure in place to encourage investments in demand side resources. ConEd could earn a rate of return on the program cost of its non-wire solution that provides an incentive, for considering demand side alternatives for network development. Network company remuneration (Pató et al. 2019a) – even though in most Member States is decoupled – the bias towards capital expenditures is still a persistent feature of most regulations. NRAs in the member states have to consider performance-based regulation, according to the Electricity Directive/Regulation – but it is not mandatory (Electricity Regulation, Art. 18(8)). Aligning incentives is a prerequisite for a fair competition between traditional and demand side solutions. Changing the DSO remuneration scheme to provide incentive for these companies to invest in demand-side options is at the mandate of national regulatory authorities.
	Informational asymmetry: The public utility commissions in the US (national regulators) have more options to reduce their information deficit compared to the utility on the cost of demand resources by benchmarking to similar programs due to the price discovery of open solicitations (tenders) for demand side resources. This is due to the fact the there are already a handful of results for demand side resource tenders that can provide a benchmark when assessing the cost estimations of demand programs provided by the utilities. European regulators are lacking such benchmarking possibility but this will evolve once demand resources are increasingly purchased on flexibility markets across Europe.
	Regulatory guidance: New York Public Service Commission prepared a CBA framework that the utilities have to consider when preparing their own CBA methodology. The framework developed is considered to be a complex but robust benefit-cost methodology encompassing most best practices in demand side resource assessment. This guidance is essential for the utilities to prepare a compliant own methodology. The national regulators in the EU member states are required by EU law to safeguard the inclusion of demand side resources in network development plans as they have the right to ask for amendment to any development plan submitted to their review (Electricity Directive Art 32(4)). Such a guidance would be a key enabling factor in this respect.
Socio-cultural context	**Transparency of planning process:** In the US, the ratemaking process and solicitations are more transparent than in Europe as rate hearings are public events where all relevant stakeholders are involved. In the EU, however, so far network planning processes are limited to the network company and the national regulator. Even though the Electricity Directive now prescribes the involvement of stakeholders, it might take some time for European stakeholders to acquire the necessary technical knowledge to be able to get involved.
Adm. context	**Organizational & human capacities:** US utilities have already some experience (Chew et al. 2018) with using demand side resources and the methodologies to assess the cost and benefits of the various alternatives. In Europe, the DSOs are accustomed to compare various network development alternatives but not comparing demand and supply options. Human capacity and methodology development would be likely required at the onset.

Conclusion on transferability to target context

The standard tests used in the US utility CBA methodologies cannot be applied without modification in the European context due to the different market structure. DSO CBAs would per definition cover a more limited scope of costs and benefits.

Key EU legislations	Electricity Directive, Electricity Regulation			
Current status of implementation	Full	Partly	**Planned**	Not considered
Current level of implementation	Supranational (European Union)	**National (Member States)**	Regional/province	Local
Transferability level	High	**Medium**	Low	None

Updating distribution system planning rules in Colorado and Nevada

Outline of primary context

Policy type: Utility provisions and guidelines **Country/province:** United States **Duration:** 2019 – ongoing

Merit in primary context: Integrated Resource Plans (IRPs) are the key power system planning tools that are used extensively in the US. Traditionally, utilities prepare a separate distribution network plan that feed into the IRP. The integration of distribution network plans is essential for considering DERs on a level playing field in IRPs. Nevada has enacted and Colorado is planning to request such integrated distribution network planning from their utilities.

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Market structure:** As there is no power system planning, similar to IRPs, in Europe the integration of demand side resource forecast to national level planning is limited to aggregating distribution system forecast to the National Energy an Climate Plans based on appropriate integrated modelling that treats demand side resources endogenously.
	DSO planning scope: DSOs are not vertically integrated utilities that are planning at generation and network in a single framework (IRP). In California IRPs are complemented with DRPs (distributed resource planning) as well. Utilities need to plan with the evolution of demand side resources. Similarly, European DSOs have to integrate demand side resources in their distribution network planning by stating the location and the level of flexibility need in their network. Even if a demand side integration has benefits and can defer investment from distribution network through transmission up to generation, the DSO will only consider its own cost and benefits. The regulator will consider just the avoided network cost when comparing demand side resources to network investment, but not the avoided generation capacity. In the European setting, hence, the avoided cost beyond the network is not included in the assessment of alternatives, while from the social point of view they exist.
	Regulatory mandate: Most US state regulatory commissions have the mandate to require from the utilities. Distribution network development plans were mostly kept internal and separate from the States' integrated resource planning efforts. The commissions in Nevada and Colorado change the rules of IRPs to better integrate distribution planning into it. In Europe, the Electricity Directive/Regulation explicitly requires the consideration on demand options in the distribution network development plans. In this respect, the regulatory move in Europe applies to all DSOs in all Member States.
Socio-cultural context	**Transparency of assessment process:** In the US, the ratemaking process and solicitations are more transparent than in Europe as rate hearings are public events where all stakeholders are involved. In Europe, however, network planning is limited to the network company and the national regulator.
Adm. context	**Organizational & human capacities:** US utilities already have some experience with using NWSs and the methodologies to assess the cost and benefits of the various alternatives. In Europe, the DSOs are accustomed to compare various network development alternatives but not comparing demand and supply options. Human capacity and methodology development would be likely required at the onset. Modelling DERs endogenously requires a more detailed knowledge on their -locational specific – impact on the network that goes beyond the aggregate capacity development forecast. The grid value of these resources is also location specific.

Conclusion on transferability to target context

The key issue of transferability is the scope of cost and benefits considered: in the US is contains the whole value chain (from generation to distribution), in Europe DSO plans are limited to those cost and benefits pertaining to the distribution network.

Key EU legislations	Electricity Market Directive, Electricity Market Regulation			
Current status of implementation	Full	Partly	**Planned**	Not considered
Current level of implementation	Supranational (European Union)	**National (Member States)**	Regional/province	Local
Transferability level	High	**Medium**	Low	None

Deferring transmission & distribution infrastructure investments through local end-use efficiency measures

Outline of primary context

Policy type: Utility provisions & guidelines **Country/province:** United States **Duration:** 1990s – ongoing

Merit in primary context: Well-designed, location-specific demand side resources can be used to significantly reduce the costs associated with upgrades in transmission and distribution (T&D) infrastructures, saving money for both the utilities and its customers. For example, U.S. utilities' Con Edison Brooklyn/Queens Demand Management program conducted auctions to procure energy efficiency, demand response, and other resources to achieve more than 22 MW of load reduction, contributing to the deferral of a new $1.2 billion substation.

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Enabling regulatory framework:** Experience from the U.S. context suggests that regulators need to impose requirements on T&D utilities to achieve a reasonable consideration of demand-side resources in utilities' network planning processes (Neme and Sedano 2012). This comes down to clearly defining the scope of resources to be evaluated as well as cost-effectiveness as a major investment decision criterion. The EU's present legal framework provides some impetus in this regard. The Energy Efficiency Directive (2012/27/EU, (EU) 2018/2002) contains the provision for MS to ensure that network operators are incentivised to improve efficiency in infrastructure design and operation (Art. 15.4) – however, without explicit reference to demand-side energy efficiency as an investment option. More pronounced are the provisions for DSOs in the Electricity Market Directive ((EU) 2019/944) to promote the uptake of energy efficiency measures "where such services cost-effectively alleviate the need to upgrade or replace electricity capacity and support the efficient and secure operation of the distribution system" (Art. 32.1). Overall, the extent of these provisions is rudimentary compared to U.S. jurisdictions with successful T&D deferral projects (Neme and Grevatt 2015). Moreover, equivalent legal provisions to consider cost-effective demand-side resources alongside supply-side infrastructures are lacking for natural gas TSOs and DSOs (Bayer 2015).
	Utility incentive structure: Appropriate financial incentives must be in place for T&D utilities to pursue cost-effective alternatives to supply-side investments. Substituting traditional cost-of-service regulation with incentive regulation is already a widespread practice in Europe: most EU countries do use incentive-based regulation in the form of a mixture of a cap regulation (revenue or price cap regulation) (CEER 2020). This can provide some motivation for T&D utilities to invest in energy efficiency and demand response as their revenue is not dependent on the kWhs they distribute (see case example on revenue cap regulation or *Decoupling*). However, this is not sufficient: network companies need to be incentivised in a way that make them indifferent to the type of supply side (CAPEX heavy) and demand side (OPEX heavy) solutions The current mainstream practice is that they earn a rate of return on capital investment and hence they rather choose to invest in assets than to look for alternatives. Promising alternatives are TOTEX mechanisms in which T&D companies are allowed to earn a rate of return on their avoided capital expenditures in order to make the financial incentives for demand-side resources comparable to investment in traditional network assets (Pató et al. 2019a).
Socio-cultural context	**Transparency of planning process:** Effective T&D deferral projects need to move away from traditionally closed planning processes towards the involvement of consumers, energy service companies (ESCO) and other relevant stakeholders to ensure that demand-side measures achieve anticipated load reductions. Examples of well-designed and executed stakeholder engagement processes are reported in (GridLab 2019). At the EU level, such processes are likely to evolve as lessons are learned and incorporated.
Administrative context	**Organizational & human capacities:** Incorporating demand side resources into traditional utility processes requires reliable and adaptable planning tools that allow accurate modelling of loads levels at the circuit and substation level and that provide sophisticated accounting of achievable energy savings and the technical and economic value associated with them (GridLab 2019). Moreover, practical experiences from the U.S. highlight the challenge of facilitating cross-disciplinary collaboration between classic system engineers and those responsible for efficiency program delivery (Neme and Grevatt 2015). Considering the lack of practical experiences with T&D deferrals in the EU, it can be assumed that institutional capabilities are not yet sufficiently robust to effectively plan for, procure, and manage such initiatives at scale.

Conclusion on transferability to target context

To transfer the practice of deferring T&D investments through demand-side measures to the EU context, multiple contextual factors need to be addressed. Appropriate regulatory frameworks and incentive structures are instrumental for enabling a scalable business case for T&D utilities to procure demand-side resources. Public guidelines on screening criteria, competitive solicitation processes, evaluation frameworks, and contracting considerations are subsequent enabling conditions. The overall likelihood of transferability increases the more these requirements are institutionalized and the more practical lessons are incorporated into planning practices.

Key EU legislations	Electricity Market Directive/Regulation, Energy Efficiency Directive			
Current status of implementation	Full	Partly	**Planned**	Not considered
Current level of implementation	Supranational (European Union)	National (Member States)	Regional/province	**Local**
Transferability level	High	**Medium**	Low	None

Replacing a polluting power plant with behind-the-meter resources

Outline of primary context

Policy type: Utility provisions and guidelines **Country/province:** United States **Duration:** 2018 – ongoing

Merit in primary context: The mix of resources including demand-side resources (energy efficiency and demand response) next to distributed generation (photovoltaic) and storage is to be used for substituting a retiring 165 MW fuel oil plant while avoiding the need for building new transmission lines or a new power plant. The selected distributed resources are expected to be operational in mid-2022, when the fossil-fuel plant retires, but the decision was already made in 2018.

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Enabling regulatory framework**: CPUC decision (2019 c) on the electric system reliability procurement for 2021-2023 states that all sources shall be considered toward the 3,300 MW requirement. This covers new and existing sources, preferred and conventional sources, CHP, and demand-side resources. It is interesting to note that CPUC chose not to set a specific target for certain types of resources. The CPUC (2019) states that "resources with different costs and benefits may be evaluated differently, so long as similar attributes are valued similarly".
	Enabling policy of the system operator: CAISO, the Californian system and market operator, has a policy on the consideration of alternatives to address local needs in transmission planning (CAISO, 2013). This was key in working together with Pacific Gas and Electric Company (PG&E), which is a regulated investor-owned utility providing services in this area, to analyse how distributed clean energy resources could become part of an alternative to the outgoing power plant and the consequent need for the reinforcement of the transmission grid. This resulted in the Oakland Clean Energy Initiative (OCEI), which was approved by CAISO in March 2018 (PG&E, 2018). PG&E and the system operator worked collaboratively over to study how distributed clean energy resources could become part of the solution. The system operator determined in its transmission plan that the OCEI would be a clean and affordable option to new transmission or a new fossil-fuel facility. In the EU, only network services (and companies) remain in the regulated segment; generation and supply are market-based activities. For this reason, dealing with a retiring generation asset would involve a different process. Regarding network planning, the new market design (EU, 2019/943 and EU 2019/944) now requires both TSOs and DSOs to consider demand side resources in their network planning that should improve the planning processes.
	CAPEX bias: The CAPEX bias has been a problem in the US in general for the large-scale deployment of DERs for system purposes. As there is 100% return on capex in California, utilities prefer traditional solutions. PBRs are used in some US states but not implemented in any scale. Regulators does not have the capability to take this issue on the agenda. The same problem exists in Europe, where the majority of DSOs are under a remuneration regime favouring capital expenses and PBRs are only used in a handful of countries (e.g. UK, Italy).
	Transparency of grid needs: PG&E maintains a detailed publicly available map showing not only load and generation interconnection possibilities but also the assumptions and results of the distribution planning process that yield grid needs related to distribution grid services (DIDF map: Distribution Investment Deferral Framework map). Transparency of distribution grid capacities is a regulatory requirement in California. Transparency must be weighted against consumer privacy and confidentiality. The EU Electricity Directive/Regulation now requires that DSO provide location-specific information on the flexibility needs on their grid.
Socio-cultural context	**Cooperation with a local energy actor:** East Bay Community Energy (EBCE) is a non-profit energy supplier (community choice aggregator) that resells - mainy renewable - electricity in the East Bay area. The OCEI project is executed as a collaboration of EBCE and PG&E. NWSs contain a mix of resources and their integration requires local knowledge and a trusted local partner.
Administrative context	**Human capacity:** The knowledge and the experience on the use of DER as alternatives for infrastructure development, and their efficient procurement so far is limited in Europe. This is true both for the distribution companies and for the regulatory agencies as well.
	Air quality standards: The repowering of the retiring power plant was not a viable option for the utility due to the stringent air quality regulation in California. This would not even allow for the repowering with fuel switching (from fuel oil to gas). The Europe gas power plants do comply with the air quality standards and hence it is not an effective limitation for generation asset replacement.

Conclusion on transferability to target context

The EU legislation on the transparency of distribution system development plans and the general requirement to consider non-wire alternatives provides the regulatory framework for similar initiatives in Europe. The success of transferability mainly depends on the national implementation.

Key EU legislations	Electricity Directive/Regulation			
Current status of implementation	Full	Partly	**Planned**	Not considered
Current level of implementation	**Supranational (European Union)**	National (Member States)	Regional/province	Local
Transferability level	**High**	Medium	Low	None

Social Constraint Management Zones to harvest demand flexibility

Outline of primary context

Policy type: Utility provisions and guidelines **Country/province:** UK **Duration:** 2018 – ongoing

Merit in primary context: Instead of accommodating increasing electricity demand by extending the capacity of the network, the new Social Constraint Management Zones (SCMZ) initiative of Scottish and Southern Electricity Networks (SSEN) involves the procurement of "non-wires" solutions from residential and community consumers in congested grid areas as a cost-efficient alternative. Operational phase in development (results available only for pilot phase).

Transferability to target context

Context	*Contextual factor*
Political/institutional context	**Additional funding/regulatory incentive:** The SCMZ program was funded through the Network Innovation Allowance, which is an element of the regulatory framework (called Revenue= Incentives + Innovation + Outputs or RIIO) of the UK. The Network Innovation Allowance provides limited funding to Distribution Network Operators (DNO) to use for smaller technical, commercial, or operational projects directly related to the licensees (DNO), network that have the potential to deliver financial benefits to the licensee and its customers. This funding provides financial incentive for the DNO to adopt new, and hence more risky solutions for grid congestion management. The risk involved in new solutions begets some regulatory support to increase the appetite for innovation.
	Solution-neutral DNO regulation: Apart from including a separate innovation budget, the RIIO framework of the UK is the only one in Europe that fundamentally relies on output-based incentives to regulate DNOs and TSOs. Using more demand-side resources that increase operation expenditures (OPEX) would require the alignment of network company regulation and the elimination of the CAPEX bias.
	Political will of the local authorities: Depending on the countries, the local authorities might have direct links with the DNOs (e.g. being in their executive board, being owners of the network). Their political will and priorities might then have an influence on whether the DNO will try new solutions or not. The involvement of the local authorities can also be through their own local energy efficiency programmes, then providing the DNO with a source of demand-side resources, either directly or through tenders like in the SCMZ initiative.
	Heat decarbonisation policy: Even though heat decarbonisation policy in the UK is still immature with only approximately 250,000 heat pumps deployed. With increasing loads – however - flexibility will become more important and heat pumps can be managed smartly to minimise the impact of adding new loads on the power system. The UK has set an ambitious policy target for substituting gas-based heating with heat pumps: 600,000 heat pumps every year by 2028. Heat pumps are excellent flexibility resources and the growth of their prospective capacity across the country makes the procurement supply bigger and more diverse. Having strong heat decarbonisation policies is a key enables for flexibility supply.
Socio-cultural context	**Will of the DNO to try alternative solutions:** The professional culture of DNOs is focused on ensuring the reliability of the network, using solutions they know well, and they can control directly. Considering demand-side resources as possible alternative solutions might change their habits, require to work with new partners (see above), develop new types of monitoring systems, etc.
	Community outreach: SSEN formed a partnership with NEA, an organisation that has good outreach to local communities. This is a good way to build trust for the quite novel project and to mobilise potential service providers with matchmaking events and support from the idea until the tendering. The UK is well known for its wide and effective community groups engaged in energy and social issues. DNOs in other Member States might find it harder to team up with such a partner.
	Stakeholders developing/aggregating demand-side resources: An initiative like SCMZ can be a way to stimulate the development of demand-side resources. If such resources are already developed (e.g. by ESCos or local energy efficiency programmes), this can increase the chances of success.
Adm. context	**Deployment of smart meters:** End-users need to be equipped with smart meters capable of registering the time of use to be able to participate in such schemes. Metering data 1) helps to identify the areas and end-uses to target; 2) can provide end-users with tailored energy advice or detailed feedback on their consumption pattern; 3) is needed for the settlement of accounts.

Conclusion on transferability to target context

The key factor in making demand-side flexibility resources more attractive for DNO is to provide the proper incentives for them to use these resources, whenever cost-efficient or create more value for the society compared to network capacity extension. Such network company regulation is lacking in the majority of Member States, even though the EU Electricity Directive/Regulation recommends the use of performance-based regulation. Complementary enabling or accompanying factors (e.g. involvement of local authorities, partner organisations for community outreach, deployment of smart meters) can facilitate the development of such initiatives.

Key EU legislations	Electricity Directive, Electricity Regulation			
Current status of implementation	Full	**Partly**	Planned	Not considered
Current level of implementation	Supranational (European Union)	**National (Member States)**	Regional/province	Local
Transferability level	High	**Medium**	Low	None

5 CONCLUSION

The concept of Efficiency First (E1st) applies across many areas of energy policymaking, planning, and investment. At the international level, various examples of policies, regulatory frameworks, utility programmes or other initiatives put the notion of E1st in practice. In a previous report (Pató et al. 2020b), the ENEFIRST project compiled and characterized a set of 16 case studies on such international experiences with the E1st principle. A next step is to explore if the merits of these experiences can be replicated in the jurisdiction of the EU, to drive the implementation of the E1st principle in EU policymaking. Against this backdrop, the **objective of this report was to systematically assess to what extent the previously identified international experiences on E1st are transferable to the political and legal system of the European Union and its Member States**. Emphasis was placed on the transferability of experiences in single countries or regions to the level of supranational EU jurisdiction. For cases already adopted in EU legislation, the objective was to determine factors that impede greater effectiveness.

With respect to the theoretical foundations, it can be concluded that the existing **literature on policy transferability generally recognises the significance of contextual factors** for policies to replicate the achievements from their primary context in the target context. Contextual factors are manifold, covering the institutional and structural setting, socio-cultural concerns, and the administrative capacity of the target country. In principle, there is nothing that prevents policymakers from simply copying a policy or regulatory approach that has proven successful to the domestic jurisdiction. However, as the literature suggests, **the more similar the contextual factors in the target context are to the ones in the primary context, the more likely it is that the policy will yield similar outcomes and achievements**. In accordance with the theoretical background, the methodology adopted in this report is centred on determining transferability by assessing relevant contextual factors for each of the 16 international experiences identified.

The 16 policy transferability frameworks suggest that **eight of the international experiences identified feature a *high* transferability level, meaning that they are either readily transferable or already have been adopted to a large extent in EU legislation**. For example, time-of-use tariffs (see case *Using Time-of-Use tariffs to engage customers and benefit the power system*) are already in place in many parts of the EU, with the Electricity Market Directive and Regulation providing a fundamental regulatory framework. However, the high level of transferability is not meant to indicate that implementation in the EU is fully completed. Instead, it suggests that there remain minor contextual factors that need to be considered when attempting to augment the measure's effectiveness as well as to expand it to all 27 Member States and all relevant market segments (e.g. applying time-of-use schemes to network tariffs).

Seven international experiences are found to feature a *medium* transferability to the target context of the EU and its Member States. This means that there exist a number of significant contextual factors that impede a direct transfer to the EU context and that are expected to result in less successful policy outcomes than in the primary context. From the transferability matrix (Chapter 4.1) it becomes apparent that these are mostly experiences from the US context and, more specifically, closely associated with the tradition of Least-Cost Planning (LCP) – i.e., the practice of encouraging or requiring utilities to consider demand side resources alongside supply side assets in their planning processes by virtue of regulatory control.[5] As pointed out in Chapter 3.2 re-elaborated upon in the transferability assessments, a major contextual factor for these cases is market structure, i.e. the question which market activities (generation,

[5] The first report of the ENEFIRST project (Pató et al. 2020a) features a detailed account of the history and background on Least-Cost-Planning and the related concept of Integrated Resource Planning (IRP).

transmission, distribution, retail) are unbundled from the other ones and which activities are conducted on a competitive basis or remain monopoly businesses. Contrary to most parts of the US, the EU features liberalized markets for power and gas, with competition in the activities of generation and retail and monopoly structures for energy transmission and distribution. In practice, this means that only the latter two market activities are suitable for regulation-approved LCP approaches, with the former two instead being subject to market forces to establish prices and thus investment incentives. As elaborated on in the transferability assessments, this difference in market structure significantly reduces the leverage points for energy efficiency and demand response to defer supply side infrastructures.

Finally, this report identified **one international experience with E1st that, in its present condition, is assigned a *low* level of transferability**. This is the case of *Demand flexibility in district heating networks* which is currently limited to pilot implementations and yet to be deployed in commercial settings. Besides its overall market prospects being uncertain, there hardly is an enabling regulatory framework for district heating and cooling at the EU level that would encourage such initiatives. It is thus concluded that in this particular case, future transferability to supranational EU Directives and Regulation is not completely inconceivable. However, the primary stimuli for its future deployment need to come from the Member States as well as local authorities as the major decision-makers in district heating and cooling policy and planning.

It should be noted that this report cannot depict the actual likeliness of policy transfers between the primary contexts and the target context of the EU. **Whether a policy approach will *actually* be adopted depends on the outcome of complex political decision-making processes**. Just because there may be no substantial contextual factors that impede transferability, it does not mean that policymakers will readily adopt the policy approaches from abroad. The case of Energy Efficiency Obligation Schemes (EEOS) described in the Chapter 1 clearly illustrates that policy transfer is more appropriate to be thought of as a lengthy and gradual process instead of a one-time action of policymakers.

To conclude, **policymakers in the EU and its Member States can certainly learn from their counterparts elsewhere to establish a level playing field between demand and supply side resources and thus help embed the E1st principle**. As discussed in (Pató et al. 2020a), the E1st principle itself is a very recent concept in the EU energy and climate policy framework that has certainly been inspired by established practices, including, 'Integrated Resource Planning' and 'Energy Efficiency as a Resource' in the US context. However, despite these similarities and as the analysis in this report has pointed out, the EU system features particularities in terms of institutional, socio-cultural and administrative aspects that, ultimately, do not allow for a direct transfer or replication of existing practices from abroad. Instead, **embedding the E1st principle in the EU, and truly putting demand side resources on equal footing with supply side infrastructures in all relevant instances, will certainly require a custom set of policy and regulatory approaches that go beyond existing international practices**. The overall topic of effective policy design for implementing the E1st principle will be further investigated in upcoming reports of the ENEFIRST project:

- Several upcoming reports use energy systems modelling to quantify the possible long-term effects of embedding the E1st principle in the EU buildings sector and thus indicate key sectors and end-uses to be addressed in policy design.
- A parallel series of reports is dedicated to exploring possibilities for introducing E1st in specific EU policy areas and to designing a set of policy options.

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ACRONYMS AND ABREVIATIONS

BEC	Better Energy Communities
BER	Building energy rating
CBA	Cost-benefit analysis
CHP	Combined heat and power
DER	Distributed energy resources
DH	District heating
DR	Demand response
DRP	Distributed resource planning
DSO	Distribution system operator
E1st	Efficiency First
EED	Energy Efficiency Directive
EEOS	Energy Efficiency Obligation Scheme
EPBD	Energy Performance of Buildings Directive
EPC	Energy performance certificate
EU	European Union
FIT	Feed-in tariff
GIWH	Grid-integrated waterheaters
GSPA	Grid services purchase agreement
HVAC	Heating, ventilation and air conditioning
IRP	Integrated Resource Planning
MS	Member State
NECP	National Energy and Climate Plan
NRA	National regulatory authority
NWS	Non-wire solutions
OATI	Open access technology international
PV	Photovoltaics
RES	Renewable energy sources
SEAI	Sustainable Energy Authority Ireland
T&D	Transmission and distribution
ToU	Time of use
TSO	Transmission System Operator
US	United States