What does the energy efficiency first principle mean in practice?

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Summary

Energy Efficiency First (E1st) is now an established principle of EU energy policy. Energy efficiency is one of the five dimensions of the Energy Union. To emphasise the prominent role of energy efficiency, the E1st principle has been embedded in various legislative pieces of the Clean Energy for All package adopted in 2018-2019 (European Commission 2016), especially with an official definition included in the overarching Governance Regulation of the Energy Union ((EU) 2018/1999).

In line with the approach of the Governance Regulation, the E1st principle is about a more integrated view of the energy systems, considering options on the supply side and demand side with a level playing field. While it might look straightforward at first sight, it requires a paradigm shift to consider more systematically the multiple impacts of investment decisions related to energy systems, as well as multiple timeframes (from short to long term). To address this, there is a clear need of resources to help policy makers and stakeholders walk the talk.

The ENEFIRST project aims at developing such resources and at showing how the E1st principle can be implemented in practice. We started by analysing the background of the E1st principle and developing a definition that can be used to operationalize the concept. The next step was to review 16 “real-life” examples where the E1st principle, or similar approaches, have been implemented.

The non-comprehensive collection of examples shows that the benefits from implementing E1st can occur at various scales and time horizons. From short-term flexibility in the energy demand (e.g. with Time-of-Use tariffs or demand response) to long term reductions in GHG emissions by avoiding lock-in effects for energy savings in buildings. From limiting the needs of on-site heat generation (as done with the Fabric first approach developed in Ireland) to avoiding building a new power plant (as done in California).

This review of examples and a first general analysis of barriers show that implementing E1st goes beyond adapting the frameworks for investment decisions to accommodating demand-side resources. It requires to have a broader view of the possible solutions to meet the energy needs, to break the silos, favour more interactions and coordination among actors of the supply-side and demand-side, and take the entire energy system and its implications on society into account.

Background

Efficiency First (E1st) is now an established principle of EU energy policy. Energy efficiency is one of the five dimensions of the Energy Union. To emphasise the prominent role of energy efficiency, the E1st principle has been embedded in various legislative pieces of the Clean Energy for All package adopted in 2018-2019 (European Commission 2016). The ‘energy efficiency first’ principle has thus officially been defined in the Regulation (EU) 2018/1999 on the governance of the Energy Union:

> " *'energy efficiency first' means taking utmost account in energy planning, and in policy and investment decisions, of alternative cost-efficient energy efficiency measures to make energy demand and energy supply more efficient, in particular by means of cost-effective end-use energy savings, demand response initiatives and more efficient conversion, transmission and distribution of energy, whilst still achieving the objectives of those decisions*." (Governance Regulation, Article 2(18))

Similar concepts such as 'Integrated Resource Planning' (IRP) and 'Energy Efficiency as a Resource' have been developed in the U.S. and tried in some European countries. The well-documented U.S. experience shows how this type of approach can be implemented in the electricity sector. The European policy goal, however, is to implement E1st in the entire energy system (Mandel et al. 2021).

Another difference is that the time horizon considered in the implementation of IRP, or similar concepts, in the U.S. is often in line with the cycles of utilities' energy planning, that is, five to ten years, whilst E1st in Europe is thought to be applied in multiple timeframes, from short-term investment planning to medium-term targets (for 2030) and long-term goals (for 2050).

Yet another important point of the E1st principle is the scope of costs and benefits considered when comparing supply-side and demand-side resources. For a fair comparison, it is needed to expand a narrow quantifiable BCA (Benefit-Cost Analysis) scope and take into account multiple impacts, hard-to-monetize benefits for the society as a whole, along with the experience gained in assessing them.

The E1st principle therefore aims at prioritizing demand-side resources (i.e. end-use energy efficiency and demand response) over investments in energy infrastructures (i.e. generators, transmission and distribution networks, utility-scale storage), acknowledging that energy efficiency can contribute to meet multiple objectives and is closely linked to all Energy Union dimensions.

In practice, putting efficiency first represents a paradigm shift. To date, E1st has only been defined in general terms. Policymakers and market actors need guidelines for words to materialize into actions.

The EU and its Member States have now, and in coming years, to make critical investment decisions about their energy systems. E1st is about ensuring that opportunities to value the most beneficial options are not missed, that there are no lock-ins created for investors and citizens, and that today's decisions will not undermine achievement of long-term climate goals.

This paper provides an overview of the first results from the ENEFIRST project that investigates what implementing E1st means in practice and how it can be done, thereby providing Member States and stakeholders with resources to operationalize the E1st principle in their practices and decision making.

The ENEFIRST project and its methodology

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

The objectives of ENEFIRST are:

- To define the principle of E1st in practical terms
- To map how E1st has been applied internationally and in the EU
- To assess the value of applying E1st across different policy areas and to quantify potential impacts for buildings' end use and related energy systems
- To develop policy proposals for the implementation of E1st in the EU buildings sector

The methodology of the project is based on three pillars:

- Identification of the most relevant policy areas where the E1st principle can be applied to achieve the highest impact in terms of energy system benefits.
- Application of E1st in existing policy instruments, through assessing the applicability & transferability of international E1st approaches and quantifying the impacts of E1st.
- Engagement with stakeholders to apply E1st through the design of new policy instruments and analyse their application in country case studies.

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

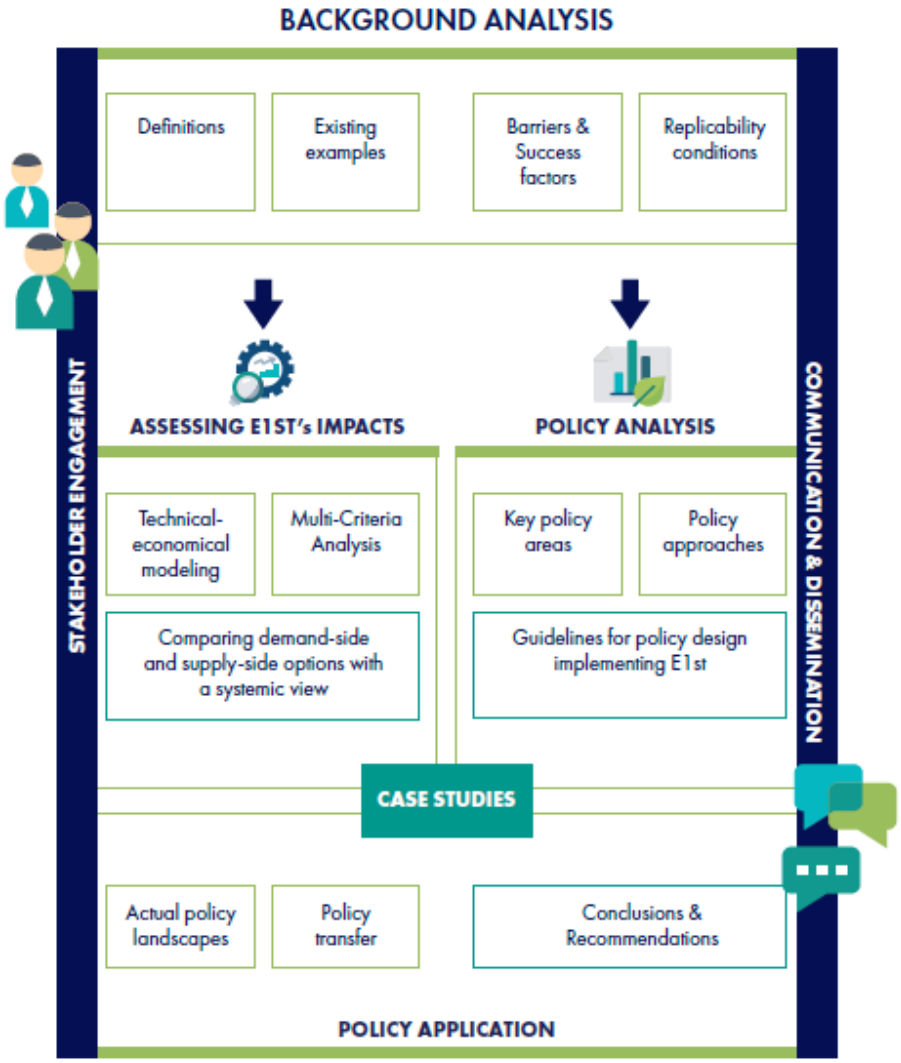

Figure 1. Process of the ENEFIRST project.

Paving the way from theory to practice

Developing a practical definition of the E1st principle

A first step of the project has been to analyse the background of the E1st principle and its existing definitions, in the EU legislation as well as in the literature (ENEFIRST 2020a). The terminology of "Efficiency First" or "Energy Efficiency First" is mostly used in Europe. It is not used in the U.S., although

the need to consider all available resources has existed in U.S. utility planning for decades, through other similar concepts including 'energy efficiency as a resource'. The Canadian state of Ontario has also been promoting a similar approach of "Conservation First"[1].

More specifically about "Efficiency First" or "Energy Efficiency First", we looked at the common elements in the various definitions found, with the aim to develop a definition that could summarize these elements and highlight them in a practical manner.

The first point was to decide whether to use "Efficiency First" or "Energy Efficiency First". Though the difference between them is subtle, there are a few arguments in favour of exclusively using the former term ("Efficiency First"). Not only for the purposes of our project but also for creating a shared understanding and usage for future use and policy making:

- Energy efficiency is a well-established notion that strongly connotes only end-user energy efficiency; hence the term 'Energy Efficiency First' is more likely to exclude other demand-side options (e.g., demand-response) in people's minds.
- Efficiency First, on the other hand, covers only a subset of energy efficiency policies and tools: those that are in the context of alternatives to supply-side options.

The core of the concept rests in the equal consideration of supply and demand resources but with no positive discrimination of the latter. That translates in the short term into the elimination of negative discrimination.

The primary contexts that are used in the various definitions are energy planning and investment decision-making, and the goal to define the least-cost resource mix. Although this goal setting is clear in theory, the inclusion and monetization of all cost and benefits, the definition of the beneficiaries (participant, energy company, energy systems, society) and the assessment methodology have a large impact on the actual least-cost mix.

The various existing definitions are thus more or less explicit in acknowledging that energy efficiency can have benefits beyond energy savings and in prioritizing demand-side resources over supply-side options when demand-side resources are as or more cost effective.

Based on these analyses, the definition of E1st adopted for ENEFIRST is as follows:

> "*Efficiency First gives priority to demand-side resources whenever they are more cost effective from a societal perspective than investments in energy infrastructure in meeting policy objectives. It is a decision principle that is applied systematically at any level to energy-related investment planning and enabled by an 'equal opportunity' policy design*". (ENEFIRST, 2020a)

This definition encompasses all the key elements identified in the above analysis:

- To systematically consider available demand-side resources before deciding about any investment in energy infrastructures, at whatever level decisions are being made (from end-users' to the EU level).
- To ensure in practice a level playing field ('equal opportunity') when comparing demand-side and supply-side options.

[1] https://www.ontario.ca/document/2013-long-term-energy-plan/putting-conservation-first

- To relate the comparison with the policy objective(s) that the decision can contribute to.
- To acknowledge the importance of society's perspective in addition to the investor's perspective, which implies:
    - to define a scope of comparison that acknowledges the full value of demand-side resources (i.e., taking into account multiple impacts in line with the policy objective(s) and not just direct energy impacts);
    - to consider the time horizon of the investors but also the timeframe of the policy objective(s).
- And as a result, to prioritise demand-side resources, whenever it is cost-effective, taking into account the elements listed above.

Operationalising the E1st principle

Investment decisions are at the core of making E1st operational as it is essentially this point where demand-side resources get adopted and used. These decisions — whether they are made in front of or behind the meter and whether they concern electricity, gas or heat as infrastructure-bound energy carriers — are nested in an overall policy and regulatory framework. Embedding E1st in strategies and policies thus requires provisions that put demand-side resources on par with traditional supply investments.

To be able to make the E1st principle operational, we have to move beyond general definitions and identify the applicability of the concept in various relevant energy policy areas. These umbrella policies reflect the overall political targets (as an administrative demand for action) and provide the overall policy direction and the main implementation tools. Investment decisions are driven by these policies. These umbrella policies should ensure that demand-side resources are recognised in national legislation and regulations.

The E1st process could be summarized as follows (and shown in Figure 2). First, all potential demand and supply options are compared and analysed, and their methodologies examined. Once the comparison is made, the various actors make their investment decisions. The role of the national regulator or public authority is to monitor the effectiveness of the regulation and adjust it if needed.

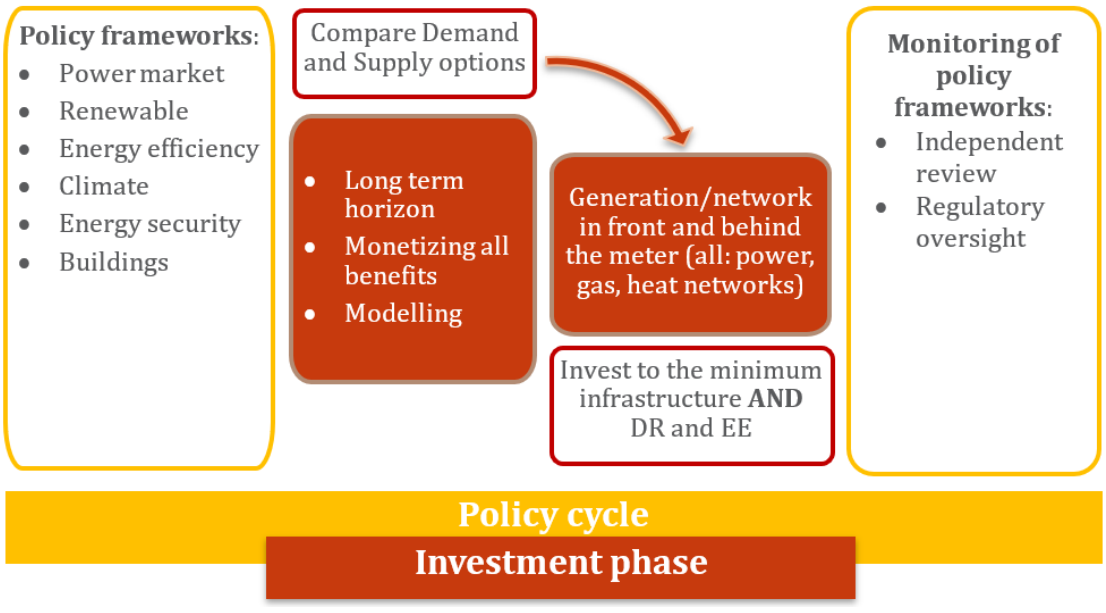

Figure 2: Investment decisions embedded in the policy cycle

Investment decisions are taken by consumers (behind the meter) and network and generation companies (in front of the meter) (see Figure 3).

The characteristics of in-front-of-the-meter investment decisions are the following:

- Aim at generating, transporting or storing energy (all supply-side investments).
- Relate to power, gas and heat networks (per energy carrier).
- Are made by energy companies that are either market players (power plants or storage) or regulated entities (network companies in Europe).
- Consider the source or fuel choice (technology for power, gas source, DH fuel choice), which has implications for generation and network investment.

Behind-the-meter investments on the other hand:

- Can target both (distributed) supply and demand.
- Can be grouped according to end-use (space and water heating, space cooling, electrical appliances and lighting, etc.).
- Are made by the owner and/or the tenant of the property.

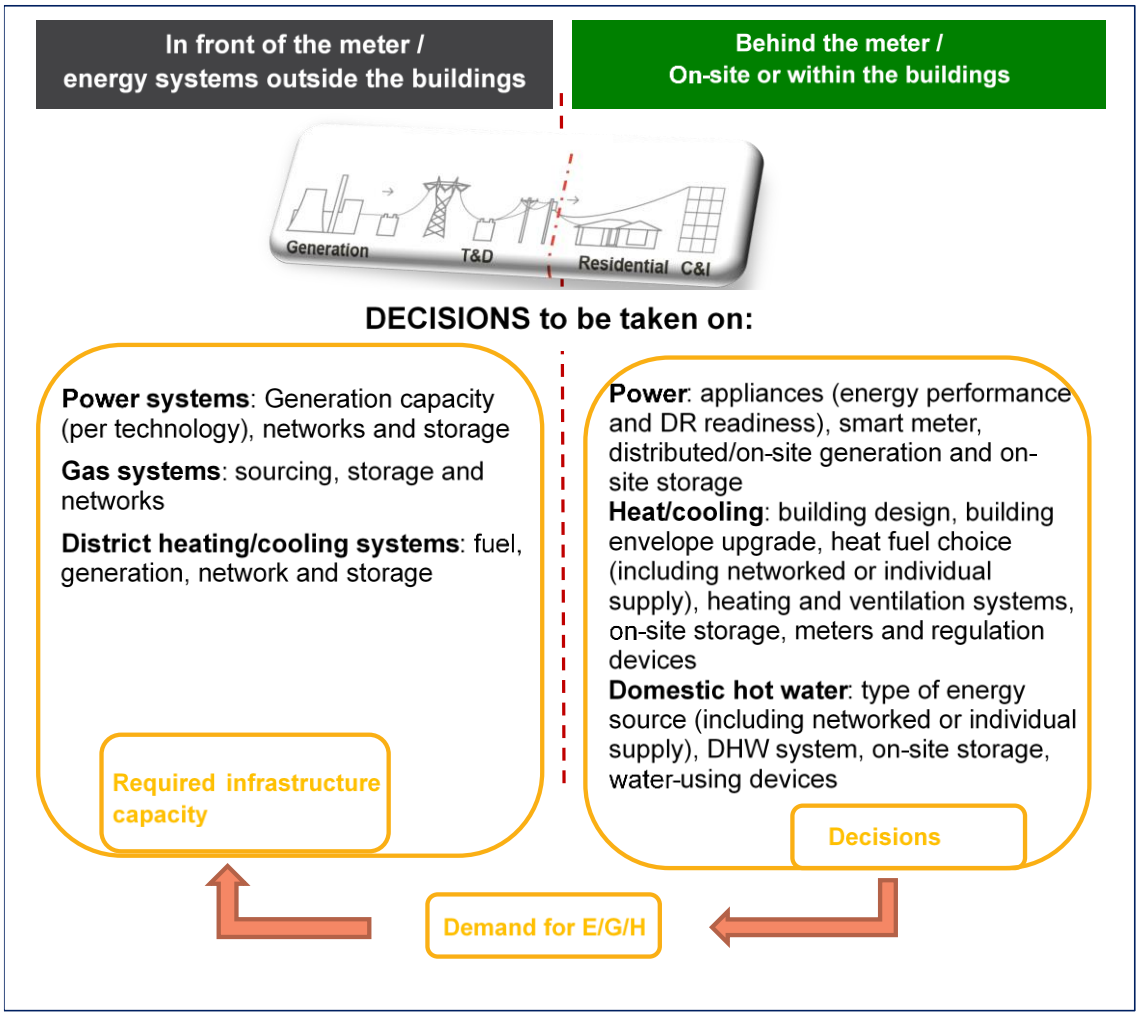

Figure 3. In-front of and behind the meter investment decisions.

The investment decisions of final consumers and energy companies are strongly interrelated: households' demand-side, storage and on-site renewable generation investments reduce the needed

volume (and change the timing) for networked supply. Hence, the policies and regulation aiming at final consumers, energy use and production have important implications at higher levels, such as the city, region, country or continent. Households that electrify their heating, for example, have an impact on the local, national and European power network by increasing the load and potentially changing the load pattern. On the other hand, a massive switch from gas to power in heating might call into question the need for new transcontinental gas pipelines, or a switch away from district heating could compromise the economic viability of existing heat networks.

For more details about the analysis of the policy frameworks and actors involved in decision making per policy area, and about the process to make comparisons between supply-side and demand-side options, see (ENEFIRST, 2020a). As a complement to the analysis of decision paths, the next section provides hands-on examples where the E1st principle (or similar approach) has been implemented.

"Real life" examples implementing the E1st principle

Objectives and methodology

We reviewed a set of 16 examples of policies, regulatory frameworks, utility programmes or other initiatives that have implemented the Efficiency First (E1st) principle in practice (see Table 1 in the sub-section below). Our objectives were to analyse why and how E1st has been implemented, and what lessons can be learned from these experiences. These examples also show policymakers, regulators and energy policy actors in general that the concept of E1st can be implemented and can provide various benefits to the energy transition.

Each example has been analysed according to the following issues:

- Background: rationale and main reasons why the initiative was launched/adopted, who is involved, how it works, the current status.
- How the E1st principle (or similar concept) has been implemented: how is the approach used in line with the E1st principle, the driver behind the choice of approach (e.g., legislation, energy regulation, specific objectives), and the role of the implementing bodies and stakeholders involved in the implementation of the initiative.
- Effects and impacts: information about the effects and impacts, and how these are monitored or evaluated.
- Changes over time: brief history of changes in features and implementation of the initiative.
- Barriers and success factors: barriers that had to be overcome (or that are still impeding the implementation of E1st) and the success factors that made it possible to overcome them, to involve stakeholders, etc. The analyses on barriers from the examples were complemented with a targeted literature review and an online survey (ENEFIRST, 2020c).
- Replicability and scalability: potential of the approach to be replicated elsewhere or to be scaled up. Transferability was analysed more in details in (ENEFIRST, 2020d).

The examples have been identified through literature review, personal communication, and web search. We did not aim for an exhaustive review. Our objective was to cover a diversity of situations and approaches (e.g., types of policy, framework or initiative, types of energy carrier targeted, etc.).

Our objective was also to include examples that clearly demonstrate the implementation of an approach in line with E1st — even if the use of the E1st principle was not explicit. Indeed, the official definition of E1st was only adopted in late 2018 in the Governance Regulation (see above). Therefore,

the term itself is not yet widely used by policymakers and stakeholders, although approaches in line with the E1st principle have sometimes been implemented for many years.

Another point was to select new examples, i.e., not already available in the literature, especially in (Rosenow et al., 2016). Examples available in the literature could be selected if a significant update seemed interesting to make.

The 16 selected examples can be categorised in various ways, such as according to the level and/or actor of decision/rule making, the energy carrier (electricity, gas, heat) concerned, or the EU policy affected. When trying to identify a typology that captures the implementation of the E1st principle most closely and offers comprehensive, yet not overlapping categories, we singled out two dimensions:

1) Which section of the energy system is driving the measure:
    - **in-front-of-the-meter** infrastructure development and usage (such as generation, transmission and distribution power and gas networks, district heating networks, utility scale storage);
    - **or behind-the-meter** infrastructure development and usage (e.g., all investment linked to the building such as space and water heating, electrical appliances, lighting, PV, micro-storage, automation/AMI allowing demand response, etc.).
2) Whether the provisions behind the equal treatment of demand and supply options:
    - focus on the use of these demand-side resources in energy system and market operation **in general**;
    - or are specifically linked to **investment decisions**.

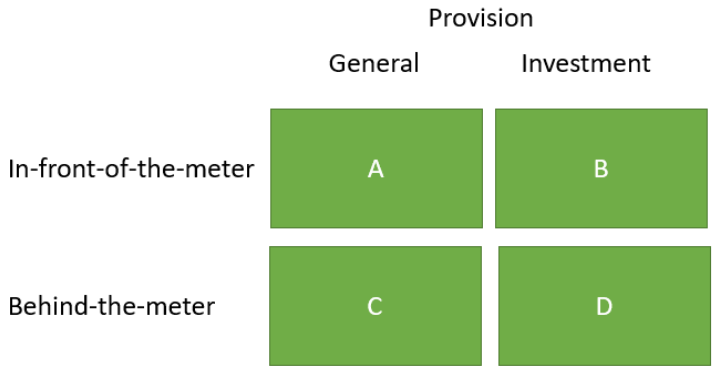

Figure 4 – Main categories of provisions to implement E1st

In this typology, “in-front-of-the-meter” means that the E1st provision applies to energy companies or other stakeholders involved in energy markets. “Behind-the-meter” means that the E1st provision first applies to energy end-users or building owners.

Likewise, “general” means that the E1st provision mainly deals with general frameworks (e.g., energy market regulations). “Investment” means that the E1st provision mainly deals with rules or incentives for investment decisions.

Moreover, we also found that the requirement level of the provisions or rationale to implement E1st varies considerably: from voluntary initiative (e.g. pilot projects) to conditioning supply infrastructure investment on the execution of a priori demand reduction. We capture this dimension in the following labels that are attached to each example to show how prescriptive the implementation approach is:

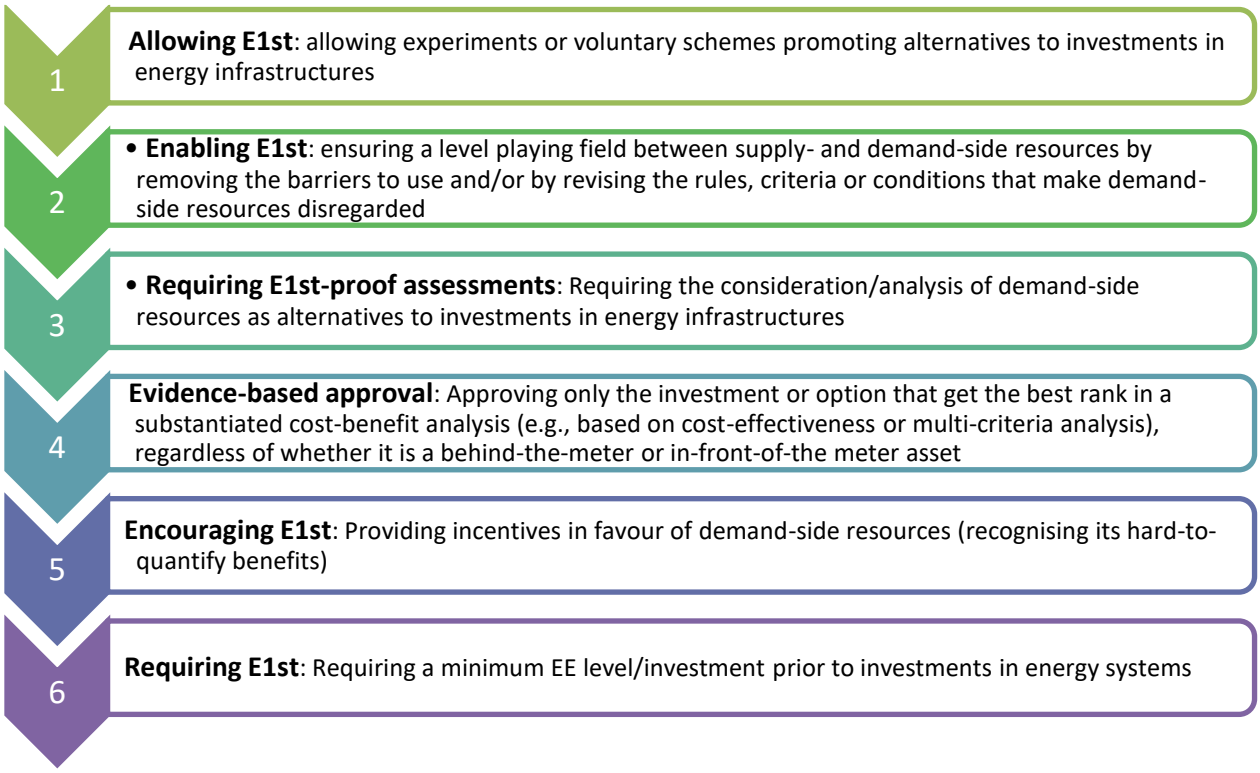

Figure 5 – Requirement levels to implement E1st

Overview of the examples

Table 1 presents the 16 examples analysed in the ENEFIRST project. Their full description can be found in (ENEFIRST, 2020b) and at: https://enefirst.eu/examples/

Table 1 – List of examples about implementing E1st

No.	Case	Type of provisions	Level of requirement	Region / Country	Targeted energy carrier(s)
1.	Using ToU (Time-of-Use) tariffs to engage consumers and benefit the power system	A. In front/ General	1. Allowing E1st	EU	Electricity
2.	Social Constraint Management Zones to harvest demand flexibility	A. In front/ General	1. Allowing E1st	UK	Electricity
3.	Demand flexibility in District Heating networks	A. In front/ General	1. Allowing E1st	EU	Heat
4.	Participation of Demand Response (DR) in French wholesale electricity market	A. In front/ General	2. Enabling E1st	France	Electricity
5.	Enabling rules for Demand Response (DR) aggregators	A. In front/ General	2. Enabling E1st	EU	Electricity
6.	Decoupling utility sales and revenues	A. In front/ General	2. Enabling E1st	EU	Electricity/Gas
7.	Replacing a polluting power plant with behind-the-meter resources	B. In front/ Investment	2. Enabling E1st	U.S. (California)	Electricity

No.	Case	Type of provisions	Level of requirement	Region / Country	Targeted energy carrier(s)
8.	Updating distribution system planning rules in Colorado and Nevada	B. In front/ Investment	3. Requiring E1st-proof assessments	U.S.	Electricity
9.	Assessing the value of demand-side resources	B. In front/ Investment	3. Requiring E1st-proof assessments	U.S. (New York)	Electricity
10.	Water heaters as multiple grid resources	C. Behind / General	1. Allowing E1st	U.S. (Hawaii)	Electricity
11.	Building Logbook – Woningpas: Exploiting efficiency potentials in buildings through a digital building file	C. Behind / General	3. Requiring E1st-proof assessments	Belgium (Flanders)	All
12.	Optimising building energy demand by passive-level building code	C. Behind / General	6. Requiring E1st	Belgium (Brussels Capital)	All
13.	Deferring T&D (Transmission & Distribution) infrastructure investments through local end-use efficiency measures	D. Behind/ Investment	1. Allowing E1st	U.S. (California)	Electricity
14.	Building energy performance requirements of the Irish Heat Pump System grant	D. Behind/ Investment	6. Requiring E1st	Ireland	All
15.	Fabric First approach under the Better Energy Communities grant scheme	D. Behind/ Investment	6. Requiring E1st	Ireland	All
16.	Linking RES (Renewable Energy Sources) support to building energy performance	D. Behind/ Investment	6. Requiring E1st	UK	All

Half of the examples analysed deal specifically with the electricity system. This predominance in the sample can be explained by the fact that interactions between supply and demand are critical for electricity systems at all times. Therefore, options such as demand-response or time-of-use tariffs have mostly been developed for electricity. This can also be seen, for example, in the history of Integrated Resource Planning that has been mostly focused on planning for the needs of electricity systems (see more details in ENEFIRST, 2020a). The supply of the other energy carriers can be more easily controlled and adapted to the demand.

Most of the examples not dealing specifically with electricity can be considered as dealing with all energy carriers. These interventions either deal with all energy end-uses in buildings or are focused on heating without focusing on a particular energy carrier. These interventions are indeed sometimes allowing, or even encouraging, energy switching. More generally, reducing the energy consumption is most often one of the main objectives of the initiatives described in these examples.

Only a few examples specifically address natural gas and district heating because these types of cases were more difficult to identify. The same can be observed in the list of examples found in other sources (see Table 2 below).

The benefits of an improved flexibility in the demand are more obvious for electricity systems. However, all energy systems can benefit from an improved demand-side management. Moreover, demand response is only one of the demand-side resources. The implementation of the E1st principle deals with other demand-side resources, and especially with end-use energy efficiency aiming at a reduction of energy consumption. Any energy efficiency programme could thus be considered as contributing to the implementation of E1st. Moreover, there are options that involve both demand response and end-use energy reduction: for example, high energy performance buildings can act as storages and allow for an operation of electric heat pumps more aligned with the power system. However, in ENEFIRST, we focused on examples where energy efficiency is explicitly promoted taking into account the interactions with energy systems that supply the energy to meet the targeted energy need(s) or end-use(s).

Two of the examples use a geographically-targeted approach (see examples 2 and 13). Example **Erreur ! Source du renvoi introuvable.** related to distribution system planning in Colorado and Nevada points out the pros and cons of area-based planning or programmes: targeted schemes enable to enter more into the details of the interactions between supply and demand, and to focus the interventions where the most effective or needed. While schemes with broader scopes enable a better coordination among system operators. The area taken into account in the scheme depends on the type of energy systems considered (e.g., area supplied with district heating, see example 3), and the targeted segment(s) of the energy system (generation, transmission, distribution).

Many of the examples we found are recent (i.e., began within the last two or three years). This is partly because older examples of E1st implementation were collected in previous studies (particularly in Rosenow et al., 2016). Information about the impacts of these recent interventions is limited. As in some cases, they are still in an experimental stage or offer just one or two years of full-scale implementation for review. However, they already provide an interesting feedback about the motivations to develop an E1st approach, and how this approach has been developed.

Further 18 examples could be found in the literature and are gathered in Table 2 below. This list does not pretend to be exhaustive. It aims at providing complementary sources for readers interested in finding more examples about the implementation of the E1st principle or similar concepts.

Table 2 – Further examples from other sources

No	Example (and source)	Type of provisions	Level of requirement	Region / Country	Targeted energy carrier(s)
17.	Holyhead Powersave Project (Rosenow et al., 2016)	B. In front/ Investment	1. Allowing E1st	UK (Wales)	Electricity
18.	French Riviera "Eco-Energy Plan" (Rosenow et al., 2016)	B. In front/ Investment	1. Allowing E1st	France	Electricity
19.	C2C Capacity to Consumers (Rosenow et al., 2016)	A. In front/ General	2. Enabling E1st	UK	Electricity
20.	Krakow Energy Efficiency Project (Rosenow et al., 2016)	D. Behind/ Investment	1. Allowing E1st	Poland	Heat
21.	Early Energy Efficiency Obligation Schemes to include energy efficiency in the regulatory framework (Rosenow et al., 2016)	A. In front/ General	6. Requiring E1st	UK and Denmark	Electricity and gas

No	Example (and source)	Type of provisions	Level of requirement	Region / Country	Targeted energy carrier(s)
22.	EU-wide Covenant of Mayors for Climate & Energy (Rosenow et al., 2016)	B. In front/ Investment	3. Requiring E1st-proof assessments	EU	All
23.	Early time-of-use tariffs (Rosenow et al., 2016)	A. In front/ General	1. Allowing E1st	Poland, France	Electricity
24.	Loire time-of-use tariff (Rosenow et al., 2016)	B. In front/ Investment	1. Allowing E1st	France	Electricity
25.	Energy efficiency as infrastructure in Scotland (Rosenow et al., 2016)	C – Behind / General	6. Requiring E1st	UK (Scotland)	All
26.	Czech Green Savings Programme (Rosenow et al., 2016)	D. Behind/ Investment	5-Encouraging E1st	Czech Republic	All
27.	Minimum energy efficiency requirement prior to renewable energy installation (Rosenow et al., 2016)	D. Behind/ Investment	6. Requiring E1st	UK and Flanders	All
28.	The eFlex Project (pilot project about demand response and heat pumps) (Dong Energy, 2012)	A. In front/ General	1. Allowing E1st	Denmark	Electricity
29.	Energy efficiency as a means to expand energy access (de la Rue du Can et al. 2018)	B. In front/ Investment	2. Enabling E1st	Uganda	Electricity
30.	Energy efficiency as a resource in the ISO New England forward capacity market (Jenkins et al., 2011 ; Rosenow and Liu, 2018; SENSEI 2020)	A. In front/ General	2. Enabling E1st	US (New England)	Electricity
31.	Ontario Save on Energy – Energy Performance programme (SENSEI 2020) (part of the Conservation First policy (Ontario 2013))	D. Behind/ Investment	5-Encouraging E1st	Canada (Ontario)	Electricity and natural gas
32.	NYSERDA's Business Energy Pro programme (SENSEI 2020)	D. Behind/ Investment	5-Encouraging E1st	US (State of New York)	Electricity and natural gas
33.	Pacific Gas and Electric Company (PG&E)'s Residential Pay-for-Performance Programmes (SENSEI 2020)	A. In front/ General	6. Requiring E1st	US (California)	Electricity and natural gas
34.	UK Electricity Demand Reduction Pilot (SENSEI 2020)	A. In front/ General	2. Enabling E1st	UK	Electricity

Conclusions & perspectives

In line with the approach of the Governance Regulation, the E1st principle is about a more integrated view of the energy systems, considering options on the supply side and demand side with a level playing field. While it might look straightforward at first sight, it requires a paradigm shift to consider more systematically the multiple impacts of investment decisions related to energy systems, as well as multiple timeframes (from short to long term). To address this, there is a clear need of resources to help policy makers and stakeholders walk the talk.

The ENEFIRST project started by analysing the background of the E1st principle and developing a definition that can be used to operationalize the concept. The next step was to review "real-life" examples where the E1st principle, or similar approaches, have been implemented.

The collection of 16 examples analysed in the ENEFIRST project, together with the 18 further examples identified in other sources, is by no means a comprehensive mapping of the existing applications of the E1st principle. They have also not necessarily been implemented as explicit applications of the E1st principle; rather, they are often considered simply as a smart use of available resources.

There may be various motivations behind developing an E1st (or similar) approach, such as the political will to reduce the need for new networks and energy infrastructures, mobilisation of consumers in emergency situations, reducing power system balancing costs, or taking into account the need to reach higher levels of energy efficiency and energy savings to make it possible to achieve long-term energy and climate goals. The explicit use of demand-side resources (including both, end-use energy efficiency and demand response) as an alternative to supply-side investments has been more developed in the U.S., especially in the power system and markets[2], where the integration of demand-side resources began in the 1980s and is embedded in the wider scope and mandate of energy sector planning.

The non-comprehensive collection of examples shows that the benefits from implementing E1st can occur at various scales and time horizons. From short-term flexibility in the energy demand (e.g. with Time-of-Use tariffs or demand response) to long term reductions in GHG emissions by avoiding lock-in effects for energy savings in buildings. From limiting the needs in on-site heat generation (as done with the Fabric first approach developed in Ireland) to avoiding a new power plant (as done in California).

New approaches (e.g., demand response) can sometimes be hindered by regulatory frameworks that might have been first designed to organise the supply-side of energy. Several of the examples show how regulatory frameworks can be adapted to enable the development of approaches relying on demand-side resources, or to give them the priority. The recast or amendment of the European directives included in the Clean Energy for All Europeans package provided a first window of opportunity to form aligned national regulations, based on these good practices. The upcoming revisions planned in the Fit to 55 package can be a chance to go a step further. In the meantime, the European Commission will soon published new guidance on Energy Efficiency First.

The examples show that regulations or mandatory requirements can be effective in wider, or even systematic, adoption of the E1st principle in assessments made by utilities or in investments made by building owners. However, the latter examples also pointed that higher requirements might lead to a lower number of building renovations supported, at least in a first time after adopting these higher requirements. A first general analysis of the barriers to the implementation of E1st has been done through a general literature review and an online survey (see ENEFIRST, 2020c). This work on barriers and providing policy guidelines is currently further developed, focusing on policy areas identified as the most relevant and promising (see ENEFIRST, 2021). These policy guidelines will then be discussed with stakeholders in dedicated workshops in the last quarter of 2021.

A general conclusion at this stage of the project is that implementing E1st goes beyond adapting the frameworks for investment decisions. It requires to have a broader view of the possible solutions to meet the energy needs, to break the silos and favour more interactions and coordination among actors of the supply-side and demand-side.

[2] At least more literature can be found about Integrated Resource Planning or other approaches close to the E1st principle for the electricity systems in the U.S.

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