November 2024

FROM COST SAVINGS TO SOCIETAL GAINS:

RETHINKING THE COST-OPTIMAL METHODOLOGY

Aligning the EPBD framework to enable buildings to play their full role in the climate and energy transition

BPIE

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Acknowledgement
BPIE gratefully thanks Eurima (European Insulation Manufacturers Association) for their financial support to enable this study.

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How to cite this report : From cost savings to societal gains: rethinking the cost-optimal methodology. BPIE (Buildings Performance Institute Europe (2024). Available at: https://www.bpie.eu/publication/from-cost-savings-to-societal-gains-rethinking-the-cost-optimal-methodology/

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EXECUTIVE SUMMARY

The Energy Performance of Buildings Directive (EPBD) is the EU's main legislative tool driving decarbonisation of the built environment. As part of its measures to advance decarbonisation, Member States are required to define minimum performance requirements for buildings using the cost-optimal approach. To support and guide Member States in this exercise, the European Commission provides a cost-optimal methodology framework, which is currently being updated to accommodate changes prescribed in the 2024 EPBD recast.

The ongoing update of the comparative methodology framework is an important opportunity to increase the focus on the multiple benefits of energy efficient buildings. This report demonstrates why multiple benefits should be considered in the cost-optimal methodology framework and proposes main multiple benefits of interest. Secondly, it discusses the impact of key economic variables on the results of the cost-optimal calculations.

Energy efficiency improvements in buildings lead to direct cost savings, as well as a range of additional positive impacts, known as multiple benefits. Recognising and incorporating these benefits into the cost-optimal methodology better reflects the true societal value of energy efficiency measures and can enhance their economic viability. Taking a broader societal view on energy policy is expected to stay at the forefront of the political agenda, as highlighted in the EU Commission President's Political Guidelines[1] presented in July 2024, which emphasise social fairness in a modern economy.

[1] EUROPE'S CHOICE: POLITICAL GUIDELINES FOR THE NEXT EUROPEAN COMMISSION 2024–2029, Ursula Von der Leyen, 2024

This report emphasizes the following multiple benefits and explains why they should be integrated into the updated cost-optimality methodological framework:

- ***Improved energy security:*** Incorporating energy security considerations into the cost-optimal methodology is essential to capture the impacts of the dependency on imported fossil fuels. In an Increasingly renewable-based energy systems new dependencies on foreign production of renewable energy technologies and critical raw materials prompt similar considerations. Enhancing energy security will reflect the role of efficient buildings in facilitating a smooth transition to renewable and local energy sources.

- ***Productivity gains:*** Including productivity improvements in cost-optimal calculations would underscore the significant impact buildings have on work performance, academic results, and healthcare outcomes. These productivity gains are vital for promoting equal opportunities and ensuring fair treatment for all social groups.

- ***Alleviating energy poverty:*** Energy efficiency measures do more than just lower energy costs for vulnerable households – they free up income for other essential needs and contribute to improved health and well-being. Accounting for these additional values should be considered in the cost-optimal methodology to ensure alignment with the social objectives of EU directives such as the Energy Performance of Buildings Directive and Energy Efficiency Directive.

- ***Benefits for the grid:*** While building renovations traditionally focus on reducing demand, they also offer significant benefits to the energy grid. Including these benefits in cost-optimal calculations, such as reduced line losses and decreased need for grid investments, will highlight the broader role of efficient buildings in driving decarbonisation.

This report also discusses the impact of the following economic variables:

1. ***Discount rate:*** A discount rate is used for comparing the value of monetised benefits at different moments in time. The updated cost-optimal methodology should reassess the choice of discount rate in view of the slow progress in decarbonising the building stock and promote low discount rates to emphasise the long-term benefits of building renovation and support deep renovation.
2. ***Energy price developments:*** Governmental interventions across the EU resulted in energy price developments unsuitable for cost-optimal calculations. The updated methodology should correct existing energy prices, which is especially important given the limited duration of several energy price protection mechanisms.

Better indicating the real societal value of energy efficiency measures would lead to more accurate results of the cost-optimal calculations. This would improve the comparison between the current market and decarbonisation goals, providing valuable guidance for EU decarbonisation efforts.

The updated framework should therefore promote the use of existing **multiple benefit monetization** approaches. To support the future integration of multiple benefits, the updated framework should also foresee the systematic collection and analysis of best practices across EU, e.g. through more detailed impact evaluation of energy efficiency policies.

INTRODUCTION

The Energy Performance of Buildings Directive (EPBD) is the EU's main legislative tool for driving decarbonisation of the built environment in a socially just and cost-effective manner. As part of its measures to guide the transition towards decarbonisation, Member States are required to conduct cost optimality calculations every five years and adjust their national minimum energy performance requirements for buildings to be within a 15% margin of the cost-optimal levels (EPBD Article 6.3). To support and ensure coherence in this process, the European Commission provides a framework for the cost-optimality calculation methodology. In the 2024 EPBD recast, changes were introduced to this methodological framework to also account for other impacts, such as health and indoor environment (EPBD Annex VII). Better reflecting the true societal value of energy efficiency measures would lead to more accurate cost-optimal calculations, improving the alignment between current market conditions and decarbonisation goals, and providing valuable guidance for EU decarbonisation efforts. The Commission has until June 2025 to adopt a new delegated act with accompanying guidelines that describe the updated framework (EPBD Article 6.1).

Updating the cost-optimal methodology is an important opportunity to elevate the prominence of efficiency policies within the decarbonisation agenda. In this context, it is vital to position the cost-optimality methodology within the framework of the 'energy efficiency first' principle established in the Energy Efficiency Directive (EED). Ensuring that the methodology delivers the right benefits for buildings, as an essential part of the energy system, is crucial. The updated methodology may also help to draw the attention of Member States to the multiple benefits of energy efficiency, which can significantly impact both the buildings we occupy and the society we live in.

Multiple benefits of improved energy efficiency are beneficial effects beyond those directly relating to saving energy and reducing energy bills. The International Energy Agency (IEA) describes multiple benefits as "the impacts of energy efficiency beyond reductions in energy demand – i.e. the benefits that occur in addition to a single prioritised policy goal"[2]. The term aims to capture the substantial non-energy benefits that investments in energy efficiency frequently bring to a broad range of stakeholders. The term "multiple benefits" reflects the view that the non-energy benefits are not second to or deprioritised in relation to energy-related benefits. Instead, they should be considered equally valuable and adequate for improving overall welfare.

There is broad consensus that the value of multiple benefits is substantial in relation to the primary objective of energy saving. According to IEA research, ***multiple benefits can deliver up to 2.5 times the value of energy demand reduction[3].***

To maximise the potential of energy efficiency, in line with the energy efficiency first principle, multiple benefits need to be considered and monetised in policy and investment decision making. Including multiple benefits would substantially change the results of Member States' cost-benefit analyses[4]. Conversely, omitting multiple benefits significantly undervalues the positive societal value of energy efficiency.

The main barrier to mainstreaming multiple benefits of energy efficiency into economic decision making is their monetisation. The process of monetising these wider benefits is context-dependent, and approaches are often complex[5]. In recent years[6], the research community has increasingly focused on developing standardised approaches to address this challenge, but it remains a work in progress. Another significant obstacle is the need to better understand the causal relationships, in addition to quantifying the multiple benefits, before they can be fully incorporated into the cost-optimality methodology[7]. It is crucial that policymakers continue to support the development of approaches for including multiple benefits, so that the true and substantial value of energy efficiency can be realised.

[2] Capturing the Multiple Benefits of Energy Efficiency, IEA, 2014

[3] Capturing the Multiple Benefits of Energy Efficiency, IEA, 2014

[4] The Multiple Benefits of the 2030 EU Energy Efficiency potential, Energies Journal, 2019

[5] Zangheri P., D'Agostino D., Armani R., Maduta C. and Bertoldi P. "Progress in the Cost-Optimal Methodology Implementation in Europe: Datasets Insights and Perspectives in Member States". Data 2023. Zangheri et al 2023

[6] the research community has increasingly focused on developing standardised approaches to address this challenge, but it remains a work in progress s received more attention from the research community E.g. through the COMBI project

[7] The Multiple Benefits of the 2030 EU Energy Efficiency potential, Energies Journal, 2019

A third barrier to realising the multiple benefits of energy efficiency stems from how and when they arise. For example, improved health and wellbeing may be very sensitive to the current level of investment. With moving forward in time, each additional euro of investment spent today may contribute more to various other benefits than to energy savings. Once properly considered, this effect may review the role of multiple benefits and increase investments in efficient buildings. This effect is especially true when it comes to building energy efficiency measures that also contribute to climate resilience, e.g. by protecting building occupants from extreme temperatures. Since heatwaves and other extreme weather events will become increasingly frequent, the value of such climate adaptive measures will increase with time.

EU buildings policy no longer focuses solely on energy demand reduction. It now acknowledges important links between buildings' energy performance, climate, environment, health, wellbeing, productivity and social welfare, and aims at taking a holistic approach to tackle several societal objectives in parallel. This view should also be integrated into the cost-optimality methodology.

EPBD AND COST-OPTIMALITY UPDATES

Rules on cost-optimality have been introduced in the 2010 EPBD[8]. The Directive requires Member States to set minimum energy performance requirements for new and existing buildings (or building units and building elements) that achieve at least cost-optimal levels (more information, see Table 1). Member States calculate and establish cost-optimal levels in accordance with the comparative cost- optimality methodology framework which was adopted by the European Commission in early 2012[9]. Member States regularly update their national calculations of cost-optimal levels and have been reporting these to the European Commission every five years since 2013.

The EPBD amendment in 2018[10] did not include changes to the cost-optimality provisions. This means that more than a decade has passed without any changes to EU legislation on this matter. For the first time, the 2024 EPBD recast[11] amends cost-optimality provisions. This includes a requirement for the **European Commission, through a Delegated Act, to revise and upgrade the comparative methodology framework by 30 June 2025 *(EPBD 2024, Article 6§1)*. Member States will then update their calculations by 30 June 2028** based on the new comparative methodology framework (and will continue to update cost-optimal levels every 5 years, *rules defined in Article 6§2*).

[8]Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.

[9]Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements; Guidelines accompanying Commission Delegated Regulation (EU) No 244/2012.

[10]Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.

[11]Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings.

New buildings

EPBD 2024 Article 7
(ex. EPBD Article 6)

The EPBD requires that minimum energy performance requirements should achieve at least cost-optimal levels *(Article 5, ex. Article 4)* and should be upheld for all new buildings.

Since 31/12/2020, the nearly zero-energy building (NZEB) standard applies to all new buildings.

Even though cost-optimality and NZEB were not legally linked on the EU level, Commission guidelines on NZEB[12] levels advise Member States to set NZEB with consideration of cost-optimal levels, as well as use cost-optimal methodology to define a range of NZEB requirements. In practice, many Member States established NZEB requirements by utilising mostly a cost-optimal approach.[13]

The 2024 EPBD establishes a direct legal link between NZEB and cost-optimality: NZEB threshold should be no worse than the cost-optimal level of Member States in 2023.

Cost-optimal levels become a reference for the zero-emission building (ZEB) standard that will apply to all new public buildings as of 01/01/2028 and to all new buildings as of 01/01/2030: ZEB threshold should be "achieving at least the most recent cost-optimal levels" of Member States and be "revised every time when cost-optimal levels are revised" (Article 11§2).

Moreover, the ZEB energy demand threshold should be at least 10% lower than the total primary energy use threshold for NZEB established in the Member States in 2024 (Article 11§3). This is another indirect link between ZEB levels and cost-optimal levels through NZEB.

As of **2012**

2010 EPBD in force

As of **2021**

NZEB Standard applies

As of **2026**

2024 EPBD in force

Existing buildings

EPBD 2024 Article 8
(ex. EPBD Article 7)

The minimum energy performance requirements *(Article 5, ex. Article 4)* apply whenever: A building undergoes a major renovation[14], and a building envelope element which has a "significant impact on the energy performance" is retrofitted/replaced.

EPBD 2024 introduces a legal definition of deep renovation as "renovation which [...] transforms a building or building unit into a NZEB before 2030, and into a ZEB from 2030" (Article 2§20). The central requirement, in connection to it, is that Member States should incentivise deep renovations with higher financial and other types of support (Article 17§16).[15]

Considering that both NZEB and ZEB levels are linked to cost-optimal levels, buildings undergoing deep renovation will need to adhere to cost-optimal levels (as defined at the national level).

Note that, ZEB levels can be different for the renovated buildings as compared to new construction (Article 11§4)

The 2024 EPBD is a big step forward for cost-optimality, providing two important changes that, if well implemented in secondary EU legislation as well as in Member States, could greatly strengthen the case to upgrade the EU's built environment and achieve climate neutrality. The first change is the mandate to the European Commission to update the comparative methodology framework, in time to support Member States in their cost-optimal level calculation. The second is a clear legal link between the cost-optimal levels and building standards such as NZEB and ZEB, and an indirect link with deep renovations through aforementioned standards (that go beyond the link between cost-optimality and minimum energy performance requirements for existing buildings). These links could also be clarified further in the methodology revision for the coherent national implementation of the EPBD recast.

The update of the comparative methodology framework gives an opportunity to address specific issues according to shifting needs. The 2024 EPBD (Annex VII) requires the methodology framework to consider detailed inputs such as climate change, earnings from energy produced, or technological developments. Multiple benefits of efficient buildings are also considered via environmental or health externalities suggested as cost-optimality inputs. However, the scope of methodology required by Annex VII might still be limiting in context and miss important elements that could have a strong impact on a Member State's decarbonisation path to achieving 2030 emission reduction goals and a Zero Emission built environment by 2050.

And beyond the question of meeting requirements and climate goals, the methodology update represents an opportunity to reflect on the broader role of buildings in the energy system, including their potential to generate key multiple benefits such as improved energy security, labour productivity, and alleviating congested energy grids. The update should also emphasise other topics equally important for achieving cost -optimal levels, such as discount rates (how to value the benefits of future savings), and energy price considerations.

Upgrading the comparative methodology framework also means learning from the experience of implementing the old methodology framework and 3 terms (2013, 2018, 2023) of Member cost-optimal level reports. This provides an opportunity to tackle bottlenecks and learn from best practices that were developed throughout the old framework's duration of almost thirteen years. Issues to reflect upon for improvement in the new comparative methodology framework can include reference building definition, optimisation variables, sensitivity analysis and energy performance assessment.[16]

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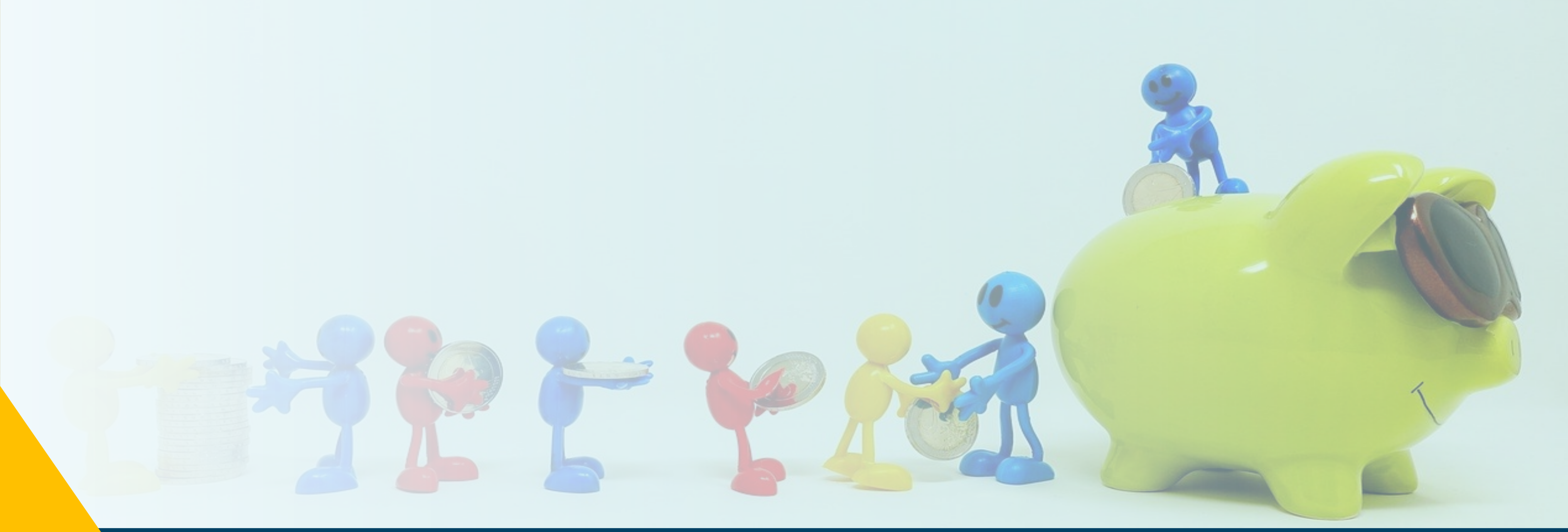
[12]Commission Recommendation (EU) 2016/1318 of 29 July 2016 on guidelines for the promotion of nearly zero-energy buildings and best practices to ensure that, by 2020, all new buildings are nearly zero-energy buildings

[13]D'Agostino, D.; Tzeiranaki, S.T.; Zangheri, P.; Bertoldi, P. A, "Assessing Nearly Zero Energy Buildings (NZEBs) development in Europe", Energy Strategy Reviews 2021.

[14]More information: Major renovation is defined in EPBD 2024 Article 2 §22 (unchanged from EPBD 2018). Fundamentally, it means: the total cost of the renovation is higher than 25% of the building's value -or- more than 25% of the building envelope's surface area undergoes renovation.

[15]More information: There is however a derogation within this rule based on technical and economic feasibility that adjusts the deep renovation definition. More details in Article 17§16 of EPBD.

[16]Review of the Cost-Optimal Methodology Implementation in Member States, JRC, 2023



MULTIPLE BENEFITS RELEVANT FOR THE COST-OPTIMAL METHODOLOGY

Review of several relevant sources suggested around 80 potential multiple benefits of energy efficiency in buildings[17] [18] [19] [20] . The list provides different levels of specificity; some multiple benefits are more general, such as "economic development", while others are very specific, such as "increased purchases of food and essentials". The first step in defining multiple benefits relevant for updating the cost-optimality methodology was to eliminate redundancies in the long list of potential multiple benefits by using the criteria explained below.

Shortlisted multiple benefits and additional relevant topics

Multiple overlapping benefits were merged or eliminated. Next, instances of potential double counting were removed. Furthermore, only benefits linked to primary markets were included, excluding those impacting secondary economic activities, such as increased demand for construction-related fuel[21].

As a result, a refined list of multiple benefits relevant for the cost-optimality update has been established. This report examines three multiple benefits from this list, which are not properly addressed in the **current cost-optimality methodology;**

- **Improved energy security,**
- **Increased productivity, and**
- **Benefits from the energy grid[22]**

[17] Capturing the Multiple Benefits of Energy Efficiency, IEA, 2014

[18] Multiple benefits of investing in energy efficient renovation of buildings, Copenhagen Economics, 2012

[19] Multiple Benefits of Energy Efficiency, IEA, 2019

[20] Multiple benefits of sustainable plus energy neighbourhoods and their potential impact on policy and investment decisions, BPIE, 2024

[21] Guide to Cost-Benefit Analysis of Investment Projects, European Commission, 2014

[22] Due to the lack of available literature, societal benefits from energy grid are analysed only briefly.

Shortlisted multiple benefits and additional relevant topics

Due to its prominence as an important social objective of energy policy, this report also briefly discusses energy poverty alleviation of energy efficiency improvements in buildings.

The report also briefly examines two key areas relevant to the calculation of cost-optimal levels. Although the current methodology addresses these areas, updating and aligning them with the latest practices and the urgent need to meet climate targets is necessary. These topics are:

- **Discount rates, and**
- **Energy price developments.**

The limited scope of this paper necessitates the selection of a limited number of multiple benefits. The selection is also made with a view to complement the ongoing study commissioned by the European Commission on this topic. Additional multiple benefits, notably from the health and environmental domains, should be considered, but are external to the scope of this study.

IMPROVED ENERGY SECURITY

Definition and characterisation

The IEA defines the concept of energy security as "the uninterrupted physical availability of energy at a price which is affordable while respecting environmental concerns" and views it as a product of three energy system aspects: reliability of resources and infrastructure, capacity to respond to disruptions, and the degree of exposure to geopolitical threats[23].

In the context of multiple benefits, energy security is not an entirely well-defined concept and may encompass different components depending on context[24]. The IEA's description of energy security as a multiple benefit reads "the improved energy security through fuel availability, geopolitical energy accessibility, affordability and (social and environmental) acceptability". This multiple benefit is closely related to energy delivery, which refers to an energy provider's improved ability to deliver energy while lowering costs and energy prices, specifically through the reduction in demand that prompts lower energy prices. Energy delivery and energy prices are categorized together with energy security under the theme of energy system security.

In other literature, the understanding of energy security as a multiple benefit focuses on the import-related aspects such as improved energy sovereignty or lower import dependency, and greater supplier diversity[25] [26] [27]. A closely related and often-mentioned view of energy security as a multiple benefit concerns the (avoided investment in) energy system infrastructure, its reliability, and capacity to respond to disruption or to integrate more renewable energy sources (RES).

Energy security as a multiple benefit should therefore be added to the cost-optimal methodology to better reflect the societal benefits from reduced import dependency. On the one hand, energy security would reduce dependencies on fossil fuel imports, aligning with the EU's priority of reducing dependence on (notably Russian) fuels. On the other hand, reduced dependency on imports would also support the EU's path towards an increasingly RES-based energy system. Supporting RES based energy systems can be achieved by reducing dependency either on imported renewable energy technologies[28] or on critical raw materials required for the expansion of renewable energy systems, electric vehicles, and batteries[29].

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[23] Capturing the Multiple Benefits of Energy Efficiency, IEA, 2014

[24] Literature Review on Energy Efficiency and Energy Security, including Power Reliability and Avoided Capacity Costs, Couder, Johan, 2015

[25] Multiple benefits of investing in energy efficient renovation of buildings, Copenhagen Economics, 2012

[26] Much broader than health: Surveying the diverse co-benefits of energy demand reduction in Europe, Energy Research & Social Science, Finn, Owen; Brockway, Paul E, 2023

[27] A comprehensive indicator set for measuring multiple benefits of energy efficiency, Energy Policy Journal, Reuter, Matthias; Patel, Martin K.; Eichhammer, Wolfgang; Lapillonne, Bruno; Pollier, Karine, 2020

[28] For instance, PV panels coming mainly from China.

[29] Most important critical raw materials are supplied from the countries outside EU, such as Argentina, Democratic republic of Congo, or South Africa.

Potential quantification and monetisation approaches

To bring multiple benefits into the cost-optimal methodology, it is necessary to quantify and monetise their impacts. The recent European research project COMBI – Calculating and Operationalising the Multiple Benefits of Energy Efficiency in Europe[30] aimed to address this issue for energy security, among other multiple benefits. Their findings could be used to inform the cost-optimality revision and towards the inclusion of multiple benefits in it.

The COMBI project developed a methodology for quantification of energy security as a multiple benefit. The project simulated the energy systems of the EU-28 and their transformation under a set of energy efficiency improvement actions including "refurbishment of dwellings". The output from this energy balance model then was used to construct energy security impact indicators, one of which was a general indicator and two of which were import dependency oriented[31] [32] [33].

- **Energy intensity (kWh/EUR)** is defined as final energy demand divided by Global Domestic Product (GDP). Lower energy intensity indicates higher energy security.
- **Import dependency (%)** is quantified as the share of net imports of fossil primary energy (coal, oil, gas) in the total energy supply. Lower net import implies higher energy security.
- **Diversification index (0-1)**: To capture the aggregated impact of import dependency and diversification with respect to energy sources and their geographical origin, the project used an indicator based on the *Herfindahl-Hirschman Index* (HHI). This indicator also considers political stability. Lower value for the COMBI HHI means higher energy security.

The COMBI project focused on fossil fuel import dependencies, but the indicators above could be applied to other energies where relevant, e.g. RES electricity imports from third countries, using the same logic. Import dependency would then be calculated as the share of net imports of electricity from a third country in the total energy supply. At present, the risk exposure for the EU's energy system associated with RES electricity imports is lower in comparison with that of fossil fuel imports, but as the EU progressively weans itself off fossil fuels, the relative importance of RES imports will naturally increase.

To enable inclusion of the multiple benefits in a cost-benefit analysis, they need to be monetised. Out of the three indicators though, only import dependency is monetised in the COMBI project.

[30]https://combi-project.eu/

[31]Quantification and monetization of selected energy system and security impacts, Couder, Johan; Verbruggen, Aviel, 2018

[32]More than energy savings: quantifying the multiple impacts of energy efficiency in Europe, ECEEE Summer Study Proceedings, 2017

[33]The Multiple Benefits of the 2030 EU Energy Efficiency potential, Energies Journal, 2019

The cost-optimality calculations could include energy security benefits by multiplying the net imports of coal, oil and gas with their respective energy prices. At national level, energy security benefit could be obtained from:

$$\begin{aligned} &\textit{National benefit from energy security}\ [€]^{34} \\ &\quad = \textit{coal imports}\ [\text{tonnes}] \times \textit{coal price}\ [€/\text{tonne}] \\ &\quad + \textit{oil imports}\ [\text{mt}] \times \textit{oil price}\ [€/\text{mt}] + \textit{gas imports}\ [\text{m3}] \times \textit{gas price}\ [€/\text{m3}] \end{aligned}$$

As in the case of fossil fuel dependencies, the indicators proposed above could be applied to RES technology quantities and prices to quantify the benefits of reduced dependency on imported renewable energy technologies and critical raw materials[35].

INCREASE IN PRODUCTIVITY

Definition and characterisation

In the IEA's pivotal 2014 study, the productivity multiple benefit primarily addresses industrial productivity, referring to an industrial firm's ability to enhance production capacity and reduce operational costs through investments in energy efficiency.[36] Most of these multiple benefits accrue to the business itself on a micro-economic scale. An alternative type of productivity is labour productivity; a human-centric version of the multiple benefit. Energy efficiency improvements can lead to both less absenteeism due to illness, and to improved work performance when on the job or at school because of better indoor environmental quality (IEQ).

Here we will focus on the human-centric type of productivity. While industrial productivity benefits mostly accrue to the business itself, the labour productivity benefits are more interesting in a societal macroeconomic perspective.

Increase in productivity as a multiple benefit would be an important addition to the cost-optimality methodology. Efficient buildings result in improved environment (indoor and outdoor) and therefore improved well-being of workers or students. As a result, these improvements lead to better performance in schools and the workplace, better care and faster recovery of hospital patients. These are indisputable societal benefits that can be captured and added to the cost-optimality methodology via increased productivity.

[34] Coal, oil, and gas imports are expressed in tonnes, metric tonnes, and cubic meters, respectively.

[35] In both cases it would be important to exclude potential double counting, such as when the energy costs (used in the financial calculations) already include the costs of imported energy.

[36] Capturing the Multiple Benefits of Energy Efficiency, IEA, 2014

Potential quantification and monetisation approaches

The COMBI project[37] developed a framework for assessing labour productivity as a multiple benefit of several energy efficiency measures using three indicators:

- **Number of days available for work**, impacted by the absence due to illness,
- **Workforce performance** per unit of time, which is affected by mental wellness, thermal comfort and air quality, and
- **Working ability**, or value added per unit of time, affected e.g. through education level.

Out of the three indicators, two were quantified. The impact on number of active days was based on reduced cases of asthma, allergy, viruses, and cardiovascular disease. Workforce performance was quantified using a performance improvement equation.

A BPIE study from 2018[38] reviewed ways to define, measure, quantify and monetize the impact of several indoor environmental quality aspects including indoor air quality and thermal comfort, in schools, offices and hospitals in Europe. The main indicators used were absenteeism and work/school performance, in line with the study above.

The result showed that a 1°C reduction in overheating in schools increases students' performance by 2.3%, while increase in the ventilation rate by 1 litre/second/person[39] improved academic performance by 1%. The corresponding numbers for offices were 3.6% and 0.8% respectively.

Regarding hospitals, the results could not be unbundled for different IEQ aspects, but the total impacts were significant, such as the length of a patient's stay and the mortality rate. The length of an average patient's stay can be reduced by up to 11%, and the mortality rate reduced by up to 19%.

Regarding monetisation, the BPIE study attempted to assign a value to each 1% improved performance in offices and found that it could be estimated to €40 - €51.5 billion per year in the EU.[40] Monetisation at the MS level could follow the assumption that performance improvements is proportional to the national GDP. If so, 1% of improved performance in offices in a MS would result in:

$$\textit{National benefit from productivity increase}\,[€] = \frac{€\ 14.5\ \text{trillion}^{41}}{\textit{National GDP}[€]} \times\ €45\ \textit{billion}^{\ 42}$$

Assigning a monetary value to the performance improvement in schools and hospitals was more challenging, but the study proposes some options for the approach in schools, such as:

- The savings gained from a two-week shorter school year,
- The increase in earning potential of students from two weeks' (theoretical) additional teaching per year,
- The income generated from two weeks' worth of extra-curricular activities, and
- The health and well-being benefits of school staff.

[38]Quantifying the benefits of energy renovation investments in schools, offices and hospitals: Methodology and results, BPIE, 2018

[39]Until 15 liter/second/person

[40]EUR 45b equals around 0.3% of EU GDP. Gross domestic product in the EU in 2021 was € 14.5 trillion.

[41]Gross domestic product in the EU in 2021 was € 14.5 trillion.

[42]The value is taken from the range €40 - €51.5 billion.

BENEFITS FROM ELECTRIC GRID

Building renovation affects the quality of energy supply as well as demand reduction. System wide impacts of energy efficiency measures can bring benefits to society in several ways and should therefore be part of the updated cost-optimality methodology.

An example of grid benefits potentially applicable to cost-optimality is reduction in line losses. Line losses are resistance induced electricity losses in wires and can go up to around 75% of total transmission and distribution losses. Line losses increase during peaks in energy demand. These losses can be reduced by improving energy performance of buildings. When quantified, average annual line losses in OECD member countries range from 7% to 11% during extreme peaks. On the other hand, marginal losses that arise when the load is changed by a single unit, i.e., losses that could be avoided with installed energy efficiency measures, are even higher and can go up to 20%.[43] [44]

Given the nature of line losses, by reducing peak demand, building renovation decreases grid energy losses, benefiting both utilities and citizens. Averting line losses with building renovation, and the resulting energy savings achieved, should be monetised and included in the cost-optimality calculations in the same way as other energy savings.

Another important and potentially valuable grid impact of building energy efficiency improvements is the potentially reduced need for capacity investments in the grid and in required reserve capacity.[45] Reinforcement of the EU's transmission and distribution grids is a pivotal part of the transition to a renewable-based energy system, as more capacity will be needed to cope with the intermittency of wind and solar power, and the electrification of important sectors including heating. The level of reinforcement needed is determined by peak loads. Building energy efficiency improvements can play an important role in this context, as the heating sector is transitioning to electric heat pumps that, aggregated, will represent a significant load. Better insulated buildings contribute to load reduction as less heating capacity is needed to maintain the indoor temperature. They also enable load-shifting, as the thermal inertia of well-insulated buildings allows for smart heat pump management.[46]

[43] Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements, RAP, 2011

[44] Capturing the Multiple Benefits of Energy Efficiency, IEA, 2014

[45] Literature Review on Energy Efficiency and Energy Security, including Power Reliability and Avoided Capacity Costs, Couder, Johan, 2015

[46] The potential of power-to-heat demand response to improve the flexibility of the energy system: An empirical review, Renewable and Sustainable Energy Reviews, Vladimir Z. Gjorgievski, Natasa Markovska, Alajdin Abazi, Neven Duić, 2021

The location of the buildings that are subject to energy efficiency measures plays a role in their impact on grid investments and the corresponding monetary value as a multiple benefit. Reducing electricity demand in densely populated areas or particularly remote areas is more likely to yield avoided costs. The unique topology and load dynamics of the energy system are also parameters that affect the monetary value of energy efficiency measures in buildings in each region.[47] This information should, however, be known by the system operators. This benefit is thus relatively well-quantifiable, but the timescale of it is rather long-term.[48] The benefit of avoided transmission capacity costs in practice accrue to the Transmission System Operator (TSO) and Distribution System Operator (DSO), but in the long run, they will also benefit customers and society at large, as regulators can take the effects into account in their tariff price level reviews.[49]

ENERGY POVERTY ALLEVIATION

Energy poverty and the social aspects of energy policy have gained significant political attention, becoming key themes in the 2024 recast of the Energy Performance of Buildings Directive (EPBD) and other central EU energy policies, such as the Energy Efficiency Directive (EED). These issues are expected to stay at the forefront of the political agenda, as highlighted in the EU Commission President's Political Guidelines[50] presented in July 2024, which emphasize social fairness in a modern economy. Among the proposals are the development of an EU Anti-Poverty Strategy and a European Affordable Housing Plan. This focus is especially relevant in the context of cost optimality and the multiple benefits approach. By integrating energy poverty alleviation as a key benefit within the cost-optimal methodology, we can ensure the full realization of the EPBD's overarching vision during implementation.

Energy poverty alleviation is hard to capture as a multiple benefit of its own, but rather works as a proxy that leads to several other, more concrete benefits. When energy costs are reduced as a result of energy efficiency improvements, low-income households can better afford better energy services and/or to better satisfy other critical needs. The value of such energy efficiency interventions thus goes beyond pure costs savings. Energy poverty is strongly associated with mental and physical health problems, particularly due to financial stress. Energy efficiency improvements can thus improve health for energy poor households. Energy efficiency is more effective than, for example, short term financial support on energy bills, since it tackles the root cause of the problem rather than the only the symptoms.[51]

[47] Capturing the Multiple Benefits of Energy Efficiency, IEA, 2014

[48] Much broader than health: Surveying the diverse co-benefits of energy demand reduction in Europe, Energy Research & Social Science, Finn, Owen; Brockway, Paul E, 2023

[49] Capturing the Multiple Benefits of Energy Efficiency, IEA, 2014

[50] EUROPE'S CHOICE: POLITICAL GUIDELINES FOR THE NEXT EUROPEAN COMMISSION 2024−2029, Ursula Von der Leyen, 2024

[51] Capturing the Multiple Benefits of Energy Efficiency, IEA, 2014

A commonly used quantitative indicator of the cost aspect of energy poverty alleviation as a multiple benefit is the impact of energy savings on the household energy costs as a share of household total disposable income.[52] Direct financial aspects of energy poverty mitigation as a multiple benefit can be monetised in terms of, for example, reduced state expenditure on energy subsidies. Capturing the indirect impact of energy poverty alleviation, such as improved health and well-being, is more complex and comes with the typical challenges of proving causality and avoiding double counting. There is, however, considerable qualitative evidence that **the value of the multiple benefits of energy poverty alleviation is significant – up to three times the direct energy cost savings.** Experts have therefore long argued that although it is challenging to produce a precise value, using indicative ranges and rough estimates is better than assuming that the value is equal to zero. These values should be added as health and wellbeing multiple benefits.[53]

DISCOUNT RATES

A discount rate (DR) is used for comparing the value of money at different moments in time. It reflects the assumption that the current value of future resources is lower than the value of the same resource available right now. Macroeconomic discount rates (MDR)[54] are used for analysing the effect of multiple benefits and explaining how a society values long-term against short-term benefits and costs.

Policy scenarios, policy impact assessments and their recommendations may depend significantly on discount rates. Low discount rates favour projects with the highest total benefits, irrespective of when they occur. Higher discount rates give more importance to the projects with immediate rather than distant benefits. Benefits from efficient buildings, such as environmental and health benefits, are distributed over future years. Considering the increasing impacts of climate change, these benefits are not just valuable over the lifetime of current generations, but even more valuable for future generations. High discount rates might discourage efficient buildings[55] as they reward projects with immediate benefits. With respect to the desirable building efficiency level, high discount rates may promote either new buildings with low performance or shallow renovation of existing buildings.

According to the current Delegated Act, the macroeconomic discount rate that closely reflects the benefits that energy efficiency investments is expected to be between 2% and 4%. The average macroeconomic discount rate being 3% (2%-5%)[56], EU Member States follow this approach. However, the updated cost-optimality methodology should propose lower discount rates that would increasingly reflect the long-term benefits of building renovation. The update of the cost-optimality methodology should be used as an opportunity to explore the potential impact of a lower discount rate. Lower discount rates would not only emphasise the importance of multiple building renovation benefits but also support building renovation projects and encourage deep renovation.

[52] A comprehensive indicator set for measuring multiple benefits of energy efficiency, Energy Policy Journal, Reuter, Matthias; Patel, Martin K.; Eichhammer, Wolfgang; Lapillonne, Bruno; Pollier, Karine, 2020

[53] Evaluating the co-benefits of low-income energy-efficiency programmes, IEA, 2011

[54] Also known as social discount rates. Commission Delegated Regulation (EU) No 244/2012 currently foresees use of financial and macroeconomic cost-optimality calculations and discount rates.

[55] Either newly built or renovated.

[56] Review of the Cost-Optimal Methodology Implementation in Member States, JRC, 2023

ENERGY PRICE DEVELOPMENTS

Recent EU energy prices were significantly affected by the 2021 energy crisis and the 2022 Russian invasion of Ukraine and subsequent war. Answering adverse impacts of energy prices on citizens and the economy required both EU level and national measures.

Subsidies aiming to protect citizens and the economy from damaging energy prices required substantial resources in 2022 and 2023. During this period, EU Member States provided around EUR 375 billion in subsidies related to energy prices rising. Furthermore, 20% of these contributions are either foreseen to end after 2025 or even lack a clear end-date, which implies their long-term effects.[57]

Governmental price interventions result in distorted energy prices that cannot properly reflect their social opportunity costs.[58] Such price interventions artificially lower the benefits of energy savings. To consider the effect of energy price mechanisms, the updated cost optimality methodology should ensure correction of the existing energy prices. This is especially important given that the expected life of renovation benefits will most likely be longer than the foreseen duration of the energy price protection measures.

Similarly, a long-term perspective should be applied when determining cost of energy supply that is used for comparing scenarios with and without energy efficiency measures. The cost of energy should consider not just short-term energy price projections but also the long-term costs of supplying renewable energy, such as grid expansions, energy storage, reserve capacity and other investments needed for the energy transition at a system level.

Energy prices have significant impact on the results of cost-optimal calculations.[59] Energy price subsidies and inadequate pricing of externalities are among the main barrier to untapping the full potential of energy efficiency as the "first fuel".[60] These biases should be addressed in policy implementation like the cost-optimal methodology to order to adhere to the energy efficiency first principle.

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[57] Report on Energy Subsidies in the EU, European Commission, 2023

[58] The opportunity cost equals the potential gain from the best alternative lost due to investing in the analysed project. All inputs to macroeconomic cost-optimality calculations should be valued at social opportunity costs.

[59] Review of the Cost-Optimal Methodology Implementation in Member States in Compliance with the Energy Performance of Buildings

[60] Directive, Buildings, Zangheri, Paolo, D'Agostino, Delia, Armani , Roberto and Bertoldi ,Paolo , 2022

[61] Capturing the Multiple Benefits of Energy Efficiency, IEA, 2014

CONCLUSIONS AND RECOMMENDATIONS

The EU's clear climate and energy objectives for 2030 and 2050, expressed in the EU Green Deal[61] and the set of policies introduced by the Fit for 55 package, rightfully integrate environmental and social goals, reflecting the complex interrelated nature of these societal challenges. The importance of creating a just transition that puts people first cannot be underestimated and, as echoed in the EU Commission President's Political Guidelines in July 2024[62], should be fully integrated when implementing EU legislation.

The 2024 recast of the EPBD clearly addresses this aspect: "The 'energy efficiency first' principle is an overarching principle that should be taken into account across all sectors, going beyond the energy system, at all levels. [...] Improved health and well-being are among the major co-benefits of applying the 'energy efficiency first' principle to improve the energy performance of buildings" (Recital 38). This is also true for the EPBD and its implementing acts, including the cost-optimality update.

The review of the cost-optimal methodology is currently ongoing under the leadership of DG ENER. A delegated act describing the new methodology must be finalised by June 2025, as mandated by the new EPBD. This revision is a not-to-be-missed opportunity to support the integration of complementary and related societal objectives in the implementation of energy policy. Integrating multiple benefits into the cost-optimal methodology is necessary in order to reflect the true societal value of energy efficiency measures in buildings. It further strengthens the macroeconomic case for energy efficiency, adhering to the energy efficiency first principle.

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[61] The European Green Deal COM(2019) 640

[62] EUROPE'S CHOICE: POLITICAL GUIDELINES FOR THE NEXT EUROPEAN COMMISSION 2024–2029, Ursula Von der Leyen, 2024

MULTIPLE BENEFITS TO BE ADDED TO THE COMPARATIVE METHODOLOGY FRAMEWORK

- The benefits of import-related energy security traditionally focused on reduced fossil fuel dependencies. However, with increasing importance of renewable energy sources, reducing the dependency on foreign supply of key technologies is crucial. Considering energy security benefits when identifying cost-optimal levels would enhance the contribution of efficient buildings to a smooth transition to renewable and local energy sources.

- Efficient buildings enhance both the indoor and outdoor environment, thereby improving the productivity of building occupants. This results in better work performance, improved academic results, and superior care for hospital patients, which are also crucial for promoting equal opportunities and fair treatment for all social groups. To properly account for the outcomes of efficient buildings, increased productivity and health benefits should be considered as an input to the updated comparative methodology framework.

- Cost-optimality calculations typically neglect the benefits efficient buildings bring to energy distribution, such as lower peak demand and lower energy losses in power lines. ***Cost-optimal calculations that incorporate energy grid benefits would systematically consider the impacts of efficient buildings and enhance their role in decarbonisation efforts.***

Quantification and monetisation of multiple benefits

- ***The updated framework should encourage Member States to report on and use the existing multiple benefit monetisation results, wherever possible.*** Early deployment, even in case of limited results, would support future monetisation adjustments and ensure constant improvement of monetisation approaches.

- ***The updated cost-optimality framework should foresee a systematic collection and analysis of best practices, especially from front-runner Member States.*** This approach would not only support the quantification and monetisation of multiple benefits, but also prepare the ground for their more comprehensive consideration in the future.

Improving the calculation of the cost-optimal levels

- If properly selected, discount rates used for calculating cost-optimal levels can highlight the value of efficient buildings and the long-term nature of their benefits. ***The updated cost-optimal calculations should influence the Member States to lower their current discount rates by exploring and proposing discount rates below 2%.*** This approach would not only promote an efficient and deeply renovated building stock but would also consider the long-term nature of the benefits they bring.

- Recent energy price interventions across the EU have resulted in prices that are not suitable for cost-optimal calculations. ***The updated cost-optimal methodology should adjust the existing energy prices to properly reflect the social opportunity costs of energy used in buildings.*** This adjustment is especially important given the limited duration of several energy price protection mechanisms.

RECOMMENDATIONS

Recommendations to DG ENER

- Introduce elements in the cost-optimal methodology that enables and favours the integration of multiple benefits in the calculation and encourage Member States to do so.
- Propose indicative ranges or estimates that can be used to capture high-value multiple benefits before precise values can be produced.
- Set up a structure for collection and dissemination of best practices with regards to monetisation of multiple benefits of energy efficiency.
- Ensure that economic variables such as discount rate and energy prices are selected in a way that does not delay measures by skewing results.

Recommendations to Member States

- Start collecting data and study the quantitative impacts of energy efficiency measures in the national context to better enable monetisation of these impact in the near future.
- Share national approaches with other Member States to build momentum for an effective revision of the methodology.
- Select a low discount rate so as to not undervalue the long-term benefits of energy efficiency measures.

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