ENSMOV PLUS

Matching existing tools and resources with needs and gaps on Art.8 EED (Member States' energy savings obligation)

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List of Abbreviations

CECs	Citizen Energy Communities
ECMs	Energy Consumption Managers
EED	Energy Efficiency Directive
EEEF	European Energy Efficiency Fund
EEM	Energy Efficiency Mortgage
EEOS	Energy Efficiency Obligation Scheme
EMIS	Energy Management Information System
EPC	Energy Performance Contracting
ESCOs	Energy Service Companies
ETS2	Emissions Trading System
EU	European Union
EUSEW	European Sustainable Energy Week
GHG	Greenhouse Gas
IHD	In-Home Display
IPMVP	International Performance Measurement and Verification Protocol
M&V	Monitoring and Verification
MEPS	Minimum Energy Performance Standards
MVP	Monitoring and Verification Platform
NECP	National Climate and Energy Plan
P4P	Pay-for-Performance
RCT	Randomised Controlled Trial
REC	Renewable Energy Community
SCF	Social Climate Fund
SMiV	System for Measuring and Verifying energy savings
UK	United Kingdom
USA	United States of America

EXECUTIVE SUMMARY

The new Energy Efficiency Directive (EED, (EU)2023/1791), officially published in October 2023, has introduced an increased target for Member States' energy efficiency obligations (Article 8 of the EED). According to the amendment, all Member States are now required to deliver 1.3% new annual savings in 2024 and 2025, then 1.5% for 2026 and 2027, and 1.9% from 2028 on. As the targets are becoming more ambitious, Member States need to consider adjusting existing or introducing new energy efficiency measures to deliver higher savings. In this regard, new challenges and needs from the side of the national policymakers as well as from other stakeholders participating in the energy efficiency chain are expected to arise.

ENSMOV Plus, a three-year LIFE project, aims to identify and address those needs through different activities, including workshops, webinars and development of resources. In this context, the present report presents a collection of relevant existing resources, identified through desk-based research, addressing stakeholder priority needs that have been identified from a needs assessment survey conducted at the early stages of the project (February 2023). The resources that have been identified are presented considering the order of the different steps of the policy cycle, meaning policy design and implementation, monitoring and verification (M&V), and policy evaluation. There is also diversity in the types of resources collected, ranging from reports and guidelines to tools, webinars and academic publications.

This compilation can serve as an invaluable asset to policymakers and other stakeholders as it encapsulates a diverse array of information offering practitioners access to essential tools and guidelines and facilitates navigating the complexities and emerging challenges on the way towards successfully achieving the new energy efficiency targets. The selected tools and resources are not intended to be an exhaustive overview of all the resources available online, but rather a selection of those that are currently considered to best address the top priority needs of our stakeholders.

Finally, after matching the resources found through our research with the needs identified via the stakeholder survey, we assessed the existing gaps and highlight where additional efforts should be directed. This indicated that public resources about innovative methods for collecting and processing data are currently limited. The same holds for resources on algorithms and other methods to facilitate verification of energy savings. Resources could also be rarely identified on the quality of individual actions and cost-effectiveness of policies and programmes, beyond those addressing the building sector. In addition, while resources are available about energy savings potentials in general, more specific analysis is often needed to consider these potentials in the context of Article 8 EED. More generally, it can be useful to look at current practices to complement the resources available, for example about how to define and reach priority groups, or how to use measurements when monitoring energy savings.

1. Introduction

1.1. Context and Background

The recast Energy Efficiency Directive (EED, (EU)2023/1791) voted on 25th of July 2023, introduces new or revised provisions aiming to strengthen the existing European Union (EU) energy efficiency framework. In this context Article 8 of the EED (formerly Article 7) about Member States' energy savings obligation, requires a new annual savings rate that will rise gradually from the current 0.8% of final energy consumption to 1.9% in 2028. This increase corresponds to an average annual increase of 1.49% in the period from 2024 to 2030. The end-use energy savings target is cumulative, meaning that Member States need to deliver additional energy savings each year on top of those from prior years (Roscini & Chapelot, 2023). Thus, Member States need to consider adjusting existing or introducing new energy efficiency measures to deliver higher savings towards achieving the new national targets.

In this regard, new stakeholder needs are expected to arise when it comes to policy design and implementation, measurement and verification (M&V) schemes and policy evaluation. ENSMOV Plus, a three-year LIFE project launched in December 2022, aims to provide support to public authorities and key stakeholders, address those needs and facilitate the successful implementation of Article 8 EED.

The project conducted a needs assessment survey at the early stages of its implementation to receive feedback from all relevant stakeholder groups on these emerging needs. These groups include:

i) *Policymakers*, which are the main target group of the project, including public authorities and agencies, and other implementing bodies,
ii) *Energy stakeholders*, such as utilities, Energy Service Companies (ESCOs), and technology providers, including obliged parties in Energy Efficiency Obligation Schemes (EEOSs) and,
iii) *Other stakeholders*, including energy and environment associations, industrial and trade associations, consumer associations, Universities/research centres, banks/financial institutions, etc.

The survey assessed stakeholders' needs emerging at all steps of the policy cycle (i.e., policy design and implementation, M&V and policy evaluation), while it also assessed the preferred forms of resources in an attempt to receive valuable feedback for the resources to be produced within the context of the project.

1.2. Objectives and scope of the deliverable

This report aims to present an inventory of tools and resources that can act as a central reference point for Member States seeking support on energy efficiency policy issues. The inventory was first developed in the Horizon 2020 ENSMOV project. Within

the framework of ENSMOV Plus, the content is updated to address the new needs and priority topics identified in the project. In addition, the overall format is further upgraded to be more user-friendly.

The final output presented here is the result of extensive desk-based research and analysis conducted to identify those tools and resources that best match the needs of relevant stakeholders when it comes to the implementation of Article 8 EED.

The selected tools and resources are not intended to be an exhaustive overview of all the resources available online, but rather a selection of those that are currently considered to best address the top priority needs derived from the needs assessment survey. The resources identified will be utilised during the knowledge exchange activities of ENSMOV Plus project, as well as in addition to those activities. Furthermore, actors that do not have the opportunity to participate in those activities can utilise this document to identify the resources most useful to them. Overall, the report can serve as a list of publicly available tools and support policymakers and other relevant actors from the supply and demand side of energy efficiency solutions by navigating them through this information.

1.3. Structure of the deliverable

The remainder of this report is structured as follows:

Section 2 Presents and analyses the results of the needs assessment survey conducted at the beginning of the project. It provides an overview of the types of stakeholders involved in the survey as well as the rating of the different needs in the three steps of the policy cycle.

Section 3 Describes the working approach and the step-by-step process employed to assemble the report and the accompanying Excel file. It presents how we identified the existing tools and resources and the creation of the relevant inventory.

Section 4 Gathers a collection of tools and resources and matches them with the top priority needs identified in each one of the three steps of the policy cycle. In doing so, it aims to facilitate policymakers and relevant stakeholders to easily identify the material of most interest to them.

Section 5 Summarises the findings of the tools and resources identification and matching process and highlights the gaps between the stakeholders' needs and the currently available material. The section links also these gaps with the resources that the ENSMOV Plus consortium is developing as part of the project.

2. Stakeholders' needs

During the first months of the project, a survey was developed (January 2023) and disseminated (February 2023) to identify the ENSMOV Plus stakeholders' needs. This first task allows us to better customise the forthcoming project's activities and resources to emerging challenges.

The survey aimed at addressing all different groups of stakeholders that the project aims to engage, meaning policymakers (energy ministries, energy agencies and other implementing bodies), energy stakeholders (energy companies and utilities, ESCOs, other energy efficiency supply chain stakeholders) and other stakeholders (trade associations, NGOs, research bodies, etc.). In total, 156 responses were received from stakeholders from 27 countries, mostly coming from the EU.

The percentage of policymakers filling in the first ENSMOV Plus survey reached 37%, while 20% of the respondents were energy stakeholders and 43% were other stakeholders.

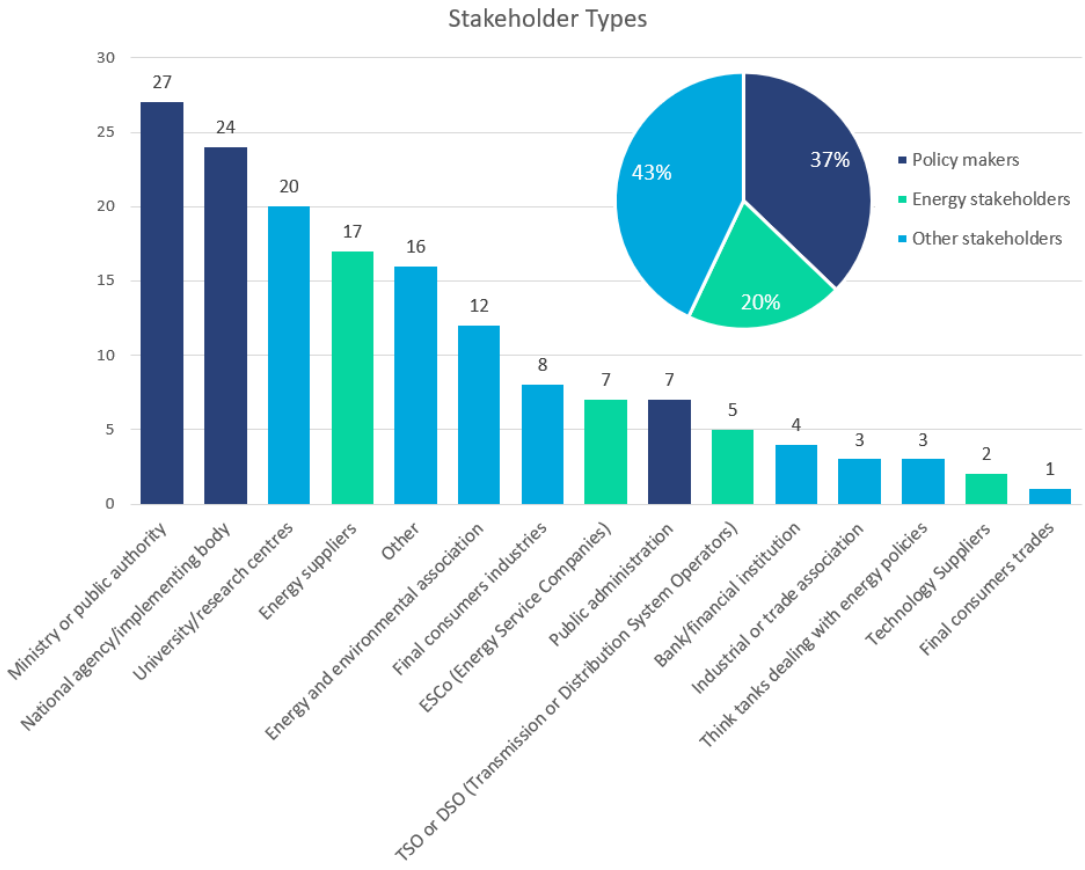

Figure 1: Types and specific stakeholders' categories

The survey was structured, in accordance with the project structure, in the three main steps of the policy cycle: **1) policy design & implementation**, **2) M&V**, and **3) policy evaluation**. For each one of these three fields, specific and broader topics and issues were pre-defined and included in the survey. The respondents were asked to rate 24 issues on a 5-point Likert scale according to how much they are interested

in getting information, experience, or support on them, where 5 corresponds to the highest priority and 1 to the lowest one.

The three following tables present the aggregated metrics of the responses collected from all stakeholder groups. More specifically the mean score and the percentage of 4 and 5 scores are included for each one of the different issues. The issues in bold are the ones that received the highest score from the stakeholders and were selected for in-depth discussion and searching of existing resources, in Section 4.

Overall, it can be derived from the results that most of the stakeholders highly prioritise the policy design and implementation issues. In this field, the identification of complementary measures to enable fuel switching as well as the identification of new or untapped energy savings potentials and gaps in the policy mix received the highest percentages of 4 and 5 scores as well as the highest mean values among all issues. Following, stakeholders are most interested in increasing and optimising funding for the implementation of energy efficiency actions, and in ensuring that policy measures effectively target the appropriate audience. When it comes to M&V, stakeholders are most interested in further employing measured savings and in algorithms and other methods to facilitate the verification of energy savings calculations. Ensuring the quality of the implemented actions and using innovative methods for data collection and processing are also among the top priorities. Finally, concerning policy evaluation, the impact evaluation of both energy savings and other energy or environmental impacts seems to be of high interest, followed by cost-effectiveness assessments and the use of modelling tools to perform ex-ante evaluations.

More information and a comprehensive analysis of the survey results can be found in ENSMOV Plus deliverable 2.1 *"Needs for the implementation of Article 7 EED (energy savings obligation)"* (Cin & Broc, 2024).

Table 1: Needs assessment survey results for policy design and implementation

Policy design and implementation	Mean value	% of 4 and 5 scores
Delivering higher targets		
Identifying new or untapped energy savings potentials, and possible gaps in the policy mix	**4.00**	**74.7%**
Increasing and optimising the funding for energy efficiency (e.g., using EU funds, fine-tuning incentive rates, valuing the multiple benefits of energy efficiency investments)	**4.11**	**75.3%**
Strategic planning (ensuring synergies or avoiding conflicts between measures, covering all end-use sectors, …)	3.92	65.4%
Identifying and anticipating possible bottlenecks (e.g. amongst installers, materials or equipment)	3.63	57.1%
Scaling up policy measures (e.g. reaching more participants, broader scope of action, higher savings per project)	3.63	54.6%
Diversifying financing or market mechanisms (e.g., criteria to increase leverage, auction schemes, pay-for-performance schemes)	3.50	50.7%

Addressing energy poverty or the distributional effects of policy measures		
Ensuring an effective targeting of policy measures	**4.00**	**73.5%**
Comparing approaches for energy efficiency policy measures to alleviate energy poverty	3.81	63.6%
Identifying and mitigating distributional effects / social impacts	3.66	59.7%
Developing partnerships with social services, local authorities, NGOs or other stakeholders	3.34	42.9%
Pivoting away from fossil fuel combustion technologies		
Identifying complementary measures needed to enable fuel switching	**4.05**	**79.1%**
Identifying alternatives to action types that will no longer be eligible	3.85	64.0%
Identifying additional saving opportunities for Member States more reliant on Russian fossil fuel imports	3.51	54.0%
Other specific issues		
Updates and changes related to materiality and additionality (e.g., due to the new ETS on buildings and transport, updates of Ecodesign regulations, updates of emission standards for vehicles)	3.66	60.5%
Coordinating and engaging stakeholders in the implementation of energy efficiency policies	3.63	55.6%
Support for the development of new Alternative measures or revising Alternative measures	3.48	52.3%
Support for the development of a new EEOS or for revising an EEOS	3.28	39.1%
Sectoral issues		
Comparing approaches used to boost building renovations	3.82	64.9%
Analysing the possible synergies between Article 7 EED and the new provisions on the public sector in the EED recast (i.e., the target to reduce the energy consumption of the public sector and stronger requirements for the renovation of public buildings)	3.65	64.7%
Analysing the possible synergies between Article 7 EED and the new provisions on energy management systems and audits in the EED recast (e.g., encouraging the uptake of audit recommendations)	3.74	63.2%
Analysing the effects of high and fluctuating energy prices on energy efficiency investments by companies	3.72	62.7%
Identifying policy measures for energy savings in transport (either measures recently reported by Member States, or measures that can be eligible but are rarely reported yet)	3.68	60.4%
Identifying synergies with the implementation of the recast of the Energy Performance of Buildings Directive (EPBD)	3.72	59.2%
Developing cooperation between energy efficiency and transport stakeholders	3.47	53.6%

Table 2: Needs assessment survey results for monitoring and verification

Monitoring and verification	Mean value	% of 4 and 5 scores
Objectives related to monitoring and verification (M&V)		
Developing the use of measured energy savings	**3.95**	**74.5%**
Ensuring the quality of the individual actions implemented	**3.83**	**70.9%**
Updating or improving the data used in standardised calculation methods	3.86	67.8%
Identifying and monitoring the share of energy savings that can count to the 'energy poverty' ringfence	3.66	61.6%

Updating or improving the guidelines for energy audits or other methods for scaled savings	3.64	57.6%
Revising and improving M&V and reporting requirements	3.56	54.9%
Identifying and mitigating frauds	3.44	51.7%
Optimising the costs of M&V systems	3.41	45.1%
Setting penalties in case of frauds, non-compliance or non-achievement of targets	3.22	44.7%
Avoiding bottlenecks in the approval of application files	3.28	44.2%
Other issues		
Use of innovative methods for data collection and processing	**3.82**	**70.4%**
Making M&V system effective for integrated reporting (e.g. as part of the National Energy & Climate Plans)	3.58	58.9%
Security of IT systems	3.37	50.0%
Benchmarking of M&V costs	3.30	46.4%
Coordination with other administrations or bodies (e.g. fiscal administration, administration in charge of consumer protection, energy ombudsmen, …)	3.29	45.3%
Independence of the M&V body or M&V operators	3.15	35.8%
Type or tool for monitoring and verification		
Algorithms or other methods to facilitate the verification of energy savings calculations	**3.88**	**71.7%**
Tools for digital measurements and verification	3.87	68.4%
Databases to collect and process data from policy implementation and monitoring	3.73	63.6%
Web platforms or applications to collect data from participants, obligated parties or other parties	3.71	62.5%
Sampling methods and strategies	3.68	59.9%
Qualification, accreditation and certification schemes for installers, energy auditors, or other types of professionals	3.63	57.5%
Auditing methods	3.51	53.3%
On-site inspections	3.30	44.7%
Survey of participants	3.16	35.8%

Table 3: Needs assessment survey results for policy evaluation

Policy evaluation	Mean value	% of 4 and 5 scores
Other topics/issues		
Identifying innovative evaluation methods	3.55	53.3%
Benchmarking evaluation costs	3.37	49.3%
Preparing specifications for evaluations	3.39	46.1%
Scope and objectives of evaluations		
Impact evaluations about the actual energy savings	**4.10**	**78.6%**
Impact evaluations about other energy or environmental impacts (e.g., peak load savings, reductions in GHG emissions, reductions in other pollutant emissions)	**3.94**	**74.3%**
Cost-effectiveness assessments	**3.89**	**69.1%**
Ex-ante assessment of energy efficiency measures (using modelling/ simulation approaches)	**3.64**	**59.1%**
Process evaluations to improve how policies function	3.49	58.0%

Impact evaluations about socio-economic impacts (e.g., employment effects, reduction of energy poverty, health impacts, impacts on GDP, impacts on public budget)	3.66	56.6%
Evaluations of market transformation or market effects (e.g., effects of EEOS on the development of markets for energy efficiency services; effects of energy efficiency policies on renovation markets)	3.49	53.9%
Types of evaluation methods		
Comparison of engineering and statistical methods	3.60	58.4%
Innovative measurements on samples of individual actions	3.52	52.0%
Evaluation methods about non-energy impacts	3.24	44.4%
Randomised Control Trials or other types of experimental methods	3.33	42.7%
The use of elasticities to evaluate taxation measures	3.07	36.2%
Stock modelling	3.04	35.8%
Other econometric methods	2.92	28.7%
Theory-based evaluation methods	2.83	25.2%

3. Working approach

To compile this report and the Excel-based inventory of resources that accompanies it we have followed the working approach presented in Figure 2 and described in detail in the rest of this section.

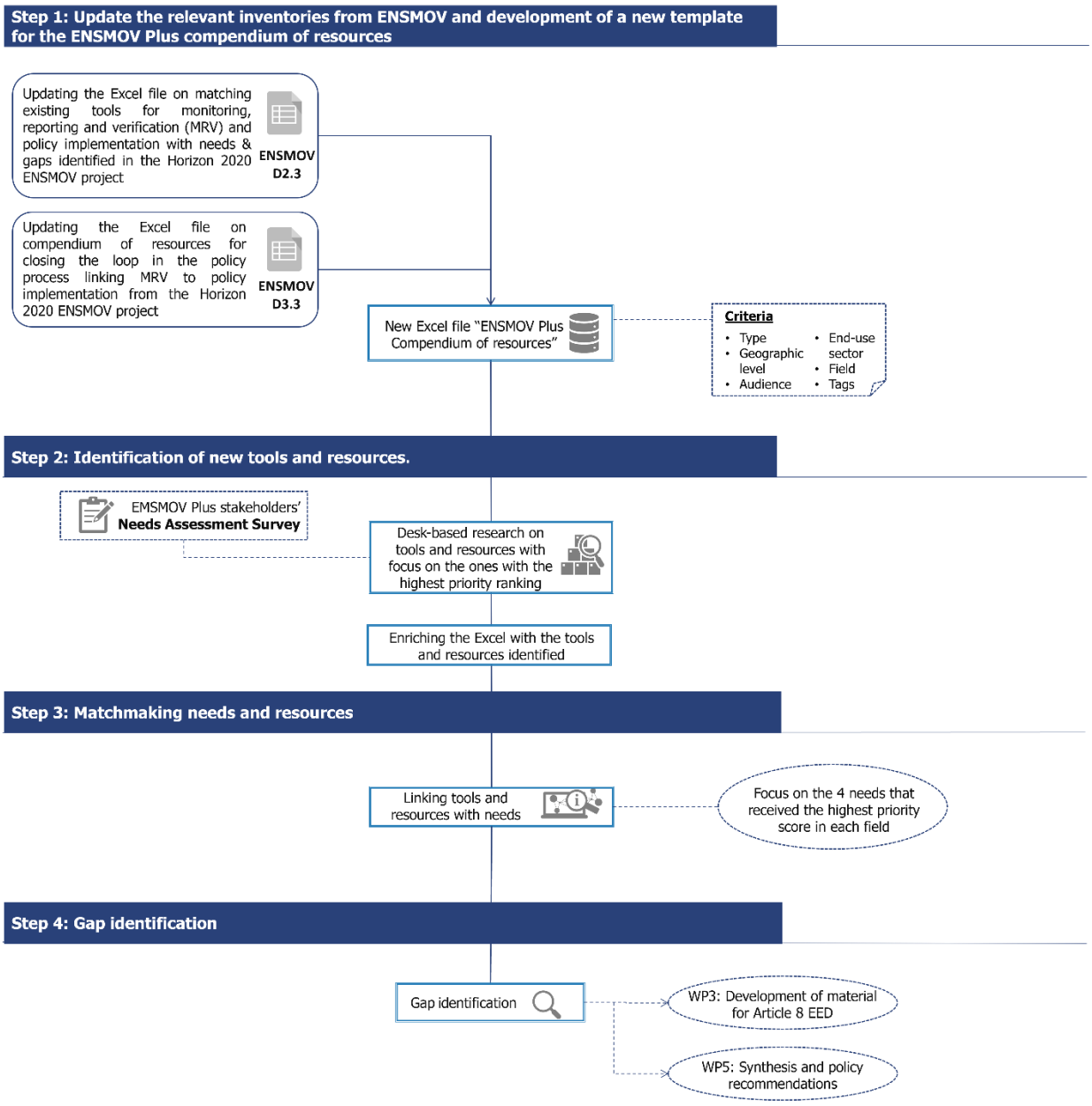

Figure 2: Working approach.

3.1. Step 1: Update the relevant inventories and development of a new template for the ENSMOV Plus compendium of resources

As the scope of ENSMOV Plus is to build upon the developments of its predecessor, the Horizon 2020 ENSMOV project, the first step in our approach was to review and update the existing relevant inventories of tools and resources. These correspond to Deliverable 2.3 *"Matching existing tools for MRV and Policy Implementation with needs & gaps"* and Deliverable 3.3 *"Compendium of resources for closing the loop in the policy process linking MRV to policy implementation"* published during ENSMOV. In this context, outdated resources were removed, and broken hyperlinks were recovered.

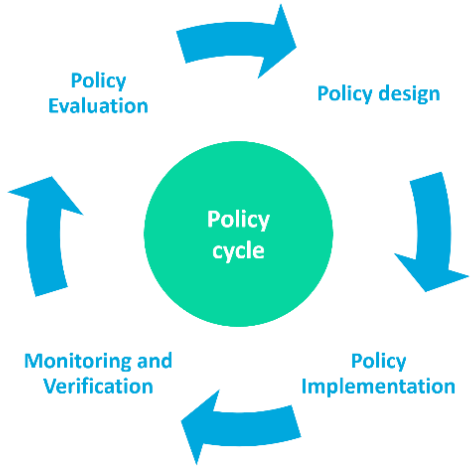

Figure 3: Policy cycle graphical representation

Following, the ENSMOV Plus template for the compendium of resources was developed, aiming to correspond to project needs. The already known resources were transferred there, while attention was given to removing duplicates. This new inventory consists of a short user guide and is divided into three parts that represent the different fields examined in the project, whose order follows the policy cycle, namely: i) the ***policy design and implementation*** part, followed by the ii) ***M&V*** and the iii) ***policy evaluation*** part. By structuring our activities in these fields, we also facilitate consistency with the work carried out throughout the project.

In each one of the three parts, the same information is presented for each resource illustrated. This includes **introductory information** such as the title, the year of publication, the author(s), a short description, and the link to the resource. The resources are also assessed against additional relevant criteria. These include the *"**geographic level or countries**"* covered by the resource, which is filled in by "EU level" if the resource is on EU wide level, "International" if the resource covers countries outside the EU- a common example is resources developed by or for United States of America (USA) organisations- and the name of the country if it is a national resource. The second criterion is the *"**Type**"* of the resources, which can be (academic) journal article, book, report/ guideline, presentation, website, online library or database, video or recorded webinar, and tools.

The third criterion is the *"**audience**"* that the resource is addressing. For this criterion we have chosen the stakeholder categories that are used throughout ENSMOV Plus,

meaning i) *policymakers*, ii) *energy stakeholders* (including energy companies, Energy Service Companies (ESCOs) and technology providers, including obliged parties in Energy Efficiency Obligation schemes (EEOSs), etc), and iii) *other stakeholders* (including energy and environment associations, industrial and trade associations, consumer associations, bank/financial institution, etc), while we differentiated the iv) *academic community* as an additional stakeholder group. Furthermore, the *"**end-use sector**"* that the resources address is included. For this, we differentiate between residential, services, industry, transport and other.

Additionally, relevant **tags and keywords** that complement the abovementioned criteria are included. These tags and keywords are also used as filters in the knowledge transfer platform of the project[1]. By using these on the report and the Excel file we facilitate consistency and interlinkage among the two tasks of the project. The keywords used are EEOS; alternative measures; energy and CO_2 taxes; additionality and materiality; energy poverty and social aspects; alternatives to fossil fuel technologies; lifetime of measures; behavior change; cost-effectiveness; energy efficiency first; multiple impacts of energy efficiency; interactions with other legislations and objectives; measurement methods and verification of energy savings.

A column that links the resources with the four most important needs identified in each field is also added to the Excel file. This allows for consistency between the Excel and the present document which are the main outputs of the *"Mapping and matchmaking tools and resources for tackling dimensions of Art8"* task. Finally, in cases where a specific resource addresses additional fields of the policy cycle, we indicate it in a separate column.

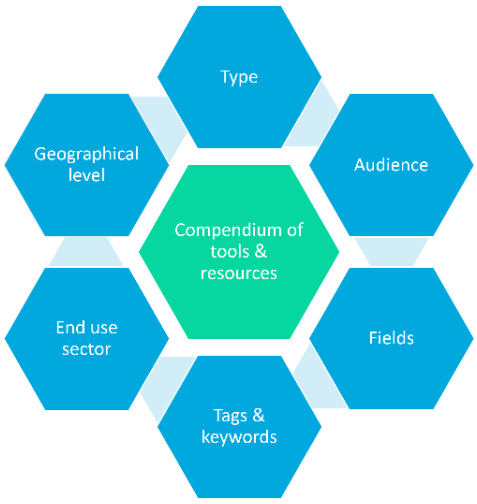

Figure 4: Type of information provided for each resource in the inventory.

[1] https://energysavingpolicies.eu

3.2. Step 2: Identification of new tools and resources

Following the review of the resources collected in the previous project and based on the most important stakeholders needs identified in the ENSMOV Plus needs assessment survey (see Section 2 above), we conducted desk-based research using relevant keywords to identify new tools and resources that could be useful to our target audience.

3.3. Step 3: Matchmaking needs and resources

The aim of this step is to match the resources gathered in all the previous steps with the most important stakeholder needs as derived from the survey. In each field, we concentrated on the 4 issues that received the highest percentage of 4 and 5 scores (see issues in bold in Table 1, Table 2 and Table 3). All resources collected were used in this matching process regardless of their territorial level and the purpose for which they were developed. We should also highlight that there are resources that although listed under a specific need can also be used to cover other important issues identified due to complementarities.

The results of this process are presented in detail in the following section (Section 4), while a table summarising all collected resources is available in the Annex. In this context, we try to avoid presenting in detail resources that were already presented in the core chapters of the ENSMOV Deliverable 2.3 *"Matching existing tools for MRV and Policy Implementation with needs & gaps".*

3.4. Step 4: Gap identification

Finally, we aimed at identifying gaps among the stakeholder needs and the available tools and resources. The results of this analysis will feed into the third WP "*Development of materials for Art.8 EED"* of the project where new tools and resources will be developed as well as to WP5 *"Synthesis and policy recommendations"*.

4. Matchmaking of tools and resources with the needs identified

4.1. Policy design and implementation

The needs that received the highest priority in the needs assessment survey regarding policy design and implementation (presented in detail in Section 2) are reminded in the figure below.

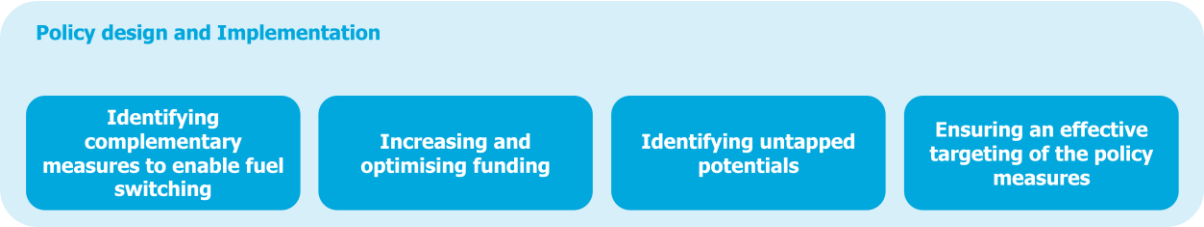

Figure 5: Policy design and implementation issues that received the highest percentage of 4 and 5 scores in the ENSMOV Plus needs assessment survey.

4.1.1. Identifying complementary measures to enable fuel switching

"Identifying complementary measures needed to enable fuels switch" is the topic that received the highest priority score when it comes to policy design and implementation. This is highly relevant to the new provisions of the EED, which seek to exclude energy savings coming from the installation of fossil fuel technologies, counting towards the Article 8 target. Based on Annex V of the EED recast[2], from 2024, the share of energy savings related to fossil fuel combustion technologies will not be counted, while from 2026 newly implemented policy measures involving the use of direct combustion of fossil fuel technologies will be ineligible. Not all fuel switching leads to end-use energy savings. Switching from fossil gas to biogas, for example, will not affect energy use, whereas the electrification of space and water heating and some industrial processes will save both emissions and end-use energy. Taking into account all of the above, resources and tools promoting fuel switching and renewable energy technologies use were found and are presented below.

The article by **Rehfeldt et al. (2020)** although focused primarily on the Greenhouse Gas (GHG) emission reduction target rather than on energy efficiency in industry, provides some valuable policy implications. Through the use of economic incentives and regulatory measures, the authors simulate the impact of fuel switching on achieving the 2030 GHG emission reduction targets. Their findings indicate that neither investment grants for electric processes nor CO_2 prices are effective. Instead, they

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023L1791

suggest that an effective policy mix for fuel switching in the German industry should concentrate on operating costs and stock replacement.

The American Council for an Energy-Efficient Economy (**ACEEE**) published a policy brief in 2022 that aims to assist policymakers design and implement programs that enable fuel switching. It provides an overview of the fuel-switching policies currently in place in each state of the USA. This overview includes information on the rules for fuel switching and additional references to policy plans, technical guidance, etc. It is worth noting that 23 out of 50 states still had no relevant policy in place, and at least another 12 explicitly prohibit or discourage fuel-switching measures (ACEEE, 2022).

The Regulatory Assistance Project (**RAP**) published in 2018 a series of policy briefs setting out the principles of beneficial electrification and the ways in which they can be applied in key end-uses such as space heating, water heating and transportation. The space and water heating papers are particularly useful in the context of the EED energy savings obligation.

Rogulj et al. (2023), through the use of an Excel-based model, quantify the effects of the building sector decarbonisation policies on energy consumption, costs, and investments. The study concludes that a combination of Minimum Energy Performance Standards (MEPS), the new Emissions Trading System (ETS2) and measures focusing on phasing out fossil heating systems effectively reduces energy consumption and costs across most countries and can account for the drawbacks associated with the implementation of a single policy measure. In this study, the phase-out of fossil fuel heating systems is examined through the use of subsidies and the revision of the Ecodesign and energy labelling regulation for heaters that will lead to a downgrading of gas boilers to the two lowest energy labels.

The policy brief published by the Environmental Coalition on Standard (**ECOS**) in 2021, by taking into account the National Climate and Energy Plans (NECPs) of all Member States, builds a series of maps that provide an overview of the ambition of each country and its evolution between 2020 and 2050 when it comes to phasing out fossil fuels (Vavre & Zill, 2021). The findings of the corresponding study suggest that certain national measures were, at that stage, more ambitious than the EU regulations when it comes to phasing out fossil fuels in the building sector from 2020 to 2050. According to the authors, if the Commission's ambition for phasing out fossil fuel supported technologies does not increase, it will not only compel countries wanting to achieve more and faster to align, but it will also endanger everyone's climate goals.

Fuel switching as an option for medium-term emission reduction - A model-based analysis of reactions to price signals and regulatory action in German industry	
Author (Date)	Matthias Rehfeldt, Tobias Fleiter, Andrea Herbst, Stefan Eidelloth (2020)
Description	The article focuses on the German industrial sector and the effect of fuel switching on the achievement of the German GHG emission reduction targets. It provides policy implications that suggest that an effective policy mix for fuel switching should concentrate on operating costs and stock replacement.

Target Audience	Policymakers, Energy stakeholders, Other stakeholders, Academic community
Geographic Area	National (DE)
Type of tool	(Academic) Journal article
Policy topic	Policy design & implementation
End-use sector	Industry
Tags	Energy and CO_2 taxes, Alternatives to fossil fuel technologies
Link/Source	https://www.sciencedirect.com/science/article/pii/S0301421520306042

State Policies and Rules to Enable Beneficial Electrification in Buildings through Fuel Switching	
Author (Date)	American Council for an Energy-Efficient Economy - ACEEE (2022)
Description	This policy brief provides information on existing state policies to assist regulators and program administrators as they seek to design and deliver effective programs that enable fuel switching and meet their maximum potential to achieve net carbon reduction benefits. This policy area is dynamic and rapidly evolving, and the information provided represents a snapshot of those policies in place as of early 2022.
Target Audience	Policymakers
Geographic Area	International (USA)
Type of tool	Report/ guideline
Policy topic	Policy design & implementation
End-use sector	Residential
Tags	Energy and CO_2 taxes, Alternatives to fossil fuel technologies
Link/Source	https://www.aceee.org/sites/default/files/pdfs/state_fuel-switching_policies_and_rules_7-21-22.pdf

Beneficial Electrification	
Author (Date)	Regulatory Assistance Project (2018)
Description	A series of four reports covering the principles of beneficial electrification and no-regrets options for policymakers in space heating, water heating and transportation end-uses.
Target Audience	Policymakers
Geographic Area	International (USA)
Type of tool	Report/ guideline
Policy topic	Policy design & implementation
End-use sector	Residential, Services, Transport
Tags	Alternatives to fossil fuel technologies, Multiple impacts of energy efficiency
Link/Source	https://www.raponline.org/be/

Decarbonisation Policies in the Residential Sector and Energy Poverty: Mitigation Strategies and Impacts in Central and Southern Eastern Europe	
Author (Date)	Rogulj I., Peretto M., Oikonomou V., Ebrahimigharehbaghi S., and Tourkolias C. (2023)
Description	This study investigates the impact of decarbonisation policies on the EU's building stock, with a specific focus on MEPS, the ETS2 for buildings, and the phase-out of fossil heating systems. The study quantifies the effects of these policies on energy consumption, costs, and necessary investments. Finally, having investigated the impacts of the recent energy policies on the low-income group of households, the study proposes policy recommendations.
Target Audience	Policymakers, Academic community
Geographic Area	EU level
Type of tool	(Academic) Journal article
Policy topic	Policy design & implementation
End-use sector	Residential
Tags	Energy poverty and social aspects, Alternatives to fossil fuel technologies
Link/Source	https://www.mdpi.com/1996-1073/16/14/5443

Member States' ambition to phase out fossil-fuel heating -an analysis	
Author (Date)	Jonathan Vavre and Mélissa Zill (2021)
Description	This report provides a comprehensive overview of the fossil fuel phase-out measures implemented by Member States. The main national initiatives of each Member State together with extensive analyses are available.
Target Audience	Policymakers, Academic community
Geographic Area	EU level
Type of tool	Report/ guideline
Policy topic	Policy design & implementation
End-use sector	Residential
Tags	Alternatives to fossil fuel technologies
Link/Source	https://www.coolproducts.eu/wp-content/uploads/2021/07/ECOS-Coolproducts-Background-Briefing-MS-ambition-to-phase-out-fossil-fuel-heating.pdf

4.1.2. Increasing and optimising funding

The second topic in terms of highest priority score is **"*Increasing and optimising the funding for energy efficiency*"**. As the energy efficiency targets are increased, the available capital, either public or private, should be used in a highly effective manner, so that the expected energy savings and energy savings consumption targets for 2030 and beyond are achieved.

Following, we point towards three funds that can be exploited by actors in implementing energy efficiency actions and policy measures.

As part of the new regulations package adopted in 2023, *Regulation (EU) 2023/955* [3] establishes the ***Social Climate Fund*** *(SCF)* for the period 2026-2032 to support policy measures (e.g., temporary income support and energy efficiency actions) addressing households, micro-enterprises and transport users affected by the introduction of emissions trading for buildings and road transport. In this respect, SCF can provide Member States with funding to support energy efficiency.

In addition, the ***InvestEU*** **fund**, part of the InvestEU Programme, offers support for public and private investments in four key policy areas (e.g., sustainable infrastructure; research, innovation and digitisation; small and medium-sized businesses; and social investment and skills). Out of the available €9.9 billion budget for sustainable infrastructure, a proportion is allocated to operations concerning energy efficiency, the development and installation of renewable energy plants, as well as energy storage units for the decarbonisation of industrial processes, as part of the Clean Energy Transition project.

Finally, the "***European Energy Efficiency Fund*** *(EEEF)"* focuses on financing energy efficiency to mitigate climate change and achieve the goals of the European Green Deal. The beneficiaries of the EEEF are municipal, local and regional authorities as well as public and private entities acting on behalf of those authorities. According to the specifications of Annex V of the EED recast, energy savings achieved by energy efficiency measures implemented by the public sector, including local and regional authorities, (Art.5 & Art.6 EED) could be used to fulfil the energy savings requirement of the Art.8(1), provided they result in verifiable end-use energy savings. On this note, the fund can be used by local and regional authorities to achieve energy savings, that can also serve the objectives of Member States' energy savings obligations.

The EU has launched numerous programs and mechanisms aimed at offering financial and technical support for energy efficiency projects and initiatives. On the "***Energy Efficiency Financing***" webpage, users can access links pertaining to both previous and current EU programs aiming at mobilising public and private funding, the creation

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32023R0955

of innovative financing products, and the development of strategies to enhance funding mobilisation through the European Energy Efficiency Financing Coalition[4].

The "***Energy Policy Tracker***" led by the International Institute for Sustainable Development (IISD) could be another useful resource for our stakeholders as it aims to provide information, for countries all around the globe, on the public money commitments for different policy actions in a transparent and easily understood manner.

When it comes to funding optimisation, **He et al. (2019)** propose an innovative decision-making framework for multiple buildings under budgetary constraints. Their multi-objective optimisation model uses energy savings and emissions reduction as environmental goals, and the net present value and the time of return as economic goals, in determining the appropriate retrofitting measures for each building in addition to suggesting the most appropriate buildings.

Forouli et al. (2019) propose a multi-objective portfolio optimisation approach to supporting energy efficiency policymaking. The authors provide a solution to the budget allocation problem by setting optimal portfolios of policy measures that achieve the best allocation of resources. The results of the study, focused on Greece, indicated that the Greek energy savings target for the period 2018-2020 could not be achieved, hence, either a broader set of more cost-effective and robust measures should be considered for implementation, or funds from and collaborations with the private sector must be secured. It is important to note that the applicability of the framework to other settings would depend on the specific energy and policy landscapes of those countries, as well as the availability of relevant data and expertise.

Meeting the ambitious energy saving targets set by the newly adopted EED requires the immediate adoption of climate policies, that should be accompanied by equivalent financing flows to close the existing financing gap (Loukoianova et al., 2022). The white paper "***Financing the green transition***", published by the NGO State of Green in late 2023, gathers several best practice examples from Denmark and worldwide on how to bridge the investment gap and make the green transition happen. Combining perspectives and case studies from both public and private partners and financial institutions, the white paper touches upon the importance of addressing the needs for investments and partnerships, together with the role that the financial sector and private investments play in the green transition.

The building stock is the largest energy consumer in the EU being responsible for 40% of total energy consumption and 36% of CO_2 emissions (EEA, 2022). Improving the energy efficiency of buildings has the potential to decrease the EU's overall energy consumption by 5-6% and lower CO_2 emissions by 5% (European Commission, 2020). Considering that the European mortgage market is valued at 46% of the EU's GDP (Hüllen, 2023), there is a significant opportunity to connect financial innovation with the energy efficiency sector. The EU Horizon 2020 funded project ***Energy Efficient***

[4] https://energy.ec.europa.eu/topics/energy-efficiency/financing/european-energy-efficiency-financing-coalition_en

Mortgages Initiative **(EEMI)** seeks to introduce greener, more sustainability-focused means of buying, renovating and living in homes. Through its EEMI 'Ecosystem' the project helps consumers optimise the energy renovation of their home with the smartest upgrade and financing solutions. The EU-funded **Energy efficient Mortgage Market Implementation Plan (EeMMiP)** project, continuing the work of the EEMI, explored the link between buildings and mortgages and attempted to bridge the gap in the development of the energy efficiency mortgages market.

Energy efficiency plays a vital role in enhancing competitiveness, ensuring energy security, and achieving global objectives in combating climate change. Nevertheless, reaching the EU's targets requires significant investments, including a scale-up of commercial financing. To tackle the issue of limited access to affordable and effective financing for energy efficiency projects, the ***Private Finance for Energy Efficiency (PF4EE)*** instrument was launched in 2014 as a joint initiative between the European Investment Bank and the European Commission. Through the PF4EE, projects that improve the energy performance of an existing building, investments that reduce the energy consumption of public lighting systems, small-scale renewable projects and many others can be financed.

REGULATION (EU) 2023/955 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 10 May 2023 establishing a Social Climate Fund and amending Regulation (EU) 2021/1060	
Author (Date)	The European Parliament and the Council (2023)
Description	Regulation (EU) 2023/955 establishes the Social Climate Fund (SCF) for the period 2026-2032 with the aim to support policy measures (e.g., temporary income support and energy efficiency actions) addressing households, micro-enterprises and transport users affected by the introduction of emissions trading for buildings and road transport.
Target Audience	Policymakers
Geographic Area	EU level
Type of tool	Report/ guideline
Policy topic	Policy design & implementation
End-use sector	Residential, Services, Industry, Transport
Tags	Interactions with other legislations and objectives
Link/Source	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R0955 https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/social-climate-fund_en

InvestEU Fund	
Author (Date)	European Commission (2021)
Description	The InvestEU Fund supports private and public investments in four policy areas: sustainable infrastructure; research, innovation and digitisation; small and medium-sized businesses; and social investment and skills.

Target Audience	Policymakers, Energy stakeholders, Other stakeholders
Geographic Area	EU Level
Type of tool	Website
Policy topic	Policy design & implementation
End-use sector	Services, Transport, Residential, Industry
Tags	-
Link/Source	https://investeu.europa.eu/index_en

European Energy Efficiency Fund	
Author (Date)	European Commission (2011)
Description	The European Energy Efficiency Fund (EEEF) aims to support the climate goals of the European Union to promote a sustainable energy environment and foster climate protection by enabling projects in European cities, regions, and communities to build resilient infrastructure.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders
Geographic Area	EU Level
Type of tool	Website
Policy topic	Policy design & implementation
End-use sector	Services, Transport, Residential, Industry
Tags	-
Link/Source	https://www.eeef.lu/home.html

Energy Efficiency Financing	
Author (Date)	European Commission
Description	EU funding programmes, support mechanisms and technical assistance on energy efficiency financing and investments.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders
Geographic Area	EU Level
Type of tool	Website
Policy topic	Policy design & implementation
End-use sector	Residential, Services, Industry, Transport
Tags	-
Link/Source	https://energy.ec.europa.eu/topics/energy-efficiency/financing_en

The Energy Policy Tracker	
Author (Date)	The Energy Policy Tracker consortium (2020)
Description	The Energy Policy Tracker website showcases publicly available information on public money commitments for different energy policies. The research follows a bottom-up approach, which involves collecting data on individual

	policies at the level of an individual government or multilateral institution, and then aggregating them.
Target Audience	Policymakers, Academic community
Geographic Area	International
Type of tool	Website, Tool, Online Database
Policy topic	Policy design & implementation
End-use sector	Residential, Services, Industry, Transport
Tags	Energy and CO_2 taxes, alternative measures
Link/Source	https://www.energypolicytracker.org/

Investment decision-making optimisation of energy efficiency retrofit measures in multiple buildings under financing budgetary restraint	
Author (Date)	Yong He, Nuo Liao, Jiajing Bi, Liwei Guo (2023)
Description	This study proposes a decision-making optimisation framework for energy efficiency retrofit investment in numerous buildings under financing budgetary restraint. The obtained investment strategy could determine which of the buildings should be invested to retrofit, and the combination of retrofitting measures for every investable building.
Target Audience	Policymakers, Academic community
Geographic Area	International
Type of tool	(Academic) Journal article
Policy topic	Policy design & implementation
End-use sector	Residential
Tags	Alternative Measures, Cost-effectiveness
Link/Source	https://www.sciencedirect.com/science/article/pii/S0959652619301362

Energy efficiency promotion in Greece in light of risk: Evaluating policies as portfolio assets	
Author (Date)	Aikaterini Forouli, Nikolaos Gkonis, Alexandros Nikas, Eleftherios Siskos, Haris Doukas, Christos Tourkolias (2019)
Description	The paper aims to aid in the redesign of the Greek national policy framework, through the adoption of a risk-oriented optimisation model, developed to support the optimal budget allocation to energy efficiency measures. The evaluation of the policy instruments is based on two criteria, namely energy savings and implementation risk, under a set of technical and financial constraints.
Target Audience	Policymakers, Academic community
Geographic Area	National (GR)
Type of tool	(Academic) Journal article
Policy topic	Policy design & implementation, Policy evaluation
End-use sector	Other

Tags	Alternative Measures, Energy and CO_2 taxes, Cost-effectiveness Measurement methods
Link/Source	https://www.sciencedirect.com/science/article/pii/S0360544218325544?ref=pdf_download&fr=RR-2&rr=8314078f5bef6f67

Financing the green transition	
Author (Date)	State of Green (2023)
Description	The publication includes examples and best practices on how to mobilise investments to accelerate the transition to a carbon-neutral and climate-resilient economy.
Target Audience	Policymakers
Geographic Area	National (NO)
Type of tool	Report/ guideline
Policy topic	Policy design & implementation
End-use sector	Other
Tags	-
Link/Source	https://stateofgreen.com/en/news/new-white-paper-financing-the-green-transition-towards-a-climate-resilient-economy/

The Energy Efficiency Mortgage Market Implementation Plan	
Author (Date)	The EeMMiP Project (2020)
Description	The EU-funded EeMMiP project, continuing the work of the EEMI, investigated the connection between energy efficiency in buildings and mortgages, aiming to close the gap in the development of the Energy Efficiency Mortgage (EEM) market. Specifically, the project designed a blueprint for established and emerging markets. It developed market-based governance and an EEM label to support recognition of and confidence in EEMs and facilitate access to quality information for market participants.
Target Audience	Energy stakeholders, Other stakeholders
Geographic Area	EU level
Type of tool	Website, Online library/database
Policy topic	Policy design & implementation
End-use sector	Residential
Tags	-
Link/Source	https://energyefficientmortgages.eu/eem-initiatives-at-a-glance/ https://energyefficientmortgages.eu/home-ecosystem/

Private Finance for Energy Efficiency (PF4EE)	
Author (Date)	PF4EE (2014)
Description	A joint initiative between the European Investment Bank and the European Commission. The instrument aims to increase the availability of debt financing for eligible energy efficiency investments and to make energy

	efficiency lending a more sustainable activity within European financial institutions.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders
Geographic Area	EU level
Type of tool	Website
Policy topic	Policy design & implementation
End-use sector	Other
Tags	-
Link/Source	https://pf4ee.eib.org/about

4.1.3. Identifying new or untapped energy savings potentials and possible gaps in the policy mix

Another topic that received a high score from the stakeholders' survey, the third highest in *policy design and implementation*, is ***"Identifying new or untapped energy saving potentials and possible gaps in the policy mix"***. Although identifying untapped energy efficiency potentials can vary across countries, regions and sectors, we provide below some resources that can act as general guidance to our stakeholders. In addition, we should highlight that studies addressing untapped potential should be considered with caution as they are rarely specific to the scope of Article 8 EED.

Energy efficiency upgrades in existing buildings are often argued to have the greatest untapped energy savings potential (Belaïd et al., 2021). The presentation "***Where to start: Energy efficiency potential in buildings***" published by the International Energy Agency (IEA) provides a useful introduction to buildings' potential including information on the types of potential, what can drive and how to calculate potential in buildings.

The private rented sector has been found to be the least energy efficient and well maintained in comparison to the rest of the housing stock (Bouzarovski et al., 2023). The energy saving potential of the sector remains untapped largely due to the lack of policies that address the tenant-landlord dilemma (also known as the split incentive) and the lack of interest and opportunities to be engaged in energy retrofits (Bouzarovski & Burbidge, 2021). The **ENPOR project**[5] has developed the *Split Incentive Quantification Tool*, available on the project's website, to facilitate tackling the landlord-tenant dilemma by quantifying the appropriate cost or subsidy rates for both parties in specific energy efficiency scenarios.

In addition, the **SmartSPIN[6] project** has developed a business model toolkit to remove the split incentive barrier in the commercial rented sector through a concept

[5] https://enpor.eu/
[6] https://www.smartspin.eu/

that couples the contractual agreements between tenants, owners and energy efficiency providers with technologies for energy monitoring, management, measurement and verification aiming to increase transparency, credibility and persistence of savings.

The **Sustainable Energy Authority of Ireland (SEAI)** has compiled a report that can inform policy (re-) design by providing useful recommendations on how to increase the households choosing to undertake energy efficiency improvements and how to maximise the delivered savings by **improving the attractiveness and effectiveness of subsidies and support programmes**.

ICF in conjunction with the European Commission, carried out an **assessment across all 27 EU Member States** (plus the United Kingdom (UK)) by applying ICF's Energy Saving Opportunity Assessment Tool at country level. This assessment covers the following four sectors: residential, commercial, industrial and transport and identifies how to best address the energy saving potential, also considering the EU energy and climate policy targets for 2030, with elements up to 2040 and 2050.

It is frequently argued in the literature that energy efficiency and technical emission reduction measures would not be enough to reach the climate targets and thus actual energy consumption reduction is required (Gynther, 2021; International Energy Agency, 2022). In this context, sufficiency policies can complement efficiency policies and deliver energy savings (Bierwirth & Thomas, 2019).

While the benefits of sufficiency are undisputed, its potential to play a crucial role in minimising the strain exerted by human actions on the environment and in ensuring that it remains within the maximum carrying capacity remains largely untapped in policy implementation (Gynther, 2021). The **ODYSSEE-MURE policy brief** published in September 2021 investigates how energy sufficiency is measured with the use of specific indicators and provides an overview of policies and measures used in Europe to address energy sufficiency. In addition, the session ***"The untapped potential of sufficiency to meet EU climate goals"*** that took place during the 2023 European Sustainable Energy Week (EUSEW) explores how sufficiency can reduce resource consumption and lower consumers' bills and can facilitate understanding of how it can be incorporated into European energy policies.

According to the new EED recast, Member States are encouraged to consider and promote the role of citizen and renewable energy communities (CECs & RECs) for the achievement of their energy saving targets. The resulting savings could be eligible under Article 8, provided that they comply with the Annex V requirements. As these communities are in close proximity to the residents, they have the potential to raise awareness locally and gain public support for renewable energy and energy savings projects. **Coenen and Hoppe (2022)** show that RECs could be used to raise the level of participation of inhabitants in neighbourhood renovation activities that would result in the achievement of energy savings. The article presents an overview of relevant measures and shows how RECs address home energy savings (e.g., raising awareness, providing education, and training to households, etc.). The study provides

insights into the assessment of actions and measures for coaching householders to achieve energy savings and low carbon goals. In addition, it shows the potential of using RECs as a new strategy to address home energy savings in the current housing stock, including options to improve the energy performance thereof.

Where to start: Energy efficiency potential in buildings	
Author (Date)	International Energy Agency (IEA) (2018)
Description	This presentation provides useful information on the types of potential, what can drive and how to calculate potential in buildings. The presentation is part of the Energy Efficiency in Buildings course provided by IEA.
Target Audience	Policymakers
Geographic Area	International
Type of tool	Presentation
Policy topic	Policy design & implementation
End-use sector	Residential
Tags	Measurement methods
Link/Source	https://iea.blob.core.windows.net/assets/imports/events/610/Buildings.2_Energy_efficiency_potential.pdf

ENPOR Split Incentive Quantification Tool	
Author (Date)	ENPOR project (2023)
Description	The Split Incentive Quantification Tool developed within the framework of the H2020 ENPOR project aims to facilitate tackling the landlord-tenant dilemma by quantifying the appropriate cost or subsidy rates for both parties in specific energy efficiency scenarios.
Target Audience	Policymakers, Other stakeholders
Geographic Area	EU level
Type of tool	Video/ Webinar
Policy topic	Policy design & implementation
End-use sector	Residential
Tags	Energy poverty and social aspects
Link/Source	https://www.enpor.eu/enpor-presents-methodologies-and-tools-to-quantify-split-incentives/ https://www.enpor.eu/the-enpor-split-incentive-tool/

The SmartSPIN toolkit	
Author (Date)	The SmartSPIN project (2021)
Description	A business model toolkit containing a set of tools and resources for stakeholders on both the supply side (e.g., energy service companies, M&V specialists) and the demand side (e.g., tenants, building owners) of the value chain. It aims to remove the split incentive barrier in the commercial rented sector via performance-based contracting.

Target Audience	Energy stakeholders, Other stakeholders
Geographic Area	EU Level
Type of tool	Website, Tool
Policy topic	Policy design & implementation, Policy evaluation
End-use sector	Services
Tags	-
Link/Source	https://www.smartspin.eu/toolkit/

Behavioural insights on energy efficiency in the residential sector	
Author (Date)	SEAI (2019)
Description	This report compiles research findings gathered by SEAI on how to increase residential energy efficiency upgrades. The information and recommendations included in the report provide a knowledge base to inform policy design to maximise the households engaged in energy efficiency retrofitting activities.
Target Audience	Policymakers, Energy stakeholders
Geographic Area	National (IE)
Type of tool	Report/ guideline
Policy topic	Policy design & implementation
End-use sector	Residential
Tags	Behaviours
Link/Source	https://www.seai.ie/publications/Behavioural-insights-on-energy-efficiency-in-the-residential-sector.pdf

Technical assistance services to assess the energy savings potentials at national and European Level	
Author (Date)	Yeen Chan, Pravnick Heer, Krzysztof Strug, Dinachi Onuzo, Lucy Pemble, Julia Menge (2021)
Description	ICF supported the Commission in analysing and quantitatively assessing in depth the remaining energy saving potential, and energy saving options, across the residential, commercial, industrial and road transport sectors, considering both technical and cost-effective energy saving opportunities. The output of this assessment provides technical information to EU and national policymakers on additional potential measures which could support delivering additional energy savings.
Target Audience	Policymakers
Geographic Area	EU level
Type of tool	Report/ guideline
Policy topic	Policy design & implementation, Monitoring and verification, Policy evaluation
End-use sector	Residential, Services, Industry, Transport
Tags	Cost-effectiveness, Measurement methods, Verification of energy savings

Link/Source	https://op.europa.eu/en/publication-detail/-/publication/511bb328-f8b9-11eb-b520-01aa75ed71a1/language-en

Energy Sufficiency Indicators and Policies	
Author (Date)	Lea Gynther (2021)
Description	This policy brief discusses energy sufficiency indicators and policies in the households, transport, and services sectors and illustrates how sufficiency policies can complement energy efficiency policies.
Target Audience	Policymakers
Geographic Area	EU Level
Type of tool	Report/ guideline
Policy topic	Policy design & implementation
End-use sector	Residential, Services, Transport
Tags	Behaviours
Link/Source	https://www.odyssee-mure.eu/publications/policy-brief/energy-sufficiency.pdf

The untapped potential of sufficiency to meet EU climate goals	
Author (Date)	EUSEW (2023)
Description	The session explores the potential of sufficiency to reduce the EU's consumption of resources while lowering consumers' bills. The speakers clarify the difference with other levers such as efficiency, show its potential in figures and present concrete measures already implemented by cities.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders, Academic community
Geographic Area	EU Level
Type of tool	Video/ webinar
Policy topic	Policy design & implementation
End-use sector	Residential, Services, Industry, Transport
Tags	Behaviours
Link/Source	https://interactive.eusew.eu/eusew-2023/sessions/0b297154-1cad-456b-8ce9-49545eec36d0

Renewable Energy Communities as a New Actor in Home Energy Savings	
Author (Date)	Frans Coenen and Thomas Hoppe (2022)
Description	The article builds on empirical data from the EU Horizon 2020 project *REScoop Plus*, about energy-saving actions implemented, and their effectiveness in terms of raising awareness, influencing the intention to save energy, and actual energy-saving behaviour. The article provides insight into the assessment of actions and measures for coaching householders to achieve energy savings and low carbon goals. It also shows the potential of using RECs as a new strategy to address home energy savings in the current housing stock, including options to improve the energy performance thereof.

Target Audience	Policymakers, Energy stakeholders, Other stakeholders, Academic community
Geographic Area	EU level
Type of tool	(Academic) Journal article
Policy topic	Policy design & implementation
End-use sector	Other
Tags	Behaviours
Link/Source	https://www.cogitatiopress.com/urbanplanning/article/viewFile/5088/5088

4.1.4. Ensuring an effective targeting of policy measures

The topic ***"Ensuring the effective targeting of policy measures"*** was also one topic that received a very high score from the stakeholders. This is highly relevant to one of the main changes in the EED recast concerning the share of energy-saving obligations to be delivered *"among people affected by energy poverty, vulnerable customers, people in low-income households and, where applicable, people living in social housing*[7]*"*. Furthermore, Member States are expected to ensure that the policy measures implemented in the context of the EED recast will have no adverse effect on these groups. In this respect, effective targeting of policies is reasonable among the top priorities of our stakeholders. As the phenomenon of energy poverty is multifaceted, with various possible causes, dimensions and manifestations, and the achievement of said savings is hindered by limited recognition of the fact that energy-vulnerable households are not necessarily income-poor (and vice versa), addressing this issue may prove to be a challenging task (Spandagos et al., 2023).

The challenges brought by the aforementioned provisions require correctly identifying both the appropriate group of people and the policy measures that are best suited to their needs. To aid stakeholders in this task we present a series of resources that focus on identifying and supporting the energy poor citizens through the energy transition. The Horizon 2020 ***POWERPOOR*** **project**[8] developed, among others, the POWER-TARGET tool that supports users in identifying whether they are energy poor. On the other hand, the SocialWatt Analyser tool, developed in the context of the Horizon 2020 **SocialWatt project**[9], aims to facilitate energy companies and ESCOs to identify energy poor households within their clients. Moreover, SocialWatt was focused on issues specific to the context of Article 8 EED (which was Article 7 EED at that time).

Spandagos et al. (2023), argue that machine learning techniques may be applied to improve the targeting mechanism of energy poverty schemes, thus enabling accurate prediction and identification of energy vulnerable households via objective, publicly available data. Their study demonstrates how artificial intelligence can

[7] Article 8(3) EED recast.
[8] https://powerpoor.eu/about/project
[9] https://www.socialwatt.eu/en

contribute to energy equity and justice through the improvement of transparency and the evaluation of the fairness potential of hypothetical energy poverty alleviation schemes.

The POWER-TARGET tool	
Author (Date)	The POWERPOOR project (2020)
Description	POWERPOOR developed support programmes/ schemes for energy poor citizens and encouraged the use of alternative financing schemes e.g., establishing energy communities/ cooperatives, crowd funding. The POWER-TARGE tool developed within the framework of the project supports users in identifying whether they are energy poor.
Target Audience	Policymakera, Energy stakeholders, Other stakeholders
Geographic Area	EU Level
Type of tool	Website, Tool
Policy topic	Policy design & implementation
End-use sector	Residential
Tags	Energy poverty and social aspects
Link/Source	http://powerpoor.epu.ntua.gr/powerpoor-toolkit/

The SocialWatt Analyser tool	
Author (Date)	The SocialWatt project (2019-2023)
Description	SocialWatt aimed to enable obligated parties under Article 8 of the EED to develop, adopt, test and spread innovative schemes to alleviate energy poverty. In this context, the project developed the SocialWatt Analyser tool to facilitate energy service companies to identify energy poor households within their clients.
Target Audience	Energy stakeholders
Geographic Area	EU Level
Type of tool	Website, Tool
Policy topic	Policy design & implementation
End-use sector	Residential, Services
Tags	Energy poverty and social aspects
Link/Source	https://www.socialwatt.eu/en/tools/socialwattanalyser

Energy poverty prediction and effective targeting for just transitions with machine learning	
Author (Date)	Constantine Spandagos, Miguel Angel Tovar Reaños, Muireann Á. Lynch (2023)
Description	The article develops an innovative machine learning framework for accurate prediction and fair targeting of energy poor households across all the current members of the European Union, and the UK.
Target Audience	Policymakers, Academic community
Geographic Area	EU level

Type of tool	(Academic) Journal article
Policy topic	Policy design & implementation
End-use sector	Residential
Tags	Energy poverty and social aspects
Link/Source	https://www.sciencedirect.com/science/article/pii/S0140988323006291#s0085

4.2. Monitoring and verification

As presented in Section 2, the needs that received the highest priority in the survey regarding monitoring and verification are summarised in the figure below.

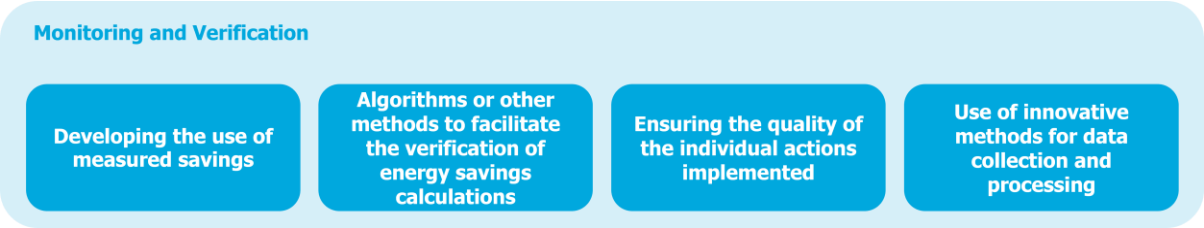

Figure 6: Policy monitoring and verification issues that received the highest percentage of 4 and 5 scores in the ENSMOV Plus needs assessment survey.

4.2.1. Developing the use of measured energy savings

"***Developing the use of measured energy savings***" raised the highest score among the M&V topics, thus we are presenting below resources that aim to support policymakers and energy stakeholders in understanding and promoting their use.

According to Annex V of the EED, Member States are required to calculate the energy savings achieved from the implementation of measures and/or policies using different methods i.e., deemed savings, metered savings, scaled savings, surveyed savings and estimated savings. The use of measurement raises issues like what will be measured or metered, how to ensure consistency in the measurement methods, etc. The **workshop** "*Measurement in monitoring energy efficiency policies: examples and further developments*"[10] conducted in the context of our ENSMOV Plus project, gave useful insights into the use of measurement in monitoring energy efficiency policies. The workshop provided examples from five countries (Croatia, France, Germany, Ireland and Italy) including background information on the schemes and the measurement methods, technical information as well as lessons learnt from actors involved in the schemes.

The Horizon 2020 **SENSEI project**[11] explored the use of Pay-for-Performance (P4P) schemes for energy efficiency in buildings, to maximise energy savings, while removing the risk of paying for unrealised savings under energy efficiency financing programmes. The project developed the *eensight tool*, a next-generation machine learning tool that will contribute to the much-needed advancement of automated measurement and verification methods for energy efficiency. Through the combination of real-time data and predictive modelling of the building's energy consumption, the tool offers continuous feedback on the impact of energy efficiency interventions in buildings. It provides investors, ESCOs, policymakers and building owners with crucial information, allowing them to accurately assess the risk and evaluate the benefits of

[10] https://energysavingpolicies.eu/materials/measurement-in-monitoring-energy-efficiency-policies-workshop-recording-and-materials/
[11] https://cordis.europa.eu/project/id/847066/results

energy retrofits (Papadelis, 2023). Also available from the SENSEI project, the book *"Rethinking Measurement and Verification of Energy Savings"* explains how eensight can be used, how the proposed methodology has been implemented, and why it is a valid option for M&V.

A **topical case study**[12] of the H2020 **EPATEE** project focused on the comparison between energy savings assessments based on metered data and based on engineering estimates. This review found that, when reliable measured or metered data of energy consumption can be collected for all participants and external factors can be controlled, measurement-based approaches likely provide more reliable results. However, in practice, these conditions are far from being commonly met. The case study discusses the pros and cons of both approaches and the cautions to take when comparing their results. Moreover, the **EPATEE toolbox**[13] provides guidance for the use of measurement-based methods in four situations[14]. The resource is addressed to policy officers in charge of energy efficiency policies or programmes, evaluators, obligated parties of EEOS, researchers and any stakeholder interested in the assessment of energy savings at the level of policies or programmes.

Finally, the report developed by **Rathmell et al. (2021)** sets out a proposal for a UK metered energy savings protocol. The approach presented in the study is also tested on pilot retrofit projects using real-world data.

Measurement in monitoring energy efficiency policies: examples and further developments	
Author (Date)	The ENSMOV Plus Project (2023)
Description	The workshop gave insights into measurement in monitoring energy efficiency policies. During the workshop presentations and discussions based on examples where measurement is used for the M&V of energy savings in five countries (Croatia, France, Germany, Ireland and Italy) took place.
Target Audience	Policymakers, Academic community
Geographic Area	EU level
Type of tool	Presentation, Video/ webinar
Policy topic	Monitoring and verification
End-use sector	Residential, Services, Other
Tags	Measurement methods, Verification of energy savings
Link/Source	https://energysavingpolicies.eu/materials/measurement-in-monitoring-energy-efficiency-policies-workshop-recording-and-materials/

[12] https://epatee.eu/sites/default/files/files/epatee_topical_case_study_comparing_estimated_vs_measured_energy_savings.pdf

[13] Specific evaluation guidance - EPATEE-TOOLBOX

[14] i) Evaluating Normative legislative policies on energy efficiency in Residential buildings using Measurement; ii) Evaluating Minimum Energy Performance Standards measures on energy efficiency in Household appliances using direct measurements; iii) Evaluating energy savings from mandatory energy labelling for household appliances using diffusion indicators; iv) Evaluating Information/ Education measures on energy efficient appliances using direct measurements

The SENSEI project and the eensight tool	
Author (Date)	The SENSEI Project (2019)
Description	SENSEI investigated the use of P4P schemes to aggregate retrofit projects, improve the effectiveness of subsidy programmes, and reward energy efficiency as an energy resource and a grid service. The project developed knowledge and insights into how P4P can benefit market players such as ESCOs, building owners and energy providers. The project developed the eensight tool, a next-generation machine learning tool contributing to the much-needed advancement of automated M&V methods for energy efficiency.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders, Academic community
Geographic Area	EU Level
Type of tool	Website, Tool
Policy topic	Monitoring and verification
End-use sector	Residential, services
Tags	Measurement methods, Verification of energy savings
Link/Source	https://cordis.europa.eu/project/id/847066/results

Rethinking Measurement and Verification of Energy Savings	
Author (Date)	Sotiris Papadelis (2023)
Description	This book presents in detail the M&V methodology that has been developed in the context of the Horizon 2020 project SENSEI.
Target Audience	Policymakers, Academic community
Geographic Area	EU level
Type of tool	Book
Policy topic	Monitoring and verification
End-use sector	Residential
Tags	Measurement methods, Verification of energy savings
Link/Source	https://hebes-io.github.io/rethinking/chapters/intro.html

The EPATEE topical case study and toolbox	
Author (Date)	EPATEE project (2017-2019)
Description	Topical case study: "Comparing Estimated versus Measured Energy Savings", including a summary of key issues from a literature review, and examples from Ireland and Lithuania The EPATEE toolbox includes specific guidance considering typical situations for assessing energy savings. Each situation is the combination of a type of policy instrument, a type of end-use sector and a type of assessment method.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders, Academic community
Geographic Area	EU Level
Type of tool	Website, Tool, Report
Policy topic	Monitoring and verification; Policy evaluation

End-use sector	Residential, Industry, Transport, Services, Others
Tags	Measurement methods, Verification of energy savings, Policy evaluation
Link/Source	Case studies: https://epatee.eu/case-studies Toolbox: https://www.epatee-toolbox.eu/

Green Finance Institute: Coalition for the Energy Efficiency of Buildings- Towards a protocol for metered energy savings in UK buildings	
Author (Date)	Alex Rathmell, Tadj Oreszczyn, Juliet Phillips, Sam Thomas, Chris Jofeh (2021)
Description	The report outlines the background and mission of the Coalition for the Energy Efficiency of Buildings (CEEB), before introducing the concept of metered energy savings. It examines specific considerations about capturing metered energy savings in the UK, outlines the various stakeholders that might use it, and the different business models it could support. It then presents the Working Group's proposed protocol, setting out the data inputs that are essential and highly desirable to be included within the methodology.
Target Audience	Policymakers, Energy stakeholders, Academic community
Geographic Area	National level (UK)
Type of tool	Report
Policy topic	Monitoring and verification
End-use sector	Residential
Tags	Measurement methods, Verification of energy savings
Link/Source	https://www.greenfinanceinstitute.com/wp-content/uploads/2024/06/Towards-a-protocol-for-metered-energy-savings-in-UK-buildings.pdf

4.2.2. Algorithms or other methods to facilitate the verification of energy savings calculations

The topic ***"Algorithms or other methods to facilitate the verification of energy savings calculations"*** received the second highest score among the M&V issues in the needs assessment survey. The EED recast requires Member States to establish *"measurement, control and verification systems under which documented verification is carried out on at least a statistically significant proportion and representative sample of energy efficiency improvement measures*[15]*"*. In order to support stakeholders in the verification of energy savings calculations, we present below the identified relevant resources.

The *"Synthesis report on European best practices for M&V schemes and coordination mechanisms"* published in 2016 by the Horizon 2020 **multEE project**[16] includes a section with the best practices on verification procedures identified across Member States at the time. The procedures presented there include inspections in a

[15] Article 9(9) and Article 10(2), EED
[16] https://www.multee.eu/

representative sample of implemented measures, use of specific datasets and specialised reports and verification through algorithms in M&V platforms.

The Efficiency Valuation Organisation (**EVO**) that owns and manages the International Performance Measurement and Verification Protocol (IPMVP), has developed several resources to support stakeholders in M&V procedures. These include guidelines and snapshots as well as training programs ranging from introductory workshops to advanced trainings. The IPMVP is used in the context of the global energy transition to a low carbon economy, offering a consistent approach to measuring and verifying carbon emissions reduction in a broad range of sectors. In the context of the IPMVP, a framework is established that is used to verify if a project has the potential to save energy and quantify site-level energy and cost impacts. The protocol is a living document whose methodologies and procedures are constantly updated enabling reflection of current and new market needs.

The Croatian System for measuring and verifying energy savings (**SMiV**) was developed by the Centre for Monitoring Business Activities in the Energy Sector and Investments – CEI to provide accurate savings measurements in a unified and proper manner. According to the country's legislation, all projects implemented with financial support from the State need to be recorded in the SMiV. Subsidy providers (i.e., the Environment Protection and Energy Efficiency Fund-EPEEF) enter into SMiV the required data for the implemented projects, while all the savings are verified and signed by authorised experts. The system addresses all sectors (e.g., residential, industry, services, transport) and uses a bottom-up methodology defined in the National ordinance "System for Monitoring, Measuring and Verification of Energy Savings"[17]. Specifically for the monitoring of the energy consumption of the public sector, the Energy Management Information System (**EMIS**), led by the Croatian Real -estate Agency is used. Measured data on electricity consumption before and after the energy efficiency project implementation are available in EMIS, and the energy savings are calculated according to metered data.

The **StreamSAVE** project aimed to assist Member States in improving their estimates regarding energy savings. The project's main goal was to expand the policy scope of energy efficiency actions in Member States to achieve potential energy savings that have been unexploited so far. The project partners developed the Energy Saving Calculation platform, to facilitate the exchange of knowledge and experience amongst stakeholders. The platform provides stakeholders with access to a community of experts and resources to better implement energy savings calculation methodologies for a selection of 10 action types.

Moreover, **Appendix XII complementing the Commission's Recommendation** on transposing the EED energy savings obligations (C(2019) 6621 final)[18], published in September 2019, includes guidance for M&V, and more specifically about

[17] https://unfccc.int/sites/default/files/resource/NC8%20and%20BR5_CROATIA.pdf
[18] http://data.europa.eu/eli/reco/2019/1658/oj

statistically significant proportion and representative sample. This guidance is still relevant now in the context of the new EED.

Synthesis report on European best practices for M&V schemes and coordination mechanisms	
Author (Date)	Minas Iatridis, Christos Tourkolias, Andrea Jamek and Nina Pickl, Jan Andersen and Tyge Kjaer, Ivars Kudrenickis, Gaidis Klavs and Janis Rekis, Lovorko Maric, Marko Matosovic and Mia Dragovic, Marc Ringel, Romualdas Skema, Sigitas Masaitis, Konstantin Dimitrov, Sashe Panevski, Eduard Jambor, Michal Nemeth, Benjamin Struss (2016)
Description	The report presents the main findings from the analysis of best practices on M&V schemes and coordination mechanisms all around Europe.
Target Audience	Policymakers, Energy stakeholders, Academic community
Geographic Area	EU Level
Type of tool	Report/ guideline
Policy topic	Monitoring and verification
End-use sector	Residential, Services, Industry, Transport
Tags	Measurement methods, Verification of energy savings
Link/Source	https://multee.eu/system/files/EU_Best_Practice_for_M&V_schemes_&_Coordination_Mechanisms_1.pdf

Efficiency Valuation Organisation (EVO)	
Author (Date)	Efficiency Valuation Organisation (EVO)
Description	EVO is a non-profit organisation that works towards ensuring that the savings and impact of energy efficiency and sustainability projects are accurately measured and verified. It provides useful trainings and resources on M&V procedures and owns and manages the IPMVP.
Target Audience	Policymakers, Energy stakeholders, Academic community
Geographic Area	International
Type of tool	Website, Report/ guideline
Policy topic	Monitoring and verification
End-use sector	Residential, Services, Industry, Transport
Tags	Verification of energy savings
Link/Source	https://evo-world.org/en/; https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp

System for measuring and verifying energy savings (SMiV)	
Author (Date)	SMiV (2018)
Description	In order to measure savings in a unified and proper manner and in accordance with the applicable Croatian law on energy efficiency, Centre for Monitoring Business Activities in the Energy Sector and Investments - CEI, in cooperation with the German Society for International Cooperation - GIZ, has developed SMiV, a system in which all plans and implemented energy

	efficiency measures are entered. Public administration, companies that have energy performance contracts, as well as EPEEF are obliged to enter all implemented measures. For every implemented measure there is a method of reporting and verification of real savings and predictions can be easily compared to achieved results.
Target Audience	Policymakers
Geographic Area	National (HR)
Type of tool	Tool
Policy topic	Monitoring and verification
End-use sector	Residential, Industry, Transport, Services
Tags	Measurement methods, Verification of energy savings
Link/Source	https://www.interregeurope.eu/good-practices/smiv-system-for-monitoring-and-verification-of-energy-savings

Streamlining energy savings calculations	
Author (Date)	streamSAVE project (2020)
Description	The 2020 streamSAVE project is a H2020 project that developed calculation methodologies in the context of Art.7 EED, with applications in 10 countries. The project also conducted dialogue meetings inviting experts to share their experience.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders, Academic community
Geographic Area	EU Level
Type of tool	Report/ guideline, Presentation, Website, Video/ webinar, Tool
Policy topic	Monitoring and verification
End-use sector	Residential, Services, Industry, Transport
Tags	Measurement methods
Link/Source	Homepage: https://streamsave.eu/ Calculation methodologies: https://streamsave.eu/wp-content/uploads/2022/08/D2.2_PracticalGuidance_final.pdf Collection of catalogues of methods: https://streamsave.eu/wp-content/uploads/2021/01/D2.1_StatusSavingsCalculationsEU-2ndRound_v3.pdf Online platform (including the proceedings of the meetings, and a Training Module to use the methodologies): https://streamsave.flexx.camp/support

Appendix XII complementing the Commission's Recommendation	
Author (Date)	European Commission (2019)
Description	Appendix XII complementing the Commission's Recommendation on transposing the EED energy savings obligations (C (2019) 6621 includes guidance for M&V specifically about statistically significant proportions and representative samples.
Target Audience	Policymakers

Geographic Area	EU Level
Type of tool	Report/ guideline
Policy topic	Monitoring and verification
End-use sector	Residential, Services, Industry, Transport
Tags	Measurement methods
Link/Source	https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A32019H1658#d1e34-87-1

4.2.3. Ensuring the quality of the individual actions implemented

The issue that collected the third highest score among the M&V topics was ***"Ensuring the quality of the individual actions implemented"***. A key issue in energy efficiency actions and policies is the achievement of measurable energy savings (Bertoldi & Mosconi, 2020). Ensuring the implementation of high-quality actions enables policymakers to maximise the impact of their policies, in this case delivering energy savings, while optimising their limited resource utilisation (Jacob et al., 2019). By incorporating quality assurance measures at every stage of the policy lifecycle, policymakers can increase the probability of achieving the desired outcomes and effectively tackling energy efficiency and societal challenges.

P4P programmes work under the principle that payment for energy efficiency should be made according to the performance of implemented measures. The paper by **Anagnostopoulos (2022)** discusses how P4P schemes can be used to increase the scale and effectiveness of energy efficiency financing. As these schemes link payments for energy efficiency projects to measured energy savings rather than assumed savings, they can play a key role in ensuring the quality of the implemented actions.

The report by **Szinai et al. (2017)** compiles data from past and ongoing P4P initiatives in the USA, that utilise a range of techniques for estimating energy savings and payment models. Following an overview of the background and development of P4P, the report establishes a classification system for key P4P components and applies it to examine twenty-two (22) case studies. Finally, it delves into risk management, business models in the private sector, and other policy considerations related to P4P strategies compared to more conventional energy efficiency programs. The aim is to provide guidance to policymakers and supporters as they develop and facilitate new energy efficiency initiatives.

The Horizon 2020 **QualitEE-project**[19] aimed to scale up responsible investments in energy efficiency services in the building sector and develop guidelines on EU-wide standardised "technical quality criteria" and "minimum financial information" for energy efficiency services. After looking at the Energy Performance Contracting (EPC) and the Energy Supply Contracting market development across 15 EU countries, the project identified important similarities, that lead to general recommendations. More

[19] https://qualitee.eu/

specifically, in the country reports prepared, the development and implementation of quality assurance systems were recommended to overcome the apparent lack of trust in service providers and low customer demand. The project contributes to market expansion through standardisation and quality assurance of energy efficiency services in an institutional framework that would be sustained well after the conclusion of the project.

Pay-for-Performance schemes to trigger energy efficiency investments	
Author (Date)	Filippos Anagnostopoulos (2022)
Description	The article discusses the role of P4P schemes in increasing the scale and effectiveness of energy efficiency financing. Using advanced M&V methods, the energy savings resulting from applied measures become a measurable quantity – essentially: an energy efficiency meter.
Target Audience	Policymakers, Academic community
Geographic Area	EU level
Type of tool	(Academic) Journal article
Policy topic	Monitoring and verification
End-use sector	Residential
Tags	Measurement methods, Verification of energy savings
Link/Source	https://www.openaccessgovernment.org/wp-content/uploads/2022/10/openaccessgovernment.org-Pay-for-Performance-schemes-to-trigger-energy-efficiency-investments.pdf

A Study of Pay-for-Performance Energy Efficiency Programs in the United States	
Author (Date)	Julia Szinai (2017)
Description	This report compiles insights gathered from previous and ongoing P4P initiatives in the USA, incorporating a range of approaches for estimating energy savings and payment models. The aim is to provide guidance to policymakers in the development of future energy efficiency endeavours.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders, Academic community
Geographic Area	International (USA)
Type of tool	Report
Policy topic	Monitoring and verification
End-use sector	Residential
Tags	Measurement methods, Verification of energy savings
Link/Source	https://www.nrdc.org/sites/default/files/pay-for-performance-efficiency-report.pdf

Quality certification frameworks for Energy Efficiency services to scale up responsible investment in the building sector (QualitEE project)	
Author (Date)	QualitEE project (2017)
Description	The QualitEE-project aimed to scale up investment in building energy efficiency by establishing quality certification frameworks for energy efficiency services across Europe.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders, Academic community
Geographic Area	EU level
Type of tool	Website
Policy topic	Monitoring and verification
End-use sector	Residential
Tags	-
Link/Source	https://qualitee.eu/

4.2.4. Use of innovative methods for data collection and processing.

The ***"Use of innovation methods for data collection and processing"*** topic scored the fourth highest priority in the M&V section of the survey. To ensure the effectiveness of their policies and their compliance with the EED recast provisions on energy saving obligations, Member States require accurate information and reliable data, thus appropriate data collection and processing methods are of outmost importance.

The ***multEE Monitoring and Verification Platform*** *(MVP),* developed in the context of the multEE project, enables monitoring of energy savings as well as the exchange of data and experience between the different policy levels. The platform incorporates innovative elements including facilitating consistency on data from different administrative levels (local, regional and national).

The **NUDGE project**[20] developed a methodology to use Randomised Control Trials (RCTs) for assessing energy savings from behavioural measures. The methodology was used in pilot cases during the project, providing also lessons learnt about its use.

Moreover, the new **streamSAVE Plus** project, started in July 2024, includes one task dedicated to advanced data collection techniques and should provide new resources in this field.

[20] https://www.nudgeproject.eu/

The multEE Monitoring and Verification Platform (MVP)	
Author (Date)	The multEE Project (2017)
Description	The MVP allows authorities to consistently measure progress towards energy efficiency targets. The platform encourages different administration levels, such as states, counties, and municipalities, to exchange their experience, share data and coordinate their actions, considering that an efficient multi-level governance approach would lead to the adoption of more integrated and sustainable energy efficiency plans, define clear and converging objectives, and ensure more transparency and coherence in the overall planning process.
Target Audience	Policymakers, Academic community
Geographic Area	EU Level (and Republic of North Macedonia)
Type of tool	Tool
Policy topic	Monitoring and verification
End-use sector	Residential, Services, Industry, Transport
Tags	Measurement methods, Verification of energy savings
Link/Source	https://multee.eu/how-innovative-web-applications-can-support-energy-efficiency-policy-planning.html

Methodology the NUDGE project	
Author (Date)	NUDGE Project (2020-2023)
Description	The NUDGE methodology can be used to assess energy savings from behavioural measures, using RCTs. The methodology covers the whole process, including data collection and processing. The methodology was tested in pilot cases in Belgium, Croatia, Germany, Greece and Portugal.
Target Audience	Policymakers
Geographic Area	EU Level
Type of tool	Website, Report
Policy topic	Monitoring and verification
End-use sector	Residential
Tags	Measurement methods, Verification of energy savings
Link/Source	Methodology: https://www.nudgeproject.eu/wp-content/uploads/2022/08/D2.2-Research-methodology-for-assessing-the-effectiveness-of-interventions-regarding-change-of-energy-efficient-behavior.pdf Results from the pilot cases: https://www.nudgeproject.eu/wp-content/uploads/2024/01/NUDGE-D4.2-D4.4_FINAL_compressed.pdf Lessons learnt about evaluating energy savings from behavioural measures: https://www.nudgeproject.eu/wp-content/uploads/2024/01/NUDGE_T2.3_Report_PilotResults_final_compressed.pdf

4.3. Policy evaluation

The needs that received the highest priority in the needs assessment survey regarding policy evaluation (presented in detail in Section 2) are summarised in the figure below.

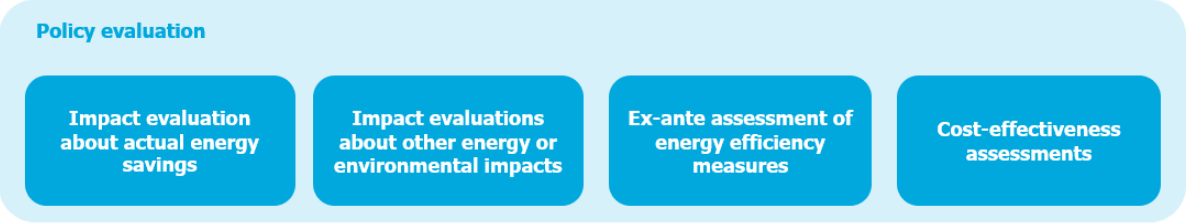

Figure 7: Policy evaluation issues that received the highest percentage of 4 and 5 scores in the ENSMOV Plus needs assessment survey.

4.3.1. Impact evaluations about actual energy savings

The ***"Impact evaluations about actual energy savings"*** was the topic that received the highest priority score in the survey in this field. In the context of the new energy savings obligations, it is important for Member States to understand what exactly the policy measures deliver in terms of energy savings so that they can appropriately (re)-design and implement their actions.

In most cases energy savings across the EU are assumed ex-ante and are rarely evaluated ex-post, thus there is a lack of focus on whether the savings reported have been achieved (Guibentif et al., 2021; Thomas & Santini, 2021). In this context, the report by **Thomas & Santini (2021)** contains seven useful recommendations for the evaluation, measurement and verification of energy savings highlighting the importance of ex-post evaluations to enhance confidence in the policy impacts. In addition, the use of the metered savings approach helps to evaluate energy savings as part of the measurement and verification process, reducing the costs of more extensive evaluation studies. However, according to the report, the use of ex-post measurement techniques, using energy consumption meter data, has been limited in Europe to a small number of industrial actions (when looking at energy savings reported by Member States for their energy savings obligations).

Bertoldi & Mosconi (2020), after conducting a literature review of the existing measurement methods and their limitations, propose an econometric model that incorporates the use of energy policy indicators based on the MURE database[21]. These policy indicators are then included, along with control variables, in dynamic panel models for each sector. The models are then used to estimate a quantitative measure of the policy-induced energy savings from 1990 to 2013, measured as a percentage of the energy consumption in the absence of energy policies.

Vringer et al. (2022) aim to demonstrate the significance of evidence-based policymaking by obtaining strong insights into the impact of Energy Consumption

[21] https://www.measures.odyssee-mure.eu/

Managers (ECMs) in the Dutch context. Impact estimates of three different feedback mechanisms – an app, email, and an In-Home Display (IHD) are derived, aiming to evaluate the energy policy in place. RCTs were used to measure the causal impact on home energy consumption. The results of the study show that the simple IHD tested saved up to 2.2% electricity and 6.9% natural gas. Contrary to that, no evidence that energy consumption information leads to actual consumption reduction was found in the trials of the app and the email.

In this context, the **EPATEE topical case study** (presented in Section 4.2.1) discussing the pros and cons of methods based on measurements vs. methods based on engineering estimates and the **NUDGE methodology** (presented in Section 4.2.4) developed for RCTs to assess energy savings from behavioural measures are also relevant resources.

Measuring and increasing impact: The next challenge for EU energy efficiency policy measures	
Author (Date)	Samuel Thomas and Marion Santini (2021)
Description	This paper recommends improvements in evaluation, measurement, and verification practices as a way of increasing the impact of the EED and enabling the Energy Efficiency First principle to be implemented.
Target Audience	Policymakers
Geographic Area	EU Level
Type of tool	(Academic) Journal article
Policy topic	Policy design & implementation, Monitoring and verification, Policy evaluation
End-use sector	Residential, Services, Industry, Transport
Tags	Energy Efficiency First, Measurement methods, Verification of energy savings
Link/Source	https://www.raponline.org/wp-content/uploads/2023/09/rap-thomas-santini-measuring-increasing-impact-eu-energy-efficiency-2021-december.pdf

Do energy efficiency policies save energy? A new approach based on energy policy indicators (in the EU Member States)	
Author (Date)	Paolo Bertoldi, Rocco Mosconi (2020)
Description	The article presents an econometric model aimed at estimating the energy savings induced by energy efficiency policies in the EU Member States in the period 1990–2013. An explicit measure of energy policy intensity based on the MURE database is introduced and used as explanatory variable in a dynamic panel model for 29 European countries.
Target Audience	Policymakers, Academic community
Geographic Area	EU level
Type of tool	(Academic) Journal article
Policy topic	Policy evaluation
End-use sector	Other

Tags	-
Link/Source	https://www.sciencedirect.com/science/article/pii/S030142152030077X#sec6

Effective energy saving policy requires causal evidence	
Author (Date)	Kees Vringer, Daan van Soest, Mirthe Boomsma (2022)
Description	The article aims to present the importance of evidence-based policymaking. Impact estimates of different mechanisms are presented and measured with the use of RCTs. The approach is tested in the Netherlands and the results indicate that the use of causal impact analysis (i.e., the RCTs) is crucial for evidence-based policymaking.
Target Audience	Policymakers, Academic community
Geographic Area	National (NL)
Type of tool	(Academic) Journal article
Policy topic	Policy evaluation
End-use sector	Residential
Tags	-
Link/Source	https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2022/4-monitoring-and-evaluation-for-a-wise-just-and-inclusive-transition/effective-energy-saving-policy-requires-causal-evidence/

4.3.2. Impact evaluations about other energy or environmental impacts

"***Impact evaluation about other energy or environmental impacts*** (e.g., peak load savings, reductions in GHG emissions, reductions in other pollutant emissions)" was also a topic that raised a high score in the needs assessment survey. In this section, we present resources and tools that deal with evaluating additional benefits delivered through energy efficiency investments. The collected resources also address the topic "Impact evaluations about socio-economic impacts (e.g., employment effects, reduction of energy poverty, health impacts, impacts on GDP, impacts on public budget)" that, although may not be among the four topics that received the highest percentage of 4 and 5 scores, is one of the four topics that received the highest mean priority.

The **MB:EE | *Multiple Benefits of Energy Efficiency* tool**, developed in the context of the ODYSEE-MURE project[22], aims to showcase a holistic view of energy efficiency benefits beyond energy savings, including environmental, economic, and social aspects.

Another relevant tool developed during the Horizon 2020 MICAT project[23], is the ***MICATool***, which facilitates policymakers and practitioners to assess the multiple impacts of energy efficiency policies and measures. The MICAT project provides also

[22] https://www.odyssee-mure.eu/
[23] https://micatool.eu/

reviews of methods and evaluations on a selection of social, economic and environmental impacts[24].

Finally, the Horizon 2020 ***M-Benefits project***[25] created a framework for the inclusion of the multiple benefits of energy efficiency in the assessment of investments and the decision-making process of companies and relevant stakeholders. The project developed a methodology to assess and quantify non-energy benefits and their impact on the financial investment evaluation. Its results highlight the relevance of co-benefits and companies' increased willingness to decide in favour of energy efficiency measures when these are taken into account (Berger & Rohde, 2021). *M-Benefits* provided tools, best practices, case studies and other training materials.

RAP set out a "layer cake" of benefits associated with energy efficiency. The **report** provides guidance on how to assess the benefits across three broad themes: energy system, participants and society more broadly.

Alexandri et al. (2022) provide estimates of the multiple benefits of energy savings for European citizens and the economy that are associated with different levels of the 2030 EU energy efficiency target. The analysis shows that the greatest impacts are associated with the *"enhanced efficiency scenario"*, which is characterised by more ambitious efficiency targets and higher investments in energy efficiency goods and services.

Moreover, examples of evaluations that covered various impacts, and discussions about evaluation methods, can be found in the resources of the **Energy Evaluation**[26] website, which gathers the proceedings of the Energy Evaluation Europe (and previously IEPPEC) conferences.

Another relevant resource in this context is the ENEFIRST report discussing the integration of multiple impacts and the Energy Efficiency First principle, presented in the next section (Section 4.3.3).

MB:EE | Multiple Benefits of Energy Efficiency tool	
Author (Date)	The Odyssee-Mure Project
Description	This tool represents a quantitative indicator approach to measure multiple benefits of energy efficiency (MB-EE) developed as part of the ODYSSEE-MURE project. It aims to show the different aspects of energy efficiency beyond energy savings and provide a more holistic view.
Target Audience	Policymakers, Academic community
Geographic Area	EU Level
Type of tool	Tool
Policy topic	Policy evaluation
End-use sector	Residential, Services, Industry, Transport

[24] https://micatool.eu/seed-micat-project-en/publications.php
[25] https://cordis.europa.eu/project/id/785131
[26] https://energy-evaluation.org/resources/

Tags	Multiple impacts of energy efficiency
Link/Source	https://www.odyssee-mure.eu/data-tools/multiple-benefits-energy-efficiency.html

Multiple Impacts Calculation Tool (MICATool)	
Author (Date)	The MICAT Project (2020)
Description	The MICATool aims to enable policymakers and practitioners to conduct simplified analyses for different data and policy scenarios, in order to compare and assess the relevance of the multiple impacts and strengthen reporting and monitoring at different governance levels.
Geographic Area	EU Level
Type of tool	Tool
Policy topic	Policy evaluation
End-use sector	Other
Tags	Multiple impacts of energy efficiency
Link/Source	https://micatool.eu/micat-project-en/

Multiple Benefits of Energy Efficiency (M-benefits)	
Author (Date)	The M-Benefits Project (2018)
Description	M-Benefits aims at including the multiple benefits of energy efficiency in investment decisions of companies and thereby substantially increasing the deployment of cost-effective energy saving potentials. It provides best-practice examples, tools and trainings on the importance of multiple benefits for investment decisions in companies.
Target Audience	Policymakers, Energy stakeholders, Academic community
Geographic Area	EU Level
Type of tool	Website
Policy topic	Policy design & implementation, Policy evaluation
End-use sector	Other
Tags	Multiple impacts of energy efficiency
Link/Source	https://cordis.europa.eu/project/id/785131

Recognising the Full Value of Energy Efficiency	
Author (Date)	Regulatory Assistance Project (2013)
Description	This report describes the "layer cake" of benefits from energy efficiency, across three broad themes: energy system, participants and society. The report adds value on the energy system benefits.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders
Geographic Area	International (USA)
Type of tool	Report/guideline
Policy topic	Policy design & implementation, Policy evaluation

End-use sector	Residential, Services, Industry, Transport
Tags	Multiple impacts of energy efficiency
Link/Source	https://www.raponline.org/wp-content/uploads/2023/09/rap-lazarcolburn-layercakepaper-2013-sept-09.pdf

2030 EU energy efficiency target: The multiple benefits of higher ambition	
Author (Date)	Eva Alexandri, Isha Dwesar, Ornella Dellaccio, Boglárka Molnár (2022)
Description	The study provides estimates of the multiple benefits of energy savings for European citizens and the economy that are associated with different levels of the 2030 EU energy efficiency target.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders, Academic community
Geographic Area	EU level
Type of tool	Report/ guideline
Policy topic	Policy evaluation
End-use sector	Residential, Services, Industry, Transport
Tags	Multiple impacts of energy efficiency
Link/Source	https://www.camecon.com/what/our-work/2030-eu-energy-efficiency-target-multiple-benefits-higher-ambition/

Energy Evaluation	
Author (Date)	The Energy Evaluation Organisation
Description	The Energy Evaluation has a wealth of resources including conference papers, online articles and webinars as well as examples of evaluations that covered various impacts, and discussions about evaluation methods.
Target Audience	Policymakers, Academic community
Geographic Area	EU Level
Type of tool	Website
Policy topic	Policy evaluation
End-use sector	Residential, Services, Industry, Transport
Tags	Multiple impacts of energy efficiency
Link/Source	https://energy-evaluation.org/resources/

4.3.3. Ex-ante assessment of energy efficiency measures (using modelling/ simulation approaches)

The topic "***Ex-ante assessment of energy efficiency measures*** *(using modelling/ simulation approaches)"* was the third top priority topic in policy evaluation. The resources available in this section present different approaches used in ex-ante assessment of energy efficiency measures.

The Horizon 2020 ***sEEnergies project***[27], aims at quantifying the energy efficiency potential in the buildings, transport, and industry sectors considering all aspects of the Energy Efficiency First principle. The project combines bottom-up knowledge with energy system modelling and spatial analysis in the EU. Its outputs therefore provide detailed assessments of energy savings potentials in the main end-use sectors, together with relevant methodologies in this field.

The Horizon 2020 ***ENEFIRST project***[28] provided policymakers, stakeholders, researchers and analysts with resources to make the Energy Efficiency First principle operational. The project's report "*Energy Efficiency First and Multiple Impacts: integrating two concepts for decision-making in the EU energy system*" employees modelling and decision-making tools to assess socio–environmental impacts of energy efficiency policy measures. As the report goes beyond energy savings, evaluating also multiple impacts of energy efficiency investments it presents complementarities with the topic presented in the previous paragraph.

France has dedicated a national grant program to the thermal renovation of private housing, complementing its white certificates scheme for actions in the residential sector. The grant scheme provides subsidies depending on household income, and the type of existing and new system. **Nogues et al. (2021)** assess the effectiveness of the scheme by using a microsimulation model, that represents the household's options when the space heating system must be replaced. The article found that the effect on low-income households, the focus group of the scheme, is limited – their energy burden in the long run is higher in 2050- in contrast to 'average' households.

In recent years, although there has been a significant increase in the requirements for reporting on measures implemented to attain energy efficiency and climate targets at both the European and national levels, ex-ante reporting processes may still be inconsistent and lack transparency. The paper by **Brunzema et al. (2022)** attempts to provide a guideline for the design and the monitoring of energy polices through the development of a consistent methodology for a good practice of ex-ante impact evaluations.

[27] https://www.seenergies.eu/
[28] https://enefirst.eu/

The sEEnergies Project	
Author (Date)	The sEEnergies Project (2019)
Description	The overall aim of sEEnergies is to quantify and operationalise the energy efficiency potentials in various sectors, combining bottom-up knowledge with temporal and spatial analyses to develop an innovative, holistic and research-based energy efficiency modelling approach going beyond current state-of-the-art science-based knowledge and methodologies.
Target Audience	Policymakers, Energy stakeholders, Academic community
Geographic Area	EU Level
Type of tool	Website
Policy topic	Policy Evaluation
End-use sector	Residential, Industry, Transport
Tags	Energy Efficiency First
Link/Source	https://www.seenergies.eu/

Energy Efficiency First and Multiple Impacts: integrating two concepts for decision-making in the EU energy system	
Author (Date)	ENEFIRST Project (2022)
Description	This report integrates the concepts of the Energy Efficiency First principle and multiple impacts, discussing the scope of different decision-support frameworks and evaluation perspectives, including modelling tools, benefit-cost analysis and multi-criteria analysis.
Target Audience	Policymakers, Energy stakeholders, Academic community
Geographic Area	EU Level
Type of tool	Report
Policy topic	Policy evaluation
End-use sector	Residential, Industry, Transport
Tags	Energy Efficiency First, Multiple impacts of energy efficiency
Link/Source	https://publica-rest.fraunhofer.de/server/api/core/bitstreams/f9cfe7ff-71d5-4ad8-ba39-ef5682e5429b/content

Evaluation of an incentive scheme for the energy renovation of low-income households: micro-economic modelling of a great policy with marginal impact	
Author (Date)	Patrice Nogues, Marie-Hélène Laurent, Dominique Osso (2021)
Description	This paper evaluates the French national grant program dedicated to helping low-income households perform renovations. For the evaluation of the impacts of the scheme, a microsimulation model is used.
Target Audience	Policymakers, Academic community
Geographic Area	National (FR)
Type of tool	(Academic) Journal article
Policy topic	Policy evaluation

End-use sector	Residential
Tags	Cost-effectiveness
Link/Source	https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2021/4-monitoring-and-evaluation-for-a-wise-just-and-inclusive-transition/evaluation-of-an-incentive-scheme-for-the-energy-renovation-of-low-income-households-micro-economic-modelling-of-a-great-policy-with-marginal-impact/

How to increase the transparency of ex-ante impact evaluations of energy efficiency and climate policies. Illustrated by the example of a funding program for energy and resource efficiency in industry in Germany.	
Author (Date)	Iska Brunzema, Barbara Schlomann, Andreas Kemmler (2022)
Description	The paper aims to develop a consistent methodology for a good practice of ex-ante impact evaluations and provides a methodological guideline for the design and monitoring of energy and climate policies and measures.
Target Audience	Policymakers, Academic community
Geographic Area	EU level
Type of tool	(Academic) Journal article
Policy topic	Policy evaluation
End-use sector	Industry
Tags	Cost-effectiveness
Link/Source	https://publica-rest.fraunhofer.de/server/api/core/bitstreams/5f56f85a-f8d2-4ad6-9f3c-6cc67444b814/content

4.3.4. Cost-effectiveness assessments.

The last topic that raised a high priority score in the stakeholders' needs assessment survey is the ***"Cost-effectiveness assessment"***. This topic is especially relevant now, as with the EED recast we are expecting the adoption of new energy efficiency policies from all Member States, in order to reach the more ambitious targets, which should result in cost-effective investments and measures in all sectors.

On this note, the Horizon Europe ***EBENTO Project***[29] aims to develop a one-stop-shop platform for stakeholders involved in building renovation to better manage EPC. The platform will consist of modules, one of which, named the "*Simulation*" module, will offer stakeholders cost-effective options for building renovations.

Belaïd et al. (2021) investigate the cost-effectiveness of energy efficiency measures in the whole French residential buildings. The article considers both the influence of the dwelling stock heterogeneity and the variability of external parameters (e.g., discount rate, energy price) on the profitability of energy efficiency measures. Finally, it also seeks to analyse the results in light of existing energy efficiency policies.

[29] https://ebentoproject.eu/

The study "*Cost-benefit Analyses of Investments in the Energy Saving Measures of the Residential Sector in Central and Eastern Europe*" published by the Institute for European Energy and Climate Policy (IEECP), analyses the implementation of the Energy Efficiency First principle by simulating various policy scenarios **(Oikonomou et al., 2023)**. The study focuses on comparing investments in fossil fuels from the supply side to ones from the demand side, with an emphasis on gas investments. It demonstrates how the budgets allocated to fossil fuel-related infrastructures and supply in different countries (Bulgaria, Croatia, Hungary, Poland, Romania, Slovakia, and Slovenia) can be effectively utilised to enhance energy efficiency.

Zachariadis et al. (2018), present an analysis of the cost-effective energy efficiency potential in the Cypriot building sector. Their approach combines comprehensive engineering modelling, cost-effectiveness analysis with the use of different indices, and practical considerations such as budgetary, technical, behavioural, and market limitations. The paper also focuses on the governance of energy efficiency policies in Cyprus as a whole. The results of the analysis conducted can be utilised in other countries grappling with similar challenges in their legislative environment.

EBENTO Project	
Author (Date)	EBENTO Project (2022)
Description	The EBENTO project supports energy efficiency in buildings by developing an integrated one-stop-shop platform for all actors involved in the building renovation to better coordinate and manage EPC. The simulation module of this platform will offer stakeholders the best physical and cost-effective options for enhancing buildings.
Target Audience	Policymakers, Energy stakeholders, Academic community
Geographic Area	EU Level
Type of tool	Tool, Website
Policy topic	Policy evaluation, Monitoring and verification
End-use sector	Residential
Tags	Cost-effectiveness
Link/Source	https://ebentoproject.eu/

Exploring the cost-effectiveness of energy efficiency implementation measures in the residential sector	
Author (Date)	Fateh Belaïd, Zeinab Ranjbar, Camille Massié (2021)
Description	This research investigates the cost-effectiveness of energy performance measures in French residential buildings. An empirical approach based on a multivariate statistical approach and Cost-Benefit analysis is developed and valuable information on the cost-effectiveness of energy renovation measures for the entire housing stock is provided.
Target Audience	Policymakers, Energy stakeholders, Other stakeholders, Academic community
Geographic Area	National (FR)

Type of tool	(Academic) Journal article
Policy topic	Policy evaluation
End-use sector	Residential
Tags	Cost-effectiveness
Link/Source	https://www.sciencedirect.com/science/article/pii/S0301421520308338

Cost-benefit Analyses of Investments in the Energy Saving Measures of the Residential Sector in Central and Eastern Europe	
Author (Date)	Vlasios Oikonomou, Shima Ebrahimigharehbaghi, Marco Peretto (2023)
Description	The purpose of this study is to examine, through simulating different policy measures, the implementation of the Energy Efficiency First principle when comparing supply-side investments in fossil fuels to demand-side ones.
Target Audience	Policymakers, Academic community
Geographic Area	EU level
Type of tool	Report/ guideline
Policy topic	Policy evaluation
End-use sector	Residential
Tags	Cost-effectiveness, Energy Efficiency First
Link/Source	https://ieecp.org/wp-content/uploads/2023/05/FOUR_SCENARIOS_VERSION_Greenpeace-_-IEECP.pdf

Determination of Cost-Effective Energy Efficiency Measures in Buildings with the Aid of Multiple Indices	
Author (Date)	Zachariadis, Theodoros, Apostolos Michopoulos, Yannis Vougiouklakis, Katerina Piripitsi, Christodoulos Ellinopoulos, and Benjamin Struss (2018)
Description	The paper describes an approach to assess the economically viable energy efficiency potential in the Cypriot building sector. The study assesses the maximum theoretically available potential, the economically viable and the realistic energy savings.
Target Audience	Policymakers, Academic community
Geographic Area	National (CY)
Type of tool	(Academic) Journal article
Policy topic	Policy evaluation
End-use sector	Residential
Tags	Cost-effectiveness
Link/Source	https://www.mdpi.com/1996-1073/11/1/191#metrics

5. Summary and gap identification

The purpose of this report is to synthesise a compendium of tools and resources that are considered useful and relevant to a wide spectrum of stakeholders towards successfully delivering on the advanced energy efficiency targets presented in the new Energy Efficiency Directive. To identify those resources desk-based research was conducted focusing on the most important stakeholders' needs identified through the survey conducted by the ENSMOV Plus project in February 2023. The survey as well as the whole project and consequently the present report is structured around three main steps of the policy cycle, meaning policy design and implementation, M&V and policy evaluation. Overall, the resources collected cover, to a good extend, many of the top priority needs identified.

Concerning **policy design and implementation**, there are numerous resources available tackling **fuel switching** policy issues including policy briefs and reports on rules and principles for energy efficiency programs and a database with information on all the fuel switching policies implemented in the USA. On **funding** increase and optimisation, we have identified three funds that can be utilised to carry out energy efficiency actions, an online library that provides information on energy efficiency policies implemented worldwide including their costs, projects aiming to exploit the energy efficiency mortgages market, as well as studies discussing decision-making frameworks for optimal budget allocation. Regarding untapped **energy savings potentials**, the collected resources discuss the identification and evaluation of energy savings opportunities in various sectors i.e., buildings, industry and transport, sufficiency measures to facilitate lowering energy consumption and recommendations for improving the attractiveness and effectiveness of support programs. Furthermore, resources addressing energy efficiency investment barriers such as split incentives have been identified to facilitate overcoming these challenges and unlocking the associated energy savings. We should highlight that studies dealing with energy savings potentials should be taken into account cautiously when considered in the context of Article 8 EED, as not all potential assessed are eligible for fulfilling the respective targets. Finally, tools and studies supporting the **identification of energy-poor households** have been identified and presented to facilitate policymakers and relevant stakeholders in effectively targeting the appropriate groups through their policy measures.

After exchanges with the project partners and other stakeholders, it was decided to work in ENSMOV Plus to develop complementary resources on energy savings potentials[30] and on how to define and reach priority groups[31]. The first topic is meant to investigate further the relevance of existing studies on energy savings potentials

[30] See the examples gathered here: https://energysavingpolicies.eu/materials/identifying-energy-saving-potentials-examples-at-eu-and-national-level/

[31] See the examples gathered here: https://energysavingpolicies.eu/materials/examples-about-targeting-priority-groups-and-tackling-energy-poverty/

when considering the scope of Article 8 EED. The second topic is to go from theory to practice, looking at the current Member States' practices to target priority groups with energy efficiency policies.

When it comes to **M&V** topics, there are several resources addressing the **use of measured savings**, including a machine learning tool, and a protocol for metered savings proposed in the UK. Although stakeholders have highly prioritised the topic on algorithms and other methods to facilitate **verification of energy savings** calculations, we have not identified resources satisfactory addressing this issue. More specifically, the presented resources include the well-known Croatian SMiV tool, the EVO website with resources on the broader topic and a report that just makes references to such algorithms and methods without further details. On the **quality of individual actions** resources on P4P schemes and certification for energy efficiency savings have been identified. Best practices and examples beyond the building sector and industry are missing in this topic. Finally, on **innovative methods for data collection and processing,** one example addressing the consistency of data gathered at various administrative levels has been identified along with a project that uses RCTs to assess savings from behavioural measures and a new project that aims to advance data collection techniques. In this respect, more focus is needed on creating or bringing into the spotlight already existing novel practices and approaches.

After exchanges with the project partners and other stakeholders, it was decided to work in ENSMOV Plus to develop complementary resources on the use of measurements, due to the high priority of this topic for policymakers. This was done by looking at examples of practices currently used in the monitoring of policies or schemes reported by Member States to Article 8 EED[32]. Further work in ENSMOV Plus on ensuring the quality of actions is under discussion.

Regarding **policy evaluation**, we found various resources that provide either specific methodologies or recommendations on ex-post evaluation trying to **determine actual energy savings** as well as on **ex-ante assessments** using modelling and simulation tools. A few resources identified are expressly designed to evaluate Article 8 related policies and measures while those that have not been developed specifically for the EED can be replicated and exploited to serve stakeholder needs. The evaluation of energy efficiency **multiple benefits**, including energy, environmental and socioeconomic ones, is an area that has been receiving growing attention in recent years, thus we have identified three tools that aim to assess such impacts as well as additional analyses in the field. Finally, we have identified several studies addressing **cost-effectiveness** of policies, programs and measures, although many of them focus on the building sector. Since the resources identified for this topic frequently

[32] See the examples gathered here: https://energysavingpolicies.eu/materials/using-measurements-in-monitoring-energy-efficiency-policies-examples-from-5-countries/
And the proceedings of the related workshop:
https://energysavingpolicies.eu/materials/measurement-in-monitoring-energy-efficiency-policies-workshop-recording-and-materials/

use simulation models or econometric techniques to assess the energy savings, they can also be relevant for ex-post and ex-ante assessment issues.

After exchanges with the project partners and other stakeholders, it was decided to work in ENSMOV Plus to develop complementary resources on the evaluation of behavioural measures[33]. It was also decided to collect references of evaluations on an on-going basis. These references are progressively added to the ENSMOV Plus' Zotero Library[34].

[33] See the proceedings of the session organised on this topic at the BEHAVE 2023 conference: https://energysavingpolicies.eu/materials/how-much-energy-do-behavioural-policy-measures-save-resources-from-the-behave-conference/

[34] https://www.zotero.org/groups/5115257/energy_saving_policies/collections/IMV3VEFV

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Annex

Resource/Tool name	Target Audience				End-use sector					Geographic Area			Policy Topic		
	Policymakers	Energy stakeholders	Other stakeholders	Academic community	Residential	Services	Industry	Transport	Other	National Level	EU level	International	Policy design & implementation	Monitoring & verification	Policy evaluation
Identifying complementary measures to enable fuel switching															
Fuel switching as an option for medium-term emission reduction - A model-based analysis of reactions to price signals and regulatory action in German industry	x	x	x	x			x			x			x		
State Policies and Rules to Enable Beneficial Electrification in Buildings through Fuel Switching	x				x							x	x		
Beneficial Electrification	x				x	x		x				x	x		
Decarbonisation Policies in the Residential Sector and Energy Poverty: Mitigation Strategies and Impacts in Central and Southern Eastern Europe	x			x	x						x		x		
Member States' ambition to phase out fossil-fuel heating -an analysis	x			x	x						x		x		
Increasing and optimising funding															
REGULATION (EU) 2023/955 of the European Parliament and of the Council	x				x	x	x	x			x		x		
InvestEU Fund	x	x	x		x	x	x	x			x		x		
European Energy Efficiency Fund	x	x	x		x	x	x	x			x		x		
Energy Efficiency Financing	x	x	x		x	x	x	x			x		x		
The Energy Policy Tracker	x			x	x	x	x	x				x	x		
Investment decision-making optimisation of energy efficiency retrofit measures in multiple buildings under financing budgetary restraint	x			x	x							x	x		

Energy efficiency promotion in Greece in light of risk: Evaluating policies as portfolio assets	x			x					x	x			x		x
Financing the green transition	x								x	x			x		
The Energy Efficiency Mortgage Market Implementation Plan		x	x		x						x		x		
The Private Finance for Energy Efficiency (PF4EE) Initiative	x	x	x						x		x		x		
Identifying new or untapped energy savings potentials and possible gaps in the policy mix															
Where to start: Energy efficiency potential in buildings	x				x							x	x		
ENPOR Split Incentive Quantification Tool	x		x		x						x		x		
The SmartSPIN toolkit		x	x			x					x		x		x
Behavioural insights on energy efficiency in the residential sector	x	x			x					x			x		
Technical assistance services to assess the energy savings potentials at national and European Level	x				x	x	x	x			x		x	x	x
Energy Sufficiency Indicators and Policies	x				x	x		x			x		x		
The untapped potential of sufficiency to meet EU climate goals	x	x	x	x	x	x	x	x			x		x		
Renewable Energy Communities as a New Actor in Home Energy Savings	x	x	x	x					x		x		x		
Ensuring the effective targeting of policy measures															
The POWER-TARGET tool	x	x	x		x						x		x		
The SocialWatt Analyser tool		x			x	x					x		x		
Energy poverty prediction and effective targeting for just transitions with machine learning	x			x	x						x		x		
Developing the use of measured energy savings															
Measurement in monitoring energy efficiency policies: examples and further developments	x			x	x	x			x		x			x	
The SENSEI project and the eensight tool	x	x	x	x	x						x			x	
Rethinking Measurement and Verification of Energy Savings	x			x	x						x			x	
The EPATEE topical case study and toolbox	x	x	x	x	x	x	x	x	x		x			x	

Green Finance Institute: Coalition for the Energy Efficiency of Buildings- Towards a protocol for metered energy savings in UK buildings	x	x		x	x					x				x	
Algorithms or other methods to facilitate the verification of energy savings calculations															
Synthesis report on European best practices for M&V schemes and coordination mechanisms	x	x		x	x	x	x	x			x			x	
Efficiency Valuation Organisation (EVO)	x	x		x	x	x	x	x				x		x	
System for measuring and verifying energy savings (SMiV)	x				x	x	x	x		x				x	
Streamlining energy savings calculations	x	x	x	x	x	x	x	x			x			x	
Appendix XII complementing the Commission's Recommendation	x				x	x	x	x			x			x	
Ensuring the quality of the individual actions implemented															
Pay-for-Performance schemes to trigger energy efficiency investments	x			x	x						x			x	
A Study of Pay-for-Performance Energy Efficiency Programs in the United States	x	x	x	x	x							x		x	
Quality certification frameworks for Energy Efficiency services to scale up responsible investment in the building sector (QualitEE project)	x	x	x	x	x						x			x	
Use of innovation methods for data collection and processing															
The multEE Monitoring and Verification Platform (MVP)	x			x	x	x	x	x			x			x	
Methodology the NUDGE project	x				x						x			x	
Impact evaluations about actual energy savings															
Measuring and increasing impact: The next challenge for EU energy efficiency policy measures	x				x	x	x	x			x		x	x	x
Do energy efficiency policies save energy? A new approach based on energy policy indicators (in the EU Member States)	x			x					x		x				x
Effective energy saving policy requires causal evidence	x			x	x					x					x
Impact evaluation about other energy or environmental impacts															
MB:EE | Multiple Benefits of Energy Efficiency tool	x			x	x	x	x	x			x				x
Multiple Impacts Calculation Tool (MICAT)	x	x	x	x					x		x				x

Multiple Benefits of Energy Efficiency (M-benefits)	x	x	x	x					x		x		x		x
Recognizing the Full Value of Energy Efficiency	x	x	x		x	x	x	x				x	x		x
2030 EU energy efficiency target: The multiple benefits of higher ambition	x	x	x	x	x	x	x	x			x				x
Energy Evaluation	x			x	x	x	x	x			x				x
Ex-ante assessment of energy efficiency measures (using modelling/ simulation approaches)															
The sEEnergies Project	x	x		x	x		x	x			x				x
Energy Efficiency First and Multiple Impacts: integrating two concepts for decision-making in the EU energy system	x	x		x	x		x	x			x				x
Evaluation of an incentive scheme for the energy renovation of low-income households: micro-economic modelling of a great policy with marginal impact	x			x	x					x					x
How to increase the transparency of ex-ante impact evaluations of energy efficiency and climate policies. Illustrated by the example of a funding program for energy and resource efficiency in industry in Germany	x			x			x				x				x
Cost-effectiveness assessment															
EBENTO Project	x	x		x	x						x			x	x
Exploring the cost-effectiveness of energy efficiency implementation measures in the residential sector	x	x	x	x	x					x					x
Cost-benefit Analyses of Investments in the Energy Saving Measures of the Residential Sector in Central and Eastern Europe	x			x	x						x				x
Determination of Cost-Effective Energy Efficiency Measures in Buildings with the Aid of Multiple Indices	x			x	x					x					x

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