D2.3 • Results from the scoping analysis

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REEFEREE: Real Value of Energy Efficiency

Results from the scoping analysis

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1 Introduction

As highlighted in Deliverable 2.2 - The state of the art of existing models and tools to support policymakers in analysing the real effects of energy efficiency measures, REFEREE has a twofold objective:

i) to analyse and quantify direct and indirect non-energy impacts investments or policies in the field of energy efficiency

ii) to develop an easy-to-use tool able to support policymakers, households, businesses, financial institutions and other interested parties to adequately take these impacts into account when assessing their investment or political planning choices.

As for the first part of the REFEREE objective, Deliverable 2.2 has carried out a state-of-the-art analysis to understand well which have been so far the methods and approaches developed to model energy efficiency and estimate the multiple benefits and continue contributing effectively and proactively to this branch of research and development.

This deliverable is instead focused on the second part of this objective and relates to the results of a scoping analysis carried out with the aim to investigate which are the opinions of the stakeholders about the importance of the non-energy impacts of energy efficiency interventions as well as their expectations about the usability, the sphere of action and the effectiveness of decision support tools to evaluate these impacts.

To this end, the scoping analysis has been carried out by using different investigative tools like a survey addressed to a wide range of stakeholders, some direct interviews mainly addressed to national and regional policymakers and a literature review, complementary to that illustrated in Deliverable D2.2 and addressed to the analysis of tools that support the decision making in the energy sector and that can be useful for the work to be done in REFEREE.

In addition to this set of activities, the first Policy Advisory Group (PAG) workshop organised by REFEREE was structured with the objective to set up and launch the scoping analysis. It is worth recalling here that the PAG brings together a selected group of stakeholders who are asked to accompany and follow the development of the models and tools until their final release.

The results from the exchange of ideas promoted within the workshop have in fact, made it possible to begin to outline the expectations of the stakeholders as well as to set up the questionnaire used in the survey and orient the questions posed in direct interviews.

The outcomes of this scoping exercise are illustrated in detail in the following chapters of this deliverable; namely, chapter 2 illustrates the results of the explorative survey, and chapter 3 outlines the results of the literature review. A final chapter on the lesson learned from this scoping analysis to set the development of the decision support tool in the most effective way closes this deliverable.

Finally, it is important to note that the part of the results of the scoping analysis and of the PAG workshop served, and will serve, to set up the architecture of the REFEREE decision support system. In this capacity, the analysis of these results was therefore also described in deliverable 2.4: REFEREE Policy Support System's Design.

2 The survey results

2.1 The online questionnaire

As part of the scoping analysis, the project team conducted an online survey among stakeholders based on pre-defined lists of contacts suggested by the project's partners[1]. As outlined in the introduction, the goal of this survey has been to source various stakeholders' opinions regarding the development of a policy support tool that meets the real needs of its potential users. The survey was conducted in the period between 18 May and 7 June among 311 stakeholders, while 80 of them answered the questionnaire.[2] In addition, the questionnaire was translated into Bulgarian and German languages in order to allow for participation by stakeholders who are not proficient in English.

Table 1 Number of contacted stakeholders

	Contacted stakeholders	Returned e-mails	Actual contacts
ISINNOVA	143	23	120
CSD	57	0	57
MCRIT	72	10	62
BAUM	28	0	28
EEB	44	0	44
TOTAL	344	33	311

The first three questions of the questionnaire frame the profile of the respondents according to their nationality, the type of organisation they work for and the position they have in this organisation. As for the country, the five most represented were Italy (18.8%), Bulgaria (17.5%), Germany (15%), Belgium (13.8%), and Spain (10%). The remaining 25% were evenly distributed between other European countries (Figure 1).

For what concerns the working position, the majority of the respondents (38.8%) work for public sector organisations, nearly 19% work for NGO/SCOs, while another 14% represent business associations (Figure 2**Errore. L'origine riferimento non è stata trovata.**). Finally, more than half of the surveyed (53.8%) occupy an expert-level position, followed by 27.5%, who have identified themselves as being top-level management representatives. The remaining 18.8% are positioned in mid-level management (Figure 3)

[1] Institute of Studies for the Integration of Systems (ISINNOVA), the Centre for the Study of Democracy (CSD), Multicriteria (MCRIT), BAUM, and the European Environmental Bureau (EEB).

[2] The Questionnaire is presented in Annex 1.

Figure 1: Country distribution of the respondents

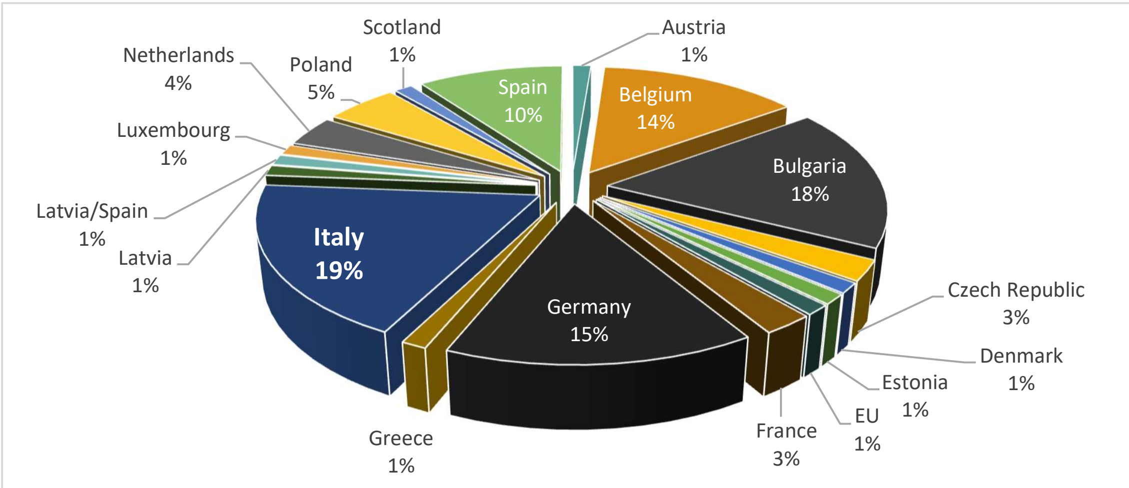


Figure 2: Type of organisation the respondents work for

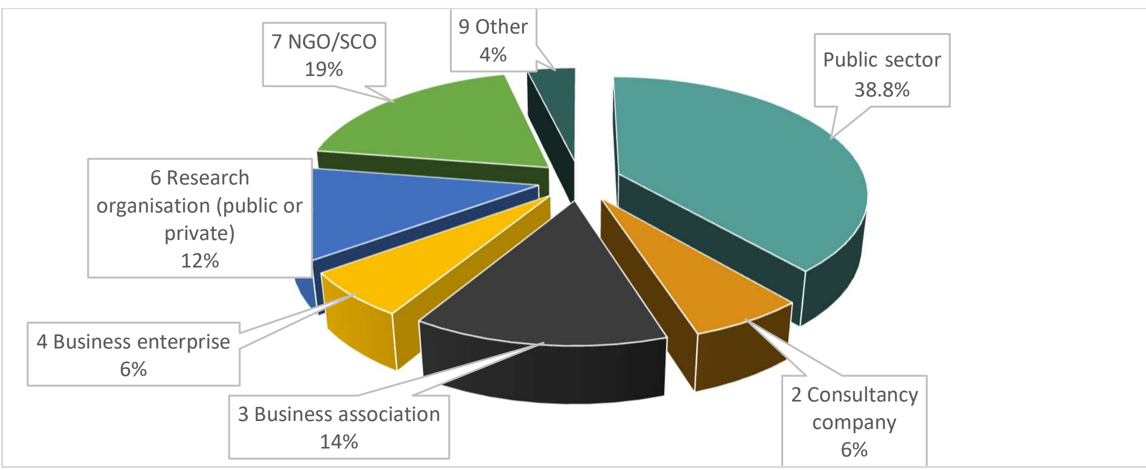
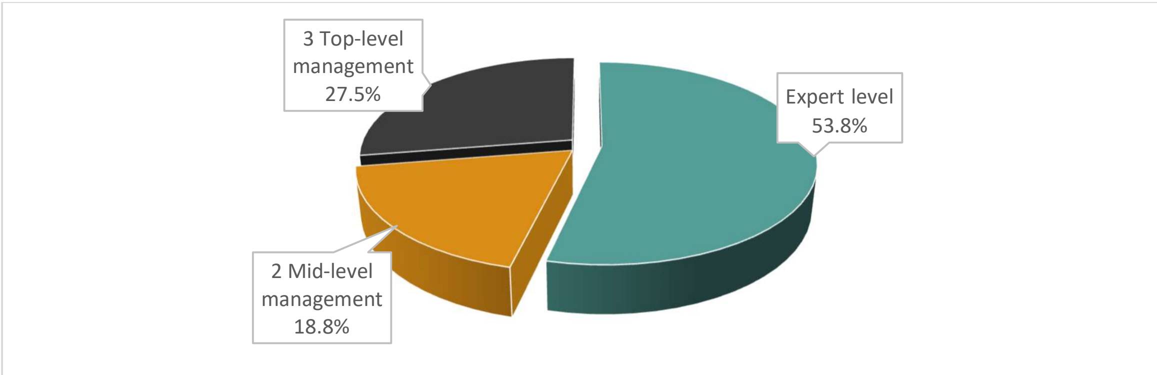
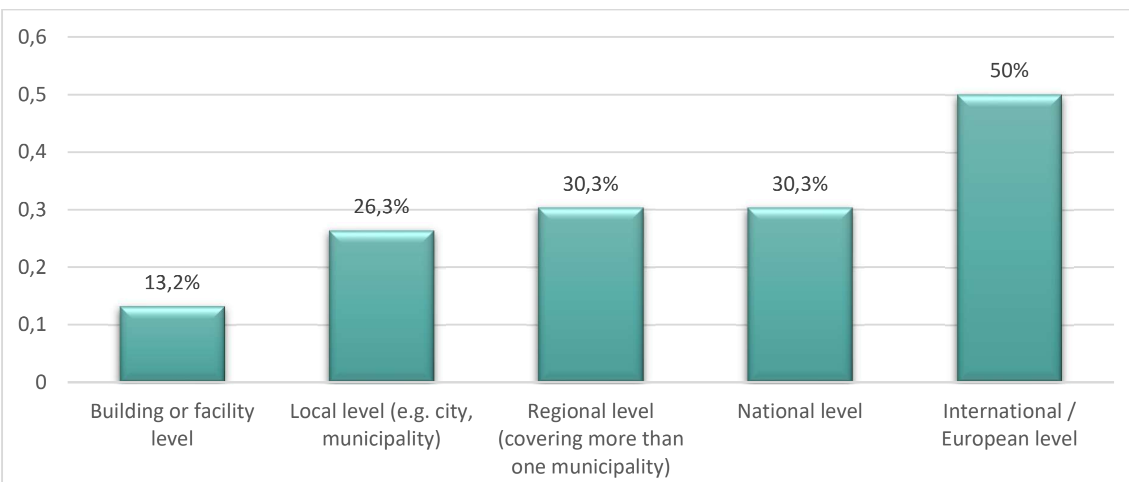


Figure 3: Position level within the organization



To close this first series of questions, the fourth asks to specify the institutional or organisational context in which the organisation with which the respondents' works is operating: from the international level to the specific sectoral one. As, logically, the question assumes multi-answers, a total of 114 responses have been received, with respondents working at the international/European level making up 50% of the cases, followed by those working at regional and national levels (30.3% each), see Figure 4.

Figure 4: Primary scope of work of the respondents' organizations



The following two other questions are the focus on the type of activity carried out by the respondents within their organisation. The work of the majority of respondents (74.7%) is then mainly concentrated on energy efficiency, followed by general energy and climate policies (54.4%), environment (41.8%), and local or regional governance (26.6%). Public health (5.1%) and business sector development (6.3%) are finally the topics less selected by our statistical sample of stakeholders (Figure 5).

Question 6 investigates then in which phase of the policymaking process the respondent is more involved. Obviously also in this case, multiple answers were allowed. It then results that the majority of the respondents (73%) are usually more involved in the policy design and planning phase of the policymaking process. Just over half of them (52.6%) acknowledge the implementation phase as the one where they are more involved, while only 39.7% are involved in the monitoring and reporting stage (Figure 6)

Figure 5: Main focus areas in the respondents' work

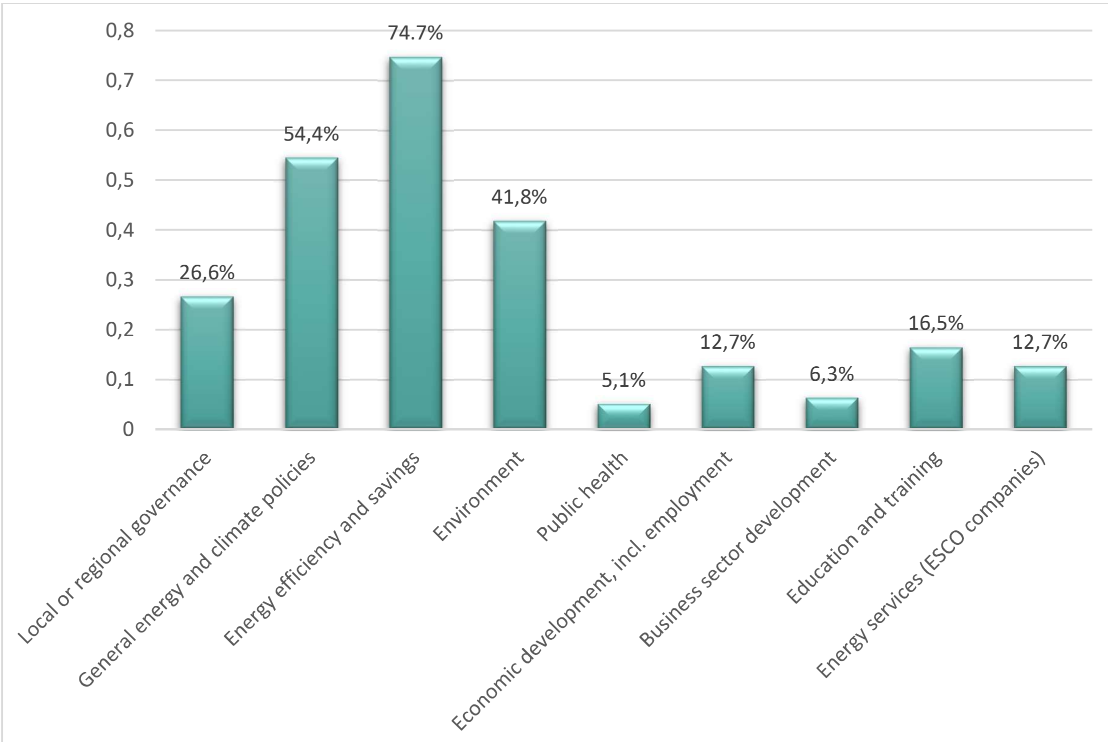
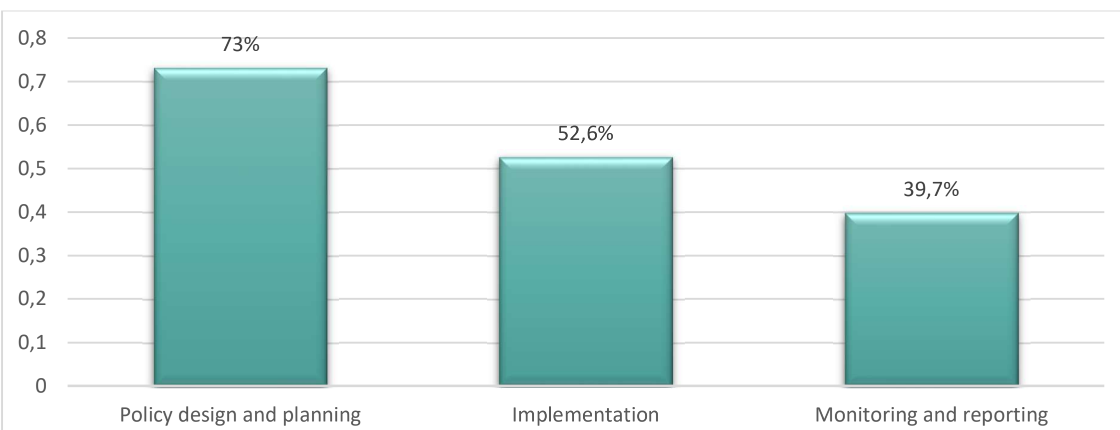


Figure 6: Phases in the policymaking process the respondents are more involved

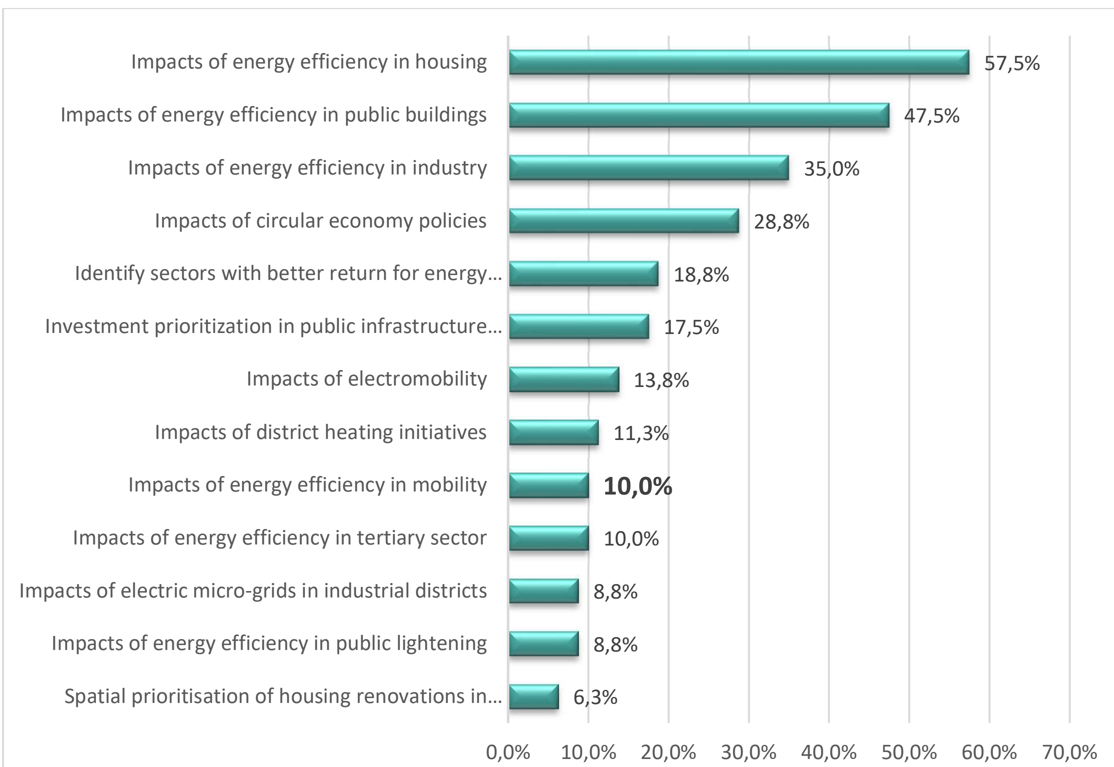


The fact that the vast majority of respondents are involved in the planning and design phase and much less in the monitoring phase would suggest that the needs of policy makers would be oriented to the use of tools to support planning and design activities rather than those for policy monitoring.

To deepen the profile of the interviewees, they were then asked which of the various possible fields of action of energy efficiency were those of greatest interest for their work (see Figure 7). The result was that about 100% of the respondents indicated the building sector as that of major interest for them, followed by the industry sector. The other answers can be considered complementary or even marginal. In detail, impacts of energy efficiency in housing were chosen by 57.5%, followed by impacts of energy efficiency in public buildings (47.5%) and impacts of energy efficiency in the industry (35%).

Only 6.3% selected spatial prioritisation of housing renovations in neighbourhoods, while 8.8% included impacts of electric micro-grids in industrial districts and impacts of energy efficiency in public lighting each, as the topic of greater interest to their work. Finally, 10% of respondents indicated their interest in the mobility sector. To this end, it is worth not that these results are somewhat biased by the sample of stakeholders to whom the questionnaire was addressed or, at least, by the sample of respondents, which included few experts working in the transport sector.

Figure 7: Topics related to energy efficiency impacts that are of specific interest to the respondents



Questions from Q8 to Q10 explore then the point of view of the respondents on the importance of the non-energy impacts when planning or implementing energy efficiency policies and investments. Question 8 asks about the need to gain knowledge on these impacts, and here the unequivocal answer is that the vast majority of the respondents, i.e. 94% considers this need as either "Very Important' (51.3%) or 'Important' (42.5%). Only 1.3% see it as 'Not at all important' (Figure 8).

Question 9 asks to select three most important non-energy impacts that need to be quantified for assessing energy efficiency investments among a list of eleven suggested impacts (see Figure 9). Here, for more than half of the respondents, the most important of these impacts that need to be quantified are the cost of energy resources for end-users (68.8%) and air pollutant emissions/air quality. (60%). Material consumption, including reuse of materials and circle economy (41%) was the third most popular choice. In contrast (and, maybe, surprisingly), only 6.3% identified healthcare costs as one of their three most significant impacts. Among the respondents, who chose "cost of energy resources for end-users" as an important, the dominant groups are from public sector (37.1%%), business associations (12.9%) and business enterprises (4.8%). Finally, question 10 probed the respondents' perception about the importance that policies supporting investments in energy efficiency should take into account the effects of the non-energy impacts. Also, here almost all agree on this requirement (95%) and only one respondent thinks it is "not at all" important (Figure 10).

Figure 8: Levels of importance of gaining knowledge on non-energy impacts when planning or implementing energy efficiency policies and investments

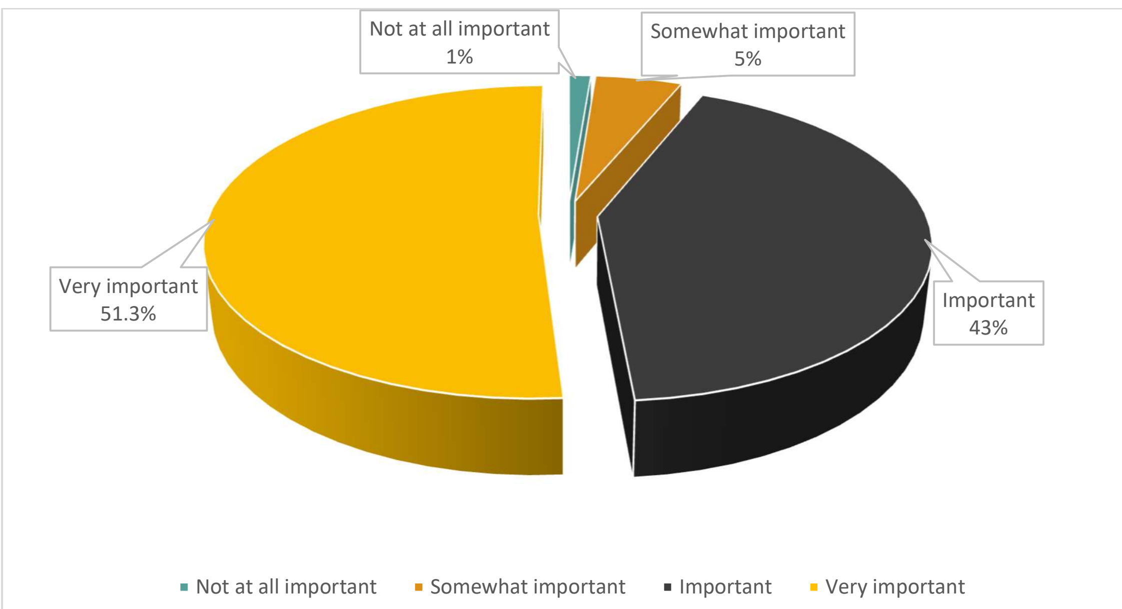


Figure 9: Most important impacts that need to be quantified for assessing energy efficiency investments

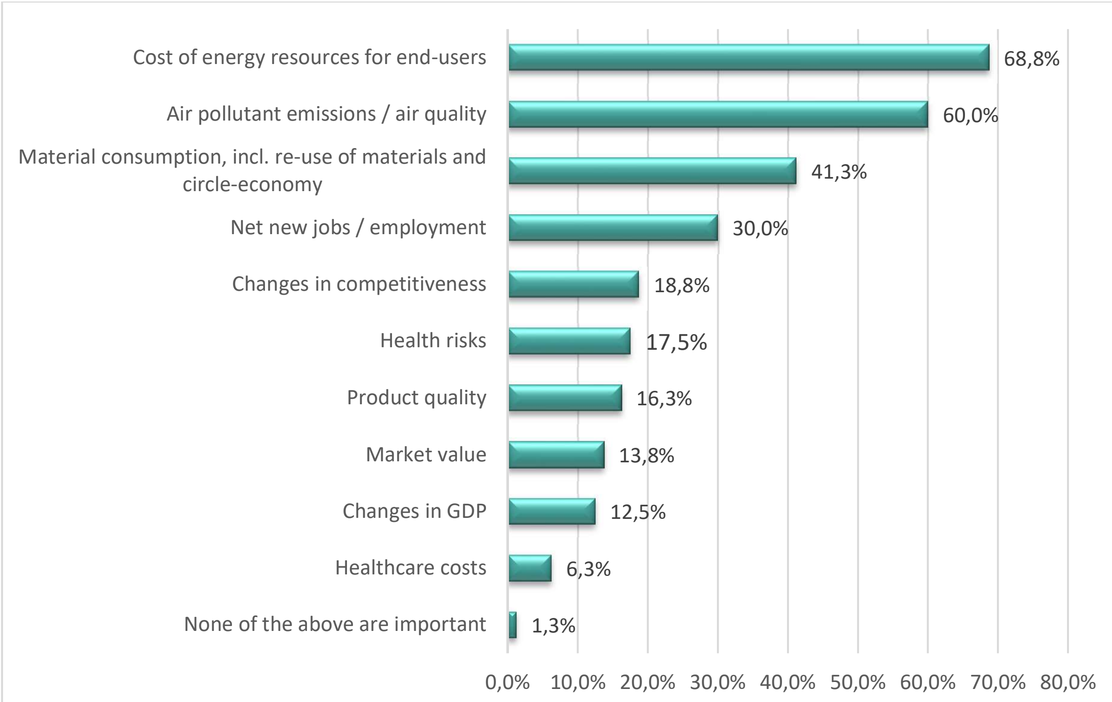
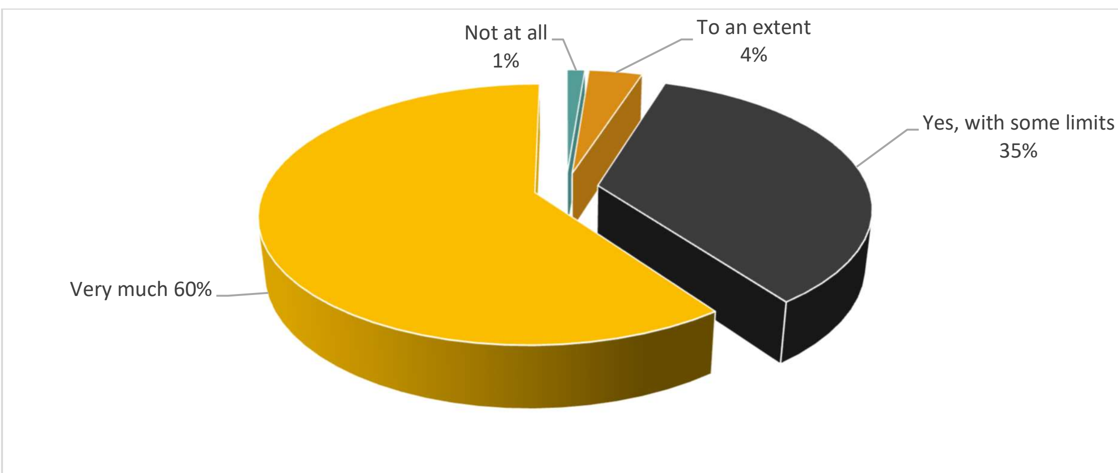


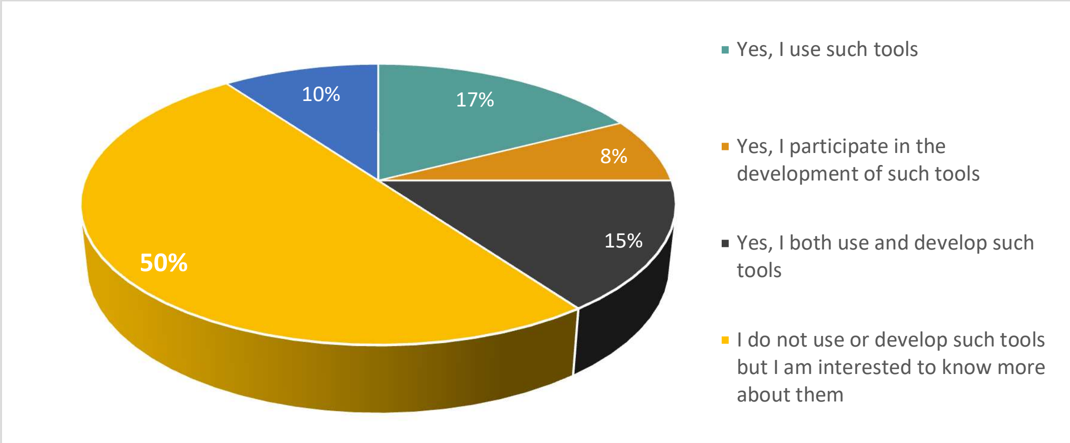
Figure 10: Levels of agreement on whether the policies supporting investments in energy efficiency should take into account the effects of non-energy impacts



The last set of 8 questions was then addressed to understand to which extent the respondents use the decision support tools and for what, being this investigation one of the main scopes of the scoping analysis.

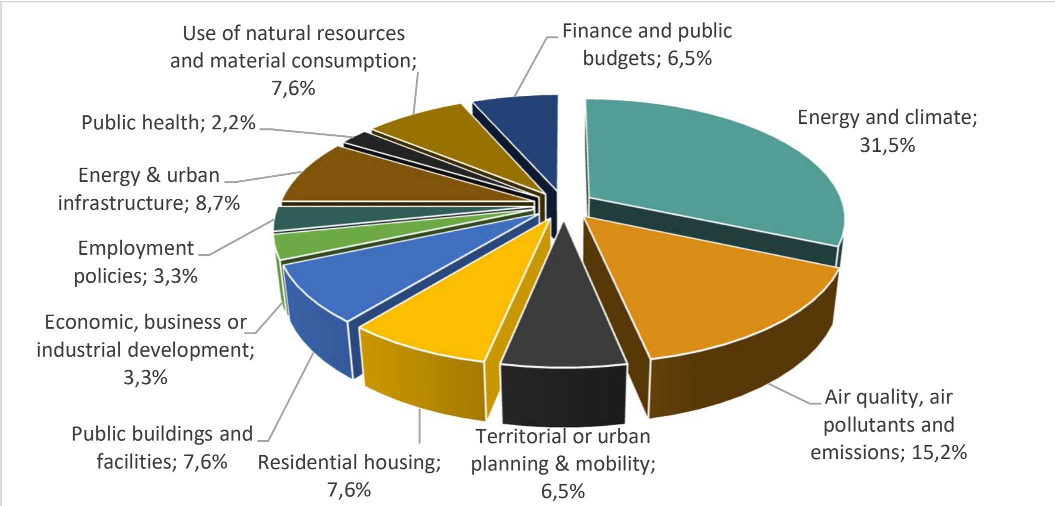
Question 11 starts then investigating how much these tools are used by the respondents. It results that their usage is moderately high as 40% of the respondents either use or even develop such tools. However, it is interesting to note that half of all respondents (50%) have never used or developed such tools but are interested in finding out more about them. Only 10% claimed that they are not interested at all in these tools. It is important to note that people who answered that they are not interested in these tools are automatically skipped out of the questionnaire, thus ending the survey with this question.

Figure 11: Respondents' usage or development of specialised software tools for supporting decision- and policymaking



For 90% of the remaining responders, the questionnaire follows investigating which are the areas of work covered by the software tools they use (or would like to use). Areas like "energy and climate" (31.5%), "air quality, air pollutants and emissions" (15%) and "energy and urban infrastructure" (8,7%) were then the most voted (Figure 12). "Energy and climate" (and partially "energy and urban infrastructure") are the policy areas for which the existing tools have been most developed, while all the other policy areas, whose scope of action is narrower, remain less covered, or substantially uncovered, by these tools. The reason could be either the composition of the survey sample and then the prevalence of general policies within the work of the respondents, or the lack of specialised tools that are used for supporting the more specific policies.

Figure 12: Areas covered by the software tools used and/or developed

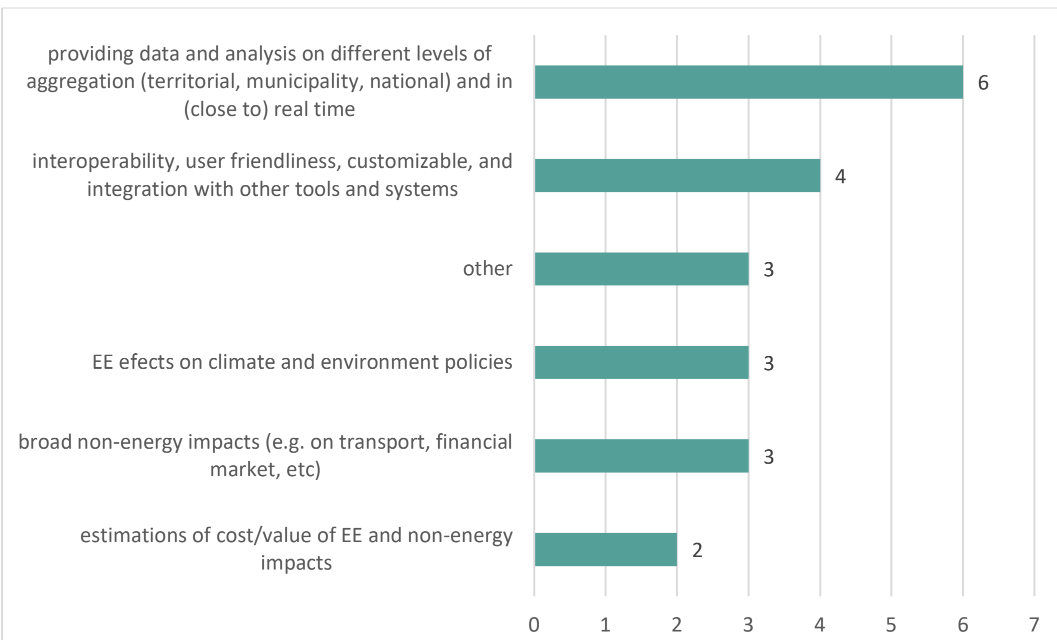


Once asked how the decision support tools are currently being used, the questionnaire explores which features the respondents would be happy to find in these tools. This question envisaged an open answer, to which, unfortunately, only 18 respondents provided their input. Nonetheless and despite the low number of answers, the results shown in Table 2 provides useful input for the setting of the REFEREE decision support tool. For example, four respondents offered data-related recommendations. One suggested that data for benchmark analysis should be publicly available, as well as verified databases on embodied energy and emissions for products and materials should be created (A1). Another proposed that data should be granulated at sectoral and MS level (A6).

Among the other recommendations were that features should be more user-friendly (A9), offer real-time monitoring (A13), and include simplified models for the calculation of energy saving when an intervention is proposed (A14).

In synthesis, by clustering the answers the respondents provided to broader categories, it appears that the majority of them would like to have systems able to provide data and analysis at different levels of aggregation (e.g., territorial, municipality, national) while general technical characteristics of the tools (e.g., interoperability, customisation and user-friendliness) have been ranked on the second place. Quantification of the impacts from energy efficiency on broader policy areas (e.g., transport, financial market) or climate and environmental policies is also in the wish-list of the stakeholders. Figure 13 shows the result of this clusterisation.

Figure 13. Suggested additional features



* Base: 21 recoded answers (a single answer could be split into 2 or more answers' categories)

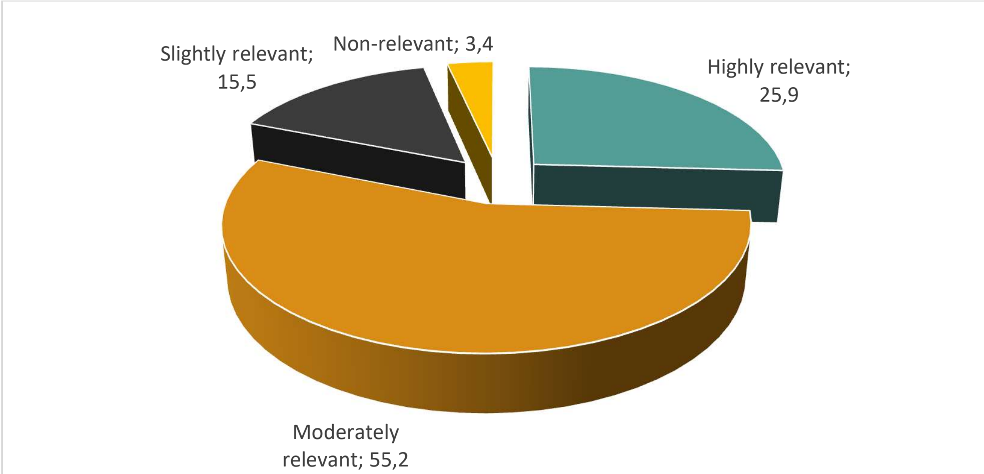
Table 2: Features not currently available that would be useful for the respondents to have in their tools

Answer No	Answer
A1	Publicly available data for benchmark analysis- verified data on different energy (including energy efficiency) and climate change technologies - verified databases on embodied energy and emissions for products and materials - data and standardisations for LCA.
A2	Adapting Polish law to the EU.
A3	Climate mitigation and adaptation synergies: how energy efficiency investments increase the resilience of buildings and urban areas to climate change
A4	Effects on natural water resources; needed capacities for implementation/use (technology know-how, civil engineering, required administrative processes etc.) subsequently including required training for usage
A5	Emissions - broad benefits - transport
A6	Granularity of data at sectoral and MS level
A7	I think it would be useful to have a quantification of the "better use of energy". For instance, energy efficiency will determine the savings from switching an electric motor from IE0 to IE4, but it will not help to determine if the motor was necessary at all.
A8	Interoperability with other SW tools, being open source
A9	More user friendly.
A10	Ongoing financial market analysis
A11	Optimisation functions for minimising/maximising given variables
A12	Possibility for local (municipality) data and analyses
A13	Real time Monitoring
A14	Simplified models for calculation of energy saving when an intervention is proposed
A15	Software for estimation of the money value of NEBs
A16	Spatial emissions data at fast frequency, BIMS, building condition, green/blue assets, the energy potential of green/blue assets
A17	Territorial scope
A18	Unify different platforms/software. For example, in electric chargers or in consumption of different energy sources renewable and non-renewable.

Questions from 14 to 17 investigated then: 1) the perceived relevance of these tools with respect to the respondents' work needs, 2) in which phase of the decision-making process they could be more helpful, 3) to which activity ambits do they should be primarily addressed and 4) which should the level of complexity of these software supports.

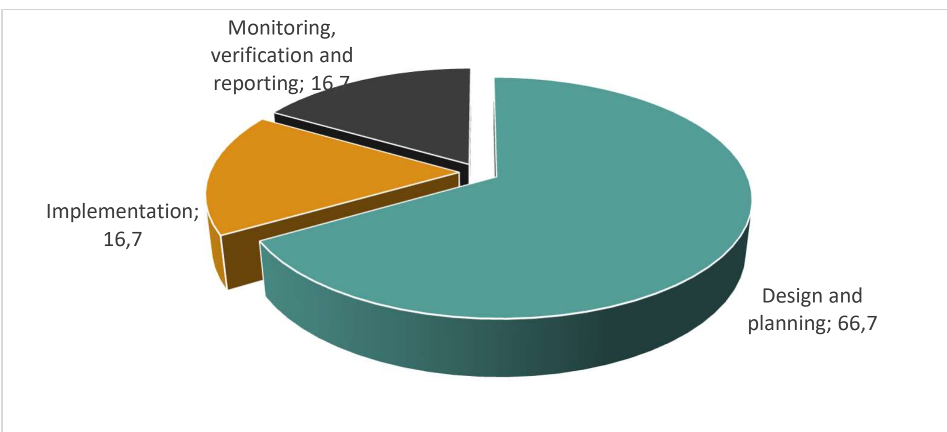
As for the first point, over 55% of the respondents using or developing tools perceive them to be moderately relevant to their work' needs. A further 26% see them as highly relevant, while only 3.4% think they are non-relevant. These results suggest a huge room for improvements to make future policy support tools more relevant to the stakeholders' everyday working needs (Figure 14).

Figure 14: Relevance of the tools in relation to the respondents' work needs



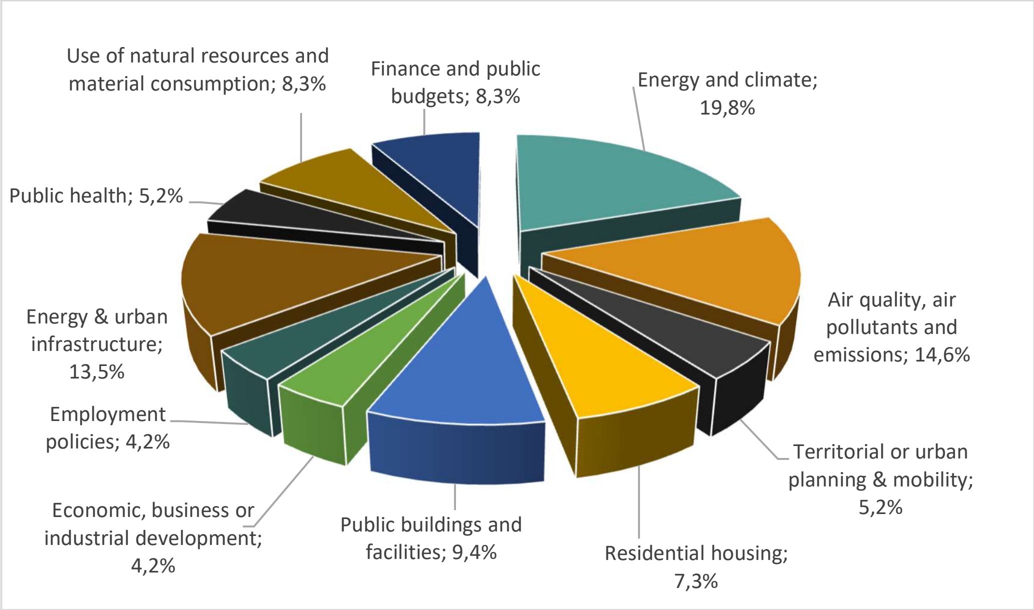
For what concerns the second point, two-thirds of the respondents claimed they would primarily use a tool that addresses the design and planning step. This may also depend on the fact that the majority of respondents who use similar tools, are also working predominantly on the design and planning of policies (66,7%), while the tools that address the implementation and monitoring, and the verification, and reporting systems are used each by the 16.7% of them (Figure 15)

Figure 15: Steps of the decision-making process a specialised software tool should address if the respondents could use one



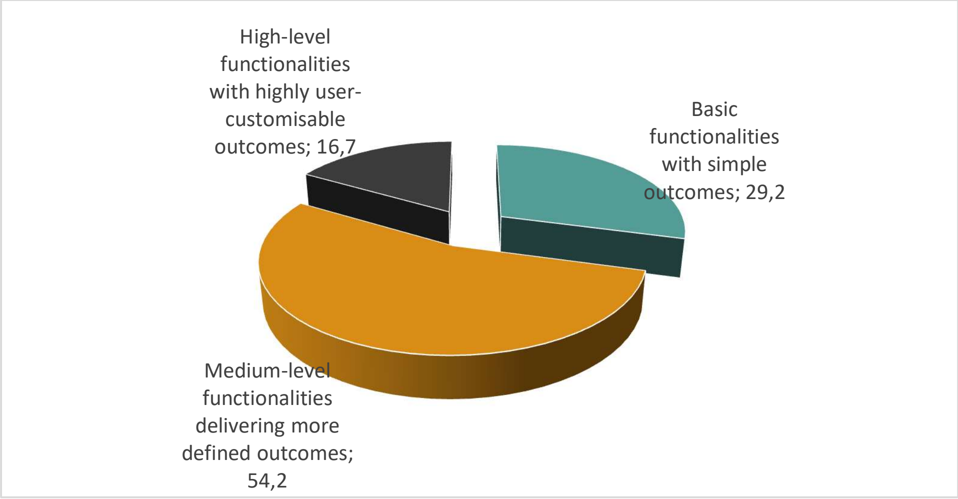
The distribution of answers regarding the activity sectors that future specialised software tools should address shows that such tools should literally cover all sectors, as there is no single sector, which is more preferred. Nearly 20% said they would use a software tool covering the energy and climate activity sector. This is the highest share of respondents, but at the same time, their answers refer to the most general and wide policy area. Another 14.6% chose the air quality, air pollutants, and emissions sector, while 13.5% opted for energy and urban infrastructure. The least popular activities were economic, business or industrial development and employment policies - chosen by 4.2% of the respondents (Figure 16).

Figure 16: Activity sectors a specialised software tool should address if the respondents could use one



Finally, Figure 17 shows the representation of the respondents' preferences on the complexity of a specialised software tool. More than half of them (54.2%) would use a software tool with medium-level functionalities delivering more defined outcomes. Nearly 30% would choose one with basic functionalities with simple outcomes. The remaining 17% would prefer a software tool with highly user-customisable outcomes.

Figure 17: Levels of complexity of a specialised software tool if the respondents could use one



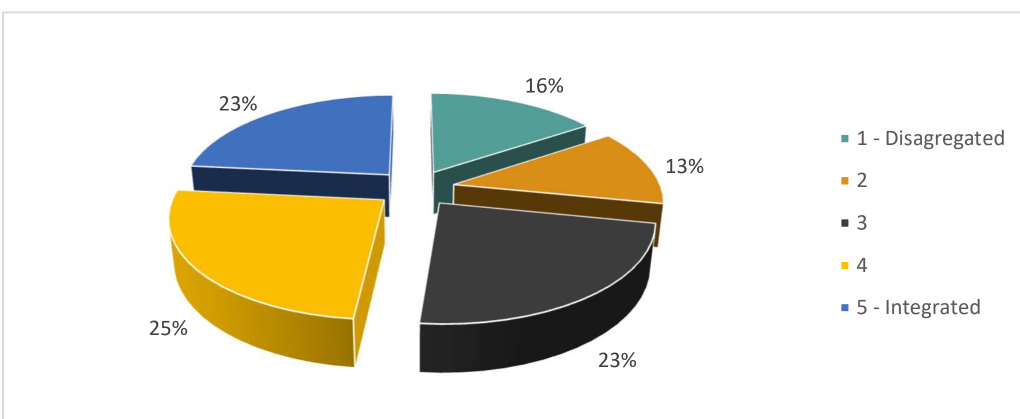
The last two questions of the questionnaire asked the respondents to position their preferences for an ideal tool in a matrix defined by a horizontal axis referring to the integration level of the tool itself and by a vertical axis referring to its planning approach: spatial vs analytical (see Figure 18.).

Figure 18: The decision support tool plan

To analyse the results of this question, we have divided them by axis, analysing the answers separately on the level of integration and then on the planning features, and finally, we have integrated these answers in a summary graph.

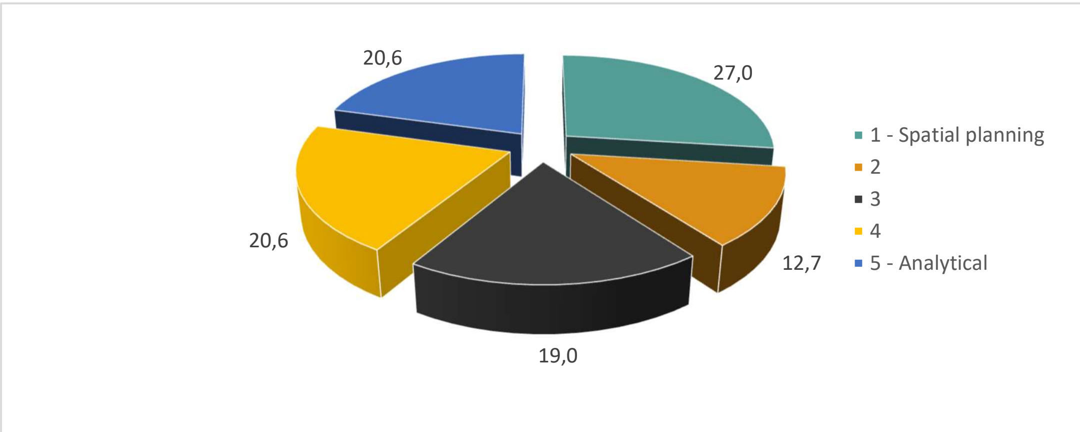
As shown in Figure 19, almost half of the respondents (48%) prefer a higher level of integration (level 4 and 5), while the lower levels of integration are noted by 29% (level 1 and 2). The preference to more integrated tools is visible also if only the two ends of the scale are compared – Disaggregated (16%) vs Integrated (23%).

Figure 19: Type of a specialised software tool that would be most useful, based on its level of integration



As for the respondents' perceptions on the usefulness of a specialised software tool based on the 'Spatial planning – Analytical approach spectrum (Figure 20), in a scale from 1 (spatial planning) to 5 (analytical approach), there is no clear preference and the shares of respondents who prefer either analytical or spatial approach are very similar (respectively 41,1% for level 4 and 5 and 39,7% for level 1 and 2).

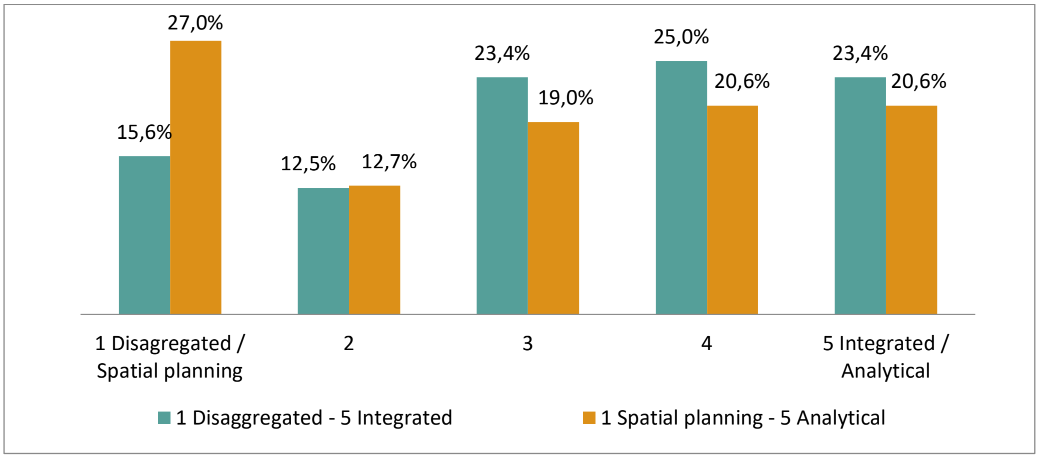
Figure 20: Type of a specialised software tool that would be most useful, based on spatial planning – analytical approach



As for the respondents' perceptions on the usefulness of a specialised software tool based on the 'Spatial planning – Analytical approach spectrum (**Errore. L'origine riferimento non è stata trovata.**), in a scale from 1 (spatial planning) to 5 (analytical approach), there is no clear preference and the shares of respondents who prefer either analytical or spatial approach are very similar (respectively 41,1% for level 4 and 5 and 39,7% for level 1 and 2).

Finally, Figure 21 indicates that respondents' preferences are equally distributed on the two axes "Disaggregated – Integrated" and "Spatial planning – Analytical". There is no strong or clear preference observed in any of the two sub-questions related to the software features.

Figure 21: Aggregated results from Q18 A and B



2.2 The in-depth interviews

2.2.1 Overview

To deepen some of the aspects covered in the survey, six interviews were carried out with as many European experts with positions of responsibility in state or regional administrations, energy agencies and NGOs and namely:

- Two people from the national energy agencies: the director of the Directorate for energy efficiency and RE at the Bulgarian Sustainable Energy Agency and the responsible for the monitoring of the energy efficiency policies at the ENEA unit for energy efficiency (Italy)
- Two people from regional agencies: the director of the Bavarian Agency for Energy and Climate (LENK) and the director of a Bulgarian Regional Agency for energy development
- One senior expert from the Burgas municipality (Bulgaria) and one expat from ICLEI, the European network for the sustainable urban development.
- Two experts representing an International NGO working closely with cities; ICLEI -. Local Governments for Sustainability.

The scheme used in these interviews aimed mainly at investigating whether agencies or regional / local authorities use DSS on their behalf, if there was a policy to support the use of these tools, what were the limits of the current tools and which are the characteristics of an ideal tool. Two more questions than concerned the non-energy impacts of energy efficiency interventions, one aimed at verifying whether future policies in support of energy efficiency should also take into account non-energy impacts and the other to verify again what the most relevant impacts are.

In general, the answers to the questions concerning the use of the DSS revealed a different position between the German and Italian experts and the Bulgarians one while those concerning the non-energy impacts revealed a more homogeneous picture.

2.2.2 The answers from the representative of the German and Italian Energy agencies

The first questions concerned the objectives and scopes of the agencies in which the interviewed experts are working. As it might be expected both the Bavarian Agency for Energy and Climate (LENK) and the ENEA Unit for Energy Efficiency broadly have the same scope that obviously differ from the spatial point of view: regional for the German agency and national for the Italian one. In fact, both aim at assisting the Regions (for ENEA) and the municipalities (for both) to reach their energy sustainable goals consistently with the regional and country energy policies.

More in particular LENK assists the Bavarian municipalities in order to help them reach the goal of climate neutrality, energy transition, prepares the steps of the process, offers recommendations for activities, master plans/roadmaps for achieving this goal.

The energy efficiency unit of ENEA, in addition to the support to the local and regional activities (carried out together with the other operative units of this agency), has also the broader scope to advise the Italian ministry for developing energy efficiency policy strategy and monitoring over time the impact of the energy efficiency measures.

The two experts were then asked if their agencies make use of these tools for their own work. The director of the LENK answered that the agency currently does not use these tools, but they are familiar with several ones used by the municipalities. However their experience is that they are often too complicated and time consuming to be used by local experts/authorities without technical expertise.

The ENEA expert on the contrary said that they use these tools but essentially to map the territories that they have to analyse in order to assess their energy saving potential. The objective is then to evaluate the potential impact of the national energy saving measures at national or local level as well as to estimate the burden sharing of the Italian regions with respect to national energy plans. For what concerns the use of these tools among the local and regional authorities the ENEA expert answered that they have not a clear view of this data but that his impression is that they are little used, while it would be important that they were.

The following two questions concerned the expected characteristics of these tools: what they should be able to do to be really useful and which should be the most important characteristics of an ideal tool. The answers of both experts were quite similar: the more comprehensive these tools are the more useful but there is the risk that the comprehensiveness increases the complexity of the tool and then its usability and even reliability. So also specialized tools could be also useful and, at least for what concerns the Director of LENK, these tools might help the work of the agency especially if directed to the monitoring of the energy and environmental measures implemented by the municipalities. For the ENEA expert, at least for what concerns the requirement of its unit, the tools should allow the access to factual and informative databases and, as far as possible, provide medium-long term impact estimation of energy policies.

For what concerns the characteristics an ideal tool should have, both experts pointed on the user friendliness and intuitiveness in its use. but not at the expense of the reliability. The ENEA expert stressed also the problem of the data availability and reliability and of their updating. Finally, according to the LENK director, a good tool should either allow the external input of data provided by the users or provide/propose their own data and, where possible, provide a methodological guidance to the users, for example "allowing for a step-by-step approach for the user to first get acquainted with one topic of most relevance to him/her and then gradually take on further topics to expand his/her expertise".

The last two questions of the interview concerned the position of the respondents with respect to the non-energy impact of the energy efficiency interventions. The first question concerned the energy efficiency policies, that is whether these in the future should also take into account non-energy impacts, perhaps equating these benefits to strictly energy ones for incentive or support purposes while the second one proposed a table in which to rank in order of importance the following set of non-energy benefits according to the national requirements:

- Pollution and air emissions
- Mortality and morbidity, public health expenditure (humidity, indoor thermal quality, pollution ...)
- Productivity and industrial competitiveness (more efficient workers, lower energy costs)
- Wealth generation and GDP
- Employment (jobs)
- Energy prices
- Real estate value
- Consumption of natural resources (water, soil ...)

- Material consumption (fossil energy resources, metals, non-metallic minerals ...)

As for the first question, both experts agreed on the importance that future energy efficiency measures might take into account non-energy benefits and moreover the ENEA expert also underlined that the agency had been pushing in this direction for some time. He also stressed the importance of involving banks in planning future energy efficiency policies so that they can more easily open lines of credit to finance energy efficiency investments and how this can be achieved more easily if the cost-benefit ratio of such investments would improve taking into account the non-energy benefits.

For what concerns the second question the ENEA expert said that practically all the proposed non energy impacts are important with a slight prevalence to: pollution and air emissions, wealth generation and GDP, employment (jobs), energy price (but only at national level) and real estate value.

The director of LENK instead gave the higher preference to use of natural resources and the use of materials, a lower preference to air pollution and the lowest preference (1 or 2 in a scale of 5) to all the remaining impacts. Finally, he suggested to add as high relevant the impact on land use / spatial utilization.

2.2.3 The answers from the ICLEI experts

Another interview was conducted with two experts from the International NGO ICLEI – Local Governments for Sustainability. The questions were posed according to the guideline as used for all the interviews in order to guarantee comparability of the responses.

Concerning the objectives and scope, ICLEI is a membership association comprising cities as members. With a view on the REFEREE project partners countries – among others - the metropolitan area of Barcelona, several cities in Germany, Burgas in Bulgaria or Rome and Florence in Italy are members. ICLEI assists cities in Europe and worldwide in reaching their sustainability and energy goals in line with international and especially European regulations and objectives, currently e.g., the European Green Deal.

Additionally, both interview partners are engaged in MICAT – Multiple Impact CAlculation Tool for assessing multiple impacts of energy efficiency. MICAT and REFEREE are both H20 projects in the same call and therefore have many parallels allowing for manifold synergies. In ICLEI one expert is responsible for the non-energy impact, social innovation and governance; the other in sustainable resource use (including (energy) efficiency, circularity etc.)

As regards the use of tools similar to the one to be developed in REFEREE, respondents mentioned a reporting platform developed by ICLEI and used by its members as well as the tool thermos (www.thermos-project.eu). The city members generally report and monitor their sustainability and energy activities in line with the requirements outlined in the SECAPs of the Covenant of Mayors – Sustainable Energy and Climate Action Plans. ICLEI offers or consults on tools used by their members. However, they hardly apply tools for their main focus of activities which are in the planning and reporting phases rather than implementation as regards the cycle of energy efficiency policies.

Similar to the director of LENK above, the experts agreed that an ideal tool should be analytical and modular rather than integrated. This allows for the users to gradually get acquainted with the tool on the example of one topic of highest interest and then gradually tackle further sectors and do-mains. By doing so the users can gradually adapt to higher levels of complexity of the tool but the entry hurdle is not too high.

As to the data to be used for the tool they recommended to rely on official country level or rather European level aggregated data as the data is not adequately and comprehensively covered in the cities.

The experts both stressed the importance of including on non-energy impact of EE interventions in policy planning and reporting. This is underlined by the fact that the respondents are both engaged in a H20 project which deals specifically with these issues. They underscored the importance of communicating measures to reach the energy transition and move forward with the European Green Deal. The topic of Energy Efficiency serves as an especially useful lever for engaging stakeholders because it is tangible and easy to understand. In the process it will bring non-energy related impacts with it. This is considered of crucial value among the experts.

In the ranking of the relevance of non-energy related fields of impact, their answers are recapped in the following lists (1 = not relevant, 5= very relevant).

- Pollution and air emissions
    - 5
- Mortality and morbidity, public health expenditure (humidity, indoor thermal quality, pollution ...)
    - 2 or 1 because it is difficult to draw a plausible chain of causality
- Productivity and industrial competitiveness (more efficient workers, lower energy costs)
    - 5 - crucial argument in the communication with stakeholders
- Wealth generation and GDP
    - 3 - not so relevant on municipal level, however in some respect it is intertwined with the previous impact field, Understood in this manner the experts ranked this point also 5.
- Employment (jobs)
    - See above – productivity
- Energy prices
    - No answer
- Real estate value
    - 5 – politically highly relevant especially if raising EE leads to higher real estate costs. However due to the risk of misinterpretation it is difficult to include this point
- Consumption of natural resources (water, soil ...)
    - 4 – important in regard to resource/energy efficiency in terms of circularity
- Material consumption (fossil energy resources, metals, non-metallic minerals ...)
    - Same as above

2.2.4 The answers from the representative of the Bulgarian energy agencies and municipality

As outlined in the brief introduction of this section in Bulgaria in-depth interviews with a top-level manager of the national energy agency, responsible for energy efficiency policy of the country, a top-manager of the regional energy agency, and a project officer at one of the 5 biggest municipalities were carried out. Additionally, informal discussions with two representatives of a consultancy company and a not-for-profit organization, dealing with technical surveys and socio-economic analyses regarding the implementation of energy efficiency measures mainly in public buildings was carried out and the topic of the use of software instruments was discussed. The consultancy provides an original software tools, used by dozens of municipalities across the country to conduct feasibility studies and to measure the effects of the implementation of energy efficiency measures on building-level.

The major topic of interest for all these people is to improve the energy efficiency of the Bulgarian energy system (both in terms of cost and amount of saved primary energy) as well as the environmental impact (e.g. CO_2 emissions, fine particulate matter) of the EE policies.

The results of the in-depth interviews and the informal discussions is that in Bulgaria, the use of policy support tools for decision making in the field of energy efficiency policies is rare at both central and local government levels, as well as among the business and non-governmental organisations, facilitating and supporting the introduction of these policies. The main reasons for not using specialized software tools, could be seen in the combination of policy domain, which is underfunded and poorly governed, lack of technical and administrative capacity, and the lack of experience in using similar policy support tools also in policy domains different from the energy and environmental one.

The only example of using policy-support tools on central government level refers to the use of ODYSSEE-MURE project's databases and tools by the state agency, which is the national correspondent for collecting and providing information for this project. Similarly, on local and regional level, there are only separate examples of using policy-support tools – in most of the cases, they refer to the development and implementation of specific support tools in pilot projects, while the only example of using such tools in a regular way by different municipalities is the application of the proprietary tools, developed locally by a private company and allowing for feasibility analyses and technical surveys of EE interventions at building level.[3]

The features and characteristics of future policy support tools, wanted by the interviewed stakeholders vary according to their particular needs but there are several common issues that could be outlined:

- level of analysis (and data) – two levels are underlined as most wanted – municipality and national level. Including in the cases, when the analyses need to be done on different levels (e.g. single building, urban area, regional), the existence of reliable reference data and results on the level of municipality and country, is seen as serious improvement as compared to the current situation. Here should be highlighted also the

[3] The regular use of these software tools in various municipalities across the country is based on the fact that they partially automate the process of collecting and analyzing data on the implementation of EE measures, following the mandatory requirements for all the municipalities to report these data to the State Agency for Sustainable Energy Development.

expressed need for customised input of data, i.e. the tool should allow for adding data that could be initially not available.

- availability of data – some data is not available and the future tool need to offer pre-filled options with reference data, that could be used. An important problem, outlined by both the representatives of the central and local government is the departmentalisation of data, referring to different non-energy benefits of the EE policies, which could be overcome by a future tool, if it integrates data from different sectors and policy domains. One specific feature of such a tool, should be also the possibility for future update of the data by the stakeholders, i.e. offering guidelines to data sources or ensuring access to reference databases and information repositories.
- applicability according to the stage in the decision making process - the use of policy support tools is most needed at the stage of design and planning of public policies (as mentioned above), as well as at the stage of monitoring the progress towards the established policy targets on all levels – single building, urban area, municipality, regional and national, and particularly when a regulatory requirement for specific regular reporting exists (e.g. the collection of data from the legal entities that are obligated parties as per Article 7 of the EE Directive4)
- coverage of impacts – using future tools that cover different impacts of the EE policies could facilitate the implementation of these impacts in the existing policies and thus, more integrated future policies that refer to various domains, e.g. circular economy, use of resources, public health, etc.

There are also some features and characteristics that the interviewed stakeholders are not familiar with and is hardly to assess their future applicability or usefulness. A typical example is the use of GIS based tools, which is still very rarely implemented for the goals of energy policies in general and EE in particular. Moreover, GIS is seen as applicable mostly on municipality level or specific urban area. It is seen also as an opportunity for integration of different types of data, coming from various sectors and policy domains (or public institutions). In this respect, the interviewee from the central government outlined also the need for integrated policy approach, as the collection of data and its analysis is embarrassed due to the existence of separated sectoral policies.

Despite the deficiency or even the lack of policy support tools in the everyday work at all governance levels, the **multiple benefits of EE are recognized as important factors for the whole decision-making process but especially for its design and planning stage**. However, the lack of specialised tools supporting the analysis of integrated data from different sectors and policy domains, incl. lack of the corresponding data, has prevented the policy makers and the NGO sector to develop an integrated approach towards the multiple benefits. With reference to the list of non-energy impact outlined in paragraph 2.2.2, those considered very important are the ones related to CO2 emissions, air quality, employment and especially the impact on the energy price. The impact on this factor is in fact considered the most important for all the

[4] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC Text with EEA relevance

interviewed stakeholders. The main reasons are the high levels of energy poverty[5] and low economic status of the majority of population, and the fact that the energy intensity of the industry is three times higher than the EU average level[6], i.e., there are substantial opportunities for increasing the energy efficiency in the business sector.

3 Results and discussion from the literature review

3.1 Introduction

The literature review within the REFEREE scoping analysis complements and reinforces that accomplished in task 2.1 that has twofold objective:

- expand the understanding of the available methodologies for the quantification of the various co-benefits of energy efficiency and their related challenges and limitations;
- highlight a range of potential approaches to use for future valuation of energy efficiency benefits", the current review aims at analysing the academic literature available on energy efficiency support tools used by a diverse range of stakeholders at national, regional and local levels.

The review is structured as follows: first, it outlines the non-energy impacts of energy efficiency measures most widely covered in the above-mentioned research articles. The range of effects analysed is wide: from economic and financial (industrial competitiveness, employment, development, public budget, etc.), through social (skills improvements, effects on life standard and working conditions, energy poverty) to environmental (effects on air quality, nature preservation etc.).

Secondly, the tools are more in-depth analysed. A particular emphasis is placed to analyse the political needs to which the tools are addressed and, more importantly, how these tools have been designed to closely respond to these needs. Thirdly, we present the actors involved in the development and the use of these tools, classifying them into two groups – public and private bodies, also demonstrating how these two groups collaborate, based on their common interests.

3.2 Overview: Energy and non-energy impacts of energy efficiency

It is known that energy efficiency measures - which can be understood as a way of utilizing less energy to yield the same amount of production - are one of the most relevant actions in order

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[5] According to different estimations, the share of energy poor varies between 45% to 60% of the population (Vladimirov et al 2019, p. 16-17)

[6] Respectively 396,43 kgoe per thousand euro in Bulgaria and 119.48 kgoe per thousand euro for EU27 in 2019. Source: Eurostat, 2021

to reduce CO2 emissions and consequently the implementation of these measures are considered strategic y in the fight against climate change.

In this context, there is an emerging literature that focuses its analysis, not only on the positive energy impacts that energy efficiency measures provided; but also on its multiple and varied benefits (economic, social, environmental, etc.). The following paragraphs briefly describe a review of these studies and projects outlining the main tools and programmes proposed by different authors to help policymakers in their needs regarding the multiple benefits of energy efficiency measures.

The topics addressed by these tools contemplate several study fields and tasks that policymakers need to analyse in order to better implement energy efficiency policies. In this sense, the most common policy needs that aim to be solved by these tools are related to building energy efficiency, health risk for the local population, energy efficiency in urban planning, general energy efficiency management and data analysis.

Each one of these tools aims to support policymakers in different stages of the public policy process, including the design, implementation, monitoring, and evaluation of energy efficiency policies.

3.2.1 Needs addressed by the tools:

The needs addressed by the analysed tool are different according to the government level of the users. Some of the tools (such as HEAT+) are used by local governments, in particular, to support their climate action decisions and identify efficient measures in emissions and pollution abatement. A similar role is played by *SIMPACTS* - a tool that helps decision-makers to calculate the potential costs of damage from pollutants and waste (produced in electricity generation) to public health and agriculture.

SIMPACTS addresses also economic needs. For example, the tool can be used to compare and rank various electricity generation options in terms of external costs. Another tool that has economic impacts at the heart of its operation is *JEDI*. One of its primary functions is to estimate the employment that can be created due to the operation of a renewable energy power plant.

Another common need for policymakers, especially at the local level, relates to the more efficient management of municipal public buildings (addressed by the PrioritEE tool). Similarly, the E-City research project has been launched to understand better current urban development issues that need to be dealt with in order to make cities more energy-efficient.

Last but not least, assessing the potential of natural resources is also proving a critical need for policymakers on both national and local levels. As indicated by the development of the RED-E tool, it is necessary to better understand how these resources can be used for the generation of renewable energy.

3.2.2 Effects on macro-level

E-City Web Platform: the related ool for Energy Efficiency at Urban Level aims to satisfy the need for energy efficiency integration into the municipal planning process. The development of an energy-efficient city, supported by ICT and digital solutions for management and planning, is an opportunity to increase cities' competitiveness and sustainability. This tool was created explicitly to organise and visualise energy performance data at the municipal scale and make them accessible to planners, stakeholders, and the population. Results and insights from the use of this tool are relevant to understanding how urban planners, policymakers, stakeholders, and the public can be informed and guided towards more energy-efficient solutions.

The municipality of Oeiras, together with *GEOTPU.LAB (a multidisciplinary research group at the Instituto Superior Técnico of the University of Lisbon)*, developed the E-city research project to articulate energy consumption and solar energy supply with land-use zoning and urban design parameters. The public administration of Oeiras has used this tool to understand critical aspects associated with current and future urban development.

Heterogeneous effects of energy efficiency and renewable energy on carbon emissions: Evidence from developing countries is a study that provides recommendations for the design and implementation of appropriate economic and energy policies to achieve environmental sustainability in the 66 developing countries. The study explores the heterogeneous effects of energy efficiency (EE), renewable energy (RE), and other variables on carbon emissions within the context of the environment Kuznets curve (EKC) hypothesis from 1990 to 2014 (Akram et al., 2020).

The objective of this empirical analysis is to derive key policy implications for policymakers in developing countries, who should design and implement growth-oriented policies and programs to achieve a consistent decline in CO2 emissions. In addition, it intends to demonstrate the vast potential gain from the implementation of energy efficiency projects in developing societies and economies.

There is no mention of collaboration in developing the study, except for the financial support by Chinese educational foundations.

Capturing the Multiple Benefits of Energy Efficiency is a study that aims at providing policymakers with better information to develop and evaluate energy efficiency policies (and broader energy policy portfolios). It promotes the triangulation of evidence from mixed methodologies to ensure that all impacts reported by beneficiaries of an energy efficiency intervention are considered and verified when assessing the net value of an energy efficiency policy (IEA, 2014).

This publication demonstrates the role of energy efficiency as a significant contributor to strategic objectives across five main themes: enhancing the sustainability of the energy system, economic development, social development, environmental sustainability and increasing prosperity.

The research results from the interaction between numerous actors: researchers, academics, public officials, and representatives from the private sector, each having a contribution on a different topic throughout the report.

3.2.3 Effects on micro-level

Energy efficiency networks for companies – concept, achievements and prospects discusses the components of energy management strategies of private enterprises intending to reduce energy costs and increase profitability (Koewener et al., 2020).

The tool consists of a joint target for all participant companies after a careful examination of profitable efficiency potentials in each one. The achievements of these companies are then monitored on yearly basis. The results show improvements in energy efficiency per company of around 100% compared to the autonomous progress. The initial profitable efficiency potential of these companies was around the 5 and 20% of their energy demand.

3.2.4 Employment

The employment impact contains the job opportunities that can arise due to the development of energy-efficient technologies and services.

An example of a tool that covers the employment impact is *JEDI (International Jobs and Economic Development Impact Models).* The tool helps estimate the job and economic potential of renewable energy projects. It also estimates the regional economic impacts of constructing and operating renewable energy plants using Excel as its platform (Ochs et al., 2016).

It has been developed by the National Renewable Energy Laboratory (NREL) in the US for use by county and state decision-makers, public utility commissions, potential project owners, and developers.

The JEDI models estimate the project costs (i.e., specific expenditures), and the economic impacts in terms of jobs, earnings (i.e., wages and salary), and output (i.e., the value of production) resulting from new or existing projects, thus facilitating the cost/benefit analysis of a power plant's performance for decision-makers.

3.2.5 Public budget

The IEA's '*Capturing the Multiple Benefits of Energy Efficiency*' report from 2014 aims at building knowledge of the multiple benefits of energy efficiency and demonstrating how policymakers and other stakeholders can use existing tools to measure and maximise the benefits they seek (Petrichenko et al., 2016).

Five key benefits areas – macroeconomic development, public budgets, health and wellbeing, industrial productivity, and energy delivery – are investigated in-depth, showing compelling returns when the value of multiple benefits is calculated alongside traditional benefits of energy demand and greenhouse gas emissions reductions.

In particular, the report shows that accompanying public budgets with the multiple benefits analysis they bring, helps corecting the misperception that energy efficiency programs cost taxpayers more money. In contrast, it shows that energy efficiency measures in the public sector deliver substantial cost savings through lower energy consumption.

The report target audiences are policymakers and stakeholders, and it addresses the design stage of the decision-making process.

3.2.6 Public health in terms of health risks for people (mortality and morbidity)

The clean energy concept contains the notion that it can improve general human health as renewable sources replacing those that have more harmful effects (air and water pollution, for example) on the environment and human health.

The Co-Benefits Risk Assessment (COBRA) tool, developed by the US Environmental Protection Agency, can calculate the value of clean energy policies such as energy efficiency or fuel switching, which can help state and local governments to consider both the costs and benefits of policy choices and support a balanced decision-making process (Petrichenko et al., 2016).

It has been designed to support the design and tracking stages of the policy development cycle and has local policymakers and experts as its target audience. The tool can help its users conduct remarkable assessments on the air quality, human health, and related economic benefits (excluding energy cost savings) of clean energy policies or programs.

SIMPACTS (Simplified Approach for Estimating Environmental Impacts of Electricity Generation) estimates and quantifies the health and environmental damage costs of different electricity generation technologies (Ochs et al., 2016). Energy analysts and decision decision-makers can use it to compare and rank various electricity generation options in terms of external costs. SIMPACTS also covers the primary electricity generation sources and most of the associated impacts on human health and the environment.

The tool has been developed by the International Atomic Energy Agency and their clients are energy ministries, environment ministries, utilities and energy planning agencies, as well as universities and research institutions.

3.2.7 Air pollution and emissions/air quality

Closely related to the previous impact, the improvement of air quality and the reduction of greenhouse gas emissions are central topics for policymakers, especially considering the ambitions declared by the EU and the US to achieve climate neutrality by 2050.

The HEAT+ (Harmonized Emissions Analysis Tool Plus) tool helps local governments account for greenhouse gas emissions, common air pollutants (CAP) and other volatile organic compounds (VOC). It helps formulate targeted action plans by leveraging measures that offer the highest impact on emissions and pollutant abatement (Ochs et al., 2016). It has been developed by ICLEI (Local Governments for Sustainability) - a global network of more than 2500 local and regional governments committed to sustainable urban development. The tool’s main goals are the improvement of air quality, the mitigation of global warming, and the protection of public health. Its current and past users include numerous local governments in 11 countries and regions – India, Philippines, Indonesia, Korea, the US, the EU, China, Malaysia, Brazil, South Africa, and Italy. The development of the tool allows:

- the creation of Inventory and forecast emission profiles,
- the measurement of energy consumption and emission performance Indicators,
- the development of time-series consumption and emission profiles,
- the creation of mitigation profiles (reduction in consumption or greenhouse gas, emission based on measures determined),
- the monitoring of low carbon action plans, to track commitments, measure progress against targets, determine priorities based on scenario reports, and report differentiated results.

3.2.8 Use of natural resources (esp. regarding the national/local resources)

More efficient use of natural resources represents a key issue for decision-makers, as they strive to discover new ways to utilise their country or region’s potential, particularly in generating renewable energy.

GCAM (Global Change Assessment Model) is designed to explore a wide range of interactions, including the energy, emission, land-use, and water consequences of policy options for climate mitigation and investigate emerging energy supply and demand technologies. As a result, the model is increasingly being used to explore the implications of climate change on energy, water, and land-use systems (Ochs et al., 2016). The simulation model is used by different clients, including energy ministries, environmental ministries, research organizations, universities, non-governmental organizations, and international agencies. GCAM produces a wide range of variables contingent on input assumptions for future population, economy, technology, and environmental policies. These include: energy supply and demand by sector, technology, and fuel for 32 geo-political regions; land-use and crop production for 283 land regions; endogenous price paths for energy and agricultural goods; greenhouse gas and pollutant emissions; and climate policy costs.

RED-E is a map-based software application that provides an intuitive, user-friendly interface for visualising and quantifying a country or region's renewable energy potential (Ochs et al., 2016).It provides a platform for integrating data on renewable energy resources and the physical or geographic factors that influence their development The data are visualised by a map that allows targeted quantitative analysis of solar, wind, and biomass potential under a variety of user-defined scenarios.

The tool is typically used by national and local governments, renewable energy developers, renewable energy investors, academia and experts, and international organizations.

3.2.9 Better living/work conditions/better conditions when using public buildings and infrastructure

Cost efficiency is a continued issue for local bodies, given that they often have to operate within budget constraints. Multiple tools, two of which are discussed below, provide examples of how local governments can be more creative in their approach to introduce energy efficiency measures across public buildings and sustainably manage them.

The Energy Sector Management Assistance Program (ESMAP) Mayoral Guidance on Buildings note outlines how cities can tap into a wide array of proven technologies, policies, and financing mechanisms to improve energy efficiency and capture cost-effective energy savings in buildings. It offers city leaders advice on how to introduce energy efficiency measures and provides lessons and examples from successful programs that have been developed worldwide (Petrichenko et al., 2016). Its target audiences are local policymakers and experts, with design and implementation being the stages of the policy development process targeted by the guidance.

The PrioritEE project "Prioritize energy efficiency measures in public buildings: a decision support tool for regional and local public authorities" is another example of a project addressing the topic of better living when using public buildings and infrastructure. It aims to support more efficient energy management of municipal public buildings in five Mediterranean countries (Croatia, Italy, Greece, Portugal and Spain) (Salvia et al., 2021). The core of the approach is developing a comprehensive and generally applicable set of tools (which constitutes the PrioritEE toolbox) aimed at professionals and experts from different levels, including energy managers, energy planners, and decision-makers.

Moreover, awareness-raising initiatives and capacity building activities were carried out throughout the project to involve key target groups, familiarise them with the PrioritEE toolbox, and ensure it was suitable for application in the five local pilots. The tool identifies a necessity to strengthen the institutional capacities of local public bodies in the sustainable management of public buildings and, in particular, in the field of EE and the use of RES. It responds to the needs of local authorities to adopt a systemic approach in order to ensure a coherent and efficient energy policy covering the entire building stock over which the local authority exercises control.

The tool is the result of the active and lasting commitment from stakeholders and target groups both at municipal and provincial/regional levels, and has included the collaboration between academics, researchers, local agencies and public authorities).

3.2.10 Territorial/urban planning

Taking energy efficiency into account ahead and during urban planning projects indicates the ambition of policymakers to facilitate the process of integrating energy-efficient solutions into urban development as much as possible.

The municipality of Oeiras, together with GEOTPU.LAB, developed the *E-city research project* aiming to articulate energy consumption and solar energy supply with land use zoning and urban design parameters. As already outlined above, this tool has been used by the public administration of Oeiras to understand important aspects associated with existing and future urban development (Amado et al., 2018).

The main policy target this research aims to satisfy is that for energy efficiency integration into the municipal planning process. The development of an energy efficient city, supported by ICT and digital solutions for management and planning, is seen as an opportunity to increase cities' competitiveness and sustainability.

This tool was specifically created to organize and visualize energy performance data at municipal scale and make them accessible to planners, stakeholders, and population. Results and insights from the use of this tool are relevant to understanding how urban planners, policy makers, stakeholders, and the public can be informed and guided towards more energy-efficient solutions.

3.2.11 Nature preservation / Climate change

As mentioned above, tackling climate change is a foremost priority for governments at every level. Therefore, there is a clear need for tools that assess the most viable policy proposals.

LEAP (Long-range Energy Alternatives Planning System) is a widely used software tool for energy policy analysis and climate change mitigation assessment developed at the Stockholm Environment Institute (Ochs et al., 2016). Its goal is to bring the policy insights of sophisticated scenario-based energy and environmental planning to a wider audience. It places powerful data management, sophisticated calculations, flexible and user-friendly reporting tools within a single accessible decision-support software tool that is made available for free to target users in developing countries. The tool has been developed for energy ministries, environmental ministries, utilities and planning agencies, universities, non-governmental organizations, consulting companies, and international agencies.

The development of the tool has entailed the creation and evaluation of long-range scenarios concerning the evaluation of primary and final energy requirements by sector, of the greenhouse gas emissions as well as emissions of local air pollutants, the calculation of the corresponding capital, operating and external costs. Summary and easy-to-interpret figures on costs and benefits comparison by scenario, as well as indicators on energy security including import dependence and diversity of supply, are also provided.

3.2.12 A tool for the multiple impact analysis of energy efficiency interventions

In addition to the tools so far analysed, there is one expressly developed by the COMBI project (Thema, 2018) to quantify the non-energy benefits of energy efficiency in the EU-28 area and incorporate those multiple impacts into decision-support frameworks for policymaking. The project identified 31 impact indicators to quantify the following effect of energy efficiency improvement actions:

- air pollution, including consequences on ecosystems and human health;
- health consequences deriving from buildings in energy poverty conditions;
- productivity impacts of residential and tertiary building refurbishments;
- changes in the use of resources considering the material footprint;
- macro-economic impacts including changes in the labour market, GDP and public budgets and energy prices;
- energy system and security effects.

The COMBI online tool offers open access to the identified indicators and provides a graph shepherd on users' needs as the main output. The graph can display the results according to energy efficiency improvement actions, countries, or selected impacts. The users can also choose between a standard or expert mode. The first setting allows a general overview of pre-aggregated sub-impacts with possible omitted indicators and limited visualisation opportunities. The expert mode admits a detailed assessment, including all impact indicators in the calculation and visualisation. Although the COMBI project has developed a sophisticated tool for quantifying the multiple impacts of energy efficiency actions, considerable research gaps and improvements in both design and distribution phases have been identified. There is room for a more systematic approach to frame the energy efficiency policies into the energy system dynamic as well as to improve the data gathering for sectoral analysis and impacts quantification, together with the co-design process and dissemination phase that can be further enhanced.

An assessment of the COMBI project and the use of the final tool by external stakeholders were discussed directly with the project coordinator. COMBI's main aim and principal effort was the quantification of the multiple non-energy benefits of energy efficiency in the EU-28 area. It was one of the first attempts at the European level to assess different Multiple Impacts of Energy Efficiency Improvement actions. Therefore, the main obstacle and most of the project work was directed toward understanding the best assessment methodology for the different impact categories. The project quantified and monetised each impact category (air pollution, resources, social welfare, macro-economy, energy system) separately because there was the need to deeply investigate and understand the consequences of Energy Efficiency Improvement actions on each different aspect of the COMBI framework. Consequently, the most complex challenge was the aggregation of multiple impacts in order to incorporate them into a common cost-benefit analysis framework. Diverse impacts have been qualified in different units, rendering impossible monetisation. Moreover, some benefit categories overlap with each other, and some impacts have not been included in the final assessment to avoid double counting. As a significant conclusion, a unique integrated model to quantify all benefits would have been better.

On the other hand, the final tool has not been used significantly for a series of reasons. A bottom-up stock model has been used to calculate reference and efficiency scenarios extrapolating past development effects and accounting for current policies. COMBI thus used a dynamic baseline that already incorporated incorporates substantial energy efficiency improvements existing EU policies. Unfortunately, this implies that energy efficiency actions can only be assessed considering COMBI scenarios, making a specific context-dependency evaluation impossible. Moreover, the project didn't perform extensive market analysis with a strong stakeholder's involvement an outstanding market launch since the budget didn't allocate considerable resources for this task. Finally, a remarkable recommendation is defining the target user precisely and performing in-depth and specific interviews to comprehend their needs adequately.

4 Conclusions

4.1 The lesson learned from the survey

The survey and the in-depth interviews carried out within the scoping analysis had the twofold objective to investigate the stakeholders' perception on the importance of non-energy impacts of energy efficiency interventions and to understand which are their expectations on the use and practicability of the decision support system to evaluate these impacts. From both sides, important insights can be drawn. First of all, we can assume that the composition of the survey sample, with all the necessary limitations and cautions, roughly reflects the composition of the final users of the REFEREE tool. The majority of these potential users work in public organisations on energy and environmental departments at different institutional levels but with some predominance of the European / international one. They are moreover predominantly involved in the planning and monitoring phases, and their first field of action is the energy-saving policies followed by the energy and environmental ones.

The different institutional level covered by respondents explains the remarkable diversity of interviewees' answers. This situation therefore requires the development of a policy support tool capable of responding flexibly to diversified business and work needs. This topic is addressed in detail in deliverable D2.4, which, as mentioned in the introduction, used the results of the survey to outline the operative characteristics of the REFEREE tool.

Regarding the type of the final output, the job responsibilities of the respondents suggest that the REFEREE tool should provide data to perform strategic and reporting analysis. Regarding this last aspect, it would be beneficial to align the information released with the requirements outlined by the local and regional authorities in their Sustainable Energy and Climate Action Plans. For what concerns the sectors to which address the impacts to be evaluated, not surprisingly, these are those related to the energy efficiency interventions in buildings and industry. The transport sector is hardly mentioned, but this could depend to the fact that this sector is poorly represented in the survey sample. In addition to these main activities,the respondents also indicated their interest in interventions where energy efficiency guarantees high returns, i.e., circular economy strategies. This particular type of intervention will have to be taken into due consideration by the REFEREE tool.

The final set of questions on the respondents' perception on the relevance of the non-energy impacts revealed the urgency to provide reliable evaluations in this sense to support the policy planning activity or investments decisions. This requirement has also been stressed during the in-depth interviews that have underlined the necessity to adjust energy efficiency regulations and incentives to include multiple energy efficiency benefits. Finally, the respondents completed the questionnaire providing their point of view on the most relevant non-energy impacts that should be taken into account. They preferred the cost of energy resources for end-users, the environmental impacts, including the material consumption and material reuse and economic and societal factors like the employment situation. These preferences have also been indicated, more or less with the same order, by the in-depth personal interviews. Other factors among those listed in figure 9 of paragraph 2.1 were considered less important but this does not mean that during the project we do not continue to deepen this topic, also in collaboration with the stakeholders who will continue to follow the project activities, given its importance.

Finally, the project will have to launch the tool carefully to address non-user representing half of our audience; namely, all respondents that affirmed to not use specialised software tools for supporting decision- and policymaking (figure 11). Besides the fact that the REFEREE tool has to be easy to use, a step-by-step guide will be handy to address all kinds of users.

4.2 Conclusions from the literature review

The review demonstrates the available research on the effects of energy efficiency and the tools used for designing and implementing related strategies in different contexts - private and public, national, regional and local. The first conclusion that can be drawn is that energy efficiency and the tools for its achievement are frequently multifaceted, covering more than one impact. The benefit of this is obvious: implementing one policy and strategy brings multiple benefits across the politico-economic and social spectrums in the societies observed. However, this wide-ranging coverage presents the researcher with the difficulty of identifying the specific impact central to each tool.

The present review identifies gaps in the available literature and research in each area discussed. The gaps, unsurprisingly, differ in size and depth between the non-energy effects of energy efficiency studied. However, for future reference, they are listed as follows: on the macro-level impacts, there has not been preliminary analysis on how policy strategies differ on a national, regional and local level, which is an important pillar to understand how their design is to be made in an optimally efficient manner.

Moreover, there is a need for a deeper examination of the relationship between energy efficiency and economic growth and development, with quantifiable results. Secondly, regarding the micro level effects, observed most frequently on corporate level, are primarily focused on profitability, with little attention to what innovations are introduced in the working process as a result and how competitiveness is accordingly increased.

4.3 The way forward

Survey results and personal interviews insights, as well as the findings provided by the literature review, including the precious indications provided by the COMBI project coordinator, confirmed the relevance of the REFEREE methodological approach and the usefulness of preliminary advancements. In addition to this, the fact that practically all the stakeholders we interviewed or even contacted as in the PAG workshop, confirmed the importance of evaluating the non-energy benefits of energy efficiency interventions, which provide us with a solid motivation to go ahead in our project with conviction. As outlined in paragraph 4.1, there is a common agreement on which impacts should be taken into consideration although some remarkable exceptions and suggestions on new types of impacts have to be carefully taken into account.

These indications will be carefully considered during the development phase of the REFEREE tools but, for the moment, the results of the scoping analysis allow us to confirm that, in general, the quantification of multiple benefits associated with energy efficiency interventions will cover exhaustively the four macro-areas identified by D 2.2: industrial productivity, socio-economic development, health & well-being, environment and climate.

The quantification exercise will thus assess in-depth the value of co-benefits and costs, trade-offs and overlaps to weigh different indicators adequately and include all possible impacts into an integrated assessment. Particular attention will be paid to industrial productivity to avoid underestimation since it is the dimension characterised by a considerable amount of co-impacts. Regarding socio-economic development, the calculation of public budget impacts will consider the lower costs of hospitalisation, medication, and medical care due to energy efficiency benefits. The improvements in public health will account for the differences among EU region in terms of climate, lifestyle, and health infrastructure. Health and well-being, which is the factor majorly contrasted by the stakeholders' preferences, but which we still consider important given its relevance in public budgets, is undoubtedly the dimension that requires more evidence to effectively assess the impact of energy efficiency investment. Finally, the environmental and climate impacts on one side can be quite easily evaluated, due to the availability of reliable data on the relationship between the energy production emissions and the corresponding environmental damage, but, on the other side, can present some challenges due to the presence of trade-off concerning the effects of energy efficiency measures on material consumption. In fact, it is possible that that the demand for material will increase in the short term due to higher investments in building renovation and the rebound effect from increased economic activity. However, in the medium-long term the material consumption is expected to return to the original level once the investments are finalised.

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Annex: the survey questionnaire

Experts Feedback Survey

REFEREE (Real value of energy efficiency) project aims to make energy efficiency more appealing to policy makers and industrial stakeholders by:

- delivering insightful and reliable information on the multiple benefits that energy efficiency measures can provide;
- developing and offering a user-friendly tool to make this information immediately operational for decision makers and industrial stakeholders.

To develop a policy support tool, that effectively answers to the real needs of its potential users, we invite you to share your opinion in this survey. The survey contains 19 questions, is fully anonymous and it will take you about 15 to 20 minutes to fill in.

We thus thank you in advance for taking the time to participate in this poll.

If you have any questions regarding the survey, you can contact us at todor.galev@online.bg.

[1] Please, indicate your country:

……………

[2] What type of organization do you work for?

Public sector

Consultancy company

Business association

Business enterprise

Trade union

Research organisation (public or private)

Other

[3] What is the level, your position in the organization corresponds to?

Expert level

Mid-level management

Top-level management

[4] What is the primary scope of the work of your organisation?

Building or facility level

Local level (e.g. city, municipality)

Regional level (covering more than one municipality)

National level

International / European level

Other:

[5] Which are the topics, your work is mainly focused on?

Local or regional governance

General energy and climate policies

Energy efficiency and savings

Environment

Public health

Economic development, incl. employment

Business sector development

Education and training

Energy services (ESCO companies)

Other:

[6] In which phases of the policymaking are you usually more involved?

Policy design and planning

Implementation

Monitoring and reporting

Other:

[7] Please, select up to 3 topics related to energy efficiency impacts that are of specific interest to your work:

Investment prioritization in public infrastructure renovation

Spatial prioritisation of housing renovations in neighbourhoods

Impacts of circular economy policies

Identify sectors with better return for energy efficiency actions

Impacts of energy efficiency in housing

Impacts of energy efficiency in tertiary sector

Impacts of energy efficiency in industry

Impacts of energy efficiency in mobility

Impacts of energy efficiency in public buildings

Impacts of energy efficiency in public lightening

Impacts of electric micro-grids in industrial districts

Impacts of electromobility

Impacts of district heating initiatives

[8] How important is gaining knowledge on non-energy impacts* when planning or implementing energy efficiency policies and investments?

	1 = Not at all important	2	3	4 = Very important
Importance for you	○	○	○	○

** Non-energy impacts of energy efficiency investments include effects on macroeconomic, public budget, health and well-being, and industrial competitiveness among others.*

[9] According to you, which are the 3 most important impacts, that need to be quantified for assessing energy efficiency investments?

Changes in competitiveness

Product quality

Market value

Changes in GDP

Net new jobs / employment

Cost of energy resources for end-users

Air pollutant emissions / air quality

Material consumption, incl. reuse of materials and circle-economy

Health risks

Healthcare costs

None of the above are important

[10] Do you think that policies supporting investments in energy efficiency should take into account the effects of the non-energy impacts?

	1 = Not at all	2	3	4 = Very much
The effects should be taken into account	○	○	○	○

** Non-energy impacts of energy efficiency investments include effects on macroeconomic, public budget, health and well-being, and industrial competitiveness among others.*

[11] In your work, do you use or develop specialised software tools for supporting decision- and policymaking?

Yes, I use such tools

Yes, I participate in the development of such tools

Yes, I both use and develop such tools

I do not use or develop such tools but I am interested to know more about them

I am not interested at all to these tools

Answer only if response to Q11=1, 2 or 3

[12] Which areas are covered by the software tools you use and/or develop?

Energy and climate

Air quality, air pollutants and emissions

Territorial or urban planning & mobility

Residential housing

Public buildings and facilities

Economic, business or industrial development

Employment policies

Energy & urban infrastructure

Public health

Use of natural resources and material consumption

Finance and public budgets

Other:

Answer only if response to Q11=1, 2 or 3

[13] Which additional features currently not available would be useful for you to have in these tools? (e.g functions, data coverage, territorial coverage, etc.)

………………

Answer only if response to Q11=1, 2, 3 or 4.

[14] How relevant do you perceive these tools in relation to your work needs?

Highly relevant

Moderately relevant

Slightly relevant

Non-relevant

Answer only if response to Q11=4.

[15] If you could use a specialised software tool, intended to support your work, which steps in the decision-making process should the tool address:

Design and planning

Implementation

Monitoring, verification and reporting

Answer only if response to Q11=4.

[16] If you could use a specialised software tool, intended to support your work, which activity sectors should the tool cover?

Energy and climate

Air quality, air pollutants and emissions

Territorial or urban planning & mobility

Residential housing

Public buildings and facilities

Economic, business or industrial development

Employment policies

Energy & urban infrastructure

Public health

Use of natural resources and material consumption

Finance and public budgets

Other:

Answer only if response to Q11=4.

[17] If you could use a specialised software tool, intended to support your work, what would be the level of complexity of such a tool, which you think would be the most appropriate for using in your work:

Basic functionalities with simple outcomes

Medium-level functionalities delivering more defined outcomes

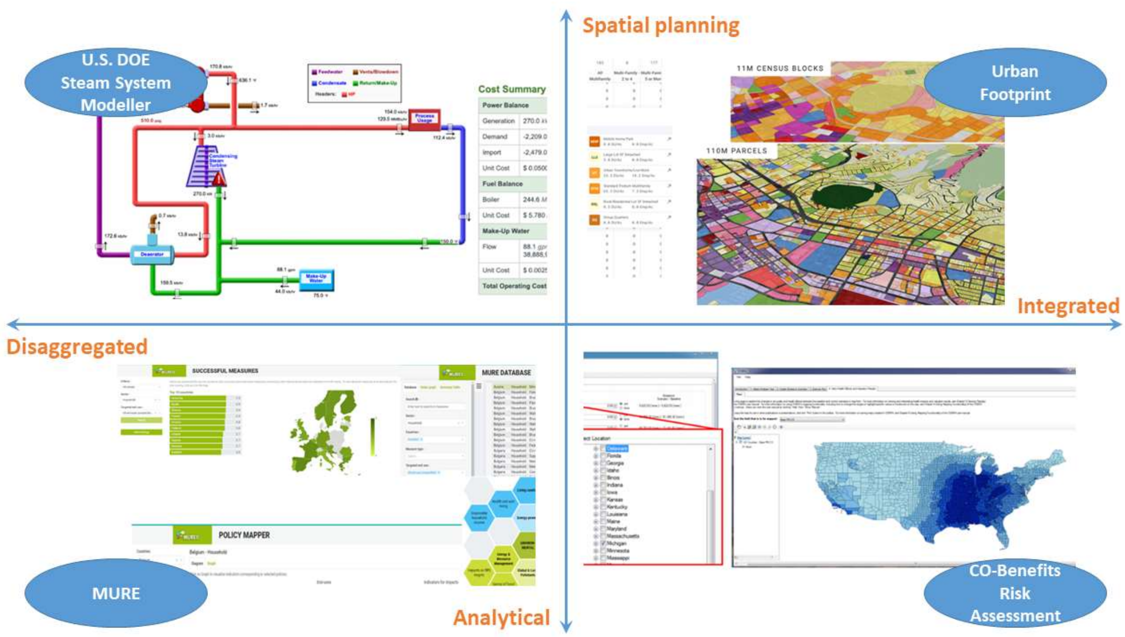
High-level functionalities with highly user-customisable outcomes

Answer only if response to Q11=1, 2, 3 or 4.

[18] Looking at the examples bellow, which type of specialised software tools, supporting policy- and decision-making, would be more useful for you?

Please position the desired tool according to the axes of "Disaggregated – Integrated" and "Spatial planning – Analytical".

See also the examples below.



1 = Disaggregated: Closer to a calculator, database or benchmarks of individual buildings, services, facilities
5 = Integrated: Holistic, integrating many sectors, services and facilities together

1 = Spatial planning: Based on maps and impact assessment for different locations and territories
5 = Analytical: Based on few aggregated indicators and analytical graphs

1 ◯ ◯

2 ◯ ◯

1 = Disaggregated: Closer to a calculator, database or benchmarks of individual buildings, services, facilities
5 = Integrated: Holistic, integrating many sectors, services and facilities together

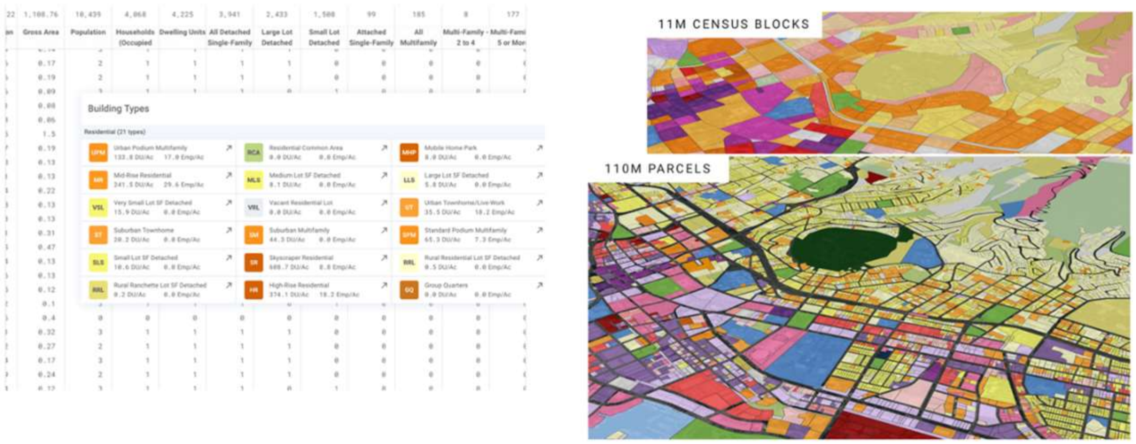
1 = Spatial planning: Based on maps and impact assessment for different locations and territories
5 = Analytical: Based on few aggregated indicators and analytical graphs

3 ◯ ◯

4 ◯ ◯

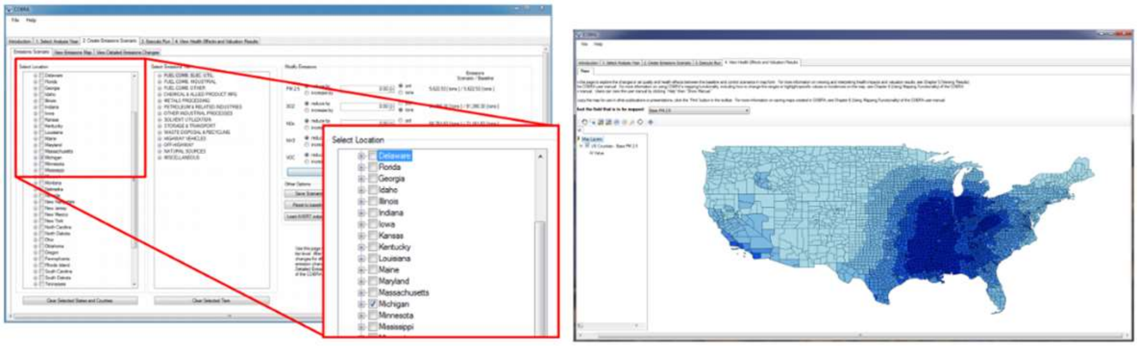
5 ◯ ◯

The U.S. DOE Steam System Modeller is a disaggregated calculator for industrial facilities. It allows for creating a model of the existing enterprise's steam system. A second model can then be created by adjusting a series of characteristics simulating technical or input changes. This allows the enterprise's management to see how each component and adjustment impacts the others and what changes may be most beneficial for increasing the overall efficiency and stability of the system. An interactive diagram is provided for each model, incl. comprehensive system properties and operational details.



Urban Footprint is a specialised tool integrating different sectors at urban level. It delivers insight to government, enterprise, and academic institutions in urban planning, finance, mobility, sustainability, healthcare, and disaster preparedness. It draws on deep understanding of the interaction between planning and mobility decisions and the fiscal, environmental, public health, and liability challenges that face states, regions, or cities.

MURE is an analytical benchmark tool portraying examples of existing energy efficiency policies and measures that have been carried out in the EU Member States. It provides information of policy implementation, costs, and main impacts. The information is accessible by query in the database. The distribution of measure by type can be visualized through radar graph, while other functionality offers specific queries (by country, industry, or transport and buildings).



CO-Benefits Risk Assessment is an analytical tool and a screening model that estimates the health and economic benefits of clean energy policies. It helps state and local governments to explore how changes in air pollution as result of clean energy policies, can affect human health at the county, state, regional, or national levels, estimate the economic value of the health benefits, and map the air quality, human health, and health-related economic benefits from reductions in emissions.

[19] If you are interested in the development of specialised tools supporting energy efficiency policies and their non-energy impacts, you can directly write us, following this link, or leave your e-mail address below and we will keep you informed about the development of the REFEREE tool.

………………………..

Your e-mail address will be not shared or used for any other purpose.