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Identifying and Comparing Obstacles and Incentives for the Implementation of Energy Saving Projects in Eastern and Western European Countries: An Exploratory Study

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Abstract: This comparison study of the implementation of energy-saving projects in buildings was conducted in order to consider the diversity of experiences between Western European countries, which have experience and expertise in this area, and those countries in Eastern Europe that are in the beginning stages. The goal of this paper is to analyze obstacles and incentives for investment in energy conservation in buildings by comparing European countries with a diverse landscape of institutional and economic developments, social-cultural values, and environmental framework conditions in order to understand if these differences are influencing the implementation of energy saving measures and how this can be used to overcome the existing obstacles. The study is based on survey results received from experts in Eastern and Western European countries. The main value of the research is that it offers an overview of the potentials and constraints (barriers) to energy efficiency in Europe, based on data from a sample of western and eastern European countries. Among the most important incentives that were implemented to stimulate energy-saving measures are costs savings and the need to meet regulatory requirements. The main obstacles that still restrict the number of already implemented projects in Europe are a lack of proper financial incentives and that many Eastern countries are still struggling to develop the market of Energy Saving Services (ESS) and to operate better energy waste control systems. The paper concludes with the successful incentives that were implemented to stimulate the energy-saving measures and the main obstacles that still restrict the number of already implemented projects in Europe. Additionally, a set of indicators related to the environmental friendliness and social significance of energy-saving measures was proposed for evaluation of the project results. These were used based on the fact that they may be measured and cater for comparisons. This paper can help improve policy-makers' selections in order to improve economic instruments appropriate to energy-saving policy objectives and specific national contexts.

Keywords: energy-saving measures; buildings; energy policy; energy efficiency; environmental impacts

1. Introduction

The International Energy Agency (IEA), in its World Energy Outlook 2017 (WEO), presented a scenario that delivers modern energy for all by 2030. Moreover, according to this plan, it is possible to achieve climate goals and reduce air pollution through a low-carbon energy transition. However, the achievement of such an energy sector pathway will be possible only by conducting essential changes in the production and use of energy. One of the key factors is that energy efficiency must be twice as high as it is now [1].

Energy efficiency is, for the purposes of this paper, defined as an optimisation in the energy use, to allow the manufacturing of products or provisions of services with the lowest possible amount of energy. It is, in other words, a “smart” way of using energy. Numerous reports and studies [2–4] have shown that the greatest energy-saving potential in Europe lies in buildings. Currently, about 35% of the EU’s buildings are over 50 years old, and they were constructed with low energy standards [5]. For example, considering deep renovation in the buildings, the energy saving potential for Bulgaria, Serbia, Hungary, Czech Republic, and Ukraine is between 67.8% and 77.2% [6,7]. It is important to point out that some studies have already sought to understand the subject in the region of study [8–11]. Among them, [10], sought to test the hypothesis of whether high tariffs lead to high efficiency of electricity suppliers. The scientists tested this hypothesis in a case of 29 Ukrainian electricity distribution companies. The result of the study showed that in most regions of Ukraine, the increase in tariffs no longer leads to an increase in efficiency. That is why investing in the renovation of existing buildings can provide excellent opportunities for an effective reduction of energy consumption and, as a result, a decrease of greenhouse gas emissions, reduced energy dependency, increased savings on energy bills, and improved health and air quality. However, according to the Buildings Performance Institute Europe (BPIE), the current allocation of Europe Union (EU) funds shows that buildings are not considered to be a critical energy infrastructure in the Central, Eastern, and Southeast European regions. Even though there are serious energy scarcities and energy security concerns, only 3% of the public funds that could be used to support energy-efficiency investments in this region are dedicated to the refurbishment of buildings [12]. In [13] the scientists reviewed current financing practices for energy renovations in Western Europe. As the energy efficiency finance market grows, new models and sources of finance were recommended to deliver the untapped energy efficiency potential of buildings.

Continuing ambition for the rapid expansion pursued in the Soviet Union led to a capital stock with low energy efficiency for buildings and the energy industry itself. In the Southeast region, a large part of the housing stock was built during the Soviet Union times (1970–80s). Constructions were made with common design and low energy efficiency standards, mostly using prefabricated sandwich panels [6]. These monotonous blocks of flats have become a symbol of the Soviet Union era. They have similar characteristics and problems; therefore, in most Eastern European countries with a large stock of this type of building, it is considered to be the biggest problem in energy policy discussions. The technology of prefabricated sandwich panels was in fact invented in the Western region of Europe. Primarily, it was used in Denmark, England, France, and other countries. However, the Soviet Union procured the right to use the technology and developed its own systems [6].

In Eastern Europe, due to low energy efficiency standards of buildings (particularly constructions from the 1970–80s), the heating energy consumption is often about two to three times higher when compared to Western Europe [14]. Opportunities for more efficient energy use were barely realised in Eastern European countries, since they did not experience the sharp increase in world energy prices in the 1970s [15]. Therefore, a centralised programme to improve thermal insulation in these buildings in Eastern European countries began only in the mid-1990s [16]. On the other hand, in Western Europe (starting in Sweden, Norway and Germany), the national energy efficiency standards were implemented already during the 1950s. The standards that were introduced mandated the use of building envelope thermal insulation [17]. Some national building renovation programs and policies for example in France and Germany (such as the “Building” and “heating check” program) have made substantial strides in supporting energy efficiency renovations. However, more efforts are necessary to increase the renovation and to shift from a single-measure approach to comprehensive renovations [18].

A common rule for all European countries is that the implementation of energy saving measures (ESM) must be done very carefully with a strict quality control. The usage of

some materials and techniques can provide a good level of energy saving, but at the same time could lead to harmful impacts on the environment and human health.

Over the last 20 years, many countries (more than 118) worldwide have developed various energy policies at the state or national levels to increase the number of implemented projects [19]. At the same time, there has been an increasing emphasis on integrated approaches in the environmental policy [20]. All these policies aim at saving costs and minimising negative environmental and human health impacts by fostering the reduction of energy use. In a growing number of policies and business instruments, the Cost Benefits Analysis (CBA) and Life Cycle Assessment (LCA) have been recognised as useful methods in policy support in terms of impact assessment, implementation measures, and monitoring needs [20].

The research questions of our study were:

1. What are the main obstacles and risks that still hold back the number of implemented projects in Europe?
2. What successful incentives were implemented to stimulate ESM in buildings in Eastern and Western European countries?
3. Which indicators related to the environmental friendliness and social significance of ESM are being considered for evaluation of the project results?

In this research, we aim to compare the difference of ESM in Eastern and Western European regions and understand which incentives increase the number and quality of energy-saving projects in buildings.

2. Materials and Methods

The paper examines implementation of energy-saving projects in buildings in the Western and Eastern European regions. The study adopted a questionnaire survey to collect quantitative and qualitative data about the investment in refurbishment to improve energy savings in existing buildings. The research methods used for obtaining and analysing data include literature reviews, questionnaire surveys, and quantitative and qualitative analyses. A three-stage process was extensively used to elicit professional opinions on ESM.

In the first stage of our research, development of the questionnaire was supported by a comprehensive literature review, which entailed some of the most recent literature and relevant works in Europe. This was followed by a second stage, which is the design of a survey instrument, namely a questionnaire. This consisted of a set of closed questions, where respondents were asked to choose their answer from a fixed set of options. These types of questions were deployed because the obtained data cater for a reliable collection and analysis [21]. General open questions were also used at the end of the structured questionnaire in order to allow respondents to identify new issues not captured in the closed questions [22]. This type of question catered for an increase in the response rates [22]. It should be noted that the questionnaire was tested with international experts on the topics that cover the study.

In the second stage of our research, an online survey was performed, with 10 questions based on the developed questionnaire. The invitation to participate in the study was sent to experts from various European regions. The data were collected through the Survey Monkey online survey tool (www.surveymonkey.com/, accessed on 20 April 2020). This web tool is widely used for survey studies because it offers a wide variety of question types, and at the same time it has a convenient interface [23]. The online questionnaire was used to present the statements with clear instructions to indicate the level of agreement or disagreement using a five-point scale where 1 was “strongly disagree”, 2 was “disagree”, 3 was neutral, 4 was “agree”, and 5 was “strongly agree”. Responses were divided accordingly between the analysed countries into the Eastern and Western European regions. It was done considering historical criteria and economic backgrounds as well as geographical location. The main idea was to understand whether economic developments and social-cultural values are influencing on ESM implementation and how this can be used to resolve the existing obstacles.

In the third stage of our empirical study, the collected data were analysed using simple descriptive statistics, namely the SPSS software (variables such as mean, standard deviation and frequency were measured). However, the frequency was considered for the presentation of the results. It is important to note that a simple statistical frequency analysis was adopted, as this is a study that aims to provide an overview of potentials and constraints (barriers) to energy efficiency in Europe, based on data from samples of Western and Eastern European countries. To test the statistical significance of differences in these estimations the Wilcoxon signed-rank non-parametric test was applied.

The sample was composed of experts who work on the subject and are knowledgeable, thus providing well-informed answers. The authors did not engage in the analysis of errors or tests of the sample, such as correlation, regression, structural equations, among others, as the work would have to obtain a larger number of responses and thus reach other groups of respondents. Answers to the closed questions were coded according to a five-point Likert scale, and answers to the general open questions were analysed using content analysis [21].

3. Results and Discussion

3.1. General Description

A questionnaire survey was undertaken among a sample of European countries. This involved the collection of quantitative and qualitative data from 55 experts, which included: energy agency managers, secretaries (General EUMEPS), climate advisors, researchers in energy, mobility and climate change fields, consultants, Energy Efficiency (EE) advisors, sociologists, energy project developers, software energy developers, project managers, energy efficiency project coordinators, analysts, technical directors, mechanical engineers, energy managers, project directors (GIZ), energy efficient analysts in NGO, freelancers, scientists, university academic teachers, professors, vice-deans, university deputy, PhD students, and the Ministry of Energy (Table 1).

Table 1. Structure of respondents.

Country of Participants	Occupation				Number of Participants, Total
	University	NGO (Energy Programs)	Private Sector (Energy Companies)	State/Municipality	
Austria	1				1
Albania	1			1	2
Belgium		1			1
Bosnia	1				1
Denmark				1	1
Estonia			1		1
Finland	1				1
France	1	1			2
Germany	11		1		12
Hungary	2	2	1		5
Ireland			1		1
Italy	1				1
Latvia	1				1
Lithuania	1				1
Poland	3				3
Portugal	2				2
Russia	1				1
Serbia	1		2		3
Slovenia	1				1
Spain	1				1
Sweden	1				1
Switzerland	1		1		2
UK			1		1
Ukraine	5	4			9
Total	37	8	8	2	55

Participants that took part in our survey were from the following countries: Austria, Ireland, Italy, Belgium, Denmark, Finland, France, Germany, Portugal, Spain, Sweden, Switzerland, the United Kingdom, Albania, Bosnia and Herzegovina, Estonia, Hungary, Latvia, Lithuania, Poland, Russia, Serbia, Slovenia, and Ukraine. Responses were divided accordingly to analysed countries in Eastern and Western European regions (Figure 1).



Figure 1. Analysed countries in Eastern and Western European regions. Source: My maps.

In addition to asking the survey participants specific questions on the selected topics, other aspects were raised in several open questions (e.g., their views on the most important risks in energy saving). The invitation to take part in the survey study was sent to European experts, and answers were received from participants that represent 24 countries from the Eastern and Western European regions. The collected responses introduce a snapshot of expert views from the largest part of the European region and present an opportunity to analyse the implementation of ESM in buildings in these countries.

Projects for significant works on building refurbishment require vast investments. However, energy efficiency and conservation still appear irrelevant to commercial investors. According to our survey results, the main investors in energy saving in buildings in the analysed European countries are the building owners (Figure 2).

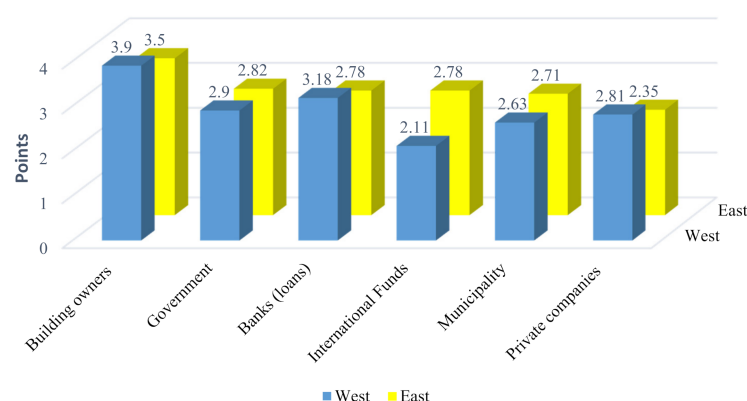


Figure 2. Main investors of energy-saving measures in buildings in Western and Eastern European regions.

For the Eastern European countries, their governments, international funds, municipality, and bank loans are at the same level in terms of energy-saving measures (ESM) financing. One possible explanation for this is that Third Party Financing (TPF) is more

common for larger investments (e.g., in case of ESM implemented by housing associations) where international agencies together with the government/municipalities have activated credit and reimbursement facilities to finance energy efficiency projects (e.g., the European Bank for Reconstruction and Development in Bulgaria, Ukraine) [23].

In the Western European region, private companies are more involved in investment, whereas support from international funds is not so strong. This can be explained by the conclusion that in those countries the banks have developed sufficient expertise and confidence in the Energy Saving Services (ESS) business (e.g., Germany, Austria). At the same time, the government and municipalities often provide incentives and tax breaks for investors in ESM in buildings (Germany, Switzerland).

Our results, similar to previous research by [24], show that the financing of ESM without governmental subsidies or incentives is very rare in Europe. Quite good levels of market activity, such as ESM financing in the Western European region, are typically supported by energy efficiency policy measures such as energy-saving obligations, tax deductions, or tax credit schemes (e.g., in Germany, Denmark and France) [24].

It is likely that commercial financing models would develop only with economic support provided through policy measures and with political stability in countries. One example of the commercial financing model is an energy service company (ESCO). It is a business that designs and implements ESM. Capital investment of the project are paid by the savings in energy costs [25].

This finding encouraged us to analyse what prevents as well as what motivates and stimulates investment in ESM projects in Europe.

3.2. Obstacles and Risks

As stated before, the Eastern European region did not experience the sharp increase in world energy prices in the 1970s as other regions did; consequently, the opportunities for more efficient energy use were scarcely realised in these countries. At the same time, many Western countries started the introduction of energy-saving measures and deployed them as a means to overcoming the obstacles they had.

The survey results confirmed the expectations that obstacles are currently perceived to not be very strong for the Western European region countries, with the highest value equal to 3.81 point (passivity of building owners). The Eastern region has the highest value of 4.6 points due to lack of proper financial stimulation (Figure 3). Two-tailed Wilcoxon signed-ranks test confirmed the statistically significant difference between the two samples with a level of significance $\alpha = 0.05$ (calculated value of W-statistics = 62 whereas $W_{critical} = W_{\alpha=0.05; n=11} = 10$). Therefore, in order to increase investment in ES in buildings, one needs to first identify and overcome the existing obstacles, acknowledging the differences revealed for both regions.

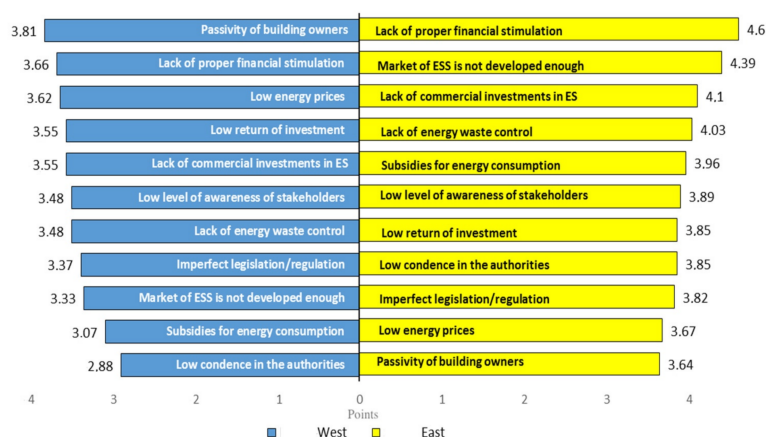


Figure 3. Obstacles to the implementation of energy-saving measures in buildings in Eastern and Western European countries.

According to the study results, lack of the proper financial stimulation is one of the major obstacles in Europe. Financial incentives are often not available to support quite expensive energy-saving measures [26,27]. Long-term payback periods only hold back the ESM implementation [28,29].

At the same time, some Eastern countries are still struggling to develop the market of ESS and to operate better energy waste control systems. There is also a need for the involvement of commercial investments in ESM. One of the reasons for low investment involvement is that in some Eastern European countries, selected groups of the population (e.g., retired, low-income families) pay discounted prices for heating. As long as subsidies for the energy prices are still driven by traditional concepts of social policy (e.g., Ukraine) this leads to a low return of the investments in ESM. The other obstacles that still hold back investment in some Eastern countries are the uncertainty in authorities and the imperfect legislation. It is likely that overall political and economic instability is strongly influencing the investors' confidence in financing ESM [30]. Considering all the other unsolved problems, for Eastern countries passivity of building owners is the last reason that has an influence on energy-saving project implementation whereas for the group of Western countries this obstacle is the most important.

At the same time, in the Western region there is strong confidence in the authorities, and the market of ESS is developed quite well. Even though subsidies for energy prices do not exist in these countries, there is still an impact on the cost of energy from the state, which can be made in the form of tax reductions (e.g., Switzerland). One of the explanations of the passivity of building owners is the low energy price that influences the return of investment by reducing it, and, as a result, the involvement of owners/investors is not strong enough. This obstacle can be improved by considering proper energy prices and financial stimulation. The other reason could be the low level of the stakeholders' awareness, which seems to be equally important for the analysed countries and takes middle position among all listed obstacles. Since the building owners mostly finance energy-saving projects in buildings, the stakeholders' passivity can be highly influential on the level of implemented ESM.

Additional data were obtained from the results to the open questions. In relation to the obstacles to ESM implementation in buildings in the countries sampled, the respondents identified the obstacles of being in two main areas: financial and structural obstacles. Due to their importance, they are herewith explained in turn.

Category 1—Financial obstacles:

Among other financial obstacles there are discrepancies in relation to those bearing the costs (usually the property owners) and those who benefit from the savings (renters). This is most relevant for the Western countries, thus far [31,32]. For example, in Germany there is a large proportion of rented buildings, but there is also little incentive for owners to invest. Firstly, this is because of the split-incentives, but it is also due to a shortage of living space (especially in the urban areas); thus, any building/apartment can be rented out, irrespective of its energy performance.

Category 2—Structural obstacles:

Among the structural obstacles, mention can be made of shortages in skilled staff due to a high overall building activity or a lack of education programmes in this field (e.g., Ukraine). In addition, the tightening of building codes means that retrofit rates are often too low. In some countries (e.g., Hungary) a lack of information and knowledge of the benefits of ESM limits their use [33,34]. Additionally, in Eastern European countries, the old and worn-out building stock, especially in multi-flat buildings, is a huge obstacle for ESM.

According to the responses from the Western European region, a building renovation is a complex undertaking that is very challenging for building owners and occupants. On the same hand, it shows that there is still room for improvement, especially with the return on investment, by regulating the energy price level and considering stronger financial support. Regarding the building owners' stimulation, it must be noted that there are

discrepancies in relation to those bearing the costs (usually the property owners) and those who are earning the savings (renters).

On the other hand, discounted prices for heating for end-users in some countries do not motivate people to save energy (e.g., Hungary, Serbia, Ukraine). Therefore, instead of state energy subsidies, an economic stimulation of ESM must be implemented [25,35,36]. Financial stimulation and real energy prices together with educational programmes and a better energy waste control system will encourage the development of the ESS market and increase the level of commercial investment in the Eastern European region. The most complicated problem that still strongly influences investors' confidence is the overall political and economic instability in some Eastern countries (e.g., Bulgaria, Ukraine).

In this vein, results of our research coincide with findings by T. Cristino et al. [37], who pointed out a small number of researches with a deep taxonomy of obstacles (three and more groups) and proposed the taxonomy of six categories: Financial, Market, Technological, Professional, Political, and Behavioural, which is quite similar to ours in naming and essence. More importantly, these scientists also investigated to relations between the implementation of energy-saving measures in buildings and types of buildings and their geographical location.

The revealed obstacles cause a mismatch between the optimal and real levels of energy saving in buildings—the so called energy efficiency gap [38]—which results in an insufficient level of investments in ESM both private and public. This finding leads us to the main risks that were indicated in our survey.

All identified risks were classified according to four main criteria: economic, technical, social, and environmental. In our study, it was evident that the economic and technical risks were the main barriers to implementing ESM in buildings.

Economic risks consist of challenges related to:

- changes in legislation, followed by a discontinuity of a state support (“stop and go” policies);
- energy-saving and payback periods that are different from what were calculated during the planning period.

Technical risks consist of the poor performance of workers and project managers, which can cause problems with renovations that are already well known:

- risk of fire (because of a wrong selection of an insulation material and poor installation of it);
- risk of damp/mould (if airtight envelopes are created without a proper ventilation);
- lock-ins (if only cheap and shallow saving measures are implemented, but deep renovations are needed).

Social risks were also identified according to our survey results:

- rent increases and the crowding-out of a vulnerable population.

Only one environmental related risk was mentioned by respondents:

- the waste problem (if non-recyclable and non-biodegradable materials are used).

According to our study results, an imperfect legislation/regulation was not considered a main obstacle to the implementation of ESM in buildings. Nevertheless, changes in legislation and the discontinuity of support appeared to be one of the most important risks. It would appear to have a strong influence on investors' confidence in financing, and create difficulties with long-term investment planning.

To avoid the risks, better planning, and control of the implementation of ESM must be applied. In relation to the Eastern European countries, education programmes for energy service companies are needed. At the same time, a fundamental trade-off between the quality and the costs of ESM can be solved by financial support from the state or international funds. This is especially true for deep and complex renovations of worn-out building stock in multi-flat buildings in Eastern Europe.

The establishment of more effective policies must be driven by the identification of the main motivations for investors while considering the most efficiently implemented incentives.

3.3. Motivations and Incentives

The main motivation factors for stakeholders appear to be very similar for Western and Eastern European countries (Figure 4). For instance, the cost savings and financial stimulations play the most important role for stakeholders across the regions. However, the Wilcoxon test again confirmed the statistically significant difference between the two samples with a level of significance $\alpha = 0.05$. Namely, respondents from Eastern European countries gave slightly higher estimations for all motivation factors except for the environmental impacts (3.2 vs. 2.68). All financial motivation factors were identified by respondents of the group of Eastern European countries as the most important and put in the top of the list. It is obvious that for respondents from these countries, access to finance is more important (particularly, the easier access to low-cost loans and state support). Support through international funds was also identified as a strong motivational factor for this group and less than neutral for Western countries (3.61 vs. 2.8). The main explanation for this, as mentioned already in this paper, is that international agencies together with government/municipalities have activated credit and reimbursement facilities to finance the energy efficiency projects (e.g., the European Bank for Reconstruction and Development in Bulgaria, Ukraine).

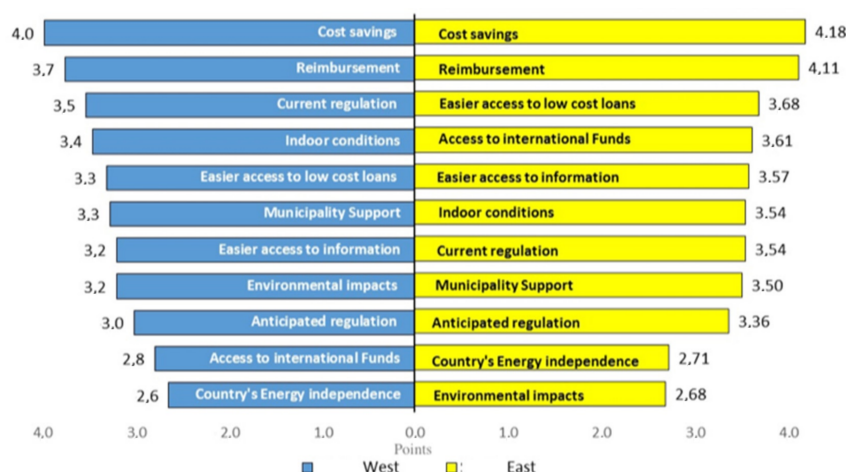


Figure 4. Main motivation factors for stakeholders to implement energy-saving measures in building.

Western countries have more experience with ESM implementation, so therefore there is more practical information available. Stakeholders are more informed on current state regulations. As a result, stakeholders know more about the advantages and risks of ESM implementation including how important is optimal indoor climate for human health. This can explain why the indoor climate is one of the main motivation factors for energy saving projects in the Western European region [39].

In addition, both the Western and Eastern European countries do not consider anticipated regulations as a strong motivation for investment (9th place out of 11). It appears that the Western European countries are satisfied with current regulations, which is why they do not expect future regulations to stimulate more. In relation to the Eastern European region, respondents do not consider the anticipated governmental regulations to be effective, apparently because of the unstable economic and political situations in the countries.

Additionally, a country's energy independence is not motivating investors to invest in ESM. An explanation for this can be that respondents do not have enough information about energy shortages and political problems. At the same time, the personal needs of stakeholders should be considered in the first place. As a result, we would not recommend considering a country's energy independence factor in stimulation instruments.

In relation to environmental impacts, they play a more important role for Western European countries, whereas they are not yet a great motivator in the Eastern European region. One of the explanations could be that there are informational campaigns on

environmental problems in Western Europe, while there is a lack of information and knowledge of the environmental impacts in some countries in Eastern Europe.

Additional information was obtained from the open question. In response to how likely the following items would motivate stakeholders to implement energy-saving measures in buildings, the main answers were:

- impartial, individual advice and coaching through the implementation process;
- better financing incentives;
- local consulting; local groups that provide advice and/or invest in energy saving.

According to our survey results, local municipalities have very limited sources for financially supporting ESM; however, they would be an efficient local entity to help the other local stakeholders. As a result, a stronger collaboration of governments, local administrations, banks, and investors for financing ESM together with coaching through the implementation process and the consultancy of investors is highly recommended. At the same time, the stakeholders' awareness of environmental impacts and social benefits must be raised.

In relation to the incentives for implementing ESM in buildings where it has been applied in the past, the deviation in responses is extremely small (Figure 5). Results of the survey regarding this question are almost the same for both regions.

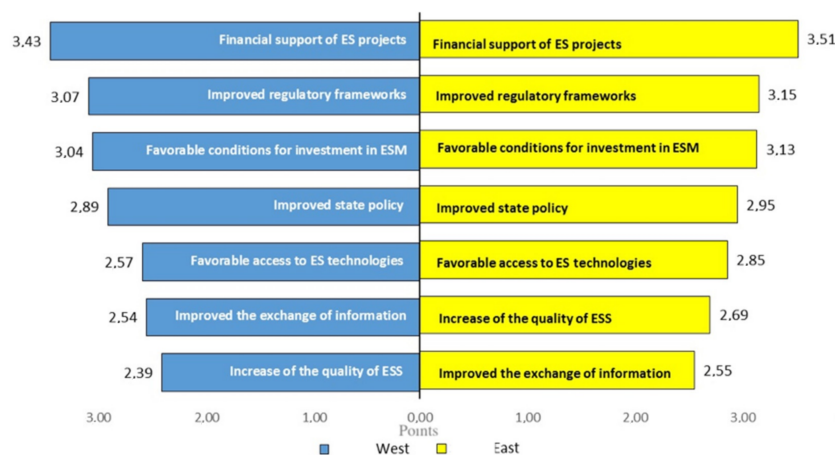


Figure 5. Incentives for implementing energy-saving measures in buildings where it has been applied in the past.

The combination of financial support for energy-saving projects, improved regulatory frameworks (including building codes and energy audit programs, e.g., Germany) and favourable conditions for investment played the most important role for both Western and Eastern European countries. These findings show that the same methods are working in both regions, and therefore the experience from Western European countries can be applied in the Eastern European countries to overcome existing obstacles [40,41].

According to the answers of our respondents, in some Eastern European countries, most of the projects are not implemented for sustainable social-economic development and energy saving, but for the personal benefits of politicians (e.g., in Bosnia). Therefore, we would suggest stronger monitoring, information publicity, and stakeholder participation.

Despite the positive role of incentives in stimulating ESM implementation, our survey study results imply that there are still numerous inducements that can be improved. For instance, Eastern European countries may benefit a lot from the rich experience of some Western European countries (such as Denmark, Germany, Netherlands, UK, etc.) in the realm of energy cooperatives [42,43]—non-profit self-organising entities aimed in satisfying local people's needs in energy services using local resources for eliminating energy poverty [44], increasing energy efficiency and taking care about the environment. However, institutional environment plays a key role in these transformations: for example,

energy cooperatives in some Post-Soviet countries (Hungary, Estonia) are much more successful than in others (Ukraine) [45].

3.4. Quality and Environmental Impacts of Energy Saving Projects

The spectrum of insulation materials has expanded significantly in recent years, but at the same time the planning or installation defects are also increasing. All potential thermal bridges such as ceilings, partitions, doors, and windows deserve special attention during renovation. Since many factors are involved in regard to the indoor climate, intervention in an old building always requires very careful planning and implementation. As a result, a building renovation does not only provide positive benefits, but can also cause possible negative impacts on the environment, indoor conditions, and human health. For example, the petroleum-based insulating materials EPS and PUR have higher levels in the categories of greenhouse gas effects and fossil fuel scarcity than mineral wool, calcium silicate, and NaWaRo-based materials (hemp, wood, and cellulose fibers). However, even with insulating materials from NaWaRo, toxicity may be an issue due to certain additives; as a result, it can have a dangerous influence on stakeholders' health [46].

The current assessment of investment projects in energy saving does not consider the additional costs of environmental measures and compensation for the negative effects of environmental pollution. Nevertheless, most of the respondents consider the evaluation of environmental friendliness and social significance of energy-saving measures as important or very important (Figure 6).

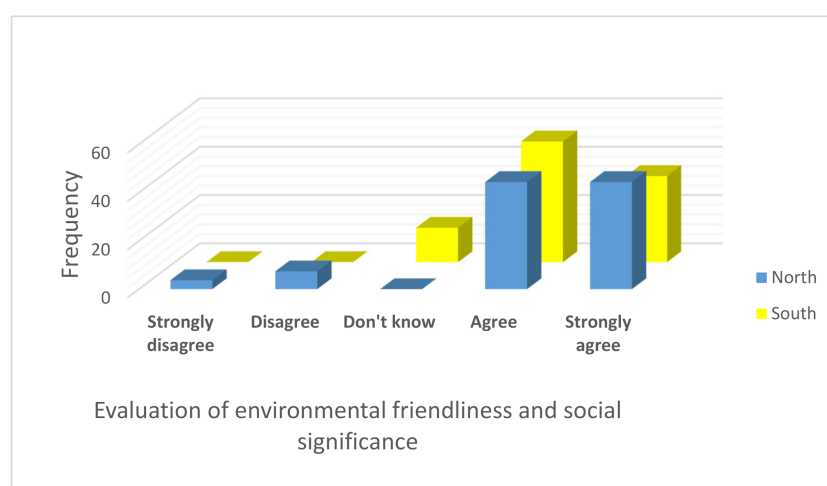


Figure 6. Need for an evaluation of environmental friendliness and social significance of energy-saving measures.

In relation to the necessity for an evaluation of environmental friendliness and social significance of ESM, experts from the Western European region have a clear-cut position on this matter and the number of neutral responses is very low, while for the Eastern European countries, there is a significant number of respondents that are not familiar with the concept or cannot give an unequivocal answer to this. One possible explanation for this is a lack of information and knowledge of the environmental impacts of ESM. In addition, Eastern European experts do not consider the evaluation of environmental friendliness and social significance of ESM to be important for the investor. It can be explained by that conclusion that environmental impacts are not considered enough within governance instruments in these countries.

Impacts caused by the production of the required materials for the renovation, transport of the materials to the construction site, usage stage (in case there were toxic additives), and disposal are considered only for bigger projects such as office buildings. This assessment is completed using certifications such as DGNB (German Sustainable Building Council), BREEAM (Building Research Establishment Environmental Assessment Method),

and LEED (Leadership in Energy and Environmental Design). However, for smaller projects, it is too complicated and too expensive to consider all these impacts during the planning process. Respectively, these aspects have not been integrated in the European countries' building regulations (e.g., Germany). In Switzerland, a standard that includes all mentioned aspects is still in the development phase.

These findings encouraged us to analyse which indicators are considered to be the most important and convenient for investors in the evaluation of the environmental friendliness and social significance of ESM.

According to our study survey results, the indoor comfort and CO₂ emissions reduction are equally acceptable and understandable for all respondents (Figure 7). Nevertheless, experts pointed out the limitation of the carbon reduction factor because of its manipulative nature. This indicator does not always relate to energy reduction, because there can be a zero-carbon building that consumes vast quantities of energy.

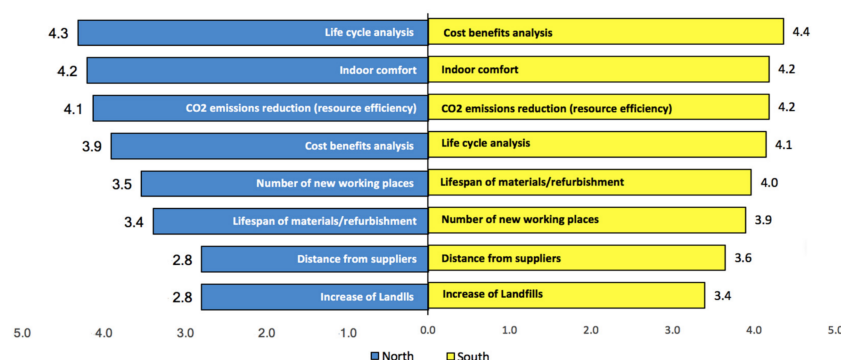


Figure 7. Suggested indicators to evaluate the environmental friendliness and social significance of energy-saving measures.

For the Western European countries' representatives, the life cycle assessment (LCA) is the best procedure for evaluating the environmental friendliness of ESM. However, mainstreaming the use of LCA is featured by lack of consistent analysis of social and economic impacts of the extension of a life cycle due to building refurbishment, although they are significant [47]. There are concerns related to data availability for new materials and techniques as well as some methodological options to ensure correct LCAs comparisons.

For the Eastern European region, the cost benefits analysis (CBA) seems to be the most reliable method for measuring the socio-economic-environmental results of the project [48,49]. CBA is an analytical tool that can be used to appraise an investment decision and to assess the welfare change attributable to it and, in so doing, the contribution to EU cohesion policy objectives. The purpose of CBA is to facilitate a more efficient allocation of resources, demonstrating the convenience for society of a particular intervention rather than possible alternatives.

Experts from both regions agreed that the distance between suppliers and consumers, as well as the increase of landfills, are not important enough to be considered for the decision-making process.

All respondents agreed that in order to increase the quality of energy-saving projects and to control the environmental impacts from the implemented measures, training and education programmes are needed (Figure 8). The only difference in answers is that according to the respondents from Western Europe, the training of (ESS) providers is more important than education programmes for consumers. That is not the case for respondents from Eastern countries, who believe that the most important approach is to teach stakeholders and then to implement a financial stimulation based on the socio-economic-environmental indexes. The implementation and monitoring of a database with information on ESS providers is considered the least important for both the Western and Eastern European regions.

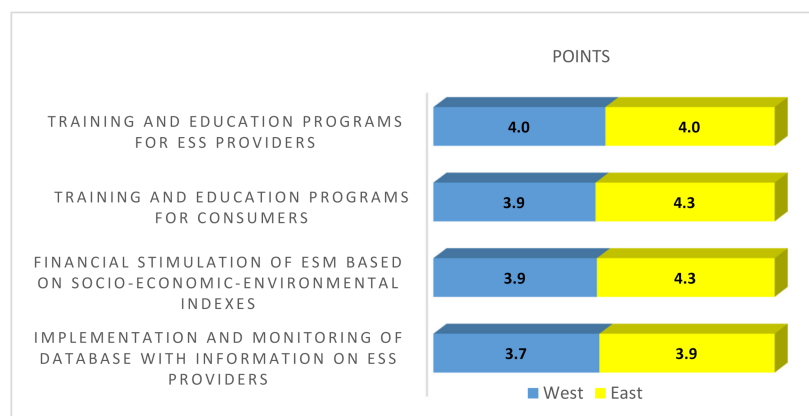


Figure 8. Measures to increase the quality of energy-saving projects and to control the environmental impacts from implemented measures.

In addition, experts suggest making more financial incentives for the independent coaching and quality control companies in order to increase the quality of the energy-saving project. Moreover, it can be a one-stop shop, where consumers can be supported throughout the whole process with technical advice, supervision, grants, and finance.

4. Conclusions

The general conclusion drawn in the paper is that there are still numerous obstacles that hold back the number of implemented ESM projects in the European region. The comparison of Eastern and Western European countries highlighted a lot of differences in obstacles but almost complete similarities in respect of incentives. The main reason for this could be the historical circumstances that influenced the economic and political situation as well as the energy scarcity. As previously stated, the Eastern European region did not experience the sharp increases in world energy prices in the 1970s, and consequently the opportunities for more efficient energy use were scarcely realised in these countries. Despite this, there has been considerable progress in energy-saving stimulation in the last decade. There is still much work needed in respect of:

- increasing the conservation of energy resources, to make building renovation financing more attractive for investors,
- increasing the social benefits of energy efficiency, and
- providing more information on environmental impacts and
- fostering the concept of life-cycle and a greater thinking about life-cycle processes

A major recommendation that this paper can make in relation to Eastern European countries is that the authorities must increase the trust of investors by stabilising the economic and political situation in countries. As long as state legislation and regulation determine the framework and process for conducting energy-saving projects, there is a strong need for the continuity of state support in all of Europe without a “stop and go” policy.

According to our survey results, the main investors in energy saving in buildings in analysed European countries are the building owners. However, building owners will not be able to finance the full amount required for refurbishment, and therefore commercial investment is highly recommended. Financial stimulation and real energy prices together with educational programmes and a better energy waste control system will encourage the development of the ESS market and increase the level of commercial investment in the Eastern European region. Regarding the building owners’ stimulation, it must be noted that there are discrepancies in relation to those bearing the costs (usually the property owners) and those who are earning the savings (renters), especially in Western European countries.

Technical risks were identified as strong barriers to investment for both regions. They consist of poor performance of workers and project managers and can cause problems with

renovations that are already well known. To increase the quality of energy-saving projects and to control the environmental impacts from implemented measures, a real management tool for national and regional authorities is needed. At the same time, independent coaching and quality control companies together with training and education programmes are needed.

As for the environmental problems, the respondents only considered the waste problem as a risk of refurbishment in cases where non-recyclable and non-biodegradable materials are used. The use of some materials and techniques can provide a good level of energy saving; however, at the same time they could lead to harmful impacts on the environment, indoor conditions, and human health. Although most respondents consider the evaluation of environmental friendliness and social significance of energy-saving measures as important or very important, it is still not integrated within European building standards. It can be explained by the situation that it is too complicated and too expensive for smaller projects to conduct this analysis during planning. Therefore, coaching throughout the planning and implementation of the energy-saving project and the consultancy of stakeholders is highly recommended. Finally, continuous monitoring of ESM implementations in terms of barriers and existing potential will be necessary to identify emerging opportunities and to derive suitable recommendations for policy makers.

For future studies, it is suggested to look from the investor's perspective: what are the motivating factors in energy saving measures in buildings in the regions of Western and Eastern Europe? Additionally, correlating with obstacles, opportunities with agenda 2030; economic aspects, and government initiatives. From the perspective of science, it would be important to verify the impact of environmental quality; social impact, and innovation initiatives that can be implemented, aiming for continuous improvement, efficiency, and better economic performance.

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Abbreviations

BREEAM	Building Research Establishment Environmental Assessment Method
BPIE	Buildings Performance Institute Europe
CBA	Cost Benefits Analysis
EE	Energy Efficiency
ESM	Energy Saving Measures
ESS	Energy Saving Services
EU	European Union
EUMEPS	European Manufacturers Association of Expanded Polystyrene (EPS) insulation
DGNB	German Sustainable Building Council
GIZ	Gesellschaft für internationale Zusammenarbeit
IEA	International Energy Agency
LEED	Leadership in Energy and Environmental Design
LCA	Life Cycle Assessment
WEO	World Energy Outlook

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