Project acronym: tunES

Grant Agreement Number: 101120926

Project full title: Tuning EPC and SRI instruments to deliver full potential

LIFE Project Grants - Programme for Environment and Climate Action (LIFE)

Call identifier: LIFE-2022-CET-BUILDPERFORM

D2.1 REPORT ON SURVEY AND INTERVIEW RESULTS

Version: 1.0

Status: Final

Dissemination Level: Public

Submission Date: 09.09.2024

Work Package: WP2

Lead partner for this deliverable: DTU

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Abstract: This report presents survey and interview results from the tunES project, assessing EPC regulation and SRI integration across seven EU countries. A combination of online surveys and expert interviews with stakeholders, including academics, industry professionals, and government authorities, highlights the need for improved standardisation, training, and awareness to enhance EPC and SRI effectiveness, ensuring better energy efficiency and harmonisation across the EU.

This project has received funding from the European Union's funding instrument for the environment and climate action (LIFE programme) under grant agreement No 101120926.

REVISION HISTORY

Version	Date	Changes	Reviewer / contributor
0.1	02.04.2024	First draft	Petr Popov, Tatiana Novikova (EMP)
0.2	29.04.2024	Review and additions of the information on the survey launch	Petr Popov, Tatiana Novikova (EMP)
0.3	02.08.2024	Analysis of survey results	Rune Korsholm Andersen (DTU)
0.4	05.08.2024	Analysis of interview results	Luca Zaniboni (DTU)
0.5	26.08.2024	Review and additions	Rune Korsholm Andersen (DTU)
0.6	04.09.2024	Peer Review	Karolina Junak (KAPE)
0.7	06.09.2024	Final Review	Georg Vogt (EMP)
1.0	09.09.2024	Submission	Georg Vogt (EMP)

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ABBREVIATIONS

Abbreviation	Definition
AI	Artificial Intelligence
BACS	Building Automation and Control Systems
BIM	Building Information Modelling
BRG	Better Regulation Guidelines
BRP	Building Renovation Passport
DTU	Technical University of Denmark
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
EU	European Union
GDPR	General Data Protection Regulation
GWP	Global Warming Potential
IEQ	Indoor Environmental Quality
KENAK	Technical Chamber of Greece for the Energy Efficiency Regulation of Buildings
LCA	Life-Cycle Analysis
MS	Member State
nZEB	Nearly Zero-energy Building
OIB	Austrian Construction Engineering
PA	Public Administration
PACEI	Pan-Hellenic Association of Certified Energy Auditors
SRI	Smart Readiness Indicator

EXECUTIVE SUMMARY

The tunES project conducted a survey and interviews across seven EU countries from April to August 2024 to evaluate the current state of Energy Performance Certificates and the Smart Readiness Indicators. This report provides an analysis of the collected data, identifying challenges, opportunities, and regional differences in the implementation of these energy efficiency tools.

Key findings:

1. **EPC understanding and standardisation:** EPCs are recognised as important, but concerns remain about their accuracy, user-friendliness, and the quality of the data on which they are based. There is a clear need for standardisation and methodological improvements, particularly to make EPCs more understandable and valuable to end-users.
2. **Dynamic data and methodological improvements:** The introduction of dynamic data-based and dynamic calculation-based EPCs could significantly improve the accuracy and relevance of energy performance assessments. However, the adoption of these advanced methods faces challenges, including technical difficulties and the need for updated regulations.
3. **National databases:** There is strong support for creating comprehensive national databases that include all EPCs and the data used to develop them. These databases would enhance transparency, improve quality control, and provide valuable resources for future EPC development.
4. **SRI awareness and integration:** While less familiar among stakeholders, SRIs are seen as having significant potential to drive the uptake of smart technologies and improve energy efficiency. The report recommends setting a minimum SRI value for new buildings and integrating SRI calculations into existing EPC processes to simplify implementation.
5. **Regional differences:** The survey revealed significant regional differences in confidence towards the current EPC methodology. Countries such as Hungary and Slovenia showed greater confidence in their EPC frameworks, while Poland and Italy identified several areas for improvement. These differences suggest that a better understanding of EPC processes correlates with a reduced perceived need for upgrades.
6. **Leveraging best practices:** Successful practices identified in certain countries should be used to develop a more harmonised and effective EPC and SRI methodology across the EU. This includes adopting best practices in professional training, data management, and public communication.
7. **Challenges in integration:** The integration of EPCs and SRIs offers both opportunities and challenges. While there is agreement on the benefits of this integration, concerns about methodological complexity, data privacy, and the adequacy of existing infrastructure must be addressed to ensure successful implementation.

1 Introduction

This report presents an overview of the survey and interview conducted by the tunES project in the period from April to August 2024 and comprehensive analysis of their results.

The tunES project aims to optimise Energy Performance Certificate (EPC) regulation and integrate it with the Smart Readiness Indicator (SRI) roll-out in seven national Energy Agencies. The agencies follow the EU Better Regulation Guideline (BRG) to identify and assess the best policy measures suitable on national circumstances. The project utilises the stakeholder consultation methods described in the BRG toolbox which includes conducting survey and interviews to ensure a comprehensive understanding of the current situation and verify needs.

As the first step, an online survey among stakeholders was developed by DTU. The aim of the survey was to establish a better understanding of the situation in the seven countries participating in tunES and to investigate if the problems listed by the Energy Agencies were also seen as problems by experts and stakeholders in each of the countries. The questions were based on the discussion of Problem Trees that the Energy Agencies presented as well as on the five building blocks defined for each of the participating countries. The survey was published on the EUSurvey data collection platform.

As the next step, tunES project carried out individual interviews with experts (academia, government, industry) and representatives of building owners and the occupants' associations, energy auditors and consultants, financial institutions, real estate agencies, and energy consultants which were identified by the Energy Agencies. DTU developed an interview guide based on the survey questions to deepen the understanding of the bottlenecks, legal, cultural or technical factors and weak points of EPC and SRI implementation and effective functioning. Interviews were conducted by each Agency individually.

2 Methodology

The survey was developed based on the question trees presented by the Energy Agencies. Common themes were identified through an iterative process and the survey was constructed to investigate these themes in the framework of the five tunES building blocks.

2.1 Overview of the methodological approach for data collection

After translation, the questionnaire was distributed to a list of experts and stakeholders compiled by the energy agencies. A newsletter with a link to the survey asking the stakeholders to participate. Additionally, a post was published on the tunES LinkedIn page on 25.04.2024. The post was shared 17 times and was seen by 816 LinkedIn members[1].

2.1.1 Survey

The survey was developed from the problem trees created by the Energy Agencies. During a project workshop held in Bonn, Germany on March 5 and 6, the Energy Agencies presented the problem trees. The problem trees and the following discussion served as a starting point for finding themes common to the seven countries. During the workshop, representatives from the Energy Agencies were asked to state preliminary questions covering the themes. After the workshop, the material was circulated between members of the TST groups for analysis and

[1] As of August, 2024

refinement of common themes and questions. In the final questionnaire the themes and questions were structured around the five tunES building blocks.

The general structure was built using 4-point Likert scales and ranking questions. The Likert scales were without a “neutral” response option to enforce an opinion from the respondents. If they did not have an opinion or not enough knowledge, a “I don’t know” response option was included.

In the ranking questions, the respondents were asked to rank the importance of options for a specific theme. All the ranking questions included an “other, please specify” option, to ensure a good coverage of response options.

The English version of the questionnaire is included in the Appendix 2.

2.1.2 Interviews

The interviews were conducted to evaluate the effectiveness and awareness of Energy Performance Certificates and the integration of the Smart Readiness Indicator. The objective was to gather insights from key stakeholders on the current state of EPCs and SRIs, identify challenges, and explore opportunities for improvement and standardisation at the EU level. The interviews aimed to capture diverse regional practices and perspectives, providing a comprehensive understanding of how these tools are perceived and utilised across different member states.

2.2 Design phase

2.2.1 Description of the survey and interview guide design

The following five common problems were identified in an iterative process starting with the presentation of the problem trees developed by the Energy Agency.

1. Lack of user-friendliness and understanding: Several organisations point out that both EPC and SRI are not user-friendly, neither for assessors nor for building owners. This can lead to a general lack of trust and negative perception of these programs.
2. Quality issues and lack of standardisation: Concerns are raised about the quality of EPCs, with several countries mentioning problems with low quality and lack of standardisation, making it difficult to compare and rely on the results. The lack of standardisation may also be a problem in the context of SRI.
3. Lack of mandatory training and control: Organisations generally mention the lack of mandatory training for assessors and lack of control over the quality of EPCs as challenges. This leads to potential errors, unreliable data, and lack of trust in the results.
4. Regional variations and complexity: Several countries point out regional differences and the complexity of legislation and requirements, making it difficult to navigate the system and compare results across regions.
5. Lack of incentives and understanding: There is also a widespread perception that clients and owners do not understand the purpose of EPC and SRI, reflecting a general lack of incentives and understanding for these programs.

2.2.2 Selection of participants

Stakeholder identification was performed by the Energy Agencies and was facilitated by the Better Regulation Guidelines Toolbox, specifically Tool #52 'Consultation Strategy', which employs six tests for stakeholder identification (see Figure 1). This structured approach helps

in listing stakeholders who are impacted, necessary for implementation, or possessing expertise and/or interest in the subject.

Figure 1. The six tests for stakeholder identification

Box 5. The six tests for stakeholder identification[766]
Test 1. Who is directly impacted?
• Whose daily/weekly lives will change because of this policy? • Who cannot easily take steps to avoid being affected by this policy? • Who will have to change their behaviour because of this policy?
Test 2. Who is indirectly impacted?
• Whose daily lives will change because others have been directly impacted by the policy? • Who will gain or lose because of changes resulting from this policy?
Test 3. Who is potentially impacted?
• In particular circumstances, who will have a different experience as a result of this decision? • Are there individuals or groups who will have to adjust their behaviour if specific conditions apply?
Test 4. Whose help is needed to make it work?
• Are there vital individuals or groups in the delivery chain? • Who will have the ability to obstruct implementation unless co-operating? • Who understands the likely impact of this decision on other stakeholders?
Test 5. Who thinks they know about the subject?
• Who has studied the subject and published views on it? • Who has detailed know-how and expertise that those implementing the policy should also understand? • Are there individuals or groups that will be perceived as knowledgeable on the subject?
Test 6. Who will show an interest in the subject?
• Are there organisations, authorities, bodies, or individuals who think they have an interest? • Has anyone been campaigning about the issue? • Is there anyone publishing or broadcasting views on this subject?

Identified stakeholders included companies and business representatives, financial organisations interested in using EPC to signal funding opportunities for energy renovations, associations of industry professionals, communities of experts, national and local authorities, civil society, and academic organisations.

2.3 Data collection phase

2.3.1 Survey translations and launch

After completing the design phase, the survey was translated into the seven national languages of the countries represented in the tunES project, specifically Croatian, German, Greek, Hungarian, Italian, Polish, and Slovenian. The translations were conducted using the DeepL Pro[2] service and Google Translate[3]. Subsequently, these preliminary versions were sent to local Energy Agencies for verification and necessary corrections, ensuring that the translations were accurate and suitable for further dissemination.

Once the translations were finalised, the survey was uploaded to the EUSurvey[4] platform. EUSurvey is a free online tool provided by the European Commission for creating, managing,

[2] https://www.deepl.com/en/translator

[3] https://translate.google.com/

[4] https://ec.europa.eu/eusurvey/home/welcome

and analysing surveys, assessments, and public consultations. This platform is widely used for its compliance with EU digital and privacy standards, making it a reliable choice for capturing and processing survey data across the member states.

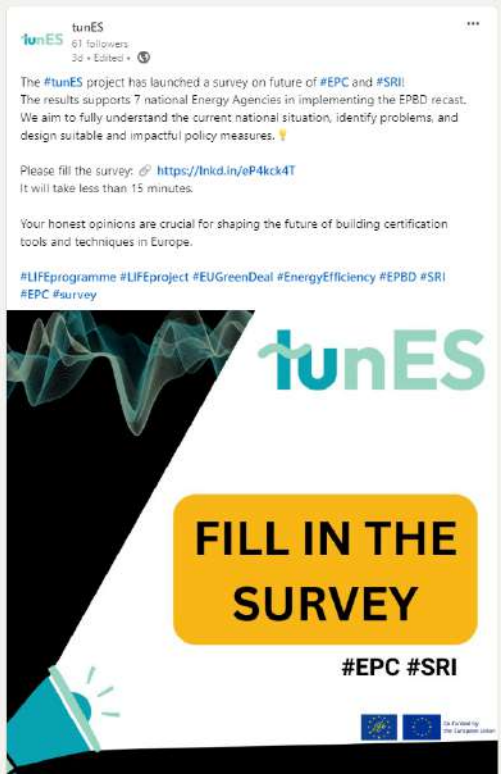
During the upload process to the EUSurvey platform, a technical challenge was encountered. Specifically, respondents were unable to add their own options in the 'other, please specify' field in rating questions. To address this, it was decided to insert an additional open text question following each rating question. This allowed participants who selected 'other, please specify' to specify their responses, which would later need to be manually integrated into the results during the analysis phase. Having 'other, please specify' option was deemed necessary as that would allow to get rating on the information that might have been initially not considered during initial design phase.

The survey was published on the EUSurvey platform on 25 April 2024 and was open for responses until August 2024.

2.3.2 Dissemination of survey

Dissemination of the survey was conducted through various channels. The survey link was shared by the Energy Agencies across identified stakeholders as described in 2.2.2 and tunES social media platforms, including the official website, LinkedIn, and Mastodon.

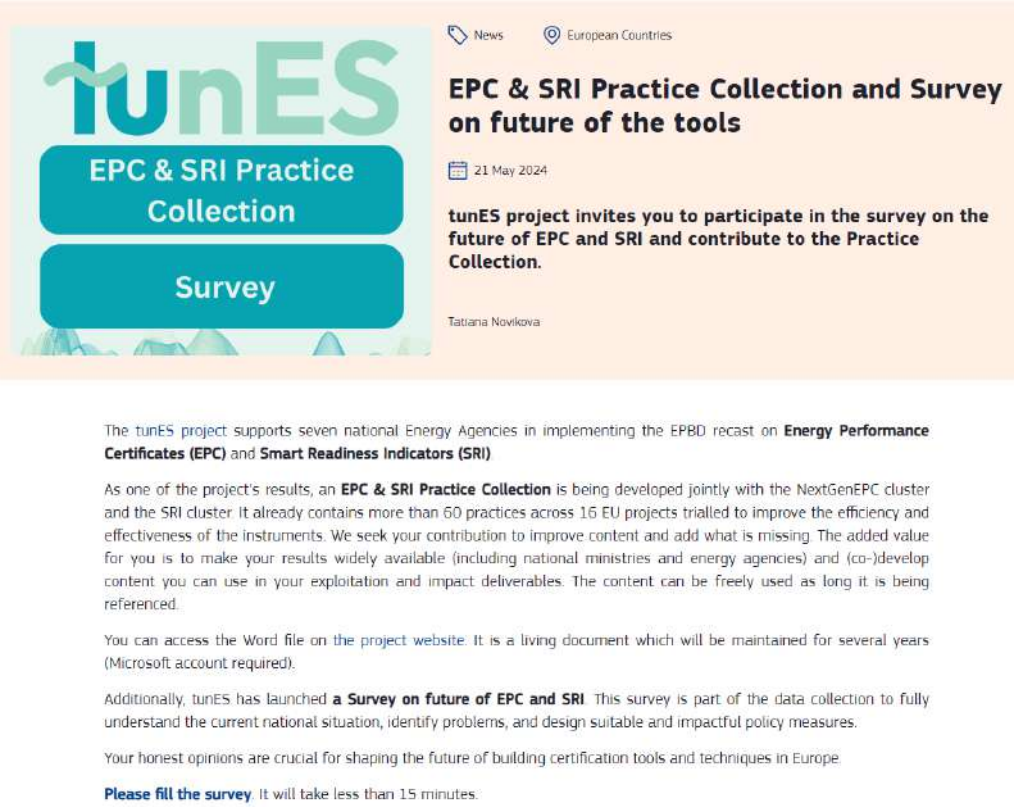
Figure 2. tunES survey promotion on LinkedIn



Additionally, the link was reposted by sister projects within the NextGenEPC cluster. The survey link was also disseminated via the BUILD UP portal[5], the European portal for energy efficiency and renewable energy in buildings.

[5] https://build-up.ec.europa.eu/en/home

Figure 3. News publication on BUILD UP portal



2.3.3 Interviews

In addition to the survey, interviews were conducted in the period from April to August 2024 with the stakeholders identified by the Energy Agencies. These interviews provided a qualitative dimension to the data collection, allowing for in-depth discussions and insights that were not captured through the survey alone. The interview dates, format, and logistics were individually coordinated by the Energy Agencies, ensuring that each session was tailored to the availability and preferences of the stakeholders involved.

3 Survey analyses: results and discussion

3.1 EU level

The present section shows the results of the surveys at EU level, i.e. considering all the combined answers from the seven countries involved. Results are indicated in percentages and divided according to the structure of the survey (“Understanding EPC”, “Upgrading EPC”, “Databases and Tools”, “SRI Development and Deployment”, “Integration of Instruments”). Results are aimed at giving a general and overall idea of the current situation and perceived problems in the whole EU area participating in the study.

Understanding EPC

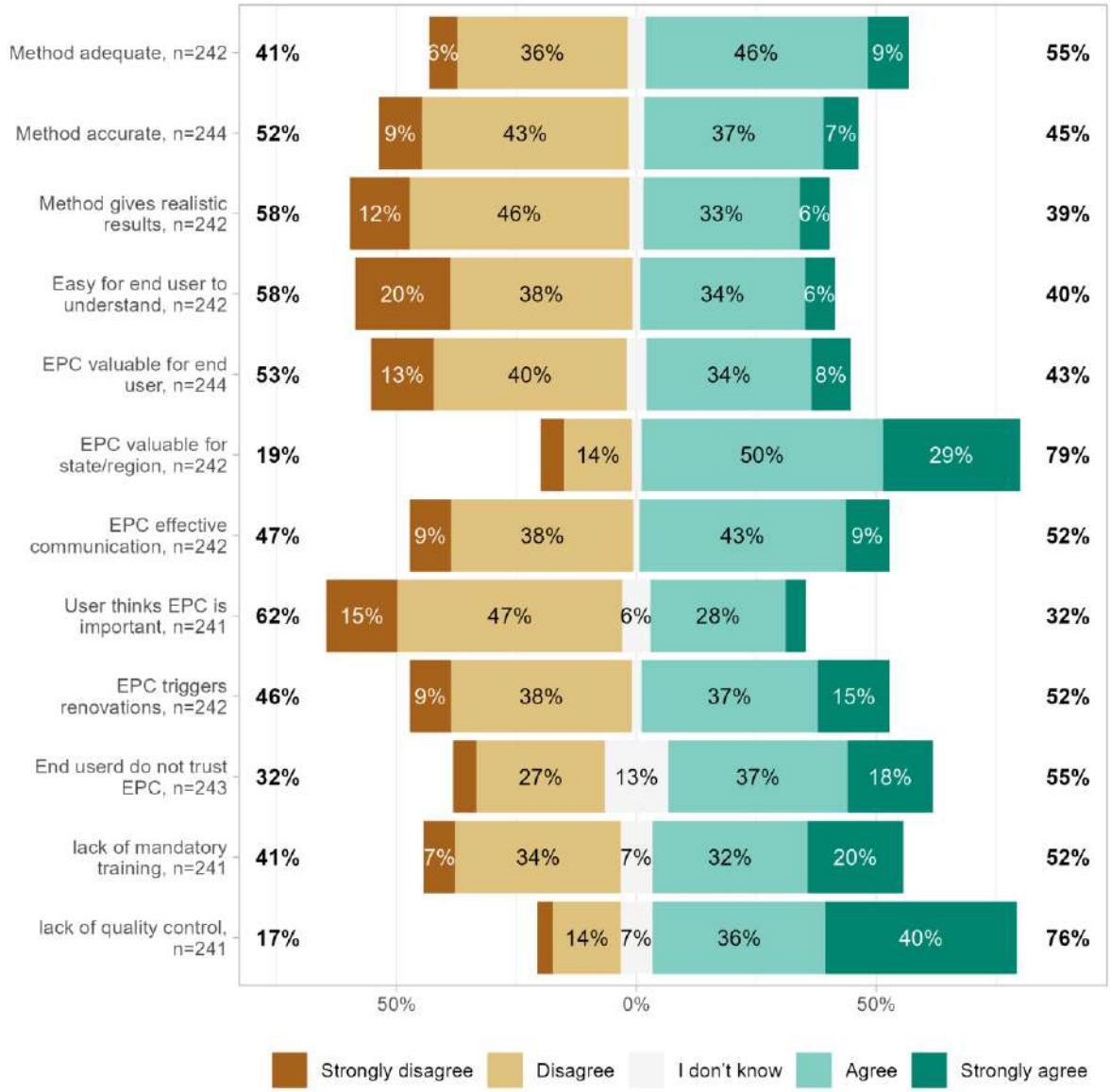
The survey results on the “Understanding EPC” section at the EU level, aggregated data from all seven participating countries, are presented in Figure 4. A small portion of respondents (≤ 7% for 11 questions out of 12) selected the option “I don’t know”, indicating that stakeholders generally have a strong understanding of EPCs and their effects. However, 13% of respondents were uncertain whether end users trust EPC, suggesting the need for better communication between specialists and users.

Opinions were often split between agreement and the disagreement, indicating possible differences between countries. Nevertheless, a significant portion of stakeholders expressed negative views on several aspects of EPCs: adequacy (41% in total, 6% strongly), accuracy (52% in total, 9% strongly), realistic results (58% in total, 12% strongly), understandability (58% in total, 20% strongly), importance (62% in total, 15% strongly), value (53% in total, 13% strongly), effective communication (47% in total, 9% strongly), renovation triggering (46% in total, 9% strongly), trustworthiness (55% in total, 18% strongly), lack of mandatory training (52% in total, 20% strongly), and quality control (36% in total, 40% strongly).

Particularly high levels of disagreement were recorded regarding the easy of understanding for end users (38% disagreeing, 20% strongly) and the perceived importance of EPCs (47% disagreeing, 15% strongly).

It is particularly interesting to notice that 76% answered that a lack of quality control is present. In particular, 40% strongly agreed on this issue. This means that, at the EU level, it is a common opinion that specialists developing energy certificates should be better checked in their outputs. This point also highlights concern about the trustability of their operation and methodology. A positive exception is constituted by 79% of respondents (29% strongly) being aware of the value of EPCs for their country or region.

Figure 4. Results of the survey at EU level, i.e. aggregating all the countries results: Understanding EPC



Upgrading EPC

The outcomes of the "Upgrading EPC" section at EU level are shown in Figure 4. Interestingly, the percentage of "I don't know" responses increased slightly, indicating a slightly lower awareness of the "upgrading" compared to the "Understanding EPC". Opinions were divided regarding the potential of dynamic data based EPCs, with 48% on the agree-side and 40% on the disagree-side. However, the majority of respondents (58% with 17% strongly agreeing) believed that dynamic calculation based EPCs have a great potential, thus implicitly suggesting a preference for more advanced methods compared to simplified calculations.

Despite recognising the potential, 63% of respondents disagreed or strongly disagreed that dynamic data-based and dynamic calculation-based EPCs could be easily introduced as common practice. This suggests significant barriers to widespread adoption.

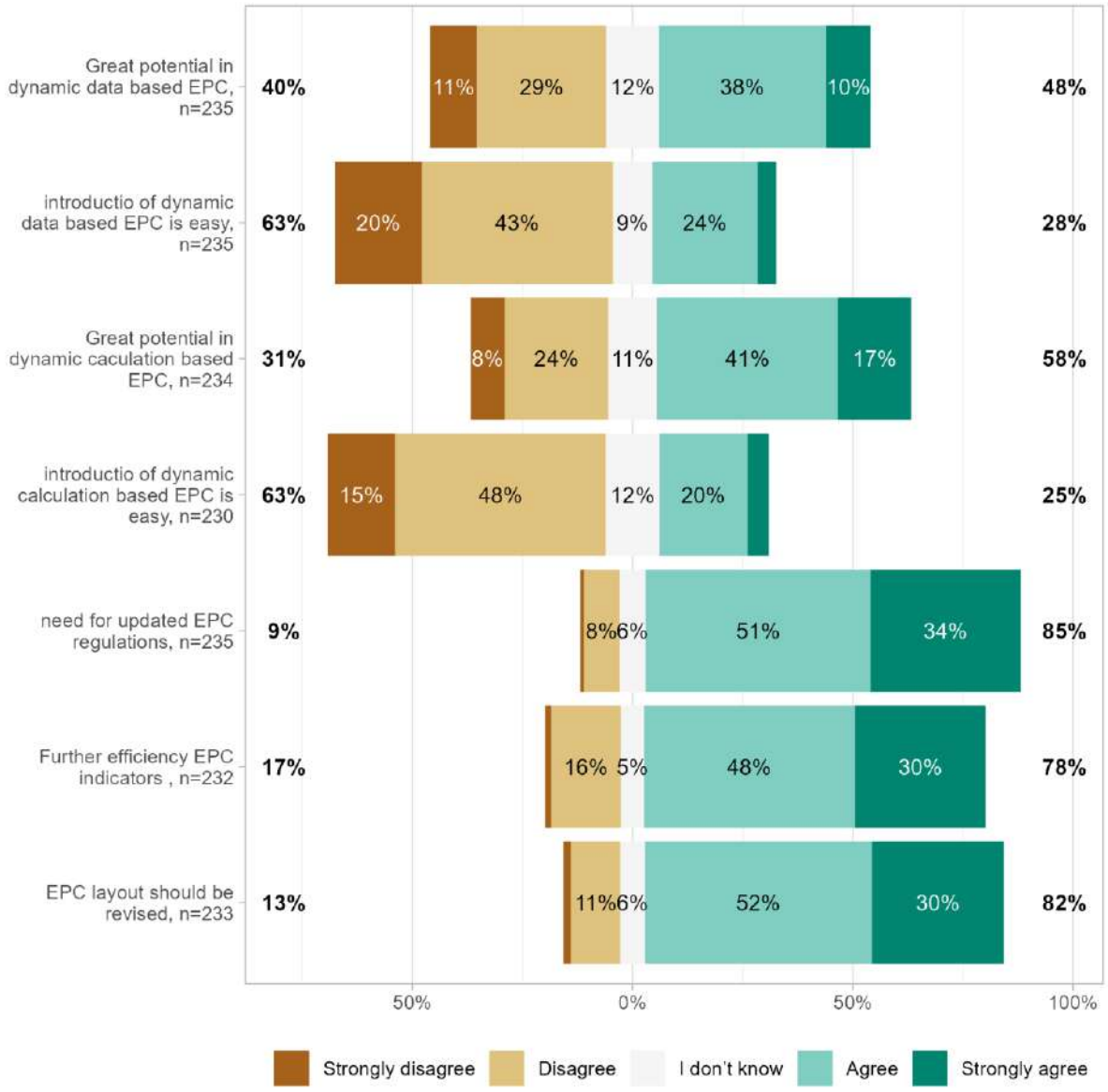
Finally, most stakeholders emphasised the need for EPCs to be updated, particularly in the following areas:

1) Regulations (85 % in total, 34 % strongly agreeing)
2) Inclusion of further indicators of buildings' efficiency (78 % in total, 30 % strongly)

3) Revision of EPC layout and information displayed to match users' expectations and needs (82 % in total, 30 % strongly)

These points are in line with the results about "Understanding EPC", where it was found that users are not aware of EPCs importance or meaning of results.

Figure 5. Results of the survey at EU level, i.e. aggregating all the countries results: Upgrading EPC



Databases and Tools

The results of the survey section "Databases and Tools" at EU level are reported in Figure 5. A small percentage of respondents (≤ 6%) answered "I don't know" to any of the questions, indicating a general familiarity with a topic. A significant majority (47% agreed, 41 % strongly agreed) expressed the need for a central national database that includes all EPCs and the information used to develop them. This highlights two key points:

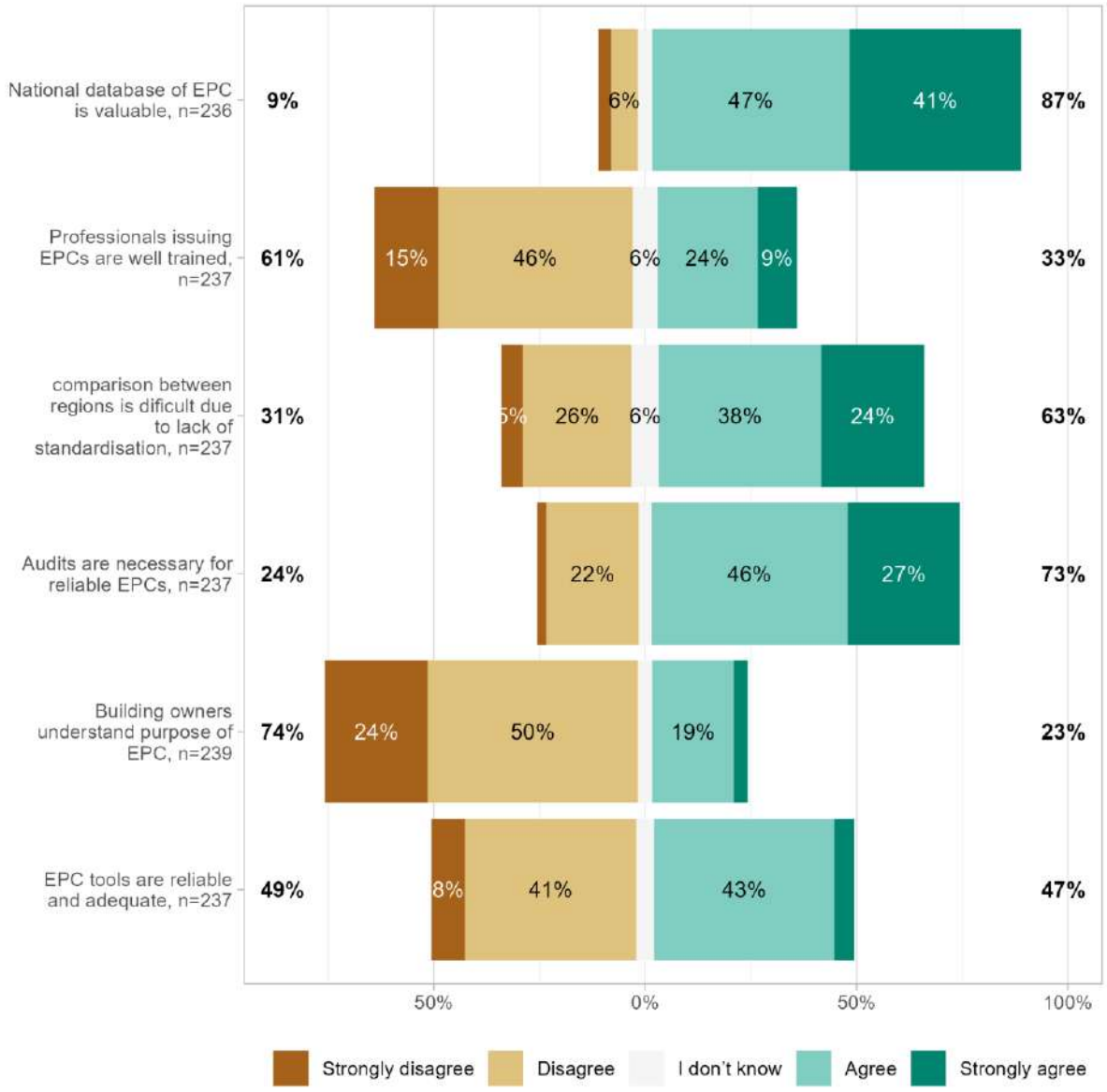
(1) further underlines the need for transparency and improved control on the topic
(2) highlights that the availability of previous EPCs could also serve as an example for correct development of new ones.

Moreover, 61 % of respondents believe that professionals issuing EPCs are not well trained. Standardisation was also seen as crucial, with 63% (24% strongly agreeing) indicating that it is needed to ensure EPC comparability across regions and countries.

The reliability of EPCs was commonly thought to dependent on audits, with 46 % agreeing and 27 % strongly agreeing, further emphasising concerns about the current methodologies. Interestingly, stakeholders reported that when dealing with clients or building owners, the understanding of EPCs appears even lower than expected, with 50% agreeing and 24% strongly agreeing.

Finally, opinions were sharply divided regarding the reliability and adequacy of tools used to create EPCs, with 43% of respondents on the agree-side and 49% on the disagree-side. These results suggest a clear need for improvements in training, standardisation, and tool development to enhance the overall effectiveness and reliability of EPCs across the EU.

Figure 6. Results of the survey at EU level, i.e. aggregating all the countries results: Databases and Tools



SRI Development and Deployment

The outcomes of the survey section on "SRI Development and Deployment" at EU level are reported in Figure 6. The graph reveals relatively high percentages of "I don't know" responses, ranging from 15% to 50%, indicating that the concept of SRI remains vague among many stakeholders. This is further underscored by the high percentage (68% in total, with 21% strongly agreeing) of respondents who stated that SRI is not a recognised among building professionals in their country.

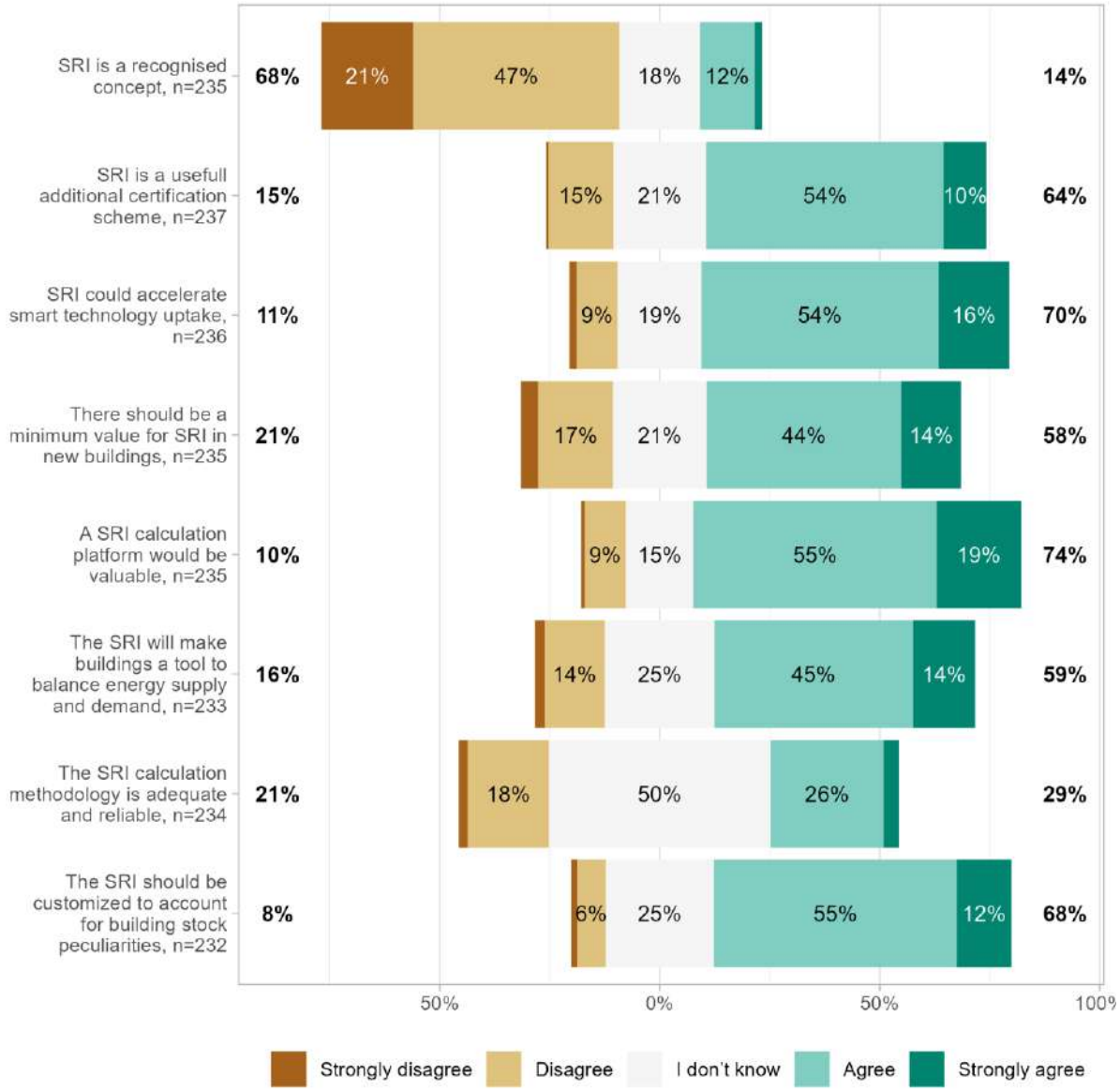
Despite this uncertainty, the potential benefits of SRI are acknowledged by a majority of stakeholders. Specifically, 64% (10% strongly agreeing) recognised its usefulness as a certification scheme, and 70% (16% strongly agreeing) believed it could accelerate the smart technology uptake of buildings. Moreover, 45% of respondents agreed and 14% strongly agreed that SRI could help balance the demand and supply of energy by enabling buildings to act as flexible loads. However, 25% of respondents were unsure about this point.

When asked about the adequacy and reliability of the current SRI calculation methodology, 50% of stakeholders answered "I don't know." The remaining responses were evenly split, with 29% on the agree-side and 21% on the disagree-side, further highlighting the uncertainty in this area.

Regarding the methodology for developing SRIs, most respondents supported the establishment of a minimum SRI value for new buildings (58% agreeing, 14% strongly agreeing) and saw value in a platform that calculates SRI based on building data (74% agreeing, 19% strongly agreeing). Additionally, a majority agreed (55%) or strongly agreed (12%) that SRI calculations and catalogues should be customised to account for the unique characteristics of building stock, though uncertainty persisted, with 25% responding "I don't know."

These findings indicate that while the concept of SRI holds significant promise, there is still considerable uncertainty among stakeholders, particularly regarding its recognition and the reliability of current methodologies.

Figure 7. Results of the survey at EU level, i.e. aggregating all the countries results: SRI Development and Deployment



Integration of Instruments

The results of the "Integration of Instruments" section at the EU level are reported in Figure 7. A considerable level of uncertainty was expressed regarding the integration of EPC and SRI, with "I don't know" percentages ranging from 11% to 41%. This uncertainty is further emphasised by the fact that 60% of respondents agreed and 21% strongly agreed on the necessity of activities showcasing the effectiveness of SRI, while 56% agreed and 26 strongly agreed on the need for better communication regarding the relationship between the two instruments.

Despite these uncertainties, stakeholders generally viewed the integration of EPC and SRI positively. The highest levels of agreement were observed for the following:

(1) the necessity to create both indicators in a single process (73% in total, 20% strongly agreeing);
(2) the appointment of the same professionals to develop both EPCs and SRIs (66% in total, 17% strongly agreeing);

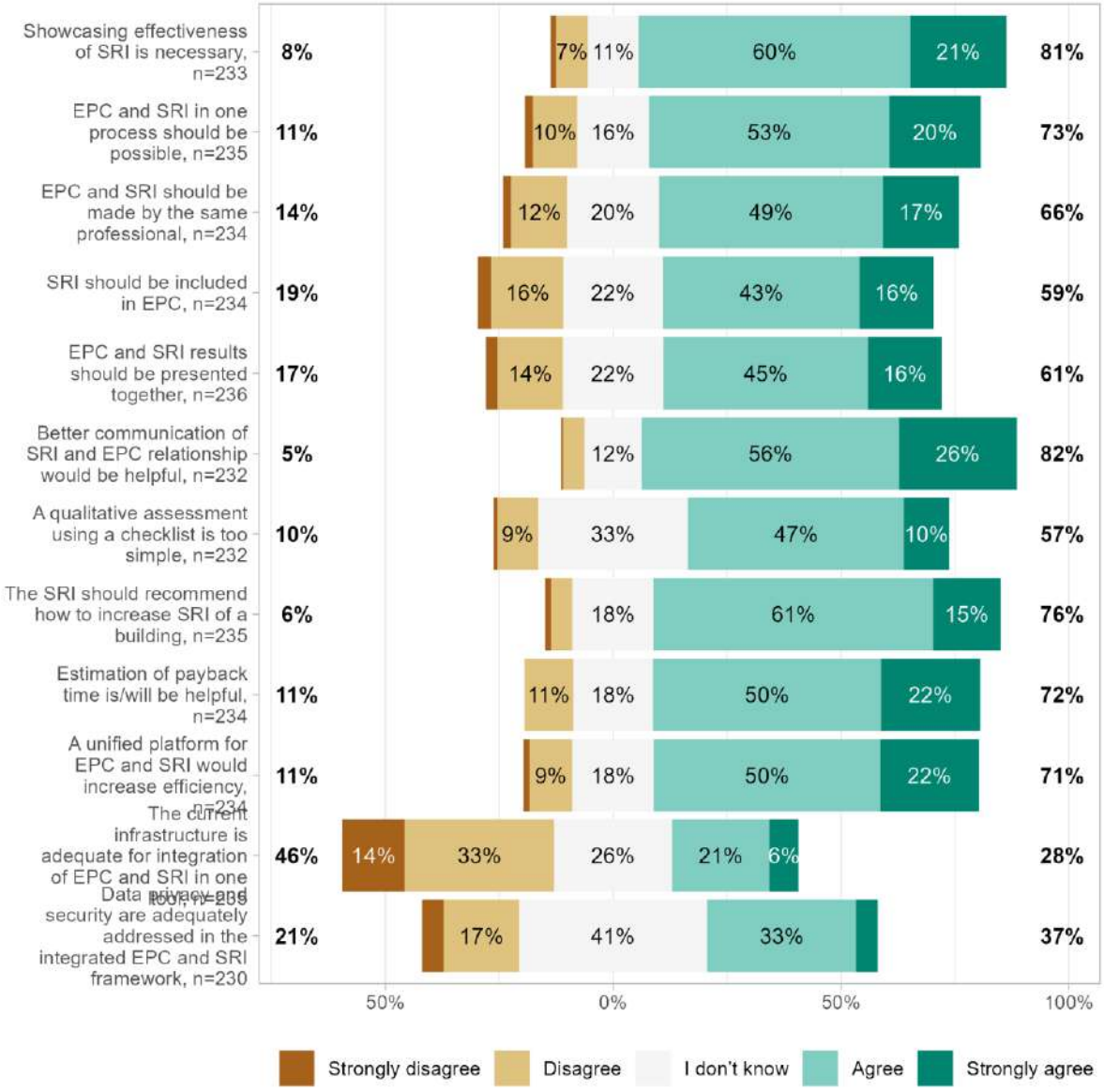
(3) the inclusion of SRI in EPC (59% in total, 16% strongly agreeing);
(4) the advantages of presenting the results of the two indicators together (61% in total, 16% strongly agreeing);
(5) the potential reduction in processing time for the two certificates through a unified digital platform (71% in total, 22% strongly agreeing).

Furthermore, concerns were raised about the methodology being used or proposed in various contexts, such as those outlined in EU Delegated Regulation 2020/2155 or similar frameworks. Specifically, 57% of respondents (10% strongly agreeing) found the use of a qualitative checklist too simplistic for assessing building smartness and comparing different system approaches. Additionally, 76% (15% strongly agreeing) believed that SRI should include recommendations for improving a building's SRI, and 72% (22% strongly agreeing) supported including an estimation of payback time. Uncertainty was still present, with 33% of respondents indicating 'I don't know' regarding the adequacy of the current checklist.

Moreover, while the need for integration is clear, stakeholders expressed concerns about the inadequacy of current infrastructure to support the integration of EPC and SRI into a single tool (46% agreeing, 14% strongly agreeing), with 26% responding "I don't know". Privacy and security concerns also raised significant uncertainty, with 41% of stakeholders unsure if these issues are adequately addressed in the integrated EPC and SRI framework.

These findings underscore the necessity for stronger awareness and better communication regarding the integration of EPC and SRI, as well as the need for infrastructure improvements to support this integration.

Figure 8. Results of the survey at EU level, i.e. aggregating all the countries results: Integration of Instruments



3.2 National level

The survey results are presented in this section highlighting the specific answers obtain by each of the seven EU countries (Austria, Croatia, Greece, Hungary, Italy, Poland, Slovenia) participating. The section follows the same structure (according to the survey) and answers are in percentages. Nevertheless, graphs do not report overall values at EU level, but the separated percentages for the different countries. The aim is to show regional differences in the perception of efficiency and state of the art of EPC and SRI, as well as regional issues detected by local stakeholders.

Understanding EPC

The results of the "Understanding EPC" section of the survey, separated by the seven participating countries, are shown in Figure 8 and Figure 9. Individual graphs for each country are provided in the Appendix. The data reveal notable discrepancies in perceptions of the methodology's efficacy across countries. For instance, stakeholders in Austria (67%), Croatia (74%), Hungary (86%), and Slovenia (75%) rated the methodology's adequacy highly, while others, particularly in Poland (51%) and Italy (55%), expressed significant dissatisfaction.

Concerns about the accuracy of the methodology were also prominent, with Italy (55%) and Poland (64%) reporting strong disagreement, whereas Hungary (71%) and Slovenia (70%) were more positive.

In terms of the realism of EPC results, Hungary (71%) and Slovenia (63%) showed confidence, while Austria (67%), Italy (62%), and Poland (67%) expressed strong disagreement. Notably, 33% of Austrian and 28% of Italian respondents strongly disagreed that EPC results are realistic, highlighting regional distrust in the methodology.

Poland also expressed significant concerns about user understanding (72%, with 29% strongly agreeing) and the perceived value of EPCs (69%, with 19% strongly agreeing). Conversely, Hungary and Slovenia were more optimistic about the ease of understanding EPCs (71% and 65%, respectively), while Austria (67%), Croatia (70%), and Greece (86%) recognised the value of EPCs for end users.

Across most countries, there was agreement on the value of EPCs for state or regional purposes, with Italy (71%) and Greece (93%) showing the highest levels of agreement. However, Poland (60%) and Italy (48%) highlighted a lack of effective communication regarding buildings' energy performance, contrasting with the more positive views in Austria (67%), Croatia (73%), Hungary (71%), and Slovenia (80%).

Concerns about users' awareness of EPCs' importance were widespread, with 44% to 67% of respondents in Austria and Poland, respectively, expressing disagreement. Interestingly, 43% of Hungarian respondents were unsure about this issue, suggesting possible communication gaps between stakeholders and users.

Opinions were divided on whether EPCs trigger renovations, with Croatia (73%), Greece (64%), and Hungary (71%) agreeing, while Italy (55%) and Poland (52%) were more sceptical. Trust in EPCs among end users also varied, with significant concerns in most countries (44% to 63%), except in Italy, where only 33% agreed, indicating that trust issues do not align directly with other criticisms.

Regarding professional training, most countries, except Croatia (33%) and Hungary (14%), agreed on the lack of mandatory training for EPC producers, with Greece showing the highest concern (93%, with 57% strongly agreeing). Similarly, most countries, apart from Hungary (43%), highlighted deficiencies in quality control, with 56% to 82% agreeing and a significant proportion strongly agreeing (22% to 45%).

Overall, regional differences are evident. Poland, which had the largest number of respondents (129), highlighted significant issues in understanding EPCs, while countries like Hungary and Slovenia showed better practices. However, Hungary's small sample size (7 respondents) may introduce biases, making these results less conclusive. To address these regional disparities, it is recommended to adopt the better practices observed in some countries as a model for standardising and improving EPC methodologies across the EU.

Figure 9. Results of the survey at national level, i.e. with results divided by country: Understanding EPC - Part 1

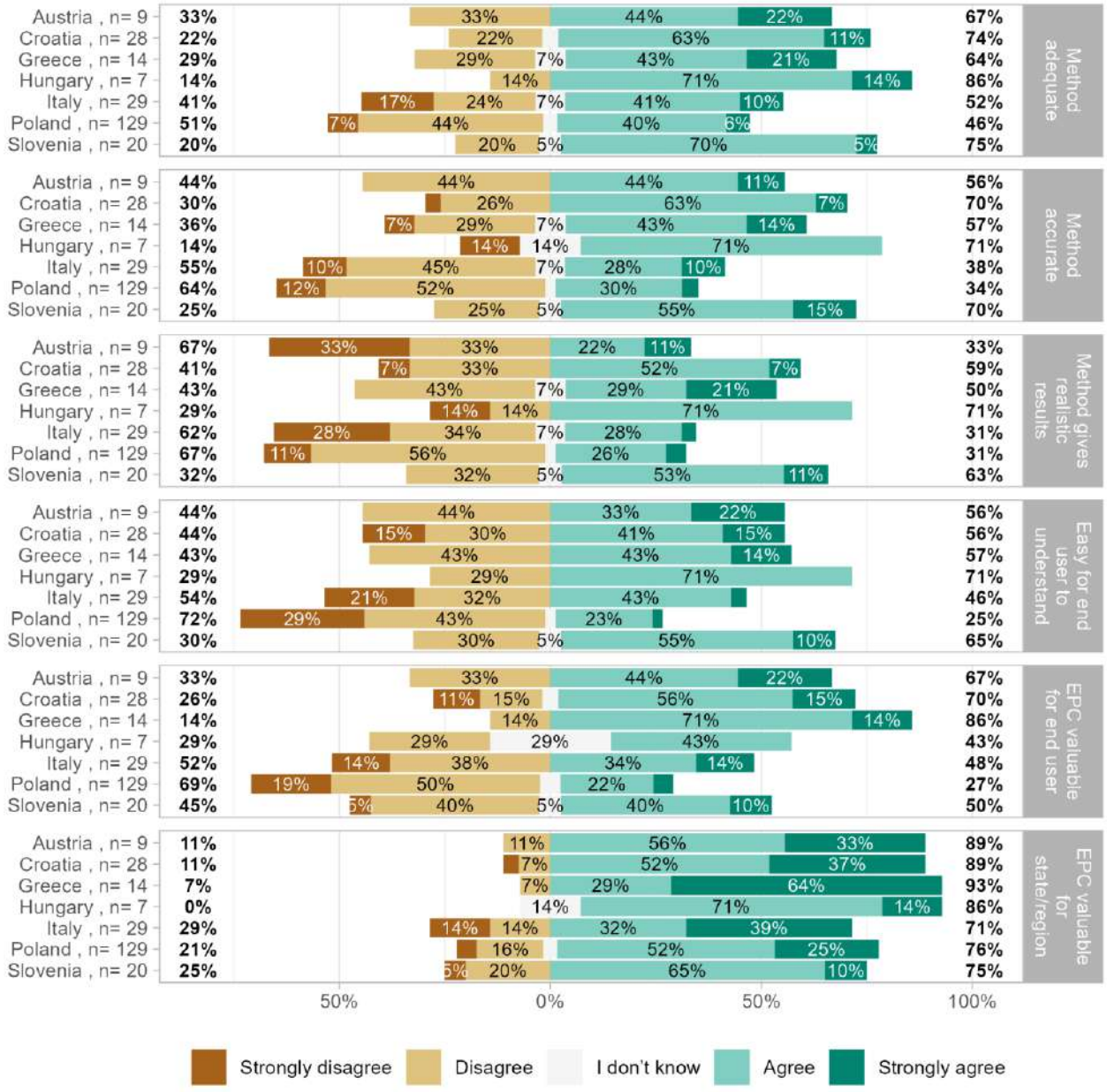
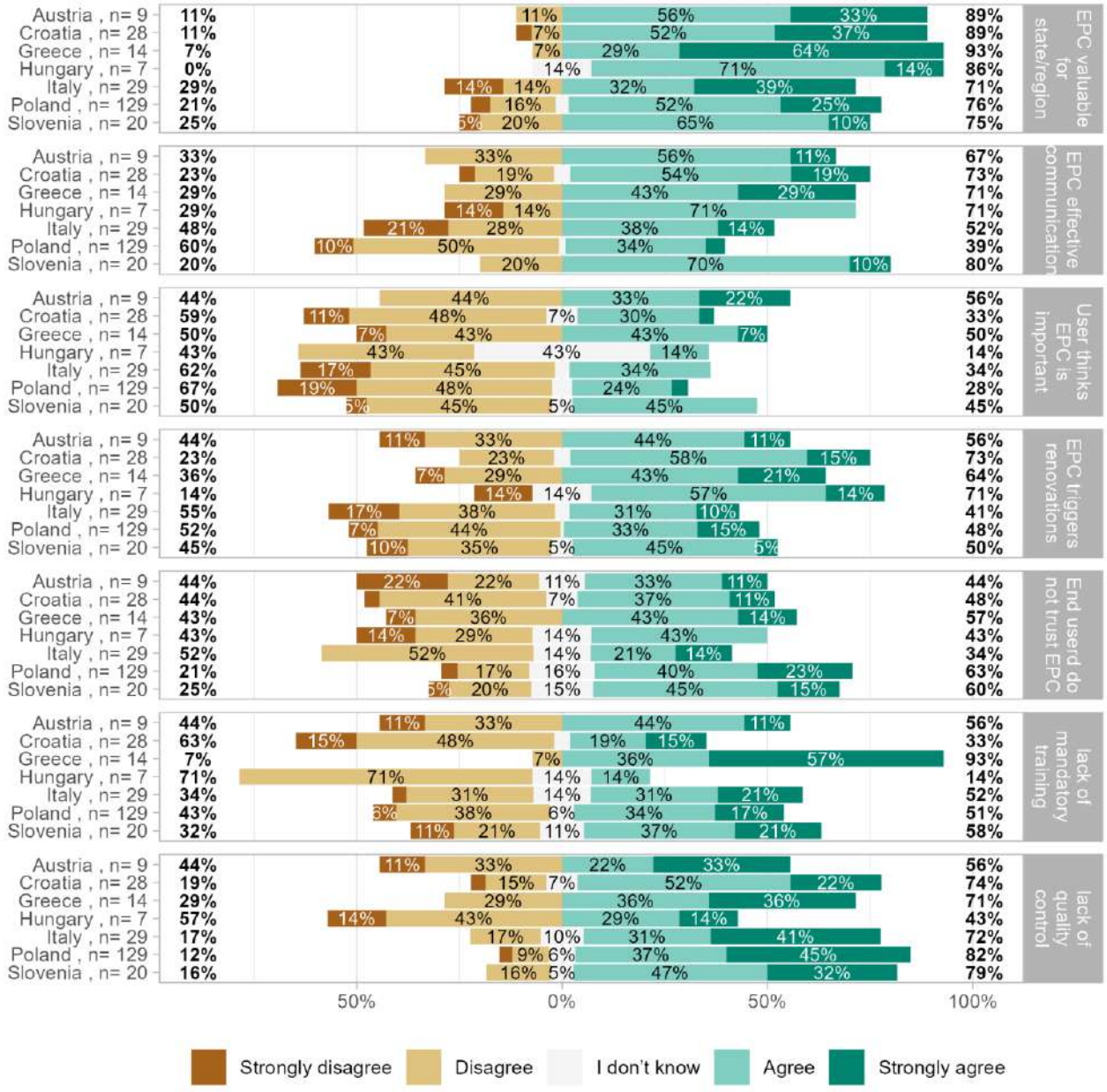


Figure 10. Results of the survey at national level, i.e. with results divided by country: Understanding EPC - Part 2



Upgrading EPC

The outcomes of the "Upgrading EPC" survey section, with data separated at the national level, are shown in Figure 10. Individual graphs for each country are reported in the Appendix. Notably, mixed opinions were expressed concerning the potential of dynamic data-based EPCs. Italy (68%) and Slovenia (65%) primarily positioned on the agree-side, while Austria (78%) and Hungary (71%) positioned on the disagree-side, with other countries showing more evenly distributed opinions. Similarly, while Italy (82%), Poland (54%), and Slovenia (75%) were mainly positive about the potential of dynamic calculation-based EPCs, other countries had more divided views. A significant portion of Italian stakeholders strongly agreed on both points (32%).

These results suggest that countries with a more positive perception in the 'Understanding EPC' section also tend to be more satisfied with the current methodology and express less concern about potential upgrades. On the other hand, the relatively high percentage of 'I don't know' responses in Croatia (21% for dynamic data-based and 17% for dynamic calculation-

based EPCs) and Poland (15% for both) indicates a need for more information about these methodologies among stakeholders in these countries.

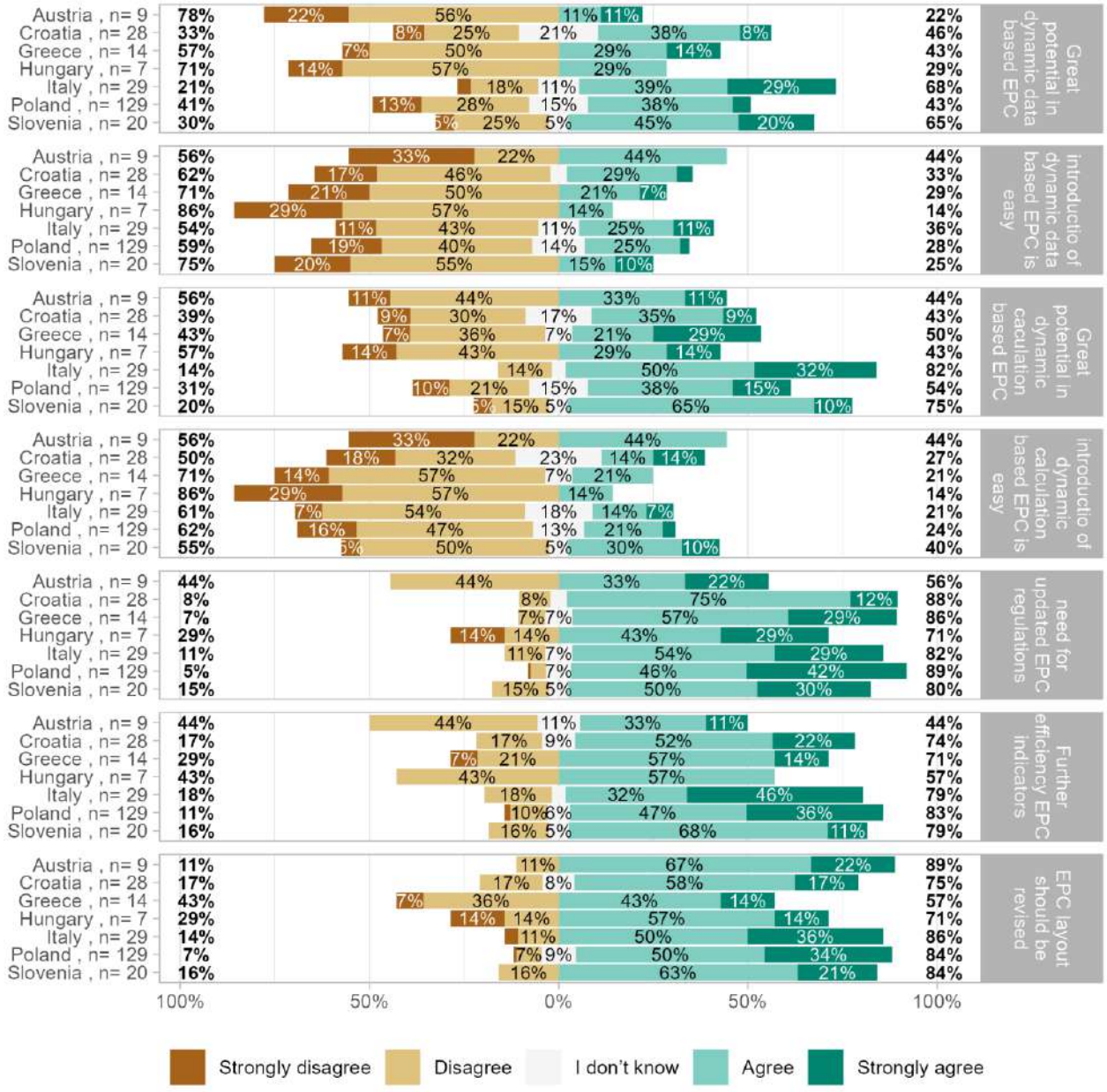
Despite mixed opinions on the potential of these methods, most countries disagreed or strongly disagreed on the ease of their introduction. Disagreement on the introduction of dynamic data-based EPCs ranged from 56% (Austria, with 33% strongly disagreeing) to 86% (Hungary, with 29% strongly disagreeing). Similarly, for dynamic calculation-based EPCs, disagreement ranged from 50% (Croatia, with 23% 'I don’t know') to 86% (Hungary, with 29% strongly disagreeing).

All countries predominantly agreed on the need for updated EPC regulations, with agreement percentages ranging from 56% in Austria (22% strongly agreeing) to 89% in Poland (42% strongly agreeing). Most stakeholders also supported the need for further efficiency indicators in EPCs, particularly in Italy (79%, with 46% strongly agreeing), Poland (83%, with 36% strongly agreeing), and Slovenia (79%, with 11% strongly agreeing). Conversely, Austria (44% disagree, 0% strongly) and Hungary (43% disagree, 0% strongly) expressed more balanced opinions on this topic.

There was broad agreement on the necessity to revise the EPC layout and displayed information, with agreement ranging from 57% in Greece to 89% in Austria.

Overall, the findings suggest that a higher level of regional understanding of EPCs may be associated with a lower urgency to upgrade inspection (dynamic data-based EPC) or calculation methods (dynamic calculation-based EPC). However, the need for updated regulations, indicators, and layout appears to be independent of the current state of understanding.

Figure 11. Results of the survey at national level, i.e. with results divided by country: Upgrading EPC



Databases and Tools

The results of the "Databases and Tools" survey section, with data separated at the national level, are shown in Figure 11. Individual graphs for each country are provided in the Appendix. Most countries highlighted the value of a National EPC database encompassing all previous EPCs and the data used to develop them, with agreement ranging from 78% in Austria to 100% in Hungary. Notably, a significant share of stakeholders strongly agreed, ranging from 32% in Croatia to 67% in Austria. However, Austria exhibited a 22% disagreement rate (all strongly), which is an anomaly that warrants further exploration. It should be noted that the relatively small sample size of Austrian respondents (9) may have influenced these results.

Opinions on the training of professionals aligned with trends observed in previous sections. Hungary (61% in total, 14% strongly) and Austria (67% in total, 44% strongly) positioned on the agree-side, indicating satisfaction with their training programs. Conversely, Greece (71% in total, 14% strongly), Italy (62% in total, 10% strongly), and Poland (70% in total, 20% strongly) were largely dissatisfied with their professional training.

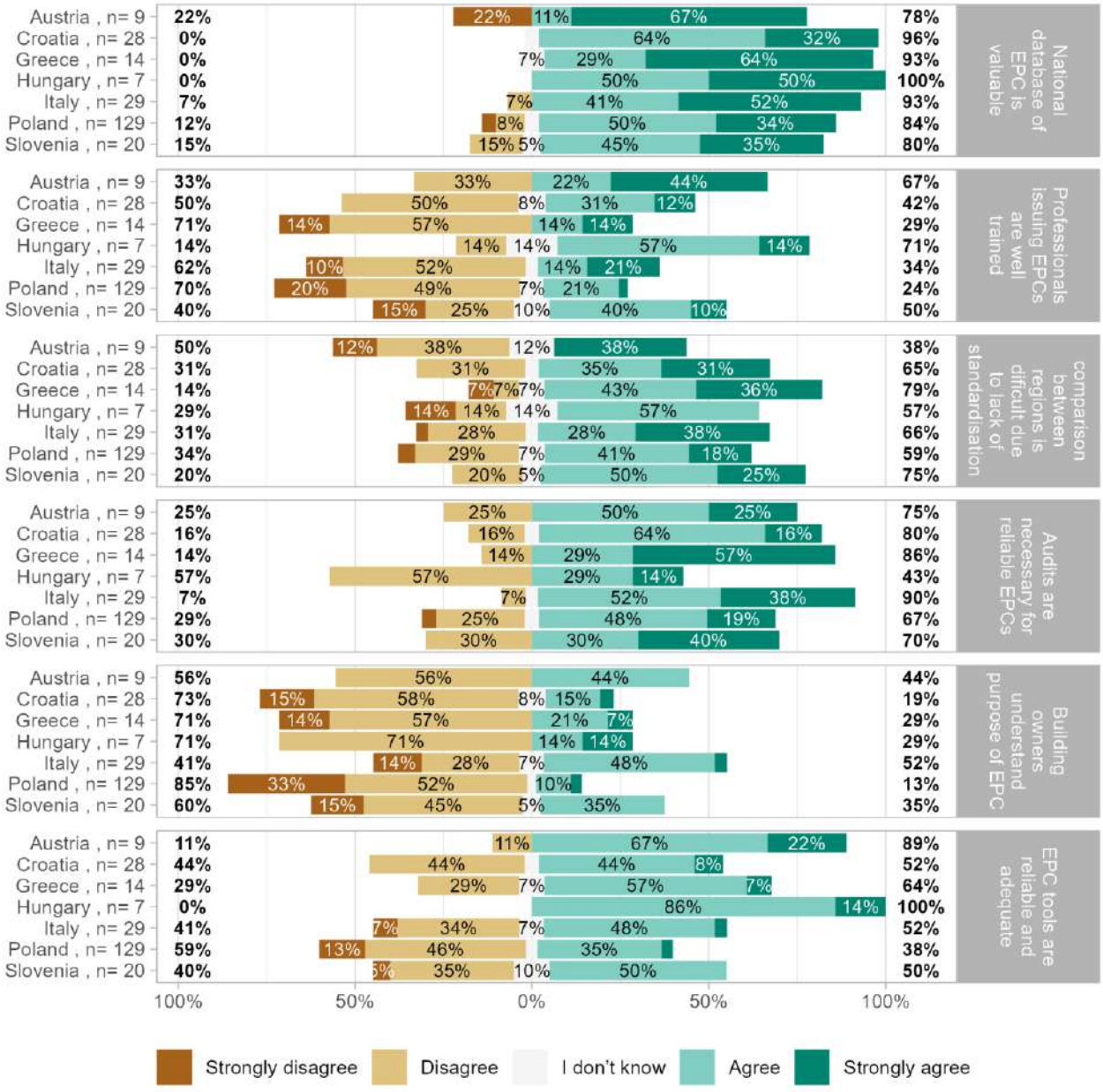
Regarding the difficulty of comparing EPCs due to a lack of standardisation, most countries except Austria (which showed more divided opinions) positioned on the agree-side, with agreement percentages ranging from 57% in Hungary (0% strongly) to 79% in Greece (36% strongly). Similarly, there was broad agreement on the necessity of audits for reliable EPCs, with agreement ranging from 67% in Poland (19% strongly) to 90% in Italy (38% strongly). Hungary, however, showed more divided opinions on this issue.

There was also a consensus among most countries that building owners do not fully understand the purpose of EPCs. Except for Austria and Italy, where opinions were more divided, the majority of stakeholders disagreed, with disagreement ranging from 60% in Slovenia (15% strongly) to 85% in Poland (33% strongly).

Finally, satisfaction with the current tools varied across countries. Austria (89% on the agree-side, 22% strongly), Greece (64% on the agree-side, 7% strongly), and Hungary (100% on the agree-side, 14% strongly) were generally satisfied with their current EPC tools.

Overall, there is broad agreement on the need for a National EPC database and the importance of audits for reliability, but significant concerns remain regarding professional training and standardisation. The variation in responses, particularly in Austria, suggests that further investigation is needed to understand these national differences fully.

Figure 12. Results of the survey at national level, i.e. with results divided by country: Databases and Tools



SRI Development and Deployment

The results of the "SRI Development and Deployment" section of the survey, with data separated at the national level, are shown in Figure 12. Individual graphs for each country are provided in the Appendix. Across all countries, SRI was generally not recognised as a well-known concept, with 53% of respondents in Slovenia and up to 92% in Greece indicating a lack of recognition. Despite this, most respondents agreed or strongly agreed that SRI would be useful (from 54% in Croatia to 72% in Italy) and that it could accelerate the uptake of smart technology (from 62% in Croatia to 85% in Greece).

However, high percentages of "I don't know" responses were recorded in several countries, particularly regarding SRI's usefulness and its ability to accelerate technology uptake. Notably, Croatia reported 33% and 21% uncertainty on these points, Hungary 43% and 57%, and Poland 25% and 23%, respectively. This indicates a need for increased awareness of the SRI concept in these countries. Greece was an exception, with no respondents indicating uncertainty on these questions.

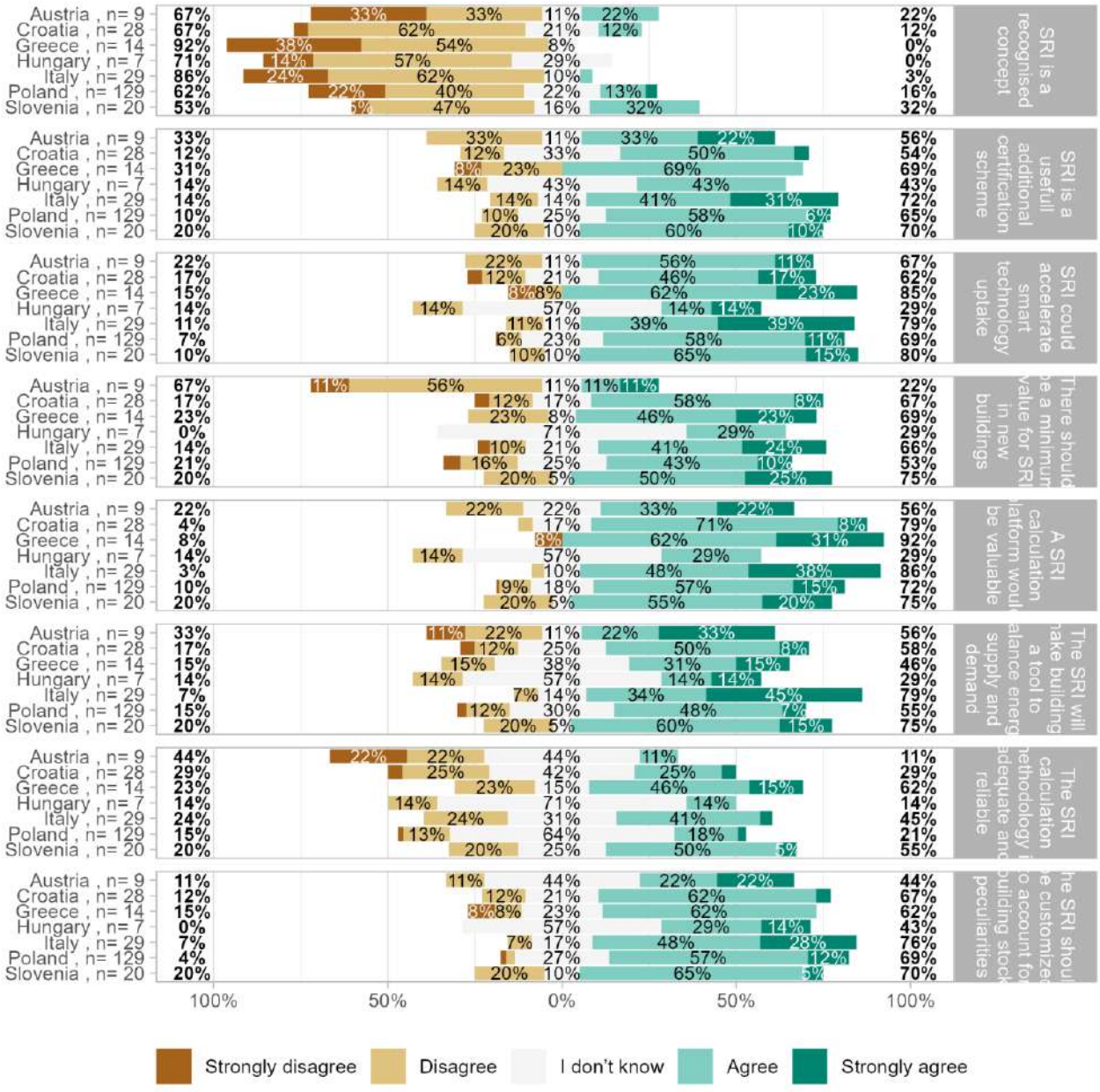
Most countries agreed on the necessity of establishing a minimum SRI for new buildings, with agreement levels ranging from 53% in Poland to 75% in Slovenia. Austria (67% disagree-side) and Hungary (71% “I don’t know”) were exceptions. Additionally, most countries recognised the usefulness of an SRI calculation platform, with agreement levels ranging from 56% in Austria to 92% in Greece (31% strongly agreeing), except for Hungary (57% “I don’t know”). There was also general agreement on the SRI's potential to transform buildings into resources that balance energy supply and demand, with support ranging from 55% in Poland (30% “I don’t know”) to 79% in Italy (45% strongly agreeing). However, high levels of uncertainty were reported in Greece (38% “I don’t know”) and Hungary (57% “I don’t know”).

Awareness regarding the adequacy and reliability of SRI calculation methodology was low across most countries, with 'I don’t know' responses ranging from 25% in Slovenia to 71% in Hungary. Greece was an exception, with only 15% indicating uncertainty, and 62%, 45%, and 55% of respondents in Greece, Italy, and Slovenia, respectively, agreeing on the methodology's adequacy and reliability. In contrast, Austria saw 44% disagreement (22% strongly) on this point.

A higher level of standardisation and clarity is necessary across regions to improve local awareness and align implementation practices with best examples from countries where SRI is already well-understood and accepted. Most countries agreed on necessity of SRI customisation to account for peculiarities of building stock, with agreement levels ranging from 62% in Greece to 76% in Italy. However, high levels of uncertainty seemed to be present, in particular in Austria (44 % “I don’t know”) and Hungary (57 % “I don’t know”).

In general, SRI seems to be recognised as a potentially valuable tool, even though there is the need of better awareness about the topic, especially in some of the EU nations who participated in the survey.

Figure 13. Results of the survey at national level, i.e. with results divided by country: SRI Development and Deployment



Integration of Instruments

The outcomes of the "Integration of Instruments" survey section, with data separated at the national level, are shown in Figures 13 and 14. Individual graphs for each country are provided in the Appendix. Hungary showed significant uncertainty regarding the necessity of activities showcasing SRI effectiveness, with 67% of respondents indicating "I don't know". In contrast, most other countries positioned on the agree-side, with agreement levels ranging from 75% in Slovenia (20% strongly) to 89% in Austria (44% strongly) and Italy (39% strongly). This underscores the need for increased awareness among stakeholders at both the EU and national levels.

With the exception of Austria and Hungary, where high levels of uncertainty were noted (44% and 57% 'I don't know' respectively across all four related questions), most countries mainly agreed on the integration of EPC and SRI. Specifically: (1) 67% of respondents in Poland (9% strongly) to 93% in Greece (29% strongly) agreed on creating both indicators in a single

process; (2) 62% in Poland (14% strongly) to 80% in Slovenia (15% strongly) supported having the same professional develop both EPC and SRI; (3) 52% in Poland (11% strongly) to 79% in Italy (39% strongly) favoured including SRI in EPC; and (4) 53% in Poland (9% strongly) to 86% in Greece (29% strongly) and Italy (39% strongly) supported presenting the results together. However, notable levels of uncertainty were expressed in Poland (18-28%) and Croatia (17-21%).

The need for stronger communication was confirmed by all countries except Hungary (57% “I don’t know”, 0% disagree-side), with agreement levels ranging from 78% in Austria (33% strongly) to 93% in Italy (50% strongly). Regarding methodology, most countries agreed that:

1) A qualitative checklist is too simple, with agreement ranging from 57% in Greece (0% strongly) to 73% in Croatia (5% strongly), except for Austria (56% 'I don’t know') and Hungary (71% “I don’t know”)
2) Recommendations for increasing SRI should be included, with agreement ranging from 71% in Poland (8% strongly) to 93% in Greece (29% strongly), again with Hungary showing high uncertainty (57% “I don’t know”)
3) Payback time estimation would be helpful, with agreement ranging from 65% in Poland (15% strongly) to 93% in Greece (43% strongly), except for Hungary (57% “I don’t know”)

Most countries agreed on the potential efficiency gains from using a unified platform for EPC and SRI, with agreement levels ranging from 67% in Poland (16% strongly) to 93% in Greece (29% strongly). Exceptions were Austria (33% “I don’t know”) and Hungary (71% “I don’t know”). Additionally, respondents in Austria (56%), Italy (57%), and Poland (50%) largely disagreed on the adequacy of current infrastructure for EPC and SRI integration, while Croatia and Hungary expressed high uncertainty (43% and 71% “I don’t know”, respectively). Slovenia and Greece had more divided opinions.

High uncertainty was also expressed regarding data privacy and security concerns within the EPC and SRI framework, particularly in Austria (44% “I don’t know”), Croatia (43%), Hungary (71%), and Poland (51%). In Italy, opinions were evenly split between the agree-side and disagree-side, while Slovenia and Greece leaned more towards agreement (55% and 71%, respectively).

Overall, there was significant uncertainty regarding the integration of the two instruments, particularly in Austria, Hungary, and Poland. In Austria and Hungary, this may be partially explained by the low number of survey respondents (9 and 7, respectively). However, this explanation does not apply to Poland, which had the highest participation rate (129 respondents). Conversely, uncertainty levels were lower in Greece and Italy, suggesting more confidence in these countries.

Figure 14. Results of the survey at national level, i.e. with results divided by country: Integration of Instruments – Part 1

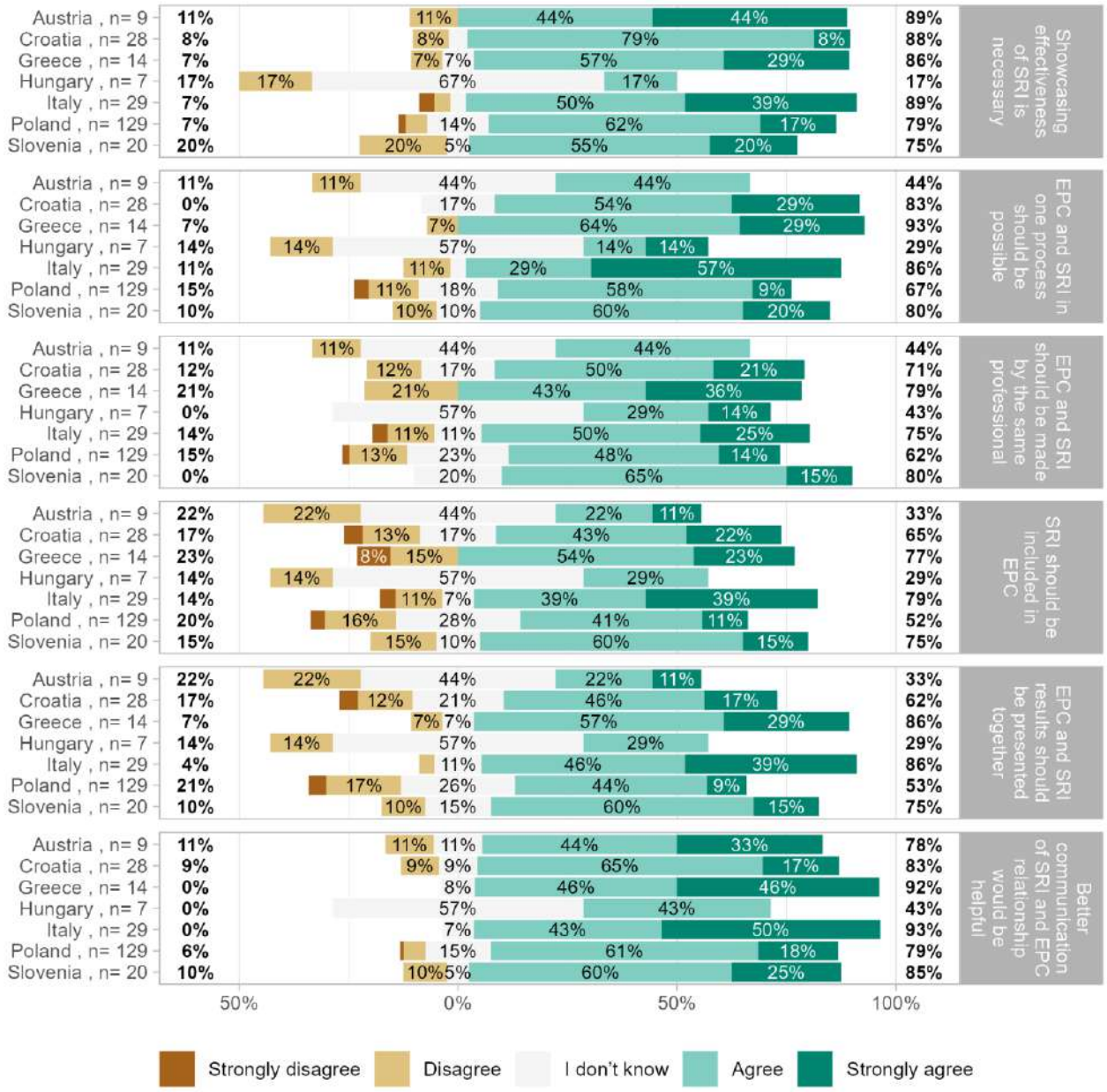
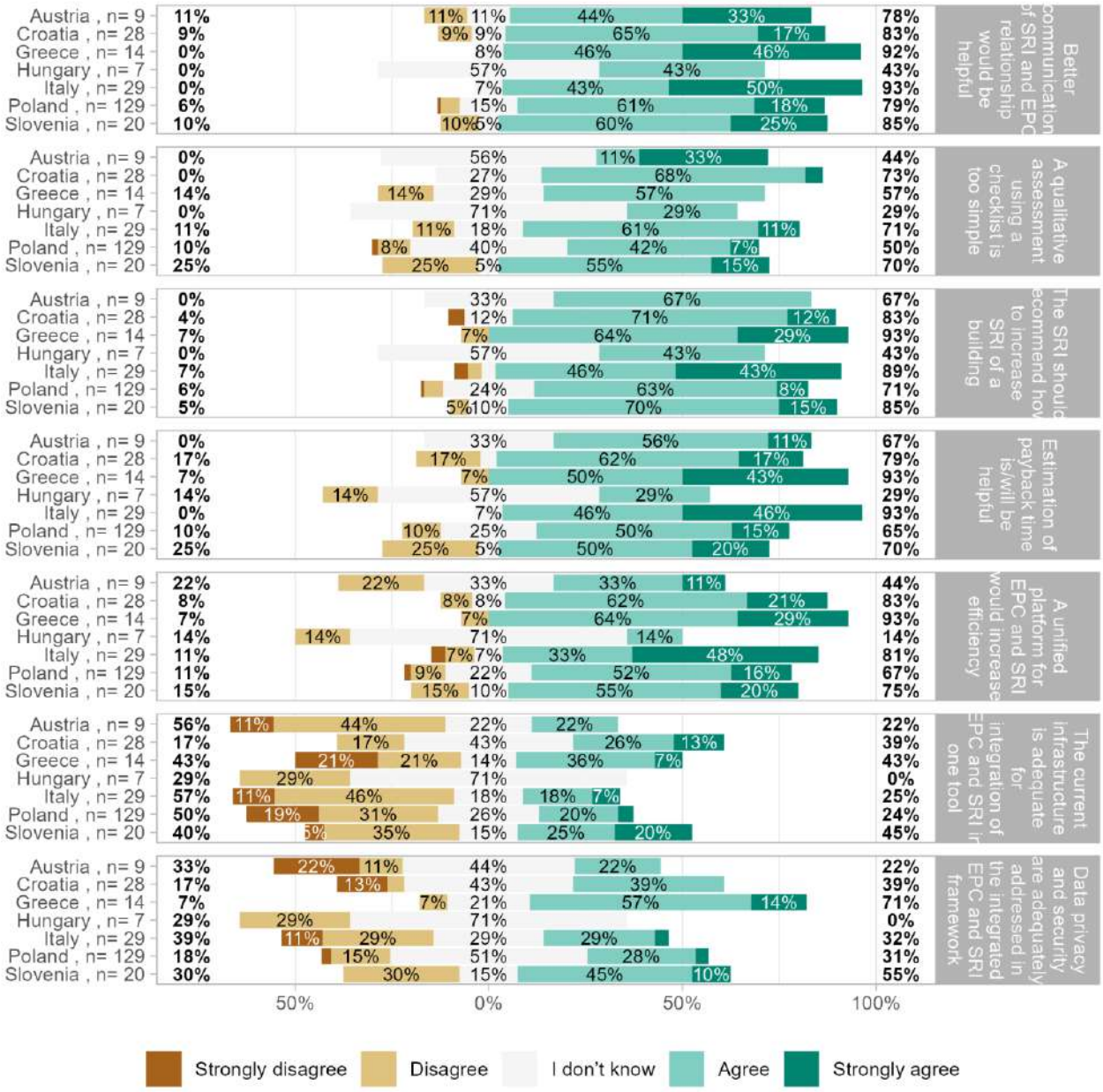


Figure 15. Results of the survey at national level, i.e. with results divided by country: Integration of Instruments – Part 2



4 Interview analyses: results and discussion

4.1 Austria

4.1.1 Profiling of participants

The details about the participants to the interview for Austria are reported in Table 1.

Table 1: Details about profiling of interview's participants for Austria

Professional figure	Company	Experience with EPC	Experience with SRI
OIB - Österreichisches Institut für Bautechnik	Academia	Yes	Yes

(Austrian Institute for Building Technology)			
AEE Intec - Institut für Nachhaltige Technologien (Institute for Sustainable Technologies)	Academia	Yes	Yes
Land Salzburg - Energiewirtschaft und Beratung, Energieberatung Salzburg	Authority	Yes	No
Land Salzburg - Energiewirtschaft und Beratung, Energieberatung Salzburg	Authority	Yes	No
GEQ - Zehentmayer Software GmbH	Business	Yes	No
ETU GmbH	Business	Yes	No
BMK - VI/6 (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology)	Authority	Yes	No
BMK - VI/6 (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology)	Authority	Yes	No
Energieagentur Tirol	Professionals	Yes	No
Energieberatung Burgenland	Professionals	Yes	No
Donau Universität NÖ - Zentrum für Bauklimatik und Gebäudetechnik	Academia	Yes	Yes
SERA Institute for Sustainable Energy and Resources Availability	Academia	Yes	Yes
BOKU – Universität für Bodenkultur Wien (University of Natural Resources and Life Sciences)	Academia	Yes	Yes

TU Wien – Technische Universität Wien (Vienna University of Technologies)	Academia	Yes	Yes
e7 GmbH - Ingenieurbüro für Energie- und Umwelttechnik	Academia	Yes	Yes
Hauskunft - Energieberatung Wien	Professionals	Yes	No
Land Salzburg - Energiewirtschaft und -beratung	Authority	Yes	No
FH Salzburg - Department Green Engineering and Circular Design	Academia	Yes	Yes
Land Salzburg - Energiewirtschaft und -beratung, Unabhängige Kontrollstelle für Energieausweise, Klima- und Energiestrategie SALZBURG 2050	Authority	Yes	No
Amt der Kärntner Landesregierung - Abteilung 15 Standort, Raumordnung und Energie, Fachbereich Energie	Authority	Yes	No
Land Vorarlberg - Abteilung VIa Allgemeine Wirtschaftsangelegenheiten Fachbereich Energie und Klimaschutz, Energieausweis-Zentrale	Authority	Yes	No

4.1.2 Summary of conclusions

Local and national authorities value academic insights for energy efficiency but are hesitant to exceed Energy Performance of Buildings Directive (EPBD) requirements due to regulatory complexities. They prefer integrating tools like Building Renovation Passports (BRPs) with EPCs for legal purposes. The research community supports user-friendly EPC, BRP, and SRI, emphasising data collection. Industry faces challenges updating software for regional regulations. End users find EPC calculations complex and costly but see value in dynamic EPCs based on real energy consumption.

4.1.3 Interview key points

Local and national authorities*:* They welcome the learning outcomes of academia gained by engaging in projects and evaluating studies, developing tools, etc. These learnings help to develop strategies for the application of energy efficiency but are reluctant in going beyond the necessary steps for the implementation of the EPBD and its mandatory articles. The reason is the structure of the government and processes, harmonizing the nine building regulations according to the laws and the regulations of regions.

Regarding the real energy consumption and EPC, the integration of tools such as BRPs and EPCs is preferred so that EPC remains as a legal document for building permits, selling or renting and major renovations and subsidies.

Integration of further indicators such as GWP should be according to the EPBD is subject of the national implementation after consultation with experts and regions.

The institution of energy consultants is well accepted for implementing energy efficiency and renovation of private SFH through renovation options and is a powerful policy instrument. The policy makers count on this for different purposes such as bringing the information to the homeowners.

Research community: Many members of academia are involved in research and projects dealing with subjects relating to EPBD. The concept of EPC, BRP and SRI is very well known, and they are in favour of making them user-friendly. They consider collecting data on the performance of the buildings are essential for their work. They are open for developing tools and instruments to be able to make prognoses for the future, using high-quality and reliable data as well as energy flexibility.

Industry or business partners: For the calculation of EPC and integration of indicators, renovation measures and the presentation of results, the experts and regions have been working closely with the software developers. According to the interviewees the challenge is to update the software according to the needs of nine Austrian regions that implement the OIB-Guidelines (adapted every four years) in their regional building codes in a different manner (in some regions the latest OIB Guideline has not been implemented yet). Integrating SRI or other indicators in the EPC is not an issue yet because there is no law for it.

Specific end user communities: They use or develop tools such as EPC and BRP. They are not very familiar with the concept of SRI since it has not been a mandatory implementation. The EPC calculation method is considered as a complex task based on Austrian Standards and building codes as well as the national energy directives (OIB GL 6 and the future GL 7 for Sustainable use of natural resources).

EPC is considered a tool for the assessment of a building under defined under certain condition, for selling or renting, building permit as well as receiving subsidies in case of renovation. The user-behaviour is based on information in Austrian Standards (as default values).

A dynamic EPC issued based on real energy consumption is considered to be complex and expensive. However, using the real energy data according to the energy bills at the point of renovation and planning the renovation measures as in the BRP is necessary. Especially, the energy advisor visiting the building and evaluating what needs to be done, can better explain the performance of the building and renovation steps to the building owner/manager. Therefore, the EPC as such can only be an administrative document. Yet, the first page(s) of the EPC could be designed in a more user-friendly way, attractively graphically designed,

containing all the essential and easy-to-understand information summarising all relevant building assessments.

4.2 Croatia

4.2.1 Profiling of participants

The details about the participants to the interview for Croatia are reported in Table 2.

Table 2: Details about profiling of interview's participants for Croatia

Professional figure	Company	Experience with EPC	Experience with SRI
Business	Real Estate Agency (Agencija za pravni promet i posredovanje nekretninama)	Yes	No
Professionals	REGEA (regional Energy Agency) - CrossCERT	Yes	Yes
Professionals	GBC – Croatia Green Building Council	Yes	No
Academia	University of Zagreb	Yes	Yes
Professionals	Croatian Association of Court expert witnesses and valuers	No	No
Authority	Ministry of Physical Planning, Construction and State Assets	Yes	Yes
Finance	Environmental Protection and Energy Efficiency Fund	Yes	No
Finance	Environmental Protection and Energy Efficiency Fund	No	No

4.2.2 Summary of conclusions

The EPC is crucial for assessing building energy performance, with key improvements needed in peer comparison, visualisation, and EU standardisation. Upgrading the EPC process involves addressing user behaviour, enhancing indoor air quality, and stricter market regulations. Developing dynamic databases, integrating APIs, and creating mobile apps can improve data management and user engagement. Simplifying SRI integration with existing processes and educating stakeholders can enhance adoption. Successful integration examples like the JRC database should be highlighted, using simple terminology and appointing expert coordinating bodies. Key projects like Monitor EE and Aldren offer valuable resources. Integrating with systems like ISGE and creating a building area database can

enhance data analysis. Continuous evaluation, stakeholder involvement, and aligning recommendations can improve strategy and document quality. Emphasizing the real need and quality of certificates ensures they are functional and valuable, not just administrative.

4.2.3 Interview key points

Understanding EPC

In Croatia, the Energy Performance Certificate (EPC) is recognised as a vital tool for assessing and communicating the energy performance of buildings. However, stakeholders have identified several challenges that need addressing to enhance the effectiveness and clarity of EPCs. A significant recommendation is to implement systems that allow for peer comparisons, enabling building owners to gauge their energy efficiency against nearby properties, thereby motivating improvements. Additionally, the development of clearer visualisations and graphical representations of EPC data is seen as essential for improving user comprehension.

There is also a strong push towards the standardisation of EPC terminology and methodologies across EU member states, which would simplify the certification process. Stakeholders have highlighted the importance of including specific energy efficiency recommendations within the EPC, accompanied by contractor contact information to facilitate action. Furthermore, there is a need for greater transparency in displaying energy costs, consumption, and CO2 emissions in ways that users can easily understand, potentially through digital versions of EPCs that are editable and shareable.

Moreover, linking EPC recommendations to available funding mechanisms and financial opportunities would further encourage energy-efficient upgrades. The inclusion of indicators for renewable energy use and the status of nearly Zero Energy Buildings (nZEB) in EPCs would also emphasise the benefits of energy efficiency. Lastly, stakeholders suggest shifting some responsibility to designers during the planning phase, ensuring they account for energy efficiency by adopting sustainable practices and materials.

Upgrading EPC

Upgrading the EPC issuance process in Croatia requires addressing several key areas to make it more effective and user-friendly. Standardised methods are needed to mitigate errors in dynamic simulations caused by unpredictable user behaviour. Incorporating indoor air quality measures within the EPC could enhance occupant health and comfort, promoting energy efficiency as a result. There is also a call for stricter market regulations to improve the quality and market value of EPCs.

Effective project management is seen as crucial, with certified project managers ensuring consistency and quality throughout the EPC process. Automating data collection is another priority, as it would reduce errors and provide more accurate data for analysis. Continuous education for certifiers is necessary to keep them updated on new methods, ensuring the sustained quality of EPCs. Furthermore, balancing the depth of analysis with the associated costs is essential for maintaining a sustainable certification process. Dynamic calculations are recommended to enable performance analysis both before and after energy retrofits, while clear data access protocols would facilitate analysis and performance comparisons.

Databases and Tools

The development of a dynamic, interactive database for EPCs is highly recommended. Such a database should be regularly updated and allow for user input and changes, enhancing its relevance and accuracy. Integration with other systems via APIs would allow for automatic updates and ensure that the information remains accurate and up-to-date. The creation of

online tools for energy class assessments and tailored recommendations based on user feedback is also encouraged, alongside mobile apps that could track energy consumption and foster a sense of community among users.

Educational initiatives, including webinars and workshops, should be organised to share insights and results derived from the database. Standardised documentation that can be easily updated and shared is crucial for adapting to new information. A feedback mechanism should be introduced to allow users to evaluate and comment on the energy measures implemented, with social media engagement used to gather feedback and share successes. Addressing the varying levels of awareness and knowledge among users through targeted education is also essential, as is advocating for legislative changes that would include criteria for valuing properties based on their energy certificates.

Finally, showcasing successful energy renovations through case studies can illustrate the benefits of EPCs, and providing personalised advice to property owners based on their specific needs will enhance their engagement. Community collaboration should be encouraged, with local campaigns raising awareness about the importance of EPCs.

SRI Development and Deployment

The development and deployment of the Smart Readiness Indicator in Croatia face several challenges and opportunities. Stakeholders believe that SRI should be integrated with existing processes like renovation passports and EPCs to ensure comprehensive building assessments. Educating both professionals and the public about the benefits of SRI through centralised platforms and campaigns is seen as crucial for its adoption.

Simplifying administrative procedures and addressing market motivation issues are necessary for effective SRI implementation. While digital tools for energy management should be embraced, it's important to allow user adaptability rather than relying solely on automation. Clear standards and guidelines are needed to ensure consistent SRI evaluations, and learning from successful initiatives like the Aldren project could provide valuable insights for implementation. A simple, understandable methodology with basic standards is essential to avoid confusion, and involving stakeholders early in the development process can help ease implementation and address diverse interests. Establishing a transparent and reliable certification system based on EPC experiences can also help build trust among users.

Integration of Instruments

Integrating EPCs, SRIs, and other building assessment tools is crucial for achieving harmonisation and efficiency in Croatia. The goal is to create a streamlined system for managing data related to EPCs and SRIs, facilitating data collection, analysis, and usage. Successful integration examples, such as the JRC database, should be highlighted to illustrate the benefits and application possibilities of such an approach.

Developing a communication strategy that uses simple, easily understandable language is essential for engaging non-experts. The Croatian Ministry should appoint a qualified organisation to coordinate integration activities, define technical specifications, and oversee the process. Utilising existing data sources can help reduce duplication and accelerate progress. Simplifying the complexity of information for end-users, particularly through visualisations and summaries, can aid in understanding and applying the results.

Ongoing training and support for stakeholders will ensure the proper use of new tools and systems, while regular monitoring and adjustments to processes will help meet user needs.

Finally, incorporating feedback from end-users in the system development will optimise tools and processes, making them more user-centric and effective.

Additional Recommendations and Thoughts

To further enhance the effectiveness of EPCs and SRIs, Croatia could benefit from collaboration with key projects and organisations such as the Monitor EE Project, Aldren Project, and CNC Horizon Project, among others. These resources can provide valuable insights and support for advancing energy efficiency efforts. Additionally, integrating certifiers' access to data from the ISGE System and establishing a building area database could improve data analysis and reduce reliance on outdated formats like PDFs.

Stakeholder engagement in strategy evaluation and the development of key documents, such as the Long-Term Strategy for Energy Renovation until 2050, is essential. Ensuring the dignity and utility of EPCs by making them more than just administrative tools is crucial, and presenting well-researched guidelines to the Ministry could drive significant improvements in energy certificates. Aligning recommendations across various projects will facilitate communication with lawmakers, and organising round tables with stakeholders will help exchange experiences and best practices.

Encouraging the formation of national clusters, rather than solely focusing on the EU level, can foster local innovation and collaboration. Ensuring that energy certificates are functional and of high quality, rather than simply cost-effective, will be key to their success in promoting energy efficiency and sustainability in Croatia.

4.3 Greece

4.3.1 Profiling of participants

The details about the participants to the interview for Greece are reported in Table 3.

Table 3: Details about profiling of interview's participants for Greece

Professional figure	Company	Experience with EPC	Experience with SRI
Head of Department	Ministry for Environment and Energy	Dealing with EPC control and quality	n.a.
Research Director	Institute for Environmental Research and Sustainable Development of the National Observatory of Athens	>20 years as a researcher	yes
Representative, involved with the preparation of the Technical Guidelines of the Technical Chamber of Greece	Pan-Hellenic Association of Certified Energy Auditors – (PACEI)	Accredited energy auditor and energy inspector of large-scale buildings	n.a.

Representative	Consultant company	Company collaborating with energy experts, energy auditors and bringing them with corporations in terms of real estate issues	n.a.
Advisor, Civil Engineer	Technical Chamber of Greece for the Energy Efficiency Regulation of Buildings (KENAK) and national funding programs on building energy renovation ("Energy Saving at Home")	Accredited energy auditor, Technical Chamber of Greece for the Energy Efficiency Regulation of Buildings	Technical Chamber of Greece for the Energy Efficiency Regulation of Buildings
Civil Engineer	Energy Policy Expert at a Non-for-profit, independent research organisation. Project Coordinator of SRI2Market project.	Policy officer in the Buildings Team of the Energy Efficiency Unit in DG Energy	Project Coordinator of SRI2Market project
Energy Efficiency Expert	Ministry for Environment and Energy, Greece	>10 years on EPC design policy	yes

4.3.2 Summary of conclusions

Energy auditors need better training to improve EPC quality and acquire knowledge on the latest technical and legislative developments. The current EPC is a stand-alone tool, and integrating new indicators requires careful planning. Public access to the national EPC database could enhance its value. SRI integration into EPCs needs training and careful implementation. Upgrading EPCs should focus on accurate data, user awareness, and avoiding unnecessary complexity.

4.3.3 Interview key points

Understanding EPC

In Greece, the Energy Performance Certificate plays a crucial role in assessing and communicating the energy efficiency of buildings. However, the effectiveness of EPCs is significantly influenced by the varied knowledge levels among energy auditors. This inconsistency affects the quality of their work and the recommendations they provide. Building owners generally have a good understanding of EPCs, which enhances the perceived value of these certificates. Nonetheless, assessors often face challenges in persuading owners of the importance of EPCs, partly due to their underpayment especially in the past, which impacts their performance and motivation.

National subsidy programs have proven effective in helping owners understand energy-efficient technologies, which in turn improves the accuracy of EPC calculations. However, the

methodology underlying EPCs needs to be updated to incorporate new technologies and correct existing errors. While users generally understand energy classifications, they can be confused by new rating systems, leading to misconceptions about the EPC's true value, which is often seen as a mere formality for real estate transactions and funding purposes.

Access to data, particularly for older buildings, poses a significant challenge, with low EPC costs further impacting the quality of assessments. There is a clear need for mandatory training for auditors to enhance the quality of EPCs especially for energy saving recommendations. The Hellenic Energy Inspectorate has been actively involved in analysing EPC results for future improvements. There is also potential for EPCs to be more than just diagnostic tools by highlighting energy-consuming aspects of buildings and encouraging efficient interventions.

Non-compulsory training provided by the Technical Chamber of Greece is available for auditors, but greater awareness through national programs is needed to ensure that building owners understand the importance of EPCs. The creation of a dynamic map for EPCs could contribute significantly to energy renovation efforts. Additionally, national funding programs have had a positive impact on end-users' familiarity with EPCs. Improving the cohesion of EPC schemes across EU member states could further enhance understanding at both national and European levels.

Upgrading EPC

The upgrading of EPCs in Greece faces several challenges, particularly regarding the need for better training for EPC assessors. Many assessors currently lack adequate training, and regular courses are necessary to keep them updated. The introduction of an hourly calculation methodology could benefit advanced technologies but may also increase costs. The use of real data in EPCs, while beneficial, is not feasible due to the limited availability of smart meters. Therefore, any upgrades to the EPC system should be carefully considered to avoid adding complex features like Indoor Environmental Quality (IEQ) and Smart Readiness Indicators under the current conditions.

Dynamic calculations are recognised as valuable for energy design, but their implementation is challenging due to the expected increase effort by the energy auditors and considering the relatively current low cost associated with EPC issuance. The existing infrastructure in Greece is insufficient to support the use of dynamic data, and this would fundamentally change the purpose of assessments. Sector-specific assessments are deemed adequate for residential buildings, but the tertiary sector requires significant upgrades. User behaviour data, while crucial for accurate performance assessments, should only be used under specific conditions.

To ensure that EPCs remain durable and consistent, they must help building owners make informed decisions. Micro-structural reforms are necessary, with a long transition period required for updates to regulations and software. The process of revoking EPCs presents difficulties, often leading to multiple certificates being issued for the same property. The deployment of smart meters is essential for implementing dynamic calculation-based EPCs. While the current quality of EPCs is considered adequate, assessors should adopt a more consultative role to enhance their value. A significant upgrade to EPCs is planned for 2024, focusing on enhancing data transparency and reliability. A cost-optimal study is also undergoing to examine the feasibility of dynamic data-based EPCs and to develop new software.

Databases and Tools

Greece has a sufficient national EPC database that is state-controlled, allowing for easy incorporation of changes and ensuring data accuracy. Recent collaborations among state units have resolved issues with erroneous data from private EPC software, improving the overall quality of the database. However, the lack of public access to this database limits its usefulness, and expanding access could significantly enhance its value. Potential upgrades to the database include linking it to a real-time energy cost platform, which would allow for more accurate calculations of appliance energy consumption.

The effective interoperability of various databases was demonstrated during the COVID-19 crisis, highlighting the importance of accurate data for database operations. Thorough on-site energy audits are essential to complement this data. Training for energy auditors is necessary to ensure they can effectively utilise the database. However, energy auditors currently have direct access to the national database only for the EPCs issued by them, which limits their ability to perform comprehensive assessments. The recast of the Energy Performance of Buildings Directive supports upgrading the database for public access and interoperability with the EU Building Stock Observatory.

Greece has also begun testing the Smart Readiness Indicator, although significant input was not available at the time of the interview. This testing phase is crucial for refining the methodology and ensuring that the SRI can be effectively integrated into the EPC framework.

SRI Development and Deployment

The development and deployment of the Smart Readiness Indicator in Greece are still in the early stages, and there is a clear need for additional training for SRI assessors to ensure effective evaluations. While the SRI should ideally be integrated into the EPC certificate, there are concerns that this may cause confusion among users. The current methodology already adequately assesses building automation, but there is a call for simplicity in SRI calculation, using only essential data to avoid unnecessary complexity. Consideration of other indicators, such as Life Cycle Assessment (LCA) and Global Warming Potential (GWP), should also be factored into the process.

Experience with large-scale SRI implementation is limited, particularly in building renovations. The focus for energy assessment should remain on the building envelope and energy behaviour, areas where progress by the Technical Chamber of Greece has been minimal. Further training for energy auditors is necessary to ensure successful SRI integration. The recent initiation of SRI testing in Greece is a positive step, but more needs to be done to link the SRI to the EPC scheme effectively. Established procedures could be utilised for this purpose, with relevant training provided to assessors.

The contribution of the SRI cluster has been significant, particularly in the development of tools and training materials. However, the practical application of these tools remains a challenge, and more support is needed to ensure widespread adoption.

Integration of Instruments

The integration of the EPC with other instruments, including the SRI, remains a challenge in Greece. Currently, the EPC is a stand-alone tool, and there are no provisions for integrating it with other instruments. Special attention is needed to identify the necessary methodologies for the integration of new indicators, such as those related to comfort and indoor environmental quality. Recording and monitoring energy data are crucial steps in increasing user awareness, but the lack of integration provisions hampers progress in this area.

Incorporating comfort and indoor environmental indicators into the EPC could be beneficial, but cost-optimal studies need to be updated to ensure that these additions do not overcomplicate the EPC process. Developing a comprehensive strategy for the integration of these tools will require careful planning and consideration of the existing infrastructure, which currently may not be adequate to support such integration.

4.4 Hungary

4.4.1 Profiling of participants

The details about the participants to the interview for Hungary are reported in Table 4.

Table 4: Details about profiling of interview's participants for Hungary

Professional figure	Company	Experience with EPC	Experience with SRI
Professional project manager, architect	Building industry, issuing certificates	10 years	“Little”
Architect	n.a.	12 years	n.a.
Expert consultant	Research institute	15 years	15 years
Senior manager, owner	Engineering	> 15 years	> 15 years

4.4.2 Summary of conclusions

ÉMI conducted interviews with experts (architects, engineers, energy efficiency experts and a representative of the Hungarian Chamber of Engineers) working mainly with EPC (more than 10 years experience). Since SRI is not widespread in Hungary yet most of the experts have little to no professional experience related to SRI.

The most important issue is the change in the Hungarian regulation regarding EPC. The former regulation (ministerial order of 7/2006. (V. 24) Decree about Determination of Energy Efficiency of Buildings) was replaced by ÉKM decree 9/2023 (V.25) ÉKM Hungarian Ministry’s Regulation on the Energy Performance of Buildings) and it is valid from 1st November 2023. The 176/2008. (VI. 30.) Hungarian Government Decree on the Certification of Energy Performance of Buildings was modified.

4.4.3 Interview key points

Understanding EPC

In Hungary, the effectiveness of Energy Performance Certificates is hindered by several key challenges, particularly regarding data access and user engagement. End-users often lack interest in EPCs, typically opting for the cheapest available option without fully understanding their significance. This is exacerbated by the limited availability of detailed building information, especially for older properties, where data is often only accessible in PDF format. Inspectors face significant challenges as they cannot enter properties to verify EPC data, further complicating the accuracy and reliability of assessments.

Recent regulatory changes introduced in November 2023 have added complexity to the EPC landscape. The new calculation method and software require time for adaptation, and for a period, both the old and new methods will need to be used simultaneously. Efforts are ongoing to make the new calculation method more user-friendly, though feedback is still pending.

Unfortunately, building owners remain primarily concerned with costs, which diminishes their engagement with EPCs, even with improved interfaces. Expert advice is seen as crucial in helping users better understand the implications of EPCs, suggesting that the presence of knowledgeable consultants could significantly enhance the value perceived by end-users.

Promoting energy efficiency through EPCs could be more effective if detailed renovation suggestions were provided to homeowners. The newly introduced EPC features include renovation alternatives at three different levels, offering a more tailored approach to energy improvement recommendations.

Upgrading EPC

The adoption of the new EPC methodology in Hungary has been slow, with experts still in the process of adapting to the changes. The new method is more complex and requires extensive administrative work, which has been a barrier to widespread adoption. Despite these challenges, the improved calculation process and the introduction of better graphical representations have made the new method more user-friendly.

Recent upgrades to the EPC system have somewhat reduced the urgency for further upgrades. However, it remains important to periodically review and update EPCs to accommodate new technologies. Additionally, the decree outlining the conditions for practicing and issuing certificates should specify these requirements more clearly to ensure consistency and quality.

A key area for improvement in Hungary's EPC system is the differentiation between architectural and engineering disciplines. This could enhance the overall effectiveness and quality of EPCs. The reliability of EPCs is heavily dependent on the expertise of the assessor, highlighting the need for more audits and stricter eligibility conditions. The use of smart meters and other diagnostic tools could also enhance the accuracy and effectiveness of EPC assessments.

There is no immediate need for new tools, as the software has been recently upgraded. However, the potential utility of a dynamic database has been recognised. Such a database could be useful but would require regular inspections and updated sizing parameters. Among experts, opinions are mixed regarding the usefulness of a dynamic database, reflecting a cautious approach to further technological upgrades.

Databases and Tools

Database accessibility remains a significant issue in Hungary. The aggregated EPC database is currently only accessible to the Chamber of Engineers, not to individual certifiers or experts, limiting its utility. Certification software databases are generally usable, but special buildings often require data entry from scratch, adding to the workload of assessors. Additionally, inconsistent data services and databases hinder effective integration and decision-making, further complicating the certification process.

Professional preparedness is another area of concern. While qualifications are required for certification, the knowledge and experience of professionals vary widely. Annual training programs should cover specialised areas such as electrical modules, building services, and renewable energies. However, engineers often lack knowledge in architectural disciplines and vice versa, highlighting the need for more comprehensive training. Various upskilling courses are available, but none are mandatory, leading to inconsistencies in the quality of EPC assessments.

Building inspections are crucial for producing reliable EPCs and should not be skipped. However, end-user engagement remains a challenge, as most users are primarily interested in

EPCs only when selling their homes. Users who are genuinely interested in understanding their homes and preparing for energy modernisation tend to engage more deeply with EPCs.

SRI Development and Deployment

The Smart Readiness Indicator is not yet widely used in Hungary, and there is a strong case for making it mandatory to accelerate its adoption. Currently, SRI is more commonly applied in large buildings as part of energy audits. However, SRI alone is insufficient for full-scale building digitalisation.

To accelerate the digitalisation of buildings, smart meters with telemetry data recording could be an effective tool. While SRI is slowly gaining traction in Hungary, there is a need for greater recognition and training to support its wider adoption. The main barriers to SRI implementation include technical and software shortcomings in processing results. Despite these challenges, Hungary is progressing relatively well compared to the EU average, but careful consideration of the local building stock and available technologies is necessary when planning for broader implementation.

SRI ratings depend heavily on the building, technology system, and local energy supply, factors that are often beyond the control of building owners. This dependency underscores the need for a more integrated approach to energy planning and SRI deployment.

Integration of Instruments

Integrating the EPC with other tools, such as the SRI and digital logbooks, presents several challenges in Hungary. Few buildings are equipped with system-level smart meters, and certifiers rarely encounter them, which limits the effectiveness of integration efforts. Additionally, there is a lack of consistency between different software tools, making it difficult to link common parameters across systems.

The inconsistency in integrating EPCs with digital logbooks and SRI is further complicated by the varying outputs of different monitoring systems. Potential solutions include encouraging vendors to create data for a common platform and developing interconnectable systems. However, this is challenging from a business perspective, particularly when it comes to installing specific systems from particular manufacturers and ensuring compatibility with other devices.

Software and parameter harmonisation are critical to improving the integration process. Comparing measured and calculated parameters remains a challenge, and significant software improvements are needed to address these issues. Harmonising definitions, legislation, and practices for basic minimum parameters at both national and regional levels would be beneficial. Moreover, selecting a method for uploading and storing certificates that allows for filtering and statistical analysis is advisable.

Current rules on certification costs and hourly rates for engineers do not support raising professional standards, highlighting the need for a more supportive regulatory framework that encourages higher standards in EPC and SRI assessments.

4.5 Italy

4.5.1 Profiling of participants

The details about the participants to the interview for Italy are reported in Table 5.

Table 5: Details about profiling of interview's participants for Italy

Professional figure	Company	Experience with EPC	Experience with SRI
Italian business development and marketing manager for Energy management and automation solutions in Buildings	Global specialist in energy management and automation solutions / Electrical manufacturer	“Quite good”	“Quite good”
Country responsible for standards and regulations	Industry/Manufacturer	“Pretty good”	“Pretty good, especially for SRI”

4.5.2 Summary of conclusions

The interviews confirmed survey trends and allowed deeper exploration. For EPC, there’s a belief that current evaluations are inadequate as they don’t consider actual building use. Users see EPCs as merely administrative. For SRI, there’s a need for awareness initiatives in the building market. Combining EPC and SRI into a single process is desirable, but requires a robust data infrastructure.

4.5.3 Interview key points

Understanding EPC

The Energy Performance Certificates in Italy face significant challenges, particularly in terms of data accessibility and the accuracy of the information they provide. The current Information System on Energy Performance Certificates covers only a small portion of the building stock, and there is a notable lack of energy data from smart meters. This limitation hampers efforts to accurately assess actual building consumption, making the EPCs less reflective of real-world energy use.

Moreover, EPCs are often based on theoretical parameters, which do not accurately reflect the true energy performance of buildings. Users tend to view EPCs as mere administrative documents, filled with abstract information that lacks the financial impact needed to motivate action. This perception is exacerbated by limited awareness and poor dissemination of current and future developments related to EPCs, which negatively affects the entire building value chain.

To address these issues, it is recommended that consumption data from buildings equipped with energy management solutions be included in EPCs to provide a more accurate baseline. Additionally, a new EPC rating system should be developed to incorporate active energy management solutions, aligned with the EN ISO 52120-1:2021 standard. This would enhance the relevance and accuracy of EPCs, making them more useful tools for improving energy efficiency.

Upgrading EPC

The adoption of new technologies in the context of EPCs in Italy faces several barriers. Awareness of these technologies is generally limited to building insulation materials, LED lighting, heat pumps, and photovoltaic systems. Few professionals are fully aware of the benefits and regulatory frameworks associated with Building Automation and Control Systems (BACS), and these systems are typically only adopted upon specific customer request.

To improve the accuracy of EPC ratings, it is essential to consider the entire 'installation-building' system, including all technical building systems. The implementation of the new Energy Performance of Buildings Directive (EPBD IV), which incorporates the EN ISO 52016 and 52120-1 standards, is seen as a more inclusive and effective approach to EPCs. To ensure compliance with current and future legislative frameworks, it is recommended to introduce promotion, incentives, or sanctions.

Dynamic data-based EPCs offer the potential for more accurate energy assessments. Dynamic calculations or hourly energy measurements are considered beneficial, although they would involve additional costs for data communication devices. Furthermore, a final inspection is necessary to evaluate the status of passive technologies and to assess the efficiency class of BACS and the Smart Readiness Indicator.

Databases and Tools

Italy's EPC-related databases currently face several challenges, including limited data availability and varying skill levels among EPC assessors. These limitations hinder the effectiveness of EPCs as tools for improving energy efficiency. Furthermore, clients and building owners often have a limited understanding of the purpose of EPCs, which diminishes their perceived value.

To enhance the utility of EPCs, it is suggested that these certificates should include corrective actions aimed at improving energy efficiency, alongside calculations based on EN ISO 52016 and EN ISO 52120-1 standards, BACS efficiency class, and SRI rating. Moreover, implementing a certification scheme for "EPC assessors" would enhance the competencies of these professionals, preparing them for the next generation of "EPC-SRI assessors," who will need to have expertise in building installations as well.

SRI Development and Deployment

The development and deployment of the Smart Readiness Indicator in Italy are currently hindered by several challenges, including limited data availability and a lack of knowledge regarding the technical architecture of buildings. Authorities and professional orders in Italy often underestimate the value impact of SRI, and demand-side management (grid flexibility) is not yet available as a market service, further limiting the adoption of SRI.

However, SRI has the potential to accelerate the digitalisation of buildings and support the Twin Transition towards a more sustainable and digital future. Public Administration (PA) could play a significant role in promoting SRI if specific targets are introduced and achieved.

To overcome these challenges, it is recommended to develop a clear rationale in the SRI methodology to reduce ambiguities and improve comparisons between buildings. Creating a building logbook and a building renovation passport would also help address issues related to finding technical documentation. Additionally, promoting SRI through activities that showcase its effectiveness, and introducing incentives or financial support linked to the SRI score, could further encourage its adoption.

Integration of Instruments

Integrating EPCs with SRIs and other building assessment tools in Italy is not expected to be significantly difficult, provided the appropriate expertise is available. However, the success of this integration depends heavily on the establishment of an effective data infrastructure. A robust and well-integrated data infrastructure is essential to ensure that EPCs and SRIs can be seamlessly combined, allowing for more comprehensive and accurate assessments of building energy performance.

4.6 Poland

4.6.1 Profiling of participants

The details about the participants to the interview for Poland are reported in Table 6.

Table 6: Details about profiling of interview's participants for Poland

Professional figure	Company	Experience with EPC	Experience with SRI
University professor	Warsaw University of Technology	Involved in energy efficiency in construction since 1998. In 1999-2002: was vice-president of the National Energy Conservation Agency. Over 100 expert opinions on energy efficiency and RES energy policy (including several expert opinions on updating energy performance certificates).	Not participated in many projects that included its calculation, but in many discussions related to this topic.
Official	Ministry of Development and Technology.	15 years	n.a.

4.6.2 Summary

Conducted interviews about the status of EPCs in Poland reveal significant challenges and opportunities for improvement. Key issues include the lack of accessible building data, public misconceptions about the utility of EPCs, and the inconsistent quality of assessments. To enhance the effectiveness of EPCs, efforts should focus on improving data management, increasing public awareness, and adopting new technologies like AI and potentially dynamic data integration. Additionally, simplifying the presentation of energy performance and ensuring a robust, transparent system can help transform EPCs from mere administrative documents into valuable tools for promoting energy efficiency and sustainability in buildings.

The development and deployment of the Smart Readiness Indicator presents both opportunities and challenges in enhancing building energy performance in Poland. While SRI holds potential as a tool for verifying technical compliance and aiding in energy planning, its

current lack of regulation and societal awareness limits its impact. Also, it is still in the very early phase of development and at this point, it would not be obligatory to implement into national legislation. To fully realise the benefits of SRI, future efforts must focus on increasing awareness and developing robust methodologies, with the priority placed on the calculation of SRI for large buildings.

4.6.3 Interview key points

Understanding EPC

In Poland, the creation of effective Energy Performance Certificates is heavily reliant on comprehensive and accessible building documentation. However, this documentation is often lacking due to historical events and changes in systems, making it challenging to produce accurate and useful EPCs. Furthermore, the EPC system is frequently exploited for compliance purposes rather than being used to genuinely improve energy efficiency. As a result, EPCs are often viewed as administrative burdens rather than tools that can highlight potential financial savings through energy efficiency improvements.

To address these issues, several recommendations have been made. First, the process of preparing EPCs should be automated, and strict controls should be implemented to ensure the reliability of these certificates. Additionally, the calculation and presentation of energy performance need to be revised to make the information more understandable, potentially through the use of energy classes that clearly convey performance levels. Moreover, promoting energy efficiency requires a bottom-up approach, involving non-governmental organisations (NGOs) and leveraging effective visual communication to raise public awareness and interest in energy performance.

Upgrading EPC

The adoption of new technologies for upgrading EPCs in Poland faces significant challenges. Implementing advanced technologies like artificial intelligence (AI) and machine learning for EPC preparation requires substantial infrastructure, such as sensor installations, to gather accurate data. Furthermore, the reliability of innovative construction technologies is crucial to avoid future issues, which has created a barrier to widespread adoption.

Several other barriers impede the effective upgrading of EPCs. There is a general lack of awareness about the practical utility of EPCs, leading to reluctance in investing in what is often perceived as unreliable documents. Additionally, the existing infrastructure is insufficient to support the preparation of advanced EPCs.

To overcome these challenges, it is recommended to increase public understanding of the benefits of EPCs by displaying them prominently and by comparing EPC results with actual energy consumption. Introducing energy management systems can further enhance the reliability of EPCs and encourage public education on the importance of energy efficiency. However, achieving dynamic data-based EPCs, which rely on extensive sensor networks and real-time data integration, remains a challenge in Poland due to current limitations in infrastructure.

Databases and Tools

Poland's current EPC database is constrained by regulations like GDPR and other data protection laws, which limit its usefulness to internal analysis rather than for the average citizen. Several barriers further complicate the effectiveness of the database, including legal restrictions that limit the ability to identify specific buildings and housing units, concerns about data security, and a lack of integration with other systems.

Moreover, the availability and timeliness of data are significant issues. Current databases contain only basic information, and there is a notable lack of advanced analytical tools for data comparison and analysis. The competence of EPC assessors also varies greatly, highlighting the need for additional training in areas such as methodology, building physics, construction law, and practical application. Automated training programs, e-learning exams, and a unified computer program could help improve the quality of certificates and the competence of assessors.

On-site visits, whether real or virtual, are essential for obtaining reliable data and documentation. However, EPCs are often not updated after project changes, leading to inconsistencies. It is crucial that auditors, who are responsible for EPC errors, obtain accurate and reliable data to ensure the integrity of the certification process.

SRI Development and Deployment

The implementation of the Smart Readiness Indicator in Poland is currently supported by some regulations that aid automatic building regulation. The SRI can play a role in verifying technical conditions and assisting in energy planning for groups of buildings. However, the lack of specific SRI regulations until 2027 makes its current usefulness difficult to assess. As SRI remains voluntary, it may face challenges when it becomes mandatory, including low awareness among both society and professionals.

SRI contributes to the broader trend of digitalisation, supported by systems like Building Information Modelling (BIM). BIM has the potential to enhance the design, construction, and production of EPCs and SRIs, promoting the use of digital tools in the construction industry. Despite this potential, SRI is not widely recognised among professionals in Poland.

Respondents were not ready to make specific recommendations on the integration of SRI, although the creation of digital twins of buildings was mentioned as a potential benefit. However, this approach requires autonomous data collection and dynamic modelling to be effective.

Integration of Instruments

The integration of additional indicators, such as SRI and GWP, into EPCs presents several challenges. Introducing these parameters could complicate the certification process, increase calculation complexity, and impact the readability of the certificates. Balancing the quantity of information with its usefulness is crucial to avoid overwhelming end users.

Several barriers to integration exist, including difficulties in obtaining data for GWP, SRI, and Indoor Environmental Quality calculations, which may affect the accuracy of certificates. Moreover, excessive information could make the certificates less transparent to end users, while the lack of clear methodologies for calculating these indicators could lead to subjective assessments that may discourage potential buyers.

Furthermore, the integration of various databases and information systems into a single platform is complex and resource-intensive. It is also essential to convince stakeholders of the relevance and benefits of new indicators like SRI to ensure their acceptance and adoption.

4.7 Slovenia

4.7.1 Profiling of participants

The details about the participants to the interview for Slovenia are reported in Table 7.

Table 7: Details about profiling of interview's participants for Slovenia

Professional figure	Company	Experience with EPC	Experience with SRI
Green building certification (BREEAM, LEED, DGNB) and energy performance certificates	Bureau Veritas d.o.o. and Energy Performance Certificate d.o.o.	5 years	5 years
Head of the Energy Use Sector	Energy Use Sector within the Directorate for Energy at the Ministry of Environment, Climate and Energy in the Republic of Slovenia	> 10 years	n.a.
Member of the Board of Directors of the Association of Energy Performance Certificate Producers	Independent Energy Performance Certificate Expert - Association of Energy Performance Certificate Producers	Several years of experience in energy performance certificates for buildings owned by natural and legal persons	n.a.
Project manager	Local Energy Agency	A lot of experience with the implementation of EPCs	Less experience with SRI: “I have performed some SRI calculations as part of another international project”
Researcher, project leader	Research institution	> 10 years in the field of EPC or SRI within the EU	> 10 years in the field of EPC or SRI within the EU

4.7.2 Summary

The main challenges include data accessibility, public understanding, the adoption of new technologies, and the integration of various assessment tools. By addressing these challenges through targeted training, methodological updates, and improved data infrastructure, these tools can be better leveraged to promote energy efficiency and contribute to the sustainable development of Europe’s building stock. Increasing public awareness about the benefits of EPCs and SRIs is essential to their effective implementation. Governments need to play a proactive role in supporting the adoption of new technologies and methodologies through regulatory updates and financial incentives.

4.7.3 Interview key points

Understanding EPC

In Slovenia, the effectiveness of Energy Performance Certificates is hindered by significant challenges related to data accessibility and public understanding. The existing data on buildings is often incomplete or of poor quality, making it difficult to accurately assess energy performance. Additionally, the lack of centralised digital databases further complicates the collection and analysis of necessary data. Many buildings suffer from outdated or non-existent technical documentation, adding to the difficulty of obtaining the information required for EPC assessments.

The general public and building owners in Slovenia often do not fully understand EPCs. The technical language, complex data, and detailed graphs included in EPCs can be overwhelming for non-specialists. As a result, EPCs are frequently viewed as mere regulatory requirements rather than as valuable tools for improving energy efficiency.

The production of EPCs faces its own set of challenges. The process is often rushed, which leads to inaccuracies. This issue is exacerbated by a lack of on-site inspections, with many EPCs relying on flawed or incomplete documentation. There is a growing concern that EPCs produced without proper building inspections are undermining the credibility of the certification process.

To address these issues, it is recommended that key indicators on EPCs be communicated in a simplified and clear manner. Regular workshops, seminars, and targeted training sessions should be organised to improve understanding among stakeholders. Centralising data in digital databases, such as the EnerGIS project, is critical for enhancing the reliability and accessibility of information.

Upgrading EPC

The adoption of new technologies for EPCs in Slovenia is hampered by several barriers. There is a pressing need for methodological updates and targeted training, especially for advanced methods like dynamic calculations and Building Information Modelling. However, the high costs and complexity associated with these technologies pose significant challenges to their widespread adoption.

Additional barriers to upgrading EPCs include concerns related to GDPR, particularly regarding the use of real-time energy consumption data. There is also a lack of sufficient mandatory training for EPC producers, which is necessary to ensure the quality and accuracy of the certifications. Moreover, there is a need for greater supervision in the EPC production process to maintain high standards.

To simplify the EPC process, it is recommended to reduce the complexity of information presented on the first page of the certificate, focusing instead on key indicators that are most relevant to users. Linking EPCs to economic incentives, such as subsidies for energy renovations, could further enhance their utility and impact, making them more valuable to property owners.

Databases and Tools

Slovenia faces challenges in establishing and maintaining the data infrastructure needed to support effective EPC assessments. The costs associated with developing this infrastructure and purchasing the necessary tools are high, which is a significant barrier to progress.

Additionally, there are concerns about whether professionals involved in EPC assessments have received adequate training to use these tools effectively.

Despite these challenges, there have been some successful strategies implemented in Slovenia. For instance, the use of public systems like the GURS database, which integrates energy performance certificates, has been a positive development. The ENERGIS public information portal is another promising initiative that could improve data accessibility and user engagement.

To continue improving the data infrastructure, it is recommended to gradually upgrade systems to ensure they are accessible and user-friendly. Further training on dynamic simulations and energy efficiency recommendations should be provided to professionals to improve the quality and reliability of EPC assessments.

SRI Development and Deployment

The development and deployment of the Smart Readiness Indicator in Slovenia are still in the early stages, with limited practical experience among professionals. One of the main challenges is the cost associated with implementing SRI, as well as the need for appropriate legislation to support its use.

Despite these challenges, SRI has the potential to accelerate the digitalisation of buildings in Slovenia. However, its effectiveness is currently limited by a lack of recognition and understanding among both professionals and the general public.

To maximise the benefits of SRI, it is recommended to align SRI calculations with energy audits, which could help reduce costs and streamline processes. Additionally, increasing awareness and adoption of SRI through targeted promotion and training is crucial for its successful implementation.

Integration of Instruments

Integrating EPC, SRI, and other tools presents significant challenges in Slovenia due to the complexity of developing appropriate methodologies. The lack of connection between separate calculations and tools further complicates the integration process, making it difficult to create a seamless system.

To address these challenges, a phased approach to integration is recommended. Starting with the inclusion of SRI calculations in energy audits could be an effective first step. Developing a unified methodology that ensures seamless interoperability between these tools is essential for future success in building energy efficiency and digitalisation efforts.

5 Conclusion

This deliverable summarises the findings from a survey and interviews conducted with stakeholders across eight EU countries to assess the current effectiveness, awareness, and integration of Energy Performance Certificates and the Smart Readiness Indicator, along with their methodologies. The study has led to several key conclusions:

1. **EPC improvement and standardisation:** There is a clear need for the enhancement and standardisation of EPCs at the EU level, particularly regarding their methodology, comprehensibility, and perceived value by users and building owners. Additionally, improved training for specialists and more rigorous verification processes should be prioritised to ensure the reliability of EPCs.

2. **Methodological advancements:** The adoption of dynamic data-based and dynamic calculation-based EPCs could significantly enhance the accuracy and relevance of energy performance assessments. Moreover, the introduction of new regulations, indicators, and layouts would further improve the clarity and usability of EPCs for all stakeholders.
3. **National databases:** The creation of national databases encompassing EPCs and the data utilised in their generation would greatly enhance both the control and methodological aspects of energy performance assessments. These databases should be underpinned by regular audits and continuous improvements in the tools used for data collection and analysis.
4. **SRI awareness and potential:** Unlike EPCs, the SRI and its associated calculation methodology remain relatively unknown among stakeholders. However, the potential of SRI in enhancing energy efficiency is widely recognised. As a result, establishing a minimum SRI value for new buildings is recommended to drive adoption.
5. **Promotion and integration of SRI:** To foster the adoption of SRI, it would be beneficial to develop a calculation platform that enables professionals to easily calculate and integrate both EPC and SRI indicators. Additionally, targeted communication efforts and demonstration activities are necessary to address stakeholder uncertainty and highlight the value of integrating SRI with EPC.
6. **Regional differences:** The survey revealed regional differences in trust towards the current EPC methodology. Countries such as Croatia, Slovenia, and Hungary demonstrated greater confidence in the existing EPC framework compared to others like Poland, Italy, and Austria. This suggests that a better understanding of the EPC process correlates with a reduced perceived need for methodological upgrades. However, disparities in response rates across countries, ranging from 9 in Austria to 129 in Poland, should be noted. Countries like Greece and Poland particularly emphasised the need for enhanced professional training related to EPCs.
7. **Leveraging positive practices:** Successful practices identified in various countries should be utilised to guide the development of a more harmonised EU-wide EPC methodology, leveraging the strengths observed across different regions.
8. **SRI integration and awareness:** While there is consensus across all countries on the potential benefits of SRI and its integration with EPC, discrepancies in understanding and methodology were noted. These variations should be carefully considered when designing communication strategies aimed at increasing stakeholder awareness of SRI.
9. **Identified weaknesses in EPC and SRI systems**: Interviews across different countries highlighted several common weaknesses in the current EPC and SRI frameworks:
    - The complexity of existing regulations and the need for more user-friendly tools.
    - The necessity for improved training of professionals involved in EPC and SRI assessments.
    - The urgent need for standardisation at the EU level to ensure consistency and reliability.
    - The requirement for a robust infrastructure to support the careful implementation of EPC-SRI integration.
    - A broader dissemination of expertise related to SRI, which remains in its early stages of development.
    - The need for increased public awareness about the goals and benefits of EPCs.
    - The importance of improved accessibility to accurate building data for better assessments.

Appendix 1. Survey results by countries

Survey results – Austria

Figure 16. Results of the survey for Austria: Understanding EPC

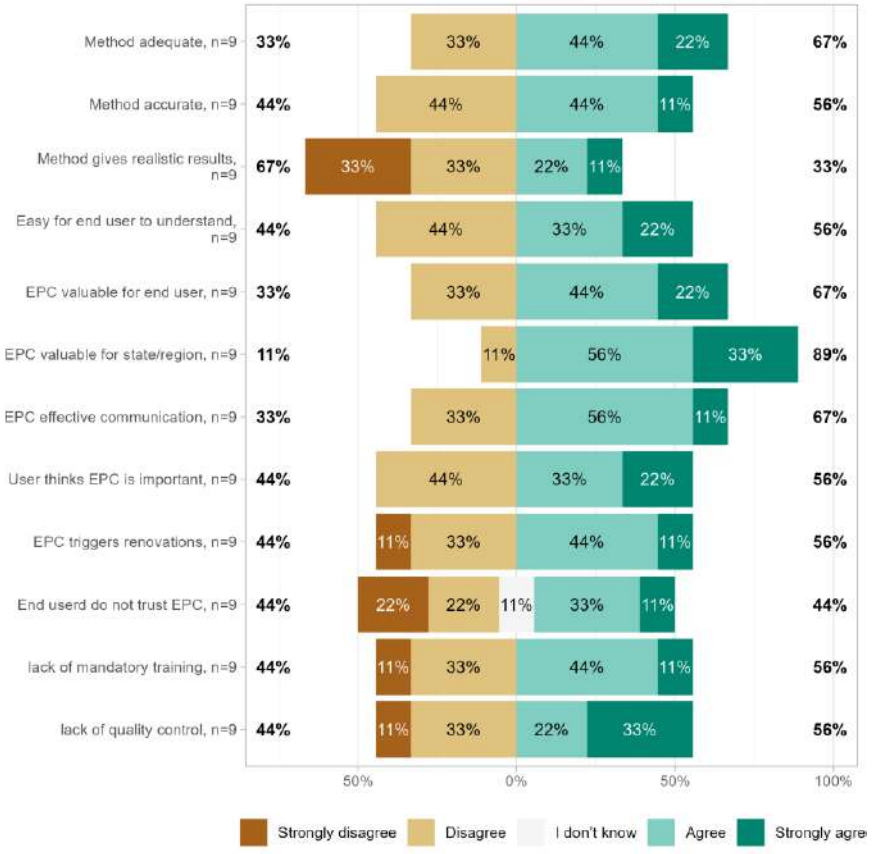


Figure 17. Results of the survey for Austria: Upgrading EPC

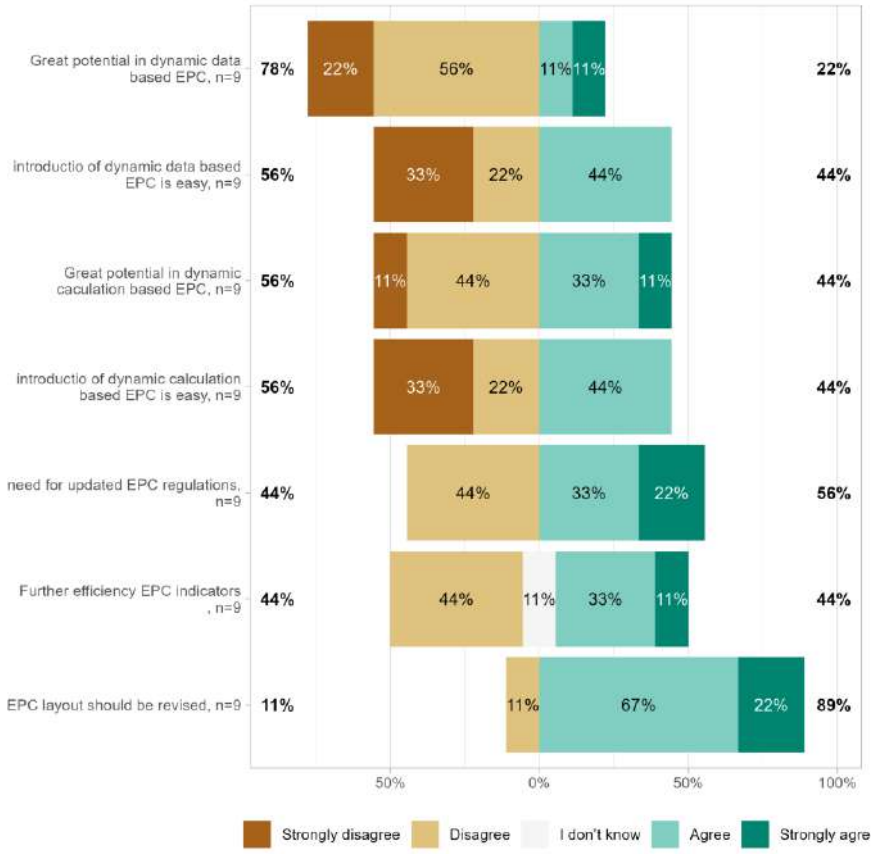


Figure 18. Results of the survey for Austria: Databases and Tools

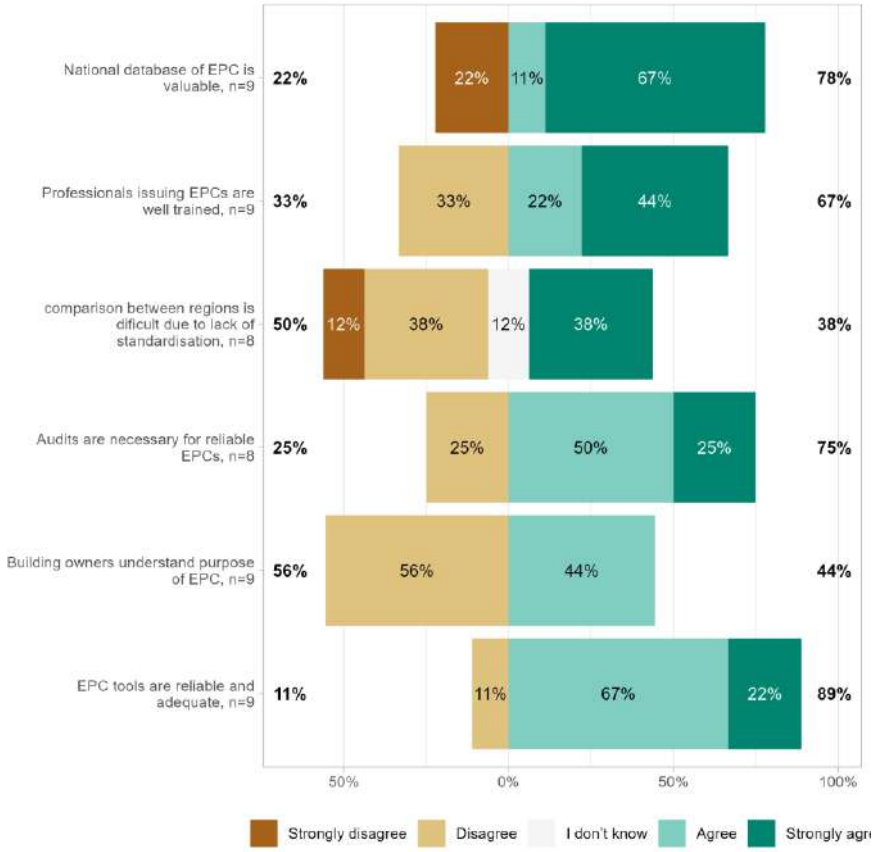


Figure 19. Results of the survey for Austria: SRI Development and Deployment

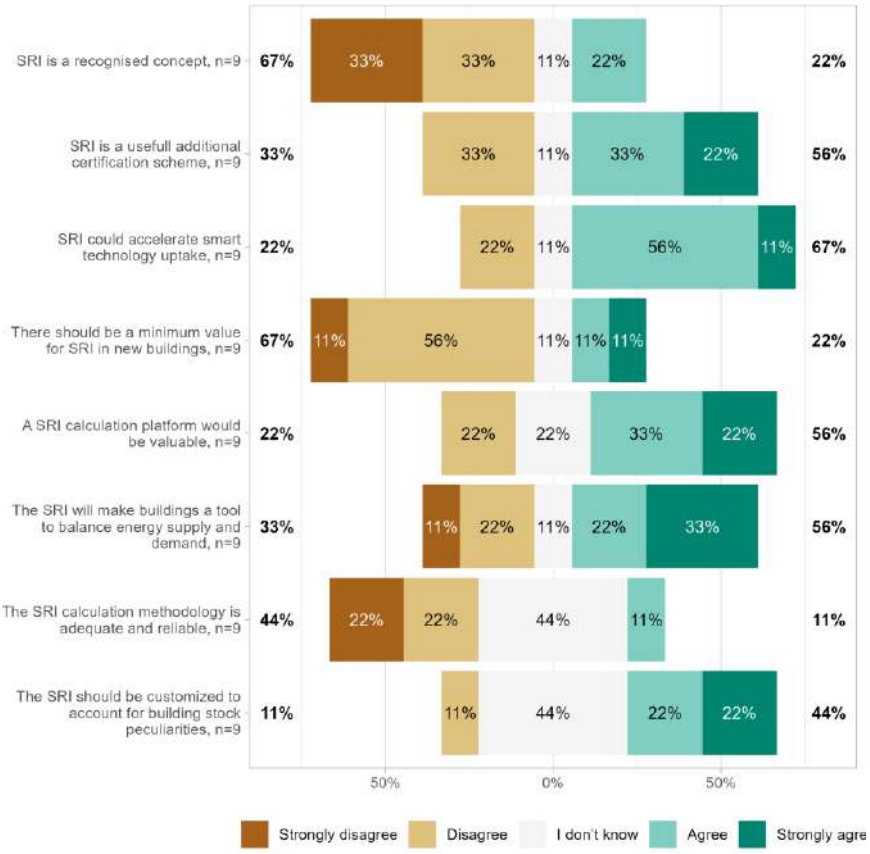
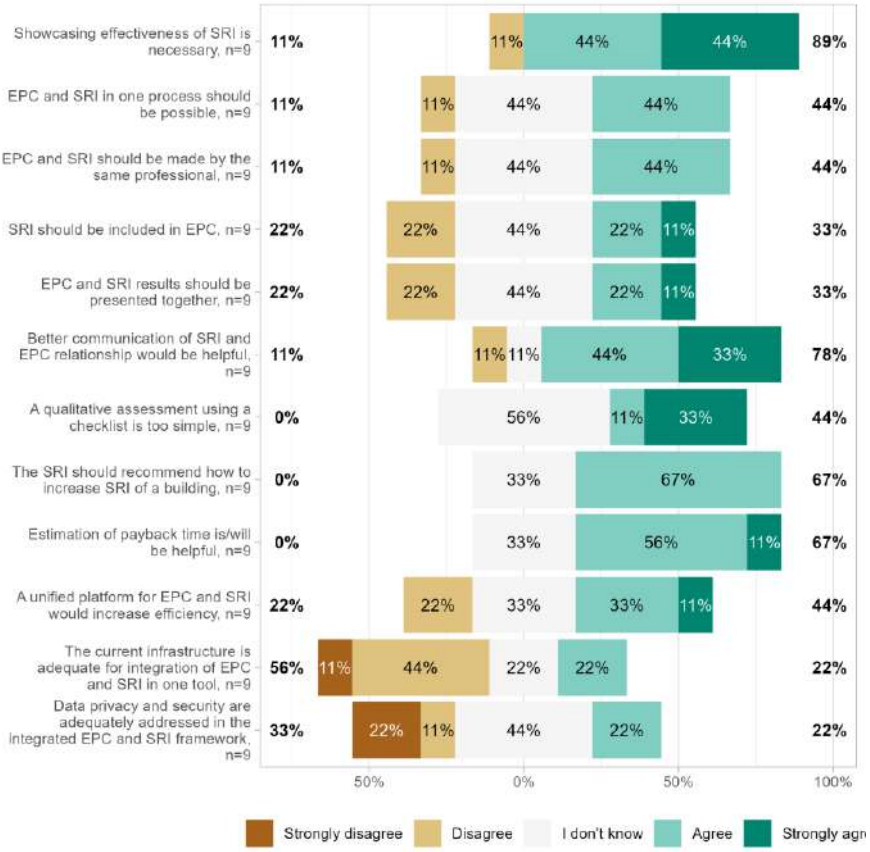


Figure 20. Results of the survey for Austria: Integration of Instruments



Survey results – Croatia

Figure 21. Results of the survey for Croatia: Understanding EPC

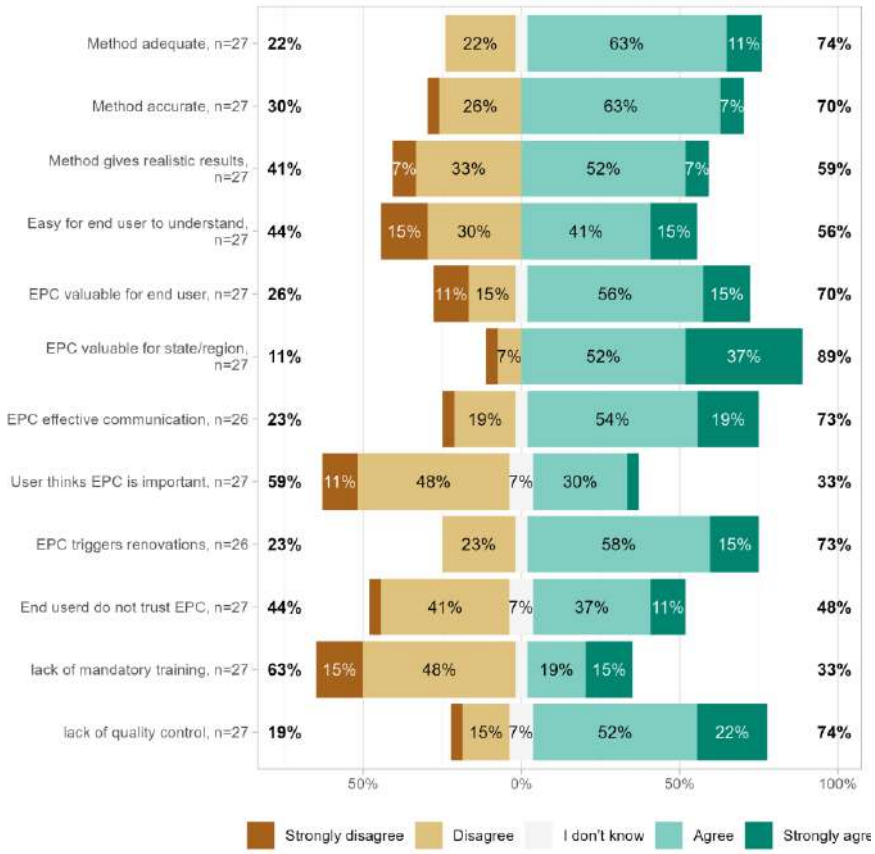


Figure 22. Results of the survey for Croatia: Upgrading EPC

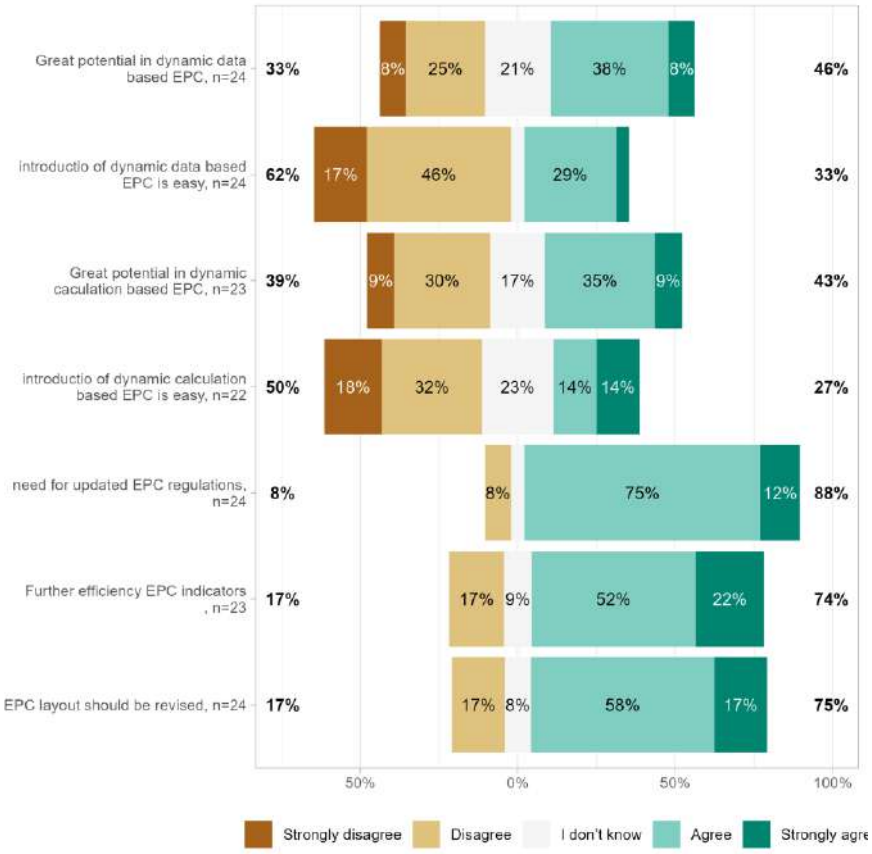


Figure 23. Results of the survey for Croatia: Databases and Tools

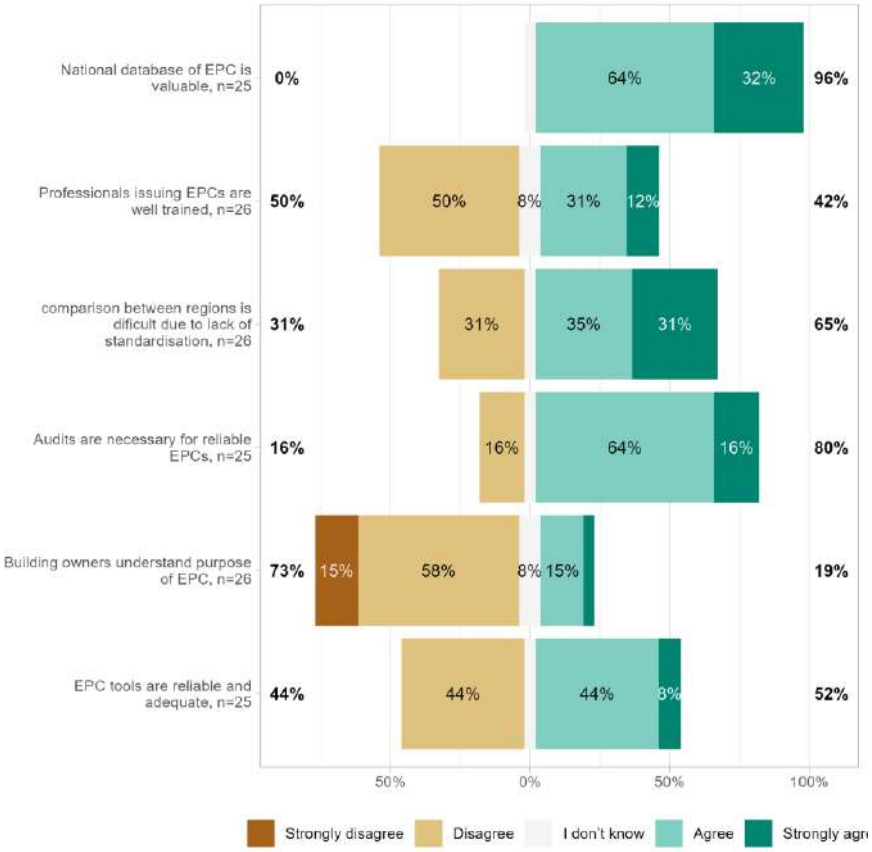


Figure 24. Results of the survey for Croatia: SRI Development and Deployment

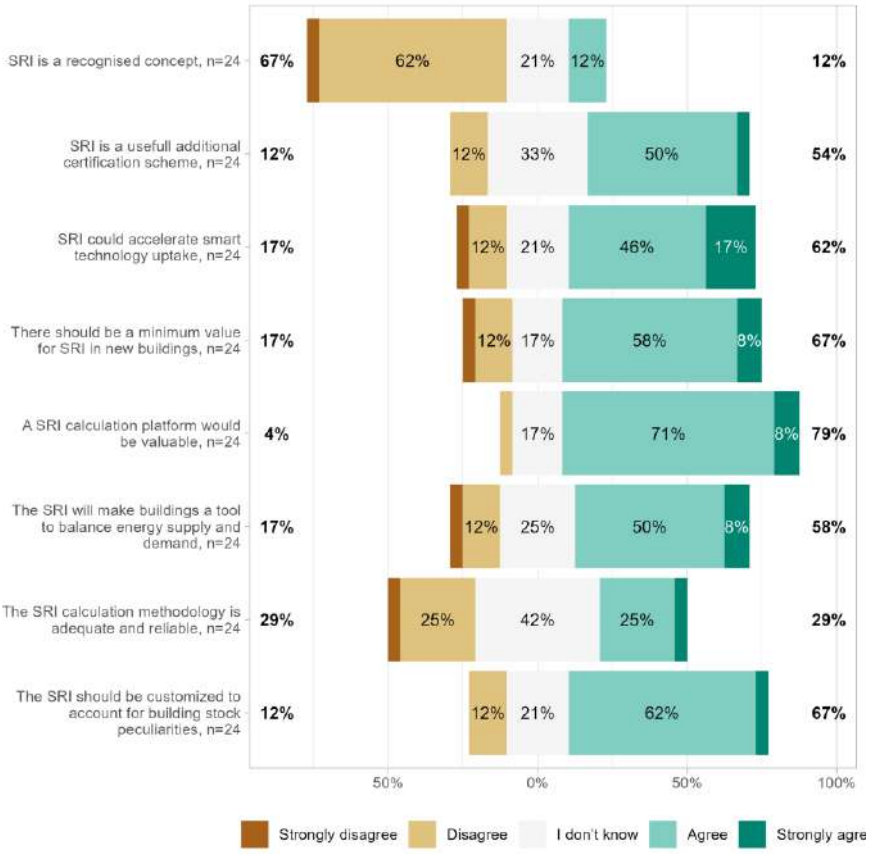
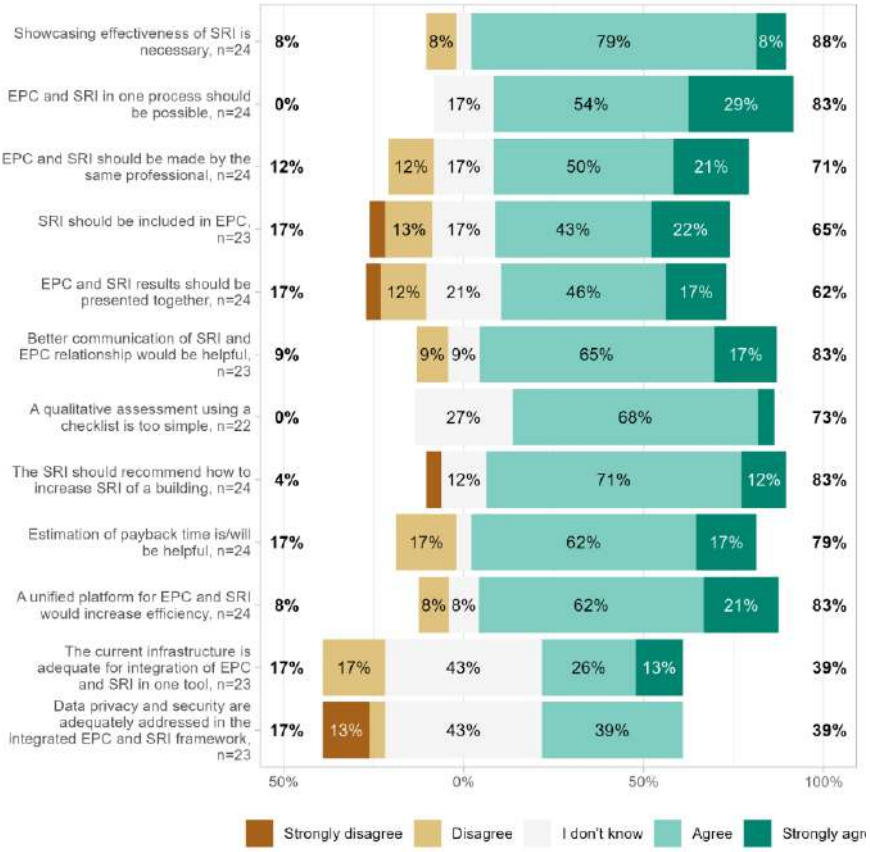


Figure 25. Results of the survey for Croatia: Integration of Instruments



Survey results – Greece

Figure 26. Results of the survey for Greece: Understanding EPC

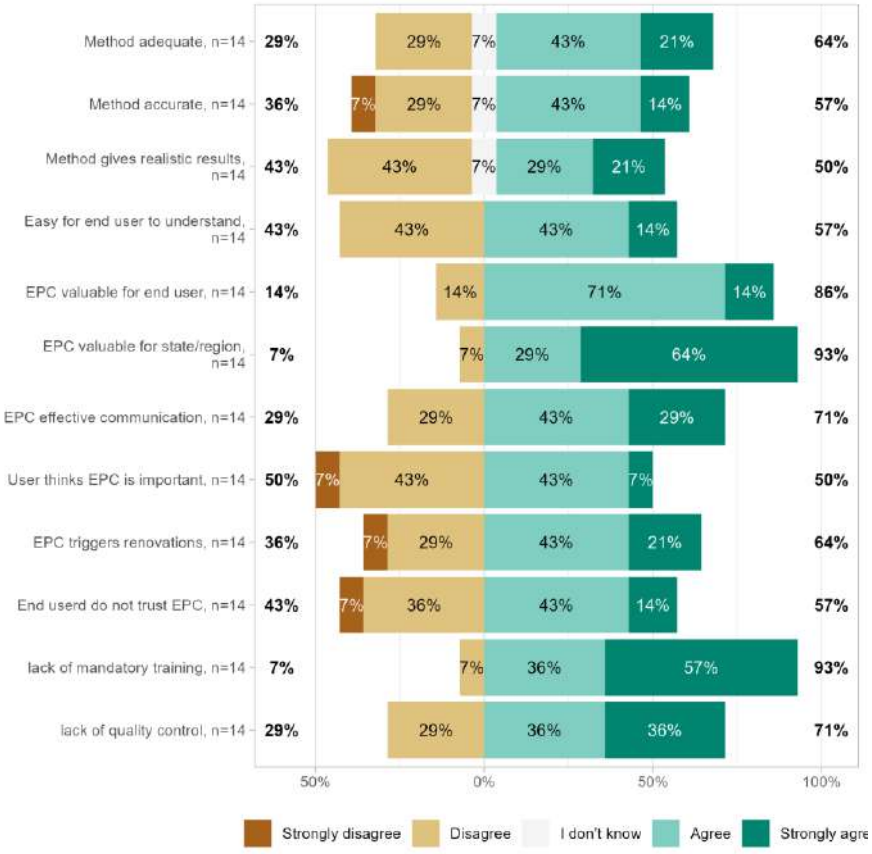


Figure 27. Results of the survey for Greece: Upgrading EPC

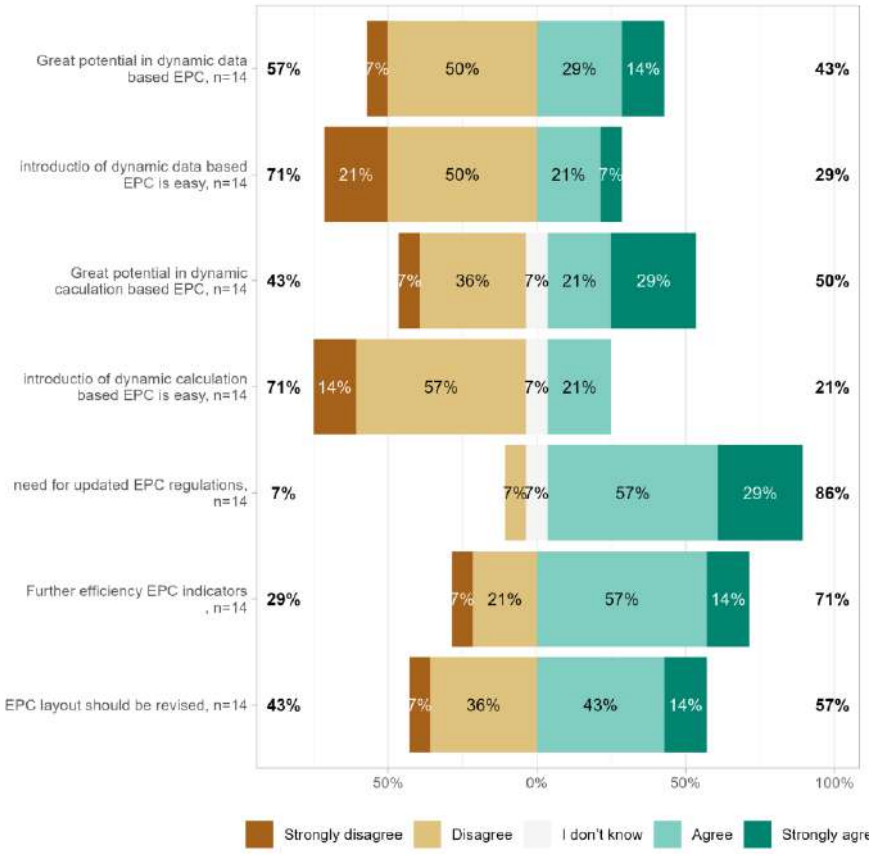


Figure 28. Results of the survey for Greece: Databases and Tools

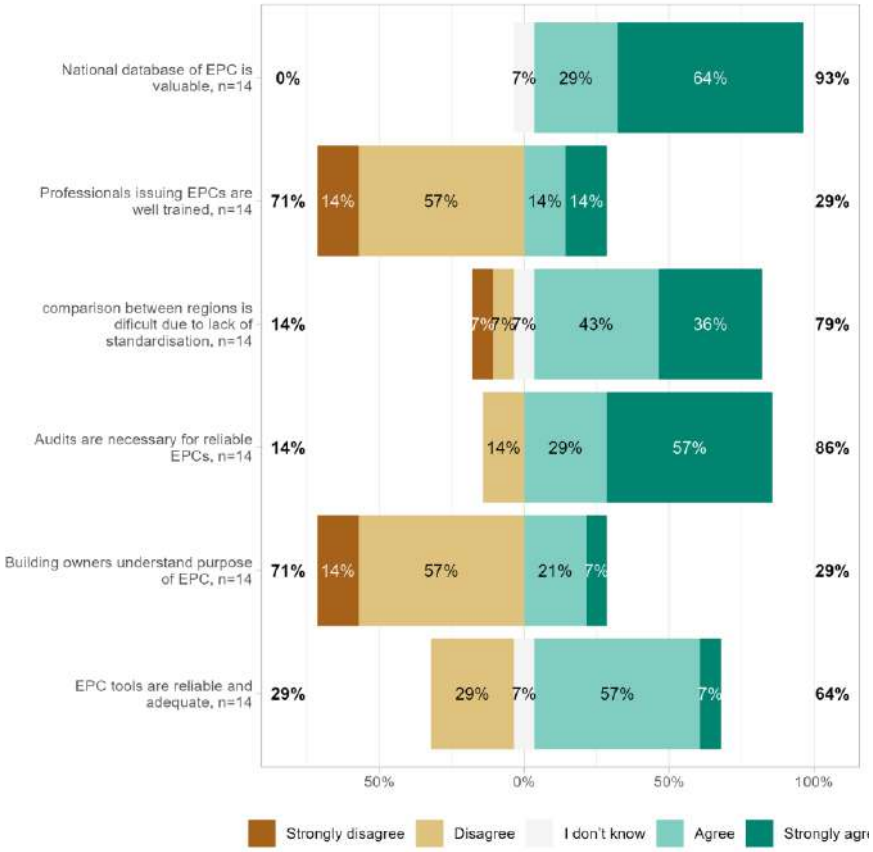


Figure 29. Results of the survey for Greece: SRI Development and Deployment

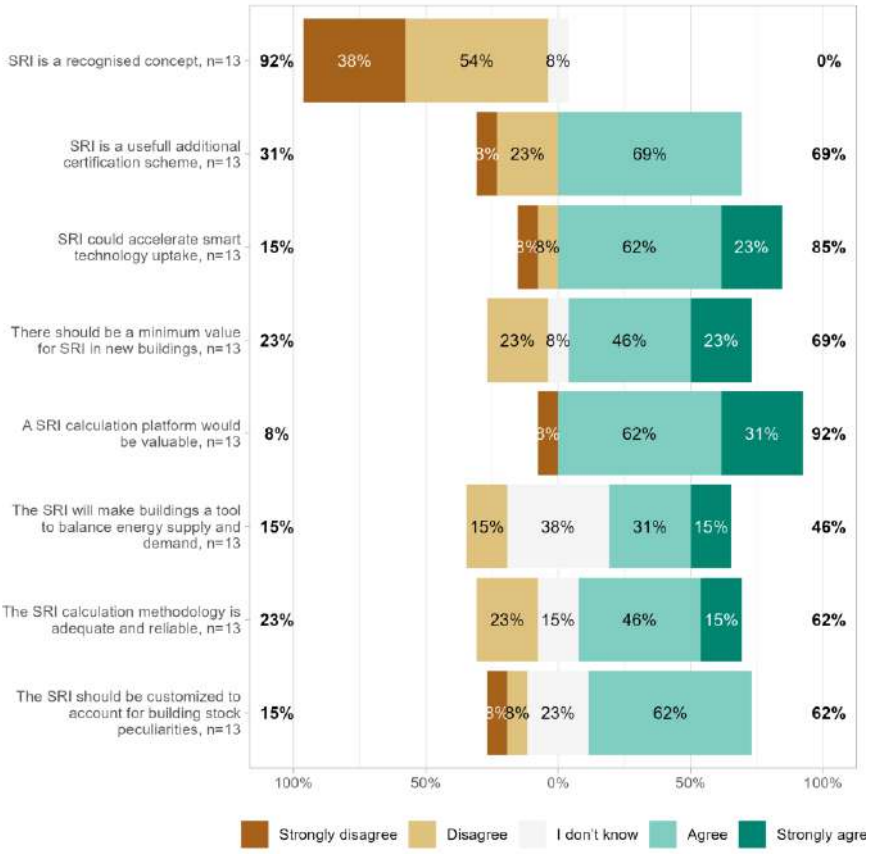
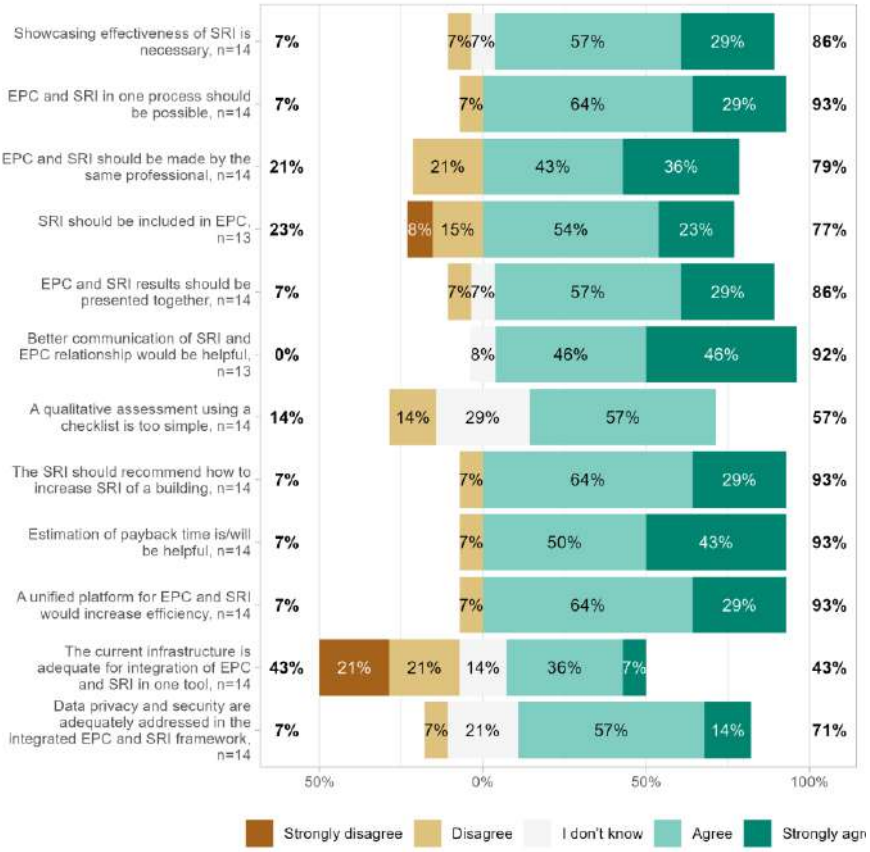


Figure 30. Results of the survey for Greece: Integration of Instruments



Survey results – Hungary

Figure 31. Results of the survey for Hungary: Understanding EPC

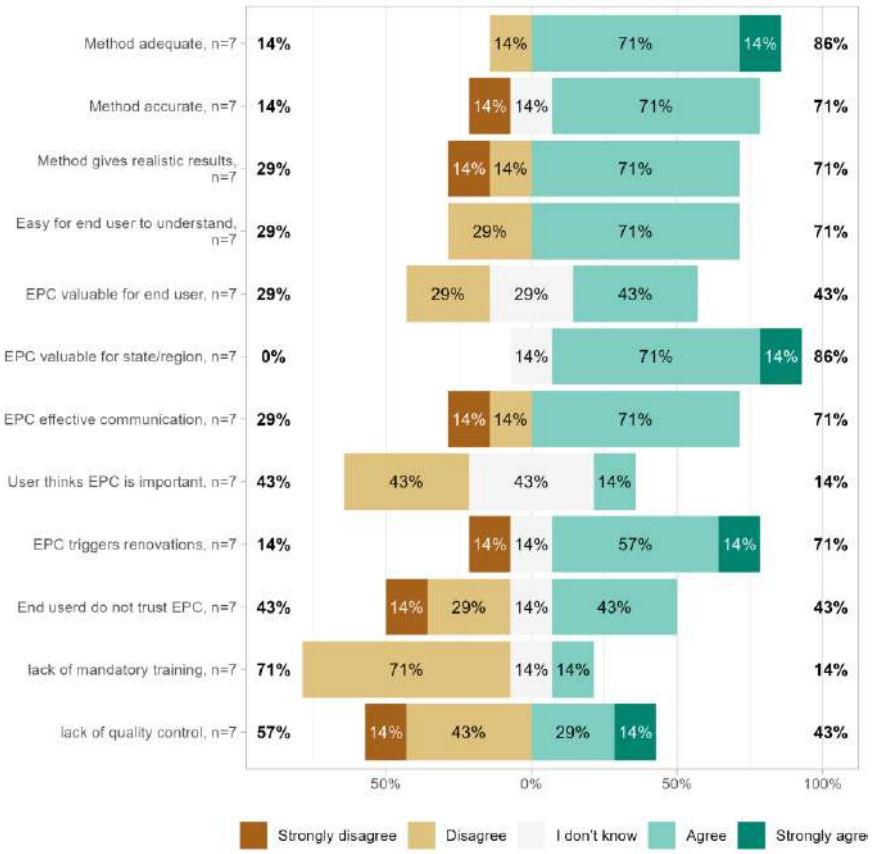


Figure 32. Results of the survey for Hungary: Upgrading EPC

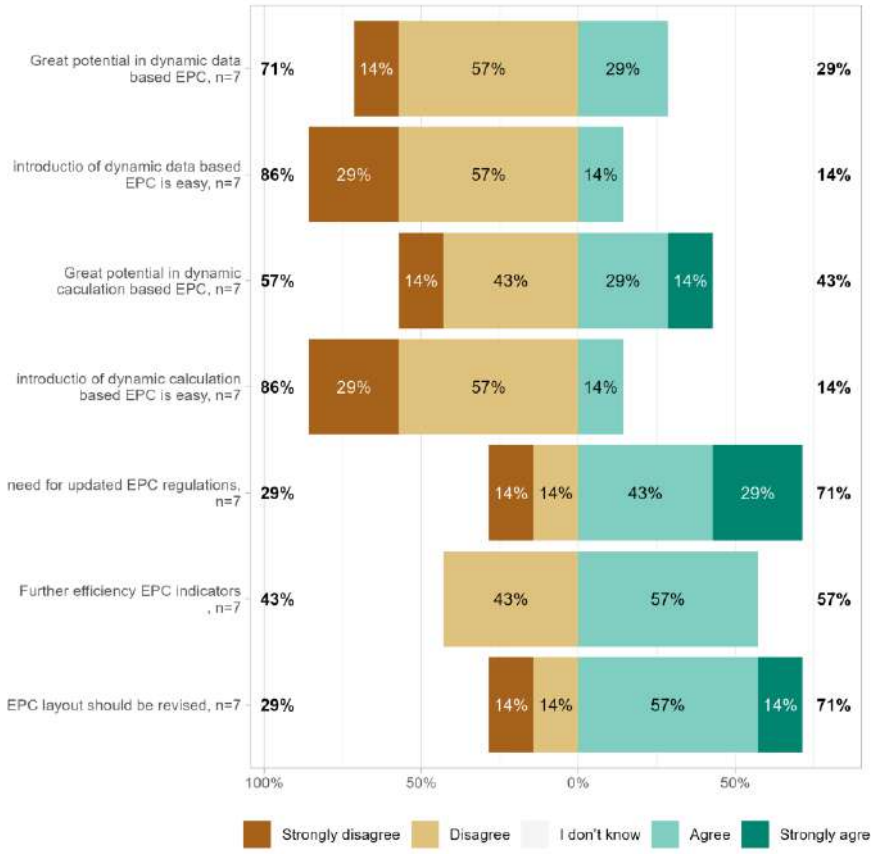


Figure 33. Results of the survey for Hungary: Databases and Tools

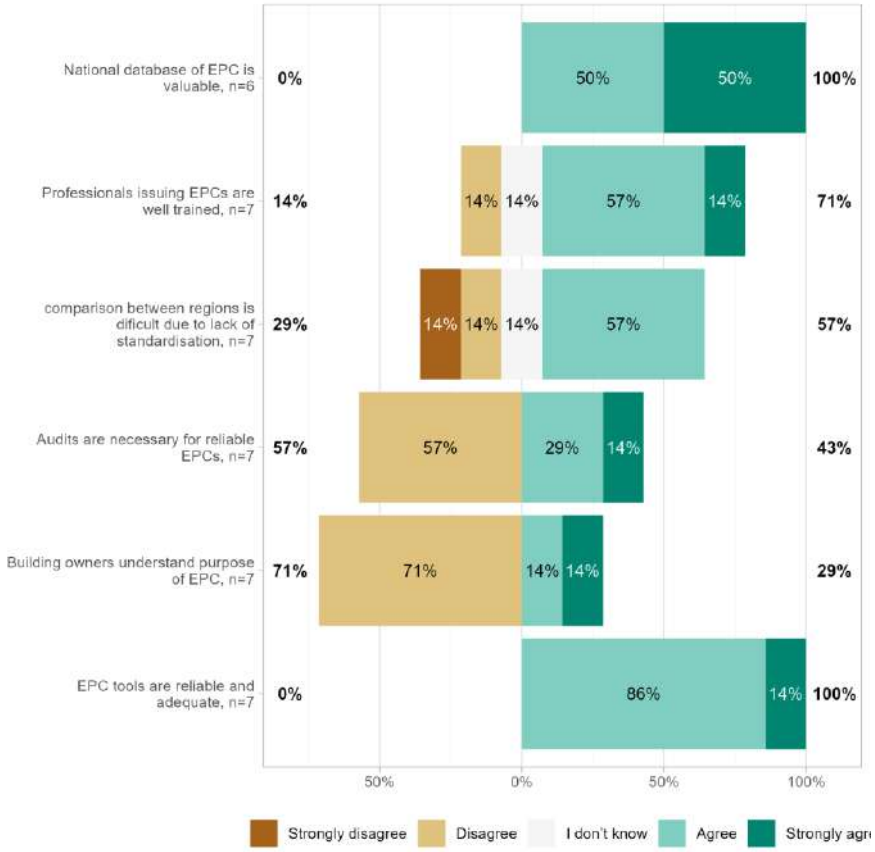


Figure 34. Results of the survey for Hungary: SRI Development and Deployment

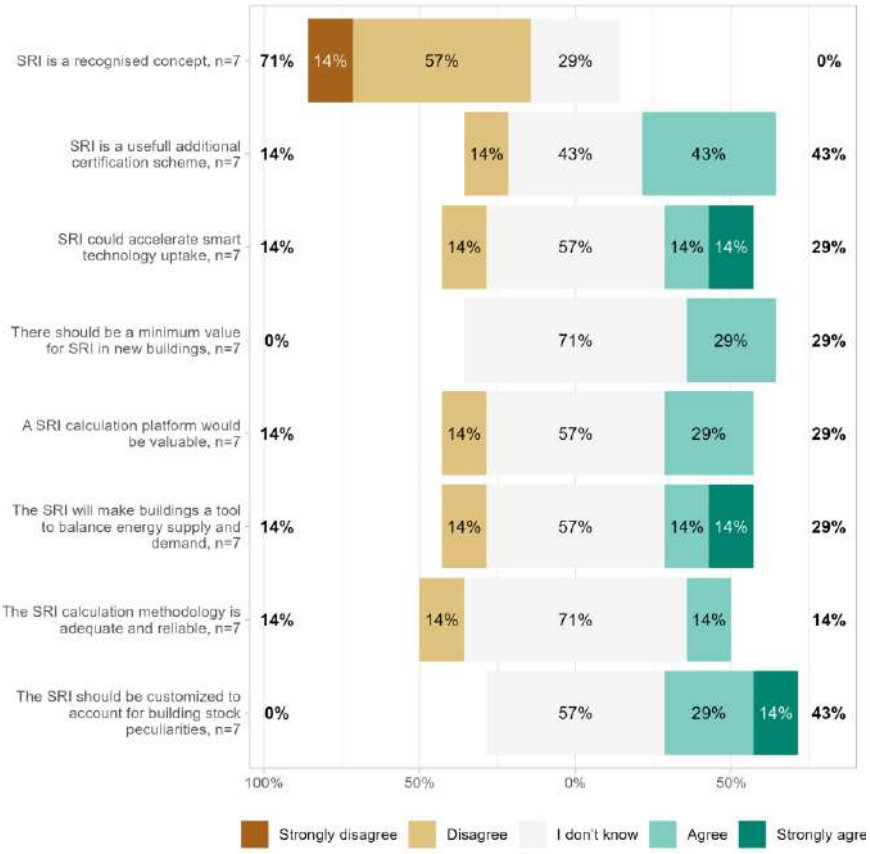
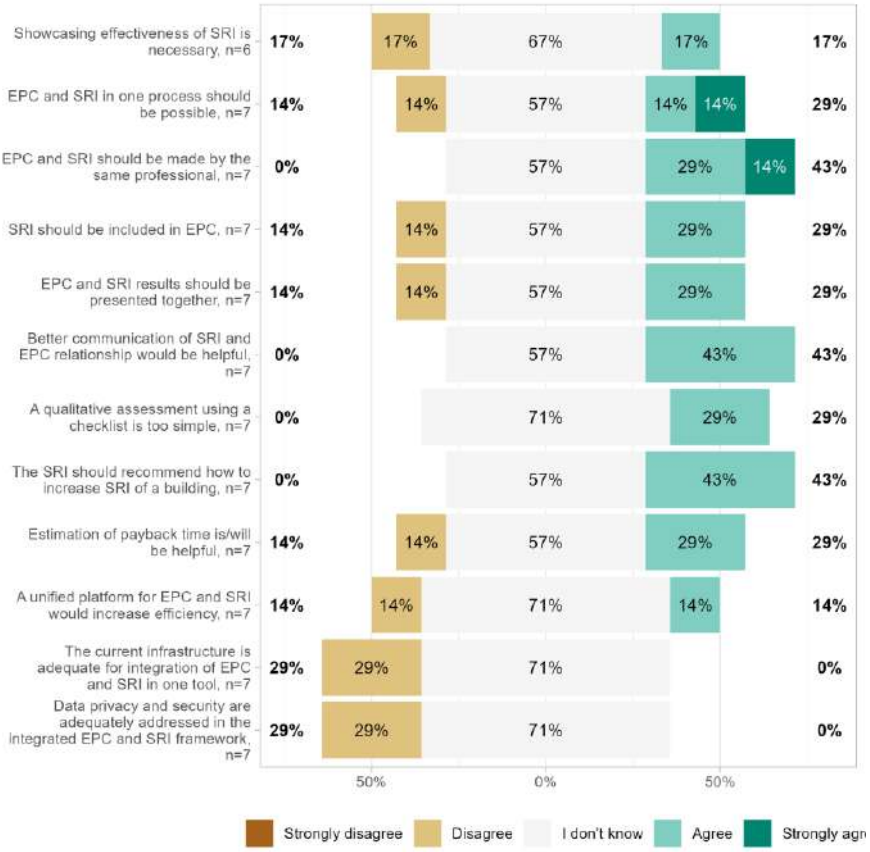


Figure 35. Results of the survey for Hungary: Integration of Instruments



Survey results – Italy

Figure 36. Results of the survey for Italy: Understanding EPC

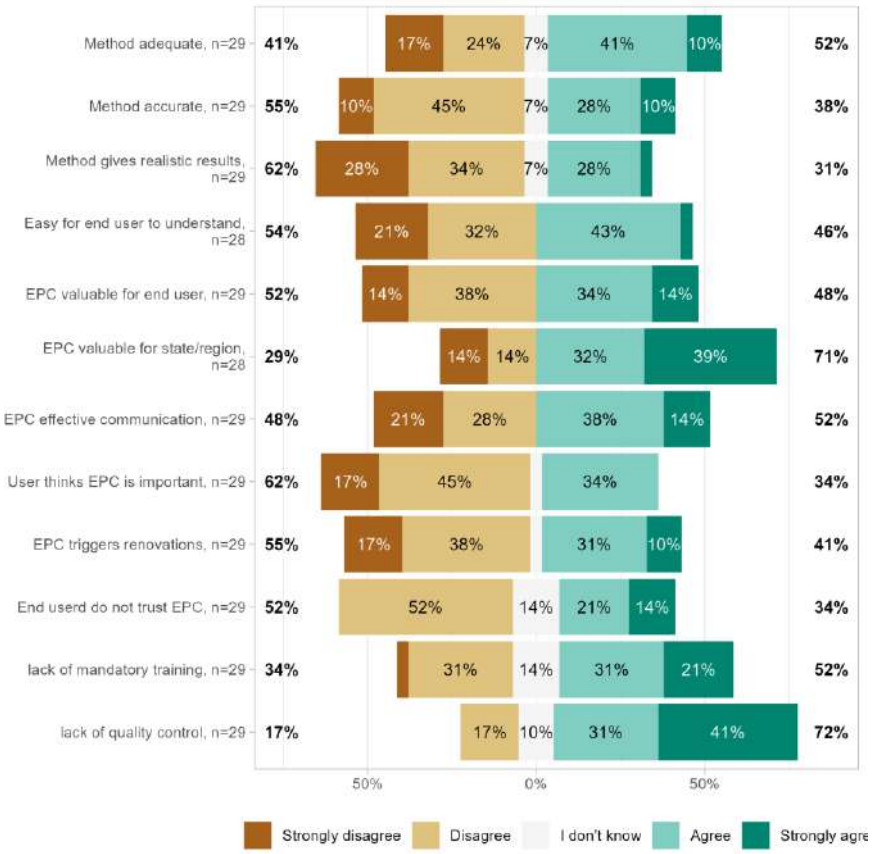


Figure 37. Results of the survey for Italy: Upgrading EPC

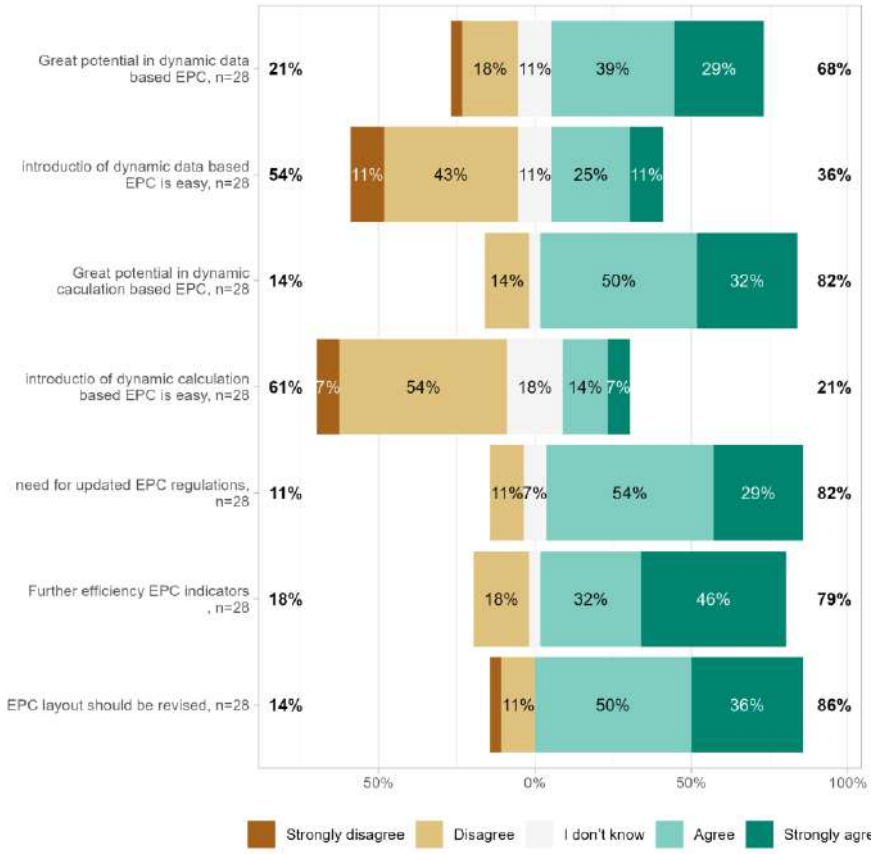


Figure 38. Results of the survey for Italy: Databases and Tools

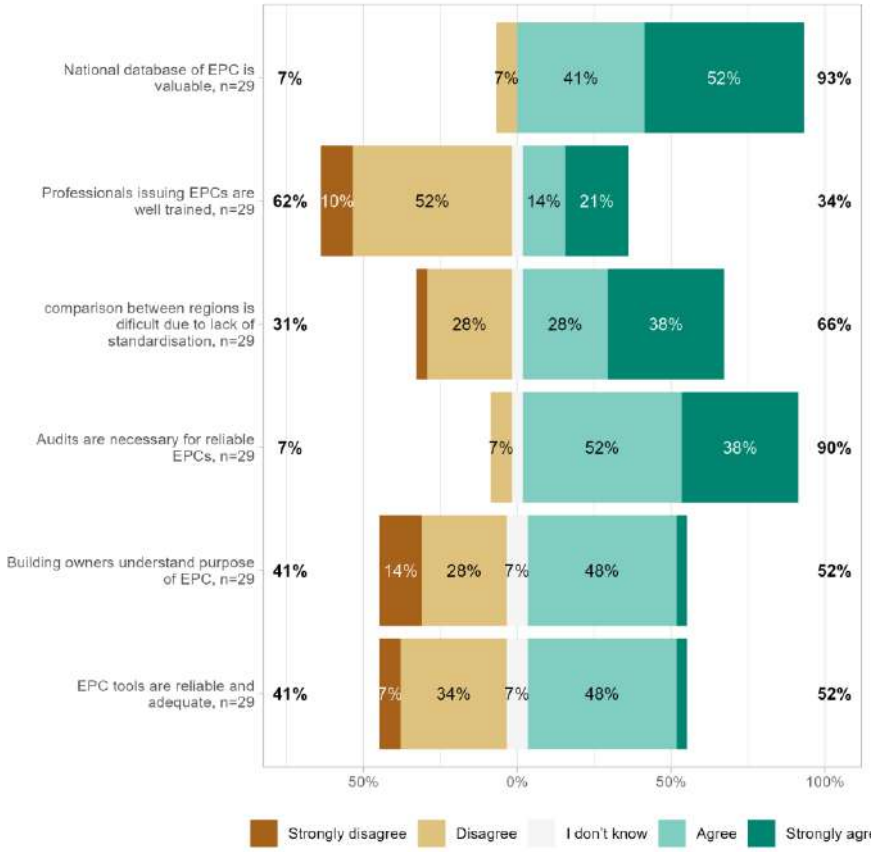


Figure 39. Results of the survey for Italy: SRI Development and Deployment

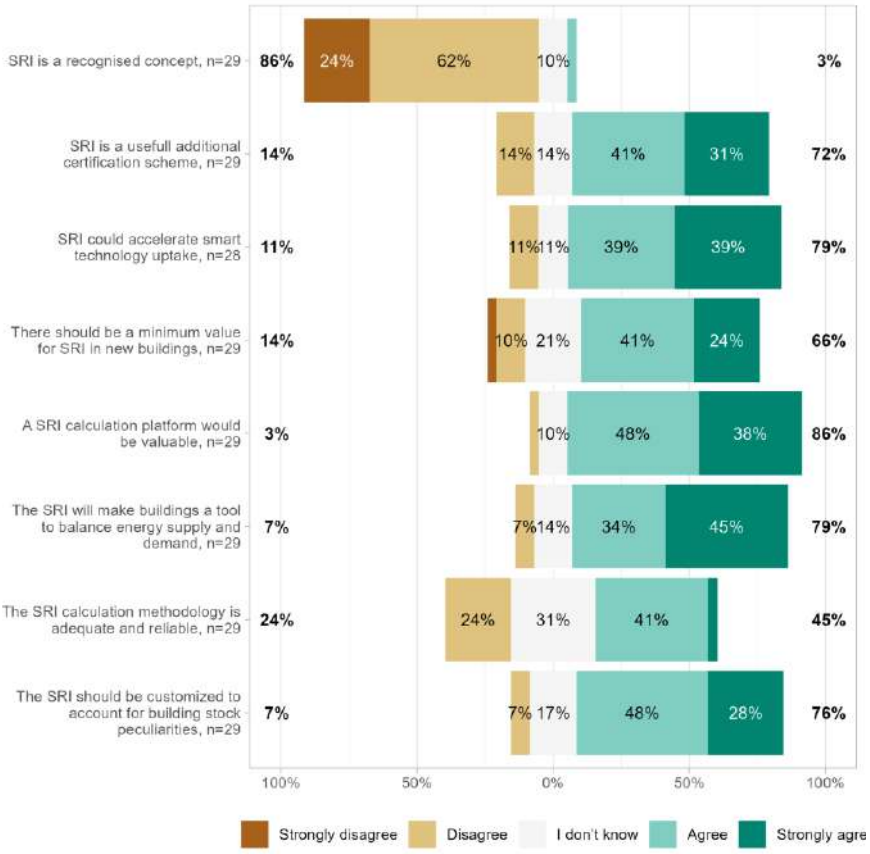
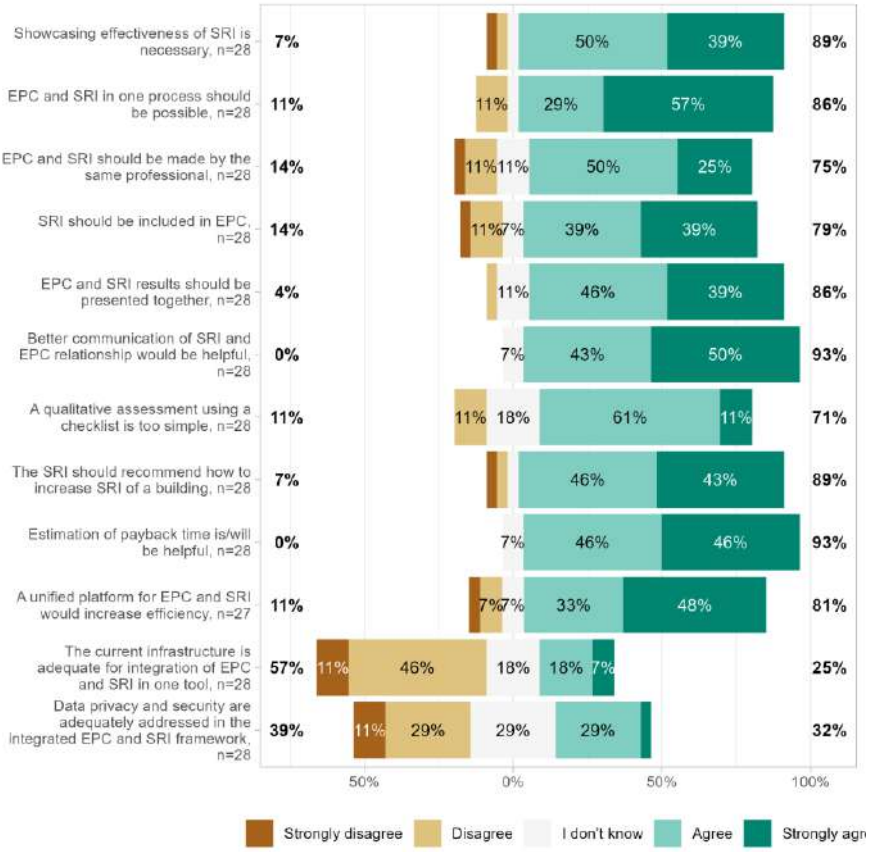


Figure 40. Results of the survey for Italy: Integration of Instruments



Survey results – Poland

Figure 41. Results of the survey for Poland: Understanding EPC

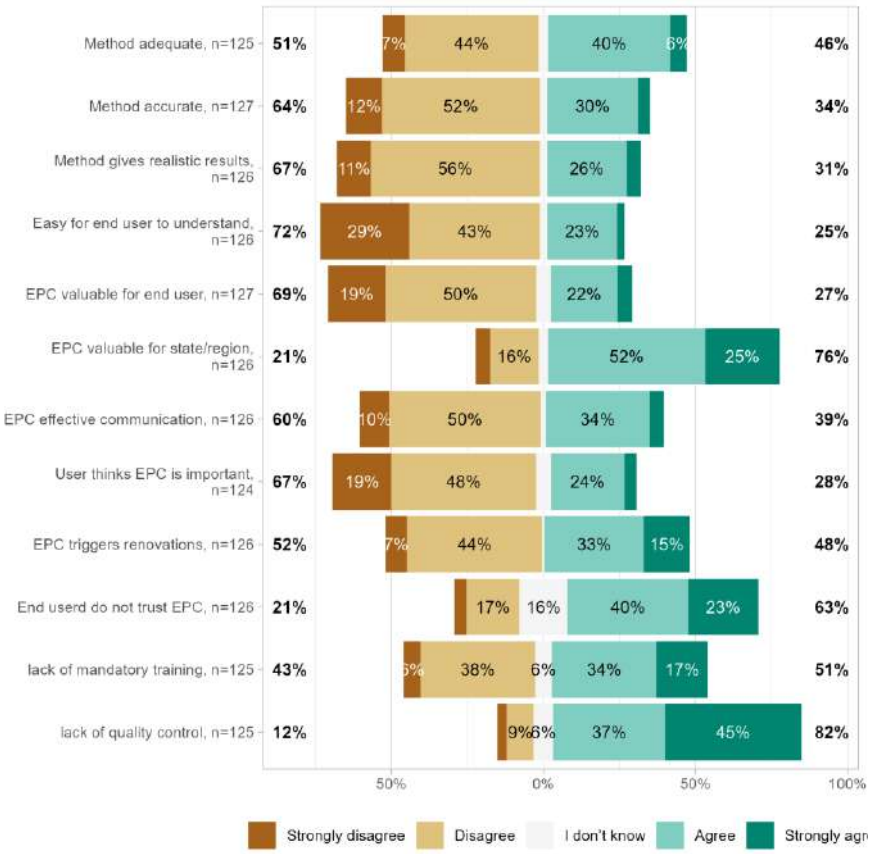


Figure 42. Results of the survey for Poland: Upgrading EPC

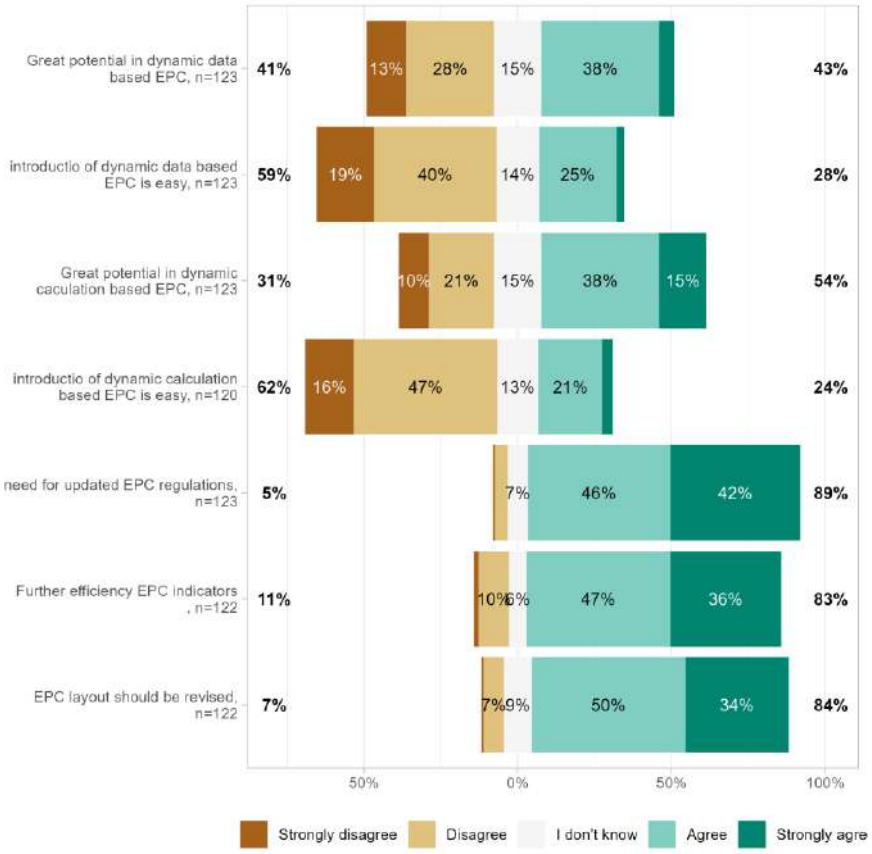


Figure 43. Results of the survey for Poland: Databases and Tools

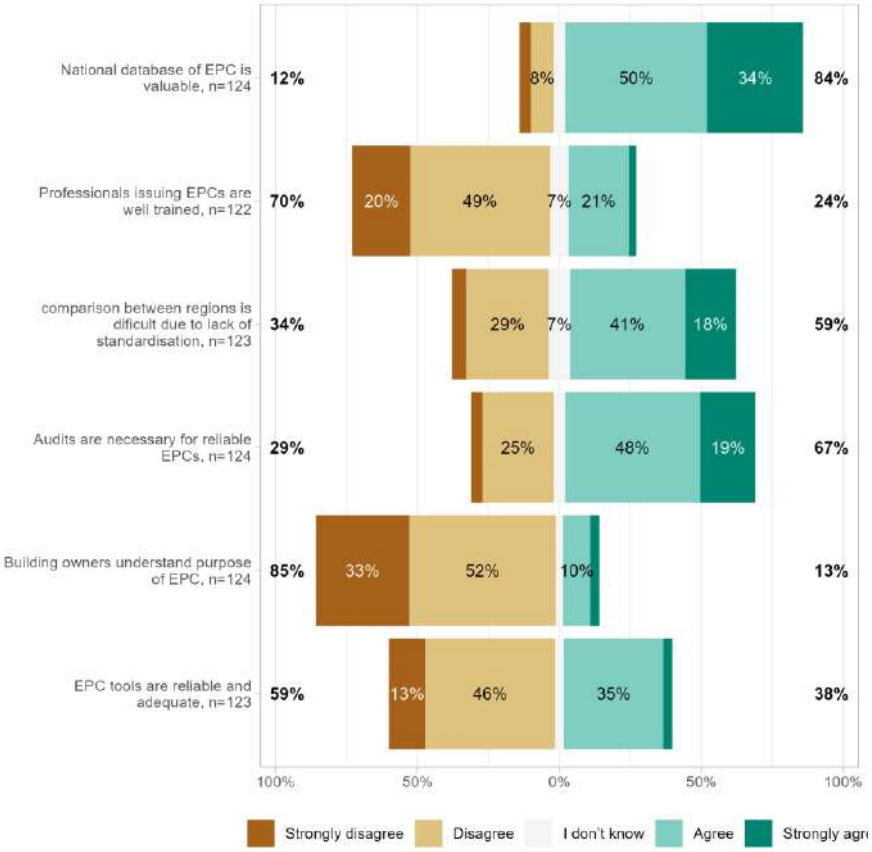


Figure 44. Results of the survey for Poland: SRI Development and Deployment

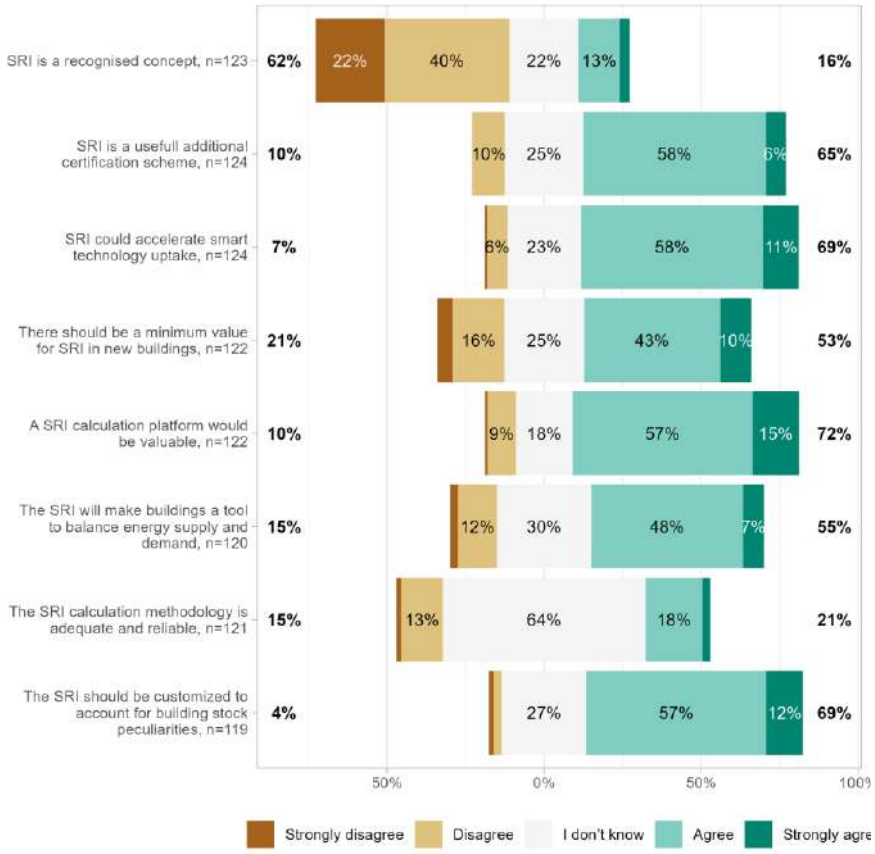
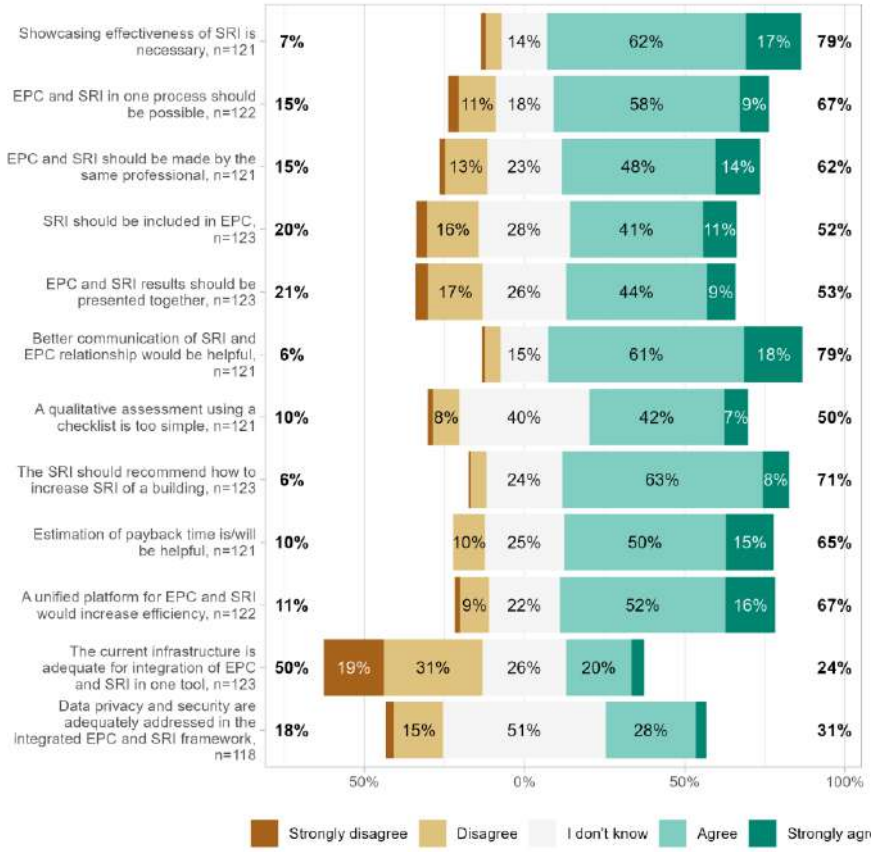


Figure 45. Results of the survey for Poland: Integration of Instruments



Survey results - Slovenia

Figure 46. Results of the survey for Slovenia: Understanding EPC

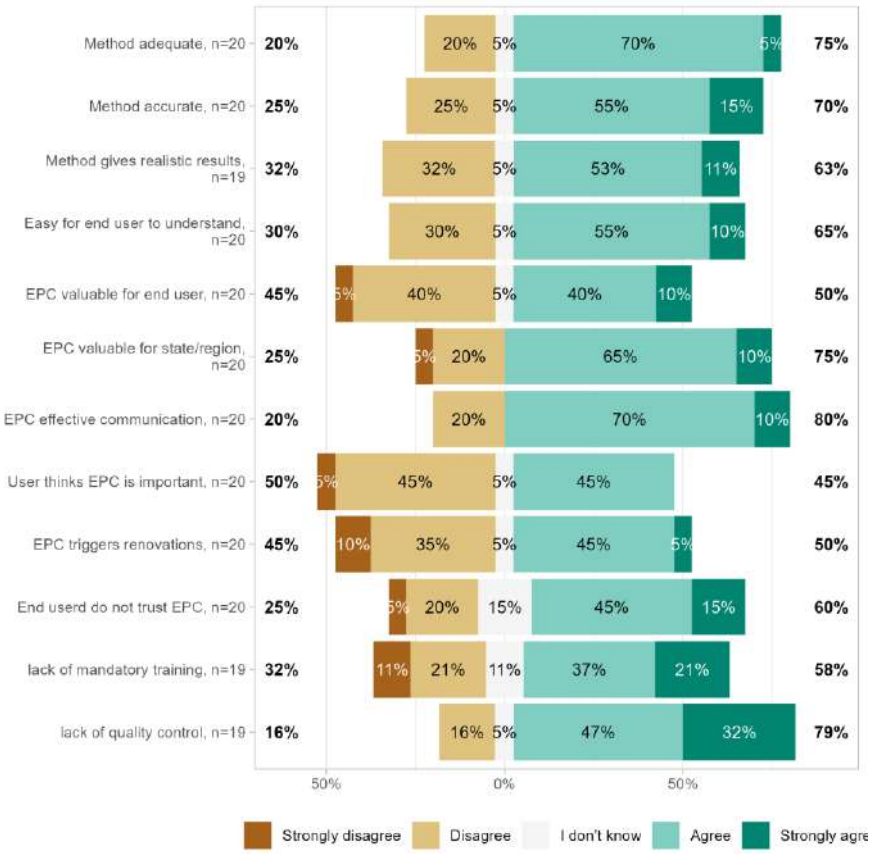


Figure 47. Results of the survey for Slovenia: Upgrading EPC

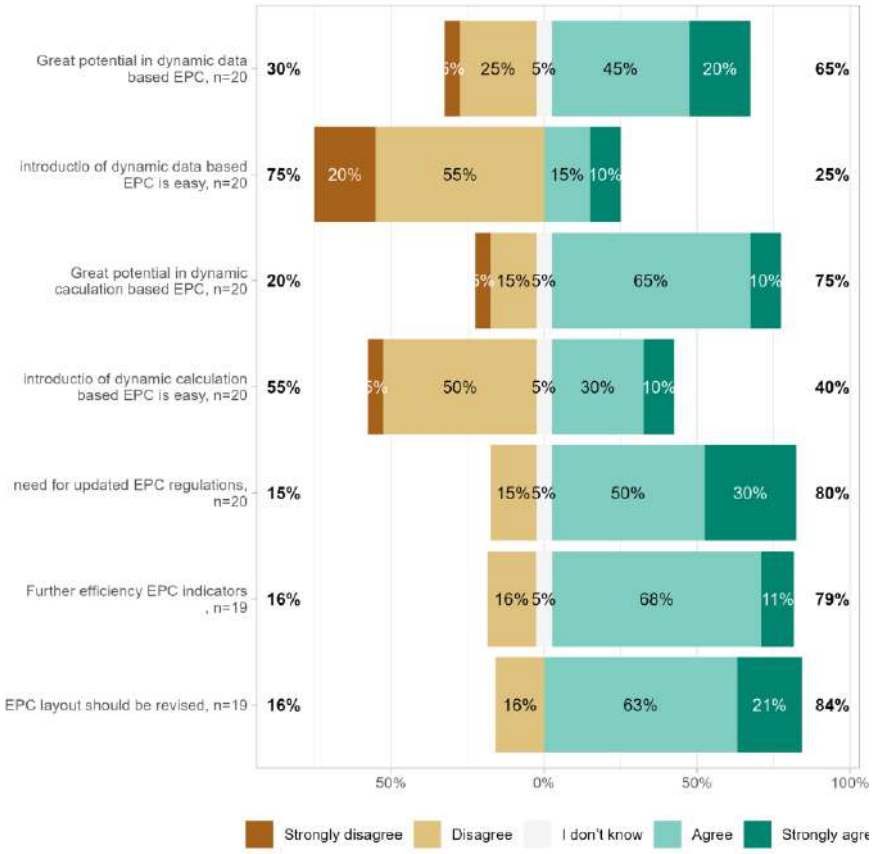


Figure 48. Results of the survey for Slovenia: Databases and Tools

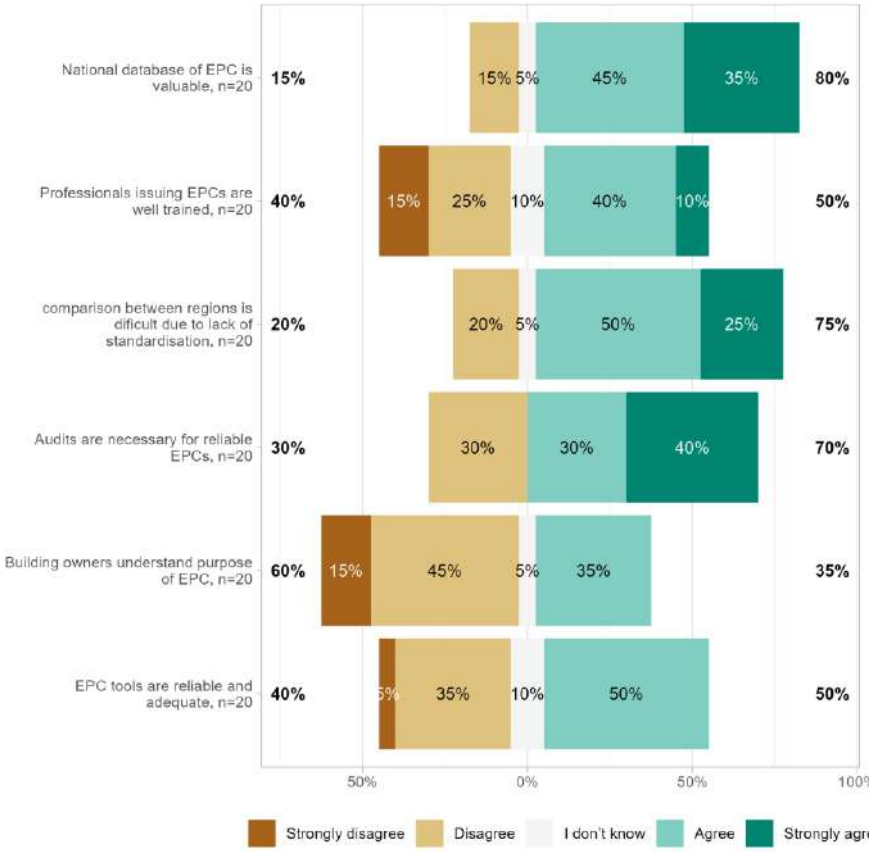


Figure 49. Results of the survey for Slovenia: SRI Development and Deployment

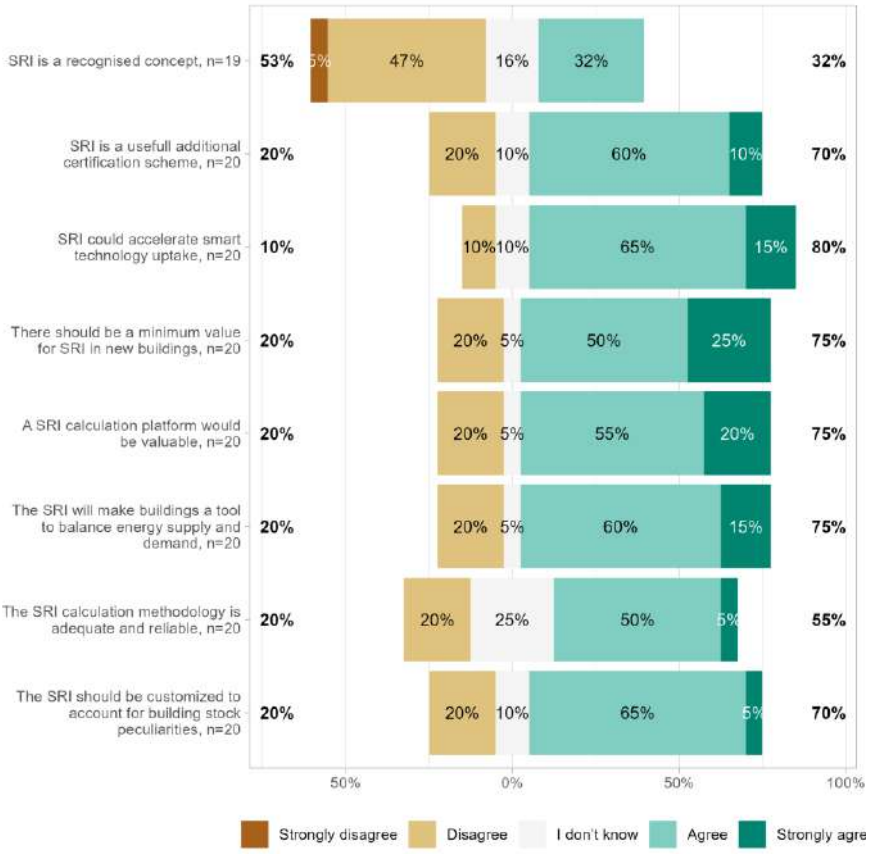
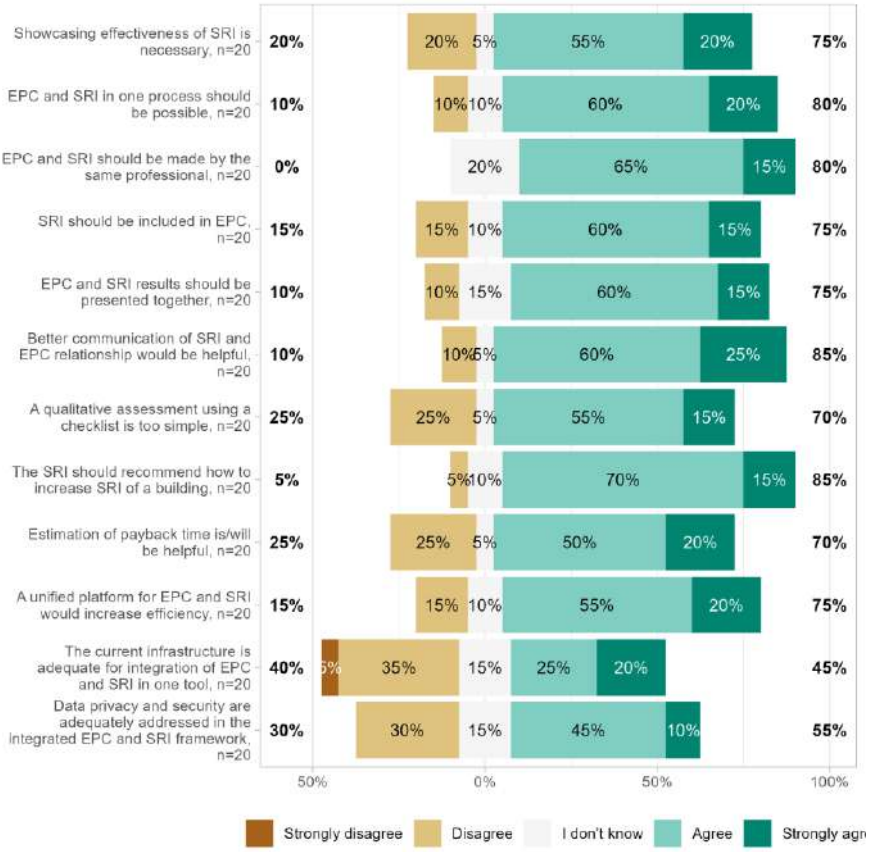


Figure 50. Results of the survey for Slovenia: Integration of Instruments



Appendix 2. Survey questions in English

General

Questions on general information	Form-field	Choices
What type of organisation do you represent?	Drop-Down	Energy Agency Business Financial organisation Association of industry or professionals National or local authority Civil society Academia Building owner Other (please specify what type of organisation you represent)_____
Please select the country you are working in	Drop-Down	Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden. Other countries (please specify the country you are from)_____
How many years of experience do you have working with Energy Performance Certificates (EPC)?	Drop-Down	less than 2 years 2-5 years 6-15 years More than 15 years
How many years of experience do you have working with the Smart Readiness Indicator (SRI)?	Drop-Down	less than 1 year 1-2 years 2-5 years More than 5 years

Understanding EPC

This part is about the current EPC practices and regulations. In the following survey, when we mention an “end user”, we refer to the user who purchases an EPC.

To what extent do you agree or disagree with the following statements? Please respond based on the EPC programme in your country/region.	Strongly disagree	Disagree	Agree	Strongly agree	I don’t know
The current method used to calculate EPCs is adequate.					
The current method used to make EPCs provides accurate results.					
The current method used for EPC calculation provides a realistic picture of the actual performance of the building.					
It is generally easy for the end user to understand the information provided in EPCs.					
The EPC scheme is very valuable for the end users.					
The EPC scheme is very valuable for the state/region. In the state/region, the EPC scheme could be used for e.g., subsidies, building permits, research etc.					
The current EPC is very effective in communicating a building's energy performance.					
The importance of the EPC and its information is well received by the end user.					
The EPC triggers renovations and improves energy performance.					
End users do not trust EPCs.					
There is a lack of mandatory training of professionals who can issue EPCs.					
There is a lack of quality control of EPCs in general.					

Question	Form-field	Choices
Please rank the following barriers to effective end-user understanding of, and trust in, the EPC.	Rank by either drag and drop or by providing a number beside each choice	• The EPC is based on a unit/concept that most people do not understand e.g. kWh/m^2 or final and primary energy. • The recommendations given on/with the EPC are difficult to understand. • The energy class/indicator does not reflect the real energy use in the building. • The financial impact of a recommended measure is not shown and therefore doesn't trigger action. • The EPC layout does not allow a good understanding of the information. • Information contained in the EPC are perceived as abstract and therefore distant from real-life needs. • Other (please specify, in case you chose to rank "other")_____

Upgrading EPC

This part is about practices on improving and optimising EPC methodology, generation process or indicators.

To what extent do you agree or disagree with the following statements? Please respond based on the EPC scheme in your country/region.	Strongly disagree	Disagree	Agree	Strongly agree	I don't know
There is great potential in dynamic data based EPCs without the need for inspections (i.e. using hourly energy measurements from the building to produce the EPC).					
The introduction of dynamic data based EPCs will be easy (i.e. the required data is available and accessible, the method to calculate a dynamic data-based EPC is well established, etc.).					
There is great potential in dynamic calculation based EPCs (i.e., based on hourly calculations/simulations).					
The introduction of dynamic calculation based EPCs will be easy (i.e. the required input data for the calculation is available and accessible, the method to calculate a dynamic EPC is well established, etc.).					
There is a need for updated or additional regulations regarding EPCs.					
EPCs should include further indicators showing the efficiency of the building.					
The EPC layout and displayed information should be revised to match end-users needs and expectations (e.g., additional indicators, different visualization…).					

Question	Form-field	Choices
Please rank the following barriers to effective EPC upgrading.	Rank by either drag and drop or by providing a number beside each choice	• The EPC is not based on actual energy measurements. • The EPC does not require a building inspection. • The EPC assessors are not adequately qualified • The EPC is not based on dynamic simulations. • There is not sufficient data for data based dynamic EPCs. • Other (please specify, in case you chose to rank "other")_____
Can you identify at least one specific technological tool or innovation that could be integrated into EPC assessments to improve their effectiveness?	Tick box with text field attached to "yes" option	Yes (please specify)_____ No
Can you identify at least one upgrade to the EPC layout and/or displayed information that could improve the EPC to match the end-users need and expectations?	Tick box with text field attached to "yes" option	Yes (please specify)_____ No
Do you think there is a need for updated or additional regulations regarding EPCs?	Tick box with text field attached to "yes" option	Yes (please specify)_____ No

Databases and Tools

This part is about practices (existing or new) on data infrastructure and tools requiring central or federated data management.

To what extent do you agree or disagree with the following statements? Please respond based on the EPC programme in your country/region.	Strongly disagree	Disagree	Agree	Strongly agree	I don't know
A central national database including all EPCs (and all information used to make the EPC) is/would be very valuable for the country.					
Professionals who issue an EPC are generally well-trained and well-prepared.					
Lack of standardised methods and tools to calculate EPCs makes it difficult to compare EPCs between regions.					
Building energy audits (i.e. inspection survey and analysis of energy flows) are necessary for reliable EPCs.					
Clients and building owners in general have a good understanding of the purpose of EPC.					
The tools that are used to make an EPC are generally reliable and adequate.					

Question	Form-field	Choices
Are there specific areas where additional training is needed?	Tick box	Yes (please specify) _____ No Don't know

SRI Development and Deployment

This part is about implementing the calculation methodology for the Smart Readiness Indicator (SRI) and the necessary processes.

To what extent do you agree or disagree with the following statements? Please respond based on the SRI programme in your country/region.	Strongly disagree	Disagree	Agree	Strongly agree	I don't know
SRI is a recognised concept among building professionals in my country.					
I consider the SRI to be useful as an additional certification scheme for building energy efficiency.					
SRI is an instrument that could accelerate the smart technology uptake of buildings.					
There should be a minimum value for SRI in new buildings.					
A platform where building data can be entered and the SRI calculated would be very valuable.					
The SRI assessment scheme will help transform buildings into resources that can act as flexible loads to balance energy supply and demand.					
The SRI calculation methodology proposed by the EC is adequate and reliable.					
The SRI calculation and related catalogues should be customized to account for building stock peculiarities.					

Question	Form-field	Choices

Please rank the following barriers to effective SRI implementation.	Rank by either drag and drop or by providing a number beside each choice	• Need for resources to install equipment and process recorded data. • Complicated estimation of costs if a minimum SRI value is introduced for existing buildings. • It is difficult to assess the SRI in larger buildings, since they are complex from an energy calculation point of view. • Residential owners are not aware of the concept of the SRI or its potential benefits. • The SRI is based on data that is unreliable and/or hard to get. • Monitoring devices are expensive in purchasing and maintenance. • Inspections, impact monitoring and evaluation of the functionalities assessed are not included in the SRI methodology. • Other (please specify, in case you chose to rank “other”)_____

Integration of Instruments

This part is about practices that integrate EPC and SRI and/or achieve harmonisation, efficiency and interoperability across EPC, SRI and other tools.

To what extent do you agree or disagree with the following statements? Please respond based on the SRI programme in your country/region.	Strongly disagree	Disagree	Agree	Strongly agree	I don't know
Activities showcasing the effectiveness of SRI are necessary.					
It should be possible to create EPC and SRI in a single process.					
EPC and SRI assessment should be made by the same professional.					
SRI should be included in EPC.					
Results from the EPC and SRI should be presented together.					
Better communication of the relationship between SRI and EPC would be helpful.					
A qualitatively focused assessment using a functionality checklist does not do justice to the individual circumstances and individual requirements of building "smartness" and does not create comparability between different system approaches and solutions.					
Recommendations on how to increase SRI in a specific building should be provided in the SRI.					
Estimation of payback time of investment costs of specific measures to increase SRI and/or improve EPC is/will be helpful.					
A unified digital platform for EPC and SRI would significantly reduce the time required for					

processing and issuing these certificates.					
The current technological infrastructure is adequate to support the integration of EPC and SRI into a single assessment tool.					
Data privacy and security concerns are adequately addressed in the integrated EPC and SRI framework.					

Question	Form-field	Choices
Please rank the following choices to make the best harmonisation between EPC, SRI, and other tools	Rank by either drag and drop or by providing a number beside each choice	• Better data visualisation and communication. • Using measured data for benchmarking. • Dissemination of best practices for efficient energy upgrades. • Promotional tools to improve the energy performance of buildings. • Guidelines for (digital) logbooks and roadmaps for energy upgrades. • Regulatory instruments for calculating SRI, EPC or renovations (standards, guidelines, legislation, incentives). • The result of an SRI assessment should be used to feed new mandatory indicators into the EPC. • Other (please specify, in case you chose to rank "other")_____

Additional questions

Questions on additional information	Form-field	Choices
If you have further remarks, observations or recommendations on EPC in your country, please enter below.	Text box	
If you have further remarks, observations or recommendations on SRI in your country, please enter below.	Text box	
Do you have any recommendations for sources of information we could use?	Text box	
May we contact you for follow-up questions solely on context of this survey and our question?		Yes No
Are you interested in receiving the tunES newsletter?	Tick box	Yes No
Please provide your email.	Text box	