



SRI-ENACT

Co-creating Tools and Services
for Smart Readiness Indicator Uptake



D2.1 – SRI CURRENT LANDSCAPE REPORT AND STAKEHOLDER ENGAGEMENT PLAN



D2.1 – SRI current landscape report and stakeholder engagement plan

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PART I – SRI CURRENT LANDSCAPE REPORT

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List of acronyms

EU	European Union
GHG	Green House Gas
EC	European Commission
ICT	Information and Communication Technologies
SRT	Smart-Ready Technologies
SRI	Smart Readiness Indicator
EPBD	Energy Performance of Buildings Directive
NZEB	Nearly Zero Energy Buildings
PEB	Positive Energy Buildings
BACS	Building Automation and Control System
TBS	Technical Building System
EMA	Energy and Managing Authorities
CEF	Connecting Europe Facility
EIB	European Investment Bank
EFSI	European Fund for Strategic Investments
EEEF	European Energy Efficiency Fund
ERDF	European Regional Development Fund
SME	Small-Medium sized Enterprise
RRF	Recovery and Resilience Facility
IEQ	Indoor Environmental Quality
EPC	Energy Performance Certificate
BIM	Building Information Modelling
IoT	Internet of Things
FAQ	Frequently Asked Questions
ME	Ministry of Energy
SEDA	Sustainable Energy Development Agency
MRDPW	Ministry of Regional Development and Public Works
EERSF	Energy Efficiency and Renewable Sources Fund
NECP	National Energy and Climate Plan
EP	Energy Performance
NOP	National Operational Programmes
EEO	Energy Efficiency Obligations
LTRS	Long-Term Renovation Strategy
MDLPA	Ministry of Development, Public Works and Administrations
RoGBC	Romanian Green Building Council
GEFF	Green Economy Financing Facility
EBRD	European Bank for Reconstruction and Development



GMP	Green Mortgage Programme
CRES	Centre for Renewable Energy Sources
BA	Building Act
EEA	Energy Efficiency Act
MPGI	Ministry of Physical Planning Construction and State Assets
EIHP	Energy Institute Hrvoje Pozar
BRP	Building Renovation Passport
EPEEF	Environmental Protection and Energy Efficiency Fund
CroBC	Croatian Green Building Council
GGF	Green for Growth Fund
PPP	Public-Private Partnership

Executive summary

This part of the deliverable aims to elaborate a state-of-the-art analysis on the level of the SRI adoption across EU, with particular focus on the eight pilot countries (Bulgaria, Czech Republic, Latvia, Romania, Croatia, Greece, Spain, Austria) of the SRI-ENACT project, providing specifications and tailored insights for the SRI-ENACT partners, where available. Furthermore, the deliverable lays emphasis on the methodology and tools that are currently used (or could be used) to calculate SRI and monitor the performance of buildings in terms of smartness. Commonly accepted practices and funding schemes supporting the building energy performance, are analysed and described, both at EU and project level. Also, considering that the SRI scheme should be accompanied by a respective regulatory framework to enable its smooth implementation at national level, we point out any financial, technical, and social challenges as well as privacy, security and interoperability issues that could arise during the process. Methodologically, the analysis is based on an extensive literature review of SRI regulations, guidelines, and application reports combined with extensive feedback from the stakeholders' network of each of the consortium partners.

1. Introduction

Based on the vision of the European Green Deal and the European Climate Law (Regulation 2021), the European Union (EU) has committed itself to reducing greenhouse gas (GHG) emissions by setting a target of 55% GHG emission reduction until 2030 and reaching climate neutrality by 2050 (European Commission 2019a). With an eye to achieving this ambitious but rather binding target, the building sector is placed at the heart of the problem, since, at global level, buildings account for 36% of the final energy consumption and approximately 37% of energy-related carbon dioxide (CO₂) emissions (United Nations Environment Programme 2021). At EU level, the respective figures for the building sector amount to 40% of the total EU energy consumption and 36% of the total GHG emissions (European Commission 2020). In this respect, multi-level renovations within the building stock are expected to play a key role in decompressing the energy system both in terms of decarbonisation and energy consumption, pinpointing the energy efficiency dimension as a prominent option towards meeting the overarching target set by the EU (BPIE, 2021). What may further highlight the potential of the building sector for energy efficiency improvements, is that almost 75% of the existing building stock comprises of non-renovated buildings, having been built before 1980, and therefore is considered energy inefficient (Filippidou and Jimenez Navarro, 2019).

Nevertheless, the pathway to fully exploit this potential entails significant challenges, stemming from the current low renovation rates, which reach approximately 1% regarding the annual building renovation, and almost 0.2% of the building stock per year regarding deep renovations with energy savings of at least 60% (European Commission 2019a). Drawing from recent estimations, around 23,000 homes per day should be renovated until 2050, leading to a total of 250 million homes if the EU's energy efficiency and climate targets are to be met (Hutton 2018). To guide the whole process of meeting the respective targets, the European Commission (EC) introduced in 2020 the "Renovation Wave" initiative (European Commission 2020), which essentially describes an action plan towards increasing the rate and depth of building renovation by 2030, part of which is to stimulate the creation of green and smart buildings (European Commission 2020).

The integration of cross-cutting ICT-based solutions is a core element of smart buildings, which significantly facilitates the optimisation of energy-efficient control of technical systems, and contribute to paving the way for healthier, more comfortable, and convenient buildings (Attoue et al., 2018), able to adjust to the users' needs while also providing the necessary energy flexibility to the grid as part of their daily operation (Ghaffarianhoseini et al., 2018). Smartness is linked to higher energy savings and as such, it should be contextualised, in respond to the local climate conditions, the different types of building typologies and specific needs of urban areas. Having

said that, the smartness level of a building is considered to be among the key enablers of a building's sustainability and is strongly associated with a building's ability to adapt to the ongoing climate change as well (To et al., 2018).

To ease understanding, a theoretical approach of the term “smartness” can be found in the following definition: “Smartness of a building refers to the ability of a building or its systems to sense, interpret, communicate and actively respond in an efficient manner to changing conditions in relation to the operation of technical building systems or the external environment (including energy grids) and to demands from building occupants” (Verbeke et al., 2020). Aiming to enhance the materialisation of Smart Ready Technologies (SRT) in buildings and the consequent overall smartification of the building stock, a European scheme for rating the smart readiness of buildings was eventually launched called the Smart Readiness Indicator (SRI).

The concept of SRI was introduced back in 2017, following a first technical study issued by the EC, where a definition of the SRI was attempted and a draft methodology for its calculation was developed. However, the crowning stone in the SRI establishment stemmed from the recast of the Energy Performance of Buildings Directive (EPBD) in 2018 (Directive 2018/844/EU), where the SRI was formally deployed as an optional EU scheme for rating the smart readiness of buildings. Subsequent regulations (Commission Delegated Regulation 2020; Commission Implementing Regulation 2020) and technical studies (Verbeke et al., 2020) initiated the SRI testing phase. EU countries can adopt and implement this assessment scheme, supported by the SRI support team which was created to provide technical guidance and assistance on this regard, having been assigned the role of the official intermediary between the EC and the Member States.

The SRI brought new opportunities for the digitalisation and modernisation of the EU building stock by providing tangible information on the technological readiness of buildings to all stakeholders engaged in buildings retrofitting (Al Dakheel et al., 2020) such as owners, tenants, property managers, technology providers, designers, engineers, and policymakers. This disassembled information is allocated to the following three pillars, which essentially constitute the main drivers behind the SRI development (Vivian et al., 2020): (a) the response to the needs of the occupants; (b) the interaction with the energy grids; and (c) energy performance and operation. On that reflection, SRI focuses mostly on the technological infrastructure of buildings rather than the building envelope itself (Apostolopoulos et al., 2022).

It is within the scope of the SRI scheme to establish the cross-sectorial role of buildings in the future energy infrastructure (Märzinger and Österreicher, 2020) by promoting synergies with the energy sector and other complementary segments such as the ICT area. SRI also seeks to raise awareness about the strengths and benefits of smart buildings to creating the conditions for the larger uptake of innovative smart systems and high-standard construction materials of the building envelope (Janhunen et al., 2020), thereby inducing significant energy

efficiency investments which in turn facilitate the integration of Nearly Zero Energy Buildings (NZEB) and Positive Energy Buildings (PEB) in the building stock.

The SRI scheme is still in its infancy and only seven countries have been formally engaged with the SRI framework, either by implementing an ongoing SRI test phase (i.e., Denmark, Czech Republic, France, Finland, Croatia, Austria) or by volunteering for conducting an SRI test phase that is expected to initiate in the near future (i.e., Spain). Be that as it may, there is a profound lack of available data regarding the implementation of smart energy efficiency upgrades within the EU building stock, although an operation pattern appears through delving into the renovation front in general, of both the residential and non-residential sector. In this context, this deliverable aims to elaborate a state-of-the-art analysis on the level of the SRI adoption across EU, focusing on the eight pilot countries of the SRI-ENACT project, providing specifications and tailored insights for the SRI-ENACT partners, where available. More specifically, in Section 2, we provide an overview of the SRI methodology, based on the EC's most recent roll outs. In Section 3, we discuss the SRI implementation pathways suggested by the EC, and in Section 4, several common EU funding mechanisms to support the SRI uptake are presented. In Section 5, the software tools that are currently used (or could be used) to calculate SRI and monitor the performance of buildings in terms of smartness are highlighted. Finally, in Section 6, we discuss the status and the context of SRI implementation in the eight pilot countries (Bulgaria, Czech Republic, Latvia, Romania, Croatia, Greece, Spain, Austria) of the SRI-ENACT project.

2. Description of the common methodological framework of the SRI scheme in the EU

The SRI calculation methodology¹ has been built upon an inventory of “smart-ready services” which could affect the smartness of a building based on the functionalities they can offer. Indicative examples of smart-ready services include heat emission control, cooling emission control, supply air flow control, window shading control, etc. Based on the existing EU provisions, the available smart-ready services are organised in a list of 54 services. The whole list of services is provided in Annex 1. The different functionalities of the smart-ready services stand for different levels of smartness and are referred to as “functionality levels”. For example, for the smart-ready service of “heat emission control”, the functionality levels could range from the practically non-smart “no automatic control” to the smartest “individual room control with communication and presence control”. The smart-ready services are classified in nine “technical domains” and produce seven types of impacts called “impact criteria”,

¹<https://ec.europa.eu/eusurvey/runner/SRI-assessment-package>

which are in turn clustered in three discrete categories reflecting the main goals of SRI, referred to as “key functionalities”. Summarised information on the abovementioned is presented in Table 1.

Table 1. Overview of technical domains, impact criteria and key functionalities included in the SRI methodology.

Technical domains	
<ol style="list-style-type: none"> 1. Heating 2. Cooling 3. Domestic Hot Water 4. Ventilation 5. Lighting 6. Dynamic Building Envelope 7. Electricity 8. Electric Vehicle Charging 9. Monitoring & Control 	
Impact criteria	Key functionalities
<ol style="list-style-type: none"> 1. Energy efficiency 2. Maintenance & fault protection 	<ol style="list-style-type: none"> 1. Energy performance & operation
<ol style="list-style-type: none"> 3. Comfort 4. Convenience 5. Health, well-being & accessibility 6. Information to occupants 	<ol style="list-style-type: none"> 2. Response to the needs of occupants
<ol style="list-style-type: none"> 7. Energy flexibility & storage 	<ol style="list-style-type: none"> 3. Energy flexibility

To gather the different domains and impact categories under a common methodological framework, a Multi-Criteria Analysis method was proposed and developed to be the formally acknowledged methodology for calculating the SRI. The methodology employed for the SRI calculation (Verbeke et al., 2020) is typically addressed to a certified assessor for its application and is summarised in Figure 1.

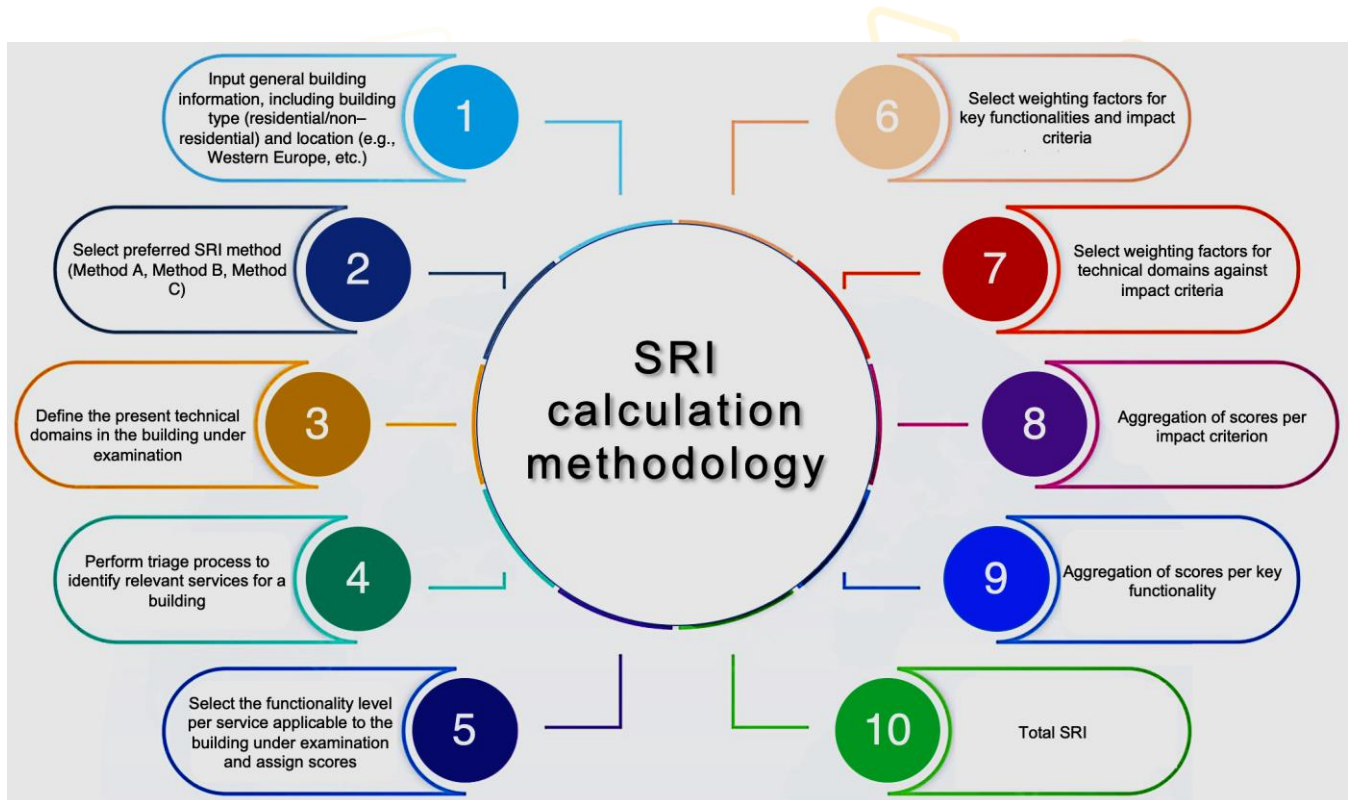


Figure 1. Methodological framework for the SRI calculation.

Step 1: General building information mainly focusing on the building’s type (residential/non-residential) and location (e.g., Western Europe, Southern Europe, South-Eastern Europe, etc.) is required, to be used for the selection of the default domain weighting factors, as described in detail in Step 7. In case a building is located outside Europe, no default domain weighting factors are available, and the assessor should proceed with defining them manually.

Step 2: To enhance the flexibility of the evaluation process with a view to the building type and available resources, the following three SRI assessment methods are suggested: a) Method A; b) Method B; and c) Method C. All methods are structured based on the same methodological components, although Method A makes use of a more simplified set of services (i.e., 27 smart-ready services), and is therefore linked to less time-consuming efforts and limited expertise to conduct the assessment compared to the other two. Method A was originally envisaged to be applied in existing residential and small non-residential buildings. Method B includes a detailed smart-service catalogue featuring 54 services, and thus, it raises the issue of expert assessment as of higher significance. The more detailed Method B was meant to be utilised in new buildings (e.g., large non-residential buildings, large multi-family buildings, etc.), with a higher complexity than Method A. Method C is considered to be the most complex method since it requires live data typically obtained from smart meters, and thereby comprehensive and inclusive specifications regarding its use are yet to be rolled out. Details regarding the differences and recommended applicability between the above methods are provided in Table 2.

Table 2. Available SRI assessment methods (adjusted based on Verbeke et al. 2020).

Area	Method A	Method B	Method C (customised)
Service catalogue	Simplified list of 27 services	Full list of 54 services	Self-reporting based on Building Automation & Control Systems
Applicability	<ul style="list-style-type: none"> › Existing residential › Small non-residential (< 500 m²) 	<ul style="list-style-type: none"> › New residential › Non-residential 	<ul style="list-style-type: none"> › Residential › Non-residential (restricted to occupied buildings)
Other	<ul style="list-style-type: none"> › Checklist approach › Assessment time < 1 hour › Self-assessment possible OR involvement of expert (certification issuing) 	<ul style="list-style-type: none"> › Checklist approach › Assessment time < 1 day › Self-assessment possible OR involvement of expert (certification issuing) 	<ul style="list-style-type: none"> › Data over a long period required › Detailed specifications not available yet

Step 3: In the scope of reflecting the technical specificities of a building, some technical domains may be non-relevant, not applicable, or even unnecessary. As a result, the user of the methodology (typically an assessor) needs to select which technical domains are present in the building, absent but mandatory (e.g., due to national regulation) or absent and not mandatory. Based on these selections, a tailored list of technical domains is formulated, with their included smart-ready services placed in the spotlight.

Step 4: In order to identify the relevant services within each technical domain to be assessed for a specific building, a triage process is applied. In case some services are considered to be non-relevant, not applicable, or unnecessary, the total SRI score is calculated as a percentage of the actual building score over the maximum attainable score of the building, and not the theoretical maximum that would have been achieved if all smart-ready services were to be included in the assessment process.

Step 5: In total five functionality levels are available for the smart-ready services (Level 0-4). The higher the functionality level of a smart-ready service, the higher the beneficial impacts to the building users or to the grid compared to services of a lower functionality level. A score within the range [0-3] is assigned to the smart-ready services against each impact criterion, across all functionality levels (Table 3). In general, these scores are defined by an accredited assessor, responsible for conducting the SRI assessment in a building. Nonetheless, assigning

scores should not constitute a matter of self-interpretation by individual SRI assessors, but rather it should be defined in a way that ensures a full replication of the SRI assessment.

Table 3. SRT functionality levels and assigned scores against each impact criterion.

Functionality levels of smart-ready services		Pre-defined scores (between 0-3) per smart ready service						
		Energy efficiency	Maintenance & fault protection	Comfort	Convenience	Health, well-being & accessibility	Information to occupants	Energy flexibility & storage
Level 0	Non-smart	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]
Level 1	...	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]
Level 2	...	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]
Level 3	...	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]
Level 4	Max smartness	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]	[0-3]

Step 6: The approach employed for weighting the “key functionalities” as well as the “impact criteria” is the “equal weighting” method. It is the same base method used for attributing weights to the “technical domains” against each “impact criterion” across all functionality levels, which is extensively analysed in Step 7. Figure 2 presents graphically the way this method operates, and the final weights assigned to the implicated SRI assessment components.

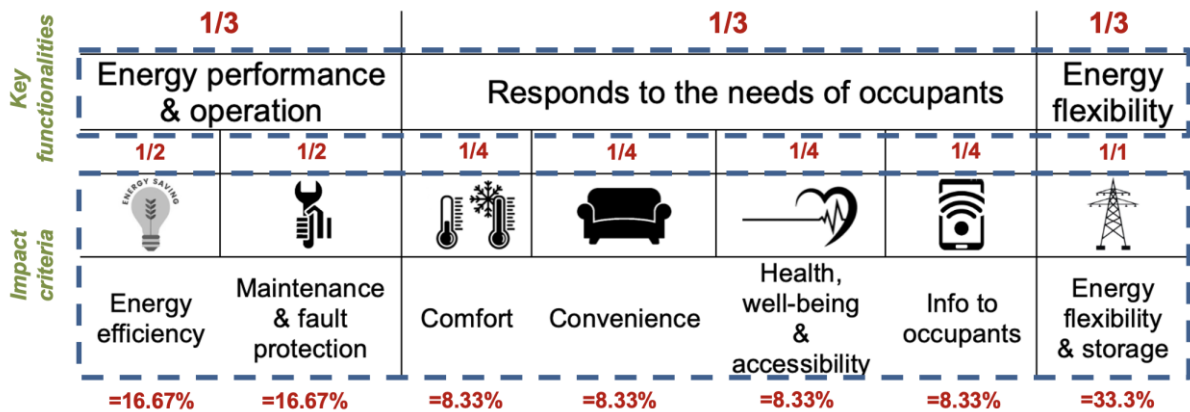


Figure 2. Application of the “equal weighting” method for assigning weights to the “key functionalities” and the “impact criteria” of the SRI assessment process, and final weights assigned.

Step 7: There are three discrete approaches to elicit the weighting factors of the nine “technical domains” against the identified “impact criteria”:

1. “Fixed weighting”: This approach prescribes a weighting method for the domains, that provides fixed estimated impacts of “technical domains” on the score of each “impact criterion”. Following this

approach, the weights of “technical domains” could be different across the “impact criteria”. For example, the “heating” domain might account for 60% of the obtainable score for the “energy savings” impact category, whereas for other impacts such as “convenience” or “comfort”, might be lower, e.g., 25%. One of the main implications in diving into such an approach is the underlying subjectivity it implies, since it is heavily relied on experts’ personal experiences and knowledge with no scientific evidence to support it.

2. “Equal weighting”: This approach provisions an equal allocation of weights among the implicated “technical domains” and diverts from the ambition to weight the domains according to their perceived relative importance to the total score for an “impact criterion”. Following this approach, the weights of “technical domains” could differ as well among the “impact criteria” (same as “fixed weighting”), however they remain the same in terms of value within each impact category. It should also be noted that the hierarchical approach is maintained between domains and included services. As of that, a domain with more services will not end up having a higher weight compared to one with fewer services. The value of the weighting factor is obtained by dividing the remaining weight for a given “impact criterion” by the number of domains that are relevant for the given “impact criterion”:

$$WF_{ewd} = \frac{100\% - \sum(\text{fixed weights})}{RD} \quad (1)$$

Where:

WF_{ewd} stands for the weighting factor of a domain based on the “Equal weighting” method,

RD represents the number of all relevant domains.

3. “Energy balance weighting”: This approach is established upon providing a weighting scheme for the “technical domains” that incorporates the estimated impact of the domains on the building’s energy balance. Typically, an energy balance allows the derivation of the relative importance of different domains, taking into account individualised buildings’ characteristics such as the building type and climate zone based on location. Regarding the building context, two types of buildings have been identified based on the respective EU legislation: (a) residential buildings; and (b) non-residential buildings. Although a further break-down of non-residential buildings (e.g., offices, hotels, educational institutions, etc.) could add on the insights drawn from the overall SRI assessment, such a provision is not currently supported by quantified data and thus has been encountered as an alternative option. As for the geographical context, five aggregated climate zones are defined: (a) Northern Europe (Denmark, Finland, Iceland, Norway, Sweden); (b) Western Europe (Austria, Belgium, France, Germany, Ireland, Liechtenstein, Luxemburg, the Netherlands, Switzerland, United Kingdom); (c) Southern Europe (Cyprus, Greece, Italy, Malta, Portugal, Spain); (d) North-Eastern Europe (Czech Republic, Estonia, Latvia, Lithuania, Poland, Slovakia); and (e) South-Eastern Europe (Bulgaria, Croatia, Hungary, Romania, Slovenia). Statistical display of the building

stock data allows for the elicitation of default weighting factors based on the following mathematical equation:

$$WF_{ebd} = (100\% - \sum(\text{fixed weights})) \cdot a_d \quad (2)$$

Where:

WF_{ebd} stands for the weighting factor of a domain based on the “Energy balance” method, a_d represents the relative importance of a given “technical domain” in the used energy balance (default values are presented in Annex 2). If the user of the methodology wishes to use manually defined values for the a_d parameter, the following equations should be used:

$$a_d = \frac{Q_d}{Q_{total}} \quad (3)$$

$$Q_{total} = Q_{Heating} + Q_{Domestic\ Hot\ Water} + Q_{Cooling} + Q_{Ventilation} + Q_{Lighting} + Q_{Renewables} \quad (4)$$

Where:

Q_d is the primary energy use for the domain under examination,

$Q_{Heating}$ is the primary energy use for space heating,

$Q_{Domestic\ Hot\ Water}$ is the primary energy use for domestic hot water,

$Q_{Cooling}$ is the primary energy use for space cooling,

$Q_{Ventilation}$ is the primary energy use for ventilation,

$Q_{Lighting}$ is the primary energy use for lighting,

$Q_{Renewables}$ is the renewable energy produced on site.

In Verbeke et al. (2020), where the formal methodology for the SRI assessment is presented, a hybrid weighting approach is employed. Based on this, the “energy balance weighing” method is applied to all “impact criteria” that are considered closely related to energy, namely “Energy savings”, “Maintenance & fault prediction”, and “Energy flexibility & storage”. However, the weights of some “technical domains” such as the “Monitoring and Control” as well as “Dynamic Building Envelope” with regard to these “impact criteria”, cannot be extracted from an “energy balance weighing” approach, and as a consequence fixed weights are assigned to these domains (i.e., 20% for “Monitoring & Control” and 5% for “Dynamic Building Envelope”). The remaining 75% is derived from the “energy balance weighing” method. In the cases where none of the abovementioned weighting methods is used, “equal weighing” is applied. Figure 3 presents the existing hybrid approach for eliciting the domain weighting factors. The table cells marked in grey are excluded from the weighting process, given that not every “technical domain” is considered relevant to each “impact criterion”.

Key functionalities		Energy performance & operation		Responds to the needs of occupants			Energy flexibility	
Impact criteria		Energy efficiency	Maintenance & fault protection	Comfort	Convenience	Health, well-being & accessibility	Info to occupants	Energy flexibility & storage
Technical domains								
	Heating	%	%	16%	10%	20%	11.4%	%
	Cooling	%	%	16%	10%	20%	11.4%	%
	Domestic Hot Water	%	%		10%		11.4%	%
	Ventilation	%	%	16%	10%	20%	11.4%	%
	Lighting	%	%	16%	10%	20%		%
	Electricity	%	%		10%		11.4%	%
	Dynamic Building Envelope	5%	5%	16%	10%	20%	11.4%	
	Electric Vehicle Charging				10%		11.4%	5%
	Monitoring & Control	20%	20%	20%	20%		20%	20%
Sum of weights		100%	100%	100%	100%	100%	100%	100%

Step 1: Fixed weights

Step 2: Equal weights

Step 3: Energy balance (depending on climate zone & type of building)

Figure 3. Hybrid approach for weighting the “technical domains”.

Step 8: Before calculating a single score for each “impact criterion”, the scores of the individual services need to be first aggregated at “technical domain” level against each “impact criterion”. The respective scores of the smart-ready services against each impact criterion are calculated by applying the following mathematical equations. The aggregation of the smart-ready services’ scores follows the “equal weighting” approach, namely the included smart-ready services within a “technical domain” are considered to be of equal importance.

$$I_{d,ic} = \sum_i^{N_d} I_{ic}(FL(S_{i,d})) \quad (5)$$

$$I_{d,ic}^{\max} = \sum_i^{N_d} I_{ic}(FL^{\max}(S_{i,d})) \quad (6)$$

Where:

d stands for the technical domain,

ic stands for the impact criterion,

N_d is the total number of services in technical domain d ,

$S_{i,d}$ is service i of technical domain d ,

$FL(S_{i,d})$ is the functionality level of service $S_{i,d}$,

$FL^{max}(S_{i,d})$ is the highest functionality level of service $S_{i,d}$,

$I_{ic}(FL(S_{i,d}))$ is the score of service $S_{i,d}$ for impact criterion ic , according to the service's functionality level,

$I_{ic}(FL^{max}(S_{i,d}))$ is the score of service $S_{i,d}$ for its highest functionality level for the impact criterion ic .

The aggregation of the “technical domain” scores to elicit a single impact score relies on the relative domain importance against each “impact criterion”, and it is implemented through the following equation. The weighting factors of the “technical domains” against the “impact criteria” are drawn from Step 6.

$$SR_{ic} = \frac{\sum_d^N (w_{d,ic} \cdot I_{d,ic})}{\sum_d^N (w_{d,ic} \cdot I_{d,ic}^{max})} \cdot 100 \quad (7)$$

Where:

d stands for the technical domain,

N is the total number of technical domains,

$w_{d,ic}$ is the weighting factor of technical domain d for impact criterion number ic , expressed as a percentage.

Step 9: A total score is then calculated at “key functionality” level as a weighted sum of all “impact criteria” scores, based on the “equal weighting” approach described in Step 6, as follows:

$$SR_f = \sum_{ic}^M (w_{f,ic} \cdot SR_{ic}) \quad (8)$$

Where:

M is the total number of impact criteria,

$w_{f,ic}$ is the weighting factor of impact criterion ic for key functionality f , expressed in percentage,

SR_{ic} is the smart readiness score for impact criterion ic .

Step 10: The total SRI score is finally calculated as a weighted sum of the scores of the three “key functionalities”, as follows:

$$SRI = \sum_f^P (w_f \cdot SR_f) \quad (9)$$

Where:

P is the total number of key functionalities,

w_f is the weight of key functionality f , where $\sum w_f = 1$,

SR_f is the smart readiness score for key functionality f .

SRI is expressed on the basis of seven smart readiness classes, following a descending order in terms of smart readiness. Each smart readiness class corresponds to a range of total smart readiness scores as follows: 90–100%; 80–90%; 65–80%; 50–65%; 35–50%; 20–35 %; < 20%.

As an optional add-on to the existing methodology, the smart readiness scores of “technical domains” for each impact criterion $SR_{d,ic}$ could be calculated, following the equation:

$$SR_{d,ic} = \frac{I_{d,ic}}{I_{d,ic}^{max}} \cdot 100 \quad (10)$$

Where:

$I_{d,ic}$ is the score of domain number d for impact criterion ic ,

$I_{d,ic}^{max}$ is the maximum score of domain number d for impact criterion ic .

3. SRI implementation pathways suggested by the EC

A pivotal driver to determine an effective SRI implementation pathway is the level of the SRI deployment that will be achieved within an examined building stock as a result of the designed pathway. Viewed from this perspective, the main challenge that arises, lies in identifying linkages with other schemes and initiatives that could trigger a significant volume of conducted SRI assessments, known as trigger points. As such, a major part of a successful SRI implementation pathway falls under selecting the optimal trigger points that would enable an SRI assessment, since these could facilitate SRI increase its roll-out rate within a short period of time. The most common SRI trigger points are presented below (Verbeke et al., 2020):

1. EPC assessment
2. Major renovations
3. New building construction
4. Buying an electric vehicle
5. Smart meter installation
6. HVAC inspections
7. Other (e.g., link to European initiatives)

Several existing European initiatives have been suggested as trigger points and foster ease-of-adoption of the SRI concept, on either complementary or feed-in basis. The terms “complementary” and “feed-in” are used to characterise the relevance of each initiative to the SRI, as the latter could be either employed to supplement the

initiatives by just providing further information to the user or being able to draw from or convey data-driven insights. Some of the most widely known EU initiatives that could potentially trigger SRI assessments are summarised in Table 4, along with a brief description and their relevance to the SRI assessment framework. It is noted that some of the presented initiatives constitute standalone trigger points (e.g., EPCs, etc.), although they are also supported by centrally coordinated efforts stemming from the EU policy making directions and planning activities.

Table 4. EU initiatives relevant to the SRI

EU initiatives	Brief description	Level of implementation	Maturity	Relevance to the SRI
EPC	Energy performance rating and recommendations for cost-effective improvements	Member State level	High	Feed-in ² : Data from EPCs could be used to feed the SRI “energy balance” weighting method Complementary ³ : Inspection site visits for EPC issuing purposes could be combined with joint SRI assessments
Level(s)	Voluntary tool oriented to private sector actors that wish to demonstrate the environmental performance of their buildings, and compare it with the wider sustainability priorities at EU level employing a series of indicators	Member State level	Low	Complementary: SRI could offer further insights on the building performance that are also related to several environmental impacts
Building Renovation Passport (BRP)	Document outlining a long-term (up to 15 or 20 years) step-by-step renovation roadmap for a specific building, resulting from an on-site energy audit	Member State/Regional level	Low	Complementary: SRI could be integrated as an extra component to the BRP
Building Information Modelling (BIM)	Digital tool aimed at the construction industry, providing a digital representation of a building’s characteristics in its whole life cycle	Private enterprises	High	Complementary: BIM framework entails site visits for inspecting the buildings and extracting data, which could be also used for the SRI

²If the case is for a better adjustment of the default “energy balance” weighting factors, as provided by the EC

³In case the default “energy balance” weighting factors are used, as provided by the EC

Broadband-ready level	Level of physical infrastructure that enables high-speed internet access	Member State level	Low	Complementary: A building's internet connectivity constitutes a precursor to many smart-ready technologies and thus could be linked to the SRI
Digital Building Logbooks (DBL)	Simple summary of a new or refurbished building in that how it is envisaged to be maintained and serviced	Member State level	New	Complementary: SRI could be integrated as an extra component to the DBL

One of the biggest challenges the SRI will have to address is the significant impact in terms of number of assessments. This is calculated as a function of the trigger points as well as the engaged European initiatives and other schemes, leading to the following set of pathways have been proposed by the EC (Verbeke et al., 2020). These pathways are expected to pave the way for all interested Member States in testing the SRI scheme, towards designing and implementing a national SRI policy framework based on a common groundwork.

1. Linkage of the SRI to the EPC so that an SRI assessment is triggered each time an EPC is about to be issued.
2. Linkage of the SRI to the construction of new buildings and major renovations.
3. Market-based voluntary scheme based on self-assessment and supported by on-line tools and 3rd party certified bodies for those willing to pay.
4. Market-based voluntary scheme based on self-assessment and supported by on-line tools and 3rd party certified bodies subsidised by the state/utilities in the context of promoting flexibility, energy efficiency, self-generation, etc.
5. Linkage to the Building Automation and Control Systems (BACS) and Technical Building Systems (TBS) deployment, drawing from Articles 8, 14 and 15 of the EPBD.
 - a. Article 8 provisions the installation, upgrade, and replacement of TBS and measures to encourage the deployment of automatic temperature regulation and zoning (Directive 2018/844/EU).
 - b. Articles 14 (heating inspections) and 15 (cooling inspections) require all non-residential buildings with equivalent rated capacity > 290 kW to have BACS by 2025 (Directive 2018/844/EU).
6. Linkage to the roll-out of smart meters.
7. Mix of the above based on subsidies, financial instruments, etc.

The above pathways are differentiated among each other in that they encompass different cases with regard to the main assessment method. Each method leads to a different rate of SRI assessments, which in turn affects the coverage of the building stock. Thus, the overall building lifecycle needs to be considered in the selection of the optimal context-specific trigger point and on whether the pathway could be followed as an independent standalone roadmap or should be linked to another initiatives and schemes.

Some of the pathways set out above, are linked to existing policies and directives, such as pathways 1, 2 and 5 which are strongly EPBD-relevant, in an attempt to support the SRI deployment through leveraging the benefits of large-scale implemented EU policies. In the same context, pathway 6 is also linked to a policy controlling the roll-out of smart meters. Nonetheless, there is a set of pathways that do not entail a link to other policies, neither at European nor at national level (pathways 3 and 4), the implementation of which is heavily dependent on a voluntary basis, where market actors and all relevant stakeholders would be engaged in the SRI value chain only if they would identify a sufficient profit merit. It is also reckoned that, unlike the other policy link-based pathways, independent pathways lack built-in communication channels to promote automatic introduction of the SRI to the target audience (e.g., building users/owners, facility managers, manufacturers, engineers, construction companies, etc.). This could potentially “squeeze” the SRI uptake rate to a much lower level, in the absence of effective marketing efforts, thereby limiting the profit merit for market actors. Pathway 4 seeks to offset this by providing financial incentives to the participants for joining the SRI scheme, which, dependent on their attractiveness, could increase the uptake rate. From this point of view, incentives, even beyond the financial dimension, could be provisioned for on horizontal basis across all pathways, but are likely to provide more added-value when supporting independent pathways rather than policy-relevant ones, since the latter imply exploiting available mechanisms to ensure uptake occurs.

4. EU funding mechanisms to support the SRI uptake

Investing in smart energy management technologies and implementing them through concrete renovation plans, is a key factor to achieve higher energy efficiency levels, and thus higher energy savings and lower energy costs. Therefore, innovative and dedicated financing instruments and mechanisms should be designed to promote SRI implementation more broadly and further exploit the potential for energy savings in all implicated activity sectors. However, up until recently, there were not any funding mechanisms that had been developed to incorporate and address the SRI concept within their provisions, and as of this, the funds to support the SRI’s larger uptake will be explored through the exploitation of the aids devoted to the wider energy efficiency front.

The EC was proud to announce that approximately €16-18 billion were spent on energy efficient solutions in housing, public and tertiary buildings over the time period 2014–2020, thus highlighting the importance of energy efficiency interventions within the building stock as an effective means to decrease the energy consumption. Whilst the EU has increased the amount of public funds available for energy efficiency, another €260 billion per year will be necessary over the period 2021-2030 in order to meet the current EU’s 2030 climate and energy targets.

In this context, the new financing instruments to be developed, are expected to enable the effective use of potentially available resources for implementing smart services in buildings, that could contribute to increasing the overall energy efficiency and simultaneously reducing CO₂ emissions. These programmes will combine public and private financing to support smart energy efficient features, aiming at specific sectors with high potential, such as the tertiary, domestic and industrial sectors. In this direction, the mechanisms that can be considered, include blended financing on favourable terms (“blended” concessional loans), lease-financing, risk-sharing instruments such as combined insurance and guarantee instruments, as well as mechanisms focusing on aggregation. These funding instruments can be used by construction and energy service companies that need financing to implement smart technologies and energy efficiency plans, whereas consideration will also be given to extending their scope to include other sectors (SMEs). A brief overview of the main funding instruments and programmes applied in Europe (based on public and private funding) are presented below:

Cohesion Fund

The EU’s Cohesion Fund in its latest 2021-2027 programming period, focuses in introducing economic and social disparity between EU countries and promote sustainable development. The fund supports energy-related projects that benefit the environment, for example by reducing greenhouse gas emissions, increasing the use of renewable energy and improving energy efficiency. Part of the Cohesion Fund is used to implement the energy union strategy with the help of the Energy and Managing Authorities network (EMA).

Connecting Europe Facility (CEF)

The Connecting Europe Facility is the EU's funding instrument for boosting energy, transport, and digital infrastructure. In 2018, CEF was renewed to cover the time period 2021-2027 with a budget of €42.3 billion to support investments in EU infrastructure networks dedicated to energy (€8.7 billion), transport (€30.6 billion) and digital transformation (€3 billion). This budget underlies a 47% increase compared to the previously allocated one of the period 2014-2020. Every two years, EC draws up a list of EU projects of common interest (PCIs) which may apply for CEF funding.

European Investment Bank (EIB)

The European Investment Bank helps finance energy projects through providing loans, equities or guarantees of different scales to the eligible organisations, which comprise entities of both the public and the private sectors. EIB financing typically starts from €25 million, however it remains open to co-financing from respective national intermediaries. Throughout the years, EIB has been playing the key supportive role in a wide range of actions including new rental construction, social inclusion measures, poverty alleviation and energy efficiency renovations

of social housing, in several countries such as the UK, Ireland, France, Belgium and the Netherlands. The ever-increasing demand for EIB finance, urged EIB to extend its coverage, having started to invest in countries like Malta, Poland, Spain, Portugal, and Ireland (Lakatos and Arsenopoulos, 2019). EIB, together with EC, launched the European Investment Advisory Hub as part of the Investment Plan for Europe. The hub acts as a single access point that provides advice and expertise on administration and project development across the EU. In November 2019, the EIB adopted a new and more ambitious energy lending policy that aimed to phase out traditional fossil fuel energy projects by 2021.

ELENA programme

ELENA is a technical assistance programme managed by EIB, that provides grants to facilitate the deployment of large-scale sustainable energy investments at local and regional level. From 2015 on, the private sector has been included in the list of beneficiaries of the programme, on the basis of further boosting the implementation of energy efficiency investments, under the same operational system combined with renewables and district heating. Typically, investment projects that are considered eligible for joining the ELENA programme are those above €30 million with a three-year implementation period for energy efficiency and four-year period for urban transport and mobility. ELENA's support is not limited to conducting feasibility and market studies only, but it is rather extended to cover technical elements such as energy audits and preparation of the tendering procedure. This support is economically valued as of 90% of the total technical costs, whilst the remaining 10% of the co-financing is up to the final beneficiary to be ensured. During the time period 2018-2021, the ELENA programme offered support to energy efficiency refurbishments and renewable energy investments in 286 buildings with a total budget of €2.7 million (EIB 2018).

InvestEU

It constitutes the successor of the European Fund for Strategic Investments (EFSI), a joint initiative between the EIB Group (the EIB and the European Investment Fund) and the EC, which was in effect until 2020, and aimed to mobilise private investment in projects strategically important for the EU, including the areas of energy efficiency, renewable energy, power grids and interconnectors. The InvestEU Programme supports sustainable investment, innovation and job creation in Europe. It will bring under the same roof the EFSI and 13 other EU financing instruments, and according to the most recent estimations, it aims to trigger more than €650 billion in additional investment over the time period 2021-2027.

European Energy Efficiency Fund (EEEF)

This fund is aimed at public authorities at local, regional and national level, or public/private organisations acting on their behalf, and is designed to support the implementation of energy saving investments through providing small-scale financing (up to €5 million) based on the equity technique (European Energy Efficiency Fund 2018). Despite the significant lower financial contribution of EEEF compared to the ones of other European funding mechanisms, it paves the way for small-housing providers that are not eligible for bigger-scale programmes of the European Investment Bank (EIB) to join and benefit. The fund contributes to the investment projects with a multi-layered risk/return structure, laying emphasis on a targeted private-public partnership which can squeeze this risk down to the minimum level.

European Regional Development Fund (ERDF)

The European Regional Development Fund (ERDF) aims to reduce economic, social and territorial disparities between the EU's regions, through supporting investments at national and regional level. Three of the ERDF's priority areas for 2021-2027 that focuses on the energy efficiency front and thus could accommodate the provisions of the “smartness” concept are to make Europe and its regions: (a). more competitive and smarter, through innovation and support to small and medium-sized businesses (SMEs), as well as digitisation and digital connectivity, (b). greener, low-carbon and resilient, (c). closer to citizens, supporting locally-led development and sustainable urban development across the EU. A minimum percentage of ERDF funding must be channelled towards low carbon projects in regions: 20% for more developed regions, 15% for transition regions and 12% for less developed regions.

Recovery and Resilience Facility (RRF)

The Recovery and Resilience Facility is the key instrument at the heart of NextGenerationEU, the EU's plan for emerging stronger from the COVID-19 pandemic. It is structured around six pillars: (1) green transition, (2) digital transformation, (3) economic cohesion, productivity and competitiveness, (4) social and territorial cohesion, (5) health, economic, social and institutional resilience, and (6) policies for the next generation. The RRF will help the EU achieve its target of climate neutrality by 2050.

However, despite the numerous available energy efficiency-related funding mechanisms, the mobilisation and channelling of the investment towards incorporating the notion of smartness and thus the SRI scheme as a whole, remains a challenge especially for the countries and all implicated stakeholders which are keen on carrying out such projects.

5. Inspection softwares

Currently, there are no commercially available tools for the assessment of a building's SRI. Instead, there are some tools developed under EU-funded projects, including those of the SRI-ENACT's sister projects Smart², SRI2Market, mainly aiming at: (a). calculating the smartness of a building unit, (b). combining the SRI and EPC assessments and provide a unified building certificate that includes both the energy performance and the SRI assessment, and (c). in some cases, extending the recommendations on improving energy efficiency and performance, etc., to include smart management components that would improve the total SRI of the buildings. The reason this EPC-related approach was pursued by the different EU-funded projects was because it is possible to embed the SRI methodology within the framework of the EPC schemes, given that in many cases data from EPCs can be used in the assessments of SRI. Some of the tools and schemes developed under EU-funded research projects, attempting to combine EPC and SRI calculations are presented below:

Smart-Ready-Go!

Smart-Ready-Go! has been developed in the scope of the EU-funded Smart² LIFE project⁴ and constitutes a cloud-based tool which aspires to become an established application for the assessment of the buildings' smartness, allowing self and online assessment of building units, in compliance with Method A and Method B of the SRI calculation methodology. This tool enables the extraction of building systems-related information from IFC documents, as well as features to inform users, on a real-time basis, on the actual smartness performance of their building unit, as well as informed recommendations on improving the smartness performance, based on a cost-optimal approach, in alignment with existing CEN standardised methods.

Smart Performance Assessment & Advisor (SPA&A)

SPA&A has been developed for the purpose of the Smart2B project⁵, and is designed to provide building users with data-driven insights about the current smartness of the building, also suggesting SRI improvement actions based on the current SRI definition, accompanied by their economic and environmental impacts. All of these services are integrated into a common framework including a data platform and an application with graphical user interfaces to ensure easy access to the included information for the building users.

⁴<https://www.smartsquare-project.eu>

⁵<https://smart2b-project.eu>

U-CERT SRI digital tool

The development of the U-CERT SRI digital tool has been included among the main objectives of the Horizon 2020 EU-funded project U-CERT⁶, which seeks to encourage the application of innovative energy efficiency solutions tailored to the building users, through introducing a next generation Energy Performance Assessment and Certification Scheme to value buildings in a holistic and cost-effective manner, including the SRI and Indoor Environmental Quality (IEQ), and supported by an EU-wide training and certification process for building professionals. The U-CERT SRI digital tool accommodates the official SRI assessment spreadsheet in a cloud web environment offering improved user experience both on the input data side (i.e., focused on the SRI assessors) and on the results' visualisation side to support decision making on investments and renovation. The tool also incorporates a service dedicated to training and certification of the SRI assessors through a Learning Management System. All SRI assessment data of the U-CERT SRI digital tool can be exploited in another U-CERT tool to generate a combined EPC label that includes the SRI score.

D2EPC

D2EPC⁷ is another Horizon 2020 EU-funded project that seeks to set the grounds for the next generation of dynamic Energy Performance Certificates (EPC) for buildings. The proposed framework sets its foundations on the smart-readiness level of the buildings and the corresponding data collection infrastructure and management systems. It is fed by operational data and adopts the “digital twin” concept to advance Building Information Modelling (BIM), calculate a novel set of energy, environmental, financial, and human comfort/wellbeing indicators, and through them the EPC classification of the building under examination. For this purpose, the project aimed at introducing and establishing the “dynamic EPCs”, integrating EPC assessment with real data from IoT devices. A web platform was developed for this purpose including various tools and services, where BIM files, IFC files and metered data are used to produce EPCs with an added value services' suite for improved energy performance including smart readiness of buildings and human comfort.

⁶<https://sri.u-certproject.eu/project/bewerken/buildinginfo/>

⁷<https://www.d2epc.eu/en>

SRI2MARKET platform

The SRI2MARKET platform is a multi-lingual web-based platform currently under development for the purpose of the SRI2MARKET project⁸, following the official SRI methodology provided at EU level. This platform includes several features such as easy customisation to national languages, national adaptations of the SRI calculation, user-friendly interface that allows users to conduct and save SRI assessments, recommendation sections based on smart and novel technologies, EPC-relevant information, functionality to dynamically create scoreboards, e-learning lessons, etc.

E-DYCE

The EU-funded project E-DYCE⁹ seeks to develop an energy performance labelling methodology, aligned to the current EPBD and NZEB definitions that can be applied to building of different typologies, locations or smartness levels, that will be closer to the actual building operation conditions. It aims to generate substantial energy savings to the buildings by guiding the users to unlock the potential of free running operation of the buildings. The proposed methodology lays hands on the issue of defining, elaborating, reporting and eventually making openly available neutral Digital EPC certification processes as a technological component to be used. The dynamic E-DYCE EPC incorporates the SRI since it relies on smart technologies to assist the building users/operators that have difficulties in relating energy use of the building with their actions as energy bills arrive relatively seldom.

Since the SRI assessment scheme is designed and regulated by the public sector, Member States are encouraged to develop an open-source calculation system to support the inspection process, certification, and data management of the scheme (Verbeke et al., 2020). Since the SRI calculation is far simpler than other well-established schemes (e.g., EPCs, etc.) as it does not require a simulation and comparison with a target building, a simpler solution can be used. Towards this direction, a centrally coordinated and managed online platform that encapsulates this calculation system would be advantageous, on the basis of providing the following functionalities:

- Streamline data collection by providing a much more user-friendly interface for the inspectors to insert building data than the current Excel calculation spreadsheet (i.e., substitute the Excel through a series of online forms).
- Save inspection data in real time to a web server, minimising data losses.

⁸ <http://sri2market.eu>

⁹ <https://edyce.eu>

- Connect inspection data to a specific building in the register, providing a digital logbook related to building smartness and allowing this logbook to be updated with data from future inspections.
- Calculate interactively the SRI score based on data inputs.
- Enable the update of the calculation methodology and the SRI services as the SRI regulation and methodology evolves.
- Provide APIs for exchanging data between the SRI platform and other services.
- Provide some first recommendations on how to improve the smartness of the building based on the results of the assessment.

Apart from supporting inspections, an online platform can play a much broader role as the official, public information portal on the national implementation of the SRI. Both the Technical Report of the EC (Verbeke et al., 2020) and the study by the ePANACEA project (Borragán and Legon, 2020) suggest that such functionality would be significant as it could increase the transparency and comprehensibility of the scheme and, subsequently, its overall social acceptance and trust. The platform could include information about the value proposition of the SRI, an introduction to the assessment methodology, as well as a Frequently Asked Question (FAQ) section with common questions. Of course, such a use case would require the platform to be user-friendly for a wide range of individuals by avoiding complexity or providing different interfaces and levels of details for non-expert and expert audiences. On this, Verbeke et al. (2020) suggest that such a platform can be designed in a hierarchical structure, showing a first overview of the information to the users to avoid overwhelming them and provide details on demand. Even further, there is great potential allowing any interested citizen to perform an SRI assessment themselves, by using a public-facing version of the Method A assessment which is already rather simple and fast to perform. Of course, a 3rd party auditor would be still required to issue an SRI certification, and only after inspecting the building independently. Nevertheless, self-assessments could help citizens understand the process of the calculation, get a first SRI score for each of the service domains and for the building overall, and receive recommendations on how and where to improve the smartness of their building.

Providing recommendations is an indispensable functionality for unlocking the impact of SRI, as the goal is not to just assess buildings in terms of smartness but to promote awareness about the potential of SRTs on improving the efficiency, comfort, and connectivity of a building. While auditors would need to provide building-specific recommendations after an SRI assessment, it would be valuable to provide beforehand some first indications to building owners through a publicly available web platform. Similar online assessment and recommendation tools

have been developed by Member States such as the Netherlands¹⁰ and Belgium¹¹ to allow their citizens to gain a first awareness on the energy performance of their buildings as well as potential improvements by filling a simple questionnaire.

6. Country context studies

This section presents the status and context regarding the SRI adoption and implementation in the eight pilot countries of the SRI-ENACT project (Bulgaria, Czech Republic, Latvia, Romania, Croatia, Greece, Spain, Austria), providing specifications and tailored insights. However, it should become clear that the following country-specific descriptions is the result of an initial desk research that has been performed, given that the SRI is a relatively new concept in most of them, and the process for capturing the context within each country is an ongoing and ever developing process. In this respect, the national SRI contexts presented below will be further elaborated and enhanced in the near future, following several rounds of stakeholder engagement that will be carried out as part of the Task 2.3 of the SRI-ENACT project, as well as the alignment and merging with the respective work that is currently being done on this topic in the SRI-ENACT's sister projects, namely Smart², SRI2MARKET and easySRI.

6.1. Bulgaria context

6.1.1. Introduction

Improved energy efficiency legislation and new regulatory framework accompanied by clearly defined requirements constitute the key prerequisites for Bulgaria in its attempt to overcome the backlog of the energy efficiency targets set (Ministry of Energy and Ministry of the Environment and Water, 2019), and foster the introduction of smart systems in both newly constructed and renovated buildings. According to the Ministry of Regional Development and Public Works, in 2022, around 93% of the buildings in Bulgaria are rated as energy inefficient, with 2,000 multi-family buildings out of around 60,000 having been renovated in the last 5 years, and around 40% of a total of 12,000 public buildings having been partially or fully renovated¹². The current regulations mention or regulate, and some of them recommend, although without specifically paving the way, the use of elements or types of smart systems, the availability of which may create conditions for SRI application in the

¹⁰<https://www.verbeterjehuis.nl/wizard/>

¹¹<https://checkjehuis.stad.gent>

¹²<https://www.investor.bg/a/451-balgariya/353275-93-ot-sgradite-u-nas-ne-sa-energoefektivni-71-ot-balgarite-iskat-sanirane>

future. As such, the level of adoption of the SRI scheme in Bulgaria is still low, in both the residential and the non-residential sector.

6.1.2. Legislation, policies and measures

Our review of Bulgarian SRI-related legislation, finds that the preparation and implementation of the corresponding regulatory texts in the Bulgarian legislation (primary and secondary legislative acts, sectoral and regional regulations, rules, etc.) is still in its infancy and thus inconsistent and unsynchronised. The Ministry of Energy (ME), the Sustainable Energy Development Agency (SEDA), and the Ministry of Regional Development and Public Works (MRDPW) are expected to lead the initiative of the adaptation and implementation of SRI in the regulatory documents in Bulgaria by formulating policies in the energy and construction sectors as well as monitoring their implementation. Having said this, a review of the main SRI-related legislation and regulations in Bulgaria are presented below:

- The *Energy Act (C(2021) 3460 final)* recommends the deployment of smart metering and smart grids for better connectivity, awareness and management of final customers' energy consumption. In case smart metering is economically viable, the Energy and Water Regulatory Commission shall draw up timetables for the introduction of smart metering systems.
- The *Energy Efficiency Act (Energy Efficiency Act, 2021)* obliges energy suppliers to provide to their customers detailed data about their energy consumption for the last 24 months, when smart metering systems are used. At the time of installation of commercial smart metering, the relevant grid operator shall provide end-customers with appropriate advice and information on the potential of these devices for metering of consumption and energy management. Energy suppliers and equipment owners may provide customers with smart metering and control systems or other technical solutions in the form of energy service, thus providing customers with data about their energy consumption. Additionally, the Act creates conditions to incentivise transmission and distribution grid operators to provide services to end customers that enable energy efficiency improvement measures to be implemented when introducing smart grids, taking into account the costs and benefits associated with each measure. Furthermore, it is ensured that both the commercial smart metering systems and the data transmission are secure, ensuring data protection and privacy.
- *Ordinance No. 15 of 28 July 2005 on technical rules and standards for the design, construction and operation of sites and equipment for production, transmission and distribution of thermal energy* (Ministry of Economy, Energy and Tourism, 2010) stipulates that the design specifications and terms of reference shall include, along with basic technological, functional, and technical requirements, the means of

measuring the fuel and energy consumed in the building, including smart metering systems, energy consumption monitoring systems, and standardized energy management systems.

- *Ordinance No. RD-02-20-3 of 9 November 2022 on the technical requirements for the energy performance of buildings¹³* is the most recent regulation and is fundamental for the application of smart technologies, having great importance and field of application for new and existing buildings. Unfortunately, there are no explicit regulatory texts on the application and assessment of smart technical tools, technologies, criteria and indicators. This is a serious omission, given the texts laid down in the aforementioned Ordinance No. 15, and it should be resolved in the near future by updating the Ordinance. On top of that, the definition of “building automation and control” included in the Ordinance poses shreds of fuzziness, since it states that these are “products, software and engineering systems for automatic control, monitoring and optimisation, human intervention and management to achieve energy efficiency, economical and safe operation of building systems equipment”. The content of this definition makes it reasonable to assume that the technical requirements for the energy performance of buildings contain elements and technologies specific to smart systems.
- *Ordinance No. E-RD-04-2 of 16 December 2022 on energy efficiency auditing, certification and assessment of energy savings in buildings¹⁴* regulates the issuing of certificates to residential and non-residential buildings in relation to the primary energy consumption class established by the energy audit. Non-residential buildings are differentiated by consumption of primary energy into nine separate types. The provisions of the Ordinance that concern the database, regular inspections of heating installations with hot water boilers over 20 kW, including heat supply control systems and circulation pumps, as well as air-conditioning installations with rated power over 12 kW, shall apply when auditing buildings are in operation. The Ordinance provides an energy certificate template for different types of buildings. The energy certificate used so far reflects the presence/absence of a building automation and control system only. It is obvious that this assessment is far too generic and has only statistical value, without quantifying the impact of all available systems (considering their interrelation) on the energy performance of a building. The certificate also indicates prescribed energy efficiency measures following the audit, which are also economically assessed over the payback period.

¹³<https://dv.parliament.bg/DVWeb/showMaterialDV.jsp?idMat=180101>

¹⁴<https://seea.government.bg/bg/dokumenti#naredba-e-rd-04-2-ot-16-12-2022-g-za-obsledvane-za-energiina-efektivnost-sertifitizirane-i-otzenka-na-energiinite-spestyavaniya-na-sgradi>

6.1.3. Options for the SRI adoption

SRI is not yet implemented and tested in Bulgaria, and no formal SRI assessments are known thus far. As of the beginning of 2023, the key documents relating to the construction and certification of buildings (Building renovation passports, Energy efficiency certificates, etc.), including renovation and reconstruction of buildings, do not provision for requirements linked to SRI or SRI assessment tools. Such linkage will become possible once the introduction of smart building systems is more specifically regulated and tailored to the national context. For the time being, only parts of the smartness aspect are dealt with, such as energy efficiency and smart metering systems, are regulated, implemented, reported, and assessed, which is a step towards the SRI introduction. On that reflection, the current Bulgarian legislation does not deliver measures for mandatory implementation and incentives available for smart building systems and SRI.

According to the national SRI-ENACT team, it appears that the most prominent implementation pathway for a wider SRI adoption in Bulgaria, would be if the measures proposed to improve energy efficiency within the energy performance certificate of the Ordinance No. E-RD-04-2 of 16 December 2022, were also assessed as to their capability to improve SRI, something that should be also reflected in the energy certificate. In other words, a direct link of the SRI to the EPC assessments raises a great deal of heated debate in Bulgaria, as the best SRI implementation pathway. According to the authors, for Bulgaria, the mandatory link of the SRI scheme to the building regulations, and the mandatory application of the latter, is the best option, compared to provision of information, incentives, or voluntary option. This is so because, although initial resources need to be invested in the preparation and implementation, the regulatory approach has been perceived to be not only the most effective one, but also an efficient one, when the costs and benefits of the implementation do not vary substantially.

Good practices in the context of SRI (with opportunities for easy adaptation) are available in new buildings – mainly administrative, commercial, and luxury multi-family residential buildings, especially buildings certified or in a process of certification under international voluntary standards for sustainable construction, such as BREEAM and LEED. More detailed information on the good practices and the focal building categories that the SRI scheme could be adopted within each country, will follow at a later phase of the project, and more specifically within deliverable D2.2 “SRI-ENACT Methodology with national adaptations (1st Release)”, where the building stock of each partner’s country will be extensively analysed and insights will be drawn based on this.

At this initial stage of the SRI-ENACT project, the practical roadmap for the implementation of a national SRI scheme could be a preliminary draft only. Based on the feedback from the engaged stakeholders in Bulgaria, a first draft of the national SRI Implementation roadmap could include the following consecutive steps:

1. Information campaign, introduction on EU policy for SRI implementation, benefits for the society/end users and the target audience overall.
2. Capacity building of decision-makers, market actors, SRI assessors, etc.
3. Non-committal test phase: selection of demo buildings for the SRI assessment (especially buildings certified under initiatives such as BREEAM and LEED) based on the official SRI methodology and the proposed services of both Method A and Method B.
4. Preparation of national legislation and regulation upgrade through dedicated Working Group.
5. Adaptation of SRI methodology for nationwide implementation in practice.
6. Linkage of the SRI scheme to the EPC assessment.
7. Provision of feasible financing schemes for SRI implementation as National Fund for Energy Efficiency and Renewable Energy Sources, ESCO, EU and international programmes on energy efficiency and sustainable development, etc.
8. Dissemination of results through publications, interviews, mass media, etc.

Beyond the strict materialisation of the SRI implementation pathway, in line with the national needs and priorities, the latter could be also assisted by several EU coordinated actions, e.g.: follow-up reminders, obligation for periodic reporting on the results of the SRI implementation process, setting up of a state authority in charge of the systematic, comprehensive and synchronous SRI implementation, incentives for SRI implementation, awareness campaigns, etc.

6.1.4. Challenges

However, the implementation pathway of the SRI scheme at national level is expected to face a number of challenges at both the development and the implementation level as well, such as:

- Lack of current regulations governing coherent and large-scale implementation of smart systems to impact energy efficiency, comfort, etc.
- Insufficient awareness among investors, planners, and the public regarding the benefits of implementing smart building systems.
- Absence of a competitive market for design, equipment, construction, maintenance and servicing of smart building systems.
- Lack of sufficient information on different types and purposes of smart building solutions and best practices.

- Reliability issues if SRI assessments are not carried out by certified energy auditors specifically trained in SRI assessments.
- Access to data and software products for monitoring and operational checks at different stages of building construction, refurbishment and operation, which would increase the understanding and results of the SRI assessments.
- Insufficient information and experience on reliability and security of smart building systems, including cyber security.
- Lack of applicable criteria, indicators and other information and computational tools for impact assessment in smart building systems.
- Investment and operations cost of for BIM systems.
- State and municipal authority's readiness for cooperation.

Lecturers, methodologies and training and certification programmes for auditors are an important stage of the SRI implementation pathway, that significant focus should be laid upon. In Bulgaria, for many years there is an established framework for training of energy auditors, including detailed regulatory requirements, available training centres, lecturers, training materials, etc. Nevertheless, there are no details or specifications on creating outlines, tests, criteria for selecting of auditors, etc., while a special provision for non-professional SRI assessment (e.g., instruction, self-study programmes, consultation centres, online platforms, etc.) should be deployed.

It should be mentioned that there are no ICT tools in use or planned to facilitate SRI uptake. As in other similar cases, digital marketing, available web-based platforms, government and business websites, demonstration and training software about to be developed within the SRI-ENACT project are expected to be used jointly to promote SRI uptake in Bulgaria. Similarly, brochures, publications, on-site training, thematic events, and social media are also typically used by the bodies responsible or interested in implementing this type of solutions.

In order to accelerate the processes of changing the regulations and all secondary documents governing the implementation of SRI, purposeful multi-directional actions by the responsible institutions for new regulations, stakeholder awareness, administrative support, etc. will be needed. This implies the inclusion of measures for support and encouragement, for example, in the preparation of assignments, tender evaluations, the easier/simplified administrative procedures, etc., in cases where difficulties, uncertainties or incompetence may become obstacles. In this sense, financial incentives for demo projects, consultants, end users, etc. could also be considered at a certain stage.

6.1.5. Funding mechanisms and programmes

We reviewed the financial schemes in Bulgaria, but we were unable to identify any available to support SRI. The only partial exception is the EU-funded Programme “Competitiveness and innovation in enterprises” 2021-2027¹⁵, which can finance the construction of smart building systems (but not their operation) in the non-residential sector. For the residential building stock, no programme funding SRI implementation has been identified. The Operational Programme “Competitiveness and innovation in enterprises” 2021-2027 and the National Programme for Renovation of Housing Stock¹⁶ are appropriate to stimulate the future application of SRI, respectively in industry and the housing sector. Other feasible financing schemes could be provided by the national Energy Efficiency and Renewable Sources Fund (EERSF), ESCOs, EU and international programmes on energy efficiency, sustainable development, etc.

6.1.6. Conclusions

The actual Bulgarian legislation and regulations do not clearly provide backing for SRI certification and smart building systems. However, there are relatively favourable conditions for SRI integration in the existing energy performance of buildings certification methodology and practices. Taking into account the potential challenges and difficulties mentioned above, we consider that the SRI uptake might be successful in case the certification procedure becomes a mandatory part of the energy performance certification scheme and financial incentives also become available.

6.2. Latvia context

6.2.1. Introduction

The total number of dwellings/units in Latvia sums up to 1.04 million, 64% of which have been built before 1990¹⁷. Approximately 10 to 15% of the residential building stock has been built during the last decade and thus are considered to be modern and well-established dwellings¹⁸. Most of the old apartment buildings will become uninhabitable over the next two decades if no action is taken¹⁹. Multi-apartment buildings suffer from inaction on energy efficiency due to the bureaucratic and complicated process of improvement, the number of parties

¹⁵<https://mayorsofeurope.eu/social-issues/sofia-presented-a-project-of-the-program-competitiveness-and-innovation-in-enterprises-for-the-period-2021-2027/>

¹⁶<https://www.mrrb.bg/bg/energijina-efektivnost/nacionalna-programa-za-ee-na-mnogofamilni-jilistni-sgradi/>

¹⁷<https://www.tvnet.lv/5166115/gandriz-70-latvijas-iedzivotaju-dzivo-padomju-laikos-celtos-majoklos>

¹⁸[ibid](#)

¹⁹<https://www.tvnet.lv/7094590/dala-daudzdzivoklu-maju-jau-savu-muzu-nokalpojusas>

involved and the need to have a majority of dwelling owners agree on such decisions, which is hard to achieve. Drawing from the key numbers and targets provided within the National Energy and Climate Plan (NECP) regarding the energy efficiency front, at least 2,000 multi-apartment residential buildings and at least 5,000 private houses will have been renovated by 2030, contributing to the overall target set for reducing the average thermal energy consumption for heating in 2030 by at least 30% compared to 2020²⁰. Regarding the tertiary sector, the NECP has broadly envisioned energy efficiency targets, but more precise numbers have been provided specifically for state buildings. To specify, for public and local government buildings, a target has been set to renovate 3% of these buildings every year, eventually reaching an average heat consumption of 100 kWh/m²/year by 2030²¹.

6.2.2. Legislation, policies and measures

Existing energy efficiency regulation in Latvia does not explicitly look into the concept of smart readiness of buildings, which, nevertheless could be approached as part of the respective energy efficiency legislative texts. As such, assessment of buildings' energy efficiency in Latvia is carried out in accordance with the requirements of the "Law on energy efficiency of buildings", which is further detailed in the Regulations of the Cabinet of Ministers No. 222 (2021) "Energy efficiency calculation methods for buildings and energy certification rules"²². A sample of policies and measures implemented in Latvia towards establishing a well-integrated energy efficiency framework and eventually increasing the actual energy efficiency of the entire building stock, is presented below²³. It is worth mentioning that the following parts of regulation are isolated in that they could accommodate provisions on the SRI implementation as well.

- *Energy certification and Energy Performance (EP) classes of residential buildings* establishes EP classes and was introduced back in 2013. In April 2021 the EP values have been recasted based on the evaluation of (a). the energy consumption for heating (A+, A-F classes), and (b). non-renewable primary energy consumption (A+, A-G classes).
- *Increasing energy efficiency in multi-apartment buildings* focuses on the implementation of measures increasing energy efficiency in multi-apartment buildings has been divided into three separate planning periods so far, namely: (a). the planning period 2007-2013 where 741 multi-apartment buildings and 55

²⁰<https://likumi.lv/ta/id/312423-par-latvijas-nacionalo-energetikas-un-klimata-planu-20212030-gadam>

²¹Ibid

²²<https://likumi.lv/ta/id/322436-eku-energoefektivitates-aprekinu-metodes-un-eku-energocertifikacijas-noteikumi>

²³<https://www.odyssee-mure.eu/publications/efficiency-trends-policies-profiles/latvia.html>

social apartment buildings were renovated, (b). the planning period 2014-2020 where almost 1,000 multi-apartment buildings are to be renovated by the end of 2023, and (c). the planning period 2021-2027 where this policy measure will continue. These energy efficiency improvement measures in multi-apartment buildings are co-financed by the ERDF within the National Operational Programmes (NOP).

- *Information programme “Let’s Live Warmer”* is a programme including a course of diverse actions devoted to raising motivation of the dwellings’ owners to proceed with renovating their apartments, whilst also sharing their best practices, both in terms of pure implementation and maintenance. The main aim of the programme is to ensure that all relevant information on the housing renovation aspect is widely available.
- *National Construction Standard LBN002-19 “Thermotechnics for building envelopes”* is a new Standard that aims to eliminate the use of inefficient construction elements in the building envelope, by incorporating the energy performance requirements in terms of kWh per m² annually, for both new and renovated buildings. This Standard has been developed to replace the previous same-named one which was in force until 31.12.2019.
- The current *Energy efficiency Obligation (EEO) scheme* was introduced back in May 2017, and it currently involves a small number of energy suppliers in Latvia, which, although is expected to be widened in order to capture suppliers of fuel for transportation, natural gas and electricity (SocialWatt, 2019). As a result, the mandatory implementation of energy efficient measures, both on the suppliers’ and the final customers’ end covers only a small number of economic operators. Starting from 2018 the government expanded the coverage of EEO to include suppliers of thermal energy (European Bank for Reconstruction and Development and Energy Community Secretariat, 2019). As of this, six heat suppliers were added on the delivery of the EEO. As a side note, it is mentioned that In Latvia, more than 70% of all heat consumed is delivered centrally, with the country ranking third in the EU statistics of buildings using district heating.

6.2.3. Options for the SRI adoption

SRI assessments are not mandatory in Latvia, and no demonstration projects that attempt to implement the SRI scheme on a local, regional or national basis have been implemented so far. Until the beginning of 2023, the key documents linked to the (re)construction, renovation and certification of buildings in Latvia, are perceived to be far from establishing comprehensive requirements that links SRI or SRI assessment tools to the existing regulatory framework under an all-inclusive conceptual umbrella. Such a provision is expected to take shape after the introduction and regulation of smart operational building systems become transparent and more aligned to the national context. Hitherto, only shreds of the smartness concept have been rolled out, with a profound lack of SRI-related tests labelling the country. The only small-scale pilot project that attempted to integrate the concept of

smart readiness of selected administrative buildings, was implemented in 2022 by the State joint stock company “State Real estate”, which is responsible for the maintenance and development of state-owned property, both in terms of land and the buildings themselves. The assessment covered buildings of various ages and sizes that are owned by the state.

In this respect, SRI-ENACT can be considered among the very first initiatives that attempt to introduce the SRI approach as such and allow to apply the SRI methodology within the Latvian context, by facilitating the development of the relative SRI legislation, provide for incentivisation measures and eventually implementing a certain pilot project. To proceed with such an initiative, several possible implementation pathways for the application of the SRI scheme at a national level can be identified according to the Latvian SRI-ENACT team, which could be followed either standalone or jointly.

More specifically, one pathway could potentially imply amendments to the existing regulatory framework to make SRI assessment advisable or compulsory for certain types of buildings and determine technical requirements for the smart readiness of new buildings or in case of complete reconstruction. SRI assessments are not mandatory, however, they can be conducted as part of inspections of heating and air conditioning systems with an installed capacity greater than 70 kW²⁴. To maximise efficiency, independent inspections are often combined with the certification of the energy performance of the building. This can be done, for instance, during renovation/reconstruction of the building or when the air conditioning/heating system of the building is re-installed. Linking SRI assessments with building energy audits and regular inspections of heating and air conditioning systems could potentially provide an all-inclusive overview of the building's energy efficiency. Should the total capacity of the heating system or air conditioning system, or this system combined with the ventilation system equal or exceed 290 kW²⁵, the inspection of the heating system or air conditioning system must be supplemented by an additional check-up according to the standard LVS EN 16946- 1:2021 “Energy Performance of Buildings - Inspection of Automation, Controls and Technical Building Management - Part 1: Module M10-11”.

Another potential pathway relates to financial incentives that can be introduced in order to encourage owners adopt the new SRI practices and invest in energy efficient technologies. For example, the key SRI characteristics can be included as requirements in the terms of reference of public procurement documentation, which in turn would ensure that all new public buildings meet the highest energy efficiency standards. The third potential

²⁴<https://likumi.lv/ta/id/322436-eku-energoefektivitates-aprekina-metodes-un-eku-energoserifikacijas-noteikumi>

²⁵<https://likumi.lv/ta/id/274815-noteikumi-par-latvijas-buvnormativu-lbn-231-15-dzivojamo-un-publisko-eku-apkure-un-ventilacija->

pathway regards capacity building activities providing training and education for building owners, architects, engineers, and contractors on the importance of SRI and the best practices for implementing it. Given that the SRI approach is a new phenomenon in Latvia, all three pathways should be followed jointly to ensure successful uptake of the SRI scheme.

6.2.4. Challenges

Up until now, no scientific evaluation has been carried out in Latvia regarding the factors that hinder the adoption of the SRI scheme. Preliminary assessment allows to capture the following challenges to be addressed:

- Additional cost to building owners/tenants/managers for implementing smart ready technologies.
- Lack of support instruments and insufficient number of experienced and most importantly certified energy auditors/SRI assessors.
- The preparation and implementation of an SRI-driven project includes time-consuming processes of high complexity.
- High interest rates applied on commercial bank loans.
- Public reluctance to take on new financial obligations by investing in expensive energy efficiency measures to support the SRI uptake.
- Insufficient number of professional SRI service providers and lack of quality control during project implementation.
- Lack of awareness and experience on handling cyber security related to the smart building systems.
- Lack of publicly available information on SRI best practices to be used as drivers.

Strong cooperation with the municipalities and local authorities in general as well as internal marketing, digital promotion, public relations, good understanding and wide demonstration of the associated SRI training software are expected to address the aforementioned challenges and minimise the risk of low acceptance or even low interest from the target audience. In this context, there are also several country-specific key factors that can help address the identified challenges such as:

- a) Introduction of the SRI concept into the national, regional, and local development planning documents, such as long-term strategies, medium-term programmes and sectoral development plans, and associating it with certain actions. This will allow for the alignment of strategic development goals with certain funding programmes. Given that the implementation of SRI-ENACT begins simultaneously with the implementation phase of the new Riga Regional Development Programme 2021-2027, an excellent

opportunity appears to integrate the project's achievements into a wider regional policy framework through practical experience.

- b) Implementation of pilot or demonstration projects or activities in other regions of Latvia based on the experience that will be gained during the SRI-ENACT.
- c) Elaboration of a guide or handbook for the practical application of the SRI methodology, in cooperation with the national policy-making authorities, energy auditors, and other relevant stakeholders.

6.2.5. Funding mechanisms and programmes

There are several sources of funding and support instruments that are aimed at improvement of energy efficiency in buildings or providing technical assistance and can potentially be used to conduct SRI assessments or implement certain solutions that increase smart readiness of buildings:

- At present, renovation of State and municipal property is typically funded by grants from the EU funds, co-financed by municipal/governmental budgets or by a loan from the State Treasury²⁶. Energy efficiency projects for commercial and industrial buildings are usually financed from companies' own budgets or a loan from a commercial bank.
- The State financial institution ALTUM offers grants and loans to improve energy efficiency in commercial, industrial, and residential buildings. Businesses can receive loans with a term of 5-14 years, which are repaid using energy cost savings. No collateral is required for this kind of loan²⁷.
- Energy efficiency improvement measures in single-family buildings are mainly funded through the programme for guarantees of energy efficiency loans that has been adopted in 2020. In February 2021 it was also adopted the grant programme both for technical assistance and for the construction works, available for two target groups: (i) families with at least three children, and (ii) buildings outside the capital city of Riga, Jurmala city and edge municipalities of Riga city.
- Energy efficiency projects in multi-apartment buildings are mostly funded through an EU support instrument managed by ALTUM, which provides grants covering up to 50% of eligible costs, and flat owners usually take out a loan for the remaining amount from a bank²⁸. ESCOs may also be involved in

²⁶<https://www.kase.gov.lv/pakalpojumi/aizdevumi-un-galvojumi>

²⁷[Energy efficiency of apartment buildings 2022-2026 - Altum](#)

²⁸<https://www.altum.lv/en/services/individuals/energy-efficiency-in-multi-apartment-buildings/grant-application/>

project implementation. Some banks, such as Swedbank, SEB Bank, Luminor, and Bank Citadele, offer loan schemes specifically for the multi-apartment building sector to finance deep retrofit projects.

The technical assistance mechanism of grants and other support mechanisms managed by ALTUM and other state-owned development finance institutions can be expanded to support introduction of SRI scheme at a national level. This assistance could potentially include SRI assessments, energy modelling, and preparation of investment concepts for measure implementation. To effectively use this tool, potential customers need to receive timely and quality information, which requires better coordination and marketing among the governmental institutions managing different support programmes.

6.2.6. Conclusions

Although the SRI concept in Latvia has not been tested in Latvia, the existing structure of the energy auditing ecosystem makes it possible to start testing through pilot activities. The most important prerequisite to success regards the ability to maintain high and continuous interest from all major stakeholder groups and the ability to justify the economic rationale of the approach.

The four main tasks to be carried out in the medium term are the evaluation of the regulatory framework, training of energy auditors, introduction of smart readiness criteria in state support instruments, and awareness raising activities in the region and the whole country. SRI-ENACT activities in Latvia will contribute to making a huge step forward, towards the implementation of these tasks.

6.3. Czech Republic context

6.3.1. Introduction

The Czech building stock was proved to be extremely inefficient until mid 1970s due to the lack of any relevant energy efficiency standards (Act 183/2006). Despite the fact that such standards were developed and started to be applied from 1976 on (introduced Czech national standard ČSN 730540), the building stock remained almost equally inefficient throughout the years that followed. A large improvement in the energy efficiency of buildings began in 1990 and more specifically in 1994, when a new standard on energy efficiency came into effect²⁹. There were three more standard updates hitherto, each of which provided for more tightened energy efficiency requirements, currently reaching the point where the requirements for new buildings are closely aligned to those

²⁹<https://www.buildup.eu/en/practices/publications/czech-republic-standard-csn-73-0540-thermal-protection-buildings>

of the passive houses³⁰. As a result, energy efficiency on the final consumption end, as measured by ODEX, was increasing on a regular basis, by an average of 1.7 %/year (or 27%) from 2000 to 2018³¹. The highest energy savings were obtained in the industry sector (3.1%/year), following by services (1.3%/year). The respective figure for the residential buildings was calculated to 1.4%/year. However, there is still significant number of buildings featuring low energy efficiency, with a potential to increase it using smart technologies. The concept of “smartness” and the consequent share of buildings that are considered “smart” in the Czech Republic is very small.

6.3.2. Legislation, policies and measures

There are several national regulations identified as crucial for the successful exploitation of the SRI scheme, although currently there is no legislative text or any regulatory framework that introduces SRI within its body. These regulations are considered crucial for the seamless implementation of energy audits and the EPC issuing as well. The identified regulations are the following:

- The *Act on Energy Management (406/2000)*³² was adopted by the Parliament in 2000 and implemented in 2001. Following an amendment in 2006, the Act established standards for energy efficiency of heat and electricity production, transmission, distribution and use, energy planning requirements, energy auditing obligations, certification of energy auditors, an energy labelling programme, energy performance of buildings, and inspection of boilers and air conditioning units.
- The *Decree on energy performance of buildings (264/2020)*³³ is a practically new Decree on the energy performance of buildings, that was approved under number 264/2020 Coll. and took effect on 1st September 2020. The Decree was the outcome of a long and resourceful effort by a working group that was shaped for this purpose, comprising of the Ministry of Industry and Trade, and members of the Council who contributed to the whole process through the Chance for Buildings. The decree includes methodological adjustments and clarifications on the energy performance calculations, feasibility assessment of alternative energy supply systems from the technical, economic and ecological aspects, and recommended measures. It also modifies the outlook of the energy performance certificate in order to provide more clarified and user-friendly results. The Decree, along with the introduction of this new

³⁰<https://www.zakonyprolidi.cz/cs/2020-264>

³¹<https://www.odyssee-mure.eu/publications/efficiency-trends-policies-profiles/czechia.html>

³²<https://www.iea.org/policies/1394-energy-management-act-act-no-4062000-coll>

³³<https://www.czgbc.org/en/news/new-decree-on-energy-performance-of-buildings>

energy performance certificate for the buildings, essentially embodies the main elements of the transposed European EPBD Directive.

- The *National requirements for energy experts (Decree on energy experts, 4/2020)*³⁴ can be approached as an extension of the Act No 406/2000, given that the first one incorporates and implements the amendments introduced by the latter in the field of energy experts. The Act introduces modifications to the training system, in order to make it more efficient and to ensure a higher level of expertise among energy experts. This is provisioned for, by enabling the selection of the topics for training actions and their form. Furthermore, Act No 406/2000 harmonises market conditions involving energy experts, in that it provides a clear discrimination between natural and legal persons (acting as energy experts), regarding the services that can be implemented. Under the new legislation, a legal person willing to offer energy expert services, must hold a certificate issued by the Ministry of Industry and Trade.
- The *National standard ČSN 730540 (Thermal protection of buildings)*³⁵ is the main Czech standard in the area of energy use in buildings, building energy performance requirements. It defines heat transfer coefficients and various other parameters.

6.3.3. Options for the SRI adoption

The Czech Republic is among the six countries where the formal SRI test phase is taking place, although without yet providing any tangible results. The test phase is carried out by Czech Technical University, the Faculty of Civic Engineering, Department of Indoor Environmental and Building Services Engineering, led by prof. Karel Kabele. Up until now, there is only little experience with SRI assessments and nearly no implementation in the Czech Republic. Nevertheless, towards paving the way for a deeper hands-on experience with the SRI, Horák and Kabele applied the SRI methodology to three residential buildings and one educational building in Czech Republic (Horák and Kabele, 2019), concluding that the methodology underlies several limitations, for example the one lying within the lack of proper provision for combined heat sources, etc., however also gaining fruitful insights, such as:

- Highly complex data and hard-to-retrieve information on HVAC systems.
- Smart buildings perceived to be smart, have low SRI (lower than 50-60%), which resulted in raising questions as to the SRI calculation process and its classification scales.

³⁴https://energy.ec.europa.eu/system/files/2020-08/cz_annual_report_eeed_2020_tra_0.pdf

³⁵https://competitionline-content.com/16xx/1673_3028045_Interpretation_of_thermal_standards.pdf

- The SRI assessment requires quite extensive knowledge of building systems, which is quite close to performing energy audits (as defined in the Czech Republic).
- The overall SRI calculation is heavily dependent on the SRI auditor, i.e., the assessment most probably includes shreds of subjectivity.

The Czech study on innovative solutions based on SRI³⁶ indicates low demand for smart solutions in general, highlighting that the SRI implementation in the Czech Republic would be challenging. However, the same study captures an important reason for moving on with the SRI implementation: the better overall Life Cycle Costs benefit of smart buildings than just initial costs and payback calculation.

The same buildings have been also tested regarding their indoor environment (thermal comfort, air, electromagnetic field, physics, acoustics, and lighting), based on the Czech Technical University's methodology HAIEQ (Indoor Environmental Quality Audit), and the indicator for one of them was calculated. The test was understood as environmental audit of the building and slightly deviates from the commonly adopted SRI methodology, in that it involves different assessment domains (location, thermal comfort during winter and summer period, acoustic comfort, indoor air quality, electromagnetic fields and ionising radiation, light comfort, building construction technology), although offering in-depth insights.

Drawing from the experiences encountered so far from the implementation of the SRI in the Czech Republic, and particularly the interlinkage on the knowledge basis with the energy audits, the SRI implementation pathway that appears to be the most prominent one is to be accommodated within the energy audits-related framework. This preliminary roadmap is expected to cover the following aspects:

- Involving key stakeholders, like Czech Technical University, Ministry of Industry and Trade, national associations of energy experts, etc.
- Sharing of project results.
- Tailoring to national specifics.
- Legal proposals (Ministry of Industry and Trade).
- Stimulating the demand side for SRI.

³⁶<https://www.czgbc.org/files/2021/01/ca29f538a6e2605225e248a1d2085f5a.pdf>

- Discussing possible stimulation of the SRI market.
- Possible adding SRI assessment as obligatory criterion for supporting schemes.

Czech Republic has adopted the energy audits scheme more than 20 years ago (Act 406/2000). The energy audits and network of energy auditors began to operate in the 90s and quickly became a wide and well-established tool for assessing buildings and facilities. There were also some cases where energy audits were mandatory, such as for facilities with high energy consumption or when attempting to apply for a financial scheme.

The energy audits were diversified later in several types of assessments, in terms of specialisation: general energy audit, energy assessments (suitable for example for funding schemes and specific energy saving measures), EPCs, HVAC controls, etc. (defined in the Act 406/2000 (Act on Energy Management)). Widely recognised energy auditors were renamed to “energy experts”³⁷, who are certified by Ministry of Industry and Trade for specific specialisations (some of them or all of them, for example: HVAC controls, EPCs, energy audits, etc.).

SRI auditors would have their own key characteristics, or they will be recruited from energy experts with specialisation on energy audits. The implementation details will be settled after first round table discussions and mainly according to the Ministry of Industry and Trade. All future SRI pilot assessments will be focused on experienced energy experts working on energy audits/assessments or EPCs. For the time being, there is a database of energy audits and EPCs which could be used for thorough analysis of future SRI auditors’ features. The database, called ENEX³⁸, is not publicly available and only very limited aggregated data is open.

Regarding the possibility of a practical application of the SRI implementation pathway on a mandatory basis, there are several advantages and disadvantages that could be mentioned on this matter. The main advantages are: (1) large data availability in the future, (2) creating demand on SRI, (3) increased competitiveness of buildings, (4) better building information on building stock in the Czech Republic, (5) increased quality of future building stock, whilst some of the profound disadvantages that should be considered are: (1) SRI assessment would be another task for national energy experts (auditors) and will increase pressure on expert education, (2) another mandatory assessment and related cost of assessment.

³⁷Sometimes translated as “energy specialists”.

³⁸<https://www.mpo.cz/cz/energetika/energeticka-ucinnost/odborne-cinnosti/informace-o-prubezne-evidenci-prukazu-energeticke-narocnosti-budov-v-cr--249720/>

As an extra step to facilitate a larger uptake of the SRI scheme in Czech Republic, the proposed implementation pathway could be further boosted by the following course of action:

- National training schemes for SRI auditors, joint effort of energy experts' associations and possibly Czech chamber of chartered engineers.
- Financial support for the first SRI assessments.
- Organise training programmes in supporting scheme EFEKT led by Ministry of Industry and Trade (EFEKT is a small-scale scheme providing various types of support, for example trainings, energy management introduction to municipalities, energy saving materials, etc.³⁹).
- SRI as evaluation criterion in other supporting schemes, i.e., Green for Savings led by Ministry of Environment (State Environmental Fund) and other funds led by Ministry of Industry and Trade.

6.3.4. Challenges

Following the first tangible involvement with the SRI concept in the Czech Republic, several challenges of different significance have been identified so far, that should be tackled in the upcoming years should the SRI scheme is considered for wide adoption. Some of these challenges are the following:

- Low demand for smart solutions in the Czech Republic.
- Complexity of required data for SRI assessments.
- Energy audits and EPCs issuing are sometimes perceived as bureaucratic burden, and thus, the SRI assessments will most probably be encountered as such.
- Lack of financial motives and funding mechanisms to support a wide implementation of smart technologies.
- High volume of data to be handled which raises GDPR and cybersecurity issues.

The challenges were identified during the interview with Prof. Karel Kabele who led Czech pilot of SRI assessments. Each identified challenge should be addressed, however, the most important is to stress overall life cycle costs benefits of smart buildings and continuous better energy management.

³⁹<https://www.mpo-efekt.cz/>

6.3.5. Funding mechanisms and programmes

There are several financial schemes where SRI as an evaluation criterion could be added in future:

- The *Green for Savings*⁴⁰ is a scheme focused on the public itself and has been developed to support the implementation of measures such as the insulation of family houses and apartment buildings, change of heat source, PV, change of window, etc.
- The *Operational Programme Environment*⁴¹ is a scheme focused on public buildings (municipal buildings, schools, etc.). The priority axe 5 of this programme supports energy efficiency and use of RES in public buildings in that it addresses heat source, insulation, lighting, etc.
- The *Operational Programme Business and Competitiveness*⁴² is a scheme focused on private companies and industry. The energy efficiency tackles industry technologies, PV, insulation, etc.
- The *National Programme Environment*⁴³ is a national scheme focused mainly on supporting the environmental protection, also addressing energy efficiency issues. The programme is designed as support to the big operational programmes. It is financed from fees and fines.

Currently, there is no financial scheme available for the direct SRI exploitation in the Czech Republic.

6.3.6. Conclusions

There are very limited experiences with SRI assessments and general smart readiness indication in the Czech Republic. There were only two experiences with SRI and SRI-relevant assessments, and as of this, the overall expertise on this topic still remains low. Several challenges were identified or tackled during these hands-on SRI attempts. The most important challenges appear to be the general limited demand for smart solutions in the Czech Republic and the underlying complexity in the process of the SRI assessment.

⁴⁰<https://novazelenausporam.cz/>

⁴¹<https://opzp.cz/>

⁴²<https://www.mpo.cz/cz/podnikani/dotace-a-podpora-podnikani/optak-2021-2027/>

⁴³<https://www.narodniprogramzp.cz/>

6.4. Romania context

6.4.1. Introduction

The building stock in Romania is considered to be a fundamental element towards meeting the national energy efficiency targets, with the household sector being the largest energy consumer (42%, of which 34% is residential buildings and the rest - about 8% - commercial and public buildings)⁴⁴. The vast majority of buildings has been built before 1990 (87%), when older technical regulations for buildings were applicable, thus featuring significantly low degree of energy efficiency (lack of thermal insulation or minimal thermal insulation, double wooden windows with reduced standards) and structural deficiencies, with little (or no) maintenance after decades of use⁴⁵. Only 6% of the national building stock has been built after 2000, when new energy efficiency standards were in place. Despite the old building stock, national statistics showed an annual 0.5% renovation rate during the period 2012-2018, with up to 5% of households having been upgraded over the same period (Sinea and Jigla, 2021). Most of these refurbishments have been achieved by exploiting financing schemes that involved 60% national sources and 40% individual or local administration sources (Sinea and Jigla, 2021). Following the overall low performance of Romania within the energy efficiency front, the implementation of smart technologies could not deviate from this trend. The only SRI-related measure currently being implemented in the country is the introduction of smart meters (initially planned for 2020), although only few pilot projects have been realized in this respect, covering less than 10% of consumers⁴⁶.

6.4.2. Legislation, policies and measures

The main piece of legislation for increasing the energy performance of buildings in Romania is Law 372/2005⁴⁷ regarding the energy performance of buildings, with its subsequent amendments and completions, which transposes into national legislation the EPBD directive and also includes the objectives stated in the national Long-Term Renovation Strategy (LTRS). According to this law, as of January 1, 2021, all new constructions must be NZEB or have the lowest possible level of energy consumption.⁴⁸ The Ministry of Development, Public Works and

⁴⁴<https://aaecr.ro/wp-content/uploads/2020/01/Strategia-Nationala-Renovare.pdf>

⁴⁵Ibid

⁴⁶Ibid

⁴⁷<https://legislatie.just.ro/Public/DetaliiDocument/66970>

⁴⁸<http://legislatie.just.ro/Public/DetaliiDocument/66970>

Administration (MDLPA) is the responsible authority for the Romanian implementation of the EPBD and for collecting the data on buildings. The institution responsible for performing quality checks is the State Inspectorate in Construction.

The Romanian legislation on energy performance of buildings was significantly updated by the completions brought by Law 101/2020⁴⁹. Overall, the set of measures aims to increase the energy performance of buildings, taking into account variables such as environmental conditions, indoor comfort requirements, energy performance standards and costs. The goal set for 2050 is to have localities with an improved urban look, new NZEB buildings and thermally retrofitted older buildings, accompanied by energy performance certificates.

In the case of new buildings, as well as in the case of major renovation of existing buildings, the technical regulations, in force at the date of project planning, should be respected, namely those regarding global energy performance, correct installation, dimensioning, regulation and control, and should target at least the following technical systems: space heating/cooling systems, domestic hot water installations, lighting, mechanical ventilation, automation and control systems, local electricity generation systems and any other combination of these.

As new measures added by Law 101/2020 are:

- For new buildings with urban planning certificate issued after September 15, 2020, investors are obliged to make sure that all new buildings are equipped with self-acting temperature control devices which should follow NZEB standards cost efficiency indicators.
- For existing buildings, private owners or investors should install self-acting temperature control devices when replacing heat or cold generators or when replacing the heating or the cooling system of buildings, provided it is technically and economically feasible.
- By December 2024, non-residential buildings that have heating systems or combined space heating and ventilation systems with a useful rated power of over 290 kW will be equipped with automation and control systems for buildings.

It is the same law that introduces the general framework for the SRI assessment; however, the calculation methodology has not been approved at national level yet.

⁴⁹<https://legislatie.just.ro/Public/DetaliuDocumentAfis/227538>

Other measures aiming to increase the energy performance of buildings are included in the newly adopted GEO 130/2022⁵⁰ amending and supplementing Law no. 121/2014 on energy efficiency, such as:

- Central and local public authorities and regional development agencies are expected to use the instruments proposed by the smart financing for smart buildings initiative, with the main purpose of facilitating investments in projects that increase the energy performance of buildings by using European grants as a financial guarantee.
- The obligation to install, until December 31, 2023, individual meters to measure the energy consumption for heating/cooling and hot water for each building unit in multi-storey buildings with horizontal heat distribution connected to district heating systems; for multi-storey buildings with vertical heat distribution, in which the use of individual meters is not technically feasible, it is mandatory to install heat cost allocators.
- Smart meters should be available for installation when existing meters need to be replaced, when a building undergoes major renovations or on demand by the final consumer from a gas distribution operator.
- In case the distribution operators implement smart-metering systems and install smart natural gas meters, these should provide end-consumers with all relevant information and energy efficiency objectives and end-consumer benefits should be fully considered when establishing the minimum functionalities of the meters and the obligations imposed on market participants.

The NECP⁵¹ also contains several priorities that lay hands on the smartness dimension itself and more specifically the smart technologies, as follows:

- Encouraging the development of prosumers alongside the development of electricity networks and smart meters.
- Provision for the implementation of smart medium and low voltage distribution networks, general objectives for the development of smart meters and smart networks, a step-by-step implementation of the smart city concept and the implementation of IoT in the residential sector.

⁵⁰<https://legislatie.just.ro/Public/DetaliiDocumentAfis/259797>

⁵¹<https://energie.gov.ro/wp-content/uploads/2022/10/Anexa-HG-PNIESC.pdf>

- Development of regional groups for sustainable energy planning, smart use of energy within SMEs, use of renewable resources and promotion of energy efficiency measures, and correlation of the proposed measures with other existing or planned strategies.

6.4.3. Options for the SRI adoption

Although the SRI is a concept yet to be considered hard to communicate and understand for the general public, there are several implementations that have taken place, which could be approached as best practices with an eye to gaining useful insights for the future to come. In this respect, the best practices that could be mentioned for Romania lies within the testing pilot that was conducted during the H2020 X-Tendo project⁵² on one single-family house, one multi-family house, one office and one kindergarten. All data were collected by walking through the technical rooms, and the results gathered in the technical documents were used as input to the project tool that provided impact and the overall SRI score. Data collection, assessor evaluation and calculation took between one hour for an old existing building and three hours for a modern office building, with an estimated extra cost of €20-50 for including the SRI feature into the EPC issuing process. The conclusion was that it would be “very practical” to implement SRI within the national EPC assessments due to the fact that the data were easily collected, and the indicator is relevant to the holders of the EPC.

EPCs are mandatory for all buildings that are constructed, sold, or leased and are issued by energy auditors based on an official calculation methodology (Mc 001-2006 approved by Ministerial Order 157/2007)⁵³, considering the EPBD standards (especially the EN 13790 for heating and cooling)⁵⁴ (there is also an alternative calculation method for heating and hot water consumption, based on previous Romanian research - C 107-2005). This calculation methodology’s provisions were not fully clear and detailed, and, in some cases, there was much room for inconsistencies and interpretation (iBROAD, 2020). Furthermore, energy auditors must keep a certificate registry with all performed assessments, and an electronic version of this registry should be sent to MDLPA. However, since there was no standardized template for the EPC, auditors collected and transmitted the data in a large diversity of forms, which made it difficult to generate a uniform national database (Vornicu and Sinea, 2021). This situation was signalled by the EC and the Romanian authorities fell under the obligation to amend the legislation

⁵²<https://x-tendo.eu>

⁵³<https://legislatie.just.ro/Public/DetaliiDocument/79682>

⁵⁴<https://www.iso.org/standard/41974.html>

and revise the methodology. The new methodology (Mc 001-2022) was approved in January 2023 by Ministerial Order 16/2023⁵⁵ and now includes a new set of standards and rules.

The testing of the SRI developed within X-Tendo project in Romania showed that the SRI assessment procedure is straightforward and that it can be easily implemented into an energy audit or the standard EPC assessment, complementing the information provided to the building owner/user regarding the quality of the building. Also, in the new Mc 001-2022⁵⁶ methodology it can be seen that the SRI value was integrated as requirement in the EPC technical information related to the building's renewable energy sources, although for now its calculation can be done on a voluntary basis. Having said this, a potential draft roadmap for the implementation of a national SRI scheme in Romania could involve the following steps:

1. Test phase: Conduct a non-committal test phase of the SRI scheme by piloting the scheme in a certain number of buildings. This test phase should be used to certify the validity of the method before it is implemented at national level.
2. Legislative process: Develop legislation to establish integration of the SRI scheme into the existing EPC framework. This legislation should include on the one hand, a system of regulations and incentives that support the uptake of smart technologies and smart buildings and, on the other hand, guidelines and calculation methodology for the SRI assessment, as well as any necessary financial incentives and technical assistance for building owners and users.
3. Administrative processes: Develop and implement administrative processes for the preparation, adaptation, and implementation of the SRI scheme. This should include the provision of training and support for EPC assessors, the creation of a national database for EPC- and SRI-related information (or adapt the existing EPC database to include SRI information), and the establishment of a national certification body to oversee the implementation of the scheme.
4. Collaboration: Collaborate with the private sector and other stakeholders to support the uptake of the SRI scheme.
5. Monitoring and evaluation: Continuously monitor and evaluate the implementation of the SRI scheme, to identify challenges and/or opportunities for improvement.

⁵⁵<https://legislatie.just.ro/Public/DetaliiDocument/263984>

⁵⁶<https://www.mdlna.ro/uploads/articole/attachments/63d8dcccfe6ae8244797864.pdf>

6. Communication and awareness raising: Develop and implement a communication and awareness-raising strategy to inform building owners and users, as well as other relevant parties, about the SRI scheme, its benefits and how to implement it.

The best way to ensure good market penetration of the SRI would be to combine the SRI with the EPC on a mandatory basis, by creating a common assessment framework within the EPC. As concluded within the X-Tendo project, extending the functionalities of existing EPC system will reduce costs and provide complementary information and will create pathways to update the so-called next-generation EPCs. The option perceived to be the optimal one for the SRI implementation in Romania, would be firstly, a voluntary EPC-driven adoption which could be applied to all buildings, and secondly, an initial mandatory implementation, for non-residential buildings which would be required to meet specific SRI goals.

Given the linkage of the SRI implementation pathway to the EPC context, and the latter's necessity to be issued for all "buildings or building units that are constructed, sold, or rented out to a new tenant" (Art 12/1 of Directive 2010/31/EU), and its extended provision included in the proposed EPBD recast, to "building units which are constructed, have undergone a major renovation, are sold or rented out to a new tenant or for which a rental contract is renewed" (Art. 17), the following trigger points are identified as the most appropriate means to accommodate an SRI assessment in Romania:

- New building construction.
- Major building renovation.
- Building sales.
- Renting out.
- Other (e.g., the interest of the building owner in improving the energy performance of the building).

Based on the insights drawn from the SRI testing within X-Tendo project in Romania, where the number of EPCs issued for each trigger point (Taranu and Zuhaib, 2022) was estimated using historical data (e.g., real estate transactions, rented dwellings and building permits, etc.), a high relevance is assumed especially for new buildings and building renovation. The high share of new building construction as a trigger point for issuing EPC, leads to a range of 50-70% of all EPC holders showing potential interest in the results of the SRI feature. As regards building retrofitting, based on the recommended scenario of the LTRS, the annual renovation rate is expected to increase gradually from the current 0.5% to 3.39% in 2021-2030, 3.79% in 2031-2040 and 4.33% in 2041-2050⁵⁷. The recommended scenario proposes a more ambitious increase in the renovation rate for the first decade compared

⁵⁷<https://aaecr.ro/wp-content/uploads/2020/01/Strategia-Nationala-Renovare.pdf>

to the Business-as-usual scenario aiming to achieve more savings by 2030 and targeting a higher share of the lowest performing buildings. This scenario focuses more on multi-family buildings (about 40% of them) as they offer the greatest potential for energy savings and CO₂ reduction. Therefore, the interest in using the results of SRI is also expected to increase. The quantitative assessment highlighted that by 2030 the share of potentially interested EPC holders in SRI is expected to range between 48% and 68%.

6.4.4. Challenges

Despite the encouraging outcomes from the hands-on experience on the EPC-related SRI implementation pathway of X-Tendo project, there might emerge some potential barriers that could hamper the SRI uptake at national level, which, for the time being, apply on horizontal basis, regardless of the selected implementation pathway. These barriers are expected to become more tailored according to the final SRI implementation pathway, which, at this stage of the SRI-ENACT project, is only presented as a draft.

For instance, the concept of a smart home is not yet well developed in Romania, thus the SRI implementation may be too early. To increase the relevance for the end-user, the benefits of SRI must be communicated very clearly. The benefits of the SRI would be greater if a system of regulations and incentives that support the uptake of smart technologies and smart buildings would be adopted.

Furthermore, regarding the technical dimension, the two SRI calculation methods (i.e., Method A and Method B) require different degrees of skills and knowledge, therefore, different types of training. For example, Method B, being more complex than Method A, can be performed only by SRI certified assessors which possess expert knowledge and skills. Potential barriers to delivering a validated certification include training costs and the lack of trained assessors during the first stages of implementation. On that reflection, it is necessary to establish a pool of qualified SRI assessors and the costs associated to this would be reduced if experts already certified through EPC would be prioritised by training programmes.

Another factor of crucial importance towards facilitating the national SRI adoption is people's awareness on this matter. Currently, in Romania there are no broad awareness campaigns or information programmes on energy efficiency and smartness upgrades in buildings. There are some NGOs and utilities that have a limited information service providing basic information, but not necessarily to motivate energy consumers to take action. Energy information centres are often funded only through externally funded projects and experience is not widely disseminated.

Individuals, flat owners' associations, and local authorities still face difficulties in identifying and accessing appropriate funds and financial resources for specific projects. Particularly, local authorities often lack the resources to develop viable projects and feasibility studies. The lack of standardised procedures, financial and

human resources for project development leads to the implementation of a small number of projects. On top of that, the lack of trained personnel in the communities and in the regional development agencies (responsible for the allocation of structural funds), as well as the high requirements, prevent the large-scale deployment of energy efficiency measures and the effective use of available funding. Public authorities' staff responsible for managing the funding requests need special technical training. Even for banks and institutional investors, the lack of capacity and standards in project development and documentation processes lowers public confidence in estimated energy savings (Boll et al., 2020). For private housing owners in the residential sector, the main barriers include limited awareness of available financial support, capital-intensive renovations and uncertainty about what measures to implement. Also, the general lack of confidence in the quality of renovations, materials and construction methods used, leads to suspicions about energy efficient renovations.

Last but not least, addressing privacy and cybersecurity issues associated with the implementation of the SRI scheme by ensuring that data collected and stored is protected and that the right to data protection is respected, should also be placed at the heart of the discussion and thoroughly secured.

6.4.5. Funding mechanisms and programmes

Access to financial support is an important prerequisite for the energy renovation of buildings and, implicitly, for energy performance assessment. Banking projects and the use of available financial resources require access to information, knowledge transfer, capacity and sufficient resources to apply and meet funding criteria. Obstacles in accessing funding opportunities include reduced capacity and skills of beneficiaries to properly prepare and implement projects, causing delays in application procedures. Since EU funding streams are not fully exploited, especially for energy efficiency work in the building sector, below are presented some of the financing schemes that are available for exploitation at national level:

- *National Multiannual Programme for the Improvement of Energy Performance in Blocks of Flats (2009 – ongoing)*⁵⁸ :
 - Buildings constructed before 2005, including public social buildings are eligible for the rehabilitation programme, which include the envelope of the building and the heating system. For multi-level blocks of flats included in the programme before 2019: 80% of the cost is covered from state (through the Ministry of Development, Public Works and Administration) and local budgets, whilst 20% should be covered by the owner associations; for blocks of flats included in the programme after 2019: 60% of

⁵⁸<https://www.mdlna.ro/pages/pncrestereperformanta>

the cost is covered from the state budget, whilst 40% should be covered by the owner associations or from local budget approved annually for this purpose.

- The target group is the flat owner associations. If the association cannot pay their share, the local authority can partially or fully take over the costs and recover the investment afterwards.
- A total budget of about €22.5 million from local funds is planned to be spent for the implementation period 2022-2024.
- *National recovery and resilience plan, Component 5 - Renovation wave, Axis 1 - Grant scheme for energy efficiency and resilience in multi-family residential buildings, Operation A.3 - Moderate or in-depth energy renovation of multi-family residential buildings (2022)*⁵⁹:
 - This call for projects supports 100% investments for increasing the energy efficiency of multi-family blocks of flats. The maximum eligible value of the project corresponds to a unit cost of €200 per m² (deployed area) for moderate renovation works and €250 per m² (deployed area) for moderate renovation works, excluding VAT.
 - The call targets territorial administrative units from rural and urban regions that can apply for funding at the owner associations request.
 - Total budget for moderate energy renovation: €745 million; total budget for deep energy renovation: €83 million.
- *National recovery and resilience plan, Component 5 - Renovation wave, Axis 2 - Grant scheme for energy efficiency and resilience in public buildings, Operation B.2 - Moderate or in-depth energy renovation of public buildings*⁶⁰:
 - This call for projects supports 90% of investments for increasing the energy efficiency of public buildings. The maximum eligible value of the project corresponds to a unit cost of €440 per m² (deployed area) for moderate renovation works and €500 per m² (deployed area) for moderate renovation works, excluding VAT. It is mandatory that each funding request will provide for the installation of one charging station for electric vehicles (over 22 kW), with two charging points per station, for every 2,000 m² of renovated deployed area.
 - The call targets central and local public authorities.
 - Total budget for moderate energy renovation: €890 million; total budget for deep energy renovation: €122 million.

⁵⁹<https://www.mdipa.ro/uploads/articole/attachments/6241b31b3c825217165347.pdf>

⁶⁰<https://www.mdipa.ro/uploads/articole/attachments/6241b31ba14d2054546070.pdf>

- *Energy Efficient House (2020 – ongoing)*⁶¹:
 - Funding from the Environmental Fund for carrying out works aimed at increasing energy efficiency in single-family homes and the use of energy from RES in single-family homes located in a building with a height regime of no more than 3 levels. The non-refundable financing amounts of max. €14,000, including VAT, for each project, without exceeding 60% of the total value of the eligible investment costs.
 - The programme is dedicated to physical persons.
 - Between 2020 and 2021, over 900 projects have been accepted for funding.
- *Green Mortgage Programme (GMP)*⁶² :
 - The GMP was developed by the Romania Green Building Council (RoGBC) together with Raiffeisen Bank, based on an innovative certification for green houses. The certification aims to assess and identify the best performing residential projects using sustainable building principles.
 - A green mortgage is a loan granted at discounted interest rates for the purchase of buildings certified by the RoGBC as "Green Housing". The programme creates a successful cooperation between a bank, the building developer, the home buyer and RoGBC, where the latter ensures that residential housing projects meet energy performance standards and quality criteria.
- *Green Economy Financing Facility (GEFF)*⁶³
 - The flexible scheme that has been active in Romania for the past 10 years involves a credit line from European Bank for Reconstruction and Development (EBRD) to local institutions of up to €5 million. These credits are used for loans to private homeowners, companies and local authorities for the implementation of energy efficiency projects or green mortgages.
 - GEFF combines financial support with technical expertise and thus supports lenders with training and marketing activities, and also established a verification mechanism. An important aspect is that the facility aims to avoid bureaucracy by ensuring an easy evaluation process of project proposals.
 - The current GEFF cycle, started back in 2017, includes a residential programme focused on financing energy efficient new constructions, energy efficient renovations, water conservation and small-scale renewable energy systems. The EBRD has made available to homeowners €100 million through Banca Transilvania and UniCredit Bank.

⁶¹https://www.afm.ro/casa_eficienta_energetic.php

⁶²<http://rogbc.org/en/projects/green-mortgage>

⁶³<https://ebrdgeff.com/romania/>

A close connection and strengthened cooperation should be established between local administrations or public authorities and the banking sector or other financial institutions to unlock and exploit more funding mechanisms, but also to develop joint strategies and solutions. Furthermore, creating a central agency focused on accessing financing for energy efficient renovations of public buildings to coordinate ongoing procedures and tenders, would speed up project development and implementation. Additional small-scale project development support facilities could help local authorities, as well as private beneficiaries, through technical and preliminary assessments (feasibility studies, business plans, database maintenance). Regional one-stop shops are a good example in supporting project development by ensuring an easy process for building owners.

6.4.6. Conclusions

To sum up, the general framework for the SRI assessment is already contained in the Romanian legislation and the newly adopted calculation methodology for energy performance of buildings integrates the SRI as part of the EPC technical information related to the building's renewable energy sources. For the time being, as a calculation methodology was not approved yet, it is expected that the SRI will be calculated voluntarily based on the calculation methodology that exists at EU level.

A number of barriers could be standing in front of the SRI adoption at national level, the most important one being the lack of awareness on this matter. To overcome this obstacle, awareness campaigns need to be developed. Communication campaigns should promote the benefits of in-depth renovation, with relevant guidance on appropriate construction strategies to achieve deep renovations, taking into account best practices and access to public financial instruments.

Potential solutions that could lead to overcoming potential obstacles in accessing funding consist of knowledge transfer and capacity building activities in local administrations or public authorities. Comprehensive technical training on energy efficiency measures and energy savings would build trust and could strengthen cooperation between public authorities and companies offering energy efficient solutions.

6.5. Greece context

6.5.1. Introduction

The total number of occupied buildings in Greece sums up to about 4.1 million, the vast majority of which (79.1%) are residential buildings, and the rest tertiary (20.9%) (ELSTAT 2015). More than half of the of the entire building stock has been constructed before 1980 (58.3%), 77.5% of which refer to residential buildings and only 22.5% to the whole tertiary sector. Only 11.6% of the building stock has been built after 2000, with the heavy contribution of 83% of this achievement being attributed to the residential sector (ELSTAT 2015). It is worth mentioning that, according to the latest available data, a small fraction of buildings has been built after 2010 (1.5%), i.e., after the

adoption of the Greek Regulation for the Energy Performance of Buildings (KENAK)⁶⁴. In Greece, despite being among the most representative countries with old building stock, and the lag behind reaching its 2020 energy efficiency targets (Forouli et al., 2019), only 1.1% of annual renovations in the residential sector is considered medium and 0.2% deep, while for non-residential buildings, the respective figures amount to 2.9% and 0.4% respectively (European Commission 2019b), which highlights the niche between the imperative need for buildings smartification and the current renovation trends. Just recently, Greece has started to explore the SRI concept and the possibility to adopt the scheme at national level, through a feasibility study that is currently being carried out by HOLISTIC S.A.⁶⁵ (George Xexakis - the person in charge of this study - is member of the advisory board in SRI-ENACT) on behalf of the Ministry of Environment and Energy (YPEN), where the overall SRI framework and its included components are disassembled and associated to the Greek context, trying to provide key insights as to where the cost-benefit scales tip for the country. NTUA has also played a key role in this study as key stakeholder during the stakeholder engagement process that was followed.

6.5.2. Legislation, policies and measures

Regarding the energy efficiency policy-making framework in Greece, the NECP that has been developed for the period 2021-2030 prescribes, among other, national targets across five key pillars: (1) decarbonisation, (2) energy efficiency, (3) security of energy supply, (4) internal energy market, and (5) research, innovation and competitiveness. The target for 2030 is to reduce greenhouse gas emissions by at least 16%, compared to 2005, for non-ETS sectors. The largest impact is expected to come from energy efficiency measures in the residential and tertiary sector. On top of that, there are several existing laws and plans that aim to increase energy efficiency as well as promote renewable energy production, such as:

- Article 70(1) of Law 4602/2019 that constitutes the successor of Article 8(1) of Law 4122/2013, highlights that as of 1 January 2021, all new buildings should comply with nearly zero-energy buildings requirements, whilst for new state- and public-owned buildings intended for housing services, the respective obligation came in effect in 2019.
- Law 4122/2013 transposes Directive 2010/31/EU on the energy performance of buildings and sets minimum requirements for new buildings and existing buildings that are heavily renovated. It also

⁶⁴<https://www.e-nomothesia.gr/kat-periballon/upourgike-apophase-upendepea-85251-242-2018.html>

⁶⁵<https://www.holisticsa.gr>

provides for measures, funding programmes and other means to support the energy efficiency increase in both new and existing buildings.

- Article 10(3) of Law 3851/2010 imposes a minimum threshold of 60% of hot water needs to be covered by solar thermal systems on an annual basis. Moreover, it states that, from 31 December 2019, all new buildings should meet their primary energy consumption using renewable energy systems, heat cogeneration, and district heating systems, as well as heat pumps. For new buildings providing public services, this obligation came into effect back in 2014.

6.5.3. Options for the SRI adoption

Greece lags behind its energy efficiency targets which cannot be met without renovating the building stock, the energy performance of which is extremely low, given that almost 67% of the Greek residential buildings are classified as of class E or lower (General Directorate of Environment, Construction, Energy and Mines Inspections, 2022). Clearly, there is still high potential for energy efficiency renovations in Greece, which can be used to trigger improvements in terms of smartness. A combination of SRI with the EPC assessment can provide recommendations on both smartness and energy efficiency. For instance, a building owner could buy an efficient heating system with IoT features, improving the efficiency of their building along with its smartness, eventually leading to further energy savings due to increased connectivity and monitoring. As Verbeke et al. (2020) also point out, buildings with low energy efficiency should be encouraged to participate in the SRI as they have some of the highest potentials for savings.

Additionally, the EPC assessments is one of the most well-established frameworks in Europe, with high coverage rate. Based on data from the EU Building Stock Observatory, EPC assessments reach almost 3.5% within the residential sector and 5% within the tertiary sector, closely followed by the smart meter installation, but far outranking the rest of the trigger points. While these figures refer to EU averages, they are assumed to reflect the coverage in Greece as well, indicated by the high numbers of EPCs that have been already issued for Greece. Since in Greece it is practically mandatory to issue a new EPC in case of a new construction or major renovation, an EPC-driven SRI pathway in Greece could be essentially combined with building constructions and renovations as well.

Adding on the fact that EPCs are already used as a central hub for estimating the energy performance of buildings in Greece, they seem to be an optimal means of accommodation for the SRI scheme, instead of creating a new alternative implementation pathway which would require substantial time and policy effort. Under this pathway, an SRI assessment would be conducted by certified energy inspectors (or auditors) qualified to perform EPC assessments, who will be also trained to perform SRI assessments, and this would (or could) occur each time an EPC is issued. In this sense, the SRI would follow the same rules as the EPC, being mandatory for all building

categories and trigger points that are assumed in the current Greek legislation (for instance, when someone tries to sell or rent a house). Nevertheless, the SRI could be also offered as voluntary, stand-alone assessment for buildings that already have an EPC.

Along with the EPC-driven SRI assessment that will provide the official certifications in Greece, it might be interesting to explore a parallel market-driven scheme, based on self-assessment. Such as that self-assessment should not be ruled out, as it can help increase coverage and reduce costs, especially for residential buildings. This is also suggested by the EC Technical Report, where self-assessment can be combined with a market-based scheme. Nevertheless, the EC also strongly recommends that self-assessment should not lead to certifications and an official, 3rd-party inspection would be needed for a certificate. Thus, self-assessment can potentially co-exist with an EPC-driven SRI pathway: while energy inspectors will still be needed to certify an SRI ranking, citizens can perform a fast and free assessment of the smartness of their house based on the same SRI criteria. This self-assessment can provide recommendations for improving the smartness of the building. Building users and owners could then go to stores and professionals that supply SRTs and request a package of improvements for increasing the smartness of their building in specific domains or for reaching a specific SRI. As part of the package, the stores could also offer an official 3rd-party SRI certification to prove that their improvements really work.

6.5.4. Challenges

Despite the connection of the SRI to the well-established EPC scheme in Greece and the consequent EPC-driven implementation pathway to be followed, it should be emphasised that the SRI should be optimally designed and integrated with the EPC to avoid some of the current problems with the EPC implementations. Some of the identified challenges are the following:

- Limited availability of open data related to the EPC inspections.
- Potential low credibility of the results, as inspectors may falsely fill the inspection sheet in order to improve the EPC class of a building (for instance, by indicating that there is a BACS in a building when it is actually absent or not working).
- Inadequate training of the inspectors.
- Lack of financial motives and programmes to support a wide uptake of smart technologies.
- Personal data to be handled as of which GDPR and cybersecurity issues are raised.

6.5.5. Funding mechanisms and programmes

A supportive framework is needed to tackle the key challenges associated to renovating large numbers of buildings, notably by helping building owners (or tenants) to obtain the required financing. Once introduced, SRI

scheme should be underpinned by available funding and finance to ensure compliance before the enforcement date. A combination of private contribution, public subsidies and finance will be necessary to ensure that all beneficiaries will be able to reap the benefits of the SRI-related implemented actions without experiencing significantly higher rents/costs of living. Furthermore, since energy efficiency standards tighten over time, short-term benefits such as the consideration of payback periods based only on the monetary valuation of the triggered energy savings, will become of less importance and relevance to the building owners.

Finance for SRI renovations could come from several sources, including funds from ERDF, the Cohesion Fund, and the RRF. The proposed new Social Climate Fund will also mobilise €72.2 billion from the EU budget for the period 2025-2032 to support households in implementing energy efficiency solutions (European Commission 2021). Critically, SRI is expected to come into effect as a mandatory from 2026 onwards, which means that RRF will not be available to support it. Instead, they will be supported by programmes under the upcoming ERDF 2021-2027. The following schemes are just some of the already-in-place programmes, and could set an example of financial instruments aimed at facilitating the SRI roll-out:

- *Exoikonomo Programme (2021-2030)*⁶⁶ was officially in effect until the end of 2021. From then on, its implementation is supported by the National Recovery and Resilience Plan in a next round during the second half of 2022. The programme's future support, within the planning period 2021-2027, is expected to fall under the scope of the ERDF. The programme has been developed to trigger energy savings and to contribute to the energy renovation of at least 105,000 homes by 2025. The programme includes separate incentives to support poor and vulnerable households in the form of an increased grant rate and a separate budget of €100 million.
- *"ELECTRA" (2020-2026)*⁶⁷ renovation program for public buildings is allocated a total budget of €640 million covered by Deposits and Loans Fund of the EIB and RRF. The programme aims at promoting renewables, use of innovative design standards and digital solutions, and highlights the exemplary role of the public sector as envisaged in the EED. The eligible buildings to join the programme should fall under energy class C or lower, which should be elevated to energy class B or even higher after the implementation of the renovation measures that will be selected. The programme was initially rolled out in 2022, and is managed by the Centre for Renewable Energy Sources and Saving (CRESS). The programme

⁶⁶<https://exoikonomo2021.gov.gr>

⁶⁷https://www.eetaa.gr/fundings/index.php?tag=view_programmata_details&programma_id=68

also leveraged additional private funding, which, together with all the public and private funds reached €1 billion.

- *Exoikonomo-Epicheiro Programme*⁶⁸ aims at upgrading SMEs through energy efficiency interventions, with a total budget of €200 million. Half of it has been allocated to the tourism sector and the other half to the commercial sector and services.
- *An infrastructure fund* has been created, based on the Decision 6269/1895A1/28.11.2017, which is intended to both private and public sectors, offering favourable financing terms for the implementation of small- and medium-sized projects, with an emphasis on energy, environment and urban development.

Apart from already established financial instruments in Greece, there are also several emerging instruments that could be exploited since their requirements are pretty much aligned with the fundamentals of the SRI implementation in buildings. These involve dedicated credit lines, Energy Performance Contracts, risk-sharing facilities, direct and equity investments, on-bill repayments and on-tax financing, and energy service agreements.

6.5.6. Conclusions

The expertise and hands-on experiences with the SRI scheme in Greece are quite limited, since, beyond some first approaches that were attempted on scientific level, there is not yet a formal and comprehensive practical application. Given the obligatoriness and the high uptake of the EPC scheme within the country, the incorporation of the SRI scheme into the EPC framework seems to be the most purposeful and insightful pathway to be followed, if a wide adoption is to be expected. Several challenges were identified during this first effort made by the SRI-ENACT national partners to draft a possible implementation pathway, which should be thoroughly examined and addressed along the way. As an overall note, it can be concluded that the concept of smartness still remains at a low level, featuring significant potential for further exploitation.

6.6. Croatia context

6.6.1. Introduction

A high share of residential (both multi-apartment and single-family) and public buildings were built before 1987, thus resulting to a very low energy performance due to wear and tear of building envelope and used technologies. As a result, the building sector (residential and non-residential buildings) in Croatia accounts for 42.3% of the national final energy consumption. In contrary, the majority of commercial buildings have been built since 2000

⁶⁸<https://ecopress.gr/exoikonomo-epicheiro-se-diavoulefsi-i/>

and therefore perform better in terms of energy performance (Ministry of Construction and Physical Planning 2017). The energy performance of buildings is determined using data available in the Information system of Energy Certificates (IEC), based on which, most buildings in Croatia fall under the energy classes E and F, followed by the G-rated ones. The energy renovation rate of buildings between 2014 and 2020 equalled 0.7% of floor area, i.e., 1.35 million m² per year, which was slightly increased in 2021 and 2022 to 1%. Regarding energy efficiency, during the 2001-2016 period, Croatia reported about 1.41 Mtoe of cumulative (technical) final energy savings mainly related to the residential sector (39%) and industry (36%), and followed by transport (17%). Per the LTRS, the intensity of renovation actions within the building stock in Croatia remains low due to the lack of policies that will direct investments towards restoration with the aim of preservation building stock. Most of the investments are aimed at new construction to meet the need for space, and for successfully increasing the rate of building renovation investments that will have an impact should be redirected in a targeted manner to increase the intensity of building renovation.

6.6.2. Legislation, policies and measures

Croatian legal framework regarding the building stock is formulated through several legislative documents, with special focus on the Building Act⁶⁹ (BA), which transposes the EPBD directive into the national context. Last two modifications and alignments of the BA in 2018 and 2019 respectively, prepared the ground for follow up work, which was eventually reflected on the set up of an obligatory technical standard for newly constructed buildings and buildings that undergo deep renovation process (officially in effect from 01/2021), as well as on the creation of the LTRS (developed in 12/2022). Both of them include provisions that oblige owners to regularly update their energy certificates and set out numerous regulations, decisions, and ordinances. Another relevant regulation can be found in the Energy Efficiency Act (EEA)⁷⁰ which transposes the EED directive in the national context and, as of lastly, introduces modifications that defines requirements applicable to the National Energy Efficiency Plan and other national energy renovations programmes, accompanied by adequate energy monitoring and verification.

In the technical front, the regulation on energy economy and heat retention in buildings dictates the standard in global energy performance, correct installation, dimensioning, regulation and control, and all technical systems: space heating/cooling systems, domestic hot water installations, lighting, mechanical ventilation, automation and control systems, local electricity generation systems. Based on this standard, all newly constructed buildings must

⁶⁹<https://www.zakon.hr/z/690/Zakon-o-gradnji>

⁷⁰<https://www.zakon.hr/z/747/Zakon-o-energetskej-učinkovitosti>

fulfil NZEB requirements, while reconstructed buildings must achieve high level energy performance by implementing both mandatory building envelope measures and other technological solutions such as installation of infrastructure for charging of electric vehicles and advanced level of BACS. Thus, these implemented standards can be perceived as a good starting point towards implementation of SRI assessment (and concept in general). Furthermore, the current BA highlights the aspects of fire safety and earthquake protection as well as parameters relevant to health such as ventilation rate, noise level, etc., which also comply with the SRI concept.

The current regulatory framework does not reflect on SRI scheme per se in terms of evaluation and applying the methodology, and thus would need to be systematically introduced through the range of documents. Given the fact that current building stock is relatively old and inefficient (and achieve low energy performance class), current SRI class could follow the same negative trend. However, several aspects of the existing legislative frameworks put strict technical requirements for new buildings and those which undergo deep renovation process. A Table of such active legal frameworks in the Republic of Croatia concerning the building stock and SRI is presented below (Table 5), and include various acts, technical regulations, ordinances and decisions^{71,72}.

Table 5. Legislative texts related to the building stock and SRI in Croatia.

Acts	Technical regulations	Ordinances	Decisions
Building Act	Technical regulation on energy economy and heat retention in buildings	Ordinance on entry in the class of design auditors	Decision on the definition of relative weights for architectural and engineering and related advisory services in construction and physical planning
Energy Efficiency Act	Technical regulation for windows and doors	Ordinance on the mandatory contents and format of construction work designs	Decision on the adoption of the Long-term Strategy for the Reconstruction of the National Building Stock by 2050
Electricity Market Act (and related bylaws)	Technical regulation on ventilation systems, partial air conditioning and air conditioning of buildings	Ordinance on the bodies, documentation, and procedures on the construction products market	Decision on the adoption of the Programme of energy renovation of multi-apartment buildings for the period by 2030

⁷¹<https://mptgi.gov.hr/access-to-information/regulations-126/regulations-in-the-field-of-building-127/127>

⁷²<https://mptgi.gov.hr/access-to-information/regulations-126/regulations-in-the-field-of-energy-efficiency-8645/8645>

Renewable energy and highly efficient cogeneration Act

Technical regulation for chimneys in construction works

Ordinance on simple and other construction works and works

Decision on the adoption of the Programme of energy renovation of buildings with the status of cultural property for the period by 2030

Physical Planning Act

Technical regulation for protection systems against effects of lightning on construction works

Ordinance on design validation

Decision on the adoption of the Urban Green Infrastructure Development Programme for the period 2021-2030

6.6.3. Options for the SRI adoption

As of recently, Croatia has entered the testing phase of SRI scheme. The SRI test phase in Croatia is led by the Ministry of Physical Planning, Construction and State Assets (MPGI)⁷³ and is supported by the non-profit scientific institution Energy Institute Hrvoje Pozar (EIHP)⁷⁴. The test phase aims at exploring the potentials and opportunities for SRI in the Croatian context where the main goal is to implement SRI methodology in alignment with a legislative framework that will be consistent with the obligations of EPBD. In coordination with ongoing EU projects (SRI-ENACT and SRI2MARKET), MPGI will perform testing and adjustments of proposed methodology to the national context. This presents a great opportunity for steady implementation of SRI scheme in various renovation programmes which will be continuously developed to reach these goals.

Current Croatian legal framework relevant for the building stock does not provide any relation to implementation (mandatory/voluntary) of SRI scheme. Although required smart systems (RES, BACS) and their integration in the buildings stock is regulated for newly constructed buildings and buildings that undergo deep/comprehensive renovation, the implementation process will have higher chances of success after testing phase of the methodology.

As per the BA, EPCs are mandatory for all buildings and are issued by energy auditors based on an official calculation methodology and therefore presents the best option for adapting the SRI scheme where the current Ordinance on energy audits and energy certification could be used and expanded to successfully implement the

⁷³https://commission.europa.eu/events/2nd-plenary-meeting-smart-readiness-indicator-platform-2022-11-23_pl

⁷⁴<https://eihp.hr/en/>

scheme alongside all other relevant subordinate acts. This calculation methodology's provisions are clear and detailed, being described through several subordinate acts to the BA, where EPCs must be uploaded to the (national) Information system of energy certificates. Therefore, possibly the best approach to ensure good market penetration of the SRI would be to combine the SRI with the EPC on a mandatory basis (after revision and update of necessary legislation) with the aim of creation a common assessment framework within the EPC. This would also benefit the creation of so-called next generation EPCs, which can be further enhanced through ongoing EU-funded projects relevant for Croatia such as CrossCert, SuperHub and TIMEPAC, and future adaptation options that will be introduced such as Levels, Building Renovation Passport and Digital Building Logbook.

There is a possibility to combine SRI scheme with voluntary reporting framework used to improve the sustainability of buildings – Level(s) – which provide a set of common indicators and metrics for measuring the environmental performance of buildings, considering their full life cycle focusing on six key areas: (1) greenhouse gas emissions, (2) resource efficiency, (3) water use, (4) health and comfort, (5) resilience and adaptation, and (6) cost and value, it directly helps stakeholders to reduce the impact of their buildings and contribute to European policy objectives. Although voluntary (for now until 2026), it presents a great option for linking the SRI scheme where necessary inputs could be integrated in Level(s) and enabling implementation in this framework for future policy initiatives in the Republic of Croatia and achieving the main goal of levels Level(s) – to provide a common ground over the concept of sustainable building.

One of the alternatives or an additional adaptation option is to connect SRI scheme and its assessment with BIM, which provides a digital representation of a building's characteristics in its whole life cycle. As it requires a detailed data collection and site visits, a methodology could be aligned to include gathering of parameters for SRI. Furthermore, either by linking SRI scheme with EPCs/BIM or by proceeding with dividing these methodologies, a very interesting option for future adaptation is linking SRI with a concept of the Building Renovation Passport (BRP) – a concept outlined in the EPBD. BRP presents a document – in electronic or paper format – outlining a long-term (up to 15-20 years) step-by-step renovation roadmap to achieve deep renovation for a specific building. It should be designed to reflect the (changing) situation of the owner or occupier and to addresses the complexity of renovation works (not just technical interventions), ensuring coordination throughout the different stages.

One of the positive sides of introducing SRI as mandatory scheme lies in the fact that it will bring more new information to complement existing (and future) schemes. Also, in case SRI is implemented as mandatory application, it could directly improve health, comfort, and safety of occupants, given the smart services that could be implemented in this respect. Being a mandatory, it will unlock a creation of national database based on which a better programming of national financial schemes (for building retrofits including energy efficiency improvements and RES implementation) will take place. As potential drawback, being a mandatory application,

SRI scheme will directly increase the overall cost and time, and it will require specific trainings for SRI assessors/auditors, thus generating more costs. The SRI scheme also has methodological limitations which will have to be resolved prior making it mandatory, such as giving similar SRI scores to buildings which use different smart technologies that cannot be evaluated as the same level of advancement. There are also serious questions raised related to proper GDPR and citizen security in terms of handling data that will be monitored remotely through different smart devices that can be easily breached and used in negative ways. Lastly, a strong emphasis is put on preventing the negative effect of price increase in new buildings (and those which undergo energy renovations) due to introduction of advanced smart technologies.

Since Croatia has already entered the testing phase, an accelerated inclusion of the SRI scheme is planned in next three-year period which will require testing of methodology to define requirements for future legal framework. To boost the implementation, a draft national SRI implementation roadmap could include the following steps:

1. Define the implementation process of the testing phase.
2. Information campaign, introduction on EU policy for SRI implementation, benefits for the society/end users.
3. Setting up the working group (which should be aligned with the national stakeholder Liaison group of SRI-ENACT project).
4. Capacity building for decision-makers, market actors, and SRI assessors.
5. Adaptation of SRI methodology for national context.
6. Preparation of national legislation and regulation upgrade also including revision and upgrade of administrative processes.
7. Set up of financing schemes for SRI implementation.
8. Monitoring and evaluation.
9. Dissemination of results and awareness raising.

In terms of ICT tools used in the building sector, several solutions exist in the market due to current legal framework and necessary verification of savings (per EEA), but also as digital applications of both public and private sectors. Based on their functionality and objectives, SRI assessment can be integrated in the following:

- *Information system of energy certificates⁷⁵*: According to the abovementioned legal frameworks and plans, MPGİ has developed and occasionally improved the IEC, which is a central point of gathering and showing energy certificates, featuring significant expansion potential to include the SRI methodology (data, analysis, results).
- *Information system for energy management - ISGE⁷⁶*: An online application for monitoring and analysing energy and water consumption in public sector buildings. It is an indispensable tool for systematic energy management - mandatory system according to the current law -, providing a large range of information based on the level of implementation. SRI assessment methodology (or results) could be integrated as part of the system, at least for the public buildings.
- *Thorium A+ app⁷⁷*: A privately developed application, specialised for carrying out an energy audit, creating reports and determining the energy class of a building according to current legal framework (including valid norms) – verified by MPGİ. This application serves as an online tool which can be used by energy auditors to produce the main output – energy certificate with verified measures aligned with norms and technical regulations. Given the examined linkage of the SRI scheme with EPCs, this application could be expanded to perform SRI assessments as well, especially if it becomes mandatory per legal framework.
- *Various GIS applications developed on local/regional level such as Energy Info Centre – the city of Zagreb⁷⁸, Zagreb County GIS platform⁷⁹*: As part of the digitalisation process, many local/regional authorities proceed with developing various GIS-based applications to create a comprehensive overview of potential for RES installation, or a transparent overview of public building renovations, as well as useful layers concerning spatial planning, energy, transport, and other sectors. In relation to SRI scheme, these applications could be expanded to include results of the SRI assessments.

According to current trends and feedback from the relevant national authority (MPGİ) as an overview of future activities, it is most likely that the SRI scheme at the national level will be introduced as a mandatory application in legal framework for the building sector. To accelerate the processes of changing the legislative framework regulating the implementation of SRI, purposeful multidirectional actions by the responsible institutions for new

⁷⁵<https://eenergetskicertifikat.mgipu.hr/login.html>

⁷⁶<https://www.isge.hr/login.xhtml>

⁷⁷<http://thoriumapplus.com>

⁷⁸<https://eic.zagreb.hr/portal/apps/sites/#/eic>

⁷⁹<https://www.zagrebicka-zupanija.hr/vijesti/6274/azuriran-web-gis-portal-zagrebicka-zupanije>

regulations, stakeholder awareness, administrative support, etc. will be needed. All this implies the inclusion of measures for support and encouragement, for example, in the preparation of assignments, tender evaluations, the acceleration of administrative procedures, etc. in cases where difficulties, uncertainties or incompetence may become obstacles. In this sense, financial incentives for projects, consultants, etc. could also be considered at a certain stage.

6.6.4. Challenges

Literature review of national plans and programmes identify challenges for further upgrading of the building stock which also concern future SRI assessment application. These challenges are broken down according to their focal point as follows:

Technical

- Low level of energy efficiency and overall building conditions, which require deep capital-intensive renovations.
- Necessary know-how in SRI assessment that needs to be acquired through the capacity building programme – Method A / Method B.
- Lack of applicable criteria, indicators and other information and digital tools for impact assessment in smart building systems.
- Lack of knowledge in project preparation.
- Insufficient information and experience on reliability and security of smart building systems, including cyber security and privacy of data.
- Low distribution of smart city/smart home concepts developed and implemented in Croatia.
- Low level of smart grid development and grid flexibility.

Financial

- Long ROI period (very capital-intensive process) for energy renovations and increase of SRI score (implementing adequate technologies).
- Limited financial capacity and access to capital for building owners.
- Underdevelopment of financial instruments and contracting models - Absence of a competitive market for design, equipment, construction, maintenance, and servicing of smart building systems.
- Weak interest of credit institutions to provide dedicated credit lines for multi-apartment buildings.

Legal

- Complex building ownership relations in multi-residential buildings.
- Complex procedures and lengthy procurement procedures for energy renovations of buildings.
- Unresolved property legality issues.
- Government regulation/price intervention of energy.
- Lack of ambition in current legal framework to boost large-scale implementation of smart systems (including low readiness and awareness of national, regional, and local authorities to cooperate on the implementation of SRI).

Social trends

- Emigration and depopulation.
- Availability of labour.

Information

- Lack of motivation without financial incentives as result of low levels of awareness on benefits of smart solutions among Individuals, flat-owners associations, and local authorities.
- Lack of sufficient information on different types and purposes of smart building solutions and best practices.
- Insufficient awareness among investors, planners, and the public of the benefits of implementing smart building systems.

6.6.5. Funding mechanisms and programmes

The long-term plan is to increase the renovation rate from the current 0.7% annually (1,350,000 m²) to 3% in 2030, to stand at 3.5% between 2031 and 2040 and 4% between 2041 and 2050. This uptake of energy renovation rate should be contributed by different on-going (and planned) national programmes for energy renovations based on EU Funds (NRRP, ERDF, EBRD) implemented by the Environmental Protection and Energy Efficiency Fund (EPEEF). Currently, there are various possibilities to adjust currently active programmes and available funds that are focused on energy renovations to also include SRI, but also some other options to form a separate way of funding (grants, programmes, credit lines, bonds) that can be used to boost SRI. As Croatia is in the testing phase of SRI, it will be crucial to include a proper modelling of financial schemes/mechanisms, especially if SRI is targeted to be a mandatory scheme in the future (and i.e., aligned with EPC). Based on previous period, and at the same time on

trends in Croatian legislation, the following funding mechanisms and programmes for energy renovation of buildings can be outlined⁸⁰:

- *Programme for single family houses 2014-2020 (OG 43/14, OG 36/15, OG 57/20)*⁸¹:
 - Grants secured from EPEEF up to 80% (2015) and 60% (2020, 2021).
 - New Programme for period until 2030 is currently under development and should be published during 2023.
- *Programme for multi-apartment buildings 2014-2020 (OG 78/14)*⁸²:
 - Grants secured from EPEEF up to 40% (until 2016) and from ESI funds up to 60% (from 2016).
 - New Programme for period until 2030 has been published (OG 143/21)⁸³.
- Programme for public buildings (OG 22/17)⁸⁴:
 - 2014-2020 – only available through ESCO model.
 - 2016-2020 – grants secured from ESI funds.
 - New Programme for period until 2030 has been published (OG 143/21)⁸⁵.
- *Programme for cultural buildings until 2030 (OG 143/21)*⁸⁶.
- *Programme to combat energy poverty, including the use of renewable energy sources in residential buildings, in assisted areas and in areas of special state concern for the period until 2025 (OG 143/21)*⁸⁷.

⁸⁰Croatian approach on deep energy renovation of building stock

⁸¹<http://thoriumaplus.com/wp-content/uploads/2020/05/Program-energetske-obnove-obiteljskih-kuca-NN-43-14-NN-36-15-NN-57-20.pdf>

⁸²https://gov.hr/UserDocImages/Dokumenti/Energetska%20obnova%20višestambenih%20zgrada//Program_EO_VS_ZGRA DE.pdf

⁸³https://mpgi.gov.hr/UserDocImages/dokumenti/EnergetskaUcinkovitost/Program_energetske_obnove_VS_zgrada_do_2030.pdf

⁸⁴https://narodne-novine.nn.hr/clanci/sluzbeni/2017_03_22_508.html

⁸⁵https://mpgi.gov.hr/UserDocImages/dokumenti/EnergetskaUcinkovitost/PROGRAM_EN_OBN_ZGRADA_JAVNOG_SEKTO RA_do2030.pdf

⁸⁶https://mpgi.gov.hr/UserDocImages/dokumenti/EnergetskaUcinkovitost/Program_energetske_obnove_kulturna_dobra_do_2030.pdf

⁸⁷https://mpgi.gov.hr/UserDocImages/dokumenti/EnergetskaUcinkovitost/Program_suzbijanja_energetskog_siromastva_d_o_2025.pdf

- *Modernisation Fund*, which is available in Croatia, can be used to some extent to boost implementation of SRI, especially in the business and industry sectors where ambitious targets for achieving high score of SRI could be defined to unlock additional co-funding rates.
- *Green Bonds* are financial instruments that allow investors to finance projects with environmental benefits. Member states such as Croatia could issue green bonds to finance renovations of public buildings or to provide low-interest loans to building owners. By doing that, an additional requirement could be set up in terms of increasing the smart readiness and implementation of adequate technologies.
- *Green loans - Soft Loans* which, Member States such as Croatia could provide soft loans to building owners to finance the implementation of the SRI. These loans could have low-interest rates, longer repayment periods, and flexible repayment terms.
- *Sustainable development Goals bonds*. The World Bank works in every major area of development, in partnership with Member States' governments to find sustainable solutions addressing local and global development challenges. World Bank Sustainable Development Bonds support the financing of a combination of green and social, i.e., sustainable development projects, programmes, and activities in Member State countries. Such financial scheme could be used at governmental level to create additional ways of funding the increase of SRI.
- *"EKO energija" - Green Energy* is a financial scheme for energy renovation of residential buildings that provides loans with a lower interest rate than regular bank loans. The scheme is operated by the Croatian Bank for Reconstruction and Development (HBOR). This mechanism could be enhanced to also include adaptations to SRI.
- *Croatian Agency for SMEs, Innovations, and Investments (HAMAG-BICRO)* is a financial instrument that provides support to investments in the energy renovation of commercial buildings through loans and guarantees with a possibility of combining them with interest rate subsidies.
- *"Kredit za energetske obnove (KEO)" - Credit for Energy Renovation* is a credit line for energy renovation of residential buildings, offered by several banks in Croatia. The credit line offers lower interest rates and longer repayment periods than regular bank loans and could be used to enhance SRI in residential sector.
- *EBRD support programme for the Croatian private sector (REENOVA+)* is intended to citizens and enterprises and could be adjusted to also include the SRI scheme.
- *Croatia Green Building Council (CroGBC) – "Eko Dizajn Kredit" – Eco Design Loan* is a financial scheme for energy renovation of residential buildings that provides loans with a lower interest rate than regular bank loans. The scheme is operated by several banks in Croatia in collaboration with the CroGBC.

- *Green for Growth Fund (GGF)* provides financing for energy efficiency and renewable energy projects in Southeast Europe and the European Eastern Neighbourhood region. This fund is available to financial institutions, energy service companies, and project developers and could be used in an adequate way to also include interventions in increasing SRI within the whole building sector.
- *Tax Incentives.* Croatia as a member State could provide tax incentives to building owners who implement energy renovations (and enhancement of SRI) in their buildings. This could include tax credits for the installation of smart technologies, lower property taxes for energy efficient buildings, or reduced VAT rates for renovation work.
- *Public-Private Partnerships (PPPs)* could be established in Croatia to finance the implementation of the SRI. This could involve the private sector financing the upfront costs of energy efficient renovations, with the public sector repaying the costs through the resulting energy savings.
- *Polluter pays mechanism:* In the Republic of Croatia, there is a fee for CO₂ emissions which could be partially used to form a programme for boosting both energy renovation process and implementation of adequate solutions for the uptake of SRI.
- *Fee on electricity generation from renewable energy sources:* The amount of fee for encouraging the electricity generation from renewable sources is 0.013 €/kWh + VAT for all electricity customers. Due to connection between SRI and electricity generation (e.g., grid flexibility, prosumers, etc.) it could be viable to consider this funding as possible way of financing SRI-related projects.
- *Crowdfunding* includes financing projects by raising funds from numerous people through different available platforms and are often intended for socially useful projects. There are four basic types of crowdfunding with respect to return of investment to donors, and platforms are based on donations, rewards, borrowing or equity. Crowdfunding is already used in Croatia as a way of financing projects in the energy sector and could be adjusted to also boost SRI.
- *Other international multilateral funding mechanisms such as EEA Financial Mechanism, Norwegian Financial Mechanism and Swiss-Croatian Cooperation Programme etc.*

6.6.6. Conclusions

To sum up, Croatia recently entered the testing phase of SRI which puts an ambitious goal of implementing the scheme as either mandatory or voluntary scheme in the future. To successfully implement the testing phase and use the generated know-how in this area, two active LIFE projects (SRI-ENACT and SRI2MARKET) will combine their efforts in supporting the SRI competent authority in Croatia, the Ministry (MPGI), to maximise the impact of their

activities, aiming to perform a proper testing of the SRI methodology and adequate adapting to the national context. Given the fact that SRI scheme is in close relation to EPC, existing legal framework could be used (and expanded) to fit the requirements of EPBD, but also to link SRI with other incentives and concepts such as LEVELS and BRP. In any case, current financial mechanisms/schemes should be adjusted to boost investments towards increasing the SRI adoption, while new ones should also be introduced following more advanced countries which are the frontrunners of this process.

6.7. Spain context

6.7.1. Introduction

The average age of buildings in Spain is more than 50 years old and can reach 77 years in cases such as Barcelona. Almost half of the old houses in Spain have an energy rating that falls under class E⁸⁸, due to the fact that the country's housing stock has a legacy of previous regulations that were not efficient. This raises the issue of increasing energy efficiency as of high significance. In the recent years, the trend to renovate and construct⁸⁹ new buildings is on the rise, thanks to the strong interest of the national government and other relevant territorial bodies. Four out of five buildings in Spain are energy inefficient. This means that 82% of the building stock in our country consumes more resources than necessary to achieve optimal levels of comfort and service, as stated in the Green Building Council Spain (GBCe) Country Report. In 2022, the demand for electricity on the peninsula is estimated at 235,620 GWh, 2.9% less than in 2021. Correcting for the influence of the calendar and temperatures, demand remains 3.8% lower. The building sector in Spain is responsible for 30.1% of final energy consumption and 25.1% of carbon emissions into the atmosphere⁹⁰.

To facilitate the whole process of upgrading the building stock and thus retaining the ascending trend in the energy efficiency front, the Spanish government has also developed and released a tool (URBAN3R⁹¹) focused on boosting urban regeneration and helping decision making for the design of regeneration plans and strategies at the urban scale, ranging from neighbourhood to municipal level. Despite the initiatives and the political will towards

⁸⁸<https://www.odyssee-mure.eu/publications/efficiency-trends-policies-profiles/spain.html>

⁸⁹<https://www.mitma.gob.es/el-ministerio/planes-estrategicos/estrategia-a-largo-plazo-para-la-rehabilitacion-energetica-en-el-sector-de-la-edificacion-en-espana>

⁹⁰<https://gbce.es/blog/2022/03/25/cuatro-de-cada-cinco-edificios-en-espana-son-ineficientes/#:~:text=25%20de%20marzo%20de%202022.&text=En%20este%20sentido%2C%20Huerta%20ha,de%20carbono%20a%20la%20atmósfera>

⁹¹<https://www.mitma.gob.es/arquitectura-vivienda-y-suelo/urbanismo-y-politica-de-suelo/urban3r>

enhancing energy efficiency in the building sector, the concept of “smartness” has not gained, as of yet, the great interest of the implicated stakeholders, explicitly resulting to a practically inexistent adoption of the SRI scheme within the country.

6.7.2. Legislation, policies and measures

Currently SRI in Spain is not regulated by any kind of legislative framework, and Public Administration is expected to develop one according to the respective EU legislation, in the near future, given the recent application of Spain to the SRI platform where the country formally expressed its intention to volunteer for conducting an SRI test phase. However, considering the SRI scope, energy and construction regulations will be taken into account and adapted accordingly, in an attempt to consolidate the SRI considerations. In this respect, below are presented some of these regulations and programmes⁹²:

- *Aids Programme to singular projects for local entities promoting the transition to a low-carbon economy (DUS EELL Programme)* has been developed to be exploited by municipalities (or groups of municipalities) with less than 20,000 inhabitants that belong to the same autonomous region or city, with an aim to reducing their CO₂ emissions through devoted project actions. These actions are primarily funded by ERDF funds and their scope falls under the achievement of specific targets, which are grouped into the following objectives: (a). improvements in building efficiency, infrastructure and public services, (b). sustainable urban mobility, and (c). use of renewable energy sources for electricity production and thermal uses in public buildings and infrastructure.
- *Law 15/2012, of 27th December, on tax measures for energy sustainability*, having been in force since 2013, intends to promote energy rationale and efficient use through establishing tax measures that are designed to communicate bilaterally with the end-users on the basis of sending a price signal. This is to act as a stimulation point to improve energy efficiency, whilst at the same point, to ensure that national policies are in line with the basic principles that govern the fiscal, energy and environmental policy of the EU.
- *Aid Programme for energy rehabilitation actions in existing buildings (PREE)* is aimed at the Autonomous Communities as their direct beneficiaries, whose responsibility is the further distribution of the aids among the ultimate recipients. It is regulated by Royal Decree 737/2020 and intends to enhance the existing building stock in terms of sustainability, through actions on both the building envelope and the

⁹²<https://www.odyssee-mure.eu/publications/efficiency-trends-policies-profiles/spain.html>

operational systems (e.g., thermal and lighting installations), giving continuity to the preceding programmes, PAREER-CRECE and PAREER II.

- *Ecological Public Procurement Plan of the General State Administration (2018-2025)* is focused on the Public Administration bodies and highlights the environmental aspect of the sustainability concept, in that it seeks to ensure the acquisition of goods, works and services with the least possible environmental impact, the incorporation of environmental clauses in public procurement, as well as enable the promotion of the Spanish Circular Economy Strategy.
- *Energy audits and management systems*. Based on the Royal Decree 56/2016, where the Article 8 of the EED is transposed, large industrial companies (or groups of companies) are obliged to perform energy audits every 4 years, within their facilities located in Spain, covering at least 85% of their final energy use.

6.7.3. Options for the SRI adoption

In Spain, no demonstration project implementing SRI at local, regional or national level has currently been explored or launched. For the time being, no legal document related to renovation and increasing energy efficiency in buildings has established the SRI tool within the current regulations. Such a provision is expected to take shape once the introduction and regulation of smart building operating systems becomes transparent and more aligned with the national context.

In this sense, SRI-ENACT can be considered among the first initiatives that attempt to introduce the SRI approach as such and enable the application of the SRI methodology in the Spanish context, facilitating the development of SRI-related legislation, providing for incentive measures and, finally, launching a certain pilot project.

More specifically, one of the pathways could be to modify the existing regulatory framework to make SRI assessment recommended or mandatory for certain building types, and to determine the technical requirements for the intelligent preparation of both new and reconstructed buildings. To maximise efficiency, independent inspections are often combined with certification of the building's energy performance. This can be done, for example, during the renovation/reconstruction of the building or when the building's air conditioning/heating system is reinstalled. Linking SRI assessments with building energy audits and regular inspections of heating and air conditioning systems could provide a comprehensive overview of the building's energy performance.

Another possible pathway relates to financial incentives that can be introduced to encourage owners to adopt new SRI practices and to invest in smart energy efficient technologies. For example, key SRI features can be included as requirements in the specifications of public procurement documentation, which in turn would ensure that all new public buildings meet the highest energy efficiency standards. The third possible avenue concerns

capacity building activities that provide training and education to building owners, architects, engineers, and contractors on the importance of SRI and best practices for implementing it.

6.7.4. Challenges

Regardless of the implementation pathway that will be followed eventually, and the size of deviation compared to the draft one presented above, there are some key challenges that apply on horizontal basis across all possible SRI implementation roadmaps in Spain, that should be addressed in the years to come, if the case is for a wide national SRI adoption. Some of these challenges are:

- Energy audits and the issuing of EPCs are sometimes perceived as a bureaucratic burden and therefore SRI assessments will most likely be found as such.
- Lack of economic rationale and funding mechanisms to support widespread deployment of smart technologies.
- GDPR and cybersecurity issues stemming from the personal data obtained.
- Lack of current regulations governing the consistent and large-scale deployment of smart systems that impact energy efficiency, comfort, etc.
- Lack of a competitive market for the design, equipment, construction, maintenance and servicing of intelligent building systems.
- Access to data and software products for monitoring and operational checks in the different phases of construction, renovation and operation of buildings, which would increase the understanding and results of SRI assessments.
- Investment and operational cost of BIM systems.
- Willingness of state and municipal authorities to cooperate.

Lectures, methodologies, training and certification programmes for auditors are an important stage of the SRI implementation process, which should be given special attention to. Due to the lack of auditors currently trained or being trained in the practice of SRI study, special provision for non-professional SRI assessment (e.g., instruction, self-learning programmes, consultation centres, online platforms, etc.) should be advocated for the time being.

6.7.5. Funding mechanisms

In Spain, there is a number of subsidies and funding mechanisms that are designed to facilitate the implementation of energy efficiency projects, thereby underlying great potential for exploitation for the SRI purposes as well. Some of them are presented below⁹³:

- *Recovery, Transformation and Resilience Plan.* Within the framework of the European Union's Next Generation programme, Spain approved the in October 2020. Among its objectives are the promotion of digital transformation and smart, sustainable and inclusive growth, including actions to boost R&D&I.
- *State Plan for access to housing 2022-2025.* Within the State Plan for access to housing 2022-2025, there is a programme to promote the improvement of energy efficiency and sustainability in housing, which finances actions that reduce energy consumption and/or demand, for example.
- *The National Energy Efficiency Fund (FNEE),* assigned to the Ministry for the Ecological Transition and the Demographic challenge through the State Secretary for Energy, intends to provide financing to the economic and technical assistance, training, information and other measures, towards increasing energy efficiency in the different energy consuming sectors, in a way that also ensures that national energy saving objective established by Article 7 of Directive 2012/27/EU is met.
- *Aids programme for SME and Large Companies in the industrial sector* is intended to fund actions in the following two categories: (a). improvements in technology equipment and industrial processes, and (b). the implementation of energy management systems.

6.7.6. Conclusions

In general, Spain is in a good position with regard to energy efficiency. However, there is a strong need to rejuvenate its old buildings at national level, within a short period of time. Said this, the imminent SRI test phase that will initiate in the country soon is a big step that would bring the country to very representative energy saving figures.

⁹³<https://www.odyssee-mure.eu/publications/efficiency-trends-policies-profiles/spain.html>

6.8. Austria context

6.8.1. Introduction

Austria is included in the limited pool of the six frontrunning countries, where a formal test of the SRI scheme is implemented. The Austrian test phase is led by the Austrian Institute of Construction Engineering (OIB) and the Austrian Climate Ministry (BMK), with the involvement of AEE Intec and of the University of Natural Resources and Life Sciences Vienna (BOKU) who are conducting the assessments. The focus of the test phase is to benchmark the SRI methodology against other methods developed in Austria with a focus on energy flexibility. A large number of different building typologies are examined and assessed on the basis of detailed documented buildings from Austrian regions or the federal government. According to the published Long Term Renovation Strategy (Austrian Institute of Construction Engineering 2020), the renovation rate ranges between 4.7% and 5.5%. In order to make the economic effects a little more transparent, according to Euroconstruct, Austria spent €5,336,000,000 on refurbishments in the residential buildings sector in 2017. The preliminary results for 2018 indicate that 5,782 private and 180 corporate renovation projects were funded, triggering sustainable investments of around €283 million. SRI development in Austrian initiatives is not always met with approval. Listing and advising potentially smart services in a building according to their presence and their functionality in relation to certain areas of impact such as energy efficiency and comfort, was deemed insufficient. Rather, an SRI should at least be able to quantitatively identify demand response potential and good comfort conditions, for example through on-field tests as well as social engagement programmes.

6.8.2. Legislation, policies and measures

The integration of the EPBD (Directive 2010/31/EU) within the existing legislation in Austria has been implemented, forming an opportunity for the development and harmonisation of a common calculation methodology, as well as for the application of new regulations for technical building systems. The issuance of EPCs was already a fact in several provinces even before implementing the EPBD and SRI testing. However, the EPBD's full implementation has resulted in further developed building regulations and respective legislative texts and programmes, such as:

- *The klimaaktiv [Climate active⁹⁴] climate protection initiative:* As part of the klimaaktiv Bauen&Sanieren [Build & Refurbish climate-actively] programme, the Federal Ministry for Sustainability and Tourism (BMNT)'s climate protection initiative developed the klimaaktiv building standard – across Austria the

⁹⁴www.klimaaktiv.at/bauen-sanieren

best-known rating system for the sustainability of buildings with a particular focus on energy efficiency, climate protection and resource efficiency. It is available for residential buildings and service buildings and provides specific help for property developers, planners, builders, housing developers and provincial housing support agencies, as well as for anyone constructing or refurbishing a building. The Federal Government offers klimaaktiv quality assurance and advice for the extensive renovation of various types of buildings at a cost-optimal level.

- *e5 programme for towns and municipalities*⁹⁵: The e5 programme encourages Austrian municipalities to act in a sustainable manner at all levels: in dealing with energy, consumption, mobility and the economy. Many municipalities want to make their power supply substantially independent from fossil energy in terms of heat, electricity and traffic while at the same time retaining value-adding activities, income and jobs in the region. As part of klimaaktiv, e5 provides consultancy and certification services to towns and municipalities that are committed to energy transition and climate protection. A network of highly qualified federal state consultants and a standardised rating scheme across Europe make it easier for the e5 municipalities to define measures in six central core areas of operation and also to allow their progress to be rated by independent experts.
- The Provincial Government of Salzburg has adopted the *Masterplan Klima + Energie 2020 [Climate + Energy Master Plan 2020]*. It has two pillars: 54% Energy and greenhouse gas savings, and 46% Expansion of renewable energy. As part of Salzburg housing support, a supplementary subsidy on top of basic support was created as early as 1993 for energy performance measures that go beyond the applicable minimum requirements in construction law. The measures eligible for support for the purpose of improving energy performance and reducing greenhouse gas emissions are continually adjusted. The minimum requirements introduced for putting nearly-zero energy construction⁹⁶ into practice, were implemented in close coordination with construction law. Renovation support includes such measures as installation, modernisation or expansion of a solar thermal collector or installation, modernisation or expansion of a photovoltaic solar installation and installation or expansion of a thermal storage facility.
- *The City of Vienna's Climate Protection Programme (KLIP II) [Klimaschutzprogramm]*, adopted in 1999, was rolled forward from 2009 to 2020. Due to the international framework conditions, the programmes of

⁹⁵<https://www.e5-gemeinden.at/english/en/e5-programme>

⁹⁶Minimum requirements for energy performance for residential buildings in accordance with the Salzburg Housing Support Ordinance [Salzburger Wohnbauförderungsverordnung 2015 – WFV 2015] Provincial Law Gazette (LGBl) No. 103/2016

measures can be expected to continue beyond 2020. The main objectives for residential construction in terms of energy supply are the prioritisation of district heating as the energy carrier and an increase in the share of renewables. Targets for energy efficiency improvements (savings targets) have also been defined for the buildings sector.

- *Smart City Vienna – Framework Strategy 2050*: The Smart City process aims to define and achieve comprehensive goals for the city and its residents. These goals are assigned and clearly presented in the resources, quality of life and innovation areas of action. A reduction of 1% per capita per year in final energy consumption for heating, cooling and hot water is planned for the buildings sector.

The National Energy and Climate Plan also contains several priorities that lay hands on the smartness aspect and more specifically the smart technologies, as follows:

- Encouraging the development of prosumers alongside the development of electricity networks and smart meters.
- General objectives for the development of smart meters and smart networks, a step-by-step implementation of the smart city concept and the implementation of IoT in the residential sector.
- Development of regional groups for sustainable energy planning, e.g., smart use of energy within SMEs, use of renewable resources and promotion of energy efficiency measures.

6.8.3. Options for the SRI adoption

The preparation of a nationally specified framework for the SRI uptake in Austria is among the main objectives of the SRI-ENACT project. In cooperation with the international project IEA EBC Annex 67 on the energy flexibility of buildings, the responsible people of the DG Energy, the VITO consortium (led by the Flemish Institute for Technological Research NV) and the national stakeholders, an inclusive proposal for the SRI adoption in Austria has been developed. Austrian technology providers, energy service providers, experts and other relevant stakeholders have been asked about their opinion and the potential of smart technologies. A technology screening, an impact analysis and classification of possible technologies and services was carried out, and the influence of/on national regulations was examined. Relevant knowledge on technologies related to smart buildings was covered by the consortium itself. Various smart technologies and services applicable to the buildings were listed and evaluated. The current state of discussion on an "intelligence factor" for buildings at EU and national level has been researched and summarised. Economic and market studies on smart building technology and energy flexibility were included for an impact analysis. The main result of this analysis served as a sound basis for the national political decision to examine whether to introduce SRI or not. The final SRI proposal was

established on the integration of the SRI into the process of issuing energy performance certification, also taking into consideration issues that were identified by previous projects teams, such as:

- *Wind power surplus:* Around 300 GWh per year of wind power has currently fallen out of the green electricity subsidy. Part of this amount of electricity is produced at times when very low prices are paid on the electricity exchange. These electricity producers are very interested in a market where electricity can be offered flexibly.
- *Heating networks operation:* The capacity of heating networks will reach its limits with the planned expansion and given that fossil fuel heat is to be increasingly reduced. Operation can be optimised both by lowering the return temperature and by shifting loads. Due to a lack of suitable information, specifications and framework conditions, this potential has only been used in a few projects so far.
- *New building cooling:* Cooling is already standard in service buildings, summer suitability can no longer be guaranteed with the normative specifications in residential buildings either, cooling is increasingly being retrofitted, the waste heat from which leads to further heating of the settlements.
- *New construction “Get out of oil and gas”:* The phase-out of oil has come a long way to achieving the climate goals, but the phase-out of gas must also be prepared. There is often a lack of attractive concepts, especially for the use of heat pumps. Their use is particularly recommended in new constructions, while district heating should rather be concentrated in existing buildings.
- *Energy certificate balancing:* So far, this has not taken into account the dynamic behaviour of buildings.
- *Building automation lag:* In contrast to service buildings, the use of building automation in residential buildings is still low. In addition, the smart meter rollout is progressing slowly.
- *Missing knowledge:* The advantages of building automation and electronic data recording have not yet been adequately recognised by building owners and users.
- *Lack of incentives:* Subsidies have not as of yet incorporated grid-friendly operation motives, and there are also no legal requirements.
- *Lost opportunities in building use:* Due to a lack of knowledge, possible energy savings and consequent economic benefits are not easily realised.
- *Lost opportunities in new buildings:* The operation of buildings as energy storage systems and as a time-flexible consumer offers a very relevant but hitherto hardly used potential for a stable network operation based on volatile energy sources. Component activation as the sole system for heating and cooling is particularly advantageous, but this has to be designed from scratch and can hardly be retrofitted.

- *Too much CO₂, too few renewables:* Austria needs more contributions to meet its climate commitments. According to mission2030, the building sector should reduce its emissions by around 3 million tons of CO₂ per year.

The testing of the SRI developed in Austria showed that the SRI assessment procedure is straightforward and that it can be easily implemented into an energy audit or the standard EPC assessment, complementing the information provided to the building owner/user regarding the quality of the building. Furthermore, it can be elicited from previous projects that the SRI value was integrated as requirement in the EPC technical information related to the building's renewable energy sources. This integration model is based on the assumption that buildings may act as stabilisers of the energy supply. This assumption is supported, for example, by the potential identified by the PowerPack Real Estate industry project I and II⁹⁷ (2021). Based on six concrete applications for several building types, the interaction between the different building networks and their flexibility management were analysed and the economic as well as the sustainability potential were worked out.

The integration of the SRI scheme into the energy performance certificate issuing process, as the most prominent implementation pathway in Austria, contributes to the buildings' increased operation in a grid-friendly and sustainable manner, and, according to the SRI-ENACT's Austrian partners, the following trigger points are identified as the most appropriate means to accommodate an SRI assessment and further boost its spread:

- New building construction
- Major building renovation
- Other (e.g., the interest of the building owner in improving the energy performance of the building)

In terms of ICT tools that could be exploited to support the SRI context, the province of Lower Austria provides the free use of an internet-based energy accounting tool. With the help of this application, consumption of energy and resources can be easily recorded and evaluated. The tool also makes it easier for the energy officer to prepare a report on the energy consumption situation, as required by the Energy Efficiency Act. This makes buildings comparable and enables benchmarks to be created.

⁹⁷<https://www.fma.or.at/netzwerk/task-forces-arbeitsgruppen-i-projekte/branchenprojekt-powerpack-immobilie-ii/>

6.8.4. Challenges

The assumption that the SRI recognises the advantages of network-friendly building operation, building automation and the corresponding technical building equipment is only shared if the information do not arrive in aggregated form and corresponds to the actual condition of the building. In general, representatives of the housing industry and many within the housing and energy departments of the federal states foresee a development that imposes ever more demands on them. Therefore, a negative attitude towards the introduction of the SRI scheme in its current form is to be expected from this market segment for the time being. Consumer protection has warned that the SRI implementation should not result in the richer population living in smart and highly efficient buildings and those who cannot afford smart living having to bear high energy costs. A fundamental negotiation on the question of who bears the cost and who is about to benefit, appears to still be work-in-progress, although other initiatives in Austria are bringing incremental improvements.

An energy performance certificate is issued when a building is newly built, sold or renovated. These are processes that typically occur at relatively large time intervals, meaning that, if a building is evaluated on the basis of an energy performance certificate, this describes the building for the next few years/decades. Once the SRI becomes part of the energy performance certificate, there is still inconsistent approach as to how changes, for example, in the electrical equipment take place. Who takes into account the adjustments when additional loads are added/removed, or existing ones are exchanged for new ones? The composition of the electrical equipment in a building is expected to change much faster than, for example, a heating/insulation/cooling system. Regarding initiatives associated with consulting and knowledge transfer such as Energieberater-Netzwerk [Energy consultants' network], the quality differences between performing energy consultations aimed to support SRI and issuing of energy performance certificates, are considerable. Particularly for end customers, it is difficult to find an independent and competent energy consultant. Although the pool of energy consultants is very large, they are often only specialised in one area of expertise and therefore may not be adequately trained to give comprehensive SRI advice.

Finally, addressing privacy, confidentiality and cybersecurity issues associated to the implementation of the SRI scheme, by ensuring that data collected and stored are protected and that the right to data protection is respected, should also be seamlessly integrated in further testing. Based on "Attitudes of Austrians to Smart Home and Smart City" explored in VITO project follow up, simplification of everyday life and time savings are primarily mentioned as advantages of smart home products, as well as "access my systems at home from anywhere" and "lower energy consumption". The main disadvantages were the collection of personal data ("transparent customer") and hacker attacks.

6.8.5. Funding mechanisms and programmes

According to the calculations of Kommunalkredit Public Consulting, subsidised measures result in annual energy savings of around 111,000 MWh, as well as annual CO₂ savings of over 35,300 tonnes. Private individuals were able to obtain up to €5,000 for replacing a fossil fuelled heating system with a climate friendly one (Raus-aus-dem-Öl [Leave oil behind]). Funding of up to €6,000 was available for the thermal renovation of the envelope. Depending on the quality of the renovation, companies were able to receive funding of up to 30% of the investment costs.

- **National funding mechanisms**

The Austrian Federal Government's Sanierungsoffensive [Renovation offensive] was launched in 2009 and has established itself as an important and successful incentive for companies and private individuals to reduce energy consumption through measures to renovate buildings. The subsidy is given in the form of one-off, non-repayable grants. In recognition of the great importance of architectural heritage for Austria's economic development, the Sanierungsoffensive was expanded in 2012 to include a category for listed buildings. The special criteria allow the promotion of thermal refurbishments while preserving the architectural appearance.

- *Raus-aus-dem-Öl and renovation cheque for private individuals 2019⁹⁸*: Thanks to the good response that the campaign in 2018 received, the subsidy offer was continued with a focus on the Raus-aus-dem-Öl bonus. In order to make the switch to a climate friendly heating system even easier, the Raus-aus-dem-Öl bonus of 2019 supported the replacement of heating systems regardless of whether the building was simultaneously being renovated. In this case, it was mandatory to submit a valid energy performance certificate for the residential building or an energy consultation report from the province. Individuals submitting thermal refurbishment measures were able to obtain a grant of up to €6,000, as well as a supplement of up to €3,000 for the use of renewable raw materials. In order to increase the impact of the funding, the funding criteria were discussed intensively with the provinces and coordinated as far as possible. The switch to online submission made it considerably easier for funding applicants to apply. A cooperation was entered into with the Province of Salzburg for this online submission, so that applicants could apply for both subsidies with a single application. The medium- and long-term orientation of the federal Sanierungsoffensive is an important component towards the finalisation of the national energy and climate plan. The goal-oriented alignment of this instrument is

⁹⁸<https://www.bmnt.gv.at/service/foerderungen-des-bmnt.html>

intended, as far as possible, to be coordinated with those of the provinces in terms of budget, content and organisation with regard to the 2030 goals. The aim is to help achieve goals in an unbureaucratic manner with the lowest possible cost burden for public budgets.

- **Regional instruments**

- **Burgenland**

In order to promote new builds, the amount of the subsidised loan is staggered according to income and the energy efficiency of the building. In addition to basic support, bonus amounts may also be awarded for, inter alia, construction that limits land consumption. The use of ecological building materials is a prerequisite for receiving support. In order to promote renovations, incentives were created, and the level of support was increased. The requirement to submit an energy performance certificate ensures that cost-optimal renovation measures are implemented. Particular attention was given to thermal and extensive energy renovation. With a corresponding improvement in the thermal quality of the building envelope (renovation of window surfaces, the roof or top floor ceiling, facade surfaces, the basement ceiling, as well as energy-relevant heating systems), up to 80% of eligible renovation costs can be funded. The use of oil- or coal-fired heaters represents a funding exclusion criterion. The Housing Act associated guidelines are published on the province's website. A non-repayable grant can be awarded for the establishment of facilities for the renewables-based generation of energy to provide space heating and hot water and to conserve energy and raw resources. The switch from an oil-fired boiler to a highly efficient alternative heating system in single- and dual-family houses is promoted under the slogan *Machen Sie Schluss mit Ihrem Ölkessel* [Call time on your oil-fired boiler].

- **Carinthia**

The overarching goal of the Carinthian Energy master plan is the complete decarbonisation of the spheres of heating and electricity. On-site energy consultation Independent, product- and company-neutral, quality-verified energy consultation is the key to the implementation of high-quality energy efficiency measures and also an essential trigger for investments in the construction industry (construction and ancillary construction trades)⁹⁹. The number of subsidised on-site energy consultations is to be significantly increased – from approximately 2,000 consultations a year currently. Carinthia's *Energieberater-Netzwerk* [Energy consultants' network] (*netEB*) Plans for the on-site energy consultation funded by the Province of Carinthia include

⁹⁹www.umwelt.ktn.gv.at

personal certification. Support is available either in the form of a one-off grant or through the award of a subsidised loan, with a higher level of support for those attaining a klimaaktiv quality level in multi-storey apartment blocks. The improvement and increase in support for the creation of living space in existing properties by converting, extending, or integrating and acquiring vacant existing properties in heavily built-up areas, is intended to bolster the use of existing resources and existing infrastructure and facilitate a space-saving way of building through high-quality redensification. Support takes the form of a low-interest loan with a term of 20 years. The incentive schemes that are key to multi-storey buildings are being created by making renewable energy sources more available, improving access to climate-friendly forms of mobility such as cycle paths and local public transport networks or providing arrangements for alternative forms of mobility, and by mandatory measures to prevent summer overheating. Residential properties that achieve a “klimaaktiv” standard are given a higher level of support¹⁰⁰.

- **Upper Austria**

Upper Austria’s housing support is a key measure to stimulate cost-effective deep renovation of buildings¹⁰¹. According to the report on climate protection measures in the buildings sector pursuant to Article 15a of the Austrian Federal Constitutional Law, Upper Austria has achieved the highest refurbishment rate in the last six years. With the support for boiler replacement under the province’s environmental support programme, significant incentives to switch from fossil fuels to renewable energy carriers/sources were put in place¹⁰².

- **Styria**

The Ich tu’s [I’m doing it] Energy consultation service provides comprehensive and competent on-site consultations tailored to the specific situation of the customer, and identifies targeted energy saving and refurbishment opportunities. This is intended to help the Styrian population to recognise the real-life energy-saving renovation options for their buildings, and in the long-term to save on electricity and heating costs. By changing behaviour, purchasing new, energy efficient appliances, investing in the control or optimisation of heating systems or investing in energy renovation or extensive refurbishment of a building, the energy consumption of a household can be reduced. This makes possible immediate savings in CO₂ emissions and a reduction in

¹⁰⁰www.wohnbau.ktn.gv.at

¹⁰¹The details are regulated in the province’s Regulations on the renovation of residential buildings.

¹⁰²<https://www.energiesparverband.at/fileadmin/esv/Broschueren/HeizkesseltauschFolder.pdf>

environmental pollution. This is intended to make a significant contribution to the implementation of the Styria 2030 climate and energy strategy. For the specific area of cost-effective, deep renovation measures, there are numerous auditable measures, such as ‘stocktake and analysis’, ‘creation of a refurbishment plan’ and ‘role model renovation measures’, which can be undertaken for municipal buildings and facilities. The Province of Styria subsidises both the e5’s programme of activities and the municipalities’ e5 membership fee¹⁰³. The subsidy of the municipalities’ membership fee amounts to 20-60%, depending on the tax paying ability per capita.

○ **Tyrol**

The Province of Tyrol founded the association Energie Tirol [Energy Tyrol] in 1992 as an independent advice centre for the promotion of environmentally friendly energy technologies and the economical use of energy. The consultation service is carried out independently of products and companies. Its focus is on energy saving construction engineering and building technology systems, as well as environmentally friendly heating. A key element of the renovation consultations is the development of an individual renovation plan. Through its financial involvement in Energie Tirol, the Province of Tyrol supports the provision of comprehensive advice on energy-efficient construction and refurbishment¹⁰⁴.

○ **Vorarlberg**

For new buildings and renovations, the Province of Vorarlberg’s housing support assists members of the public via a low-interest loan and/or a one-off subsidy in order to meet its objective of establishing cost effective and sustainable residential buildings. Support for new buildings is provided in the form of a loan. The term is 35 years. There is a choice between an increasing rate (from 0.5% to 3.25%) and a fixed rate (1.75%). The amount of the loan is made up of the basic support and bonuses. These in turn are expressed in € per m², multiplied by the eligible useful floor area. An energy saving and environmental bonus is paid out for improved building envelope quality, a low total primary energy requirement, low CO₂ emissions, as well as for the use of renewable and ecologically sound construction materials. The installation of solar thermal collectors, heating systems based on renewable energy carriers and ventilation systems with heat recovery are also supported through outright grants.

¹⁰³ <http://www.wohnbau.steiermark.at/cms/beitrag/12674570/113383975/>

¹⁰⁴ <http://www.energie-tirol.at>

6.8.6. Conclusions

To sum up, the general framework for the SRI assessment is already contained in the Austrian legislation and the newly adopted calculation methodology for energy performance of buildings integrates the SRI as part of the EPC technical information related to the building's renewable energy sources. An evaluation methodology for SRI districts plus calculation examples should continue to be carried out on a broad basis. In the medium term, the incorporation of the goals of the SRI into the energy certificate calculation itself, or the questioning of the key data there, as well as the strengthening of dynamic processes, the inclusion of real data for better assessment and validation of key figures for the SRI and others in relation to energy flexibility assessment, should be further considered.

6.9. Contexts summary

Table 6 presents the summarised context of each pilot country based on the information laid out in the above sections to facilitate readability.

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Table 6. Summarised contexts of each pilot country.

Country	SRI current status	Legislative framework	Funding mechanisms	Potential options for SRI adoption	Challenges
Bulgaria	The level of adoption of the SRI scheme in Bulgaria is still low, in both the residential and the non-residential sector. Only some parts of the smartness aspect are considered, such as energy efficiency and smart metering systems.	The implementation of the corresponding SRI regulatory texts in the Bulgarian legislation (primary and secondary legislative acts, sectoral and regional regulations, rules, etc.) is still in its infancy and thus inconsistent and unsynchronised.	No available funding mechanism to directly support the SRI implementation in Bulgaria. Few established energy efficiency funding schemes could be exploited.	A direct link of the SRI to the EPC assessments raises a great deal of heated debate in Bulgaria, as one of the best options for the SRI implementation.	<ul style="list-style-type: none"> Regulatory framework Raising awareness Competitive SRI market Data access and tools Certified SRI assessors Cyber security Investment cost
Latvia	SRI assessments are not mandatory in Latvia, and no demonstration projects that attempt to implement the SRI scheme on a local, regional or national basis have been implemented so far.	Existing energy efficiency regulation in Latvia does not explicitly look into the concept of smart readiness of buildings, which, nevertheless could be approached as part of the respective energy efficiency legislative texts.	Several sources of funding instruments aimed at the improvement of energy efficiency in buildings could potentially be used to support SRI assessments.	<ul style="list-style-type: none"> SRI assessments could be conducted as part of inspections of heating and air conditioning systems. SRI characteristics can be included as requirements in the terms of reference of public procurement documentation. 	<ul style="list-style-type: none"> Investment cost Support instruments Time Public acceptance Expertised parties Raising awareness Best practices - drivers
Czech Republic	The Czech Republic is among the six countries where the formal SRI test phase is currently taking place. The test phase is carried out by Czech Technical University, the Faculty of Civic Engineering, Department of Indoor Environmental and Building Services Engineering, led by prof. Karel Kabele.	There are several national regulations identified as crucial for the successful exploitation of the SRI scheme, although currently there is no legislative text or any regulatory framework that introduces SRI within its body.	No financial scheme available for the direct SRI exploitation in the Czech Republic but several financial schemes dedicated to energy efficiency could accommodate the SRI as an evaluation criterion.	The SRI implementation option that appears to be the most prominent one is to be accommodated within the well-established energy audits-related framework.	<ul style="list-style-type: none"> Public acceptance Data complexity Data volume GDPR issues Bureaucracy Funding mechanisms
Romania	The only SRI-related measure currently being implemented in the country is the introduction of smart meters, although only few pilot projects have been realized in this respect.	Several pieces of legislation in Romania regulating the energy efficiency front, although none of them including provisions for the SRI.	EU funding streams are not fully exploited in Romania, especially for energy efficiency work in the building sector, however there is a number of financing schemes that are available for SRI exploitation at national level.	Drawing from the results of the SRI pilot testing in Romania during the H2020 X-Tendo project, it would be “very practical” to implement SRI within the national EPC assessments due to the fact that the data are easily collected, and the indicator is relevant to the holders of the EPC.	<ul style="list-style-type: none"> Raising awareness SRI methods complexity Funding mechanisms Standardised process
Greece	Greece has recently started to explore the SRI concept through a feasibility study that is currently being carried out on behalf of the Ministry of Environment and Energy (YPEN).	A few Articles and Laws governing the energy efficiency deployment in Greece, which are open to further adjustment in order to incorporate the SRI framework as well.	Finance for SRI renovations in Greece could come from several EU sources (e.g., ERDF, RRF, etc.) and few national energy efficiency-related programmes.	<ul style="list-style-type: none"> A combination of SRI with the EPC assessment is explored since it can provide recommendations on both smartness and energy efficiency. 	<ul style="list-style-type: none"> EPC data availability Low credibility of SRI results Expertised parties Funding mechanisms GDPR issues

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			<ul style="list-style-type: none"> • Parallel market-driven scheme, based on self-assessment, given that it can help increase coverage and reduce costs, especially for residential buildings in Greece.
<p>Croatia</p> <p>As of recently, Croatia has entered the testing phase of SRI scheme. The SRI test phase in Croatia is led by the Ministry of Physical Planning, Construction and State Assets (MPGI) and is supported by the non-profit scientific institution Energy Institute Hrvoje Pozar (EIHP).</p>	<p>The current regulatory framework in Croatia does not reflect on SRI scheme per se in terms of evaluation and applying the methodology. The legal framework regarding the building stock is formulated through several legislative documents, with special focus on the Building Act (BA), which transposes the EPBD directive into the national context.</p>	<p>Currently, there is an intention to adjust currently active programmes and available funds that are focused on energy renovations to also include SRI, but also some other options to form a separate way of funding (grants, programmes, credit lines, bonds) that can be used to boost SRI.</p>	<ul style="list-style-type: none"> • An option to ensure good market penetration of the SRI would be to combine it with the EPC on a mandatory basis with the aim of creation a common assessment framework within the EPC. • Combine the SRI scheme with voluntary reporting framework used to improve the sustainability of buildings (e.g., Level(s), BRP, etc.). • Connect the SRI scheme with BIM, which provides a digital representation of a building's characteristics in its whole life cycle. <ul style="list-style-type: none"> • Investment cost • Expertised parties • Raising awareness • Cyber security and GDPR issues • Adoption of smart solutions • Grid flexibility • Access to finance • Competitive market • Bureaucracy • Emigration and depopulation
<p>Spain</p> <p>Spain has recently applied to the SRI platform, formally expressing its intention to volunteer for conducting an SRI test phase.</p>	<p>Energy and construction regulations will be taken into account and adapted accordingly, in an attempt to consolidate the SRI considerations, in alignment with the SRI test phase.</p>	<p>In Spain, there is a number of subsidies and funding mechanisms that are designed to facilitate the implementation of energy efficiency projects, thereby underlying great potential for exploitation for the SRI purposes as well.</p>	<ul style="list-style-type: none"> • Linking SRI assessments with building energy audits and regular inspections of heating and air conditioning systems could provide a comprehensive overview of the building's energy performance. • Key SRI features can be included as requirements in the specifications of public procurement documentation. • Training and education to building owners, architects, engineers, and contractors on the importance of SRI and best practices for implementing it on their own. <ul style="list-style-type: none"> • Bureaucracy • Funding mechanisms • GDPR and cyber security issues • Regulatory framework • Competitive market • Access to software products and tools • Investment cost • Cooperation with the authorities (both local and national)

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Austria	<p>Austria is included in the six frontrunning countries, where a formal test of the SRI scheme is implemented. The Austrian test phase is led by the Austrian Institute of Construction Engineering (OIB) and the Austrian Climate Ministry (BMK), with the involvement of AEE Intec and of the University of Natural Resources and Life Sciences Vienna (BOKU).</p>	<p>The integration of the EPBD (Directive 2010/31/EU) within the existing legislation in Austria has been implemented, forming an opportunity for the development and harmonisation of a common calculation methodology, as well as for the application of new regulations for smart technical building systems.</p>	<p>Subsidies and funding mechanisms dedicated to energy efficiency renovations in effect for both private individuals and companies.</p>	<p>The testing of the SRI developed in Austria showed that the SRI assessment procedure is straightforward and that it can be easily implemented into an energy audit or the standard EPC assessment, complementing the information provided to the building owner/user regarding the quality of the building.</p>	<ul style="list-style-type: none">• Pressure on the housing industry• Social gaps• Effect on the EPC• Expertised parties• Data privacy• Cyber security issues
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Annex 1

Table 7. Summary of smart-ready services and functionality levels of detailed service catalogue (Method B).

Technical domain	Smart-ready service	Functionality levels				
		Level 0	Level 1	Level 2	Level 3	Level 4
Heating	Heating emission control	No automatic control	Central automatic control (e.g., central thermostat)	Individual room control (e.g., thermostatic valves, or electronic controller)	Individual room control with communication between controllers and to BACS	Individual room control with communication and occupancy detection
	Emission control for TABS (heating mode)	No automatic control	Central automatic control	Advanced central automatic control	Advanced central automatic control with intermittent operation and/or room temperature feedback control	-
	Control of distribution fluid temperature (supply or return air flow or water flow)	No automatic control	Outside temperature compensated control	Demand-based control	-	-
	Control of distribution pumps in networks	No automatic control	On/off control	Multi-stage control	Variable speed pump control (pump unit (internal) estimations)	Variable speed pump control (external demand signal)
	Thermal Energy Storage (TES) for building heating (excluding TABS)	Continuous storage operation	Time-scheduled storage operation	Load prediction-based storage operation	Heat storage capable of flexible control through grid signals (e.g., DSM)	-
	Heat generator control (all except heat pumps)	Constant temperature control	Variable temperature control depending on outdoor temperature	Variable temperature control depending on the load (e.g., depending on supply water temperature set point)	-	-
	Heat generator control (for heat pumps)	On/off control of heat generator	Multi-stage control of heat generator capacity depending on the load or demand (e.g., on/off of several compressors)	Variable control of heat generator capacity depending on the load or demand (e.g., hot gas bypass, inverter frequency control)	Variable control of heat generator capacity depending on the load AND external signals from grid	-
	Sequencing in case of different heat generators	Priorities only based on running time	Control according to fixed priority list e.g., based on rated energy efficiency	Control according to dynamic priority list (based on current energy efficiency, carbon emissions and capacity of generators, e.g., solar, geothermal heat, cogeneration plant, fossil fuels)	Control according to dynamic priority list (based on current AND predicted load, energy efficiency, carbon emissions and capacity of generators)	Control according to dynamic priority list (based on current AND predicted load, energy efficiency, carbon emissions, capacity of generators AND external signals from grid)
	Report information regarding heating system performance	None	Central or remote reporting of current performance KPIs (e.g., temperatures, submetering energy usage)	Central or remote reporting of current performance KPIs and historical data	Central or remote reporting of performance evaluation including forecasting and/or benchmarking	Central or remote reporting of performance evaluation including forecasting and/or benchmarking; also including predictive management and fault detection

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Technical domain	Smart-ready service	Functionality levels				
		Level 0	Level 1	Level 2	Level 3	Level 4
	Flexibility and grid interaction	No automatic control	Scheduled operation of heating system	Self-learning optimal control of heating system	Heating system capable of flexible control through grid signals (e.g., DSM)	Optimized control of heating system based on local predictions and grid signals (e.g., through model predictive control)
Domestic How Water (DHW)	Control of DHW storage charging (with direct electric heating or integrated electric heat pump)	Automatic control on/off	Automatic control on/off and scheduled charging enable	Automatic control on/off and scheduled charging enable and multi-sensor storage management	Automatic charging control based on local availability of renewables or information from electricity grid (DR, DSM)	-
	Control of DHW storage charging (using hot water generation)	Automatic control on/off	Automatic control on/off and scheduled charging enable	Automatic on/off control, scheduled charging enable and demand-based supply temperature control or multi-sensor storage management	DHW production system capable of automatic charging control based on external signals (e.g., from district heating grid)	-
	Control of DHW storage charging (with solar collector and supplementary heat generation)	Manual selected control of solar energy or heat generation	Automatic control of solar storage charge (Prio. 1) and supplementary storage charge	Automatic control of solar storage charge (Prio. 1) and supplementary storage charge and demand-oriented supply or multi-sensor storage management	Automatic control of solar storage charge (Prio. 1) and supplementary storage charge, demand-oriented supply and return temperature control and multi-sensor storage management	-
	Sequencing in case of different DHW generators	Priorities only based on running time	Control according to fixed priority list e.g., based on rated energy efficiency	Control according to dynamic priority list (based on current energy efficiency, carbon emissions and capacity of generators, e.g., solar, geothermal heat, cogeneration plant, fossil fuels)	Control according to dynamic priority list (based on current AND predicted load, energy efficiency, carbon emissions and capacity of generators)	Control according to dynamic priority list (based on current AND predicted load, energy efficiency, carbon emissions, capacity of generators AND external signals from grid)
	Report information regarding domestic hot water performance	None	Indication of actual values (e.g., temperatures, submetering energy usage)	Actual values and historical data	Performance evaluation including forecasting and/or benchmarking	Performance evaluation including forecasting and/or benchmarking; also including predictive management and fault detection
Cooling	Cooling emission control	No automatic control	Central automatic control (e.g., central thermostat)	Individual room control (e.g., thermostatic valves, or electronic controller)	Individual room control with communication between controllers and to BACS	Individual room control with communication and occupancy detection
	Emission control for TABS (cooling mode)	No automatic control	Central automatic control	Advanced central automatic control	Advanced central automatic control with intermittent operation and/or room temperature feedback control	-
	Control of distribution network chilled water temperature (supply or return)	Constant temperature control	Outside temperature compensated control	Demand-based control	-	-

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Technical domain	Smart-ready service	Functionality levels				
		Level 0	Level 1	Level 2	Level 3	Level 4
	Control of distribution pumps in networks	No automatic control	On/off control	Multi-stage control	Variable speed pump control (pump unit (internal) estimations)	Variable speed pump control (external demand signal)
	Interlock: avoiding simultaneous heating and cooling in the same room	No interlock	Partial interlock (minimising risk of simultaneous heating and cooling e.g., by sliding setpoints)	Total interlock (control system ensures no simultaneous heating and cooling can take place)	-	-
	Control of Thermal Energy Storage (TES) operation	Continuous storage operation	Time-scheduled storage operation	Load prediction-based storage operation	Cold storage capable of flexible control through grid signals (e.g., DSM)	-
	Cold storage capable of flexible control through grid signals (e.g., DSM)	On/off control of cooling production	Multi-stage control of cooling production capacity depending on the load or demand (e.g., on/off of several compressors)	Variable control of cooling production capacity depending on the load or demand (e.g., hot gas bypass, inverter frequency control)	Variable control of cooling production capacity depending on the load AND external signals from grid	-
	Sequencing of different cooling generators	Priorities only based on running time	Fixed sequencing based on loads only e.g., depending on the generators' characteristics such as absorption chiller vs. centrifugal chiller	Dynamic priorities based on generator efficiency and characteristics (e.g., availability of free cooling)	Load prediction-based sequencing: the sequence is based on e.g., COP and available power of a device and the predicted required power	Sequencing based on dynamic priority list, including external signals from grid
	Report information regarding cooling system performance	None	Central or remote reporting of current performance KPIs (e.g., temperatures, submetering energy usage)	Central or remote reporting of current performance KPIs and historical data	Central or remote reporting of performance evaluation including forecasting and/or benchmarking	Central or remote reporting of performance evaluation including forecasting and/or benchmarking; also including predictive management and fault detection
	Flexibility and grid interaction	No automatic control	Scheduled operation of cooling system	Self-learning optimal control of cooling system	Cooling system capable of flexible control through grid signals (e.g., DSM)	Optimized control of cooling system based on local predictions and grid signals (e.g., through model predictive control)
Ventilation	Supply air flow control at the room level	No ventilation system or manual control	Clock control	Occupancy detection control	Central Demand Control based on air quality sensors (CO ₂ , VOC, humidity, etc.)	Local Demand Control based on air quality sensors (CO ₂ , VOC, etc.) with local flow from/to the zone regulated by dampers
	Air flow or pressure control at the air handler level	No automatic control: Continuously supplies of air flow for a maximum load of all rooms	On/off time control: Continuously supplies of air flow for a maximum load of all rooms during nominal occupancy time	Multi-stage control: To reduce the auxiliary energy demand of the fan	Automatic flow or pressure control without pressure reset: Load dependent supplies of air flow for the demand of all connected rooms	Automatic flow or pressure control with pressure reset: Load dependent supplies of air flow for the demand of all connected rooms (for variable air volume systems with VFD)
	Heat recovery control: prevention of overheating	Without overheating control	Modulate or bypass heat recovery based on sensors in air exhaust	Modulate or bypass heat recovery based on multiple room temperature sensors or predictive control	-	-

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Technical domain	Smart-ready service	Functionality levels				
		Level 0	Level 1	Level 2	Level 3	Level 4
Technical domain	Supply air temperature control at the air handling unit level	No automatic control	Constant setpoint: A control loop enables to control the supply air temperature, the setpoint is constant and can only be modified by a manual action	Variable set point with outdoor temperature compensation	Variable set point with load dependant compensation. A control loop enables to control the supply air temperature. The setpoint is defined as a function of the loads in the room	-
	Free cooling with mechanical ventilation system	No automatic control	Night cooling	Free cooling: air flows modulated during all periods of time to minimize the amount of mechanical cooling	H,x- directed control: The amount of outside air and recirculation air are modulated during all periods of time to minimize the amount of mechanical cooling. Calculation is performed on the basis of temperatures and humidity (enthalpy).	-
	Reporting information regarding IAQ	None	Air quality sensors (e.g., CO ₂) and real time autonomous monitoring	Real time monitoring & historical information of IAQ available to occupants	Real time monitoring & historical information of IAQ available to occupants + warning on maintenance needs or occupant actions (e.g., window opening)	-
Lighting	Occupancy control for indoor lighting	Manual on/off switch	Manual on/off switch + additional sweeping extinction signal	Automatic detection (auto on/dimmed or auto off)	Automatic detection (manual on/dimmed or auto off)	-
	Control artificial lighting power based on daylight levels	Manual (central)	Manual (per room/zone)	Automatic switching	Automatic dimming	Automatic dimming including sense-based light control (during time intervals, dynamic and adapted lighting scenes are set, for example, in terms of illuminance level, different correlated colour temperature (CCT) and the possibility to change the light distribution within the space according to e.g., design, human needs, visual tasks)
Dynamic Building Envelope	Window solar shading control	No sun shading or only manual operation	Motorised operation with manual control	Motorised operation with automatic control based on sensor data	Combined light/blind/HVAC control	Predictive blind control (e.g., based on weather forecast)
	Window open/closed control combined with HVAC system	Manual operation or only fixed windows	Open/closed detection to shut down heating or cooling systems	Level 1 + Automised mechanical window opening based on room sensor data	Level 2 + Centralized coordination of operable windows, e.g., to control free natural night cooling	-
	Reporting information regarding performance of dynamic building envelope systems	No reporting	Position of each product & fault detection	Position of each product, fault detection & predictive maintenance	Position of each product, fault detection, predictive maintenance, real-time sensor	Position of each product, fault detection, predictive maintenance, real-time & historical sensor data (wind, lux, temperature, etc.)

D2.1 – SRI CURRENT LANDSCAPE REPORT AND STAKEHOLDER ENGAGEMENT

Technical domain	Smart-ready service	Functionality levels				
		Level 0	Level 1	Level 2	Level 3	Level 4
					data (wind, lux, temperature, etc.)	
Electricity	Reporting information regarding local electricity generation	None	Current generation data available	Actual values and historical data	Performance evaluation including forecasting and/or benchmarking	Performance evaluation including forecasting and/or benchmarking; also including predictive management and fault detection
	Storage of (locally generated) electricity	None	On site storage of electricity (e.g., electric battery)	On site storage of energy (e.g., electric battery or thermal storage) with controller based on grid signals	On site storage of energy (e.g., electric battery or thermal storage) with controller optimising the use of locally generated electricity	On site storage of energy (e.g., electric battery or thermal storage) with controller optimising the use of locally generated electricity and possibility to feed back into the grid
	Optimizing self-consumption of locally generated electricity	None	Scheduling electricity consumption (plug loads, white goods, etc.)	Automated management of local electricity consumption based on current renewable energy availability	Automated management of local electricity consumption based on current and predicted energy needs and renewable energy availability	-
	Control of combined heat and power plant (CHP)	CHP control based on scheduled runtime management and/or current heat energy demand	CHP runtime control influenced by the fluctuating availability of RES; overproduction will be fed into the grid	CHP runtime control influenced by the fluctuating availability of RES and grid signals; dynamic charging and runtime control to optimise self-consumption of renewables	-	-
	Support of (micro)grid operation modes	None	Automated management of (building level) electricity consumption based on grid signals	Automated management of (building level) electricity consumption and electricity supply to neighbouring buildings (microgrid) or grid	Automated management of (building level) electricity consumption and supply, with potential to continue limited off-grid operation (island mode)	-
	Reporting information regarding energy storage	None	Current state of charge (SOC) data available	Actual values and historical data	Performance evaluation including forecasting and/or benchmarking	Performance evaluation including forecasting and/or benchmarking; also including predictive management and fault detection
	Reporting information regarding electricity consumption	None	Reporting on current electricity consumption on building level	Real-time feedback or benchmarking on building level	Real time feedback or benchmarking on appliance level	Real time feedback or benchmarking on appliance level with automated personalized recommendations
	EV Charging Capacity	Not present	Ducting (or simple power plug) available	0–9% of parking spaces has recharging points	10–50% of parking spaces has recharging point	> 50% of parking spaces has recharging point

D2.1 – SRI CURRENT LANDSCAPE REPORT AND STAKEHOLDER ENGAGEMENT

Technical domain	Smart-ready service	Functionality levels				
		Level 0	Level 1	Level 2	Level 3	Level 4
Electric Vehicle Charging	EV Charging Grid balancing	Not present (uncontrolled charging)	1-way controlled charging (e.g., including desired departure time and grid signals for optimisation)	2-way controlled charging (e.g., including desired departure time and grid signals for optimisation)	-	-
	EV charging information and connectivity	No information available	Reporting information on EV charging status to occupant	Reporting information on EV charging status to occupant AND automatic identification and authorisation of the driver to the charging station (ISO 15118 compliant)	-	-
Monitoring & Control	Run time management of HVAC systems	Manual setting	Runtime setting of heating and cooling plants following a predefined time schedule	Heating and cooling plant on/off control based on building loads	Heating and cooling plant on/off control based on predictive control or grid signals	-
	Detecting faults of technical building systems and providing support to the diagnosis of these faults	No central indication of detected faults and alarms	With central indication of detected faults and alarms for at least 2 relevant TBS	With central indication of detected faults and alarms for all relevant TBS	With central indication of detected faults and alarms for all relevant TBS, including diagnosing functions	-
	Occupancy detection: connected services	None	Occupancy detection for individual functions, e.g., lighting	Centralised occupant detection which feeds in to several TBS such as lighting and heating	-	-
	Central reporting of TBS performance and energy use	None	Central or remote reporting of real time energy use per energy carrier	Central or remote reporting of real time energy use per energy carrier, combining TBS of at least 2 domains in one interface	Central or remote reporting of real time energy use per energy carrier, combining TBS of all main domains in one interface	-
	Smart Grid Integration	None - No harmonisation between grid and TBS; building is operated independently from the grid load	Demand side management possible for (some) individual TBS, but not coordinated over various domains	Coordinated demand side management of multiple TBS	-	-
	Reporting information regarding demand side management performance and operation	None	Reporting information on current DSM status, including managed energy flows	Reporting information on current historical and predicted DSM status, including managed energy flows	-	-
	Override of DSM control	No DSM control	DSM control without the possibility to override this control by the building user (occupant or facility manager)	Manual override and reactivation of DSM control by the building user	Scheduled override of DSM control (and reactivation) by the building user	Scheduled override of DSM control and reactivation with optimised control
	Single platform that allows automated control & coordination between TBS + optimisation of energy flow based on occupancy, weather and grid signals	None	Single platform that allows manual control of multiple TBS	Single platform that allows automated control & coordination between TBS	Single platform that allows automated control & coordination between TBS + optimisation of energy flow based on occupancy, weather and grid signals	-

Annex 2

Table 8. Relative importance of a domain by climate zone for residential buildings, based on the energy balance weighting (a_d).

Residential buildings	North	West	South	North-East	South-East
Heating	39.9	45.3	42.2	40.5	27.5
DHW	12.4	10.2	13.3	18.6	7.7
Cooling	0	4.1	9.2	0	19.5
Ventilation	25	23.8	12.3	25.4	14.4
Lighting	4.9	2	3.6	0.8	1.2
Electricity	17.8	14.8	19.5	14.7	29.6

Table 9. Relative importance of a domain by climate zone for non-residential buildings, based on the energy balance weighting (a_d).

Non-residential buildings	North	West	South	North-East	South-East
Heating	41.8	36.4	40.3	39	38.3
DHW	7.2	11	14.3	12.5	15.4
Cooling	12.5	16.9	15.7	11.2	9.9
Ventilation	26.2	19.1	11.7	24.4	20.1
Lighting	10.4	13.8	16	9.7	11.9
Electricity	2	2.8	2.1	3.1	4.4



PART II – STAKEHOLDER ENGAGEMENT PLAN

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Executive summary

Stakeholder engagement is a crucial success factor for SRI-ENACT project and the current Stakeholder Engagement Plan contributes to an effective engagement with key actors and target groups. The Plan specifies the objectives of stakeholder engagement in the project and describes who can be considered as a project stakeholder. Advantage is taken of two different classifications of the levels of engagement to provide practical steps on how to approach each stakeholder group. Information is provided about the engagement methods, tools, success factors, challenges, and potential solutions to address them. This Plan then specifies the project stakeholders in the SRI-ENACT pilot countries - Austria, Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania, and Spain. Their assessment identifies the most appropriate members of the national Stakeholder Liaison Groups (LG). These LG are expected to closely collaborate with the project partners.

Stakeholders' motivation to join the national LG, the appropriate tools to communicate with LG, and the relevant considerations, challenges, and potential solutions have been identified for each of the pilot countries, based on the national circumstances. Additionally, for each pilot country, the approach to establish and operate the LG smoothly and effectively has been elaborated. In most countries, advantage will be taken of other relevant initiatives, such as existing working groups related to SRI test phase and sister SRI projects.

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1. Introduction

1.1. SRI-ENACT project

The Smart Readiness Indicator (SRI) was introduced into the revised Energy Performance of Buildings Directive to provide a standardised methodology for evaluating the smart readiness of buildings. However, the realisation and uptake of SRI from EU countries induces a number of open challenges related to SRI definition and tailoring to different national contexts, lack of SRI expertise among the energy auditors, the need to address scalability and reliability issues for large-scale deployments, low engagement of relevant stakeholders, and difficulties in informed decision-making for energy smartness upgrades.

To address these challenges, the SRI-ENACT project, funded by LIFE programme of EU, provides a holistic solution to facilitate the SRI uptake in Europe, by engaging stakeholders in the co-creation of nationally tailored SRI implementations and the development of the SRI-ENACT toolkit, encompassing SRI assessment and decision support tools to promote informed decision-making for smartness upgrades. Additionally, the project delivers a package for the training and certification of the prospective SRI auditors. The project covers 8 EU countries - Austria, Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania, and Spain – and the pilot SRI implementation in these countries will support SRI uptake by identifying best practices, designing financing schemes, and delivering policy recommendations.

1.2. Stakeholder engagement plan

The SRI-ENACT project can achieve high impact only if it engages relevant representatives of the key actors and target groups in the project decision-making (co-creation), in recruiting auditors and identifying buildings (building owners/users/managers) for the pilot SRI assessment, in the dissemination of SRI concept and project results, and in project follow-up activities, such as drafting legislation, elaborating financial schemes, and maintaining auditor training. Stakeholder engagement, therefore, is the foundation for SRI-ENACT success.

In this context, the current Plan aims to contribute to effective engagement with the stakeholders who are crucial for the project success. It serves as both plan and guidance for SRI-ENACT (and potentially other SRI project) partners. It is important to note that the current Plan is elaborated in the very beginning of SRI-ENACT, before establishing the first contacts with stakeholders and before a detailed project implementation plan is available. As the engagement activities strongly depend on both the stakeholders' feedback and project planning, this stakeholder engagement plan must be viewed only as a preliminary one.

The Plan starts with a description of the need of stakeholder engagement – both in general and in SRI-ENACT (Chapter 2). Then, based mainly on literature review, it explains the term “stakeholder” and provides details about the levels of engagement, methods and tools of engagement, and relevant engagement considerations and

challenges (Chapter 3). Next, the Plan introduces the national and EU Stakeholder Liaison Groups – the most important bodies in SRI-ENACT that support numerous project activities – and provides both general and country-specific details about the development of the groups (Chapter 4). Finally, the document presents initial observations about tailoring of the general stakeholder engagement project methodology into the national contexts of the 8 pilot countries (Chapter 5).

2. Key considerations for stakeholder engagement

2.1. Purpose of stakeholder engagement

Stakeholder engagement is an intentional activity with aims linked to both stakeholders' and engager's (e.g. project's) interests. Stakeholder engagement enables dialogue between an organisation (or project) and its stakeholders (Kujala J, 2022). Moral aims of stakeholder engagement are the ones mentioned most often. The majority of authors see legitimacy, trust, and fairness as important moral aims of stakeholder engagement. Other important moral aims are responsibility and environmental and sustainability concerns (Kujala J, 2022).

Engagement can be defined as communication practices, processes, and actions that an organization (or project team) must perform to secure stakeholders' involvement and commitment, or reduce their indifference or hostility. Engagement means that the project's stakeholders are aware of the project and are prepared to have the necessary involvement in the work (Bourne L., 2016).

Stakeholder engagement provides important benefits for research and promotional actions, such as SRI-ENACT. These include (Durham E., et al, 2014):

- benefits to the teams involved in the action, such as higher impact of the action, dissemination of results, better knowledge and data, and higher potential to leave a legacy.
- benefits to stakeholders, such as improved knowledge, empowerment, trust among stakeholders, better policies, new business opportunities, and a sense of ownership of results.
- benefits to the wider society, such as more inclusive outcomes of the action and improved trust.

For example, the engagement of local stakeholders in the development of a new policy would help identify who and how is affected by the policy and who and how can influence its outcome. In that way, the engagement would make the policy more tailored to the local context and contribute to anticipating and mitigating potential problems in advance. Additionally, the stakeholder participation would substantially increase the chance to build consensus about the policy and implement it successfully.

The benefits of engagement can far outweigh the costs and risks and that is the reason why engaging diverse stakeholder communities is a key part of many projects.

2.2. Objectives for stakeholder engagement in SRI-ENACT

The SRI-ENACT project develops country-tailored SRI methodologies, a web-based SRI toolkit, and a package for training and certification of the prospective SRI auditors. To ensure high quality and large-scale application of these outputs, the project has to involve the target groups (building owners/users) and key actors (building energy auditors, SRI-related equipment suppliers, policy makers, etc.). The key actors will be involved in the co-creation of the outputs, their promotion and dissemination, as well as in ensuring sustainability of the project outputs beyond the project duration.

More specifically, the objectives of stakeholder engagement in SRI-ENACT are the following:

- Co-creation of country-tailored SRI methodology and SRI-ENACT toolkit.
- Informing and stimulating building owners/users to participate in the SRI assessment, implemented within the project. SRI-ENACT methodology will be tested in 1200 buildings across Europe, so to achieve this challenging number it is crucial to motivate the building owners, building managers, and building users to support the assessment, e.g. by providing data and information about the buildings.
- Identifying and recruiting 120 experts interested to become SRI auditors. These SRI auditors will both carry out the SRI assessments within the project and will be available for similar SRI-related assignments beyond the project, e.g. on a commercial basis.
- Carrying out promotional activities through the stakeholders, particularly they are expected to promote the:
 - Info Days and SRI pilot programmes for the assessment of 1200 buildings in their respective city/region.
 - use of SRI-ENACT methodology and toolkit and motivate all target groups and key actors to engage them both within and beyond the project; in other words, the aim is to ensure dissemination, exploitation, and replication of these outputs.
 - training of SRI auditors, both within and beyond the project.

3. Background & principles of stakeholder engagement

3.1. Who is a stakeholder?

There are numerous opinions over who or what exactly stakeholders are (Reed M., 2009, Ackermann, F., & Eden, C., 2011). In this Plan, we use a very broad definition, namely:

“A stakeholder is any individual or group affected by the project, and/or who may be interested in the project, and/or is able to influence the project’s outcomes”. Our definition is based on the one of Durham (Durham E., 2014), according to which, the stakeholders include a wide range of people of groups, namely:

- Ones affected by the project, either directly or indirectly;
- Ones with either current or potential future interest in the project; and
- Ones able to influence the project outcomes either positively or negatively.

A group of stakeholders may be defined broadly, such as “policy makers” or “market actors”, but the members of such broad groups may be quite differently affected by the project and may have different interests and influence. In that case, it is necessary to distinguish each sub-group and consider it separately.

3.2. Levels of stakeholder engagement

Engagement is the active involvement and participation of external people/parties in the project. There are different levels of engagement and in individual projects, typically different stakeholders are engaged at different levels. The most basic one, appropriate for the most passive stakeholders, is simple provision of information, while in the highest level of engagement stakeholders actively collaborate and are effectively partners with the project team (Durham E., et al, 2014).

For simplicity, four levels of engagement can be defined (Durham E., et al, 2014):

1. Inform – it typically consists of a one-way information flow, e.g. sharing information about the project;
2. Consult – stakeholders are asked for opinion or information;
3. Involve – relatively active participation in the project;
4. Collaborate – the highest level of engagement, involving simultaneously interested and influential stakeholders, co-creating the research questions.

For each level of engagement, there are benefits to the project team, benefits to stakeholders, and benefits to the wider society. An example of such benefits when stakeholders are engaged in a research project is shown in the below table. Note that the benefits specified for a lower level of engagement also apply to all higher levels, i.e. the ones for “inform” also apply to “consult”, “involve”, and “collaborate”.

Table 1: Levels of stakeholder engagement and associated benefits. Source: Durham E., 2014

Benefits of engagement	Level of engagement			
	Inform	Consult	Involve	Collaborate
Benefits to research teams	Higher profile and enhanced reputation Useful contacts for future engagement Improved dissemination of results Enhanced impact of research Increased support for the research	Improved chances of funding success Better knowledge Opportunities for learning Better quality data	More resources provided Potential to improve methods	Improved research questions Better analysis Improved potential to leave a legacy
Benefits to stakeholders	Opportunities for learning Better access to knowledge Improved decision-making Improved policies	Access to better technologies Business opportunities Sense of inclusion and involvement	Opportunities to be paid for providing data or facilities	Opportunities to influence or drive research A sense of ownership
Benefits to wider society	Better knowledge in applied policy and practice Reduced barriers between science and society	Improved trust and respect Access to opportunities	Better evidence	Shared responsibility & decision-making More relevant and inclusive research

In addition to the benefits presented above, the classification “inform”, “consult”, “involve”, and “collaborate” is useful for the identification of the most appropriate engagement tools, reviewed in the next section.

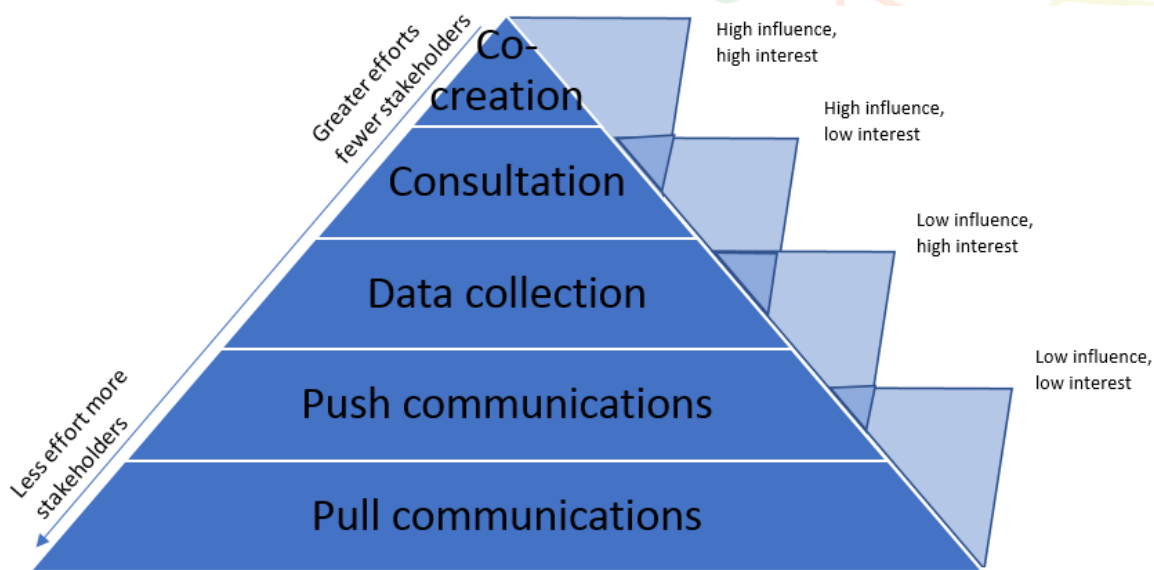
It is good to consider one more (very similar) classification of the levels of engagement, because there is a clear guidance how to define the appropriate level. That classification is based on the assumption that the level of engagement of stakeholders depends on (Mayer D., 2019):

- their interest in participating in the project;
- their influence on the project and its outcomes (if the influence is high, the engagement should deepen);
- the methods of engagement and knowledge elicitation.

According to that classification, the levels of engagement, starting from the lowest one and ending with the highest one, are the following five (Mayer D., 2019):

1. Pull communications – one-way information is made available and stakeholders decide whether to engage with;
2. Push communications – one-way engagement, where information is broadcasted to stakeholders;
3. Data collection – the stakeholders can influence the project by provision of data or information;
4. Consultation – participation in consultations, workshops, and review of outcomes;
5. Co-creation – co-create research questions, serious involvement in the project.

These five levels and the corresponding stakeholder groups characterized by their influence and interest are shown



in the below figure:

Figure 4: Relationship influence/interest/effort at different levels of engagement. Source: Mayer D., 2019

The highest level of co-creation, as a form of high-quality collaborative relationship, means working together to diagnose the challenge, produce knowledge, develop capabilities, and design and implement solutions. Interaction and solution development simultaneously build positive relationships and effective strategies (Kujala J., 2022).

3.3. Methods and tools for stakeholder engagement

There is a wide variety of methods to engage the project stakeholders. Their selection depends on the purpose and desired/appropriate level of engagement, i.e. on whether we want to inform, consult, involve, or coordinate. Additionally, at different project stages, different methods may be the most appropriate ones to approach the same stakeholder group. Finally, the methods must consider the needs, capacity, and expectations of stakeholders (Durham E., 2014)

Each method has advantages and disadvantages and one needs to be aware of them, in order to select the best mix of methods for the purpose. Often projects harness a combination of many methods and tools to engage appropriately with stakeholders.

The methods can be informative (one-way) or participatory (two-way). Informative methods need to consider the needs of stakeholders and normally they are co-defined or co-designed with the stakeholders. The participatory methods include (Durham E., 2014):

- Opening out methods for opening up dialogue and collecting information. These are useful during the initial project phases, where the project is adapted to better fit to the needs of stakeholders. The methods include:
 - **Brainstorming.** It is used to rapidly identify initial ideas from a group. Participants are encouraged to share any ideas, even if they do not appear relevant.
 - **Metaplan.** Participants are given note papers (typically 2 – 5 each) and asked to write their ideas - one per piece of paper. Then participants place the note papers on a wall, grouping similar ideas together. The facilitator summarizes each group and possibly allows participants to further elaborate their views.
 - **Venn diagrams.** It helps participants identify key issues and overlaps between them.
 - **List ideas or information.** Participants, e.g. in group work or via social media, are asked to list ideas or information on a specific topic
 - **Carousel.** Participants are divided in groups and each group contributes to one of the topics, before being rotated to the next. Participants read the ideas of the previous groups before adding new points.
- Exploring methods – they enable participants to explore and evaluate project findings. They include:
 - **Categorisation.** Participants are asked to group ideas into themes.
 - **Mind-mapping.** It is used to quickly capture and link ideas with stakeholders.
 - **Problem tree analysis.** It is similar to mind-mapping, but simpler and with more limited use. It is applicable when the purpose is to keep the process simple and quick.
 - **SWOT analysis.** Participants are asked to specify the strengths, weaknesses, opportunities, and threats related to the research question.

- **Timelines.** They are used to help discuss historical or future events with a strong temporal dimension. Participants may be asked to write comments at different points.
- Closing down and deciding methods, such as
 - **Voting.** It is a quick and democratic method, but the participants are unable to explain their preferences and there is a risk of biased results, unless anonymity is ensured.
 - **Ranking.** It is used to get ideas in rank order. Although reaching a consensus might be challenging, the discussions might be fruitful.
 - **Prioritisation.** It differs from ranking, because here participants can express the strength of their feeling about options.
 - **Multi-criteria evaluation.** It is used to decide on an issue involving multiple dimensions or criteria.

The methods can be implemented via a number of tools, such as:

- Public events
- Workshops
- Training courses
- Focus group meetings
- One-to-one meetings
- Interviews
- Questionnaires and surveys
- Telephone/video calls
- E-mails
- Articles, press releases, newsletters
- TV and radio
- Websites (including blogs)
- Social media (including online forums)
- Printed materials – posters, brochures, leaflets

- Practical demonstrations
- Steering group
- Online tools designed to support the implementation of specific participatory method(s)

Different methods and tools are appropriate for different levels of engagement. An example of the appropriateness of selected popular tools is shown in the below table.

Table 2: Examples of tools and associated levels of engagement. Source: Durham E., 2014

	Inform	Consult	Involve	Collaborate
Website	**	**	*	*
Social media	**	**	*	*
Multi-stakeholder forums		*	**	*
One-to-one meetings and interviews		*	**	*
Workshops		*	**	**
Questionnaires / surveys		**	*	*
Steering group				**

** most appropriate level of engagement for a particular tool; * relevant level of engagement

3.4. Stakeholder engagement considerations and challenges

Successful stakeholder engagement requires careful design and implementation. It needs to be credible, relevant, and legitimate, in order to give it more validity and make it impactful (Durham E., 2014):

- **Credibility** is the perceived quality and validity of the engagement process and the people involved with the engagement. High credibility requires clear stakeholder engagement objectives, use of appropriate people and methods/tools, and transparency.
- **Relevance** is the usefulness of the engagement process and its outcomes – to what extent it addresses the needs of the project and the stakeholders and to what extent it is responsive to changing needs. High relevance is achieved through attracting the right stakeholders, using understandable language, ensuring appropriate outcomes of the engagement, and others.
- **Legitimacy** - the perceived fairness and balance of the engagement process, is important in cases where conflict may occur. High legitimacy can be reached by: a clear, appropriate, and agreed engagement process; use of appropriate methods and tools; stakeholders’ feeling that their interests are well considered; and

inclusion of a balanced group of stakeholders with minimal internal conflicts among them, and employing unbiased facilitators to run engagement activities.

Ensuring credibility, relevance, and legitimacy takes time, effort, and resources. Unfortunately, it is not always possible to ensure that all three are reached at the same time. However, there are several general recommendations, shared by many (e.g. Mayer D., 2019, Durham E., 2014):

- start the engagement early, so that the process is more credible and relevant; Additionally, as highlighted by Shrama R. (2008), nobody wants to be surprised by change, due to fear, suspicion, and ego reasons.
- attract the right mix of participants, without excluding any group, to make the engagement more legitimate and credible.
- communicate regularly to ensure awareness of the project, the benefits of the project, and the personal benefits for the stakeholders involved.

To achieve effective engagement, the **core values** of the stakeholder participation need to be considered (Jeffery N., 2009):

1. Stakeholders should have a say in decisions that could affect them
2. A promise needs to be made that the stakeholder's contribution will influence the decision. In addition to the formal promise, the engager shall "listen with both ears open" be open to receive and incorporate input as people can spot an insincere approach and may not believe that their opinion is considered (Sharma R., 2008). It is therefore fundamental to carry out stakeholder engagement with good intent, i.e. with willingness and capacity to receive and respond to stakeholder feedback (Sinclair M., 2011)
3. Sustainable decisions can be reached by recognising and communicating the needs and interests of all participants, including decision-makers.
4. The involvement of those potentially affected by or interested in a decision need to be ensured.
5. Input from participants in designing how they participate is necessary.
6. Participants need to be provided with the information they need to participate in a meaningful way.
7. Communication with participants about how their input affected the decision (i.e. feedback) is necessary. Similarly, documenting the stakeholders' inputs and consultation outcomes/decisions may greatly enhance transparency.

When planning stakeholder engagement, project teams need to be aware of potential challenges and timely address them. Some of the main challenges and possible ways to mitigate them are summarized below:

- Stakeholders may have **unrealistic expectations** of their impact on the project, or the project's impact on particular outcomes. When such unrealistic expectations are not met, stakeholders may disengage. It is therefore, necessary, to clearly explain to stakeholders both their role in the project and the project's capability and risks to achieve impact (Mayer D., 2019).
- **Consultation fatigue:** stakeholders easily tire of engagement processes, especially if they are time consuming and with no immediate results (Mayer D., 2019). This problem can be mitigated by: clearly informing stakeholders about the project and their commitments in it and ensuring clear benefits for them from the engagement process.
- **Biased representation** of stakeholders, or missing stakeholder group may question the legitimacy of the outcomes. For example, sometimes traditional leaders, or other wealthier and politically connected individuals participate, but they do not actually represent the needs of their group (Pade-Khene C., et al, 2013). To avoid it, a detailed stakeholder analysis needs to be conducted in advance and ensure the representation of all who have influence or interest, even marginalised groups (Durham E., 2014).
- **Power imbalances** within stakeholder engagement activities may result in dominance of particular individuals, while others feel marginalised. Stakeholders have different capacities to participate, e.g. historically disadvantaged individuals, who had previously been excluded from decision making, are frequently further disempowered by the types of used participatory approaches (Pade-Khene C., et al, 2013). Here a professional facilitator could be of help. One could consider parallel activities for groups in conflict or with differences in power, as well as the use of facilitation methods that ensure that all voices are heard, possibly anonymously (Durham E., 2014).
- **Short term engagement**, only during the project duration, may prevent the expected long-term impact. It is, therefore, necessary to involve organisations with a long-term presence in the project topic, plan the project legacy with them, and give them sufficient ownership of results (Durham E., 2014).

4. Development of the Stakeholder Liaison Groups

4.1. Introducing the concept of Stakeholder Liaison Groups

One of the main objectives of SRI-ENACT project is to introduce or evolve (depending on the context) SRI in Austria, Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania and Spain, by engaging stakeholders in the co-creation of

country-tailored implementations. The involvement of stakeholders in the project will take place mainly via the so-called “Stakeholder Liaison Groups”. In each of the eight countries, one Stakeholder Liaison Group will be established and coordinated by the respective project partner – BPE (Austria), BSERC (Bulgaria), REGEA (Croatia), SEVEn (Czech Republic), NTUA (Greece), RPR (Latvia), ISPE (Romania), and Veolia (Spain).

Each **national Stakeholder Liaison Group** (LG) will consist of at least 10 persons, representing the key target groups (building owners/users) and key actors (building energy auditors, SRI-related equipment suppliers, policy makers, etc.). Each group will closely collaborate with the respective SRI-ENACT partner and support (through advice, contacts, dissemination, etc.) the country-related implementation of the project. Each LG will meet regularly, minimum three times over the course of the project.

The national LGs have an important role in SRI-ENACT. They will support the project partners in the following:

- 1) To co-design the national SRI methodology that would be later applied in pilot assessments of buildings.
- 2) To attract building owners, building managers, and building users, willing to participate in the SRI assessment, implemented within the project. SRI is planned to be tested in over 100 buildings in each country, so a large number of building owners, managers, and users need to be motivated. It is expected that representatives of these stakeholders will be part of the LG, so they may have a direct link to buildings. Additionally, key actors such as energy auditors, may have good connections with owners of audited buildings.
- 3) To identify and recruit experts interested to become SRI auditors. After passing a training course, the SRI auditors will carry out the project SRI assessments and will be available to provide SRI assessments on a commercial basis. Each LG will agree on the national eligibility criteria for becoming an SRI auditor and promote this business opportunity nationally.
- 4) To promote Info Days and SRI pilot programmes within SRI-ENACT, using their communication channels.
- 5) To promote the SRI-ENACT methodology and toolkit, as well as SRI training opportunities. These activities will not end with the project, but continue at least for 5 years after its end - Memorandums of Cooperation with LG members might be signed to officially confirm their commitment. In that way, the LG could ensure sustainability of the project results.

In addition to the national LGs, an **EU Stakeholder LG** will be established by EHP SRI-ENACT partner. It will consist of at least 20 members, representing mainly bodies at EU level, for example members of the SRI platform, associations of building owners/managers/users, associations of smart building technology suppliers, energy service provider associations, associations of local and regional authorities, LIFE’s SRI project cluster members, etc. Members may also be relevant organisations from countries outside the project pilot ones. The EU LG may carry out the following activities:

- Provide feedback on the project outputs, based on recent information about new SRI-related policy developments at EU level, technology developments and technology statistics.
- Promote SRI and SRI-ENACT outputs at EU level, particularly concerning common EU policy and financing for SRI.
- Promote SRI and SRI-ENACT outputs in non-project countries.

Given that the EU LG activities are closely related to SRI-ENACT outputs, it is planned to establish the group and define its specific role later, once the key project outputs are produced.

4.2. Identification of SRI-ENACT project stakeholders at national level

The SRI-ENACT stakeholders are all key actors and target groups related to the project. Their identification and assessment would clarify the context, in which the project operates, and would enable the project team to develop a strategy for approaching each stakeholder.

SRI-ENACT stakeholders are generally the stakeholders related to SRI topic. They include all stakeholders who take part in the EU's SRI Platform (Verheyen J., 2021), but are not limited to them, due to the large variety of the project activities. Here is an indicative list of **SRI-ENACT stakeholders**:

- Policy makers – ministries, agencies, and others in charge of energy and buildings, especially ones defining and implementing EPBD-related policies. In countries that have undertaken SRI testing, policy makers may be currently engaged with SRI, while in other countries they may potentially have a role in future SRI implementation
- Universities and other research bodies, training centres, or individual researchers engaged with SRI-related topics
- Energy auditors, energy auditor associations, and other individuals and organisations potentially interested in becoming SRI auditors
- Building owners, including both private and public ones (e.g. local and regional authorities) and their associations
- Building users and their associations
- Facility managers and their associations
- Real estate investors and their associations
- Service providers, Energy Service Companies (ESCOs), and their associations

- Utilities, Network operators, and their associations
- Manufacturers of technical building systems and their associations
- Design and Engineering companies
- Insurance companies
- National and EC programs and funds on renewables, energy efficiency, and innovation
- NGOs in the area of energy and environment
- Standardisation bodies
- National partners in other projects dedicated to SRI, especially the projects in the SRI cluster of LIFE-funded projects. In addition to SRI-ENACT, the projects in SRI cluster are SmartSquare, easySRI, and SRI2MARKET.

The above stakeholder list serves only as a checklist for the identification of concrete stakeholders in SRI-ENACT pilot countries, because the profile and role of organisations and individuals may vary substantially from country to country. Using this checklist, initial lists of concrete SRI-ENACT stakeholders (specific organisations and individuals) have been developed for Austria, Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania, and Spain.

4.3. Stakeholder mapping

The SRI-ENACT stakeholders initially identified in the eight SRI-ENACT pilot countries are mapped in the below figure. The classification of stakeholders into groups is conditional, since some people and organizations may belong to more than one group, e.g. a regional authority may be both a building owner and policy maker, while an expert may be both a researcher and energy auditor.



Figure 5: Initial mapping of SRI-ENACT Stakeholders in Austria, Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania, and Spain.

- it is not suitable for identifying relations, interactions, and influences between stakeholders, as it focuses on the individual stakeholders;
- the content of the interest is not visible and may be lost;
- the interest of a stakeholder may relate to different parts of the life-cycle;
- the approach may be refined, if the matrix is expanded to a “cube” by adding a third dimension: attitude; the assessment of this third dimension, however, is often problematic, so it is rarely considered.

The stakeholders in the eight SRI-ENACT pilot countries are assessed and allocated to the quadrants of the interest-influence/power matrix. This exercise helps select the appropriate approach for each particular stakeholder and the members of the national LGs. Typically, the “Key Players” (see Figure 6) are the most appropriate LG members, followed by “Keep informed” and “Meet their needs” groups, while the “Low Priority” is the least appropriate. However, additional factors need to be considered, such as the precise level of interest/ influence/power, the balanced representation of stakeholders in the Group, and the influence/power of a stakeholder on others.

The matrices for Austria, Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania, and Spain, where the potential Liaison Group members are highlighted in bold, are below.

Influence/power (high)	<ol style="list-style-type: none"> 1. Federal Ministry of Transport, Innovation and Technology (BMVIT) 2. Technology platform Smart Grids Austria 3. Austrian Innovation Agency (FFG) 4. ÖGNI - Austrian Sustainable Building Council 5. Austrian Green Roof and Living Wall Association (VfB) 6. Regional Energy Agencies 7. Municipalities 	<ol style="list-style-type: none"> 1. AEE INTEC – Institute for Sustainable Technologies 2. Joanneum Institute 3. Austrian Energy Agency 4. Climate and Energy Fund 5. ÖGUT - Austrian Society for Environment and Technology 6. 17&4 Organizationsberatung GmbH – SRI consultants 7. BOKU - University of Natural Resources and Applied Life Sciences 8. SERA GLOBAL GmbH 9. AUSTRIAN STANDARDS INTERNATIONAL - STANDARDISIERUNG UND INNOVATION 	
	(low)	<ol style="list-style-type: none"> 1. Chamber of Architects 2. Association of Real Estate Companies 3. NGOs on EE 4. NGOs on Ecology 5. Insurance company 6. Coworking spaces 	<ol style="list-style-type: none"> 1. Energy Community Secretariat – EU Agency 2. OurPower Coop – Association of Energy Communities 3. University of Applied Sciences Technikum Wien 4. Municipal energy utilities (e.g. EnergieSteiermark or Kelag) 5. Financing institutions 6. ESCO companies 7. Smartbuilding facility managers (e.g. Green Point 42)
	(low)	Interest	(high)

Figure 7: SRI-ENACT stakeholders in Austria in interest-influence matrix (in **bold** are potential Liaison group members)

Influence/power (high)	<ol style="list-style-type: none"> 1. Ministry of Energy 2. Association of District Heating Companies 3. Municipal Network for Energy Efficiency 4. National Association of Municipalities 5. Senior University researcher in building sector 6. Ministry of Environment and Water Resources 	<ol style="list-style-type: none"> 1. Ministry of Regional Development 2. Agency for Sustainable Energy Development 3. EnEffect 	
	Influence/power (low)	<ol style="list-style-type: none"> 1. Chamber of Architects 2. Association of Real Estate Companies 3. NGO on EE 4. NGO on Ecology 5. Insurance company 	<ol style="list-style-type: none"> 1. National Fund for Energy Efficiency and RES 2. Chamber of Engineers 3. Association of Energy Auditing Companies 4. Association of Companies on Automation 5. Facility Management Association/Companies 6. Financial Institutions on EE and RES 7. Large suppliers of building management systems 8. Companies on Sustainable Development Certification of Buildings
	(low)	Interest	(high)

Figure 8: SRI-ENACT stakeholders in Bulgaria in interest-influence matrix (in **bold** are potential Liaison group members)

Influence/power (high)	<ol style="list-style-type: none"> 1. Regional public authorities – 4 2. Cities and municipalities – at least 4 3. Facility managers or associations 	<ol style="list-style-type: none"> 1. Ministry of Economy and Sustainable Development 2. Ministry of Physical Planning, Construction and State Assets 3. Energy Institute Hrvoje Požar 4. Croatian Chamber of Economy 5. Design companies – at least 1 6. Engineering companies (IT) – at least 1 	
	Influence/power (low)	<ol style="list-style-type: none"> 1. An insurance company 	<ol style="list-style-type: none"> 1. Universities - 2 2. Croatia Green Building Council
	(low)	Interest	(high)

Figure 9: SRI-ENACT stakeholders in Croatia in interest-influence matrix (in **bold** are potential Liaison group members)

Influence/power (low)	<ol style="list-style-type: none"> 1. Association of energy specialists 2. Czech chamber of licensed engineers 3. International Facility Management Association in the Czech Republic (IFMA.CZ) 4. Association of energy auditors 5. Buildings 21 	<ol style="list-style-type: none"> 1. Ministry of Industry and Trade 2. Czech Technical University
	<ol style="list-style-type: none"> 1. Czech Union of Civil Engineers 2. Passive House Centre 	<ol style="list-style-type: none"> 1. Czech Green Building Council 2. State Environment Fund

<ul style="list-style-type: none"> 3. Construction Industry 4.0 4. Union of construction Entrepreneurs (SPS) 5. Brno University of Technology (VUT Brno), Faculty of Civil Engineering 6. Technical University of Ostrava (VSB Ostrava), Faculty of Civil Engineering 	<ul style="list-style-type: none"> 3. Architecture and Building Foundation (ABF) 4. University Centre for Energy Efficient Buildings, Czech Technical University, Prague 5. Ministry of Environment
(low)	(high)

Interest

Figure 10: SRI-ENACT stakeholders in Czech Republic in interest-influence matrix (in **bold** are potential Liaison group members)

Influence (high) (low)	<ul style="list-style-type: none"> 1. Construction company 1 2. Construction company 2 3. Insurance Company 4. EVchain (EC Programme) 5. Institute of Energy for South-East Europe (IENE) 6. KEDE – Central Union of Municipalities of Greece 	<ul style="list-style-type: none"> 1. Ministry of Environment and Energy (2 policy makers) 2. Technical Chamber of Greece 3. CRES (CENTRE FOR RENEWABLE ENERGY SOURCES AND SAVING) 4. SRI2MARKET 5. EasySRI-CERTH (EC Programme)
	<ul style="list-style-type: none"> 1. Real Estate Agencies (4) 2. Insurance company 	<ul style="list-style-type: none"> 1. ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers - Hellenic Chapter) 2. EIPAK (Hellenic Passive House Institute) 3. Energy auditor 4. INZEB (Initialising Energy Balance Towards Zero) (NGO) 5. SUSTAINABLE CITY: Cities Network for Sustainable Development and Circular Economy (Incl. 30 Municipalities in Greece) 6. Zenith (Utility) 7. PPC (Utility) 8. HEDNO (Hellenic Electricity Distribution Network Operator) 9. Ianic (IoT/Software Development company) 10. EKPOIZO (NGO) 11. Consulting Company 1 12 Consulting Company 2
	(low)	(high)

Interest

Figure 11: SRI-ENACT stakeholders in Greece in interest-influence matrix (in **bold** are potential Liaison group members)

Influence (low)	<ul style="list-style-type: none"> 1. financial organizations (such as state-owned development finance institution “Altum”) 2. Association of facility managers of Riga 	<ul style="list-style-type: none"> 1. the Ministry of Economics of Latvia 2. the Ministry of Climate and Energy of Latvia 3. State Construction Control Bureau (SCCB) of Latvia
	<ul style="list-style-type: none"> 1. Riga Energy Agency 2. Local municipalities in the Riga planning region (of which two were considered for the Liaison Group) 3. Municipal energy utilities 	<ul style="list-style-type: none"> 1. Riga Technical University 2. Association of energy auditors of Latvia 3. Competence assessment centre for independent energy auditors

	<p>5. Cities and municipalities, their associations, municipal networks on energy efficiency</p> <ul style="list-style-type: none"> - City Council of Valladolid (Sustainable energy action plan) - Valladolid Municipal Energy Agency (AEMVA) 	
<p>1. Buildings’ users (or their associations)</p> <p>2. Private organizations</p>	<p>1. Universities and other research bodies, training centres, or researchers engaged with SRI</p> <ul style="list-style-type: none"> - University of Valladolid - Research projects on energy efficiency and the application of renewable energies in building operations <p>2. Building owners (or their associations)</p>	
(low)	<p>Interest</p>	(high)

Figure 14: SRI-ENACT stakeholders in Spain in interest-influence matrix (in **bold** are potential Liaison group members)

The stakeholder identification and assessment for the establishment of the LG at EU level will be carried out at a later stage of the project, when the particular role of that LG is defined.

4.5. Stakeholder Engagement Strategy

For each stakeholder group, it is necessary to identify:

- 1) How to motivate them to join the Liaison Group or to support SRI-ENACT in other ways, i.e. what is the value proposition? The relationship between the project and a stakeholder is a balanced exchange of value and interests (Silvius G., Schipper R., 2019), so the motivation needs to consider the values and interests of each stakeholder (group) individually.
- 2) What are the most appropriate tools to approach them? The selection of tools depends on many factors. For example, as illustrated in Table 2, for each level of engagement, some tools are more appropriate than others. Additionally, there are several other factors that need to be considered, such as the type of stakeholders, number of stakeholders, and purpose/method of engagement.
- 3) What are the possible challenges and considerations related to their participation in the Liaison Group. This information is shown in a concise form in the below table.

Table 3: Motivation, tools, and considerations for main stakeholder groups in SRI-ENACT

Stakeholder group	Motivation/Value proposition to join a Liaison Group	Appropriate tools to approach stakeholders (source Durham E., 2014)	Challenges/ Considerations
<p>Policy Makers / Government Authorities</p> <p>⇒ Ministries and agencies in charge of energy efficiency, environment, and buildings</p>	<p>National contribution for effective EPBD implementation. Holistic simplified approach to improve the energy efficiency in Building sector.</p>	<ul style="list-style-type: none"> • steering group meetings • workshops • one-to-one meetings • newsletters <p>Additional tools*:</p>	<p><u>Challenge</u>: engagement for project duration only, or even shorter, may prevent the expected long-term impact. <u>Solution</u>: ask to sign an official Letter of commitment in the</p>

Stakeholder group	Motivation/Value proposition to join a Liaison Group	Appropriate tools to approach stakeholders (source Durham E., 2014)	Challenges/ Considerations
⇒ National and EC programs and funds on renewables, energy efficiency, and innovation	Improves environmental protection through energy/emission control in buildings.	<ul style="list-style-type: none"> e-mails 	beginning and promote ownership of results
Public Authorities ⇒ Municipalities ⇒ Municipal Networks on Energy Efficiency, Renewable energy, Ecology, and Sustainable Urban Development	Demonstrate the benefit of SRI application in pilot projects for public and residential buildings. Fast track to upgrade the local building stock's database and improved monitoring on energy efficiency measures feedback. SRI certification process creates new local business opportunities. Increases the awareness of buildings' users on energy efficiency and dwellings' quality/value.	<ul style="list-style-type: none"> steering group meetings workshops one-to-one meetings newsletters Additional tools*: <ul style="list-style-type: none"> e-mails public events interviews printed materials practical demonstrations 	<u>Challenge</u> : irregular presence or changes of the stakeholder representative. <u>Solution</u> : the stakeholder should appoint officially the responsible person and his commitment to the entire project timeframe; the stakeholders should be properly informed about the project goals ensuring clear benefits for them from the engagement process.
Private organizations ⇒ Companies, Agencies, and Professional Associations of Energy Auditors, Facility Management, and Engineering of Building /Energy Management Systems ⇒ NGOs ⇒ Consulting Companies ⇒ Professional Associations of Engineers and Architects Universities and Training Centres ⇒ ESCO Companies ⇒ Real Estate Companies and Associations ⇒ Business oriented Investment Banks ⇒ Insurance Companies ⇒ Associations of Home Managers/Owners ⇒ Utilities/Network operators ⇒ Mass Media	New knowledge, skills and tools for new business opportunities. Potential for cost-effective upgrade of existing building energy systems. The SRI certificate ensures higher properties' value and attractiveness for building users and tenants. The SRI certification procedure is transparent, comprehensible, and easy to apply.	<ul style="list-style-type: none"> workshops questionnaires/surveys newsletters Additional tools*: <ul style="list-style-type: none"> e-mails public events training courses interviews telephone calls social media printed materials practical demonstrations 	The SRI certification procedure cannot replace the adopted national methodologies and tools for buildings energy auditing. However, it is a necessary addition for reliable and complete energy efficiency analysis and monitoring of the applied measures' effectiveness. Provision of Letter of Project commitment is recommended to ensure the official engagement of stakeholders. It is necessary to clearly indicate to them both their role in the project and the project's capability and risks to achieve impact.
Individuals ⇒ Energy Auditors	New knowledge, skills and tools for new business opportunities.	<ul style="list-style-type: none"> workshops questionnaires/surveys newsletters 	It is recommended that an appropriate Letter of Project commitment is

Stakeholder group	Motivation/Value proposition to join a Liaison Group	Appropriate tools to approach stakeholders (source Durham E., 2014)	Challenges/ Considerations
<ul style="list-style-type: none"> ⇒ Energy Engineers ⇒ Automation Engineers ⇒ Consultants on Sustainability Development ⇒ Investors ⇒ Bank Specialists ⇒ Facility Managers ⇒ Building Managers ⇒ Building Users ⇒ Lecturers and Students 	<p>The SRI certification procedure is transparent, comprehensible, and easy to apply.</p> <p>The SRI certificate ensures higher properties' value and attractiveness for building users and tenants.</p>	<ul style="list-style-type: none"> • website <p>Additional tools*:</p> <ul style="list-style-type: none"> • e-mails • public events • training courses • interviews • telephone calls • social media • printed materials • practical demonstrations 	<p>signed by all individuals upon their business/social position.</p>

* The additional tools are authors' suggestions, as no relevant literature for these tools has been identified.

The motivation of each stakeholder's group needs to be addressed throughout the engagement process. To sustain the motivation and in general to increase the effectiveness of the two-way interaction, it is useful to (Bourne L., 2016):

- personalize the messages, considering what is known about stakeholders, such as their stake or interest, culture, personality, and gender;
- monitor and measure the effectiveness of the communication.

4.6. Liaison Groups setup

The previous sections reviewed the relevant SRI-ENACT stakeholders, assessed which are appropriate national Liaison Group (LG) members, and proposed a strategy to engage them. The personalised approach to each stakeholder makes these steps work-intensive, but this effort is justified, because the successful implementation of these steps establishes a good foundation for the smooth LG operation during and beyond the project.

The stakeholders could be invited to join a LG through bilateral communication (one-to-one meeting or a telephone call) and an official invitation, e.g. sent by e-mail. When invited, they will be informed about the project, the role and specific activities of the LG, and will be asked to sign commitment to participate. To maximise the chances to have the desired stakeholders on board, the communication will be tailored to the expected motivation of the person or organisation (e.g. see Table 3). It may help mentioning that the LG may act as a country supervisor and important decision-making body in the project, with potential impact on the national SRI implementation. For organisations that provided Letters of Support to SRI-ENACT, it is recommended to contact the same person who signed the letter.

Collaboration with other ongoing initiatives will be sought. If an appropriate working group is already in place in the country (e.g. in relation to ongoing SRI testing of the country), or such is planned (e.g. within a sister project in SRI project cluster), a common group may be established.

As a bare minimum, the LG members need to meet 3 times during the project, but perhaps more meetings and other communication tools will be necessary. Each meeting (physical or online) will start with an introduction of SRI-ENACT project and its progress, as well as a reminder about the role and responsibilities of the LG. This introduction would be especially helpful to new members.

The project partners will put effort to build friendly and trusted relationships within the group. To encourage free sharing of ideas, there will be no audio/video recording of the LG meetings and the minutes of the meetings will be anonymised.

5. Tailoring of Stakeholder Engagement Methodology to national contexts & Sustainability

5.1. Establishment of Liaison Groups in national contexts

5.1.1. Austria

In 2018-2019 Federal Ministry for Innovation and Transport in Austria (BMVIT) has tendered a research service as part of the "City of the Future" program, where the consortium led by AEE INTEC, with Technology Platform Smart Grid Austria, 17&4 Organisationsberatung and FH Technikum Wien has developed a proposal as to what such a "Smart Readiness Indicator" (SRI) for Austria could look like. As part of this work, partners organised workshops, interviews and engagement of different stakeholders in Austria. The interest in the topic was generally high at the time as in Austria the energy efficiency of buildings due to various programmes and initiatives, such as the house of the future or activities of the IG Passivhaus etc. were very important, the feedback on the SRI for the energy certificate was also very positive. However, SRI development since then has been fragmented and one challenge is invigorating this interest. In order to ensure consistency, a part of the Liaison Group will be selected from representatives of this past project, enriched with the institutes and associations (societies) that have in more recent years been very active in SRI related areas, as well as funding bodies and companies.

Another challenge is that while there is high interest in self-consumption, and grid-related purposes are foreseen, not one evaluation of short-term variable "intelligence technologies" has been given proof of their actual benefit. Therefore, BLUEPRINT will motivate bodies such as FFG or Energy Agency, with knowledge sharing with proof of benefit from two Horizon projects performed – one related to the flexibility of buildings and one with the flexibility provided to the grids, as well as other recent relevant projects.

Finally, as Austrian companies and associations tend to be very formal and slow in terms of bureaucracy, difficulties with provision or delay of official commitment documents may be expected. However, these would be mitigated by participation from the start of high positioned decision-makers to ensure more active cooperation, particularly important for government/public institutions.

Newsletters, meetings, and targeted workshops with a structured schedule would be operated from the beginning of the activity.

5.1.2. Bulgaria

The introduction of SRI in Bulgaria is most likely through the incorporation of SRI obligatory within the established building sector energy certification legislation and code of practice. Therefore, a “Top-Down” strategy for future SRI implementation will be adopted in SRI-ENACT and the same approach is applied in the Bulgarian Liaison Group (BG-LG). Basically, the approach follows the established good business relations with different bodies and experts in order to ensure that BG-LG consists of all necessary and creative key players as indicated below:

Energy efficiency policy and regulation makers, also well-recognized influencers



Financial/funding institutions and programs focused on EE and RES



Associations of engineers, energy auditing companies, Universities



Automation engineering and Facility management companies

The Liaison group participants’ motivation, specified in Table 3, is expected to be valid, but following the first meetings’ outcomes, the motivation will be clarified and the Group composition may be altered.

It is planned to carry out a series of individual meetings, focused on the specific interest and capacity of each potential representative. Discussions will cover project benefits, difficulties, and problems, and how the potential member could contribute to the achievement of the commonly agreed goals. A signed commitment would be considered as a necessary step for public institutions and professional associations. For businesses it would be decided case by case.

Potential challenges related to the BG-LG establishment:

- Difficulties with provision or delay of official commitment documents
- Non-presence in scheduled Liaison group meetings
- Key Group member(s) insufficient capacity or scope of engagement vs planned ones

Possible actions to overcome the challenges:

- Initial meetings with high positioned decision makers to ensure more active cooperation, particularly important for government/public institutions

- Assistance by Group member(s) for common action to solve any particular problem
- Invite/involve other convenient player(s) on a temporary or regular basis.

5.1.3. Croatia

The establishment of the LG in Croatia (and selection of members) is heavily influenced by the (positive) current situation regarding SRI scheme where the Ministry of spatial planning, construction and state assets (MGIPU), as the main national policy maker, opted out for joining the testing phase of SRI. Thus, the North-West Croatia Regional Energy-Climate Agency (REGEA) already initiated the cooperation with the Energy Institute Hrvoje Požar (EIHP), a support partner to MGIPU in testing phase and a partner of SRI2MARKET project.

As the process of adoption of the SRI scheme is on the right track by entering the testing phase, throughout the LG, REGEA, and EIHP as co-chairs of the Group, will perform all organisational and implementation activities, ensuring visibility and usefulness of project results (and developed methodology). Following the ambitions of SRI-ENACT project, the main goal of the LG is to test and reflect on SRI methodology with the aim of setting out a clear structure for implementation of “SRI auditing” in Croatian legal framework. This will allow MGIPU to dedicate various financial schemes for the uptake of SRI scheme in Croatian building stock as most of the activities.

By setting out this goal, REGEA plan to define LG members. Initial activities include the organization of an official meeting with MGIPU to set up a pathway for signing a Letter of Commitment (LoC). This LoC ensures forming a Working group for SRI (the official name for the LG) to position ourselves as a valuable decision-maker in adaptation of SRI scheme.

In order to secure involvement of relevant members of Industry and Business sector, the LG will include the Croatian Chamber of Economy as the central point of communication, enabling a great reach to all project activities, but mostly for a large pool of their members from technical and financial sector. It is expected that they will act as an additional channel/hub for increasing the impact of organized activities (WP 3 - WP6). Furthermore, REGEA will carry out SRI scheme integration in public buildings and therefore include various representatives of local/regional public authorities, while EIHP will facilitate SRI scheme in the private/business sector. All members of the LG will sign the LoC, adjusted to their needs and accepted obligations.

As the level of impact and collaboration in the future LG has high goals, the main challenge related to the Group establishment will be to involve all relevant stakeholders who can contribute to the process of SRI scheme implementation in Croatian legal framework. This will require a reasonable amount of time for preparation activities, especially since the first step is a direct contact to the relevant Ministry (MGIPU), but also with the Chamber of Economy. However, this challenge will be jointly mitigated by REGEA and EIHP by performing a deep stakeholder analysis and setting out clear organizational structure.

5.1.4. Czech Republic

Czech Republic was one of the European countries where SRI test phase took place. Thus, the Liaison Group will be established on the foundations of SRI test phase team. The Czech SRI test phase team is consisted of Ministry of Industry and Trade representatives and Czech Technical University, Faculty of Civil Engineering, Department of Indoor Environmental and Building Services Engineering led by prof. Karel Kabele. As preliminary discussed, the Liaison Group establishment and any other communication will take place in mutual coordination. Also, Czech Green Building Council, the industry association, tackled SRI in their materials and will be a crucial member of the initial Liaison Group foundation process and further communication.

The Liaison group will have several important tasks to fulfill. The tasks grouped in similar areas are:

- new SRI auditors identification
- training, education
- pilot assessments
- communication with important stakeholders
- sustainability of SRI-ENACT and general SRI key activities in the Czech Republic.

These core activities determine the stakeholders of the Czech LG. Crucial stakeholders with knowledge, contacts, and competence are the following:

- energy experts associations
- technical universities
- energy agencies and building stock experts
- civil engineering industry representatives
- state and local authorities.

The most important expected challenges are insufficient motivation to SRI and “smart” buildings, lack of relevant experts, and lack of time and availability of experts. These challenges are shared in different stakeholder groups. The Czech team plans to overcome them by presenting the advantages of SRI, selecting motivated Liaison Group members, and highlighting the chance to be among the first energy experts specialised in SRI methodology – a prestigious occupation with a promising future.

5.1.5. Greece

The selection process was based on a brainstorming session between SRI-ENACT Greek partners (NTUA and Singular Logic), focusing on stakeholders whose involvement could bring significant added value to the Liaison Group and the overall project.

Partners from previous projects and other professionals who have a proven record in smart solutions and technologies application in buildings, were the first to be added in the stakeholder list. Also, other private and public organisations and individuals were included, on the basis of their influence and interest in SRI. Specifically, the plan is NTUA to invite and host a Liaison Group consisted of representatives from the Ministry of Environment and Energy, and the Technical Chamber of Greece; A cities network representing over 30 Greek Municipalities; Construction and Consulting companies, utilities, building owners, research institutions, energy auditors and representatives of other SRI-related EU projects.

Most of the potential stakeholders have already built a communication channel with the Greek partners, due to previous collaboration. Therefore, the approach will be more personal, yet formal. An invitation will be sent via email, providing first level information on the project. Then, a call will follow in order to discuss more details and prepare the ground for engagement and formalities (Letter of commitment). Signing a Letter of Commitment is a formality that is considered to be necessary in most cases, however, for the Greek LG members it might be optional, due to the already established close professional relationship.

Throughout the previous years of collaboration, trust has been built between the Greek SRI- ENACT partners and many of the organisations and individuals who are planned to be invited. This provides fertile ground for strengthening the bonds between the group and creating the right conditions for long-term engagement.

One of the most significant challenges that we can foresee, is establishing solid foundations and a strong strategy to maintain the LG members onboard throughout the whole duration of the project, and beyond. Clarity on purpose and strong motivation can be the foundational stones that may lead the Liaison Group to stay aligned and achieve its goals in the long run. Losing motivation and deriving from purpose is not something unusual in team work. That is why it is necessary to facilitate this engagement process in a way that the moments of lack of motivation will be identified and a strategy will be addressed to overcome them.

A way to boost the members' motivation and alignment to the group's purpose, could be by finding connections between the LG's purpose and what stakeholders actually find interesting, highlighting how crucially important is their engagement for moving the current Greek SRI landscape from theory to practice.

Creating conditions for capacity building and knowledge sharing could be also highly motivational for the group.

5.1.6. Latvia

Considering that the adoption of the SRI scheme in Latvia is at a very early stage, the main task when creating the project Liaison Group will be to ensure that national policy makers, relevant intermediary institutions and potential end users, such as energy auditors, building owners and managers, are represented in the Group. It is expected that the group will become a hub where planned initiatives for national SRI legislation will be discussed,

and it will ensure a solution-oriented dialogue in the field of smart readiness. SRI-ENACT partner Riga Planning region will chair the LG in Latvia. Other LG members will include representatives from all major stakeholder groups. In Latvia, the national government decides to implement and/or test the SRI. Municipalities, businesses and research institutions interested in the SRI can contact the national authority to inform them about their willingness to implement or test various phases of the SRI. The national government has appointed the Ministry of Economics as an authority responsible for the transposition of the EPDS in Latvia. The Ministry is also responsible for the construction policy in Latvia. Given that the implementation level of the SRI scheme is in its early stages, the SRI-ENACT Riga team will address the Ministry as the most important stakeholder and invite their representatives to co-chair the project LG in Latvia.

SRI-ENACT partner Riga Planning Region, which functions as a regional development agency and acts as a development facilitator rather than a direct implementer, will formally chair the LG in Latvia and perform organisational duties. The planning regions are important intermediary actors who bridge the municipal and national levels of government. The RPR will bring together policymakers, local municipalities, companies, NGOs and owners thus allowing to put into practice the SRI-ENACT pilot project in Latvia.

Local municipalities are also among the most important stakeholders. There are 9 local municipalities located in the Riga Planning region, including Riga, the capital of Latvia. Each municipality has either an energy efficiency department or an energy planning specialist who cooperates with the energy auditors in the municipality. The municipality of Riga has a proper energy agency.

Individual energy auditors or companies are the third and probably the most important stakeholder group. They will be approached via the municipalities or the professional associations and those willing to engage in the SRI-ENACT activities in Latvia, will be invited to participate in the SRI-ENACT training sessions.

5.1.7. Romania

For establishing the Romanian Liaison Group (RO-LG) stakeholders have been selected from the wide range of quadruple helix stakeholders categories already targeted and mapped during the stakeholders' engagement analysis (see Figure 9). To this aim, the RO-LG will have a structure consisting of one, maximum of two potential representatives from each stakeholder included in the following categories:

- Public entities [Ministry of Development, Public Works and Administration (MDLPA); Mayoralties (SRI pilot cities/municipalities)];
- Research & Academia [National Institute for Research-Development in Construction, Urbanism and Sustainable Territorial Development (INCD URBAN-INCERC); Technical University of Civil Engineering Bucharest (UTCB)];

- Professional associations / NGOs and clusters [Romanian Association of Energy Auditors for Buildings (AAECR); Order of Energy Auditors from Romania (OAER); Association Cluster for Promotion of Nearly Zero Energy Buildings (Pro-nZEB); Alba Local Energy Agency (ALEA); Regional Development Agencies];
- Media – an “online newspaper” dedicated, in particular, to the energy field.

The Ro-LG motivation to join this “informal co-creation structure” and, thus to indirectly support SRI-ENACT, is not far different from those listed in Table 3, considering the values and interests of each stakeholders’ categories involved.

Additional value propositions will be related to:

- Opportunities for enhancing the skills needed for further SRI auditing activities;
- Supporting the members’ willingness to be engaged and to co-create in order to focus each members’ expertise to a common purpose of increasing buildings’ energy efficiency at national level;
- Professional interests in connecting with experts and policy makers;
- Open access to SRI-ENACT knowledge shared;
- The need to update the related legislative framework and align it with the EU legislation;

The approach of each entity, according to the RO-LG structure above will be classic - emails followed by phone calls, customised depending on each entity’s role in the buildings’ EE market. It is important that the whole process of nominating LG members takes less time.

The RO-LG members’ engaging steps will be: 1. Invitation email to join RO-LG, with a brief presentation of SRI-ENACT project's objectives and the purpose of the LG, including useful links, followed by the request to nominate 1-2 experts; in the end the benefits gained as RO-LG members (see the value propositions above) will be mentioned; 2. Tracking phone to check and monitor the Invitation email; 3. Finally, since there isn’t an existing communication channel with all selected entities, a face-to-face or virtual individual meeting with each nominated member will be organised. The purpose of this informal meeting is to have the proposed members from each stakeholder to fill-in e an interests - capabilities diagram. By ticking the respective boxes related to their professional background/expertise and their motivation to engage in the LG we will better understand how of the LG members will cover the specific tasks mentioned in chapter 5.2.1.

Even if the participation in the RO-LG will be on a voluntary basis, at the end, when the list of members is finalised, a request to sign a commitment letter will be made, but it will not be mandatory.

In order to overcome the potential risks of zero-feedback or no-engagement or replacement of the nominated member back-up solutions will be: communication with other similar entities from the Romanian stakeholders list

(see Figure 9); the nomination request should be addressed for two representatives, of which one put aside for exceptional situations (retirement, change of job).

5.1.8. Spain

The national Liaison Group membership in Spain will follow the general SRI-ENACT process considering the national variations described below.

SRI aspects were mainly taken into account through research and innovation EU funding projects, with the involvement of Research Centres, Academia, Public Institutions and some Private companies. The first iteration of the members nominations will consider all those entities that have been working previously in these projects. All the SRI knowledge acquired by these entities will be an added value to be included in the Spanish Liaison Group (SP-LG). If the number of stakeholders identified and nominated to the SP-LG are not enough to achieve SRI-ENACT objectives, new nominations will be considered with other stakeholders with the same profile.

SP-LG members' motivation is generally the same as the one specified in Table 3. Additionally, as SRI concept is quite new in Spain, there is a specific motivation for the members to be among the first entities to gain knowledge, to describe the procedures, and to define the new business models.

Veolia as the main partner related with the Spanish market has a good position in several technical associations, and a good relationship with research centres and public institutions. Veolia will use its position and prior contact to communicate directly with the stakeholders or to obtain contact information of these stakeholders. Once nomination members are selected, Veolia will introduce SRI-ENACT and follow the process to engage these stakeholders in SP-LG. If the final number of stakeholders engaged in SP-LG are not enough to achieve SRI-ENACT objectives, the process will start again.

The main challenge of this process is the SRI low level of awareness in the Spanish market and added value identification by the stakeholders. A secondary challenge is the duration of the initial engagement decision process - some stakeholders will probably follow different internal processes to acquire the final commitment to join SP-LG.

5.2. Implementation of co-creation process and Empowerment of Liaison groups

5.2.1. Liaison Group operation in national contexts

Each national Liaison Group will meet at least 3 times to carry out the following tasks:

- co-design the national SRI methodology

- support the pilot SRI assessment by: 1) contacting building owners, building managers, and building users willing to provide pilot buildings; 2) agreeing on the national eligibility criteria for becoming an SRI auditor and recruiting potential SRI auditors
- promote the project activities and outcomes, such as SRI-ENACT methodology and toolkit, pilot assessment programme, auditor training courses, Info Days, and others.

An indicative and preliminary timetable of these activities is shown in the below figure.

Project month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Calendar month	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	Jan-25	Feb-25	Mar-25	Apr-25	May-25
Establishment of the national liaison group	Identify and invite members				Update the composition of the Group - e.g. new members																									
Tailoring of SRI methodology to country	Roundtables, interviews, focus groups with stakeholders																													
Find buildings for pilot SRI assessment					Group members contact building owners, managers, and users to participate in SRI assessment																									
Recruitment of SRI auditors					Group members identify and recruit SRI auditors to participate in training courses and pilot assessments																									
Promotion and dissemination					Promote Info Days, SRI-ENACT pilot assessments, auditor training opportunities																Promote SRI-ENACT methodology and toolkit									

Figure 15: Indicative timetable of the Liaison Group activities

The Liaison Group may need to operate differently in different countries, in order to fit well to each national context, for example:

- In some countries (e.g. where SRI is in ongoing test phase) there may be high interest of policy makers in SRI, while in others there may be little interest. In case of a low interest, to attract policy makers into the Group and make them consider SRI-related changes in policy and legislation, a bottom-up approach may be adopted, i.e. the market players, both at the supply and demand side of SRI technologies, interested in the new business opportunities or savings, could be the driving force.
- In some countries it is likely that more intensive communication will be needed to maximize the impact of SRI-ENACT, so additional plenary meetings, one-to-one meetings, e-mail exchange, telephone calls, newsletters (specific for the Group members), and interviews might be used.
- Depending on the usual practice in the country and the particular composition of each Liaison Group, more or less formal communication may be preferred. This would influence the choice of communication tools, the choice of meeting venues, language, etc.
- In some countries, meeting participants are typically passive and not used to co-creation exercises. In these cases it is particularly important to have a skilled facilitator.

5.2.2. Austria

Given the involvement of Austria in BMVIT and other SRI activities and previously described intentions, the SRI-ENACT LG will try to act as a formal structure – a Working Group – monitoring the progress of SRI-ENACT project and establish a foundation for the implementation of the above-mentioned activities in cooperation with various stakeholders. As the main goal is the influence on the implementation of the future legal framework, it is expected that more intense communication will be carried out in the initial phase, in order to create a steady ground for decision making. Then, the LG will proceed to follow the proposed general plan. The Austrian LG will consist of a core group of 10 stakeholders, while the exact number of “external” stakeholders will vary according to the type of event and nature of collaboration.

The type of LG events will be tailored to the concrete purpose. There may be both online, physical and hybrid events - workshops, seminars, bilateral meetings, capacity building, etc. Co-organization of events with other similar (in terms of topic and target groups) events will be sought to involve more stakeholders.

5.2.3. Bulgaria

Advantage will be taken of all available engagement tools, according to the particular circumstances and personalities. In addition to the mandatory 3 plenary meetings of the Liaison Group, it is planned to carry out bilateral informal meetings with key Group members, in-house co-creation individual exercises in order to speed-up the process of coordinated project outcomes/documents, selection of methods and language customised to each individual Group member, etc.

A possible challenge is the absence of a consolidated opinion or decision due to the absence of key partners. This would be addressed by providing minutes to absentees with questions with different response options. Another possible challenge is the absence of a consolidated opinion or decision due to disagreement on a decision by key members. It would be overcome by providing time for reformatting and consolidating various decisions, attracting authoritative specialists for clarifications, etc.

5.2.4. Croatia

Given the involvement of Croatia in the testing phase and previously described intentions, the SRI-ENACT Liaison Group will try to act as a formal structure – a Working Group – monitoring the progress of SRI-ENACT (and SRI2MARKET) project and establishing a “platform” for implementation of above-mentioned activities in cooperation with various stakeholders. As the main goal is the influence on the outcome of the testing phase and implementation in the future legal framework, it is expected that more intense communication will be carried out in the initial phase, especially between REGEA and EIHP, in order to create a steady ground for decision making. Then, the LG will proceed to follow the proposed general plan. The LG in Croatia will consist of a core group of 10

stakeholders, while the exact number of “external” stakeholders will vary according to the type of event and nature of collaboration.

As part of the LG activities, different types of events will be carried out, depending on the purpose of the meeting – roundtables, workshops, webinars and bilateral meetings on policy development, capacity building, info days and communication. Dedicated events will also be aligned with already established/on-going initiatives which will be used to reach out to potential SRI auditors, attract the financial sector for potential business model development and motivate i.e. representatives of local/regional public authorities to include SRI scheme in their future plans.

Depending on the level of organization (low/medium/high), most of these meetings will have a formal approach, which requires more time for preparation in terms of defining topics, participants, promotion and logistics (organization). However, the Chamber of Economy (besides REGEA and EIHP), as a valuable stakeholder, will increase the number of included stakeholders among the public and business sector which can be perceived as final beneficiaries as they are proven to be a great communication channel.

All included (main) stakeholders – REGEA, EIHP, MGIPU, and Croatian Chamber of Economy, will maximize the usage of their usual means of communication/networking to share the knowledge about SRI scheme and motivate various stakeholders to join the process. It is expected that the Liaison Group will also include coordinated promotion and information through newsletters, social media channels, emails and others.

If the LG will have a legal basis in Letter of Commitment by MGIPU, it is expected that its activities will be present even after the project implementation phase where members will continue to develop SRI scheme and market in Croatia.

5.2.5. Czech Republic

The Liaison Group will be founded on the team of SRI test phase which took place in the Czech Republic. Details of operation of the SRI team will be discussed later with the Ministry of Industry and Trade.

There will be different type of events and activities as part of Liaison Group: roundtables, physical and online workshops but also direct bilateral meetings. The events will be aligned and formed to existing meetings to tackle the current tasks and objectives (for example use of existing conferences and training events of energy expert associations, etc.).

5.2.6. Greece

The Greek Liaison Group will operate according to the aforementioned engagement strategy. As a start, a skilled facilitator will be appointed to support the group to be more actively engaged during the plenary meetings.

NTUA's role will be catalytic on the operation of the Greek LG, by serving as the main focal point in communication and organization. NTUA will be assisted by SLG and CERTH in the establishment and operation of the Greek LG. Apart from the plenary meetings, several online progress meetings will be run, in order to hear the members' needs and discuss with them possible solutions. Based on these progress meetings, the initial engagement strategy will be continuously re-adjusted, serving in that way, dynamically, both stakeholders' and the overall project's needs. In addition, tools such as workshops, training courses and practical demonstrations will be utilised within the duration of the project and in different timings, aligning stakeholders in the purpose of the LG and boosting their motivation for engagement.

Furthermore, if some LG members face specific challenges, assistance will be provided by email, telephone, or/and one-to-one meetings.

Communication tools between SRI-ENACT and LG members during operation will be:

- E-mails (Mailing list)
- Communication platforms such as Teams, Skype, Google teams.

Communication and other operational tools used by the LG for engaging other stakeholders (e.g. auditors) will be:

- Website
- Social Media (LinkedIn, Twitter)
- Questionnaires/ Surveys/ Interviews
- Workshops/ Training courses/ Practical demonstrations
- Public events (e.g. Info days)
- Newsletter.

The Liaison Group, with the facilitator's support will be able to identify obstacles and potential challenges that might slow down or affect the smooth and effective operation of the group. Acting preventively will be at the core of the group's operations and creating a strategic operation plan in advance will be essential so as the group to collaborate efficiently and bring long-term, tangible results.

5.2.7. Latvia

The SRI-ENACT Liaison Group in Latvia will act as an informal forum for dialogue rather than a formal structure. In addition to information on project progress and results, systemic issues such as drivers, development opportunities, and barriers that prevent taking up the SRI scheme will be discussed with the relevant actors and stakeholders. However, group meetings will be documented and key issues summarized in meeting minutes to ensure appropriate feedback. The group will not have the authority to make binding decisions, but some

organisations represented in the group already possess certain tools that can influence the successful introduction of the SRI scheme in Latvia.

Apart from being LG members, some stakeholders will also be directly involved in certain project activities within WP3, WP4, WP5, and WP6, for instance, participating in SRI training activities for local energy auditors, facilitating the dissemination of project results, and participating in the elaboration of the policy recommendations to national energy and construction policy makers with the purpose of enabling the introduction of the SRI scheme elsewhere in Latvia.

Although the members of the Liaison group represent the metropolitan region of Latvia for the most part, the Liaison Group will focus on the whole territory of Latvia. The SRI-ENACT Liaison Group in Latvia will consist of a core group of 10-15 stakeholders and up to 20 "external" stakeholders who will be invited to attend according to their competence, especially regarding thematic workshops and policy development meetings.

Group work will mostly use typical approaches: round table discussions and workshops for discussing specific issues. Bilateral meetings or online consultations are also possible for solving specific issues.

It is expected that the Liaison Group will continue its work as a platform for cooperation even after the project implementation phase in order to allow for further consultation as the SRI scheme is introduced to the legal acts that regulate the smart readiness of buildings in Latvia.

5.2.8. Romania

In Romania, based on Law no. 101/2020 modifying and completing Law 372/2005 on energy performance of buildings, the Ministry of Development, Public Works and Administration (MDLPA) issued the Ministerial Order no. 16/2023 approving the updated calculation methodology for the energy performance of buildings, where SRI is included in the energy performance certificate of the building only optionally, the calculation of this indicator being voluntary at the time of publication of this regulation. Thus, it is recommended this calculation to be carried out according to "Final report on the technical support to the development of a smart readiness indicator for buildings" -Publications Office of the EU. So, RO-LG will operate differently than in countries where SRI is in ongoing test phase.

Once the RO-LG is established the co-creation process can start in order to empower the RO-LG nominated members. The co-creation strategy that will be followed is based on:

- online kick-off meeting, including a "tour de table", a project brief and LG members' responsibilities - to do list and next steps; the first meeting will end with commonly deciding on the next meetings schedule;

- online survey (google form) in order to effectively cover RO-LG responsibilities (example of questions: a) which type of stakeholders can you contact (i.e. building owners, building managers, and building users) willing to provide pilot buildings; b) what kind of national eligibility criteria do you consider for becoming a SRI auditor and recruiting potential SRI auditors; etc.);
- co-creation virtual workshops will be organised, using the white board in ZOOM application and other interactive tools, in order for members to deliver the maximum input possible;
- periodic news info-emails will be sent to members for further promotion;

There is a risk that not all nominated members will be present at one of the scheduled meetings, and then the absence will be filled with the second representative of the stakeholder.

Considering that not all members are from the same city or region of the country, the meetings will be mostly virtual - therefore sustainable both in terms of resource consumption and time spent for travel.

5.2.9. Spain

SP-LG will operate according SRI-ENACT strategy defined above. Veolia as the only Spanish partner, having years of experience in collaborative projects, will take SP-LG leader role in order to organize and creating the conditions for a fruitful collaboration.

One of the first steps is to define each member's point of view, skills, and how to be deployed into the LG. Another important issue is communication, both internal and external. Internal periodic meetings must be scheduled with at least one physical meeting twice a year, strengthening internal relationships and promoting collaborative work. Externally, depending on the target group, different members will be selected to communicate SP-LG actions and needs. Also, SP-LG will take into account each member's Communication Department to improve and promote the LG's actions.

Considering the intention of Spain to undertake a formal SRI assessment, SP-LG will consider the opinion of the National Government. SRI-ENACT activities and outputs could be tailored in a way that they can become a part of the assessment.

Veolia will create a G-SUITE based structure to deploy and organise a virtual workspace for SP-LG, considering also cybersecurity needs. SP-LG operation will be flexible and adaptable to different issues that appear along the project, including to those specific for Spain.

5.3. Co-creation workshop and interviews

A workshop will be organised in each of the pilot countries – Austria, Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania, and Spain – where the LG members will work in focus groups to co-create the country-tailored SRI. This workshop will be the official LG launch for each country and will aim to provide feedback on the tailoring of SRI methodology to national specific regulations and practices, as well as to establish contacts with the participating stakeholders.

Following the workshops, in each pilot country, about 80 interviews with key stakeholders will be performed to better understand the needs of the stakeholders and their expectations and desires concerning the pilot SRI assessments within the project. Interviewees may be recruited from the workshop's participants, the project supporters providing Letters of Support, and the contacts of LG members and the project partners.

5.4. Sustainability and continuous growth of Liaison Groups

The relevance of the Liaison Group (LG) members will be regularly evaluated, considering the evolving interest of the members and other contacted stakeholders, the SRI-related developments in the country, and other factors. Based on the evaluation, efforts will be put to continuously improve and expand the LG.

In each pilot country, exploitation and sustainability plan will be developed to ensure maximisation of the project impact. The LG will play a key role in achieving project sustainability. To ensure the commitment of the Group members, at the end of the project each member will be asked to sign a Memorandum of Cooperation and minimum two such Memorandums will be signed per country. The Memorandum will oblige the LG members to meet for at least five years after the project end. Additionally, the document will specify the concrete role and obligations of the person / organisation in relation to (1) maintaining and promotion of the SRI-ENACT toolkit; and (2) promoting and coordinating SRI auditors training programme, so that trained auditors can in turn train others. Opportunities will be sought to combine the LG activities beyond the project with other SRI-related initiatives.

To motivate LG members to continue their involvement beyond the project, different stimuli may be used, for example:

- Providing LG members with privileged access to SRI-ENACT toolkit (e.g. access to the statistical information in the country);
- Placing LG member logos in the national toolkit;
- Institutionalisation of the LG – it may be recognised by the Government as the official working group working on SRI development in the country.

A few more preliminary ideas to ensure sustainability include:

- Public action plans and financial schemes related to SRI's implementation. These can support stakeholders that would like to turn their interest to initiatives for market uptake and exploitation of the SRI. Public action plans and financial schemes, especially for the private sector, local administration and other public entities, could become the foundations of the project's sustainability plan and the overall SRI implementation.
- Liaison Group, acting as country supervisor. Providing the LG with access to the official SRI assessment tool will create a distinguished role for the group and its members in relation to the national SRI implementation. Additionally, providing the group with a post-project role could bring effective results in terms of sustainability and future actions.
- Annual SRI event. Ministries in cooperation with the Liaison Groups could organize annually an informative national SRI event, for sharing SRI related topics and updates, engaging stakeholders and individuals who show interest to learn more about the indicator and its implementation. LG's collaboration with the Ministry during the event preparation and implementation will also add value upon the group's overall role on the national SRI landscape.

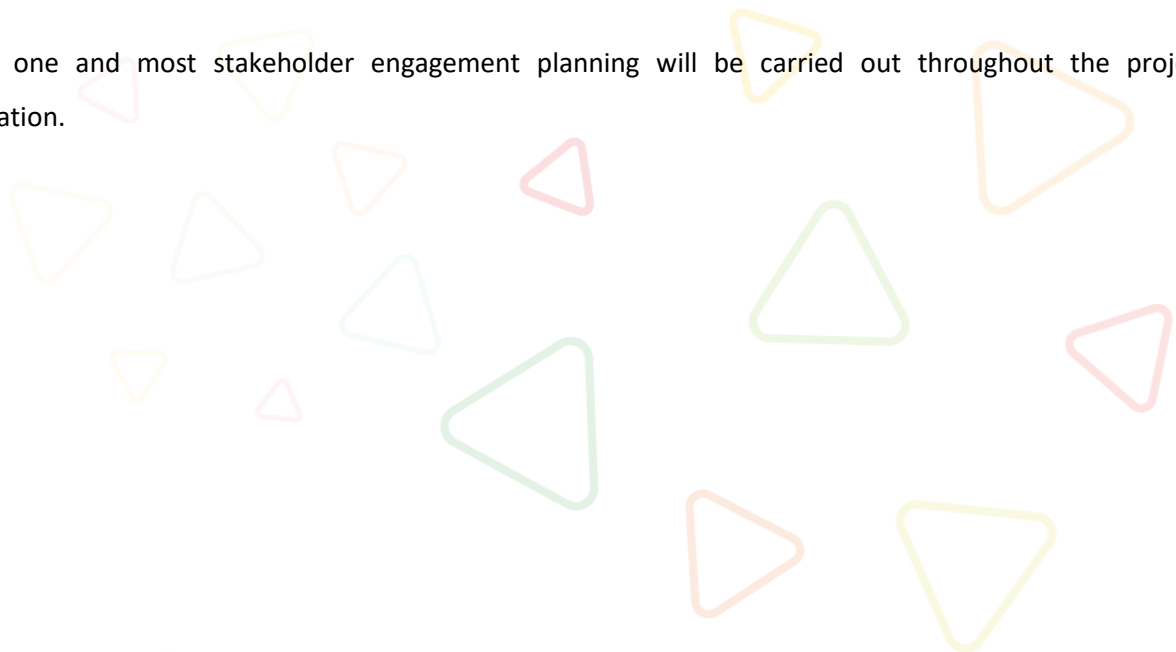
6. Conclusion

This Stakeholder Engagement Plan specifies the project stakeholders (key actors and target groups) in the SRI-ENACT pilot countries - Austria, Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania, and Spain. SRI-ENACT partners' assessments identified the ones who look the most appropriate potential members of the national Stakeholder Liaison Groups – the groups expected to closely collaborate with the project partners.

For each stakeholder group, the motivation to join the national LG, the appropriate tools to communicate with them, and the relevant considerations, challenges, and potential solutions have been proposed, both in general and individually for each of the pilot countries, based on the national circumstances. Additionally, for each pilot country, the approach to establish and operate the LG smoothly and effectively has been elaborated. In most countries, the advantage will be taken of other relevant initiatives, such as existing working groups related to SRI test phase and sister SRI projects.

Generally, the current Plan provides a good foundation for successful stakeholder engagement. The Plan's preparation, however, takes place at the very beginning of SRI-ENACT, before establishing the first contacts with stakeholders and before a detailed project implementation plan is available. For that reason, this Plan is only a

provisional one and most stakeholder engagement planning will be carried out throughout the project implementation.



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