SMART2
ENHANCING THE INTELLIGENCE OF BUILDINGS IN EUROPE

SRI Outlook 2023

ACKNOWLEDGEMENT

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Welcome to the SRI Outlook 2023!

The European landscape is rapidly evolving towards a smarter and more sustainable future, with the Smart Square project playing a supporting role. By making readily available tools that enhance awareness and the intelligence assessment of buildings via the Smart Readiness Indicator (SRI) scheme, Smart Square is seamlessly weaving the fabric of Europe's twin digital and green evolution. Not only is Smart Square addressing the mandates of the revised 2018 Energy Performance of Buildings Directive (EPBD), but it's also laying a solid foundation for the upcoming EPBD recast and furthermore the lasting adoption of the SRI scheme. Key initiatives such as the SRI Observatory will ensure continuous monitoring and updates, culminating in the release of our annual "snapshot" **SRI Outlooks** in **2023**, 2024 and 2025. As the SRI scheme gains momentum across member states, Smart Square remains committed to bridging knowledge gaps and connecting the European stakeholders to the smart building movement.

EXECUTIVE SUMMARY

The SRI Outlook 2023 documents the status of Smart Readiness Indicator (SRI) policy developments at the EU level, tracks national implementation status, and outlines the most relevant research developments in the field of building smartness.

"Visit the online SRI Observatory site to stay continuously updated on the progress of the SRI through digital and interactive features".

The Smart Square project brings forward the SRI Outlook in which the status of Smart Readiness Indicator (SRI) policy developments at the EU level, national implementation, and the most relevant research developments in the field of building smartness are outlined. The present SRI Outlook covers the developments during the year 2023. Subsequent versions will be released annually. Ever updated information on the evolution of the SRI and related building smartness initiatives can be found in the online SRI Observatory, also brought by Smart Square.

The remainder of the document is structured as follows. An overview of the SRI status at European level, as indicated by the Energy Performance of Buildings Directive (EPBD) and related acts is presented. Next, a description of the national implementation status is given. The progress of research in the field of building smartness, both from EU-funded projects and other scientific research is outlined. A section is included at the end with resources developed by the Smart Square project to further increase the knowledge on the SRI.

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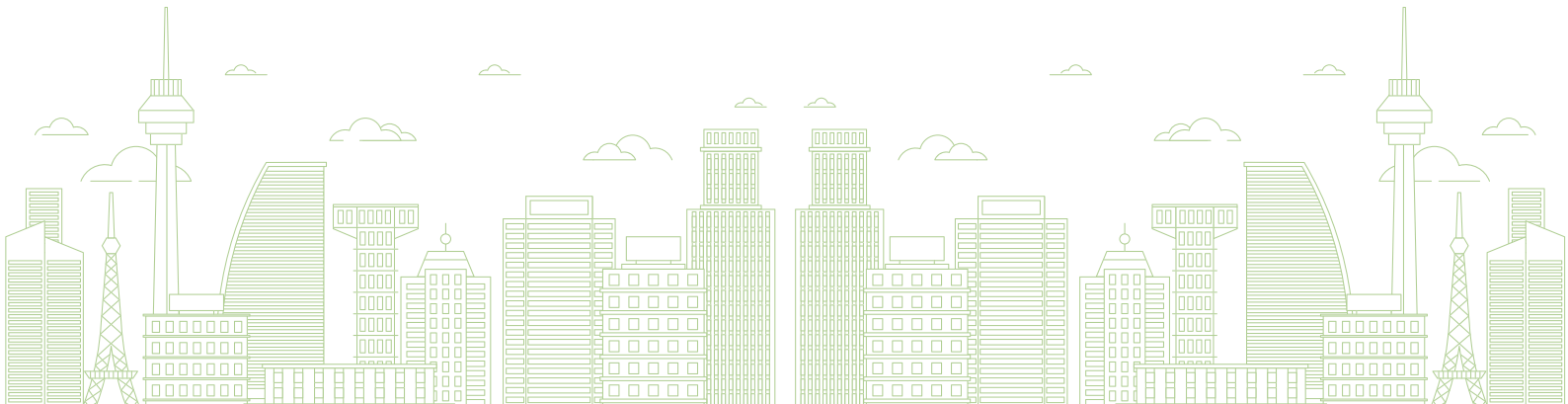

EU POLICY

The 2018 revision of the European Energy Performance of Buildings Directive (EPBD) heavily emphasised the potential of smart technologies in the building sector, to improve both energy efficiency and the wellbeing of people.

In this section:

- History of the SRI - Understand how the SRI came into being and learn about the different policy instruments that made it possible.
- SRI core methodology - The SRI core methodology defines the required framework for the calculation of the SRI.
- SRI certificate - The SRI certificate defines the required information to be included in the certificate resulting from the SRI assessment by an expert.
- SRI default calculation - The SRI support team has produced an SRI assessment package to facilitate the SRI testing and implementation in EU Member States.
- SRI assessment procedure - The SRI assessment aims to determine with sufficient reliability what services are present or planned in the building, and if so, the functionality level for each of those services.

HISTORY OF THE SRI

First SRI technical study for the EC
Definition of the SRI and draft methodology.
Intensive stakeholder consultation.

2017, 2018

2018

Introduction of the SRI in the **2018 revision of the EPBD** as an optional scheme.

Second SRI technical study for the EC
Fine-tuning of the definition and associated calculation methodology.

2019, 2020

2020

Commission Delegated Regulation
Definition and calculation methodology of the SRI.

Commission Implementing Regulation
Technical modalities for the effective implementation.

Set up of the SRI support team
Provision of technical assistance for testing and implementation of the SRI.

2021

2022

Launch of test phases by voluntary countries

EPBD recent Trialogue

2023

1 2018 revision of the EPBD

The **amendment of** Directive 2010/31/EU on the energy performance of buildings (EPBD) outlined the impact of the energy system digitalisation in the energy landscape, from integration of renewables to smart grids and smart-ready buildings. As a result, smart-ready systems and digital solutions in the built environment are to be promoted through the provision of targeted incentives. Consequently, **the introduction of the Smart Readiness Indicator (SRI) as a common European scheme for rating the smart readiness of buildings.** The power to adopt acts to supplement the directive and to establish the definition of the SRI and the calculation methodology was delegated to the European Commission (EC). The powers regarding the modalities for its implementation were also conferred to the Commission. As preparatory work, a **first SRI technical study** was launched in March 2017 by the EC and conducted by VITO, WSEE, ECOFYS, and OFFIS including a **preliminary definition of the SRI and calculation methodology,** as well as an extensive stakeholder consultation. A second SRI technical study conducted by VITO and WSEE for the **fine-tuning of the definition and calculation methodology** started in December 2018 and concluded in June 2020. As a result, the Commission Delegated Regulation 2020/2155 and the Commission Implementing Regulation (EU) 2020/2156 were published.

2 Commission Delegated Regulation 2020/2155

The Delegated Regulation established a common definition and calculation methodology for the SRI. Consequently, **the** smartness **of a building or building unit was defined as to its ability to sense, interpret, communicate, and actively respond in an efficient manner to changing conditions in relation to the operation of technical building systems, the external environment, and demands from building occupants.** The calculation methodology and smart readiness rating was described in annexes I to VIII, though striving for consistency and comparability of building ratings across the EU, flexibility to adapt the calculation to specific conditions is enabled. **The SRI scheme was labelled as optional,** leaving the decision for its implementation to Member States. The SRI calculation methodology enables connection or integration of the SRI scheme with national EPB schemes; markedly, EPCs. Nevertheless, the SRI can never substitute, only complement, energy performance and sustainability assessments. Furthermore, digital building models shall be allowed to be used to facilitate the calculation of a building's SRI. The SRI certificate was defined as the document for communicating the smart readiness indicator of a building or building unit. It was established that only qualified or accredited experts could issue SRI certificates. If implemented, the SRI ought to have an independent control system, which may be linked to that in place for the energy performance certification schemes.

3 Commission Implementing Regulation 2020/2156

The Implementing Regulation detailed the accreditation and qualification of smart readiness indicator experts. It indicated that the experts accredited or qualified for issuing energy performance certificates, or for carrying out inspection of heating, air- conditioning, combined heating or air-conditioning and ventilation systems under Directive 2010/31/EU, or for performing energy audits under Directive 2012/27/EU, are also competent for issuing smart readiness indicator certificates. It posed that additional requirements may be set, particularly in relation to training. Regarding the validity of the SRI certificate, the Regulation indicated that it shall not exceed 10 years. It indicated that self-assessment by building owners, users and other interested stakeholders ought to be enabled. However, any smart readiness assessment without the intervention of an expert may not lead to the issue of a smart readiness indicator certificate. In its article 9, the details on the national testing of the smart readiness indicator scheme were outlined.

4 SRI Platform

In 2021, a service contract was awarded to VITO, WSEE, R2M Solution, and LIST to provide technical assistance for testing and implementation of the SRI. In 2022, some countries launched a voluntary test phase of the SRI.

5 EPBD Recast

In examining the stances taken by the European Commission, European Parliament, and the Council of the EU on the SRI within the Trialogue meetings of EPBD during Summer - Autumn 2023 differences emerge in terms of timelines, scope, and subsequent actions. It's expected that the 3 institutions of the EU will reach agreement by the end of 2023 and adoption in early 2024.

The European Commission suggests adopting a delegated act by 31st December 2025. On the other hand, the European Parliament is keen on a faster approach, urging for the act's adoption a year earlier, by 31st December 2024. The Council of the EU introduces an additional facet tied to the positive outcomes from the test phase of the SRI as prerequisite before preparing a delegated act by the close of 2026.

When it comes to the scope of application, both the European Commission and the Council of the EU emphasize using the common Union scheme. This scheme rates the smart readiness of non-residential buildings, specifically those systems with an effective rated output for heating or combined space heating and ventilation exceeding 290 kW. The European Parliament, however, takes a more expansive view. They suggest including air-conditioning systems in the mix with heating and combined space systems. Moreover, they advocate for the scheme's application to non-residential buildings boasting an effective rated output surpassing 70 kW, a change proposed to take effect from 1st January 2030.

In contract from the European Commission and the European Parliament, the Council of the EU adopts a sequential strategy. They propose that once the smart readiness indicator undergoes its test phase, a report should be presented by the Commission by 1st January 2026. If this report validates the indicator's assessment positively, the Council sets the stage for a subsequent delegated act by the end of 2026. This would bolster the application of the common Union scheme.

The commitment to advancing the SRI through a delegated act is a shared sentiment among the three European institutions. Yet, the European Parliament stands out with its ambitious timeline and extended scope. Contrarily, the Council of the EU treads with prudence, infusing a tiered mechanism reliant on the affirmative assessment of the smart readiness indicator. Meanwhile, the European Commission adopts a balanced posture, offering a distinct timeline, devoid of the Parliament's enhanced scope or the intricate steps favoured by the Council.

Overall, a common thread uniting the European Commission, European Parliament, and the Council of the EU is their emphasis on elevating the role of the SRI across various articles of the EPBD. Their collective discourse underscores the importance of weaving the SRI seamlessly throughout the Directive, ensuring it doesn't stand in isolation but interacts holistically with the EPBD's broader objectives. More significantly, these institutions envision the SRI as tool interlinked with other policy instruments stemming from the EPBD. This intricate web of connections brings the SRI into direct interface with mechanisms like data exchange practices, digital building logbooks, Energy Performance Certificates (EPCs), renovation passports, independent control systems and more. Such integration aims to ensure that the SRI becomes part of a larger ecosystem, offering insights and informing policies within the European building sector. This unified approach reflects the European entities' commitment to harnessing the potential of the SRI as a catalyst for transformative change in the realm of continuously improving the performance of buildings (energy, environment, indoor environment quality etc.).

SRI CORE METHODOLOGY

The SRI core methodology defines the required framework for the calculation of the SRI.

1.Introduction

As indicated by the Commission Delegated Regulation 2020/2155, the smart readiness of a building or building unit is determined based on the assessment of smart-ready services present or planned in, or relevant for, the building or building unit, and their functionality level. The smart readiness of a building or building unit is expressed by a rating that derives from a total smart readiness score expressed as a percentage and that represents the ratio between the smart readiness of the building or building unit compared to the maximum smart readiness that it could reach. Therefore, it assesses the effective capabilities of the building or building unit to adapt its operation to the needs of the occupants and the grid, and to improve its energy efficiency and overall in-use performance compared to a given potential.

2. Key functionalities, impact criteria and technical domains

The SRI methodology is structured in

3 key smart readiness functionalities (f),

as highlighted in point 2 of Annex Ia, to Directive 2010/31/EU, within which there are certain impact criteria (ic).

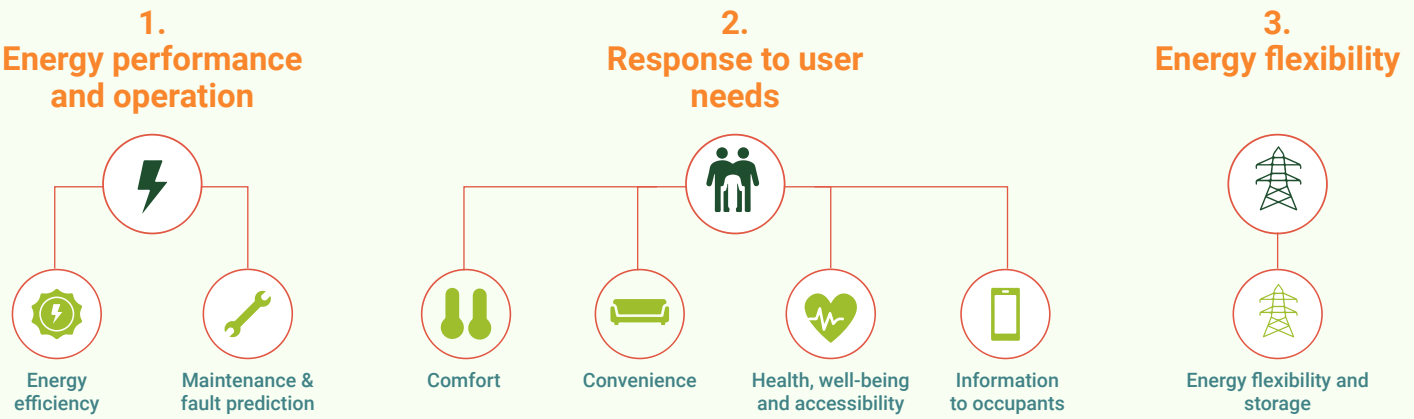

Figure 1. Relevant impact criteria per key functionality.

The SRI assesses

9 technical domains

listed below and depicted in Figure 2.

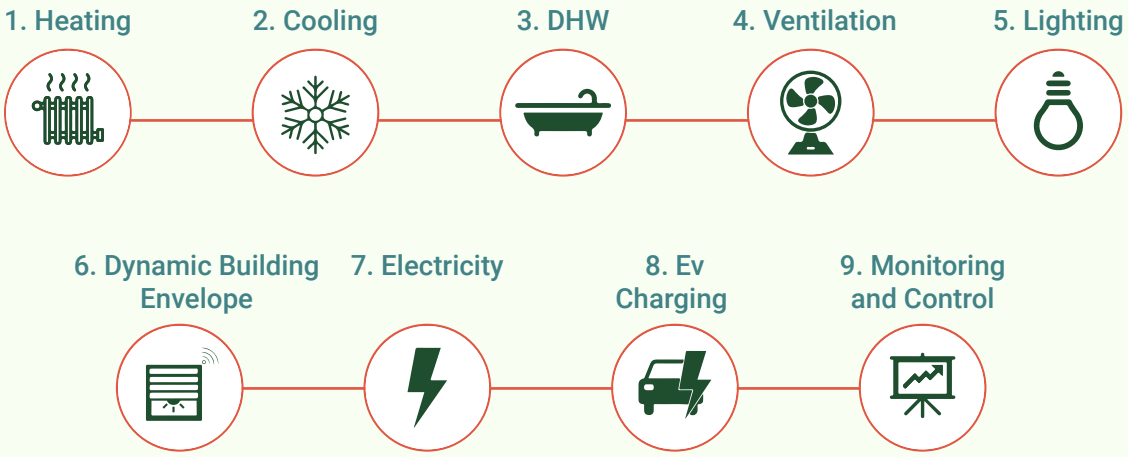

Figure 2. SRI technical domains.

For each technical domain (d), smart-ready services ($S_{i,d}$) shall be defined by Member States, as part of a smart-ready catalogues, including their related functionality levels ($FL(S_{i,d})$), and corresponding individual scores for each impact criterion (I_{ic} ($FL(S_{i,d})$)). The smart-ready catalogues shall reflect the state of art of smart-ready technologies, which may be different among building types. Hence, several smart-ready catalogues may exist. The smart-ready service catalogue shall define the maximum score of each technical domain for each impact criterion (I_{max} (d,ic)).

Member States shall define the respective weighting factors ($W_{d,ic}$) characterising the influence of each technical domain (d) on each impact criterion (ic). Such factors ought to be expressed as a percentage, the sum of which ought to be 100% for each impact criterion. Weighting factors may be different between building types. As a result, it is possible to obtain the smart readiness score for each impact criterion (SR_{ic}).

Member States shall define the respective weighting factors ($W_{(f,ic)}$) of relevant impact criteria (ic) within each key functionality (f), which enables to obtain smart readiness scores (SR_f) along the three key functionalities. Next, the weighting factor (W_f) indicate the influence of each key functionality (f) in the total smart readiness score (SR). Ultimately, the ratio between the smart readiness of the building or building unit compared to the maximum smart readiness that it could reach results in the smart readiness rating. The ratio yields a rating based on the seven-class scale: 90-100%; 80-90%; 65-80%; 50-65%; 35-50%; 20-35%; <20%, ranging from highest to lowest smart readiness.

SRI CERTIFICATE

The SRI certificate defines the required information to be included in the certificate resulting from the SRI assessment by an expert. It sets certain features expected to be common across Member States.

The content of the smart readiness indicator certificate, as defined by Annex IX of the Commission Delegated Regulation 2020/2155, includes the following.

General certificate information

- Unique ID of the certificate.
- Date of issue and date of expiry of the certificate.
- An informational text clarifying the scope of the smart readiness indicator, in particular about energy performance certificates. Where available, the energy performance class of the building or building unit as specified by a valid energy performance certificate.

General building or building unit information

- Type of building or building unit
- Surface area.
- Year of construction and where relevant, of renovation.
- Location.
- Etc.

Smart readiness of the building

- Smart readiness class of the building or building unit. Optionally, total smart readiness score of the building or building units.
- Smart readiness scores along the three key functionalities, and per impact criterion. Optionally, scores of each technical domain for each impact criterion.

An informational text clarifying that the certificate reflects the smart readiness at the date of issuance and that any significant modifications to the building and its systems would affect smart readiness and would therefore require an update of the information given on the certificate.

Optionally, additional information on the assumptions made in the calculation of scores such as weighting factors of impact criteria used for calculating smart readiness scores for key functionalities.

Available information on connectivity

- Where possible, available information on connectivity, in particular on the existence of high-speed-ready in-building physical infrastructure, such as the voluntary 'broadband ready' label. Also, where possible, available information on interoperability, cybersecurity of systems and data protection, including where relevant on conformity to commonly agreed standards, and information on related risks.

Improve the smart readiness

- Optionally, recommendations on how to improve the smart readiness of the building or building unit considering, where relevant, the heritage value.

SRI DEFAULT CALCULATION

The SRI support team has produced an SRI assessment package to support the SRI testing and implementation in EU Member States.

The SRI support team has produced the SRI assessment package (v4.5 being the latest version). It is comprised of a practical guide for the SRI calculation framework and a calculation spreadsheet. The spreadsheet is a representation of the methodology for calculating the SRI, based on the multi-criteria assessment method defined in the Commission Delegated Regulation 2020/2155. The spreadsheet is a tool to support the SRI testing and implementation in EU Member States. It includes a default service catalogue and weighting factors, while enabling the use of customised values.

1 Default Service catalogue

The SRI assessment package produced by the SRI support team defines a service catalogue in which each technical domain is composed by several service groups, which contain smart ready services as in Table 1.

Table 1. Default service catalogue. SRI assessment package (v4.5).

Technical domain	Service group	Smart-ready service
Heating	Heat control – demand side	Emission control
		Control of distribution fluid temperature
		Control of distribution pumps in networks
		TES for building heating, excluding TABS
	Heat control – supply side	Generator control
		Sequencing in case of different generators
	Information to occupants and facility managers	Report regarding system performance
	Flexibility and grid interaction	

Technical domain	Service group	Smart-ready service
Cooling	Cooling control – demand side	Emission control
		Control of distribution fluid temperature
		Control of distribution pumps in networks
		TES for building heating, excluding TABS
		Interlock avoiding
	Cooling control – supply side	Generator control
		Sequencing in case of different generators
	Information to occupants and facility managers	Report regarding system performance
	Flexibility and grid interaction	
Domestic hot water	Heat control – supply side	Storage - generator control
		Sequencing in case of different generators
	Information to occupants and facility managers	Report regarding system performance
Ventilation	Air flow control	Supply air flow control at room level
		Supply air flow control at the air handling unit level
	Air temperature control	Heat recovery control
		Supply air temperature at the air handling unit level
	Free cooling	
	Information to occupants and facility managers	Report regarding system performance
Lighting	Artificial lighting control	Occupancy control for indoor lighting
	Control artificial lighting based on daylight levels	
Dynamic building \envelope	Window control	Solar shading control
		Opening control, combined with HVAC system
	Information to occupants and facility managers	Report regarding system performance
Electricity	Locally generated electricity storage	
	Locally generated electricity self-consumption optimization	
	Combined Heat and Power generation control	
	Demand Side Management	Support of (micro) grid operation
	Information to occupants and facility managers	Report regarding local electricity generation
		Report regarding local electricity storage
		Report regarding local electricity consumption
Electric vehicle charging	EV Charging	Capacity
		Grid balancing
		Connectivity

Technical domain	Service group	Smart-ready service
Monitoring and control	Cooling control – demand side	Run time management of HVAC systems
	Fault detection	
	Technical building system interaction control	Occupancy detection
	Smart Grid integration	
	Information to occupants and facility managers	Report regarding demand side management performance and operation
		Report regarding demand side management performance and operation
	Override DSM control	
	Single platform that allows automated control, coordination between TBS and optimization of energy flow	

Several incremental functionality levels, ranging from 0 to 4, are defined in a technology neutral manner for each technical domain's smart ready service. A higher functionality level reflects a smarter performance. The SRI calculation spreadsheet enables user-defined smart ready services.

2 Default weighting factors

The SRI assessment package produced by the SRI support team defines default weighting factors for each of technical domains per impact criterion for 5 climatic zones in Europe (i.e., South-East Europe, North-East Europe, South Europe, West Europe, and North Europe). Such factors are different for residential and non-residential buildings. Also, the **weighting factors** of each key functionality in the total smart readiness score.

The SRI calculation spreadsheet enables user-defined **weighting factors.**

3 Contextual adaptations

Service catalogues ought to be defined by the Member States. As a result, different smart ready services per technical domain may be considered among European countries.

The definition of **weighting factors** of technical domains per impact criterion is the prerogative of Member States as well. The standard approach is to define the weighting factors of certain technical domains (i.e., heating, domestic hot water, cooling, ventilation, lighting, and electricity) as the energy balance per climatic zones. The remaining technical domains' weighting factors per impact criterion (i.e., dynamic building envelope, electric vehicle charging, and monitoring and control) are either fixed or equally distributed. For the calculation of the energy balance, energy performance in buildings assessments as per the energy performance certificates may be used. The climatic zones are defined by Member States, and it is possible

to have diverse sets of weighting factors depending on the building type. Approaches for the weighting factors definition which deviate from the standard approach are also possible.

Member States shall also define the **weighting factors** related to the influence of each key functionality in the total smart readiness score.

To avoid unfairly penalising a building or building unit, some smart-ready services may be omitted in the calculation of the smart readiness scores in case those services are not relevant for that building or building unit. Member States shall define the conditions for allowing such adaptations of the calculation procedure. Member States may define additional considerations in terms of inclusiveness, connectivity, interoperability, cybersecurity, data protection, etc.

SRI ASSESSMENT PROCEDURE

The SRI assessment aims to determine with sufficient reliability what services are present or planned in the building, and if so, the functionality level for each of those services.

1 Introduction

The final report of the second SRI technical study investigated three potential SRI assessment methods (i.e., Method A, Method B, and Method C). Method A and B are based on the assessment of the smart-ready services that are present, or planned at design stage, and their functionality level. The assessment aims to determine with sufficient reliability what services are present or planned, and if so, the functionality level for each of those services. For this purpose, when available, digital models of buildings, including building information models or digital twins, may be used. The main difference is that Method A considers a reduced service catalogue, and thus spans a subset of the smart-ready services considered in Method B. Consequently, Method A requires less effort, time, and potentially expertise. By default, Method B would require an on-site inspection to the assessed object. Alternatively, Method C aims to be based on measured data, quantifying the operational smartness of in-use buildings.

Method A and B are methodologies included in the SRI assessment package produced by the SRI support team, whereas Method C is considered a potential future evolution. The generic process of the SRI assessment following Method A or B is outlined in Figure 3.

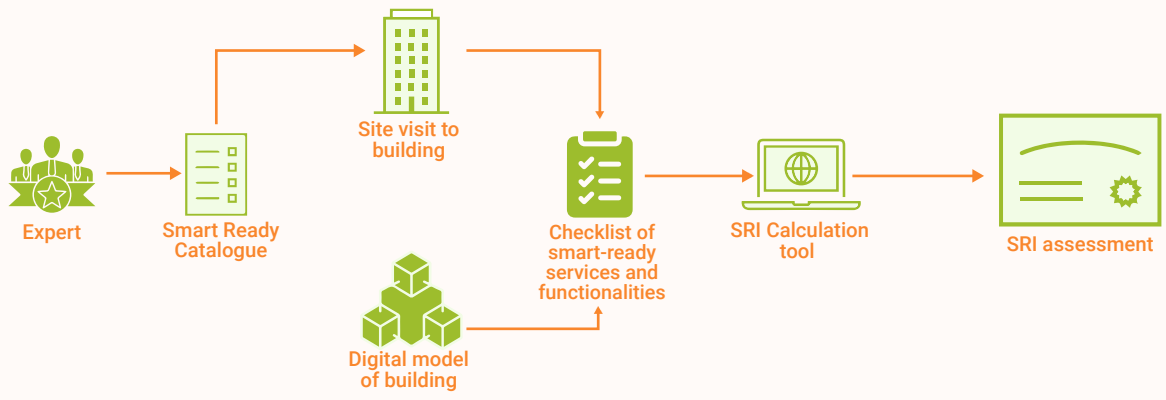

Figure 3. Generic SRI assessment process. Method A or B.

In principle, Method A allows building occupants to perform a self-assessment without the intervention of an expert. Nevertheless, such self-assessment won't result in a valid SRI certificate. In the following subsections, the SRI assessment procedure taking as reference Method B and the default calculation methodology will be explained.

2 Input data

Performing an SRI assessment requires the identification of general information of the assessed object as well as retrieving the inputs needed for the calculations, similarly to that required for the issue of energy performance certificates. The SRI assessment, as per the calculation spreadsheet developed by the SRI support team, requires the definition of certain input data, which can be structured according to the following:

- Assessor information.
- General building information.
- Methodology selection.
- Definition of applicability of smart ready service and main functionality level.
- Assessment date.

The input data regarding **assessor information**, the **methodology selection**, and the **assessment data** is trivial, and therefore not of interest in this document. The **general building information** contains items which correlate with overarching preparation steps for Energy Performance in Buildings (EPB) assessments. The **definition of applicability of smart ready service and main functionality level** is the core calculation methodology for the SRI. For each technical domain's smart ready service, certain functionality levels may be defined. Such functionality levels are enabled by certain smart-ready technologies either present or planned at the building or building unit. Depending on the applicable smart service catalogue the input data gathering process may be variable in terms of time and effort needed. Furthermore, where they are available, digital models of buildings, including building information models or digital twins, may be used to increase the reliability and reduce the time of the assessment.

3 Calculation

Once the main functionality level has been defined to each applicable technical domain's smart-ready service, the calculation proceeds as indicated in the section on the SRI core methodology. Each smart-ready service ($S_{i,d}$) has a certain functionality level ($FL(S_{i,d})$), which is equivalent to a score for each impact criterion (ic). The scores $I_{ic}(FL(S_{i,d}))$ of each technical domain (d) and impact criterion are defined by Equation 1, as the sum of the scores of the smart-ready services within a given technical domain.

Equation 1. $$I(d,ic)=\sum_{i=1}^{ND} I_{ic}\,(FL(S_{i,d}))$$

The calculation is reproduced considering the maximum functionality level per applicable smart-ready service contained in the smart-ready service catalogue ($FL_{max}(S_{i,d})$). It is indicated in Equation 2.

Equation 2. $$I_{max}(d,ic)=\sum_{i=1}^{ND} I_{ic}(FL_{max}(S_{i,d}))$$

It is possible to produce the smart readiness score per technical domain and impact criterion following Equation 3.

Equation 3. $$SR_{d,ic}=\frac{I(d,ic)}{I_{max}(d,ic)}\cdot 100$$

Next, the scores per technical domain are summed considering their respective contribution to each impact criterion. The result is divided by the maximum possible score, resulting in the smart readiness score per impact criterion (SR_{ic}) as per Equation 4.

Equation 4. $$SR_{ic}=\frac{\left(\sum_{d=1}^{N} W_{d,ic}\cdot I(d,ic)\right)}{\left(\sum_{d=1}^{N} W_{d,ic}\cdot I_{max}(d,ic)\right)}\cdot 100$$

Also, the smart readiness per technical domain, following Equation 5.

Equation 5. $$SR_{d}=\frac{\sum_{ic=1}^{M} W_{d,ic}\cdot I(d,ic)}{\sum_{d=1}^{N} W_{d,ic}\cdot I_{max}(d,ic)}\cdot 100$$

The smart readiness score per smart readiness functionality (f) is obtained as the weighted addition of the scores per impact criterion as per Equation 6.

Equation 6. $$SR_{f}=\sum_{ic=1}^{ND} W_{f}(ic).SR_{ic}$$

Finally, the total smart readiness score is obtained as the weighted addition of the scores per smart readiness functionality as in Equation 7.

Equation 7. $$SR=\sum W_f \cdot SR_f$$

For the calculation process, the contextual adaptations may have a significant impact.

The total smart readiness score corresponds to a smart readiness rating (SR_{class}), expressed based on seven smart readiness classes; namely, 90-100%; 80-90%; 65-80%; 50-65%; 35-50%; 20-35%; <20%, ranging from highest to lowest smart readiness.

4 Output data

The results of the SRI assessment are included in the SRI certificate, The output data of the calculations is depicted in Table 2.

Table 2. SRI assessment output data.

Discription	Symbol	Unit
Total smart readiness score	SR	%
Total smart readiness rating	SR_{class}	-
Smart readiness score, per key functionality Energy performance and operation Response to user needs Energy flexibility	SR_{f}	%
Smart readiness score, per impact criterion Energy efficiency Maintenance and fault prediction Comfort Convenience Health, well-being, and accessibility Information to occupants Energy flexibility and storage Smart readiness score, per technical domain	SR_{ic}	%
Smart readiness score, per technical domain Heating Domestic hot water Cooling Ventilation Lighting Dynamic building envelope Electricity Electric vehicle charging Monitoring and control	SR_{d}	%

COUNTRIES

Member States may undertake a non-committal test phase of the SRI scheme at national level. In 2023, 8 countries participated in a SRI test phase.

Austria

The OIB. Österreichisches Institut für Bautechnik is the Austrian Institute for Construction Engineering is the authority publishing the legal guidelines no 1 to 6, which are the legal basis of turning the EPBD into Austrian federal states' law.

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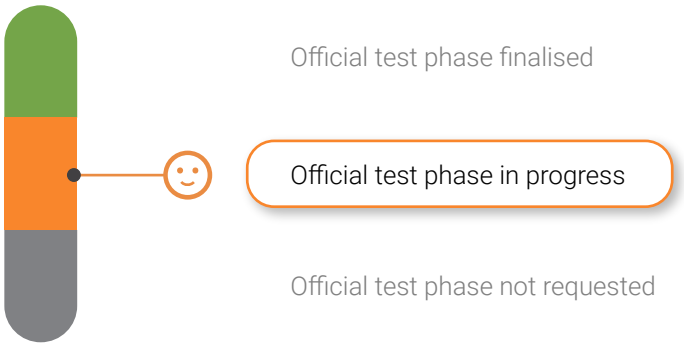
1 Overall assessment of SRI test phase



2 Coordination of SRI test phase

Austria volunteered to the non-committal test phase after the first call for expression of interest sent by the European Commission to all Member States in October 2021. 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.

3 Timeline of SRI test phase

The test phase started and was reported to the European Commission in September 2021, and it is expected to last for 2-3 years.

4 Activities carried out during the SRI test phase

During the test phase 17 buildings of diverse typologies (e.g., 6 educational, 6 office, 1 double-family and 5 multi-family) have been examined and assessed based on detailed documentation from the Austrian region and the federal government. The methodology followed focuses on energy flexibility estimation as the buildings ability to store energy as crucial for using renewables to meet CO_2 reduction targets is considered vital.

In addition to the baseline SRI methodology, three more methods are analysed. The first one, developed by AEE Intec, represents a qualitative and quantitative calculation which also evaluates the load shift using dynamic profiles, intelligent equipment features as well as the user needs. The second one, proposed by BOKU calculates the buildings load shift potential based on indicators in terms of storage capacity and buildings' communication with the network. Lastly, the third method is based on indicators from the international project *"Energy-flexible buildings as part of resilient, low carbon energy systems"*, focuses on the energy flexibility and represents a methodology for a simple quantitative SRI assessment as a flexible indicator.

Croatia

The Ministry of Physical Planning, Construction and State Assets is the Croatian EPBD implementing body.

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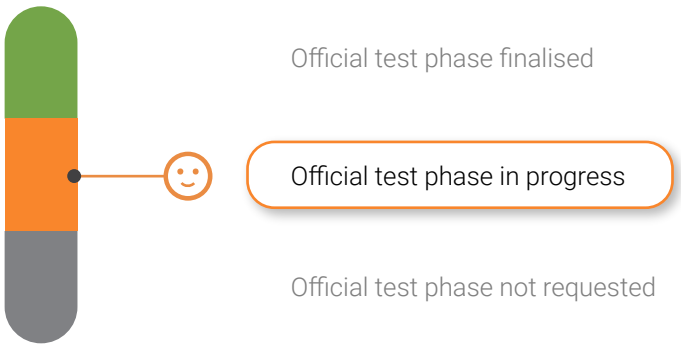
1 Overall assessment of SRI test phase



2 Coordination of SRI test phase

The SRI test phase in Croatia is led by the Ministry of Physical Planning, Construction and State Assets and is supported by the non-profit scientific institution Energy Institute Hrvoje Pozar (EIHP).

3 Timeline of SRI test phase

The timing is unknown. However, the non-committal test phase is being supported by the SRI2market LIFE project, whose timeline is from November 2022 to October 2025

4 Activities carried out during the SRI test phase

The test phase has recently started, so there is not yet detailed information.

Czech Republic

The Ministry of Industry and Trade (MTO) is the EPBD implementing body in Czech Republic.

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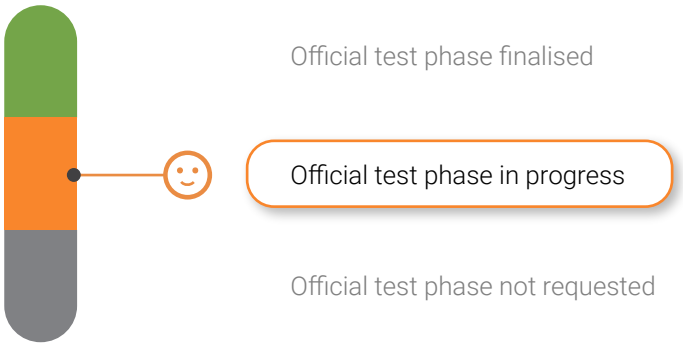
LINK

1 Overall assessment of SRI test phase



2 Coordination of SRI test phase

Czech Republic volunteered to the non-committal test phase after the first call for expression of interest sent by the European Commission to all Member States in October 2021. The Czech test phase is led by the Ministry of Industry and Trade (MPO), with support from the Department of Environmental and Building Services Engineering of the Czech Technical University in Prague (CTU).

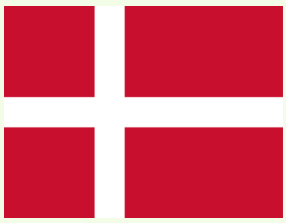
3 Timeline of SRI test phase

It started in June 2022 and its duration was expected to be 1 year.

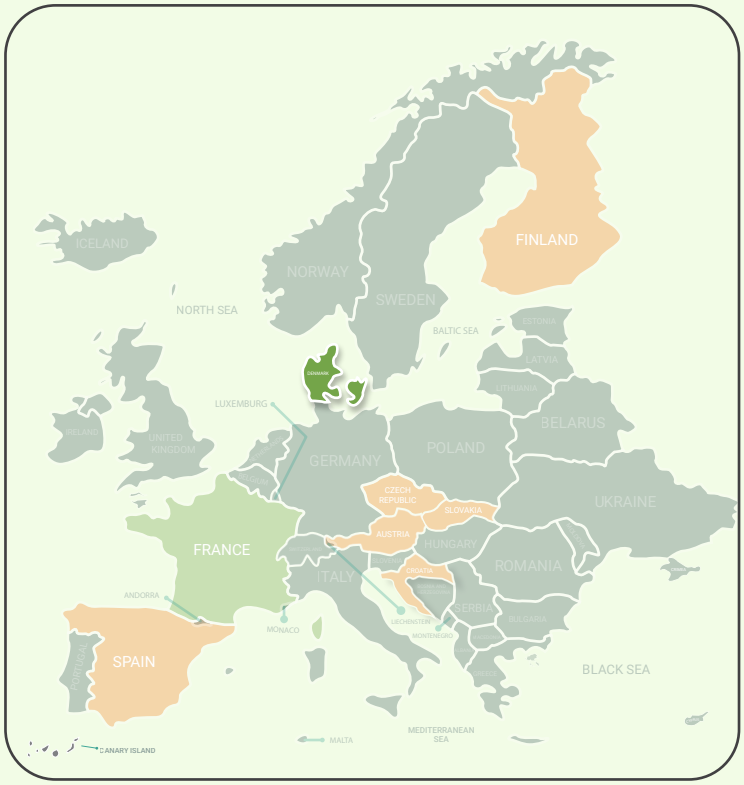
4 Activities carried out during the SRI test phase

During the test phase the common SRI methodology is applied, and depending on the sensitivity of the results, some adaptations may be undertaken in a later phase. SRI evaluations are conducted by the team of the University. 5 SRI building assessments have been conducted in educational and residential buildings by the university team using the official SRI assessment package, whereas 6 more assessments will be carried out during 2023. Depending on the results sensitivity, some adaptions may be taken into account in a later phase.

Denmark



The Danish Energy Agency (DEA) is the EPBD implementing body in Denmark.



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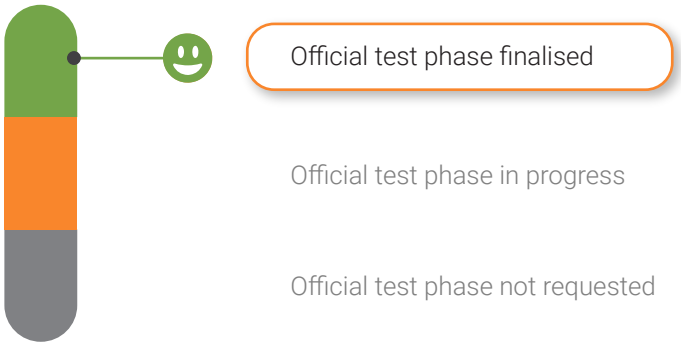

2 Coordination of SRI test phase

Denmark volunteered to the non-committal test phase after the first call for expression of interest sent by the European Commission to all Member States in October 2021. The Danish test phase was led by the Danish Energy Agency (DEA) in cooperation with the Danish Technological Institute (DTI).

3 Timeline of SRI test phase

The test phase started in December 2021, and it finished in 2023.

4 Activities carried out during the SRI test phase

During the testing phase, 27 SRI assessments were performed in various buildings, including old and new, with different energy carriers. The assessments are carried out by assessors from the Danish Technological Institute. In detail, 9 single-family and 5 apartment buildings, 7 offices, 5 education and institution buildings and 1 shopping centre.

In addition, interviews of building owners for the performed tests were carried out, focusing on the building owners' expectations as well as understanding and experience of the labelling. A proposal in terms of how the SRI methodology can or should be adapted to the Danish context was prepared.

Finland

The Ministry of the Environment is the EPBD implementing body in Finland.

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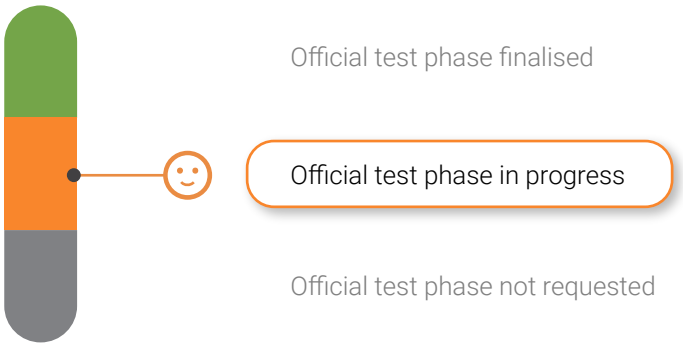


2 Coordination of SRI test phase

Finland volunteered to the non-committal test phase after the second call for expression of interest sent by the European Commission to all Member States in June 2022. The SRI test phase in Finland is led by the Ministry of the Environment with the support of MOTIVA Ltd, a company dedicated to promoting and supporting sustainable development.

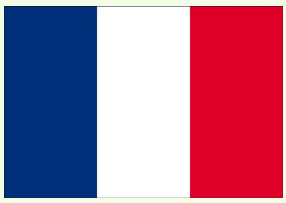
3 Timeline of SRI test phase

It started with an opening seminar in Q4 2022, and it is expected to run until Q2 2024.

4 Activities carried out during the SRI test phase

Initially, a pre-study was carried out, assessing the willingness of building owners (mostly non-residential) to facilitate their building for SRI assessments. In addition, the disposition of SRI assessors was found aligned with receiving training on the SRI, as well as performing three different assessments in buildings.
The official test phase started in September 2022 with an opening seminar. Next, during 2023, 30-50 assessors with different backgrounds, such EPC assessors, and professionals at area of building services shall receive training webinars with the support of the EU. Consequently, the SRI assessments shall be performance in 100-150 buildings of various types. As a result, both a social impact and suitability assessment shall be done with regards to the implementation of the SRI scheme in Finland. Results to Finnish government and to EU shall be reported during the first semester of 2024.

France



The Ministry for Ecological Transition is the French EPBD implementing body.

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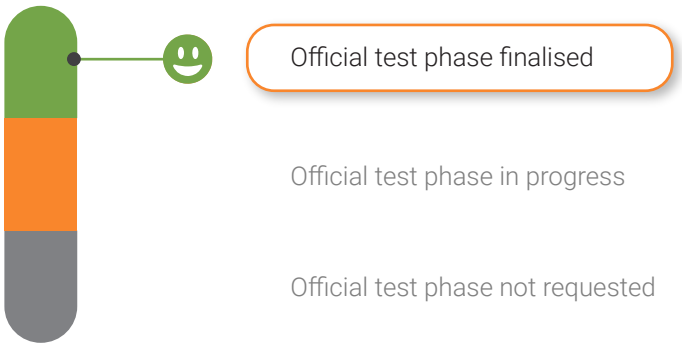

2 Coordination of SRI test phase

France participated in the European Working Group B that supported the development of the SRI calculation methodology in 2018. Then, it volunteered to the non-committal test phase after the first call for expression of interest sent by the European Commission to all Member States in October 2021. The French test phase is led by the Ministry for Ecological Transition with the support of CEREMA.

3 Timeline of SRI test phase

The non-committal test phase is expected to last from September 2022 to June 2023.

4 Activities carried out during the SRI test phase

The approach was to stay close to the common methodology with small adaptions, mainly in terms of mandatory domain definitions, implementation for connectivity and interoperability and weightings adoption to the building configuration. There is a strong intention of coordinating EPCs and the SRI.
The assessments during the test phase were performed by eligible EPC assessors that were recruited and trained for this goal by CEREMA. The target was to assess at least 30 buildings as a first step in order to determine if and how the experimentation could be continued.

Slovenia

The Ministry of Infrastructure is the Slovenian EPB implementing body.

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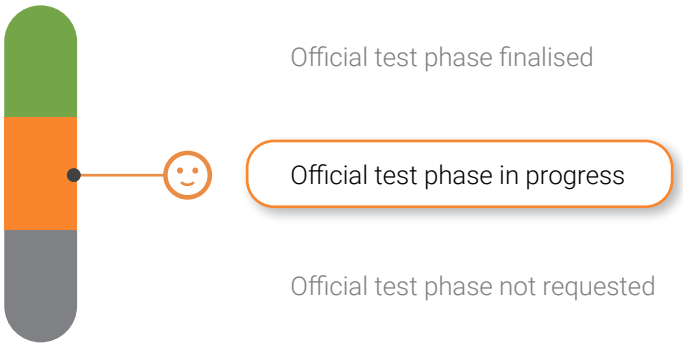

2 Coordination of SRI test phase

The SRI test phase in Slovenia is led by the Ministry for Environment, Climate and Energy with the support of Jožef Stefan Institute (Energy Efficiency Centre) and Goriška Local Energy Agency, in cooperation with the Horizon 2020 project TIMEPAC.

3 Timeline of SRI test phase

The test phase recently started in 2023, and is expected to last 2 years.

4 Activities carried out during the SRI test phase

A sample of at least 50 representative buildings will be assessed, covering different typologies, ages and uses. Assessments will be conducted by personnel from Jožef Stefan Institute and Goriška Local Energy Agency, and by external assessors to be trained through dedicated workshops.

Spain

The Instituto para la Diversificación y el Ahorro Energético (IDAE) is the EPBD implementing body in Spain.

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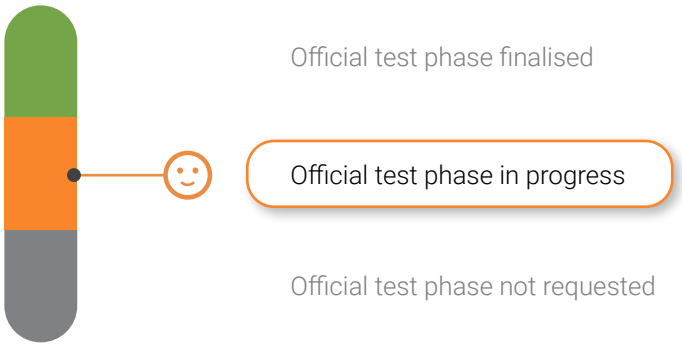

2 Coordination of SRI test phase

The SRI test phase in Spain is led by the Ministry for the Ecological Transition and the Demographic Challenge with the support of CENER - National Renewable Energy Centre within the context of the LIFE project SRI2MARKET.

3 Timeline of SRI test phase

The test phase recently started in 2023 and ought to last around 21 months.

4 Activities carried out during the SRI test phase

The test phase will include training sessions for EPC assessors to become SRI experts, based on the SRI2MARKET e-learning platform and training programme. SRI assessments will be conducted on a sample of at least 50 buildings across Spain.

EU-FUNDED PROJECTS

In parallel with policy developments, the European Commission has over a number of years supported research, innovation and market uptake projects that help Europe use energy more sustainably.

The recent LIFE-2021-CET-SMARTREADY topic aimed at creating the conditions for a global improvement of smart readiness of European buildings. It funded the following projects, coordinated by CINEA through the SRI cluster.

Smart Square

Smart Tools for Smart Buildings: Enhancing the intelligence of buildings in Europe.

The project Smart Square aims to develop and deliver the appropriate tools and applications, which will enable the promotion and establishment of intelligence assessment of buildings in Europe, through buildings Smart Readiness Indicator (SRI) scheme. Smart Square aspires to deliver a cloud based open platform for assessing the intelligence of buildings, available in all 24 EU official languages, considering as well the specificities of the Member States, with a view to maximize synergies with other EU initiatives.

SRI2Market

Paving the way for the adoption of the SRI into national regulation and market.

The SRI2MARKET project will improve the knowledge and capabilities of six (6) Member States (Austria, Croatia, Cyprus, France, Portugal, and Spain) with regards to the introduction of the SRI in their national regulation and market. The project will use lessons learned by countries that are well advanced in rolling out SRI to support countries still beginning their test phases and/or struggling to encourage smart upgrades. The effort should accelerate the adoption of the indicator and facilitate the design of policies that inspire action among those that are not early movers.

SRI-Enact

Co-creating Tools and Services for Smart Readiness Indicator Uptake.

SRI-ENACT aims to engage stakeholders in national and EU level to co-create tools and services for the Smart Readiness Indicator (SRI) uptake. The project will develop tools and services that calculate the SRI and provide recommendations and guidance for buildings smartness upgrades.

easySRI

Improving and demonstrating the potential of SRI.

easySRI aims to enable a smooth and extendable web platform that offers services for the automated calculation of the SRI according to the Final report on the technical support to the development of a smart readiness indicator for buildings accomplished under the authority of the European Commission DG Energy ENER that will act as a basis for an effective implementation of the SRI and allow further testing at Member State level.

The projects funded under the LIFE-2021-CET-SMARTREADY build on the results of previous initiatives. Notably on the **SmartBuilt4EU**, an already finished project, that aimed to foster collaboration between stakeholders of the smart building value chain, promote their innovations, and identify R&D gaps and policy recommendations to support the further uptake of smart buildings.

Given the synergies between the Smart Readiness Indicator (SRI) and Energy Performance Certificates (EPC), the progress of building smartness research shall be studied together with the projects focused on enhancing the evolution of Energy Performance Certificates in the EU. Such research initiatives are coordinated through **the Next Generation Energy Performance certificates cluster.** The cluster ensures that the knowledge base is continuously enlarged, fostering that new projects take the baton from those that come to an end. The projects that included in the cluster are listed below, those closer to the top are the most recent ones. ***Check their websites out!***

SCIENTIFIC RESEARCH

Building smartness is increasingly receiving more attention from researchers. The most relevant scientific publications on the topic are gathered here.

Building smartness research tracker

The approaches of scientific research on building smartness are diverse. However, the relevance of the Smart Readiness Indicator (SRI) in relation to smart buildings is remarkable. Other related research terms are depicted in the network graph below.

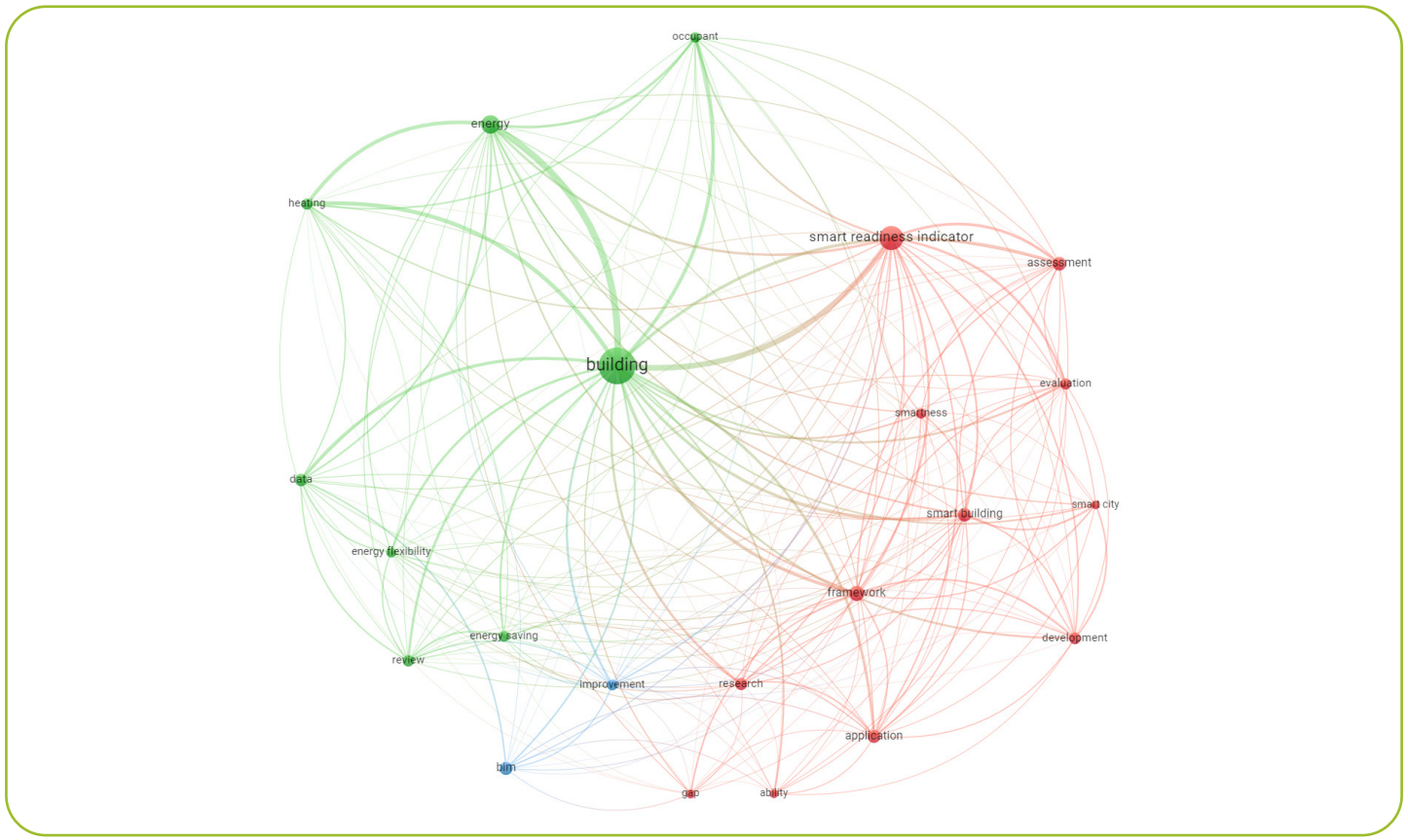

Figure 4. This map has been generated using VOS Viewer. It depicts the co-occurrence of terms identified in the titles and abstracts of many scientific publications using natural processing algorithms

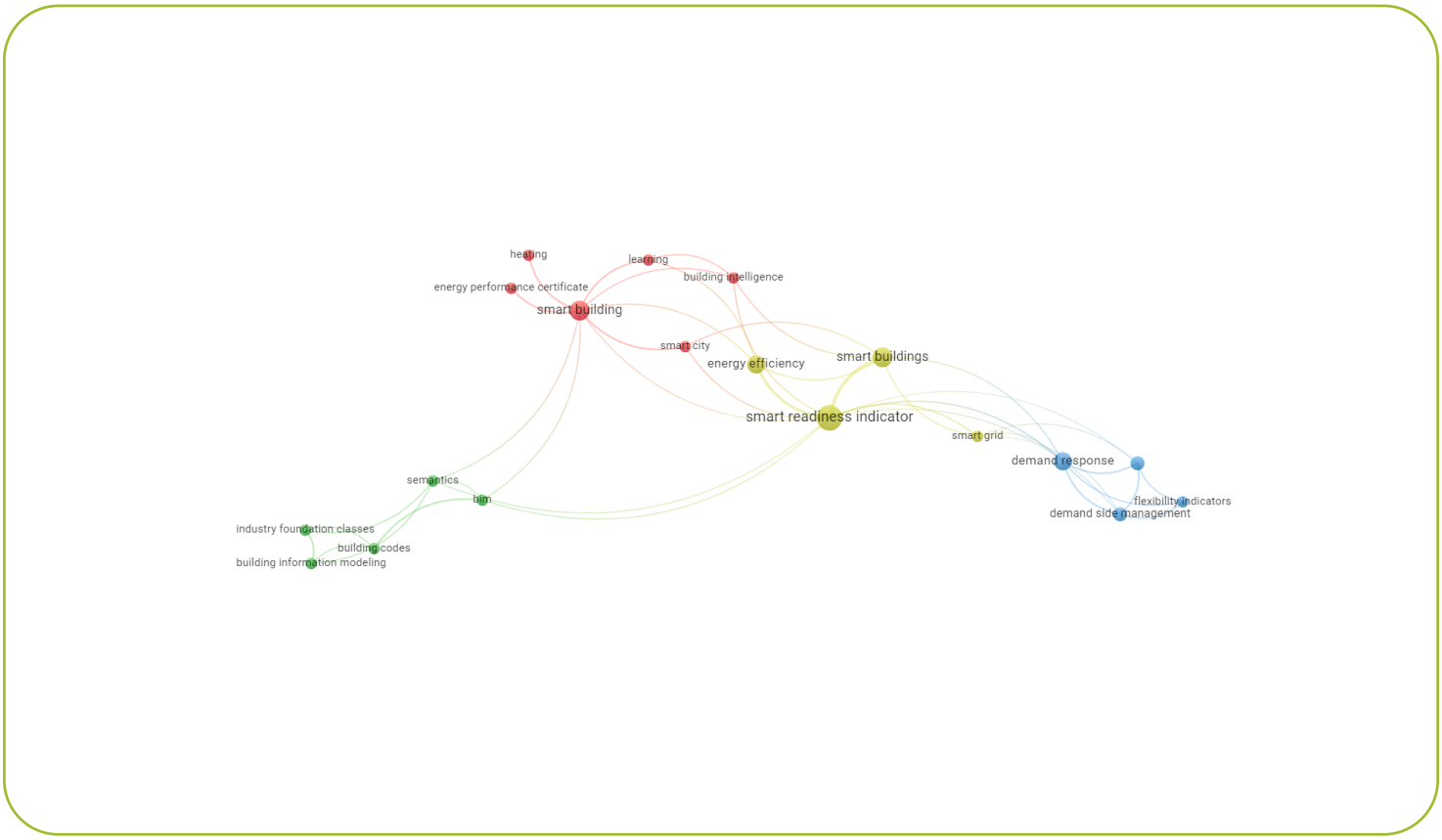

Figure 5. This map has been generated using VOS Viewer. It depicts the cooccurrence of keywords of many scientific publications.

To date, 47 scientific articles are identified as relevant for the research on building smartness. Also, 5 conference proceedings and 3 book sections.

The details of the selected research initiatives are provided below further reference.

Joud Al Dakheel, Claudio Del Pero, Niccolò Aste, & Fabrizio Leonforte (2020). Smart buildings features and key performance indicators: A review. Sustainable Cities and Society, 61, 102328.

Kari Alanne, & Seppo Sierla (2022). An overview of machine learning applications for smart buildings. Sustainable Cities and Society, 76, 103445.

Kari Alanne (2021). A novel performance indicator for the assessment of the learning ability of smart buildings. Sustainable Cities and Society, 72, 103054.

Rasa Apanaviciene, Rokas Urbonas, & Paris A Fokaides (2020). Smart Building Integration into a Smart City: Comparative Study of Real Estate Development. Sustainability, 12.

Vasilis Apostolopoulos, Paraskevi Giourka, Georgios Martinopoulos, Komninos Angelakoglou, Konstantinos Kourtzanidis, & Nikolaos Nikolopoulos (2022). Smart readiness indicator evaluation and cost estimation of smart retrofitting scenarios – A comparative case-study in European residential buildings. Sustainable Cities and Society, 82, 103921.

Alessia Arteconi, Alice Mugnini, & Fabio Polonara (2019). Energy flexible buildings: A methodology for rating the flexibility performance of buildings with electric heating and cooling systems. Applied Energy, 251, 113387.

Stella Athanasaki, & Katerina Tsikaloudaki (2022). Smart buildings for smart cities: Analysis of the Smart Readiness Indicator. Green Energy and Sustainability.

C Becchio, S Corgnati, G Crespi, Maria Cristina Pinto, & S Viazzo (2021). Exploitation of dynamic simulation to investigate the effectiveness of the Smart Readiness Indicator: application to the Energy Center building of Turin. Science and Technology for the Built Environment.

G Benndorf, N Réhault, M Clairembault, & T Rist (2017). Describing HVAC controls in IFC – Method and application. Energy Procedia, 122, 319-324.

Visit the sriobservatory.eu

to access the full ever-updated list of research initiatives in the field of building smartness!

LEARN MORE

Understand what happens behind the SRI Observatory scenes. Also, access additional resources produced by the Smart Square EU project to learn more about the SRI.

SRI FAQ

Find the answer to common questions about SRI with the SRI FAQ guide developed by the Smart Square EU project.

SRI Virtual Training Centre

Access learning material related to the understanding of the major principles of the SRI, as well as to the innovative digital tool developed by the Smart Square EU project to easily assess the SRI of a building or building unit.

Coming up in 2024

SRI OBSERVATORY

Stay up to date of the latest news on the SRI at https://sriobservatory.eu/

ABBREVIATIONS

Item	Description
DHW	Domestic Hot Water
EC	European Commission
EPB	Energy Performance of Buildings
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance of Buildings Certificate
EV	Electric Vehicle
SRI	Smart Readiness Indicator
TABS	Thermally Activated Building Structure
TES	Thermal Energy Storage

Icon	Description
	Heating technical domain of the SRI
	Cooling technical domain of the SRI
	DHW technical domain of the SRI
	Ventilation technical domain of the SRI
	Lighting technical domain of the SRI
	Dynamic building/envelope technical domain of the SRI
	Electricity technical domain of the SRI
	EV charging technical domain of the SRI
	Monitoring and Control technical domain of the SRI

SMART 2

ENHANCING THE INTELLIGENCE OF BUILDINGS IN EUROPE

SRI OBSERVATORY