Boosting Research for a Smart and Carbon Neutral Built Environment with Digital Twins –
SmartWins

Smartness and Energy Efficiency in buildings: The SRI methodology tool and the IsZEB Standard

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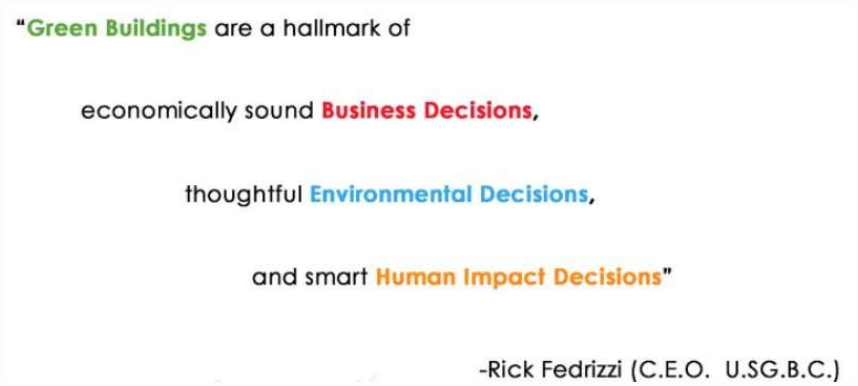
07 July 2023
Thessaloniki

Funded by the European Union

This project has received funding from the European Union's Horizon research and innovation programme under grant agreement No 101078997

SmartWins

Concept: Sustainable Development -> Smart, Energy Efficient Buildings



- Established and expanding in all areas of human activity with special focus on the **construction sector**
- Trend of adopting **bioclimatic design principles and monitoring the performance** of **existing and new buildings**, with the aim of **minimizing energy consumption and reducing costs throughout their life cycle**
- The need to ensure an established way to collect, evaluate and organize all the necessary information, in order to make the right decisions that lead to the desired performance results, motivates the development of various **assessment tools and certification standards**. They are specially **designed to evaluate the energy, the environmental performance and the smartness of buildings**

Smart Readiness Indicator (SRI)

In summary…

- Introduction to the SRI framework
- Overview of the SRI scoring methodology
- How to assess the Smart Readiness of a building
- IsZEB Certify – SRI Calculator

Introduction to the SRI framework

Backround and Vision

- With the European Green Deal and the Renovation Wave**, the European Union promotes the renovation of buildings, to help people cut their energy bills and energy use**
- 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 well- being of people**
- EPBD thus introduced the concept of a “Smart Readiness Indicator” (SRI): a **common EU framework for rating the smart readiness of buildings**
- The SRI concept has then been developed in close cooperation with Member States and relevant stakeholders of the building value chain
- Member States are now officially invited to implement the SRI (with possibly a preliminary test phase)

Introduction to the SRI framework

At building scale, an average 30% savings of final energy can be obtained when implementing an advanced package of smart building technologies

Smart technologies will be an essential enabler to decarbonise the building sector, while offering healthier, more efficient, and comfortable living environments

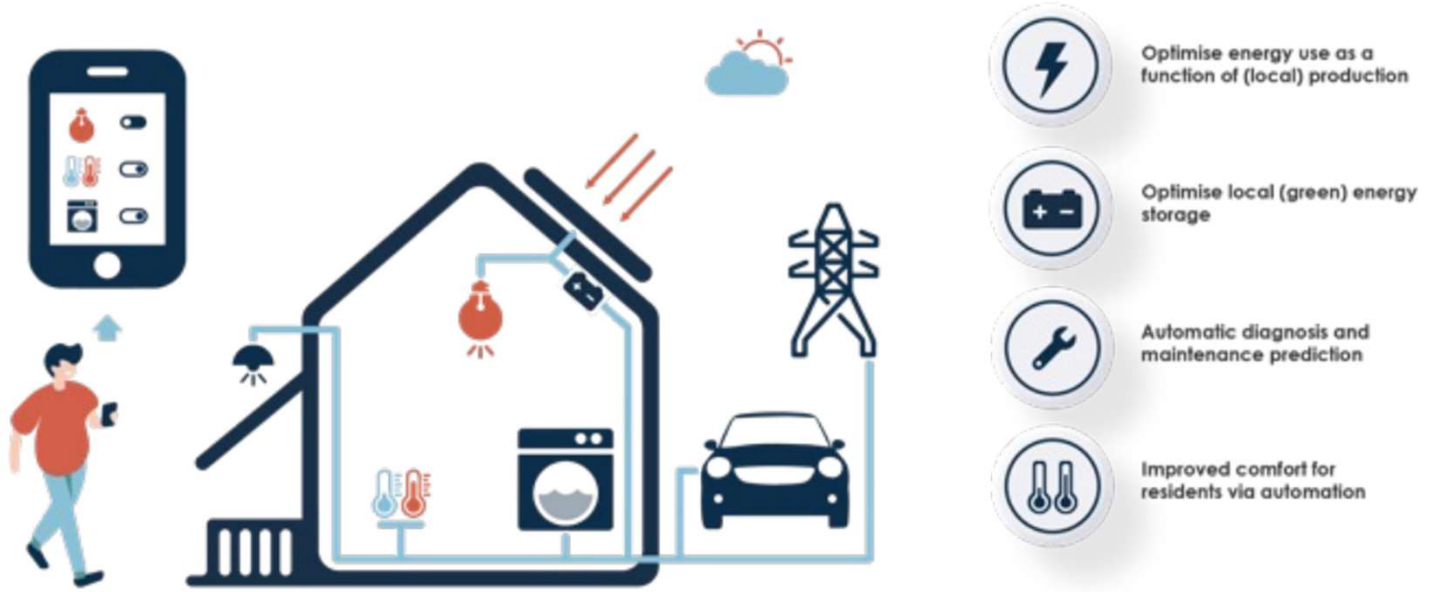


Figure source: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/smart-readiness-indicator_en

Introduction to the SRI framework

➢ Why Is SRI Relevant?

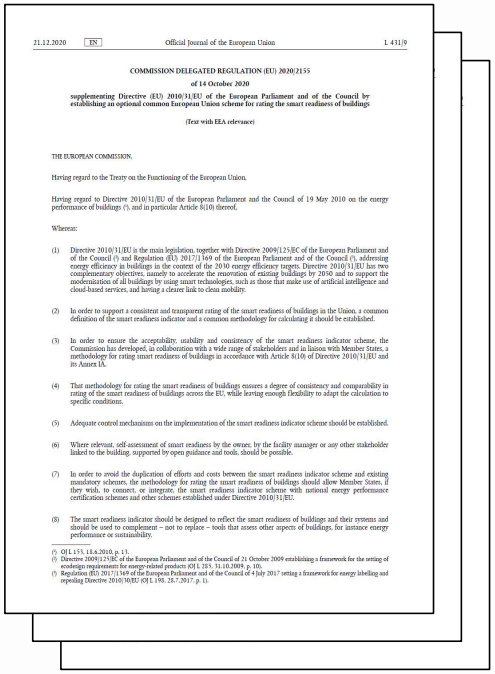
For instance:

- Digital technologies, such as smart thermostats and lighting control can pay back within 2 years.
- Smart technologies, such as automated sun shading control or ventilation control based on air-quality sensors can also improve health, well-being and comfort.
- Intelligent scheduling of energy consumptions (electric vehicles, etc) can result in significant energy savings and at the same time contributes to grid balancing.

SRI → provides a common language for building stakeholders (owners, designers, solution providers, etc).

EU Regulation: Smart Readiness Indicator

The scheme has been established by EU Regulation 2020/2155 where the **Smart Readiness Indicator (SRI)** and the methodology by which it is to be calculated are defined.



21.12.2020 EN Official Journal of the European Union L 431/9

COMMISSION DELEGATED REGULATION (EU) 2020/2155

of 14 October 2020

supplementing Directive (EU) 2010/31/EU of the European Parliament and of the Council by establishing an optional common European Union scheme for rating the smart readiness of buildings

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2010/31/EU of the European Parliament and the Council of 19 May 2010 on the energy performance of buildings (1), and in particular Article 8(10) thereof,

Whereas:

(1) Directive 2010/31/EU is the main legislation, together with Directive 2009/125/EC of the European Parliament and of the Council (2) and Regulation (EU) 2017/1369 of the European Parliament and of the Council (3), addressing energy efficiency in buildings in the context of the 2030 energy efficiency targets. Directive 2010/31/EU has two complementary objectives, namely to accelerate the renovation of existing buildings by 2050 and to support the modernisation of all buildings by using smart technologies, such as those that make use of artificial intelligence and cloud-based services, and having a clearer link to clean mobility.

(2) In order to support a consistent and transparent rating of the smart readiness of buildings in the Union, a common definition of the smart readiness indicator and a common methodology for calculating it should be established.

(3) In order to ensure the acceptability, usability and consistency of the smart readiness indicator scheme, the Commission has developed, in collaboration with a wide range of stakeholders and in liaison with Member States, a methodology for rating smart readiness of buildings in accordance with Article 8(10) of Directive 2010/31/EU and its Annex IA.

(4) That methodology for rating the smart readiness of buildings ensures a degree of consistency and comparability in rating of the smart readiness of buildings across the EU, while leaving enough flexibility to adapt the calculation to specific conditions.

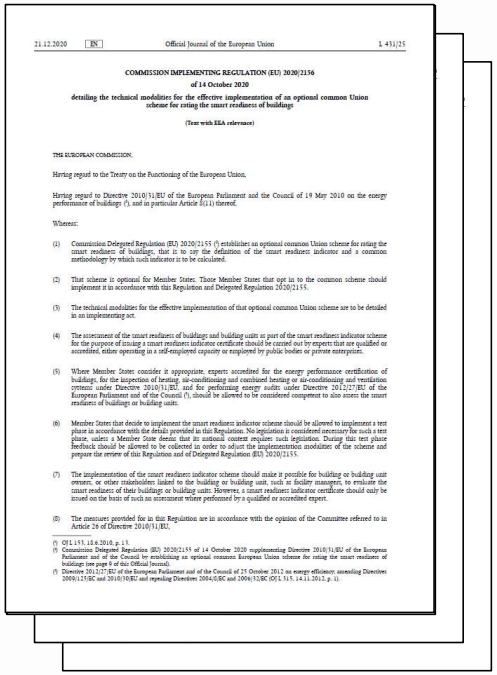
(5) Adequate control mechanisms on the implementation of the smart readiness indicator scheme should be established.

(6) Where relevant, self-assessment of smart readiness by the owner, by the facility manager or any other stakeholder linked to the building, supported by open guidance and tools, should be possible.

(7) In order to avoid the duplication of efforts and costs between the smart readiness indicator scheme and existing mandatory schemes, the methodology for rating the smart readiness of buildings should allow Member States, if they wish, to connect, or integrate, the smart readiness indicator scheme with national energy performance certification schemes and other schemes established under Directive 2010/31/EU.

(8) The smart readiness indicator should be designed to reflect the smart readiness of buildings and their systems and should be used to complement – not to replace – tools that assess other aspects of buildings, for instance energy performance or sustainability.

(1) OJ L 153, 18.6.2010, p. 13.
(2) Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (OJ L 285, 31.10.2009, p. 10).
(3) Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017 setting a framework for energy labelling and repealing Directive 2010/30/EU (OJ L 198, 28.7.2017, p. 1).



21.12.2020 EN Official Journal of the European Union L 431/25

COMMISSION IMPLEMENTING REGULATION (EU) 2020/2156

of 14 October 2020

detailing the technical modalities for the effective implementation of an optional common Union scheme for rating the smart readiness of buildings

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2010/31/EU of the European Parliament and the Council of 19 May 2010 on the energy performance of buildings (1), and in particular Article 8(11) thereof,

Whereas:

(1) Commission Delegated Regulation (EU) 2020/2155 (2) establishes an optional common Union scheme for rating the smart readiness of buildings, that is to say the definition of the smart readiness indicator and a common methodology by which such indicator is to be calculated.

(2) That scheme is optional for Member States. Those Member States that opt in to the common scheme should implement it in accordance with this Regulation and Delegated Regulation 2020/2155.

(3) The technical modalities for the effective implementation of that optional common Union scheme are to be detailed in an implementing act.

(4) The assessment of the smart readiness of buildings and building units as part of the smart readiness indicator scheme for the purpose of issuing a smart readiness indicator certificate should be carried out by experts that are qualified or accredited, either operating in a self-employed capacity or employed by public bodies or private enterprises.

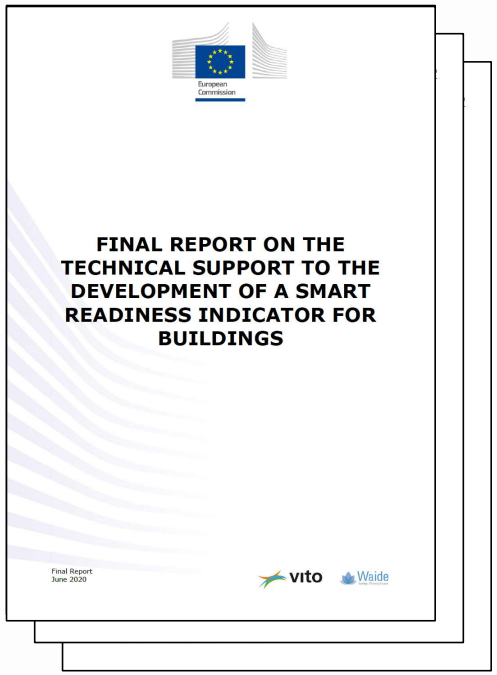
(5) Where Member States consider it appropriate, experts accredited for the energy performance certification of buildings, for the inspection of heating, air-conditioning and combined heating or air-conditioning and ventilation systems under Directive 2010/31/EU, and for performing energy audits under Directive 2012/27/EU of the European Parliament and of the Council (3), should be allowed to be considered competent to also assess the smart readiness of buildings or building units.

(6) Member States that decide to implement the smart readiness indicator scheme should be allowed to implement a test phase in accordance with the details provided in this Regulation. No legislation is considered necessary for such a test phase, unless a Member State deems that its national context requires such legislation. During this test phase feedback should be allowed to be collected in order to adjust the implementation modalities of the scheme and prepare the review of this Regulation and of Delegated Regulation (EU) 2020/2155.

(7) The implementation of the smart readiness indicator scheme should make it possible for building or building unit owners, or other stakeholders linked to the building or building unit, such as facility managers, to evaluate the smart readiness of their buildings or building units. However, a smart readiness indicator certificate should only be issued on the basis of such an assessment where performed by a qualified or accredited expert.

(8) The measures provided for in this Regulation are in accordance with the opinion of the Committee referred to in Article 26 of Directive 2010/31/EU,

(1) OJ L 153, 18.6.2010, p. 13.
(2) Commission Delegated Regulation (EU) 2020/2155 of 14 October 2020 supplementing Directive 2010/31/EU of the European Parliament and of the Council by establishing an optional common European Union scheme for rating the smart readiness of buildings (see page 9 of this Official Journal).
(3) Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (OJ L 315, 14.11.2012, p. 1).



SRI Methodology: General Context

The methodology can **assess the smart readiness** of a building which in turn has an effect on **energy efficiency**, **occupant comfort** and the **building's ability to adapt** its operation to the grid.

Final SRI Score and Rating

Key Smartness Functionalities of SRI

Impact Criteria

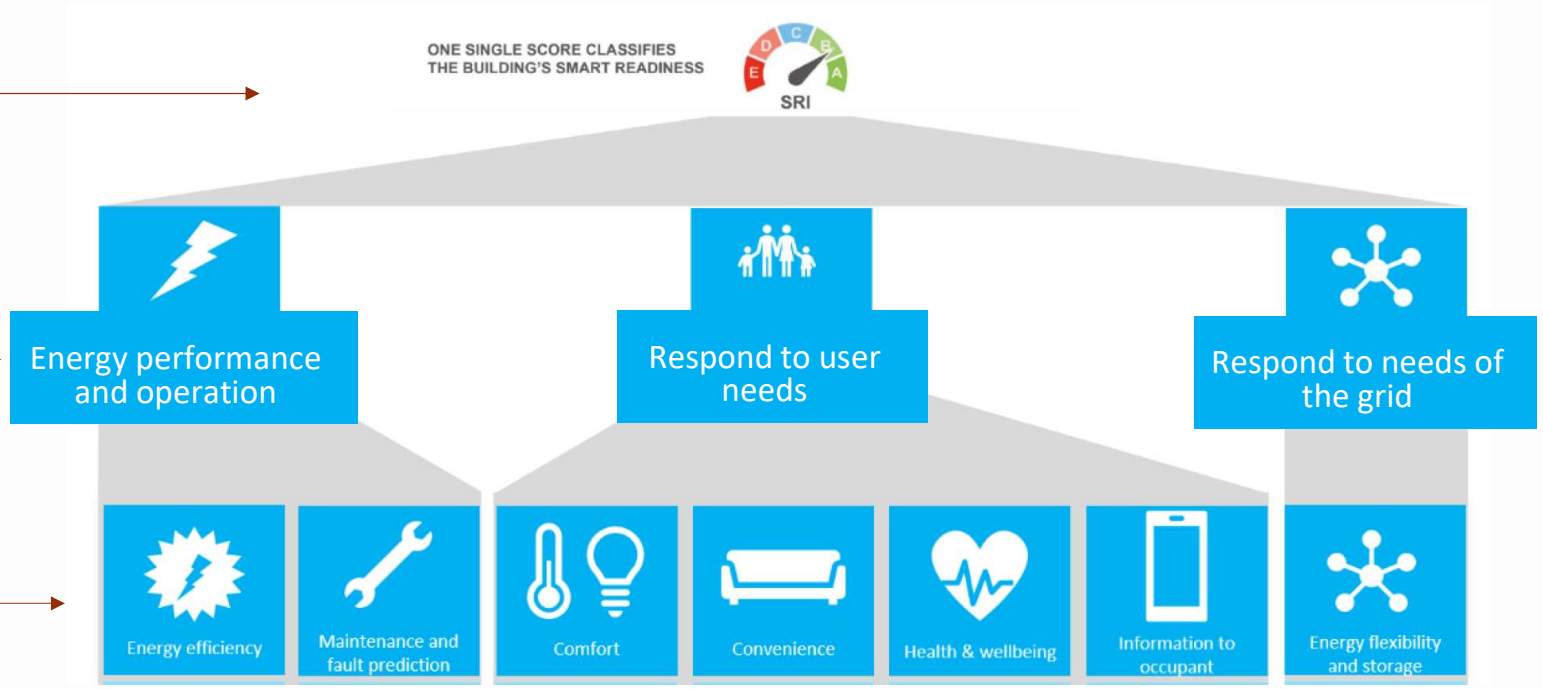


Figure source: Verbeke et al. "Final report on the technical support to the development of a smart readiness indicator for buildings", June 2020

3 Key Functionalities

The SRI assesses buildings (or building units), based on their capacity to satisfy three key functionalities:

Figure source: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/smart-readiness-indicator_en

7 Impact Criteria

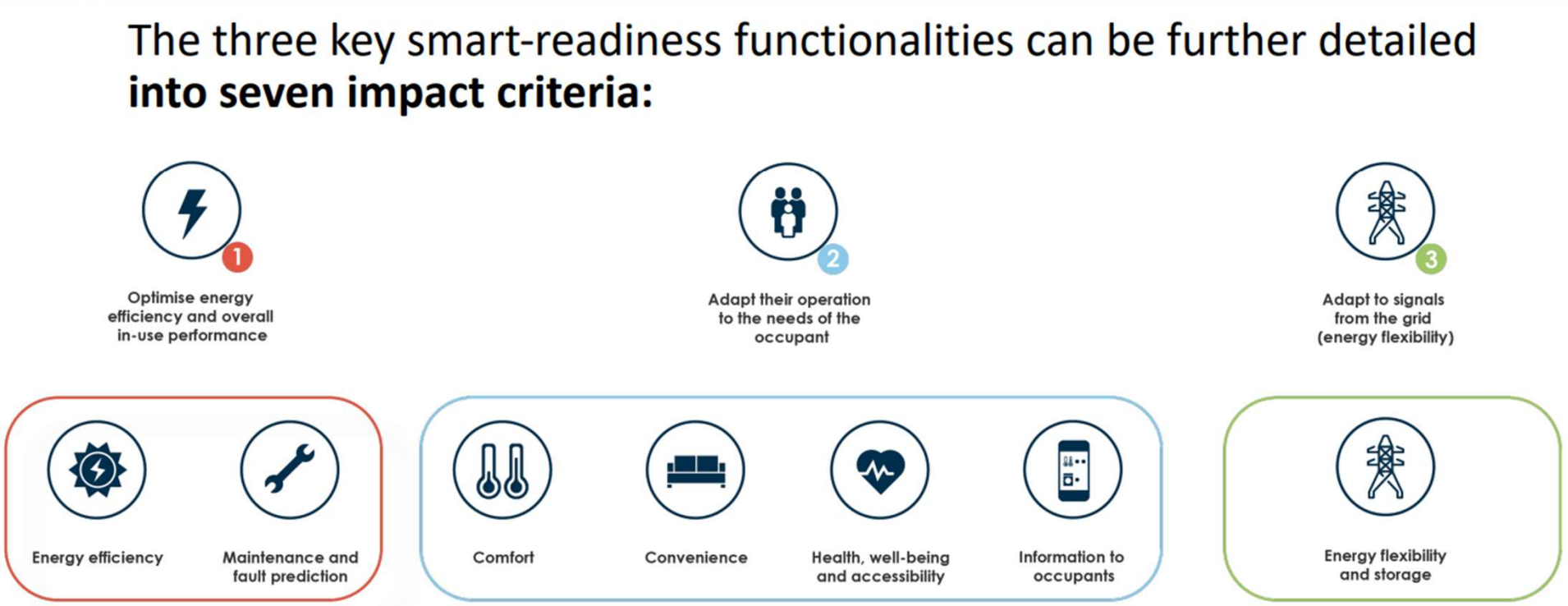


Figure source: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/smart-readiness-indicator_en

SRI Methodology: Technical Domains and Services

The methodology **assesses 9 technical domains**:

- ✓ Heating
- ✓ Cooling
- ✓ Domestic hot water
- ✓ Controlled ventilation
- ✓ Lighting
- ✓ Dynamic building envelope
- ✓ Electricity
- ✓ Electric vehicle charging
- ✓ Monitoring and control

Each **domain** contains **services**, where each one describes a particular aspect of building or system automation.

A **functionality level**, or "smartness" level is then assigned to each service.

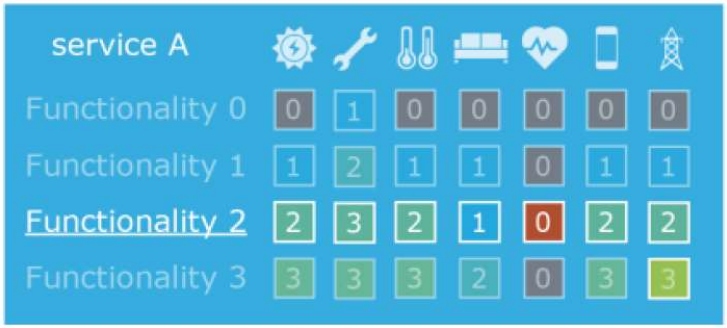


Figure source: Verbeke et al. "Final report on the technical support to the development of a smart readiness indicator for buildings", June 2020

SRI Methodology: Triage process – Multicriteria Analysis

Technical Domains can be:

- ❑ Present
- ❑ Absent and mandatory
- ❑ Absent and not mandatory

Multicriteria Analysis & Calculation Methodology

- Select operation levels for each service.
- The choice is based on the level of automation.
- Definition of Functionality Level Scores (FLEs).

From non-smart... *... to maximum smartness*

Code	Smart ready service	Functionality level 0 (default)	Functionality level 1	Functionality level 2	Functionality level 3	Functionality level 4
H-1a	Heat 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
DHW -3	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
C-2a	Generator control for cooling	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	

Figure source: Provisional guidance on the implementation of the SRI- Paul Waide, Stijn Verbeke, Sophie Dourlens & Regis Decorme, Sylvain Kubicki. European Commission

Scores calculated at different levels

The assessment provides detailed scores by domain and impact criterion (up to 57 scores)…

	Energy efficiency	Maintenance and fault prediction	Comfort	Convenience	Health, well-being and accessibility	Information to occupants	Energy flexibility and storage
Heating	%	%	%	%	%	%	%
Cooling	%	%	%	%	%	%	%
Domestic hot water	%	%	%	%	%	%	%
Ventilation	%	%	%	%	%	%	%
Lighting	%	%	%	%	%	%	%
Dynamic building envelope	%	%	%	%	%	%	%
Electricity	%	%				%	%
Electric vehicle charging		%		%		%	%
Monitoring and control	%	%	%	%	%	%	%

Figure source: Smart Readiness Indicator, version 2.0 (January 2022), European Commission

Scores calculated at different levels

	Overall SRI score (%) + SRI class							
	%		%				%	
	Optimise energy efficiency and overall in-use performance		Adapt its operation to the needs of the occupant				Adapt to signals from the grid (energy flexibility)	
	%	%	%	%	%	%	%	
	Energy efficiency	Maintenance and fault prediction	Comfort	Convenience	Health, well-being and accessibility	Information to occupants	Energy flexibility and storage	
Heating	%	%	%	%	%	%	%	%
Cooling	%	%	%	%	%	%	%	%
Domestic hot water	%	%	%	%	%	%	%	%
Ventilation	%	%	%	%	%	%	%	%
Lighting	%	%	%	%	%	%	%	%
Dynamic building envelope	%	%	%	%	%	%	%	%
Electricity	%	%				%	%	%
Electric vehicle charging		%		%		%	%	%
Monitoring and control	%	%	%	%	%	%	%	%

Figure source: Smart Readiness Indicator, version 2.0 (January 2022), European Commission

… and the overall SRI score with the corresponding SRI class (7 classes)

Two methods for the assessment process

Method A (simplified)

- Simplified service catalogue
- Typically for existing residential buildings or small non-residential buildings (low complexity)
- Check-list approach
- Assessment time < 1 hour
- Self-assessment possible

Method B (detailed)

- Full, detailed service catalogue
- Typically for **new buildings** and **nonresidential buildings** (higher complexity)
- On-site inspection / walk-through needed
- Assessment time < 1 day
- Necessary involvement of an expert, with support from a facility manager

✓ The assessment process is the same for both methods
✓ The service catalogue is different, which means the level of expertise required to conduct the assessment is different

The SRI Calculator - IsZEB Certify: The solution

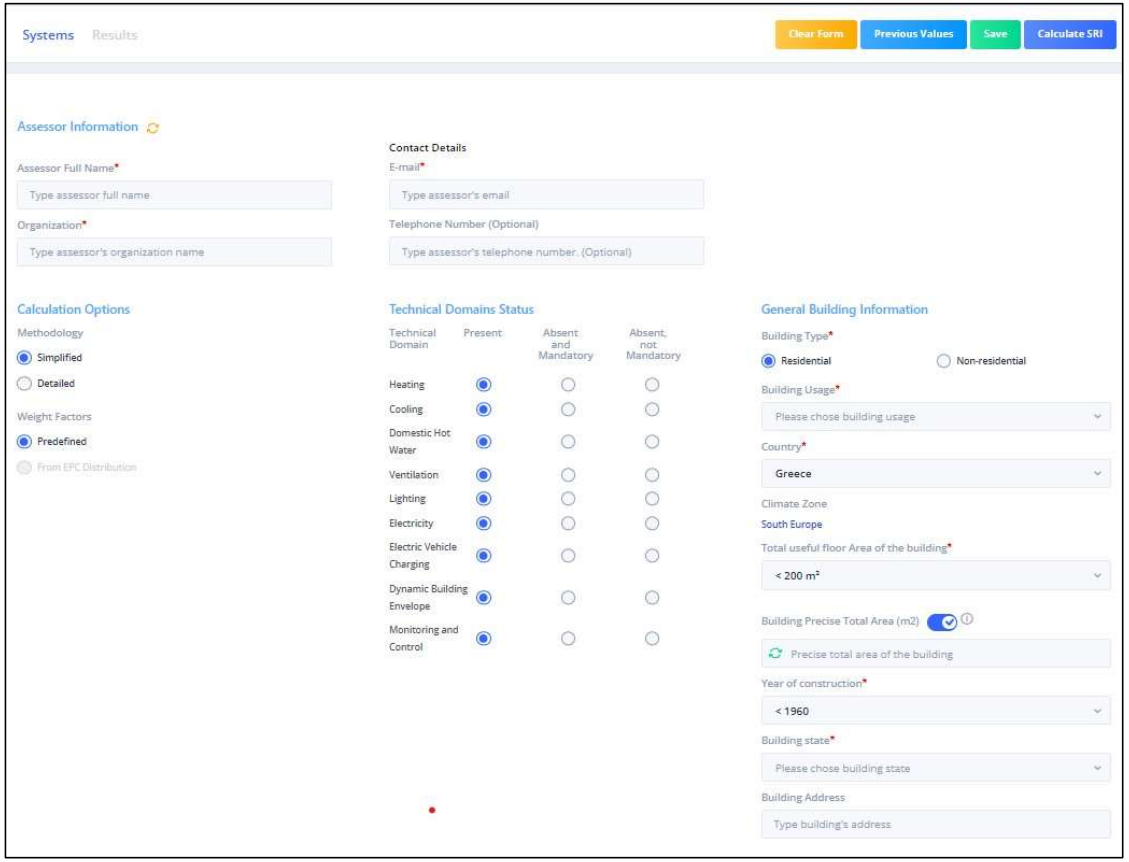


Image from IsZEB Certify

SRI Calculator: A **novel computational tool** has been developed to perform buildings' **SRI assessments**, according to the SRI Methodology

Added value: The tool can bring **added value** to the buildings owners by **evaluating** the buildings smartness readiness indicator and highlighting buildings' smartness improvement scenarios

The SRI Calculator: The process

Heating (10/10)

Code	Description	Percentage - Level
☑ H-1a	Heat emission control	50 % ☑ FL0 - No automatic control 0 % ☐ FL1 - Central automatic control (e.g. central thermostat) 50 % ☑ FL2 - Individual room control (e.g. thermostatic valves, or electronic controller) 0 % ☐ FL3 - Individual room control with communication between controllers and to BACS 0 % ☐ FL4 - Individual room control with communication and occupancy detection
☐ H-1b	Emission control for TABS (heating mode)	100 % ☑ FL0 - No automatic control 0 % ☐ FL1 - Central automatic control 0 % ☐ FL2 - Advanced central automatic control 0 % ☐ FL3 - Advanced central automatic control with intermittent operation and/or room temperature feedback control
☑ H-1c	Storage and shifting of thermal energy	0 % ☐ FL0 - None 0 % ☐ FL1 - HW storage vessels available 100 % ☑ FL2 - HW storage vessels controlled based on external signals (from BACS or grid)
☐ H-1d	Control of distribution pumps in networks	100 % ☑ FL0 - No automatic control 0 % ☐ FL1 - On off control 0 % ☐ FL2 - Multi-Stage control 0 % ☐ FL3 - Variable speed pump control (pump unit (internal) estimations) 0 % ☐ FL4 - Variable speed pump control (external demand signal)
☐ H-1f	Thermal Energy Storage (TES) for building heating (excluding TABS)	100 % ☑ FL0 - Continuous storage operation 0 % ☐ FL1 - Time-scheduled storage operation 0 % ☐ FL2 - Load prediction based storage operation 0 % ☐ FL3 - Heat storage capable of flexible control through grid signals (e.g. DSM)

Image from IsZEB Certify

The assessor chooses the **proper Functionality Level** for each technical domain service.

The Catalogue of services is **automatically updated** based on the Mechanical, Electrical and Plumbing (MEP) systems that are present in the building.

The SRI Calculator: The analysis

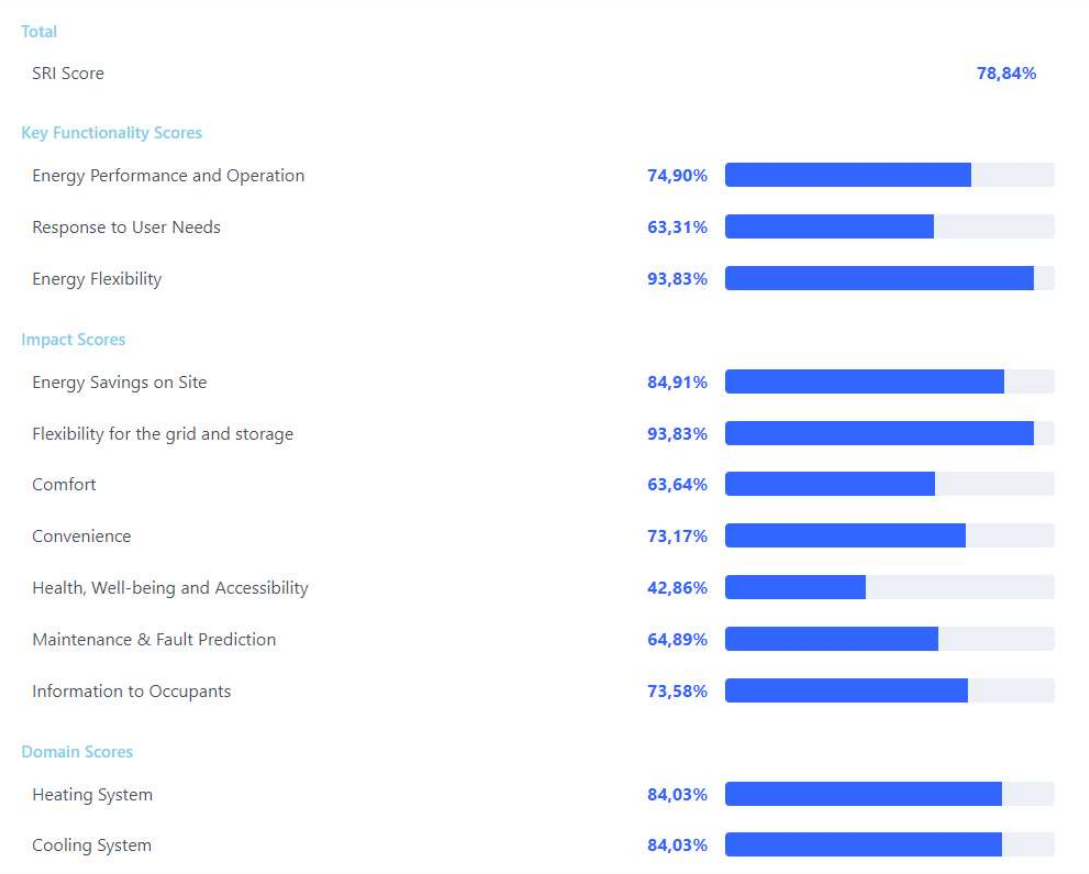


Image from IsZEB Certify

IsZEB Certify

Calculates:

- **Overall** SRI Score
- **Technical Domains** Score
- **Impact Criteria** Score

The final results consist of an SRI Certificates issuance, accompanied with a complete technical report, including descriptions and chart representations, as well as benchmarking analysis of buildings' smart readiness between the current situation and the proposed improvement scenarios.

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The SRI Calculator: The overall matrix

Smartness Readiness Indicator Results (SRI)

IMPACT CRITERIA

TECHNICAL DOMAINS	Smartness Readiness Score	Energy Performance	Maintenance & Fault Prediction	Comfort	Convenience	Health, Well-being and Accessibility	Information Distribution to Tenants	Energy Flexibility & Energy Storage	Technical Domain Score
Heating	100%	100%	50%	87.5%	87.5%	66.67%	66.67%	100%	84.03%
Cooling	100%	100%	50%	87.5%	87.5%	66.67%	66.67%	100%	84.03%
Domestic Hot Water	0%	0%	0%	0%	0%	0%	0%	0%	0%
Ventilation	0%	0%	50%	0%	0%	42.86%	66.67%	0%	26.19%
Lighting	100%	100%	0%	80%	80%	66.67%	0%	0%	85.33%
Dynamic Building Envelope	20%	20%	0%	20%	16.67%	0%	0%	0%	9.58%
Electricity	80%	80%	83.33%	0%	90%	0%	100%	100%	91.67%
Electric Vehicle Charging	0%	0%	0%	0%	100%	0%	66.67%	25%	44.44%
Monitoring & Control	87.5%	87.5%	81.82%	100%	76.47%	50%	77.78%	88.89%	83.2%

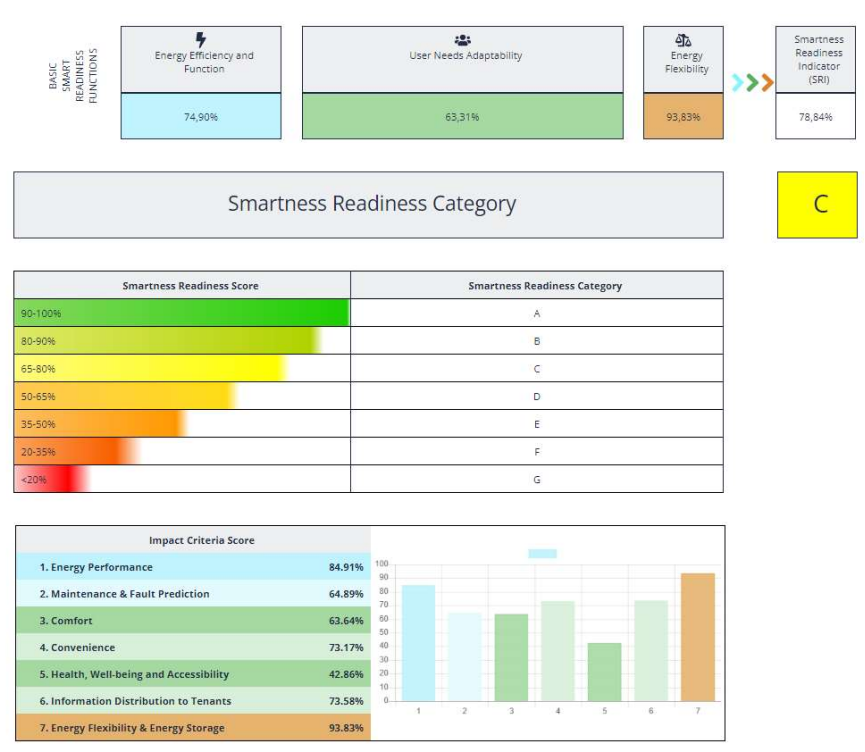

Image from IsZEB Certify

IsZEB Standard - Methodology

In summary…

- The Concept of the Standard
- The added value
- Evaluation Methodology
- IsZEB Certify – IsZEB Standard Calculation tool

Digitalize: The concept of the Standard

A dynamic framework for the development of Smart and NZEB - Positive Energy Buildings (PEBs)

Including:

- Standard Handbook (Guidance, Specifications, Best Practices)
- Assessment Methodology, Digital Tools
- Certification Process, Buildings Register
- Ecosystem

Methodology	Provides a **holistic** assessment of energy efficient and smart buildings throughout the **whole lifecycle** of the building
Building analysis	**Analyses and elaborates** existing standards and methodologies on a national and international level (ex. TOTEE, KENAK, SRI, Ecodesign and Ecolabelling schemes)
Innovation	Encompasses R&D Results – **Methodology Core Engine**, **Exploitation of BIM techs**
Feedback from WGs	**Stakeholders** provide and elaborate **technical knowledge** and insight of the Construction sector **actual needs**
On going process	**Future** editions will include more levels of building assessment (ex. **LCC, LCA**)
Digitalization	Support by innovative **RnD digital calculation tools**

Standard: The Added Value

1. **Multilevel analysis of a smart and energy efficient building** under a unified quality badge
2. **Assessment of all the significant energy consumptions** and parameters for **all building** categories
3. Applied in **new** or **existing** buildings under refurbishment
4. Dynamic Standard: **Continuous development** under the Ecosystem

5. Supported by innovative, user friendly **tools** and **educational activities**
6. **Exploitation** of **digital tools** that enhance **digital maturity** in Construction SMEs
7. Can be utilized for **Funding Programs** and **Property Evaluation**
8. Interconnects **Innovation** and the **real needs** of the Construction Sector Market

Evaluation Methodology Under the Standard

Evaluation Structure								
Building Level	**Energy Efficiency**	**Smartness**	**Building Shell Properties**	**Internal Air Quality (I.A.Q.)**	**Thermal Comfort**	**Sound Insulation**	**Structural Fire – Anti- seismic Protection**	**Waste Management**
Evaluation Domains	8	9 Domains 7 Impacts	4	3	5	1	2	3
Evaluation Services	114	54	13	11	11	5	8	3
Functionality Levels	0-4 per service	0-4 per service	0-4 per service	0-4 per service	0-4 per service	0-4 per service	0-4 per service	0-4 per service

Evaluation Methodology Under the Standard

Domains

Energy Efficiency	Smartness	Building Shell Properties	Internal Air Quality (I.A.Q.)	Thermal Comfort
•Passive Design •Heating •Cooling •Mechanical Ventilation •D.H.W •Lighting •R.E.S Generation •Electrical Equipment	•Heating •Cooling •D.H.W •Ventilation •Lighting •Dynamic Envelope •Electricity •Electric Vehicle Charging •Monitoring and Control	•Humidity Control •Dehumidification •Thermal Inertia •Radioactivity	•Mould Growth •I.A.Q. Monitoring •Ventilation	•Moisture Control •Building Shell •Passive Design •Heating •Cooling

Sound Insulation	Structural Fire Protection	Anti-seismic Protection	Waste Management
•Thermal Insulation and Sound Proofness	•Thermal Insulation and Fire Protection	•Thermal Insulation and Anti-Seismic Protection	•Management of waste during construction/ reconstruction •Municipal waste collection (by users) •Municipal waste collection (by the competent public/ private agency)

Exploiting The Results

Increasing the IsZEB Score means **achieving a building:**

- with lower energy consumption
- with lower operating costs
- with a longer life of its structural elements and machinery
- with better conditions of thermal and acoustic comfort and air quality
- with more safety in case of fire or earthquake
- with a less environmental footprint
- more adapted to the needs of the user and the energy grid
- more user interactive

SmartWins

www.iszeb.gr

Thank you !

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Boosting Research for a Smart and Carbon Neutral Built Environment with Digital Twins – **SmartWins**

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Funded by the European Union

This project has received funding from the European Union's Horizon research and innovation programme under grant agreement No 101078997

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