Smart Readiness Indicator for building – integration in the ALDREN EPC

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The smart readiness, achieved by better automation, new functionalities related digitalisation and electromobility, contribute to a better building quality and increase the building value. The Commission Delegated Regulation (EU) 2020/2155 (oct 2020) establish a smart readiness methodology defining a Smart Readiness Indicator (SRI). This article presents the EU methodology and the practical implementation by the ALDREN Energy Performance Certificate.

Keywords: Building automation, Commission Regulation, smart Buildings, Smart Readiness Indicator, Energy Performance Certificate

1. Context

DIRECTIVE (EU) 2018/844 of 30 May 2018 amending the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED) complete the energy assessment of buildings by an optional indicator called "Smart Readiness Indicator" (SRI). The intention is to support building digitalisation, new functionalities, automation and monitoring of technical building systems for improvement of energy efficiency. The Commission Delegated Regulation (EU) 2020/2155 of 14 October 2020 establish an optional common Union scheme for rating the smart readiness of buildings defining the smart readiness indicator and a common methodology for calculation **[1].**

The integration of the SRI underlines the more and more holistic approach of the building assessment, (e.g. by enlarging the assessment from energy to health and wellbeing), digitalisation and the integration of the building in the infrastructure of an overall decarbonisation of the economy, e.g. by including the transport sector. Car batteries, and their smart charging - discharging, make possible to use them as a source of power and storage, e.g. to secure intermittent energy supply of on-site renewable energy production.

The smart readiness indicator measures the capacity of buildings to use information and communication technologies to adapt the operation of buildings to the needs of the occupants and the grid, to improve the energy efficiency of the building and the energy chain (supply and demand optimisation).

The SRI should raise awareness and confidence of the value of building automation, new enhanced-functionalities and equipment by showing the Smart readiness level of the building. The SRI, based on transparent advisory tools, will also contribute to reduce the risk of investments in the building sector if used in due diligence.

The SRI completes the information of the building owner and user on the quality of the building and should therefore be integrated in the Energy Performance Certificate as the ALDREN EPC (https://aldren.eu/) **[3]** and the EPC RECAST (still ongoing) **[4].**

2. The structure of the SRI rating system – SRI methodology

- **Three "SRI key functionalities"**

Annex IA of the Directive establish a general framework for the rating of the smart readiness of buildings. The framework relies **on three SRI key functionalities**:

- the ability to maintain the energy performance by the adaptation of the energy consumption;
- the ability to maintain healthy indoor climate conditions, by adapting its operation mode to the needs of the occupant and to report on energy use;
- the ability to establish a grid flexibility of the building's overall electricity demand (e.g. load shifting).

To work out the details and to support Member States in the transposition of the general framework, the EU Commission financed a service contract **[2].** To illustrate the three SRI key functionalities a tri-partite mnemonic is proposed (see **figure 1**).

Figure 1: Tri-partite mnemonics illustrating the three SRI key functionalities
(source: Technical support studies on SRI – EU DG for Energy Efficiency: Buildings and Products **[2]**)

- **Seven smart ready service impact criterion**

The rating of the SRI is based on "smart ready services". Smart-ready service means a function, or an aggregation of functions provided by one or more technical components or systems. Examples of Smart ready services are heat emission control, control of distribution pumps, generator control for cooling, etc. The information source to define the smart ready service are largely based on European standards**.** A smart ready service can provide several impacts. An impact criterion means a key impact that smart-ready services are designed to achieve. In the proposed approach, a set of seven "impact criteria" is evaluated (see **figure 2**).

Figure 2: The seven Smart service impact criterion
(source: Technical support studies on SRI – EU DG for Energy Efficiency: Buildings and Products **[2]**)

The seven impact criterion are linked to the three SRI key functionalities in the following way:

a) Key functionality **"Energy savings and maintenance"** is linked to the impact criterion:

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- "Energy savings on site" which refers to energy saving capabilities (e.g. resulting from better control of room temperature settings);
- "Maintenance and fault prediction" which may significantly improve the operation of the technical building systems;

b) Key functionality **"Comfort, ease & wellbeing"** is linked to the impact criterion:

- "Comfort" which refers to conscious and unconscious perception of the physical environment, including thermal comfort, acoustic comfort and visual performance (e.g. provision of sufficient lighting levels without glare);
- "Convenience" which refers to services which "make life easier" for the occupant (e.g. systems requiring fewer manual interactions);
- "Health and well-being" which refers to smarter controls that can deliver an improved indoor air quality compared to traditional controls;
- "Information to occupants" which refers to the provision of information on building operation.

c) Key functionality "**Grid flexibility"** is linked to the impact criterion:

- "Grid flexibility and storage" which refers to the energy flexibility potential of the building on the grid (e.g. electricity grids, district heating).

In the actual proposal a list of 55 smart ready services is proposed.

➢ **"Functionality level" and "impact score"**

Each of the services can be implemented with various degrees of smartness. The degree (level) of smartness is expressed by the "functionality level". For each service up to 5 functionality levels (level 0 – level 4) are defined. A higher functionality level reflects a "smarter" implementation of the service, which provides more beneficial impacts to the building.

For each functionality level an "impact score" (e.g. 0-3) has been defined for each of the seven impact criteria (see **figure 3**). While most of the impacts are positive, some of them may also be negative (e.g. uncontrolled charging of batteries on grid flexibility).

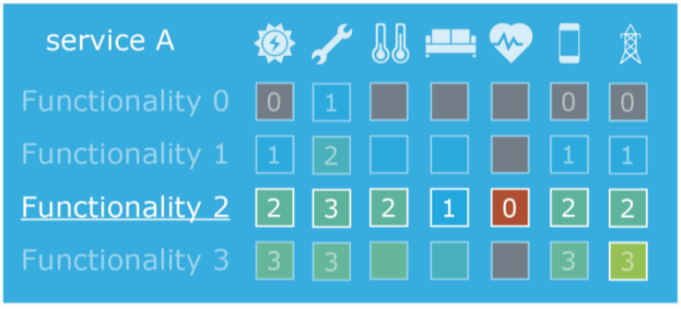

Figure 3: Functionality levels and impact scores for the seven impact categories of "service A" (source: Technical support studies on SRI – EU DG for Energy Efficiency: Buildings and Products **[2])**

Figure 4 shows the example of the smart ready service "Heat emission control" where five functionality levels are defined ranging from "no automatic control" (level 0) to "occupancy detection" (level 4). It is considered that the impact score for level 0 is 0 for the seven impact categories. Functionality level 4 has an impact score of 3 on impact category "Energy savings on site".

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domain	heating							
code	service	1						
Heating-1a	Heat emission control		Service group:	Heat control - demand side				
Functionality levels		IMPACTS						
		Energy savings on site	Flexibility for the grid and storage	Comfort	Convenience	Health & wellbeing	maintenance & fault prediction	information to occupants
level 0	No automatic control	0	0	0	0	0	0	0
level 1	Central automatic control (e.g. central thermostat)	1	0	1	1	1	0	0
level 2	Individual room control (e.g. thermostatic valves, or electronic controller)	2	0	2	2	2	0	0
level 3	Individual room control with communication between controllers and to BACS	2	0	2	3	2	1	0
level 4	Individual room control with communication and occupancy detection	3	0	2	3	2	1	0
	Information sources							
	Standard?	EN 15232						

Figure 4: Example of service "Heat emission control" and impact scores for the seven impact categories (source: Technical support studies on SRI – EU DG for Energy Efficiency: Buildings and Products **[2])**

- **"Technical domains"**

A technical domain means a collection of smart-ready services which, together, realise an integrated and consistent part of the services expected from the building or building unit such as heating. In the developed SRI service catalogues the smart ready services are structured within nine "technical domains": heating, cooling, domestic hot water, controlled ventilation, lighting, dynamic building envelope, electricity, electric vehicle charging, monitoring and control.

The technical domains are also the most detailed level of smartness scores information (see **figure 5**).

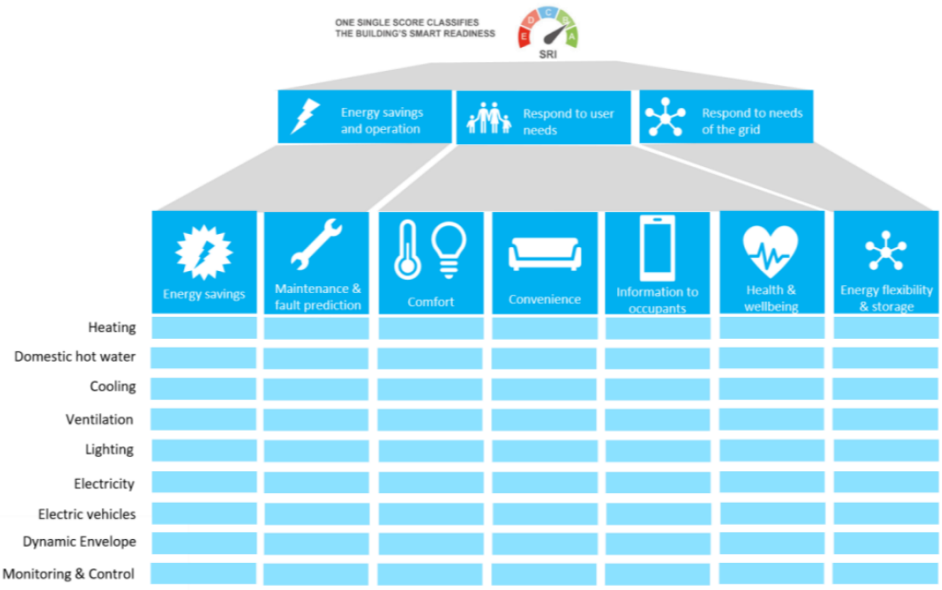

Figure 5: Overall structure of 9 domains, 7 impact criterion, 3 SRI key functionalities and the final single score (source: Technical support studies on SRI – EU DG for Energy Efficiency: Buildings and Products **[2])**

- **Smart readiness score (%) – from the smart ready service to the single building score**

The smart readiness score means the score obtained by a building or building unit as part of the process for rating smart readiness. The process of scoring starts with the assessment at domain level, per impact criterion by evaluating the impact scores (absolute values).

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Once all these individual services impact scores are known, an aggregated impact score is calculated for each technical domain. The domain impact score is calculated as the ratio (expressed as a percentage) between individual scores of the domains' services and theoretical maximum individual score.

For each impact criterion, a total impact score is then calculated as a weighted sum of the domain impact scores. The weight of a given domain will depend on its relative importance for the considered impact. The weighting factors for the technical domains are derived from the importance of the domain in the overall energy balance of the building. For example, the heating domain will gain importance in northern areas of Europe, whereas the relative importance of the cooling domain would increase in southern areas of Europe. For domains where no direct link with an energy balance can be made (e.g. monitoring & control), a weighting factor can be defined based on the estimated impact.

The proposed methodology provides default weighting factors which are differentiated by building type and climate zone.

The final single building SRI score (see **figure 6**) is the weighted sum of the 3 SRI key functionalities. The aggregated SRI score indicates the overall smartness level of the building, while sub-scores allow to assess specific domains and impact categories.

Figure 6: Example of final single building SRI score
(source: Technical support studies on SRI – EU DG for Energy Efficiency: Buildings and Products **[2]**)

3. The ALDREN-SRI contribution and integration in the ALDREN EPC

The objective of the European Commission funded H2020 project ALDREN (**AL**liance for **D**eep **REN**ovation in buildings) is to support the holistic approach of the EPBD building assessment by providing practical common methods and tools to help the Member States to implement the new requirements of the amended EPBD (2018). The backbone of ALDREN is the European Voluntary Energy Performance Certificate (ALDREN-EPC **[5]** including the most detailed set of indicators, e.g. non-renewable primary energy, indoor environment score and quality indicator ALDREN-TAIL, financial risk, reliability (see **figure 7**).

The ALDREN EPC is completed by the ALDREN-BRP (Building Renovation Passport) **[6]** which contains a Building data depository (the building logbook) and a Building Renovation Roadmap (see **figure 8**). The optional building renovation passport and the step-by-step renovation roadmap is a recommendation in the amended EPBD.

The ALDREN EPC has a modular structure that allows Member States to adopt specific modules to complete the official certification scheme and comply with other duties of MSs coming from EU commitments, such as the reporting for SRI.

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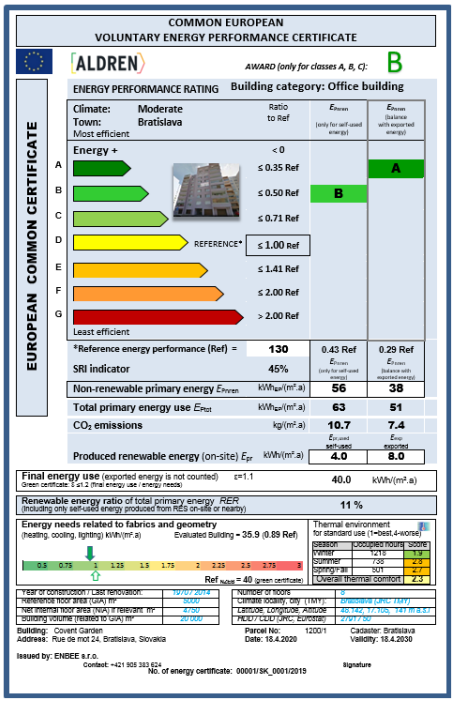

Figure 7: Front page of the ALDREN-EPC (source: The ALDREN project https://aldren.eu/)

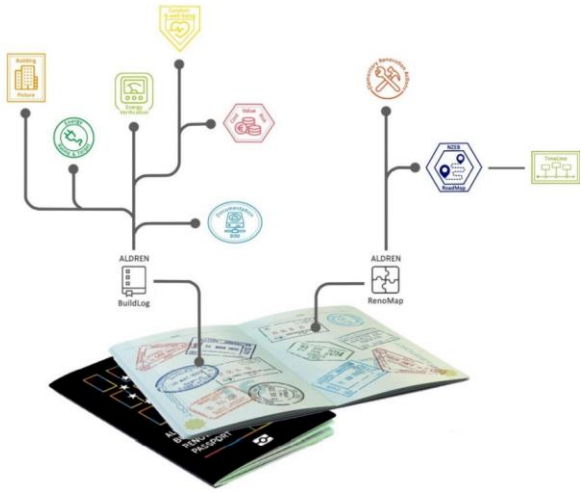

Figure 8: ALDREN BRP elements and modules (source: The ALDREN project https://aldren.eu/)

- **Assessment procedure and Data structure / collection (Inspection protocols)**

In the proposed SRI methodology, three SRI assessment procedures are described:

- Method A is based on a simplified and limited service list (e.g. for residential buildings). The assessment should take less than one hour for a single-family home;
- Method B is based on a full catalogue of smart services (e.g. for more complex non-residential buildings). The assessment could take 0,5 to 1 day;
- Method C could be a metered/measured method.

The assessment time depends on the degree of complexity of the SRI, but also on the available data. Therefore, ALDREN included in the ALDREN-BRP data catalogue a section related to the SRI, considering the Smart Readiness services and the functionality levels (see **figure 9**).

During an ALDREN EPC inspection, the needed SRI data should be collected at the same time. Some of the SRI data are redundant with the ALDREN EPC data, for example the Heating control data are needed for the SRI and the EPC. By harmonising the SRI data with the ALDREN modules, synergies will be created, redundancy and overlapping data collection will be avoided. Common Inspection and Data collection protocols will be further developed in the EPC RECAST project.

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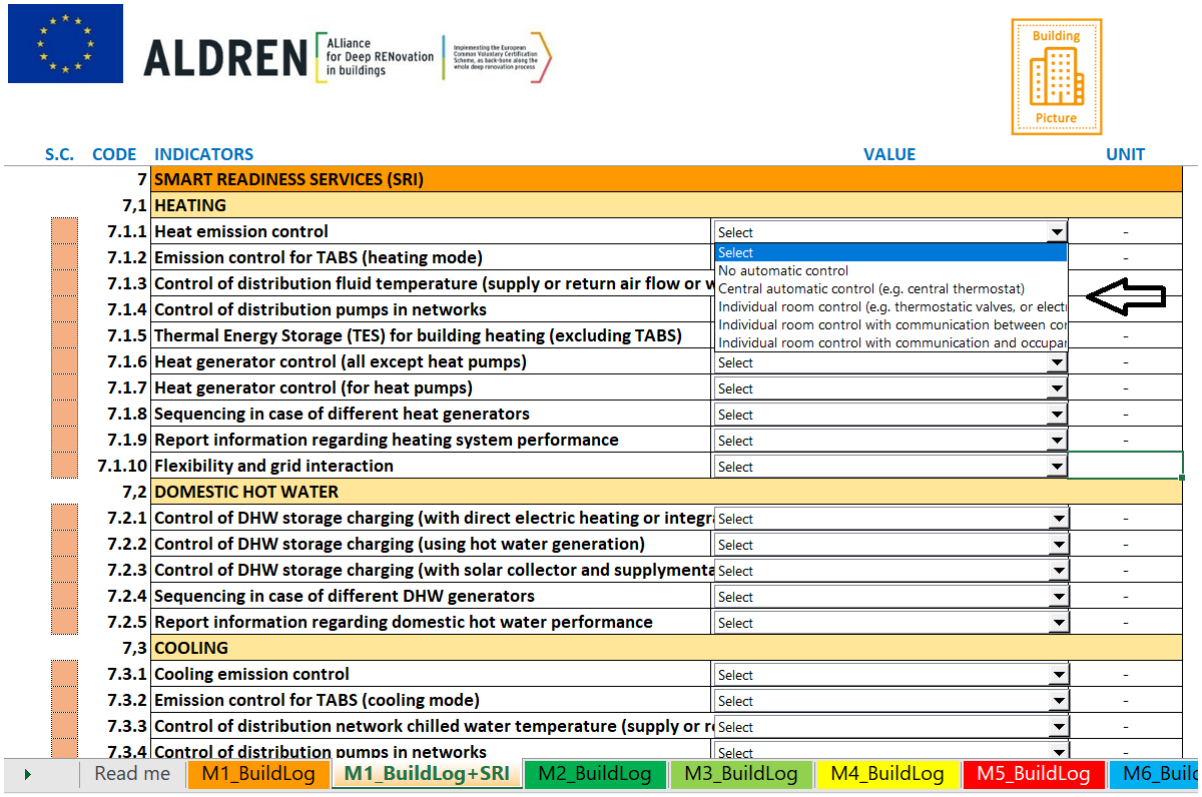

Figure 9: ALDREN-BRP data catalogue considering SRI Smart Readiness services and functionality levels (source: The ALDREN project https://aldren.eu/)

- **Recommendations – the ALDREN "upgrade action package"**

One of the main targets in Energy Performance Certificates (EPC) is allowing building owners, investors to better understand the quality of the existing building, e.g. on controls, services and the potential for improvements. In the SRI methodology the potential improvements are indicated in functionality levels of each of the 55 Smart ready services. This leads to the fragmentation of the information and makes it complicated for the SRI evaluator to formulate a coherent and understandable recommendation to the building owner.

In the SRI proposal, the Smart Ready services and related functionality levels are structured by technical domain. In addition, ALDREN developed a tool, clustering potential upgrades in "action packages". For example, the possible recommendations to reach a higher SRI score by control functionalities are resumed in the following upgrade action packages:

- Presence of controllable flexibility;
- Interactions with the grid;
- Demand Side Management (DSM) & control.

In the ALDREN-EPC a page is dedicated to the Smart Readiness Indicator. The SRI scores are presented for the current situation and the potential score after a proposed improvement. **Figure 10** shows an example related to the impact criteria "Energy demand flexibility". The recommendations to improve the flexibility score of the building are reported under the table based on the three action packages shown before.

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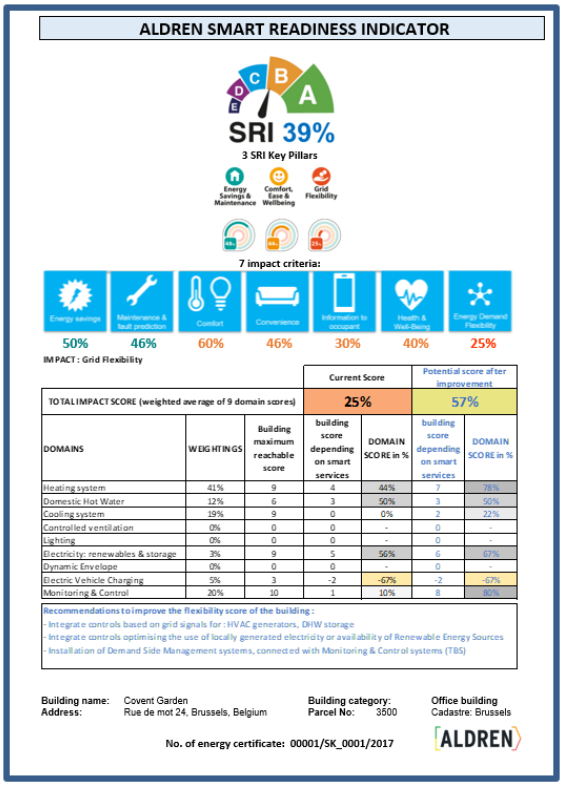

ALDREN SMART READINESS INDICATOR

SRI 39%

3 SRI Key Pillars

7 impact criteria:

50% 46% 60% 46% 30% 40% 25%

IMPACT : Grid Flexibility

	Current Score	Potential score after improvement
TOTAL IMPACT SCORE (weighted average of 9 domain scores)	25%	57%

DOMAINS	WEIGHTINGS	Building maximum reachable score	building score depending on smart services	DOMAIN SCORE in %	building score depending on smart services	DOMAIN SCORE in %
Heating system	41%	9	4	44%	7	78%
Domestic Hot Water	12%	6	3	50%	3	50%
Cooling system	19%	9	0	0%	2	22%
Controlled ventilation	0%	0	0	-	0	-
Lighting	0%	0	0	-	0	-
Electricity: renewables & storage	3%	9	5	56%	6	67%
Dynamic Envelope	0%	0	0	-	0	-
Electric Vehicle Charging	5%	3	-2	-67%	-2	-67%
Monitoring & Control	20%	10	1	10%	8	80%

Recommendations to improve the flexibility score of the building :
- Integrate controls based on grid signals for : HVAC generators, DHW storage
- Integrate controls optimising the use of locally generated electricity or availability of Renewable Energy Sources
- Installation of Demand Side Management systems, connected with Monitoring & Control systems (TBS)

Building name: Covent Garden
Address: Rue de mot 24, Brussels, Belgium
Building category: Office building
Parcel No: 3500
Cadastre: Brussels
No. of energy certificate: 00001/SK_0001/2017

Figure 10: ALDREN EPC page reporting SRI example on Energy demand Flexibility
(source: The ALDREN project https://aldren.eu/)

CEN-CE
CEN EPB Standards Certified Experts

Certificate

Registration number: HR-01-C-029-2019

confirming that

Mirko Boljevic

born on 17.09.1966

attended training, passed exam
and is a CEN EPB Standards Certified Expert for the following EPB Standards:

Overarching standard EN ISO 52000-1:2017 (M1-1, M1-2, M1-3, M1-5, M1-7, M1-8, M1-9, M1-10)					
Heat load EN 12831-1:2017 (M3-3)			Emission & controls EN 15316-2:2017 (M3-5)		
DHW needs EN 12831-3:2017 (M8-2)			Distribution systems EN 15316-3:2017 (M3-6)		
Measured energy EN 15378-3:2017			Generation - Boiler EN 15316-4-1:2017		
Inspection of boilers EN 15378-1:2017			Generation – Heat pump EN 15316-4-2:2017		
Economics EN 15459-1:2017			Generation – Solar, PV EN 15316-4-3:2017	4.12.2019	✓
Wind turbines EN 15316-4-10:2017 (M11-			Integrated cogeneration EN 15316-4-4:2017 (M3-8-4)		
District Heating & Cooling EN 15316-4-5:2017			Storage systems EN 15316-5:2017 (M3-8-7)	4.12.2019	✓
			Generation - Local heaters EN 15316-4-8:2017		
EQF level 5, 6					

Zagreb, 4.12.2019

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Figure 11: Examples of CEN-CE modular training Certificate
(source: The CEN-CE project https://www.cen-ce.eu/

4. The SRI, not stand-alone but part of the EPBD ecosystem

The EPBD "ecosystem" is mainly composed by Building quality assessment (EPC, BRP) and qualified experts using both national or common European methods based on European Standards.

The SRI is an additional and complementary indicator of the EPBD for building quality assessment. The EPBD defined already other indicators as the Renewable Energy Ratio (RER), the non-renewable Primary Energy Indicator (PEnren) etc. All together they contribute to inform about the quality of the building via the Energy Performance Certificate and the Building Passport.

Therefore, the SRI should not be considered as a "stand-alone" but as a part of the EPBD ecosystem. As already mentioned, this holistic approach will avoid misleading information and will allow to create and take benefit of the synergies, for example in common Inspection and data collection protocols.

The training on SRI assessment and the qualification of SRI expert should also be part of an integrated training on the EPBD (e.g. the methodology for calculating the energy performance of buildings (Article 3), the issue of energy performance certificates (article 12), the inspection and report on technical building systems (articles 14,15,16), the quality check (article 18) etc). Article 17 on Independent experts also request that the certification of buildings and the inspection of systems are carried out in an independent manner by qualified and/or accredited experts. It is likely that the SRI training and certification of expert only on SRI is economically not sustainable and technically not suitable because the synergies mentioned

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before would not be reached. The SRI training should be part of a modular training and certification structure of experts (see **figure 11**) as proposed in the H2020 CEN-CE project **[7].**

As the EPBD is a framework Directive, the final technical details of transposition on national level are defined by the Member States. The Commission Delegated Regulation (EU) 2020/2155 stipulates:

- Annex III: Member States shall define the respective weighting factors of relevant impact criteria;
- Annex VI: Member States make available at least one smart-ready catalogue. It includes the related functionality levels, and corresponding individual scores for the impact criteria.

In the EU there are around 30 different regional and national methodology for calculating the energy performance of buildings transposing article 3/EPBD. This leads to a fragmentation of the EU market, where easy comparability and rating of energy performance is impossible. The consequence are also barriers for the qualification of experts EU wide and additional costs for the industry and the user.

This situation should be avoided for the SRI implementation. To help the Member States to harmonise their calculation methodologies, the Commission supported the development of European Standards (mandate 480). When possible, these standards (e.g. EN 15232 **[8]**, EN ISO 52000-1 **[9]**) should also be the basis of the smart-ready catalogue and the related functionality levels. The link to the EU standards will also facilitate further development of the SRI methodology, for example from a purely qualitative methodology to a more quantitative appreciation. The EN ISO standard 52000-1 proposes already in Annex G Electrical grid load matching indicators (Use matching fraction, Production matching fraction, Grid interaction indicators) which could be used as **quantitative SRI indicators** in further SRI methodology development and applied consistently with the calculation of energy performance of building.

5. Resume and Conclusion

The definition of the SRI was a needed to show the value and contribution of building automation + control, of new enhanced-functionalities (e.g. operation flexibility) and equipment (e.g. electro vehicle loading station). The definition of a Smart Readiness Indicator is recommended in the amended EPBD (DIRECTIVE 2018/844 of 30 May 2018). An SRI methodology was worked out in an EU Commission financed "Technical support study on SRI". The principle of this study has been overtaken in the Commission Delegated Regulation (EU) 2020/2155 of 14 October 2020.

The ALDREN project integrated the SRI methodology in the ALDREN Energy Performance Certificate (EPC) and the ALDREN Building Renovation Passport (BRP) to demonstrate the practical implementation of the SRI methodology and to show the synergies between SRI, EPC and BRP. ALDREN harmonised the data structure of the SRI assessment with the data structure of the EPC / BRP to make the data collection more efficient, to avoid overlaps and redundancy. Common inspections and data collection protocols will be further developed in the EPC Recast project. ALDREN also developed a tool to structure the recommendations allowing building owners, investors to better understand the quality of existing controls/services and the potential for improvements.

The ALDREN SRI is a practical implementation of the Commission Delegated SRI regulation in the ALDREN EPC / BRP and an example of the integration in the EPBD ecosystem. A stand-alone SRI will complicate the market uptake because synergies with other EPC indicators would be missed, for example with the energy

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calculation in EN ISO 52000-1, which would complete the actual qualitative SRI approach by the quantification of the SRI impact.

Europe is the front runner in climate change mitigation. Several tools are under development or update (e.g. the EPBD, the EU green taxonomy, etc). It is key that all these tools talk a common language to keep consistency and to reduce the reporting burden. The synergies of SRI, EPC and the European Standards related to smart ready services should be used to create practical applications (e.g. inspection protocols, training and qualification of experts). A consistent approach would also allow to complete in future developments the purely qualitative approach of the actual SRI by a quantitative impact of smart ready services e.g. by using the software tools related to the EPBD.

The ALDREN-EVC, the ALDREN-BRP, the ALDREN-SRI are pieces which, if up taken by the EU Member States and other building key actors, contribute to build a common, coherent EU methodology to successfully reach the overall decarbonisation in the EU building sector by 2050.

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