Smart Readiness Indicator (SRI) for buildings not so smart as expected

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Progress of the technical study commissioned and supervised by the European Commission services (DG ENERGY) towards the development of a smart readiness indicator for buildings was reported in stakeholder meeting of 28 May 2018. SRI is a policy initiative by the European Commission, which is part of the amended Energy Performance of Buildings Directive (EPBD) [1]. In more detail, SRI is described in the second progress report from June 12 2018 [2].

Proposed SRI is a catalogue of smart ready services – 52 of such services are to be inspected. This should happen in a site visit, where an assessor inspects which smart ready services are present in a building, and to what functionality level they are implemented. This is assessed based on a simple check-list approach, e.g. "control the power of artificial lighting". Each of the services can be implemented with various degrees of smartness (referred to as 'functionality levels'), e.g. "manual on/off control of lighting", "automatic on/off switching of lighting based on daylight availability", or even "automatic dimming of lighting based on daylight availability". A higher functionality level is assumed to provide more beneficial impacts to the users of the building or the connected grid compared to a lower level. The smarter services with the higher functionality level the higher the score of the SRI.

Smart ready services are grouped into 10 domains; for every service or subservice, the functionality level is assessed with five options, i.e. from level 0 to 4. Assessed functionality levels result in impact scores in 8 impact criteria, which are listed in **Figure 1**. The 10 domains of the services are the following:

1. Heating
2. Domestic hot water
3. Cooling
4. Mechanical ventilation
5. Lighting
6. Dynamic building envelope
7. Energy generation
8. Demand side management
9. Electric vehicle charging
10. Monitoring and control

As a catalogue of smart ready services, SRI does not make an attempt to assess the performance of the building by any calculation or measurement. Therefore, there is no real performance quantification and it is quite evident that in different buildings the same service or technical feature can result in different outcomes. This calls for wider discussion how SRI should be set up. The current approach is very much targeted to existing (old) buildings, where checklist-based assessment is cheap and easy to conduct. However, existing buildings are not the only use case of SRI, as the most focus of EPBD is on design of new buildings and major renovations. In the design phase, quantitative assessment for instance with energy and indoor climate simulation tools, would be natural way for the performance assessment. As the development of SRI is in a half way, it is possible that quantitative, performance-based approach would be considered in next steps.

What are the main challenges of the quantitative approach? According to EPBD SRI should focus on

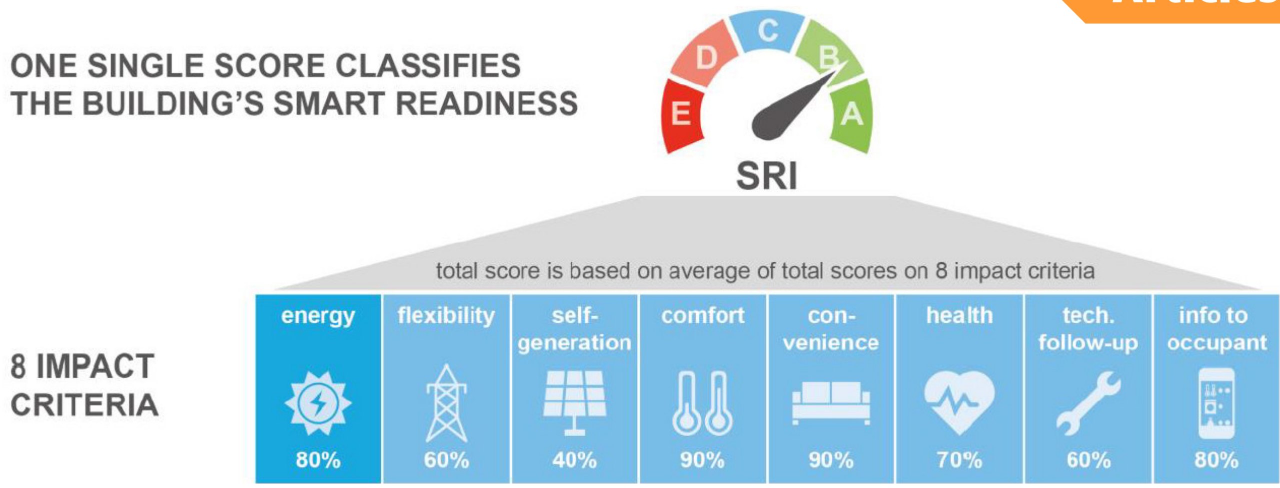

Figure 1. Proposed SRI indicator based on a catalogue of smart ready services, which functionality levels result in scoring on 8 impact criteria [2].

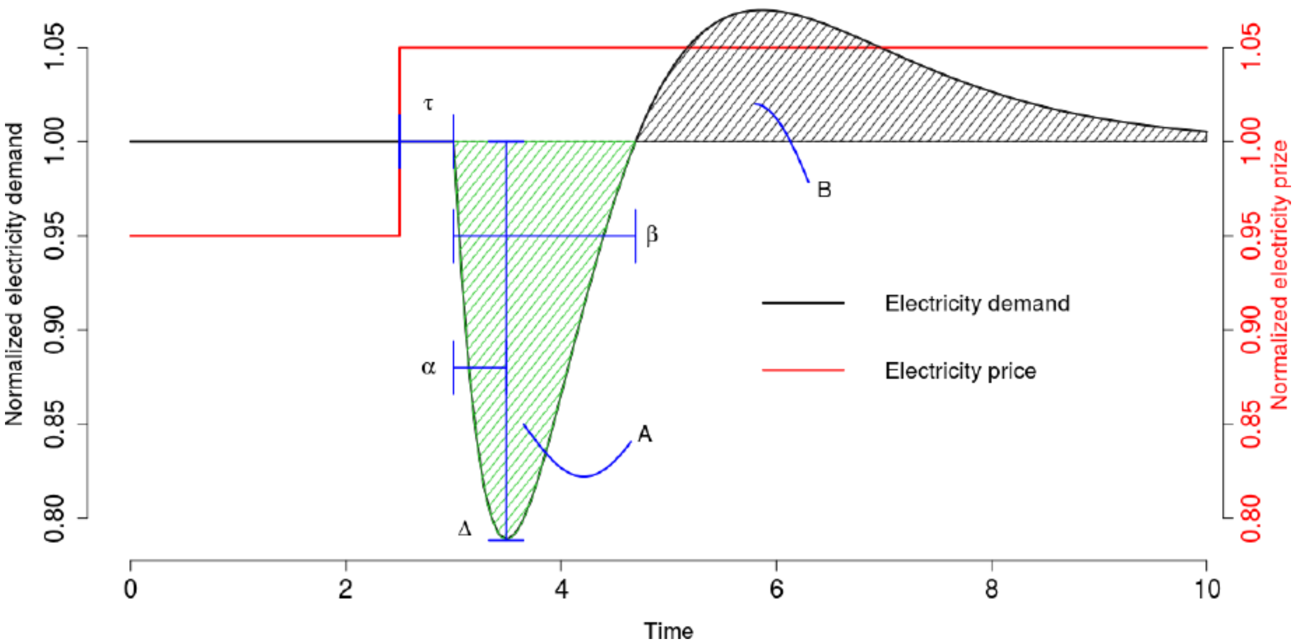

Figure 2. Example of electric power flexibility – response of building's electricity demand to a price signal. *τ* is the delay time from signal submitted to an action starts, *α* is the time to max response *Δ*, *β* is the duration of the response, *A* is the shifted amount of energy and *B* is the rebound effect for returning the situation back to the balance. [5]

building's adaptation to user and grid needs. EPBD Annex 1A list the key scope of SRI as follows:

(a) Adaption of energy consumption to more renewable sources;
(b) Adaptation in response to user needs;
(c) Flexibility of electricity demand in relation to the grid.

In technical terms it sounds that at least two indicators (or set of indicators) are needed to cover this scope, because it is not meaningful to combine the adaptation to user and to grid needs. (a) and (c) may be combined to flexibility/demand response indicator, because these represent two sides of power generation – surplus and shortage situation. User needs (comfort, air quality, lighting, convenience,…) are not measured in power units and will need completely different set of indicators.

Therefore, the key scope of SRI can be broken down into electric power flexibility and user need indicators. A flexibility indicator basically will indicate how much electric power can be shifted and for how long time – typically from electricity high price situation to low price situation. There are 12 available performance-based indicators [3] listed by IEA EBC Annex 67 Energy Flexible Buildings [4], the concept is explained in **Figure 2**. Therefore, it would be relatively easy to fit some of these existing ones to EPBD purpose and to set up a flexibility indicator that is possible to calculate or measure.

Adaptation to user needs may be described with well-being, convenience as well as relevant information to occupant. These features can be measured with indoor air quality, thermal and visual comfort (acoustic comfort may also be an issue through equipment noise) generally describing occupant satisfaction with the building. For indoor environmental quality a set of indicators based on prEN 16798-1 [6] items and categories are possible to use. An example of measuring user needs related to indoor air quality and thermal comfort is shown in **Figure 3**. Convenience could describe how easy it is to operate the building and its technical systems and perhaps the same for the maintenance, but there are not yet standardized indicators for this domain. Generally, different user needs cannot be summed to one indicator, because for instance good air quality will not compensate bad thermal comfort and vice versa. Therefore, a set of users' needs indicators is needed. Most basic user needs as thermal comfort and indoor air quality can be easily obtained from energy and indoor climate simulation – a method already in use in some Member States for compliance assessment with minimum energy performance requirements.

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There is some ongoing discussion to which extent the mandate of EPBD SRI covers the user needs, as the adaptation by smart operation and controls maybe seen on the top of the technical systems basic capacity. However, as every technical system today has built in controls being an essential part of the system and its operation, it is almost impossible to compare the operation with and without controls because without controls situation does not exist in reality. The same applies for self-regulating or passive systems and solutions which also do an adaptation to user needs but not in actively controlled manner. Thus, the only reasonable way seems to assess the adaptation to user needs as user perceives the wellbeing and convenience in the building, i.e. based on indoor climate and some possible other criteria to cover all aspects included.

To summarize, SRI checklist and scoring proposed by the preparatory study is clearly oriented to be used in existing old buildings to make the assessment easy and cheap. New buildings and major renovations (excluding single family houses) will deserve more credible SRI being based on quantitative calculation, for which purpose energy calculation (hourly) methods could be extended to be used in a fashion some Member States

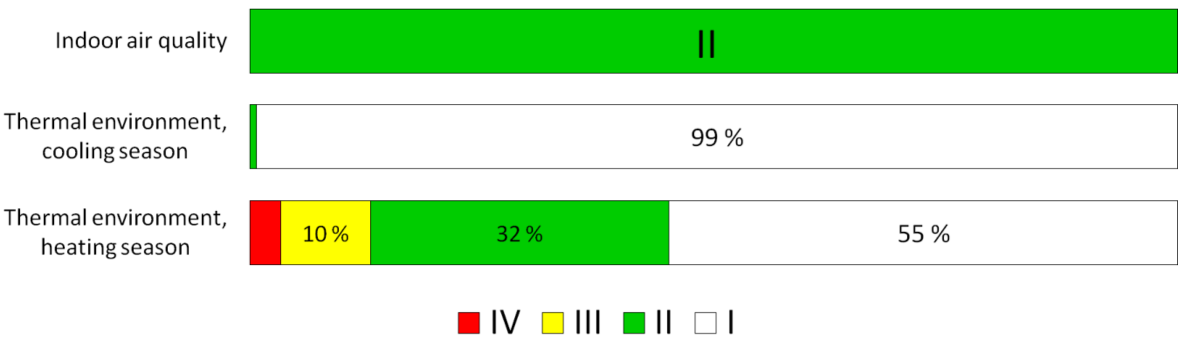

Figure 3. An example of user needs rating based on thermal comfort and air quality Category I, II, III and IV definitions of prEN 16798-1 (replaces EN 15251).

do already energy simulation for compliance assessment and EPC issuing. These simulation calculations allow also to include the add-ons as thermal storages (heat and/or cold) as integral part of the HVAC system. In addition to this electric storage systems could be considered, their dynamic behaviour and proactive role to stabilise the building grid load. While the control based on electricity price signal will direct demand response in the right direction, this is not enough for the stabilising benefits on the local grid level. It would be important to require that the local grid is smart as well. Currently this is not the case, thus, to define an SRI of a building without having a clue if the local grid is smart enough to interact, will reduce its added value.

To continue the development of SRI towards quantitative calculation, already available electric power flexibility indicators proposed by an IEA Annex and a set of criteria for indoor climate describing user needs according to existing European standard, will form a solid basis for next steps. Both should be easily customized for EPBD purposes resulting in the method and allowing to determine real benefits of smart services.

As a next step, the policy making process towards the establishment of the SRI will be undertaken by the European Commission and will formally start when the revised EPBD enters into force. The revised EPBD requires the establishment of two legal acts: a delegated act for the definition and calculation methodology of the SRI and an implementing act for detailing the technical modalities for the effective implementation of the SRI scheme. Both legal acts shall be adopted by 31 December 2019. ■

References

[1] Directive (EU) 2018/844 of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.

[2] Support for setting up a Smart Readiness Indicator for buildings and related impact assessment. Second progress report. 12 June 2018. https://smartreadinessindicator.eu/sites/smartreadinessindicator.eu/files/sri_secondprogressreport_final_0.pdf

[3] Control strategies for building energy systems to unlock demand side flexibility – A review. https://www.researchgate.net/publication/324877113_Control_strategies_for_building_energy_systems_to_unlock_demand_side_flexibility_-_A_review.

[4] IEA EBC Annex 67 Energy Flexible Buildings. http://www.annex67.org

[5] Position Paper of the IEA Energy in Buildings and Communities Program (EBC) Annex67 "Energy Flexible Buildings". http://www.annex67.org/publications/position-paper/

[6] prEN 16798-1 (Will supersede EN 15251:2007). Energy performance of buildings - Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics - Module M1-6.