SRI Topical Group C (SRI TGC)

- 1st recommendations report – (developed during January – May 2020)

Table of Contents

Executive summary

Overall, the SRI should serve towards the achievement of the EU Green Deal goals, and especially through the Renovation Wave initiative. It should not be just an image tag. Moreover, the SRI assessment should be incorporated in all phases of the building life cycle and furthermore be validated and tracked, therewith providing comfortable buildings at minimum use of energy and maximizing the flexibility potential buildings can deliver in a smart energy grid.

Specifically, for advancing the development in the field of smart buildings, especially in light of the need to continuously improve the SRI methodology and its implementation (as it deals with fast evolving building technology), it would be helpful to have a very basic acknowledged definition of a Smart Building e.g.

"A building that can leverage metadata from technical building systems (building services), occupants and surrounding environment to deliver all expected benefits associated with:

- *Satisfying the evolving needs of the people.*
- *Continuously improving the building's performance.*
- *Continuously improving the energy system's performance."*

This SRI Topical Group C (TGC) 1st recommendations report is work in progress and its content non-exhaustive. The aim is to provide an overview of the possible ways to ensure the SRI delivers all its promises and even more by outlining existing practices and proposing possible avenues to be further explored as SRI starts to be implemented at national level and the evolution process begins. Like building performance, the SRI should also be looked at as an ongoing process and not a one-time exercise.

The recommendations are structured under three main pillars:

- Updates to the existing methodology.
- In-use SRI - automated methods A and B (software synced with technical building systems).
- In-use SRI – a new method C based on measured data (real-time building performance).

For coordinating the process of **updating the existing methodology** considering both lessons learned and emerged needs during the testing and implementation, the key is to ensure consistency between the assessment and final SRI scores at EU level. The Member State level tailoring of the methodology should be done in such a way that the seamless conversion to the EU SRI default methodology is ensured. This would enable and facilitate analysis and comparison of the readiness level in different Member States and regions providing the basics for an inclusive and streamlined updating process.

Automating methods A and B is highly likely to increase the EU-wide market uptake of the SRI which in turn would support the performance improvement (also indoor climate) process of the EU's building stock. In many buildings and with the introduction of the revised EPBD, automation or at least more control possibilities than currently available will be introduced in buildings. Developing an SRI which can use these systems to generate automatically comparable indicators on different levels would help the market. The same building technology needed for automated methods A and B enables continuous real-time data monitoring of technical building systems' operation which has high potential in closing building performance gaps throughout a building's life cycle and so introduce a new method C.

For **a new method C** it is very important to keep in mind that the whole point of this method is to let the SRI evolve from a parameter which consists of factors levelling functionalities of services from the Smart Services Catalogue (currently methods A and B) to a parameter which quantifies the building's impacts for all 3 relevant categories (building occupants needs, building operational efficiency and building energy flexibility) with a strong focus on the impact upon the reduction of CO_2 emissions. A

new method C would add further value to real estate. Therefore, go-to-market strategy should be considered to support added-value in the market. As such, having a clear and transparent (sustainable) business case (value proposition) from the very beginning is essential. Just considering the goal of decarbonising the EU's building stock, monetisation should be quantified at least in terms of CO_2 savings. In addition, benefits like enhanced productivity by an improved indoor work environment, reduced investment cost for upgrading the energy grid by fully employing the building flexibility potential and reduced total cost of ownership by the use of data driven predictive maintenance techniques should be quantified.

!! The entire SRI process will be managed and further developed via the so called "SRI platform". The "SRI platform" (for which a basic concept is proposed in the report) should be established by end 2020 to support the work of the SRI TGC and enable the exchange with and between Member States during the SRI national testing.

!! The national testing provides a unique window of opportunity to assess if/how it is sensible and market relevant to apply the recommendations provided within this report aiming at further consolidating the SRI. Furthermore, having the "SRI platform" operational would also enable the coordination of ongoing and upcoming EU funded projects (e.g. Horizon 2020, Horizon Europe, both Coordination and Support Actions and Innovation Actions) that include activities related to SRI, especially testing, demonstration, further development and market uptake.

Currently, EU strategic priories in the post-COVID Recovery Plan are to invest in green, digital and resilient future including the Renovation Wave as a key component. In this respect, we believe that the SRI has an important role to play in turning our European buildings into healthy, efficient and smart places, and advocate for the SRI broad and fast uptake (as element in the Renovation Wave) in order to speed-up this transition.

Introduction

This SRI Topical Group C (3rd) was created in late 2019 during the 2nd SRI technical study to facilitate and enable the ongoing improvement and further development of the SRI for buildings. In contrast to the other two SRI Topical Groups (A and B), this group is self-managed (reporting to European Commission DG Energy services indefinitely and to SRI study team until June 2020) and all activities are on a volunteer basis. All members of the SRI TGC have been involved in the SRI's development process since its beginning and have furthermore participated in the beta public testing exercise that ran during Autumn 2019.

The inputs needed to develop these 1st recommendations have been collected and aggregated under the following process:

- Defining the content.
- Survey (see Annex 1) + DOCX (to facilitate the internal work of associations/federations).
- Compilation + aggregation.
- Commenting + review.
- Web meetings (throughout the afore listed steps).

The Smart Readiness Indicator for buildings[1] is the 1st ever exercise to combine three key 'smartness' functionalities (given in the Annex 1a of the revised EPBD) i.e.

- Energy performance and operation.
- Response to the needs of the occupant.
- Flexibility of a building's overall electricity demand.

Although there isn't yet an acknowledged clear and holistic definition of a Smart Building in Europe, nor worldwide for that matter, within the scope of the revised EPBD[2] the smartness of a building covers the Energy Performance of Building (EPB) related technical building systems.

For advancing the development in this field it's worth though considering, especially in light of the need to continuously improve the SRI methodology and its implementation (as it deals with fast evolving building technology), this very simple/cornerstone definition of a Smart Building:

"A building that can leverage metadata from technical building systems (building services), occupants and surrounding environment to deliver all expected benefits associated with:

- Satisfying the evolving needs of the people.
- Continuously improving the building's performance.
- Continuously improving the energy system's performance."

The entire SRI process will be managed and further developed via the so called "SRI platform". According to the members of the SRI TGC the SRI platform should have in mind this basic concept:

- Forum for exchange of information (e.g. best practices, national testing, possible next steps) in a neutral setting.
- The membership should cover both the political and technical levels of:
    - SRI Member States opt-in + Member States observers.
    - SRI stakeholders.
- Structure:
    - Management board: European Commission DG Energy + Member States (+ other EU institutions as needed).

[1] SRI 2nd technical study - 3rd interim report https://smartreadinessindicator.eu/milestones-and-documents

[2] https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en

        - Expert Group on the EPBD.
        - Energy Performance of Buildings Committee.
    - Advisors to the management board: Chair & co-chairs (max. 2) of the Working Groups.
    - Working Groups:
        - SRI Methodology (former SRI TGA) – link to CEN/ISO EPB standards.
        - SRI Implementation (former SRI TGB)
        - SRI Evolution (former SRI TGC) – link to CEN/ISO EPB standards
    - Central Training and Certification Operator (blended, web based):
        - Master Trainers (EN).
        - Train-the-Trainers (EN):
            - National Training Operator e.g. EPC scheme
                - Trainer e.g. EPC trainer (EN must + national language) – certified.
                - Trainee e.g. EPC assessor (national language, EN is a plus) – certified.
    - Plenary (cross-cutting exchange place): all the above.

For the further work of SRI TGC, it is essential to monitor the transposition of SRI in the Member States that opt-in and learn from the results in the national SRI testing. To facilitate analysis and comparison it would be extremely useful to have SRI scores from different buildings in different Member States, converted to the EU SRI default methodology. This is one of the key lessons learned when developing the set of EPB standards under European Commission's mandate M/480 (https://epb.center/epb-standards/background/) and arriving at the national annexes approach (https://epb.center/implementation/national-annexes/).

The "SRI platform" should be established by end 2020 to support the work of the SRI TGC and enable the exchange with and between Member States during the SRI national testing. The national testing provides a unique window of opportunity to assess if/how it is sensible and market relevant to apply the recommendations provided within this report aiming at further consolidating the SRI. Furthermore, having the "SRI platform" operational would enable the coordination also of ongoing and upcoming EU funded projects (e.g. Horizon 2020, Horizon Europe, both Coordination and Support Actions and Innovation Actions) that include activities related to SRI, especially testing, demonstration, further development and market uptake. The above mentioned is valid for all three main workstreams of SRI TGC:

- Updates to the existing methodology
- In-use SRI – automated methods A and B
- In-use SRI – leveraging measured data in a new method C

It should be noted from the beginning that this 1st recommendations report is work in progress and its content is non-exhaustive. It endeavours to provide an overview of the possible ways to ensure the SRI delivers all its promises and even more by outlining existing practices and proposing possible avenues to be further explored as SRI starts to be implemented at national level and the evolution process begins. Like building performance, the SRI should also be looked at as an ongoing process and not a one-time exercise.

Mixture of interests represented by SRI Topical Group C members

Preamble

As humans we are aiming to overcome subjectivity and put in place objective decision-making processes. At the end of the day many (or most) of our decision-making processes are intersubjective putting to use the shared mind of the involved people. The SRI TGC is not an exception and as such the mixture of interests represented by the members of the SRI TGC need to be transparent to begin with.

When looking at the ongoing digitisation, digitalisation and digital transformation of human activities it's crucial having an answer to "How much is enough to meet or goals?". The technological level of development reached in buildings nowadays is more than impressive and in addition to the specific added value it brings, it can furthermore close many still existing gaps in the processes of the fragmented buildings sector. Hence, one should use this transition of the built environment to also get the basics right and leverage building technology if/as needed. It should be noted that overall quality management is a prerequisite for technology throughout a building's lifecycle: concept, design, installation, commissioning, operation, upgrade and end-of-life/re-use.

Three key 'smartness' functionalities

The SRI TGC members are overall satisfied with the current SRI methodology as can be further seen in Annex 2.

The specific subjective **ranking of the importance for the three key 'smartness' functionalities** (given in the Annex 1a of the revised EPBD) according to the SRI TGC members is as follows:

1. Energy performance and operation (Figure 1).
2. Flexibility of a building's overall electricity demand (Figure 2).
3. Response to the needs of the occupant (Figure 3).
4. All three of equal importance (Figure 4).

To understand the above overall ranking, one needs to carefully consider the calculation behind. Since rank 1 marks the highest importance and rank 4 - the lowest, it basically means that the less points one key functionality gets the higher the overall rank is. Hence, the above ranking is valid only within this logic. Generally, one can easily analyse and judge visually for oneself and clearly see that on the whole the three key 'smartness' functionalities are close to actually being of equal importance, which looks like the most sensible path to take during SRI's evolution process.

The numbers associated with each colour in the following graphics represent level of importance followed by the percentage of voters who selected that level of importance. For instance, the numbers 1, 25% means 25% of the voters found the respective functionality to be the most important in the SRI.

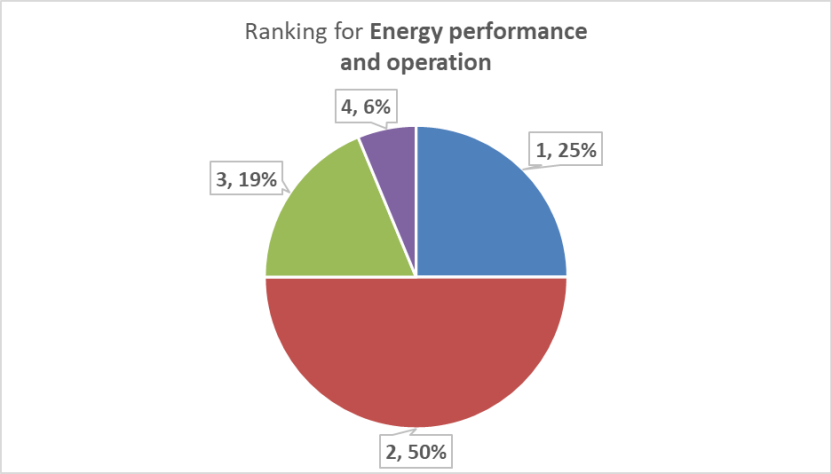

Figure 1 Ranking (& its percentage) for Energy performance and operation (rank 1 highest – rank 4 lowest)

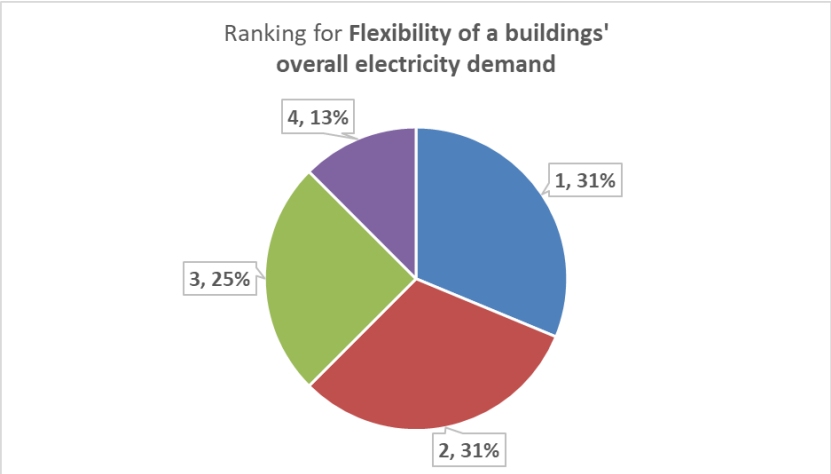

Figure 2 Ranking (& its percentage) for Flexibility of a building's overall electricity demand (rank 1 highest – rank 4 lowest)

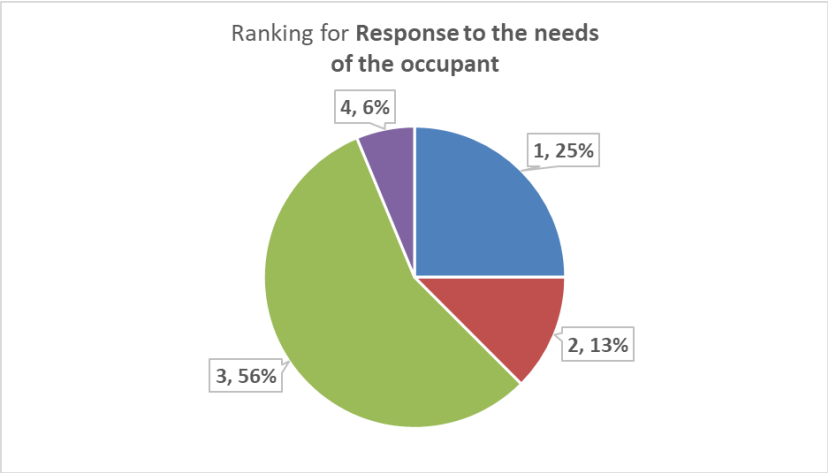

Figure 3 Ranking (& its percentage) for Response to the needs of the occupant (rank 1 highest – rank 4 lowest)

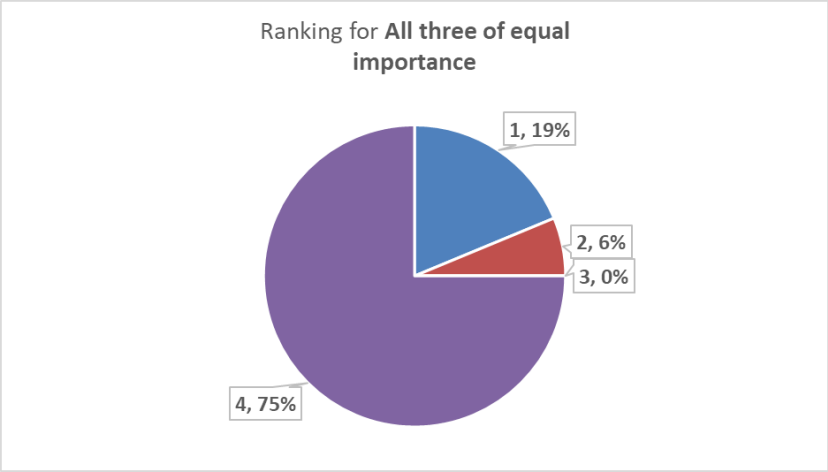

Figure 4 Ranking (& its percentage) for All three of equal importance (rank 1 highest – rank 4 lowest)

Notes:

- The current SRI methodology provides equal weights to the three key smartness functionalities and thus reflects most accurately the intentions of the EPBD regarding the balancing of the need for energy savings, the needs of occupants and the needs of the energy grid.

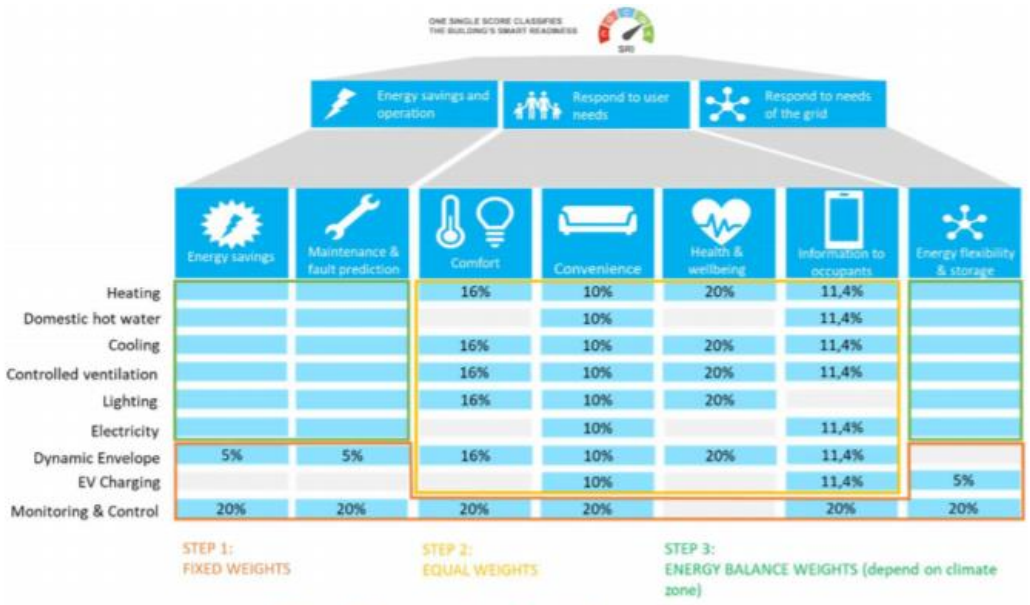

Figure 23 - overview of weighting scheme

- This is almost inherently aligned to the energy efficiency 1st principle reflected in the NZEB definition of the EPBD according to which the 1st step would be demand reduction. Subsequently this would unburden energy systems and facilitate flexible integration of buildings.
- Since the SRI is an inherent part of the EPBD, energy efficiency and CO2 reduction in buildings are important aspects. Two other significant elements are the "Response to the needs of the occupant" and "Flexibility of a building's overall electricity demand", as they both cover the new elements introduced in the EPBD: demand-side flexibility (also called: demand-response) and the increased focus on health and wellbeing of building users. The relationship between those three elements (energy savings, the needs of the occupants, and demand-side flexibility) is complementary, though does not have the same legal basis. Whereas the energy efficiency aspect is covered by several regulations, including the EPBD's implementation (e.g. energy performance certificates scheme), the occupant's needs and demand-side flexibility are the completely novel/untapped aspects in the EPBD. The EPBD's implementation covers indirectly to a certain extent indoor climate, however the consideration of the needs of the occupants is not covered particularly well elsewhere.
- The Member State tailoring of the methodology should be either minimal (only if/as needed) and/or should be always possible to convert to the EU SRI (default) to be able to compare the readiness level in different Member States and regions.

From the perspective of a Member State, it's recommended to have in mind the above judgement process and indicative ranking and as possible to complement it with the results of a national level stakeholder consultation for adequately defining the priorities which shall ultimately serve one main purpose: healthy, sustainable and safe EU built environment while empowering people.

Updates to the existing methodology

The SRI needs to be continuously updated because it deals with fast evolving building technology. Several versions would coexist on the market (like national Energy Performance Certificates) depending on the moment of issuing. Since it's dealing with 'smartness' the SRI should be a positive example in this direction:

- By design a few clicks away to update version → buildings with an existing SRI would immediately be updated to the latest version (the SRI assessor would have this responsibility and should be included in the initial costs of its services).

The testing phase is a very welcomed and needed approach for such a new process. The proposed SRI methodology enables a lot of flexibility to the Member States in the implementation phase. It would provide valuable insights if the Member States opting-in would rank their national level priorities "Energy performance and operation", "Response to the needs of the occupant", "Flexibility of a building's overall electricity demand" and "All 3 of equal importance" at the beginning of the SRI testing/implementation process.

To draw accurate conclusions and suggest improvements the following are recommended:

- Key to ensure consistency between the assessment and final SRI scores at EU level. The Member State tailoring of the methodology should be either minimal (only if/as needed) and/or should be always possible to convert to the EU SRI (default) to be able to compare the readiness level in different Member States and regions.
- Key to ensure consistency between the assessment and final SRI scores at EU level. Programs to train and certify the assessors should be put in place. Importance should be given to the section "expert advices to users", in which the assessor should give suggestions on how to further improve the smart readiness of the building. Site visit, interview with the Building Operator and proof for high-score functionality should be mandatory for Method B. References: LEED certification, energy audits.
- Define a solid methodology which relies on digital assets and data analytics. Also:
    - Central SRI assessor training and certification
    - Central SRI certification for Method B
    - Financial incentives should be linked to improvement in SRI score
- Buildings could be divided in several categories:
    - Low energy/ passive building: they don't need to be necessarily smart in respect of the overall energy system. Nonetheless, increasing and developing smart services would result only in positive changes to low energy/ passive building.
    - Smart buildings reaching also low energy/ passive building performance (or even producing more from renewables than consuming).
    - "Big potential" buildings: existing or new buildings with high energy demand that must be improved:
        - Not smart nor reaching low energy/ passive building performance.
        - Smart and not reaching low energy/ passive building performance.
    - Smart buildings: it only matters to which extent they can fulfil their smartness targets.
- Further insights would be needed e.g. open access to monitoring data (if/as available per building, ideally at least hourly data related to renewable production to be compared to monitored consumption data per different uses/TBS i.e. heating, cooling, ventilation, lighting etc.), ongoing building performance quality management (technical monitoring, commissioning).
- The public beta testing of the existing SRI methodology showed that in residential buildings the results are quite weak – the SRI is between 0 and 50% in these buildings, which might

make it unclear how to go further. To go beyond that and get more stable results it is worth considering testing different definitions and weighting factors of the SRI in parallel.

Some specific fine-tuning points are considered to have priority when the existing methodology will be updated:

- Worth considering to make mandatory or at least consider leveraging the EPC input/output data in the energy saving domain weighting method.
- The geographical based localization of the methodology (i.e. proposed weighting factors) has no or minimal impact on the results of the SRI calculation. This should be reconsidered if it is worth implementing or how could it be improved.
- SRI could be made mandatory for certain building segments:
    - New built.
    - Deep renovation.
    - Costless assessment i.e. embedded in existing procedures according to Method B e.g.
        - All non-residential buildings (existing + new) above 290kW must be equipped with certain BACS functionalities by 2025 (EPBD).
        - Functional test is part of the commissioning process (new & existing buildings).
- "Thick data"/user-centred approach should be considered in Method B in case of on-site visit: interviews with the building operator or occupant for explaining and discussing the SRI scores and advantages of higher-score functionality (e.g. as done in LEED certification, energy audits).
- Central training and certification operator & national training operators for Method B.
- Financial incentives could be straightforwardly linked to verified SRI.
- The process of adding new smart services is not really covered yet. This is relevant for addressing the needs from those who would like to take a step further on SRI.
- In terms of flexibility the SRI should have a holistic approach reflecting the national context of all EU's Member States and as such include the entire energy system (all networks, also thermal networks).
- Extension by physical indicators regarding load, storage technologies and indoor climate requirements. Seasonal flexible capability (differences depending on the period of the year) should be also considered.
- Connectivity should be assessed like a new domain and not optionally like the actual method. For example, its impact on flexibility could be a starting point.

Existing practices (content)

- Austria:
    - Studies related to the SRI:
        - https://nachhaltigwirtschaften.at/en/sdz/projects/sri-austria.php
            - Pages 46 to 58 the different steps we would like to take by a simple methodology to follow the three EPBD pillars or key 'smartness' functionalities, as you call them in your enclosed report. It is about including load information, potential of storage, component heating and cooling, different importance of services like the SRI study team suggested and about occupants' comfort in the sense of making flexibility possible.
        - https://www.mdpi.com/1996-1073/12/10/1955
    - Building certification:
        - "Klimaaktiv" building certification has also put some resources on thinking about how to include energy related smartness into buildings.
- Germany:
    - Workshops:

        - https://projektinfos.energiewendebauen.de/fileadmin/user_upload/18-08-29__PL-Treffen_Essen_online.pdf (from page 39)
- France:
    - Gimelec and IFPEB worked on an assessment tool to estimate the "flexible" electrical capacity, a building can access according to the BACS technologies and services deployed in it. The indicator is called GoFlex (https://gimelec.fr/goflex-le-nouvel-indice-de-flexibilite-energetique-des-batiments/): it is an easy-to-read and easy-to-evaluate indicator that gives a quantitative information (the amount of flexible energy) and a qualitative information (the services in the building used to ensure this capacity of flexibility).
- Basis for additional services within lighting
    - CIE 222 includes an analysis of lighting control strategies with implications on light quality and user acceptance.
- IEA EBC Annex 67 – Energy Flexible Buildings
    - http://www.annex67.org/
    - http://www.annex67.org/publications/position-paper/
- IEA EBC Annex 81 – Data-Driven Smart Buildings
    - https://annex81.iea-ebc.org/

Suitable implementation avenues (process)

- Irrespective of the implementation avenue might be the integration of new smart services as well as new domains and functionality levels is not really covered and needs to be soon addressed for having a clear underlying process.
- At EU/Europe level the set of CEN/ISO Energy Performance of Buildings (EPB) standards (developed for the EPBD's implementation, https://epb.center/epb-standards/background/) seems like a good implementation avenue to consider i.e. make the SRI methodology an EN (maybe also ISO) standard (EN SRI standard would be adopted automatically at national level, although not mandatory, easing the SRI implementation). As such the CEN SRI working group could be integrated in the overall (envisioned) SRI platform and more content in terms of relations to other EN (maybe also ISO) standards would be easily incorporated. High attention should be though given to the length of the updating cycles i.e. the SRI might need shorter cycles because it is dealing with fast evolving technology.
- At national level the EPC schemes seem to be the most obvious implementation avenues, which are by now mature and poses a lot of "dos and don'ts". The SRI could be a voluntary or mandatory add-on on the current EPC. It could thus be ensured that the framework of the EPC (which is widely accepted and known by the public) acts as a multiplier for the SRI. At the same time a go-to-the market could be a voluntary based scheme.
- GoFlex (https://gimelec.fr/en/goflex-the-new-building-energy-flexibility-index/) could be a good implementation in the methodology to calculate a portion of the SRI. For example, the qualitative assessment on building services ensuring flexibility of the GoFlex indicator can be implemented on the method B. Besides, this part of the GoFlex assessment tackles services that are not linked to the "flexibility for the grid" impact for the moment in the SRI (energy load prediction, latency in data transmission, ...). The qualitative assessment (and also the quantitative assessment) was elaborated with the help of several TSO (transmission system operator) and electricity markets experts. Therefore, the services included in the qualitative assessment were identified as essential to make a building fully efficient, reliable and operational in terms of flexibility.

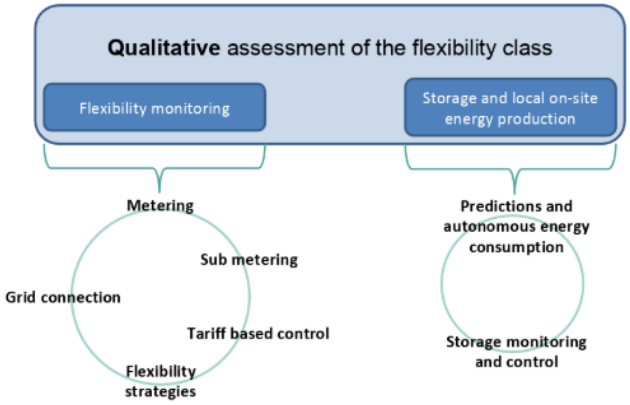

Figure 5 GoFlex qualitative assessment of the flexibility class

In-use SRI – automated methods A and B

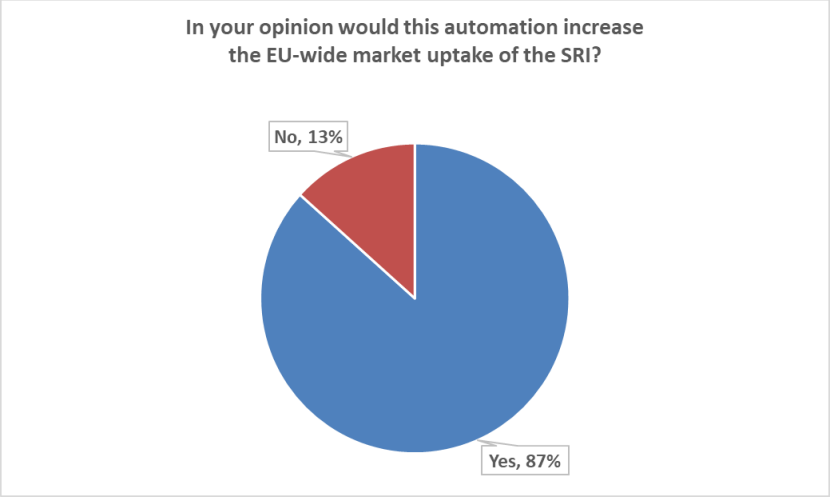

Figure 6 Would the automated method A and B increase the EU-wide market uptake of the SRI

Figure 6 illustrates well that automating methods A and B is highly likely to increase the EU-wide market uptake of the SRI which in turn would support the performance improvement process of the EU's building stock. In many buildings and with the introduction of the revised EPBD, automation or at least more control possibilities than currently available will be introduced in buildings. This is also true if one looks at strong increasing numbers of home-automation systems. Developing an SRI which can use these systems to generate comparable indicators on different levels would help the market, but also the real idea behind effective use of energy. As such this needs to be further explored to the extent possible during the national testing exercises for several reasons:

- It seems highly likely to minimize possible associated additional costs while simplifying/streamlining the roll-out and scale-up processes:
    - Whilst automation is no substitute for the rigour of a third-party hands-on process it will allow a more stream-lined process and easier access to the SRI. Even for third-party on-site inspections it could be useful to help collate and process information.
- From the technical perspective it would:
    - Enable the automatic recalculation of the SRI every time the methodology is updated.
    - Make available continuously real-time data, which is beneficial in the operation of buildings e.g. enabling the implementation of technical monitoring (https://www.rehva.eu/hvac-guidebook-repository/rehva-guidebook-29) which has high potential in closing building performance gaps throughout a building's life cycle.
- It will support self-sustaining business cases if a user-friendly interface and a well-branded automation would help and support using and easily communicating the SRI performance.
- Overall, in terms of awareness raising of the possibilities more attention in collecting "points" will create more attention of building owners, also more understanding of the effect on the three major target areas.
- This could potentially be a relatively slow process which could be further accelerated as needed by adding EU regulatory benefits when applying the SRI and/or the SRI evaluation could be linked to funding and incentives, where an assessment would be mandatory for an application.

Existing practices (content)

Automating methods A or B could be already done using solutions already available today on the market.

One such solution was developed in the H2020 project Quantum (https://www.quantum-project.eu/home/) i.e. Performance Test Bench (https://www.quantum-project.eu/tools/) providing the following: tool for functional specifications of Building Services, link between the description of individual BMS functions and an automated statistical analysis and evaluation of the corresponding operation data, and clear metrics for system performance.

Another solution was developed with national funding in Austria for assessing how to integrate and test automation in "daily" building routines i.e. PEAR – Test facility for energy efficient automation and control of buildings (https://nachhaltigwirtschaften.at/en/sdz/projects/pear-test-facility-for-energy-efficient-automation-and-control-of-buildings.php"): assessing the energy efficiency of control strategies in the fields of air conditioning systems, concrete core activation and free cooling.

Suitable implementation avenues (process)

There should be a centrally developed methodology defining the required automated inputs and data transfer applying the lessons learned (involving experts) from existing solutions. There could be a common central tool/ SW application implemented in each MS to receive the inputs and calculate SRI.

- Such solutions would need to be verified/validate, which in the case of the SRI should be coordinated at EU level. Ideally, there should be independent 3rd party certification bodies that would validate the solutions that can automatically calculate the SRI indicators, otherwise credibility and trust are potentially compromised.
- Draft preliminary proposals:
    - Overall: Automated method would be the automatic input from the building in the SRI calculation tool. The SRI Assessor should only randomly double-check the scores during random visits to some buildings. SRI App that could be installed in the building collects all necessary data and automatically calculates the SRI score. This might need some one-time initial configuration to map the data points.
    - Overall: The automated method A & B could rely on a database from which the information is collected to make the SRI-calculation. This data should be provided by the manufacturers of the different technologies and the data must be somehow validated, like in the EPREL-database. There is support from the industry to go down this path, because this allows manufacturers to differentiate themselves and their products.
    - Specific for method A, a simple tick-box system that considers the presence/absence of a service within a domain. The option to indicate a service is not applicable could be provided, however this should also require 1 or 2 sentences input to justify this otherwise it is too easy to misuse without clear visibility. Default responses should be available where applicable and valid.
    - Specific for method B, an assessment procedure, guiding an assessor through the process and collating and quantifying data entry could be useful. However, access to default values should be minimised to prevent "lazy" assessing."

Lastly, the lessons learned from the national Energy Performance Certificate calculation tools represent an invaluable input to this process, even more so if the SRI would be integrated within the national EPC scheme.

For addressing this question more research and interaction is needed between specific experts in the building, energy and ICT sectors via working groups in automatic solutions (digital tool) development.

In-use SRI – leveraging measured data in a new method C

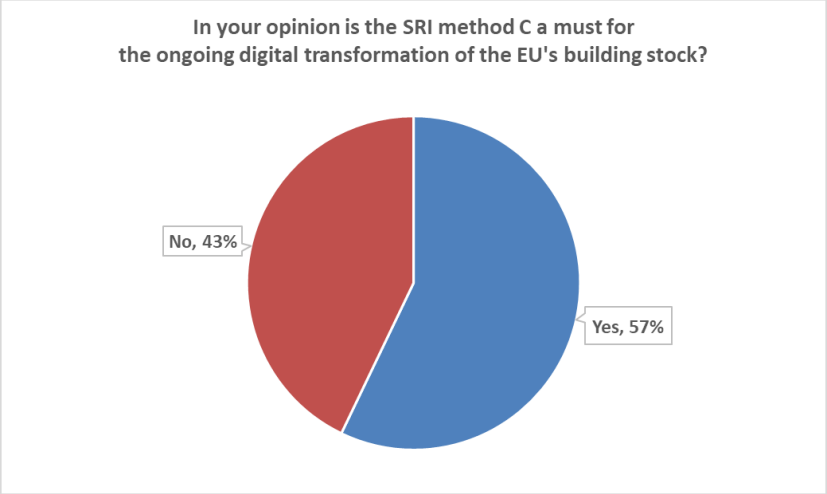

Figure 7 SRI method C a must for ongoing digital transformation of the EU's built environment

The digital transformation of the built environment is an ongoing process like water flowing down hill, meaning it is happening and we can't predict the exact path it'll take. Thus, an SRI new method C, based on measured building performance data, couldn't be really considered a prerequisite. A little over half of the SRI TGC members (Figure 7) feel though that method C would bring added value and would actually be needed.

A SRI new method C is though a framework/process that would bring all relevant stakeholders together and gear the digital transformation of the built environment towards reaching the EU's long term goals. On the shorter term having operational building performance data would help advance the development in this field and furthermore enable evidence based decision-making processes (at all decision levels and most relevant for strategic decisions):

- In order to fully reap the benefits of SRI method A and B, automated and "fault free" or "automated fault corrected" methods are needed and furthermore a method C (natural complement to methods A and B) measuring actual smart performance is required. Understanding the smart readiness potential of a building, using methods A and B of the SRI, is a valuable step to producing efficient buildings, in terms of energy and occupant satisfaction. However, unless this potential can be turned into achieved outcomes it is wasted. The actual performance of building services and integrated energy system should be analysed in the existing building stock. Method C would show the real effect of smart installations and can be used to assess the effect of new measures.
- There are various regulatory benefits, when using a proven (data driven) SRI method. Method C, once it will be available at large scale, will be the most reliable method: relying on real data, it is the most accurate and convenient, eliminating the risk of inconsistencies. Policy developments (like a proper implementation at national level of the revised EPBD) should drive the uptake of Method C on a large scale. Lastly, post-occupancy evaluation should be standard. It always provides insights about the real performance of a system design.

The SRI will most likely be developed step by step. While testing methods A and B, method C should be considered as an additional layer and it would anyhow take years to be possible to implement it (one reason is that many systems have proprietary information and cannot be simulated while verified simulation tools are needed, another reason is that it is not yet clear enough how building services and related equipment that are out of the scope of the EPBD should be considered).

Clear identification and alignment among stakeholders on the reason why to move towards a quantitative information, the added value, the target audience should be addressed and which

building types should be covered. Digitalization requires smart data from smart technologies in buildings.

- For example, in terms of demand-side flexibility the active interaction of buildings with the surrounding energy system relies on the deployment of digital decentralised energy resources. The quantification of their demand-side flexibility would be both a pull and push for the uptake of smart solutions and the digital transformation of the EU building stock. There are no existing practices for the quantification of actual flexibility performance of buildings, but this could be the innovative evolution of the SRI. As the demand-side flexibility of buildings is currently valued by aggregators (which sell it in different electricity markets), their direct involvement could support the development of the in-use SRI methodology.

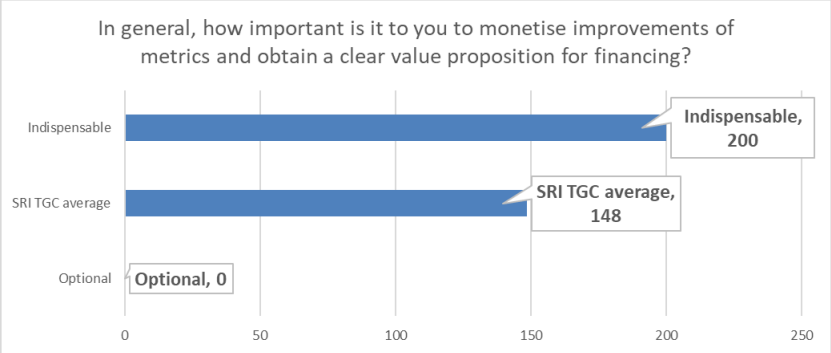

Figure 8 The importance of monetising metric improvements (SRI method C) for clear value proposition

It could always be questioned if automation solutions, even if clearly overall beneficial and cost-effective, should be or not a must because it is about investing money in technology and software. Irrespective if mandatory or not the SRI TGC members agree (Figure 8) it is crucial to have a clear value proposition for enabling self-sustaining business models which would act as a strong market pull. An SRI method C would highly support this process and in the case of automated buildings (no matter if as a "must" or not) an in-use-SRI would be swiftly derived.

Having in mind the overall goal of decarbonising the EU's building stock, monetisation should be quantified at least in terms of CO_2 savings as such the SRI would be a good tool to address this scope. Because the SRI is intrinsically linked to the main objectives of the revised EPBD, additional aspects that indirectly relate to energy performance in buildings are newly included in the SRI, e.g. building user needs.

Energy performance and operation metrics

Advice:

- The energy performance as asset rating is already covered by the current EPCs and should therefore be covered in a complementary manner by the SRI.
- European implementation and validation study of an automated, real(time) data driven SRI approach.
- Teaming with IEA ABC Annex 81 (https://annex81.iea-ebc.org/) activities may be considered.
- The methodology of C should be different than A&B. In C, there should be clearly focus on the actual performance for the set KPIs in three areas.
- Please see exiting acquis on energy performance KPI's and energy performance certificates of buildings.
- For lighting the method contained within EN 15193 allows the energy performance to be assessed accounting for lighting controls, daylight availability and occupancy patterns. The method allows the calculation to be as comprehensive as the input data allows but for a more useable and less daunting approach defaults should be defined to help guide a user through

the process. EN 15193 does provide default inputs but these should be examined as to their suitability and validity within the SRI process and an improved approach may be defined that balances simplicity with a reasonable level of validity. EN 15193 does suggest a methodology for using measured data as opposed to default design data allowing it to align with the aims of method C."

Proposals:

- kWh/m2/year e.g. (leveraging smart meter data) with and without adjustment to weather conditions (outdoor temperature)
- Specific max values per building type (guidelines currently under development within The Netherlands)
- Austrian studies:
  - https://nachhaltigwirtschaften.at/en/sdz/projects/sri-austria.php
  - https://www.mdpi.com/1996-1073/12/10/1955
- KWh/m2/year
- KWh/m2/year e.g. as done in Energy Star Portfolio Manager (USA)
- Net energy consumption per occupant and same per square meter, LCA and other metrics likewise based on occupants as well as on m^2
- At least kWh primary energy per energy uses/TBS via submetering for electricity, gas, DHC systems. For higher resolution kWh primary energy per performance unit (e.g. operation hours, occupant, space) would be needed

Response to the needs of the occupant metrics

Advice:

- This aspect is closely interlinked with energy efficiency and should only be included in this specific energy-related context. Additional gadgets or features should not be considered as part of the SRI.

Proposals:

- User satisfaction # of complaints/ building
- Hours of deviation from temperature setpoint per year
- Forward-looking automatic control features, adjustability or manual override, occupants' satisfaction level
- Simple controls allowing control of the lit environment should be used. Control strategies for different non-residential buildings are shown in CIE 222:2017 considering light quality and user acceptance and this could possibly be used as a basis of quantifying the smartness for the occupant.
- Hours of operation outside of comfort range per year, e.g. outside of specified temperature range
- Air quality (e.g. O_2, TVOC, CO_2, PM, relative humidity levels – TVOC, relative humidity and CO_2 are generally accepted IAQ-indicators and are easier, also cheaper, to measure, especially valid for CO_2) during the day (should be kept optimal regardless of number of people in the building as ventilation adapts)
- There could be indicators from direct standardized questionnaires of building users (used in Austrian “klimaaktiv in operation” certification system), or ones derived from ISO 7730 (there are tools available for that) or one could more relate to actual used comfort ranges and their help for flexibility etc.
- Humans perceive the surrounding conditions differently, even if the same, depending on various factors, thus a two-fold approach would provide the needed insights:

- Objective assessment (KPIs): indicators based on monitored indoor environmental quality parameters e.g. ALDREN TAIL index https://aldren.eu/aldren-tail/ developed in H2020 ALDREN project (https://aldren.eu/)
- Subjective assessment (post-occupancy evaluation): people satisfaction, health, performance etc. via online surveys e.g. https://www.comfortmeter.eu/en/home-eng/ developed in H2020 Quantum project (https://www.quantum-project.eu/tools/)

Flexibility of a building's overall electricity demand metrics

Advice:

- A quantitative approach (similar to and based on the EPC), that assesses the load shifting potentials of buildings rather than a qualitative approach, that assesses a series of functions, should be considered.
- This is essentially the core of the SRI. How flexibly can a building react to the grid? How much, in which timeframe can a building take energy from the grid, store it and give it back to the grid? The key in this context is to quantify this aspect and not solely rely on qualitative criteria.
- For lighting this is not applicable. Lighting that is correctly controlled will be running optimally, unnecessary lighting will automatically extinguish and electric lighting will adjust to available daylight and user needs. As lighting has an instant response it is difficult to use demand response for even a short period without an instant impact.

Proposals:

- Provide a quantifiable approach for the load shifting assessment of buildings to support the SRI: In order to support the development of the SRI, the below article describes a methodology for a simplified quantitative assessment of the load shifting potential of buildings. The aim of the methodology is to provide a numerical, model-based approach, which allows buildings to be categorized based on their energy storage capacity, load shifting potential and their subsequent interaction with the grid. A key aspect is the applicability within the Energy Performance Certificate (EPC) in order to provide an easy to use calculation, which is applied in addition to the already established energy efficiency, building services and renewable energy assessments. The methodology provides an initial assessment at planning stage and is suitable for all energy types and carriers (e.g. thermal, electrical, gas). The full article can be found here: https://www.mdpi.com/1996-1073/12/10/1955
- Flex potential, kWh and kW (shiftable amount of kWh's / building and max rate, kW), linked to two main factors:
  - Firstly, the time it takes for the building to receive notification that it is ready to implement its flexibility strategy. Does the building have several days, one day, one hour, 30 mins to react and implement its strategy and shift energy or power loads? The load shifting potential will depend on this.
  - Secondly, the duration of the flexibility event. Will the building have to adapt its consumption and shift loads for 30 mins, 1 hour, or more? In that case, the flex potential will vary according to the duration of the event.
- Energy storage capacity (kWh) – thermal and electricity
- IEA EBC Annex 67, where possible indicators for quantifying energy flexibility in buildings have been defined: http://www.annex67.org/publications/articles/
  - http://www.annex67.org/media/1894/examples-of-energy-flexibility-in-buildings.pdf
- Follow KPIs of the set energy flexibility indices (power/energy point of view and dynamic energy tariff point of view)
- kWh /year traded on the electricity market
- Share of flexible demand/ supply relative to overall demand/ supply
- Differentiation between intraday, daily, weekly and seasonal flexibility

- kWh of offered volume per year to the electricity markets
- Load profile 24 hours combined with electricity price
- GoFlex (https://gimelec.fr/en/goflex-the-new-building-energy-flexibility-index/) quantitative assessment is relevant for Method C: the load of flexible electricity available without compromising comfort and using the data available on a building and the services the owner or user want to make "flexible". It also take into account the BACS and BMS performances of your building and the timeframe between receiving the external signal and the actual event of flexibility.

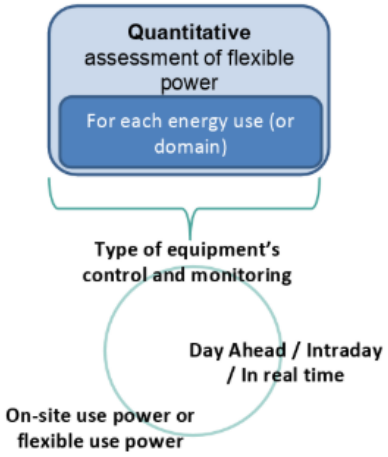

Figure 9 GoFlex quantitative assessment of flexible power

- AEE INTEC could offer a Flexibility Evaluation Tool (FET), which is described and to be downloaded at http://www.annex67.org/publications/software/, actual view also at http://aee-data.at/Flexibility/Flex1/FlexibilityEvaluationTool_WEB4.htm. It is described shortly in the manual there, including two simple indicators used to describe the energy flexibility of buildings - S-flex and E-Flex.
- Measured energy use and energy volume shift based on requests from the production side (i.e. renewable production hours) e.g. https://www.tandfonline.com/doi/abs/10.1080/23744731.2015.1035590

Suitable implementation avenues (process)

There should be a centrally developed EU methodology defining the required performance metrics and automated data transfer. There should be a common central tool/software application implemented in each MS to receive the inputs and calculate the SRI method C. The CEN/ISO set of EPB standards (https://epb.center/support/overview-epb-standards/) provides a good basis for developing SRI method C. Preliminary development and testing is already being conducted in the H2020 U-CERT project (https://u-certproject.eu/u-cert-building-operational-rating/). Furthermore, additional existing standards specific to certain TBS should be examined as their suitability for the development of a scoring system e.g. for lighting systems the strategies given within CIE 222 should be examined.

SRI TGC is the best starting point for discussion on that, whenever possible together with experts of different automation protocols for best exploitation and results and it's possibly helpful to involve standardization groups and national experts. The process could also take place in CEN/ISO and the result could be additional EN/ISO standards to the existing set of EPB standards.

- Step 1. EU broad validation and implementation study (e.g. initial focus on office buildings)
- Step 2. Build upon existing legislation
- Step 3. Broaden to full building stock

A thorough testing activity should accompany this development process e.g. during the national SRI testing and further H2020 projects (which would need to be coordinated in the SRI platform).

- A suitable implementation lies in the proposal of a sound quantification of performance metrics i.e. create a self-sustaining business model for the SRI first of all.
- Decide KPIs and then test the method in case buildings. One starting point could be to select a few representative KPIs for the three key functionalities respectively. Through an iterative approach they could be refined and add more KPIs to measure the progress in achieving the EU goals.
- Decide relevance of including overall building services and related equipment into the discussions and have their inputs and complexities considered in order to have a holistic and future proof method C.

General considerations and recommendations

- The options on the table are either a "checklist" approach (A or B) or an assessment based on measured data (C). A or B and even C would rely on "qualified assessors". It should be acknowledged that this adds a level of subjectivity to the process and as such quality assurance is among the top priorities.
- SRI Method C could be used for planning purposes e.g. the desired smart services/capabilities should be specified together with their respective KPIs. For actual performance assessment a link to the CEN/ISO set of EPB standard would be needed e.g. CEN/ISO set of EPB standards might define minimum requirements of capabilities of a smart building.
- One challenge to be tackled in method C is how to handle user behaviour. For example, the flexibility of the building's performance, much depends on the user's willingness to be flexible with his needs. Method C will most likely require normalization of the measurements to make results comparable, especially when considering user behaviour.
- The lift industry sees several advantages to include lifts within the heart of the discussions or proposal as they can address all the concerns.
- All lessons learned from the smart meters' roll-out activities need to be valued to ensure the SRI delivers all (or most) of its promises.
- It might be useful to analyse the international building rating schemes using digital online platforms, e.g. LEED ARC platform that calculates a performance score out of 100 across multiple performance dimensions such as Energy and Human Experience, based on data from many sources.
- In-use-SRI (automated methods A and B + new method C) should contain and tell the public and market much more than the currently developed SRI. EU-wide SRI communication campaign should be prepared asap.
- For the SRI's evolution process to be meaningful and useful it is invaluable to leverage to the maximum extent possible the national SRI testing and ongoing H2020 projects.
- Include SRI scores in the EU Building Stock Observatory.
- Incorporate SRI assessment in all phases of the building life cycle, validate and track. The SRI should serve towards the achievement of EU Green Deal goals, and especially through the Renovation Wave initiative. It should not be just an image tag.
- Integrate SRI in BIM.

SRI Topical Group C members

The following organisations have actively contributed to the development of this SRI TGC 1st recommendations report and support its content with the consent to have their logo and website displayed. The order random, except the first three i.e. REHVA (chair), smartEn (co-chair) and TNO (co-chair).

Logos

REHVA

smartEn
Smart Energy Europe

TNO

Cerema

OiB AUSTRIAN INSTITUTE OF CONSTRUCTION ENGINEERING

SOMFY

GCP EUROPE
The voice of €fficient building engineering services

EPEE

EVIA
European Ventilation Industry Association

APPLiA

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

ESSO
EUROPEAN SOLAR-SHADING ORGANIZATION
Energy Savings & Comfort

Aalto University
School of Engineering

AEE INTEC

ELA
European
Lift Association

LIGHTINGEUROPE
THE VOICE OF THE LIGHTING INDUSTRY

Websites

- **REHVA** *(Federation of European Heating, Ventilation and Air Conditioning Associations)*
  - https://www.rehva.eu/
- **smartEn** *(Smart Energy Europe)*
  - https://smarten.eu/
- **TNO** *(the Netherlands Organisation for applied scientific research)*
  - https://www.tno.nl/en/
- **Cerema** *(French Centre for Studies and Expertise on Risks, Mobility, Land Planning and the Environment)*
  - https://www.cerema.fr/
- **OiB** *(Austrian Institute of Construction Engineering)*
  - https://www.oib.or.at/en/homeen
- **Somfy Group**
  - https://www.somfy-group.com/en-en/
- **GCP Europe** (EU level association of Building Services Installers: plumbing and HVAC)
  - https://gcpeurope.eu/
- **EPEE** (European Partnership for Energy & the Environment)
  - https://www.epeeglobal.org/
- **EVIA** (European Ventilation Industry Association)
  - https://www.evia.eu/
- **APPLIA** (Home Appliance Europe)
  - https://www.applia-europe.eu/
- **Federal Ministry Republic of Austria**
  - https://www.bmk.gv.at/en/
- **ES-SO** (European Solar Shading Organization)
  - http://es-so.com/
- **Aalto** *(Aalto is a multidisciplinary technical, design and business university in Finland)*
  - https://www.aalto.fi/en
- **AEE INTEC** (Institute for Sustainable Technologies)
  - https://www.aee-intec.at/
- **ELA** (European Lift Association)
  - https://ela-aisbl.eu/
- **Lighting Europe** (The voice of the lighting industry)
  - https://www.lightingeurope.org/

Annex 1 Survey

Mixture of interests represented by SRI Topical Group C members

How satisfied are you with the current SRI approach? (3RD INTERIM REPORT) *

1 - It requires fine-tuning.
2 - It is overall good.
3 - I am very satisfied with it.

Would you care to elaborate the response above by suggesting improvements to the current SRI approach?

This input is meant to be used during the next iterations of the SRI and for improving the co-creation activities of the members of SRI TGC.

0 / 500

Please rank the three key 'smartness' functionalities given in the Annex 1a of the revised EPBD in order of importance to you, first being the most important: *

- Energy performance and operation →
- Response to the needs of the occupant →
- Flexibility of a building's overall electricity demand →
- All three of equal importance →

1.

Updates to the existing SRI methodology

Please share existing practices (content) that should be considered. *

Please include references to the extent possible for allowing more in depth assessment.

0 / 500

Please propose suitable implementation avenues (process) that should be considered.

Please include references to the extent possible for allowing more in depth assessment.

0 / 500

In-use SRI - automated method A or B

In your opinion would this automation increase the EU-wide market uptake of the SRI? *

- ◯ Yes
- ◯ No

Would you care to elaborate the response above?

Please share existing practices (content) that should be considered. *

Please include references to the extent possible for allowing more in depth assessment.

0 / 500

Please propose suitable implementation avenues (process) that should be considered.

Please include references to the extent possible for allowing more in depth assessment and also reflect about how to check compliance of the tools that automatically calculate SRI method A or B.

0 / 500

In-use SRI - leveraging measured data in method C

In your opinion is the SRI method C a must for the ongoing digital transformation of the EU's building stock? *

- ◯ Yes
- ◯ No

Would you care to elaborate the response above?

Please suggest one or more suitable performance metric for "Energy performance and operation" and practical ways of quantification.

Please include references to the extent possible for allowing more in depth assessment.

0 / 500

Please suggest one or more suitable performance metric for "Response to the needs of the occupant" and practical ways of quantification.

Please include references to the extent possible for allowing more in depth assessment.

0 / 500

Please suggest one or more suitable performance metric for "Flexibility of a building's overall electricity demand" and practical ways of quantification.

Please include references to the extent possible for allowing more in depth assessment.

0 / 500

Please propose suitable implementation avenues (process) that should be considered.

Please include references to the extent possible for allowing more in depth assessment.

In general, how important is it to you to monetise improvements of metrics and obtain a clear value proposition for financing?

Optional Indispensable

Any last thoughts?

Please share your further suggestions if/as needed.

0 / 500

Annex 2 Setting the scene

Almost half of the SRI TGC members are completely satisfied with **the current SRI approach**, while a 56% believe it requires fine-tuning as can be seen in Figure 10. This illustrates that the current SRI approach is well developed for the testing phase to be implemented by the Member States that decide to opt-in.

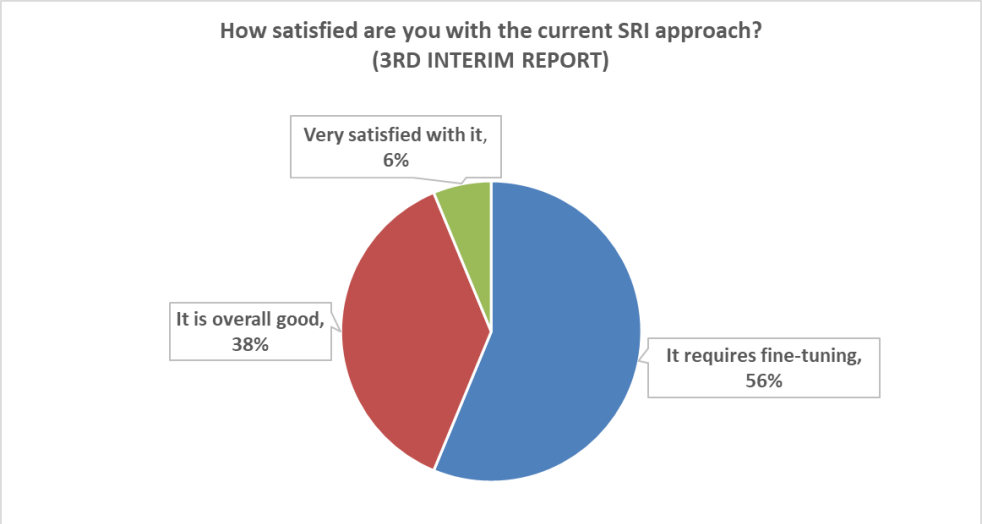

Figure 10 The satisfaction levels of SRI TGC members with the SRI 2nd technical study 3rd interim report

The 3rd interim report is developed in detail and the process has become more specific over time. Even so, some perceive the current SRI approach as too theoretical, not very practical and presumably relatively expensive (value for money). Nonetheless, it is the state-of-the-art (building) smartness assessment (checklist approach) to date that encompasses people, buildings and energy systems.

Thus the 3rd interim report is also a good starting point for broad and automated implementation of SRI in the future. Next iteration should focus on automated generation of SRI based upon real (energy use) data.