



Aalto University

Smart Readiness Indicator (SRI): a tool to prove smartness of building services ?

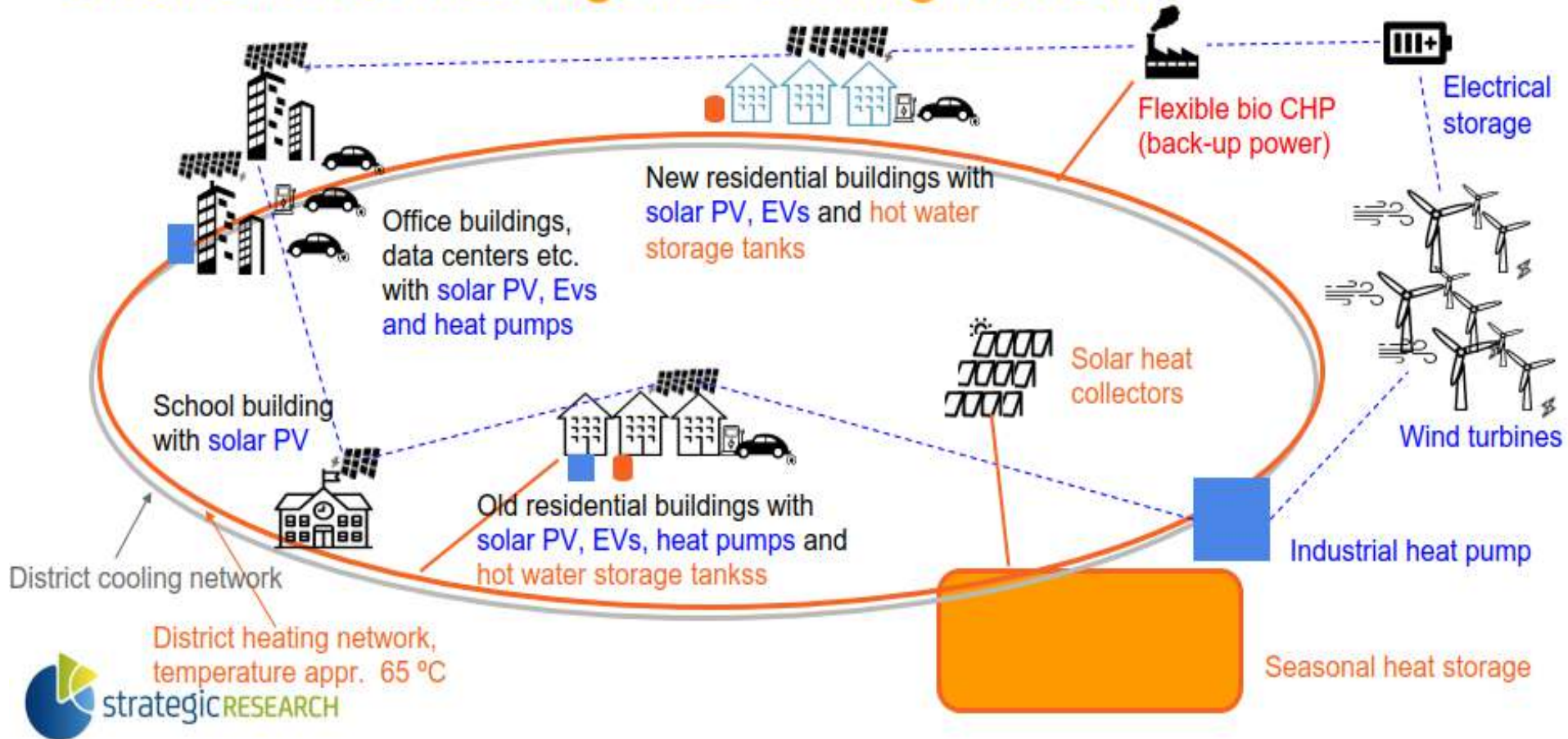
Workshop in Aarhus
on 6th of November 2019

Prof. Risto Kosonen

Overview of the presentation

- Background of Smart Readiness Indicator (SRI)
- SRI methodology
- SRI experiences in test buildings
- Next steps of SRI implementation
- Conclusions

Clean district heating and cooling network



Smart buildings and interoperability

Interoperability is prerequisite for real smartness


**Challenges:
open interfaces
and cyber security**



Need to develop knowledge-intensive services for high performing buildings


← Undergraduate Centre Otakaari 1 · 1st floor

U107
U107 free




10 SEATS 3.88 (24) ★★★★★

Reserve whole space

30 MIN 60 MIN 90 MIN 

Spaces Find Map Scanner More

← Undergraduate Centre Otakaari 1 · 1st floor



10 SEATS 3.88 (24) ★★★★★

Room settings

Room temperature

- Colder **Auto** Warmer +


Air ventilation

Auto Boost

U107 RESERVED **CANCEL** **29:55**

Spaces Find Map Scanner More

← Undergraduate Centre Otakaari 1 · 1st floor



11 SEATS 3.05 (38) ★★★★★

Room settings

How satisfied are you with the indoor conditions of this room?

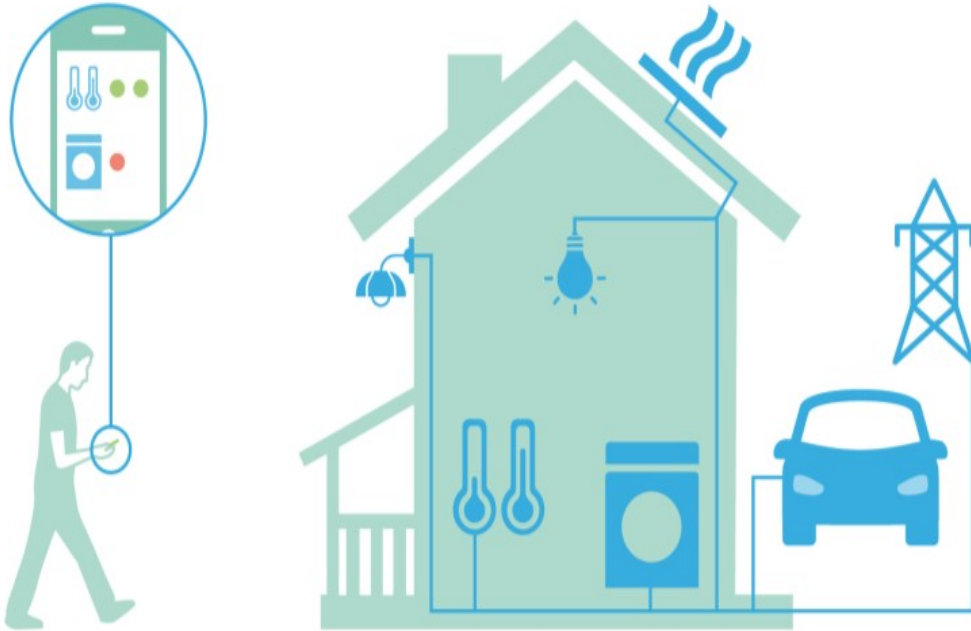
★ ★ ★ ★ ★

U105 RESERVED **CANCEL** **09:26**

Spaces Find Map Scanner More

Background

Expected advantages of smart technologies



EXPECTED ADVANTAGES



optimised energy use as a function of (local) production



optimised local (green) energy storage



automatic diagnosis and maintenance prediction



improved comfort for residents via automation

Background of the Voluntary Smart Readiness Indicator (SRI)

- Developed by European Commission to help recognize smarter building technologies and functionalities which enhance the energy efficiency and other relevant performance characteristics
- SRI is part of the new Energy performance of buildings directive, but at the moment voluntary

Measure the technological readiness of your building



1



Readiness to

adapt in response to the needs of the occupant

2



Readiness to

facilitate maintenance and efficient operation

3



Readiness to

adapt in response to the situation of the energy grid

Three potential assessment methods

A

**Simplified online
quick-scan**

Simplified services list

Online

Self-assessment
(or contractor,...)

15 minutes

Restricted to residential
buildings

B

**Expert SRI
assessment**

Checklist approach, covering
catalogue of smart services cf. 1st
study outcomes

On-site inspection

Third-party qualified
expert

1 hour – max 2 days

Non-residential: offices and
education (+ others later on?)
+ Residential as well

C

***In-use smart building
performance***

*Measured / metered data
(potentially restricted set of
domains)*

*In-use buildings, metered data
Part of the commissioning?*

*TBS self-reporting their actual
performance*

*Gather data over a long period
(e.g. 1 year)*

*Residential and non-residential
Restricted to occupied buildings
(not in design phase)*

In future

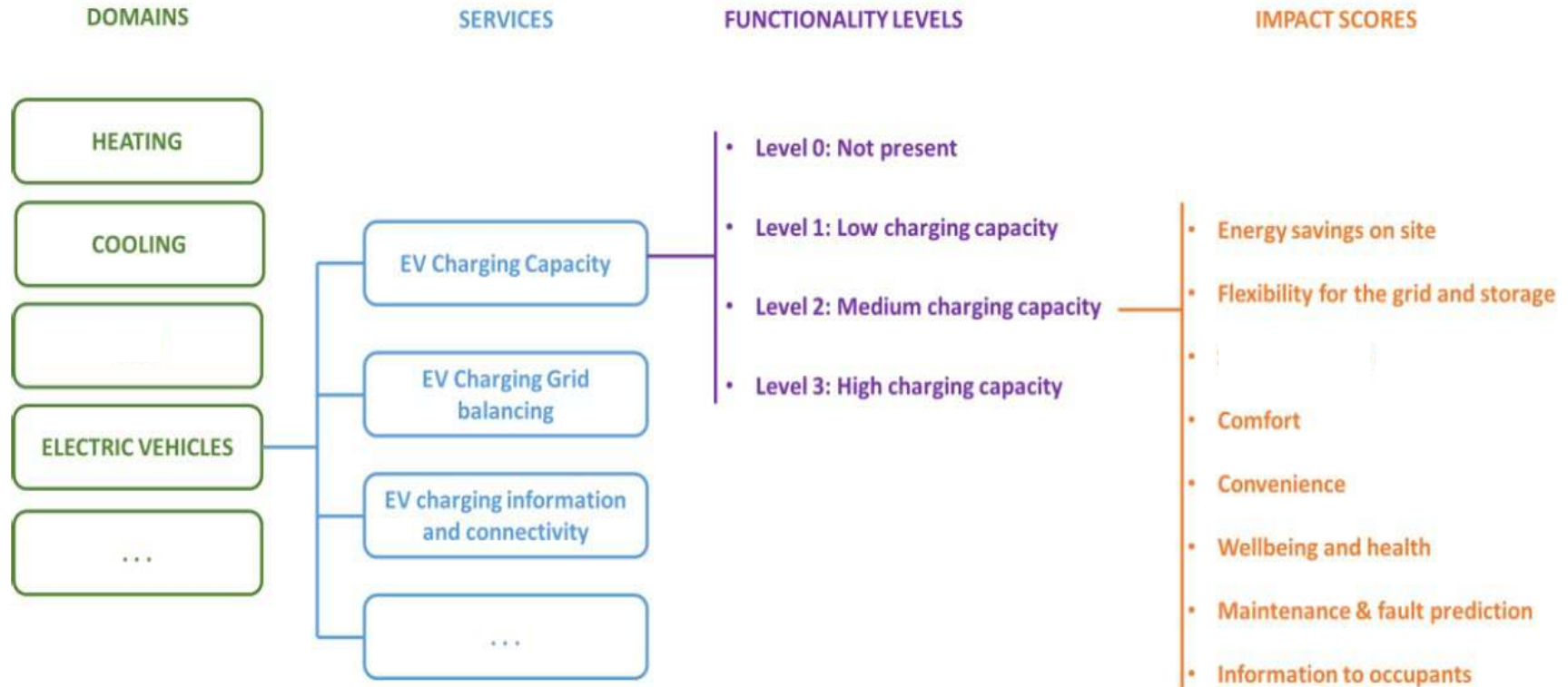
Smart readiness indicator (SRI)

Based on multi-criteria assessment

- The smartness of a building is assessed qualitatively by Specific technologies are not required to be described
- Service should just be able to implement and not necessary used yet (software issue)
- Service that is not relevant could be neglected (triage process).

Note: some services are specified to be mandatory in the methodology

Structure of the smart ready services catalogue



Domains in SRI

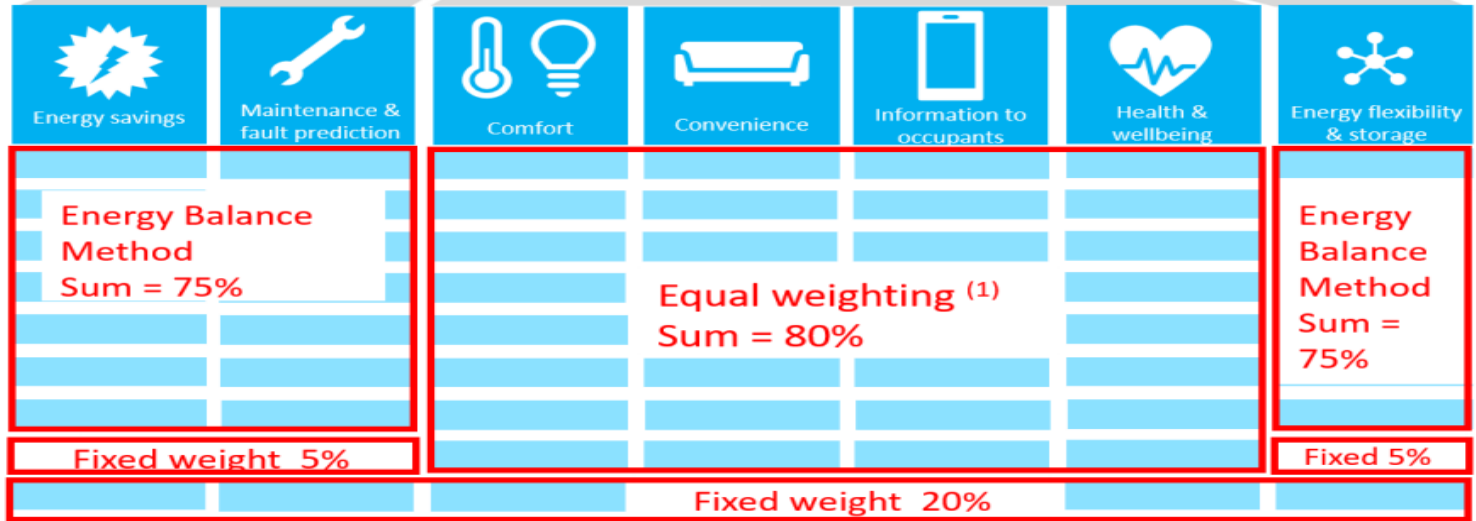


The impact criteria in SRI



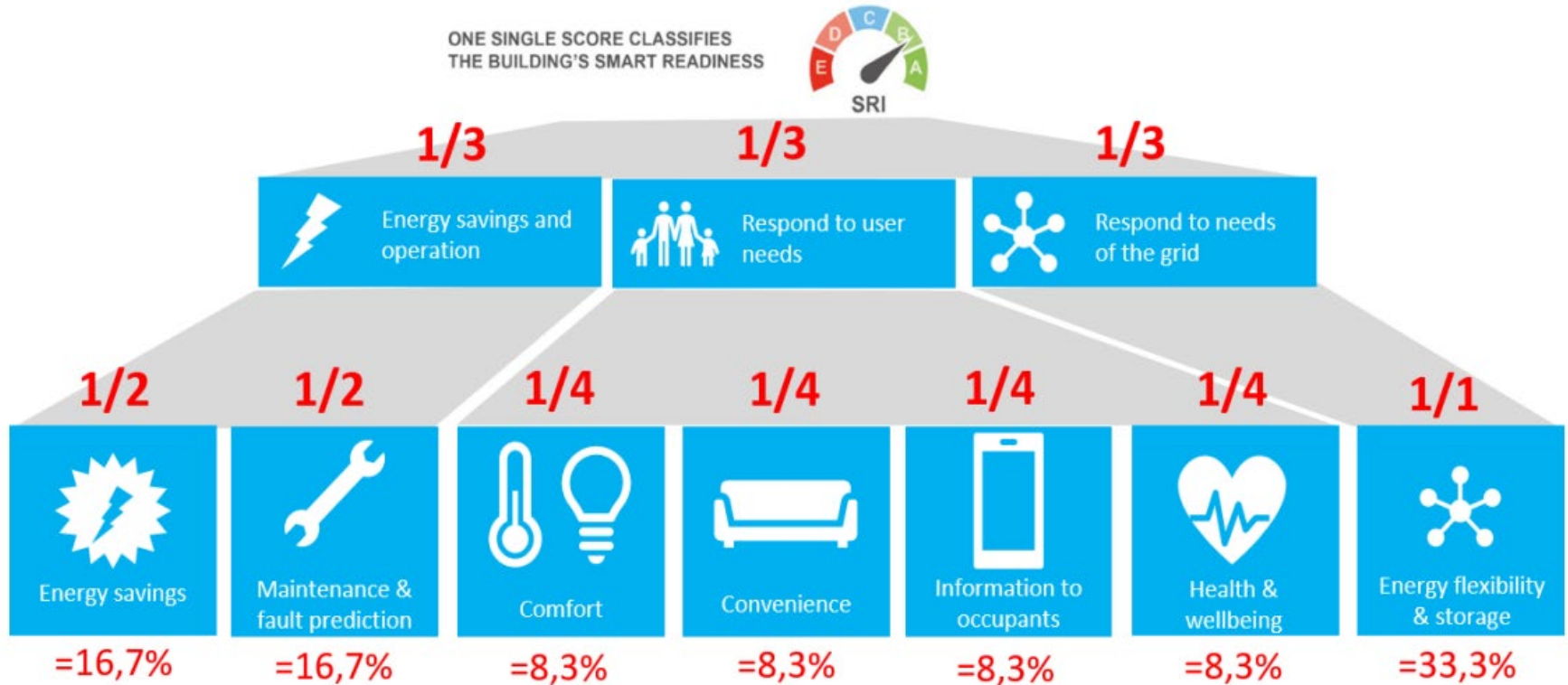
Proposed weighting schemes in domeins

ONE SINGLE SCORE CLASSIFIES
THE BUILDING'S SMART READINESS



⁽¹⁾ correction if no services

Proposed weighting scheme for impact categories



Triage process could be used

service A 	service B 	service C 	service D 	service E
Functionality 1 	Functionality 1 	Functionality 1 	Functionality 1 	Functionality 1 
Functionality 2 	Functionality 2 	Functionality 2 	Functionality 2 	Functionality 2 
Functionality 3 	Functionality 3 	Functionality 3 	Functionality 3 	Functionality 3 
Functionality 4 	Functionality 4 	Functionality 4 	Functionality 4 	Functionality 4 

For this example, the service E is not considered relevant for the building and thus is not evaluated.



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Mandatory Services for Assessment (SRI phase 2)

Method A – residential buildings

Heating-S1 (aiemmin Heating-1a): Heat emission control

Ventilation-S1 (aiemmin Ventilation-1a): Air flow control at the room level

Lighting-S1 (aiemmin Lighting-1a): Artificial lighting control



Mandatory Services for Assessment (SRI phase 2)

Method B – non-residential buildings

- Heating-1a: Heat emission control **except in case when TABS is present**
- Heating-1e: Intermittent control of emission and/or distribution - One controller can control different rooms/zones having same occupancy patterns
- Ventilation-1a: Supply air flow control at the room level
- Ventilation-1b: Adjust the outdoor air flow or exhaust air rate
- Ventilation-6: Reporting information regarding IAQ
- Lighting-1a: Occupancy control for indoor lighting
- Lighting-2: Control artificial lighting power based on daylight levels

Tool for SRI Scoring to assist the evaluation

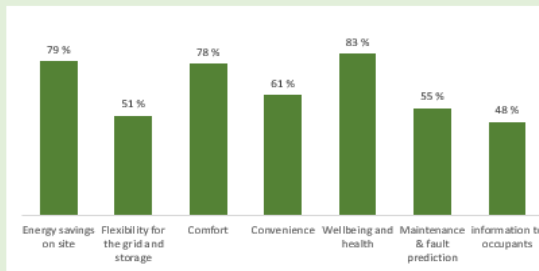
Smart Readiness Indicator for Buildings

Please note that the presentation of results does not reflect the final intended presentation/format of the SRI, but is merely provided for testing purposes. Research on the proper format is ongoing.

TOTAL SRI SCORE 67 %

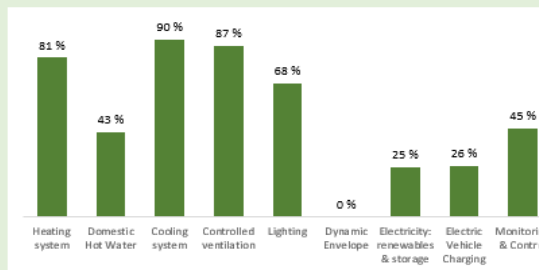
IMPACT SCORES

Energy savings on site	79 %
Flexibility for the grid and storage	51 %
Comfort	78 %
Convenience	61 %
Wellbeing and health	83 %
Maintenance & fault prediction	55 %
information to occupants	48 %



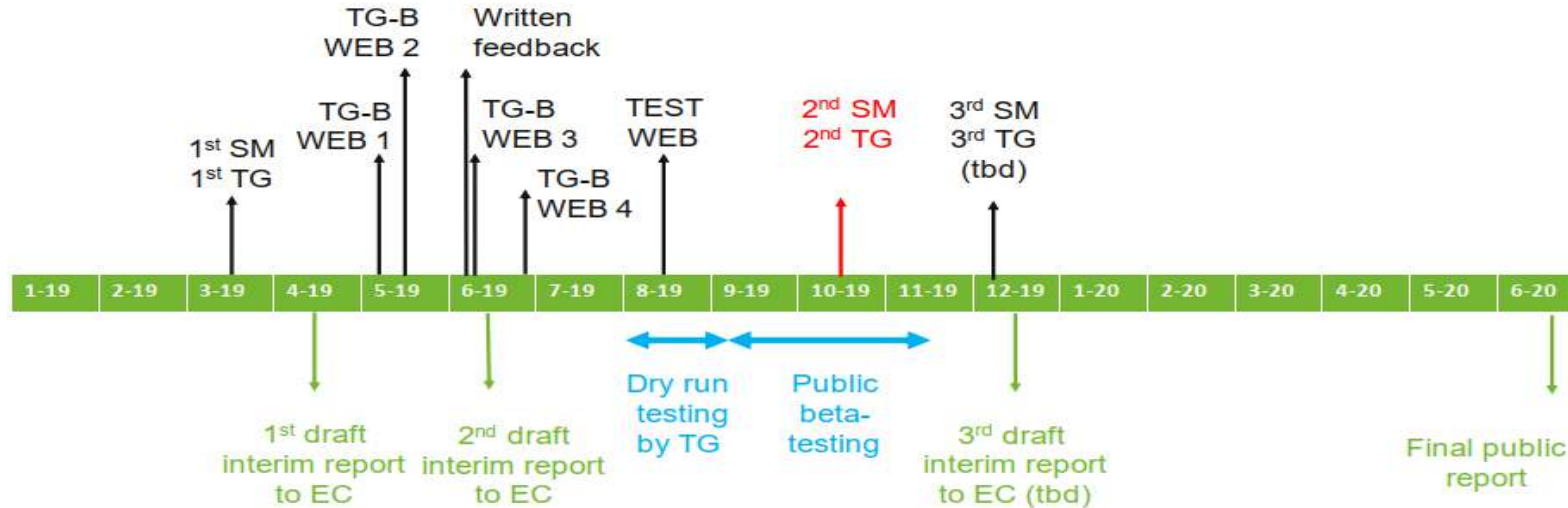
DOMAIN SCORES

Heating system	81 %
Domestic Hot Water	43 %
Cooling system	90 %
Controlled ventilation	87 %
Lighting	68 %
Dynamic Envelope	0 %
Electricity: renewables & storage	25 %
Electric Vehicle Charging	26 %
Monitoring & Control	45 %



← ... Calculation Sheet Results Weightings overview_of_services Feedback

Time table for the next development phases



SRI public beta testing

- Participation to public testing still possible:
feel free to spread the message in your network / organization!
- Please register on <https://smartreadinessindicator.eu/testing-sri>

Results of public beta testing

						SCORE	
		Typology	Country	Size	Age	Method B	Method A
RESIDENTIAL	}	SFH	Greece	200-500	1990-2010	14%	11%
		MFH	Greece	1.000-10.000	1990-2010 renovated	13%	21%
		SFH	Finland		1960-1990		14%
NON-RESIDENTIAL	}	Office	UK	1.000-10.000	1990-2010	15%	
		Office	Italy	500-1.000	1960-1990 renovated	34%	
		Office	Greece	1.000-10.000	<1960 renovated	18%	21%
		Educational	Finland	>25.000	>2010	67%	
		Retail	Finland	>25.000	1990-2010	91%	

Case-study analysis of SRI in Finland

- Ten buildings have been assessed (offices, education, shopping mall, hotel, residential)
- Most of the selected new buildings represent the state-of-the-art buildings (“A-class”) and some older buildings as reference
- Typical assessment took around 1.5-2 hours where experts of SRI methodology and building technical services were present

Main findings so far

Relevancy of services and functionality levels in Finland

- The triage process is required because many of the services are not relevant for Finnish conditions
- Energy storages always get higher functionality level in assessment, even in practice it might be more reasonable to use energy directly, especially with district heating/cooling.
- The increase in smartness from lower to higher level is not necessary giving any benefits for building owner



60's Rowhouse

Project Data

Location	Helsinki, Finland
Year of Construction	1967
Type of Building	Residential Rowhouse
Floor Area	2 570 m ²
Number of Floors	1
Energy Class	N/A
Indoor Climate Class	S3

Basic Design Features

- District Heating + Water Radiators
- Mechanical Exhaust Ventilation



Heating and domestic hot water above medium level



Cooling, ventilation, lighting, dynamic building envelope, energy generation and demand side management 0 %



The age of the building affects the SRI score

Design by Laura Remes

SRI – phase 2 (beta)

60's Rowhouse



SRI score

14%



Design by Laura Remes



Väre

Project Data

Location	Espoo, Finland
Year of Construction	2018
Type of Building	Educational Building
Floor Area	43 000 m ²
Number of Floors	4
Energy Class	A
Indoor Climate Class	S2

Basic Design Features

- Ground Source Heat Pump + Radiant Panels
- District Heating for Supporting Heat Generation
- Mechanical Balanced Ventilation with Heat Recovery
 - Ground Coupled + Radiant Panels
- Chillers for Supporting Cooling Generation
 - Solar PV Utilization

- ↑ Intelligent lighting, automatic heating system, 90 % of domains covered
- ↓ Demand side management and storage of locally generated energy not applied
- ?! Low scores on energy generation, because there is no storage. The best energy class A!

Design by Laura Remes

SRI – phase 2 (beta)

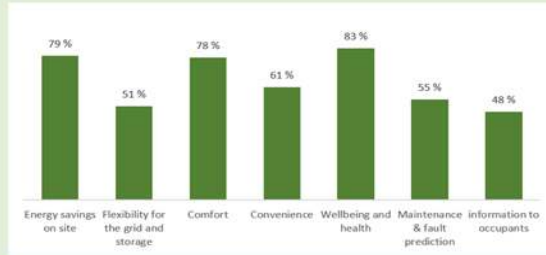
Väre

SRI score

67%

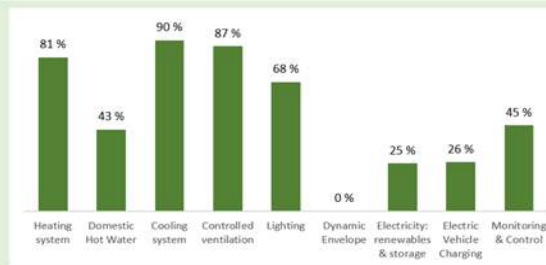
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DOMAIN SCORES

Heating system	81 %
Domestic Hot Water	43 %
Cooling system	90 %
Controlled ventilation	87 %
Lighting	68 %
Dynamic Envelope	0 %
Electricity: renewables & storage	25 %
Electric Vehicle Charging	26 %
Monitoring & Control	45 %



Design by Laura Remes



Sello

Project Data

Location	Espoo, Finland
Year of Construction	2003
Type of Building	Shopping Centre
Floor Area	100 000 m ²
Number of Floors	N/A
Environmental Certificate	LEED Platinum
Indoor Climate Class	S2

Basic Design Features

- District Heating
- Air Heating
- Mechanical Balanced Ventilation with Heat Recovery
- Solar PV Utilization
- Advanced Demand Management
- Electricity Storage

↑ 90 % of domains above medium level, 40 % of domains 100 %, high SRI scores for all impact categories, SRI A level

↓ Dynamic building envelope not applied

?! Part of the smart energy system, microgrid functionality. High SRI score is achievable with district heating.

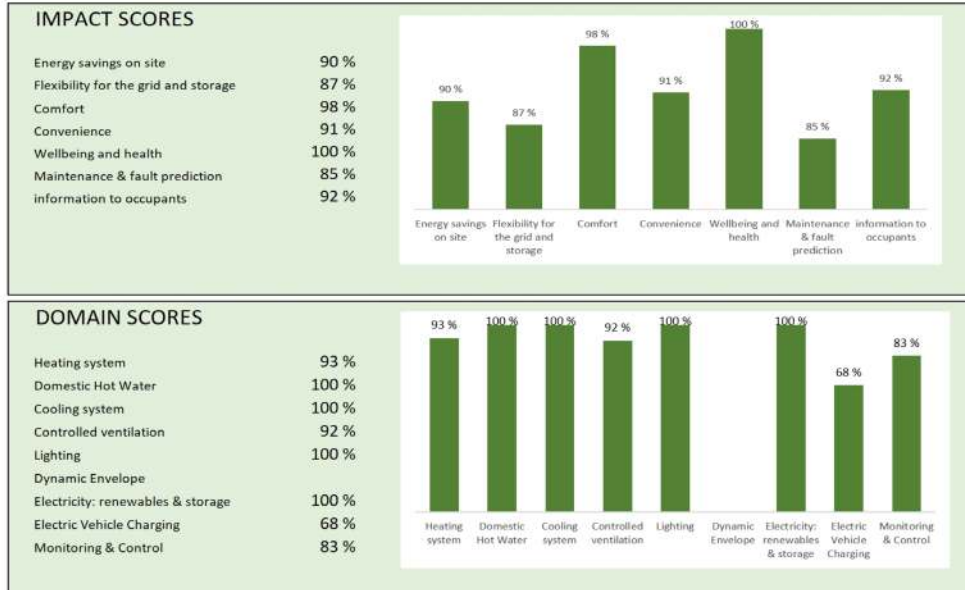
Design by Laura Remes

SRI – phase 2 (beta)

Sello

SRI score

91%



Design by Laura Remes

SRI scores with different design solutions (previous phase scoring system)

Building Type	Year of Construction	Assessed Services	Absolute SRI Score	Relative SRI Score
Shopping Centre	2003	41/52	73 %	92 %
Office	1990	36/52	43 %	60 %
Office	2014	44/52	48 %	55 %
Educational	2018	45/52	47 %	52 %
Office	2013	44/52	42 %	50 %
Educational	2015	33/52	35 %	46 %
Office	2004	36/52	35 %	46 %
Residential	2018	28/52	28 %	46 %
Hotel	(2020)	39/52	33 %	41 %
Residential	1967	20/52	11 %	40 %

- ⇒ **Smart energy system**
- ⇒ **Old building with monitoring services**
- ⇒ **Energy efficient and good indoor climate**
- ⇒ **Fulfills just building code (new)**
- ⇒ **Fulfills just building code (old)**

Discussion : the cost of incremental points in SRI

Project Data	
Location	Helsinki, Finland
Year of Construction	1990
Type of Building	Office Building
Floor Area	6 998 m ²
Number of Floors	4
Environmental Certificate	BREEAM Very Good
Indoor Climate Class	S2
Basic Design Features	
▪ District Heating + Water Radiators	
▪ Mechanical Balanced Ventilation with Heat Recovery	
▪ Passive Chilled Beams	



Intelligent monitoring control, 87,5 % of impact categories covered, most of them above medium level



30 % of domains not applied



Overall SRI score above the medium level as most of the impact categories

Discussion : how to earn more points in SRI

- Windows and solar shading 900 000 euro
 - Light fittings: occupancy and automatic dimming 300 000 euro
 - Ventilation: airflow control & pressure optimization, free-cooling and reporting 120 000 euro
 - Heating: motorized valves, inlet water/pump demand—based control, DH sub-station & reporting 50 000 euro
 - Cooling: motorized valves, inlet water/pump demand—based control, chiller & reporting 50 000 euro
 - **NOTE: even there is no investments, software change costs could be significant to transform building from “smart readiness” to “smartness activated mode”**
-

Potential SRI implementation pathways include:

- A. Linkage of the SRI to the EPC (potentially in a mandatory way) so an assessment would be offered each time an EPC is conducted
- B. Linkage of the SRI to new buildings and major renovations so that each time a new build/or renovation is undertaken it would be a requirement
- C. A market-based voluntary scheme where self-assessment is supported by on-line tools and 3rd party certified assessment is offered to those willing to pay for it
- D. As option C. but with 3rd party assessments supported, or subsidized, by the state and/or utilities seeking to roll out flexibility, energy efficiency, electromobility and self-generation measures
- E. Linkage to the TBS/BACS deployment trigger points in Articles 8, 14 & 15 in the EPBD
- F. Linkage to smart meter deployment
- G. A mosaic of the aboves

Conclusions

- Need for smart buildings that adapts the need of occupants, guarantee high performance of building services and integrate with energy systems
- Novel services are required to fulfill requirement of smartness
- Standard building level of SRI scores is at 15-50 %
- In SRI, to obtain high SRI (over 60 %) scores requires demand response readiness and utilization of energy storage
- SRI scheme is still under development phase

A large, modern building with a green, sloped roof and a red brick facade, surrounded by lush green trees and a grassy lawn with people walking. The building has a distinctive angular design with a prominent red brick section on the right side. The foreground is a well-maintained lawn with several people walking and sitting. The sky is blue with scattered white clouds.

Thank You !