REHVA

Smart Readiness Indicator & Digitalization, Energy and IEQ

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Main issues in 2nd recast of the EPBD

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The main focus in renovation and digitalization, as the latest political issues addressed:

- the content, development and implementation of the long-term renovation strategy;
- electro-mobility;
- the Smart Readiness Indicator;
- the inspections and their alternatives;
- primary energy and weighting factors;

Long-term renovation strategy

- It is stated that Member States shall establish a long-term strategy facilitating the cost-effective **transformation of existing buildings into nearly-zero energy buildings**
- This includes setting out a roadmap with measures and domestically defined measurable progress indicators, with a view to the long-term 2050 goal of reducing greenhouse gas emissions in the Union by 80-95% compared to 1990
- According to the EC's impact assessment, 3 % renovation rate would be needed to accomplish the Union's energy efficiency ambitions in a cost-effective manner
- The roadmap shall include indicative milestones for 2030, 2040 and 2050
- The strategy should cover:
  - policies and actions to stimulate cost-effective deep renovations
  - mobilisation of investments into the renovation

EPBD ANNEX 1: ventilation, IAQ and comfort levels

- In EPBD Annex 1, new requirements are set:
  - "The energy needs for space heating, space cooling, domestic hot water, lighting, ventilation and other technical building systems shall be calculated in order **to optimise health, indoor air quality and comfort levels defined by Member States** at national or regional level"
- → clear mandate to MS to establish minimum ventilation and other IEQ requirements for new buildings and major renovations to implement the directive
- Mandate to The Commission to conduct before 2020 a feasibility study on stand-alone ventilation systems inspection, clarifying the possibilities/timeline to introduce this

Smart Readiness Indicator SRI

The 2nd EPBD recast introduces a new indicator, the Smart Readiness Indicator (SRI)

"*an assessment of the capabilities of a building or building unit to adapt its operation to the needs of* ***the occupant and the grid*** *and to improve its energy efficiency and overall performance*"

Smart Readiness Indicator SRI

A delegated act will establish an optional common EU scheme for rating the smart readiness, that:

- define the building smart readiness indicator
- establish a methodology to calculate it

Final report of first technical study published 26 Aug, 2018:
https://smartreadinessindicator.eu/milestones-and-documents

The work on the development of the SRI will continue in the next months, in view of its adoption. The EC is planning to launch a second technical study on the SRI in the last quarter of 2018. This additional study will review and consolidate the draft SRI framework proposed by the first study, investigate the implementation of the indicator, and take further the evaluation of potential impacts.

SRI Indicator hierarchical structure

SRI INDICATOR

Based on multi-criteria decision making method

↳ 10 DOMAINS

Importance depends on building category

↳ SERVICES

each domain: 3 to 17

↳ FUNCTIONALITY LEVELS

each service: 2 to 5

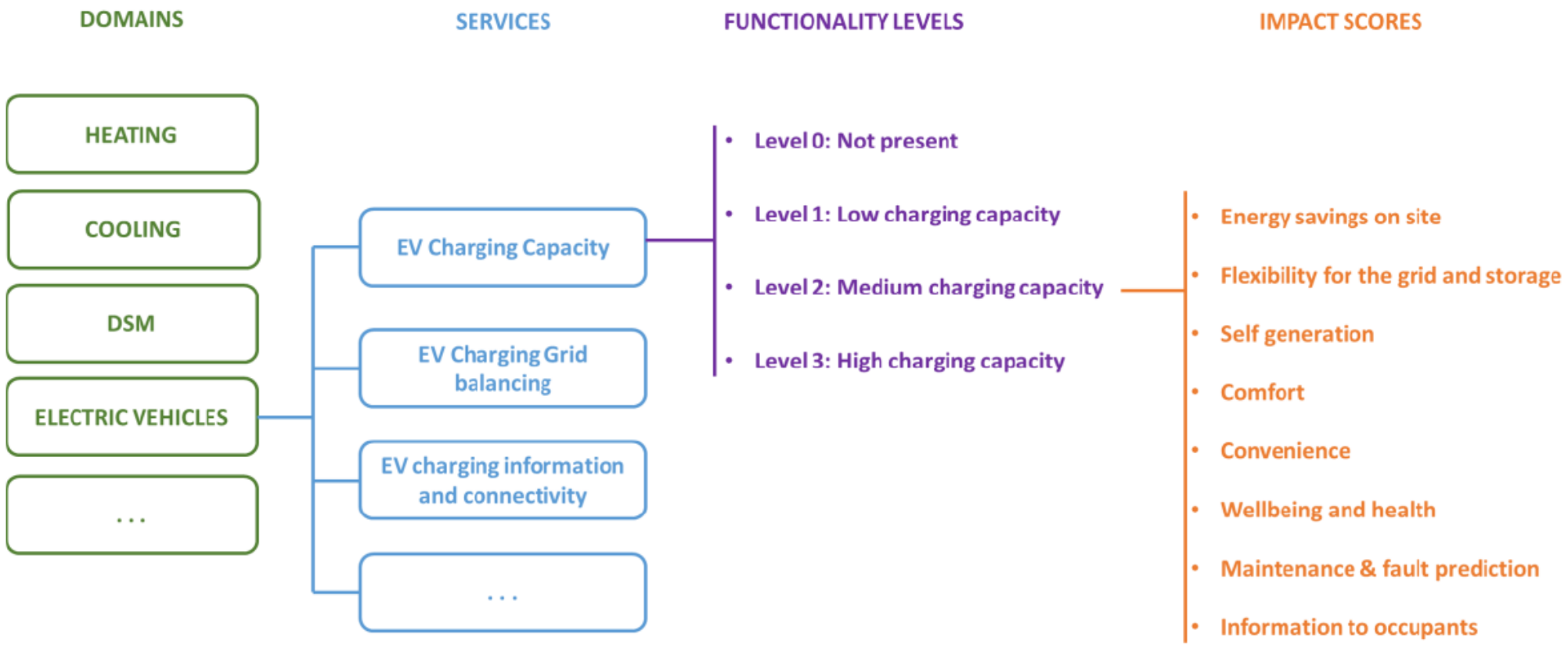
Different importance given by the score

↳ IMPACT SCORES

8 impact categories

Impact categories provisionally equally important

SRI Calculation Methodology - catalogue of smart ready services



Functionality level score:
basic element for SRI determination

SRI Domains

- 10 Domains:
  - Heating
  - Domestic hot water
  - Cooling
  - Mechanical ventilation
  - Lighting
  - Dynamic building envelope
  - On-site energy generation
  - Demand side management
  - Electric vehicle charging
  - Monitoring and control

SRI Services: ex. Heating Domain

Domain	Service	Sub-service	Description
Heating	**Heating-1**		**Heat control – demand side**
		Heating-1a	Heat emission control
		Heating-1b	Emission control for TABS (heating mode)
		Heating-1c	Control of distribution network hot water temperature (supply or return) - Similar function can be applied to the control of direct electric heating networks
		Heating-1d	Control of distribution pumps in networks
		Heating-1e	Intermittent control of emission and/or distribution - One controller can control different rooms/zones having same occupancy patterns
		Heating-1f	Thermal Energy Storage (TES) for building heating
		Heating-1g	Building preheating control
	Heating-2		**Control heat production facilities**
		Heating-2a	Heat generator control (combustion and district heating)
		Heating-2b	Heat generator control (heat pump)
		Heating-2c	Sequencing of different heat generators
		Heating-2d	Heat system control according to external signal (such as electricity tariff, gas pricing, load shedding signal etc.)
		Heating-2e	Heat recovery control (e.g. excess heat from data centers)

SRI Functionality Levels

- Functionality levels are ordinal numbers, implying that ranks cannot be compared in between distinct services.
- The number of functionality levels varies from service to service, the maximum level can be as low as 1 or as high as 5.
- A higher functionality level means “smarter” service

Functionality levels for Subservice Heat Emission Control - Heating-1a	
level 0	No automatic control
level 1	Central automatic control (e.g. central thermostat)
level 2	Individual room control (e.g. thermostatic valves, or electronic controller)
level 3	Individual room control with communication between controllers and to BACS
level 4	Individual room control with communication and presence control

SRI Impact Categories

- 8 Impact field
  - Energy savings on site
  - Flexibility for the grid and storage
  - Self generation
  - Comfort
  - Convenience
  - Health
  - Maintenance & fault prediction
  - Information to occupants

Same importance provisionally assumed

Impact of a Functionality Level

- Qualitative relation between Functionality Level of a Subservice and its Impact
- 9 levels cardinal scale : ----,---,--,-,0,+,++,+++,++++

code	service	Subservice?		
Heating-1a	**Heat emission control**	**yes**	If subservice: overarching service is:	**Heat control - demand side**

Functionality levels		**IMPACTS**							
		Energy savings on site	Flexibility for the grid and storage	Self generation	Comfort	Convenience	Health	maintenance & fault prediction	information to occupants
level 0	No automatic control	0	0	0	0	0	0	0	0
level 1	Central automatic control (e.g. central thermostat)	+	0	0	+	+	0	0	0
level 2	Individual room control (e.g. thermostatic valves, or electronic controller)	++	0	0	++	++	0	0	0
level 3	Individual room control with communication between controllers and to BACS	++	0	0	++	+++	0	+	**0**
level 4	Individual room control with communication and presence control	+++	0	0	++	+++	0	+	**0**

Impact Scores

- Ordinal functionality level rankings mapped to nominal impact scores
- 9 qualitative values: ----,---,--,-,0,+,++,+++,++++
- 9 score values (cardinal numbers)

Ordinal ranking	Nominal impact score
++++	4
+++	3
++	2
+	1
0	0
-	-1
- -	-2
- - -	-3
- - - -	-4

Impact Scores of a Functionality Level of a Sub-service

- Qualitative relation between Functionality Level of a Subservice and its Impacts
- Score cardinal values, $SC_{I,D,SS,F}$ (I=impact, D=domain, SS=sub-service, Functionality level)

code	service	Subservice?		
Heating-1a	**Heat emission control**	**yes**	If subservice: overarching service is:	**Heat control - demand side**

Functionality levels		**IMPACTS**							
		Energy savings on site	Flexibility for the grid and storage	Self generation	Comfort	Convenience	Health	maintenance & fault prediction	information to occupants
level 0	No automatic control	0	0	0	0	0	0	0	0
level 1	Central automatic control (e.g. central thermostat)	1	0	0		1	0	0	0
level 2	Individual room control (e.g. thermostatic valves, or electronic controller)	2	0	0	2	2	0	0	0
level 3	Individual room control with communication between controllers and to BACS	3	0	0	2	3	0	1	**0**
level 4	Individual room control with communication and presence control	4	0	0	2	3	0	1	0

SR Impacts Scores

For any given sub-service (SS) in each domain (D) there is a maximum score value for any **impact criterion** (I), $SC_{I,D,SS,Fmax}$

When aggregated across all the sub-services in the domain, a weighting procedure can be applied or not to these maxima as:

$$SC_{I,D,MAX} = \sum_{SS=1}^{N_{SS}} SC_{I,D,SS_{Fmax}} \cdot w_{SS} \quad ; \quad \sum_{SS=1}^{N_{SS}} w_{SS} = 1$$

and these maxima can be used to derive normalised scores as:

$$NSC_{I,D,SS_F} = \frac{SC_{I,D,SS_F} \cdot w_{SS}}{SRS_{I,D,MAX}} 100 \Rightarrow NSC_{I,D} = \sum_{SS=1}^{N_{SS}} NSC_{I,D,SS_F} \leq 100$$

Max Impacts Scores for each Sub-service

Domain	Service	Sub-service	Impacts Max Score Values							
			E.S.	Flex.	S.G.	Com.	Conv.	Health	M&FP	INFO
Heating	**Heating-1**		**2**	**0**	**0**	**2**	**2**	**0**	**0**	**0**
		Heating-1a	3	0	0	2	3	0	1	0
		Heating-1b	2	0	0	2	3	0	1	1
		Heating-1c	2	0	0	1	2	0	1	0
		Heating-1d	3	0	0	3	0	0	0	0
		Heating-1e	3	0	0	3	3	0	0	0
		Heating-1f	2	0	0	1	0	0	0	0
		Heating-1g	2	0	0	2	2	0	0	1
	Heating-2		**2**	**0**	**0**	**2**	**1**	**0**	**0**	**0**
		Heating-2a	2	0	0	2	0	0	0	0
		Heating-2b	2	1	0	2	0	0	0	0
		Heating-2c	1	1	0	0	0	0	0	0
		Heating-2d	2	1	0	1	1	0	0	0
		Heating-2e	3	0	0	0	0	0	0	0
	Subservices max scores sum		**27**	**3**	**0**	**19**	**14**	**0**	**3**	**2**

Impacts Scores Aggregation among Domains: weighting factors

Example: Domain-level impact weightings used in the Office case study

Domain	Energy savings on site	Flexibility for the grid and storage	Self generation	Comfort	Convenience	Health and well-being	maintenance & fault prediction	information to occupants
Heating	49%	2.5%	0%	40%	10%	10%	10%	7%
Domestic hot water	10%	2.5%	0%	10%	10%	10%	10%	7%
Cooling	6%	2.5%	0%	15%	10%	10%	10%	7%
Controlled ventilation	7%	2.5%	0%	10%	10%	10%	10%	7%
Lighting	10%	2.5%	0%	10%	10%	10%	10%	7%
Dynamic building envelope	7%	0.0%	0%	5%	10%	10%	10%	7%
Energy generation	0%	2.5%	80%	0%	10%	10%	10%	7%
Demand side management	0%	40%	10%	5%	10%	10%	10%	7%
Electric vehicle charging	0%	40%	10%	0%	10%	10%	10%	7%
Monitoring and control	11%	5.0%	0%	5%	10%	10%	10%	40%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Example: SRI scores for the office building

	Energy	Flexibility	Self-generation	Comfort	Convenience	Wellbeing and Health	Maintenance & fault prediction	Information to occupants
Ordinal impact score case study building	54	18	5	34	42	13	16	20
Maximum obtainable score for the case study building	73	25	5	45	61	19	23	30
Relative score	74%	72%	100%	76%	69%	68%	70%	67%

SRI Final Assessment

Table 29 – Example of SRI scores and scale

SRI	Class
>86%	A
>72%	B
>58%	C
>44%	D
>30%	E
>16%	F
16% or less	G

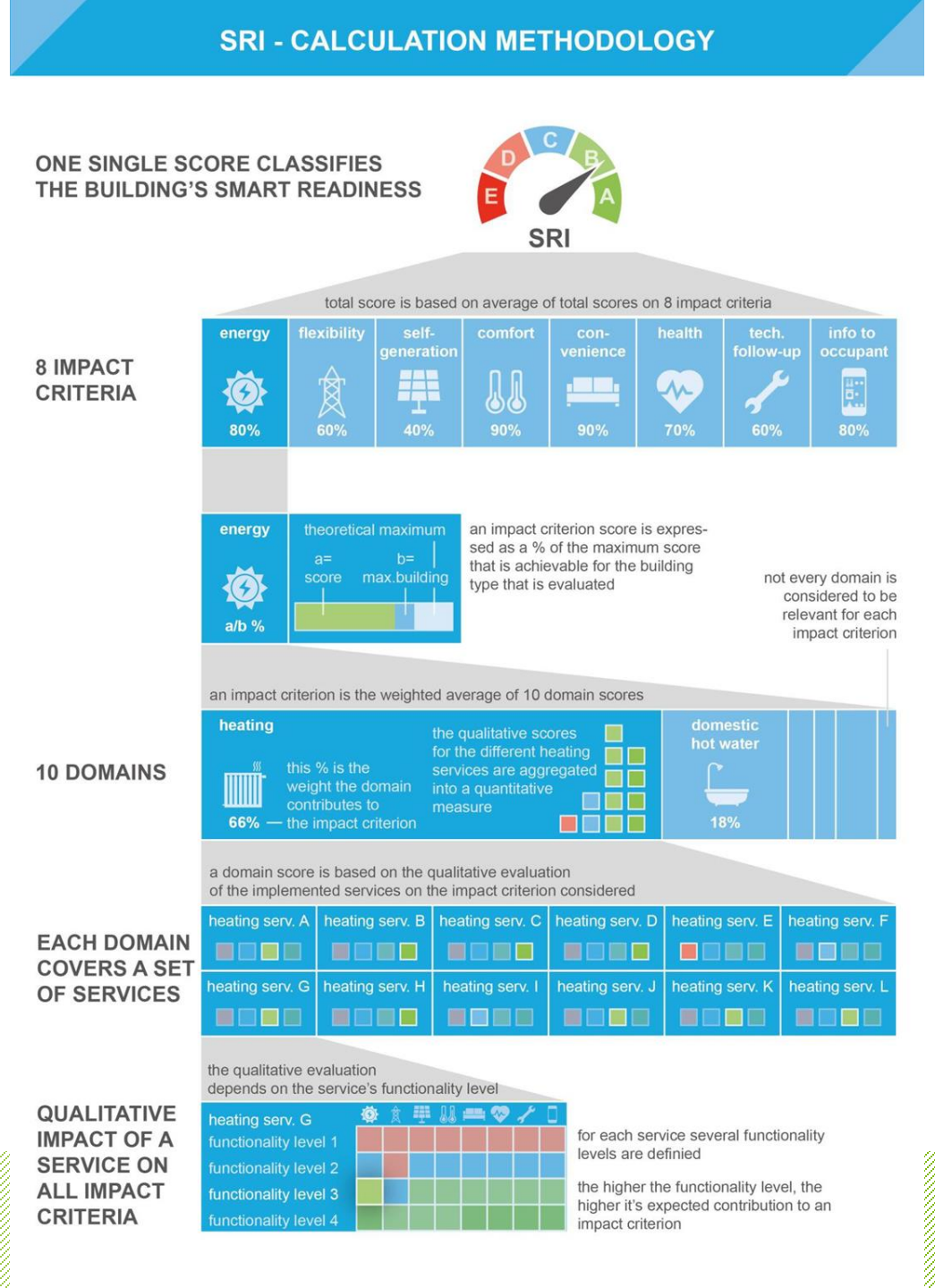
Based on multi-criteria decision making (MCDM) method (linear weighted method), *SRI* is then:

$$SRI = \frac{1}{N_I} \sum_{I=1}^{N_I} NSC_I \cdot w_I \leq 100 \quad ; \quad \sum_{I=1}^{N_I} w_I = 1$$

to have a final *smart readiness indicator SRI* between 0 and 100 for the building.

In this case, N_I = 8 always, because all impacts have to be evaluated.

Method Overview



REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations

REHVA position: Some basic questions

- Performance based vs. prescriptive method – proposed methodology represents prescriptive approach very much targeted to (simple) existing buildings
- Can it be used for new buildings in a meaningful fashion?
  - Technology neutral approach vs. list of technologies to be scored based on installed features
  - The more features installed the better SRI? How the measures will sum up and result in performance, how to account passive or self-regulating measures?
  - Universal list of technical features for all climates and building categories vs. endless number of alternative options and combinations to achieve the performance
  - How to avoid creating an industry game instead of real improvement of buildings performance

REHVA position: Adaptation to user needs and to the grid to be assessed with the same indicator?

- EPBD Annex 1A: *"(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 like two indicators at least:
  - (a) and (c) may be combined to flexibility/demand response indicator
  - User needs (comfort, air quality, lighting, convenience…) will need completely different set of indicators

Flexibility

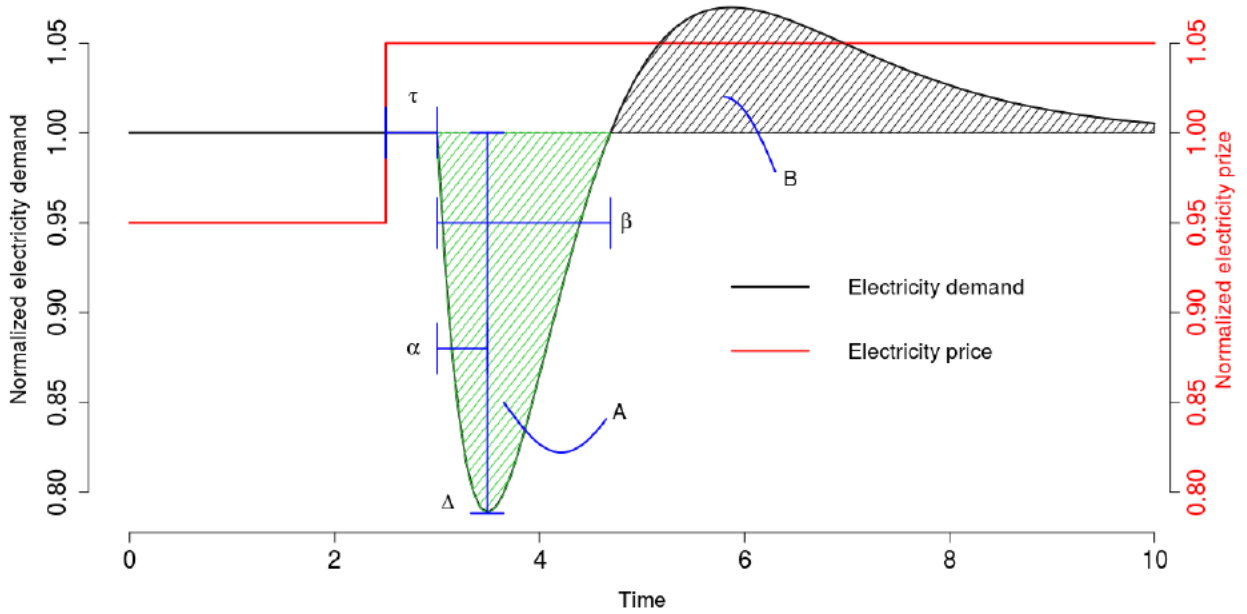
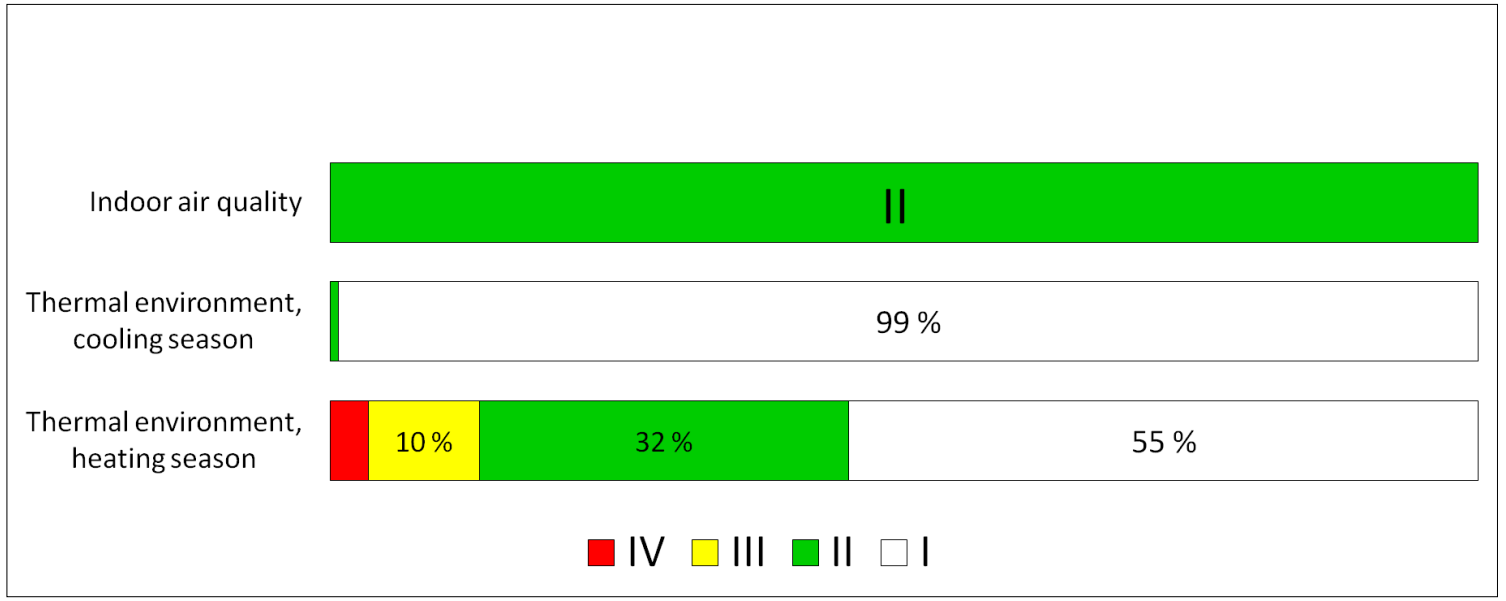


Figure 1 Example of response of a building's electricity demand to a penalty signal, where τ is the time from the signal is submitted to an action starts, α is the period from start of the response to the max response, Δ is the maximum response, β is the duration of the response, A is the shifted amount of energy, B is the rebound effect for returning the situation back to "reference" [12].

- How much power can be shifted and for how long time – typically from electricity high price situation to low price situation
- 12 performance based indicators listed by IEA EBC Annex 67 Energy Flexible Buildings

User needs



- EN 15251 (prEN 16798-1) rating based on Category I, II, III and IV definitions
- Different needs (comfort, air quality, etc) cannot be summed, i.e. good air quality will not compensate bad thermal comfort

REHVA recommendations

- Checklist type of assessment – catalogue of smart ready services – can be justified for existing (old and simple) buildings
- For new NZEB SRI shall be transparent and meaningful i.e. performance based
- REHVA recommends defining performance-based flexibility indicators that are technology neutral, future proof, and can be simulated or measured. Existing energy calculation methods can be extended for this purpose.
- For user needs REHVA recommends to set indicators based on prEN 16798-1 items and categories