

**Smart SpecialiSation  
UNiversity Campus**

**S3UNICA**

**Interreg Europe**



European Union  
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Development Fund

# **Smart Readiness Indicator (SRI): case study application and development**

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# SRI calculation(EU): methodology

- Based on three key functionalities of the building:
  - Energy efficiency and energy consuming adjustment;
  - **Ability to adapt operation mode in response to occupant's needs, and send energy consumption related data;**
  - Active Demand Response.

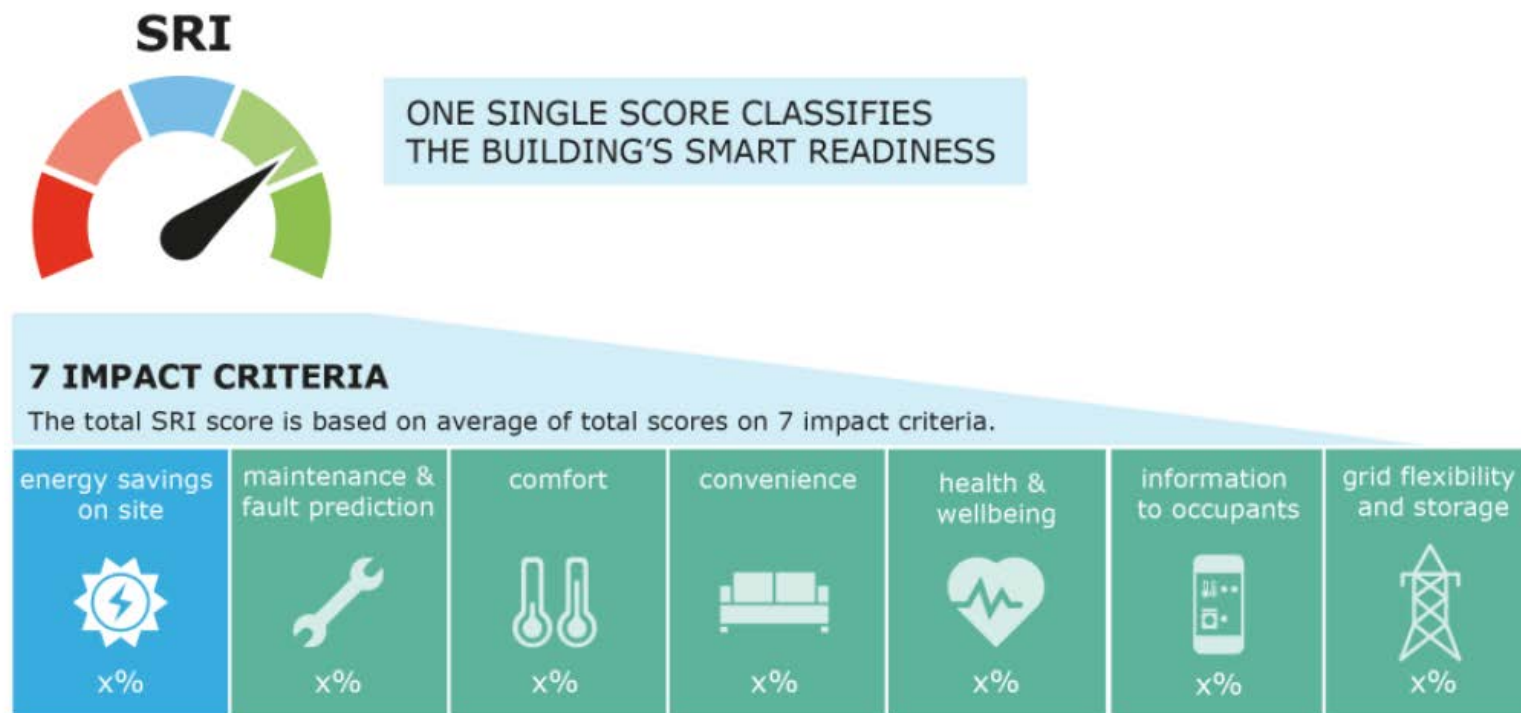
# SRI calculation(EU): methodology

## 9 DOMAINS



- Heating
- Cooling
- Domestic hot water
- Ventilation
- Lighting
- Dynamic building envelope
- Electricity
- Electric vehicle charging
- Performance monitoring and control

# SRI calculation(EU): methodology



Every domain impact is evaluated on 7 impact criteria

# SRI calculation(EU): methodology

service A							
Functionality 0	0	1				0	0
Functionality 1	1	2				1	1
Functionality 2	2	3	2	1	0	2	2
Functionality 3	3	3				3	3

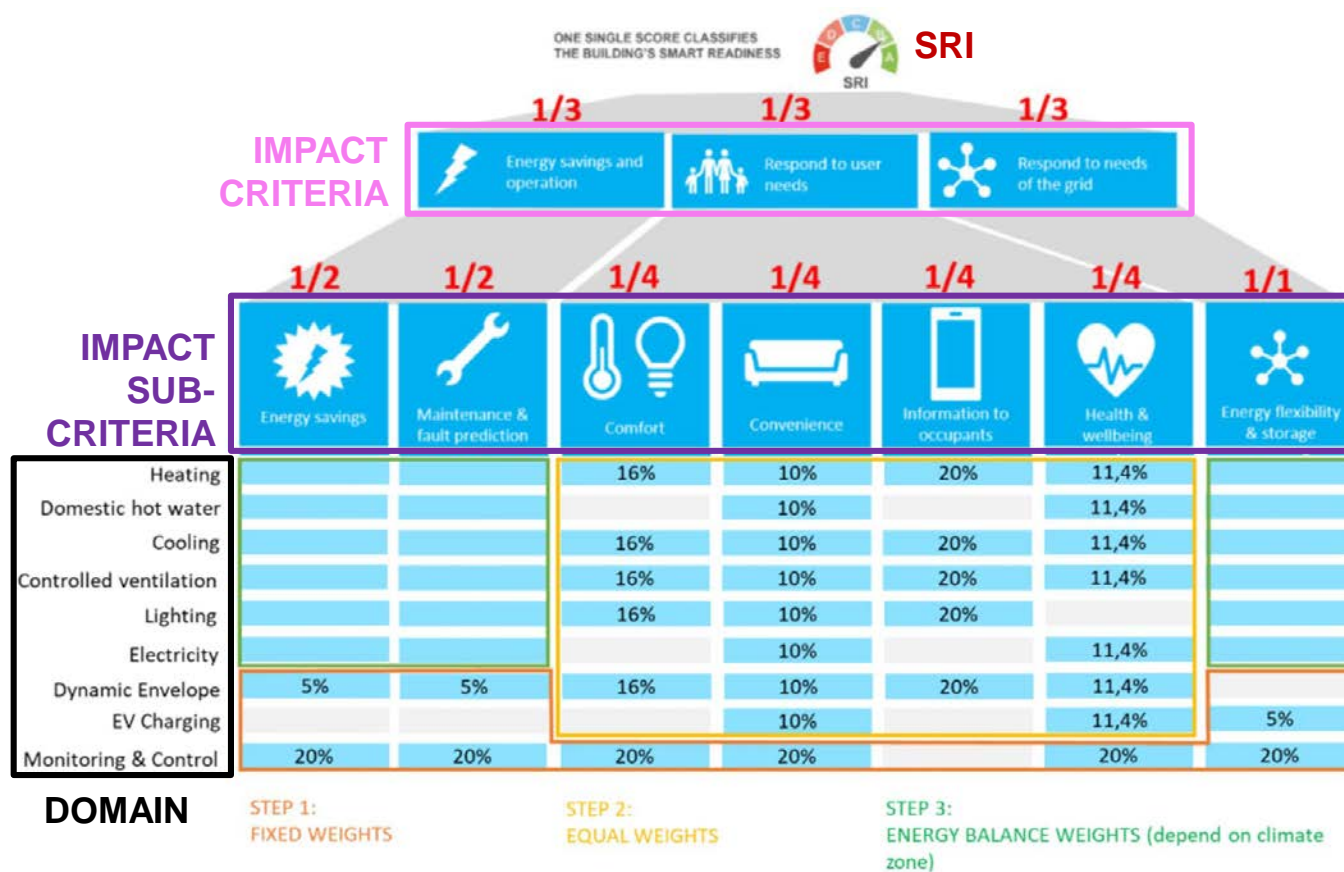
energy savings on site	maintenance & fault prediction	comfort	convenience	health & wellbeing	information to occupants	grid flexibility and storage
Impact score 2	Impact score 3	Impact score 2	Impact score 1	Impact score 0	Impact score 2	Impact score 2
A	B	C	D	E	F	G

The evaluation of the SRI is of a multi-criteria type based on the expected impacts of the services present in a building

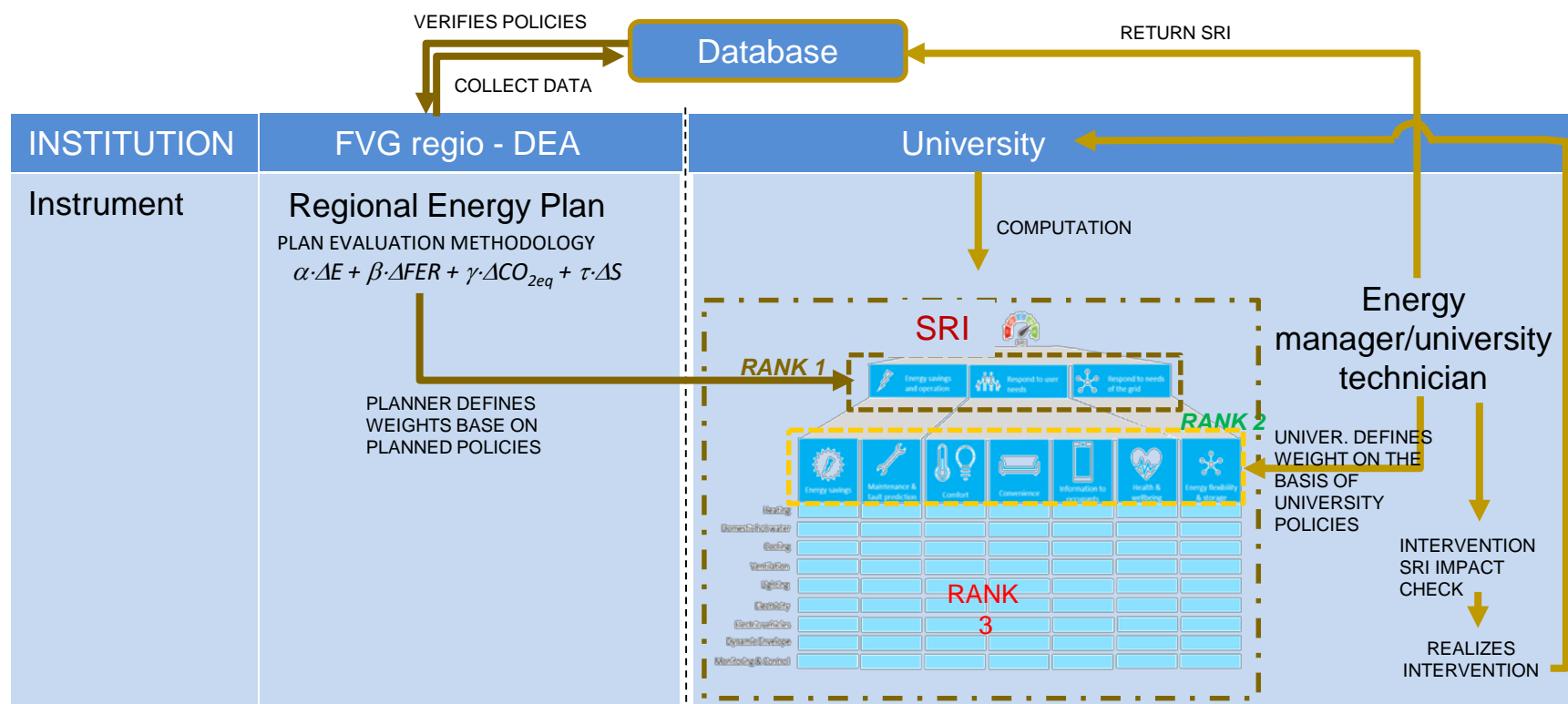
$$N = a \times A + b \times B + c \times C + d \times D + e \times E + f \times F + g \times G$$

$$SRI = \sum N$$

# SRI calculation(EU): weightings



# A tool for action plans



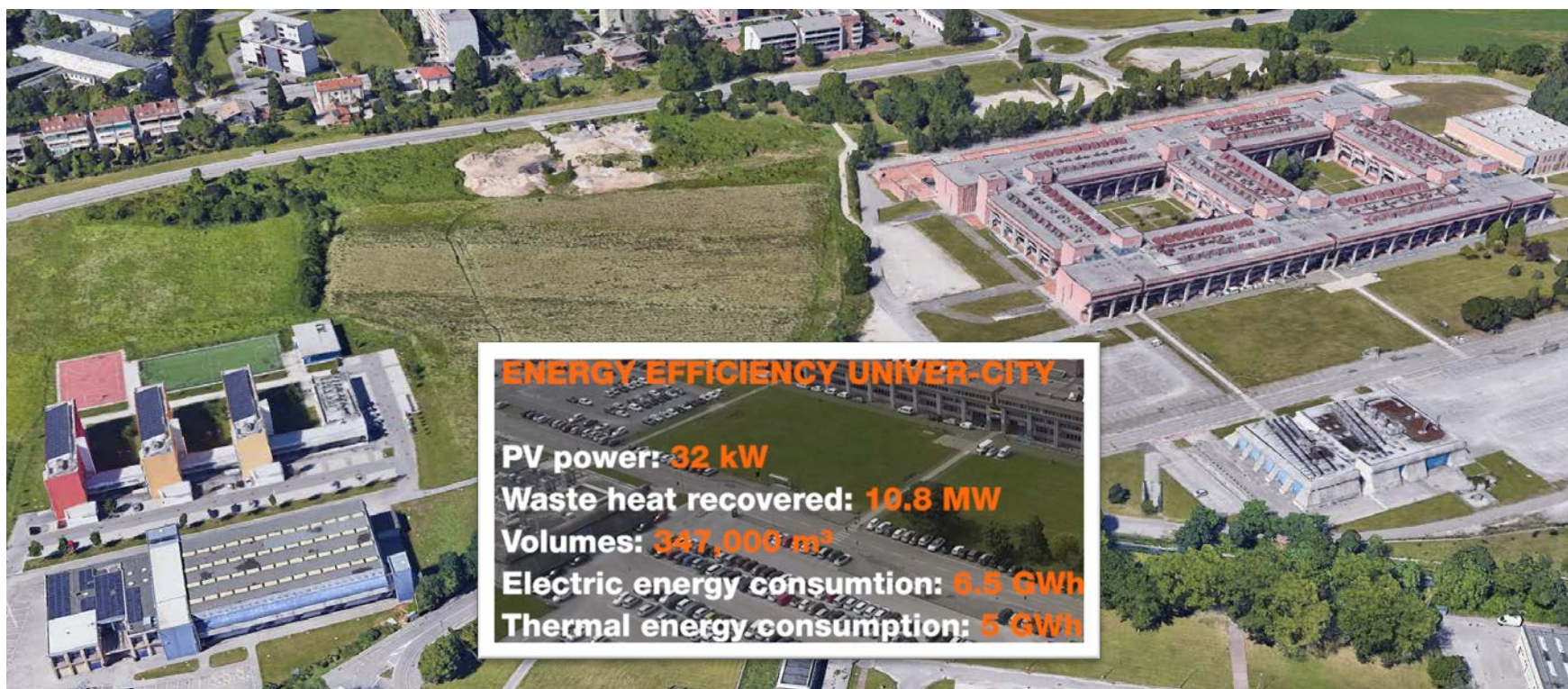
# S3UNICA: SRI tool

Domain	Theme	Code	Service group	Smart ready service	Functionality level 0 (as non-smart default)	Functionality level 1	Functionality level 2	Functionality level 3	Functionality level 4	part of the proposed simplified indicator	Preconditions / Dependency on other services or building types	Functionality level	
												2	Level 2
Heating	Controllability of Performance: Emission	Heating											
Heating	Controllability of Performance: Production	Heating S2a			No automatic control	Central automatic control (e.g. central thermostat)	Individual room control (e.g. thermostatic valves, or electronic controller)	Individual room control with communication between controllers and to BACS	Individual room control with communication and presence control	1	Always to be assessed (if domain is relevant)	2	Level 2
					Constant temperature control	Variable temperature control depending on outdoor temperature	Variable temperature control depending on the load (e.g. depending on supply water temperature set point)			1	Not applicable to heat pumps	2	Level 2
Heating	Controllability of Performance: Production	Heating S2b			On/Off-control of heat generator	Multi-stage control of heat generator capacity depending on the load or demand (e.g. on/off of several compressors)	Variable control of heat generator capacity depending on the load or demand (e.g. hot gas bypass, inverter frequency control)	Variable control of heat generator capacity depending on the load AND external signals from grid		1	Only applicable in case of a heat pump	0	Level 0
							HW storage vessels						
				Storage and DSM					1	Only applicable if storage is present		1	Level 1
Domestic hot water	Information to occupants	DHW-S3	Information to occupants and facility managers	Report information regarding domestic hot water performance	None	Indication of actual values (e.g. temperatures, submetering energy usage)	Actual values and historical data	Performance evaluation including forecasting and/or benchmarking	Performance evaluation including forecasting and/or benchmarking, also including predictive management and	1	Always to be assessed (if domain is relevant)	2	Level 2

	Energy Saving and operation		Respond to user needs				Respond to needs of the grid
	Energy savings	Maintenance & fault prediction	Comfort	Convenience	Health & wellbeing	Information to occupant	Flexibility for the grid and storage
FACTOR TO SET	50%	50%	25%	25%	25%	25%	100%
FACTOR TO SET	33%		33%				33%



# University of Udine: case study



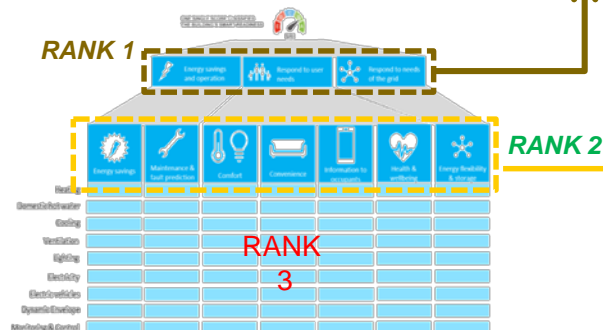
# Case study: SRI tool application

SMART READINESS INDICATOR

32.70%

Functionality level	
2	Level 2
2	Level 2
0	Level 0
2	Level 2
2	Level 2
0	Level 0
1	Level 1
2	Level 2

	Energy Saving and operation		Respond to user needs				Respond to needs of the grid
	Energy savings	Maintenance & fault prediction	Comfort	Convenience	Health & wellbeing	Information to occupant	Flexibility for the grid and storage
FACTOR TO SET	50%	50%	25%	25%	25%	25%	100%
FACTOR TO SET	33%		33%				33%



Domain weightings	Energy savings on site	Maintenance & fault prediction	Comfort	Convenience	Health & wellbeing	Information to occupants	Flexibility for the grid and storage
Heating	31.67%	32.84%	16.00%	10.00%	16.00%	11.43%	37.62%
Domestic hot water	9.98%	10.35%	0.00%	10.00%	0.00%	11.43%	11.86%
Cooling	6.88%	7.14%	16.00%	10.00%	16.00%	11.43%	8.18%
Controlled ventilation	9.20%	9.54%	16.00%	10.00%	16.00%	11.43%	0.00%
Lighting	2.68%	0.00%	16.00%	10.00%	16.00%	0.00%	0.00%
Dynamic building envelope	14.60%	15.14%	0.00%	10.00%	0.00%	11.43%	17.34%
Electricity	5.00%	5.00%	16.00%	10.00%	16.00%	11.43%	0.00%
Electric vehicle charging	0.00%	0.00%	0.00%	10.00%	0.00%	11.43%	5.00%
Monitoring and control	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%



# Domain weighting factors

Domain	Theme	Code	Service group	Smart ready service	Functionality level 0 (as non-	Functionality level 1	Functionality level 2	Functionality level 3	Functionality level 4
Heating	Controllability of Performance:	Heating-S1	Heat control - demand side	Heat emission control	-5.60%	-3.86%	-2.13%	-0.62%	0.00%
Heating	Controllability of Performance: Production	Heating-S2a	Control heat production facilities	Heat generator control (all except heat pumps)	-1.69%	-0.84%	0.00%		
Heating	Controllability of Performance: Production	Heating-S2b	Control heat production facilities	Heat generator control (heat pumps)	-10.14%	-6.48%	-5.63%	0.00%	
Heating	Storage & Connectivity	Heating-S3	Control heat production facilities	Storage and shifting of thermal energy	-5.63%	-2.82%	0.00%		
Heating	Reporting functionalities	Heating-S4	Information to occupants and facility management	Report information regarding heating system performance	-5.69%	-3.46%	-3.13%	-2.81%	0.00%
Domestic hot water	Controllability of Performance	DHW-S1	Control DHW/ production facilities	Control of DHW/ storage charging (with direct electric heating or integrated electric	-2.45%	-0.68%	0.00%		
Domestic hot water	Storage & Connectivity	DHW-S2	Flexibility DHW/ production facilities	Control of DHW/ storage charging	-3.62%	-2.35%	0.00%		
Domestic hot water	Information to occupants	DHW-S3	Information to occupants and facility managers	Report information regarding domestic hot water performance	-3.26%	-1.62%	-1.30%	-0.98%	0.00%
Cooling	Controllability of Performance:	Cooling-S1	Cooling control -	Cooling emission control	-1.66%	-0.89%	-0.32%	0.00%	0.00%
Cooling	Controllability of Performance: Production	Cooling-S2	Control cooling production	Generator control for cooling	-0.39%	-0.19%	0.00%	0.00%	
Cooling	Connectivity	Cooling-S3	Flexibility and grid interaction	Flexibility and grid interaction	-1.40%	-1.06%	-0.77%	-0.65%	0.00%
Cooling	Reporting functionalities	Cooling-S4	Information to occupants and facility	Report information regarding cooling system	-1.09%	-0.77%	-0.45%	-0.12%	0.00%

# SAT future improvements

- Solve questionnaire limit: intentional technology lacks are penalized
- Vito-Waide domain weighting factor adjustment

DOMAIN WEIGHTINGS		
northern europe		
	Energy savings on site	Flexibility for the grid and storage
Heating system	0,30	0,43
Domestic Hot Water	0,09	0,13
Cooling system	0,00	0,00
Controlled ventilation	0,19	0,00
Lighting	0,04	0,00
Electricity: renewables & storage	0,13	0,19
Dynamic Envelope	0,05	0
Electric Vehicle Charging	0	0,05
Monitoring & Control	0,2	0,2
	1,00	1,00
IMPACT WEIGHTINGS		
	Energy savings on site	Flexibility for the grid and storage
	0,17	0,33

domain		monitoring and control								
code	service	Functionality levels		IMPACTS		Comfort	Convenience	Health & wellbeing	maintenance & fault prediction	information to occupants
				Energy savings on site	Flexibility for the grid and storage					
level 0	None			0	0	0	0	0	0	0
level 1	Single platform that allows manual control of multiple TBS			0	0	0	1	0	1	0
level 2	Single platform that allows automated control & coordination between TBS			1	0	0	2	0	1	0
level 3	Single platform that allows automated control & coordination between TBS + optimization of energy flow based on occupancy, weather and grid signals			2	0	0	3	0	1	0
level 4	0									
level 5	0									
code	service									
MC-S2	Smart Grid Integration	Service group: Smart Grid Integration								
code	service	Functionality levels		IMPACTS		Comfort	Convenience	Health & wellbeing	maintenance & fault prediction	information to occupants
				Energy savings on site	Flexibility for the grid and storage					
level 0	None - No harmonization between grid and TBS; building is operated independently from the grid load			0	0	0	0	0	0	0
level 1	Demand side management possible for (some) individual TBS, but not coordinated over various domains			0	2	0	0	0	0	0
level 2	Coordinated demand side management of multiple TBS			1	3	0	1	0	0	0
level 3	0									
level 4	0									
code	service									
MC-S3	Central reporting of TBS performance and energy use	Service group: Back-Reporting information								
code	service	Functionality levels		IMPACTS		Comfort	Convenience	Health & wellbeing	maintenance & fault prediction	information to occupants
				Energy savings on site	Flexibility for the grid and storage					
level 0	None			0	0	0	0	0	0	0
level 1	Central or remote reporting of realtime energy use per energy carrier			1	0	0	1	0	1	1
level 2	Central or remote reporting of realtime energy use per energy carrier, combining TBS of at least 2 domains in one interface			1	0	0	2	0	2	2
level 3	Central or remote reporting of realtime energy use per energy carrier, combining TBS of all domains in one interface			1	0	0	3	0	3	3
level 4	0									



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Thank you for your time

Questions welcome



*Project smedia*