The Revised EPBD in the frame of Fit for 55 program

REHVA EXPERT TALK, 14 March 2024, MCE

EU Decarbonization pathway; study case of the SmartLivingEPC project

Cătălin Lungu

President

Mandate: 2022 - 2025

REHVA

Apartment Building
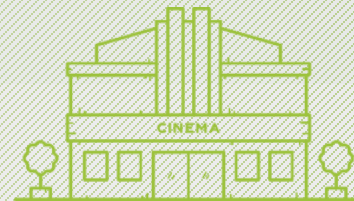
Corporate Building

Industrial Site

Hospital

Mall

Hotel

Congress Center & Institution

Cinema Theater

Airport

Buildings - the heart of our lives (general context)

We spend **up to 90%** of our lives in buildings

We were born, raised, educated

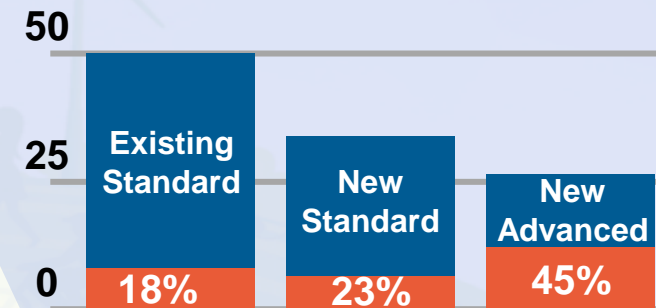We eat, sleep, enjoy ourselves and work

We are healed or protected against natural phenomena

Buildings are essential for climate change mitigation and adaptation

Both energy-related operational emissions and emissions embedded in building materials must be drastically reduced

Total emissions: 37% of energy CO_2 in 2021 (20% of GHG global emission)

The global buildings surface should double by 2060.

The building sector should align with the objectives of the Paris Agreement

The building sector is key for our economy, social life and wellbeing.

Global trends in life cycle emissions of buildings, average $kgCO_2eq/m^2a$

Existing Standard	New Standard	New Advanced
18%	23%	45%

50 — 25 — 0

The equivalent of Paris is added in new building every 5 days

8.2% of the EU GDP

11-13% of the global GDP

10% of EU total employment
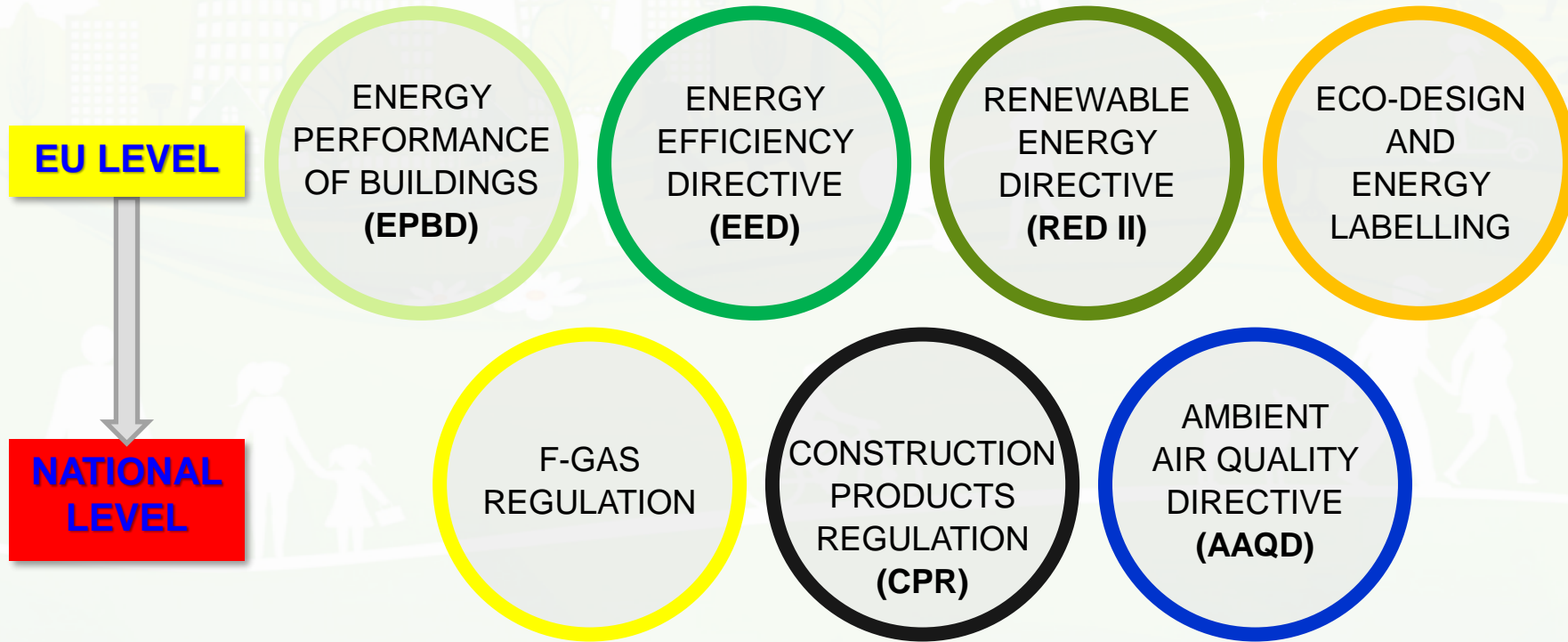
7% of global employment

13.4 million people per year

200 million people per year

EU Decarbonization pathway; study case of the SmartLivingEPC project

Dr.eng.Cătălin LUNGU

EU context & paradigm shift

- **EU Green Deal (strategy) December 2019**

  - **March 2020 –** Fit for 55 package
  - **October 2020 -** Renovation Wave and Action Plan
  - **May 2022 -** RePowerEU Action Plan

EU LEVEL

NATIONAL LEVEL

ENERGY PERFORMANCE OF BUILDINGS **(EPBD)**

ENERGY EFFICIENCY DIRECTIVE **(EED)**

RENEWABLE ENERGY DIRECTIVE **(RED II)**

ECO-DESIGN AND ENERGY LABELLING

F-GAS REGULATION

CONSTRUCTION PRODUCTS REGULATION **(CPR)**

AMBIENT AIR QUALITY DIRECTIVE **(AAQD)**

NEW EU GD 2030

Minimum 55% cut in greenhouse gas emissions compared to 1990 levels

At least a 42,5% share of renewables in final energy consumption

At least a 39% energy savings compared with the business-as-usual scenario

EU Decarbonization pathway; study case of the SmartLivingEPC project

Dr.eng.Cătălin LUNGU

LEVEL(s) - the common language of sustainability

1. Greenhouse gas emissions along a buildings life-cycle

2. Resource efficient and circular material life-cycles

3. Efficient use of water resources

4. Healthy and comfortable spaces

5. Adaption and resilience climate change

6. Optimised life-cycle cost and value

Level 1: Conceptual Design Assessment

Level 2: Detailed Design and Construction Assessment

Level 3: As-built and In-use Assessment

EU Decarbonization pathway; study case of the SmartLivingEPC project

Dr.eng.Cătălin LUNGU

LEVEL(s) - set of 16 common indicators

Thematic areas	Macro-objectives	Indicators			
Resources use and environmental performance	1. Greenhouse gas emissions along a building's life cycle	1.1. Use stage energy performance (kWh/m2/year)	1.2. Life cycle Global warming potential (CO2 eq./m2/year)		
	2. Resources efficient and circular material life cycles	2.1. Bill of quantities, materials and lifespans	2.2. Construction and demolition waste	2.3. Design for adaptability and renovation	2.4. Design for deconstruction
	3. Efficient use of water resources	3.1. Use stage water consumption (m3/occupant/year)			
Health and comfort	4. Healthy and comfortable spaces	4.1. Indoor quality	4.2. Time out of thermal comfort range	4.3. Lighting	4.4. Acoustics
Cost, value and risk	5. Adaption and resilience to climate change	5.1. Life cycle tools: scenarios for projected future climatic conditions	5.2. Increased risk of extreme weather	5.3. Sustainable drainage	
	6. Optimised life cycle cost and value	6.1. Life cycle costs (€/m2/year)	6.2. Value creation and risk factor		

2.4 Life cycle tool: Cradle to cradle Life Cycle Assessment

Overarching assessement tool

SRI-European legal framework for smart readiness

NextGenEPC cluster

Next Generation Energy Performance Certificates cluster

aims to:
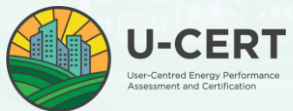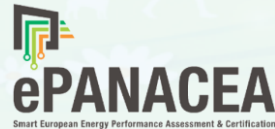
2019 **2020** **2021** **2022**

1. facilitate the convergence of quality and reliability of Energy Performance Certificates (EPCs) across the EU

2. overcome barriers to quality and reliability of current EPC scheme

3. transform EPCs into catalysts for the deep energy renovation of European buildings.

These projects have received funding from the European Union's Horizon 2020 and Horizon Europe research and innovation programmes. The European Union is not liable for any use that may be made of the information contained in the documents prepared by the projects' consortia, which are merely respecting the authors' view

Study case - SmartLivingEPC

- **17 partners**
- **10 countries**

Advanced Energy Performance Assessment towards Smart Living in Building and District Level

Duration: 36 months (July 2022-June 2025)
Coordinator: Centre for Research and Technology Hellas, Information Technologies Institute (CERTH)

PARTNERS	
Centre for Research & Technology, Information Technologies Institute	**Greece**
IsZEB - Intelligent Solutions for Zero and Positive Energy Buildings	**Greece**
Frederick Research Center	**Cyprus**
Federation of European Heating, Ventilation and Air Conditioning Associations	**Belgium**
Asociația Inginerilor de Instalații	**Romania**
IES - Integrated Environmental Solutions Limited	**Ireland**
DEMO Consultants BV	**The Netherlands**
R2M Energy	**Italy**
R2M Solution	**Italy**
University of Deusto	**Spain**
QUE Technologies	**Greece**
GoiEner	**Spain**
Tallinn University of Technology	**Estonia**
Austrian Standards International	**Austria**
ANEC	**Belgium**
Eunice Energy Group	**Greece**
Waide Strategic Efficiency Europe	**Ireland**

- Operational behaviour of the building
- Life cycle performance aspects & building smartness assessment
- Compatible with digital logbooks and building renovation passports
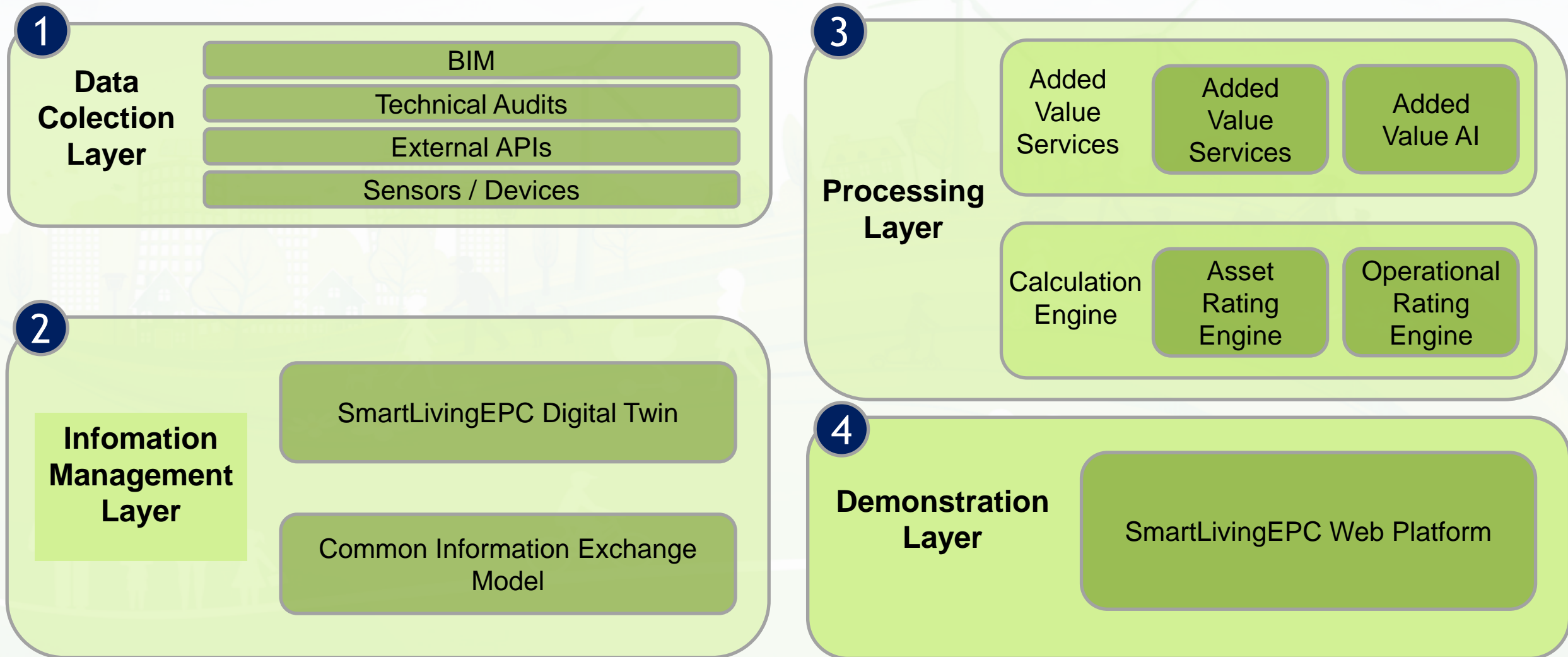- EPC application in building complexes

SmartLivingEPC – Layered Architecture

1

Data Collection Layer

- BIM
- Technical Audits
- External APIs
- Sensors / Devices

2

Infomation Management Layer

- SmartLivingEPC Digital Twin
- Common Information Exchange Model

3

Processing Layer

- Added Value Services
- Added Value Services
- Added Value AI
- Calculation Engine
- Asset Rating Engine
- Operational Rating Engine

4

Demonstration Layer

- SmartLivingEPC Web Platform

SmartLivingEPC – Layered Architecture

SmartLivingEPC - detailed architecture

SmartLivingEPC – example of the asset rating

each energy rating contributes in x% to the new overall Smart Living EPC rating

X% X% X% X% X%

ENERGY RATING
LEVEL(S)
BUILDING SYSTEMS TECHNICAL AUDIT
SMART REDISRINESS INDICATOR (SRI)

weighted energy ratiing parameters

SMART LIVING EPC

new EPC rating

ENERGY RATING

LEVEL(S)
European framework for sustainable buildings
© European Commission

BUILDING SYSTEMS TECHNICAL AUDIT

SMART REDINESS INDICATOR (SRI)

ENERGY INDICATOR

Default and User-defined weighting
similar to SRI

C xx%
F xy%

ENERGY — SRI

66,19 C

LCA — NON-ENERGY
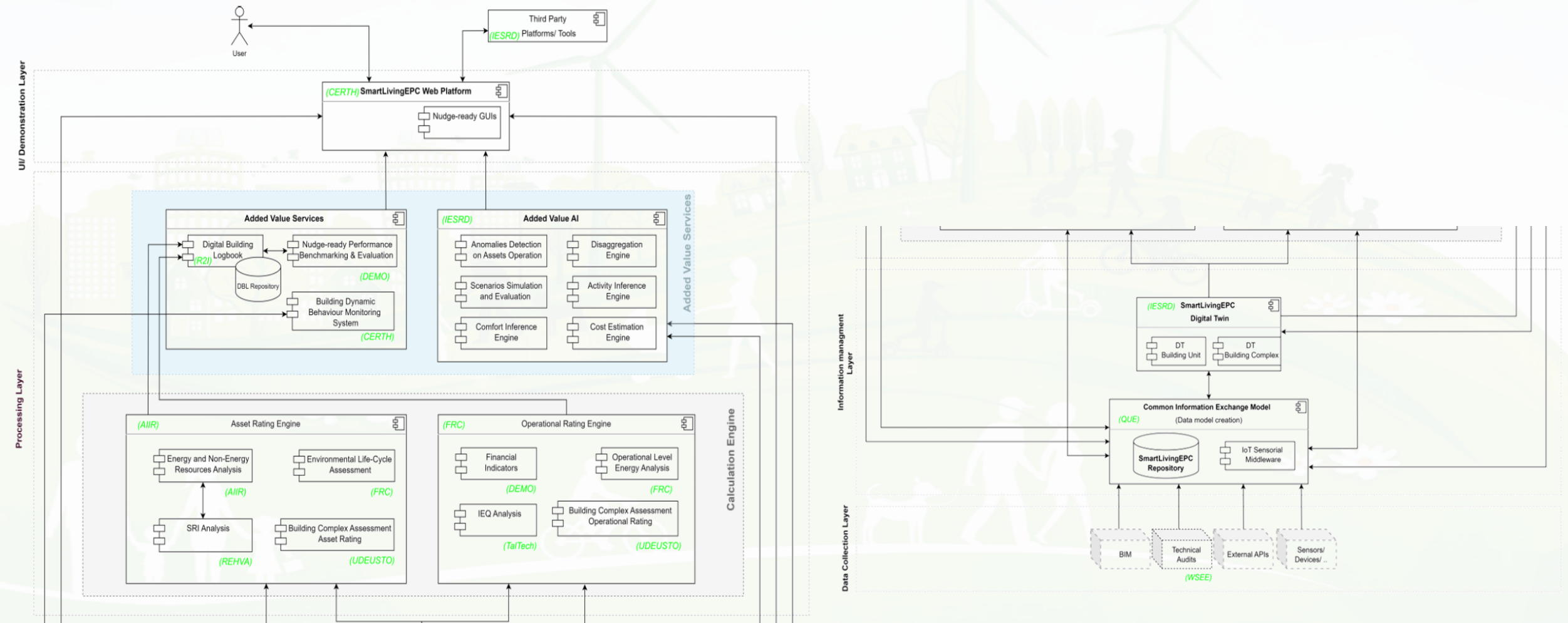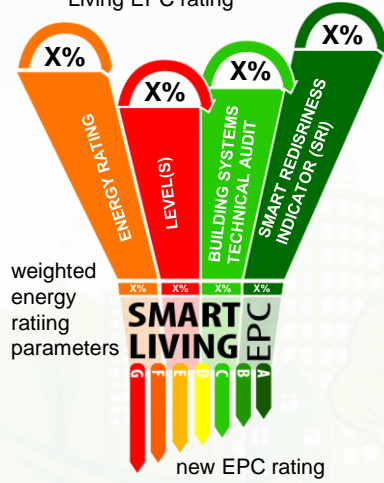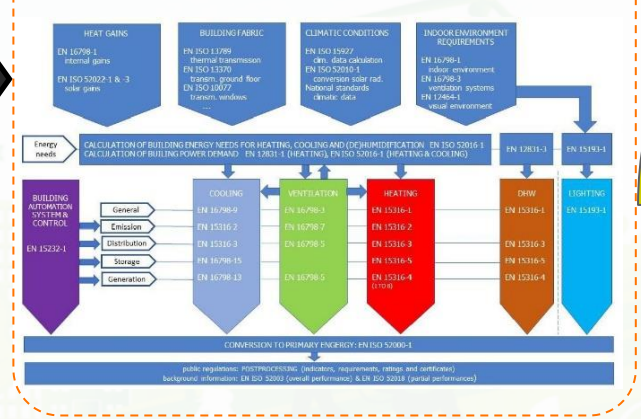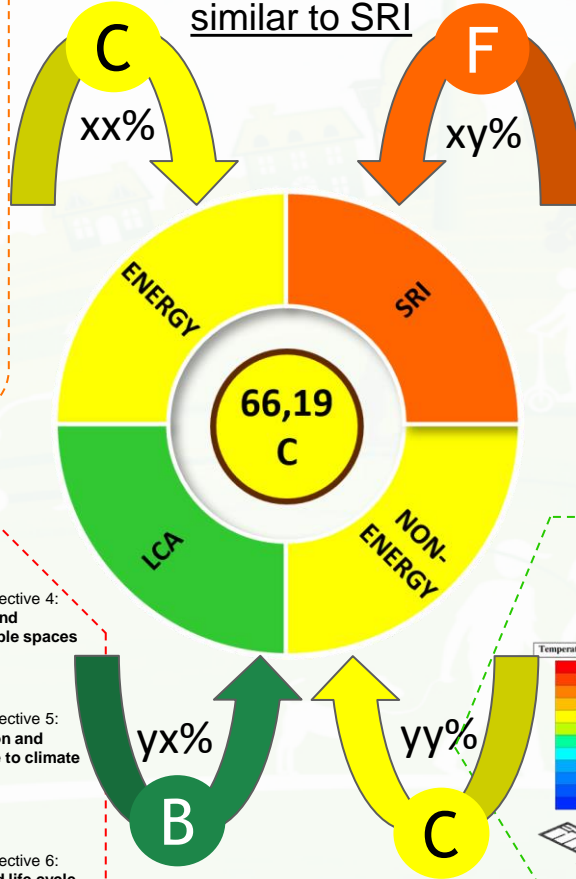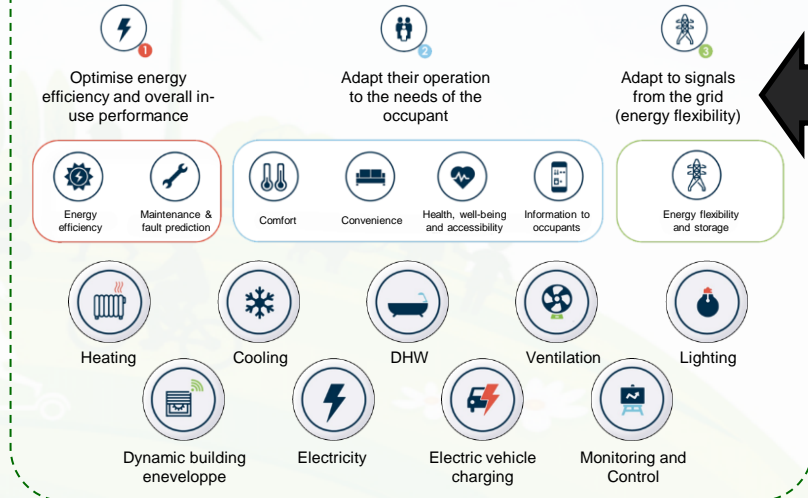
B yx%
C yy%

SRI

Optimise energy efficiency and overall in-use performance

Adapt their operation to the needs of the occupant

Adapt to signals from the grid (energy flexibility)

Energy efficiency | Maintenance & fault prediction
Comfort | Convenience | Health, well-being and accessibility | Information to occupants
Energy flexibility and storage

Heating | Cooling | DHW | Ventilation | Lighting
Dynamic building eneveloppe | Electricity | Electric vehicle charging | Monitoring and Control

LEVEL(s)

Macro-objective 1: **Greenhouse gas and air pollutant emissions along a buildings life cycle**

Macro-objective 4: **Healthy and comfortable spaces**

Macro-objective 2: **Resource efficient and circular material life cycles**

Macro-objective 5: **Adaptation and resilience to climate change**

Macro-objective 3: **Effcient use of water resources**

Macro-objective 6: **Optimized life cycle cost value**

NON-ENERGY INDICATORS

Category IV
Category III
Category II
Category I

Temperature [°C]

Server

3rd Floor
2nd Floor
1st Floor

Indoor air quality by the concentration of CO_2 - Residential [ppm]

2500
2000
1500
1000
500
0

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Zone 1 Zone 2 Zone 3 Zone 4

Fig. 2. Air temperature 3D plot for different zones of the building

TECHNICAL AUDIT & VISUAL INSPECTIONS

REHVA

SmartLivingEPC - lists of KPIs for the asset rating

Total SRI readiness indicators

(per technical functionality, per impact criterion, per technical domain)

Indicator name	Total smart readiness	
	Score	Rating
Description	This indicator displays the overall smart readiness score	This indicator displays the overall smart readiness rating
Input	Refer to input data from Section 2.4.1.2	
Sensors	None	
Algorithm	Refer to calculation from Section 2.4.1.2	
Output	Value in %	Value within 7-step scale
Worked example	Refer to calculation from Section 2.4.1.2	
References	SRI assessment package (v4.5) [6].	

LCA indicators

	Indicator Name	Units
1	Climate change (global warming potential)	kg CO2 equivalents per kg [kg CO2 eq / kg]
2	Ozone depletion potential	kg CFC 11 equivalents [kg CFC 11 eq]
3	Acidification potential	mole H+ equivalents [mol H+ eq.] kg SO2 equivalents per kg [kg CO2 eq / kg]
4	Eutrophication aquatic freshwater	kg P equivalents [kg P eq.]
5	Eutrophication aquatic marine	kg NMVOC equivalents [kg NMVOC eq.]
6	Depletion of abiotic resources - minerals and metals	kg Sb equivalents [kg Sb eq.]
7	Depletion of abiotic resources – fossil fuel	Mega Joules [MJ]
8	Water use	Water use
9	Use stage energy performance	kilowatt-hours per square meter per year (kWh/m2 /yr)
10	Life cycle Global Warming Potential	kg CO2 equivalents per square meter per year (kg CO2 eq./m2/yr
11	Bill of quantities, materials, and lifespans	Unit quantities, mass, and years
12	Construction & demolition waste and materials	kg of waste and materials per m2 total useful floor area
13	Design for adaptability and renovation	Adaptability score
14	Design for deconstruction, reuse, and recycling	Deconstruction score
15	Deconstruction score	m3/yr of water per occupant

SmartLivingEPC - lists of KPIs for the asset rating

BUILDING LEVEL		
ENERGY INDICATOR at BLDG LEVEL		**MU**
1,2	NON-REN PRIMARY ENERGY, **HEATING** (EL & TH)	kWh/m2,y
3,4	REN PRIMARY ENERGY, **HEATING** (EL & TH)	kWh/m2,y
5,6	NON-REN PRIMARY ENERGY, **DHW** (EL & TH)	kWh/m2,y
7,8	REN PRIMARY ENERGY, **DHW** (EL & TH)	kWh/m2,y
9,10	NON-REN PRIMARY ENERGY, **COOLING** (EL & TH)	kWh/m2,y
11,12	REN PRIMARY ENERGY, **COOLING** (EL & TH)	kWh/m2,y
13	NON-REN PRIMARY ENERGY, **VENTILATION** (EL)	kWh/m2,y
14	REN PRIMARY ENERGY, **VENTILATION** (EL)	kWh/m2,y
15	NON-REN PRIMARY ENERGY, **LIGHTING** (EL)	kWh/m2,y
16	REN PRIMARY ENERGY, **LIGHTING** (EL)	kWh/m2,y
17	NON-REN PRIMARY ENERGY, **BAC** (EL)	kWh/m2,y
18	REN PRIMARY ENERGY, **BAC** (EL)	kWh/m2,y
19	**TOTAL NON-REN PRIMARY ENERGY, TH**	kWh/m2,y
20	**TOTAL NON-REN PRIMARY ENERGY, EL**	kWh/m2,y
21	**TOTAL REN PRIMARY ENERGY, TH**	kWh/m2,y
22	**TOTAL REN PRIMARY ENERGY, EL**	kWh/m2,y
23	BUILDING LEVEL EP CLASS, **HEATING**	A…G
24	BUILDGING LEVEL EP CLASS, **DHW**	A…G
25	BUILDING LEVEL EP CLASS, **COOLING**	A…G
26	BUILDING LEVEL EP CLASS, **VENTILATION**	A…G
27	BUILDING LEVEL EP CLASS, **LIGHTING**	A…G
29	BUILDING LEVEL EP CLASS, **TOTAL PE CONSUMPTION**	A…G
30	TOTAL CO2e EMISSIONS (operational CO2)	kgCO2e/m2,y
31	CO2e pollution level (Operational CO2)	A…G
32	**RER**	%
33-34	**Exported primary energy, EL & TH**	kWh/m2,y

BUILDING LEVEL		
No	**NON-ENERGY PARAMETER**	**MU**
1	ACCOUSTIC CONFORT	score
2	VISUAL CONFORT	score
3	IEQ (including a group of indicators)	score
4	POTABLE WATER CONSUMPTION	m3/m2,year
5	RADON	Bq/m3
6	SEISMIC SECURITY LEVEL	cathegory level

SmartLivingEPC – pilot buildings

Demo Site 1
nZEB Smart House DIH, Mixed-use
Thessaloniki
Greece

Demo Site 2
Frederick University Main Building
Limassol
Cyprus

Demo Site 3
Ehituse Mäemaja, Tallinn University of Technology, Tallinn, Estonia

Demo Site 4
Single family house, Leitza
Spain

Demo Site 5
Private flat
Leitza
Spain

Demo Site 6
Mixed-use Building
Leitza
Spain

Demo Site 7
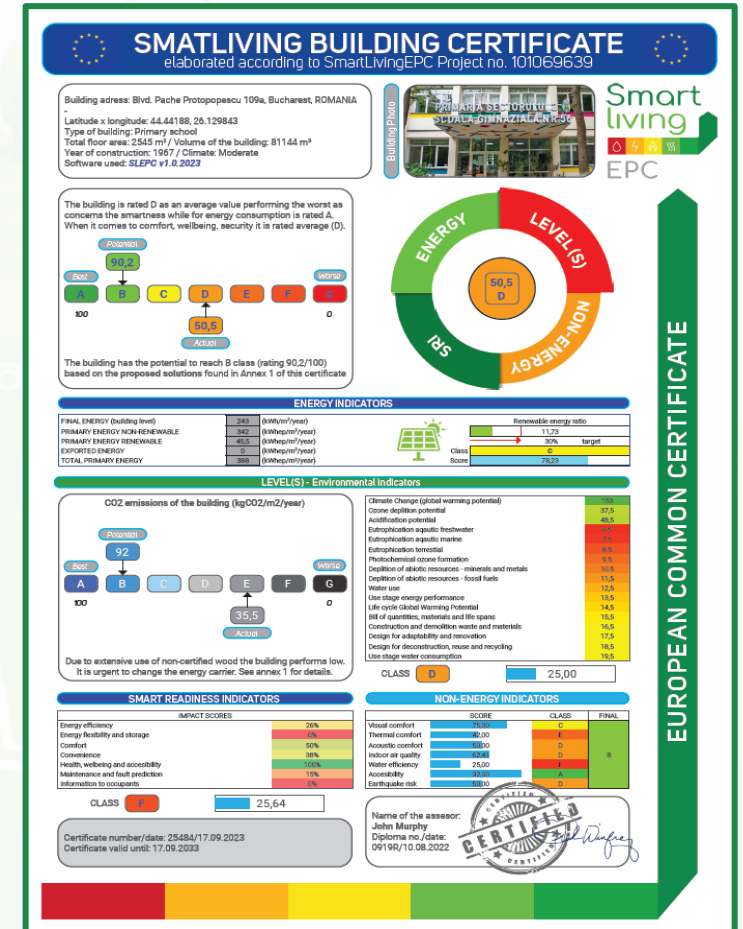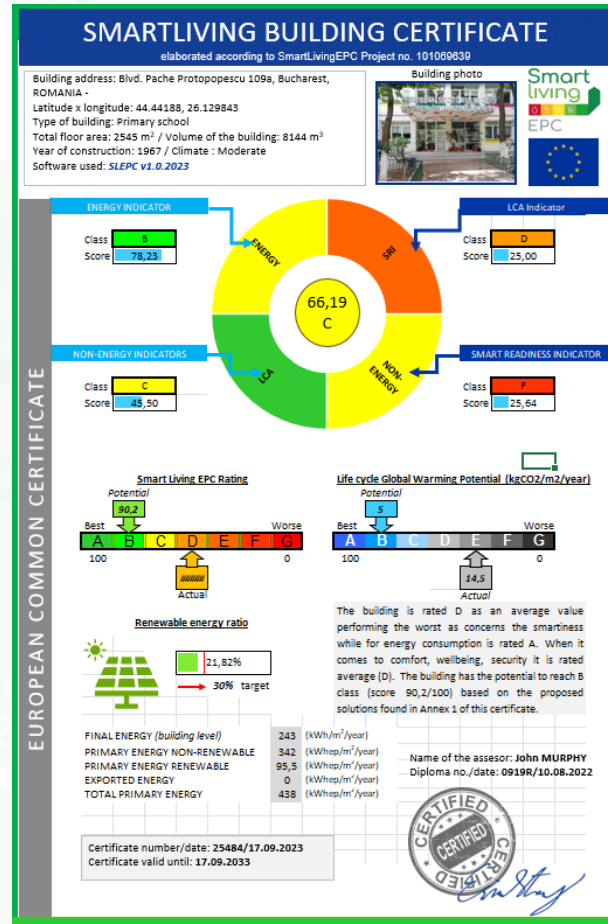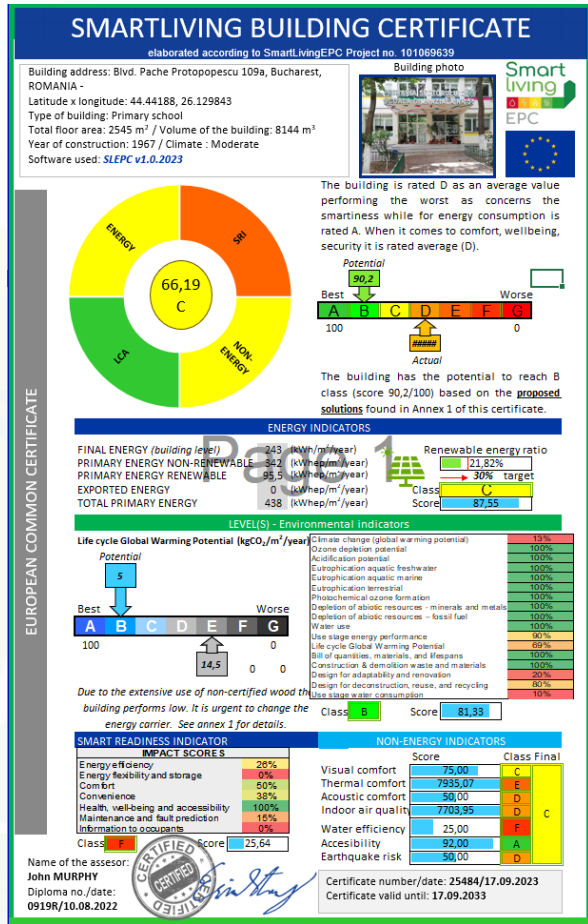Town Hall
Leitza
Spain

Demo Site 8
School Building Facilities, Leitza
Spain

Demo Site 9
Sports Centre
Leitza
Spain

SmartLivingEPC – potential results

These EPCs are **only simple proposals** and need to be discussed with all partners to agree a specific form and content

SmartLivingEPC - overall concept

PLATFORM

Nudge Reality UIs | Visual Analitics | Advanced UIs

DIGITAL BUILDING LOGBOOKS

COMMON INFORMATION EXCHANGE MODEL (CIEM)

District — Lighting — EVs — Smart Grids

IoT & BMS Interrfaces

Dynamic Building Information
- Energy Consumption
- Energy Generation
- Energy Storage
- IEQ Measurements
- Life-cycle Coating

BUILDING

ADDED VALUE SERVICES FOR SMARTLIVING EPCS
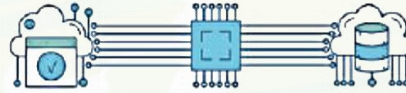a. Performance benchmaking
b. Scenarios simulations & evaluation
c. Recommendations towards performance improvement

API FOR EPC CALCULATION (BOTH BUILDING & COMPLEX)

A
B
C
D
E
F
G

SmartLivingEPC complex rating calculation methodology (both Asset & Operational)

SmartLivingEPC Operational rating calculation methodology

SmartLivingEPC Asset rating calculation methodology

Building Dynamic Behaviour Monitoring System

Digitalization & calculation of SmartLivingEPCs

Digital Twin | EPC Calc. Services

Operational Building Information

CIEM

Asset Building Information

Static Building Information
- SRIs
- Energy Sources
- Non-Energy Sources
- Environmental
- Life-cycle Assessment
- Technical Audits and Inspections

SMART LIVING EPC

Conclusions & Perspectives

- SLE based on SRI and Level(s) will support the efforts for reducing overall carbon emissions, while offering healthier, more efficient, and comfortable living environments

- **SLE and other NextGen HE projects** could ease the EuCom's intention to **harmonize of EPCs** (comparability of the EPCs and MEPS)

- **new era of BPCs* or CPCs* (no more EPCs)** will begin after the new EPBD inforcement (using LCA, SRI, LEVEL(s), BIM, even operation EPCs concept that makes use of data from building real-time monitoring, etc.)

* BPC-building performance certificate / CPC – community performance certificate

- *Article-Simplified evaluation and rating of non-energy parameters for buildings as part of a new complex energy certification scheme, T.Catalina, C. Lungu*

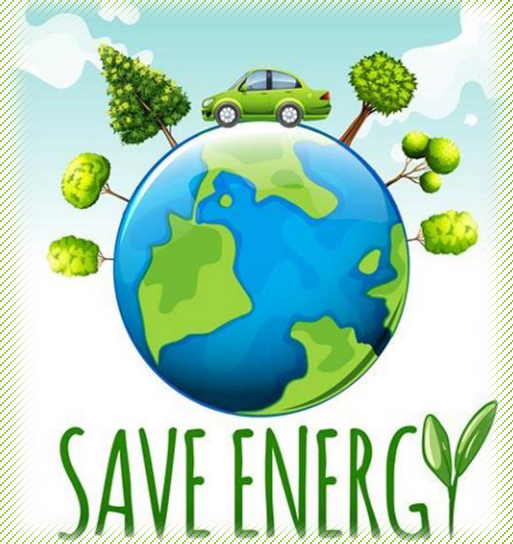Taylor & Francis
Taylor & Francis Group

SHARE/PRINT

Submit a Manuscript to the Journal
International Journal of Sustainable Energy
For a Special Issue on
Advancing Net-Zero and Zero-Energy Buildings: Challenges and Opportunities in Sustainable Design and Operation

REHVA

Grazie per l'attenzione !

CONTACT INFO

Associate Professor Cătălin Lungu, PhD
Technical University for Civil Engineering –Bucharest, ROMANIA
www.utcb.ro, www.aiiro.ro, www.rehva.ro
president@rehva.eu, catalin.lungu@utcb.ro
+4021 2524295, Bucharest/Romania