SUSTAINABLE PLACES 2024

Organised by

Paper Session #7

Session Chair

Sophie Dourlens-Quaranta
R2M Solution
sophie.dourlens@r2msolution.com

Supported by

Supported by the Luxembourg National Research Fund (RESCOM/2024/SR/18805979)

Opening | Paper Session #7 AGENDA

9:00 - 9:05 | **Sophie Dourlens-Quaranta**, Session Chair, Managing partner, R2M Solution France
Opening and welcome

9:05 - 9:25 | **Branca Delmonte** and **Stefan Maas**, University of Luxembourg
“The impact of optimised set-values in secondary school-buildings”

9:25 - 9:45 | **Juan Carlos Guerrero Ramos**, AIDIMME Technological Institute
“Circular economy-based materials development to foster the transition to sustainable and high energy performance buildings at optimal costs”

9:45 - 10:05 | **Sultan Cetin**, **Henk Visscher** and **Sun Ah Hwang**, Delft University of Technology
“Data collection techniques and technologies for digital building logbooks: Three logbooks and a case study”

10:05 - 10:25 | **Merve Mermertaş** and **Beril Alpagut**, Demir Enerji
“District Energy Concept Evolution: From Positive Energy Districts (PEDs) to Positive Clean E Districts (PCEDs) – What are the main considerations from annual surplus energy to climate neutra

10:25 - 10:30 | **Sophie Dourlens-Quaranta**, Session Chair, Managing partner, R2M Solution France
Wrap-up and closing

UNIVERSITÉ DU LUXEMBOURG

Interreg North-West Europe ENERGE

European Regional Development Fund

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SUSTAINABLE PLACES 2024

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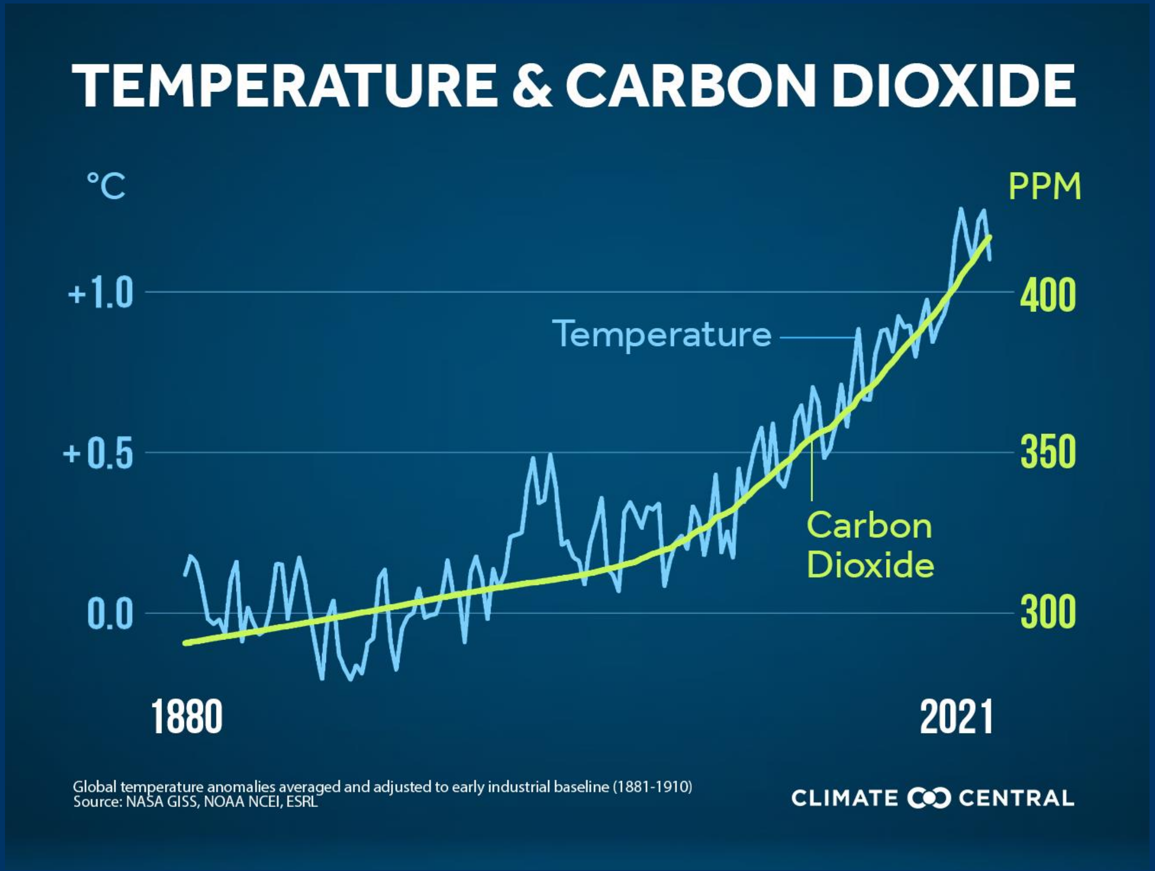
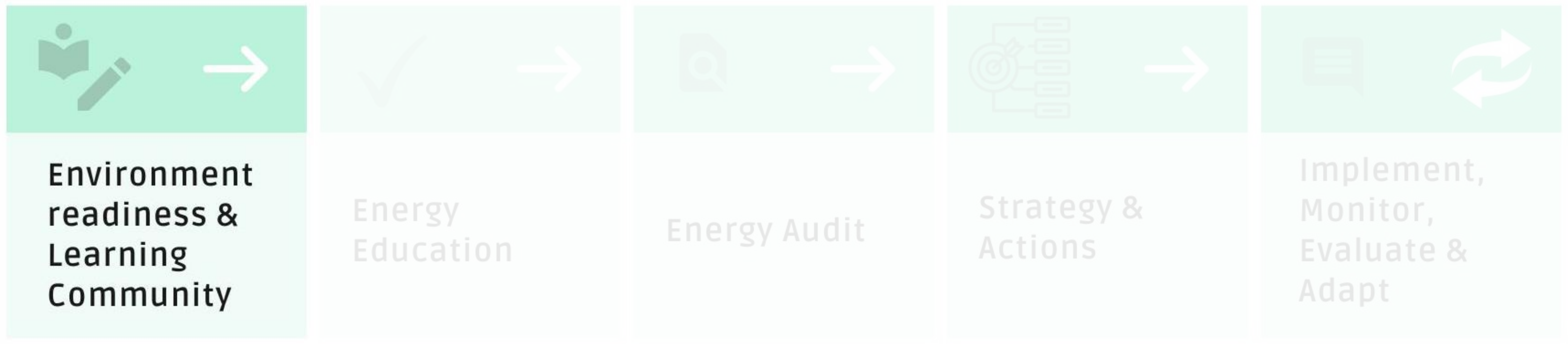

TEMPERATURE & CARBON DIOXIDE
°C
PPM
+1.0
+0.5
0.0
400
350
300
Temperature
Carbon Dioxide
1880
2021
Global temperature anomalies averaged and adjusted to early industrial baseline (1881-1910)
Source: NASA GISS, NOAA NCEI, ESRL
CLIMATE CENTRAL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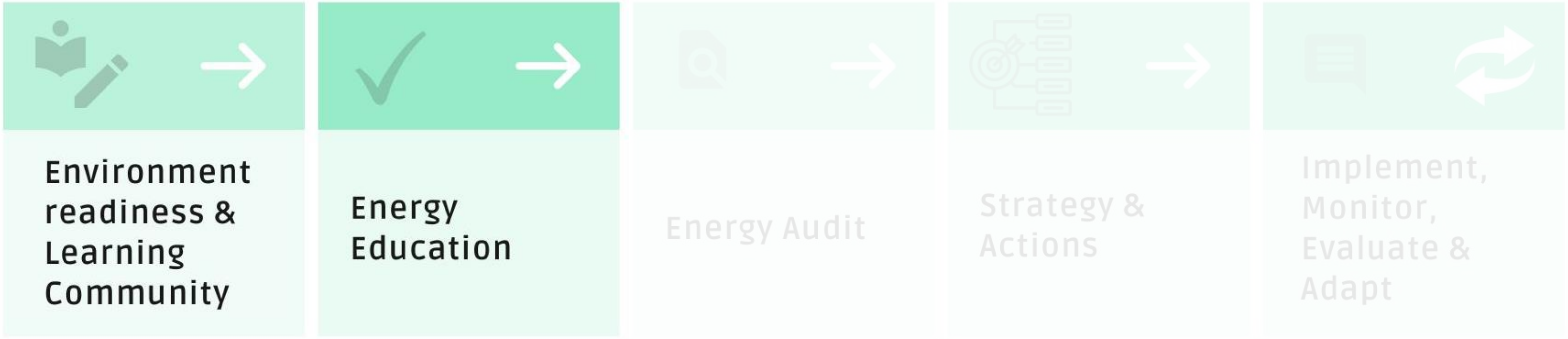
Energy Education
Energy Audit
Strategy & Actions
Implement, Monitor, Evaluate & Adapt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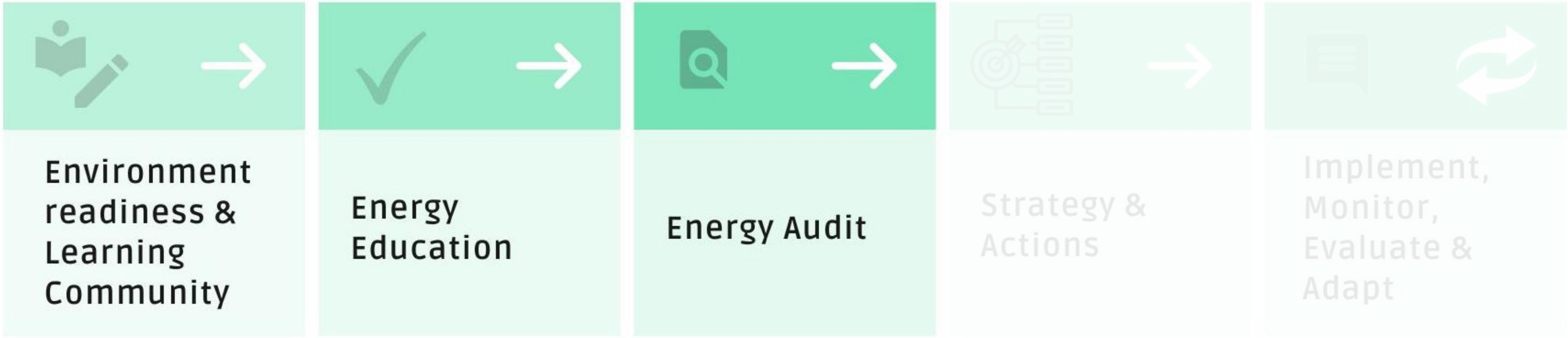
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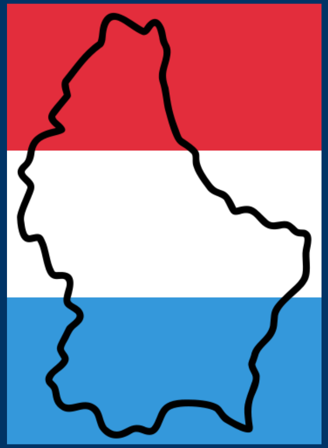

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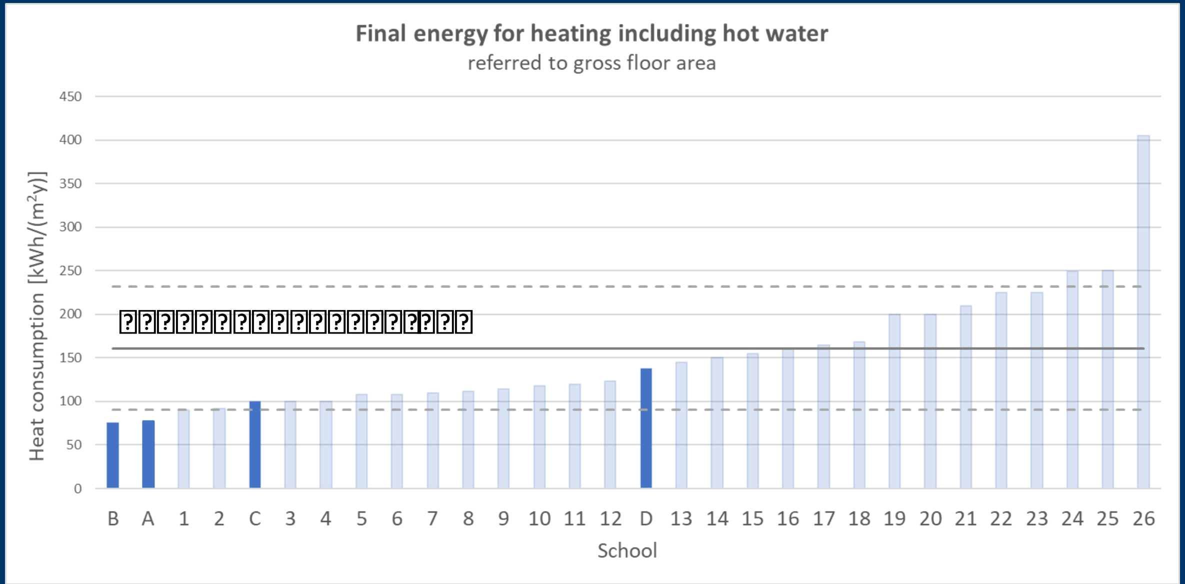

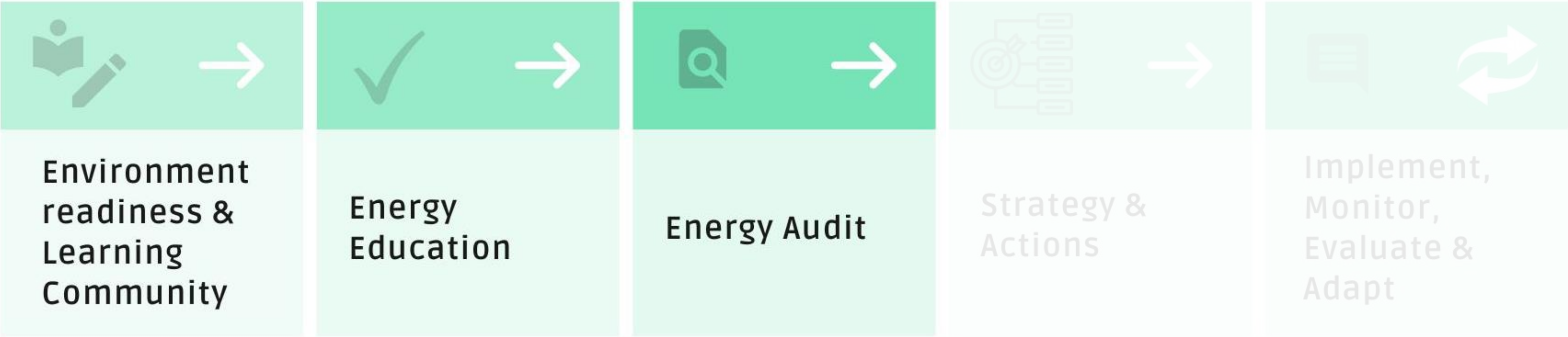
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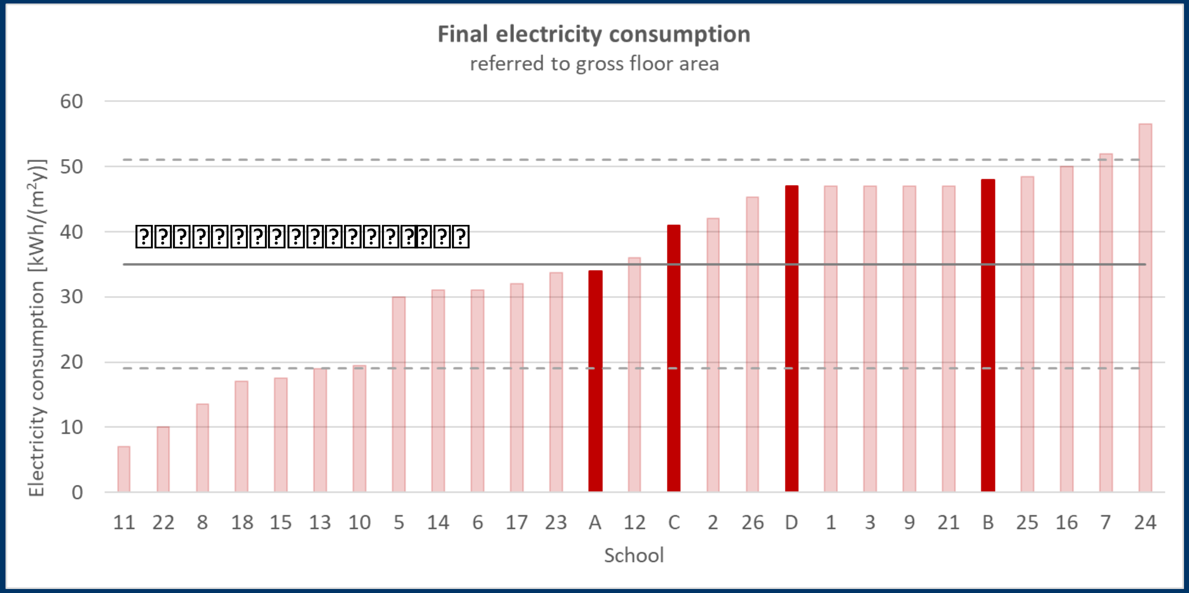
Final electricity consumption
referred to gross floor area
Electricity consumption [kWh/(m²y)]
60
50
40
30
20
10
0
11 22 8 18 15 13 10 5 14 6 17 23 A 12 C 2 26 D 1 3 9 21 B 25 16 7 24
School

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Environment readiness & Learning Community → Energy Education → Energy Audit → Strategy & Actions → Implement, Monitor, Evaluate & Adapt

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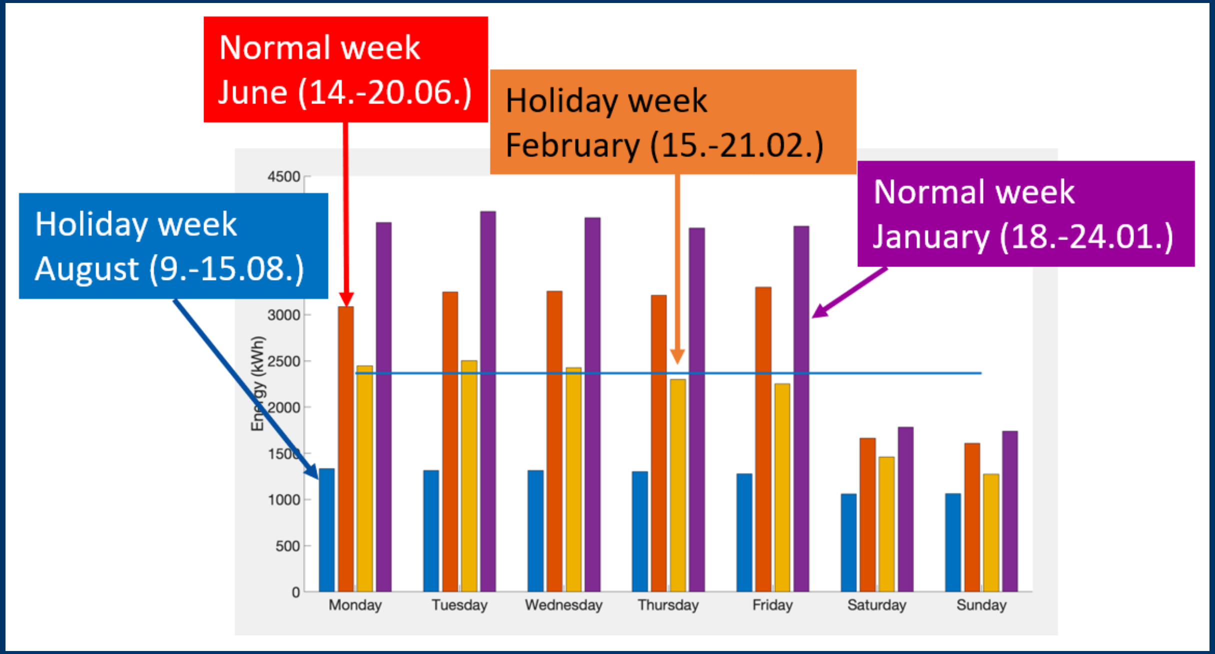

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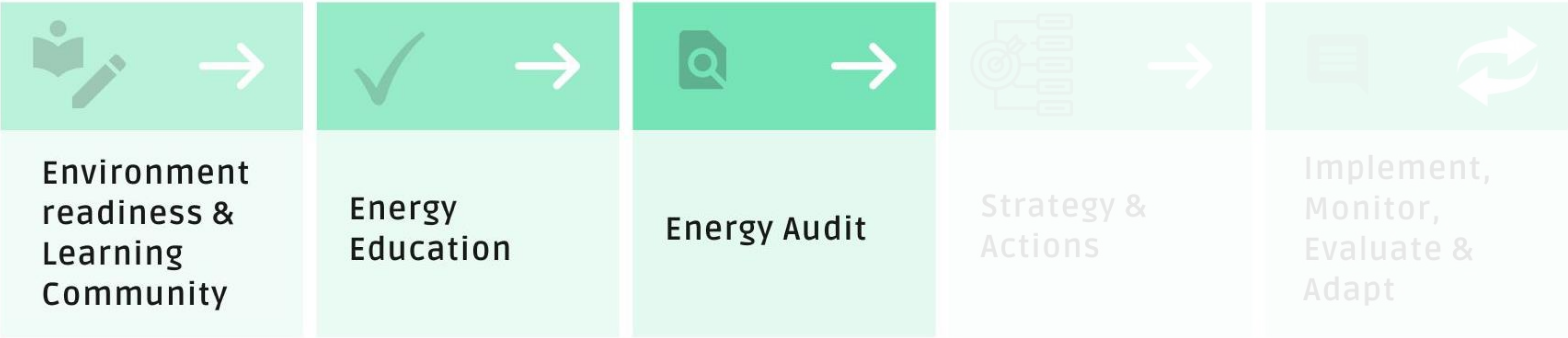

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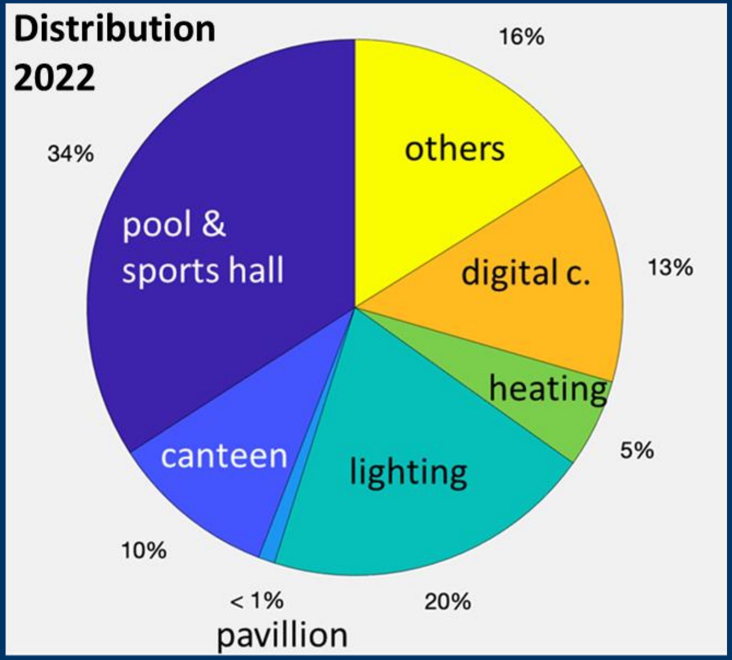
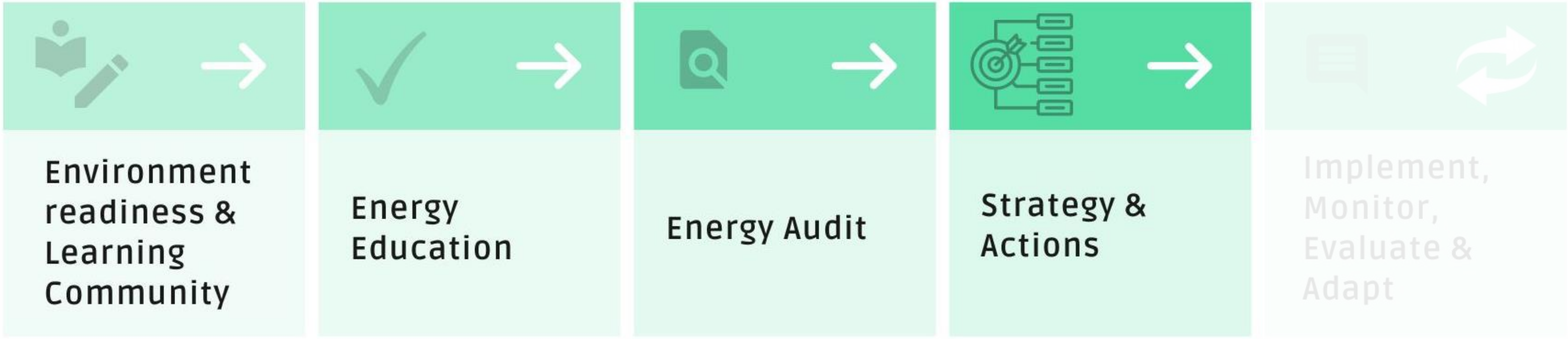


Distribution 2022
16%
others
34%
pool & sports hall
digital c.
13%
heating
5%
canteen
lighting
10%
< 1%
pavillion
20%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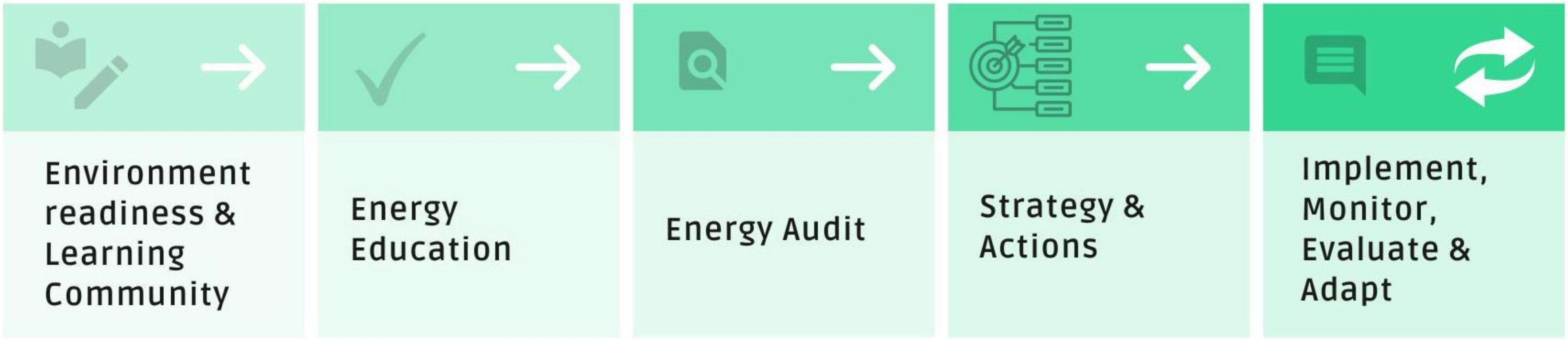
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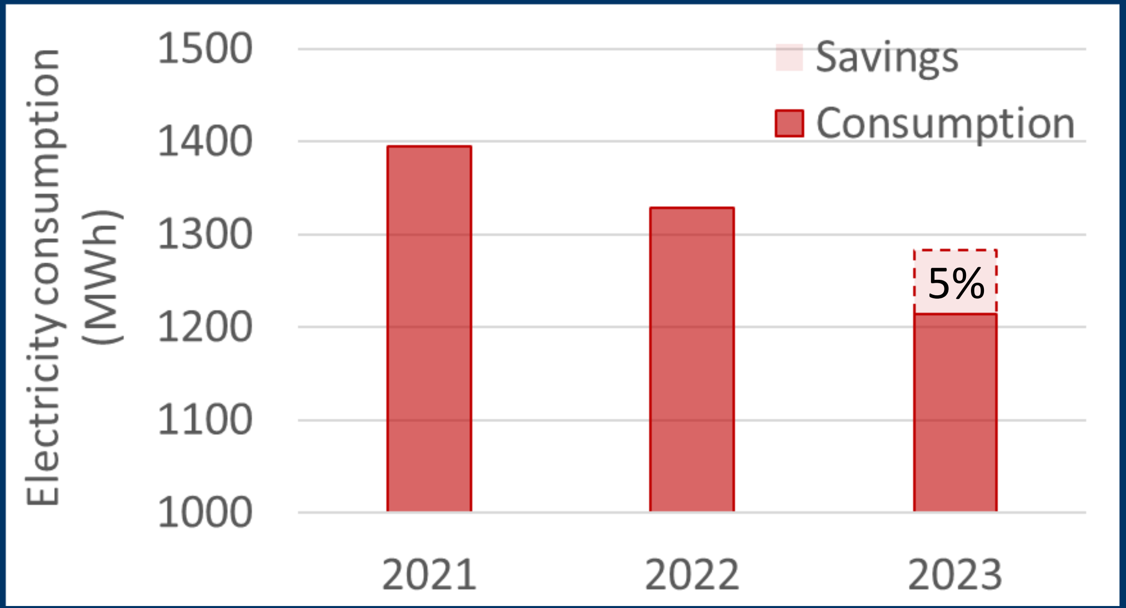
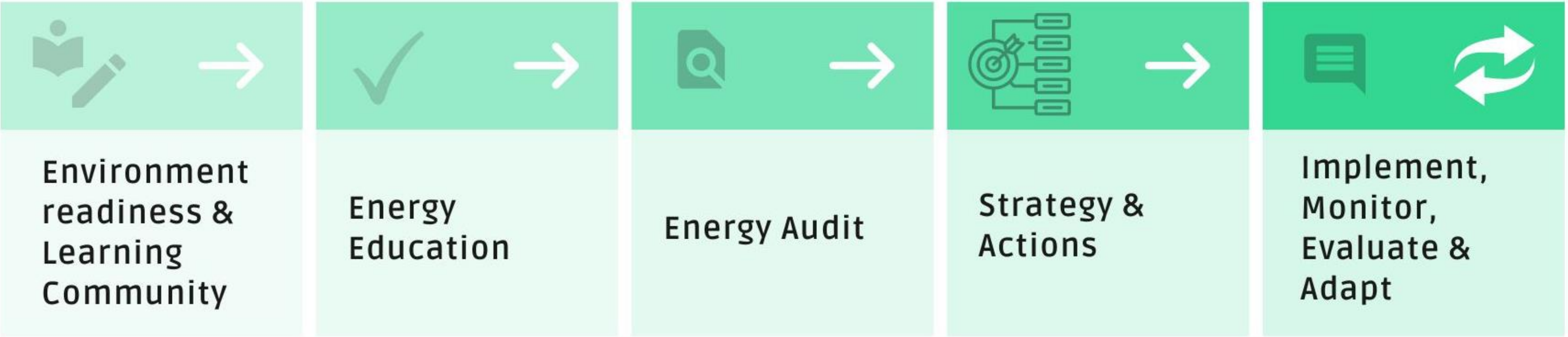

Electricity consumption (MWh)
1500
1400
1300
1200
1100
1000
Savings
Consumption
5%
2021
2022
2023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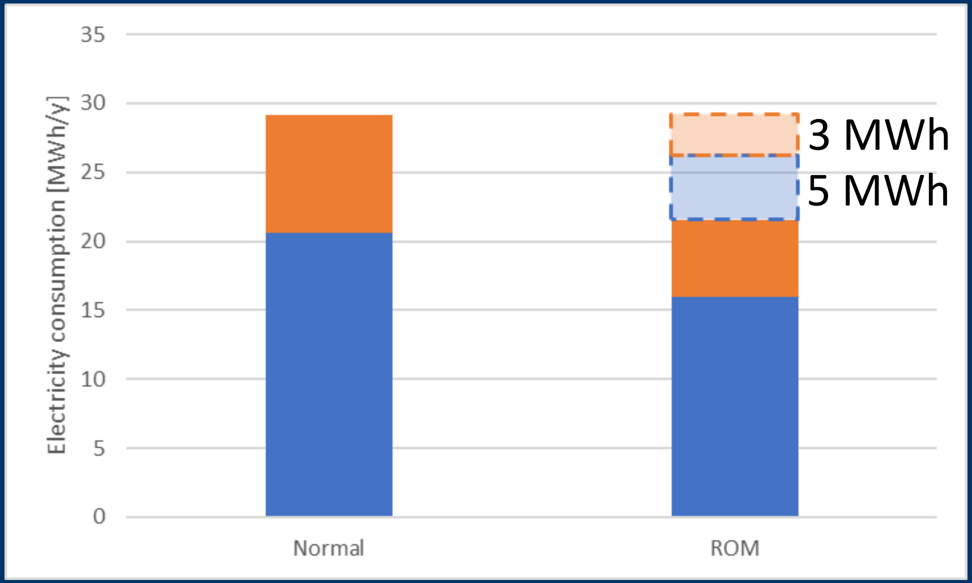
Electricity consumption [MWh/y]
35
30
25
20
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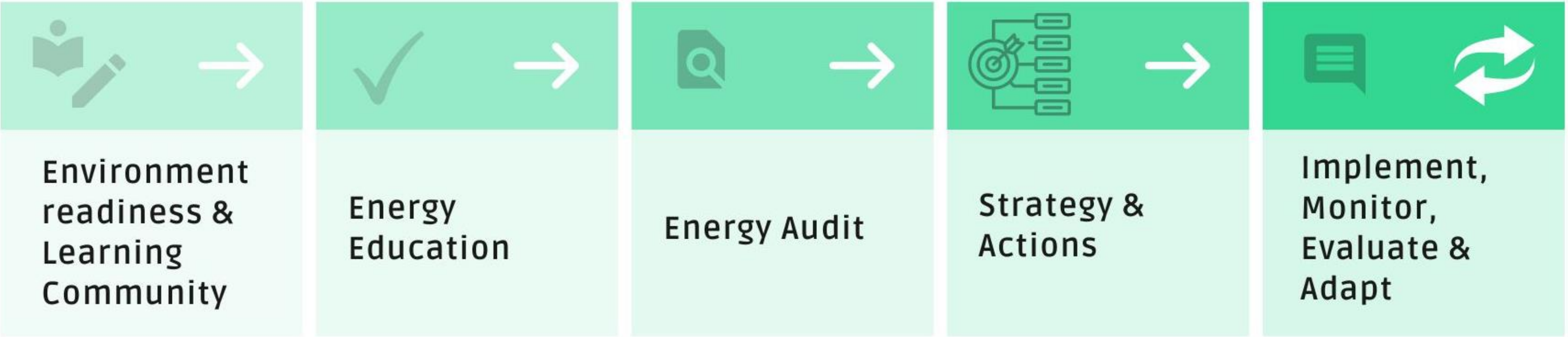
10
5
0
Normal
ROM
3 MWh
5 MWh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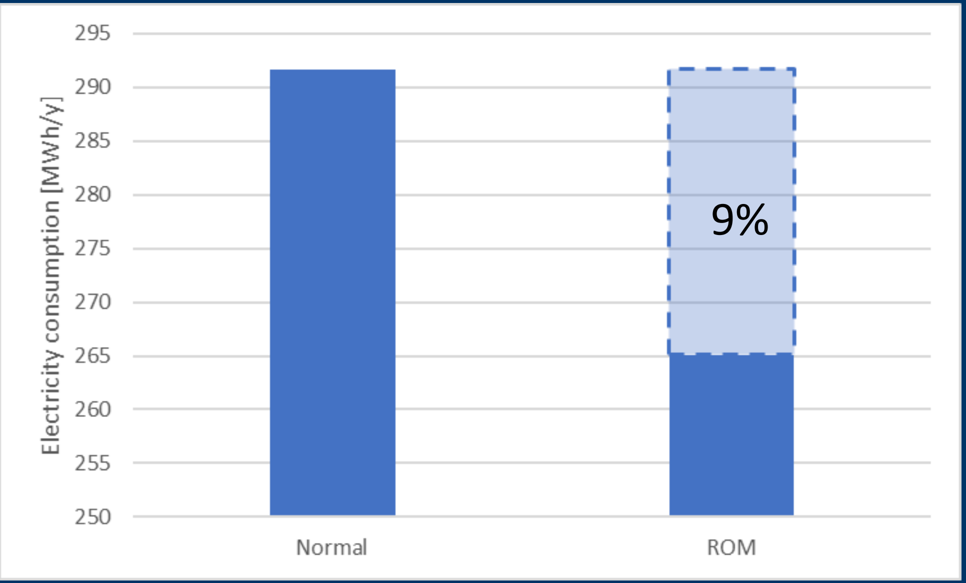
Electricity consumption [MWh/y]
295
290
285
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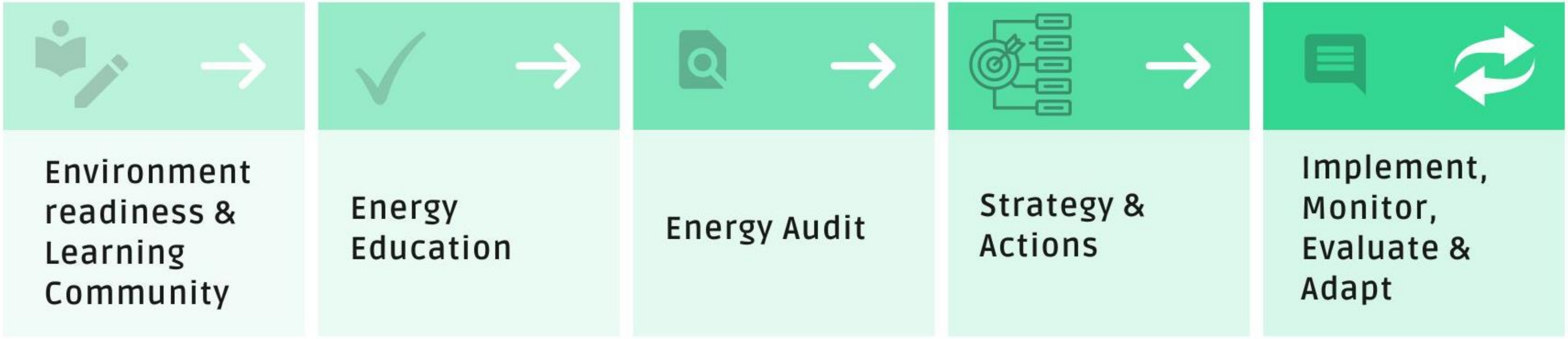
270
265
260
255
250
9%
Normal
ROM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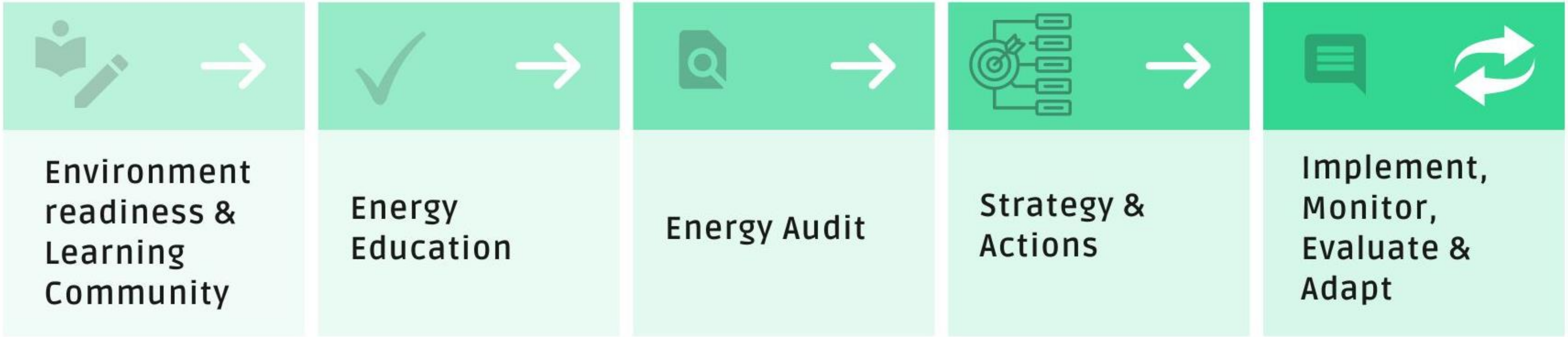
Environment readiness & Learning Community
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SNUG

"Circular economy-based materials development to foster the transition to sustainable and high energy performance buildings at optimal costs"

Juan Carlos GuerreroRamos – AIDIMME

Date: 25/09/2024

SUSTAINABLE PLACES 2024

Co-funded by the European Union

UK Research and Innovation

Project funded by

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Education, Research and Innovation SERI

Transforming the buildings of tomorrow

SNUG is a European project that aspires
to contribute to a world where buildings seamlessly integrate with the environment by reshaping the construction industry and fostering the transition to Zero-Energy Buildings (ZEBs).

Project ID

Project Name	**Innovative methodology based in circular economy and artificial intelligence to foster the transition to Sustainable and very high eNergy performance bUildinGs at a cost optimal level**
Acronym	SNUG
Project Number	101123150
Call	HORIZON-CL5-2022-D4-02
Topic	HORIZON-CL5-2022-D4-02-05
Type of Action	HORIZON Innovation Actions
Project starting date	1 November 2023
Project end date	30 April 2027
Project Duration	42 months

Partners

SNUG

AIDIMME INSTITUTO TECNOLÓGICO

Becsa Simetría

ctcon Centro Tecnológico de la Construcción

University of Stuttgart Germany

CHIMAR.

CRH

FGS

ΚΑΠΕ CRES

BRIMATECH

keey AEROGEL

AUSTRIAN STANDARDS

Høgskolen i Østfold

KASTAMONU

TAKKENKAMP GROEP

AGITEC green efficiency

LURTIS AI Solving Your Tech Challenges

Globalcyclus Simetría

Presentation order

SNUG

→ SNUG project. Objectives, Ambition and Methodology.

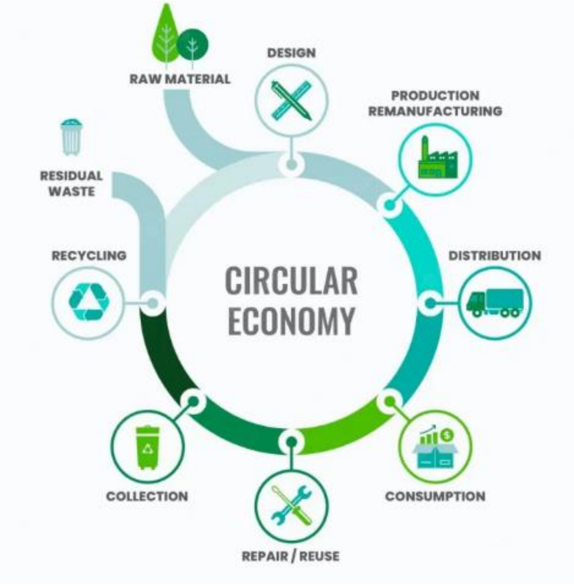
→ Analysis and design optimization of the Biomass-based materials (AIDIMME).

→ Industrialization and validation of the innovative solutions (Next Steps).

SNUG Project

Objectives, Ambition and Methodology

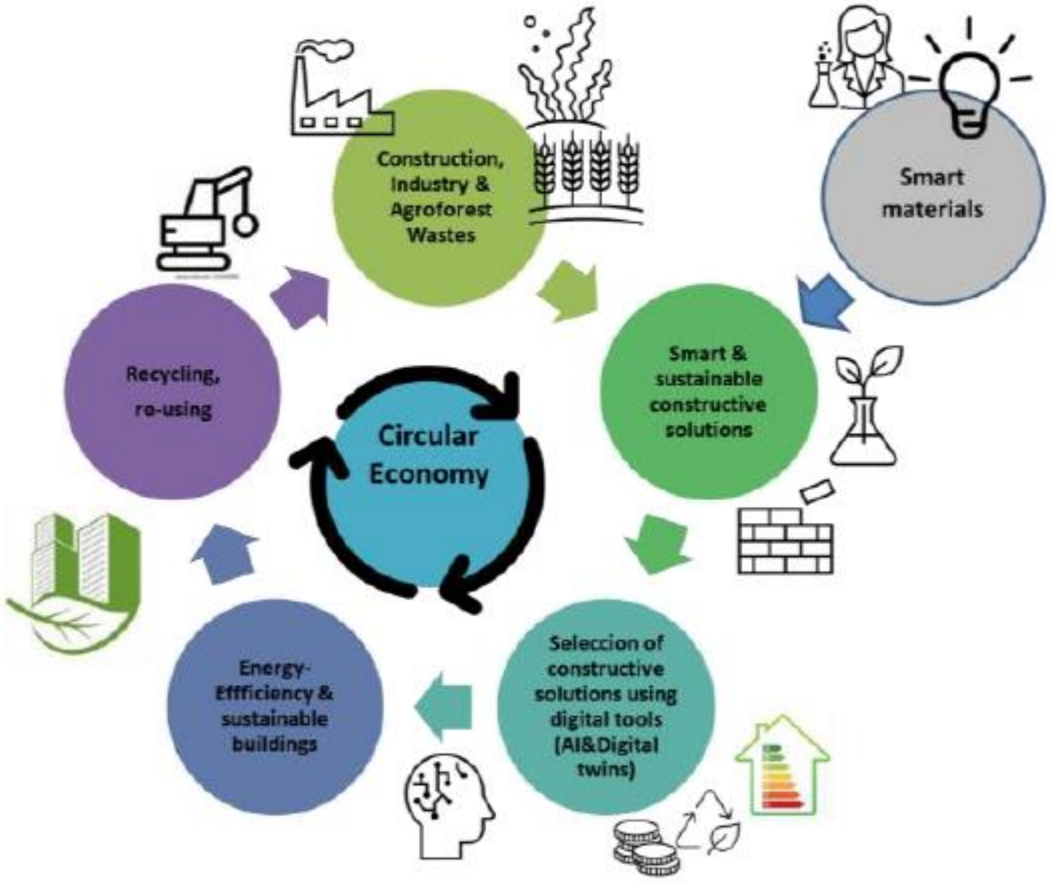
Ambition



- In order to stimulate Europe building rehabilitation EU introduced ambitious new policies to encourage the improvement of energy efficiency of buildings:
  - **Zero Emissions Building (ZEB) →** all existing buildings to be transformed into ZEBs by 2050.
  - **Renovation Wave Strategy →** more energy-efficient, less carbon-intensive and more sustainable.
  - **The circular Economy Plan** which promotes designing products and infrastructure for longer lifetimes, reusing and recycling raw materials.
- **Assess buildings** energy and emissions performance from a life-cycle perspective. **Embodied + Operational.**
- **Implement energy efficiency measures during the design phase** which will minimize the operational and embodied emissions.
  - **Low carbon materials**
  - **Monitor** and test **materials** in a **real environment**.
  - **Standardization** for **new materials**.

Objectives

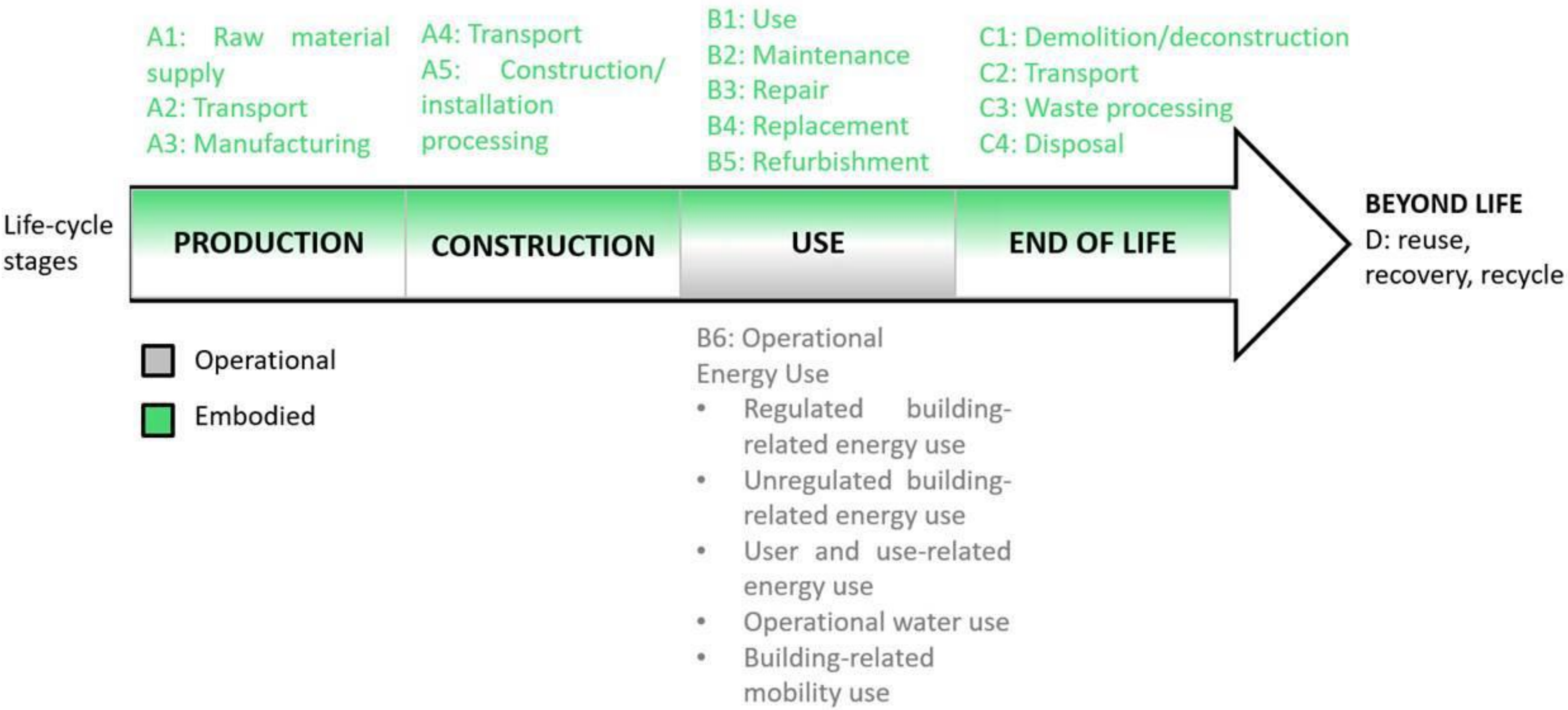
- The best strategy in the design of **ZEBs** is **to act on the envelope or retrofit.**
- The installation of **insulation materials** proved to be **very effective** in the r**eduction of energy consumption.**
- **SNUG** aims to **develop and demonstrate a methodology to help** builders, architects, engineers, etc., **in the selection** of the most appropriate set of **thermal insulation materials or constructive solutions** by the development of:
  - **Digital Tool Assistant (DTA) based on AI and virtual simulation.**
  - **A set of sustainable-by-design thermal insulation materials and lightweight prefab solutions.**
  - **A database of thermal insulation materials, including metrics and LCA information.**
  - **A Digital Building Logbook**
- **Maximize** the **energy efficiency** and **minimize GHG emissions** of the building envelope **throughout its life cycle…**



Methodology

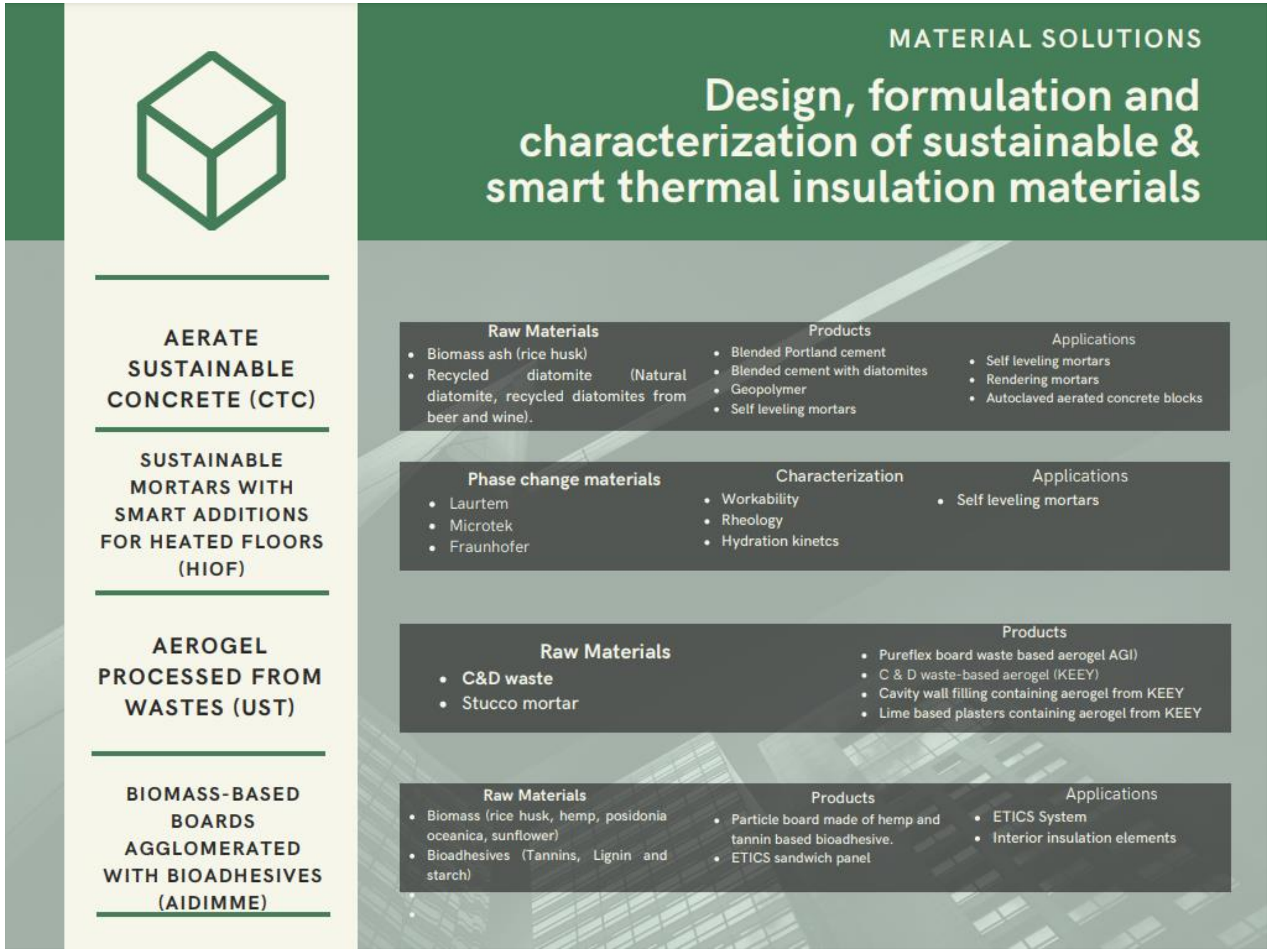
SNUG

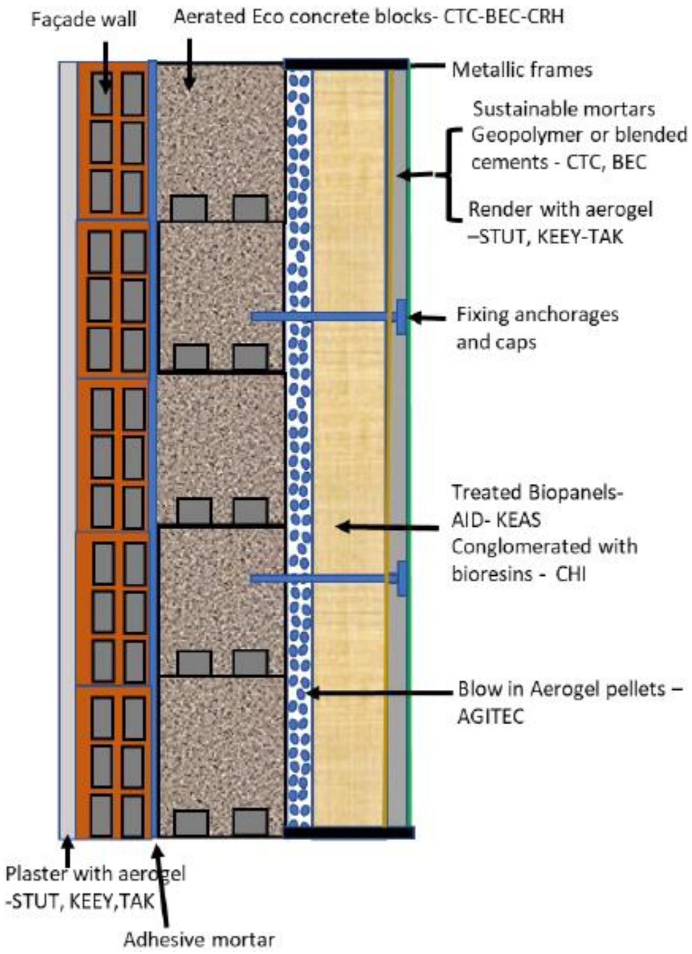
Life-Cycle stages and modules with details on the operational and embodied impacts.



Specific Objectives

- **SO1.** Optimize advanced and durable sustainable-by-design thermal insulation materials and multifunctional prefabs based on circular economy:





Specific Objectives

- **SO2. Industrialization** of advanced **thermal insulation materials and multifunctional products** developed at a pilot scale .
  - **Scale up** the developed materials to a preindustrial step **(TRL 6-7)**
  - **Reproduce features and performance** of products developed at pilot scale
  - **Minimizing the energy demand** of the industrial process.
  - **Achieve cost effective and sustainable** thermal insulation materials.
  - **Deploy advanced, market ready prefabs** and multifunctional materials with **recycling a reducing potential**.

1

2

3

4

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Specific Objectives

SNUG

- **SO3.** Development of **Digital Tool Assistant (DTA)** able to **select the best thermal insulation solutions and installation.**
- **SO4. Demonstrate in three real buildings of different features, use and climatology**, methodology proposed for the selection of **best solutions adapted.**
- **SO5**. **Clustering and cooperation with other relevant projects** and HE Partnerships with related topics.

Switzerland

Spain

Norway





Biomass-based materials (AIDIMME)

Analysis and Design Optimization

Background

- AIDIMME investigated the feasibility of using sustainable prefab elements, developed by the institute itself in previous local projects.

- The construction elements for exterior (ETICS) and interior insulation were installed to study their behaviour in a real environment by a digital monitoring system.

SNUG KPI's

4 BIOPANELS AND SANDWICH PANELS

ENVIRONMENTAL BENEFITS

Table 13. Environmental KPI's

	Bio-panels			Sandwich panels		
KPI'S	**Circularity**	**Embodied energy**	**CO_2 emissions**	**Circularity**	**Embodied energy**	**CO_2 emissions**
Units	% vol	MJ/m^3	kg/m^3	% vol	MJ/m^3	kg/m^3
End project	95-100	700-1800	50-150	Ext.: 85-95 Int: 95-100	Ext: 750-900 Int: ~1800	Ext: ~ 150 Int: ~50

PERFORMANCE BENEFITS

Table 14. Thermal Performance KPI's

	Bio-panels			Sandwich panels		
KPI'S	**Thermal conductivity**	**Dimensions**	**Density**	**Thermal conductivity**	**Dimensions**	**Density**
Units	W/mK	mm	kg/m^3	W/mK	mm	kg/m^3
End project	0,045 – 0,060	Th = 50 W = 350-1000 L= 600-1000	190 – 300	<0,070	Th = 60 W = 350-1000 L = 600-1000	Ext: 510-530 Int:180-190

Table 15. S&S Performance KPI's

	Bio-panels		Sandwich panels	
KPI'S	**Reaction to fire**	**VOC's**	**Reaction to fire**	**VOC's**
Units	Classification	ppm	Classification	ppm
End project	C	0	B-s1, d0	0

COST

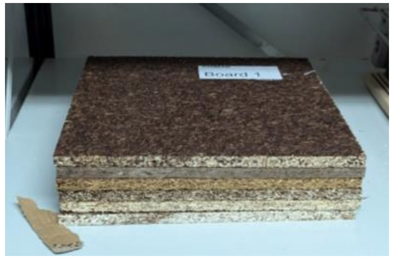
Table 16. Economical KPI's

		Bio-panels	Sandwich panels
KPI'S	**TRL**	**COST**	**COST**
Units		$(€/m^2)$	$(€/m^2)$
End project	7	<170-185	<160

Analysis (Tests)

SNUG

Material	Density (kg/m3)	Thermal Cond. (W/m-K)	Reaction to fire (*MAHRE)	Acoustic Insul. (dB)	Internal Bond. (Mpa)
Hemp	443	0,0757	93,0	21,0	**0,61**
Rice Husk	453	**0,0634**	-	16,5	-
Sunflower	475	0,0718	**72,2**	**21,8**	0,12
Citrus waste	487	0,0741	85,8	12,3	0,09
Posidonia	490	0,0661	-	21,3	0,03



***MAHRE HRR (kW/m2): máximum average heat reléase per unit area**

Formulation Design Optimization

Chimar Hellas SA participated in the evaluation of the **compatibility** and performance of a series of **bio-adhesives** and the different **natural fibres** used.

Those **adhesives** were **developed by Chimar Hellas SA** and had to be **bio-based**, so resins with **tannin, lignin, soy and starch** were tested in the process.

Finaly in conjunction with Chimar, AIDIMME and Kastamonu took the decision for one combination.

HEMP FIBRES

+

TANNINS BASED RESIN

Characterization: Work to do (AIDIMME)

SNUG

AIDIMME will study at lab-scale the final formulation through the **identification and selection of parameters** that will **influence** the system **performance** such as bio-adhesive percentage, thickness, density, application to existing surfaces.

Then with the bio-based panels in a sandwich system the following **characteristics** will be experimentally **tested**.

Test	Standard
Moisture content	UNE-EN ISO 18134-1:2016. Part 1.
Ash content	UNE-EN 14755
Sand content	UNE 56744:1988
Fungal resistance	EN ISO 846
Specific Heat	Internal Method
Compression resistance	EN 826
Shear Strength	EN 12090
Traction	EN 1608 and EN 1607
Water Absorption	EN ISO 29767
Dimension Stability	EN 1604
Water Vapor Transmission	EN 12086

Thank you

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Confederazione Svizzera
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Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Education, Research and Innovation SERI

Data collection techniques & technologies for digital building logbooks- A multiple-case study

Dr. Ir. Sultan Çetin

Ph.D (c). Sun Ah Hwang

Prof. Dr. Ir. Henk Visscher

25 September 2024-Luxembourg

TU Delft | Bouwkunde

Demo Blog

SUSTAINABLE PLACES 2024

Digital Building Logbook

A **digital building logbook** is a centralized repository for essential building data, promoting transparency and informed decision-making among stakeholders. It records and organizes information such as ownership changes, maintenance activities, technical details, performance data, and building ratings, while ensuring data security and user control. It enables **circularity** and enhances **energy performance** of buildings towards a sustainable built environment.

Short definition based on EC Report by Volt et al., 2020

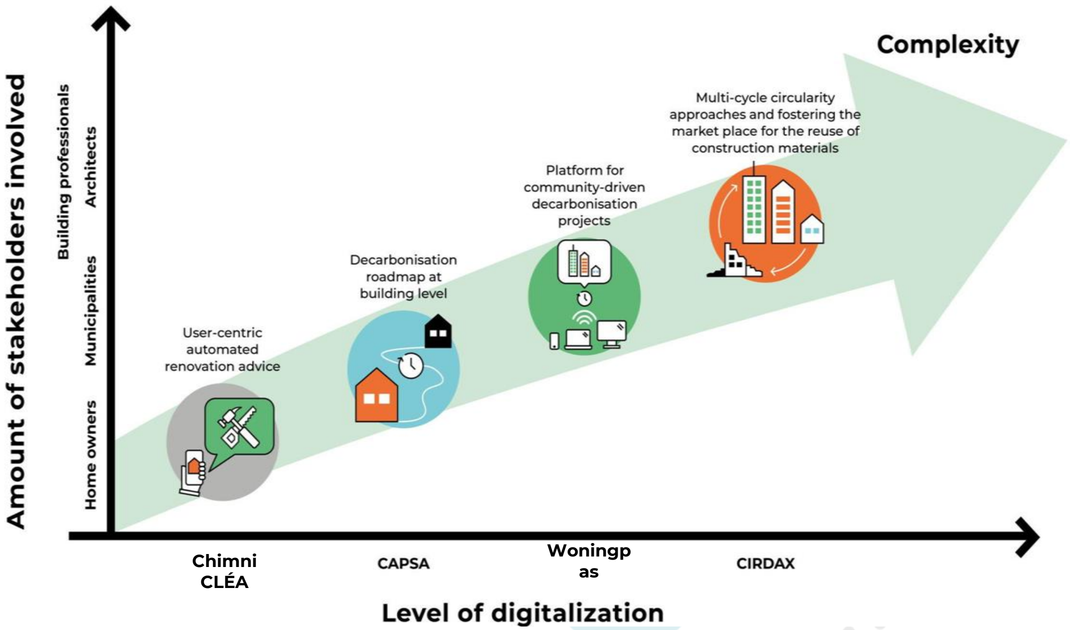
Policy Development

*A timeline of **the development of the DBL concept** in EU policy strategies, action plans and the resulting tenders:*

2020	2021	2022	2023	2024
Circular Economy Action Plan (CEAP)	**Revision** of the Energy Performance of Buildings Directive (EPBD) **proposal**	Making sustainable products the norm	Transition Pathway for Construction (TPC)	Energy Performance of Buildings Directive (EPBD)
Strategy for a Sustainable Built Environment (SSBE) **Note: Not published to date.*		**Proposal** for a new Ecodesign for Sustainable Products Regulation (ESPR)	Technical Study for the Development and Implementation of Digital Building Logbooks in the EU	
Renovation Wave		**Revision** of the Construction Products Regulation (CPR)		
Study on the Development of a European Union Framework				

DEMO Blog

- **5 different DBLs** with a total of 4.5 million registered units and a wide variety of target groups offering scale and diversity
- **4 diverse functionalities** addressing key societal challenges, ranging from ‘quick wins’ (renovation advice and community driven decarbonisation pathways) to complex industrial transaction objectives (circularity)



Co-funded by the European Union

This project has received funding from the European Union’s Horizon Europe research and innovation programme, under grant agreement No. 101091749

The five DBLs

Woningpas (BE)

CIRDAX (NL)

CLÉA (FR)

CAPSA (DE)

Chimni (UK)

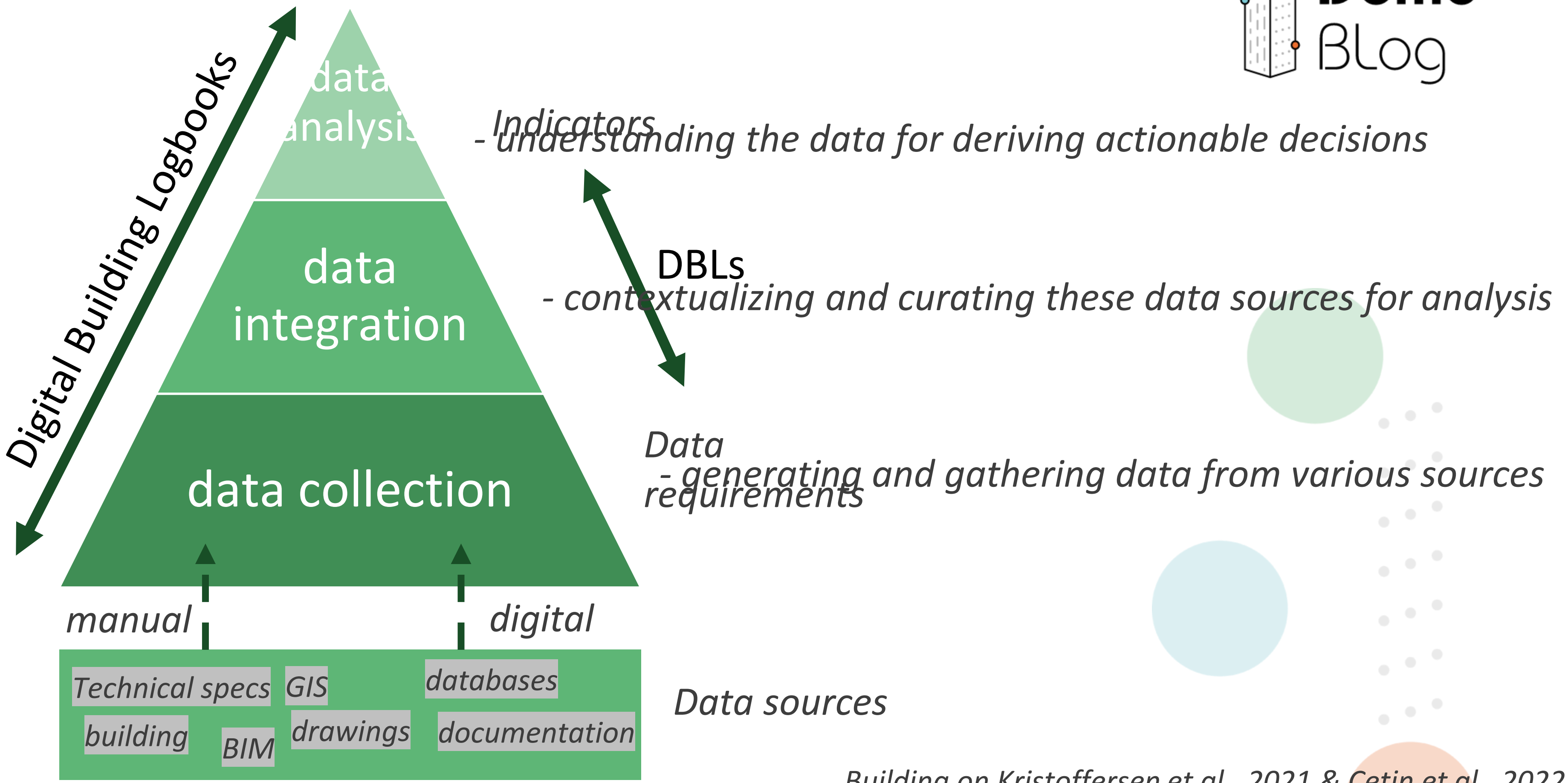
Co-funded by
the European Union

This project has received funding from the European Union’s Horizon Europe research and innovation programme, under grant agreement No. 101091749

Research context:

- *There are **data holes across the life cycle stages in** buildings due to complex and siloed supply chain,*
- *We need reliable and accessible data for sustainable interventions,*
- *Although DBLs are seen **potential solutions**, there is **a lack of unity** in data requirements and insightful indicators,*
- *DBLs offer **different functionalities** (e.g., calculating EPC or reuse potential) and **data collection** is utmost importance to fulfil each functionality.*

Data flow processes



Building on Kristoffersen et al., 2021 & Çetin et al., 2022

Research aim:

*To examine **how different types of DBLs collect data** to fulfil their sustainable **functionalities** and how can their data collection processes be **enhanced through digital technologies**.*

Building on Kristoffersen et al., 2021 & Çetin et al., 2022

Multiple-case study

Demo Blog

WONINGPAS Vlaamse overheid

Online

1 x interviews

CIRDAX MATERIAALPASPOORT

Onsite

2 x interviews

COPSA

Onsite

1 x interviews

Data collection from a sample house

DreamHus
@ TU Delft, Green Village

Cross-case analysis

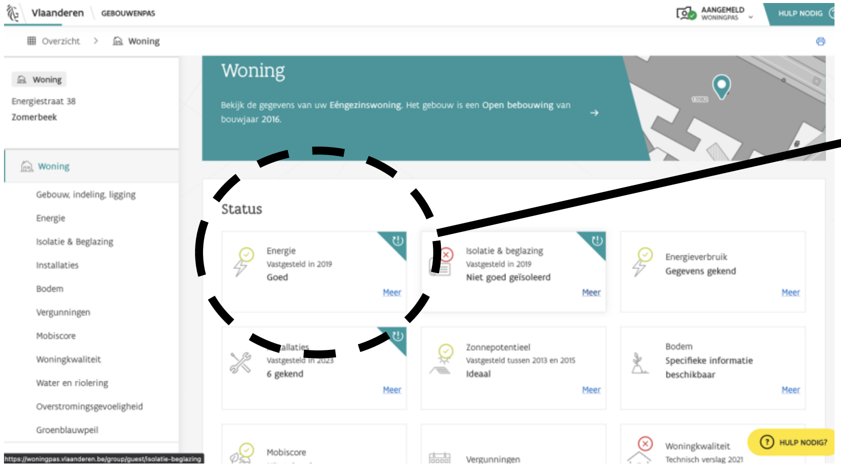
Case introductions

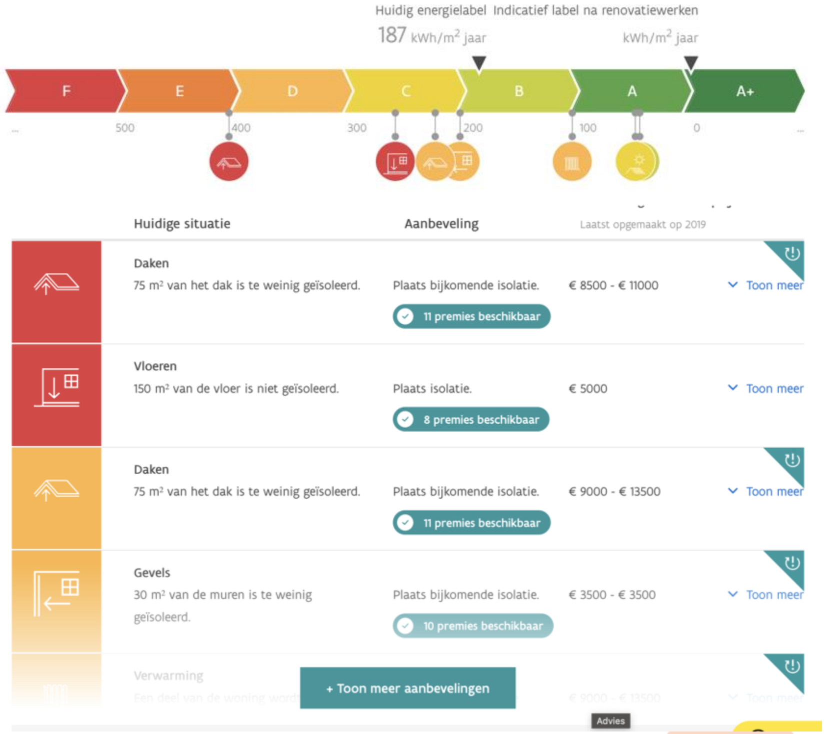
Demo Blog

	Overarching Aim	Initiative type	Target users	Lifecycle stage
CASE 1 *WONINGPAS*	Energy transition	Public	All homeowners	Use
CASE 2 *CIRDAX*	Circularity & carbon reduction	Private	Architects, demolishers, etc.	Use & End-of-use
CASE 3 *CAPSA*	Energy transition	Private	Social housing organizations	Use

CASE 1
WONINGPAS

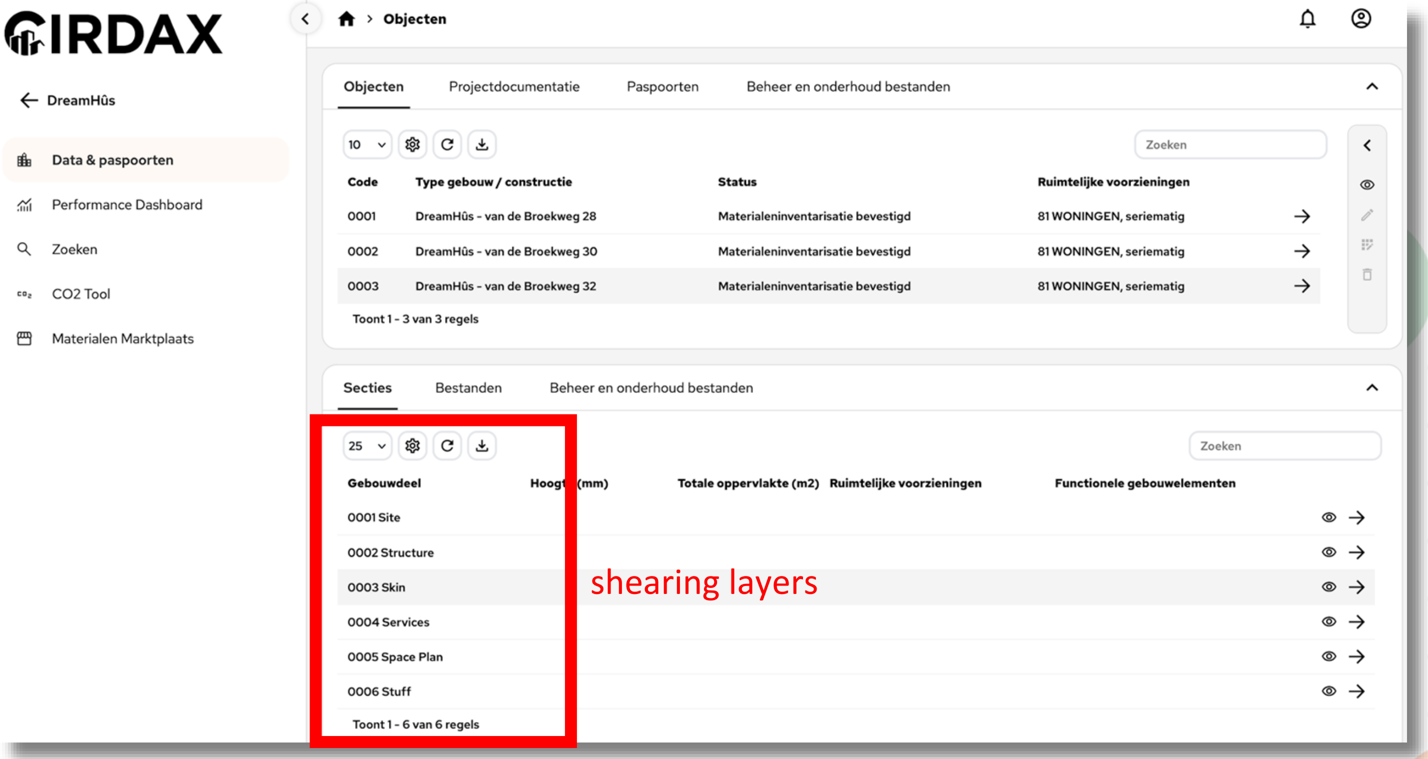
Demo Blog





CASE 2
CIRDAX

Demo Blog



CIRDAX

← DreamHûs

- Data & paspoorten
- Performance Dashboard
- Zoeken
- CO2 Tool
- Materialen Marktplaats

Objecten

Objecten | Projectdocumentatie | Paspoorten | Beheer en onderhoud bestanden

10 | Zoeken

Code	Type gebouw / constructie	Status	Ruimtelijke voorzieningen
0001	DreamHûs - van de Broekweg 28	Materialeninventarisatie bevestigd	81 WONINGEN, seriematig
0002	DreamHûs - van de Broekweg 30	Materialeninventarisatie bevestigd	81 WONINGEN, seriematig
0003	DreamHûs - van de Broekweg 32	Materialeninventarisatie bevestigd	81 WONINGEN, seriematig

Toont 1 - 3 van 3 regels

Secties | Bestanden | Beheer en onderhoud bestanden

25 | Zoeken

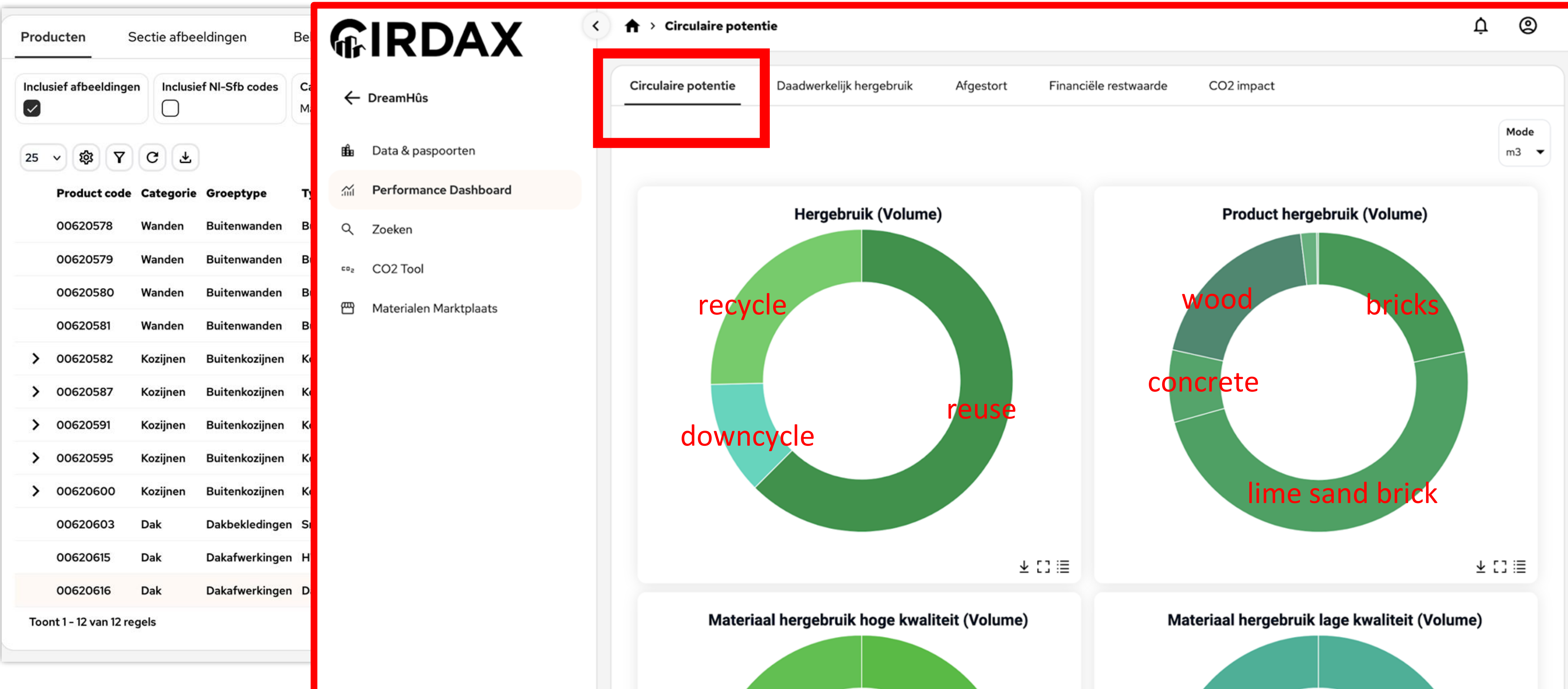
Gebouwdeel	Hoogte (mm)	Totale oppervlakte (m2)	Ruimtelijke voorzieningen	Functionele gebouwelementen
0001 Site				
0002 Structure				
0003 Skin				
0004 Services				
0005 Space Plan				
0006 Stuff				

Toont 1 - 6 van 6 regels

shearing layers

CASE 2
CIRDAX

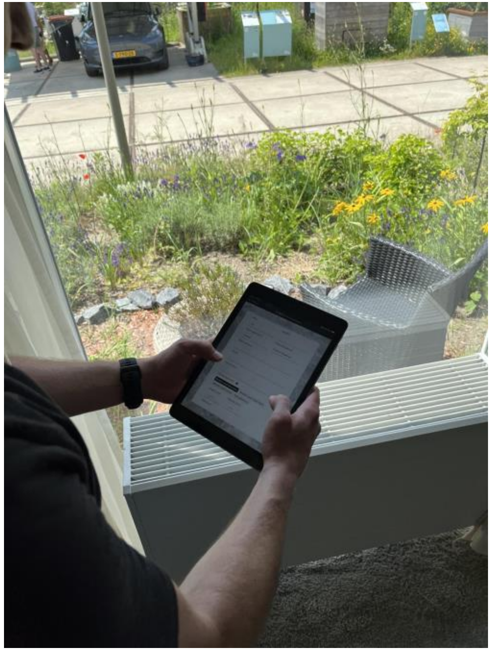
Demo Blog



CASE 2
CIRDAX

Demo Blog

Manual data collection *through site inspection*

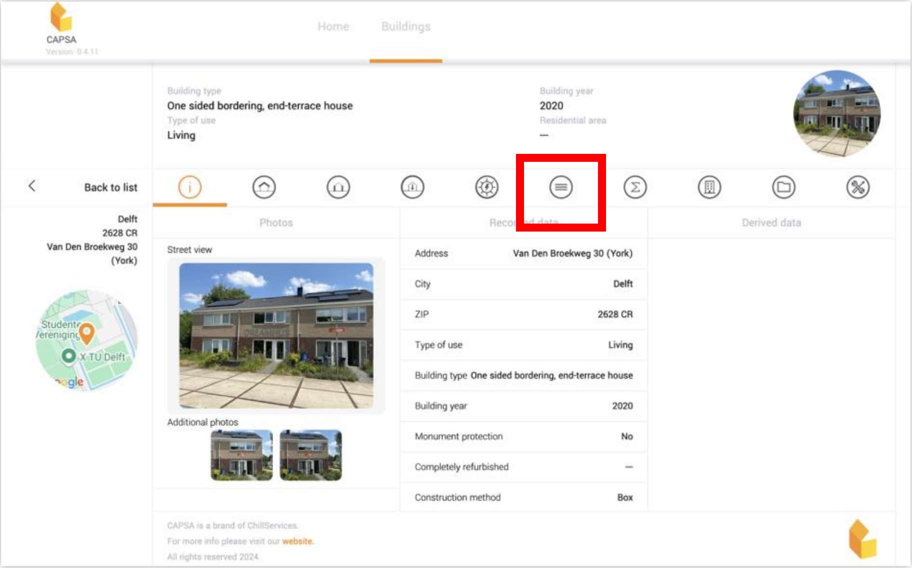


Digital data collection

- *Desk research through the documents and drawings shared by the Green Village.*
- *If the BIM model was available, this would have helped to measure products and access data.*
- *Experimenting with other scanning technologies such as infrared scanners, point cloud, but these are only helpful with geometry not identifying materials/layers.*
- *3D Modelling quality is very important to get correct data.*
- *AI (image recognition) can be a path to go but expensive and does not deliver what promises*

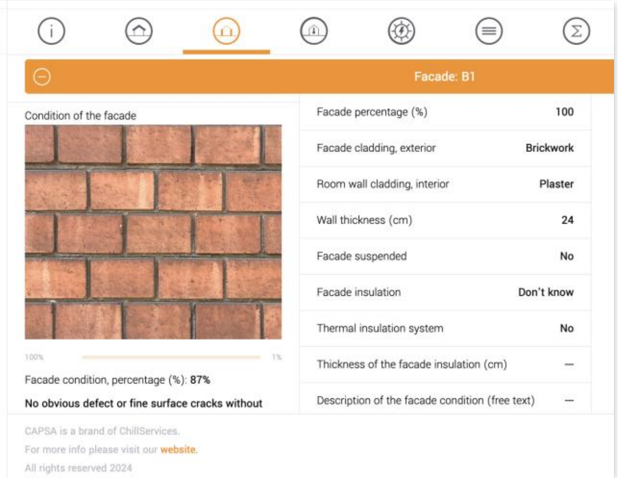
CASE 3
CAPSA

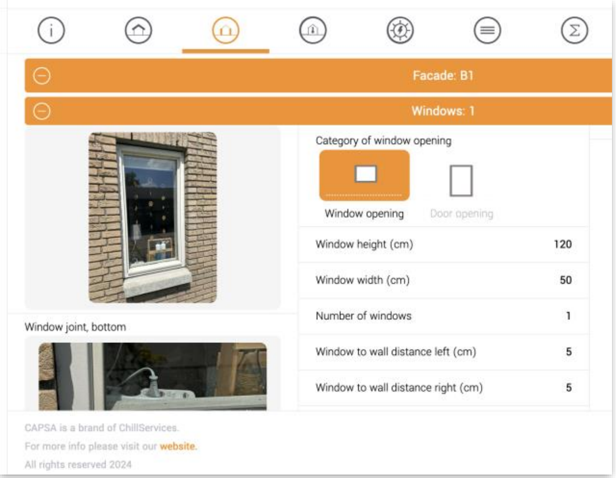
Demo Blog



- the generation of decarbonization and refurbishment advice,
- the digitization and automation of maintenance & documentation

CASE 3
CAPSA





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- *Data collection by (non-skilled) a building owner,*
- *A data collection app with an easy-to-use interface acts as a guide with questions*
- *Within an hour simple measurements, quailty check, HVAC systems, etc.*
- *Experimented with chatGPT but the answers were not reliable, it is used to improve the quality of collected data*
- *Lidar in mobile app in early stage,*
- *BIM and GIS data quality bad*

CLOSING REMARKS

- *Understanding the data requirements for DBL indicators/functionalities is key*
- *Data collection technologies are advancing but we should find a balance between costs, manual input and digitalisation*
- *AI seems to offer several options to experiment with data collection*

- *Any technology suggestions to include in our research?*

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District Energy Concept Evolution:

From Positive Energy Districts (**PEDs**) to Positive Clean Energy Districts (**PCEDs**)

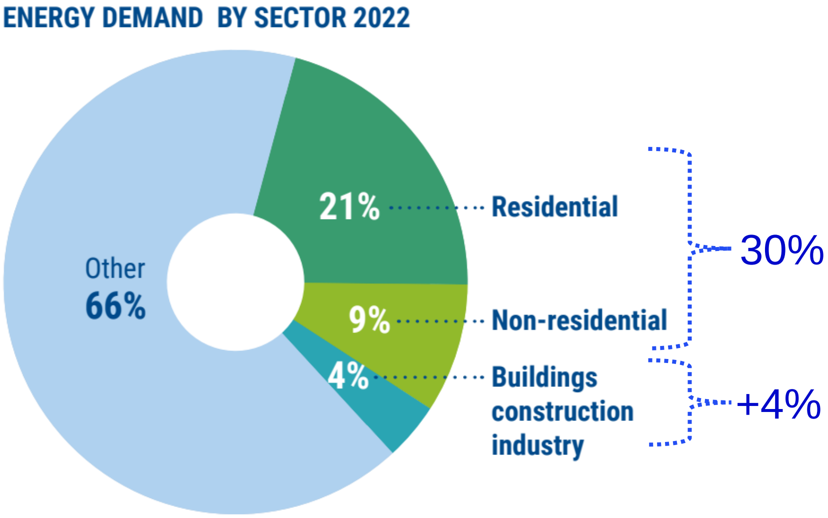
What are the main considerations from annual surplus energy to climate neutrality?

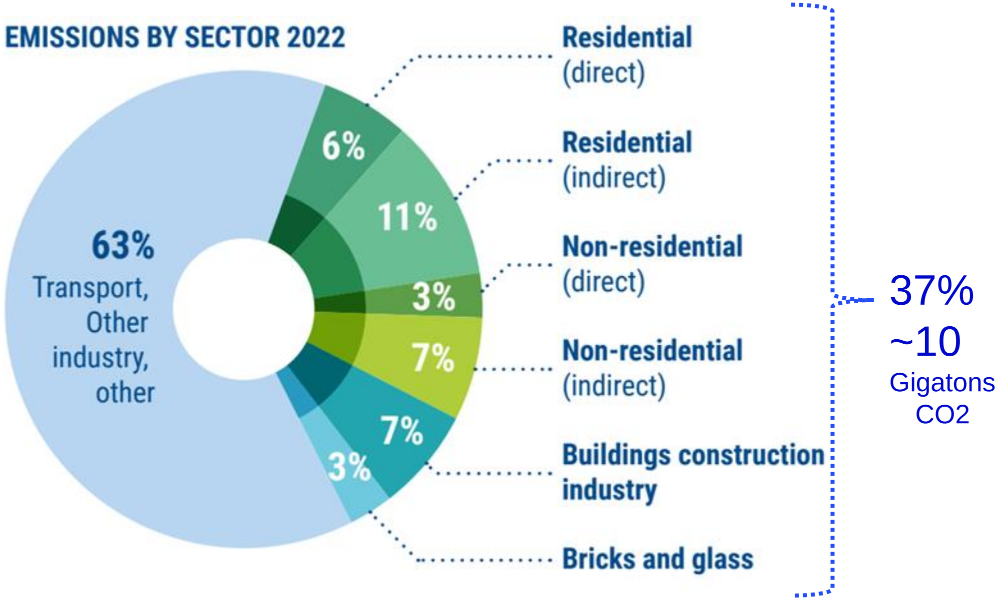
Merve Mermertaş, Demir Enerji

Funded by
the European Union

Sustainable Places Conference, 2024
25.09.2024, European Convention Center Luxembourg

Climate Change Status of Global Building Sector





(Main Source: Global Status Report for Buildings and Construction)
(Source: IEA 2023a. Adapted from ‘Tracking Clean Energy Progress’)

The State of the art Review on PEDs and Climate Friendly Neighbourhoods (CFNs)

The terminology frequently used;

- *Zero Emission Neighbourhood (ZEN)*
- <u>*Positive Energy Districts (PEDs)*</u>
- *Low Carbon District (LCD)*
- *Nearly Zero Energy Districts (nZED)*
- *Low Carbon Neighbourhood (LCN)*
- *Net Zero Energy Neighbourhood (NZEN)*
- *Net Zero Energy Districts (NZED)*

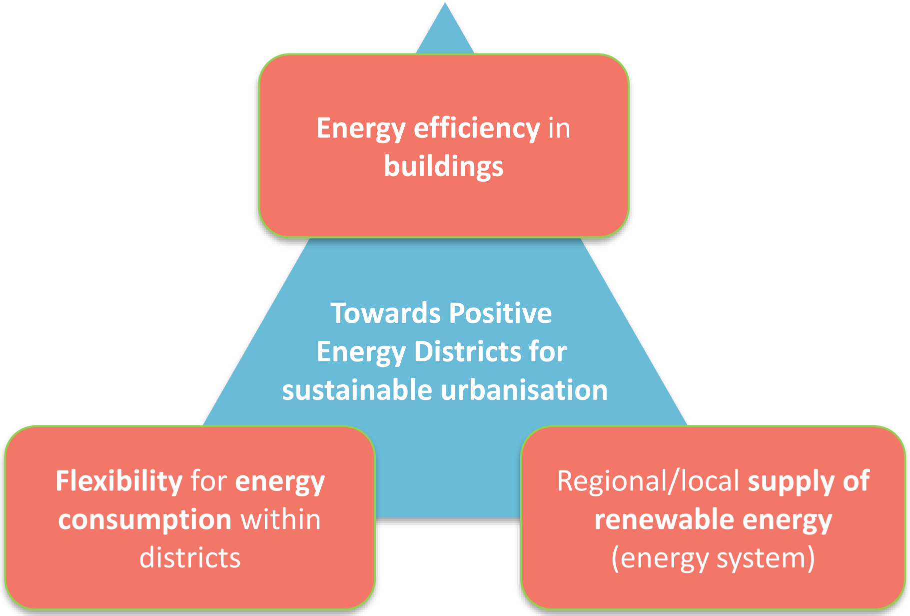
Positive CLEAN Energy Districts (PCEDs)

''Clean'' Concept isn't promoted yet…

- *Nearly Zero Energy Neighbourhood* (nZEN),
- *Positive Energy Block* (PEB),
- *Energy Positive Neighbourhood* (EPN),
- *Low Carbon District Heating* (LCDH),
- *Zero Energy Neighbourhood* (ZEN),
- *Plus Energy District* (pED),
- *Zero Energy District* (ZED),
- *Positive Energy Precinct,*
- *Zero Carbon District,*
- *Zero Carbon Neighbourhood,*
- *Smart City Eco District,*
- *Zero Energy Emission District,*
- *Zero Non-Renewable Energy Neighbourhood,*
- *Plus Energy Neighbourhood,*
- *Nearly Zero Energy Settlement,*
- *Net Zero Exergy District,*
- *Net Zero Carbon Emission District,*
- *Low or Zero Emission District Heating,*
- *Low Carbon Energy District,*
- *Low Carbon Local Energy Community,*
- *Net Positive Energy Neighbourhood,*
- *Energy Positive District,*
- *Smart Energy Community,*
- *Net Zero Energy Block,*
- *Nearly Zero Carbon Neighbourhood,*
- *Net Zero Energy Settlement,*
- *Net Zero Energy Campus,* and
- *Net Zero Energy Community.*

Brozovsky, Johannes & Gustavsen, Arild & Gaitani, Niki. (2021). Zero Emission Neighbourhoods and Positive Energy Districts – A State-of-the-Art Review. Sustainable Cities and Society. 72. 103013. 10.1016/j.scs.2021.103013.

Positive Energy District (PED) Framework *~defining milestones*

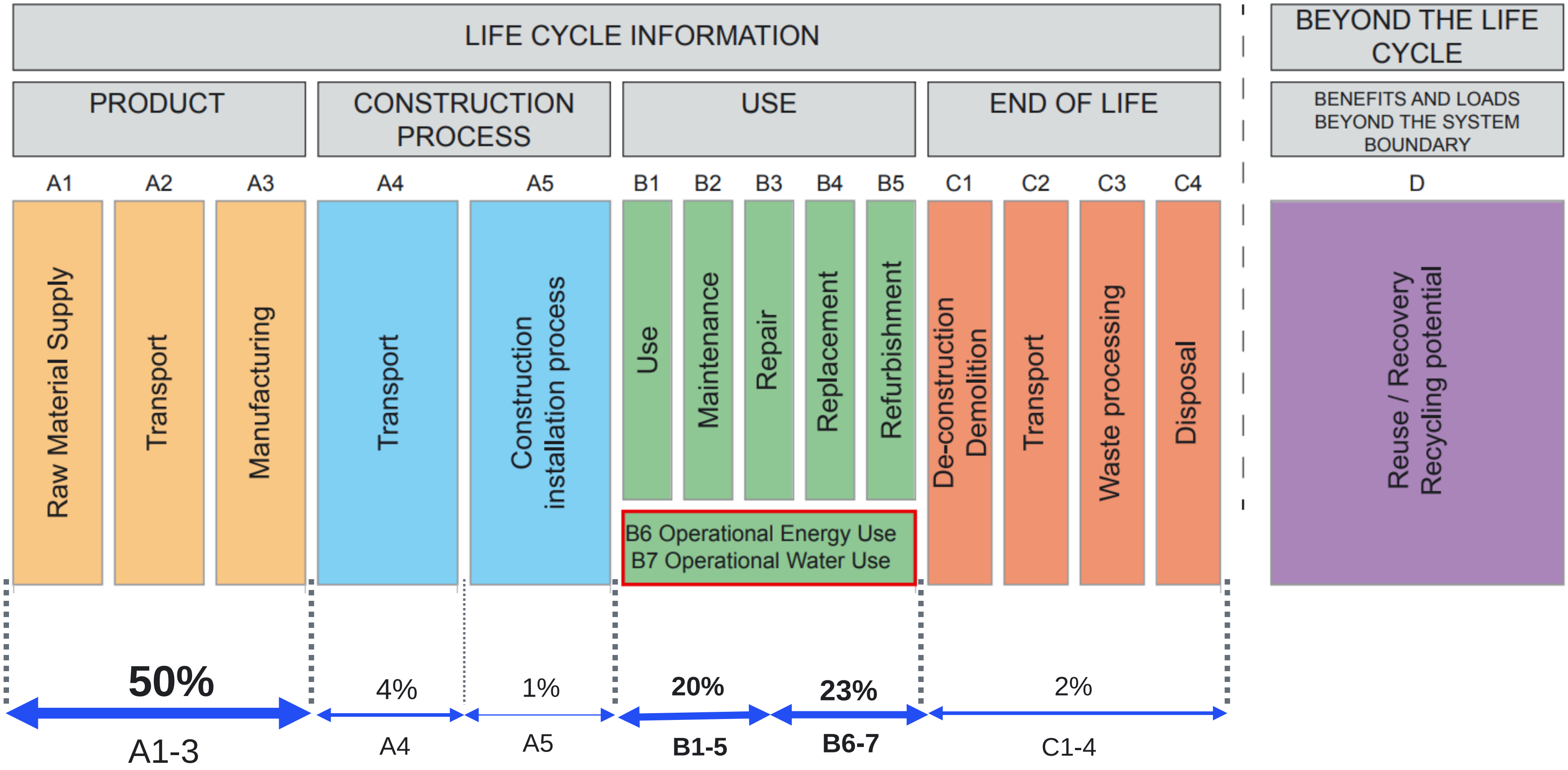


Source: MAKING-CITY

PEDs are energy-efficient groups of connected buildings which produce net zero greenhouse gas emissions and actively manage an annual local surplus production of renewable energy.

The amount of energy produced > The amount of energy consumed

PED➡PCED Level Assessment Stages:



PED➡PCED Level Environmental Impact Categories ~ *through Climate Neutrality*

The existing terminology for climate neutrality focused on Energy and Carbon Emission. Should we include?

Global Warming Potential
($kg\ CO_2eq.$)

Eutrophication Potential
($kg\ PO_4\ eq.$)

Ozone Depletiton Potential
(kg CFC-11 eq.)

Photochemical Smog Formation
($kg\ O_3\ eq.$)

Acidification Potential
($kg\ SO_2\ eq.$)

Abiotic Depletiton Potetial
Fossil Fuel Depletiton
(MJ)

The comprehensive approach for PCED Concept:
Life Cycle Balance

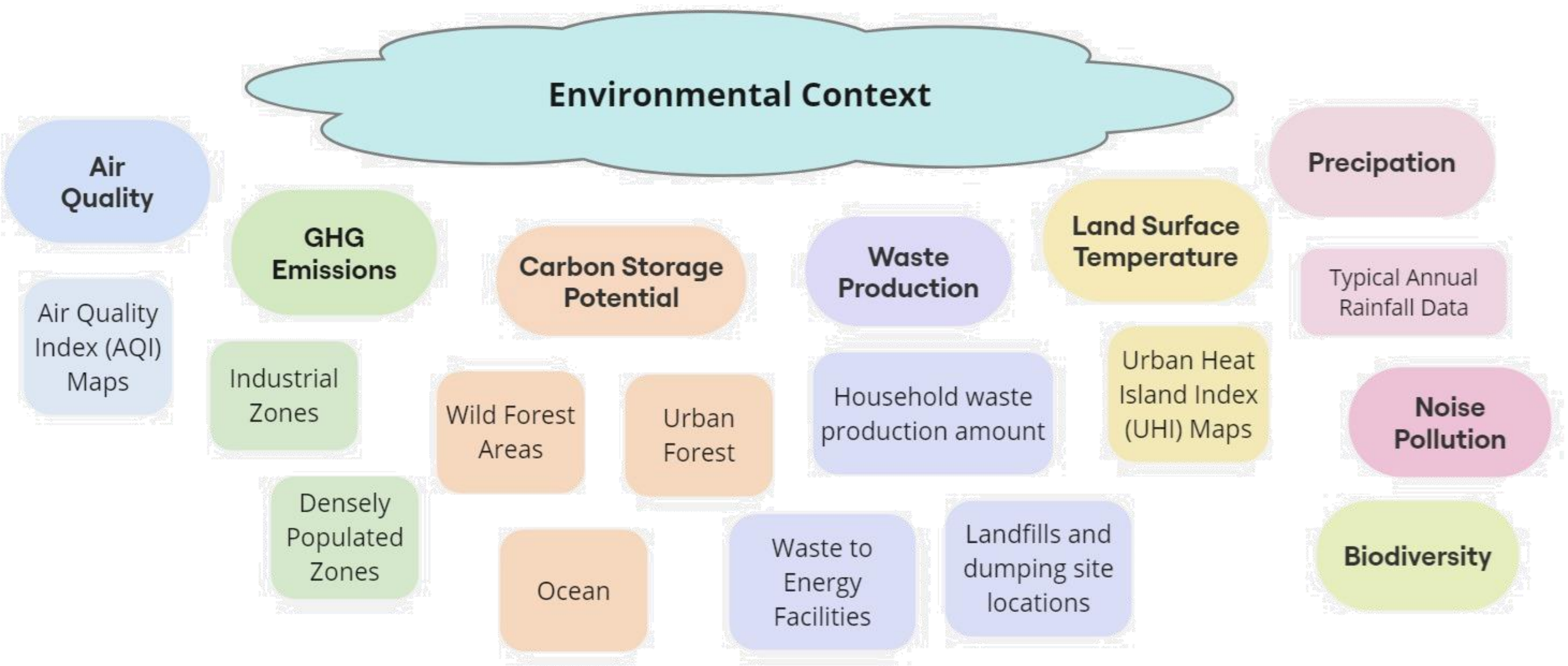
The district where the energy consumed and the embodied impact within its materials and systems over the lifetime is at least equal to or less than the total environmental impact and from the energy produced by its renewable energy systems within the district over its lifetime.

The Critical Elements for a PED

<u>Plays a key role;</u>

- Defining suitable zones
- Designing different pathways
- Considering where the solution be more easily expanded
- Appying suitable technological solutions

The critical elements for a PCED : PED + Environmental Context



Thank you!

2030
NEUTRALPATH

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