



BPIE

#### KU LEUVEN

#### Supporting the development of a roadmap for the reduction of Whole Life Carbon of buildings

Kick-off webinar 08 March 2022



## Welcome

Xavier Le Den (Director, Ramboll)



**Welcome** 15:00 - 15:05

**Introducing the EU WLC roadmap: context and ambition** 15:05 – 15:20

**Informing the EU WLC roadmap: support study** 15:20 – 15:50

**Q&A session** 15:50-16:10

**Closure** 16:10-16:15

## If you have any questions or remarks during the presentation

Leave a comment in the **Q&A section** 





## Introducing the EU WLC roadmap: context and ambition

Josefina Lindblom (European Commission, DG ENV) Philippe Moseley (European Commission, DG GROW)

## Roadmap Whole Life Carbon







### Whole life carbon





## Why act at the building level?







### By 2050

The EU has the potential to cut buildings' embodied carbon emissions by

60-80 %

(Source: EEA and UNEP)

We must act at the building level through modern building policy.



## Policy development

- Requiring assessment and reporting
  - Spread knowledge and understanding
  - Comparison of design options
  - Awareness of potential
  - Soft reduction of whole life carbon



# Sustainable Finance – Climate Change Mitigation

**New Buildings** 

3. For buildings larger than 5000 m<sup>2 285</sup>, the life-cycle Global Warming Potential (GWP)<sup>286</sup> of the building resulting from the construction has been calculated for each stage in the life cycle and is disclosed to investors and clients on demand.



## Energy Efficiency Directive (EC proposal)

#### **Public Procurement**

Given that buildings are responsible for greenhouse gas emissions before and after their operational lifetime, Member States should also consider the whole life-cycle of carbon emissions of buildings. That takes place in the context of efforts to increase attention to whole life cycle performance, circular economy aspects and environmental

impacts, as part of the exemplary role of the public sector. Public procurement can thus serve as an opportunity to address the embodied carbon in buildings over their life-cycle. In this regard, contracting authorities are important actors that can take action as part of procurement procedures by purchasing new buildings that address global warming potential over the full life-cycle.



# Energy Performance of Buildings Directive (EC proposal)

#### **New Buildings**

The life-cycle Global Warming Potential (GWP) of new buildings will have to be calculated as of 2030 in accordance with the Level(s) framework, thus informing on the whole-life cycle emissions of new construction. Whole-life cycle emissions are particularly relevant for large buildings, which is why the obligation to calculate them already applies to large buildings (with a useful floor area larger than 2000 square meters) as of 2027.

4. Member States shall address, in relation to new buildings, the issues of healthy indoor climate conditions, adaptation to climate change, fire safety, risks related to intense seismic activity and accessibility for persons with disabilities. Member States shall also address carbon removals associated to carbon storage in or on buildings.



## Certification of carbon removals

**Communication on Sustainable Carbon Cycles (December 2021)** 

Conference on Sustainable Carbon Cycles (31 Jan 2022)

Call for Evidence\* open until 2 May 2022

> Legislative proposal (Q4 2022)

Set robust requirements for measurements, risks and additionnality, while ensuring environmental integrity

All kinds of removals, including carbon farming, industrial solutions, and use of carbon-storing materials

Governance framework for implementation and stakeholders involvement



## Policy development

- Quantified targets
  - Benchmarking
  - Limit values

 $\rightarrow$ Roadmap setting out milestones



## Renovation Wave Action Plan

#### Whole Life Carbon Roadmap

4. → Developing ·a·2050 ·whole ·life-cycle · performance ·roadmap ·to ·reduce ·carbon · emissions ·form ·buildings ·and ·advancing · national ·benchmarking ·with ·Member · States ·¶



## Whole Life Carbon Roadmap

- Bring together expertise and initiatives
- Be inspired by front runners engage across the EU
- An accelerator



**Reference: LETI CEDG** 

## A basis for climate objectives

- Underpin policies and strategies, objectives and visions
- Encourage and support policy making and market initiative
- Be consistent with other EU initiatives
- Understand performance and improvement potential



## What will it look like?

- Quantified targets, with milestones up to 2050
- Embodied and operational carbon
- Robust and relevant, in time and place
- Not a list of policy recommendations



## **Ongoing study** Dec 2021-March 2023

- Establish baseline
- Future embodied carbon (BaU)
- Trajectory for embodied carbon, towards climate objectives
- Identify reduction solutions
- Trajectory for operational carbon, towards climate objectives
- Stakeholder consultation



## Roadmap development

- Conducted by the Commission
- Study results
- Learn from others having developed roadmaps
- Stakeholder consultation





## Thank you

European Commission

## Informing the EU WLC roadmap: our support study, your contribution

#### 1. Introduction (Xavier Le Den, Ramboll)

- 2. Building archetypes (Martin Röck, KU Leuven)
- 3. Scenario analysis (Judit Kockat, BPIE)
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### About us



**Ramboll** is a global consultancy delivering sustainable change across 35 countries.

With a civil-engineering legacy, Ramboll also comprises management consulting, architecture, and environmental services to deliver a holistic take on the green transition – in the buildings sector and in similar industries.



**BPIE** (Buildings Performance Institute Europe) is a leading independent think tank on energy performance and climate adaptation of buildings.

Our vision is a climate-neutral built environment, aligned with the ambition of the Paris Agreement, and in support of a fair and sustainable society. We provide actionable, data-driven policy analysis, advice, and implementation support to decision-makers in Europe and globally

#### **KU LEUVEN**

**KU Leuven**'s research group Architectural Engineering tackles innovation in the design of buildings by approaching architecture from an engineering point of view.

The emphasis is placed on the technological aspects of architecture. Structure, materials, services, and comfort requirements are considered in a multidisciplinary setting to quantify, assess, and improve the quality, cost and environmental impact of buildings and the built environment.

### Our approach



### EUCalc building stock model

Top down framework for upscaling and efficiency scenarios

EUCalc project funded by Horizon 2020



#### Building LCA model MMG/Totem

Bottom up modelling with regional archetype variations

Episcope project funded by Intelligent Energy Europe

Scaled up with



### WLC carbon reduction solutions

Defined solutions catalogue on the level of technical design & implementation

<u>CE Actions project commissioned</u> by the European Energy Agency

Applied to

#### Our response to methodological challenges of the initial request:

- A detailed bottom-up results so that the impact of low carbon solutions in various European countries/regions and building types is understood
- A top-down calibration to observed activity levels in terms of floor space and material demand
- Linkage to the most recent EU and national policies for energy efficient buildings and overall climate targets

Ramboll

We will build on previous work, ongoing initiatives and collaboration to build the evidence base for EU policy making



High-Level Construction Forum's transition pathway towards a green, digital and resilient construction ecosystem (EC)

- Land Use and Building Act in Finland
- Whole life carbon regulation in Denmark
- >#BuildingLife (WorldGBCs)
- European Cement Association's Carbon Neutrality Roadmap (Cembureau)
- Pathways to a CO2-neutral European steel industry (Eurofer)
- IEA EBC Annex 72 Assessing Life Cycle Related Environmental Impacts Caused by Buildings
- Toward embodied carbon benchmarks for building in Europe (Ramboll/BUILD with support from Laudes Foundation)

 $\blacktriangleright\dots$  and many others

## Informing the EU WLC roadmap: our support study, your contribution

- 1. Introduction (Xavier Le Den, Ramboll)
- 2. Building stock model & archetypes (Martin Röck, KU Leuven)
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### Building stock modelling: Characterization and activities

## **Building stock data – Characterization and activities**

- EU building stocks data from statistical sources and previous projects
- Activity data for 2020 to 2050 (m<sup>2</sup> of operation, renovation, demolition, new construction)
- Grouping of MS into geocluster regions (acc. EPBD)
- Definition of representative building archetypes from weighted regional averages



#### **Building stock data**

- EU Countries (27+2)
- Pear year (2015 2050)
- Economy-wide scenarios
- Clustered by region (EPBD)



#### Activities

- Existing building operation
- Energy retrofit
- Deconstruction, demolition
- New building construction

### Building stock modelling: Archetype-approach

#### Archetype = A representative building

- Definition using 'real examples' or 'synthetical averages'
- Identification of regional archetypes for different types of buildings
- Definition based on various sources (e.g., Tabula/Episcope archetype database)





#### Weighted average

- Building type
- Floor area
- Construction period
- Energy performance
- Materialization



### Building archetype variants specification



#### Building stock data

- EU Countries (27+2)
- Pear year (2015 2050)
- Economy-wide scenarios
- Clustered by region (EPBD)



#### Activities

- Existing building operation
- Energy retrofit
- Deconstruction, demolition
- New building construction



#### **Building types**

- Single Family Houses (SFH)
- Multi-Family Houses (MFH)
- Office buildings (OFF)



#### Energy performance

- Per region & building type
  - Existing average
  - Energy retrofit depths
  - New building levels

#### Elements / Materials

- Default per region & building type
- Low carbon, bio-based materials
- Carbon reduction strategies



### Building archetype LCA modelling & analysis

#### Life cycle assessment (LCA) for WLC analysis

Based on KU Leuven MMG-LCA tool

#### **Hierarchical inventory modelling**

- Buildings Elements Worksections Materials
- Analysis of embodied carbon hotspots (space, time)
- Carbon profile, emissions across life cycle stages

#### **Scope of the assessment**

#### Comprehensive building part scope

 Foundations; External walls/roofs; Internal walls/floors; Windows/doors; Technical systems (Heating, DHW, Electrical)

#### Full life cycle scope

• Production and construction process (A1-3, A4-5); Operation, maintenance, replacement (B2, B4, B6); End of life, deconstruction, processing (C1-4)



### Upscaling and calibrating from building archetypes to the EU building stock

#### Carbon profile

one example for one building archetype in one region



Embodied emissions Operational emissions









Building stock data - characterization and activities

• Definition of representative building archetypes from regional averages



• Building stock activities [m<sup>2</sup>] (operation, renov., demol., new construction)



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## Using the EUCalc tool for scenario building & activity levels for construction, renovation, demolition



#### **EUCalc is:**

- Online, real-time model integrating all sectors
- Choices in one sector affect the other sector
- Scenarios are sensible to limitations and prerequisites in other sectors, i.e. for buildings the constructed floor area depends on the population development

#### **EUCalc enables:**

 Scenario building within the predefined options on the left, i.e. building envelope measures, HVAC measures, living space per person development

http://tool.european-calculator.eu/app/buildings/building-types-area/?levers=1j1233333l11211mp2b11133333pppppp11f411111e3211r211l21n221



### Choices for scenario building in EUCalc



The operational emissions from buildings can be influenced through 4 levers:

Buildings
Building envelope
District heating share
Technology and fuel share
Heating and cooling efficiency
Appliances efficiency



### We will work around three scenarios

	Business as usual Current policy	Scenario 1 Reduce Embodied Carbon	Scenario 2 Reduce WLC to support 1.5C
	"Current Policy"	"Today's low-carbon solutions"	"All hands on deck"
Regionalised building archetypes	Building on archetypes with current policy low carbon solutions	Wide application of available low- carbon solutions	Radical shift to circular bioeconomy and considering future material innovation potential
Lifestyle	Living space per person increases based on historic trend	Living space per person moderately decreases	Living space per person strongly decreases
Renovation and construction rate and energy performance	Renovation and construction activity can be Renovation rates can vary between of which deep/ highly energy performant for renovations and new constructions.	chosen per scenario with the envelope lever 1% and 3% 5% and 70%	



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### Approach to the carbon reduction solutions

#### Long List

A long list of possible carbon reduction solutions or actions are ditributed in the following groups:

- 1. Reduce the use of new material
- 2. Use less or greener concrete
- 3. Use timber
- 4. Efficient or greener production and sourcing

#### **Short List**

Some of the actions are selected for a short list and quantified based on their impact on:

- 1. Materials
- 2. Building elements
- 3. Life Cycle Modules
- Carbon Reduction potential on a projejt level
- Penetration potential on the entire buildings market

#### Input for modelling

Short listed actions are prepared for modelling using standardized input sheets.



#### Report

The carbon reduction methods are described in detail along with the sources used for the quantification of reduction potential.

### Categorization of carbon reduction solutions



#### Reduce, Reuse, Recycle

- 1. Renovate instead of new construction
- 2. Reuse deconstructed material
- 3. Use reclyced material









## Efficient production and scourcing

- 1. Improved efficiency of material production
- 2. Regional materials

## Less and/or greener concrete

- 1. Industry by products instead of cement
- 2. Use Void Formers in concrete slabs
- 3. Cement alternatives

- **Bio-based (timber etc)**
- 1. Full timber structure
- 2. Hybrid structures
- 3. Timber elements in standard structure

### **Selection of actions**

#### **CE Action – example Long List**

Renovate instead of new construction

Use recycled materials (Glas, Metal)

Recycle concrete as aggregate for new concrete (Downcycle)

Industry by products instead of cement (Green concrete)

Use void formers in concrete slabs

Full timber structures in new construction

Hybrid (concrete +Timber) structures in new construction

Timber roof elements in standard structure

Efficient cement production

Efficient steel production and other metals

Efficient Glas production

Use of regional meterials

#### **CE Action - Short List**

Examples:

2

3

### Input for modelling

Description of reduction method

	Life cycle modules	A1-A3 etc
Building Elements and materials	Reduction %	
Foundation External wall Etc		

The selection of actions to the **short list** is based on their score on the following attributes:

#### • Impact

- Applicability
- Feasibility
- Measurability

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### Stakeholder engagement strategy

We will rely on the contributions and expertise of key stakeholders and experts



Two expert groups on

- Archetypes and emission reduction solutions
- Emissions reduction solutions and future trajectories
- Aim: capitalise on the expertise of key stakeholders and gather their feedback

Interviews with key stakeholders

Aim: focus on a specific topic and fill potential gaps



Presenting the study and its findings via this webinar, via meetings of relevant expert groups, during a conference at the start of 2023

Aim: promote the study and gather feedback



The contribution of sources and materials shared by stakeholders such as you via email

Aim: build on the relevant work that has already been done

### Contribute to the study

Visit our website: <a href="https://c.ramboll.com/whole-life-carbon-reduction">https://c.ramboll.com/whole-life-carbon-reduction</a>



Or send us an email to <u>WholeLifeCarbonRoadmap@ramboll.com</u>

#### or use this QR code





# Do you have any questions?

Let us know if you have questions about our study by typing them in the Q&A section.



## Closing remarks

Josefina Lindblom (European Commission, DG ENV)

Bright ideas. Sustainable change.

