CO2NSTRUCT

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The CO2NSTRUCT European project: Modelling the role of Circular Economy in construction value chains for a carbon-neutral Europe

Olympia Polyzou & Theoni Oikonomou on behalf of

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Greek National Workshop, Athens, Greece, 12 June 2026

CO_2NSTRUCT project facts

Title: CO_2NSTRUCT - Modelling the role of Circular Economy in construction value chains for a carbon-neutral Europe

EU funding programme: Horizon Europe

Call: HORIZON-CL5-2021-D1-01: Climate sciences and responses

Topic: HORIZON-CL5-2021-D1-01-02

Type of action: HORIZON Research and Innovation Actions

Start date: 01-06-2022

End date: 30-09-2026

Duration: 52 months

Budget: 5 million Euro

Coordinator: Technical University of Denmark - DTU

Consortium partners

National Laboratory for Energy and Geology

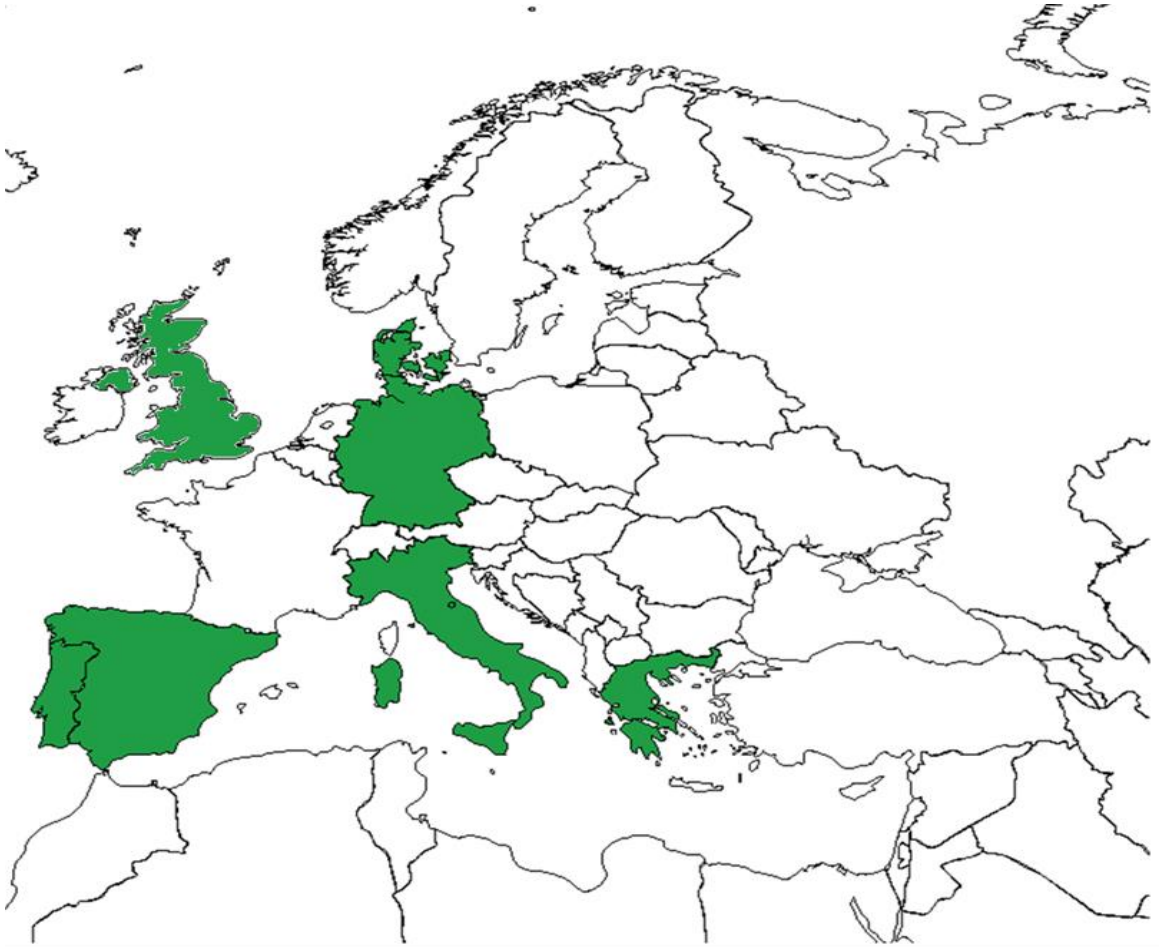
Centre for Renewable Energy Sources and Saving

Ruhr University Bochum

University of Pisa

University of Sheffield

Technical University of Denmark



Consortium Partners

CO₂NSTRUCT

DTU
Construction materials
Circular economy
Sustainability

Rebound effects
Supply and value chains
Circular economy

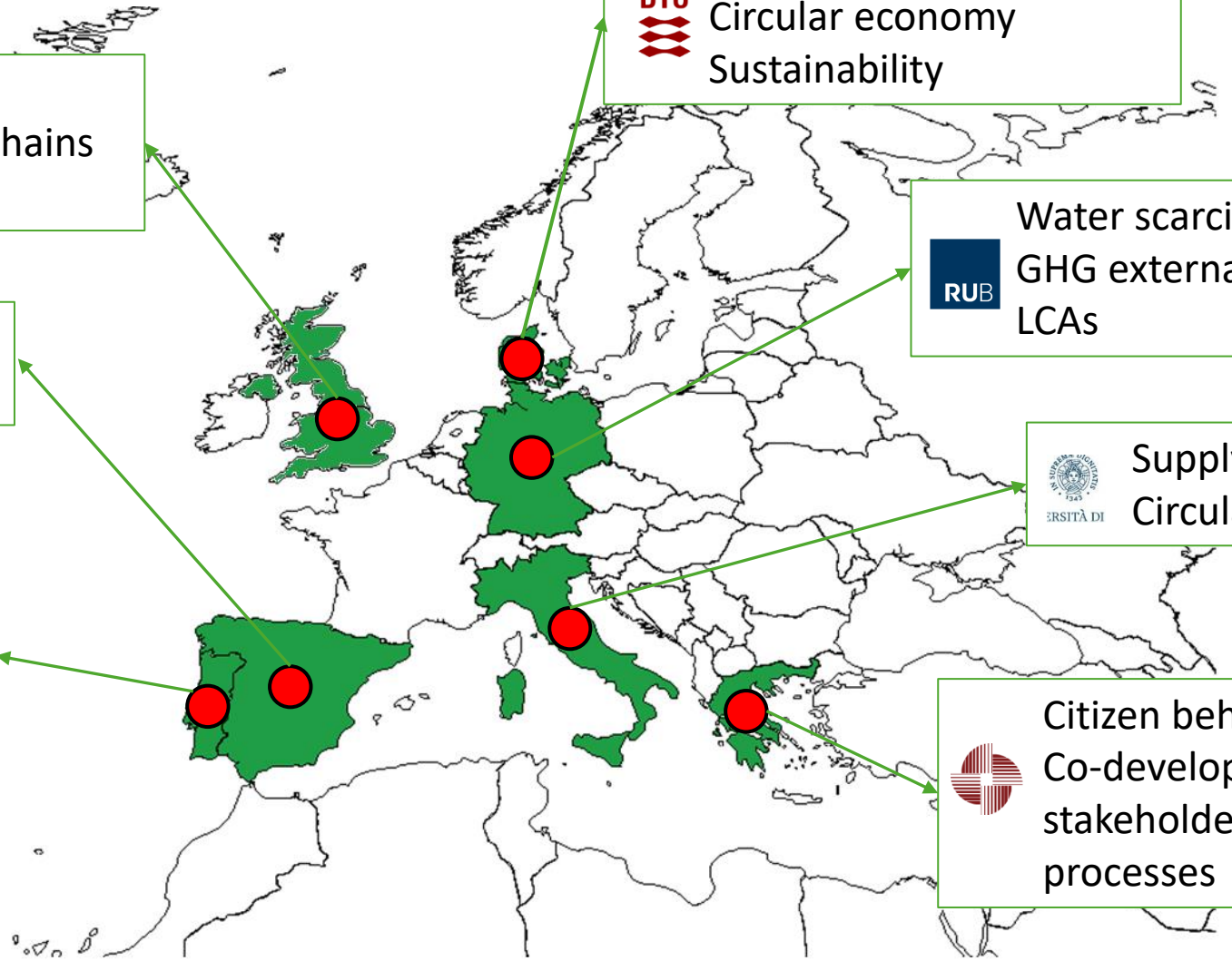
RUB
Water scarcity
GHG externalities
LCAs

Sustainability
LCAs
Ciemat

ERSITÀ DI
Supply and value chains
Circular economy

LNEG
Climate mitigation modelling
GHG externalities
Policy
Energy poverty

Citizen behaviour
Co-development & stakeholder engagement processes



DTU
RUB
UNIVERSITÀ DI PISA
The University Of Sheffield.
LNEG
GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN
Ciemat
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
ΚΑΠΕ CRES

Scope: From linear to circular

- To augment current linear climate mitigation models with circular economy measures for construction materials.
- To contribute to achieving the emission reduction targets set by policymakers.

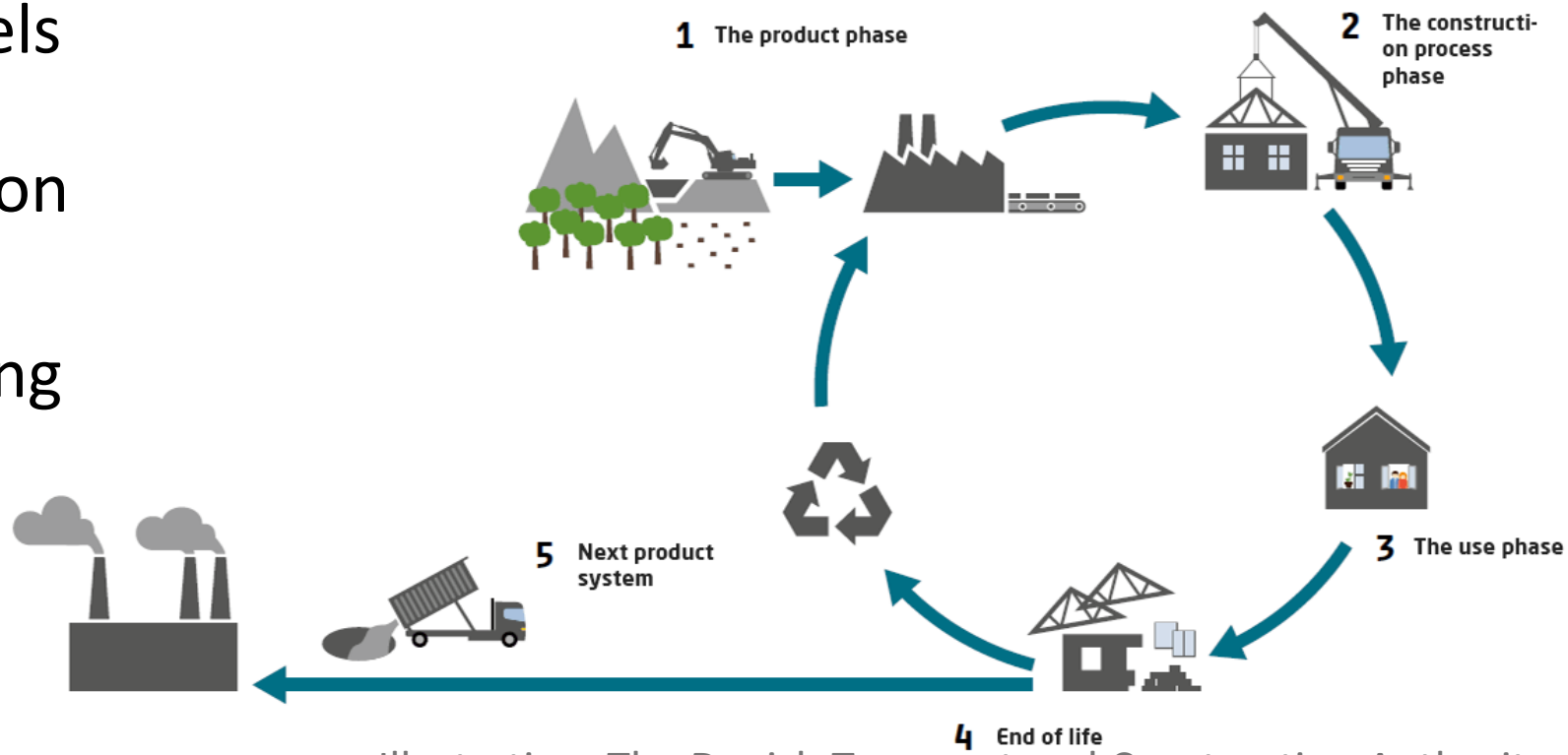


Illustration: The Danish Transport and Construction Authority

3 reasons for the necessity of CO_2NSTRUCT project

1. The **construction sector** is one of the world's **largest consumers** of energy and raw materials and **producers of waste**.
2. A **circular economy** for materials plays a key role in the transition to more **sustainable use of natural resources** in construction and a carbon-neutral society.
3. **Current climate mitigation models** (e.g. JRC-EU-TIMES, PRIMES) cannot account for materials' **circularity**.

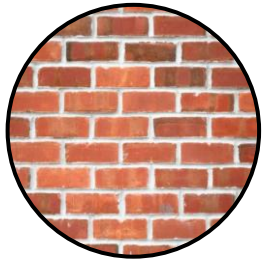
Focus on six carbon-intensive materials

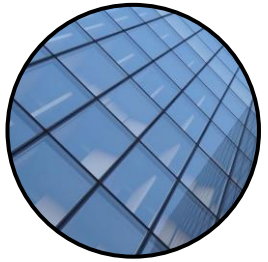
The CO_2NSTRUCT project focuses on six pervasive construction materials.

Analysis of the impacts of the extraction of raw materials, logistic, transformation, and consumer industries covering the whole life cycle of these materials.

- Cement
- Steel
- Brick
- Wood
- Glass
- Insulation materials








CO_2NSTRUCT objectives

- Creation of a **dataset** for construction materials, including Circular Economy (**CE**) **measures**.
- Developing a strategy to quantify **citizen behaviour** and **key stakeholder opinion** toward CE and climate mitigation.
- Mapping CE practices in the **supply and value chains** in the construction sector.
- Identification of potential **rebound effects** and **social impacts** of CE measures implementation.
- Developing CO_2NSTRUCT Circular Climate Mitigation Modelling **Framework** and **Scenarios**.
- Integrating CE into climate action, policies, and externalities.

CO_2NSTRUCT objectives

Creation of a dataset for construction materials, including CE measures

- **To define** the **baseline** of **material flows**, **carbon**, **water**, and **embodied energy** of materials across 4 (+2) carbon-intensive construction materials value chains and **to create a dataset** for construction materials, **including CE measures**.
- Creation of an **open-access database** verified by key stakeholders.

CO_2NSTRUCT objectives

Developing a strategy to quantify citizen behaviour and key stakeholder opinion toward CE and climate mitigation

- To **develop a strategy** to quantify citizen behaviour and key stakeholder opinion on CE measures of six construction materials and **incorporate its results in the TIMES** energy-climate mitigation model.
- Performing of a **survey** in the 7 participating countries, involving at least **1400 citizens** and conduction of at least **25 key stakeholders' interviews**.

CO_2NSTRUCT objectives

Mapping CE practices in the supply and value chains in the construction sector

- To map the CE value chain for each of the **4 (+2)** carbon-intensive construction materials.
- Creation of a **value chain conceptual model**, validated by key stakeholders.

CO_2NSTRUCT objectives

Identification of potential rebound effects and social impacts of CE measures implementation

- To identify the **social implications** of the transition towards CE in the selected value chains.
- The created open-access **database will include estimated social impacts**, allowing for visualization of data on mitigation options, value chains and framework structure.

CO_2NSTRUCT objectives

Developing CO_2NSTRUCT Circular Climate Mitigation Modelling Framework and Scenarios

- To develop a **new climate mitigation modelling framework** for the construction materials value chain that **includes** an account for CE feedback loops and other **CE tools**, their **rebound effects**, expected **citizen engagement**, and an evaluation of **externalities** for different CE climate mitigation scenarios.
- Creation of **an augmented open TIMES** energy-climate mitigation model including CE options.

CO_2NSTRUCT objectives

Integrating CE into climate action, policies, and externalities.

- The TIMES model results will be translated into **policy recommendations** to integrate CE into climate, energy, environmental, and economic policies toward carbon neutrality.
- At least **10** policy-making **recommendations** and at least **19 meetings/workshops** with policy makers and other key stakeholders.

CO_2NSTRUCT
Indicative Results

Greek National Workshop, Athens, Greece, 12 June 2026

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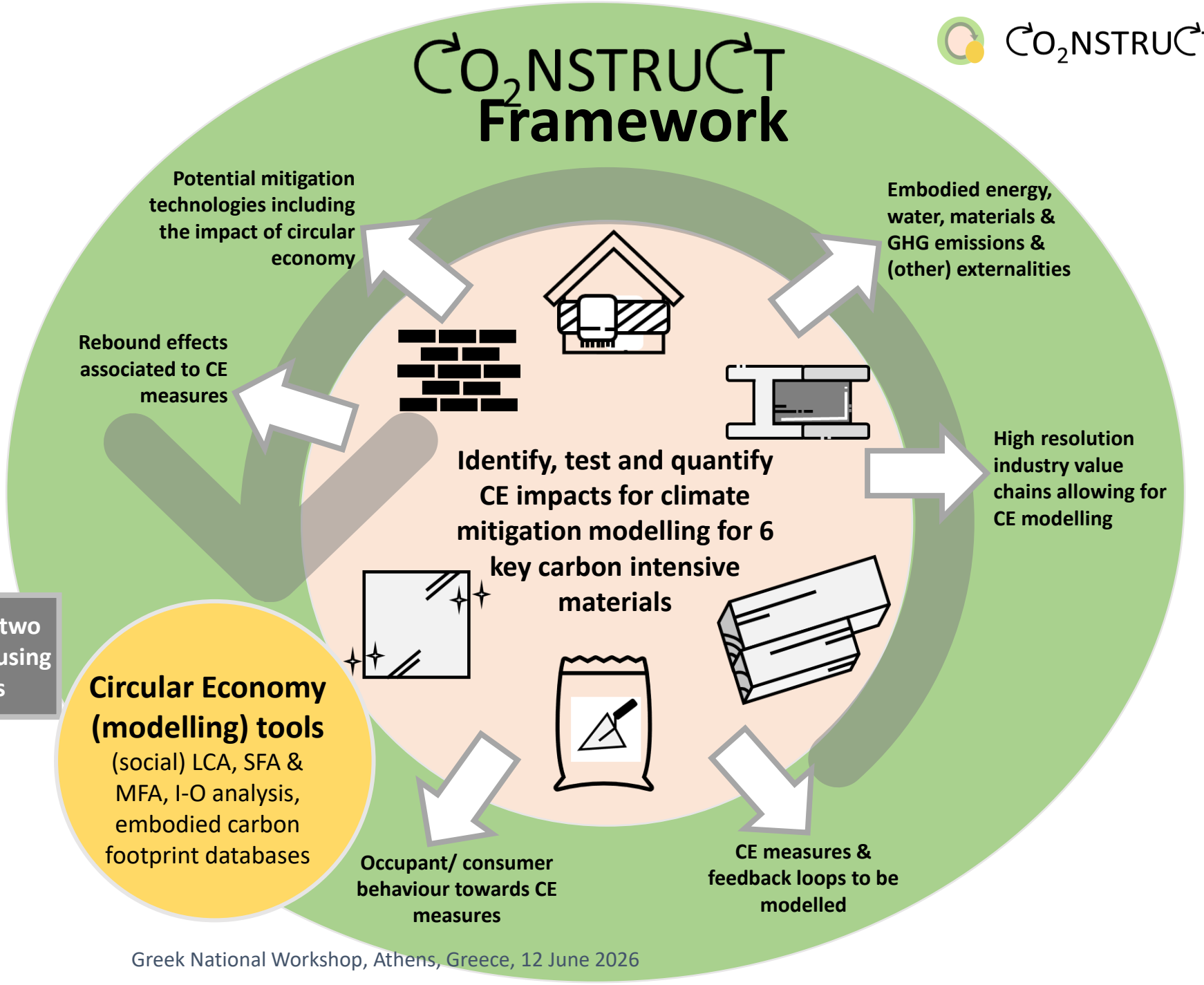
Framework development



Cluster 1: Offshore

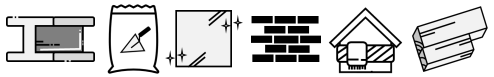
Cluster 2: Buildings

MAPPING CIRCULARITY

Building

Offshore wind

Material Value Chains



MODEL AUGMENTATION

JRC-EU-TIMES

LCA

Social LCA

WaterGAP

FRAMEWORK RESPONSES

Carbon Mitigation

Environment

Social

Water

Economic

Transport

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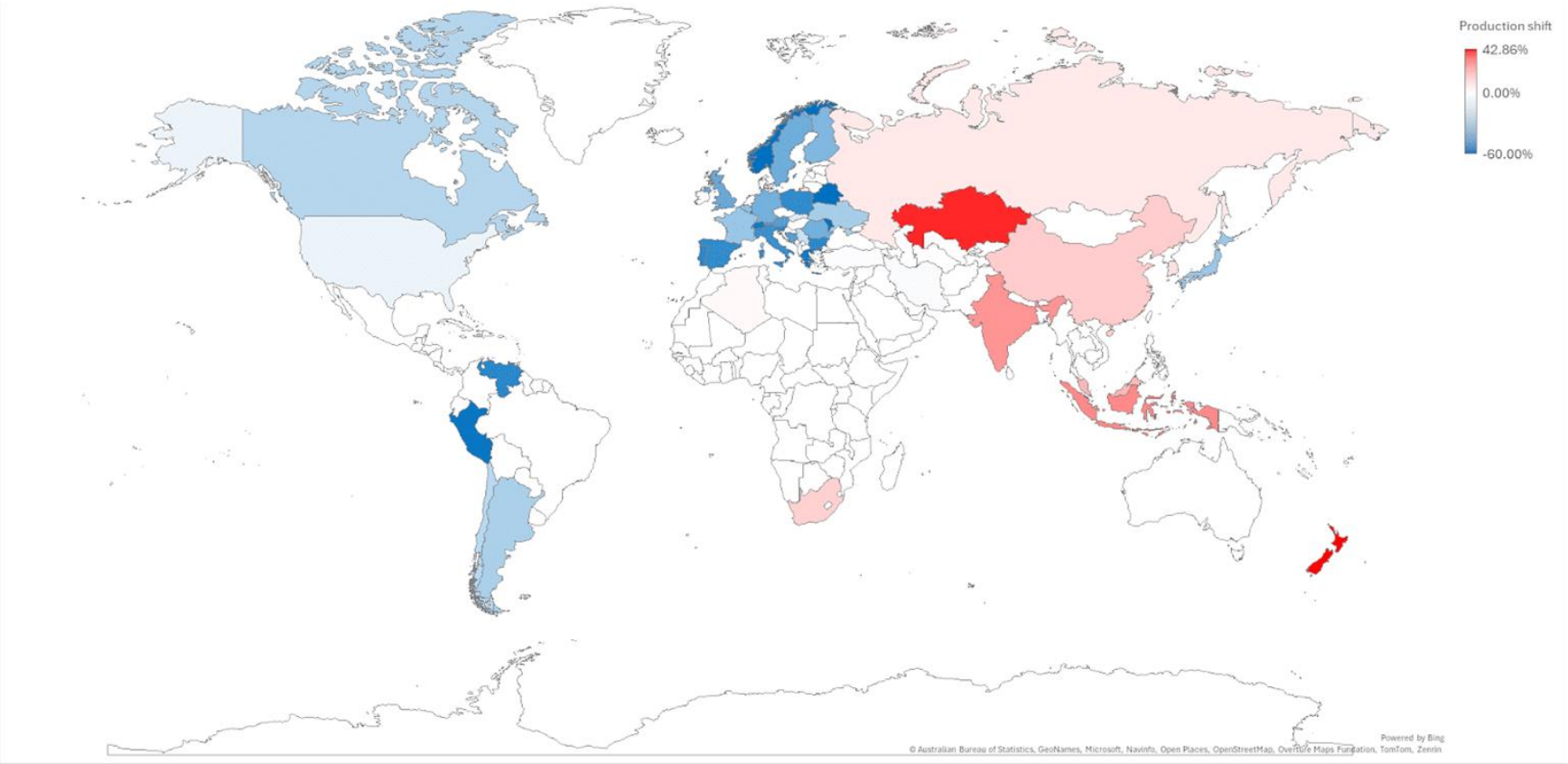
Rebound effects and social impacts

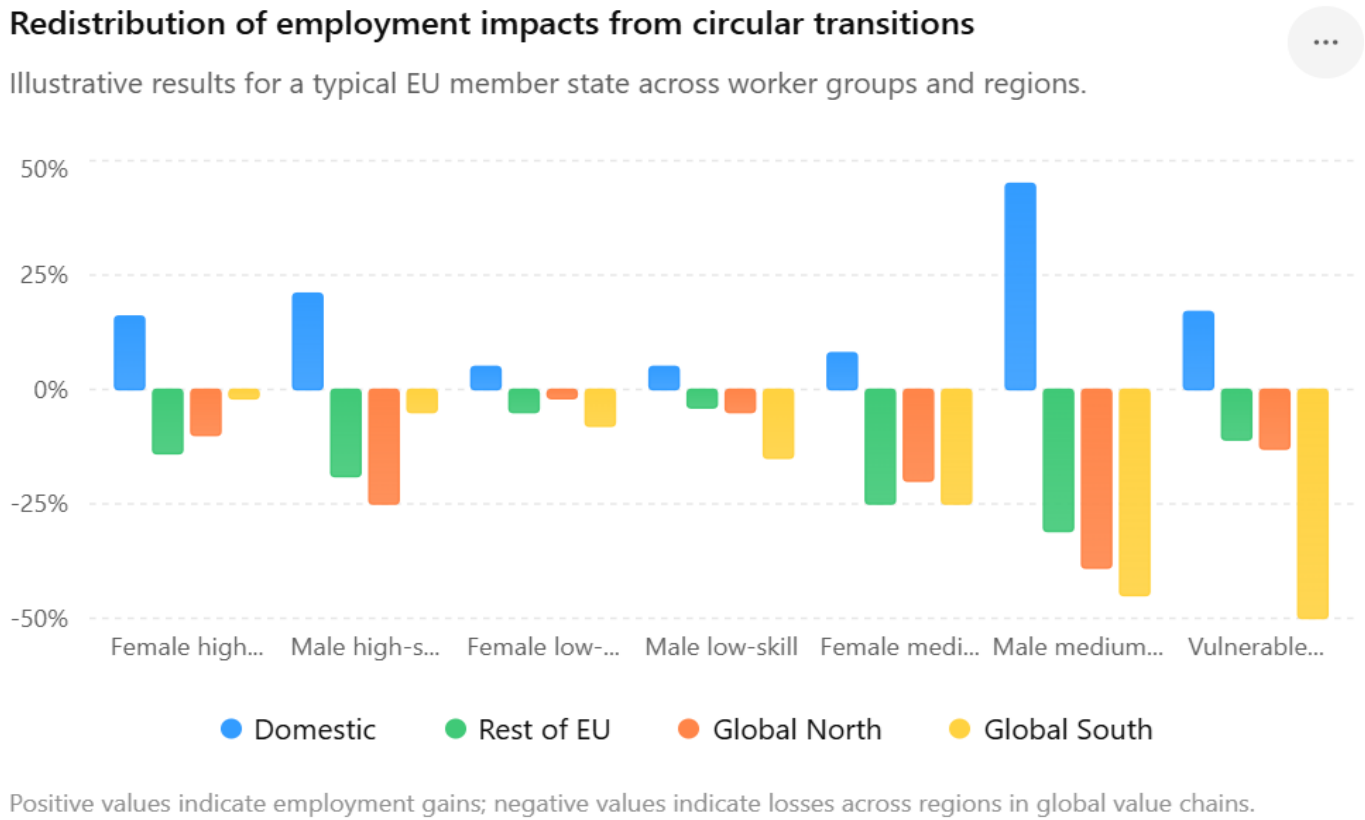
Global production shifts



Even a globally coordinated approach, under the current EU decarbonisation objectives, would return a pathway towards a two-speed steel industry

Rebound effects and social impacts

Employment impacts



- Circular economy strategies may generate uneven employment outcomes across regions and socio-economic groups.
- While some domestic sectors may benefit from increased local activities, impacts can differ according to geography, skill levels and worker characteristics, potentially creating new distributional challenges.

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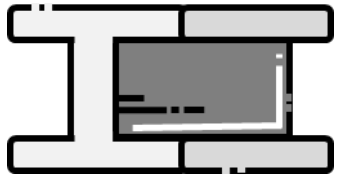
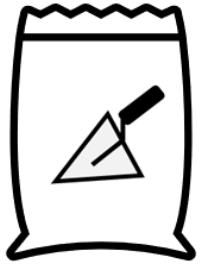
Creation of a dataset for construction materials



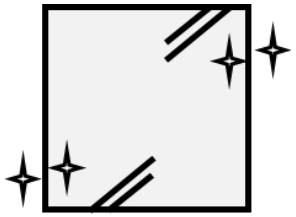
STEEL

- Structural
- Reinforced
- Sheet products



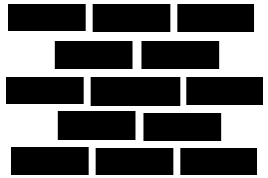
CEMENT

- CEM I
- CEM IIA
- CEM IIB



GLASS

- Flat glass
- Fiber glass

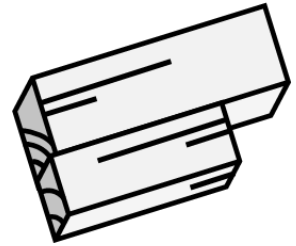


BRICK

- Roofing
- Facade
- Pavers

INSULATION

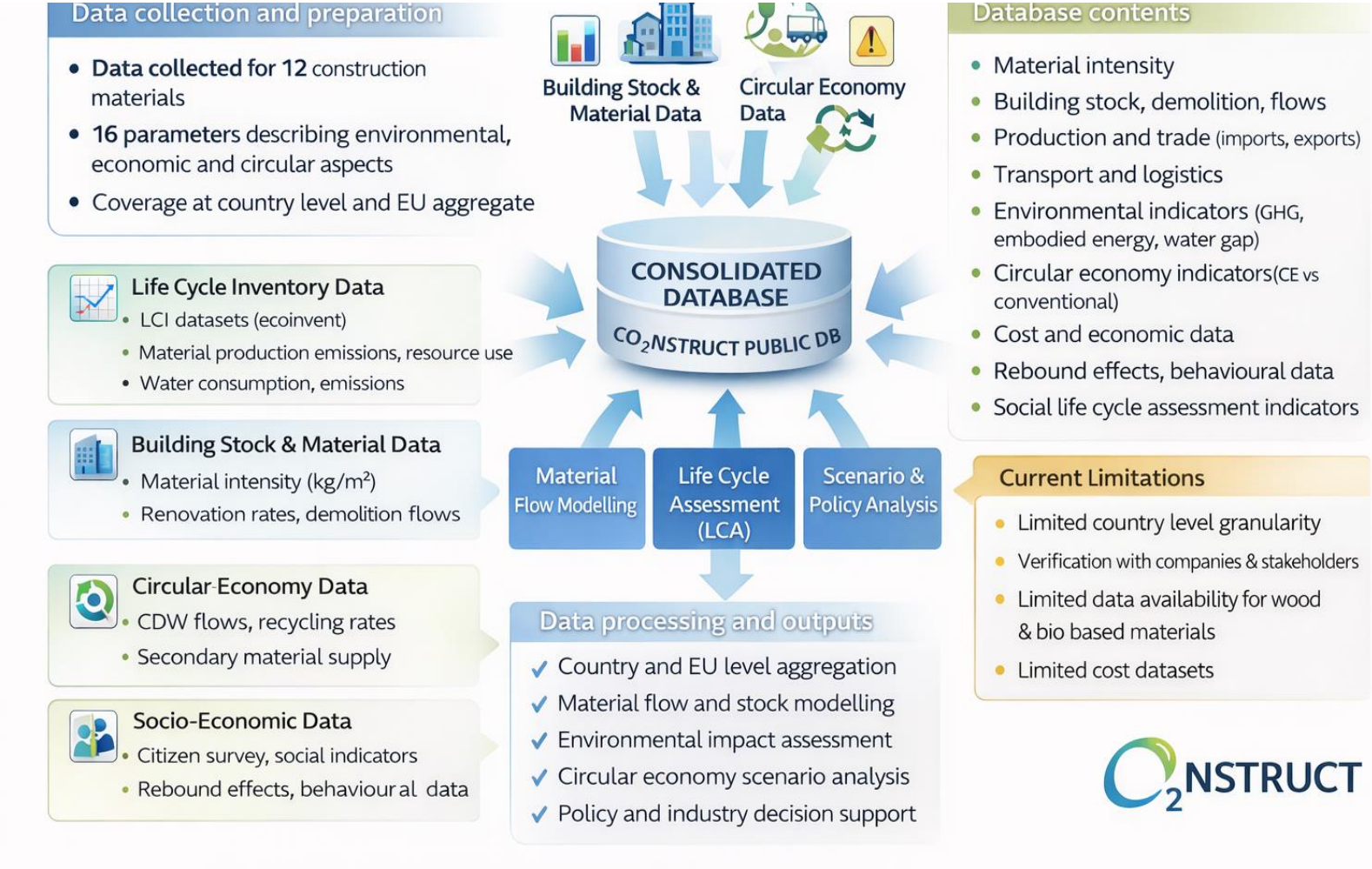
- Glass wool
- Stone wool
- EPS/XPS/PIR/PUR
- Biobased



WOOD

- Sawn wood
- Particle board
- Fibre board

Creation of a dataset for construction materials



CO_2NSTRUCT Data-Webtool

- It is an online data visualization and exploration platform designed to support research, policy analysis, and decision-making in the building and construction sector.
- The tool provides access to harmonized datasets related to building stocks, construction materials, and associated environmental indicators across European countries. stakeholders, and urban planners in evaluating sustainability transitions within the built environment
- Webtool link (beta version):

  http://199.247.21.7/#/

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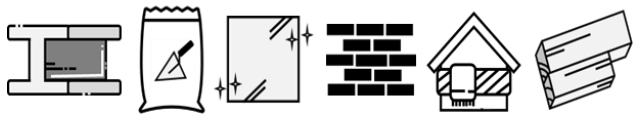
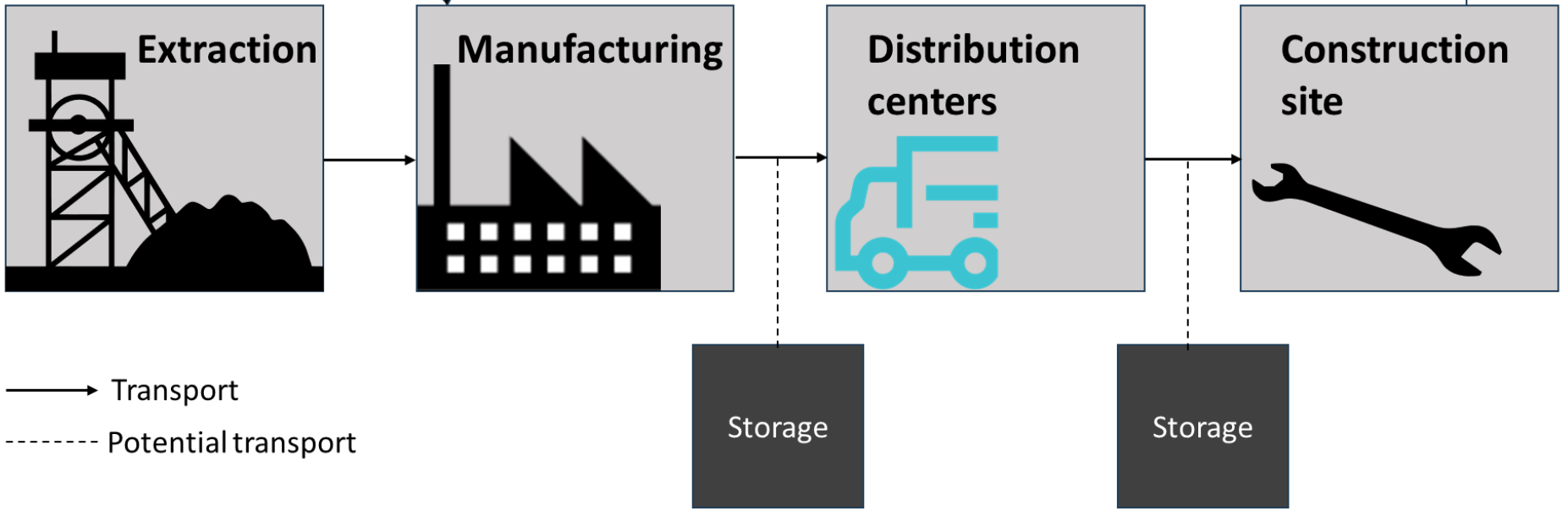
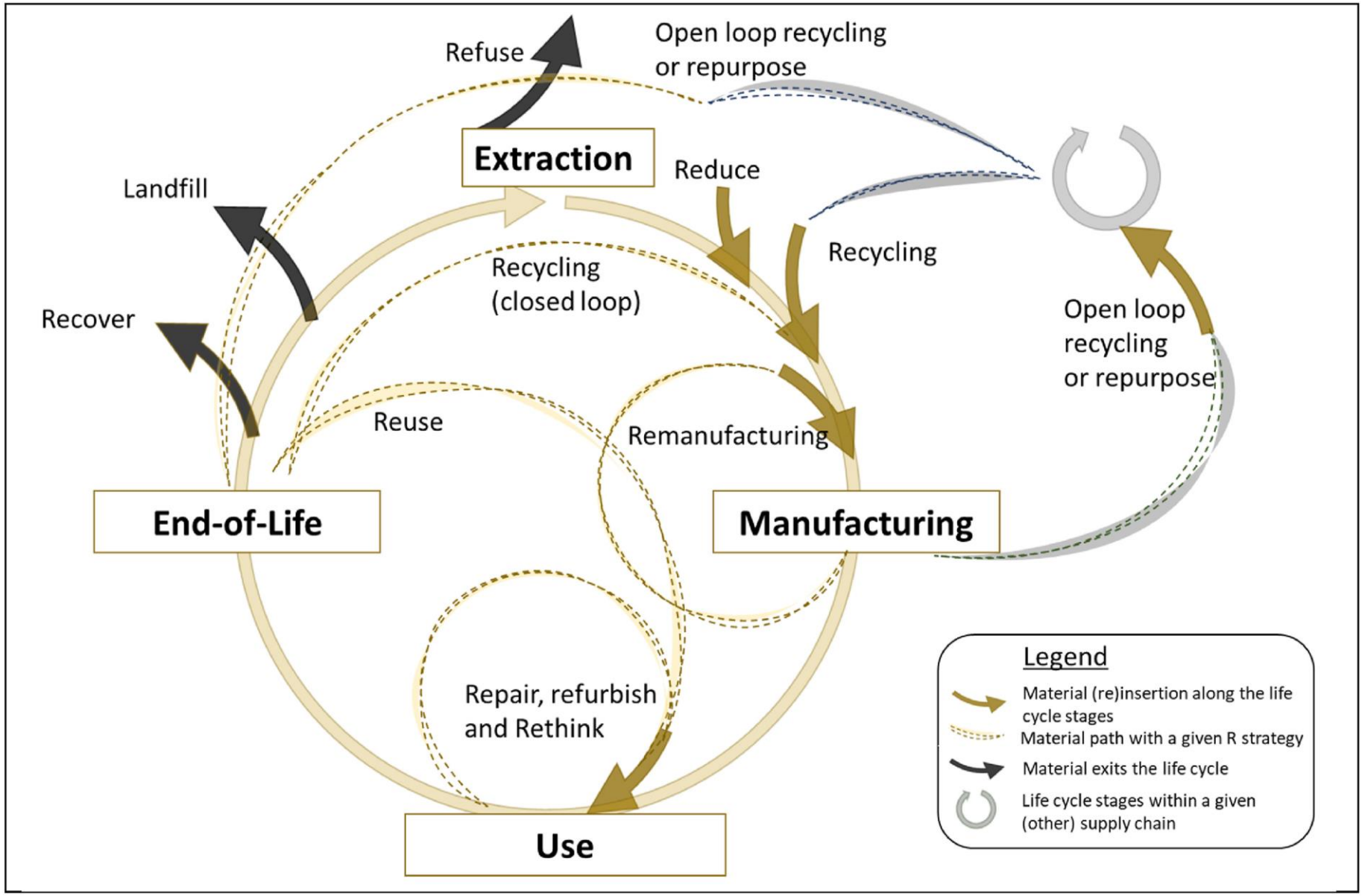
Supply and value chains: mapping CE practices

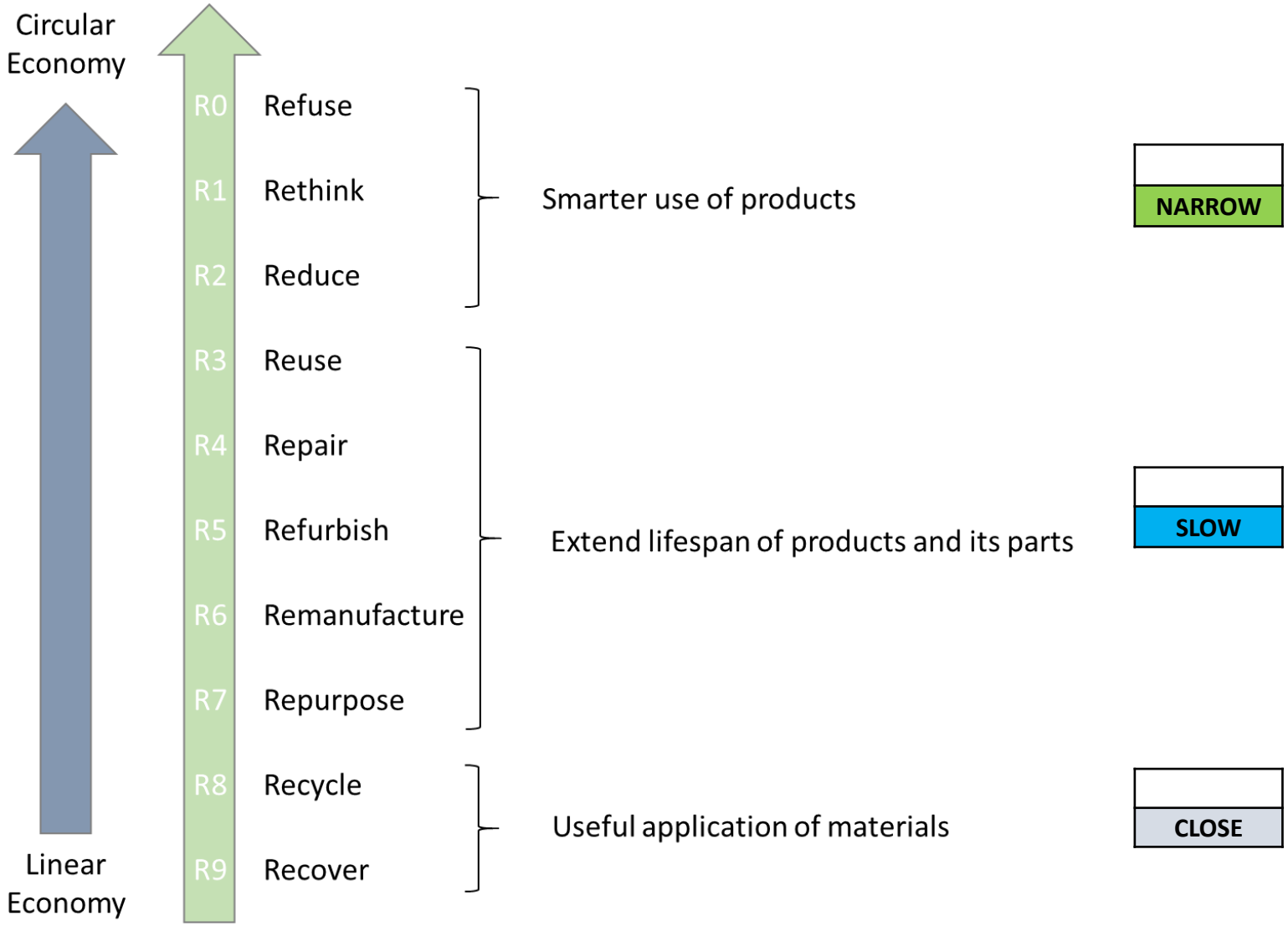




Supply and value chains: mapping CE practices



CE practices in the construction sector



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CE practices

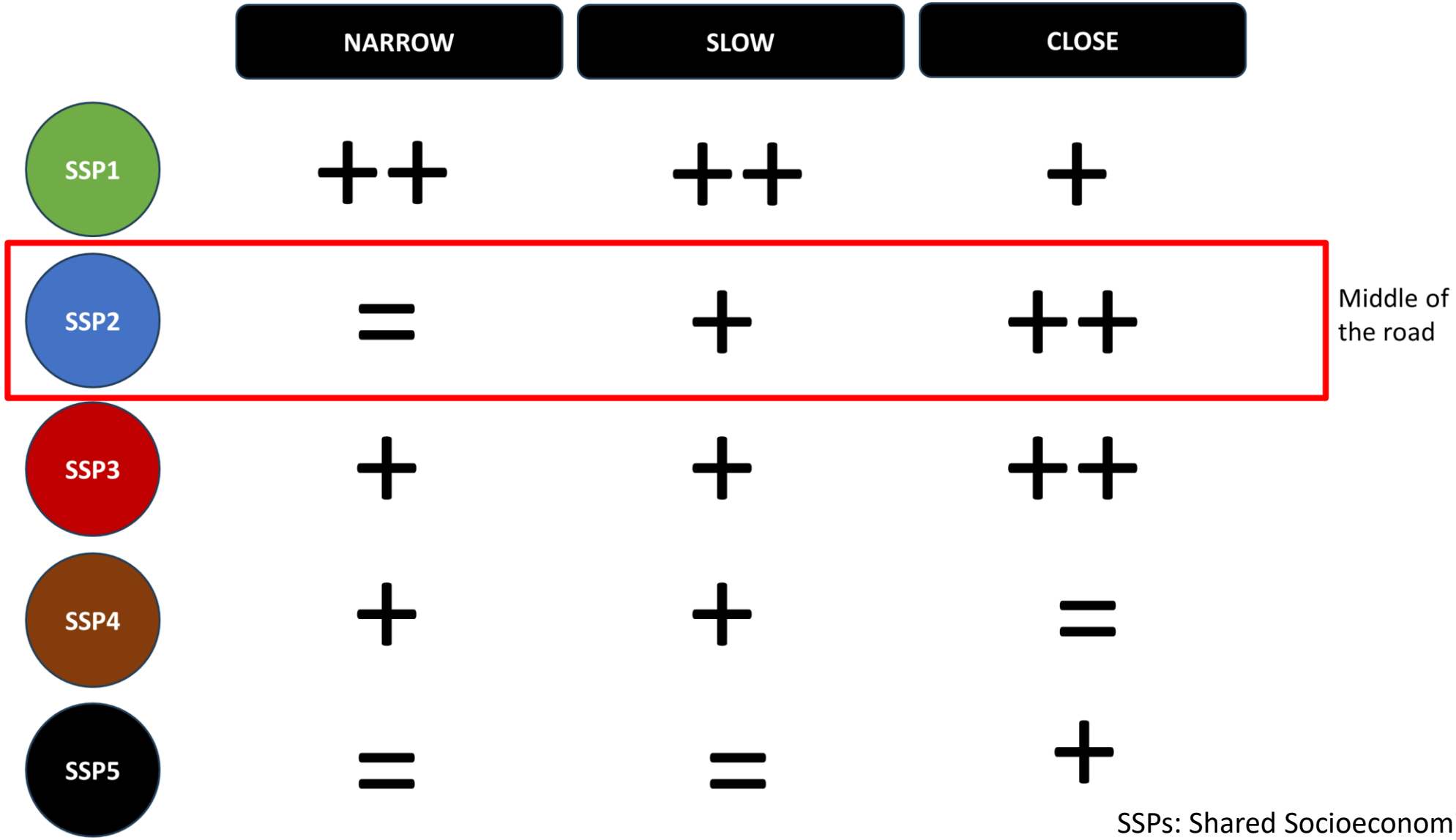
88 → 26

total — quantifiable

€ Out of the 26 practices, 17 are studied based on cost-effectiveness – this means that they will contribute to carbon neutrality if they are sufficiently cheap

Option ID	OptionName	Narrative
CE_M2	Remanufacturing external cullet from glaziers €	CLOSE
CE_M3	Recycling of End-of-Life flat glass from CDW €	CLOSE
CE_M4	Reuse of End-of-Life flat glass from CDW €	SLOW
CE_M6	Reuse of End-of-Life bricks from CDW €	SLOW
CE_M7	Recycling of End-of-Life bricks from CDW €	CLOSE
CE_M9	Recycling of glass wool from construction waste €	CLOSE
CE_M11	Recycling of stone wool from construction waste €	CLOSE
CE_M12	Reuse of End-of-Life steel from CDW €	SLOW
CE_M13	Recycling of End-of-Life steel from CDW €	CLOSE
CE_M14	CEM II: Refusing clinker through substitution with fly ash €	CLOSE
CE_M15	Recycling of End-of-Life concrete from CDW €	CLOSE
CE_M16	CEM III: Refusing clinker through substitution with blast furnace slag €	CLOSE
CE_M17	Recycling of End-of-Life flat glass for glass wool production €	CLOSE
CE_B1	Refuse to use carbon-intensive materials in new buildings construction by using more wood	NARROW
CE_B2	Refuse to build new residential buildings by increased sharing of flats	NARROW
CE_B3	Sharing office spaces leading to less new offices construction	NARROW
CE_B4	Reduce material use in new building construction (residential and non-residential) via lightweight design	NARROW
CE_B5	Adaptative reuse of unoccupied residential buildings	NARROW
CE_B6	Reuse of buildings by transforming unoccupied offices into flats	SLOW
CE_B7	Repairing & renovation of residential buildings to increase lifespan	SLOW
CE_B8	Reduction in the floor area per capita for new flats	NARROW
CE_O1	Reuse of wind offshore power foundations for new wind offshore plants €	SLOW
CE_O2	Recycling End-of-Life elements of offshore power plants €	CLOSE
CE_O3	Reduce material needs in new offshore construction via lightweight design	NARROW
CE_O4	Repowering existing wind offshore power plants (10 MW to 12 MW), reuse of towers & recycling €	SLOW
CE_O5	Repowering offshore power (10 MW to 15 MW) and recycling €	CLOSE

Future levels of adoption of CE options considered in the circular climate modelling framework



SSPs: Shared Socioeconomic Pathways
SSP2: Middle-of-the-road development

Augmented open TIMES energy-climate mitigation model including CE options

Relative to Reference in 2050 for the construction materials value chain

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