Circular Economy in the construc-tion industry

How to overcome existing hurdles? From thinking and talking to doing.

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Context and importance

The construction sector follows the linear “take-make-waste“ model, and thus, construction and demolition waste accounts for more than a third of all waste generated in the EU (European Commission, 2018). Only 1% of building elements are reused in North-West Europe (FCRBE, 2018) and only 14% of the industry’s material resources in the EU come from recycled and recovered sources (ING , 2023). Given this, the transformation towards a circular economy is essential for sustainable construction and requires a holistic approach throughout the entire lifecycle of construction projects. This involves efficient use of building materials and rethinking industry practices from design to end-of-life, with a strong emphasis on circularity.

Various regulations and initiatives, like the EU-taxonomy, Ecodesign for Sustainable Products Regulation and European Green Deal, are pushing for a shift towards a circular built environment. As a major player in the European construction industry, STRABAG is committed to following these EU-wide goals by moving from a linear economy to a circular one. STRABAG’s goal is to minimize the consumption of primary raw materials, by reducing, slowing down and closing material cycles. Therefore, the company wants to handle building materials and components throughout their entire life cycle, and beyond, – from the production of materials and their use in construction to dismantling, reuse and recycling in multiple cycles.

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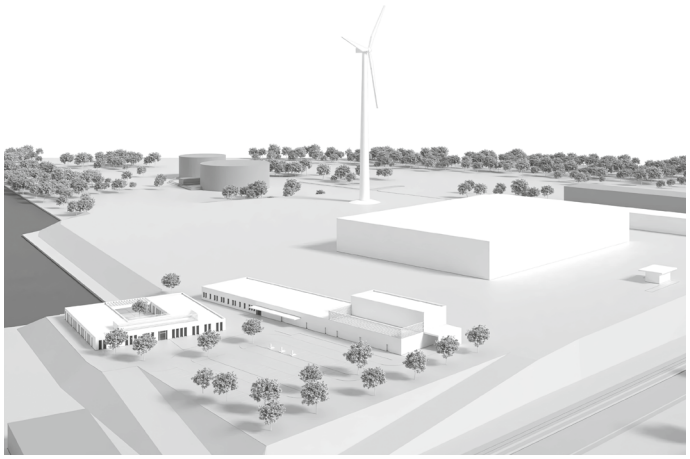
STRABAG labs

During the European Forum Alpbach 2024, STRABAG organized three-day workshops on the theme of “Circular Economy in the Construction Industry.” These workshops brought together representatives from industry, academia and policy to actively identify challenges and explore solutions. Experts from STRABAG shared their insights, focusing on the topics “Blueprint C3 Bremen – Circular Construction & Technology Center”, “Building in Existing Structures” and “Low Carbon & Renewable Raw Materials”.

This policy paper is a key outcome of these labs. It summarizes the main recommendations for policymakers to support the transformation of the construction industry from a linear to a circular economy.

POLICY RECOMMENDATIONS

Rendering of C3 Bremen, Germany



Circular Construction & Technology Center | Blueprint C3 Bremen

“Urban relief” – Produce secondary materials, not exploding landfills

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Rupert Grienberger

1. The concept

The Circular Construction & Technology Center (C3) in Bremen, Germany, serves as STRABAG’s blueprint for Circular Economy centers and lays the foundation for similar initiatives. Located near the city, C3 is equipped with all the necessary technical facilities to extract secondary raw materials from the urban environment, recycle them, and reintegrate them into the material cycle, thereby minimizing waste.

Unlike most conventional recycling centers that downcycle demo-lished materials (such as using them in road base layers), C3 Bremen focuses on recycling high-quality secondary materials. We achieve this by combining existing technologies in innovative ways to return these materials to regional construction projects in their original quality and purpose. A major challenge is that C3 Bremen is located on a contaminated brownfield that has been unused for decades and needs remediation. Through the remediation this challenge is turning into an economical and environmental benefit from which the local community in Bremen benefits by new green jobs at various educational levels. Additionally, STRABAG aims to operate C3 as CO_2-neutral and energy self-sufficient as possible.

Top 3 recommendations to foster the solution:

1. Provision of areas for setting up C3s
2. Incentives from the government for the construction of such centers
3. Tax incentives for secondary raw materials & products

2. Main advantages and gains during the workshops

- **Reduction of Waste:** Recycling Centers, such as the proposed blueprint for the C3 Bremen, significantly reduce waste by recycling high-quality construction materials into secondary products and materials, thereby decreasing the need for extracting new raw materials. This contributes to the conservation of natural resources and lowers environmental degradation associated with material extraction and waste disposal (European Commission, 2020; Ellen MacArthur Foundation, 2015).

- **Reduction of Carbon Emissions:** Reducing energy consumption for the production by using secondary materials instead of primary materials and additionally operating the center as CO_2-neutral and energy self-sufficient aligns with global efforts to combat climate change. By minimizing greenhouse gas emissions related to material production and waste management, a center like this contributes to a smaller carbon footprint in the construction sector (European Environment Agency, 2020).

- **Economic Growth and Job Creation:** The remediation of the contaminated brownfield site not solely revitalizes unused land but also generates green jobs across various educational levels. This stimulates the local economy and provides employment opportunities in sustainable industries (World Economic Forum, 2016; Ghaffar et al., 2020).

- **Innovation in Recycling Technologies:** By integrating existing technologies innovatively, the proposed C3 center sets new standards for high-quality recycling in construction. This fosters technological advancements and improved processes that can be replicated in other regions, promoting wider adoption of circular practices.

- **Enhancement of Circular Economy Practices:** Serving as a blueprint for future centers in the DACH region, C3 promotes a shift from linear to circular models in construction. This encourages sustainable development and inspires stakeholders to adopt similar environmentally friendly practices.

- **Improved Public Perception of Recycled Materials:** Demonstrating the viability and quality of recycled construction materials helps overcome the negative image often associated with recycled products. This can increase market demand and acceptance of secondary materials (Ghaffar et al., 2020).

3. Overview of the challenges

a. Political

i. Lack of available sites for C3 centers and/or long-lasting approval processes
ii. Low demand of secondary construction products in public procurement
iii. Practical and legal hurdles when transforming waste to valuable resources
iv. Slow permitting processes

b. Economical

i. Higher costs of circular model compared to linear model due to high resource requirements of the pilot phase and higher complexity

c. Social

i. Lack of competences and labor
ii. Negative image of recycling materials
iii. Insufficient interdisciplinary cooperation between relevant stakeholders
iv. Noise impact and environmental pollution depending on the location

d. Technical

i. Complexity of high-quality and standard-compliant processing
ii. Lack of sufficient data of the building stock and the embedded materials
iii. No digital ecosystem for logistics, material availability and matching of supply and demand

4. Actionable recommendation for policy makers

To overcome the existing hurdles, we recommend that policy makers implement the following proposals:

a. Policy and Regulation

- **Norms:** Adapt existing norms to support circular models and building materials (e.g. quotes for share of recycled materials; allocate recycling material requirements in building material/product regulations rather than waste regulations), develop new norms with a focus on circularity and speed up the process of permission.

- **Awarding and tendering criteria and public procurement:** Incorporate circularity into awarding and tendering criteria, with the public sector leading by example. Implement minimum secondary material thresholds in public procurement.

- **Regulatory sandbox:** Establish regulatory sandboxes from the operative side to find solutions outside the existing regulatory corset and realize lighthouse projects.

b. Incentives and Support

- **Tax:** Offer tax incentives for secondary raw materials & products and increase taxes on primary raw materials & products.

- **New companies:** Support the founding of new companies and encourage the formation of inter-disciplinary (local) collaborations that bring together diverse expertise and perspectives.

- **Sites:** Provide sites near urban areas for recycling and processing plants.

c. Data, Education, and Technical Solutions

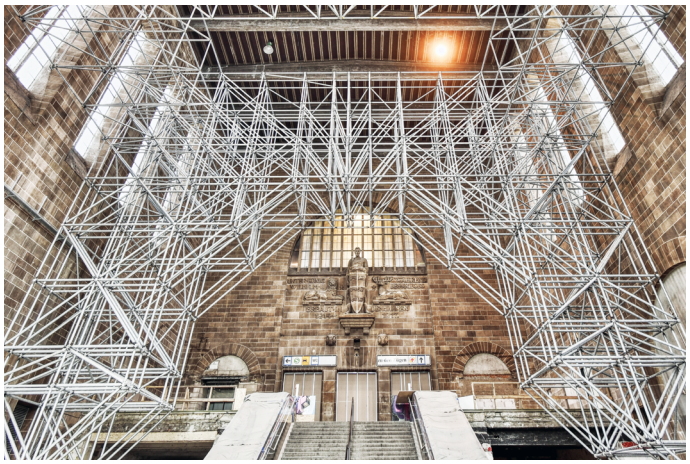
- **Mandatory resources passports for buildings:** Implement mandatory digital resources passports for forward looking planning to optimize material streams. These passports should give information about when which material is available, at what quality and quantity to match it with specific needs of the area.

- **Education:** Implement sustainability and circularity aspects at all levels of public education.

- **Advisory boards:** Implement cross-disciplinary advisory boards for future C3 projects to consider different stakeholder interests.

- **Ecosystem creation:** Foster a collaborative ecosystem uniting education, regulatory bodies, innovation sectors, and industry. This approach will facilitate stakeholder cross-collaboration, enabling efficient implementation of circular economy principles and leveraging shared knowledge to overcome barriers. Implement cross-disciplinary advisory boards for future C3 projects to consider different stakeholder interests.

Bonatz building Stuttgart, Germany © Arnim Kilgus



Building in existing structures

"From grey to golden energy" – Preservation instead of demolition to reduce primary materials consumption and emissions

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1. The concept

The future of our industry lies not only in new construction. STRABAG – BEST AND BEYOND focuses on existing buildings, preserving the cultural identity of neighborhoods and enhancing the value of clients' properties. Through repairs, modernizations, redesigns, and expansions, added value is generated. By managing the modernization of existing buildings in both an economically and ecologically responsible manner, a significant step towards a more sustainable future in construction can be taken.

Top 3 recommendations to foster the solution:

1. Mandatory assessment before making a demolition decision
2. Subsidies and incentive models only for refurbishment
3. Adaption of regulations for new constructions rather than direct application to renovations.

2. Main advantages and gains during the workshops

- **Environmental Sustainability:** Focusing on existing buildings reduces the demand for new raw materials and minimizes waste generation associated with demolition. This approach conserves natural resources and decreases environmental degradation, contributing to a lower ecological footprint in the construction sector.
- **Preservation of Cultural Heritage:** Maintaining and enhancing existing structures helps preserve the cultural and historical identity of neighborhoods. This fosters community continuity and maintains architectural heritage.
- **Economic Efficiency:** Refurbishing existing buildings can be more cost-effective in the long term when considering life cycle costs. It can also lead to increased property values and attract investment in the local area.
- **Reduction of Urban Sprawl:** Utilizing brownfields and existing urban spaces prevents unnecessary expansion into undeveloped areas, mitigating urban sprawl and its associated social and environmental challenges.
- **Job Creation and Skill Development:** The focus on refurbishment and modernization creates employment opportunities and requires specialized skills, promoting workforce development in sustainable construction practices.
- **Innovation in Sustainable Practices:** Implementing modern technologies and sustainable materials in existing structures drives innovation and sets new standards for ecological responsibility in the industry.
- **Improved Regulatory Compliance:** Adapting existing buildings to meet current regulations, including energy efficiency standards, ensures compliance and reduces future regulatory risks. This aspect is crucial in the emerging discussion regarding the „brown discount"—a reduction in property value due to non-compliance with environmental standards.

3. Overview of the challenges

a. Political

i. Lack of clear contractual regulations on ecological aspects
ii. Lack of incentives for preserving buildings
iii. Existing regulatory and building codes for new construction are technically hard to implement for existing buildings and are enormous cost drivers
iv. Demotivating case by case approvals
v. Missing distinction between new construction and reconstruction in building codes as well as standards
vi. No obstacles to demolition regarding CO_2 footprint

b. Economical

i. Often higher construction costs of refurbishment compared to erecting a new building
ii. Cost risk due to unforeseen events during construction – often with unfair risk sharing models between the partners
iii. Focus on building- and operational costs instead of whole life cycle costs
iv. Missing consideration of cost risk due to unforeseen events during construction in existing contractual models

c. Social

i. Brownfields in residential areas are not being used. Instead, new areas are being developed, which leads to urban sprawl and thus to high infrastructure costs for the municipality as well as social challenges
ii. Lack of ecological awareness of the involved decision makers
iii. Vast amounts of vacancies are blocked by the owners
iv. Lack of skilled labor regarding expertise for the refurbishment of the existing building stock

d. Technical

i. Existing buildings are not designed for disassembly, making it difficult to recover pure materials without significant effort
ii. Many existing buildings contain materials now recognized as harmful, and there is a lack of information about these materials
iii. Inventory management of existing buildings involves a high level of manual effort
iv. Lack of data on the existing building stock

4. Actionable recommendation for policy makers

To overcome the existing hurdles, we recommend that policy makers implement the following proposals:

a. Policy and Regulation

- **Exceptions:** Implement exceptions to the existing regulatory followed by adaptions of regulations for new constructions rather than directly applying them to renovations, while ensuring stability in the regulatory framework and providing reliable, long-term decision-making throughout the transformation process of the existing building stock.
- **Greenfield development restrictions:** Permission for greenfield development only if all other existing options are not feasible.
- **Obligation to inspect before demolition:** Require inspections of building components before demolition and create inventories of reuseable components and recyclable materials.
- **Preservation before replacement / permit for demolition:** Implement a mandatory assessment as a prerequisite for the demolition permit based on uniform criteria and methods considering greenhouse gas savings, resources efficiency throughout the lifecycle, etc.
- **CO_2-benchmarks:** Implement maximum CO2-benchmarks per m^2 including standardized calculation (no permission if benchmarks are missed; high penalty if benchmarks are failed after commissioning)

b. Incentives and Support

- **Subsidies:** Implement subsidies and incentive models only for refurbishments
- **Permissions:** Install fast-track permission for reconstruction.
- **Service offer:** Implement easily accessible one stop shops as a service to all aspects of reconstruction.

c. Data, Education, and Technical Solutions

- **Mandatory resources passports for buildings:** Ensure that buildings have a detailed digital documentation of materials used and establish a central public repository for resource passports of buildings that enables data driven decisions.
- **Activate vacancies:** Develop political steering mechanisms to counteract vacancies (e.g. vacancy taxes) and to promote reconstruction rather than the construction of new buildings.
- **Contractual models:** Establish new contractual models for reconstruction for fair risk sharing between contractor and client.
- **Education:** Technical education and training at all educational levels.

Insulation board made from hemp and flax © Rudolf Fröse

Low Carbon & Renewable Raw Materials

"Boost with Green" – Regenerative materials for low-carbon and sustainable buildings

Winona Reddig
Leopold Leonhartsberger
Herwig Sumetzbergerh

1. The concept

STRABAG is actively working on the integration of sustainable building materials made from renewable raw materials, such as hemp, straw and wool, into its building materials production portfolio. The initial focus is on the development of new products in the form of insulating materials and panels.

Top 3 recommendations to foster the solution:

1. Mandate renewable materials in public tenders and policies
2. Provide financial incentives and streamline approvals
3. Create a centralized database and improve education on sustainable materials

2. Main advantages and gains during the workshops

- **Environmental Sustainability:** Sustainable and low-emission building materials protect the environment and people's health by improving indoor air quality and reducing allergies and do not contain harmful substances. Further, renewable raw materials are biodegradable and thus do not create waste.

- **Job creation and Social Aspects:** Creation of attractive jobs with the opportunity to work with non-harmful materials (generation change). They also promote regional value creation and secure local jobs (in agriculture), since waste products from agriculture are used.

- **Economic Efficiency:** Sustainable building materials are currently more expensive because they are only available in small quantities and have not yet been scaled (despite being largely made from residual materials). By scaling and integration into the construction industry, costs will be reduced. Additionally, conventional building materials will become more expensive in the coming years due to the expected CO_2 taxes. The costs can only be maintained through a combination with sustainable building materials.

- **Substitution:** The gradual replacement of conventional building materials is driven by factors such as partial landfill bans (due to EU regulations) and the high emissions generated during the production of conventional materials. Sustainable building materials serve as potential substitution of these conventional materials by offering emission reductions and Cradle-to-Cradle (C2C) solutions.

3. Overview of the challenges

a. Political

i. Lack of clear regulations for buildings with sustainable building materials
ii. Lengthy and costly standardization and certification processes
iii. Dissemination and use of sustainable building materials is particularly challenging for smaller companies and pioneers

b. Economical

i. Low costs of many non-renewable building materials due to hidden environmental costs, such as CO_2 emissions and resource depletion
ii. Lack of scaling opportunities of renewable materials to reduce production costs and make these materials more competitive
iii. Need for shadow costs for conventional materials to increase demand and production of renewable materials at reduced costs

c. Social

i. Lack of sufficient data that e.g. there is a decrease of sick leave of workers working with natural materials
ii. Lack of acceptance and education in the construction industry to establish renewable materials across the board

d. Technical

i. Lack of technical evidence for sustainable building materials, as the authorization procedures are costly
ii. Lack of knowledge about the correct application and installation of these materials

e. Material-specific

i. Clay: Energy-intensive processing; energy-intensive transport
ii. Straw: Not enough reference objects (acceptance); other uses
iii. Reeds: Dependent on location; no broad utilization possible
iv. Wood: Partly energy-intensive transport; tree mortality as a risk
v. Hemp: Land consumption; partial use of binding agents and flame retardants

4. Actionable recommendation for policy makers

To overcome the existing hurdles, we recommend that policy makers implement the following proposals:

a. Policy and Regulation

- **Tenders:** Integrate sustainable and low-emission building materials into tenders
- **Regulatory framework**: Implement clear regulations for buildings with low carbon and renewable raw materials.

b. Incentives and Support

- **Subsidies:** Create financial incentives and subsidies to support the production and use of sustainable and low-emission building materials and to enable scaling
- **Tax:** Implement taxing on CO2 and environmental impact to make low-emission materials more attractive.
- **Approval:** Generate faster approval and authorization procedures for these materials to accelerate their integration into construction projects.

c. Data, Education, and Technical Solutions

- **Database:** Develop a database for sustainable and low-emission building materials and integrate them into existing databases.
- **Knowledge:** Promote and improve training in new building materials.
- **Acceptance:** Advertise targeted information.

The integration of sustainable and low-emission building materials should be driven forward in a targeted manner, but always in the right context and after a comprehensive review of all sustainability aspects. Each construction project, each location and each climate zone must be considered individually to ensure that the materials are actually sustainable and suitable.

Executive Summary and Outlook

The STRABAG labs titled "Circular Economy in the Construction Industry," brought together experts from both industry and academia, fostering fruitful discussions, that lead to concrete policy recommendations. To shift from a linear to a circular economy, we need

- **Policy and Regulation,** e.g standardized circularity assessment and implementation of circularity criteria in public tender and procurement for informed decision making
- **Incentives and Support,** e.g. tax incentives for secondary raw materials and products and increased taxes on primary raw materials and products as well as subsidies to support the production and use of low-emission building materials
- **Data, Education and Technical Solutions,** e.g. mandatory digital resources passports to enable data-driven decisions as well as technical education and training at all educational levels.

We urge policymakers to implement these recommendations to accelerate the transition towards a sustainable, circular economy in the construction industry, ensuring resource efficiency and long-term environmental benefits.

Acknowledgements

We would like to acknowledge the participants for their valuable insights and contributions to this policy paper which was initiated through the Strabag Labs that took place at the European Forum Alpbach in August 2024. Their expertise and collaboration have been instrumental in shaping its content. Special appreciation to the group leaders Kamilla Marosi, Andrea Di Tommaso and Emily Bankert.

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