

CIRCATHON - THE CIRCULAR ECONOMY CHALLENGE: **Build a Sustainable Business Model for a Circular Construction Center in Maribor, Slovenia**

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Circular Economy in Central Europe

Circular construction is reshaping the construction industry by embracing the principles of the **circular economy**, prioritizing **sustainability**, **resource efficiency**, and **waste reduction**. Traditionally, construction has been a **resource- and energy-intensive sector**, often criticized for its **high emissions** and **environmental impact**. As awareness grows regarding the consequences of fossil fuel dependence and pollution, innovative solutions such as **modular construction**, **digital twin technology**, and **Building Information Modeling (BIM)** have become essential for improving efficiency and minimizing waste. However, technological progress alone is not enough—**true transformation requires coordinated efforts in technology development, business creation, subsidy support, legislation, and education**.

The scale of the construction industry's impact is substantial. In **2020**, global solid waste generation reached **2.24 billion tons**, with **construction and demolition waste (CDW)** accounting for **at least 30%** of this total. Urban expansion is expected to drive this number even higher. While CDW recovery rates vary by country—ranging from **7% to 90%**! — an estimated **35% still ends up in landfills**, although **75% of it could be reused or recycled**. The sector's carbon footprint is equally concerning. According to the **International Energy Agency (IEA)**, **buildings were responsible for 26% of global carbon emissions in 2022**, with **9.6 Gt of CO₂** produced from energy use in buildings' heating, cooling, and lighting. This highlights the **urgent need for structure and civil engineering construction change**.

Recognizing these challenges, the **European Union** has pushed toward a circular economy since 2014, introducing policies that encourage **material reuse**, **waste reduction**, and **environmental integration** in construction. This transition requires collaboration across the supply chain and greater transparency to ensure all stakeholders benefit from sustainable practices. Despite hurdles such as regulatory complexity and gaps in education, **momentum is growing**, especially among younger generations who advocate for environmental responsibility. Beyond its ecological advantages, circular construction **fosters innovation**, **creates sustainable jobs**, and **ensures long-term resilience** in the built environment. By redefining traditional practices, the industry can **align economic growth with environmental stewardship**, paving the way for a **more sustainable future**.

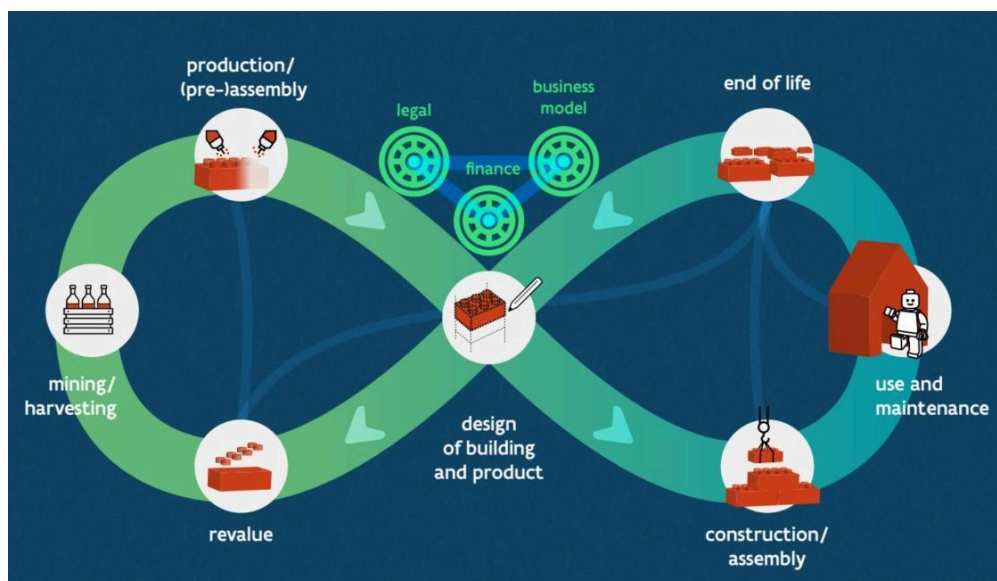


Figure 1: The circular construction model



To reduce the environmental impact of the construction sector, it is crucial to adopt circular and digital practices. **The ReBuilt project promotes these practices through an educational program and the implementation of innovative solutions.** In addition, the project partners are working on a transnational strategy for circular and digital construction, focusing on green labeling, end-of-waste criteria, and sustainable public procurement. Interreg Central Europe funds this initiative and spans 13 regions across nine countries: Slovenia, Italy, Austria, Croatia, Hungary, Slovakia, Poland, the Czech Republic and Germany.

In recent years, some steps have been taken toward a more **sustainable and circular** construction sector in Central Europe. One notable example is many Italian architects' adoption of the **Building Design for Disassembly (DfD)** concept. This approach involves designing buildings so that **materials can be easily separated and reused** at the end of their life cycle, thereby supporting the **circular flow of materials** and minimizing **landfill disposal**. Another example of good circular construction practice is the Austrian start-up **Hempstatic**, which focuses on developing **eco-friendly construction materials** like **hempcrete**. Based on the initial assessment of Central European construction, almost all countries have examples of entities producing hempcrete and other nature-based building materials as a **sustainable alternative** to traditional building materials. Other most often occurring example is using recycled aggregate (especially waste concrete) in new concrete products. Digital services are slowly occurring especially with BIM designing and construction monitoring, although in most country BIM shall become obligatory for some public buildings.

The **ReBuilt** project targets several gaps in Central Europe's construction sector, such as:

- **Reluctance to adopt secondary raw material (SRM)-based products**
- **Lack of a functional SRM-based construction market**
- **Insufficient data on the quality and traceability of SRM-based products (from waste to final product)**
- **Absence of administrative and legal frameworks for product reuse**
- **Lack of established best practices for circular economy business models**
- **Limited transnational training programs for circular economy professionals**
- **Spatial inconsistencies in material sourcing**
- **Contamination issues and quality concerns with recyclable materials**
- **Tenders require materials of too high a quality, making recycling (e.g., recycled concrete) unfeasible**
- **Complex logistics, such as challenges in SRM separation and insufficient collection systems**
- **Resistance to using circular and bio-based materials due to a lack of experience**
- **Public mistrust regarding the quality, price, and convenience of recycled materials**

The project aims to **ReBuilt the industry's mindset and raise awareness about the benefits of circular and digital construction.** This will be achieved through developing an educational program, improving and testing new technical and digital solutions, and enhancing demand-side measures, including green labeling, end-of-waste criteria, and green public procurement. Moreover, ReBuilt will create the first Central European circular and digital construction strategy, which will be implemented through a network of regional circular and digital construction hubs.

For more information, please visit:

ReBuilt: <https://www.interreg-central.eu/projects/rebuilt>



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About Slovenian National Building and Civil Engineering Institute (ZAG)

ZAG is Slovenia's leading building and civil engineering institute. It is recognized for its expertise, advanced equipment, and multidisciplinary approach, which includes life cycle analyses of construction materials. ZAG collaborates internationally with the European Union (EU), the United States, and other countries, having participated in over 50 EU-funded projects in the past decade.

ZAG's research and testing are organized into departments focusing on materials, building physics, structures, geotechnics, and fire engineering. It also provides Certification and Technical Assessment services under the Construction Products Regulation (CPR) and Environmental Product Labelling.

ZAG's main activities include:

- Research in building materials and structures
- Development of testing methods
- Certification and conformity assessment
- Training of technical staff
- Contribution to technical codes and standards

Many of our ongoing national and international projects are closely connected to the principles of the circular economy. ZAG aims to raise awareness and explore new ways to reduce the use of raw materials in construction while emphasizing the importance of reuse and recycling.

ZAG's efforts go beyond simply demonstrating that these practices are possible. ZAG is committed to finding ways to track and ultimately reduce carbon emissions. The goal isn't just to identify sustainable material solutions and establish best practices that raise awareness and inspire others to strive for the same objectives. Ultimately, ZAG strives to uncover key solutions that align eco-friendly practices with economic needs and legislation.

For more information, please visit:

ZAG: <https://www.zag.si/en>



The Challenge: How to Build a Sustainable Business Model for a Circular Construction Center in Maribor, Slovenia?

Overview of the Current Situation and the Circumstances that Led to the Challenge

NIGRAD is a public utility company dedicated to sustainable business practices and an environmentally responsible policy. In alignment with the global shift towards circular construction and green procurement, NIGRAD demonstrates its commitment to sustainable development and environmental responsibility through various initiatives, both proprietary and European.

In recent years, NIGRAD has established a new facility in Dogošë, Slovenia, focusing on **waste recycling and material reuse**. As part of these efforts, they have constructed a building using SRM (Secondary Raw Materials are recycled or reclaimed materials that can replace or supplement virgin raw materials in construction) and created multiple test fields to explore the utilization of recovered materials in buildings and infrastructure. The Dogošë Circular Construction Center serves as a prominent example of best practices and is frequently visited in the context of several international projects.

Using SRM can offer several advantages, including enhanced supply security, reduced material and energy consumption, lower environmental impacts, and cost savings. However, the widespread use of SRM faces challenges, such as the lack of EU-wide quality standards for specific materials (e.g., plastics), difficulties trading SRM across EU borders, and harmful chemicals in recycled materials. Despite these challenges, SRMs are vital for a circular economy because they can re-enter the production value chain, reducing dependency on primary resources. The European Union defines SRM as waste that can be recycled, reintegrated, or reused in the economy.



Figure 2: The circular construction center in Maribor, SRM management center Dogošë



Basic Information About the Challenge

The Reasons that Brought Us to the Challenge

The **Circular Economy** is one of Slovenia's strategic development priorities and closely aligns with the **Sustainable Development Goals (SDGs)**. It is embedded in key national documents such as **A Vision for Slovenia in 2050**, the **Slovenian Development Strategy 2030**, and **Slovenia's Smart Specialisation Strategy**. These strategies share a common objective: **improving the quality of life for all citizens**. Slovenia acknowledges that transitioning from a linear to a **circular economy** is not merely an option but a **critical step towards sustainable growth**. One example of this transition is the **Circular Construction Center in Dogoše, Slovenia**.

However, Dogoše is not the only example of good practice. The **European Centre for Circular Construction and Transformation** demonstrates the EU's commitment to advancing circularity globally, supporting the transition toward **sustainable, climate-neutral societies**.

The **Circular Construction Center in Dogoše** is still not recognized for its work within Slovenia. We aim to **find solutions to increase its appeal** to the public, businesses, and institutions. We strive to **broaden our knowledge** in this field and **spread awareness beyond the region**. We extend our reach across Slovenia's borders to further **promote the circular economy in the construction field**.



Why is it Important to Solve the Challenge?

Circular construction is crucial for **sustainable development** and profoundly impacts the **quality of life**. By addressing this challenge, we aim to highlight the **significance of circular construction**, now and in the future. We can **enhance the quality of life through closed loops** while **preserving the Earth's resources**.

Our goal is not only to **raise awareness** about the importance of the **5R's concept** (**Rethink, Refuse, Reduce, Reuse, and Recycle**), **secondary raw materials (SRM)**, and their use in the construction industry within the **student community** but also to **extend this awareness** on a **regional** or maybe even on a **global scale**.

Obstacles or Secondary Challenges That We Come Across While Searching for the Solution

Obstacles or secondary challenges that we come across while searching for solutions for developing effective business models for the circular economy include:

- **Legislation:** Existing regulations may not fully support or incentivize circular construction practices, and navigating complex legal frameworks can delay or limit implementation.
- **Illegal practices:** Unregulated or illicit disposal and waste management practices can undermine efforts to promote sustainability and create a fair playing field for circular construction solutions.
- **Poor quality of potential solutions:** Many proposed circular construction solutions may lack the necessary quality, reliability, or scalability, making them unsuitable for widespread adoption.
- **Heterogeneity of materials and low quantities:** The wide variety of materials involved in construction and waste management makes sorting, recycling, and repurposing more complex, increasing costs and limiting the efficiency of recycling processes.
- **Public funding dependencies:** Projects reliant on public funding may face limitations in budget, timelines, and political influence, which can restrict innovation and long-term sustainability.
- **Invisibility in the public eye:** Lack of visibility and awareness in the public sphere can lead to low support or demand for circular construction initiatives, making it harder for new business models to gain traction.
- **Secrecy of privately funded projects:** Privately funded projects often operate in secrecy, preventing the sharing of best practices or collaboration, which is essential for fostering innovation and scaling circular construction solutions.
- **Resistance to change:** Stakeholders within the construction industry and waste management sectors may hesitate to shift from traditional linear practices to circular models due to perceived risks or higher initial costs.
- **Economic viability:** Financial uncertainty and the potential for higher upfront investments in circular solutions can deter businesses from adopting innovative models, especially when immediate returns are uncertain.
- **Supply chain complexity:** Developing an efficient, transparent, and sustainable circular supply chain can be complex and time-consuming, especially when dealing with diverse stakeholders and fragmented industries.
- **Lack of consumer demand:** Without clear incentives or demand for sustainably sourced or recycled materials, businesses may struggle to justify the costs of transitioning to circular economy models.



Example of a Good Practice: Dogošë Circular Construction Center

The **Dogošë Circular Construction Center** is a prime example of circular construction practices, demonstrating a model for **circular resource utilization** that has **reduced negative environmental impacts by up to 20%**. This facility was developed as part of the **H2020 CINDERELA** project, which took place in **2022** and was primarily carried out by **Nigrad** and **ZAG**. The project's main objective was to **raise awareness** and demonstrate that **construction and demolition waste (CDW)**, alongside **industrial, municipal, and other waste streams**, can be transformed into valuable **secondary raw materials (SRM)** for construction. This approach holds immense potential for **reducing the demand for virgin materials**, **minimizing waste production**, and **maximizing the value of recovered materials**. Other projects have been supporting the development of the Dogošë Circular Construction Center: **LIFE IP RESTART** (e.g., creation of a certification scheme for reclaimed soil), **Interreg Circular Economy City Water Circle** (e.g., establishment of infrastructure for reclaiming water to be used at the production facility) and others.

Why the Dogošë Circular Construction Center was established?

In **2016**, **Slovenia** collected **5.498 million tonnes of waste**, with **construction waste** being the most significant contributor at **2.165 million tonnes (39%)**. This was followed by **municipal waste (0.982 million tonnes, or 18%)** and **industrial waste from thermal processes (0.905 million tonnes, or 17%)**. The need for circular economy practices became clear given that **construction is the largest waste generator**, and **treated waste can be utilized in large quantities for construction purposes**—particularly for **terrestrial works**. The **CINDERELA** project focused on addressing the anticipated **growth in urban construction**, with nearly **86% of the global population expected to live in urban centers by 2050** as **construction consumes a significant amount of raw materials**—the project aimed to promote more **sustainable and economically efficient practices** in the sector.

The origin of the Dogošë Circular Construction Center

The project began in 2018 by rehabilitating a degraded area, a former mining site, which was completed in 2020. As part of the CINDERELA project, several initiatives were carried out, including the construction of a noise barrier made from recycled materials, a road on the site created from four different sections using recycled materials (such as reclaimed asphalt, recycled mixed construction waste, and fly ash as alternative binder), and a demonstration building made of recycled concrete blocks produced on-site using a mobile mixing plant. These efforts resulted in the creating of a demonstration site, where waste processing and other development activities continue today.



Figure 3: Construction site after revitalisation of degraded area and before construction of pilot



The Goal of the Project of Building This Model

The project's primary objective was to establish a regional center for the long-term treatment of non-hazardous construction waste and other waste, including certain types of biological fractions of municipal waste, waste from trimming, and other waste materials classified under different waste codes.

Materials Used in Construction

The **Dogoše model** promotes using **SRMs from recycled construction waste, industrial waste, mining by-products, and some municipal waste**. Recycled aggregates from mixed construction and demolition waste were used primarily for **rehabilitating and restoring the site**. Additionally, recycled materials were incorporated into various site developments, such as the road **embankment** and the **demonstration facility**. The **on-site concrete blocks** were made from multiple materials, including recycled concrete. Today, almost all non-hazardous construction and demolition waste from NIGRAD business activities (e.g., road construction and maintenance in the city of Maribor) and road construction and maintenance of other companies are **processed on-site**.

Facility Layout

The facility is a single-story building designed to accommodate various functions. It includes a spacious room for presentations and workshops, a laboratory, two office rooms, toilet facilities, and a stairway leading to the roof. The floor and walls are constructed using green concrete, incorporating recycled aggregates.

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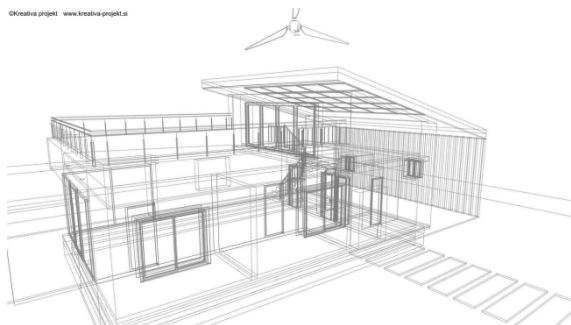


Figure 5: Schematic representation of the built center

Current and future use of the Dogoše Circular Construction Center

Today, the Dogoše Circular Construction Center is fulfilling its intended purpose and is progressing toward its long-term goal. By 2025, it is expected to obtain all necessary environmental permits for the permanent operation of the site, officially transforming it into a regional processing center legally capable of handling all non-hazardous construction waste. Within the next 2-3 years, the site is anticipated to secure permits to process biological waste and certain other materials classified under code 20.



Who Cares About the Challenge?

Circular construction is a key driver of sustainable development and will continue to play an increasingly vital role. Circular construction centers are designed to support this transition by providing innovative waste management and recycling solutions. While these centers can take many forms, they share the same overarching goal: to create a world without waste.

Several important sectors are engaged in the circular construction in Maribor, Slovenia, including NIGRAD and other public utility companies within the holding group, waste management operators, local decision-makers, NGOs, and the public, including the media. All these stakeholders contribute to advancing the principles of the circular economy, working together to create a more sustainable and resource-efficient future for the city.

Who is the Target Group?

The target group consists of:

- **Residents** of Maribor and the surrounding area
- **Businesses** in and around Maribor

What do We Want to Achieve With the Final Solution to the Challenge?

We aim to generate innovative **business-oriented solutions** that will support the long-term operation and development of the **Dogoše Circular Construction Center**. Instead of focusing on communication or promotional approaches, the emphasis should be on practical **business opportunities and revenue-generating models** for the Center.

We seek **creative ideas and proposals** to strengthen the Center's position as a sustainable circular hub. These may include new **services, business models, or partnerships**, whether targeting **B2B or B2C sectors**. All proposed solutions should aim to contribute to the financial sustainability of the Center and promote the use of secondary raw materials (SRM) in construction.

An important goal is to explore how the Center can generate new income based on its existing or new infrastructure (within budget constraints) and resources while maintaining compliance with EU legislation and circular economy principles.

What is Expected from the Participants of this Circathon?

Participants are expected to develop **concrete business solutions** for the **Dogoše Circular Construction Center**, with a focus on creating **new business opportunities and models** that are feasible and impactful.

More specifically, your solution should include:

- **Innovative ideas or business models** that leverage the Center's capabilities, expand its services (for B2C, B2B, or both), and are commercially attractive for the region where the Center operates.



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- A clear **revenue model**: How will the proposed solution bring new income to the Center?
- A realistic and actionable **implementation plan** for your solution (action plan).
- Consideration of the **maximum available budget of €200,000** for implementation.
- Compliance with all **relevant EU legislation** and sustainability goals.

Your proposal should move beyond theoretical concepts and provide a **practical, business-driven roadmap** for the Center's further development and growth in the circular economy.

Evaluation Criteria

The evaluation of solutions will be conducted based on **three criteria**:

- **Innovativeness of the solution** (40% of the final score)
- **Applicability of the solution** (40% of the final score)
- **Presentation of the solution** (20% of the final score)

Each category will be scored on a scale from 1 to 10. The final score will be calculated by summing the scores of all three criteria, considering their respective weight in the final assessment.

The team with the highest total score will receive the grand prize.



Literature

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