Green Growth

# Circular economy in practice:

## Case studies & exercises for trainers in construction

Green Growth

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**Erasmus+ Programme of the European Union, call 2020.**

Key Action 2 of the Cooperation for innovation and the exchange of good practices within the Strategic Partnerships for Vocational Educational and Training.

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SUSTAINUM INSTITUT

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# Preliminary remarks

## 1) The Green Growth project

Green Growth is a European project belonging to the Key action 2 of the Erasmus+ programme: "Strategic Partnerships for vocational education and training". It started in 2021, and it aims to reduce the impact of the construction sector on the environment through the development of innovative Vocational Educational Training (VET) training tools.

The project is founded by a strong international partnership of organizations working in fields ranging from technological development to VET and sectoral organizations from Germany, Slovenia, Italy, Belgium, and Spain.

During its 30-month implementation period Green Growth is pursuing the following objectives:

↗ **Raising awareness** about building with circular principles to trainers in construction, workers, SME's and VET training centres.

↗ **Strengthening the capacity of VET centres** to adopt a Circular Economy holistic approach and implement it in their workshop delivery.

↗ **Responding to current emerging skill needs** of the construction sector concerning the reuse and recycling of materials and waste management, affecting blue collar workers and SME specialized in renovation works.

↗ **Empowering cooperation between educational institutions and business**, as a result of tailoring and sharing training solutions between both worlds.

↗ **Improving opportunities for integration into the "green" labour market** and creating career opportunities for blue collar construction workers and SME.

## 2) What is Circular Economy?

A circular economy (also referred to as "circularity") is basically an economic system aimed at eliminating waste and the continual use of resources. Circular systems employ reuse, sharing, repair, refurbishment, remanufacturing and recycling to create a closed-loop system, minimising the use of resource inputs and the creation of waste, pollution and carbon emissions. The circular economy aims to keep products, equipment and infrastructure in use for longer, thus improving the productivity of these resources. Waste materials and energy should become input for other processes: either a component or recovered resource for another industrial process or as regenerative resources for nature (e.g. compost). This regenerative approach is in contrast to the traditional linear economy, which has a "take, make, dispose" model of production.


## Sustainability aspects

Intuitively, the circular economy would appear to be more sustainable than the current linear economic system. Reducing the resources used, and the waste and leakage created, conserves resources and helps to reduce environmental pollution. However, it is argued by some that these assumptions are simplistic; that they disregard the complexity of existing systems and their potential trade-offs. For example, the social dimension of sustainability seems to be only marginally addressed in many publications on the circular economy. There are cases that might require different or additional strategies, like purchasing new, more energy-efficient equipment. In addition, it is important to underline the innovation aspect in the heart of sustained development based on circular economy components.

## Scope

The circular economy can cover a broad scope. It is focused on different areas such as e.g. industrial applications with both product-oriented, natural resources and services, practice and policies to better understand the limitations that the CE currently faces, strategic management for details of the circular economy and different outcomes such as potential re-use applications and waste management.

The circular economy includes products, infrastructure, equipment, and services, and applies to every industry sector. It includes 'technical' resources (metals, minerals, fossil resources) and 'biological' resources (food, fibres, timber, etc.). Most schools of thought advocate a shift from fossil fuels to the use of renewable energy and emphasize the role of diversity as a characteristic of resilient and sustainable systems. The circular economy includes discussion of the role of money and finance as part of the wider debate, and some have called for a revamp of economic performance measurement tools. Recycling initiatives are often described as a circular economy and are likely to be the most widespread models.

## 3) Circular economy in construction

The construction sector is one of the world's largest waste generators. The circular economy appears as a helpful solution to diminish the environmental impact of the industry. Construction is very important to the economy of the European Union and its state members. It provides 18 million direct jobs and contributes to about 9 % of the EU's GDP. The main causes of the construction's environmental impact are found in the consumption of non-renewable resources and the generation of contaminant residues, both of which are increasing at an accelerating pace.

Decision making about the circular economy can be performed on the operational (connected with particular parts of the production process), tactical (connected with whole processes) and strategic (connected with the whole organization) levels. It may concern both construction companies as well as construction projects (where a construction company is one of the stakeholders).

End-of-life buildings can be deconstructed, hereby creating new construction elements that can be used for creating new buildings and freeing up space for new development. Modular construction systems can be useful to create new buildings in the future and have the advantage of allowing easier deconstruction and reuse of the components afterwards (end-of-life buildings).

Another example that fits the idea of circular economy in the construction sector on the operational level, there can be pointed walnut husks, that belong to hard, light and natural abrasives used for example in cleaning brick surfaces. Abrasive grains are produced from crushed, cleaned and selected walnut shells. They are classified as reusable abrasives. A first attempt to measure the success of circular economy implementation was done in a construction company. The circular economy can contribute to creating new posts and economic growth.

# Case studies

*Source: www.woodscraper.de*

# Case study 1:
# "WOODSCRAPER"

**Construction of a mainly wooden building, following the principles of circular economy, Germany.**

Best practice ID

**Operating company / organisation:**

Partner & Partner Architects, Berlin, Germany (Cradle-to-Cradle certified), together with a team of engineering companies and an university of applied science (Hochschule Ostwestfalen-Lippe)

**Year:** 2022 (construction start)

**Country:** Germany, Wolfsburg-Hellwinkel

**Scope:** Local, can be reproduced internationally.

## Good practice related to circular economy:

Woodscraper is a residential building, following the newest standards of the circular economy. It is part of a new housing area and aims mainly at young families.

It is a resource-positive high-rise building made primarily from renewable raw materials, with wood and straw at the centre of the development. Resource positive means that the of the timber high-rise building stores more $CO^2$ than is emitted for its construction.

↗ Most parts of the ceilings and all the outer walls are made with massive wooden constructions.

↗ The inner walls are mainly dry straw sheets.

↗ Composite materials are almost completely avoided. Also, walls have no plaster or wallpapers.

↗ The design includes several options to change the layout of the flats, so that future residents may choose different living environments.

↗ The installation techniques (pipes, cables etc.) allow an easy separation of the components.

The Woodscraper project is supported by the German Federal Environmental Foundation (DBU) as a milestone project in circular economy in construction.

The project won the German "Sustainable Design Award" 2020!

## Stakeholders involved:

Architects: Partner und Partner Architekten

Team: Klaus Günter, Jörg Finkbeiner, Jeroen Meissner

Structural engineering: merz kley und partner, Dornbirn

Technical building services: IFB Ingenieure, Bad Teinach-Zavelstein

Fire safety: Dehne/Kruse Brandschutzingenieure, Wolfsburg

Landscape designers: JUCA Landschaftsarchitektur, Berlin

## Target groups:

Residential building aiming mainly at young families.

## Success factors:

↗ Space gain through slim walls and ceilings, drastic reduction of construction time, reduced building services, as well as reduced maintenance and operating costs.

↗ Pollutant-free building materials, processed in a way that can be dismantled, ensure sensible subsequent use and thus the value retention of the resources used.

↗ Connections of components are not made with any type of gluing, but screwed or clamped. Also tiles are not glued but just joint. Dry screeds is used for the floor.

↗ Renewable building materials are used wherever it makes sense and is possible. The energy for construction is almost compensated for by the low proportion of grey energy in the renewable building materials.

↗ Breathable building materials control the indoor climate. Wood is allergy-friendly and has a radiation-shielding effect. The innovative heating and electrical technology reduces electrosmog in the building.

↗ The individual components are prefabricated regardless of the season and erected on site within a very short time. This allows better control of the used material and a shorter construction time.

↗ The design results in a healthy and ecological living space. The resources used can be reused without hesitation at the end of their service life. WOODSCRAPERs are therefore living space with a future.

The differences to standard constructions in numbers:

| | | |
|---|---|---|
| **Energy savings** | **25%** | Through optimised construction techniques and heating technology |
| **More $CO^2$ storaget** | **80%** | Through timber construction as a resource store |
| **Habitable space** | **15%** | Increase through reduced element dimensions |
| **Cost of electrical services** | **28%** | Through intelligent planning and technology |
| **Site time** | **50%** | Through pre-fabrication |

*Source: www.woodscraper.de*

## Constraints:

Only the staircases in the centre of the building are made from armoured concrete. Apart from this, there are no constraints of any significance.

## Replicability and/or up-scaling potential:

The building can easily be replicated internationally. Future re-use is also very easy: Due to its innovative design, the floor plans of the Woodscraper can be flexibly changed in the event of a change of use.

Even in the case of a demolition the material values will last beyond the end-of-life of the building. At the end of its use, the construction can be dismantled as far as possible. The resources used can be recycled and reused for new buildings in order to close material cycles.

### Learn more

Link to the project:

3 D-view of the interior:

*Source:https://modemovimiento.com/*

# Case study 2:
# "MO DE MOVIMIENTO"

## A retrofitted space which takes advantage of demolition waste, Spain

Best practice id

**Operating company/ organisation:**

**Developers:** Proyectos Conscientes (Felipe Turell and Javier Antequera)

**Design**: Relax the Coconut, Lucas Muñoz

**Construction company:** Zimenta,

**Engineering company:** Zetus Soluciones Energéticas,

**Year:** 2020

**Country**: Madrid, Spain

**Scope:** Local

## Good practice related to circular economy:

This old theatre which was used for multiple purposes over the years, such as nightclub or a recording studio was retrofitted and converted into a restaurant.

The retrofitting work is the result of multidisciplinary and artisanal work, aiming to achieve a sustainable and circular project in all areas: construction process, energy use, interior design, furniture, food produce supplies, human resources management etc.

The location has a 1000 m2 surface and has been rented for 20 years in the framework of this project. The retrofitting work lasted 16 months and it implied the demolition of the roof of the theatre for its patio transformation.

## Stakeholders involved:

- Curators: Gonzalo Machado and Mafalda Muñoz.
- Sustainability consultants: Cristina Freire (The Next Sustainability) and Marcel Gómez
- Landscaping: Fernando Marcos
- Local food producers
- Social organizations working in the file of inclusion through employment (Jóven Norte and Fundación Raices)
- Design: Relax the Coconut, Lucas Muñoz
- Landscaping: Fernando Marcos
- Textile design: Inés Sistiaga

## Target groups:

- General public, consumers
- Local food producers
- Organizations in the construction sector
- Organizations working in crafts linked to refurbishment (furniture and textile)

## Success factors:

What makes this restaurant a good practice in circular economy is the adoption of a holistic approach to sustainable retrofitting including aspects related to the design and use of building. By supporting local and recovered materials, traditional technologies and new solutions not yet consolidated in the market, this project implies the revitalisation of trades and the use of skilled labour, while reducing the ecological footprint by more than 70%.

*Source:https://modemovimiento.com/*

One of the ways the retrofitting project ensured circularity in the building process was by reusing materials from the demolition process and incorporating recycled materials (1,700 tons of construction waste was generated on site):

- Rubble (inert waste) was used to make elements such as seating benches, the sink and wash basin, etc.
- The wood from the venue was reassembled to make furniture, e.g. chairs.
- The kitchen and bathrooms were tiled with leftovers from other demolition works.
- The light fittings were recycled from old fluorescent boxes from the car park.
- The original staircase of the building was dismantled and relocated elsewhere in the premises.

↗ Other waste was used to decorate the premises.

↗ Software has been used to determine the sustainability of the materials (it does not say which one).

As far as the organization, ethics, business model and building uses are concerned, the following aspects can be highlighted:

↗ Water treatment: Rainwater is collected, filtered, treated, and used for irrigation, in the cooling system, for tap water in washbasins and sinks and for drinking water (triple filtered). Wastewater from sinks and washbasins is reused in toilets.

↗ Heating and cooling: Two handmade wood-fired ovens are used as part of the heating system. This is achieved with a coil of pipes above the vault of the ovens, through which water circulates and is heated. The hot water is distributed to the rest of the room via a circuit with radiators and underfloor heating. Passive cooling systems consisting of large jars with holes hanging from the ceiling (filled with water. The evaporation of the water through the holes and the ceramic surface cools the room with the help of mechanical ventilation. The same system is used in the courtyard through terracotta benches on the walls.


*Source:https://modemovimiento.com/*

↗ Fabrics: The seat cushions are made from recycled and shredded clothing. The aprons are made of organic cotton with a waxed treatment to prevent washing. The waiters' shirts are second hand purchased from welfare organisations, restored, and dyed with natural dyes extracted from the rust on the nails in the courtyard.

↗ Vegetation: Orange trees that were to be discarded, from Valencia crops, have been placed in the courtyard.

↗ Products: Local, ecological and artisan products are used for the preparation of the meals. Including oranges from the orange trees in the courtyard.

↗ Organic waste: Organic waste is collected by a composting machine and most of it is sent to local suppliers. The rest is used as compost for the restaurant's plants.

↗ Staff: Half of the staff belongs to social groups at risk of exclusion with the aim of training for a year and then integrating into the labour market.

## Constraints:

It is a unique, experimental, and artisanal project, where many decisions have been taken on the fly, on the construction site itself. There is no objective quantitative data on the amount of waste recycled or reused and the energy savings provided by the passive cooling systems or the heating system based on the heat generated by the ovens. It is labour-intensive as many of its components imply craftwork.

## Replicability and/or up-scaling potential:

The project could be replicable in concept, the idea of applying a circular economy paradigm to all the processes surrounding the life of the building, including its uses is exemplary and can induce change in existing practices. But its uniqueness does not make it easily exportable on a large scale.

*Source:https://modemovimiento.com/*

### Learn more

Link to the Restaurant's:

Article about Mo de Movimiento on the national newspaper El País: Mo de Movimiento, el restaurante sostenible gracias a grandes dosis de innovación | Transformación Digital | Tecnología | EL PAÍS:

Article about Mo de Movimiento on an specialized website:

*Source: Philip Dujardin - www.archidayly.com*

# Case study 3:
# "PEOPLE'S PAVILION"

## a building created out of reused and borrowed materials, The Netherlands

Best practice id

**Operating company / organisation:**

**Design:** bureau SLA & Overtreders W

**Designers:** Peter van Assche, Hester van Dijk, Reinder Bakker

**Structural engineering:** Arup

**Urban Mining advise:** New Horizon

**Main builder:** Ham & Sybesma, Amsterdam

**Year:** 2017

**Country:** Eindhoven, The Netherlands

**Scope:** Local and regional

## Good practice related to circular economy:

This pavilion was built to hold an international annual event "World Design" organized by the Dutch Design Foundation. It served as a meeting space for the general public as well as a venue for cultural events such as concerts and exhibitions. It could accommodate 200 seated or 600 people standing.

The main idea around which the people's pavilion revolved was to create a building as sustainable as possible were no materials were lost in the building process. For this purpose it was built using borrowed and reusable materials which were then returned to lenders and/or reused in other building projects, thus "designing out" permanent or semi-permanent binding elements such as gluing components, screws or nails.

The pavilion's structure included concrete ground piles and a set of square shaped pine-wood pieces which were held together using tension straps to support the greenhouse roof. The façade was made up of recycled glass partition walls and the building covering was made up of recycled PVC plastic tiles.

The building had a 250 m2 dimension and the main materials used were:

<u>For the structure:</u>

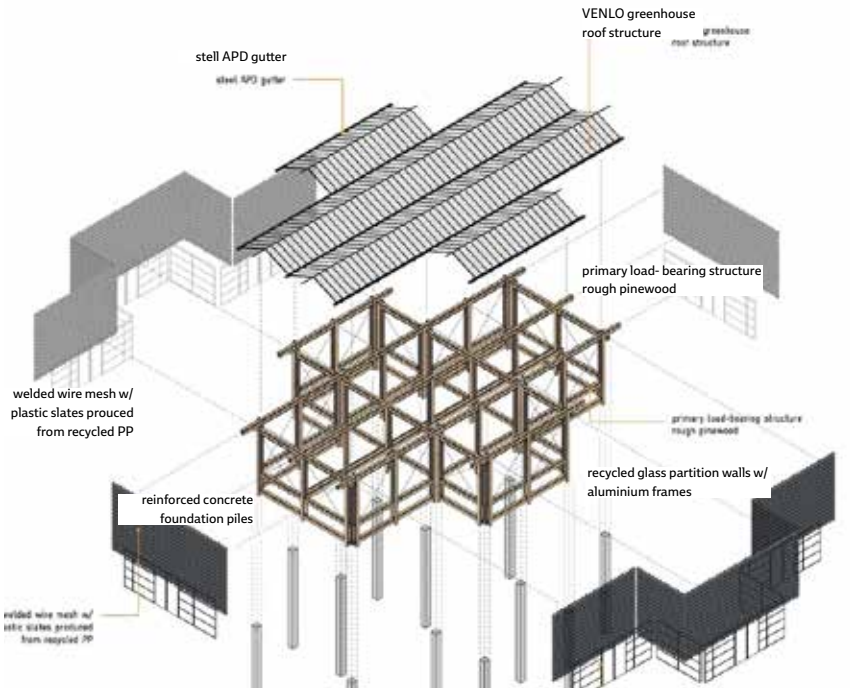
- 12 concrete foundation piles
- 19 wooden frames (unplanned wooden beams of standard dimensions)
- 350 tensioning steel straps
- Greenhouse roof panels

The façade:

- More than a thousand recycled plastic tiles
- Glass partitions leftover from a refurbishment work

The interior:

- Benches lent by a church




## Stakeholders involved:

- University of Eindhoven
- Foundation piles: IJB groep, Lemmer
- Wood, steel materials providers: Stiho group, Nieuwegein
- Facade tiles: Govaerts, Hasselt (B)
- Ground floor façade designers: Tetris, Amsterdam
- Electrical wiring & lights: Elektroned
- Glass roof: DEGO, Monster
- Concrete flooring: Heezen, Eindhoven
- Tensioning straps: Logistiek Concurrent

- Containers for plastic waste: Van Happen, Eindhoven
- Plastic washing/shreddering: Morssinkhof, Haaksbergen
- Church benches: Keizersgrachtkerk, Amsterdam

## Target groups:

- General public, attendants to the World Design Event
- Citizens of Eindhoven
- Educational and Cultural organizations such as the University of Eindhoven and the Dutch Design Foundation
- Construction material producers (turned "lenders") from the building industry
- Public authorities of the Eindhoven

## Success factors:

What made this case a success in the application of circular economy principles was both its commitment to the principles of zero waste generation and its capacity to implicate numerous stake holders in the process. All of this, while introducing a new business model for construction materials (lending) and achieving an aesthetically appealing result.

This was achieved on the one hand, ensuring that all the materials were either recycled or borrowed to construction suppliers:

- The foundation piles and the wood and steel materials were borrowed and returned to local suppliers.
- The roof was sourced from a local greenhouse supplier.
- The glass façade elements on the ground floor were recycled materials leftover from a refurbishment work.
- Interior elements such as lighting and heating were also borrowed.

And on the other hand, and what gives this endeavour and additional impact, involving other organizations and groups such as a church from Amsterdam and more generally residents from Eindhoven:

- The benches inside the Pavillion were lent by an Amsterdam church.
- The building's external upper envelope consists of plastic tiles produced out of discarded PVC from Eindhoven households including flooring and rainwater piping for instance. These tiles were then redistributed among citizens after the occasion's closure.

*Source: Philip Dujardin - www.archidayly.com*

## Constraints:

It is a building designed to be ephemeral, assembled and disassembled in a short period of time. This determines its structure and construction systems and it also limits its application to very specific short term uses.

Moreover, the built system, using tie-down straps, tension belts and cable ties required extensive assessment, as it was very uncommon and innovatory, requiring close collaboration with expert engineers to achieve tailored solutions to the conditions and the materials used.

## Replicability and/or up-scaling potential:

This concept can be replicated in similar ephemeral architecture contexts clinging to the strong ideas which drove its success which are the shifting from the traditional paradigm of producing, using and discarding to a fully circular scheme keeping resources in use by involving multiple stakeholders to spread its social impact.

Moreover, this experience has the potential to create circular economy friendly networks and derived innovations, in this case some of the partners involved in the project (BureauSLA and Overtreders W) continued to work on the market inclusion

of the developed recycled plastic tiles by seeking their certification as a construction product to encourage more architects and designers to work with recycled plastic. They just recently (2020) achieved their reuse in another construction, a school music pavilion in Oosterhout, the Netherlands.

## Learn more

Detailed information of the project:

Timelapse video of the construction of the People's Pavilion:

Video presenting People's Pavillion concept:

Article about the project:

*Source: https://www.edificio-socrates.com/*

# Case study 4:
# "THE GONSI SÓCRATES BUILDING"

## adopting a cradle-to-cradle approach as a design and construction principle, Spain

## Operating company / organisation:

Best practice id

**Client:** Inmobiliaria GONSI Barcelona. Imma Simó

**Architects:** PICHARCHITECTS

**Construction company:** ConstruCia

**Year:** 2019

**Country:** Viladecans. Barcelona, Spain

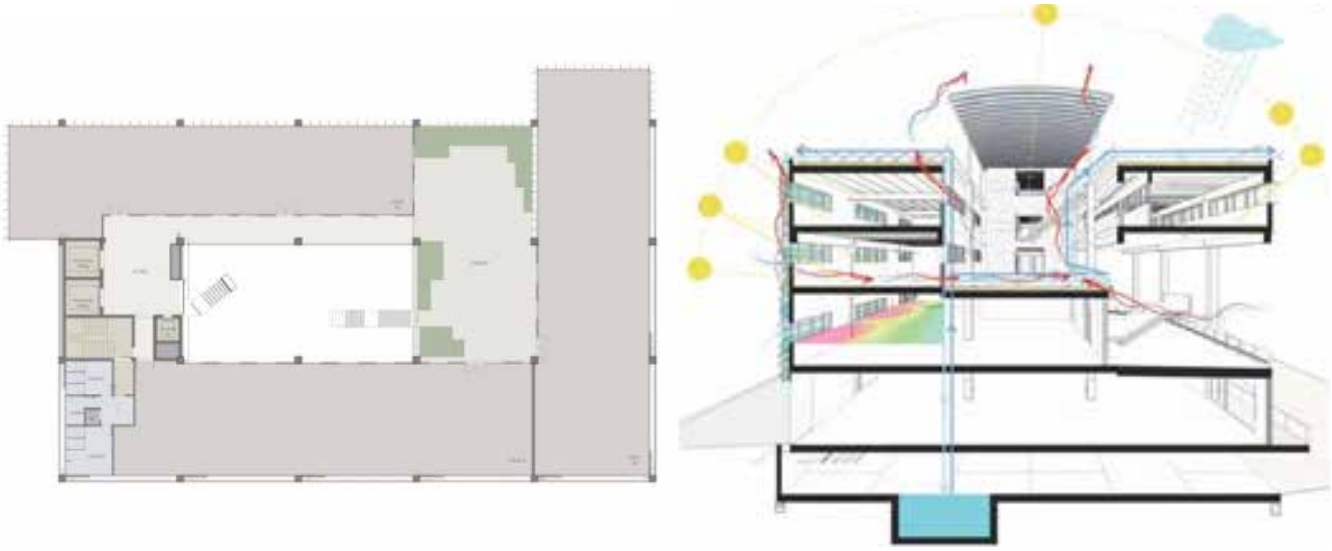
**Scope:** Local and regional

## Good practice related to circular economy:

The Gonsi Sócrates Building is a mixed-use 100% circular building from its design to the construction process and the envisioned deconstruction process. It achieves this circularity by adopting multiple strategies such as BIM based Life Cycle Analysis and a Cradle-to-Cradle approach (C2C) to material use.

The built surface consists of 6200 m2 comprising four levels plus a semi-basement car park. It is located in "Viladecans Business Park", a new business development area dedicated to emerging companies and new business models. The two lower levels, with a floor-to-ceiling height of 4.75 m, are designed for industrial, warehouse and retail use, with spacious premises and road access from loading and unloading platforms. The two upper floors, with a clear height of 3.55 m, are designed to house workshops and offices, with smaller premises.

The core of the building has open spaces that serve as connection and circulation areas and circulation areas. The rooftop houses a partially covered communal terrace with a landscaped area (green roof), an area dedicated to air conditioning and ventilation equipment and photovoltaic panels.



*Source: XV International Conference on Durability of Building Materials and Components DBMC 2020, Barcelona Building Circular Economy: a Case Study Designed and Built Following a BIM-B ased Life Cycle Assessment Approach Mauro Manca, Zuzana Prochazkova, Umberto Berardi, Licinio Alfaro and Felipe Pich-Aguilera*

## Stakeholders involved:

- Suppliers: Aplacat, METALPANEL, Precon, ROCKWOOL, Sun Power
- Engineering: Barny, Construcia instalaciones
- Landscaping: Picharchitects/pich-aguilera
- Consultants: EIG. Eco Intelligent Growth, LPD coach management
- Industrialised structure: Precon
- Envelope: Emmometal
- Cistern cover and vegetation: Vivers del ter i botanica

## Target groups:

Start-ups and Innovative industries

Building industry stakeholders including product providers and logistics companies

## Success factors

The main drivers of this building's success in applying circular economy principles to its design and use were the intention to deliver maximum spatial flexibility, structural durability and material disassembling and traceability. The aim being that a company or a professional team who chooses to rent this space can have in the same building facilities to carry out all of their activities: offices, workshops, laboratories, warehouses, showrooms...

These were the main strategies to achieve the expected results:

↗ A LCA (life cycle analysis) was performed with the digital BIM model of the architectural proposal, then integrated with a customised database of building products, based on BEDEC, the building materials database with technical details, costs and environmental information. The whole process took place within the TCQi-GMA software (TCQi-GMA).

Eventually materials were chosen considering their traceability. 99% of the products used in the construction have been checked against the basic criteria of the Cradle to Cradle (C2C) certification methodology. 84% of the materials are C2C certified, and others have been assessed during the process or have an environmental product declaration (EPD). In this sense, 100% of site waste can be tracked through the waste management protocol, and 99% is reused, excavated soil was reused on site.

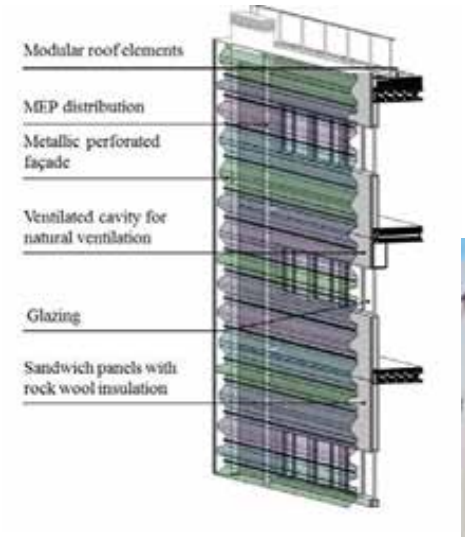
↗ Industrialised construction was the chosen approach, with prefabricated structure and façade elements. The different construction elements were dry assembled on site. This reduced the amount of waste on site and favoured the traceability of materials and future deconstruction. An Integrated Delivery Process (IDP) was applied in the design and construction phase, aligning all stakeholders

towards the common goal of designing a circular building. The green roof consists of a prefabricated modular system including an irrigation system. The rest of the roof is finished with concrete slabs. The interior spaces have no additional finishes.

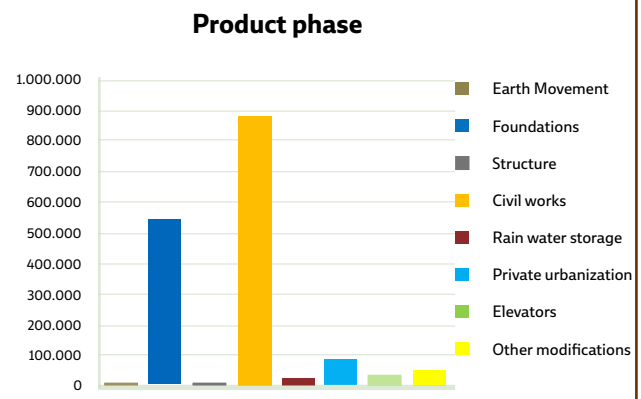
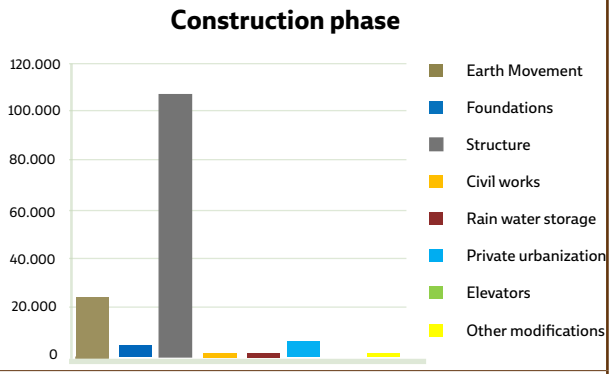
↗ The simulation programme "Energy plus" was used to optimise the energy performance of the building. - The heating, ventilation and air conditioning (HVAC) system is powered by a 303 kW geothermal heat pump that covers 80% of the heating and cooling demand. In addition, the building is equipped with photovoltaic panels which are estimated to cover 38% of the expected consumption.

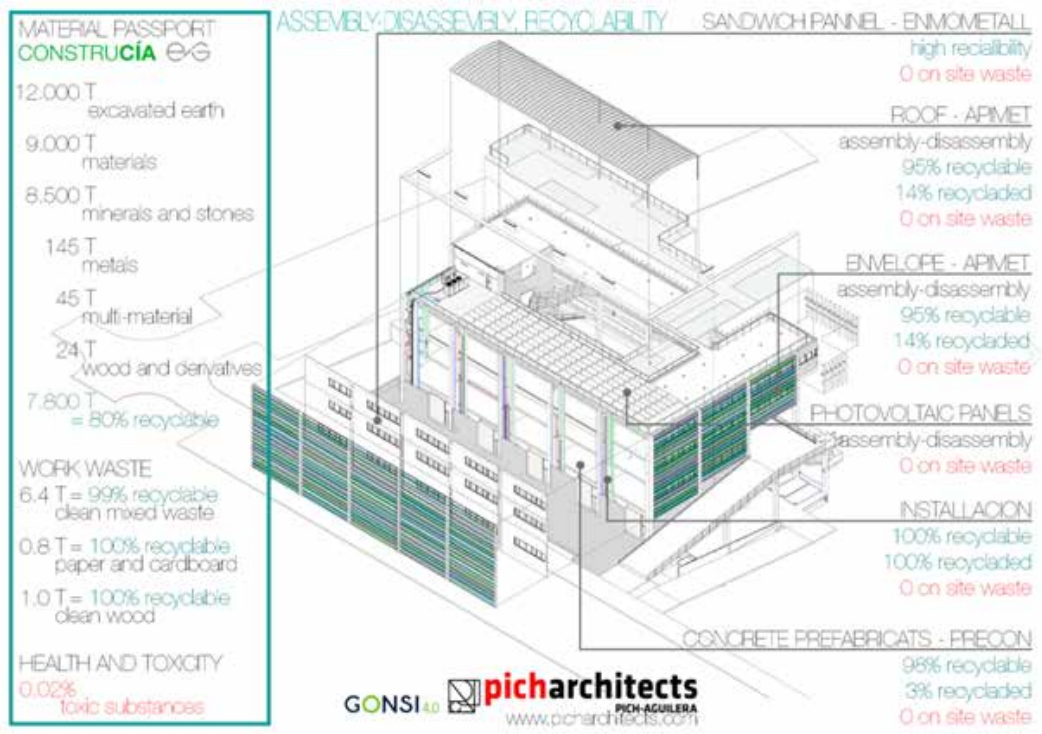
The installation distribution systems run along the façade and are connected to the ventilation system of each interior space. This configuration was chosen to facilitate maintenance and improve internal spatial flexibility, offering multiple connection options to external services without affecting the interior spaces.

↗ Overall, the LEED v.4 certification protocol was used to better structure all aspects related to sustainability.




*Source: XV International Conference on Durability of Building Materials and Components DBMC 2020, Barcelona Building Circular Economy: a Case Study Designed and Built Following a BIM-B ased Life Cycle Assessment Approach Mauro Manca, Zuzana Prochazkova, Umberto Berardi, Licinio Alfaro and Felipe Pich-Aguilera*

| | |
|---|---|
| Daylight factor across 75% of the working area | 25% |
| Reduction of overall energy consumption compared with baseline model according ASHRAE 90.1 | 80% |
| LCA (life cycle assessment) | |
| Product Phase |  |
| Construction phase |  |
| Construction material recyclable | 88 % (7,800 tons) |
| C²C certified materials | 84 % |
| | 0,02 % toxix substances |
| Waste production (including excavation) | 25 tons (99 % re-valorized) |




*Source: https://www.picharchitects.com/2019/11/20/congreso-rebuild-edificio-gonsi-socrates/*

## Constraints:

Logistics represent a considerable challenge in any industrialized construction, since hugely sized components must be transported from the factory to the construction site. The vertical structure is made up by: prefabricated concrete pillars of 0.6x0.6 cm section (mostly) and 22 metres in height, transferred to the site in one piece, and prefabricated reinforced concrete walls.

The horizontal structure is made up of industrialised beams with a span of about 9.40 m and an average cross-section of 60 x 60 cm and hollow core concrete slabs with a 30 cm edge + 10 cm compression layer.

Moreover, some of the material used might not be considered completely sustainable as they are newly sourced such as concrete, XPS insulation and metal.

## Replicability and/or up-scaling potential:

The thorough use of BIM and industrialized processes make its replicability a workable option. Moreover, the building is likely to be replicated as it "a safe bet", customisable and resilient, with a high potential for transformation of use and distribution over time, which gives it possibilities to extend its useful life.

The same developer has overseen the design, construction and renting of the building. In order to be profitable this project aims at a useful life of the building as long as possible, thus lifetime extension has been a critical concern.

## Learn more

Scientific publication about the Socrates building:

Blog entry about the Socrates building:

Presentation of the Socrates building:

Cradle to Cradle demosntration using Socrates building as an example:

*Source: https://economiacircolare.com/comunita-energetica-napoli/*

# Case study 5:
# COMUNITÀ ENERGETICA DI NAPOLI

## Italian energy community in a popular district of Naples, Italy

Best practice id

**Operating company/ organisation:**

**Client:** Citizens of Naples

**Company:** 3E

**Promoter:** Legambiente

**Year:** 2021

**Country:** Naples / Italy

**Scope:** Local

## Good practice related to circular economy:

The construction sites of the energy community of Naples started on March 2021: the 53 kW photovoltaic system on the roof of the headquarters of "Fondazione Famiglia di Maria", district of San Giovanni a Teduccio, is now ready. 40 families living in the district, together with the Foundation, produce and consume energy on site. This is one of the very first renewable energy communities born in Italy, as implementation of the "Milleproroghe" 2020 Decree.

## Stakeholders involved: citizens / associations for the environment

## Target groups: citizens of Naples

**Success factors**:

The project, promoted by Legambiente and carried out by the construction company 3E of Naples thanks to the support of the Foundation "Fondazione con il sud" – covering the costs of about 100 thousand euros, partly recovered thanks to the tax credit – is the beginning of a path that involves the community. The work of Legambiente and Fondazione Famiglia di Maria will in fact continue with children, moms and associations of the district, providing them environmental education paths, active citizenship actions monitoring their electricity consumption and heat dispersions of homes and then info days for high schools on employment opportunities related to green jobs. The purpose is to create a community richer not only in energy.

Thanks to the early transposition of part of the EU directive 2018/2001 on the development of renewables that allowed the birth of the energy community of Naples, the ownership of plants (up to 200 kW) and the energy produced can be shared by families and companies that occupy properties close to each other. The complete transposition of the European Directive, expected by the year, will allow to exceed the current limit on the size of shared plants by increasing the positive effects, from an environmental point of view (reduction of climate-changing emissions) and economic, not only for families (who will also receive incentives): Europe is pushing energy communities as a tool for the growing diffusion of renewables, which also means less energy dependence on foreign countries.

## Constraints:

The process that led to the energy community was not very easy. Having been the first they had to face bureaucracy without having the chance to refer to someone who had done it before them,

## Replicability and/or up-scaling potential:

A challenge that Legambiente calls "revolutionary", with important repercussions not only environmental but also social point of view. This model will open-up important opportunities to help the families of the district, a working-class neighborhood with big social and employment problems. In short, a concrete opportunity for regeneration of the suburbs. In Italy there are over two million families in energy poverty, which today we be can helped thanks to the self-production and sharing of energy from renewables and through interventions that reduce the consumption in private houses. Furthermore, thanks to the accumulation system, unused energy will be sold to the State and the proceeds will be distributed among members of the community, becoming a real addition to household income.

An opportunity for people and for the territory: the relaunch of South Italy will pass through projects of this type, which enhance the contribution of sun energy within projects of social regeneration and urban planning. The ecological transition that starts from the bottom up and keeps communities within the change in action.

The idea is to reach 100,000 energetic communities, a model of energy transition that makes citizens protagonists for a present generation and towards a forgotten periphery. Respect for the environment and for a community that will provide good practices in a mutual aid chain: environment, solar energy, educational equality, are the ingredients that are supposed to be replicated in other suburban areas.

*Source: https://www.sapereambiente.it/primo-piano/da-comunita-educante-a-comunita-energetica-la-transizione-ecologica-della-fondazione-famiglia-di-maria/*

### Learn more

Article about the initiative in specialized media:

Article about the initiative in international media:

*Source https://www.sisifo.eu/progetti/fra-sole-assisi/*

# Case study 6:
# "PROJECT FRA' SOLE ASSISI"

## Sustainability Project for the Monumental Complex of Assisi, Italy

**Best practice id**

**Client:** Citizens of Naples Assisi

**Company:** Sisifo

**Promoter:** Custodia Generale del Sacro Convento di Assisi dei Frati Minori Conventuali ARPA Umbria

**Year:** Started in 2017 – still ongoing

**Country:** Assisi/ Italy

**Scope:** Local

## Good practice related to circular economy:

An organic project of sustainability of the monumental complex of the Sacred Convent of Assisi, including the Upper Basilica, the Lower Basilica, the Tomb of St. Francis, the Convent and the Selva. The Project is promoted by the General Custody of the Sacred Convent.

The General Custody of the Sacred Convent of Assisi signed on 28/09/2017, at the Ministry of the Environment, a memorandum of understanding with the Regional Environmental Protection Agency of Umbria and with company Sisifo – Sustainability and Resilience, aimed at the realization of a project of unitary sustainability of the monumental complex including the Basilicas, the tomb of the Saint and the convent.

The religious community of the Sacred Convent of Assisi, faithful to the original Franciscan charism, has always been animated by a marked sensitivity towards the care of the "common home". For this reason, it has long started a path of progressive reduction of its environmental impact, towards more efficient and sustainable lifestyles and monumental complex management.

The Memorandum of Understanding expresses the intention to make more organic the interventions of improvement in the use of material and energy resources.

Scenario:

The building of the Sacred Convent has a very complex and articulated structure, the result of the additions and modifications that have followed in the eight centuries since the initial settlement. Currently, 11 elevation levels can be identified in which there are many functions, sizes and characteristics of the building.

The complexity of the building and the specific characteristics of the stable community that inhabits it and of the many people who occasionally and continuously are housed in the same, requires extreme attention and competence in the analysis and identification of adequate sustainability solutions.

Objectives:

The project has two kinds of objectives:

↗ Contextual objectives: analysis, planning and implementation of the best strategies, technologies and tools for a significant reduction in the environmental, social and economic impact of the complex.

↗ Scenario objectives: declination of the principles and sustainability strategies that animate the project in order to make it replicable in similar situations and to involve the many pilgrims and visitors in a path of renewed environmental awareness.

Activity:

The activity is divided into 4 moments:

↗ Analysis of inbound and outbound flows of materials, water, energy, finance and information.

↗ Preparation and implementation of a sustainability plan of the flows examined in environmental, social, and economic declination.

↗ Drafting of a sustainability and resilience specification for the replicability of the project in similar situations.

↗ Raising the awareness of all pilgrims visiting the complex to good sustainability practices.

Results achieved:

↗ Installed about 200 separate waste collection points inside the structure.

↗ Organic waste composting point installed.

↗ Revised the policy on the purchase of materials.

- Use of disposable catering tools in compostable material during events.
- Eliminated the use of plastic bottles and installed 8 water dispensers.
- Activated supply of electricity from renewable sources.
- Sustainability dissemination KIT for pilgrims.
- Presentation and dissemination of the project during important events at national level (Ecomondo, Fa' la Cosa Giusta Milano and Fa' La Cosa Giusta Umbria, Koiné, Festival Francescano).
- Support for the sustainability plan of the Bologna Franciscan Festival.
- National Competition Award "Towards a Circular Economy 2018".
- Recognition on the European Circular Economy Stakeholder Platform of the European Union.

Next steps:

- Installation of internal vertical signs to facilitate separate collection.
- Technical inspection for efficiency of energy systems and supplies.
- Drafting of the sustainability specification for the replicability of the project.
- Publication of a popular monographic publication.

- Scientific publication with the results achieved at the end of the interventions.
- Further energy diagnosis: the goal is to achieve energetic class higher than the A2 already certified.

## Stakeholders involved:

- General Custody of the Sacred Convent of Assisi of the Friars Minor Conventuals.
- ARPA Umbria.
- Dicastery of the Holy See for Integral Human Development.
- Ministry of the Environment and Land and Sea Protection.
- Umbria Region.
- Municipality of Assisi.

## Target groups:

- Staff of General Custody of the Sacred Convent of Assisi of the Friars Minor Conventuals.
- Pilgrims.

## Success factors:

- Reduction of packaging and increase in levels of internal separate waste collection.
- Recovery of organic waste for composting for internal use.
- Reduction of energy consumption thanks to energy efficiency actions.
- Energy supply from renewable sources.
- Reduction of water consumption.
- Containment of harmful emissions into the atmosphere.
- Widespread awareness of environmental issues.

**Constraints:** NA.

## Replicability and/or up-scaling potential:

The project can be replicated in contexts where community conditions of residents concentrated in a single housing complex occur, such as religious and prison communities and others with similar conditions.

### Learn more

Website of the project:

Technical characteristics of the project


*Source: https://press.vub.ac.be*

# Case study 7:
# TiCircular RETROFIT LAB

## Full Renovation of Prefabricated Student Housing Modules for Multiples Uses, Belgium

**Best practice id**

**Operating company/ organisation:** Vrije Universiteit Brussel (VUB), Brussels/ Belgium

**Year:** September 2016 – February 2019

**Country:** Belgium

**Scope :** international (European project)

The Circular Retrofit Lab is one of the 6 international case studies of the HORIZON2020 project Buildings As Material Banks (BAMB) funded by the European Commission. In the context of this project the VUB led the construction of the Circular Retrofit Lab as a demonstrator lab, which integrates new and existing building solutions that are demountable, adaptable and reusable.

## Good practice related to circular economy:

In this pilot project the VUB tested and implemented different scenarios for the reuse and refurbishment of prefabricated student housing of the 1970s. The circular refurbishment tested dismountable, adaptable and reusable solutions for maximizing waste reduction. The pilot developed a co-creative process all along the (re) design, (re) build, (re)use, repurpose or dismantling phases. This necessitated a close collaboration with all the value network stakeholders and future users in the early development phase. The university organized several round tables with industry stakeholders where design solutions were debated and improved, as well as hands-on workshops with students where solutions were tested.

The overall concept of the Circular Retrofit Lab is the principle of change-oriented construction and multifunctional buildings: this Lab can be used as a student room, a study room, a laboratory, a classroom or even an ecological guest house.

## Stakeholders involved:

For the realization of this project, the VUB joined forces with various partners from the construction industry. Specifically, the façade was built with a modular system of prefabricated facade panels developed by Reynaers Aluminium, Beenes and Jonckheere Projects. For the interior of the Circular Retrofit Lab, the researchers used a dry floor system from Tarkett and four different interior wall systems developed by Saint-Gobain, Systimber, Geberit and JuuNoo - respectively a demountable wall system, a wall system with wooden beams, a modular construction kit and a rapidly mobile and adjustable velcro system. Smart techniques for the heating, lighting and water supplies of the Circular Retrofit Lab were next developed by companies such as Jaga, Bao Living, Zehnder and the VUB spin-off, Lumency. General contractors Groep Van Roey managed the coordination of the entire project in the right direction; Kaderstudio and MK Engineering assisted with the architectural design and techniques.

## Target groups:

- Students
- Academics

## Success factors:

The use of modular, prefabricated and kit-of-parts design approach not only fostered flexibility in assembly and efficiency in manufacturing but allowed scaling up the implementation. In this respect, the team together with the industry partners implemented efficient operational solutions, such as the use of dry, robust and reversible technical solutions and the use of materials able to endure multiple reuses without being damaged.

The Circular Retrofit Lab pilot project applied a step-by-step innovation strategy based on products available on the market. This strategy thus incrementally improves products that are already technically and commercially viable. Selected products, such as partition walls, had a high initial potential to reach circularity objectives. Together with the manufacturers, the team sought to add new product capabilities, such as new functionality (ex. from a prefabricated service module to a fully reversible partition wall system), reversible connections, etc. and test their application in a practical retrofitting project.

## Constraints:

Although a large majority of the implemented systems in the Circular Retrofit Lab are developed to be demountable and reusable, their actual reuse and waste reduction potential can only be realized through the use of business models and Material Passports, and most importantly their management and maintenance during the project life.

## Replicability and/or up-scaling potential:

The Circular Retrofit Lab is likely to serve as a circular renovation model for the other student housing modules located on the VUB campus. The team paid a special attention to the needs of potential users. In this respect, the project reflects on potential business models able to cope with the evolution of the users' requirements, thus enhancing the reproducibility and perpetuity of a flexible model.

*Source: http://www.kaderstudio.eu/index.php?/tags/projects/essays/circular-retrofit-lab/*

## Learn more

The whole construction process documented in detail, with sketches and pictures, in the Feedback report of the H2020 BAMB Project (pages 66-90).

Pictures of the project:

Video about the initiative (Dutch with English subtitles):

Blog entry containing project details:

Information about the initiative on the BAMB project website:


*Source:©Trane -https://www.guidebatimentdurable.brussels/fr/reutilisation-d-un-groupe-de-ventilation.html?IDC=10965*

# Case study 8: BRUSSELS MULTI TOWER

## Dismantling of a large ventilation unit for reuse, Belgium

Best practice id

## Operating company / organization:

- Research and coordination: Rotor DC

- Design office: Cenergie

- Clients: Whitewood (building owner) and Aquafin (recipient of the reused ventilation unit)

- Demolition company: De Meuter

- General contractor: Cordeel

- HVAC contractor: Trane

- Logistics: De Groote NV (subcontractor for Trane)

**Year:** October 2019

**Country**: Belgium

**Scope**: local/regional

## Good practice related to circular economy:

A ventilation unit from an office building in the heart of Brussels was dismantled, transported, and stored, in order to be reused in a renovation project, instead of being thrown away.

## Stakeholders involved:

- Project coordinator between all the different parties

- Building owner had to agree to the reuse of the ventilation unit

- New owner had to place the order for the reused ventilation unit

- Design office had to ensure that the unit would fit into the new project

- Demolisher had to clear the way for the ventilation unit to the opening in the building

- HVAC supplier (specialized firm) dismantled the ventilation unit and supervised the transport

## Target groups:

↗ Building owners

↗ Clients for renovation projects

## Success factors:

↗ Circular ambition: both the owner of the place where the ventilation unit was originally installed and the owner of the building to be renovated had the ambition to reuse the materials and installations (corporate social responsibility).

↗ Since several partners were involved in the dismantling and moving of the ventilation unit, good preparation and coordination were crucial. To ensure that nothing was damaged, and that the ventilation unit arrived at its new destination in good condition, clear communication between the various parties was necessary.

↗ Reuse potential of ventilation units: many components of large HVAC equipment trade at sizeable sums of money, and most installations are very well documented.

↗ Reuse of the ventilation unit was estimated to be cheaper than acquiring a new one.

## Constraints:

↗ In order to reuse the ventilation unit in a different environment:

- the ventilation unit must be in good shape and well-maintained
- the ventilation must be well-documented (dimensions, flow rate, heat recovery process, space for maintenance, energy efficiency criteria, ...)
- the ventilation must be suitable and efficient enough for the new application

↗ Ensure clear planning and communication between all teams involved, especially as this recovery process differs from traditional demolition practices.

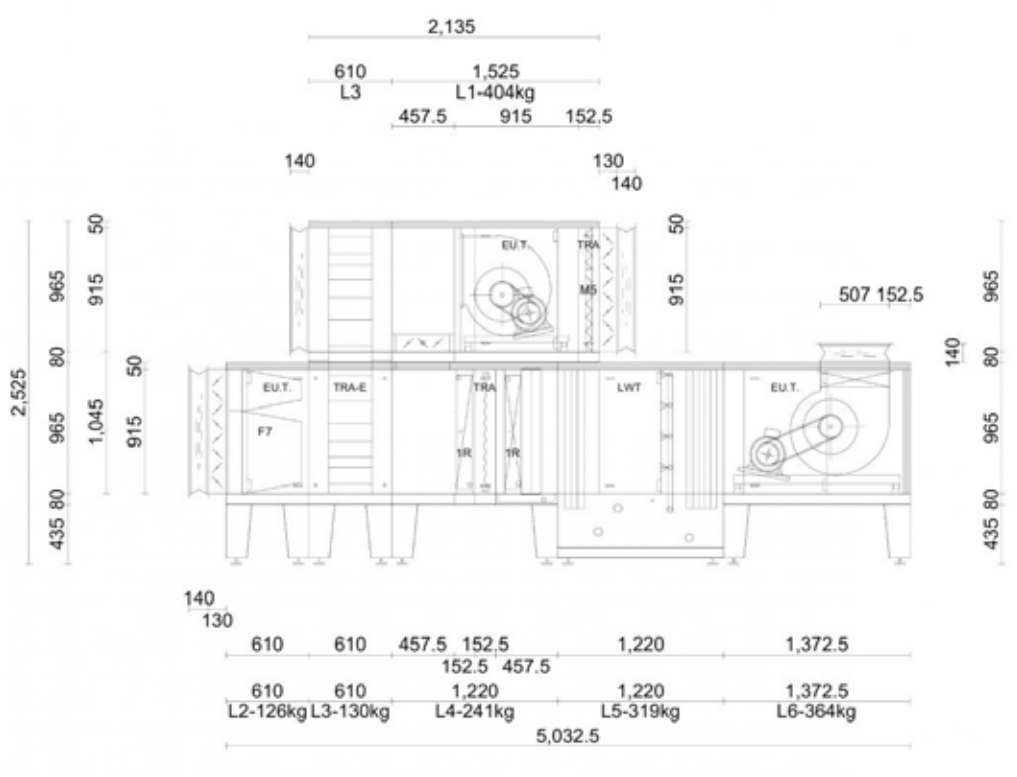
↗ Coordination between the demolition and dismantling teams: demolitions to be done ideally before dismantling, to avoid having to ensure additional protection of the dismantled elements

↗ Ensure appropriate protection and transport of the dismantled elements

## Replicability and/or up-scaling potential:

This process could be replicated on other projects of demolition / renovation of office buildings.

## Media:




**Dimensions of the ventilation unit**

*https://www.guidebatimentdurable.brussels/fr/reutilisation-d-un-groupe-de-ventilation-projet-de-brouckere.html?IDC=15198&IDD=22941*

**Ventilation unit**

*©Rotor - https://rotordc.com/extraction-ventilation-system-multi-tower/*

*©Rotor - https://rotordc.com/extraction-ventilation-system-multi-tower/*

## Learn more

Presentation including images and further explanations of the case study:

Technical information about the case study:

Article about the case study in the professional journal Sanilec:

*Source: InnoRenew CoE https://innorenew.eu/*

# Case study 9:
# "INNORENEW COE RESEARCH INSTITUTE"

## The largest wooden building in Slovenia

## Best practice id

**Operating company / organisation: Center odličnosti InnoRenew CoE:**

Main funds: Horizon2020 Programme. InnoRenew is one of ten centres of excellence selected by the European Commission for co-financing in the amount of EUR 15 million from Horizon 2020 from 169 registered projects, to which the Slovenian government has transferred another EUR 30 million in investment funds. Project started in 2018. The Municipality of Izola transferred the building right to the coordinator free of charge on part of the land on the Livade university campus.

**Main builder:** VG5, d. o. o., in njegov partner Marles hiše Maribor, d. o. o.

**Investment**: 11 Mio. EUR

**Size**: 8,200 sqm

**Location**: Livade, Izola, Slovenia (on the heaps of waste land)

**Year:** Start year of building 2021 (predicted)

**Country**: Izola, Slovenia

**Scope**: local and regional

## Good practice related to circular economy:

InnoRenew is one of ten centres of excellence selected by the European Commission for co-financing the amount of EUR 15 million from Horizon 2020 out of 169 registered projects, to which the Slovenian government has transferred another EUR 30 million in investment funds.

InnoRenew CoE was established as the main goal and result of the InnoRenew project.. The research institute's building will consist of a hybrid combination of timber, concrete and steel. Construction of the upper part of the complex will be completely wooden, making the institute the largest wooden building in Slovenia. The InnoRenew CoE building is a research project itself, as during and after construction there will be intensive monitoring to provide insight into the aging of timber used for construction and to facilitate the planning of wooden construction in the future.

*View of the institute from the west side. Image: InnoRenew CoE https://innorenew.eu/*

## Stakeholders involved:

European Comission: Horizon2020 Programme staff

Investor/coordinator: Center odličnosti InnoRenew CoE (private research institute)

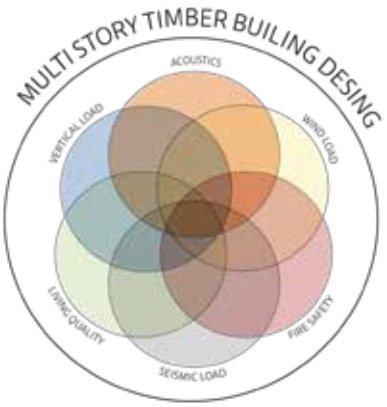
Public authority: Government of Republic of Slovenia and a local community (The Municipality of Izola)

## Target groups:

Building materials industry, contractors and investors

## Success factors:

The building is designed as a hybrid construction of wood, concrete and steel. The upper three floors of the main building will be entirely wooden, so it will be the largest wooden building in Slovenia so far.Thebuilding structure is adapted to regional conditions.




| INTERACTIONS<br>+positive<br>- negative<br>N neutral | VERTICAL LOAD | WIND LOAD | SEISMIC LOAD | FIRE SAFETY | ACOUSTIC | LIVING QUALITY |
|---|---|---|---|---|---|---|
| VERTICAL LOAD | | + | - | - | + | N |
| WIND LOAD | + | | + | N | - | N |
| SEISMIC LOAD | - | + | | N | - | N |
| FIRE SAFETY | - | N | N | | + | - |
| ACOUSTICS | + | - | - | + | | - |
| LIVING QUALITY | N | N | N | - | - | |


*Principles of the InnoRenew apporach*

## Constraints:

high public co-financing needed (on a national level)

## Replicability and/or up-scaling potential:

low– medium- high

### Learn more

Website of the project:

Article about the Project including two videos:

# Exercises

# Exercise 1: Circular economy principles

## Please, investigate the meaning of:

Life cycle of a building / construction (e.g. residential house, bridge, highway):

Reuse of building materials:

Minimizing use of materials in different phase of the life cycle of a building / construction:

External recycling of building materials:

## Exercise 2: Circular economy principles

### Imagine and define the life cycle of residential house and how in different phases of the life cycle of this kind of premise aspects of circular economy are the be considered:

Planning phase:

Building phase:

Using phase:

Renovation phase / refurbishment phase:

Deconstruction phase / demolition phase:

# Exercise 3: Case study "Mo de movimiento"

## Exercise 3a

List the requirements that the "Mo de movimiento" restaurant fulfils to be considered an example of circular economy in construction

Describe the passive cooling system it uses and which element it is inspired by

## Exercise 3b:

Find another example of a building that uses rainwater for drinking water.

Indicate what other circular economy practices ´Mo de Movimiento´ delivers in areas other than construction .

# Exercise 4: Case study "People´s Pavillion"

## Exercise 4a

List the requirements that this pavilion fulfils to be considered an example of circular economy in construction.

Indicate what its particularities are and in what kind of buildings you think they could be replicated.

## Exercise 4b:

- Imagine what other materials could be borrowed or rented.

Which recycled elements were designed exclusively for the construction of the pavilion and which products did they come from?

Investigate if there are other buildings that have used similar recycled products.

# Exercise 5: Case study "Gonsi Socrates"

## Exercise 5a

List the requirements that the Gonsi Socrates building fulfils to be considered an example of circular economy in construction.

Describe what BIM methodology is and what it contributes to the design of buildings based on the circular economy.

## Exercise 5b:

Find other examples where BIM methodology has been used, not only in the design phase, but also in the maintenance phase of the building!

What is Cradle to Cradle certification?

Look for other buildings that have achieved LEED v.4 certification in your city!

# Exercise 6: Case study "Italian energy community"

## Exercise 6a

List the requirements that the Italian energy community in a popular district of Naples (ITALY) fulfils to be considered an example of circular economy in construction.example of circular economy in construction.

Describe the process of awareness raising for the specific target group.

## Exercise 6b:

Find other similar examples in your city / country.

Which EU directive has been fulfilled?

Look for other interesting activities carried out by Legambiente Association.

# Exercise 7 :Case study "Project fra' sole assisi"

## Exercise 7a

List the requirements that the PROJECT FRA' SOLE ASSISI (ITALY) fulfils to be considered an example of circular economy in construction.

Describe the 2 main objectives taken into consideration when implementing this project

## Exercise 7b:

Find other examples where this methodology has been used for building complexes subject to a big amount of visitors

Which energy class was already achieved?

Look for other interesting project awarded by the European Circular Economy Stakeholder Platform: https://circulareconomy.europa.eu/platform

# Exercise 8: Case study "Circular Retrofit Lab"

## Exercise 8a

How does the use of a modular, prefabricated and kit-of-parts design approach (similar to a "Lego" or "Meccano") contribute to a more circular construction?

Do you think that the use of prefabricated parts will increase or decrease the time needed on site for the construction of the building?

Are you aware of work sites in your country where such modular approaches have been used?

## Exercise 8b:

Compare the demolition of a "traditional" building and the one of a modular building: in your opinion, which one will produce more unusable waste

How could a modular design extend the lifetime of construction materials?

# Exercise 9: Case study "Brussels Multi Tower"

## Exercise 9a

Which conditions must a ventilation unit meet in order to be successfully reused?

Which actors are involved in the dismantling and reuse of a ventilation unit?

Are you aware of work sites in your country where such recovery processes of technical elements have been used?

## Exercise 9b:

Explain why good coordination between all actors involved in the dismantling and reuse of a ventilation unit is an essential factor of success.

Can you think of new technologies and work methods in the construction sector that could help facilitating communication between project partners and therefore ensuring an efficient collaboration?

# Exercise 10: Case study "InnoRenew CoE Research Institute "

## Exercise 10a

Please comment the EC President statement and explain what is meant with an example .
(https://ec.europa.eu/commission/presscorner/detail/ov/SPEECH_20_1655):

*Our buildings generate 40% of our emissions. They need to become less wasteful, less expensive and more sustainable. We know that the construction sector can even be turned from a carbon source into a carbon sink, if organic building materials like wood and smart technologies like AI are applied."*

## Exercise 10b

Wooden constructions have great potentials in the global goal of transition to a low-carbon society, which in the last decade is reflected in the global growth of the share of wooden construction not only at the level of single-family houses, but also in medium and high building stock. The development of high-performance engineered wood products (EWP) in the last few decades, such as glued laminated timber (GLT) and cross laminated timber (CLT) have contributed to the exponential growth of new wooden constructions around the world. In addition to single-family houses, the market share of wooden structures has also increased significantly in multi-apartment buildings, kindergartens, schools, hotels, industrial and sports facilities, etc. With new scientific findings and consequently technical solutions, wooden construction is becoming increasingly competitive not only in low-rise buildings, but also in medium-high buildings and, more recently, in high-rise buildings.

What is your view of multi-storey wooden buildings (built on concrete foundations of course)? Have you ever been, are you or do you intend to work, do business, live in such a building? Do you relate any special threats or reluctance toward such buildings? What do you think traditional stereotypes about wooden construction: questionable fire resistance, flexibility or ductility of the structure and durability/ impermanence of the material?


Green
Growth