

# The challenges and potential of circular procurements in public construction projects

Produced as part of the EIT Climate-KIC Circular Cities project



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*Circular public procurement is an approach of 'greening' procurement, which recognises the role that public authorities can play in the transition towards a circular economy. Circular procurement can be defined as the process by which public authorities purchase works, goods or services that seek to contribute to closed energy and material loops within supply chains whilst minimising – and in the best case – avoiding negative environmental impacts and waste creations across their whole lifecycle.*

# Foreword

The increasing population growth and urbanisation intensifies the pressure on cities around the world. In addition, resources and assets are used inefficiently in the current linear system, which makes cities unsustainable.

Instead, cities should use their potential to be both cradles and catalysts for circular change considering their innate potential emerging from a high concentration of citizens and businesses and the ability of city administrations to plan and support large societal transitions. The role of public procurement has already been recognized as an important aspect in the promotion of circular economy, but the opportunity has not yet been fully exploited by cities and municipalities.

Circularity principles can potentially play a key role in procurement practices to help public sector buyers choose a more holistic approach to sustainability. A holistic approach would consider the whole life cycle of a product, from the early stages of the procurement process to the end of product life, while achieving potential savings.

Circular procurement can therefore be the instrument to leverage many of the pressing resource challenges facing growing cities today, including waste reduction and resource depletion, while simultaneously securing sustainable growth. The question is: What needs to be done on a municipal level to turn theory into practice and how

can current policies, alongside business and civil society initiatives, contribute to a circular transition?

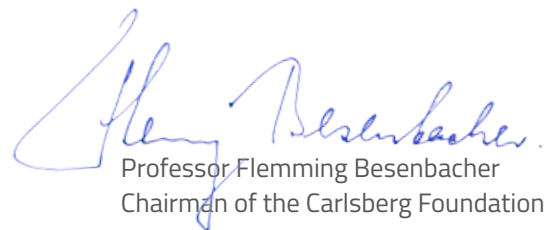
City officials and policy makers have an important role to play in the transition to a circular economy. The public sector is uniquely placed in taking the required long-term perspective when setting ambitious goals and driving positive change, with city officials and policy makers positioned as key actors.

The EIT Climate-KIC orchestrated Innovation Ecosystem programme is specifically looking for initiatives that have been accumulated through the Climate-KIC Circular Cities project and that promote and catalyse the sharing of circular economy innovation between cities, regions and urban networks on a global level.

This first white paper on circular procurement within construction provides a unique overview of the benefits of incorporating circular procurement at city and district level, including an assessment of the associated financial benefits as well as the potential negative effects. We see this white paper addressing some of the most crucial circular procurement questions of today and we encourage mayors and city practitioners, businesses and academia from across the world to learn from the cases in order to unlock the full potential of cities by creating a truly circular city transition through practical procurement application.



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# EIT Climate-KIC's Circular Cities Project – Using Circular Procurement to Fast-Track Zero Waste Cities

This publication is the first white paper in EIT Climate-KIC's Circular Cities project. It entails ten cases of concrete circular procurement initiatives from across Europe that serve as inspiration and examples for potential replications in other cities.

The City of Helsinki has managed and delivered this publication with support from the Circular Cities partners and important stakeholders. The white paper showcases how circular procurement can be addressed and implemented by municipalities in an urban environment and especially within the construction sector.

The publication highlights that the transition of becoming a more circular city is a complex journey involving many different organisations, companies, technologies and resources. It shows how cities in the world have rolled out several sustainability policies and environmental programmes, setting strong policy targets that support a circular transition. The white paper shows the impact a circular transition can have on a large range of stakeholders, who all need to be involved early in the transition process in order to obtain positive and impactful results.

The EU Action Plan for the Circular Economy from 2015 has established different concrete and ambitious action programmes that help to 'close the loop' of product lifecycles. It proposes to prolong resource life cycles

in the economy to retain the value of these resources. This publication is building upon those circular economy solutions and provides case studies with real examples of how cities work with circular procurement and use individual purchase power to stimulate deliveries of circular products that are sustainable, low carbon, resource efficient and competitive.

The Circular Cities project recognises public procurement as a key driver in the transition towards the circular economy. The EU Action Plan for the Circular Economy is the engine, which sets out goals for new actions, with the European Commission then facilitating an integration of the circular economy principles in the European member states.

When applying circular procurement in a city, there are several considerations to make. This white paper provides a detailed overview of the practical approaches with examples from nine different cities across Europe with the aim of helping other cities to embed circularity into procurement processes. The findings of this white paper highlight that circular procurement requires a shift from technical specifications being set solely by the procurer, to a process where specifications are set through exchanges between suppliers and procurers. Such an approach provides an opportunity to communicate needs, gather information on the availability of goods and services, and to test the viability of possible award



criteria. On a wider scale, engaging with suppliers can help coordinate circular activities across relevant sectors and regional economic systems.

This white paper is expected to constitute valuable input for new actions across the EU and to help highlight how multidimensional circular procurement can be used in practice. It also demonstrates how different views need to be considered before a transparent and measurable circular procurement process can be launched.

If cities increase their demands specifically for circular solutions, it naturally becomes more attractive for designers and producers to offer circular products and services. However, procurers often lack the knowledge of how to incorporate relevant circular requirements for suppliers and how to design tender documents to promote circularity. In addition, procurers often lack knowledge of the economic and environmental benefits associated with procuring circular solutions.

It is often seen that the dialogue between procurers and enterprises ahead of a purchase tender process is limited, as there is a lack of simplifying tools that make it easier to set the relevant circular requirements. These shortcomings for circular procurement are some of the many recommendations addressed in the white paper. The Circular Cities project hopes that the suggestions

and guidance provided are useful and that these will inspire good practices in several cities.

A warm gratitude is extended to all individuals from the city municipalities, the City of Helsinki and other project advisors who contributed to the ten detailed case studies selected for this white paper.



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# The potential of public procurement in mitigating environmental impacts

Half of the population of the Earth – 3.5 billion people – currently lives in cities. The number is expected to only rise further, reaching five billion by 2030. Although cities cover only approximately three per cent of the world’s land area, they consume 60–80 per cent of the world’s energy and produce 75 per cent of global CO<sub>2</sub> emissions<sup>(42)</sup>. Understandably, cities have been recognised in numerous contexts to be one of the key factors in mitigating climate change<sup>(3, 47)</sup>.

It is estimated that 67 per cent of the world’s greenhouse gas emissions are related to the consumption of materials<sup>(41)</sup>. As such, it is clear that operations based on circular economy principles, which involve minimising the consumption of virgin natural resources, also play a major role in efforts to combat climate change.

Circular solutions and sustainable consumption of materials also have the potential to restrain the decline of natural biodiversity, the primary cause of which is the disappearance and decline of natural habitats. This, in turn, is caused in large part by the global increase in consumption and the overuse of natural resources necessitated by increasing consumption<sup>(46)</sup>.

“A circular economy is one that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles”<sup>(8)</sup>. In a circular economy, “the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste is minimized”<sup>(10)</sup>.

Cities have many ways of promoting circularity, with one of the most effective tools being public procurements.

Public procurements concern a variety of goods and services (e.g. health or food services) and building projects. In Europe, the volume of public procurements is large, accounting for approximately 14 per cent of gross domestic product<sup>(32)</sup>. This translates to annual purchases of EUR 1,800 billion – made by over 250,000 European public sector actors. The Nordic Countries alone spend EUR 171 billion in public procurements every year<sup>(26)</sup>. For example Helsinki, the capital of Finland, spends approximately EUR 2.2 billion on public procurements a year, accounting for as much as 40 per cent of the city’s expenditure<sup>(15)</sup>.

*By driving demand for circular and sharing economy services and products, public procurements can also accelerate circular business activities overall*

The public procurements carried out by municipalities can help promote the development and scaling of sustainable products and services. By driving demand for circular and sharing economy services and products, public procurements can also accelerate circular business activities overall.

Through their own responsible procurements, municipalities can also serve as examples to others and spur each other towards more sustainable solutions. For example, since it participated in the construction project of the Brummen municipality Town hall, the construction company BAM has adopted circularity in its operations. The company was one of the first to become a part of Ellen McArthur foundation’s network CE100. In addition, municipalities throughout the Netherlands have been inspired by this example and started to use circular criteria in their construction projects.







# The effectiveness of public procurements is highlighted in construction projects

It has been calculated that the demand for the four most important materials in the world (steel, plastic, aluminium and cement) will increase two-to-fourfold by 2100 on a global level <sup>(21)</sup>. All four of these materials are used as raw materials in construction. The carbon dioxide emissions resulting from the increasing demand

for these materials (918 Gt CO<sub>2</sub>) are by themselves high enough to exceed the carbon budget (800 Gt CO<sub>2</sub>) defined for limiting the global temperature increase to below two degrees Celsius <sup>(21)</sup>. The good news is that transitioning to a more circular economy can potentially reduce the emissions resulting from the production of

## The environmental impacts of concrete

Compared to other construction materials, the environmental impacts resulting from the production of concrete are particularly high. Concrete is the most used construction material in the world: the annual construction volume of concrete is approximately 13 billion cubic metres. The environmental impacts of concrete are caused primarily by the production of its main raw material, cement, which accounts for 5 per cent of global greenhouse gas emissions. Cement production consumes large quantities of energy, in addition to which limestone releases considerable amounts of carbon dioxide when heated <sup>(43, 45)</sup>.

Concrete industry has recognized its huge environmental impact and has taken action to promote circularity in its actions. Besides its carbon footprint, concrete is also known for its carbon dioxide uptake by carbonation, an effect which is further accelerated when concrete is crushed <sup>(35)</sup>. The benefits and potential of carbonation are currently being studied in several development projects, including as part of the EU-Life Towards Carbon Neutral Municipalities and Regions-project <sup>(39)</sup>. In addition to this, some suppliers have developed types of concrete with lower emissions, such as Vihreä Betoni ('Green Concrete') developed by concrete producer Rudus. The greenhouse gas emissions of Green Concrete are at least 20-50 per cent lower compared to the emissions of conventional concrete. In the production of Green Concrete the aim is to use the lowest concrete strength class when possible, so that the amount of cement can be minimized.

Cement should be mixed with or replaced by other substances in the adhesive as much as possible and rock material should be replaced by recycled rock material. Transportation distances shall also be taken into consideration <sup>(40)</sup>.

Concrete can be re-utilised in accordance with circular economy principles. The disassembly of entire concrete elements for reuse is currently prohibitively expensive and problematic in many ways. The disassembly of the elements and components without damaging them requires careful work, which in turn is time consuming. The elements need to be tested for their wholeness, strength, capacity and quality before they can be reused. However, used concrete can be utilised as raw material for new concrete. There is still much to be done with regards to the productisation, though new products made of recycled concrete are entering the market all the time. In cases of demolition of buildings, the disassembly of elements should be carefully planned, including an assessment of recycling potential of different elements like concrete. The demand for recycled concrete products is already increasing in areas such as landscape construction.

Concrete can also be utilized as aggregate in infrastructure construction. For example in Finland, the Government Decree on the Recovery of Certain Wastes in Earth Construction allows the reuse for recovery in earth construction of waste that has been recovered and removed from a structure <sup>(13)</sup>.

these materials by as much as 56 per cent by 2050. This decrease in emissions can be achieved through material recycling (especially that of steel, plastic and aluminium; cement is more difficult to recycle), improving the material efficiency of products and developing new circular economy business models <sup>(21)</sup>.

Construction and demolition waste (CDW) is one of the heaviest and most voluminous waste streams generated in the EU, accounting for approximately 25% - 30% of all waste generated in the area <sup>(44)</sup>. When it comes to new buildings, the greatest environmental impacts caused by construction are related to energy and material choices and the placement of buildings relative to the rest of the city structure <sup>(35)</sup>.

Knowing that the waste streams developed by the construction industry are very significant, cities and businesses around the world have started to take action and investigate how buildings could be constructed with less waste and loss.

**Good practice:  
Traditional waste company has found a business case within circular construction**

Veolia France operates as a key element with industrial partners on more and more streams. They develop and encourage material banks and recycled material prototypes in partnership with users and in co-development with industrial partners and research centers.

Veolia leads demolition works, dismantling and recycling subsidiaries to get and feed the market with sorted, prepared and recycled materials to be reintroduced in the industries processes. These materials include for example gypsum, glass for windows, insulation, PCV carpets and also plastics, which can be

collected and transformed in granulates to be reused for other applications.

Key reasons making Veolia's operation possible:

- Building diagnostics
- Dismantling techniques on site to avoid sorting and contamination (for example asbestos)
- Quality and traceability of the sorted resources to fit with industrial processes specifications of material makers
- Intention to pay recycled material
- Massification and logistics

Key issues to overcome the remaining obstacles in the field of demolition works:

- To improve the performances we need to get more recyclability from the material makers
- More communication on the success stories of material recycling to help mentality change
- Convince the legislators
- Inform the decision makers in the territories and cities to help them to sensitize and ask circular approaches in the tenders specifications, since the beginning of either lands or building transactions.

Infrastructure construction has considerable potential as a source of recycled materials, especially soil <sup>(25)</sup>.

**Good practice:  
Re-use of soil material (Helsinki)**

There is plenty of new construction taking place in Helsinki. These construction projects, especially infrastructure ones, involve the excavation of large quantities of soil. With places able to receive excess

*By the end of 2018, this had resulted in savings of EUR 37 million, 5.3 million litres of fuel and 11,400 tonnes of CO<sub>2</sub> emissions, primarily from reduced transportation needs and shortened transport distances*

soil being few and far between in Helsinki, in previous years excavated soil had to be transported over great distances to other cities. This practice not only generated emissions, but also caused the city to incur considerable costs.

In order to rectify the situation, in 2009 the Mayor of Helsinki established a working group to coordinate the use of soil material (soil working group) that prepared a development programme for the use of soil material for Helsinki for 2014-2017.

The aims of the development programme were to reduce the volume of soil excavation, promote the re-use and material recycling of soil and secure storage areas for surplus soil material.

Thanks to the measures of the development programme, the utilisation of soil material has become an established practice in construction projects in Helsinki. By the end of 2018, this had resulted in savings of EUR 37 million, 5.3 million litres of fuel and 11,400 tonnes of CO<sub>2</sub> emissions, primarily from reduced transportation needs and shortened transport distances.

In other words, there is significant potential in construction procurements for promoting circularity. As the operating energy efficiency of buildings continues to improve and clean energy production methods become more widespread, construction emissions and especially material choices will continue to become increasingly important in terms of the life cycle environmental impacts of buildings.

**Good practice:  
Circular building (Amsterdam)**

The City of Amsterdam has calculated the material and emission reductions that the city could achieve if it were to transition to circular building. In the value chain of buildings alone, material savings could be as high as 500,000 tonnes, which is a significant amount considering that the City's annual material inflow is 1.5 million tonnes. At the annual level, this would mean a reduction which corresponds to 2.5 per cent of the City's total carbon dioxide emissions. <sup>(6)</sup>







# What is circular procurement?

Circular procurement means the procurement of goods, services or contracts in a way that minimises the consumption of virgin resources and does not result in the generation of waste.

Instead, the raw materials and the value bound in them are kept in 'circulation' for as long as possible. In practice, circular procurements can be defined as procurements that support the five principles of the circular economy (see below) and circular economy business models (see figure 1) <sup>(7, 19, and 36)</sup>:

1. **Preventing the generation of waste by means of planning** by improving the material efficiency of products, production processes and services; designing products to be re-used, refurbished, re-manufactured and recycled; focusing on usage and service orientation instead of ownership, for example
2. **Extending life cycles** by allowing products to be modified, repaired and updated; multiple successive life cycles for different purposes enabled by high-quality and sustainable materials, for example
3. **Relying on renewable energy** and minimising energy consumption in all stages of the production chain
4. **System-level thinking**, i.e. examining the parts and different material streams of the system as parts of a larger whole in order to perceive the various opportunities offered by a circular economy (industrial symbioses, other cooperation and business opportunities, avoiding partial optimisation). The realisation of this principle requires adaptability and agility on the part of the operating environment in particular (such as the procurement unit).

PRODUCT AS A SERVICE	CIRCULAR SUPPLY CHAIN	LIFE CYCLE EXTENSION	SHARING PLATFORMS	RETURNS & RECYCLING
<ul style="list-style-type: none"> <li>▪ Total cost of ownership is borne by producers and retailers</li> <li>▪ Leasing and paying for use</li> <li>▪ Performance over quantity, sustainability over disposal</li> </ul>	<ul style="list-style-type: none"> <li>▪ Renewable, recyclable and biodegradable materials</li> <li>▪ Successive life cycles</li> </ul>	<ul style="list-style-type: none"> <li>▪ Active maintenance of products</li> <li>▪ Repair</li> <li>▪ Upgrading</li> <li>▪ Remanufacturing</li> <li>▪ Remarketing</li> </ul>	<ul style="list-style-type: none"> <li>▪ Increasing the utilisation of goods and resources</li> <li>▪ Renting</li> <li>▪ Sharing</li> <li>▪ Exchange</li> </ul>	<ul style="list-style-type: none"> <li>▪ Waste is valuable raw material</li> <li>▪ Recycling and use for other purposes</li> <li>▪ Waste-to-energy</li> </ul>

Figure 1. Circular economy business models that can be supported through procurement according to Herlevi, 2015<sup>(17)</sup>.



5. **Recycling biological material streams** as efficiently as possible and ultimately returning them to the nutrient cycle

In addition to these five principles there are some other factors that may help define circular procurement:

- Product design that enables dismantling
- Recycling of products and materials
- Minimization of value destruction
- Promotion of new business models
- Elimination of hazardous chemicals and harmful substances

Procurement that promotes the circular economy can therefore consist of the procurement of products by leasing instead of ownership, the prioritisation of renewable and easily recyclable raw materials in products or the utilisation of sharing services relying on digitality, which can help improve the utilisation rate of products and thus reduce the need to manufacture new products, for example.

The system-level transition to the circular economy, including procurements carried out based on circular economy principles, often require procuring units to adopt new operating methods and/or procurement practices. The key is to engage in proactive dialogue with the market and other interest groups, as the service or product needed may not have been developed yet. Thus, circular procurements can be considered to share many similarities with CleanTech procurements and innovation procurements.

The subject of innovation procurement is usually a new or clearly improved product or service that has not yet entered widespread use. An innovation procurement can also be a new way of carrying out procurement or a project, such as a construction contract. The

## Procurement legislation can enable circular procurement

In Finland, the public procurement legislation enables circular procurement. According to the section 2(2) of the Act on Public Procurement and Concession Contracts, contracting entities shall endeavour to arrange their procurement operations so that procurements can be implemented with optimal economy, quality and orderliness, taking advantage of existing competitive conditions and allowing for environmental and social aspects. According to Section 95 of the Act, the contracting entity may apply life cycle costs (such as life cycle climate and environmental impacts) as a criterion for evaluating the costs of a procurement, which is also one of the cornerstones of a circular economy.

By enabling the consideration of life cycle environmental perspectives as the basis for procurement decisions, the Act also enables the promotion of circular procurement on the general level, even though the concept of a circular economy is not specifically mentioned in the Act or its justifications. Circular economy perspectives can be taken into consideration in procurement/the preparation of a procurement in many ways, such as in the form of suitability requirements, criteria and contract terms. The Act makes it possible to carry out market consultation, which can facilitate the development and identification of new solutions that promote circularity<sup>(1)</sup>.

procurement contract may include the development and piloting of a new solution. Instead of being based on a pre-defined implementation model, the procurement can emphasise the desired results and impacts, providing suppliers with more freedom to propose alternative solution models<sup>(18)</sup>.

# The procurement process of a circular building

The multifaceted role of cities as creators and re-modellers of urban environments provides them with unique opportunities for promoting the circular economy, especially in construction projects; cities plan land use, order and commission construction projects and serve as permit authorities. Public building projects involve numerous important actors who can either promote or hinder circular building in their part. These actors and their roles in the construction process are presented in figure 2.

A circular building can be defined as follows: "The design, construction and demolition of a building in such a way that it incorporates not only the high-value use and reuse of materials, and an adaptive and futureproof design, but also ambitions for sustainability in relation to energy, water, biodiversity and ecosystems at the building an area level." <sup>(12)</sup>.

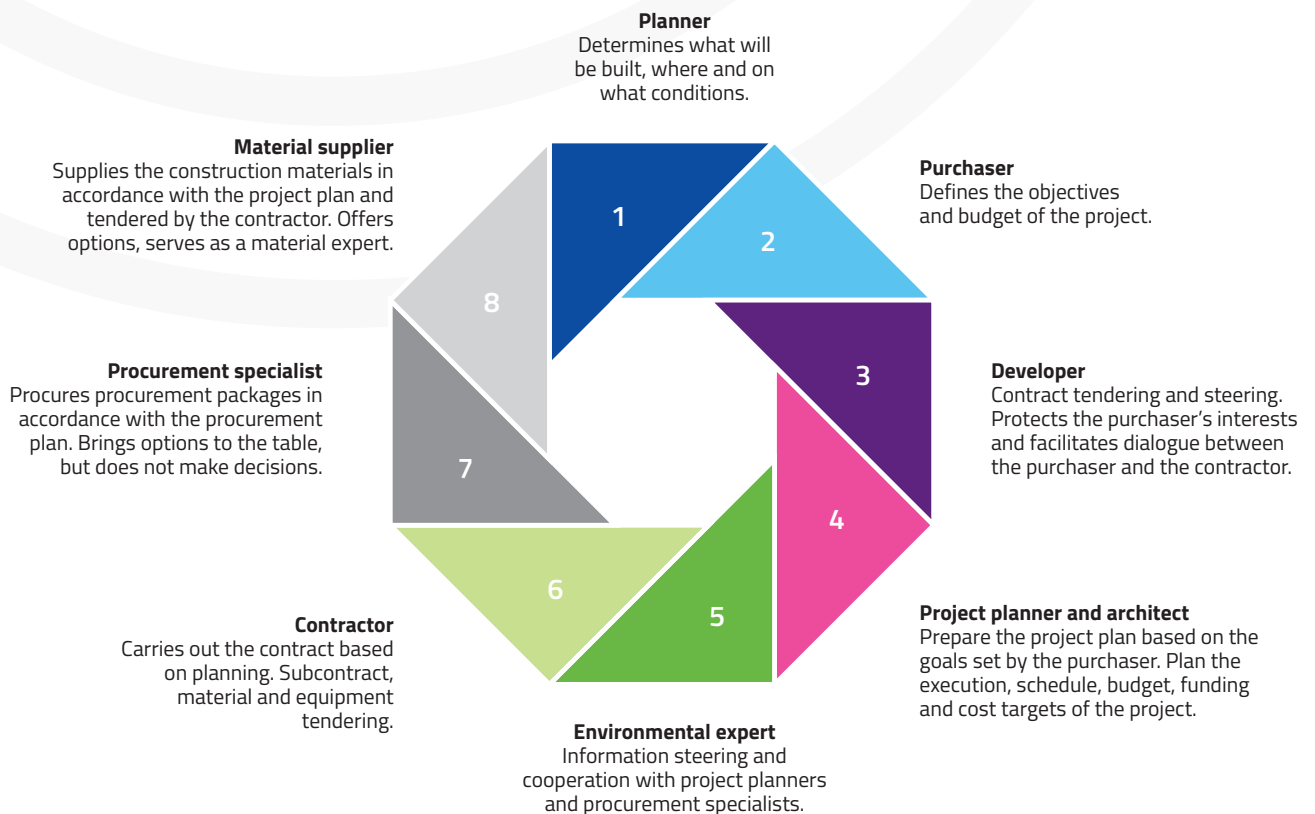


Figure 2. The parties involved in public constructions projects and their roles.



*Public building projects involve numerous important actors who can either promote or hinder circular building in their part*

The procurement of a circular building is not a simple process. In addition to the fact that there seem to be as many definitions for the concept of circular economy as there are parties defining it, the procurement process of a building is complex, lengthy and expensive compared to the procurement of many other goods. In the case of public construction, the greatest difference compared to the procurement of conventional goods or materials is that instead of an existing product or service, the thing being purchased is the procurement of design, contracting, and, in some cases, construction management. In addition to this, the life cycle of a building also encompasses the procurement of maintenance and demolition.

**An example of a building procurement process (used by the City of Helsinki):**

The building procurement process begins with a project needs assessment, followed by the decision to launch the project. The next step is the procurement of a design service, the provider of which is responsible for designing the building together with the purchaser's representatives and the developer. The project planning phase concludes with the preparation of a project plan and the definition of the maximum price of the project.

After this, especially in major projects, the investment decision is processed by one of the city's decision-making bodies. During the follow-up planning phase, the plans are clarified further with regards to material choices and energy production methods, for example.

As we can see, actual procurement is carried out in several stages of a building project. In most cases, a public purchaser only procures services during a construction project, such as design, construction and maintenance. Construction equipment and products are usually included in the procurement contract <sup>(22)</sup>.

The subject of a public building procurement can consist of the following <sup>(22)</sup>:

- design services
- a construction contract
- the procurement of building products or equipment
- the procurement of energy services
- design-build construction (DB contract)
- life cycle service (combined design, building and maintenance)
- a combination of the above



Figure 3. The principles of circular building as seen in Gemeente Amsterdam (2017). Roadmap Circular Land Tendering – An introduction to circular building projects <sup>(12)</sup>.

Circular economy could be taken into account in all of the above subjects of procurement, opening up a wide range of opportunities for reducing the harmful environmental impacts of construction.

The targets and criteria set for design services are especially important, not only in terms of circular building, but in terms of environmental impacts as well. The criteria used must always be determined based on the building project at hand <sup>(22)</sup>.

**Good practice:**

**The four principles and criteria for circular building by the city of Amsterdam**

The City of Amsterdam has defined the following as its principles of circular building: reduce the need for

raw materials, utilise synergies, supply sustainably and manage effectively. These four principles are further presented in figure 3.

The City of Amsterdam has defined criteria for circular buildings that have been piloted in three procurements. The criteria include items related to the **materials used, adaptation and resilience, water consumption, energy solutions and impacts on ecosystems and biodiversity**. These criteria can serve as examples or starting points for defining criteria for your own city or procurements. The criteria are presented in more detail in figure 4.

	<b>MATERIALS</b>	<b>ADAPTIVITY AND RESILIENCE</b>	<b>WATER</b>	<b>ENERGY</b>	<b>ECOSYSTEMS AND BIODIVERSITY</b>
<b>Reduce</b>	Use of materials during the lifespan  Environmental impact of materials used (Environmental Performance of Buildings, MPG indicator score)	Reduce dependence on external material and energy streams  Climate-resilient building	Reduction of water demand	Energy efficiency  Embodied energy	Embodied biodiversity impacts
<b>Synergize</b>	Design for disassembly (DfD)  Theoretical reusability of materials or components at an equivalent level of quality  Use of secondary materials for the building process  Reuse of earth and residual streams during the construction phase	Integration in the urban development  Flexible, redundant and adaptive design	Cascading of water streams: recovery of grey water and rainwater  Recovery of resources from wastewater	Energy cascading	Ecosystem services
<b>Supply</b>	Policy on circular contracting  Certification of materials  Use and capture of scarce and critical materials  Use of renewable materials			Renewable energy  Energy matching	
<b>Manage</b>	Material passport	Information management systems	Existence of water management system: monitoring and feedback  Rain-proof design	Performance feedback  Energy performance contracting	
<b>Apex criteria</b>	Total score on circular material use				
<b>Produce</b>					Enhancement of local biodiversity

Figure 4. Criteria for circular building as seen in Gemeente Amsterdam (2017). Roadmap Circular Land Tendering – An introduction to circular building projects <sup>(12)</sup>.

# Bottlenecks of circular building: You get what you pay for?

Circular building is still quite rare concept in Europe. In practice, planning and procurement are steered by energy-efficiency and the aim of reducing the consumption of energy than by going “wholly circular”. The Netherlands and Denmark can be considered as pioneers in circular building, as several pilot projects involving circular building solutions have been carried out in these countries at numerous private and public housing, commercial and infrastructure (for example street or park) construction sites.

However, even in the Netherlands and Denmark, circular building efforts have so far consisted of individual examples; no systemic change towards the adoption of circular building has been detected yet.

Circular building and circular procurement can be defined in numerous ways. Although getting stuck on definitions is rarely fruitful, the fact is that the complexity of the concept of circular economy hinders procurement processes in many ways. Even if the traditional procurement process is highly polished, adopting a circular economy perspective necessitates the re-examination of the entire process.

The Circular Cities project wanted to investigate the biggest obstacles of circular procurement within public

building projects to make it easier for the cities to adopt the circular procurement processes. The most notable bottlenecks and suggestions for solutions were collected by interviewing experts working in or with city of Helsinki construction sector. The interviews were conducted during autumn 2018 and spring 2019. Greatest bottlenecks are presented in the figure 5 and are explored in greater detail along with potential solutions on the following pages.

*The Circular Cities project wanted to investigate the biggest obstacles of circular procurement within public building projects to make it easier for the cities to adopt the circular procurement processes*

It is good to notice that public building projects already involve many procedures that could be defined as circular building, but are not automatically considered as such. Factors such as flexible modifiability, longevity and maintainability, energy-efficiency and the use of renewable energy sources are nowadays taken into account even in traditional projects.

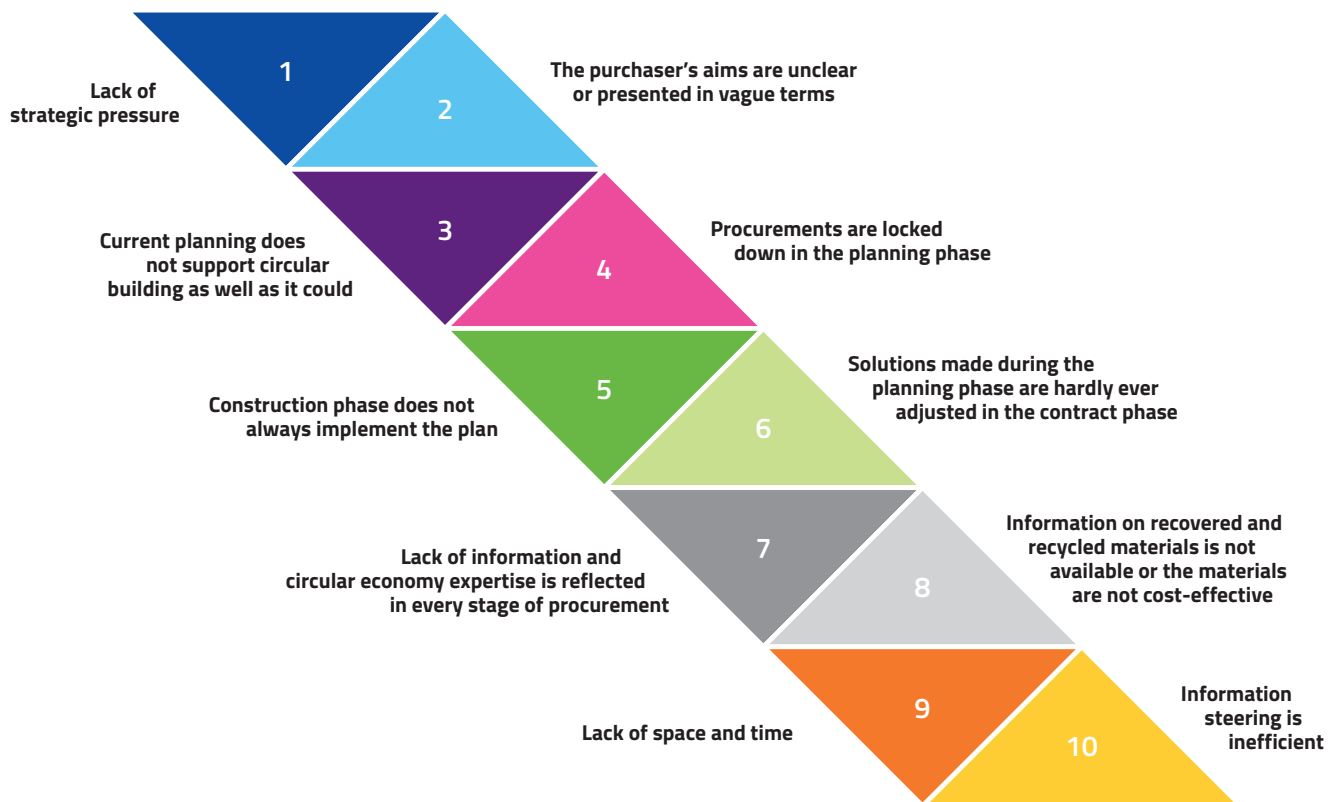


Figure 5. The bottlenecks of public procurement in construction projects.

## Bottleneck 1:

# Lack of strategic pressure

The absence of strategic pressure makes justifying circular procurement more difficult and time-consuming. If the circular economy has not been highlighted as a key focus area in national- or city-level strategy, circular procurements are difficult to justify at the performance level. This is recognized by experts, procurement specialists, planners, companies and directors of higher level.

**SOLUTION:** The change in procurement practices necessitated by circular procurement and the systematic acknowledgement of circularity in procurements require the commitment of public sector management <sup>(35)</sup>. Higher-level strategic policies promote the circular economy and facilitate lower-level decision-making and the implementation of measures. The lessons learned in possible pilot projects must be communicated to the decision-making level, as otherwise there is a risk that the benefits of the good practices established in the projects will remain tenuous and unimplemented into the city's everyday operations.

Some pioneering cities, such as Amsterdam, have made the circular economy the very foundation of their city strategy. If the aim is to integrate the circular economy into the city's construction strategy only, it should be reflected as a cross-cutting theme in housing and commercial construction, infrastructure and real estate services alike. This decision is to be taken by the city management.

**Good practice:**  
**A city-wide circular economy strategy (Amsterdam)**

The Netherlands aim to realise a complete circular economy by 2050 and reduce the consumption of primary raw materials by 50% by 2030. As part of these efforts, the City of Amsterdam has declared its aim of

becoming an international circular economy pioneer and proving that the circular economy is a realistic and productive concept. The aforementioned aims are recorded in Amsterdam's sustainability programme entitled The 2015 Sustainability Amsterdam Agenda.

Amsterdam was one of the first cities in the world to carry out a comprehensive scan of its material flows and the material benefits of adopting a circular economy. Since then, over 70 circular economy projects have been launched in the city, the majority of which concern the built environment <sup>(6)</sup>.


**Good practice:**  
**The Carbon Neutral Helsinki 2035 action plan (Helsinki)**

The promotion of a circular economy was first highlighted in the Helsinki City Strategy in 2017 <sup>(16)</sup>. The city strategy was followed by the Carbon Neutral Helsinki 2035 action plan <sup>(15)</sup>, approved by the City Council in December 2018, the purpose of which is to make Helsinki carbon neutral by 2035. The programme includes a total of 147 highly concrete measures, many of which also aim to increase circular procurements in the City's operations. The action plan's concrete measures for promoting circularity include:

44. The obstacles and opportunities related to increasing the proportion of recycled materials in housing construction, infrastructural construction and maintenance. Actions and instructions for this will be prepared.

Parties responsible: Buildings and Public Areas / Built Assets Management, Premises Services, Construction Contracting, Land Use and City Structure, Heka Housing.





*The change in procurement practices necessitated by circular procurement and the systematic acknowledgement of circularity in procurements require the commitment of public sector management*

88. The City will promote wooden construction through detailed planning.

Parties responsible: Land Use and City Structure / Detailed Planning.

89. The City will promote wooden construction in its own projects.

Parties responsible: Buildings and Public Areas / Built Assets Management, ATT Housing Production, Heka Housing, HASO, Auroranlinna.

107. Existing procurement criteria will be developed and new criteria introduced to the procurements of the City of Helsinki, with regard to life cycle, circular economy and the climate.

Parties responsible: Divisions, Procurements and Tendering + Environmental Services (role as the facilitating expert).

108. Procurements that are significant in terms of greenhouse gas emissions and circular economy will be identified, and emission calculations, life cycle models and climate impact assessment will be developed for these procurements. The impact of procurements will be assessed in terms of the environment.

Parties responsible: Divisions, Procurements and Tendering + Environmental Services, the environmental network for procurements.

One of the measures included in the action plan is the creation of a city-level road map for circular economy, which will be implemented collaboratively between the different City sectors and other local actors. The focus areas of the road map were defined in collaboration with national experts in autumn 2018. The road map is expected to be completed by the end of 2019. The aim is to create a concise package consisting of 20–30 measures, which will clearly define the City's strategic focus areas in the promotion of circularity and how to achieve defined targets. The road map will also clarify the political aims of the promotion of circularity.

**Good practice:**

**City-wide circular economy road map (Paris)**

Paris began working on a circular economy road map in 2015 with the establishment of an administrative committee for the promotion of circularity. Through multidisciplinary collaboration, the City produced a circular economy white paper, which included a total of 65 action proposals to promote the growth of the circular economy. Of these, the thirty most effective actions were ultimately included in the Paris circular economy road map, which was published in 2017. The proposed actions will be implemented in 2017–2020 in all of the city's departments. Out of the thirty actions, four have direct CO<sub>2</sub> reduction potential. The production of the road map has cost a total of EUR 230,000 over the years, and data on the resulting cost savings is expected to be received in 2019 <sup>(6)</sup>.

## Bottleneck 2:

# You get what you pay for

If the purchaser's aims are not clear right from the start of the construction project, you cannot expect circular building in public construction projects. Planning and contracting are first and foremost ways of realising the purchaser's aims.

Municipalities have three means of issuing detailed construction regulations to external developers. These means are planning decisions, land use agreements and plot assignment stipulations<sup>(33)</sup>. Through plot assignment stipulations, cities can set various binding conditions for construction in exchange for handing over land to the developer. The aforementioned means can also be used in the promotion of circular building.

Purchasers are rarely experts on circular building, unlike for example material producers. This may lead to situations in which the purchaser's aims remain unclear and the instructions provided to designers and the contractor remain vague and cursory.

**SOLUTION:** Purchasers need to set clearer goals and provide clearer guidance. Nebulous wishes are of no use to anyone! What is needed is more open and broad-minded dialogue between purchasers, contractors and material suppliers. Furthermore, requests for tenders should focus more on the procurement of the desired activities or outcomes, instead of getting bogged down in technical specifications<sup>(5)</sup>.

### Good practice:

#### Rapid Circular Contracting (RCC)

The municipality of the Dutch city of Nijmegen has procured the renovation of one of their city's streets, the Malderburchtstraat, in an innovation oriented way, using the Rapid Circular Contracting (RCC) approach developed by Stichting Circulaire Economie. Stichting Circulaire Economie is a Dutch consultancy and project organisation which works based on the circular approach.

Within an RCC, there is no upfront designed solution or Program of Demands; there is only a Program of Ambition. Selection of the winner is not based on the most appealing final image or lowest price, but on the most suitable partner in adding value to the issues at stake. With the ambitions of the City of Nijmegen in mind, the contractor is selected based on their vision, suggested approach and ability to make it happen.

After signing the commitment contract, the contractor and the procuring municipality start an RCC team and, together, use the eight RCC principles to design and realize the optimal solution. In this case focusing on the city's ambitions: optimizing functionality, maximising circularity, reducing CO<sub>2</sub> emissions and offering instruments to measure the solid impact they achieve by creating the best possible solutions.

Again, this RCC project shows that contractors who really want to embody circularity, sustainability and other forms of added value innovation, thrive by this way of working, as they are offered professional and creative space to further develop and illustrate their circular craftsmanship and talent to innovate.

### Bottleneck 3:

# Current planning does not support circular building as well as it could

Town and land use planning play a major role in the promotion of circular building projects and circular procurement. Decisions made in the town planning phase have the potential to undermine circular building for decades to come. In practise, the situation is rarely this bad, and the town planning does allow some kind of building-specific or infrastructure-related circular economy. The question that needs to be addressed is, whether enabling is enough, or should circular operations be required in the plans? If the circular economy were to be highly sought after in the built environment, the proactive involvement in the planning would be natural. So, to be more than just an enabler.

Since cities are yet rarely designed in accordance with circular economy principles, there is a risk that the potential of circular buildings projects to promote circularity will end up being wasted before project planning can even begin. For example, even if the building project otherwise fulfils circular economy criteria, there is the possibility of planning ordinance making the use of renewable energy impossible. The use of renewable energy is often considered a very significant part of circular economy <sup>(12)</sup>.

However, town planning can also promote circular building. Planning can, for example:

- enable the realisation of circular economy principles in construction
- define circular economy areas
- define various material solutions. The materials used in facades are determined at the planning level, for example.

**SOLUTION:** Introducing other than already tried and tested solutions is difficult in planning. On the other hand, planning is also a way of disseminating good practices across the city after successful pilot projects. For example in Helsinki this has already happened when it comes to the green roofs and solar panels, which are now almost automatically included in new planning areas. In fact, newly planned project areas are the best way for cities to take circular economy principles into account.

The examination of new planning areas from a circular perspective is already taking place, at least partially: good transport connections and creating opportunities for the use of renewable energy are essential elements in the promotion of a circular economy. In addition to this, it is important to examine the utilisation of the material streams produced in the area. A good example of this is the extracted soil generated during construction. How can we plan in a way that it prevents the generation of unutilised soils in construction? Another important factor is to, in a planning phase, enable flexible changes in the use of buildings – for example from office buildings into residential buildings. By reusing the building, it would be possible to avoid, to some extent, building demolition and rebuilding and environmental effects created during demolition and building phase.

Circular economy principles can be taken into account in different ways in different levels of planning: less in master plans, but more concretely in component master plans and detailed plans. It is particularly important to ensure that plans do not prevent circular building at any point. Additionally, planning can also ensure that there is sufficient room for the handling of construction materials and products during the construction stage.

## Bottleneck 4:

# Procurements are locked down in the planning phase

The procurement of design services and project planning are the most critical steps in circular building. A significant number of a building's environmental impacts are defined in its design phase. In the construction phase, the possibilities of improving on environmental impacts are more limited and usually concern the comparison of the environmental impacts of alternative execution methods <sup>(22)</sup>. This is why it is vital to reserve adequate personnel and time resources for design and its steering.

In practice, the success of a public building project's circular procurements is largely dependent on the circular economy expertise of the designers and architects. In the case of the City of Helsinki, for example, the architect is procured by the Demand and Project Planning unit, while HVAC and electrical design and building automation design are procured by the Construction Contracting unit. The procurement of design services can be influenced by environmental and energy specialists, who can also choose an energy and life cycle planner.

### Good practice:

#### The design process of the New Laakso Hospital (Helsinki)

The New Laakso Hospital will be the City of Helsinki's first new building project involving the testing of circular building principles. The aim is to carry out both new construction and repair construction in accordance with circular building principles in the existing hospital area. The project is currently in the project planning phase, which, as previously established, is one of the most critical steps in terms of circular economy solutions.

As part of the project planning process, the City organised a circular economy workshop for the project's planners and other participating parties. The City also invited circular economy experts from the

Finnish Environment Institute, the Ministry of the Environment and Green Building Council Finland to attend the workshop. During the workshop, the planners examined different circular economy principles and how they could be implemented in practice in the New Laakso Hospital project. How can the material left over from the buildings demolished in the area be utilised in the new buildings or in regional construction? What kind of recycled materials are available? What should be taken into account in the demolition?

The tendering of the project's designers was not based on circular economy criteria but hospital planning expertise. This was natural concerning the very demanding nature of the project. It would be easier to test these kinds of new approaches in a smaller and more routine project. It will be interesting to see whether this ultimately has an impact on how circular economy principles are taken into account in the project. Some of the ways in which circular economy criteria can be applied in the tendering of design services include requesting references concerning the realisation of previous circular design and the tenderers' assessments of how the desired circular economy perspectives will be taken into account in the contract <sup>(5)</sup>. However, the request for tenders must clearly define what kind of construction references qualify as circular building references in the context of the project at hand.

**SOLUTION:** Sufficient time and resources must be reserved for the procurement of design services and the design process itself.

The typical stages of the procurement of a building or design services are:

1. Project planning
2. Procurement phase

3. Contract phase
4. Commissioning
5. Activities during operation <sup>(22)</sup>.

Often the first actual procurement of a building project is the tendering of design services. One of the recommended criteria to be used in the tendering of design services is that the design company should have previous experience in designing circular economy construction. This will make the actual design process considerably easier. If applying such a criterion is not possible, it could be recommended to at least place emphasis on the designer’s innovativeness and broad-mindedness as we are talking about relatively new procurement approach. This could be implemented for example by scoring the samples of the tenderers works.

The project planning phase is perhaps the most important phase of the project in terms of circular procurement. The project planning phase is when aspects such as energy solutions and the size of the building are defined, and the frame of the building is selected. The project planning phase is followed by the implementation plan. The key is to understand that after the amount of funds to be invested has been locked down, making major changes in regard to procurements becomes impossible. This is to be happened during project planning phase.

In the planning phase, circular economy targets can be integrated into either tenderers’ suitability requirements or the description of the subject of procurement. Circular economy targets used as suitability requirements have to do with the tenderers’ expertise and references. Reference requirements and their strictness should be assessed in relation to the building to be constructed so that it will not prevent the participation of new actors and the introduction of innovations <sup>(22)</sup>.

Circular economy targets integrated into the description of the subject of procurement can consist of exact design goals and technical specifications thereof. These include target levels for energy efficiency or carbon footprint, for example. By linking the goals of the circular economy with the description the subject-matter of the procurement and the eligibility requirements, the

tenderers can be given a clear picture of what the project aims for <sup>(22)</sup>.

**Good practice:**  
**Circular building as part of an environmental classification system**

It is important to think about the means by which circular economy criteria are applied to construction procurements: should every new building be provided with project-specific targets and criteria or should they instead be based on some existing environmental classification system (such as BREEAM, LEED or Nordic Swan)?

Existing environmental classification systems are constantly being expanded with circular economy criteria. At least BREEAM and Nordic Swan already include circular economy criteria, which are only being further added to and made stricter as part of the updating of the criteria. The applicability of BREEAM to circular building has been examined in a dedicated study <sup>(4)</sup>, the conclusion of which was that BREEAM already takes into account numerous factors that are relevant to circular building as well (such as energy efficiency, the preservation of biodiversity, air quality and other factors related to health and water consumption), but has deficiencies particularly in regard to the use of materials.

The Finnish Environment Institute <sup>(37)</sup> has conducted same kind of study of the Swan label. The study presents an analysis of the ways in which circular economy aspects are included in the Swan label award criteria, explore the role the Swan can have in promoting innovative ways of consumption and production, and discuss the role that the Nordic Swan can have in steering products in a circular economy direction in the future. The “circular approach of the Swan” is based on six parameters: requirements for renewable, recycled and sustainable raw materials, strict chemical requirements, reduced use of resources and energy, quality requirements and lifetime, requirements for product design, dismantling and reparability and finally, requirements for optimum waste handling <sup>(27)</sup>.

## Bottleneck 5:

# Construction phase does not always implement the plan

Although the planning phase is the most critical phase in terms of the success of circular procurements, the realisation of the targets set in the plans is ultimately determined by the success of the building contract <sup>(22)</sup>. Although rarely the case, it is possible, that despite good intentions and planning, the construction phase may turn out to be not as circular as originally hoped.

If the project plan does not clearly specify whether circular economy perspectives should be taken into account in construction (in the form of recovered or recycled materials, for example), it is largely up to the developer whether or not recycled materials are considered as an alternative to virgin materials. Planners and contractors, in particular, are of the opinion that in this case an individual developer is granted considerable decision-making power in regard to what kind of solutions to apply in the project.

In some building contracts, the use of recycled materials is outright prohibited by the City. In some cases, the use of recycled materials is not even considered due to nobody having demanded the use of such materials in the past.

**SOLUTION:** In order to the construction phase to implement the circular approach, we need to clearly define how the circular targets are set in the procurement of building contracts. The Green Public Building Procurement Guide (2017) states the following regarding the procurement of building contracts: "There are many ways of integrating environmental targets into the procurement of building contracts. One of these is to set the contractor's experience or expertise in similar building projects that have aimed at reducing the environmental impacts of building as one of the selection criteria for contractors. Another is to include clear technical specifications concerning the environmental

impacts of the building being procured in the description of the subject of procurement of the building contract. The description can, for example, specify limit values for energy efficiency, carbon footprint or material efficiency, or specific environmental certifications. Usually these target levels are directly inherited from the design documents included as the appendices of the description of the subject of procurement. If the subject of procurement is a design-build contract (DB) or life cycle service, the environmental targets concerning design can be integrated into suitability requirements or the description of the subject of procurement".

In addition to the environmental targets in the building contracts, it is vital to strongly engage the developer and project manager to the circular approach from the very beginning of the project, in order to the construction phase to implement the circular agenda.

*The realisation of the targets set in the plans is ultimately determined by the success of the building contract*

Discussions with the developer on what would be the best way to turn recovered and recycled materials and other circular economy solutions into viable alternatives to traditional solutions are needed. Perhaps this could also be incentivised somehow?

In the largest projects, it is of course usually the case that a political decision-maker decides the outcome of a building contract tendering. In order to make it easier to implement circular criteria cities could, in principle, define politically an additional amount that circular buildings are allowed to cost.

## Bottleneck 6:

# Solutions made during the planning phase are hardly ever adjusted in the contract phase

The shared view among different actors is, that the solutions made in the planning phase are hardly ever adjusted in the context of the procurements made during the contract phase. This is not a problem per se, if the planning was carried out thoroughly and taking into account all the necessary circular economy elements. If this is not the case, however, being able to propose competing alternative solutions during the contract phase can ultimately benefit the project.

**SOLUTION:** More frequent utilisation of alliance or similar cooperation models, which improve the dialogue between the purchaser and the contractor. Cooperation meetings focusing on various issues are already held between many different actors, so maybe such meetings could also be held over circular economy issues? This would make it easier to present good proposals throughout all project phases.

## Bottleneck 7:

# Lack of information and circular economy expertise is reflected in every stage of procurement

**SOLUTION:** Circular economy training in all levels affecting procurement, including planners, developers, procurement specialists, environmental experts, contractors, management ... Everyone!

Investing in the internal dissemination of information within the city organisation as well. Cities must keep

in mind that in addition to city departments, they also encompass subsidiary communities and organisations that are subject to the same environmental goals as the parent organisation. It is important to promote these communities' commitment in the city's shared environmental goals, and the environmental cooperation with them must encompass more than just reporting.



## Bottleneck 8:

# Information on recovered and recycled materials is not available or the materials are not cost-efficient

A recycled product is a product made of recovered materials, i.e. recycled waste. A good example would be a new glass product made of recycled glass. A recovered product, on the other hand, means a product that is recycled as a product or material to be utilised for a new demand in a new building site, for example <sup>(35)</sup>.

Based on the interviews, the single biggest black hole in circular buildings seems to be the use of recovered and recycled materials and building parts. At present, buildings are, with a few exceptions, still being designed in a way that makes the recycling of materials difficult once the building has reached the end of its service life. The reason for this is the fact that by then the materials are often outdated, damaged, deteriorated or their functional characteristics cannot be ascertained <sup>(12)</sup>. Because of this, the majority of modern demolition materials are not re-utilised for similar level purposes as they were originally used.

At present, there are still relatively few recycled and recovered products available on the market, and their use on a commercial scale is still largely impossible. The use of many recycled materials is hindered by their lack of CE (Conformité Européenne) marking <sup>(35)</sup>. The CE marking is the product manufacturer's indication that the product complies with the requirements set for it in the European Union <sup>(2)</sup>. The purpose of the CE marking system is to strengthen the competitiveness of the European construction industry by removing obstacles set for the mobility of construction products by differing national requirements and by establishing an open construction product market encompassing the entire European Economic Area. When a product is appropriately CE-marked, it can be placed on the market in all countries in the European Economic

Area without the need to demonstrate its properties in each country separately.

However, in the context of construction products, CE marking alone does not indicate compliance with regulations. The applicability of the product for the building to be constructed must always be assessed on a case-by-case basis, based on the intended use, local conditions and the requirements of national building regulations. If there are no harmonised product standards for the product, CE marking is not mandatory, but can still be obtained. In Finland, for example, it is up to municipalities to decide whether to grant building permits to recycled products that are not CE marked or demand additional testing. The availability of CE-marked recycled products is much higher than that of CE-marked recovered products <sup>(35)</sup>.

*Based on the interviews, the single biggest black hole in circular buildings seems to be the use of recovered and recycled materials and building parts*

For example in the case of concrete, the reuse of construction products as products for the same or similar-level purpose as originally is possible primarily only when the products can be easily detached without damaging them. In practice, this is the case only in hall-like buildings that can usually be dismantled for moving. In such cases the building parts can be used to re-assemble a similar building or as parts of a new type of building <sup>(34)</sup>. Otherwise the re-use of concrete building parts on a commercial scale is not currently possible.



Crushed concrete, on the other hand, can be utilised especially in infrastructure earth construction to substitute for virgin raw materials. In addition to this, crushed concrete can also be used as a raw material for new concrete. In the production of recycled concrete, the consumption of natural rock material is reduced, but on the other hand the product's carbon footprint may increase <sup>(35)</sup>.

**SOLUTION:** To be able to utilize the building materials that we use today in the future, we now need to start using materials that can be re-utilised after demolition. Within procurement, this means for example using pure materials that can be easily re-used or recycled. It is very vital to consider the ways in which the materials are used and fastened as well, such as adhesives.

It is also important to keep in mind that the most profitable circular economy solution is not always the one that first comes to mind. Instead, the most effective solution may end up being traditional construction shaped by a new perspective. Such solutions can include reducing the number of load-bearing concrete walls or utilising old concrete frameworks, for example. It should also be noted that construction products do not necessarily need to be used for the purposes that they were originally produced. For example, windows that can no longer be used for their original purpose due to stricter energy efficiency etc. regulations can potentially be used as partition walls instead.

Mapping the market availability of alternative recycled products should be demanded as part of the planning process. To facilitate this, the Finnish Environment Institute mapped the recycled and recovered materials available on the market and carried out a survey on the CE marking status of construction materials in spring 2019 as part of this survey <sup>(35)</sup>.

If the use of recycled or recovered materials is not possible in the actual building, demand for them can be created at secondary sites, such as yard buildings, structures and landscaping, which will in turn increase supply.

Wood is not a recycled material, and at present it cannot usually be re-used once it has reached the end of its life cycle as a building material. This is largely due to the surface treatment agents used in wood materials, which are usually harmful to the environment <sup>(31)</sup>. Because of this, the wood removed from buildings usually ends up being utilised as waste-to-energy, i.e. for a much lower purpose than its true potential. This also causes the carbon dioxide sequestered in the wood to be released into the atmosphere, accelerating climate change <sup>(24)</sup>.

Nevertheless, wood is currently our only truly renewable construction material that can be utilised on a larger scale, the carbon sequestration features of which are undeniable <sup>(24)</sup>. In recent comparison studies, wooden buildings have also been demonstrated to have a lower life cycle carbon footprint than corresponding concrete buildings <sup>(28)</sup>.

**Good practice:  
Think Corner (Helsinki) and Opaali-talo  
(Vantaa)**

Commissioned by the University of Helsinki and designed by JKMM Architects, the renovation of University of Helsinki Think Corner <sup>(38)</sup> was carried out by utilising the building's old reinforced concrete frame. This approach provided considerable savings in greenhouse gas emissions. The renovation was completed in 2017. Apart from the concrete frame, practically everything else in the building, from the facade to partition walls, was rebuilt.

One of the aims in the construction of Opaali block of flats <sup>(30)</sup>, commissioned by VAV Group and designed

by Optiplan, was to examine how natural resources could be saved and the carbon footprint of construction reduced in the construction of a residential block of flats. The building was constructed with the aim of utilising recycled materials and material efficient solutions. The building was completed in 2015.

As the construction of Opaali-talo moved forward, it was soon discovered that the ambitious plans concerning the use of recycled materials would have to be abandoned, as the availability of recycled materials was not yet sufficient in 2014. At the time, there were no guarantees available for recycled materials, nor were the materials CE marked. As a result, the building's load-bearing structures could not be constructed out of recycled materials. In the end, the building was constructed out of concrete, though the amount of concrete used was considerably lower than usual. This was made possible by the design of the building, in which the concrete frame was optimised so that load-bearing walls were only placed where they were absolutely necessary. This and other solutions implemented in the building allowed its carbon footprint to be significantly reduced compared to a corresponding conventional building.

Actual circular materials ended up playing only a minor role in the project. Circular building solutions were utilised mainly in the building's outdoor storage spaces (hemcrete) and concrete stair elements (crushed glass). Carbon footprint calculations were carried out throughout the project and used to justify the solutions used. While the carbon footprint of most of the recycled materials was considerably lower than that of virgin materials, this was not the case with all of them. For example, the carbon footprint of crushed glass was notably low, whereas the difference between the carbon footprint of recycled bricks and conventional bricks was nearly non-existent.

The availability and cost efficiency of recycled materials is not yet at good level in housing and commercial construction, even though supply has increased in these areas as well. Nevertheless, the competitiveness of these options increase when procurements are examined from the perspective of life cycle costs <sup>(25)</sup>.

Life cycle costing (LCC) is a process that tells an organisation how much a product to be procured will cost, not just at the point of investment, but during its use and decommissioning, in the form of electricity, maintenance and waste management costs, for example. Other factors that need to be considered include the sensibility of renovation, partial decommissioning, expansion and complete re-construction. LCC tools can be applied in the planning and needs assessment phase of procurement, as well as in the evaluation and comparison of products and tenders <sup>(23)</sup>. Life cycle costing makes sense in both infrastructure and housing construction projects, as both are long-term and energy-intensive projects. Unfortunately, the use of total life cycle costs as a procurement criterion is still rare, with the immediate costs of the construction project often considered to be the primary defining factor of the project instead.

Using Life cycle costing tools is skills and time demanding and a consultant or a planner in a public construction organization may do it. Nowadays, there are some tools freely available, one developed for example by Swedish National agency for Public Procurement <sup>(20)</sup>.

For example in Tyrnävä municipality the construction of Rantarousti school is expected to have low life cycle cost. As a versatile building without classrooms, a separate dining room or partitions, it has saved 1 300 m<sup>2</sup> in space. Although there aren't yet any calculations to support this, it can be assumed that the saving in space will also gain savings in maintenance costs.

## Bottleneck 9:

# Lack of space and time

From the perspective of a building contractor, the real problem at demolition sites in particular, but new building sites as well, is a lack of on-site space. Buildings under demolition are notable from the perspective of circular procurement due to their potential of serving as material banks for new buildings. In practice, however, a lack of space at the work site results in the foregoing of sorting during demolition or the need to transport materials over distances of several kilometres, which increases greenhouse gas emissions.

Another problem is the storing of movables. In the case of Helsinki, the city cannot currently store movables or materials from buildings under demolition on a large scale. The current process would require the participation of a third actor to carry out the storing and re-sale of the material and movables received from buildings under demolition. Luckily, these types of operations focusing on excess materials have already sprung up: for example Raksanouto and Rakennusoutlet, Finnish startups productised in 2018, pick up useful excess materials from work sites and sell them via an online shop at prices that are lower than the rest of the market by around half. For now, these business operations are based solely on the utilisation of excess materials, but in the future, it may be possible to increase the reception of demolished materials as well.

A lack of time is an issue that often comes up in the context of planning, market dialogue, the definition of procurement criteria, interim storage and on-site sorting during demolition. These are all processes that take more time than standard processes.

**SOLUTION:** Town planning that takes circularity into account can affect whether there are areas in the city structure that could be used for more effective handling of construction materials.

Unfortunately, there is no magic trick for addressing a lack of time. The key is to accept that learning new ways of doing things takes more time than standard procedures. The amount of time reserved for development work must be sufficient so, as to ensure that getting side-tracked or thoroughly mapping specific issues will not compromise circular economy targets. The mandate for this must perhaps come all the way from the City's management.

## Bottleneck 10:

# Information steering is inefficient

Despite the fact that information steering (such as sustainable procurement guides) is not as effective as the steering of everyday work (such as guidelines for supporting procurement), the former is carried out much more in the context of circular procurement. In tendering, however, general procurement instructions are no longer enough, as suitable circular economy criteria must be defined separately for every building contract. The carrying out of sufficiently detailed information steering is also hindered by the complexity of building procurement processes and poor overall management.

Actual procurement is most often strictly scheduled and pressured work, in which there are simply not enough resources for seeking circular alternatives, unless procurers are specifically instructed to do so. When a procurement is launched, only the specifications and instructions included in the prepared plans are taken into account.

**SOLUTION:** Instead of information steering, the focus should be on cooperation between the environmental expert and procurement specialist and on concrete planning and procurement instructions. Focus on cooperation between the procurement's subject matter expert, the procurement specialist and the procurement lawyer. The subject matter expert and the procurement lawyer must be involved in the creation of circular economy criteria. The criteria need to be ambitious, especially in the context of framework agreements.

Existing tools, i.e. model documents, into which the circular economy perspective should be integrated are:

- Tendering of designers
- Model work reports
- Design instructions
- Model contract programmes, commercial documents

The steering of procurements can be greatly aided by easy-to-understand descriptions of the procurement processes.

Procurement specialists can emphasise environmental issues in both the description of the procurement and tenderers' suitability requirements. Once the key environmental impacts of the subject of procurement have been identified, they can be used as a basis for setting targets and preparing the specifications needed for the procurement. From the perspective of the procurement process, the specifications most relevant in terms of environmental impacts are: tenderers' suitability requirements, the minimum requirements for the subject of procurement, selection criteria and the tender evaluation method <sup>(22)</sup>.

### Good practice:

#### Roadmap Circular Land Issue (Amsterdam)

The Roadmap Circular Land Issue describes 32 criteria for incorporating circularity in a land issue process. These criteria cover five themes: materials, energy, water, ecosystems and resilience. When applying the roadmap, criteria are selected for the area in question, in line with local ambitions, area characteristics, and urban planning frameworks. From the day of publication, the Roadmap has proven to be authoritative in the Netherlands and is widely used to tender circular ambitions. Actual practice shows that some criteria could be fine-tuned and improvement in the application of the criteria is still possible. Therefore, it is important to continue to test the Roadmap, improve its criteria along the way and apply focus <sup>(12)</sup>.

### Good practice:

#### The circular economy criteria of Green Building Council Finland (Suomi)

In 2018, Green Building Council Finland brought together circular economy pioneers in the built environment sector from over 60 companies. Organised into working groups, the participants collected recognised operating models and best practises for implementing circularity in the different stages of building projects. The resulting guide includes operating models for planning, design, building construction, infrastructure construction and demolition <sup>(14)</sup>.







# From idea to action – checklist for a successful circular building pilot

The key to circular building is to simply start somewhere and think about what kind of circular solutions would be best suited to the project at hand. **The following checklist can help your city to think about how to take circularity into account in public building projects.** Please note that not all these solutions are necessarily intended to be used in a same project.

Three most effective ways to minimize climate and other environmental impacts on buildings:

- **Energy solutions** (utilisation of renewable energy and energy efficiency)
- **Minimisation of transports** (including the utilisation of extracted soil on-site, mass-balance)
- **Material choices** (as low carbon as possible, re-usable, safe, healthy)

However, you should not forget the following aspects:

Before you even start:

- Think about demand: do you have to build something new or could you utilise existing structures? Make the most out of your existing space.
- Pilot projects need **slightly higher budgets** than normal ones – choose a site whose budget can still be adjusted.
- **Budget time for development work.** Getting side-tracked is more than likely.
- Take care of scheduling in good time – plan which circular policies to apply in each project stage.
- Engage **project manager** to circular targets at a very early stage.

Plan:

- During planning, keep in mind that the building should be **climate, resource and people positive.**
- Pay particular attention to **the maintainability of the building** and how structures such as pipelines and cables could be laid in such a way as to enable repairs without having to knock down half a wall.
- Tender design services based on circularity criteria.
- Integrate circularity criteria into design guidelines.
- **Design spaces to be as adaptable as possible** and utilise the possibilities of **the sharing economy** by taking into account shared spaces in designing phase and not preventing the flexible changes in the use of buildings.
- **Examine the recycled materials available** on the market and their utilisation potential at the site during the planning phase.

Measure:

- It is important to examine **the life cycle emissions of the building.** These include emissions from the production of materials, the construction itself, use, maintenance and demolition.
- Calculate not only the site's **carbon footprint**, but its **carbon handprint** as well.
- Can you measure some other environmental impacts?

Utilize different green solutions:

- Utilise green solutions and related cycles.
- Utilise rainwater.
- Implement a **green factor approach**.

During the process:

- Utilise a **material passport** during construction.
- Demand an ambitious construction waste recycling and re-use plan and observe that it is followed.
- Prepare a **circular economy plan to be added to plot assignment stipulations**.
- Use materials that can be **re-utilised** after demolition. The purity of the materials is key. Consider the ways in which the materials are used and fastened as well, such as adhesives.
- **Utilise recovered and recycled materials, as well as recycled building parts**, insofar as it is sensible according to a life cycle assessment.
- Utilise the **alliance model** in the project or enable close cooperation between the different actors of the project in some other way.
- Make sure that **procurement specialists** receive all the support that they need from the **procurements' subject matter expert** and **procurement lawyer**.
- **Emphasise market dialogue**, especially in regard to material producers, as they are the most knowledgeable about the circular solutions that they provide.
- **Communicate boldly and broadly throughout the project** – the concept of circularity is new to everyone!





# Ten cases of European good practice

Circular procurement is still a relatively new theme and especially in the construction sector, circular procurements are still rare globally. In order for cities to achieve their ambitious emissions reduction targets and sufficiently slow down climate change, we must take action now, even if the solutions do not appear to be straightforward or clear at a first glance.

The purpose of this case catalogue is to prove that it is possible to develop circular procurement processes for the public construction sector. The examples presented also show the diversity of the circular solutions that can be taken into account in the procurement. The examples have been chosen to represent different types of public construction and are written by municipal experts, company representatives and regional circular economy experts.

We hope that the good practice presented here will inspire other municipalities and encourage them to take circular economy perspective into account in their procurements by showcasing the drivers and benefits of circular economy procurement.

The key connecting factor for all the cases is their innovativeness: these purchases have rarely had a clear formula to follow. In these cases, experts are also boldly opening up of the challenges of circular procurement. By providing this information, other municipalities are not forced to stumble across the same obstacles.

We warmly thank all the individuals who participated in the production of these cases.

# Brummen, The Netherlands

## Brummen municipality Town hall

### What was the vision/goal?

The municipality didn't have any environmental goals. Circularity did not yet exist as a term.

Municipal restructuring is ongoing in the Netherlands. The municipality of Brummen expects to become a part of a larger entity in the future, which will make the town hall obsolete. Therefore, the municipality requested a temporary structure.

RAU could offer the municipality a beautiful temporary building with all the space and comfort they were expecting but didn't think it would be feasible in a temporary structure.

### Who was the team?

Municipality Gemeente Brummen, RAU, Turntoo as the circular advisor, the construction company (BAM).

The request by the municipality for a temporary structure was an important trigger to convince all stakeholders to comply to the circular design protocols set out by RAU/Turntoo. Guidance by RAU/Turntoo teams on specific requirements was essential – RAU/Turntoo organized a very intense working relationship with all the stakeholders to ensure an integral process.

### Project description and circular solutions adopted in the project

Materials were not glued together, but instead mechanical joints were used so that parts could be taken apart without demolishing the building. Wood is a perfect material for this, concrete would have been more difficult.

Other features:

- The building has a biodegradable moss-sedum rooftop layer
- The reception desk of the town hall is made of recycled cardboard
- The carpet is C2C-certified
- A flexible system for the interior walls makes it possible to modify the floorplan during the usage period.

### Did you use circular criteria in construction planning guidelines?

Yes, the circular criteria were design for disassembly, flexibility, reassembly and reuse.

*The construction company has adopted circularity in their operations and it was one of the first companies to become a part of Ellen McArthur foundation's network CE100*

Examples:

- Wooden beams were made thicker than necessary, which gave the supplier more flexibility for the next use-cycle and according to the company 20% higher residual value
- The interior of the new building extension allows modifications in the floorplan without demolition



### Did you use circular criteria in your tenders?

The municipality did not use circular criteria in the tender for the building, but the tender did request a temporary structure.

RAU/Turntoo sat down with the construction company and the suppliers and explained the concept. The brief to all suppliers was to deliver products / building materials, which they would be able to take back and reuse. They all created and worked with the circular criteria together.

### Did you use materials passport?

Yes.

A material passport as such did not exist then, and neither were there any tools to support this. Brummen town hall was the first building in the world, which was equipped with a material passport. All the materials, which were used in different parts of the building, were documented. This documentation was handed over to the municipality.

### Costs

It is very important to create a planning process from the beginning, engaging all the partners (architects, constructors, suppliers). The earlier this is done, the lower the costs will become. It will be more time consuming, but it doesn't have to be more expensive. The design costs might be somewhat higher, but they are not very relevant in the whole budget.

Failure costs: every building project calculates a failure cost, which is produced when people don't build according to the design, things are not delivered in the right way, logistics are complicated, etc. The thorough planning process incorporated in circular construction lowers the margin for failure costs.

## Summary

The historic town hall of the municipality of Brummen was too small so it has been enlarged by a temporary addition. The original building is intact and a structure of glass and wood has been built around it. The structure resembles lego parts: it can be taken apart and rebuilt somewhere else, or the components can be reused.

## Construction period

The tender was won in 2011 and the construction project was finished in 2013.

The actual construction time was reduced by 6 weeks compared to traditional construction. The reason is that everything was thoroughly planned and prepared in advance and the materials just had to be assembled.

## Relevant links & documents

<http://www.rau.eu/portfolio/gemeentehuis-brummen/>

*The brief to all suppliers was to deliver products / building materials, which they would be able to take back and reuse. They all created and worked with the circular criteria together*

### **What were the challenges?**

The challenge was to communicate to all the different partners, which the goals were, to line everybody up and make people aware that they were creating something special and revolutionary.

The aim was to provide the municipality with a building as a service contract, the contractual framework and financing was developed. RAU/Turntoo, together with the suppliers and Dutch municipal bank, drafted a contract where the municipality could have only rented the building and all the materials would have remained in the ownership of the material supplier. However, the municipality wasn't ready for this innovation.

### **Direct GHG reduction?**

No CO<sub>2</sub> impact was measured. However, for the construction in general it is fair to say, that apart from the potential savings on GHG emissions through the reuse of materials in the future, the preference of wood as construction material produces savings in GHG emissions compared to e.g. concrete. Wood is a carbon sink rather than a carbon emitter.

The building is also very energy efficient; the design maximizes the use of daylight, the façade is equipped

with a self shading structure and the building uses a system of natural ventilation.

### **What was achieved?**

The municipality was very proud of the new building. It has received attention on a national level and served as an example for many tenders by other public bodies.

It is a building, to which people like to go.

After the project, the construction company has adopted circularity in their operations and it was one of the first companies to become a part of Ellen McArthur foundation's network CE100.

### **Next steps**

The municipality of Brummen, and also other municipalities throughout the Netherlands, have been inspired by this example and started to use circular criteria in their construction projects.

### **Contact details**

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# Haarlem, the Netherlands

## Cooperation Agreement Project Management and Engineering Services and Framework Agreement Maintenance Public Terrain

### What was the vision/goal?

Haarlem aims to procure green, fair and circular. The city is working hard to transition into a gas free city with a circular economy in which cooperation between businesses, government, knowledge institutions and citizens ensures we work effectively, innovatively and sustainably. The agreements focus on collaborating with our contracting parties on the realization of sustainability goals.

In the preparation of projects, the city of Haarlem sets guidelines and goals. The businesses are responsible for the implementation of the project within these guidelines and are free to realize the project within the given framework. So, the contractors are obliged to realize certain goals, yet are free in choosing the method of implementation.

Part of the framework are the following organizational goals:

1. Collaboration with the city and its inhabitants (participation in decision making)

The city of Haarlem is open and cooperative towards the people in the city. People from Haarlem have influence in the way the city operates.

2. Sustainable and circular

Sustainability is an important topic for the city of Haarlem. The city has signed the Green Deal GWW 2.0. This is an agreement between market parties and several public authorities to achieve goals on sustainability, climate adaptation and the circular economy in the infrastructure.

3. (Cost) Efficient

The contract partners are obligated to show that they work cost efficiently.

4. Political sensibility and orientated on the effects for the society

The contract partners are expected to realize that they operate in a politically sensitive environment and have to act accordingly.

Corporate Social Responsibility (by creating opportunities for people with poor job prospects, in the Netherlands it is called Social Return on Investment – SRoI) is incorporated in the contracts. The contract partners have the obligation to spend 4 % of their yearly revenue on the incorporation of people with poor job prospects.

With the contracts, Haarlem also aimed to achieve (technical) innovation and an overall increase in quality of its infrastructural projects.

### Project description and circular solutions adopted in the project

The innovative part of this procurement project was the fact that we didn't describe everything in detail beforehand. Sustainability and circularity was part of the awarding criteria. The tenderers could apply their best sustainable and circular solution.

The tenderers had to fill in the form according to the tool [DuboCalc](#). This tool help contracting authorities to compare the offers (including the use of materials) on their ecological, sustainable and circular impact.





## Who was the team?

The procurement-, technical-, contract managing- and sustainability departments worked closely together under the supervision of the responsible alderman.

The key of success was working together to achieve a common goal. Therefore, everybody was essential. The above-mentioned departments proposed this way of tendering. The local politicians and responsible managers made it happen.

## How did you do it?

The tender consisted of two stages. In the first stage, businesses were invited to apply if they could meet the selection criteria. These were based on economical demands (insurance, revenue) and experience (references, experience with certain contracts, technical ability). The demands in the first stage were deliberately kept low, so many parties would be interested and local parties would have a chance.

In the second stage the remaining applicants were invited to describe how they would help Haarlem achieve its political and organizational goals. These descriptions were used for award criteria. The parties were free in what they offered to obtain these goals. All parties were invited to give a presentation about their plans. This presentation was also taken into account during the selection procedure. There was no financial paragraph other than the question of how the applicants show they remain competitive with the rest of the market. This way we created the possibility for the market to formulate creative and innovative solutions on how to tackle our political and organizational goals, like sustainability, climate adaptation and the circular economy.

The market was very interested in the contracts. It was an opportunity for them to show the possibilities

## Summary

Key elements are active collaboration with the market by setting frameworks and sustainability goals, but entrusting responsibility (and opportunity) to the contracting parties. We work together with our contract parties, not opposite them. This way an energetic synergy is created between political goals and business opportunities.

## Construction period

2017-2022

## Relevant links & documents

[https://www.youtube.com/watch?v=Vm\\_QKRnhLAM](https://www.youtube.com/watch?v=Vm_QKRnhLAM)

<https://houtplein-inbeeld.nl>

of their business model and their distinctiveness from the competition.

The first stage attracted more companies than the maximum that was allowed for the second stage. By lot drawing the number of companies was brought down to twelve contractors and six engineering companies. These companies competed in stage two for the final selection.

For the final selection, all remaining companies handed in strong applications. In the end, the selection resulted in four contractors and two engineering companies.

### What was achieved?

The implementation of the contracts has delivered several beneficial results. Some examples of these solutions are:

Collaboration with the city and its inhabitants:

- Fixed project teams, which know the ways around the municipality and the parties they communicate with, thereby significantly improving quality and reducing start-up costs.
- Fixed community engagement managers for local inhabitants and interest groups, resulting in satisfied stakeholders.
- Better communication and cooperation with the people of the city. For example: <https://houtplein-inbeeld.nl>

Sustainable and circular:

Significantly reducing CO<sub>2</sub> emissions (by reducing logistical movements, by using of electric equipment and solar panels) and improving reuse of materials.

(Cost) Efficient:

Lower project costs by reducing start-up time and effort, optimization of design and technical specifications and by letting the business partners focus on their own strengths and their solutions for our problems.

Political sensibility and orientated on the effects for the society:

- Corporate Social Responsibility of 4% (by creating opportunities for people with poor job prospects)
- Creating a sense of community: the (local) government, the business partners and the inhabitants are all in it together.

*Bringing client, engineering company and contractor together results in smoother performance and better results. Collaboration does pay off*

### Cost

- Lower project costs by reducing start-up time and effort, more efficient community engagement and design process.
- Optimization of design and technical specifications in projects by better sharing of knowledge and improving innovation capacity.
- By letting the business partners focus on their own strengths and their solutions for our problems, the friction costs of implementing someone else's modus operandi were avoided.



### **Direct GHG reduction?**

Sustainable and circular:

- A local hub for raw materials, significantly reducing CO<sub>2</sub> emissions (by reducing logistical movements) and improving reuse of materials.
- Electric building equipment.
- Solar panel powered construction shacks.
- An app is being developed for the reusing of materials. With this app, contracting parties know which materials are available and are thus strongly encouraged to use each other's materials. This is a significant step into a circular economy.
- Reuse of raw materials (sand) at the project sites by adding an additive for the holding capacity of the sand. Normally, it would have been removed and new sand (with the right holding capacity) would have been brought in. Now, with the reuse of raw materials, the logistic movements surrounding project sites is reduced with a beneficial effect on CO<sub>2</sub> emissions and steps are being made towards a closed energy and materials chain.

### **Type of circular procurement conducted**

Demolition, construction, planning and engineering of foundation and surface works, paving and asphaltting works, road furniture, et cetera.

### **Did you use circular criteria in your tenders?**

We used it as awarding criteria in the road works / public physical infrastructure tender. We asked the tenderers what will happen with the materials after the usage and about the possibilities of reuse and recycling.

### **Did you use circular criteria in construction planning guidelines?**

We did not provide planning guidelines because it is a framework agreement. However, the planning of the works based on this framework agreement in relation

with logistics is very important. For example, a local hub for materials is used and sand is reused on site. In the past big trucks/lorries transported the sand away and it wasn't clear what would happen with it (landfill site or clean and reuse?). Right now, the reuse is guaranteed.

### **Did you use materials passport?**

In this particular tender, we did not use a materials passport, but we are busy to incorporate the specifications in our ICT systems to make use of the materials passport possible in the future tenders. We are almost ready with the implementation and expecting to start using the materials passport in May 2019.

### **What were the challenges?**

Organizational and political objectives such as sustainability, climate adaptation and circular economy, can be attained with procurement. The market is able and willing to invest time and energy in delivering innovative solutions. Bringing client, engineering company and contractor together results in smoother performance and better results. Collaboration does pay off.

It is essential to remain focused on the main goals, to dare to ask the market for their solutions, and not to fall back on old and familiar ways. It requires a different look on the function of the government: not a know-it-all-organization, but one that provides freedom to and puts faith in the hands of our business partners, while securing the necessary framework and direction. Be firm when required, be flexible when feasible.

Openness, trust and optimism are key for the realization of optimal results. This requires time, energy and constant evaluation of applied methods. The best way is to aim for a win-win-situation: on the one hand, help businesses to develop their innovation and sustainable strengths and on the other hand make sure the government achieves its goals. The political and organizational

goals of the City of Haarlem are not to be debated, yet the businesses can contribute significantly to how we are getting there. This leads to a transformation of the market itself: the innovative and sustainable businesses are put into a much better competitive position than before. They have developed more knowledge, more experience and do have results to show.

We have thus created a foundation for a future that is economic, ecological and social. The desired results are on the horizon, while creating a social-cultural impact of togetherness that will last longer than the present or even the near future. We need each other to face the challenges of today and tomorrow. That solid belief resonates also in the way we do business: together.

It is very difficult, especially in the current market in which prices increase at a very high rate, to quantify all the benefits obtained from these contracts. It is about a new way of doing business, a social-cultural change. All we can emphasize is “dare to ask” and the social, economic and ecological magic begins.

### **What were the key reasons for the procurement to succeed?**

The key reason for the procurement to succeed is to give the contract parties the opportunity to share knowledge on sustainable and circular solutions in an early stadium of the projects. With that in mind, we (the municipality, the engineering companies and the contractors) can secure the room in the contract to implement sustainable innovations.

In more traditional contracts, there is often lack of room to implement sustainable innovations, suggested by contractors, as traditional procurements demands certain solutions without the opportunity for alternative solutions. Therefore, this procurement stimulated the businesses to present their sustainable and innovative

solutions to the municipality. It opens doors for the implementation of innovations now and in the near future.

### **Next steps**

The City of Haarlem is applying for URBACT Action Network Planning Call with a proposed Partnership on Advancing Circular procurement of Infrastructure & CIVIL Works: ACTIVO.

ACTIVO aims to advance innovative, sustainable and circular solutions for constructing and renewing the physical infrastructure. The network will develop and implement a framework that includes:

- Recommendations for the necessary procurement expertise and approaches
- Market research and outlining of sustainable solution
- An analyses of the knowledge and capabilities of the suppliers
- Suggestions for circular and sustainable public procurement criteria.

Exchange of knowledge and expertise within Europe will provide input for this practical procurement framework.

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# Tyrnävä municipality, Finland

## Rantarousti School

### What was the vision/goal?

The goal was to build a school for the future, by choosing renewable energy resources and considering the most economical solution from the life cycle point of view.

Tyrnävä municipality has joined the Finnish HINKU (Towards carbon neutral municipalities) forum in 2016 and is committed to conducting activities that promote the transition towards a low carbon municipality.

### Who was the team?

The municipal project group included elected officials, municipal manager, director of education, technical director, regional architect, school representatives, sports secretary and food service director.

**Constructor:** Tyrnävä municipality

**Architect:** Arkkitehtitoimisto Hannu Jaakkola Oy

**Structural design:** WSP Finland Oy

**HVAC planning:** Optiplan Oy

**Acoustic planning:** A-Insinöörit Suunnittelu Oy

**Construction contractor:** NCC Suomi Oy

**HVAC contractor:** LVI-Xpert Oy

**Electrical contractor:** Aro Systems Oy

**Automation contractor:** Trentec Team Oy

The Public Private Partnership between the municipality and the construction contractor has succeeded through collaboration. All the actors have participated in the negotiations from the beginning. This way the users have been heard and things are working.

### Project description and circular solutions adopted in the project

The municipality regarded that one of the most simple ways to build ecologically was to save in space; the construction of a versatile school building without

classrooms, a separate dining room or partitions has helped save approximately 1 300 m<sup>2</sup> in space.

Regarding material and technical solutions, life cycle impacts were taken into consideration. For example, the northern exterior wall of the school building is made of wood, whereas the southern wall is made of brick, as wooden structures on the sunnier side would need more maintenance.

The main heating source is geothermal heating, which covers 98% of the building's needs. The remaining heat energy is received by district heating, which is produced by a wood chip power plant. There are also solar panels on the roof of the building. They produce electricity for the building.

### Did you use circular criteria in construction planning guidelines?

In the coordination of HVAC solutions sustainability has been taken into consideration. Materials and solutions have been chosen with functionality and life cycle in mind.

### Costs

The construction costs were 14.8 M€. The saving of 1 300 m<sup>2</sup> in space has been calculated to be worth 3.1 M€.

The yearly maintenance costs according to the maintenance contract are 338 000 €. In addition there are other costs for 50 000 € per year. It has been estimated that the saving in space will also gain savings in maintenance costs, although there aren't any calculations to support this yet.

Planning and interaction have been more time consuming than usual but at the same time, this has been seen to benefit the whole project.



## What were the challenges?

A decline in the number of bidders created a significant challenge in the procurement phase. Initially three actors participated in the bidding competition, but due to the character of the project, only one actor was left in the final negotiations.

## What was achieved?

The users have been very happy with the results. They have been heard already in the planning phase and they've had the chance to genuinely influence the realization of the premises. The indoor air quality is good and the acoustics work even better than was expected.

Continuous monitoring makes it easy to follow development and to react fast to potential anomalies.

A steering group gathers quarterly, concerning the follow up of the maintenance contract and the Public Private Partnership.

## Next steps

The goal is to exploit the successful solutions of this project also in other building projects in the future.

As a member of HINKU forum Tyrnävä municipality is committed to certain emission reduction goals. Regarding municipality owned property, the aim is to give up heating systems that are based on fossil fuels. So far, in one school building oil has been replaced with wood pellets in the heating system.

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## Summary

The new Rantarousti school building in Tyrnävä municipality was created into an open learning environment in accordance with the new national curriculum. The school building is divided into four teaching cells and it lacks classrooms, partitions, school desks and a dining room. The municipality and the construction company have made a cooperation agreement regarding maintenance of the school building for the first 20 years.

## Construction period

The planning started in the year 2013 and the construction work was carried out in the years 2016–2017.

The construction work didn't last any longer than the construction work of a conventional school building.

## Relevant links & documents

<https://navi.finnisharchitecture.fi/en/rantarousti-school/>

# Copenhagen, Denmark

## Circular Courtyard Garden

### What was the vision/goal?

To focus on material recycling, rainwater as a resource and circular economy. This innovative professional angle combined with a project process characterized by a co-creative innovation process in co-operation with the citizens. Thereby reduce the climate footprint, empower the citizens and enhance the liveability.

### Project description and circular solutions adopted in the project

Solid coatings, sheds and furniture are cleared to ensure the climate and cloudburst-proof farm and to create a new context and openness in the courtyard. In the design phase, it is assessed to what extent playground equipment and old materials from sheds and coatings can be recycled. Most of the farm's self-sown and shrub-like trees are felled to make room for the farm's edge and rainwater management.

The smaller trees and shrubs that are worthy of conservation are excavated and deposited for replanting in the new patio. The climate edge is produced by recycled concrete, which is mixed with sand-blasted bricks, glass or similar to produce a living surface. Recycled wood is used for terraces, facade cladding, sheds and benches.

Fields of recycled tiles are laid on the footpaths and in the greenhouse as an aesthetic and natural coating. The greenhouse is primarily carried out with recycled windows.

### Who was the team?

**Project management:** City of Copenhagen

**Architect/engineering/construction:** Lendager Group

**Citizens/property owner:** E/F Straussbo, E/F Enghave Hus, A/B Enghavehus II

The citizens, who are members of the owners associations, were an essential stakeholder group for this project to succeed.

### How did you do it?

Through the innovation and involvement process, which was carried out in co-operation with the Copenhagen Innovation House, the residents received help in identifying exactly the parameters that they thought would create the good backyard garden for them. The innovation process also had another important function, which was to open up the residents' horizons for innovative initiatives and ambitious solutions, which they would not have thought of or been interested in.

*We see it as a necessary investment in a more sustainable future, and the solutions found here won't be as costly next time*

When the thoughts of circular economy and recycling was brought forward, the residents were therefore already ready to think differently, and the implementation of this approach gave the residents even more ownership of the project, as it became more meaningful not only within their own yard, but also did a difference in a larger perspective.

### What was achieved?

In order to establish the climate edge, approximately 500 tonnes of recycled concrete made of crushed



concrete from the yard is used. Compared to new concrete, this results in an estimated CO<sub>2</sub> saving of 7.4 tonnes.

It is expected that disposal of land and access to new soil can be reduced by 80% compared to a traditional gardening project. This corresponds to 19 filled trucks with soil.

It is expected that up to 20% of the existing building materials, fixtures and fittings in the yard can be recycled.

It is expected that up to 90% of the building materials in the project will be recycled. Experience shows that up to 50% CO<sub>2</sub> emissions can be saved with this approach.

## Cost

12 million DKK

The project is not finished yet, so we don't know the total amount of the project. So far, there has been no surprises.

The project will probably cost 40-50% more than traditional renovations. This is mainly due to the experimental character of the project. This means there are far more costs connected to process and methodologies. Crossing traditional industrial and bureaucratic (mainly legal issues) sectors and borders always takes longer time and involves more stakeholders. In addition, documentation and experimenting with new workflows drives cost up. We see it as a necessary investment in a more sustainable future, and the solutions found here won't be as costly next time.

## Direct GHG reduction?

In order to establish the climate edge, approximately 500 tonnes of recycled concrete made of crushed

## Summary

The Circular Courtyard Garden in South Harbour is the first courtyard conversion in Copenhagen developed with a focus on material recycling, rainwater as a resource and circular economy. This innovative professional angle combined with a project process characterized by a co-creative innovation process in co-operation with the citizens has created a sketch proposal, there is a move for what to expect from a courtyard conversion.

## Construction period

Planning: 2017-2019

Construction: 2019-2020

concrete from the yard is used. Compared to new concrete, this results in an estimated CO<sub>2</sub> saving of 7.4 tonnes.

### **Type of circular procurement conducted**

Initially circular economy was not part of the tender. However, during the innovation process it became clear, that there was a potential for circular economy, which was then implemented.

### **What were the challenges?**

This is a new approach, and a lot has been learning by doing.

The most outstanding challenge was of legal/financial character. In Denmark the cost allocated to water treatment, garden yards and rain water drainage is divided between different legislative bodies. An integrated part of the project was to recirculate and treat water locally. The municipality can support the local treatment, but a solution does also include the utility company, and they cannot finance a non-sewer based rainwater treatment, even though it reduces their costs for wastewater treatment. To overcome this challenge, a lot was done to be able to find a legal financing model that could handle this. Which we have eventually succeeded in.

### **What were the key reasons for the procurement to succeed?**

By starting the process around the Courtyard Garden at Strausvej with a citizen-relevant innovation process, it was easier for all the actors to set ambitious goals and

be ready to embark on implementing circular economy in the project. The circuit idea initially set a direction in the project, which means that the sketch proposal clearly creates more value and solves more problems than a customary estate formation would.

### **Next steps**

Next step in promoting circular procurement within construction is first dismissing the lessons learned (and still learning) from our experimental projects and secondly, integrate the solutions in upcoming tenders. Thirdly, planning to get better knowledge of qualities, volume and location of regenerative materials in the city.

A very important part of this journey are the different actors and public agencies that has to co-operate. That's why we're also very focused on governance models like living labs.

We are also going to develop a set of procurement guidelines.

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# Helsinki, Finland

## Laakso hospital

### What was the vision/goal?

The City of Helsinki has ambitious targets for reducing greenhouse gas emissions (Carbon Neutral Helsinki 2035 action plan) and the circular economy is an important factor in achieving the goals. So far, building construction projects have been focused on energy efficiency and renewable energy solutions, which, of course, are a big part of low-carbon construction. Now we want to widen our focus from considering only energy solutions to covering the emissions, life cycle impacts and material efficiency produced by other design solutions as well.

The project includes not only new construction but also renovation and demolition, so it was considered a good opportunity to carry out circular economy actions, for example in the reuse of materials that were dismantled. Since the project is significant at a national level, it has an opportunity to not only act as a national example, but also get sparring and expert advice outside the project.

### Project description and circular solutions adopted in the project

During the project planning, a circular economy workshop was organized in cooperation with the Ministry of the Environment, the Finnish Environment Institute and Green Building Council Finland. The workshop identified design solutions based on circular economy thinking and the related challenges and opportunities.

One of the goals that is strongly guiding the design of the project is multifunctionality. The hospital environment with its functions changes in a fast cycle and the facilities have to be easily adapted to the changing needs.

Multifunctional space supports the idea of building for long-term use and for a variety of uses, resulting in a smaller need for future demolition and new construction. Multifunctionality at Laakso Hospital means among other things generic hospital facilities and technology that can be flexibly converted for various uses. As part of the project planning, a multifunctionality plan has been prepared.

The goal is that easy maintenance and longevity of materials and building components are taken into account already in the planning phase. The goal is also to favor recycled and recovered materials wherever possible. It is also important to enable a circular economy in a use-phase.

*So far, building construction projects have been focused on energy efficiency and renewable energy solutions, which, of course, are a big part of low-carbon construction*

Energy solutions are an important part of the circular economy and they have a significant impact on the carbon footprint of buildings. The main principle of the Laakso hospital project is to first minimize the energy consumption and then maximize the cost-efficient energy produced by the use of recoveries and renewable energy sources. Based on the comparisons made, it has been concluded that the hospital area is divided into two heating and cooling areas, within which waste heat is recovered and utilized where the need is at each moment. After waste heat, geothermal heat is used for

# HOSPITAL FOR PSYCHIATRIC AND SOMATIC CARE



heating and only lastly district heat. During the upcoming planning phase, we will examine the elasticity of electricity and heat consumption as well as energy storage in the form of heat and cold batteries.

Some of the roofs will be used for different meanings, but the remaining roof area is equipped with green roofs that facilitate storm water management on a rocky plot, as well as solar panels.

As part of the demolition planning of at least one demolition building, demolition mapping will be carried out to evaluate recyclable and reusable building components and materials, movable property and their subsequent use, as well as the amount of waste generated by the demolition as well as treatment recommendations. The aim is to find out if the demolition materials can be used in hospital buildings or on the site.

## Who was the team?

The circular economy theme is maintained mainly by environmental and energy experts from the City of Helsinki's built asset management service, who work as client's experts during the project.

In order for the circular theme to be the project's cross-cutting content, including both planning of construction and operation, the mandate should have come even from a higher level.

## How did you do it?

Can't be evaluated yet, as the project is at an early stage.

## What was achieved?

Since the project is still at a very early stage, it is impossible to assess what the outcome will be, and what circular economy objectives will be achieved. So far, one can think that one achievement has been the raised

## Summary

Laakso hospital is the first building project in the city of Helsinki, the objectives of which include a circular economy. The project includes not only new construction but also renovation and demolition, so it was considered to be a good chance to test circular economy approach, for example in the reuse of materials to be dismantled. Since the project is significant at a national level, it is possible not only to act as a national example, but also to receive sparring outside the project group.

## Construction period

Project planning has started in 2018 and will continue until the end of 2019. The project decision will be made in summer 2020. The project will be implemented in stages so, that new buildings are first completed, after which the renovation of existing buildings begins. According to preliminary estimates, new construction will begin in 2021 and renovation in 2024.

awareness among designers and other project organizations of low carbon and circular economy thinking.

### **Cost**

Can't be evaluated yet, as the project is at an early stage.

### **Direct GHG reduction?**

Can't be evaluated yet, as the project is at an early stage.

### **Type of circular procurement conducted**

Hospital planning expertise was used as a design criterion, because of the nature of the project. No other purchases were made at this stage.

### **Did you use circular criteria in your tenders?**

Hospital planning expertise was used as a design criterion, because of the nature of the project. No other purchases were made at this stage.

### **Did you use circular criteria in construction planning guidelines?**

Planning goals as part of the life-cycle goals, in addition to holding a separate circular workshop, with which goals were further refined:

- at least one of the buildings that is going to be dismantled will be subjected to demolition mapping as part of demolition planning
- making use of materials from the plot and dismantling, wood as well as recycled materials and products on the market where possible

- avoiding material wastage in design and construction, recycling energy and storm water, designing a building for flexibility
- taking into account already in designing phase that the technology that is being used is easily repairable and interchangeable and, where possible, recyclable at the end of its useful life

### **Did you use materials passport?**

Not yet, but possibly when buildings are completed.

### **What were the challenges?**

The challenge of the project is that no one in the project (including designers, customer and builder) has any experience of circular economy solutions for a building construction project: information about existing recycled materials, products or other circular economy solutions and services. In this case, designers have been selected based on the hospital designing expertise.

*In order for the circular theme to be the project's crosscutting content, including both planning of construction and operation, the mandate should have come even from a higher level*

Another challenge was that the circular economy target was not the goal of the project from the beginning. The circular economy should have been one of the planning goals of the project even before the designers were procured.

Has it been so, a circular economy perspective could have been one of the selection criteria for designers, and thus circular economy goals would have been clear to all designers even before they started working. Since the goal was decided later, to commit all the designers to circular economy goals seems difficult, partly due to the lack of experience and expertise and because the theme is found difficult. For the above reason, there is no money allocated for developing and implementing the circular theme. The project might have required a separate circular economy consultant, but that would have been a clear additional cost for the project.

The challenge of the project is its size: the project is very big and there are a lot of different designers and work-groups involved. Communicating circular economy goals to everyone is challenging.

To be realized, a circular economy requires a major change in thinking and operating models across the entire construction industry, including customers, designers, contractors, equipment and material manufacturers and other service providers.

The challenge is that ready-made processes for demolition mapping, material storage, etc. do not yet exist, but must be created as part of the project. This takes time and resources and is not possible due to the tight schedules of the projects.

There are currently no known services or operators for extensive reuse of furniture and movables or technical building systems when considering the reuse possibilities.

### **Next steps**

Helsinki city government adopted the Carbon-neutral Helsinki 2035 Action Plan in December 2018. The plan contains actions that aim to promote circularity i.a. in the city's procurement processes and construction projects. There is also an action regarding the creation of a roadmap for circular and sharing economy. The roadmap work is ongoing, with construction as one of its main themes. The learnings from the Laakso hospital pilot project will help promote the actions and goals, which are stated in the Carbon-neutral Helsinki 2035 Action Plan and in the coming roadmap.

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# Gothenburg, Sweden

## Procurement requirements for circular flows in the construction and demolition process

### What was the vision/goal?

The purpose of the project is to accelerate the transition to a circular economy in the construction and demolition processes and to meet the challenge of reducing waste and reducing the use of primary raw material in the construction industry.

The project will increase knowledge of how procurement requirements can be formulated. It will develop an implementation plan for a construction or a demolition project, where the stated procurement requirements can be tested and evaluated in practice. The aim is to head towards circular material flows during construction and demolition.

There is great interest in reducing the amount of waste in Gothenburg area. Circular Gothenburg is a city led initiative, which aims to drive a shift from linear to circular economy. In the year 2018, Circular Gothenburg carried out a pre-study on how the city could reduce the amount of construction and demolition waste it produces. The results showed that the solutions lay in prevention, reuse and recycling. Due to the pre-study Gothenburg city got invited by a consultant agency to participate in this project.

### Who was the team?

Circular Gothenburg at the city's Consumer and citizen service is in charge of the project lead and coordination. In addition to that, the project team includes the following partners:

- Lokalförvaltningen, the city's department which builds, manages and develops public facilities
- Bostadsbolaget and Framtiden byggutveckling. These companies belong to Framtidskoncernen which is a municipal property corporation
- Entrepreneur CS Riv och Hålltagning AB
- IVL Swedish Environmental Research Institute

The project has also a reference group. Currently the group is small but broad and the aim is to broaden it further with more stakeholders who are interested in giving their input to the projects results.

### Project description and circular solutions adopted in the project

The focus of the project is on public procurement (according to the Public Procurement Act), with a limitation on buildings (no infrastructure such as roads and bridges), e.g. apartment houses, office and industrial buildings. The processes include construction, maintenance, renovation and demolition.

The first task is to examine and describe the current situation regarding construction sector and especially the procurement criteria related to construction projects. The methods will include questionnaires, interviews with the project partners and workshops with the reference group. At the same time, IVL will work with defining the scenario for the year 2030.

After the first phase is completed, the project participants will proceed to create a gap analysis between the current situation and the scenario for the year 2030. The analysis will strive to describe what the requirements, needs and possibilities are to reach the desired scenario, with the City of Gothenburg as a case study.

Based on the gap analysis the project participants will draw up recommendations on concrete requirements that may be included in the procurement process. Some of the requirements can be put to use already today, whereas others will need more time and call for greater efforts or even changes in the legislation.

Finally, communication material on the recommendations will be directed to different operators within the



construction sector. The goal is to have the recommendations implemented in their work.

The project research aims to emphasize the following themes:

- optimal use of materials that will minimize waste
- which are suitable materials for reuse and how to maximize the share of reused materials in construction
- recycling of materials to high value use
- in which stages of the construction process circular efforts and work methods should be implemented

## Costs

Vinnova Sweden's Innovation Agency is financing the project.

## What were the challenges?

It is challenging to create incentives for different operators within the construction sector to reduce waste and to increase reuse. The climate aspect is not enough to motivate everyone – e.g. the economic advantages must also be clarified.

There is also a great need for more dialogue between different stakeholders, especially between the buyers and the entrepreneurs. Communication is necessary for the development of appropriate procurement requirements.

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## Summary

The project will create a circular scenario for public procurement requirements in the construction sector for the year 2030. In addition, based on a gap analysis between the current situation and the desired scenario, recommendations for procurement requirements will be drawn up. The goal is to reach the scenario step by step.

## Construction period

The projects duration is December 2018 – December 2019.

## Relevant links & documents

[www.ccbuild.se](http://www.ccbuild.se)

[www.goteborg.se/cirkularagoteborg](http://www.goteborg.se/cirkularagoteborg)



# Hyvinkää, Finland

## Sustainable pre-school building using Nordic Swan Ecolabel standard

### What was the vision/goal?

We wanted a pre-school building that is low in energy consumption, is durable and have healthy indoor environment without chemical emissions, have a good ventilation and dry construction. A building meeting these criteria would also mean less repairing in the future and thus save in costs.

Hyvinkää municipality has a range of environmental aims that this building has to honor, including eco-efficient construction and maintenance, effective energy use and climate protection.

The building needed to be safe, emission-free and healthy for all. We wanted it to provide an environment that encouraged and made possible to organize the pre-school's everyday activities in most versatile way during the day.

Hyvinkää municipality's one aim as a public procurer is to be an innovator and set an example to other public procurers. Therefore, something not done before was called for, that included all our focus points.

### Project description and circular solutions adopted in the project

Public procurement Design & Build. Extensive market dialogue was carried out prior to construction and involvement of stakeholders was ensured during the building process at all times. The contractor was responsible for the Nordic Swan labelling process with the municipality being a link to Nordic Swan Ecolabel authority.

The building has been constructed using ecolabel approved chemical free materials and products only,

which ensures that the emissions to both indoor and outdoor environment are minimal. Building processes were also carefully monitored and managed during the construction phase in order to ensure no environmental or structural risks appear later in the building's lifecycle.

The materials used are either recyclable or can be safely eliminated at the end of the building's lifecycle. The building has also been constructed so that if necessary, it can be dismantled, and either reconstructed elsewhere or have modules safely dismantled and recycled at the factory.

*The key to success in this project was the thorough market dialogue prior procurement in order to commit all parties in the common goals*

The outdoor play equipment also fulfils the Swan Ecolabel standards, and has been manufactured from untreated wood or certified FSC timber, and climbing ropes are made from natural fibers.

### Who was the team?

Procurement and construction department of the municipality as the main team (procurement specialist and the head of building construction). Other stakeholders included the daycare and preschool personnel (who would be placed in the building), kitchen and cleaning personnel, maintenance staff and an art work designer. The children who would be cared for in this building were involved in choosing color schemes and furniture.



Essential for this project to succeed was the fact that all stakeholders were heard and involved. The project management was down to procurement specialist and the head of building construction. One of the key members of the team was the contractor's project manager who was responsible for the ecolabelling during the building process.

#### How did you do it?

The key to success in this project was the thorough market dialogue prior procurement in order to commit all parties in the common goals. We were then able to identify the possible obstacles beforehand and deal with them without them becoming a problem. Obstacles were navigated through together. The team during the building process included the D & B contractor and the key stakeholders with the municipality's head of construction as the head of team.

#### What was achieved?

The resulting building offers a pleasant indoor environment in terms of lighting, noise and ventilation. Through smart architectural design, the daylight factor is at least 2.5% in common rooms, which is difficult to achieve in the Nordic region. The noise environment also presented challenges, due to the fact that the building houses 200 children, but by following ecolabel criterion, the resulting noise is noticeably lower than in a standard pre-school building. In addition, the ventilation is demand controlled and automatically adjusted according to readings from moisture and CO<sub>2</sub> monitors (i.e. reading devices which automatically prompts actions in ventilation), thus creating a comfortable atmosphere for all.

The outdoor play equipment fulfils the Swan Ecolabel standards. All playground equipment has been manufactured from untreated wood or certified FSC timber. Climbing ropes are of natural fibres.

## Summary

The materials used are either recyclable or can be safely eliminated at the end of the building's lifecycle. The building has been constructed so that it can be dismantled, and either reconstructed elsewhere or recycled at the factory. Materials are environmentally friendly and so lowers the carbon footprint of the building. While around 10-15% of building material normally ends up as waste, in this project, this was limited to 5%.

## Construction period

2016-2017

The construction period was slightly longer than in traditional construction project because of the ecolabelling process.

## Relevant links & documents

[http://www.procuraplus.org/fileadmin/user\\_upload/Procura\\_case\\_studies/Procuraplus\\_case\\_study\\_Hyvink%C3%A4%C3%A4.pdf](http://www.procuraplus.org/fileadmin/user_upload/Procura_case_studies/Procuraplus_case_study_Hyvink%C3%A4%C3%A4.pdf)

[http://ec.europa.eu/environment/gpp/pdf/news\\_alert/Issue75\\_Case\\_Study\\_150\\_Hyvinkaa.pdf](http://ec.europa.eu/environment/gpp/pdf/news_alert/Issue75_Case_Study_150_Hyvinkaa.pdf)

In order to ensure the building's accessibility to all children, rooms were also built to cater to disabled children's needs, including wider doorways and extra space within rooms to increase maneuverability. There is also a separate hall entrance, which is spacious enough to allow users of wheelchairs and other aid equipment to enter and store equipment.

Pre-school personnel employed by the municipality across Hyvinkää who have strong allergies or asthma were also offered the opportunity to be relocated to the new building, thereby providing them with a safer work environment which is better suited to managing their conditions.

Financially the reduction in running costs as the building's ventilation is demand controlled and automatically adjusted according to readings from moisture and CO<sub>2</sub> prods. Water taps are on-demand only.

Temperature uniformity is solved by heat regulation and cooling, which is connected to ventilation. This way the cooling energy is recovered. Electrical engineering is modern: daylight adjustable and equipped with presence detectors

### **Cost**

Initial estimated cost was around 7 M euros, all costs financed by Hyvinkää municipality. The final cost came to around 6 M euros.

It was estimated that the ecolabel criteria and the costs relating would increase the overall cost as much as 25%. The costs were estimated to consist of ecolabelled

building materials, approval process and the cost of the licence.

### **Direct GHG reduction?**

Reduction in material use: Usually there is about 10-15% building material waste; in this case, the amount is max. 5%, because for example the reusable waste parts are used in the next project. Wood pieces are used to warm up the factory. Pre-cut materials have saved waste in this product and the suppliers have taken care of their own efficient waste part use. Materials used have a low CO<sub>2</sub> footprint (wood and wood based products were used).

*The building has been constructed so that if necessary, it can be dismantled, and either reconstructed elsewhere or have modules safely dismantled and recycled at the factory*

### **Type of circular procurement conducted**

Construction work:

Modular constructions are built ready in dry and stable factory conditions, delivered in modules and re-assembled on site. Due to offsite construction method, the buildings and their materials remain dry throughout the building process, and are delivered well-sealed. The indoor air is safe and clean. The procurement process and material logistics is well-controlled with combined deliveries, and the amount of construction waste is minimal. The production facilities' recycling system is

efficient. Energy consumption and carbon footprint of the production process is smaller than in traditional construction. Low-energy production process equals less lost energy in lighting and heating. Indoor construction is also efficient, healthy and safe for workers.

Building materials:

All materials used have to be approved by the Nordic Swan Ecolabel before use. Emission-free and non-toxic.

Demolition:

The building is mobile and can be relocated at any time. The building has been constructed so that if necessary, it can be dismantled, and either reconstructed elsewhere or have modules safely dismantled and recycled at the factory.

Furniture:

The indoor furniture has also been selected to fulfil environmental safety, i.e. emission-free and non-toxic, criteria in wood-based products, metals and chemical used.

### **Did you use circular criteria in your tenders?**

Building itself: Nordic Ecolabelling for Small houses, apartment buildings and buildings for schools and pre-schools (Version 3.2)

Indoor furniture: GPP criteria on wood, metals, chemicals and textiles.

### **Did you use materials passport?**

At the time there were no materials bank for the building constructor to refer to, but now the suppliers have enlisted ecolabelled products in the material bank of the criteria.

### **What were the challenges?**

Key challenges during the procurement process were to establish whether the criteria was too demanding, whether at all possible to follow and whether there would be any interest to form a partnership with us.

Key challenges for the building process was to find suitable materials to use in some cases where there was not a readily available product. The approval process of material was cumbersome and slow at times, thus delaying building process.

### **What were the key reasons for the procurement to succeed?**

The carefully conducted market dialogue prior to procurement was essential. The focus being common to all parties had an impact on success as well as the involvement of the key stakeholders and end-users. The back-up of decision makers.

### **Next steps**

Different other municipalities in Finland are beginning to adopt the same approach. For example, Tuusula municipality has a pre-school building project ongoing, to which they are considering using the Nordic Swan Ecolabel criteria among other environmental criteria. This is largely due to an existing example and experiences in Kenttätökatu project.

Tuusula is also going to implement ecolabelling criteria to building repairs in the next suitable project.

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# Gothenburg, Sweden

## Preschool Hoppet

### What was the vision/goal?

The goal is primarily to minimize climate change impact by requiring building materials with low climate impact from a lifecycle perspective.

### Who was the team?

The city government plays a very central role in promoting this theme, as it has included the construction of a fossil free preschool in the city's budget.

Contact with suppliers has been important in order to assess which materials there are in the market.

The preschool board also participates in the planning and construction processes. This way the project will gain the users' acceptance and commitment.

### Project description and circular solutions adopted in the project

The bidding competition was finished in May 2019.

Prior to the competition, a qualification check was performed in order to verify which companies were qualified to tender. Each company was required to have a systematic quality and sustainability work and social insurance.

The city aims to make a partnership agreement with the construction company that wins the tender. This means that the customer will be able to negotiate and influence things also during the process, for example choose building materials. This is a quite new type of arrangement in Gothenburg city and it is still under development.

The planning process began with an inventory of the materials that are typically used in the construction of a

regular preschool. The aim is to examine which materials and components contain fossil fuel-based raw materials.

Research and discussions with suppliers have shown that there aren't many non-fossil products on the market and therefore the project will concentrate on bio-based products, recovering of materials and reusing building materials.

Another investigation was carried out, a calculation of the overall climate impact of a traditionally built preschool. The "cradle to gate" LCA perspective was used in the calculation. The results indicated a climate impact of about 250 kg CO<sub>2</sub>-equivalents/m<sup>2</sup>.

*The project has called for more effort on communication than was expected in the original plans. There is much less information to work on than expected*

### Did you use circular criteria in construction planning guidelines?

No, but reuse of building materials as a means to fulfill the goal of a fossil-free preschool was highlighted. In addition, it was stated that reused fossil based materials are accepted. Low climate impact is required for all transport and handling of materials. The constructor is also required to document any climate impact.





## Did you use circular criteria in your tenders?

There were no specific requirements in the tenders regarding circularity. There are, however, general requirements regarding construction of schools and pre-schools for the city of Gothenburg. These requirements contain a document regarding technical requirements and instructions, including materials. The requirements are updated every year.

The city drew up a list of priorities for the bidding competition, stating that the materials used in the construction work should have a low climate impact, for example by being bio-based and/or one should reuse existing materials.

## Did you use materials passport?

The project participants will create a logbook, which will contain information on e.g. non toxic materials in the building. However, the logbook will not provide any detailed information on the location of different materials in the building.

## Costs

The planning process, including necessary investigations and changes in the architect's drawings, will be particularly time consuming. Consequently, the presumption is that the construction project of the preschool will be more expensive compared to a regular preschool construction.

A material with a higher price might be accepted, but there should be a potential for the material to be competitive in the long run.

## What were the challenges?

The project has called for more effort on communication than was expected in the original plans. There is much less information to work on than expected. For example, many suppliers do not actively market their products,

## Summary

Gothenburg city aims to build a fossil free pre-school. The examination and planning process encompasses all the stages from material extraction to production of building materials, transport and construction. Regarding building materials, the goal is primarily to replace fossil fuel-based materials with bio-based materials and secondarily to reuse materials.

## Construction period

The construction work will begin after the summer of 2019 and it will be finished in the year 2021.

There has been a long initial phase of research work but the goal is for the actual construction work not to last much longer than a conventional construction work.

## Relevant links & documents

<https://goteborg.se/wps/portal?uri=gbglnk%3a2018219132018166>

even if they are made of recycled materials. The reason is that according to the suppliers, the customers do not give any additional value to a product if it is produced of reused materials.

There is a need for environmental product declarations to verify the climate impact of products and to compare different products on the same basis.

### **Next steps**

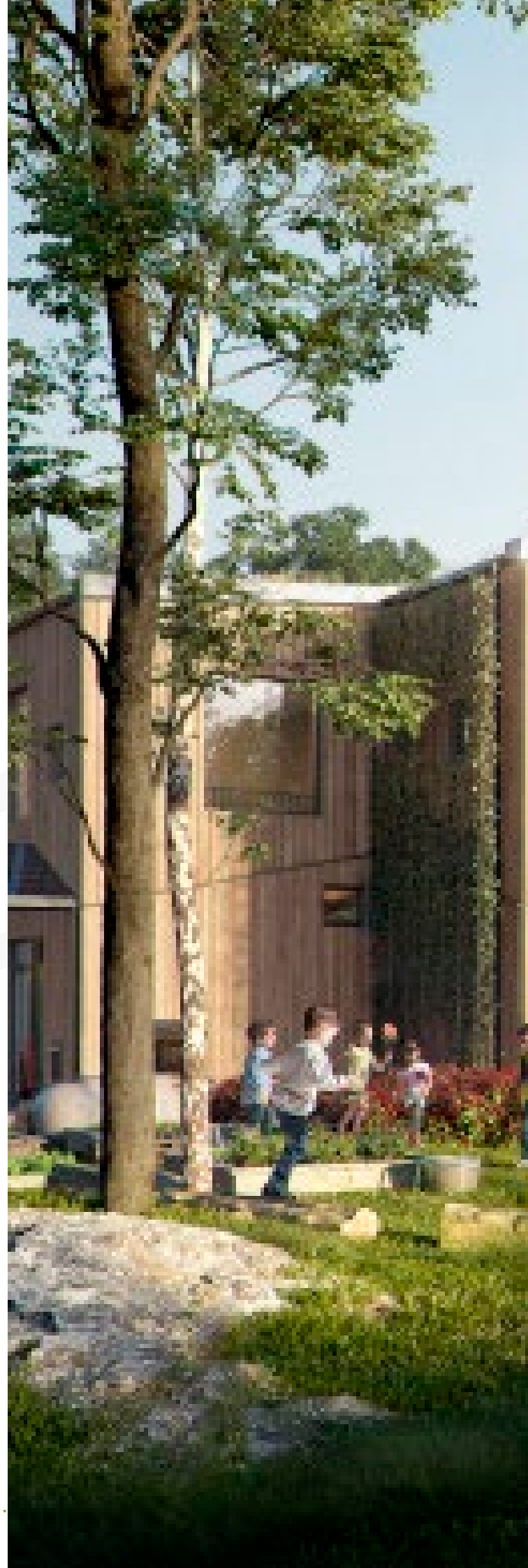
Gothenburg city government's goal is to become the first fossil free government by the year 2030. The whole city aims to be defined as climate smart, including all the city's buildings.

The city of Gothenburg is participating in several research projects on circularity in the construction sector. An important part is the investigation on how to evaluate reused products in terms of climate impact.

The city also collaborates with research institutes and demolition companies to increase the usage of procurement to increase circularity and demand demountable buildings.

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# Aarhus, Denmark

## Circle House – Denmark’s first circular housing project

### What was the vision/goal?

The declared objective is that 90% of the projects materials can be reused without loss of value.

### Project description and circular solutions adopted in the project

Not build yet. Will be bid out on market terms.

An all-circular building, from superstructure and installations, to inner walls and facades.

### Who was the team?

Over 60 stakeholders across the industry and value chain has been involved in the project.

#### Group Leaders:

Lejerbo (Client), GXN Innovation, Foreningen for Byggeriets Samfundsansvar (FBSA), MT Højgaard, Danish Building Research Institute (SBI).

#### Municipality:

Aarhus Municipality (The site of the construction).

#### Collaboration Studio:

3XN Arkitekter, Lendager Group, Vandkunsten.

#### Industry Partners:

Orbicon, Spæncom, Dansk Beton, Peikko, Velfac, Rockwool, Caverion, Gyproc, RGS Nordic, NCC Construction, Kingo Karlsen, Tscherning, Tarkett, Kalk, Dovista, Troldekt, Fischer Lighting, Tåsinge Elementer, Thermocell, Aisol, InnoTherm, Papiruld Danmark, Derbigum, Komproment, Rheinzink, Convert, Haki, Kvadrat, Bewi Synbra Technology, Gutex, Isolenawolle, Scan Underlay, Thors Design, Kebony, Climate Recovery,

CBI Danmark, Egetæpper, Metisse, ENKL, Amorim, Overtreders W, Bureau SLA, KorkBYG og Hunton.

#### Consultants:

Responsible Assets, Horten Lawyers, Lauritzen Advising, Hildebrandt & Brandi

#### Education:

CINARK – Center for Industrialised Architecture, Aarhus University School of Engineering

The project is supported by:

Realdania and the Danish Environmental Protection Agency’s Development and Demonstration Pool (MUDP).

*We have developed a fully circular project and built a demonstrator of the system. It has proved that it can be built, as well as confirmed our ideas about it being faster to build*

### How did you do it?

It has been key to involve the whole value chain. GXN and the client has facilitated the process, and the many stakeholders interest and the quality of the project.

### What was achieved?

We have developed a fully circular project and built a demonstrator of the system. It has proved that it can be built, as well as confirmed our ideas about it being faster to build etc.



### Cost

Budget around DKK 120.000.000 for the building alone from the client, Lejerbo.

Plus DKK 10.000.000 research grant to develop the circular principles and spread them to the industry from Realdania and the Danish Environmental Protection Agency's Development and Demonstration Pool

### Direct GHG reduction?

We do not know the GHG reduction at this point.

The Danish Building Research Institute will carry out an LCA on the final building.

### Did you use circular criteria in your tenders?

Circular criteria is still under development, but it will be bid out on market terms. Our criteria will be based on the 15 principles from our book Building a Circular Future:

<http://www.buildingacircularfuture.com/>

### Did you use circular criteria in construction planning guidelines?

Yes, again based on the 15 principles from our book Building a Circular Future: <http://www.buildingacircularfuture.com/>

### Did you use materials passport?

To be done, using BIM.

### Contact Details

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### Summary

Circle House is Denmark's first circular housing project, and its purpose is to disseminate knowledge and know-how about circularity principles to the entire construction sector, as a scalable lighthouse building project offered and constructed on market terms.

The Circle House project, with Lejerbo housing association as the client, is building Denmark's first social housing constructed according to the principles of circularity. This means, among other things, that the project's buildings are designed to be dismantlable so that its structural components can be reused with scarcely any loss of value.

### Construction period

Construction has not started yet, but is expected to happen 2020-2021. The construction is not expected to take longer than traditional project. However, development has taken longer because of the new circular principles has to be integrated.

### Relevant links & documents

<https://gxn.3xn.com/project/circle-house>

<https://gxn.3xn.com/project/circle-house-demonstrator>



# Hague, Netherlands

## Tendering Circular Furniture: maximising residual value of furniture at Province Zuid-Holland

### What was the vision/goal?

To maximize the circularity of our furniture for the coming decade.

The province has the obligation to be a first mover when it comes to the circular economy. The province aims to be a launching customer for the region, setting the example to other public organisation and boost circular innovation preferably out of the regional ecosystem.

### Project description and circular solutions adopted in the project

1. Determination of scope and ambition
2. Setting up the business case to connect to the internal organisation, showing the financial consequences of reusing furniture.
3. Follow a non-public procedure for which market parties could qualify with a.o. their visions on circular economy and own operational management.
4. Investigation of status quo of available furniture by selected parties.
5. Offer by parties describing how and how much of the existing furniture would be reused.

### Who was the team?

The province was the only decision authority for this case implying direct influence on the market as a launching customer.

Stakeholders: Management team finances, Concern director, Provincial Executive, Innovation team, Team Circular Economy, program manager Province of Values, project lead renovation main building.

Team: project lead, booster sustainability, contract manager, purchasing agent, external advisor.

### How did you do it?

Before this pilot, we had little expertise about circular procurement. PIANOo helped us out and advised us to hire an external consultant. Clearly, circular procurement is a discipline on its own.

We investigated several strategies amongst which furniture as a service. However, this required many adaptations of our processes: operations, finances and legal. This would have been so radical and time consuming that we took another road.

Leasing furniture was another option that did not turn out to have a business case, as the province can borrow money at a very low rate and leasing is relatively expensive.

Therefore, we chose the buy-and-buy-back model making residual value the core of the business model, including it in the price and awarding of the contract.

The following working definition was drawn up for the trajectory:

- Extension of life span of existing furniture by maintain, repair, refurbish of repurpose strategies.
- Discarded furniture is to be reused/redistributed outside the organisation for as valuable as possible purposes.
- In case of (well-considered) need for extra furniture:
- Fulfil this need with existing furniture that is not needed any longer (or temporarily) elsewhere by refurbishing, remanufacturing or recycling.
- If nothing is available consider new, yet circular, furniture that can be reused (after a life at the province) on product, component and material level. This

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implies timeless and modular design, and non-toxic materials.

- The stock of furniture should (partly) be multi-purpose and could partially be exchanged in case of change of needs, for example because of new ways of working.
- The energy used to (re)make and transport the furniture is fossil free, self-supplied and renewable as much as possible.
- Cooperation in the supply chain ensures circular maintenance and production.

## What was achieved?

A contract is signed for 10 years that forces province and Gispert to optimise life span of existing furniture. This includes a search outside the province for reusable furniture if necessary and only if no other choice remains, to offer new furniture that meets very strict circular demands.

## Cost

Period of contract:

10 years, extremely long for a framework agreement

The transition to a circular society requires investments and effort of the supplier. To enable the supplier to recover the costs on these investments, the contract can be extended up to 10 years.

Costs:

Tendering at least 2.5 million Euros.

The business case – made to create support for circular procurement – showed that total costs of ownership (TCO) are lower over a period of 10 years. Repurpose could turn out to be a little more expensive, but on average furniture will be cheaper and overall furniture

## Summary

Province Zuid-Holland signed the national ambition of the Netherlands to close all material loops and be 100% circular in 2050. One of the main instruments governments have is procurement. The first pilot as a start to develop circular procurement procedures was a tender for circular furniture for 10 years.

Most of our furniture is in perfect shape as is a lot of replaced furniture from other governments and companies. Reuse of this furniture, after check and minor revisions, was to be the basis of the contract.

The aim is to wake up the market: keeping furniture in a good state will increase the value after first use. The key for new contracts should be maintenance, easy replacement of parts of furniture and return streams: preserving as much value of materials and products as possible. Herewith we hope to give an impulse to the redesign of furniture so the larger public can profit from this initiative as well.

As circularity had an impact score of over 50%, this tendering process can be considered a true circular tender.

## Construction period

October 2017 – February 2019 Start of exploration until signing contract.

We deliberately took more preparation time than usually as circular is a completely new theme for the province, so it has to be done right and in cooperation with different departments. As it was a pilot with the aim to 'change the organisation and its procedures' it has to be done properly and with the right people to grow support for the future.

## Relevant links & documents

<https://www.zuid-holland.nl/actueel/nieuws/februari-2019/meubilair-provincie/>

costs will probably not be higher. The province is willing to take the risk in favour of a circular economy.

### **Direct GHG reduction?**

Non-applicable.

CO<sub>2</sub> targets in practice conflict with circular targets on a regular basis. As this should not be the case, the province is currently diving deeper into this matter.

### **Type of circular procurement conducted**

Furniture

### **Did you use circular criteria in your tenders?**

Tendering criteria:

#### **GC1: Representative case (impact: 25)**

##### **GC 1.1 Functionality (impact 10)**

Furniture in the representative case should at least meet functionality as state in Appendix II 'Look and Feel of furniture'.

##### **GC 1.2 Circular reuse (impact 10)**

High-quality reuse of the existing furniture is the basis.

##### **GC 1.3 Circular sources (impact 5)**

Reuse of own furniture is most important

#### **GC2: Offering new circular furniture (impact: 10)**

##### **Material Passport (10%)**

A material list of all requested furniture is required.

##### **Origin of used materials (30%)**

Specify origin of material for each piece of furniture:

- % recycled content
- % short-term renewable

##### **Recyclability (30%)**

Specify materials and volumes that can be recycled or biodegraded:

- % recyclable
- % biodegradable/compostable

##### **Toxicity (10%)**

Which C2C banned list chemicals are used in offered furniture.

##### **Demount ability 1 (10%)**

Which components are 100% separable with common tools like screwdrivers, scissors, wrenches, etc.

##### **Demount ability 2 (10%)**

Which materials are 100% separable using common tools like screwdrivers, wrenches, scissors, etc.

#### **GC3: Plan of Approach (impact: 35)**

##### **GC 3.1 Cooperation (impact 15)**

How to cooperate with Province Zuid-Holland as clients in general and with regard to the 'renovation of building C' specifically. A protocol for reuse, risks and maintenance measures for reuse should be made. To be included in your project approach: planning, unforeseen circumstances, dealing with end-user, exchanging furniture and continuity of running organisation.

##### **GC 3.2 Circular (impact 15)**

Which KPI's are used to ensure circularity of supply over the period of the contract.

##### **GC 3.3 Residual value and return streams (impact 5)**

How to maximize economic residual value of the complete furniture portfolio of the province including existing, new and discarded pieces.

#### **GC4: A pilot set-up should be placed consisting of (impact: 10)**

- (1) sit/stand desk
- (1) refurbished (meeting)chair

#### **GC5: Price (impact: 20)**

##### **GC 5.1 Representative case (impact 15)**

List prices of all furniture needed for the representative case.

##### **GC 5.2 Services (impact 5)**

List prices for each service required

#### **Did you use circular criteria in construction planning guidelines?**

In tendering process: long preparation time before putting tender on the market, including market consultation.

After signing the contract:

- KPI's are specified together with Gispén (the winner) to be able to achieve circular targets: the market has to do it.
- Innovation is guaranteed in the contract. It is set on the evaluation agenda, and includes cooperation with start-ups a.o.
- Evaluation twice a year
- Sharing learnings within the organisation to improve future circular procurement processes.
- A reuse protocol is developed together with Gispén.

#### **Did you use materials passport?**

The market does not use a material passport for furniture yet.

The province aims for a transparent supply chain for new furniture, so we have agreed with Gispén to set up a system to create as much transparency in the supply chain as possible. We are currently working on setting up the process.

#### **What were the challenges?**

Lessons learnt:

- Start in time. You'll probably need more preparation time
- Involve all stakeholders and put a lot of effort in creating support inside your organisation. A lot could change in the future; you better have them on board.
- Involve circular experts (inside and outside) and educate your team, for example with learning networks like Pianoo (<https://www.pianoo.nl/en>)
- Pick a team that is used to think outside the boxes and can organise and claim space to execute circular procurement.
- Determine shared ambitions and clear working definition.
- Do not (just) focus on new furniture, focus on preserving value; the needs of your organisation; and re-using the existing.
- Involve your contract manager from day 1
- Check your procurement strategy with market parties (is it attractive and feasible for them?).
- Consider extension of contract periods for the sake of circularity.
- Formulate your KPI's together with market parties to make them feasible and optimally achieved.
- Provide room for input and criticism from market parties. This has to be a co-creation process. Be aware that you, as a client, do not know what is actually possible and what the most effective way is to fulfil your needs.

*The province has the obligation to be a first mover when it comes to the circular economy. The province aims to be a launching customer for the region, setting the example to other public organisation and boost circular innovation preferably out of the regional ecosystem*

#### Challenges:

- How to measure the circularity of furniture, especially without disturbing existing (ordering) processes.
- How to ensure actual procurement of circular furniture during the contract period.
- How to ensure that the supplier does cooperate with the most innovative market parties, especially when these are not preferred suppliers of your organisation or the supplier that won the contract?
- How to make sure that adverse incentives do not seduce the supplier to sell us new furniture instead of fixing existing furniture. And which are the best incentives to stimulate and facilitate circular operations?

#### What were the key reasons for the procurement to succeed?

- Motivated team (bottom-up)
- Circular objectives of the organisation (top-down)
- Support within the organisation (you will never succeed alone)

#### Next steps

We are currently translating the lessons learned to other procurement processes and getting a circular procurement team together including internal people, external people and a dedicated transition manager to make circular procurement the new standard.

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CONCENTRATIE





# The pitfalls of circular building

As is the case with the adoption of any new operating method, the adoption of circular building should also be subject to critical discussion. Buildings are, in many ways, a high-risk subject of procurement: people spend the majority of their waking hours in buildings, so it is clear that buildings need to be safe, durable and healthy. For example, the renovation of certain buildings, such as day care centres and schools, is often challenging even with new materials due to concerns related to building materials.

When it comes to circular building materials, the construction sector in Europe is still in the middle of a development phase in which carrying out pilots is essential for assessing the positives and negatives of the concept. Much more experience will need to be accumulated about the use of recycled materials before circular building can become a standard procedure in the sector, as there are many preconceptions associated with recycled materials in regard to their purity, health impacts, durability and life cycle carbon footprint.

The use of recycled materials does not automatically guarantee the best possible outcome in building projects. The reuse of a material is problematic when the material is used for a lower purpose than what it could be used for. This is the case with wood used for energy after its first life as a building material, for example. Furthermore, recycled materials that cannot themselves be reused at the end of their life cycle (such as blended fabrics) are problematic despite being recycled. The use of recycled materials can also require additional

procedures, such as manual cleaning or transportation, which may generate unexpected emissions and expenses.

As such, it is important to incorporate emissions and cost calculations into pilot projects in order to make it easier to justify the benefits of circular building materials in the future. This could be done for example by using LCA methods that take into consideration recycled materials and are able to calculate the carbon footprint of buildings. One such method is One Click LCA developed by a company called Bionova <sup>(29)</sup>. On the other hand, such calculations can also reveal if a material or operating method is not the most economically advantageous or viable due to its life cycle environmental impacts. The carbon footprint of some recycled materials may end up being greater than that of equivalent virgin materials, for example.

However, it would seem obvious that the challenges of climate change and decrease in natural biodiversity that we now face as a society are so massive and dire that we cannot afford to leave any potential ways of addressing them unused. It is unquestionable that circular economy solutions show significant potential in mitigating climate change and preserving natural biodiversity. There are already many CE-marked recycled materials on the market whose viability in construction projects has long since been proven. Such materials include crushed concrete and glass wool, which have been utilised for such a long time that their use is not necessarily even considered to be part of a circular economy.

# About this report

For this report, the City of Helsinki interviewed a total of 34 individuals operating in the construction value chain, from procurers to planners, environmental experts, building contractors, companies providing recycled materials and government officials. The majority of the interviewees participate, or have participated, in the City of Helsinki's construction projects, due to which the report reflects the situation in regard to the City of Helsinki's construction projects in particular. The preparation of the report involved a literature review of circular procurements in public building projects in Europe. In addition to this, dozens of European circular economy experts were contacted and interviewed in order to gather ten good practise cases around the Europe.

The selection of interviewees was carried out based on snowball sampling, a technique in which the researcher initially has one key person who then leads them to another informant. In other words, the research data is collected by the researcher moving from one informant to the next as they are introduced to new key individuals.

The interviews focused on procurements in new building projects, especially in the context of housing and commercial construction. Infrastructure construction and building demolition were given less emphasis, as it became apparent in the very first interviews that several circular economy measures are already being implemented in infrastructure construction and demolition, and that the greatest deficiencies can be found in the fields of housing and commercial construction. However,

infrastructure construction and demolition were touched upon in several interviews, and the information gained from these interviews was also integrated into the report.

Two experts were interviewed in the context of planning and regional planning, even though planning is not a part of procurement as such. However, planning and regional planning were deemed to play an important role in promoting circular procurement in construction.

Although the first half of the report is first and foremost a description of the state of circular building in the city of Helsinki, it can also be used for benchmarking in other European cities. In the European context, building procurements are somewhat similar, so the results of the report can also be generalised to other European cities, insofar as applicable.

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