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# Circular Economy in the Built Environment in Finland - A case example of collaboration

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**Abstract.** Circular Economy in the building and construction sector is challenging the conventional habits and models of work. It demands comprehensive collaboration between stakeholders and collaborations even with unconventional partners. Nevertheless, circular economy model can give remarkable opportunities to tackle the climate change with the help of building and construction sector and helps to find sustainable solutions to the growing urbanisation and to expansion of the cities.

Very crucial obstacle in order to implement circular economy into building and construction sector's processes is the sector's difficulties to adopt new methods. This includes difficulties to use new recycled materials and building components, legislation obstacles, contract models do not support circular economy solutions etc. Often these obstacles are result of absence of life cycle thinking and coordination. Key to solve these kinds of situation where no stakeholder alone can take the responsibility is to gather all the stakeholders together and boost them to solve these cross sectoral obstacles.

To support the adaptation of circular economy into Finnish building and construction sector, The Finnish Innovation Fund Sitra launched a project "Circular Economy in the Built Environment" in the beginning of year 2018. The coordinator of this project is the Green Building Council Finland. Target of this project is:

1. To increase the knowledge on circular economy on the construction and building sector
2. Define how we can support circular economy in building and construction sector and what indicators we can use to authenticate this development
3. Create new collaboration between different stakeholders
4. Develop the procurement and designing processes

The project started by identifying key persons that can advance circular economy in Finland in the building and construction sector. These key persons were asked to point out more circular economy professionals. The project succeeded to collect a network with hundred professionals. With this network and workshops, we defined what circular economy means in build environment and what is our common targets in the implementation of it.

As a result, in the project we defined seven imperative targets that must happen in the building and construction sector. These targets are:



1. Construction and building sector have a common goal to advance circular economy
2. Norm and regulation steer strongly to circular economy
3. Renewing the habits
4. Life cycle thinking is the starting point of all planning and design
5. Areal planning advances circular economy
6. Procurement support circular economy
7. All spaces and locations are in maximal use

In the project we also defined action proposals how to achieve these targets.

As a conclusion we argue that achieving circular economy targets and actions that the whole sector is ready to implement willingly demands common work and the will to work together must come from the stakeholders themselves. Different stakeholder has different motives, but this does not prevent collaboration if there is a neutral platform where to co-work with colleagues.

## 1. Introduction

The definition of circular economy is multidimensional and comprehensive. Several studies describe it from different angles and its economical and societal concepts are not clear yet as we can see from the very recommended article by Kirchherr et al. [1]. Also, how it is implementing into built environment is under discussion and opinions and understanding are developing through experiences. The expanded definition of circular economy by Ellen MacArthur Foundation [2] underlines the re-thinking of the economical process. After Ellen MacArthur Foundation the circular economy is: looking beyond the current take-make-dispose extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. After Ellen MacArthur Foundation the circular economy is based on three principles:

- Design out waste and pollution
- Keep products and materials in use
- Regenerate natural systems

These principals go well with the objectives of good quality urban planning and construction. Thus, this Ellen MacArthur Foundation's definition was a stable basis to build a definition what circular economy means in built environment.

We also find that the definition by van Buren et al. [3], is written with greatest clarity and we thus particularly recommend his definition. After van Buren unlike the current economy, which is largely based on the principle "take-make-waste" (linear economy), the focus point in a circular economy is to not unnecessarily destroy resources. She states that this implies far more than the reduction of waste through recycling, stresses the following focal points: reducing the consumption of raw materials, designing products in such a manner that they can easily be taken apart and reused after use (eco-design), prolonging the lifespan of products through maintenance and repair, and the use of recyclables in products and recovering raw materials from waste flows. After van Buren a circular economy aims for the creation of economic value (the economic value of materials or products increases), the creation of social value (minimization of social value destruction throughout the entire system, such as the prevention of unhealthy working conditions in the extraction of raw materials and reuse) as well as value creation in terms of the environment (resilience of natural resources).

This definition work already done was a good starting point to develop a definition for the built environment sector in Finland.

What is clear is that the circular economy is a powerful tool for climate mitigation. Materials production alone risks exceeding the total remaining carbon budget for a 2°C scenario. It is calculated that we can consume for the total material production 300 gigatons CO<sub>2</sub> by year 2100 in a 2°C scenario but the calculation shows that materials emissions even with energy efficiency production will reach 918 gigatons CO<sub>2</sub> with existing business models and concepts. [4] So, we have an enormous gap that demands zero-carbon energy production but also definitely a prolongation of material's life cycles and a shift towards circularity. There are different estimates of the climate impact of the resources usage in the building and construction sector. Material economics estimates that by 2050, just cement, steel, aluminium and plastic used for construction would result in emissions of 230 Mt CO<sub>2</sub> if they were made with today's production processes ref. It is imperative for the sector to move to more circular resources usage and to adapt new business models that would support them. Yet we recognize that big barriers for change are lack of common understanding and joint vision of how the sector should develop to be climate neutral also from the materials perspective, lack knowledge and skills within the sector professionals on circular material choices and life cycle design, and finally lack of incentives, both economic and regulatory ones, that would drive changes in the market.

To tackle these barriers in Finland the Green Building Council proposed a project "Circular Economy in the Built Environment". The project aims to support the adaptation of circular economy into Finnish building and construction sector by gathering all the stakeholders together and facilitating them to solve cross sectoral challenges together and steering the sector towards more circular practices. The primary objectives for the project were fourfold.

First objective was to increase the knowledge over circular economy on the construction and building sector within the stakeholders in general.

Secondly, we aimed to build a joint vision over the implications of circular economy in construction sector. Together with the stakeholders we clarified the definition of circular economy in the building and construction sector, and defined means to support the change in the sector and indicators, that can be used to authenticate this development.

Thirdly, we facilitated the networking process in order to create new collaboration between different stakeholders. Finally, we pushed the stakeholders to draw together concrete plans and develop the procurement and designing processes for the whole industry.

## **2. Data collecting and methods to build a network**

The project started by identifying key persons that can advance circular economy in Finland in the building and construction sector. In order to recognise the experts in Finland that were both interested in circular economy and were experts on field of sustainable built environment we used a snowball technique as it used to recognize members of a rare population described by Tompson [5] and again by Handcock [6]. We approached ten known experts and asked them to join the network and also to point other experts. To collect their answers, we used an internet form that could be answered anonymously.

Our target in the beginning was to form a network of a hundred experts. That number of persons was more or less reached during the spring 2018. The yammer group that was establish for the network

includes today exactly 100 members. The network consists from designers, engineers, city officers and from experts from different backgrounds.

The Green Building Council Finland organized two full day stakeholder workshops for the identified expert network. The goal of the first workshop was to introduce the concept of circular economy and build a joint vision and goals for circular economy in the building and construction sector together with the network. The goal of the second workshop was to translate the previously set goals into an action plan for the whole sector to take forward. Working groups were appointed in the expert network to develop the action plans further and lead the change in the industry.

The workshops were held a month apart from one other in order to ensure that the participants will have enough time to develop their knowledge over the topic and finalize as a network the joint definition of circular economy in the building and construction sector and satisfy with the set goals. The workshop results were uploaded to the network's Yammer group for a review by all the network members not only the workshop participants.

### 3. Results

After two workshops in spring 2018 was, the experts agreed and came to conclusion, that a circular economy cannot be achieved in the built environment without a circular economy of materials. The goal is for Finland to build its competitiveness by means of sustainable material use. The demand for virgin materials will be minimised, the length of material and product life cycles maximised, and products designed so that they can be maintained and reused at the end of their first useful life.

After the experts, the real estate and construction industry has a downright obligation to move towards a circular economy to ensure that the built environment – as a major consumer of energy and resources – will not exceed the carrying capacity of nature. A circular economy provides the industry with great potential for development and change. The principles of a circular economy should be embedded in the entire ecosystem, and the industry will create system-level innovations that challenge current practices and business models.

The main findings of the two workshops were encapsulated in seven essential objectives that we have to reach in Finland in order to make happen the change to circular economy in the built environment:

*Table 1. The seven essential objectives to reach circularity in built environment*

Essential objective	Definition of the objective
1. Objective: Pursuing a common goal to promote a circular economy in the real estate and construction industry	<ul style="list-style-type: none"> <li>- The real estate and construction industry have defined a common goal and targets for a circular economy. All operators are aware of the goal and committed to reaching it.</li> <li>- The industry has defined generally accepted circular economy criteria to support planning and decision-making. Criteria have been set, among others, for the following sectors: <ul style="list-style-type: none"> <li>○ Planning</li> <li>○ Construction products</li> </ul> </li> </ul>

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	<ul style="list-style-type: none"> <li>○ Land use planning</li> <li>○ Architecture</li> <li>○ Procurement</li> <li>○ Infrastructure</li> <li>○ Use of space (affects construction demand and methods).</li> </ul>
	<ul style="list-style-type: none"> <li>- Based on these criteria, a list has been drawn up of measures required to promote the circular economy. The implementation of these measures has started, and progress will be monitored.</li> </ul>
2. Objective: Policy instruments and legislation efficiently promote the circular economy	<ul style="list-style-type: none"> <li>- The state and cities have recognised their role in promoting the circular economy in the property and construction industry. This is reflected in concrete actions.</li> </ul>
	<ul style="list-style-type: none"> <li>- The Ministry of Economic Affairs and Employment, the Ministry of the Environment, the Ministry of Agriculture and Forestry, the Ministry of Education and Culture, the Ministry of Finance and other administrative organisations have set common objectives for promoting the circular economy in the property and construction industry and agreed on measures to achieve the objectives. These objectives should be maintained across electoral terms.</li> </ul>
	<ul style="list-style-type: none"> <li>- Political parties have recognised their role as drivers of a circular economy, and their own government programme objectives include the promotion of a circular economy in the real estate and construction industry.</li> </ul>
	<ul style="list-style-type: none"> <li>- A circular economy is strongly featured in the Land Use and Building Act that is currently under preparation.</li> </ul>
3. Objective: New practices in the industry promote the circular economy	<ul style="list-style-type: none"> <li>- Synergies between projects and the overall optimisation of life cycles will be ensured through efficient exchange of information within and between projects.</li> </ul>
	<ul style="list-style-type: none"> <li>- New circular economy companies are being created in the building and construction industry.</li> </ul>
	<ul style="list-style-type: none"> <li>- Best practices are promoted through international co-operation.</li> </ul>
	<ul style="list-style-type: none"> <li>- Each organisation will be appointing a circular economy expert, and these experts collaborate via a shared forum for the industry.</li> </ul>
	<ul style="list-style-type: none"> <li>- Activities to promote the circular economy will be rewarded (e.g. industry awards).</li> </ul>
	<ul style="list-style-type: none"> <li>- An operating model for increasing social capital has been created and taken in use</li> </ul>

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	(more open and transparent urban planning and development).
4. Objective: Life-cycle thinking guides planning in infrastructure and building construction	<ul style="list-style-type: none"> <li>- We have common calculation rules that cover the whole life cycle, a common, open and up-to-date database as well as scenarios for realising end-of-life recycling and reuse.</li> <li>- Key opportunities for promoting the circular economy are being identified at each stage of planning.</li> <li>- Life-cycle costing directs procurement and decision-making, and operators are moving away from partial optimisation.</li> <li>- Each structural design includes a plan for recovery and recycling.</li> </ul>
5. Objective: Land use planning and zoning promote the circular economy	<ul style="list-style-type: none"> <li>- Urban circular economy is supported with a versatile urban structure.</li> <li>- Processes to change the purpose of use of a property are smooth.</li> <li>- Land mass logistics in earthworks are locally coordinated and appropriate.</li> <li>- There is efficient information exchange and co-operation between land use planning, infrastructure construction and building construction: synergies are identified and utilised.</li> </ul>
6. Objective: Procurement processes and purchasing expertise are developed to support the circular economy	<ul style="list-style-type: none"> <li>- Municipalities are using the upcoming Ministry of the Environment's guidance on public construction projects.</li> <li>- Purchasing organisations are aware of their own opportunities to promote the circular economy and include the circular economy in their procurement criteria.</li> <li>- The property and construction industry have developed common circular economy criteria for purchasing organisations and procurement in different sectors: <ul style="list-style-type: none"> <li>o Infrastructure construction</li> <li>o Regional planning</li> <li>o Building construction</li> </ul> </li> </ul>
7. Objective: Use of space is efficient	<ul style="list-style-type: none"> <li>- Operators managing spaces (private and public buildings and other spaces) are providing a wide range of usage opportunities through different interfaces.</li> <li>- Design of spaces is taking into account and enabling multiple and shared use.</li> </ul>

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- Use of spaces is as efficient as possible and target levels have been set. New ways of using spaces will be developed, alongside with means of continuous improvement (measuring, monitoring and setting new targets).
  - Restrictive legislation and operating models have been identified and abolished.
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These findings were published by the Green Building Council Finland as general recommendations and guidelines for the industry and other stakeholders to adopt circular economy in build environment.

#### 4. Discussion

In the built environment, the circular economy refers to an operating model adopted by the industry and policies supporting the model. Together, these two aspects drive a transition towards a sustainable built environment. The built environment plays a key role in the circular economy in Finland, particularly in optimising material and energy cycles, returning resources into these cycles and producing new resources.

The concept of a circular economy will steer us to design our environment in a way that the changing needs of users can be met, and new forms of use adopted. Thus, we will be able to support a sharing economy. When designing environments in accordance with the principles of a circular economy we create more sustainable and more low-carbon neighbourhoods.

The collaborative process proved to be successful in disseminating the ideas of circular economy in the building and construction sector. By letting the stakeholders to define together the importance of circular economy for the sector and formulate the most important objectives and actions for themselves and their peers, we think to witness a much faster pace of adoption of the ideas within the sector than we would have achieved with a more traditional top-down awareness raising campaign. The workshops gathered a lot of enthusiasm from the participants, and that resulted to a quite good participation rate to the subsequent seven working groups. However, after a while the working groups suffered some loss in participation as the first sparks of enthusiasm for the subject at hand vanished.

We also note that it requires a lot of effort to keep up the discussion among the network members between the face to face meetings. The discussion forum Yammer was rather quiet, yet functions as an important clue for the network, something tangible that concretizes the network.

#### 5. Conclusion

While writing this, this project is still going on. The current work is focusing to concretise the actions needed in order to reach the essential seven targets. The goal is also to get the right stakeholders to commit to the change towards the circularity.

For further research it would be useful to compare the similar approaches in other Nordic countries. Norway and Denmark have similar circular economy targets but the methods to implement these targets to the national building and construction sectors are different than what has been done in this project. By comparing different implementing methods, we could point out the successful concepts to commit

the construction and building sector to the circular economy and the business models that support the change to circular economy in built environment.

### Acknowledgments

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- [6] Handcock M S and Gile K J 2011 On the Concept of Snowball Sampling available online at <https://arxiv.org/pdf/1108.0301.pdf>

## Appendix 1

Organisation that has participated to the workshops.

As the participants have not signed the permission to publish their names, the writers are not presenting them here. There were often several persons participating from the same organisation, working in different thematical groups. Thus, here the organisation is mentioned as many times as there were persons joining the workshops and the thematical work after the workshops.

1) aalto yliopisto, EKO SAFA	42) INFRA ry
2) ACRE (Aalto)	43) INFRA ry
3) asoypalvelut.com	44) INFRA ry
4) asoypalvelut.com	45) INFRA ry
5) Delete Oy	46) INFRA ry
6) Delete Oy	47) Kliffa
7) Delete Oy	48) Kuntaliitto
8) Destaclean Oy	49) Logikor Oy
9) Destaclean Oy	50) Lujatalo
10) Destaclean Oy	51) LUKE
11) Espoon kaupunki	52) LUKE
12) Espoon kaupunki Tilakeskus	53) NCC Finland Oy
13) Espoon kaupunki Tilakeskus	54) Nomaji maisema-arkkitehdit Oy
14) FCG Finnish Consulting group Oy	55) Nomaji maisema-arkkitehdit Oy
15) Fira Oy	56) Porin kaupunki / CIRCWASTE
16) Fira Oy	57) Puhas Oy
17) Gaia Consulting	58) Pääkaupunkiseudun Kierrätyskeskus Oy
18) Gaia Consulting	59) Pääkaupunkiseudun Kierrätyskeskus Oy
19) Gaia Consulting	60) Rakennustuoteollisuus
20) Gaia Consulting	61) Ramboll
21) Gaia Consulting	62) Saint-Gobain Finland Oy
22) Green Building Council Finland	63) Saint-Gobain Finland Oy
23) Green Building Council Finland	64) Senaatti-kiinteistöt
24) Green Building Council Finland	65) Sitowise/ Maapörssi Oy
25) Green Building Council Finland	66) Sitowise/ Maapörssi Oy
26) <u>Green Net Finland</u>	67) Skanska Oy
27) Helsingin kaupunki	68) Skanska Oy
28) Helsingin kaupunki	69) Skanska Oy
29) Helsingin kaupunki	70) Skanska Oy
30) Helsingin kaupunki	71) <u>Suomen Erityisjäte oy</u>
31) Helsingin kaupunki	72) Suomen Erityisjäte oy
32) Helsingin kaupunki	73) Syke

33) Helsingin kaupunki	74) Sykli
34) Helsingin kaupunki	75) Sykli
35) Helsingin seurakuntayhtymä	76) Tulevaisuuden tutkimuskeskus / Turun yliopisto
36) Helsingin kaupunki	77) Tulevaisuuden tutkimuskeskus / Turun yliopisto
37) HSY	78) Valonia
38) HSY	79) Valonia
39) HSY	80) Vantaan kaupunki
40) IAH - arkkitehtuuritoimisto	81) VTT
41) IAH - arkkitehtuuritoimisto	82)