CIRCULAR

KONGSVINGER REGION

PHASE 1 & 2

KONGSVINGER KOMMUNE

CIRCLE ECONOMY

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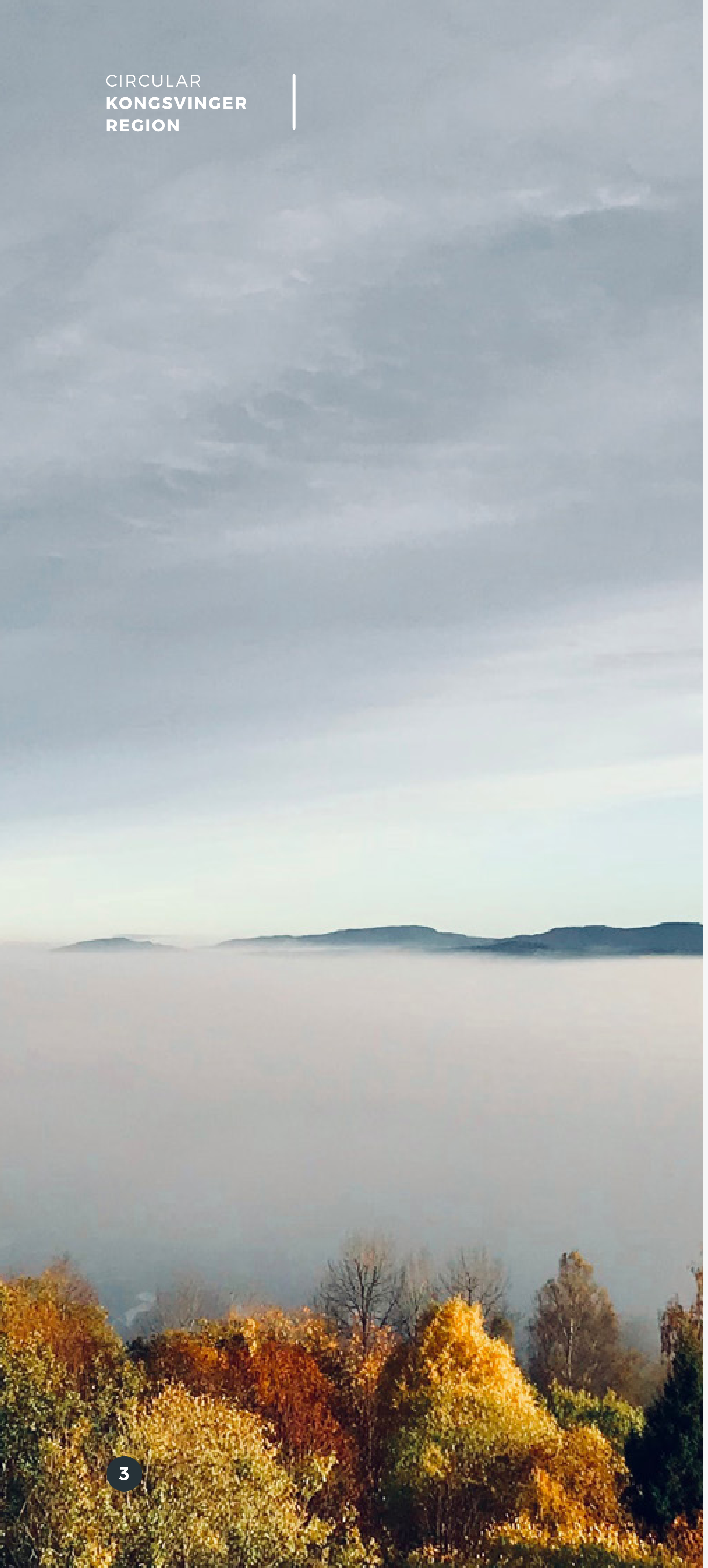

INTRODUCTION

From a linear to circular economy

Today, in the current linear economy, the creation of prosperity is accompanied by the use of materials - we extract over 100 billion tonnes of materials worldwide every year.[1] The already incredible demand for raw materials continues to increase due to growing prosperity and an equally growing world population. In the linear system, the finite supply of raw materials (a given) leads to scarcity, price volatility, and faltering economic development.

The circular economy offers an alternative to our take-make-waste society by closing resource cycles and retaining value as much as possible, for as long as possible.

Cities and regions play a key role in the transition

Cities and regions represent a key enabling environment for the circular economy. All over the world, urban areas are undergoing rapid growth and it is projected that 60% of the world's population will be living in urban environments by 2030. Urban areas are tightly connected to economic growth, producing over 80% of the world's GDP while consuming 75% of global resources. It is clear that sub-national regions hold an enormous leadership opportunity to pioneer urban and peri-urban spaces and ways of living that strengthen ecosystems and promote high social and economic welfare.

In the business strategy for the region of Kongsvinger (2016-2028), approved by the six municipal councils of Åsnes, Sør-Odal, Nord-Odal, Grue, Eidskog and Kongsvinger, four priority areas for the region growth were set out, based on the region's competitive advantages.[2] Two of the priorities highlight the regional focus on the bioeconomy and the construction sector, which are key elements of the region's economy and tradition. Thus, there is a clear opportunity for circular economy strategies to combine these focus areas, together with local stakeholders, within the scope of the built environment value chain.

The Kongsvinger region can exploit the opportunities of the circular economy and make optimum use of it for economic development and job creation with a reduced impact on the environment. For example, by exploring new models of consumption, closing (waste) material cycles within the region borders, establishing new collaborations between businesses and sectors, and piloting innovations that can make the Kongsvinger region an attractive place for people to live and work.

The beginning of a collaborative journey

The Circle Region (or City) Scan is designed to reveal where opportunities lie for the circular economy in the Kongsvinger region and will help develop practical and scalable pilot projects at a regional level. The process of executing the scan depends highly on a collaborative and multistakeholder approach. We guide stakeholders from the six municipalities and the business community through a common narrative and facilitate connections and collaboration where possible as we move towards possible solutions and projects.

PROCESS OVERVIEW

Circle city scan phases

The Circle Region (or City) Scan encompasses four sequential phases which form a guided process to develop and select the best circular economy strategies for the Kongsvinger built environment value chain.

This document presents the methodology, results and conclusions of Phase 1 and Phase 2 of the Circle Region Scan of the Kongsvinger region. Phase 1 started in July 2019 and finished in October 2019 and Phase 2 started in November 2019 and finished in March 2020. A report for phases 3 and 4 of the scan will be written at the end of the project.

As already mentioned, the information contained in the present report is intended to support the decision-making process in identifying opportunities where circular economy strategies could support the region built environment value chain in its transition towards a circular economy.

Phase 1

Understanding the built environment value chain in the region, which maps the relevant stakeholders, current construction practices, relevant policies and existing circular initiatives in the value chain.

Phase 2

A Material Stocks and Flows Analysis, which provides insight into material stocks and flows in the built environment value chain. This enables us to identify major key challenges in the current system and to pinpoint circular opportunities that can address them.

Phase 3

Circular strategies definition, which develops the circular opportunities identified in phase 2 into an integrated approach for a circular built environment in the region with concrete circular strategies.

Phase 4

Pilot projects action plan, which translates the selected circular strategies into tangible pilot projects together with local changemakers, including the definition of necessary next steps to execute the pilot projects in the short, medium and long term. This framework for action aims to secure successful circular implementation on the ground.

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Understanding the built environment value chain in the region

The first phase of the Circle Region Scan developed a deep understanding of the built environment value chain in the region of Kongsvinger. The analysis not only focused on the circular economy dimension, but embraced a holistic approach to highlight the strategic positioning of the built environment value chain within the regional economy. The realisation of interviews and surveys with local stakeholders as well as desk research supported the value chain's regional influence with regards to its environment, social, and economic impact.

Stakeholder mapping and current trends

To complement the value chain's reality in the region, which is illustrated through the socio-economic analysis, two additional analyses were developed. Firstly, a stakeholders mapping, in order to create a clearer picture as to the type and number of active players in the region along the value chain. Secondly, current trends in construction practices in the Kongsvinger region were also explored. This second part enabled us to deepen the understanding of local construction expertise and innovations.

Current state of circularity

A very important part of the phase 1 analysis aimed to assess the current state of circularity of the built environment value chain in the region.

To do this, first of all we tried to capture the level of understanding of the circular economy among local stakeholders, which proved to be high but, nevertheless, lacked some important elements, such as urban mining or collaboration, to unlock a systemic transformation of the value chain. Additionally, through these interviews and surveys, we were able to identify the main challenges the stakeholders perceived are facing in order to get started or further develop circular initiatives.

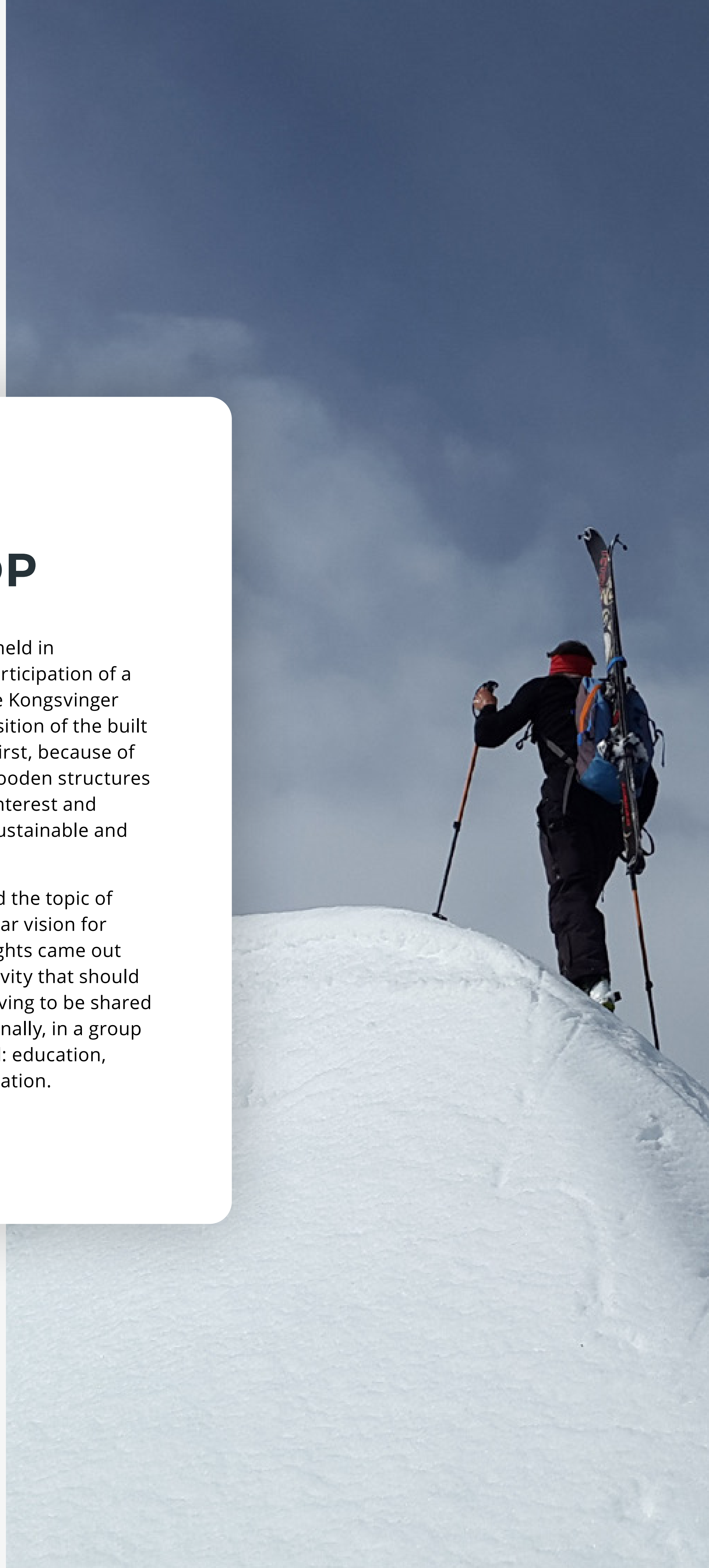
Second of all, a list and mapping of the ongoing local circular initiatives was made, in order to get a sense of how the concept of the circular economy is being articulated in the region and, even more importantly, to capitalise on what's already being done.

Finally, to get a complete picture of the system, we researched the (national and regional) current policies and targets on the built environment that are directly or indirectly connected to sustainability and, more specifically, to the circular economy.

OUTCOMES & **SECOND WORKSHOP**

The above analysis was brought to the first workshop, held in Kongsvinger on the 15th of October of 2019 with the participation of a group of local stakeholders. The message was clear, the Kongsvinger region has the potential to be a frontrunner in the transition of the built environment value chain towards a circular economy. First, because of its abundance of wood and the use of manufactured wooden structures in new buildings, and second, because of the growing interest and practical examples already happening in the space of sustainable and circular construction.

The workshop facilitated interesting discussions around the topic of circularity. There was even an attempt to create a circular vision for a circular built environment in the region. Valuable insights came out from these discussions, such as: design being a key activity that should be placed at an earlier stage in the value chain, data having to be shared across all players or the need for more collaboration. Finally, in a group effort, the key levers for transformation were identified: education, legislation and regulation, and stakeholders' communication.



KONGSVINGER REGION AT A GLANCE

The Kongsvinger region is situated in Hedmark county. With 26,084 km2 (total area of Norway: 385,203 km²), it is ranked as the fourth biggest county of Norway, representing almost 7% of the total country area. At the same time, Hedmark is one of the least urbanised areas in Norway, with about half of the inhabitants living on rural land.[3]

The population of Hedmark is mainly concentrated in the agricultural district of Mjøsa. Due to its location, largely bordering Sweden, Hedmark has developed a well-functioning and important logistics network.[4]

Besides logistics, timber production has historically been, and remains to be, an important economic activity for the region. Hedmark has 1.35 million hectares of productive forest and 0.1 million hectares of arable land, which account for 20 percent of Norway's forest resources. This cropland acreage is equivalent to about 125,000 football fields, or 10 percent of Norway's total agricultural area.[5] Another relevant proof of the importance of the timber production in the region is Kongsvinger's membership in the Nordic wood cities network, which aims to foster the use of wood in construction practices and give the wood resource a more central and prominent role in urban development.[6]
All of the above makes Hedmark Norway's leading farming and forestry county.

Households

23,738 x

Average people per household

2

Total population

48,700 x

Composition by age

22%	50%	28%
0-19	20-59	60+

Total employment

19,100 x

1,178 primary sector
3,557 secondary sector
14,365 tertiary sector

Composition Kongsvinger region

80%	10%	10%
Wooded	Urban	Other

ECONOMIC SECTORS OF KONGSVINGER

In order to put the built environment value chain in the perspective of the entire Kongsvinger region economy, a socio-economic analysis was undertaken. The 12 sectors (according to the 2008 SBI framework, see Annex 1) presented in figure 1below are analysed on their overall importance to the region, based on three indicators: Gross Value Added (2018, million NOK), total employment (2018, Full-time equivalents), and total GHG emissions (2018, kilotonnes CO2-eq), see annex 2 for more detail. Taken as a whole, these indicators provide a basis for comparison between sectors and support the rationale for assessing the relevance of the built environment value chain in the region's economy.

By looking at the sectors independently, an overview of the region's economy can be depicted. As the focus of our analysis is on the built environment value chain, the attention should be on looking at the construction sector in comparison to the rest of the sectors of the local economy. Out of the 12 sectors forming the regional economy, the Construction sector on its own is the 5th most polluting sector of the region (more than 5600 tonnes CO2-eq), the 6th sector in terms of jobs creation (more than 1500 full time equivalent jobs were offered in the sector in 2018) and the 7th sector creating the most economical value in the region (almost 400 million NOK in 2018).

Figure 1 on the right presents a sectoral analysis that narrows the scope to the impact of the construction activities, which represent just a part of all the activities taking place in the built environment value chain. Even though the above figures show the relevance of the socio-economic and environmental impact of the construction sector in the region, the approach taken in this Scan is to gain a systemic understanding of the dynamics of the built environment value chain in order to create holistic and transformative circular solutions. This is why other activities are incorporated and taken into consideration in the analysis, such as the extraction of materials, transport, manufacturing of building products or waste management.

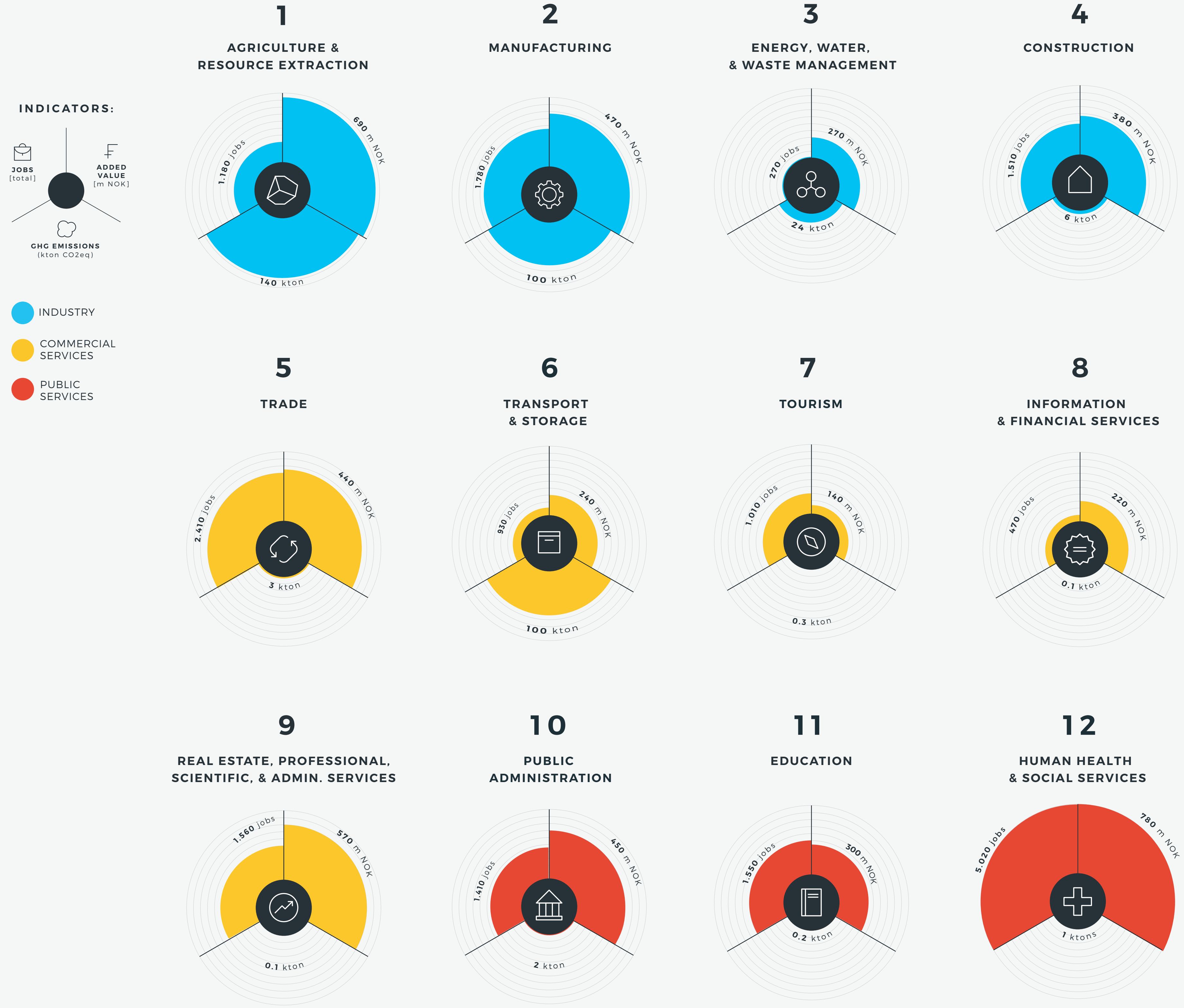


Figure 1. Sector comparison

Circular Built Environment value chain vs. Circular Buildings

This report focuses on a “circular built environment” as opposed to “circular construction of buildings”. The focus thus lies on the structural challenges and opportunities of the entire built environment value chain - from resource extraction, to building design, construction, use and waste management - as opposed to indicating how to create a one-off circular building. It is primarily about finding a systemic approach to the transition towards a circular economy.

Holistic view of the value chain

It is important to look at the built environment value chain as a cluster of different sectors interacting between each other. In figure 2, all the sectors being part of the value chain are presented in one visual to offer a more reliable picture of its socio-economical and environmental impact. Observed as a value chain, it is likely that the built environment creates more jobs, adds more value and produces more GHG emissions than any other individual sector. Therefore, deciding to start focusing on the built environment value chain in the transition towards a circular region has the potential to have a great effect in the region’s environmental, economic and employment impact.

Impact of the value chain

Even though the built environment value chain encompasses all the sectors presented in figure 2 , not all the activities developed by these sectors are meant to deliver products and services to the built environment value chain. For instance, the manufacturing sector buys raw materials to manufacture products and sell them to different (B2B and B2C) markets. Some of these markets are related to construction activities, but many others are not, such as the food industry or textiles. Therefore, for each of the 5 sectors, that together with construction, complete the built environment value chain, only a share of their Gross Value Added (2018, million NOK), total employment (2018, full-time equivalents), and total GHG emissions (2018, kilotonnes CO2-eq) account for their activities in the built environment value chain. There is currently no data aggregating the value of these indicators for the built environment value chain. In order to gauge its socio-economic and environmental impact to the regional economy, three scenarios of the share of products and services these five sectors deliver to the built environment value chain were created.

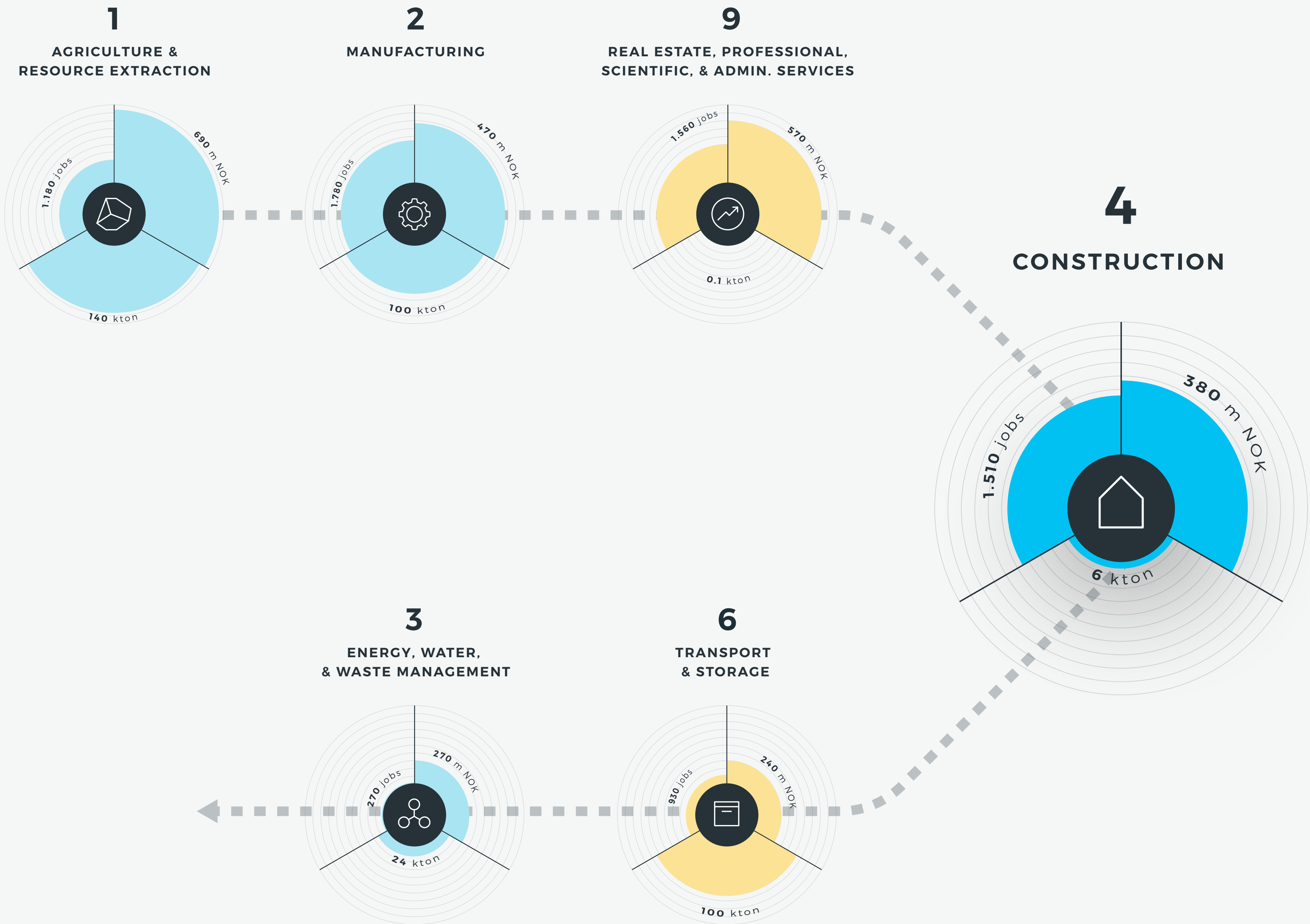


Figure 2. Sectors integrating the built environment value chain

Assumptions were made based on the percentage share of products and services delivered to the built environment value chain: 10%, 20% and 40%.

The scenarios presented in table 1 (see next page) shed some light on the socio-economic and environmental impact the value chain has in the region. The built environment is creating between 2,082 and 3,798 jobs, generating between 603 and 1,275 millions NOK and between 43 and 154 kilo tonnes CO_2-eq of GHG emissions. These figures entail that the value chain has an outstanding position in the regional economy. Employment wise, the value chain is between the second (after human health and social services) and the most employment intensive sector. In terms of economical value, it is placed between the third (after human health and social services and agriculture, and material extraction) and the most GVA generator in the region. And finally, in terms of environmental impact, the value chain is between the forth (after agriculture, and material extraction, transport and storage and manufacturing) and, again, the most polluting sector.

Therefore, even in the scenario with the lowest percentage (10%), the built environment still has one of the greatest impacts when compared to the other individual sectors.

Insights from local stakeholders

On top of the fact-based arguments of the socio-economic and environmental impact of the value chain, insights from surveys and interviews with local stakeholders as well as the desk research 4 additional arguments to start focusing on the built environment when thinking about transitioning towards a circular economy were identified.

1 RESOURCE USE

40 to 50% of all resources worldwide are used for construction.[7] In the Kongsvinger region, traditionally buildings were made from wood, nowadays hybrid forms have been more popular (concrete, steel and wood).

2 WASTE

25-30% of waste in Europe stems from construction & demolition.[8] Based on the analysis of waste statistics of manufacturing industries, service industries, the building and construction sector and households, we can conclude that the largest flows of waste in the region are concrete (minerals), wood (biomass), iron and steel (metals) and mixed waste.[9]

3 KEY RESOURCES

The region stands out because of its availability of wood, good logistics, stable and competent workforce and craftsmanship and has the right competencies to develop a circular built environment value chain.

4 REGIONAL KNOWLEDGE

Companies of the built environment in Kongsvinger have a relevant role outside the region because of their knowledge and expertise (e.g. developers).

BUILT ENVIRONMENT VALUE CHAIN			
SCENARIOS	Employment (full-time eq)	GVA (million NOK)	GHG (kt CO_2-eq)
SCENARIO 1 10%	2082	603	43
SCENARIO 2 20%	3558	827	80
SCENARIO 3 40%	3798	1275	154

Table 1. Three scenarios for the estimation of thee total impact of the Built Environment value chain.

Once the rationale behind the importance of focusing on the built environment value chain in the transition to a circular economy is set, it is important to grasp what is a circular built environment and what is the local perception about the topic of circular economy.

First, what is understood as circular construction?

Challenges lie in the fragmentation and lack of collaboration within the value chain, short-term revenue models, and perceived high costs of failure. Practical and scalable solutions for circular construction require a holistic perspective which takes account of the construction process and entire value chain.

The design, construction and harvesting process need to interlink closely: communication and cooperation between different players is key. Innovation takes time, but companies that experiment and routinize these innovative processes will gain competitive benefits in the long term.[10]

Regional perception and knowledge of the circular economy

Taking into account the above description, it is now interesting to know how the local stakeholders in the value chain - the ones that have a key role in this transition - perceive and view the application of a circular economy in the built environment value chain.

In order to capture the local perception of a circular economy, 36 stakeholders were interviewed or part of the survey. See Annexes 3 and 5 for an overview of the contacted stakeholders. Most of the stakeholders were suppliers/vendors (n=10) and regulators/ legislators (n=6).

As it can be seen in figure 3, the stakeholders interviewed were familiar with the core of the concept of a circular economy, which proves why the bioeconomy is such a strategic element for the region's growth (regional business strategy plan 2016-2028).

However, it can also be seen how some crucial elements, such as collaboration, urban mining and product as a service models were not associated with a circular economy model. This fact proves the importance of bringing the local stakeholders along the scan process in order to unlock the full potential of circularity in the region.

Distribution of the 49 participants to our stakeholder research

Survey question: What is a circular economy?

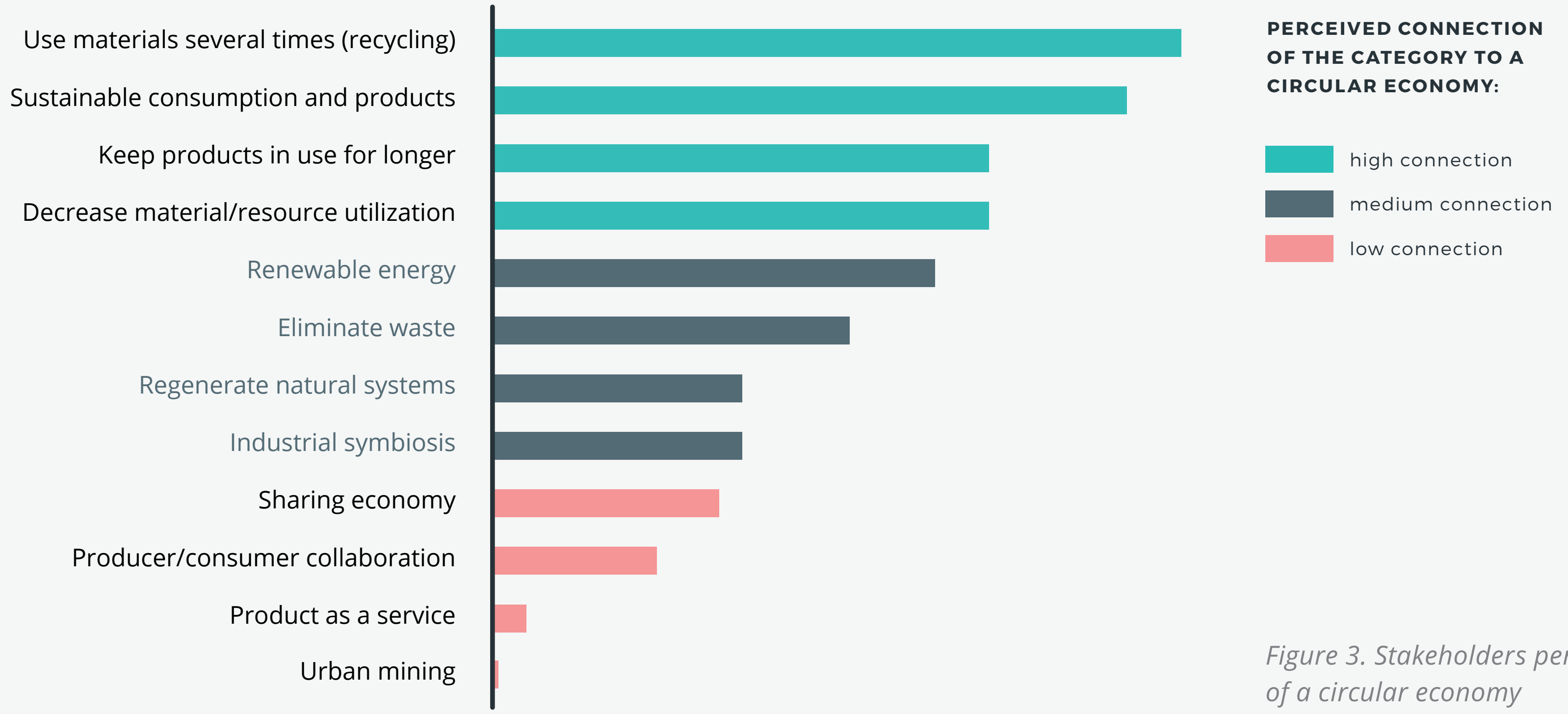


Figure 3. Stakeholders perception of a circular economy

Before entering into the core of the circular built environment value chain in Kongsvinger, some local construction trends are shared with the objective to offer a high-level idea of the current practices that are taking place and being developed by local stakeholders in the region:

Prefabricated and modular construction elements

These are factory-produced pre-engineered building units that are delivered to site and assembled as part of a larger construction unit. These elements can increase the efficiency and the sustainability of constructions sites.[11]

Solid wood buildings

These are buildings that utilise a large share of wood (for example in walls and ceilings). There are several advantages of building with wood, such as carbon sequestration, as well as a higher insulation rating than either steel or plastic as a result of its natural cellular structure. This means that homes and buildings require less energy to maintain heating and cooling. Plus, wood is said to help regulate humidity levels to a small degree.[12]

Flat roofs

Proven resistant to weather, flat roofs are already considered as an alternative to sloped roofs. When carefully designed, professionally constructed, and regularly maintained, flat roofs can offer a space which is easily accessible, for energy systems (e.g. photovoltaic panels) and green roofs and roof gardens, improving the sustainability performance of the building.[13] Additionally in spatial terms, flat roofs can be highly efficient, reducing the apparent mass of a building

Construction of multiple dwellings houses

Is a classification of housing where multiple separate housing units for residential inhabitants are contained within one building.

Steel fibre in flooring and walls

Steel fiber concrete flooring can provide superior resistance to minimise cracks in hardened concrete, as well as maximum resistance to withstand heavy loads.[14]

Low carbon concrete

Low carbon concrete has attracted significant attention due to the amount of CO2 that 'conventional' concrete emits. These are forms of concrete based on a ternary blend of calcined clay-limestone-clinker that produce less carbon than 'conventional' concrete.[15]

Passive houses

This is a voluntary standard for energy efficiency in a building, which reduces the building's ecological footprint. The design (e.g. orientation of the building and materials used) results in an ultra-low-energy building that requires minimal energy for space heating or cooling.[16]

Demand for retrofit of buildings from the 1950s/60s

Retrofitting a building involves changing its systems or structure after its initial construction and occupation. This work can improve amenities for the building's occupants and improve the performance of the building. As technology develops, building retrofits can significantly reduce energy and water usage.[17]

Once the Kongsvinger built environment value chain role in the local economy has been set, the circular built environment concept has been defined and compared with the local understanding of the topic, and a high-level understanding of what are the current local construction trends has been reached, it is now time to start shaping the circular built environment value chain of the region.

Figure 4 shows a visual representation of a circular built environment value chain. It is composed of nine core activities. Starting with the extraction of the resources that later on are being transformed into building materials (e.g. wood). The second and third steps in the value chain are the manufacturing and the assembly, in which the resources are transformed into final products, and in some cases also going through an assembly process, to be shipped to the construction sites (e.g. wooden window frames or roof structures). In the design phase, architects create their construction plans based on aesthetics and materials use efficiency. The construction companies are to develop all the construction plans based on the defined design. Once the construction is finished, the building enters its use phase for a certain period of time (life span), ideally as long as possible. Finally, at their end of life, buildings are deconstructed, generating construction and demolition waste which is treated by the waste management players.

Loops within the chain (in order of priority)

1. **Maintenance** within the use phase, to extend and preserve the life expectancy of the buildings (use - use)
2. Existing buildings can also be **renovated**, supported by the designers (design - use).
3. Materials and components of deconstructed buildings can be directly **reused** in other constructions (deconstruction - construction).
4. Construction waste can also be **re-fabricated** into (re-assembly (waste - assembly)).
5. Waste can also be **recycled** being fed back to manufacturing (waste - manufacturing).

BUILT ENVIRONMENT
VALUE CHAIN

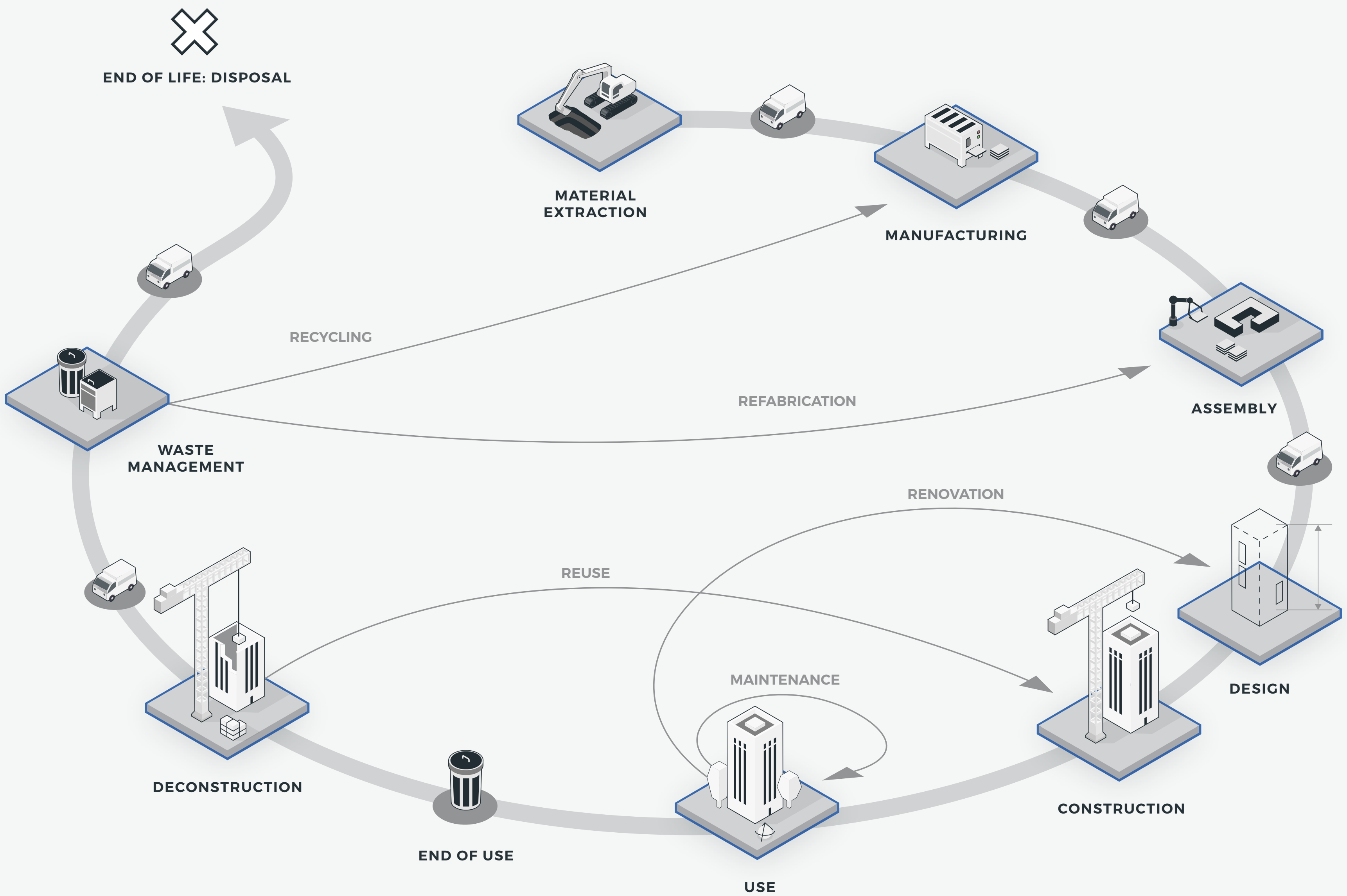


Figure 4. Built Environment Value Chain

STAKEHOLDERS IN THE REGION VALUE CHAIN

The transition towards a circular built environment requires stakeholders to adapt or change their role in the value chain.[18] But who are the stakeholders involved in the built environment value chain in Kongsvinger?

Multiple stakeholders are active in the built environment, each with their specific and interlinked roles and interests.
The stakeholders and their roles will change in the transition from a linear to a circular built environment. The stakeholders in figure 5 take a central position in the transition to a circular built environment.[18]

BUILT ENVIRONMENT
VALUE CHAIN

OVERARCHING ROLES FOR THE WHOLE VALUE CHAIN

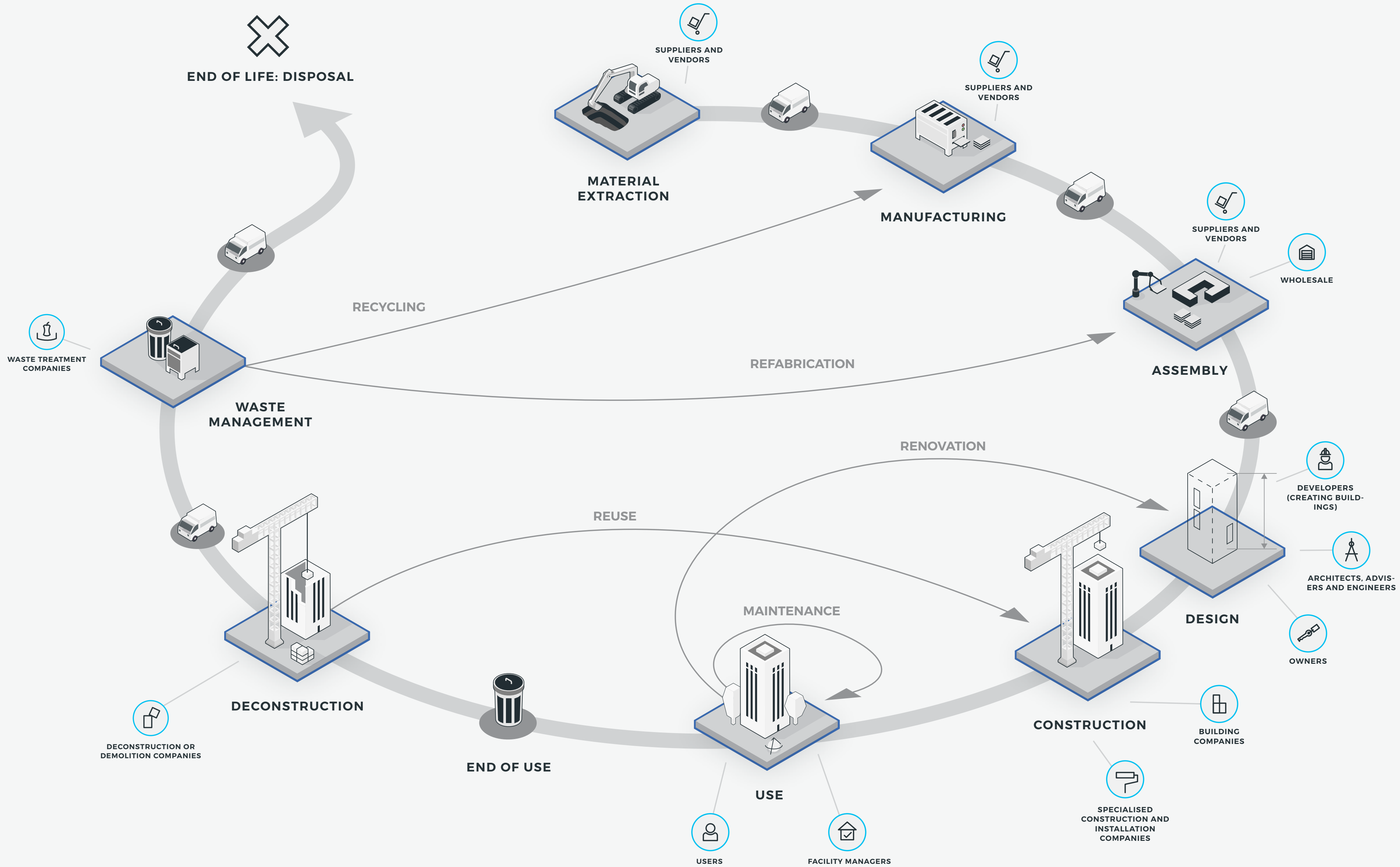


Figure 5. Stakeholders in the Built Environment Value Chain

STAKEHOLDERS IN THE REGION VALUE CHAIN

The transition towards a Circular Built Environment requires a shift in the setup of the built environment and requires stakeholders to adapt or change their role in the value chain. In order to accelerate the transition, it is key to know who are the active players along the Kongsvinger's value chain. Figure 6 displays the number of stakeholders in each part of the regional built environment value chain. It is important to note that the number of players in a specific role does not indicate a high or low relevance of a specific part of the value chain (e.g. 30 companies working in manufacturing does not directly translate into a higher economic performance compared to the 6 companies developing their activities in the extraction of resources). This analysis gives an idea of the concentration or fragmentation of certain parts of the value chain, which can influence the strategy of the local stakeholders management in the adaptation or change of their roles in the transition towards circularity.

As it can be observed, most of the companies are located in the manufacturing, design and construction activities of the value chain. As the activities developed are very diverse and numerous, some examples are described: The few actors working in the extraction of resources focus on timber harvesting and supply to a variety of sectors, among which the bioenergy production has an important share. Most of the manufacturers deal with wood products and, to a smaller extent, with aluminium and steel products. The assembly players have an important role in the prefabrication and assembly on site of steel and timber structures, which is one of the main trends identified in the previous section. It is also important to note the high concentration of actors in the design and construction parts of the value chain, which are critical in the endeavours to transition towards a circular economy.

Those are just some examples that show the variety of activities happening along the value chain and prove the importance of fostering collaboration and coordination to ensure alignment and cooperation in enabling systemic change.

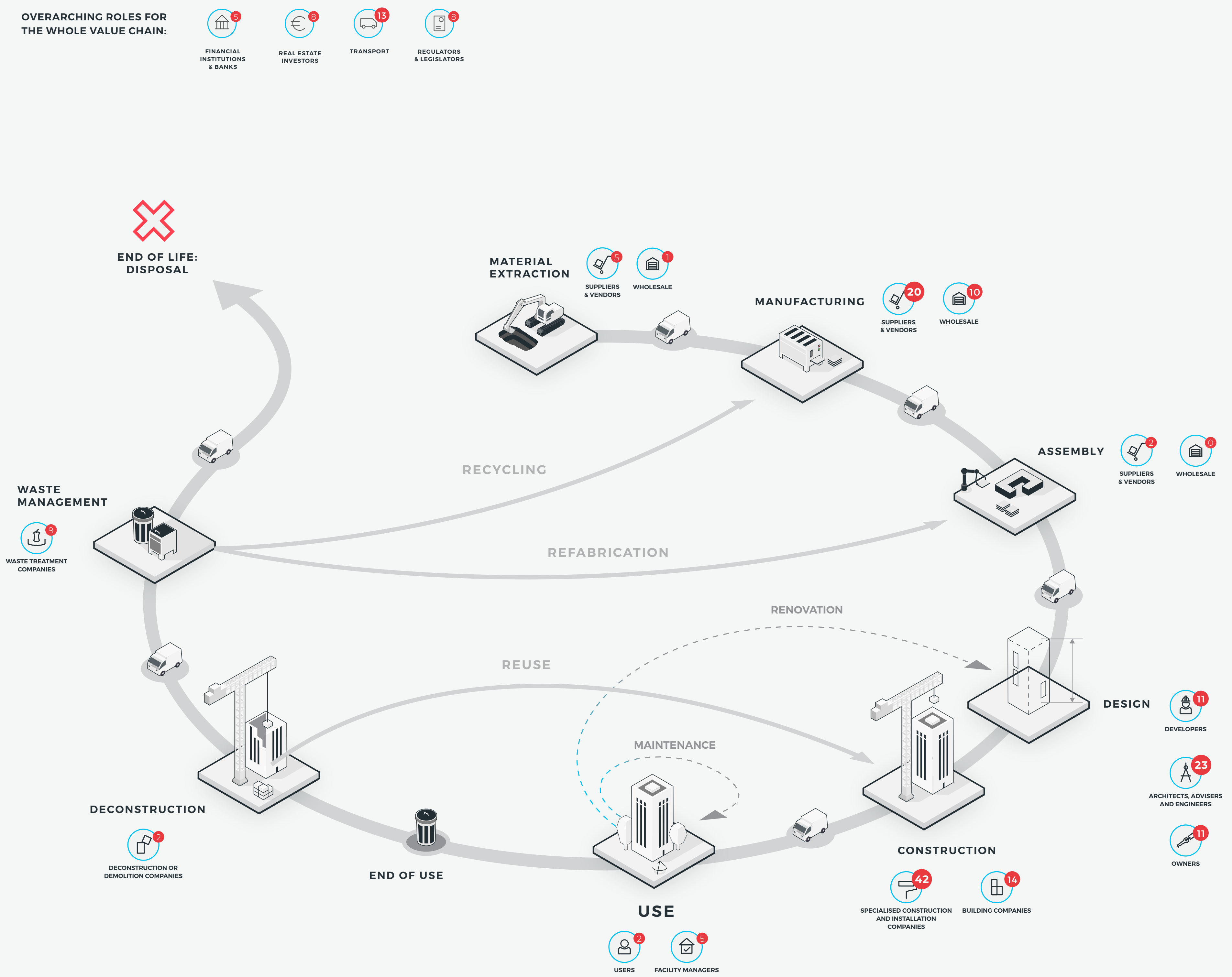


Figure 6. Local stakeholders in the Built Environment Value Chain

CIRCULAR INITIATIVES IN THE KONGSVINGER **BUILT ENVIRONMENT VALUE CHAIN**

Through desk research as well as interviews with local stakeholders, a long list of local circular initiatives in the value chain was developed. Looking at the circular initiatives currently being developed in the region is key to setting the current level of circularity. By knowing what is already happening in the region, the rest of the project can focus on capitalising the value chain's strengths and supporting the development of new initiatives

Figure 7 shows where the current local circular initiatives in the region are taking place throughout the value chain. As it can be observed, manufacturing and the use phase are the ones centralising the most initiatives, followed by waste management, construction, material extraction and design. Surprisingly, no circular initiatives are currently taking place in the assembly of building elements and the deconstruction of buildings.

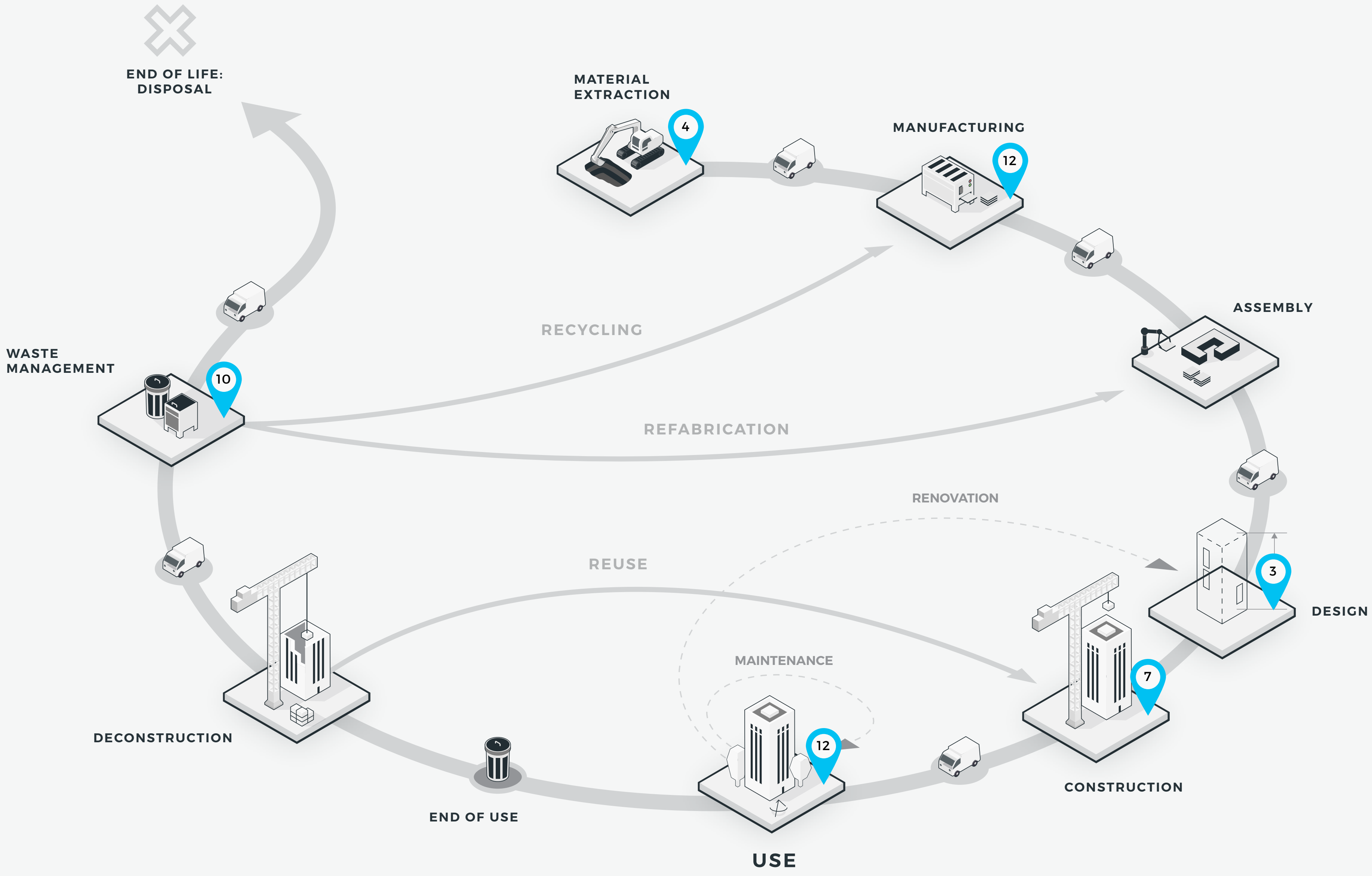


Figure 7. Circular Initiatives in the Built Environment Value Chain

Figure 8, mapped with the DISRUPT 7 key elements (see Annex 6) of the circular economy, shows the type of initiatives that are being developed in each of the activities of the built environment value chain*.

Using waste as a resource stands out as being the strategy that has been the most developed among local stakeholders. Prioritise regenerative resources follows as the second most common circular practice. Other initiatives are also being developed through new business models, design, collaboration and preservation and extension the life time of buildings. However, at the time this research was undertaken, no circular initiatives on incorporating digital technology into the built environment value chain were developed and running. These findings show the potential the circular economy has to develop new innovative initiatives following the different circular strategies presented by the 7 disrupt key elements.

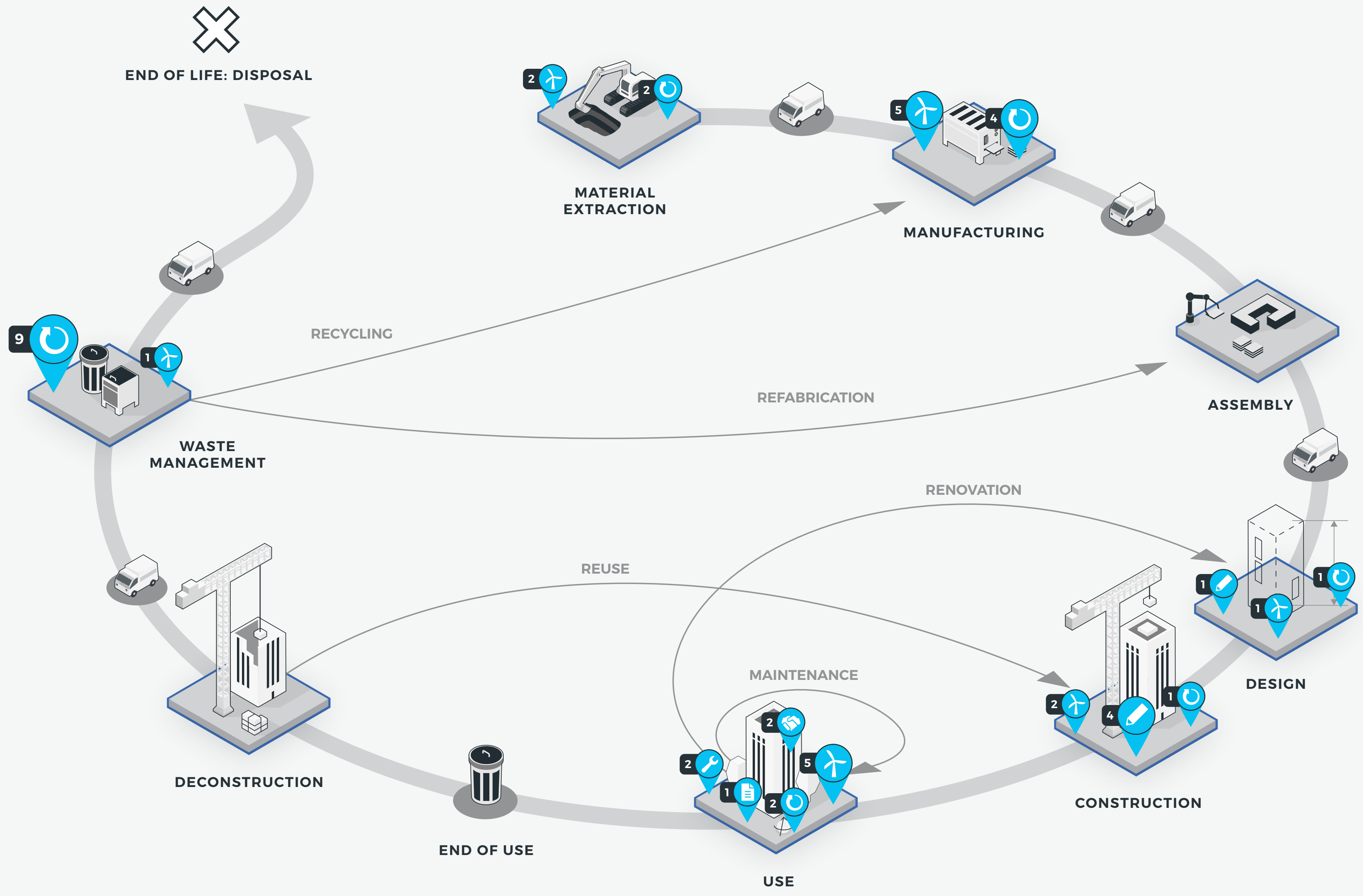


Figure 8. Type of circular initiatives in the value chain

CIRCULAR INITIATIVES IN THE KONGSVINGER
BUILT ENVIRONMENT VALUE CHAIN

The Kongsvinger region businesses working in the built environment value chain have already shown interest in circular economy practices.

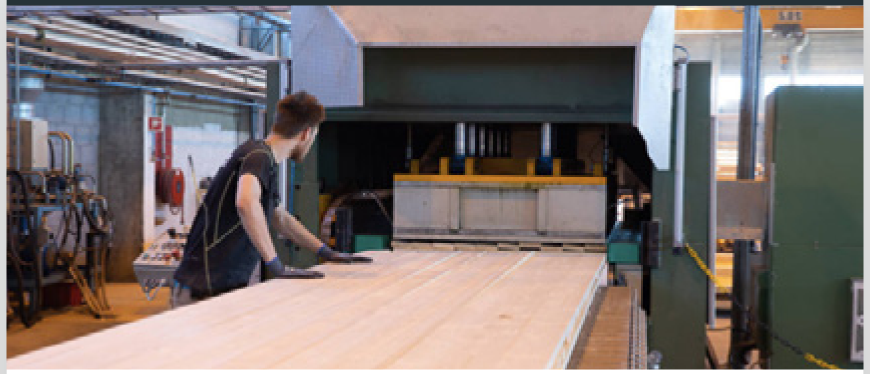
Some innovative examples of current local circular initiatives along the value chain are showcased in this section:

MATERIAL EXTRACTION

Eidskog Stangeskovene

Extracting regenerative building materials: Eidskog Stangeskovene is investing in the extraction of timber to produce solid wood elements. They are a competitive alternative to building structures made from concrete and steel.

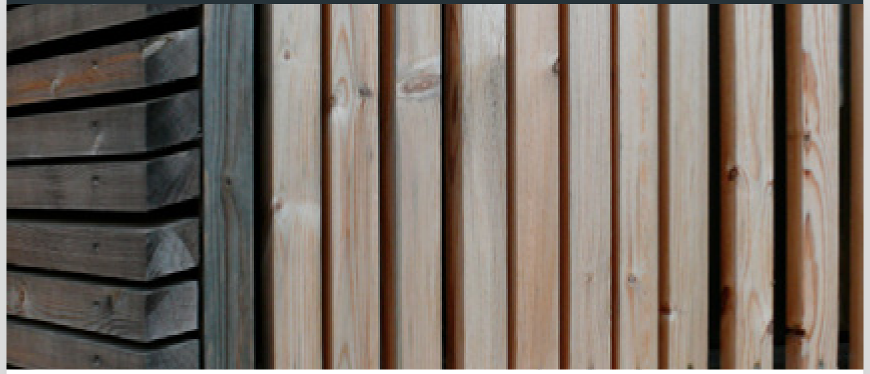
MANUFACTURING



Nordisk Massivtre

Production of solid wood panels with raw material from the Eastern Norway region and Western Sweden.

DESIGN



Tredriver'n

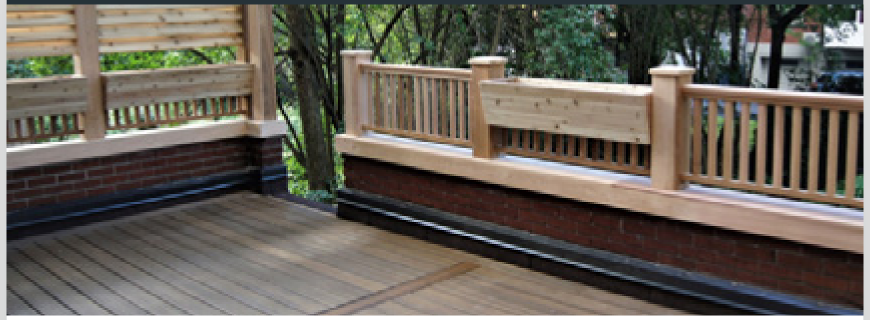
Contribute to increase Hedmark's use of wood in construction through the development and realization of industrialized and competitive solutions, concepts and value chains.

CONSTRUCTION

Kongsvinger Municipality

Construction of new school building in solid wood (KUSK).

USE



Bergeneholm

Bergeholm offers wooden planks with "Do It Yourself" guides to help private homeowners to build a patio, playground, pergola and much more, allowing to adapt the house to the user's needs.

WASTE MANAGEMENT

Mapei

Recycling of residual concrete. Transforms soft residual concrete into dry aggregate (crush), which can be used in the production of new concrete.

TARGETS AND POLICIES

It is important to build a good understanding of the local political agenda and strategic ambitions of the Kongsvinger region. An overview of political targets, measures, and challenges were compiled and can be seen in figure 9. This list will not present all relevant policies of the Kongsvinger region, but a selection deemed most relevant from a circular construction perspective.

At a regional level, the main action plans for the environment are:

- Kongsvinger environment & climate strategy: Support the regional forestry sector as the “green heart” of Norway
- Business strategy Kongsvinger: Focus on construction, manufacturing, bio-economy and logistics.
- Goal to foster cooperation between municipalities and businesses, create alliances, R&D for increased sustainable value creation.
- Procurement: Kongsvinger procurement strategy in alignment with climate strategy, support of multipurpose buildings and demand for solid wood.

At a national level, the main policies are:

- Forest protection
- Plan & building law
- Waste regulations
- Regulations on documentation of construction products: requires that new & reused materials hold the same standards.

Additionally there are some cross-national policies and standards that might be of relevance for the region, such as the ISO norms for production and tendering, Construction Products Regulation.

To consider the targets and policies applied or influencing the built environment value chain of the region is key to assess where the momentum for change might be or where there are needs for change in the legislation and policies in order to enable a transition towards a circular economy.

As it can be observed, ambitious targets and policies vertebrate the value chain of the region, mainly focusing on increasing the recycling rates and decreasing its carbon footprint. However, the concept of circular economy is not explicitly present. The focus on resources efficiency and materials is not yet part of the main targets and policies whereas it is key in order to get started and start implementing and scaling circular economy in the built environment.

As it will be seen in the next analysis of the challenges and again in phase 2, regulation is perceived as one of the main barriers for implementation of a circular economy.

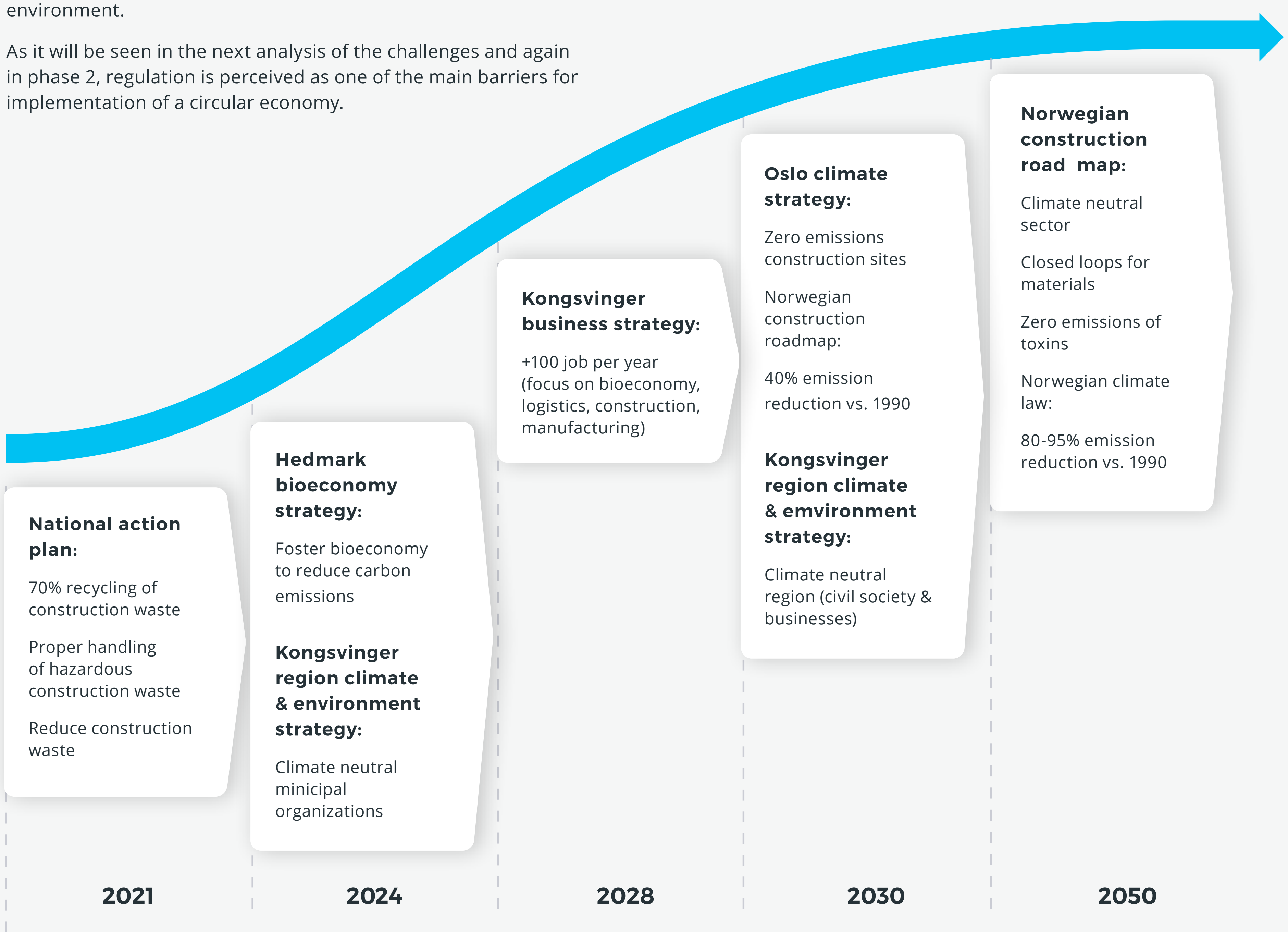


Figure 9: Main targets relevant for the built environment

CHALLENGES

The last important aspect to consider to get a complete understanding of the current level of circularity of the built environment in the region is the main challenges that stakeholders are facing in their efforts to transition towards a circular economy.

The challenges of implementation of the circular economy can be summarised into 5 main categories: regulation, technology, market, culture and others. For each of them, specific challenges of implementation of the circular economy are listed:

1 REGULATION-RELATED CHALLENGES

Policies:

- Lack of incentives
- Lack of regulations regarding circularity (e.g. sustainable material choices)
- Lack of quality standards: Quality (assurance) of circular materials in comparison to common materials (e.g. carrying capacity in trusses)
- National building laws and rules limit flexibility of design (e.g. rules related to wall thickness rather than quality)
- Limited influence:
- Procurement: It is difficult to foster local production (one key aspect of circularity) by using public procurement.
- Much waste handling on construction sites instead of at production.

2 TECHNOLOGY-RELATED CHALLENGES

Policies:

- Poor waste separation for small waste volumes on construction sites

3 MARKET CHALLENGES

Economic factors:

- Prices for circular materials are higher, which hinders companies from working in the circularity space and being competitive in the market.
- Waste prices are based on weight, which makes it difficult to establish a financially viable business case for the recycling or reuse of light materials.

Lack of demand:

- Customers are not willing to pay more for circular materials.
- Dependence on tenders criteria, if circularity is not a requirement, price is what counts.
- Lack of supply:
- Insufficient volume available (e.g. import of wood from Switzerland and Austria as there is not enough wood supply for the local wooden building school projects).
- Life cycle: Long transport of circular materials is more impactful than the purchase of non-circular local products and materials (e.g. concrete).
- No market for trading of secondary materials.
- Financing:
- Little knowledge on how to finance circular business models.
- Lack of sustainability criteria in the financial sector.

4 CULTURAL CHALLENGES

Lack of awareness in the industry:

- Low awareness about circularity (no sense of responsibility) and no circularity-related strategies or targets among businesses.
- Linear mindset, profit- and growth-driven organisations.

Consumer behaviour:

- Traditional behaviours are sometimes against the circularity principles (e.g. brand new products always prefered).
- Customer requirements in terms of aesthetics (e.g. with prefabricated elements, buildings tend to look more alike).
- Cost-focus of consumers (e.g. low maintenance costs for buildings).

5 OTHERS

- Lack of technical knowledge about circularity.
- Isolated operations: Some stakeholders do not consider themselves as being part of the built environment value chain despite their connection.
- Different characteristics of circular materials (e.g. walls are much thicker when using solid wood) make force design and construction to adapt.

Workshop phase 1

On the 15th of October of 2019, the first workshop of the region scan process was conducted in Kongsvinger. Attending the workshop were 13 city officials representing the six municipalities that are part of the project. All workshops planned for the Kongsvinger Region Scan follow the following objectives:

- Support decision-making that guides the process
- Critically assess and enrich the information presented
- Create momentum for a common agenda

During the workshop, the Circle Region Scan process was introduced to all attending participants. After which the interpretation of what a circular economy is was discussed. In the next parts the socio-economic results of phase 1 were presented and enriched. The participants were asked to map the relevant stakeholders and already existing circular initiatives. Lastly during an interactive part we identified the challenges and vision of a circular built environment value chain.

Key insights

Design is key
Most of the participants expressed that design is a key activity that should be placed at the earliest stage of the value chain. By designing in a smart, sustainable and resource efficiency-focused manner, waste generation could be minimised and materials and resources lifespan can be maximised. Some examples that were brought up are: reduction of packaging, sharing information and data on what type of materials are entering the stock for new constructions or renovations, and design for deconstruction.

Centralising and sharing data
Data transparency and availability. Participants considered the data is being gathered but in a scattered manner, so efforts are needed in centralising it and sharing it across the value chain.

Focusing on more than profit
There was a wide awareness of the fact that the value chain only focuses on profits. There should be another focus, which would need to be incentivised: societal goals.

Key levers for change

Education is Key
This was pointed as a key driver for systemic transformation and one of the main challenges of the region.

Legislation and regulation
The public sector can use tools to create change, some examples that were brought up: Improve waste sorting activities, increase the tax pressure on raw materials extraction, favor deconstruction instead of demolition, include circular criteria in procurement, change incentives across the value chain, consider waste as a resource, or more ambitious recycling goals.

Stakeholders communication
Communication across the value chain to increase collaboration and data exchange. Some of the participants' ideas were: Take advantage of the sustainability network in the region to foster collaboration, a close relationship between users and architects to make smarter designs, or establish a close relationship for information sharing between key stakeholders for better use of resources.

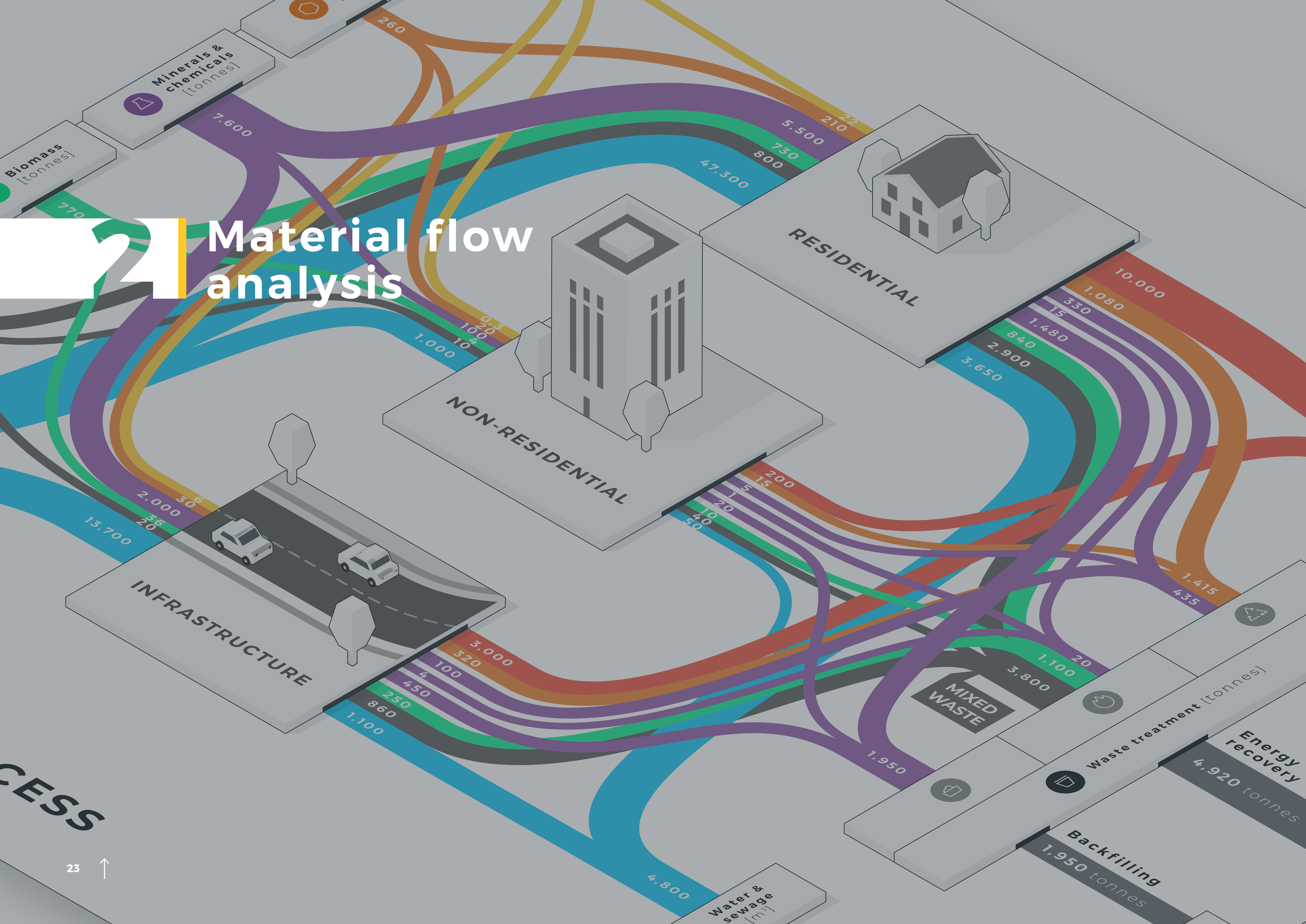
Final remarks phase 1

Phase 1 of the Circle Region Scan delivered a systemic analysis to the current state of circularity of the built environment value chain in the Kongsvinger region. In this phase, it has been identified that circularity is increasingly attracting the interest of the local stakeholders in the region, shown by the good understanding of the concept, the regional trends in innovative and sustainable construction practices and the already ongoing local circular initiatives.

Nevertheless, throughout the process, some important gaps and needs have been identified as key in the efforts of transitioning towards a circular economy, such as: collaboration, data exchange and centralisation, increasing the supply of secondary materials or changing the mindset of local stakeholders.

All these insights are very valuable in informing the analysis that will take place in phase 2. In this second phase, the resource flows and stocks of the region will be analysed to identify the main challenges and opportunities that the circular economy faces in the Kongsvinger region.

2 Material flow analysis



PHASE 2 OVERVIEW

This part of the report presents the second phase of the Circle Region Scan, which ran from November 2019 to March 2020. The methodology, results and conclusions for the Material Flow Analysis (MFA) and the Building Stock Analysis (BSA) are presented. The overall goal of this phase is to reveal where tangible opportunities lie for the circular economy in the region built environment value chain, which can then be developed into practical and scalable pilot projects in phase 3 of the Scan.

Material flow analysis

In the second phase of the Circle Region Scan, a Material Flow Analysis (MFA) was carried out to map how resources, such as water, energy, biomass, metals and minerals, flow through the built environment in the region - in order to get an understanding of the metabolism of the value chain. The material flow analysis is completed thanks to a data collection process of relevant public and private data sets, which then is summarised in a visual map that depicts the flow of the resources in the Kongsvinger region built environment value chain. In the map, the key environmental, economic and social impacts that are associated with resource consumption and waste generation have been identified. These 'impacts' are defined as challenges, which are used as a starting point to envision a circular built environment value chain within the Kongsvinger region.

Building stock analysis

The MFA insights were enriched with a Building Stock Analysis (BSA) which looks into the material composition of the building stock in the Kongsvinger region. The purpose of this analysis is to provide insight into the type and quantity of materials locked in the built environment of the region with the objective identifying circular opportunities related to materials stock management.

Outcomes

Through the MFA and the BSA, the main challenges that the built environment is facing are identified to define and select (together with the relevant local stakeholders) the key opportunities for effective development of a circular built environment value chain. This is a critical analytical step that brings together the most recent data to visualise the current material stocks and flows in the region value chain.

The data sources that were used to construct the MFA and BSA visuals are provided in the Annex of this document, and additional remarks are provided on how (if at all) data were combined and processed to arrive at a final figure. The main types of data sources include:

Data sources and processing

The data sources that were used to construct the MFA and BSA visuals are provided in the Annex of this document, and additional remarks are provided on how (if at all) data were combined and processed to arrive at a final figure. The main types of data sources include:

Top-down data:

- National Input-Output table: EXIObase is the database that forms the basis for the material flow and the building stock analysis. It records the national input-output of physical goods in Norway, classified by NACE sectors.

Bottom-up data

- Region of Kongsvinger, county of Hedmark, or Norway national statistics (Statistics Norway): Additional data sources from the cities, county, or the nation are used to refine the data from EXIObase. Local and more recent data are used wherever possible, however, data is often not fully available to comprehensively cover the entire flow and stock of materials.
- Literature and studies: A variety of relevant literature and studies are used in both analyses to add greater contextual information, such as environmental or social impacts with material consumption or waste.

Summary of the main findings

To summarise the main findings of the Material Flow Analysis and the Building Stock Analysis, a short overview of the main circular opportunities and the challenges addressed are presented:

MFA identified opportunities

Circular Opportunity 1: Circular design
Challenges:

I Reuse of building components during renovation is marginal
II.a High non-renewable material consumption
II.b Low material re-use, cascading
III High volumes of Mixed waste

Circular Opportunity 2: Increase use of secondary materials
Challenges:

I Reuse of building components during renovation is marginal
II.a High non-renewable material consumption
II.b Low material re-use, cascading

Circular Opportunity 3: Increase high-value management of residual construction streams
Challenges:
III High volumes of Mixed Waste
IV Low-value treatment of wood

Circular Opportunity 4: Value Chain GHG emissions reduction
Challenges:
V Embodied Emissions

BSA identified opportunities

Circular Opportunity 5: Urban mining
Challenges:

I Reuse of building components during renovation is marginal
II.a High non-renewable material consumption
II.b Low material re-use, cascading
IV Low-value treatment of wood

Circular Opportunity 6: Matchmaking of secondary materials
Challenges:

I Reuse of building components during renovation is marginal
II.a High non-renewable material consumption
II.b Low material re-use, cascading
IV Low-value treatment of wood

Circular Opportunity 7: Capacity building
Challenges:

I Reuse of building components during renovation is marginal
II.a High non-renewable material consumption
II.b Low material re-use, cascading
III High volumes of Mixed Waste
IV Low-value treatment of wood
V Embodied Emissions

METHODOLOGY: MATERIAL FLOW AND BUILDING STOCK ANALYSIS

Material categories and products

The material flow and building stock analysis illustrate resource flows and stock in a sector, depicting annual material use, waste production and treatment, and material composition of the stock. The material flow and stock categories include:

Energy
The energy flows include energy in various forms, from fuels to heat energy and electricity.

Biomass
The biomass flows include different kinds of wood used from construction such as timber, lumber etc. Example: wooden window frames.

Water
The water includes the amount consumed in the given year for the different phases of construction (construction and end-of-life).

Minerals & Chemicals
The minerals & chemicals flow includes solid materials that are present in nature, such as clay, sand, stone, bricks, ceramics, aggregate, limestone or granulate, used for building construction. In most cases, they appear under the form of mineral binder materials.

Metals
The metal flows include raw and processed metals and products of iron and steel used in the construction of buildings in the region.

Emissions
The emissions flow includes greenhouse gas emissions, the overwhelming majority of which consists of CO_2

Waste treatment in the MFA

Waste treatment is expressed in six categories: reuse, recycling, energy recovery, backfilling, landfill, and incineration - where reuse and landfill are respectively the most and least desirable options. Waste treatment numbers, too, are given in amounts per year, based on the most recent available data. It is important to mention that not all waste treatment techniques are present in the region:

Reuse
Products are reused, maintaining their original shape and characteristics. Often, this requires the repair or replacement of parts of the product. Reuse is the most desirable treatment method, for it guarantees the highest level of value retention.

Recycling
Products are processed in order for its source materials to be reused. Throughout the recycling process, value is lost, rendering recycling a suboptimal choice of waste treatment method.

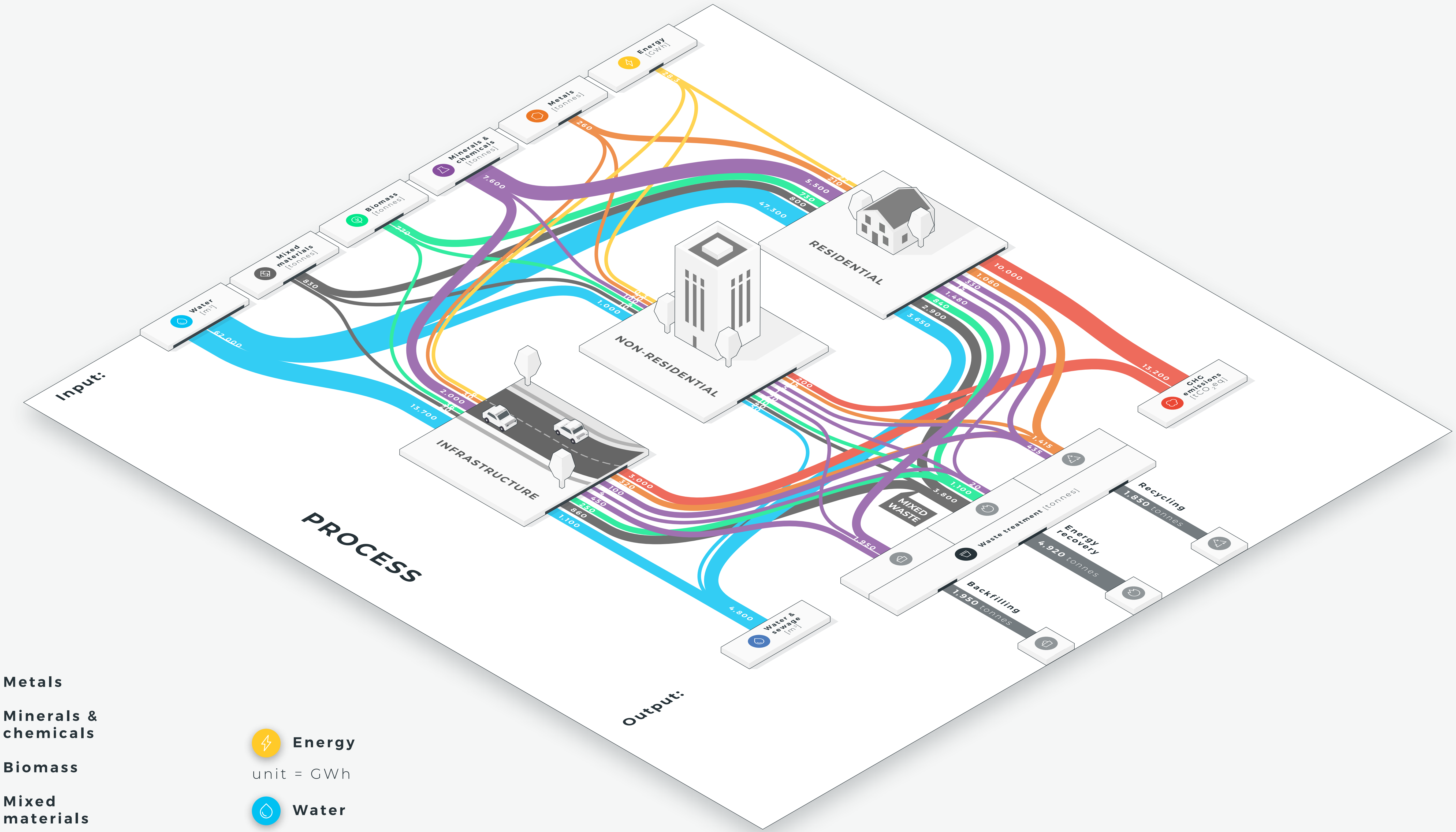
Energy recovery
Resources are burned in order to generate heat or other energy. Whereas a small fraction of the product's value is captured, most value is lost.

Backfilling
Resources are directly applied on, and provide value to, the land. Common examples include backfilling of materials to reclaim land or landscaping, use on agricultural land in a similar manner to fertiliser

Incineration
Resources are incinerated and converted into emissions. No heat or energy is captured and resources thus lose all value.

Landfill
Resources are diverted to a landfill site, or discharged in surface water. Not only is all value lost, but landfilling waste also causes high levels of environmental pressure.

MATERIAL FLOW ANALYSIS



Metals

Minerals & chemicals

Biomass

Mixed materials

unit = tonnes

Energy

unit = GWh

Water

unit = m³

Figure 10: Material Flow Analysis of the Kongsvinger built environment value chain

Key insights Material Flow Analysis

The MFA is an analytical tool that enables us to present the resource flows like water, energy, and different types of materials, into a given system, in this case, the built environment value chain, in a given year - in this case, a snapshot of 2018 - creating a refined picture, and capturing the first insights regarding environmental challenges and circular opportunities. The structure of the MFA is normally composed of the resource flows entering the system (inputs), the stock (buildings, households, etc.), and the outputs (which can be divided into outputs and waste treatment, the former being secondary materials, water and emissions. The main insights provided by this summary can be found on this page.

INPUT

Construction is a material-intensive sector
The Kongsvinger construction sector as a whole consumed around 9,000 tonnes of materials in 2018, which account for approximately 21% of all resources being consumed by the region's economy. These materials were used for all construction activities in the built environment chain within the Kongsvinger region. And these materials were used to build 129 buildings.

Non-renewable material consumption
80.4% of the total material consumed for construction activities in 2018 consisted of minerals and chemicals and another 2.75% for metals. Regarding the former, for the most significant part, minerals consist of concrete - often used for walls, and the structural foundation (skeleton) of buildings. This percentage is lower than in other European cities and regions (such as Lausanne, Basel or Prague), where minerals and chemicals represent around 96% of the total.

Biomass comprising of different wood types accounts for 8.15% of the total construction input
The use of wood has been common practice in the regional construction activities throughout the years. This percentage is higher than the share of wood in construction practices that have been encountered in other regions undertaking a Circle Scan. This shows how wood is an essential resource for the region and supports the value chain's endeavours to be more sustainable in its materials usage.

Miscellaneous materials account for more than 8.7% of total products entering the system
This category refers to a large extent to composite materials, which are a combination of two or more constituent materials that can offer better performances when assembled together (for example: Fibre-reinforced polymer (FRP) or Glass-fibre-reinforced plastic (GFRP). Looking at the historical data, it can be observed how the use of this type of products has increased rapidly in the last decades, putting pressure on the stakeholders at the waste treatment side of the value chain because of the complexity of treating this type of materials, which in most cases end up incinerated[19].

STOCK

The buildings typologies in the analysis are:

- **Residential:** single-family houses (detached, semi-detached and row houses) and multi-family houses (apartment and community buildings)
- **Non-residential:** mainly consisting of office and industrial buildings
- **Infrastructure:** Civil engineering, such as bridges, rails or streets

As the building stock analysis will show in the next section, the most part of construction activities are directed to building residential stock. 76% of materials consumed by the sector are directed to the construction of residential buildings, 22% to infrastructure and 2% to non-residential buildings. In 2018, 129 buildings were constructed, from which 127 (111 single-family houses and 16 multi-family houses) were residential and 2 non-residential. Looking at figure 11, it can be observed how construction activities in 2018 were lower than the average (164) buildings constructed per year since 2000.

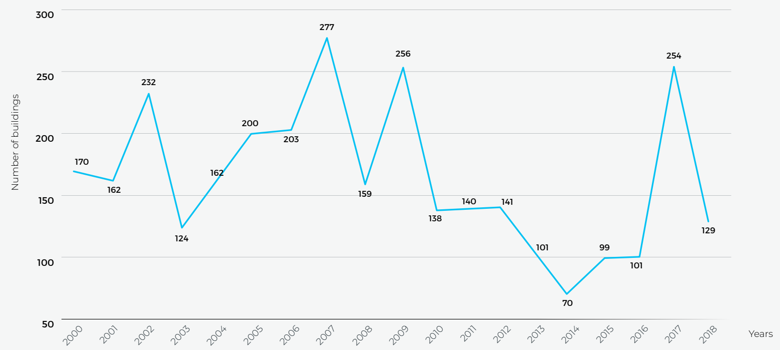
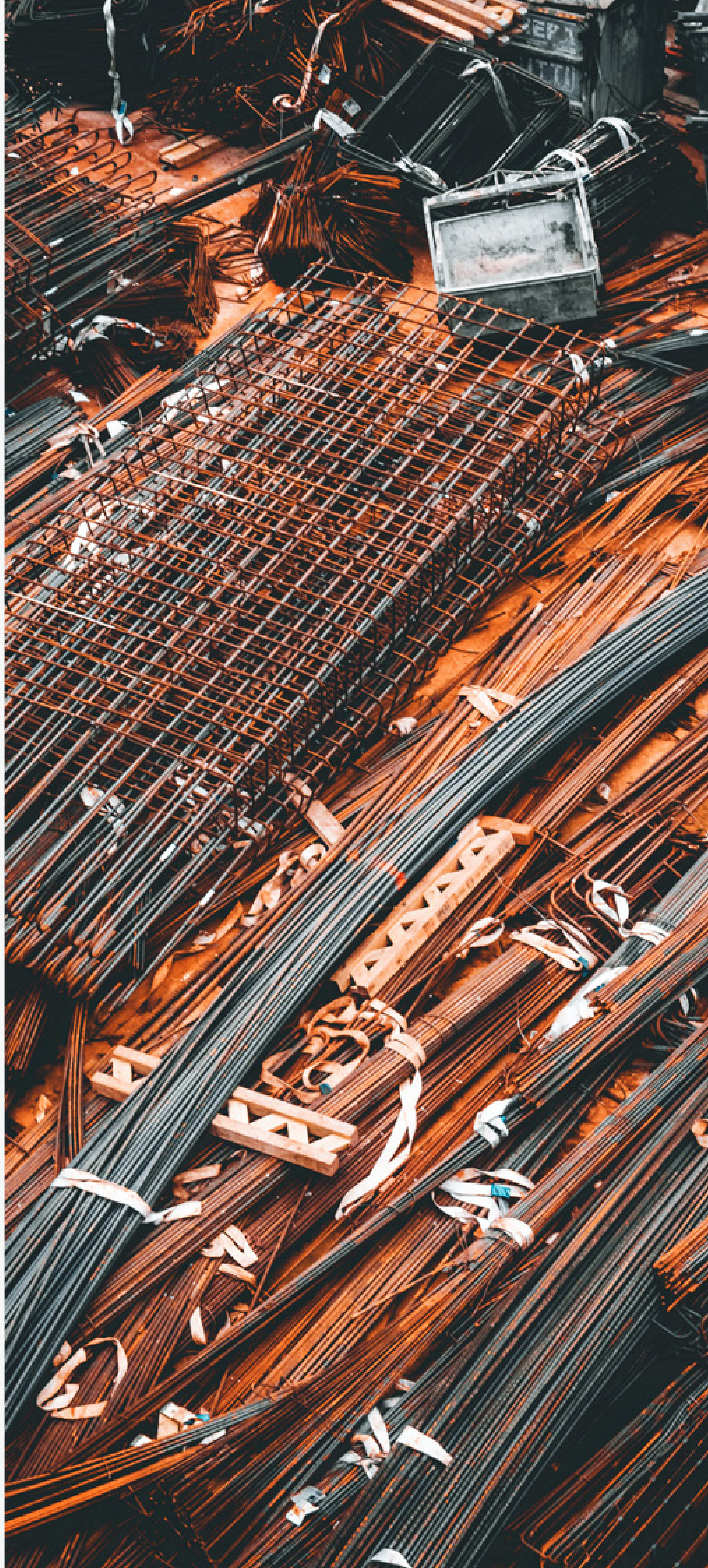


Figure 11: Number of buildings constructed per year (2000-2018)



OUTPUT

Value loss in construction, demolition and renovation
Of all construction, demolition and renovation waste, 21% is being recycled, 57% is being treated for energy recovery and the remaining 22% of total waste is being backfilled. These figures show the potential for improving the sector with regards to a higher-value treatment of the waste generated. Private contractors commonly prioritise virgin materials over secondary materials since clients want new products, as these are currently much easier and faster to buy, and do not have to deal with circular economy and Environmental Product Declaration (EPD) regulations[20]. Therefore, changes in regulation are needed in order to change this picture, as the current regulation (TEK 17) is hindering a higher use of secondary materials.

GHG emissions
These emissions account for 24% of the emissions of the whole value chain. Accounting for activities in the entire chain - including all mining, wood manufacturing, waste management and real estate activities - approximately a total of 370 kilotonnes of CO_2-equ. GHG emissions are emitted. Oslo is pioneering in reaching fossil-free and carbon neutral construction sites. Within the Kongsvinger region, most heavy machinery and equipment is not electric yet, contributing to the fossil fuel consumption of this sector.

Low-value treatment of wood
All biomass waste (which is essentially wood) is currently being incinerated for energy recovery. This raises the question as to whether a better capturing of the value of wood coming out from construction, demolition or renovation activities could be obtained. A higher value treatment of this wood through reuse or recycling could greatly improve the sustainability performance of the built environment of the region.

81% of mineral waste is backfilled
Most of the mineral waste is being used for backfilling and pavement subgrade while only 18% is being recycled. Most mineral construction waste is recycled as aggregate concrete and reclaimed asphalt pavement, which represents a loss of potential value as these same materials could be recycled as construction materials.

Mixed waste represents 43% of waste generated
3,800 tons of mixed waste is being incinerated for energy recovery. This amount of mixed waste complicates the valorisation of the construction, demolition and renovation waste as it is difficult to sort and send to recycling plants. A closer look into the use of composite materials in the construction phase and a better sorting on-site could help reduce the amount of waste being mixed.

MATERIAL FLOW ANALYSIS

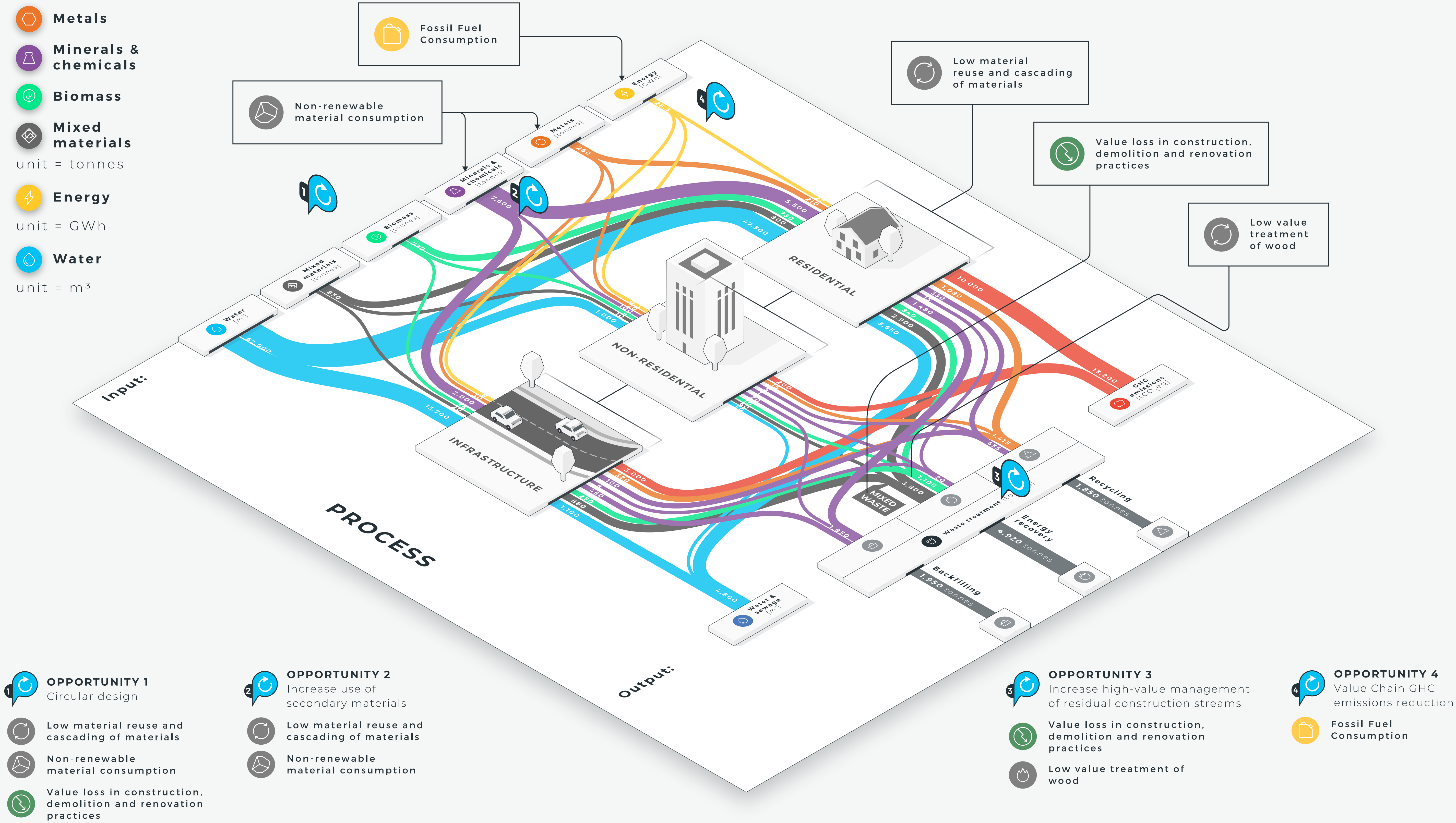


Figure 12: Material Flow Analysis including Challenges and Opportunities 2018)

OPPORTUNITY 1 - CIRCULAR DESIGN

Adressing:

- Low material reuse and cascading
- Non-renewable material consumption
- Value loss in construction, demolition and renovation practises

In the Kongsvinger region, new constructions are planned in the coming years to meet the expected population growth and increasing business activities. Currently, conventional building design limits high-value recovery of materials at the end of the functional lifespan. This can be seen in the relatively low rates of material recycling (21%) and in the fact that direct reuse only accounts for less than 1% of C&D waste treatment. It is, therefore, key to explore new ways of thinking and cross-sectoral collaboration to optimally manage and valorise waste, while simultaneously designing for a future where the built environment value chain operates on a paradigm of circular resource management.

POTENTIAL DIRECTIONS

Circular design for deconstruction
There is a substantial amount of mixed waste being incinerated due to the complexity of higher value treatment which entails a resource value loss. There is an opportunity to explicitly design new buildings with modularity, adaptability and deconstruction in mind.

Design for low energy consumption overtime
Improve the overall energy performance through circular insulation materials from recycled or biobased materials, and circular energy systems, such as green roofs that even offer broad energy, materials and social benefits.

OPPORTUNITY 2 - INCREASE USE OF SECONDARY MATERIALS

Adressing:

- Low material reuse and cascading
- Non-renewable material consumption

As it can be seen in the MFA analysis, approximately 80% of the materials consumed by the construction sector in 2018 were minerals and chemicals, while renewable materials such as wood represented approximately 8% of total resources consumed. In addition, there is currently no public data available on the share of secondary materials being consumed by the value chain, which complicates the correct assessment of its resource management performance.

In an ideal circular built environment value chain, all the materials consumed will originate from renewable and/or reused/recycled sources. Therefore, there is an opportunity for Kongsvinger's built environment value chain to increase the quality and quantity of data regarding these materials, to enable effective circular decision making and to increase the overall share of materials that are consumed from secondary sources.

POTENTIAL DIRECTIONS

Use of low-carbon and/or secondary construction materials
There is an opportunity to directly decrease the environmental footprint of the sector through the utilisation of greater shares of low-carbon and/or secondary materials. In essence, reducing the amount of virgin minerals and increasing the amount of more regenerative resources.

Circular tendering
The Kongsvinger region can drive market demand and stimulate innovation through circular-based tendering. These criteria could demand a minimum proportion of secondary materials in the project, or that the building is modular, or designed to be deconstructed.

OPPORTUNITY 3 - INCREASE HIGH-VALUE MANAGEMENT OF RESIDUAL CONSTRUCTION STREAMS

Adressing:

- Value loss in construction, demolition and renovation practises
- Low-value treatment of wood

Waste management of construction, demolition and renovation waste tends towards low-value applications. This can be explained due to the method of demolishment and later sorting of waste, which seems to not be focussed on the recovery of these materials. As an example, wood waste is currently not being recovered and being fully incinerated for energy recovery. With carbon sequestration being one of the benefits of wood reuse, there seems to be potential to find higher-value uses for this resource.

POTENTIAL DIRECTIONS

High-value recovery and recycling of construction materials
Circular and higher-value recovery and recycling of construction and demolition wastes, through new construction practices or new technologies, can enable higher-value applications as new materials. For example, selective deconstruction practices are increasing the share of high-value and reusable structural components[21], while new technologies are increasing high-value applications of construction materials within buildings (such as Stonecycling, Smartcrusher and HenningLarsen[22]).

Improvement of waste sorting to maximise resources recovery

In order to ensure an optimal capturing of waste resources value, an improvement of waste sorting practices remains crucial. This can be developed through on-site sorting and through advanced end-of-pipe solutions for advanced waste treatment that can increase the sorting capacity of the waste management system of the region.[23]

OPPORTUNITY 4 - REDUCE VALUE CHAIN'S GHG EMISSIONS

Adressing:

- Fossil Fuel Consumption

Decarbonising strategies for logistics are urgently required, and could involve the electrification of vehicle fleets, or exploring the use of alternative fuels (biofuels, hydrogen) in existing vehicle fleets. As the Kongsvinger region is a key hub for Norway's logistics, the utilisation of more efficient modalities could result in a sizable footprint reduction.

On the other hand, exploring opportunities to maximise the use of local products in construction activities can also be an alternative to increase the circularity performance of the value chain while decreasing the embodied emissions associated with materials consumption.

POTENTIAL DIRECTIONS

Carbon-free construction sites
Carbon-free building sites are a step along the path towards zero-emission construction processes. Increasingly, construction sites are cutting their greenhouse gas emissions. According to a new report, virtually all construction in Oslo could be zero-emission by 2025.[24]

Shorten the value chain
Nowadays, imports of wooden products account for a big part of the built environment value chain consumption.[25][26] Fostering the use of low-carbon and sustainable materials and products can help to cut embodied emissions of transport while stimulating innovation and value creation in the local economy.

Key insights Building Stock Analysis

From a circular economy point of view, in order to lower the pressure for raw materials extraction, it is important to know which resources are already there and think of ways to access and make use of them. It is key to take into account the building stock resources when designing strategies for more sustainable and resource-efficient constructions. The Kongsvinger region has a large pull of secondary materials in the stock (about 2.5 million tonnes) that could cover the approximate 10,000 tonnes of materials consumed by the value chain every year.

Through the Building Stock Analysis (BSA), the material composition of the regional building stock is analysed. The purpose of this analysis is to create a reliable picture of the type and quantity of materials that have been 'locked' into the built environment through construction activities from the nineteenth century up to 2018.

By means of this analysis, the composition of the region's building stock has been presented in greater clarity - where the different materials can be found and in which quantities - in order to support the identification of circular opportunities and innovations that can improve the materials stock management of the region. The material composition of the regional building stock is visualised in figure 13.

The building stock represented is composed of all residential (single-family and multi-family houses) and non-residential buildings constructed in the region up to 2018. Data on infrastructure stock was not available and therefore, has not been included in the total stock. The visual includes:

- Total quantity of materials (in tonnes) and total number of buildings locked in the stock, in the top bar.
- A break-down of the material composition of the region's total building stock by mass by six material typologies: wood, iron and steel, mineral binder (such as concrete), stone and aggregate, ceramics and bricks and miscellaneous (i.e. composite materials). This can be seen in the top bar.
- A break-down of the material composition of each type of building: single-family, multi-family and non-residential. This refers to the second, third and bottom bars in figure 13.

MATERIAL COMPOSITION OF THE BUILDING STOCK (IN TONNES)

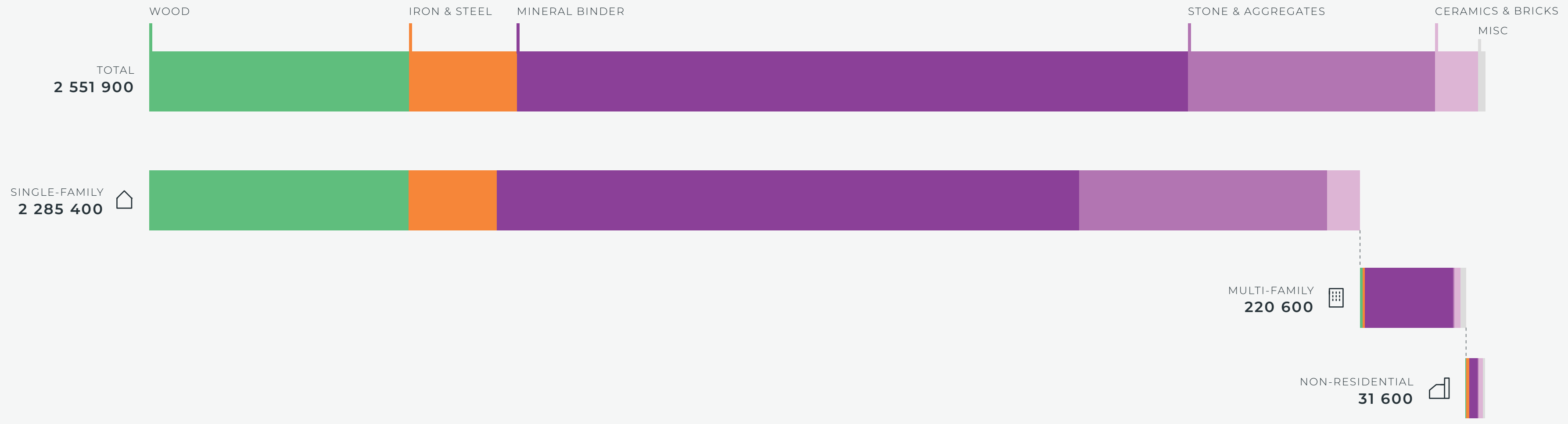


Figure 13: Material composition of the building stock (intonnes) & Bricks material intensity across time (tonnes)

BUILT-UP STOCK

According to data provided by Statistics Norway, Hedmark is the county with the largest total area of built-up land[27].Through the building stock analysis, we have attempted to shed some light on the amount and type of materials that the Kongsvinger region brings to this regional built-up land. Figure 14 highlights the building stock of the region, accounting for the available data up to 2018. The Kongsvinger region has approximately 2,500 kilo tonnes of materials locked in 25,083 buildings, which represent 54% of the land use for constructions other than roads in the region.

In terms of material density, out of the total building stock, 90% is stored in single-family houses (detached, semi-detached and row houses) accounting for 21,970 buildings, 9% multi-family houses (apartment buildings and community buildings) accounting for 2,570 buildings and 1% non-residential (office and industrial buildings) accounting for 545 buildings in the whole region. This snapshot of the region's building stock composition seems to steer most of the attention towards residential buildings, both for circular design, renovation and deconstruction. However, in the following parts of the analysis, it will be seen how a more dynamic observation of the stock will bring more nuances to the conclusions.

Even though there is no recorded data on the material stocked in infrastructure in the Kongsvinger region, in terms of land use, Hedmark is placed at the top because of its large amount of road area and agricultural buildings. This is well in line with its positioning as a key territory for logistics and the primary sector of the country.

As it was seen in the MFA, nowadays, a large percentage of materials flowing into the built environment of the region end-up in residential buildings. However, the outstanding amount of infrastructure such as roads should also drive the attention towards this type of built-up areas for its circular renovation and circular construction for new stock (according to the MFA, 22% of the materials flowing into the system are directed to infrastructure).

MATERIALS STOCK

This section provides further insights of each of the key material categories present in Kongvinger's building stock. The data represented in figure 13 reveals the amount and type of materials locked in the built environment:

1. Mineral binder 50.24%

Mineral binder (e.g. cement or gypsum) represent the largest share of material locked in the three building typologies, but are particularly dominant in both multi-family buildings and non-residential buildings. As presented in the MFA, this type of materials represents around 80% of materials consumed annually. This suggests that the total share of such materials in the total stock will increase rapidly over the next years.

If the Kongsvinger region aims to transition towards a circular built environment, closer attention should be paid to limit the use of new non-renewable mineral binding materials and to giving a second life to these materials locked in the stock. Figure 14 shows the evolution of the use of material binding materials in new constructions, where it can be observed a high growth in the 40's and 50's and how it has remained in a high use intensity to date.

2. Wood 19.42%

Unsurprisingly, wood represents the second largest material locked in the Kongsvinger building stock. Almost 20% of the stock is made out of wood, which can mainly be found in residential buildings, accounting for a great tradition of wooden building practices. It is important to note that, when looking at material stock by volume, the proportion of wood in the total building stock grows to over 40%. However, as already mentioned, the building stock analysis looks at materials density.

Wood is one of the most abundant resources in the Kongsvinger region and a key renewable material in circular construction. Therefore, there is an opportunity for the region to take special care of supporting its traditional wooden-construction practices and even incentivising innovation for a larger use of wood in new constructions.

As highlighted by the MFA, nowadays, wood represents around 8% of the materials used in new constructions. This proportion has undergone a significant decline - Figure 15 reveals how wood was massively used in new constructions until the emergence of the binding materials as one of the primary construction resources.

3. Stone & aggregate 18.48%

A large amount of single-family houses built prior to the 1940s contain a considerable amount of stone and aggregate, which currently represent around 18% of the building stock. After the 1940s, the use of stone and aggregate as primary materials vanished. This can be seen in figure 16, where a large drop in its material intensity in new constructions can be observed in the 1940s. As it will be seen in the future demand matchmaking analysis, a smart management of these resources locked in the stock will be key to prevent its waste.

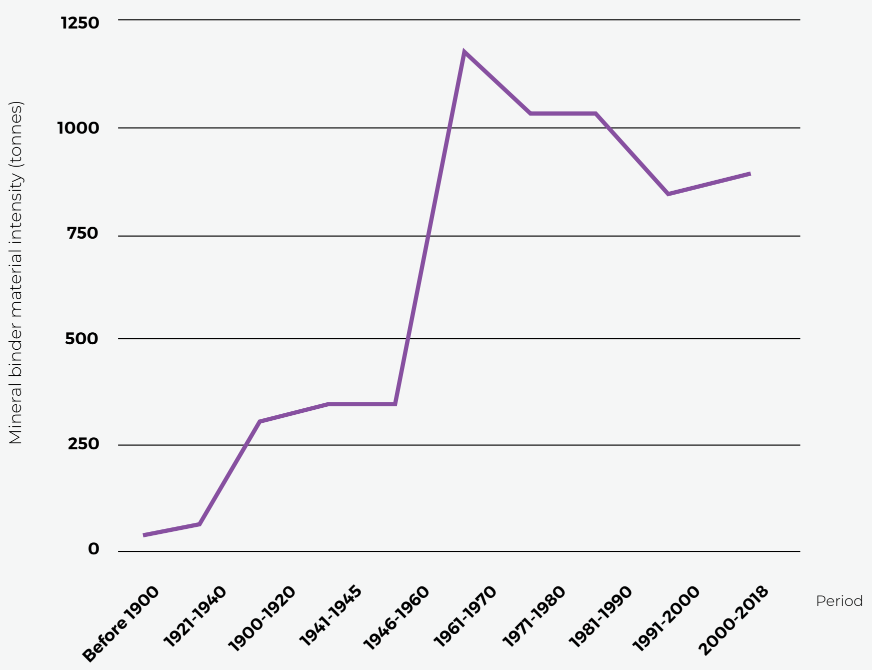


Figure 14: Mineral binder material intensity across time (tonnes)

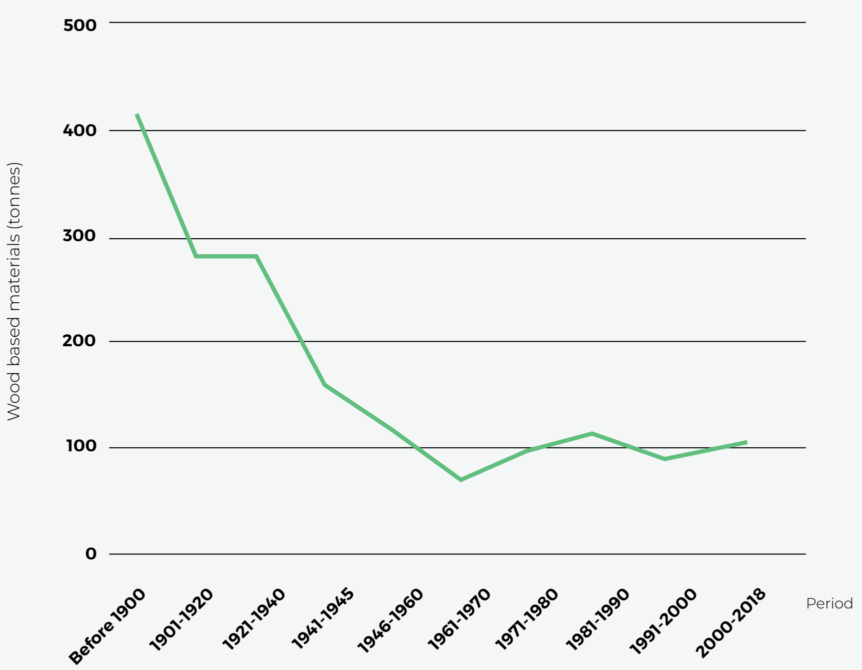


Figure 15: Wood-based material intensity across time (tonnes)

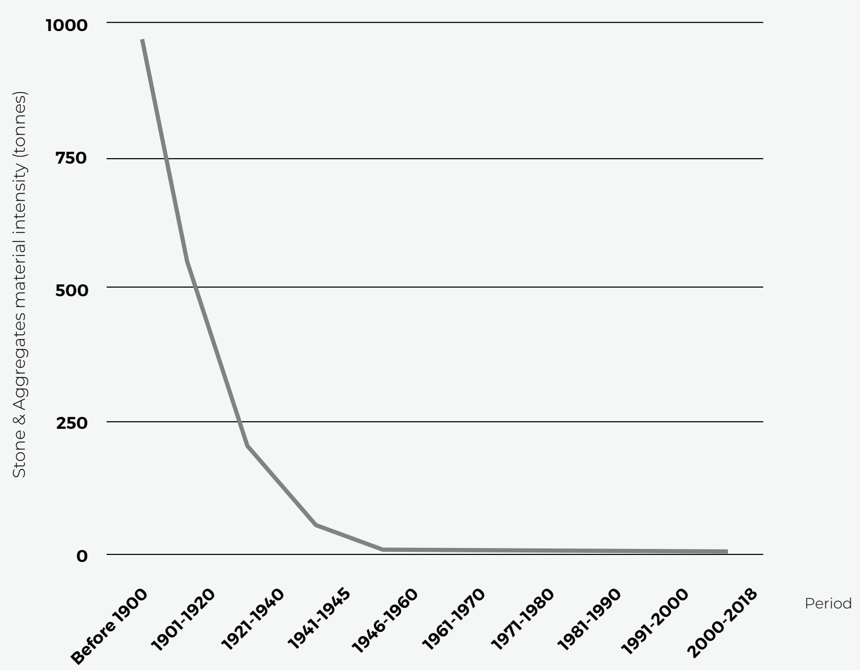


Figure 16: Stone & aggregate material intensity across time (tonnes)

4. Iron & steel 8.08%

8% of Kongsvinger's building stock is made out of iron and steel. Figure 17 shows how its use in new constructions has been steady since its peack in the 1940s. Even though metals have a high recovery potential, efforts should be put on preserving the value of the approximately 200,000 tonnes of metals locked in the stock for as long as possible

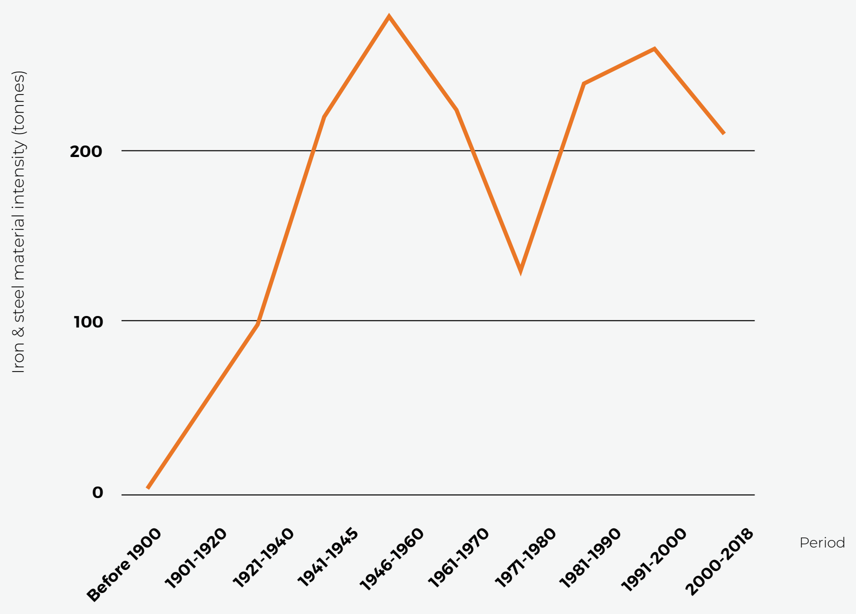


Figure 17: Iron & steel material intensity across time (tonnes)

5. Ceramics & bricks 3.23%

Similarly to what has been seen with stone and aggregate, figure 18 unveils how ceramics and bricks rapidly stopped being used in construction in the 1960s, coinciding with the peak of use of mineral binding materials. Even though these materials were broadly used in the first half of the 20th century, they currently represent a small 3% of the current stock. However, solutions will have to be found for approximately 82,000 tonnes of ceramics and bricks that have the potential to be released in the coming decades.

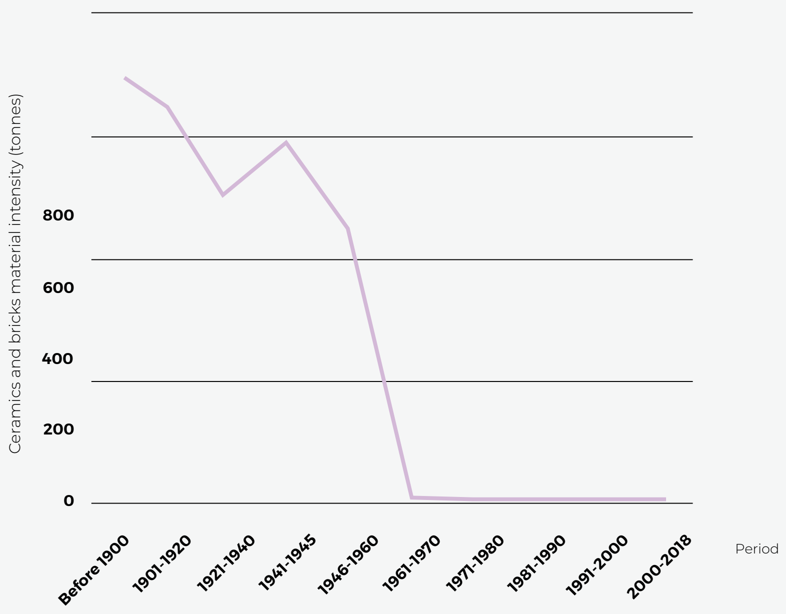


Figure 18: Ceramics & Bricks material intensity across time (tonnes)

6. Miscellaneous 0.56%

Lastly, miscellaneous materials represent less than 1% of the building stock. Even though the figure is very low, part of the materials considered to be minerals or wood in the analysis could probably fall under this category. As it has been seen in the MFA section, composite materials are increasingly being used in construction practices and represent a challenge for the construction, demolition and renovation waste treatment of the value chain.

Material composition across years

To add a layer of understanding to the building stock snapshot presented in figure 13 and complement the analysis done for each material, figure 19 sheds light on the material composition of the stock constructed per time period up to present.

Figure 19 gives an integrated picture of the analysis per material previously presented. The main insights that can be extracted are:

- The growing use of mineral binding materials in new constructions. The material started to be used in the early 1920s and has represented more than a 70% of total new stock since the 60s up to date.
- The high use of wood in the early 20th century and its later steady share of the stock, between approximately 15% and 19%, from the 1970s up to present.
- A similar pattern can be observed for stone and aggregate, and ceramics and bricks. These materials represented a considerable share of the building stock in the first half of the 20th century and disappeared in favour of mineral binding materials and metals.
- If the information in figure 19 is combined with the quantity of stock per period it is important to note that approximately 50% of the total stock of the region was built between 1940 and 1980. It is, therefore, important to have a close look at the buildings which are part of this stock in the efforts of maintaining the value of the resources locked in the stock.

Finally, to give further context to the building stock analysis, figure 20 shows the evolution of multi-family buildings across four time periods: before 1900, 1901-1940, 1941-1980 and 1981-2018.

As it was seen in figure 13, multi-family buildings are mainly made out of mineral binding materials. Figure 20 shows a clear increase in the number of multi-family buildings being constructed in the region, which is in line with the trend that was identified in the interviews of an increase of multi-dwelling houses construction. Even though single-family houses represent a large share of the current building stock, multi-family houses are gaining more and more presence in the region and this trend entails a higher use of non-renewable materials. This is important to take into account when working with circular design of new constructions.

Figure 19: Material composition of the building stock across years (in tonnes)

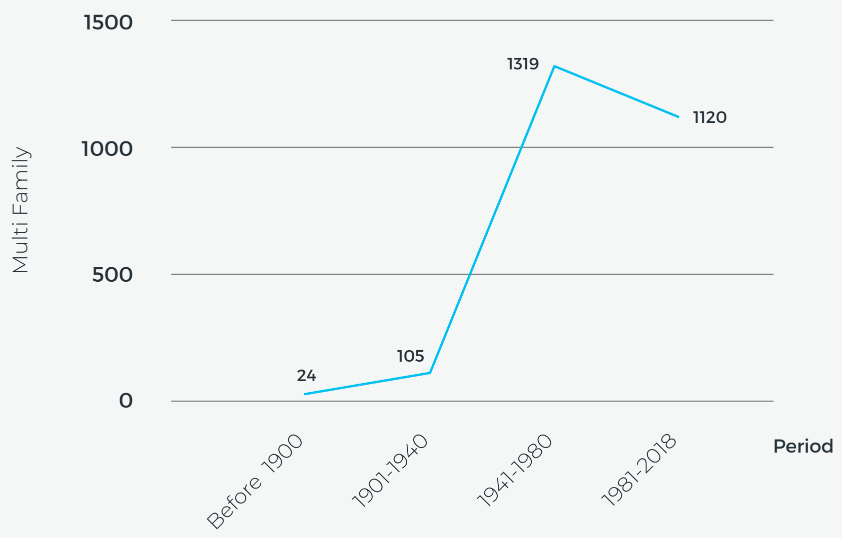


Figure 20: Number of multi-family buildings being constructed in the region (since before 1900 - 2018)

Key Insights future Demand matchmaking

The last part of the analysis undertaken in phase 2 is a matchmaking of the future demand with the resources locked in the building stock. This analysis is a first attempt to foster reflection around the management of the resources locked in the built environment. A more in-depth analysis and modelling should follow this project in order to apply targeted measures for specific material streams in the stock.

What do we mean with matchmaking?
Based on population growth for the next 20 years and on the material composition of buildings over the last 18 years, we have estimated the number of dwellings that will be needed and the subsequent materials that will be required to construct them. The question raised is the following: how much of the future demand of materials for new constructions has the potential to be covered with the materials that will be released with deconstruction of current buildings?

METHODOLOGY

Three scenarios of future demand for the period 2020-2040
As data on future construction plans in the region was not available, three different scenarios of future demand of materials based on future needs for new dwellings were created. The demand is based on the current typologies of buildings in the region:

1. **Low-demand of materials**
(based on the main alternative population growth 2020-2040, Statistics Norway)[28]
   - 608 buildings, 1500 dwellings
   - This is equivalent to building half of Grue

2. **Medium-demand of materials**
(based on the high alternative population growth 2020-2040, Statistics Norway)[28]
   - 1372 buildings, 3379 dwellings
   - This is equivalent to building a whole new Nord-Odal

3. **High-demand of materials**
(based on construction activities in the last 18 years)
   - 3444 buildings, 8489 dwellings
   - This is equivalent to building a whole new Eidskog and Åsnes

For simplicity, in the development of the matchmaking analysis, the focus is on the medium-demand of materials scenario. The choice of this scenario has been based on its likelihood to occur as it is the closest one to the materials consumption per year that has been calculated through the MFA, which is around 10'000 tonnes of materials per year.

Two typologies of building based on age for the demolition rate applied in the period 2020-2040
An estimation of future release of materials was made based on the demolition activities between 2000 and 2018. Two time periods of 40 years were selected to account for the typology of buildings with the highest likelihood to be demolished. Demolition likelihood was defined based on average buildings lifespan and qualitative considerations regarding aesthetics, ruling out buildings constructed prior to 1900 because of demolition restrictions due to historical value.

1. **1901-1940:** This time period includes the oldest buildings, which therefore have the greatest likelihood of demolition. The buildings constructed between 1901-1920 can potentially also be affected by demolition restrictions due to historical and cultural value, reason why it is only included in this time period.

2. **1921-1960:** This time period also includes buildings constructed between 1921-1940, which are considered in this analysis as the most likely to be demolished. 1941-1960 buildings are included because of their quality and aesthetics, which can also lead to potential demolition.

Three scenarios of recycling rates for the period 2020-2040
It is important to note that all the materials that are released through demolition have to be treated to be cycled back into the system as secondary materials. Based on the national target of reaching a 70% recycling rate of construction and demolition waste by 2030, 3 recycling scenarios were created:

1. **Business as usual: the recycling rates presented in the MFA remain the same until 2040.**
   - Metals (iron & steel): 90%
   - Mineral and Chemicals (mineral binder, stone & aggregate and ceramics & bricks): 18%
   - Biomass (wood): 0%

2. **50% recycling:** metals are kept to its 90%.

3. **90% recycling**

Results

The future demand matchmaking aims to shed light on the importance of managing the resources that are locked in the stock in order to use them as secondary materials for new constructions instead of sourcing primary resources. In these efforts, quality and technical fit of the secondary materials used in new constructions is not considered. Therefore, the analysis only attempts to compare the demand of materials and the potential supply of secondary materials with the objective of showing the potential of creating closed-loops in the system, even though it is technically not possible to construct a new building with recycled materials only.

It is also important to note that this analysis is based on the assumption that average demolition rates over the past two decades will remain steady until 2040. Renovation has not been included in the analysis to simplify the scope of the analysis and because local experts and desk research point that Norway has a good performance in terms of building renovation,[29] which suggests that this shouldn't be a strategic priority for this project in the efforts of implementing circular pilot projects. Nevertheless, it is worth stating that from a circular economy point of view, demolition rates would decrease thanks to fostering circular renovation of the building stock, and circular design of new constructions. The latter has been taken into account in the definition of the opportunities in the material flow analysis.

Future demand match-making with 1901 - 1940 buildings demolition

A 100% reflects all the materials needed in order to construct all buildings planned in the 2020-2040 time period

Figure 21 represents the matchmaking of materials released by deconstruction with predicted future materials demand for the scenario of buildings of the period 1901-1940 being demolished.

It is interesting to observe how in both a 50% and 90% recycling scenario, the supply of secondary wooden materials would be higher (129% in scenario 2 and 233% in scenario 3) than the demand of wood for new constructions. In case of demolishing buildings within this time frame, wood would be a very valuable material released, with high-potential of usability in new constructions. Because of the low rate of use of mineral binders and metals in buildings constructed in the period 1901-1940, small quantities of these materials would be released to fulfill part of the demand for new constructions, 13% of the demand for mineral binder in the highest recycling scenario and only 5% of the demand for metals in all scenarios.

Figure 22, however, shows the amount of materials that would be released but would not be suitable for use in new constructions, based on the new buildings material composition data.
As it was observed in previous sections, many buildings constructed in the period 1901-1940 were built with stone & aggregate and ceramics & bricks, which entails a large release of these materials if these buildings were demolished. In a scenario with recycling is business as usual, in the next 20 years almost 8000 tonnes of secondary stone & aggregate and almost 4000 tonnes of ceramics & bricks would be made available. However, this supply would not match any demand in the built environment value chain. These figures increase drastically in 50% and 90% recycling scenarios: up to 34000 tonnes of stone & aggregate and up to 19,000 tonnes of ceramics & bricks in the highest recycling scenario. It is key to start thinking about closed (within the value chain) or opened (in other value chains) loops that could give a second life to these materials that are currently not being directly used as construction materials for new buildings. Closed loops could be created to use the materials as low value aggregate in infrastructure projects or in the production of new construction materials[22]. Open loops could enable other industries to capture the value of excess supply of secondary construction materials[30]. It is important to note that a circular economy would also prioritise an adaptation of the design of new buildings in order to use these materials for new constructions.

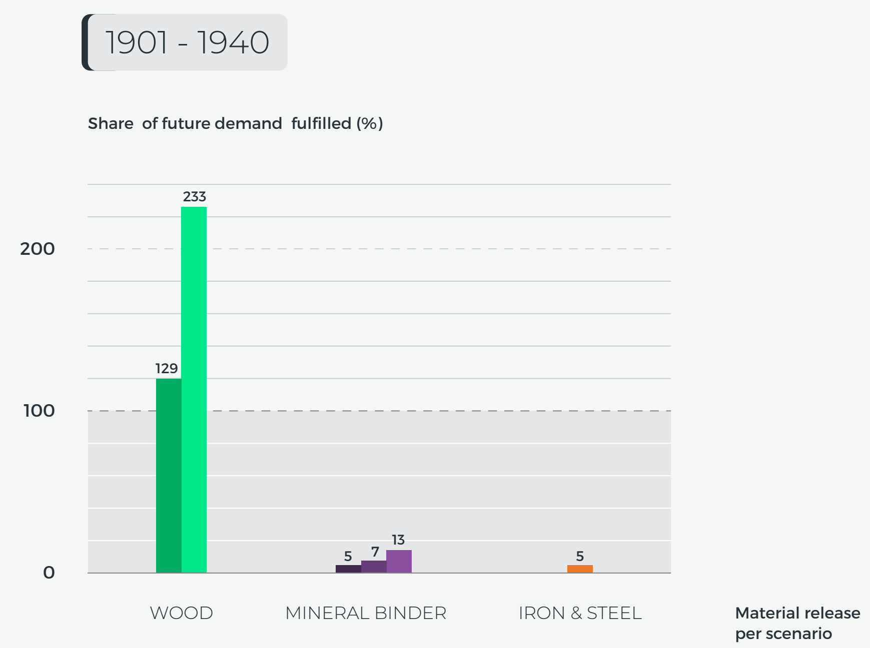


Figure 21: Future demand match-making with 1901 - 1940 buildings demolition

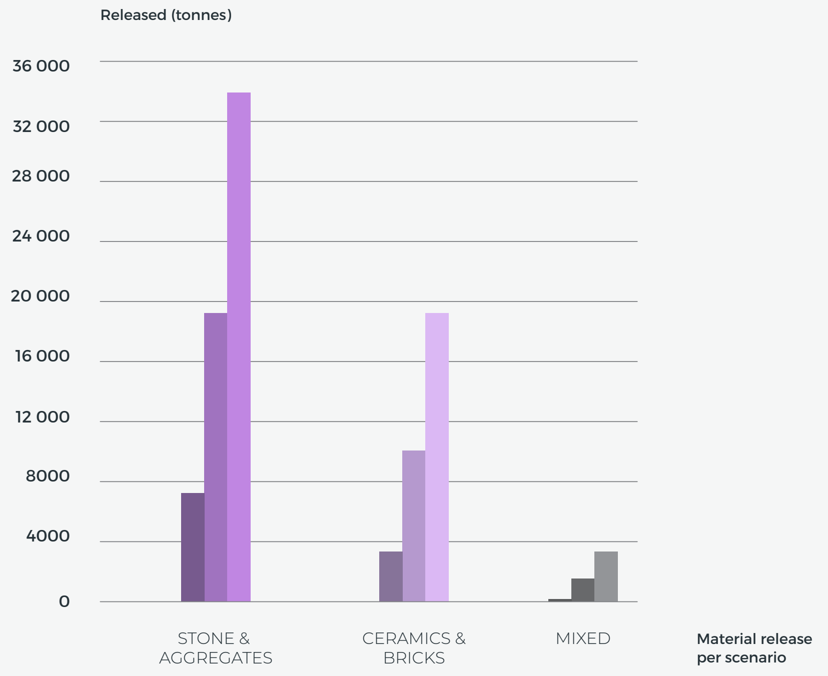


Figure 22: Excess materials released with 1901-1940 building demolition

Future demand match-making with 1921 - 1960 buildings demolition

The same analysis is undertaken for the demolition of buildings constructed in the period 1921-1960. As the material composition of these buildings varies from those constructed between 1901 -1941, the quantity per type of material release also varies.
It can be observed how the amount of secondary wood available is lower and only in a scenario of 90% the demand could be fully covered. On the other hand, the amount of secondary mineral binder and metals being released is much higher than in the previous case, showing how these materials were increasingly used after the 1940s.

Finally, when looking at excess materials released in figure 24, representing those materials not matching any demand of materials for new building constructions, a large amount of secondary ceramics & bricks and composite materials (miscellaneous) would be released. In case buildings of the 1921-1960 period would be demolished, circular strategies to give these materials a second life should be developed to avoid high volumes of materials being wasted. As presented in the analysis of excess materials for the period 1901-1941, attention should be on circular strategies for closing open and close loops and on circular design of new constructions to absorb the supply of secondary materials.

1921 - 1960

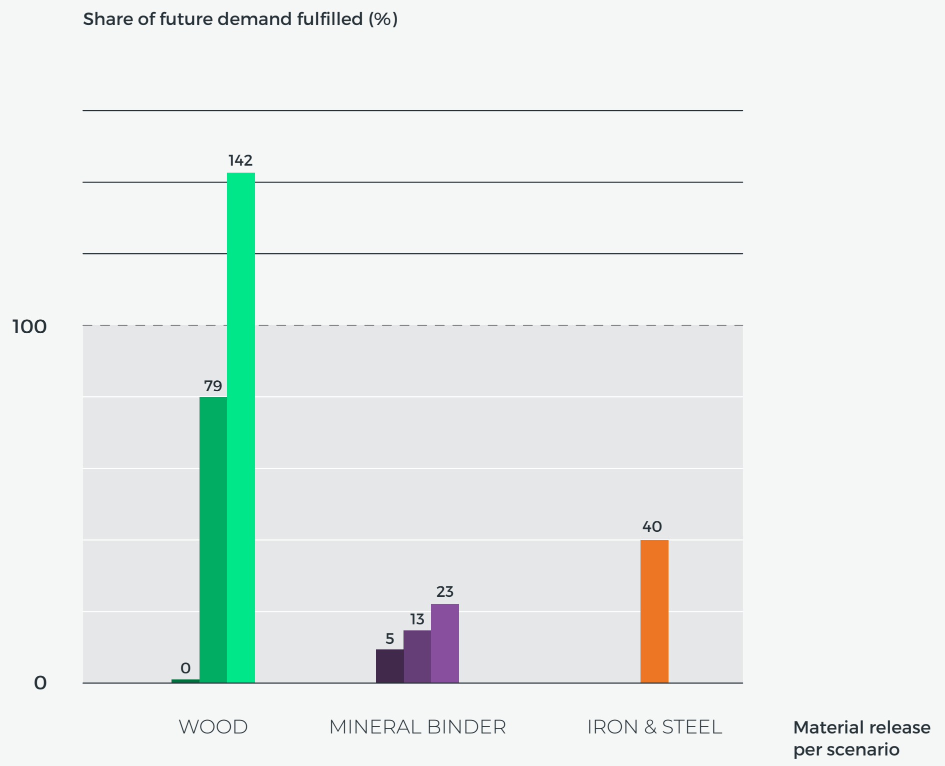


Figure 23: Future demand match-making with 1921 - 1960 buildings demolition

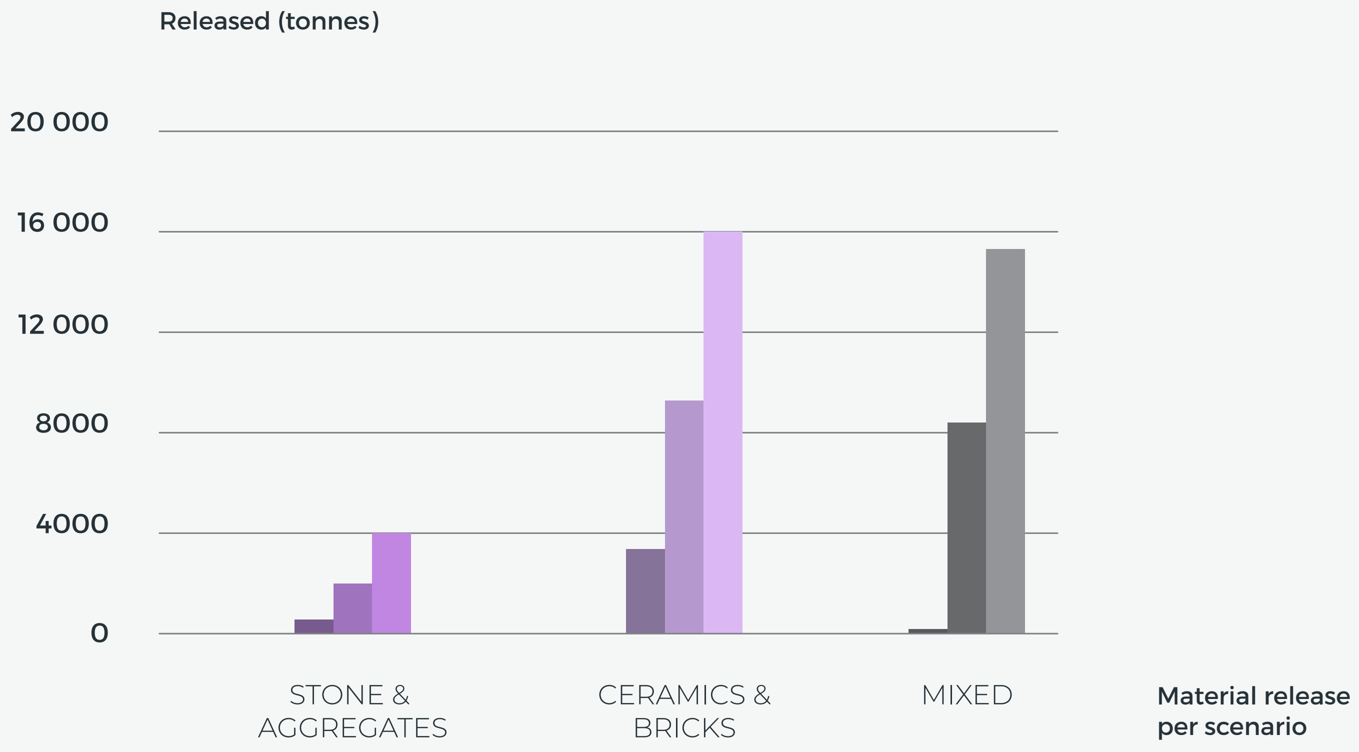


Figure 24: Excess materials released with 1921 - 1960 buildings demolition

Main conclusions of the future demand match-making

The main objective of this analysis is to emphasise the importance of capturing the value of the resources locked in the stock to lower the pressure on raw materials extraction. The insights extracted from the analysis should inform decision-making regarding design, demolition and renovation practices:

- Circular design to enable secondary materials use in new constructions and to ensure future building deconstruction for sorted construction waste release.
- Selective demolition to ensure an effective match-making of materials demand and secondary materials supply.
- Circular and selective renovation to enable secondary materials use in new renovations, ensure sorted renovation waste release, and prioritise the renovation of certain buildings to regulate the supply and demand of secondary materials. As it has been presented in the building stock analysis (material composition across years), close to 50% of the stock is locked in constructions made between 1941-1980.

However, as mentioned in section 1, stakeholder communication is a key element to enable the transition towards a circular economy. Most notably in this case, it is important to enable sectoral and cross-sectoral collaboration in order to most efficiently manage resources.

1. Urban Mining

Addressing:

I Reuse of building components during renovation is marginal

II.a High non-renewable material consumption

II.b Low material re-use, cascading

IV Low value treatment of wood

Information about the availability and location of certain materials can help develop circular strategies. There is an opportunity to reuse the materials and elements embedded in existing buildings. For example by fostering supply driven architecture, a practice where the whole or part of a building is designed according to the supply of secondary materials sourced from demolition sites, or ideally from a full online marketplace. Required materials can be mapped against upcoming demand for building materials in new constructions or even these materials can be connected to other value chains (open-loops).

POTENTIAL DIRECTIONS

Building stock material database

It is possible to build a geological map of the region that can showcase the presence and availability of certain metals (iron, copper and aluminium), with a focus on the built environment - Kongsvinger's 'Urban Mine'. With this information, strategies can be developed to further explore the possibility of most effectively extracting materials from this 'urban mine'[31].

Building Stock Design

There is an urge for designers to smartly use materials from existing building stock that is about to be demolished by using building information modeling (BIM). By designing with secondary materials in mind - design can structurally decrease the need for new (raw) materials.[32]

2. Matchmaking of secondary materials

Addressing:

I Reuse of building components during renovation is marginal

II.a High non-renewable material consumption

II.b Low material re-use, cascading

IV Low value treatment of wood

In order for the matchmaking of the demand of materials and the supply of secondary materials to take place, it is key to know what materials are available and have a marketplace where to buy and sell the resources. The materials that could be traded in this marketplace could include precious metals and minerals, as well as elements such as window frames, doors and inner walls.

POTENTIAL DIRECTIONS

Digital Marketplace

Material marketplaces can help to connect supply and demand and centralise available materials to be used in construction projects. Combined with digital tools to map existing materials in the building stock, secondary materials can be reserved by construction before they are recovered from buildings.[33]

Material Passport

Innovative digital technologies can ensure the gathering of important information of the current available material stock by mapping all new materials used in (digital) material passports and disassembly plans.

Materials in the building stock can be reserved before deconstruction, which can enable the large-scale reuse of construction materials.[34]

3. Capacity building

Addressing:

I Reuse of building components during renovation is marginal

II.a High non-renewable material consumption

II.b Low material re-use, cascading

III Mixed waste

IV Low value treatment of wood

V Embodied Emissions

As already mentioned in previous sections of the report, the built environment value chain transition towards a circular economy needs a systemic approach. All different local stakeholders need to collaborate in the development of a circular value chain and embrace the opportunities a circular economy can bring. The role of education and training is crucial in achieving this ambition. Capacity building can enable a mindset shift and empower local stakeholders with the required skills and tools to kick-start the value chain transition towards circularity.

POTENTIAL DIRECTIONS

Regional Knowledge Development on Circular Built Environment practices and mindset

Advancing the understanding and knowledge on Circular Built Environment practices, such as Building Stock Modelling. Develop and deliver professional training and educational programs[35].

The Kongsvinger region has kick-started its transition towards a circular economy through the process of the Circle Region Scan. The presented material flow analyses and building stock analysis provide a holistic picture over the material streams within the built environment value chain of the region, which allows to find the largest potentials to reduce material use, close loops, and recover values in the system. Following a collaborative and fact-based innovation process, seven circular opportunities have been presented that hold significant transformative potential for the region in the built environment value chain. Each opportunity has been identified based on its potential influence on key material flows, while taking into account the local context to secure implementation.

Selecting opportunities to take forward

A multi-stakeholder workshop was held on March 4th, 2020, where the insights of this report were presented and discussed. Following the presentation of the material flow analysis and building stock analysis results, an interactive group exercise allowed the participants to actively comment, discuss, and shape the proposed list of challenges and opportunities. The interactive exercise concluded with a short voting round. During the voting, several opportunities were selected to further explore based on impact, region fit, feasibility and innovativeness. The selected opportunities from the workshop were:

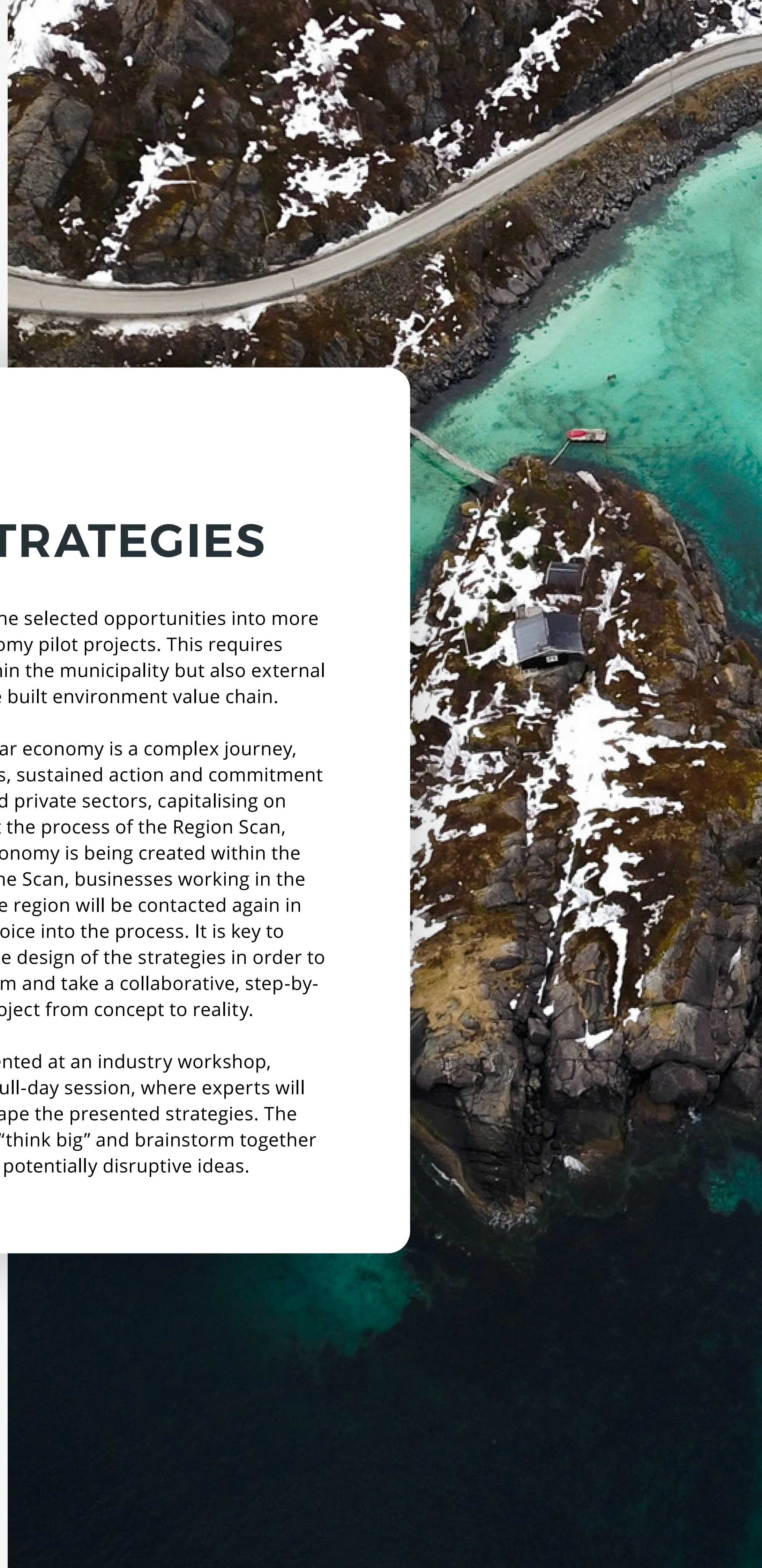
- Increase the use of secondary materials
- Value chain GHG emissions reduction, which was decided to narrow it down to shorten the value chain
- Capacity building

NEXT STEP: CIRCULAR STRATEGIES

The goal of Phase 3 is to translate the selected opportunities into more specific strategies for circular economy pilot projects. This requires broad input from stakeholders within the municipality but also external experts who are working within the built environment value chain.

Transitioning towards a more circular economy is a complex journey, and will not happen overnight. Thus, sustained action and commitment is required from both the public and private sectors, capitalising on each other's strengths. Throughout the process of the Region Scan, momentum towards the circular economy is being created within the Kongsvinger region. In phase 3 of the Scan, businesses working in the built environment value chain of the region will be contacted again in order to bring their expertise and voice into the process. It is key to take a public-private approach in the design of the strategies in order to capitalise on the existing momentum and take a collaborative, step-by-step approach to take each pilot project from concept to reality.

The defined strategies will be presented at an industry workshop, which is a creative and interactive full-day session, where experts will be invited to come together and shape the presented strategies. The Industry workshop is a moment to "think big" and brainstorm together in expert groups on innovative and potentially disruptive ideas.



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Annex

ANNEX

1. NACE codification of sectors

This analysis compares 12 different sectors by using the NACE definitions of industries. This is the European classification system for industries.
The sectors correspond to the SBI 2008 classification on the first digit, or combinations thereof. These sectors are then clustered based on their core type of economic activity. In total we take into account 12 sectors in three categories:

Industry
- Agriculture and mineral extraction (ie. farms, mining)
- Energy, waste and water management (ie. incineration of waste)
- Manufacturing industry (ie. life sciences activities*)
- Construction and real estate (ie. building, property rental)

Commercial services
- Transport and storage (ie. trucking, warehousing)
- Trade (ie. wholesale, retail)
- Tourism (ie. catering and culture)
- Business services (ie. advisory, financial and legal services)
- Advanced services (ie. IT, communication, and financial services)

Public services
- Public administration (ie. government services)
- Education (ie.schools and universities) • Health and social services (ie. social welfare and healthcare)

Information about the availability and location of certain materials can help develop circular strategies. There is an opportunity to reuse the materials and elements embedded in existing buildings. For example by fostering supply driven architecture, a practice where the whole or part of a building is designed according to the supply of secondary materials sourced from demolition sites, or ideally from a full online marketplace. Required materials can be mapped against upcoming demand for building materials in new constructions or even these materials can be connected to other value chains (open-loops).

2. GVA, employment and GHG emissions indicators

The methodologies for the three indicators are as follows;
Employment
Employment is calculated by measuring the total number of full-time equivalents per sector for the year 2018. In case of different used categories they were reorganised to make them NACE (https://www.ssb.no/en/statbank/table/07984). Employment is calculated by measuring the total number of full-time equivalents per sector for the year 2018. In case of different used categories they were reorganised to make them NACE (https://www.ssb.no/en/statbank/table/07984).

Gross value added
Gross Value Added (GVA) is a common economic performance indicator and is measured in millions of Norwegian Kroner (NOK) for the year of 2018. To establish the gross value added regionally, we scaled the available national data with a scaling factor determined with the employment data. Data was collected from SSN (https://www.ssb.no/en/statbank/table/09171/).

Greenhouse gas emissions
Gross Value Added (GVA) is a common economic performance indicator and is measured in millions of Norwegian Kroner (NOK) for the year of 2018. To establish the gross value added regionally, we scaled the available national data with a scaling factor determined with the employment data. Data was collected from SSN (https://www.ssb.no/en/statbank/table/09171/).

3. Stakeholders interviewed in phase 1

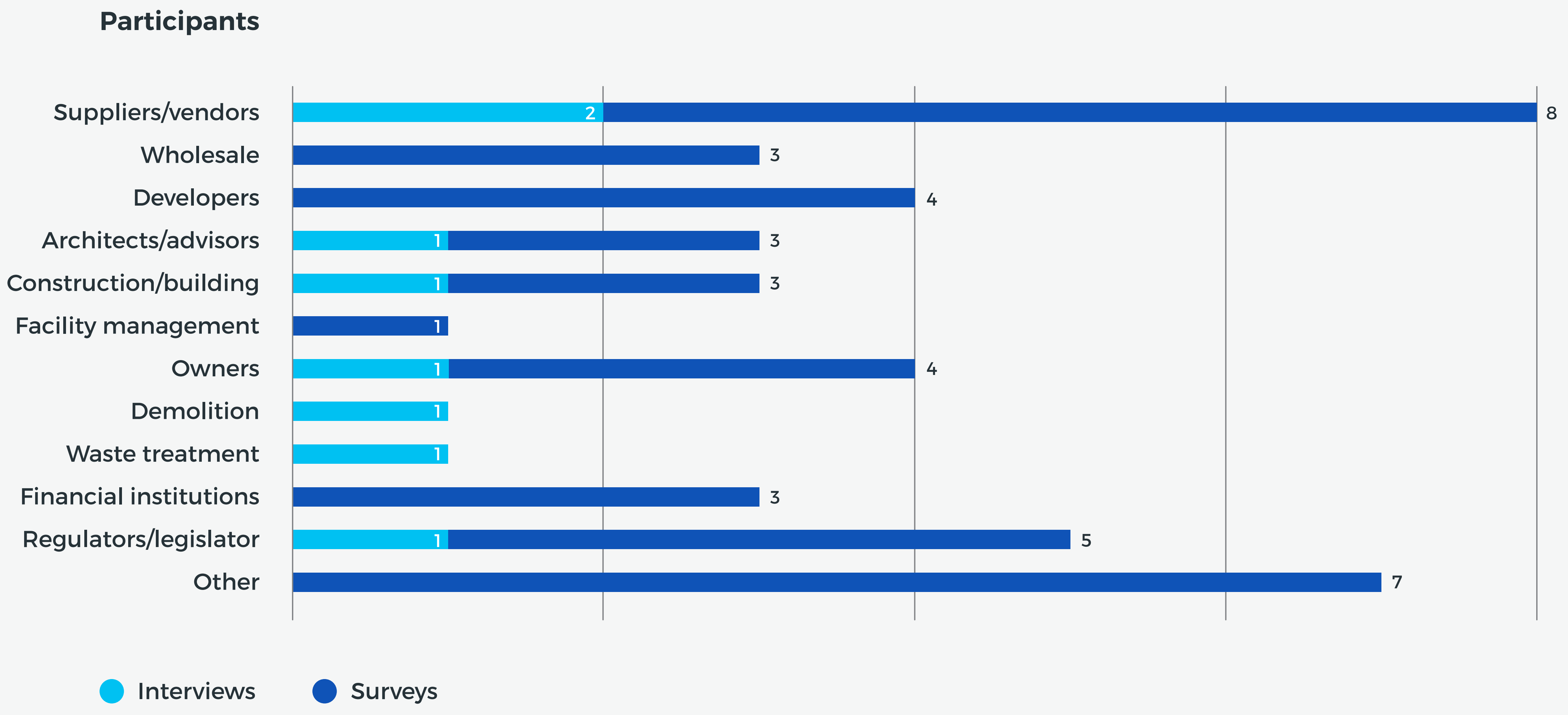
Interviewee	Name	Function	Organisations
1	Kai Engbraten	Administrative Director	Retura Glama
2	Brende Bredersen	Administrative Director	Bredersen Opseth
3	Odd-Anders	Head of Competence and Improvement	OM Fjeld
4	Rune		Kongsvinger
5	Anders	Architect	Arkitetlaget
6	Gunnar	Administrative Director	Arkitetlaget
7	Anders	Architect	Kobbl
8	Per Anders Bakke	Property Manager	Hedmark Fylkeskommue,

4. Stakeholders interviewed in phase 2

Interviewee	Name	Function	Organisations
1	Ole Gunnar Hoen	Project manager, construction	Sør-Odal Kommune
2	Odd Anders	Head of Competence and Improvement	OM fjeld

5. Overview stakeholders that contributed to phase 1

....Stakeholders asked



6. DISRUPT: 7 key elements of the circular economy

The circular economy assumes dynamic systems, meaning there is no specific end-point, but it is rather a process of transformation. The DISRUPT model describes 7 key elements that give direction to this transformative process, with the aim of slowing the flow of resources, closing the loop and narrowing resource flows, while switching to regenerative resources and clean energy. The 7 elements describe the full breadth of relevant circular strategies and will be used throughout the report.

D

Design For the Future: Adopt a systemic perspective during the design process, to employ the right materials for appropriate lifetime and extended future use and optimal recovery.

I

Incorporate Digital Technology: Track and optimise resource use and strengthen connections between supply-chain actors through digital, online platforms and technologies.

S

Sustain & Preserve What's Already There: Maintain, repair and upgrade resources in use to maximise their lifetime and give them a second life through take-back strategies, where applicable.

R

Rethink the Business Model: Consider opportunities to create greater value and align incentives through business models that build on the interaction between products and services.

U

Use Waste as a Resource: Utilise waste streams as a source of secondary resources and recover waste for reuse and recycling.

P

Prioritise Regenerative Resources: Ensure renewable, reusable, non-toxic resources are utilised as materials and energy in an efficient way.

T

Team Up to Create Joint Value: Work together throughout the supply chain, internally within organisations and with the public sector to increase transparency and create shared value.

7. List of local circular initiatives

Name of initiative	Link or description	Initiative type	If other, specify:	7 Key Elements
Samling	https://samling-bolig.no/	Partnership	Bank. library. Apartments. Made of Swiss CLT....	Regenerative to some extent. Imported CLT.
Bioheating / Industrial symbiosis	https://www.nord-odal.kommune.no/category18411.html	Service	BASF customer	Regenerative
E.ON Windpower (planned)	https://www.nord-odal.kommune.no/category18411.html	Service	BASF customer	Regenerative
Vakkerlia – "green" cabin project	vakkerlia.no	Product	Kongsvinger	Design for the future
Glomma industrier	glommaindustrier.no	Project regarding circular construction	Mainly on the furniture-side. Cooperate wit Fretex	Business model
Mo kindergarden		Other	Planned public building. Procurement. Possible to influence sustainability requirements	
7Sterke Bærekraftnettverk	https://www.7sterke.no/baerekraftnettverket/	Partnership	Sustainability network	Collaboration
Glåmmasvingen skole	https://www.sor-odal.kommune.no/glommasvingenskole/	Other	Public building - CLT	Regenerative
KUSK	https://www.kongsvinger.kommune.no/category20870.html	Other	Public building - CLT	Regenerative

Name of initiative	Link or description	Initiative type	If other, specify:	7 Key Elements
GIR	https://gir.hm.no/	Partnership	Must find ways to decrease waste - upcycle?	Waste as resource
GIVAS	https://www.givas.no/avlop/slam	Service	Must find ways to deal with sludge	Waste as resource
DNB	https://www.dnb.no/bedrift/tema/baerekraft.html?tms_click=nav_list_b_baerekraft	Service	sustainable business incentives	Business model
Arbaflame	http://www.arbaflame.no/	Product	wood pellets - replacing coal	Waste as resource
Forestia	https://www.forestia.no/om-forestia/miljoe/	Project regarding circular construction	wood panels	Regenerative
Solør Bioenergi	http://solorbioenergi.com/about-us/	Service	Heating - impregnated wood	Waste as resource
Nordisk Massivtre	http://nordiskmassivtre.no/	Partnership	CLT - prefabricated	Regenerative
Klosser - Innovasjonsløftet	https://klosser.no/vi-leder-regionale-utviklingsprosjekter/innovasjonsloftet/	Business model		Collaborate
Solør Næringshage	https://www.solornh.no	Project regarding circular construction	Solør Næringshage	Waste as resource

ANNEX

Name of initiative	Link or description	Initiative type	If other, specify:	7 Key Elements
Esvald miljøpark/ AF gruppen/ GHG	https://afgruppen.no/nyheter/2017/03/etablerer-ny-miljopark-pa-ostlandet/	Service		Waste as resource
Klosser - Interregprosjekt	https://klosser.no/biobasert-naeringsutvikling/grenselos-vekst-basert-pa-fotosyntesen/	Project regarding circular construction		Waste as resource
Moelven	https://www.moelven.com/about-moelven/division-timber/moelven-valer-as/	Product		Regenerative
Norexeco	https://www.norexeco.com/	Service	Pulp and paper exchange. Futures	Business model
Odal biovarme		Service	Now part of solør bioenergi	Waste as resource
HEdmark biogas	https://klosser.no/biobasert-naeringsutvikling/biogass/	Service		Waste as resource
Tretorget	http://www.tretorget.no/prosjekter/tredrivern/	Project regarding circular construction		Prioritise regenerative resources
Nordiske Trebyer	https://www.nordisktreby.org/nettverket-den-nordiske-trebyen	Partnership	City of Kongsvinger member.	Procurement power
Retura		Service	Handle most of the waste from the built environment i the region	Waste as resource
GIR		Service	Cooperate with Retura	Waste as resource

Name of initiative	Link or description	Initiative type	If other, specify:	7 Key Elements
AF Gruppen (Construction/GHG Owner. Local)	http://www.asfaltgjenvinning.no/	Service	Recycling of asphalt from the region. Akershus	Waste as resource
WITO	https://omfjeld.no/selskaper/wito/	Service	Building rehabilitation	Preserve
Kongsvinger municipality			Fjernvarme, etterissolasjon	Preserve
Kongsvinger municipality			Ongoing project 30 units /nursing homel	Procurement power
Kongsvinger municipality			New fire station	Procurement power
EPC project (Energy performing contracts)	http://hedmarkdalarna.com/bruk-av-epc-i-hedmark-fylkeskommune/	Service	All municipalities are invited to use	Preserve
Climit	https://www.gassnova.no/en/climit		Programme for research, development and demonstration of Carbon Capture and Storage technologies	Prioritise regenerative resources
Nordic Smart House	https://www.theexplorer.no/solutions/creating-affordable-and-energy-efficient-homes/	Project regarding circular construction	modular home developed to meet growing demand for smaller, cheaper and more sustainable housing	Design for the future

ANNEX

Name of initiative	Link or description	Initiative type	If other, specify:	7 Key Elements
Foamrox	https://www.theexplorer.no/solutions/sustainable-building-material-from-recycled-glass/	Project regarding circular construction	Sustainable building material from recycled glass	Waste as resource
Re-Con zero evo	https://www.mapei.com/no/no/re-con-zero-evo-temaside	Project regarding circular construction	Recycling concrete	Waste as resource
AF Gruppen (Construction/GHG Owner. Local)	http://www.asfaltgjenvinning.no/	Project regarding circular construction	Recycling of asphalt from the region. Akershus	Waste as resource
Campus Evenstad	Campus Evenstad, is a project that was made with a fossil fuel free construction, and it creates some of its own energy.	Project regarding circular construction	A project that was made with a fossil fuel free construction, and itcreates some of its own energy.”	Prioritise regenerative resources
Mårud, Norske Backer, GIVAS	http://www.maarud.no/	Other	Reuse of soil sludge (investigations. Oslo MET partner)	Waste as resource
HEdmark biogas	https://klosser.no/biobasert-naeringsutvikling/biogass/	Other	Reuse of soil sludge (investigations. Oslo MET partner)	Waste as resource
BEtong ØST	https://betongost.no/	Other	e of so	Waste as resource
Norsk Hydro	https://www.hydro.com/no-NO/om-hydro/hydro-worldwide/europe/norway/magnor/	Other	euse of aluminum sludge (investigations. Oslo MET partner)	Waste as resource
Forestia. Schutz Nordic	https://www.forestia.no/	Service	excess heat (investigations. Oslo MET)	Waste as resource

Name of initiative	Link or description	Initiative type	If other, specify:	7 Key Elements
BErgene Holm > Optimera > ØM Fjeld	https://www.bergeneholm.no/	Business model	Skip intermediary/ wholesale. Local material supply	Business model
“Circle Condo”		Project regarding circular construction	Building prototype. 50% recycled material	Waste as resource
	They recently built two new school buildings in solid wood. They thought about environmentalimpact when building/planning the schools. They also thought about how it would impact the solid wood industry in the region when municipality focus on it.	Project regarding circular construction	policy instrument	Design for the future
	Kongsvinger is part of a network called Nordic wood cities. The network has been latent for a little while, but they are currently working to get it up and running again. They will have a meeting in September to discuss the future of the network. The network discusses topics such as solid wood industry and environmental strategies. Eksjø has been a frontrunner for other cities in the network.	Network	Ongoing project 30 units /nursing homel	Prioritise regenerative resources
Glommen Mjosen skog	program EDEL: This is a program for sustainable forestry where they implement, economic, environmental and social aspects.	Other	Program to foster sustainability practices in forestry	Prioritise regenerative resources
Betong Øst	Low-carbon concrete	Product		Waste as resource
OM Fjeld	Reuse glass walls office building	Project regarding circular construction		Design for the future
Norsk Bio	Norsk Bio. They have used Norsk bio at two construction sites .	Business model	Service	Prioritise regenerative resources

CIRCULAR **KONGSVINGER REGION**

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