SirkTRE | CircWOOD

SirkMAGAZINE

midway evaluation

SirkTRE

FOREWORD

A word from Kristine Nore, Project Manager of SirkTRE

Dear reader,

We are now past midway in the SirkTRE project. For the last 2.5 years, a total of 30 partners through 23 sub-projects have worked hard to realize the ambition of the SirkTRE project: establishing the necessary value cycles to reuse structural wood and recycle wood chips into building materials in Norway. When we reach our goals, the reduced carbon emissions will account for 8 % of Norways net zero by 2030.

With this magazine, we want to show you some of the inspiring initiatives SirkTRE has spurred, ranging from highly efficient sorting systems to innovative wood-based panels, to circular system houses, to mention some.

Hopefully you'll learn something new, get some ideas for projects of your own, or maybe even find a project or company you'd like to get involved with.

Don't hesitate to reach out if you have any questions, comments or thoughts regarding the magazine – or if you're wondering how you can partake in creating a circular evconomy for the timber and forest industry.

Happy reading!

kristine.nore@omtre.no

> “Our goal is to bring back used wood for use in construction. We sort residual and demolition wood, quality-assure timber and bring it back for new use as structural timber.

For those unfamiliar with the Norwegian “pant” system, it is a recycling initiative where consumers buy beverages in bottles or cans, they pay a small additional amount known as a “pant.” This deposit acts as an incentive to return the container for recycling. After consuming the drink, individuals return the empty bottle or can to a machine and receive their deposit back, usually through a voucher that can be used in the store or as cash. This system effectively encourages recycling, reduces litter, and promotes environmental sustainability. It's widely used and accepted in Norway, with high return rates contributing to the country's efficient recycling efforts. The SirkTRE and CircWOOD projects aims to encourage wood reuse in much the same way.

CONTENT

SirkTRE - It's foolish to burn good materials!

WHAT

SirkTRE is a Green Platform project that establishes value circles to realize reuse and recycling of structural wood and high quality wood chips in sustainable regions. SirkTRE is the main project, with it's sister project CircWOOD, a 100% funded research project within SirkTRE. The partners are from the entire value cycle, with key positions. The budget for this project is 181 million NOK, making it the largest Green Platform project yet. Progress is evaluated through key performance indicators (KPI's), which you will find on the next page.

WHY

SirkTRE's ambition is to turn half of today's wood waste into building products by 2030. When we have succeeded, the reduced carbon emissions will account for 8 % of Norways net zero by 2030 and the valueable wood resources gets increased lifespans.

HOW

SirkTRE standardizes! So far, three standards are financed by SirkTRE. Partners engage in the establishment and follow-up of standards, from defining the circular construction industry, wood constructions, frameworks for Environmental Product Declaration (EPD), calculating climate gains from reuse, and more! SirkTRE will contribute to "CIRCULUTION" – the connection of circularity and solution. We believe materials must be kept "working" over a much longer period.

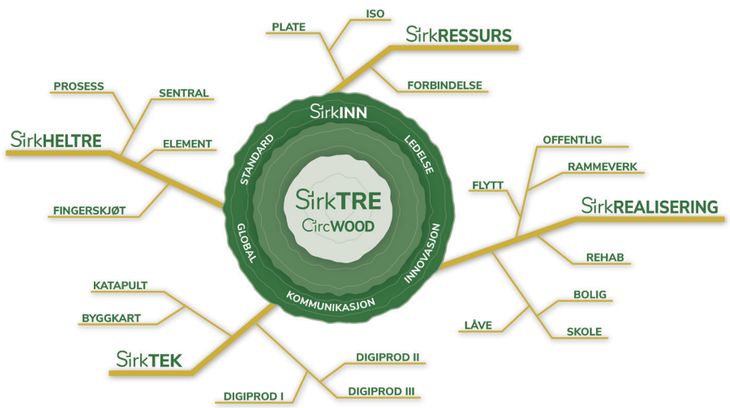
SO NOW WHAT

We at SirkTRE want to show the modern way of reusing wood in construction. We know that by developing value cycles, Norway can be at the forefront of construction's CIRCULUTION.

PROJECT STRUCTURE

In this magazine you will find sub-projects (SP), that is divided into work packages. The PhD's of CircWOOD are shown in the articles in the last section of this SirkMagazine.

Example: Within SirkTRE, you will find sub-project SirkHELTRE. This is further divided into work package PROSESS, FINGERSKJØT, etc. You will find the relevant sub-project and work package on the top left corner on each page.



SirkTRE is (re)establishing the timber value circles.

How do we speed up the reuse of timber? What is needed to make reuse happen?

In this World Conference on Timber Engineering seminar, we share SirkTRE's halfway results.

Scan and take a look!

KPI - Key Performance Indicators

KPI	Status 2023	Goal 2024	Ambition 2030
KPI. 1 Volume of wood products/chips in value circles (m^3)			
a) Conservation	1 000	7 500	100 000
b) Reuse	350	7 500	100 000
c) Recyceling	50	20 000	750 000
d) Design for reuse	3 500	30 000	2 000 000
KPI. 2 Climate effect of wood products/chips in value circles (ton CO_2-eq)			
a) Conservation	2 000	15 000	200 000
b) Reuse	700	15 000	200 000
c) Recyceling	100	40 000	1 500 000
d) Design for reuse	4 690	40 200	2 680 000
KPI. 3 Development in value creation (bn. NOK)			
			3
KPI. 4 New jobs/workplaces as a result of SirkTRE (pcs)			
		150	1 000
KPI. 5 Business ideas, start-ups and scale-ups (pcs)			
		50	500
KPI. 6 R&D projects with funding (pcs)			
a) Norway	15	20	
b) International	5	10	
KPI. 7 New areas of expertise - circular skills (pcs)			
a) BA and MA theses	40	100	
KPI. 8 New standardized documents (pcs)			
	3	10	
KPI. 9 Innovations and demonstrations (pcs)			
a) Pilots	5	30	
b) Concepts/methods	10	20	
c) Contract documents	2	20	
d) Mapped buildings	10	30	
e) Envir. documentation	2	5	

VITAL QUESTIONS

In our efforts to (re)establish value circles for reuse and recycling of structural wood and high-quality wood chips in Norway, we have identified some obstacles that must be overcome. To highlight these, we ask the following questions:

- Why is it allowed to burn usable timber? - Burning should be the last resort.
- Why is it so difficult to turn waste into product? - Legislation must be adapted to facilitate value cycles. Could one solution be a “reuse category”, to circumvent waste? After all there are only resources ...
- Why is waste measured in tons? Wood, or any structural timber, is strong but light weight, thus of less “weight-value” and of less interest in circularity, sorting, and reuse ...
- Why is it allowed to demolish buildings? – The SirkTRE project wants to encourage dismantling, never demolishing.
- Why aren’t there more “standard” built constructions? - Reduce risk – standardize! We must promote standardization and build standard documents for reuse.
- Why are there no requirements for reuse when there is a legal requirement for reuse mapping?
- Why isn’t the public sector reusing more?
- Why aren’t there more incentives to increase the degree of reuse? – support of dismantling when reused, reduced VAT in circular systems, carbon premium for storage, tax-incentives a.s.o.

SirkTRE

SirkHELTRE

SirkHELTRE innovates in reclaimed wood, developing technology for efficient use and creating a marketplace, driving the industry towards a sustainable, circular economy.

SirkHELTRE is dedicated to establishing pioneering logistics solutions and further processing reclaimed wood to the fully circular value chain for reclaimed wood. The process starts off with mapping available resources and influencing the flow of goods. We are working on creating a state-of-the-art cleaning facility which is a crucial step before the wood pieces reaches the finger jointing facility, designed to maximize the use of short-length timber and offcuts from construction sites. Additionally, we are focusing on the development of mass timber elements from reclaimed wood. We are also committed to establishing a physical marketplace and a center of excellence for reclaimed wood products. Our mission encompasses various facets, and we’re excited to share our project’s goals and progress with you.

RAGN SELLS
En del av kretsløpet

OMTRE

Sirkulær Ressurssentral

Photo: Kathrine Torday Gulden, NIBIO

COLLECT, TREAT AND RECYCLE WASTE

The core of this project revolves around creating a new value chain that starts with an upstream resource assessment. This involves the meticulous identification of customer segments, the evaluation of dimensions and qualities, and the categorization of product flows and customers.

Our ultimate aim is to compile Environmental Product Declarations (EPD) and data that can be effectively utilized for the environmental assessment of future products. Our research is not just limited to assessment; it encompasses the identification of the required technology, defining missing tools, and developing digital solutions for data capture. This approach will help us make reclaimed wood more readily available to various customer groups through multiple user platforms.

Project Goals include resource and technology assessment, the analysis and systematization of product flows, and the testing and recommendations for logistics. Key activities to achieve these goals encompass identifying customer segments in the upstream market based on both volume and quality, conducting value chain analysis, evaluating the knowledge and competence gap, defining criteria and system boundaries for Life Cycle Assessment (LCA), as well as focusing on digitalization and exploring necessary technology.

Regarding milestones achieved, significant progress has been made across various project aspects. This includes the successful completion of the resource and data assessment, efficient test sorting at the facility, delivering product samples to validate our work, facilitating pick-and-sort analysis, conducting rigorous collection and logistics testing and analysis, and participation in numerous productive meetings, workshops, and interviews.

Despite these accomplishments, challenges have arisen on our journey. These challenges include the lack of new technology and significant variations in maturity across our activities. Addressing issues related to a lack of awareness and knowledge, cost-effectiveness, and striking the right balance between volume and quality has been an ongoing effort.

In terms of our status, we've successfully navigated these challenges and have important experiences and results to share. Notably, over 50% of the reclaimed wood at sortin facilities is considered good quality, suitable for reuse and material recycling. However, sorting at collection and recycling facilities remains resource-intensive. The ever-evolving market conditions, with changes in prices and increased competition, have posed new challenges, particularly concerning volume. Nevertheless, we remain dedicated to SirkHELTRE and are enthusiastic about continuing our journey toward sustainable and innovative solutions for reclaimed wood logistics.

This work is led by Per Johannessen from Ragn-Sells. We also have the invaluable research and development support of NIBIO and Treteknisk Institutt.

> "We want to be living proof that caring for the earth and business go hand in hand.

RAGN SELLS
En del av kretsløpet

Ragn-Sells is a privately held corporate group, operating companies in four countries. Since 1966, we've been involved in waste management, environmental services and recycling. We collect, treat and recycle waste and residual products from businesses, organisations and households.

FROM SHORT TO LONG

Within this sub-project, our core focus is the definition of characteristics and the establishment of a highly efficient sorting system for reclaimed timber, aiming to maximize its utilization. We're striving to identify and reduce weaknesses, damages, and contaminants that might compromise the desired quality. The challenge we are addressing involves the industrial handling of substantial quantities of short-length timber, from the intake phase to the final production of finger-jointed timber. Our primary objective is to prepare the ground for the future establishment of a sustainable finger-jointing facility, encompassing the strategic decisions about its location and integration into the value chain.

Our activities to attain this goal have been comprehensive. We've recommended advanced technology for quality control, sorting, and meticulous record-keeping. By simulating processes, we've uncovered technical risks and made the necessary adjustments. Our team has systematically analyzed, designed, and calculated a comprehensive investment framework, which will guide our decision-making process when the time comes for the construction of the finger-jointing facility. We have also made significant progress in the installation, training, and test runs to ensure the facility's readiness. As of now, we have successfully laid the foundation for an economically sustainable finger-jointing facility, which will become operational in the future.

Challenges lie ahead of us, such as the development of appropriate sensor technology for identifying and localizing contaminants on timber pieces. Additionally, we need to further refine the technology for data-based separation of timber pieces, along with establishing a seamless information flow between these two elements. The purification of timber pieces from non-toxic contaminants is an area where we are seeking integration into new production facilities. While we have made significant strides, we still face challenges regarding specific parameters, such as capacity and precise requirements related to materials, dimensions, quantities, and contaminants. Additionally, we need to define the exact specifications of the final product.

In conclusion, we have made promising progress in this sub-project. It's important to clarify that the finger-jointing facility is currently in the planning and development stages, not yet in operation. Our work signifies a crucial step toward our overarching project goals, which are focused on the sustainable and efficient utilization of reclaimed timber resources.

OLD WOOD, NEW WALLS

In this sub-project, our primary focus, led by Arild Øvergaard of Norsk Massivtre, is to define the requirements for reclaimed timber in our own products.

We aim to design and test new products that incorporate reclaimed timber, pushing the boundaries of sustainable construction. This entails the development of innovative solutions for efficient assembly and disassembly, as well as the establishment of markets and customers for these new, environmentally friendly products.

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> The barn at Noresund is the largest modern agricultural building constructed with reclaimed timber.

Our milestone, M1.3, involves the development and testing of these new products. The deliverables include recommended technology for quality control, sorting, and record-keeping, along with the establishment of a production line for reclaimed timber use, ready to dispatch the first shipment.

We are committed to furthering our building design and production line to streamline the efficient utilization of reclaimed timber. More specifically designing for reuse, developing elements based on reclaimed timber, introducing a movable container jig, incorporating elements for roofs and walls, and developing a pilot designed for both the use of reclaimed materials and future reuse. Ultimately we will build a concept hall of reclaimed materials designed with future reuse in mind.

While challenges lie ahead, including limited access to well-sorted and suitable lengths, quality and dimension of reclaimed timber (particularly 2x4”-2x8”), we are diligently working on enhancing our production line and introducing new elements based on our experience. Notably, screw-fixed solid timber which already is a well-established method, also allows for easy disassembly. Technical challenges related to sorting, storage, and transportation also feature prominently.

SP1 SirkHELTRE, ELEMENT

While building the marked, there is a need to expand the projecting part (engineers and architects) mindset from “what to make” to include “what to make it from” . We seek projects that put these new requirements on all actors and have already built experience from several projects.

Our approach involves building a sufficient production line and laboratory testing of relevant element types. The container jig is a component under consideration, and we aim to evaluate production lines and plan for the construction of a production hall in stages.

The market demonstrates a keen interest in reclaimed timber-based elements, driven in part by the uniqueness and sustainability of the products. We anticipate that, in the long term, the market will demand reclaimed timber products with similar qualities to new materials but at a lower price. However, the market is still evolving and we with it.

Navigating these challenges will require a focus on logistics, efficient resource utilization, and competitive pricing together with close cooperation with projecting part in an early stage. Our strategy involves selecting customers with relevant needs, presenting them with viable solutions, reaching agreements on projects, and successfully executing them. Pilot customers have been identified, and we are actively collaborating to develop solutions and build relationships throughout the project’s duration.

The ultimate goal of Norsk Massivtre is to be a preferred supplier of innovative, environmentally friendly building elements in solid wood.

NORSK MASSIVTRE

OMTRE

For more than 15 years, Norsk Massivtre AS makes prefabricated building parts in solid wood that are joined with screws. The solid wood elements, made from local or reclaimed timber, are used in floors, walls and ceilings. We project and supply both complete building sets for houses and cabins, as well as building parts to order. As a supplier and manufacturer, we go to great lengths to find good solutions in each individual project.

REUSABLE BUILDING MATERIALS

Pådriv Oslo is a tool for more sustainable urban and community development that future generations can be proud of. It's a tool openly available to anyone who wants to achieve more - private individuals, businesses, organizations or municipalities. Pådriv Oslo is particularly well-suited to use on complex issues where several people have responsibilities and thus depend on collaboration across the board. Pådriv Oslo owns Sirkulær Ressurssentral 100%.

Sirkulær Ressurssentral is a non-profit company working as a change agent to make reuse the natural first choice in the construction industry. Sirkulær Ressurssentral has established and owns Norway's largest physical warehouse for reusable building materials located in Oslo, runs a national knowledge arena for reuse in the construction industry, and initiates and manages projects aiming to remove substantial barriers for reuse of building materials.

Ombygg operates Sirkulær Ressurssentral's building warehouse and intermediate storage for reusable building materials. Ombygg's aim is to make it possible for used building materials to be at least as attractive as new ones, and in that way contribute to the construction industry being able to easily, efficiently and to a greater extent utilize the material resources in existing buildings.

In this sub-project our primary objective is to receive, store and sell reclaimed timber that cannot be directly sent from the source to customers or projects. Reclaimed timber may arrive in various forms, such as construction timber, different types of wooden boards and glulam beams. Our milestone focus is on developing circular economy models to enhance reuse of reclaimed timber. To achieve this, we work on different key aspects of the value chain, such as systematization of effective communication with the market, the establishment of testing and processing for resource recertification, and the testing and operationalization of the resource center as a key node in local value chains.

The purpose of this work package is to establish and pilot a sustainable resource center in Oslo, focused on circular reuse of building materials, including reclaimed timber. The Recourse center will encompass storage facilities and a marketplace for reused building materials. We aim to develop circular economy models to increase reuse, with the ultimate objective of contributing to a substantial reduction of 10,000 tons of CO2-equivalents by 2024.

To achieve these objectives, we're implementing various activities. including the systematization of efficient communication with the market. Our activity related to market communications involves engaging in dialogue with customer segments and technology/solution providers to develop a robust digital information flow and, through operational activities, to test, demonstrate, and evolve a set of customer-focused services for receiving, storing, redistributing, testing, recertifying, and processing reclaimed timber. Simultaneously, we're working on the development of circular economy models to optimize the resource center's services. We aim to create a business model based on circular economy principles that can ensure the resource center's economic sustainability, provide value to other actors in the value chain, and significantly contribute to reducing greenhouse gas emissions, waste reduction, and reduce the need for extraction of raw materials.

Several activities have been completed, such as assessing market needs and interests through target audience and stakeholder analyses, as well as designing value chains for reuse both upstream and downstream, designing service descriptions and circular business models for the resource center, and constantly initiating pilots to iteratively test and adjust these value chains and business models. On March 14, 2023 the resource center Ombygg officially opened. Since the opening in March we have been able to put our initial theoretical work to the test and have been working closely with large scale projects to find sustainable ways to source reclaimed timber. We are now working with both demolition projects and construction projects to find new ways to keep high quality timber elements in closed value cycles.

The project does face challenges in the form of existing solutions for the handling and delivery of timber, which require significant manual labor for warehouse staff in Ombygg. Similarly, the current timber collection method has limitations on length and may involve significant manual work. With future delivery forecasts, there's a need to increase focus on market dialogue and sales to avoid impractical storage durations.

> "We aim to develop circular economy models to increase reuse.

Sirkulær Ressurssentral

OMBYGG

PÅDRIV OSLO

SirkRESSURS

SirkRESSURS comprises three groups: FORBINDELSER, PLATE, and ISO, focusing on innovative, sustainable construction practices from wood connections to waste reduction and insulation recycling, enhancing industry efficiency and sustainability.

SirkRESSURS consist of 3 working groups. FORBINDELSER, lead by Aanesland treindustri, are currently developing a structural unit where the emphasis is to develop wood-to-wood connections that minimize the use of metal, simplify the reutilization of timber structures, and extend the lifespan of these constructions. PLATE, lead by Hunton, are working on reducing the waste at the building site when installing water-based heating system in wood based panels. The approach focuses on reducing waste volumes by harnessing Building Information Modeling (BIM) to create customized panels for hydronic heating systems. These panels are precision-milled with all the necessary features for each specific construction project. ISO, lead by Hunton, is working on the recycling of wood fiber insulation and porous boards, further enhancing the sustainability of the production processes. In addition to developing a system for reuse of already produced and new wood fiber insulation and porous boards, Hunton is looking into the possibility to make their new products out of A1 post-consumer wood. This approach not only contributes to environmental sustainability but also adds value to the construction industry by promoting efficiency, reusability, and reduced waste.

FORESTIA

HUNTON
Av naturen. For naturen.

NIBIO

Aanesland Treindustri
Norsk kvalitet siden 1945

NO STEEL EQUALS REUTILIZATION AND RECYCLING

This sub-project, under the leadership of Aanesland Fabrikker AS, is dedicated to the development of solid wood connections for industrial use. Our primary goal is to reduce the reliance on steel, which enables the reutilization and recycling of timber structures. Through the standardization of wood-to-wood connections, we aim to enhance competitiveness when compared to conventional steel and concrete structures.

Our milestone, involves the design of connections, testing, modeling, and the creation of prototypes. Our deliverables include the development of methodologies and solutions for design, as well as the standardization of connections. This project is geared towards facilitating the reusability of timber constructions by minimizing steel usage and streamlining wood-to-wood connections, ultimately promoting competitiveness in comparison to traditional steel and concrete structures.

The key activities to achieve these goals encompass connection design, testing, modeling, and the creation of prototypes. Additionally, we are developing methodologies and solutions for design, and we are standardizing connections.

We have made progress in the testing of this technology on a laboratory scale, with partial success. New research projects are being identified to further test and refine this technology, and we are actively seeking effective methods for calculations.

Nonetheless, challenges persist, including the balancing of practical requirements like dimensional constraints and aesthetics with structural demands. Optimizing various aspects remains a concern, and we continue to address practical execution on production sites, including precision, moisture conditions, and timber types. Ensuring cost-effectiveness in this context is essential, as are finding pilot customers willing to shoulder some risk. Additionally, production processes and customer satisfaction are aspects that require continuous attention, as does marketing the innovation to a wider audience.

In summary, while we have partially tested the technology at the laboratory scale and are actively exploring further research opportunities and improved calculation methods, several practical and logistical challenges remain to be addressed as we move towards full-scale implementation and standardization.

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> We are proud to be involved in building the country in wood, through three generations and a vide variety of products and services.

WATER BASED HEATING IN WOOD BASED PANELS

The primary goal of this project is to increase the competitiveness of wood-based panels. By analyzing the market, mapping existing practices and identifying barriers, one has so far got a platform for proposing and developing solutions for intelligent planning and installation of water-based heating systems in wood-based panels for flooring. Five bachelor students in building technology at NTNU Gjøvik have been involved in the project during the spring of 2023 to map existing practices and analyze new possible solutions. Their contribution has been seen as valuable.

While the project provides a promising approach to more efficient water-based heating installation within wood-based floor panels, we await the outcomes of the work to address specific challenges and deliver effective solutions. The project has been owned by Hunton Fiber AS and Forestia AS 2022-Sept 2023. In this period, Federica Mudu, PhD, from NWC was project leader on behalf of the owners.

HUNTON
Av naturen. For naturen.

Forestia AS develop and produce a wide range of particleboards to the Scandinavian and Northern European building market.

Forestia also trade OSB and plywood products. The factory is located at Braskereidfoss, Norway.

Forestia is a part of the Byggma Group.

Hunton is one of the Nordic region's leading manufacturers of sustainable wood-based products for the construction and civil engineering industry. Hunton is the only manufacturer of porous wood fiberboards in Norway and is a significant producer in the European context. Furthermore, Hunton Fiber has recently started the production of wood fiber insulation in Gjøvik.

The business is operated with a factory / head office at Gjøvik and a sales office in Asker. In addition, there are own sales companies in Sweden and Finland. All products are sold under the brand name Hunton.

The vision of Norwegian Wood Cluster SA is to give the world wood constructions based on innovation and sustainability. Our members represent important companies within the wood industries as well as architects, consultants, house producers, research institutes among others in Norway. The key role of the cluster is to connect companies and connect companies and research institutes, and to develop international network.

THE ONLY MANUFACTURER OF POROUS WOOD FIBERBOARDS IN NORWAY

This project, led by Inger Gamme of Hunton, seeks to gain a deeper understanding of circular solution for Hunton products. NIBIO is a research partner. The project aims to map current practices in waste management within the renovation, refurbishment, and extension market, as well as the disposal of Hunton's products. This includes tracking the material flow of Hunton's products from the factory to their return for potential reuse.

The project objectives include the need to acquire and develop knowledge about the challenges and opportunities associated with the material consumption, waste, reuse, or redesign of Hunton's products. Furthermore, it seeks to understand the proportion of Hunton's products that can be returned for use in their own production and how much can be used in other products or developed as new ones.

To achieve these goals, the project has undergone external surveys and internal assessments of waste flows. This involves gaining a better understanding of what happens to Hunton's products among contractors and at various environmental stations throughout the country. Analyses have been conducted to verify the possibility to detect content of used products. Possibilities to establish systems for product tracking have also been explored.

Challenges include the limited presence of Hunton's products at waste stations. To address this, the project plans to map various types of waste stations and their regulations for different types of waste. Collaboration with contractors involved in demolishing single-family homes is desired to assess opportunities for better reuse of Hunton's products. Insight into how other waste management companies handle Hunton's products are also sought. While the project is currently gathering data and conducting tests, its results are yet to be fully realized. However, it represents a significant step towards understanding and optimizing the potential reuse and redesign of Hunton's products in a sustainable manner.

«Hunton is one of the Nordic region's leading manufacturers of sustainable wood-based products for the construction and civil engineering industry. Hunton is the only manufacturer of porous wood fiberboards in Norway and is a significant producer in the European context. Furthermore, Hunton Fiber has recently started the production of wood fiber insulation in Gjøvik. The business is operated with a factory / head office at Gjøvik and a sales office in Asker. In addition, there are own sales companies in Sweden and Finland. All products are sold under the brand name Hunton."

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A significant producer in the European context.

HUNTON
Av naturen. For naturen.

NIBIO

SirkREALISERING

The SirkREALISERING project advances sustainable construction with wood reuse, aiming to inspire industry-wide adaptation of more environmentally friendly practices and a circular economy.

The SirkREALISERING project is focused on developing methods, concepts, and tangible construction projects based on the principles of wood reuse and design for reuse.

The project's goals are to not only promote sustainable construction but also to generate substantial ripple effects within the industry. By embracing the principles of sustainability and reusing wood in construction, SirkREALISERING aims to reshape the way buildings are designed, constructed, and maintained. This innovative approach is expected to significantly reduce the environmental footprint of the construction industry and contribute to a more circular and resource-efficient economy.

The SirkREALISERING project's impact will extend beyond its immediate activities and outcomes. It will create a foundation for more sustainable practices in the construction sector, serving as a model for future projects and inspiring other industry players to adopt similar approaches. As a result, the ripple effects of SirkREALISERING are expected to be substantial, influencing the construction industry and contributing to a more sustainable and environmentally friendly built environment.

IZA

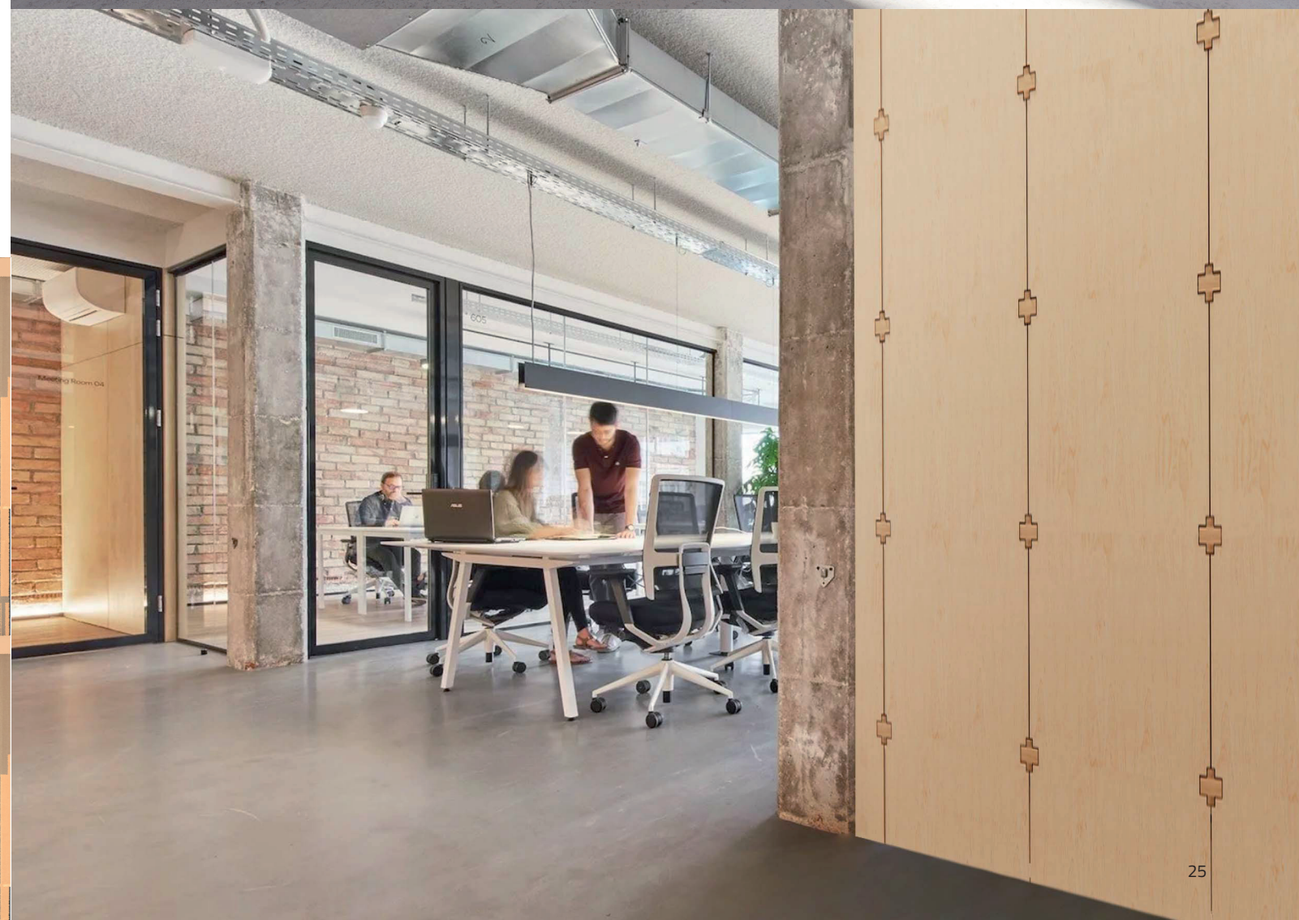
FRAGMENT

Grape:

OMTRE

OLA ROALD ARKITEKTUR

VILL ENERGI



Sustainable Modular Houses

Today's construction methods and material use frequently lead to the disposal of building components at the end of their life cycle, a practice that notably contributes to 25% of all waste in Norway. The SirkBO project is dedicated to the development of circular modular houses, which can be recycled and reused in a new cycle to contribute to reduced environmental impacts. The project's milestones involve completing the pre-project phase, including adapting designs to a specific location, and constructing prototypes. The project aims to provide methodological, material, design concepts, component development and jointing solutions. Furthermore, the project will enter the detail phase and work on producing a pilot project.

SirkBO's motivation is rooted in the observation that many major modular house producers, place little emphasis on sustainability, CO_2 accounting, climate adaptation, and circular building materials. Therefore, the sirkBO project seeks to challenge the entire system house industry to produce circular homes for the future, with minimal CO2 footprint, climate-adapted healthy structures, and a particular focus on disassembly and a circular materials bank. The goal is to design circular system houses with a 50% reduction in CO_2 compared to conventional residential buildings and a 70% circularity rate.

Haugen/Zohar Arkitekter and Norgeshus aspire to build seamless, modular system solutions that simplify the choice of environmentally friendly housing. The project aims to challenge the entire prefab house industry to create entirely circular homes with a low CO_2 footprint, climate-adapted healthy structures, and a strong focus on disassembly and a circular materials bank.

To achieve these objectives, the project team will:

Survey the materials bank.

Develop design concepts for homes.

Evolve concepts and adapt them to specific building sites.

Advance to the pre-project and adapt the plans to specific sites.

Proceed to the detail phase.

Provide a concrete implementation of the pilot.

> "Haugen / Zohar Arkitekter and Norgeshus aspire to build seamless and modular solutions which simplifies the choice of environmentally friendly housing

Haugen/Zohar Architects AS is an award-winning architectural office based in Oslo.

We make up a group of civic-minded people with high architectural ambitions. We have a fundamental attitude that the more responsibility we take upon our actions today, the better our future lives and surroundings will be. Our office is daily involved in a broad spectrum of projects, shifting from private housing commissions to large-scale public programs, urban design, and art.

Norgeshus: For 30 years, Norgeshus has built more than 18,500 homes from Svalbard to Kristiansand. Norgeshus is one of Norway's largest housing suppliers, with dealers all over the country. They deliver detached houses, housing projects and commercial buildings all over Norway.

ASSEMBLE AND DISASSEMBLE

The project aims to develop construction kits for a disassemblable wooden apartment building. These buildings feature wooden structures with load-bearing components, shafts, and vertical connections. The key objectives are to double the lifespan of the buildings and achieve up to a 90% reduction in greenhouse gas emissions through full reuse. The milestone involves making the concept available to property developers. The deliverables include the development of wooden structures and the construction of four five-story apartment buildings, totaling 44,000 square meters of open structures by the end of 2024.

The background of this project is rooted in Fragment's long-standing efforts to involve residents in housing development. In 2016, the office created a model for a wooden apartment building, with a constructive framework that enabled residents to participate in the construction process.

The project's primary goal is to develop circular wooden frameworks for self-assembly. These frameworks should have parameters for size, height, and reuse of wooden materials. The activities to achieve this goal involve planning, modeling, user participation development, communication, and meetings with potential developers.

The project has successfully designed a user process and a framework for a modular low-rise building. The low-rise building is constructed with a column-beam system, bracing shafts, modular facades, and a low-threshold, accessible technical system that can be easily replaced and disassembled.

Challenges the project tries to answer are how we can separate technical infrastructure and construction, in order to optimize the building for resident planning in the early phase and for possible adaptation and remodeling during the building's lifetime. Among the various technical challenges are vertical access, technical solutions, transition between inside and outside, acoustic conditions, fire and other challenges with detailing. In addition, participation with future residents is key.

The current status of the project reflects the experience and results achieved so far in the development of a circular framework for self-assembled wooden structures. The project aims to provide innovative solutions that promote circularity, self-assembly, and sustainability in the construction of wooden apartment buildings.

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> Fragment aims to double the lifespan of the buildings and achieve up to a 90% reduction in greenhouse gas emissions through full reuse.

Fragment is an architectural office that works with inclusive site development and the multifunctional city.

The office draws service buildings in cities and towns such as schools and cultural centres. But we have a special heart for housing. And we design with consideration for nature and the neighbourhood, always with thorough user involvement and a certainty that those who will use the houses know best how they want to feel.

OLD TO NEW IN BÅTSFJORD

In Båtsfjord, one of the most northern municipalities in Norway, a new school and kindergarten is being built. The school, which is almost finished, is roughly 5000m2 including a sports hall, cultural arena and swimming pool, and will function as one of the public arenas for Båtsfjord's 2000 residents.

The new school and kindergarten will replace two older schools and one older kindergarten. Instead of demolishing these, the project is aiming at incorporating materials from the old buildings, called "donor" buildings, into the new projects. Båtsfjord kindergarten is for this purpose chosen as the main case study pilot, and is to be built with a substantial amount of the materials and building components from the donors.

The overarching goal is to use this case study pilot as a steppingstone for developing a system of methods and collaborative processes that enable effective reuse of building materials. The underlying intention is to promote sustainability and circularity in building projects, significantly reducing CO_2 emissions through completely avoiding the emissions from new production.

The project has been segmented into several activities. First the existing buildings were mapped. The registration and processing of this data lays a crucial basis for the method. The mapping is then followed by a feasibility study, where available materials and components for refurbishment, repurposing and / or reuse, are weighted and evaluated. Using materials without the need for disassembly is a priority, as it demands the least amount of processing. This led to the decision to reuse the construction and fundament of Nordskogen school, one of the donor buildings, classifying the first part of the project as a refurbishment.

Next priority is to find solutions for reusing smaller material groups from the donor buildings, that are possible to disassemble and reassemble. This is both with focus on facades and interior walls, and on the light structures of the new kindergarten, like furniture and cladding inside as well as outdoors.

An important criterion is the amount of work and repair needed for the new use. The project involves a strong digitalization component to allow for identification and refinement of qualities within the collected mapping data. A substantial portion of the work is dedicated to the development of these alternatives and solutions for reuse and refurbishment while continuing to evolve the established methods.

One example regards timber. As a SirkTRE-partner, it is a specific aim to identify practical solutions for timber reuse. Demolished timber is often easy and cheap to discard, when it would have been relatively easy to reuse. It also adds up in the carbon footprint.

As the project proceeds, the collaborative dialogue with others within the network of SirkTRE is essential for the development. Especially because the standardization and methods for material reuse as well as exploring practical reuse solutions within the timber sector, is actively discussed and conclusions mutually beneficial for all the parties.

Key challenges in the project include the need to scale up the system to encompass more parameters at the same time as ensuring compliance with regulations and staying within a reasonable budget. The perceived costliness of reusing materials from older buildings is as known a common challenge in similar initiatives. One way this is delt with in the project, is that the contractors have been involved from the beginning, allowing pricing considerations as well as relevant practical input from the builders to influence the evaluation process.

Ola Roald Arkitektur creates sustainable designs and human-centric architecture, through our expertise on wood as a building material, attention to detail and care for user needs.

OLA ROALD ARKITEKTUR

FULLY CIRCULAR INTERIOR WALL SYSTEM

The project aims to create a fully reusable interior wall system using timber, suitable for use in both rehabilitation and new building projects. This wall system offers the flexibility to be disassembled, moved within the same building, or reused in other contexts. The design aims to meet strict sound insulation requirements, possess a distinctive architectural character, and consist primarily of reclaimed timber.

The project has been developed from the concept design stage and prototyping through to the construction of a full-scale prototype, which has subsequently undergone extensive and rigorous testing. The wall system provides good acoustic properties, adaptability, modularity, ease of maintenance, and a high degree of circularity with regard to its future reuse. A key focus has been the testing of sound transmission across the wall's cross-section using 48 mm solid timber with varying designs using the principles of tongue and groove construction, with and without the addition of wood fiber insulation. The project has also assessed the properties of different wood types suitable for screwless connections, such as oak, birch, beech, spruce, and pine.

In collaboration with Magne Skålevik at Brekke & Strand Acoustics, the project is subject to ongoing tests using various wall layer configurations within a provisional acoustic testing setup. The results achieved to date successfully meet the sound insulation requirements between cellular offices and show promising trends concerning the relationship between wall thickness and overall sound characteristics. The theoretical reduction figures in the best sound tests are around Rw 42-43dB.

The plan is to achieve higher reduction figures before proceeding to full-scale testing (TRL 4-5). The goal is to reach sound-reduction figures of 48-49 dB in the testing setup by spring 2024 (TRL 6-7). This will involve larger test sections, including structural nodes.

Lease agreements for business premises often have a duration of 7-10 years. This also often represents the lifespan of interiors and lightweight plasterboard walls. Plasterboard walls can be recycled but are not typically designed for easy disassembly and cannot be reassembled afterwards.

If we start from a 20-year perspective, a plasterboard wall has potentially been replaced three times during this timeframe and has therefore been put up completely new, three times. Whereas, in using our fully-circular timber wall system, which can be easily disassembled and reassembled with a high degree of reuse, the same material can be utilised all three times.

This example shows how big an effect circular thinking can have over time. That is why we, in collaboration with Per Jørgensen at Vill Energi, carry out life cycle analyses and actively use them in our work.

The initial life cycle assessments are promising and show that the plasterboard wall has twice as large a CO_2 footprint when it is built the second time, compared to our circular wall system in timber.

In spring 2024, the project is set to reach TRL 4-5, targeting the establishment of a pilot customer relationship and the installation of the wall system in a real-world scenario (BRL 4-5). The projects status so far reflects the progress and experience gained, and ongoing work is intended to develop a market analysis based on potential customer needs.

For us at Grape, the value of the project is three-fold:

- We are increasing our expertise and that of our partners in the use of reclaimed wood in construction projects
- We are researching how reclaimed wood can help to close the material gap left by single use products in our building economy.
- We highlight the positive effects of using wood, and most importantly: The positive effect of reclaimed timber on both the environment and the economy when we see it from a life cycle perspective.

Prosjektteam Grape architects:

Angelica Kveen

Alexander Mertens

Jannicke Stadaas

Aleksander Rene

Acoustics: Magne Skålevik, Brekke Strand

LCA: Per Jørgensen, Vill Energi

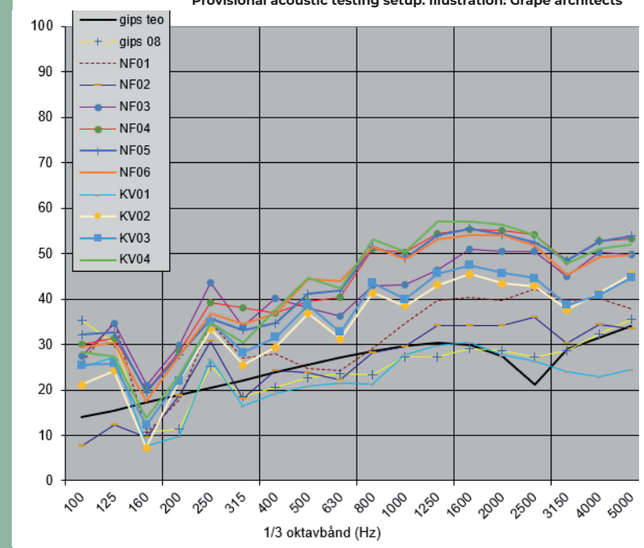
About Grape Architects:

We are architects, urban planners and designers. Working together in shaping the city of the future. We care about people. All our projects are developed with a responsibility for social sustainability. We always strive to create inclusive situations and urban spaces for people and communities. We do not limit our work to certain scales or typologies, but always seek social and environmental sustainability.

We initiate our own projects where we see potential for a valuable contribution.

New building techniques based on traditional woodcraft. Illustration: Grape architects

Provisional acoustic testing setup. Illustration: Grape architects



Provisional acoustic testing results. Illustration: Brekke&Strand

Circular interior wall system in possible use. Illustration: Grape architects

Grape:

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> Effective reuse of these barns, while preserving their historical character, can mark the beginning of a new era for the reuse of structural timber.

OLD BARN -BIM- NEW BARN

This project is focused on promoting the reuse of timber components in construction by digitally transforming existing timber structures into Building Information Models (BIM). Currently, the sale of structural timber for reuse is not standardized. The SirkLåve initiative is pioneering the reuse of timber, with a particular focus on the donor buildings, in this case, barns.

Norway boasts approximately 10,000 historical barns constructed for horse-drawn carriages, which hold significant cultural and landscape value. Effective reuse of these barns, while preserving their historical character, can mark the beginning of a new era for the reuse of structural timber.

The milestone for this project entails conducting thorough mapping and planning to ensure that the timber reuse process can be executed cost-effectively. The project aims to deliver a method for constructing new buildings with reclaimed timber, starting with barns. The reuse of timber from buildings set for demolition represents a critical resource within the holistic timber circular economy.

The primary project objectives are to:

- Map and plan in a manner that enables cost-effective timber reuse.
- Digitize existing timber structures for use in 3D modeling during the design of new buildings.
- Develop methods for constructing new structures using reclaimed timber, starting with barns.

OMTRE

SirkTEK

In a world that constantly evolves, the construction industry stands at the crossroads of tradition and innovation. As we face the pressing challenges of climate change, resource scarcity, and the ever-growing demand for high-quality living spaces, the need for improvement in construction methods has never been more apparent. In the SirkTEK work packages, we will explore several topics relevant for manufacturers of buildings, and producers of building elements who are poised to take a leap into the future of construction through the development of advanced production technologies.

Explore the latest strategies in streamlining construction processes. This chapter covers the principles of lean manufacturing applied to construction, the integration of smart technologies, and the refinement of supply chain management, all aimed at enhancing productivity and reducing waste.

Dive into the world of quality assurance and control in construction. Understand the emerging technologies that enable precision and consistency, and learn about new materials that promise longevity and resilience, setting new benchmarks for quality in the industry.

Unearth new methods for efficient use of materials and energy. This chapter discusses modular construction, innovative design approaches that minimize resource use, and the adaptation of renewable energy sources within building designs.

Discover the principles of circular economy as applied to the construction industry. This chapter provides insights into material reuse and recycling, design for disassembly, and the life-cycle analysis of building components for a sustainable construction ecosystem.

Anticipate the future by understanding the present. This chapter presents an overview of cutting-edge technologies like 3D printing, robotics, and artificial intelligence, and how they are set to revolutionize the way we build.

The construction industry is on the brink of a new era. By embracing research, development, and innovation, stakeholders can not only contribute to a more efficient, high-quality, and sustainable future but also drive the industry forward into a new age of construction excellence.

LANDHEIM

BoligPartner

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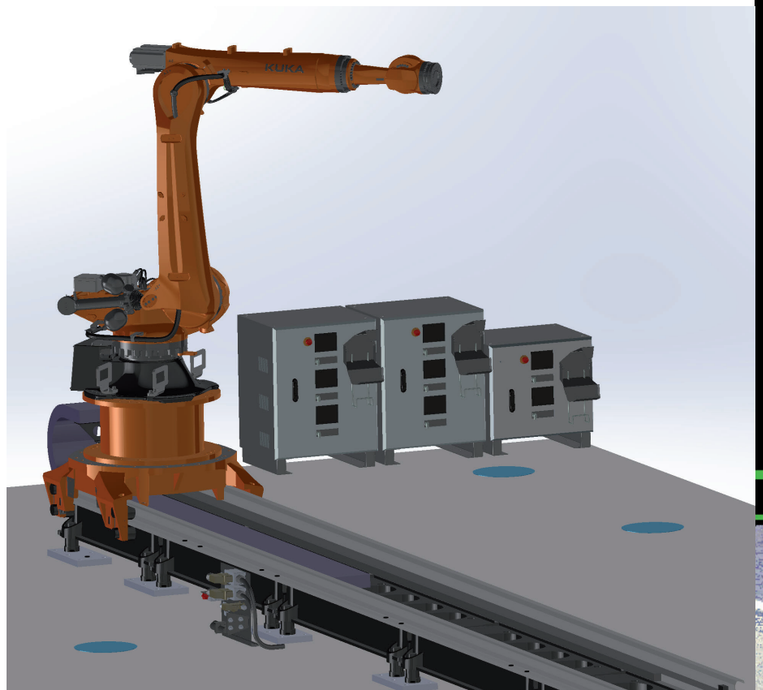

DIGITAL TWINS FOR BUILDINGS

The project, led by Kristine Nore and Christine K. Jørgensen in Omtre AS, focuses on identifying, mapping, and analyzing existing building stock with the aim of developing digital twins for buildings slated for demolition, particularly emphasizing the potential for reusing building materials, especially wood.

Their milestone involves selecting a method for building registration. The expected outcomes include a developed solution for scanning to Building Information Modeling (BIM), which includes data for evaluating the characteristics of timber components.

The main project goals are to create digital twins for buildings earmarked for demolition or refurbishment, to digitize existing timber constructions for rehabilitation and reuse planning, to establish a platform for storing scanned building data, explore methods for quick transformation into BIM, evaluate wood quality, load-bearing capacity, and propose reuse options, and to provide guidelines or potential standards for simplifying model use.

The activities include building registration and data collection to gather experience for developing efficient applications.

The project faces challenges related to the adoption of existing technologies, finding the best methods for their use, and determining the specific offerings for customers. Additionally, issues of data formats, storage, and utilization of large point cloud files need to be addressed. The project is in a learning phase regarding the technical aspects, such as 3D scanning and environmental analysis, and how to derive the best results from them. The practical applications and benefits of the point cloud data are still being explored, along with identifying the value it provides to customers. Marketing and communication strategies are under consideration, and the project is evolving in its use of the digital point cloud for various purposes.

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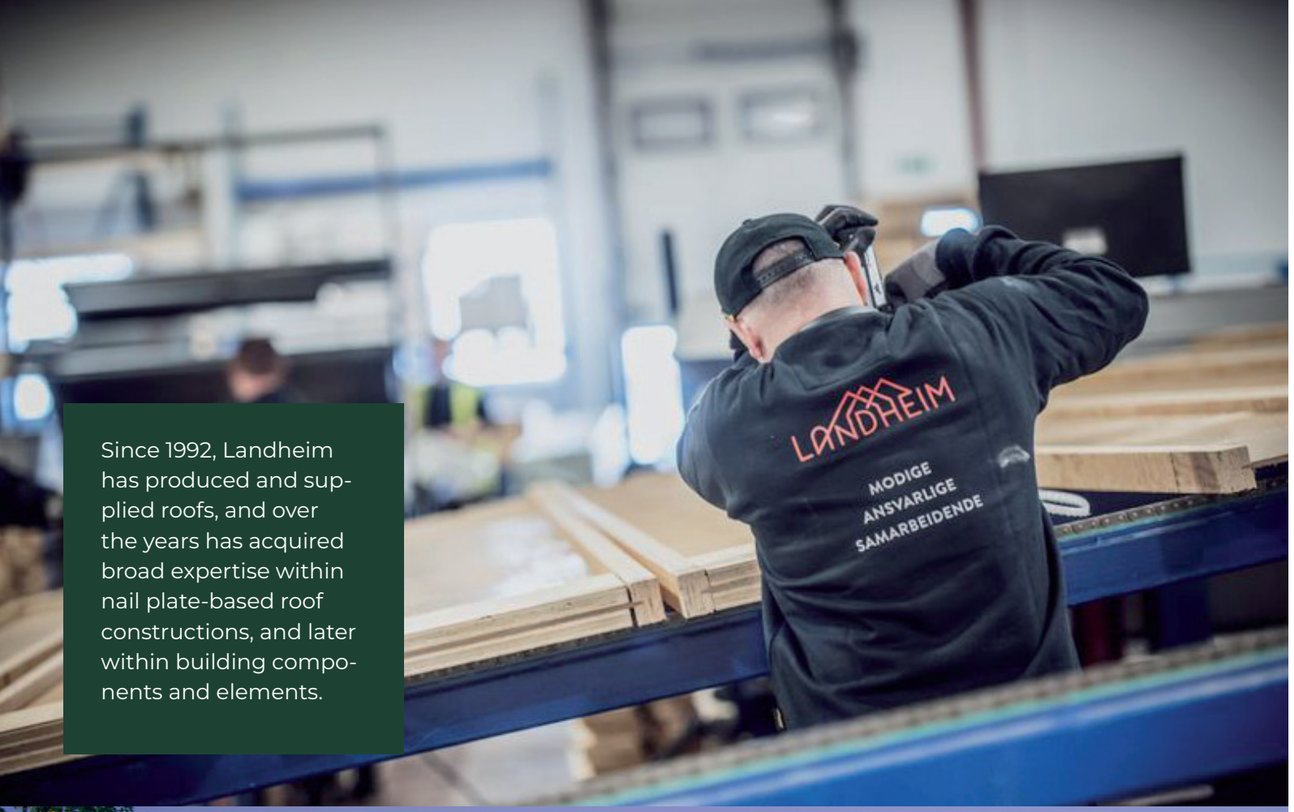
> The expected outcomes include a developed solution for scanning to Building Information Modeling.

OMTRE



Since 1992, Landheim has produced and supplied roofs, and over the years has acquired broad expertise within nail plate-based roof constructions, and later within building components and elements.

BoligPartner delivers architect-designed houses, cabins, apartments and multi-family dwellings within the prefab concept and has more than 25 years of experience as a Norwegian housebuilder. Since its establishment in 1993, BoligPartner has realized close to 14,500 housing and cottage dreams for our customers.

SirkTRE | CircWOOD

SEAMLESS FLOW

These projects, led by Thomas Haavi at NTNU, is focused on the prefabrication of building elements, and aims to develop and describe potential digital and automated solutions from design to fabrication.

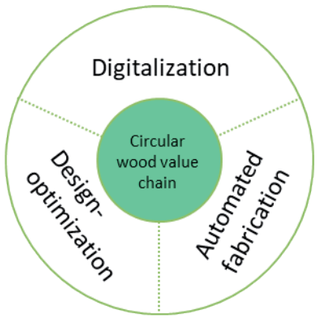


Figure 1 – Thomas Haavi

The primary project goal is to achieve effective use of digitalization, design optimization, and more circular and efficient fabrication.

The activities aimed at achieving this goal, involve ensuring a seamless flow of information from design to the final product, improving and developing building elements, and automated prefabrication.

However, there are challenges that need to be solved, including the proprietary digital technology in the timber industry, which complicates the integration of design with new, open, and flexible fabrication systems. Additionally, both new and reclaimed timber can exhibit significant variations in dimensions, straightness and warping, which must be accounted for in the fabrication processes. Several fabrication processes rely on pre-established solutions that are challenging to automate using current design and fabrication technology. The existing fabrication technology is designed for large volumes with limited flexibility, while the project aims to start with smaller volumes and higher flexibility, necessitating the development of more open and flexible technology.

As of the current status, the projects are actively working to address these challenges, especially in terms of promoting innovative solutions that includes flexible, circular and efficient fabrication methods within the timber industry. Testing fabrication processes in the new robotic lab, which is developed in WP 4.5, will be an important part of this.

BoligPartner

LANDHEIM

NTNU

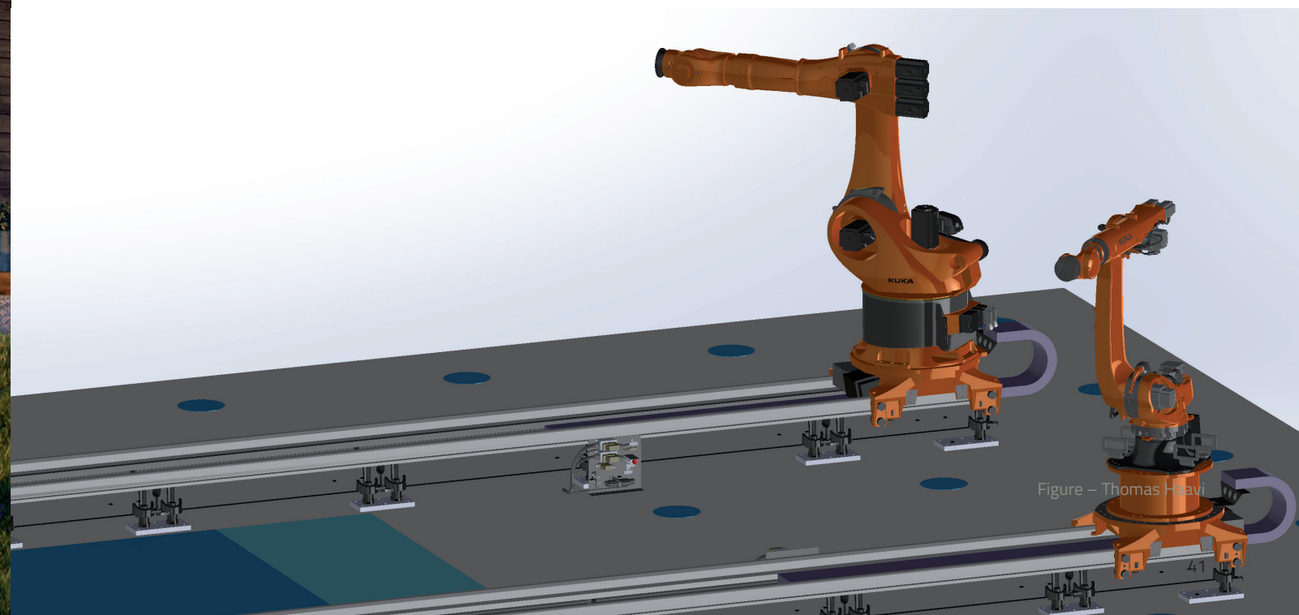


Figure – Thomas Haavi

CIRCULAR AND EFFICIENT

This project, led by Thomas Haavi at NTNU, focuses on the prefabrication of cabin modules and aims to develop and describe potential solutions for material and information flow (ICT) to achieve more circular and efficient production. The goal is to streamline the entire production process, from planning and design to assembly on the construction site. This project explores the use of BIM models connected to production equipment, the optimization of existing production machinery, and the integration of future production technologies, such as robotics.

The milestone for this project, involves a comprehensive review of current production processes, information flow, material utilization, and waste management. The deliverables are proposals for improvement areas and opportunities for more circular and efficient production. It's important to note that, in the Norwegian construction industry, production primarily relies on manual labor and often occurs on the construction site.

The primary project goal is to develop solutions for material, process, and information flow to achieve more circular and efficient production.

Activities to achieve this goal include reviewing current production processes, information flow, material utilization, and waste management, as well as testing digitalized processes from design to production. There are also trials of automated processes conducted in a laboratory setting.

Challenges faced by the project include the closed nature of digital technology in the timber industry, making it more challenging to integrate design with new, open, and flexible production systems. Additionally, both new and reclaimed timber can exhibit significant variations in dimensions, straightness, and warping, which must be considered in the production process. Several production processes in use have predefined solutions that are challenging to automate with existing design and production technology. The existing production technology is designed for large volumes with limited flexibility. The project aims to start with smaller volumes and higher flexibility, necessitating the development of more proprietary technology.

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> The primary goal is to develop solutions for material, process, and information flow to achieve more circular and efficient production.

In 2019, the LY Cabin was finally realized, with the launch of the world's first LY cabin at the Hyttemessen in Hellerudsletta. The idea behind LY Hytta is to give more people the opportunity to buy a modern cabin with a distinctive character, at a reasonable price. Our cabins are made by craftsmen who have solid experience in the carpentry trade, and who know what they are doing. At LY Hytta, sustainability is at the top of the agenda. Our ambition is to be the best in our industry. That is why we are now working on a comprehensive project to provide the Norwegian market with cabins that are built with the environment and sustainability in the centre.

LY HYTTA

MANUFACTURING TECHNOLOGIES

In this project, led by Omtre in collaboration with NTNU, the aim is connecting the consortium with the Manufacturing Technology's catapult throughout the project period and rapidly testing project ideas. The main deliverables are to ensure that new technological developments are shared and disseminated among SirkTRE's partners and collaborators continuously throughout the project. The project aims to connect 10 ideas with the catapult program each project year.

These projects seek to utilize Building Information Modeling (BIM) to a greater extent than just in the design phase. The goal is to develop and test a digitalized workflow for the entire timber value chain. This includes aspects like mapping raw materials (reclaimed timber) as a basis for design (scanning to BIM). Furthermore, the project intends to test the digitalization from design and planning to production (BIM to digitalized production). Automation in the construction industry is challenging, particularly in the context of unique and custom-building projects. The project's aim is to transition from the BIM model effectively and simply into automation equipment.

The Norwegian catapult program consists of national centers that offer facilities, equipment, expertise, and a network to help innovative companies develop prototypes, test, simulate, and visualize their ideas, resulting in quicker, better, and lower-risk idea development. As part of the project, SirkTRE will establish a testing center at NTNU Gjøvik in collaboration with MTNC.

The project's primary goal is to connect the consortium with the MTNC catapult throughout the project duration and to rapidly test project ideas. Additionally, it aims to ensure that new technological developments are consistently shared and communicated with SirkTRE's partners and collaborators during the entire project.

The activities designed to achieve these goals include information sharing, inspiration, and recruitment. The project is ongoing, and any updates or results will depend on the specific project ideas tested and the outcomes they yield.

> "The goal is to develop and test a digitalized workflow for the entire timber value chain.

MANUFACTURING TECHNOLOGY | NORWEGIAN CATAPULT CENTRE

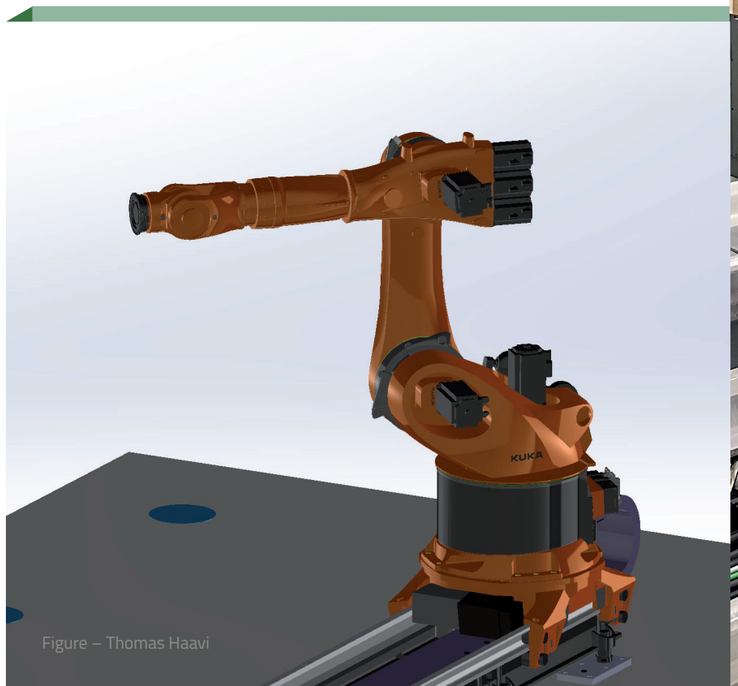
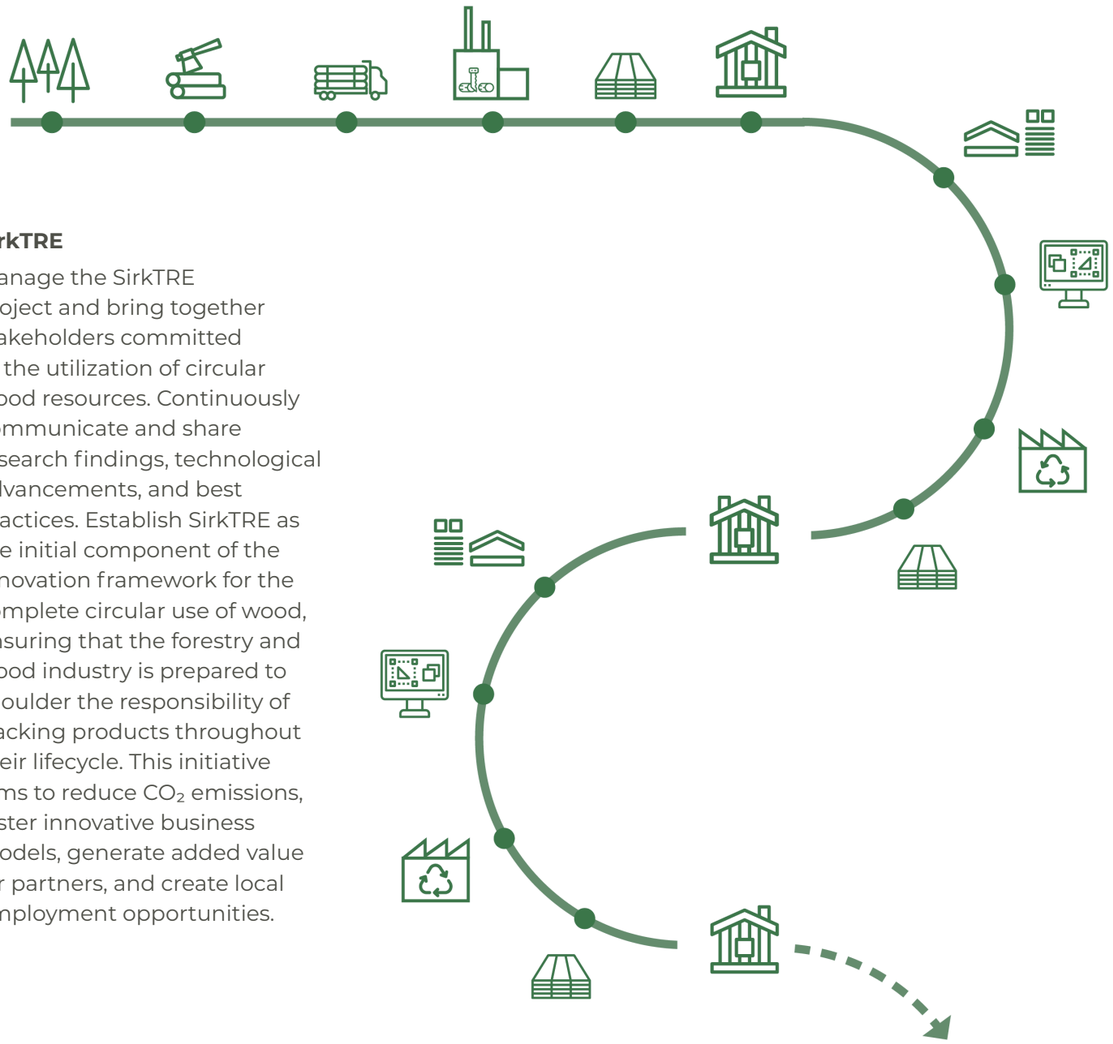


Figure – Thomas Haavi

Photo – Wendy Wyuts

SirkINN

SirkINN plays a leadership role in SirkTRE. The activities include coordinating, knowledge sharing, establishing new standards, development of new business areas and facilitating export initiatives based on the outcomes generated from



SirkTRE

Manage the SirkTRE project and bring together stakeholders committed to the utilization of circular wood resources. Continuously communicate and share research findings, technological advancements, and best practices. Establish SirkTRE as the initial component of the innovation framework for the complete circular use of wood, ensuring that the forestry and wood industry is prepared to shoulder the responsibility of tracking products throughout their lifecycle. This initiative aims to reduce CO_2 emissions, foster innovative business models, generate added value for partners, and create local employment opportunities.

NEW PRODUCTS AND SOLUTIONS

The main objective of INNOVATION is to foster a sense of responsibility among raw material suppliers and manufacturers towards the utilization and reutilization of their resources within the circular wood value chain. This entails establishing an overview of pertinent research facilities and promoting collaborative efforts among them. The ultimate project aim is to deliver 5-10 new products and solutions each year, contributing to circularity and extending the lifespan of wood as a valuable resource. Achieving these innovations is critical for scaling up the circular utilization of wood, requiring successful investments in digitalization, industrial development, and the realization of demonstration projects.

The INNOVATION work package focuses on enhancing innovation levels and exploring opportunities for discovering new business domains and crafting innovative solutions and products within the circular wood value chain. By cultivating new knowledge, fostering collaboration, and harnessing wood resources within the value chain, the project seeks to bolster the collective expertise of those involved. Furthermore, it aims to provide insights into ongoing initiatives related to finance and sustainability, particularly within the context of the forest and timber industry.

The primary outcomes of this work package will include the annual creation of 5-10 new products and solutions that not only promote circularity but also extend the lifespan of wood. It will conduct analyses of test data, suitability for reuse, material flows, and logistics within the wood value chain. Additionally, the INNOVATION activities will support innovation endeavors along the entire spectrum, spanning from technology development to the launch of products into the market. Lastly, the work package will offer guidance on the financing of investments within the circular wood value chain. Ultimately, the project aspires to elevate innovation, providing more opportunities to identify new business sectors and develop innovative solutions and products within the circular wood value chain.

Urda Ljøterud Høglund from Omtre is leading the INNOVATION.

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> The INNOVATION work package focuses on enhancing innovation levels and exploring opportunities (...)
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> OMTRE

SirkTRE | CircWOOD

IF THERE WERE NO STANDARDS

The work package, owned by Standards Norway and led by CEO of Norwegian Institute of Wood Technology, Audun Øvrum, manages the standardization work within the SirkTRE project. The primary objective is to ensure the effective reuse of wood through the development of new standards, revising existing standards and participating actively in ongoing relevant international work.

The involvement of all work packages with relevant expertise and experience in the circular use of wood is essential for this initiative.

Standards open up possibilities for documenting properties of reclaimed wood, thereby increasing the applications and value of wood as a building material. Key milestones for this work package include recognizing what needs for standards for reclaimed timber currently exist and answering those needs with developing national documents as well as participating in relevant international activities that may influence the market situation for reclaimed timber. This aims to the creation documents for the entire circular wood value chain. Standard Norway aims to contribute to the development of standards and standardization work as tools to realize the project’s ambitions.

The SirkTRE project underscores the significance of standardization, with standards serving as common “recipes” for how something is made or executed. Standardization is the process from need or idea to a fully developed standard.

Project goals within the national context include the development of standards for evaluating reclaimed wood (ongoing), initiating the creation of designs for reuse (pre-phase), design guidance (under evaluation), formulating guidelines for demolition (under evaluation), and addressing reuse and guidelines for carbon accounting (under evaluation).

Internationally, the project extends its focus to areas such as design rules, monitoring work on Eurocode 5, as well as exploring the possibilities of incorporating reused materials. Active participation is seen in ISO/TC 287 Sustainable Processes for Wood and Wood-Based Products, WG3 Sustainability Aspects, and CENCLC/JTC10 Material Efficiency Aspects for Products in the scope of Ecodesign Legislation.

To achieve these goals, the project ensures the participation of all work packages with relevant expertise and experience in the circular use of wood.

NTI (Norwegian Institute of Wood Technology) is the R&D center for the sawmill and timber industry in Norway. Our main tasks are research and development projects, quality control, quality documentation, laboratory tests and dissemination of knowledge from R&D to the Norwegian wood industry.

Standard Norge develop, publish and manage standards in most areas of society. We are Norway’s member in ISO and CEN, and publish NORSOK and Norsk Standard (Norwegian Standard).

Standard Norge

Treteknisk

CONNECTING GLOBALLY

The primary objective is to contribute to export opportunities for products, solutions, and expertise developed in SirkTRE. This entails international communication of project results and promoting the project's efforts on a global scale. Additionally, this work package aims to secure participation in Horizon Europe, the European Union's flagship research and innovation program.

Key milestones in this work package include the selection of applications and potential consortium partners for international projects. The main deliverable is building competence based on SirkTRE, enabling the use of the entire circular wood value chain in Europe and globally. This includes facilitating solutions for export by supporting internationalization of results and creating opportunities to present project results on various platforms.

The project's specific goals encompass the following aspects:

- Enhancing expertise based on SirkTRE for the utilization of the circular wood value chain in Europe and globally.
- Creating solutions for export, including support for internationalization efforts such as identifying financing and suitable international platforms.
- Effectively communicating project results to the international community.
- Active participation in Horizon Europe, ensuring that SirkTRE becomes part of international initiatives.

To achieve these objectives, activities include staying updated on SirkTRE's results and informing internationalization opportunities, as well as supporting prioritized cases and application initiatives. This work package has participated in various international events, and future plans for 2024 include attendance at several conferences and events to expand international collaboration and promote the project's goals on a global scale.

Challenges and opportunities are recognized, and the project is making progress toward its objectives, with the aim of accumulating valuable experiences and results in promoting circular wood value chains internationally.

Ola Rostad, representing NWC, heads the SirkInternasjonal work package within the SirkTRE project.

NORWEGIAN WOOD CLUSTER

Norwegian Wood Cluster is a business cluster for the forest and wood mechanical industry and wood construction. Our members consist of players in the entire value chain, from timber suppliers to the wood industry, architects, consultants, house manufacturers, financial players, research institutions and more. The cluster's main role is to create meeting places and projects that will develop innovative and climate-friendly building solutions in wood.

SirkTRE | CircWOOD

BRINGING IT ALL TOGETHER

Kristine Nore, representing Omtre, leads the SirkLEDELSE work package. This work package is primarily responsible for overseeing the project and ensuring it progresses toward its goals effectively. The main focus is on managing the project and making key decisions in the early stages to maintain strong relationships and successful implementation throughout the project duration.

One of the critical milestones in this work package is the evaluation of the speed of the transition toward the circular wood value chain. This evaluation aims to determine if any adjustments are needed to ensure the project's success. The primary deliverables include maintaining collaboration with the project's Steering Group to ensure good progress and handle unforeseen changes. An annual consortium gathering with a professional conference helps foster cohesion and provides visibility for SirkTRE externally.

The project's goals are ambitious and include establishing the circular wood value chain in collaboration with competent partners and leading the development of circular and industrial wood use in Europe.

The activities within this work package are focused on keeping SirkTRE activities on track, actively making important decisions throughout the project's duration, and maintaining strong connections with stakeholders.

One of the challenges is to ensure that the project maintains its momentum and flexibility to adapt to changing circumstances and requirements. The project is continually working to meet its objectives and aims to contribute valuable experiences and results to advance the circular wood value chain in Europe.

SCIENCE FICTION PROTOTYPES

This article delves into what is termed the 'imagination crisis'. Wendy Wuyts, a researcher from Omtre, employs future and foresight methodologies to address this crisis in previous work, but also in different projects under Omtre, like Sirktre. "It could be argued that human society is defined by two principal boundaries: one delineated by the constraints of the natural environment and the other by our collective imagination" (Griffin, 2005).

The critique of circular economy: an abstract concept that can be imagined in so many ways

The concept of a circular economy is, in fact, a subject of debate, capable of being envisioned in numerous ways. For instance, the mention of a circular economy in timber construction evokes diverse images: some may envision the well-preserved timber buildings of Røros, others might imagine products free from adhesives, while a different group could conceive of modular constructions in the heart of Oslo. Who possesses the accurate depiction? The reality is that all are correct.

The circular economy is an abstract notion. In the context of sustainable transitions, challenges arise when various stakeholders involved in innovation lack a unified vision or a clear, collective understanding of how the future should unfold. How can one determine the necessary actions to achieve a vision of the world that is not yet fully conceived? Moreover, how can progress be gauged if the ultimate goal remains undefined? In the corporate sphere, numerous methodologies, known as futures and foresight methods, are utilized to assist individuals in identifying and exploring potential and preferable futures. Among these is the technique of science fiction prototyping.

This image was created with the assistance of DALL·E 2, Wendy Wuyts

Science fiction prototyping

Science fiction (SF) prototyping serves as a powerful tool for exploring the future, particularly when traditional scenario development methods fall short in capturing the complexities of social-ecological systems. According to Merrie et al. (2018), while scenarios are instrumental in enabling individuals, communities, corporations, and nations to develop strategies for navigating the unknown and preparing for the unpredictable or the possible yet unlikely, traditional scientific methods for developing these scenarios have their limitations. These limitations primarily stem from two factors: the inadequate incorporation of non-linear change and the neglect of co-evolutionary dynamics within integrated social-ecological systems. SF prototyping, a method which was proposed in Intel almost 15 years ago, addresses these shortcomings by leveraging narratives that are both grounded in scientific fact and imbued with imaginative speculation.

As defined by Burnam-Fink (2015, p.49 in Merrie et al, 2018), science fiction prototypes are "short works of fiction, grounded in scientific fact and crafted for the purpose of starting a conversation about the implications, effects, or ramifications of technology and the future." This approach enables a more holistic exploration of potential futures by allowing for the integration of complex, non-linear, and co-evolutionary dynamics that traditional scenario development methods might overlook. By fostering imaginative yet plausible narratives, SF prototyping encourages stakeholders to think critically about the broader implications of emerging technologies, including ethical considerations, societal impacts, and potential ecological consequences. These reflections might help to create more holistic roadmaps.

Omtre's experiment

In November 2023, Wendy and her colleagues Sebastian, Christine and Francisco embarked on creating five science fiction prototypes that concentrated on the themes of wood reuse and the integration of emerging digital technologies.

The creation process of the SF prototype building unfolded in three phases. In the first phase, world-building, the Omtre colleagues were tasked with envisioning a Norwegian circular city or neighborhood set in 2050, integrating elements of circular modernism and high-tech advancements while considering the coexistence of diverse beings and sustainable infrastructures. This phase encouraged deep thinking about the use of renewable energies, sustainable materials as alternatives to long-lasting pollutants like plastics, inclusivity for people with disabilities, and the sensory experiences within this future setting. The second phase focused on character development, asking participants to imagine individuals who inhabit this world, detailing their roles, interactions with digital technologies, livelihoods within the circular economy, personal attire adapted to future climate conditions, and their integration into community structures. On purpose, they selected existing jobs that are now emerging in SirkTRE. The final phase introduced a narrative twist with a cyber attack, challenging participants to explore the character and organizational responses to this conflict, thereby testing the resilience and adaptability of the envisioned future society and its technological infrastructure.

They crafted posters and utilized DALL-E to generate images, which they later presented at a workshop with one of their partners to solicit feedback and reactions.

The following photos present two different characters that interact with a crisis in a circular digital future.

Wendy Wuyts, Christine Jørgensen, Francisco Tienda and Sebastian Larsson, Omtre

Circular use of wood for increased sustainability and innovation

CircWOOD

> CircWOOD will investigate aspects of wood use in the Norwegian economy, with particular emphasis on the reuse of wood in construction projects, and recycled wood as raw material in today's wood industry.

Photo: Lone Ross, NIBIO

Introduction

In Norway, around 13 million m³ timber are logged per year. According to the national strategy for the forest and timber industry, SKOG22, there are sustainable grounds to increase the amount of timber to at least 15 million m³ per year. However, if our society is to succeed in reducing its greenhouse gas emissions in line with the Paris Agreement, it is expected that the need for resources will be significantly greater than that.

To increase the use of wood in construction, short-distance raw materials are needed. Recycled wood will be a crucial input factor through new reuse and material recycling solutions. Increased innovation and value creation must go hand in hand to take advantage of the opportunities recycled wood has to offer.

CircWOOD

In order to close knowledge gaps related to the availability and quality of recycled wood, CircWOOD will investigate aspects of wood use in the Norwegian economy, with particular emphasis on the reuse of wood in construction projects, and recycled wood as raw material in today's wood industry. Research results, especially related to resource access and material flows, will be linked to the facilitation of circular flow of goods, handling, environmental impact, design and production of wood in, and towards, relevant markets in Norway and abroad. CircWOOD will follow the life cycle of Norwegian recycled wood and find new ways to make use of this resource.

The project will analyze the sustainability and environmental footprint of the wood-value chain based on strategies and new technologies that contribute to circularity. CircWOOD will identify and investigate ways in which processes can be simplified, by using the latest methods for digital collection, analysis and sharing of data. In addition, the project will address the underlying political frameworks and study the economic impact they have.

CircWOOD is an integral part of SirkTRE that aims to lift the wood industry and the construction industry towards the holistic circular, green shift.

Project structure:

WP1: Availability and quality. Leader: Lone Ross / NIBIO

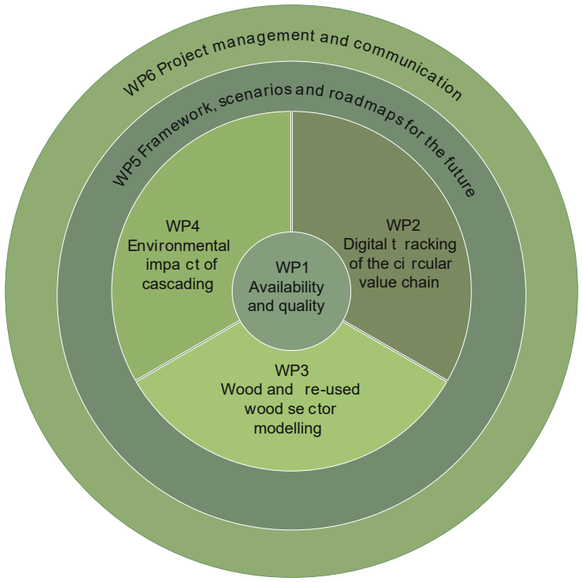
WP2: Digital tracking of the circular value chain. Leader: Lizhen Huang / NTNU

WP3: Wood sector modelling. Leader: Erik Trømborg / NMBU

WP4: Environmental impact of cascading. Leader: Roja Modaresi / TRET

WP5: Framework, scenarios and roadmaps for the future. Leader: Hanne Sjølie / HINN

WP6: Project management and communication. Leader: Lone Ross / NIBIO



Both photos: Kathrine Torday Gulden, NIBIO

Photo: Sigurd Fløistad, NIBIO

Analysis of returned wood at Ragn-Sells in Moss

As part of Work Package 1 in CircWOOD, the first picking analyses were conducted at Ragn-Sells recycling station during the spring of 2022. The analysis provides an indication of which fractions are dominant in the post-consumer wood delivered to Ragn-Sells in Moss.

In the period between May 9 and May 13, a total of 287 tons of mixed processed wood and 27 tons of treated wood were delivered to Moss. Ragn-Sells separates mixed wood from treated wood. In this study, a total of 11.1 tons of mixed wood was sorted. Of this, untreated solid wood was the largest fraction, constituting 29% (Figure 1). In total, untreated and treated solid wood accounted for 47% of the wood. The fraction of wood-based panels was the second largest, comprising 23% of the total analyzed quantity. Wood packaging accounted for 21%, and the furniture and doors fraction constituted 3%. Preservative-treated materials covered 6%. In this fraction, both CCA-treated wood and wood treated with copper were found. Because Ragn-Sells separates preservative-treated wood from non-preservative-treated wood, this fraction is considered incorrectly delivered and is recorded as a deviation.

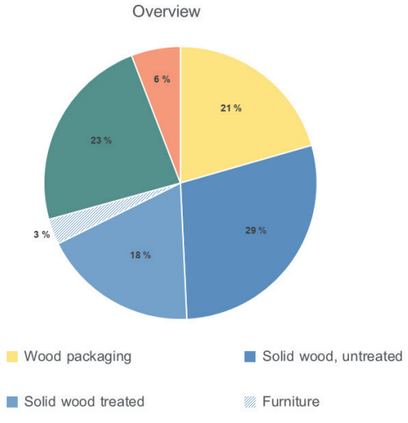


Figure 1 – Woodwaste divided in fractions

In Statistics Norway's waste accounts for Norway, waste quantities are registered by source. The sources are defined by origin – i.e., industry, construction and civil engineering, service industries, private households, and others. The results from this analysis indicate that the wood from construction and demolition/rehabilitation includes a larger proportion of solid wood than that from private households and recycling stations. Wood-based panels (44%) were the largest fraction in the wood waste from private sources, with more treated solid wood than untreated (Figure 2). Additionally, it was observed that a significant proportion of materials came from cladding and kitchen fixtures.

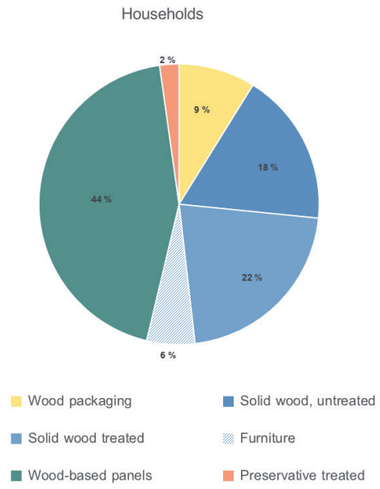


Figure 2 – Private fractions

Unpainted solid wood constituted the largest fraction of the wood from construction and demolition/rehabilitation (Figure 3). Treated and untreated solid wood accounted for 56% and together represented the largest fraction by far.

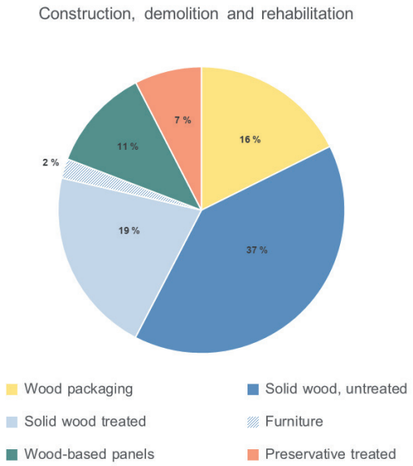
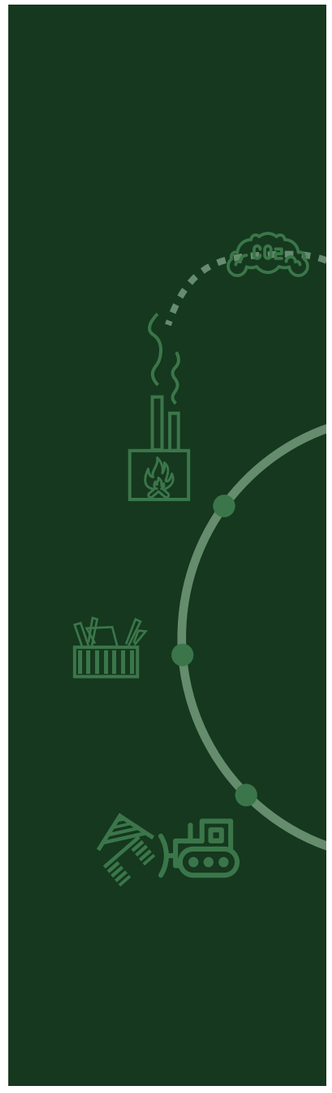


Figure 3 – Fractions from building and construction

In the analyses from Moss, there was less wood from private sources than from construction and demolition/rehabilitation. Of the total wood analyzed, private sources contributed 3 tons compared to 7.2 tons from construction and civil engineering. Industrial waste accounted for 841 kg and consisted exclusively of wood packaging.



RAGN-SELLS

NIBIO

Treteknisk

1. Avfallsregnskapet (2021) SSB. Obtained from: https://www.ssb.no/natur-og-miljo/avfall/statistikk/avfallsregnskapet (Dato hentet: 28 June 2022).

Kristina Gedde Bringedal (NIBIO), Erik Larnøy (NIBIO), Andreas Stenstad (Treteknisk), Per Johannessen (Ragn-Sells) and Lone Ross (NIBIO)

Carbon storage in wood products

All wood products in Norway could be regarded as one large carbon store. When the amount of wood products supplied to the market exceeds the amount of wood waste incinerated, this carbon store increases. By compiling data on wood waste and production of wood products (sawnwood and wood-based panels) in the period 2012-2022 we see an average annual increase in this carbon store equivalent to 926,000 tonnes of CO2, or 1,594,000 tonnes of CO2 if we adjust for net import. Calculations made in accordance with rules for Norway's official greenhouse gas accounts result in a corresponding increase of 368,000 tonnes of CO2.

Through photosynthesis, trees sequester substantial amounts of carbon dioxide (CO2) from the atmosphere and store carbon as they grow. Carbon constitutes about half of the woods dry matter. When the wood is incinerated or decomposed, the carbon returns to the atmosphere. When the forest's carbon stock increases, an equivalent amount of greenhouse gases are removed from the atmosphere.

Logging drains the forest's carbon stock, but carbon passed on to a wood product remains stored throughout the products life cycle. The sum of all wood products could be considered as a carbon store which increases when new wood products are supplied to the market and decreases when wood waste is incinerated.

Annual changes in harvested wood products (HWP) are included in the official reporting of Land Use, Land-use Change and Forestry (LULUCF), and a part of Norway's obligations under the United Nations Framework Convention on Climate Change (UNFCCC). Norway has chosen a so-called production approach for its HWP reporting, which means that it is based solely on domestic production of goods categorized as sawnwood, wood-based panels and paper and paperboard and their expected lifetime (half-life functions).

In this article we present Norwegian data reported to the Food and Agriculture Organization of the United Nations (FAO) combined with national data on roundwood removals and waste accounting provided by Statistics Norway (SSB). Calculations of CO2 equivalents of wood products and wood waste are based on factors set out in the IPCC's 2019 Refinement to the 2006 Guidelines for National Greenhouse Gas Inventories.

This compilation differs from the official HWP reporting in three ways. Firstly, we exclude the product category paper and paperboard from our analysis. Second, we use data on wood waste to calculate outflows from the wood products carbon stock, rather than the estimated lifetime of the products. Third, we also include net imports of sawnwood and wood-based panels to assess the wood products carbon stock from a consumption perspective, in addition to the production perspective.

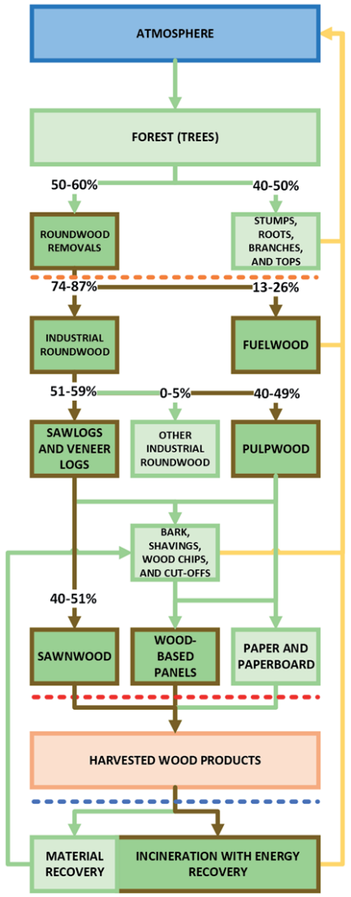


Figure 1: The carbon cycle of Norwegian wood products illustrated with a flowchart. Percentage intervals are presented based on FAOSTAT and SSB data from 2012 to 2022 and a NIBIO report from 2018.

The flowchart (Figure 1) illustrates the carbon cycle related to wood products. Dark green boxes and brown arrows represent data included in the compilation, while unknown and excluded quantities are illustrated in light green. The percentage intervals indicate the largest and smallest shares observed in the period 2012-2022. The dotted lines mark measurement points for roundwood removals (orange), production/net export of sawnwood and wood-based panels (red), and wood waste (blue).

Figure 2 compiles domestic production and consumption of wood products and recorded wood waste. We see that the production and consumption volumes of wood products are roughly 50 percent and 100 percent greater than of wood waste throughout the entire period 2012-2022, which implies a strictly increase in the wood products carbon store.

By subtracting annual CO2 equivalents for wood waste from produced and consumed wood products, respectively, Norway's net wood products carbon flows are estimated. In figure 3 these estimations are compared to HWP calculations (excl. paper and paperboard) based on Mohr et al. (2022). The comparison shows significantly higher estimated increases of carbon store when offsetting recorded wood waste rather than using the official HWP method (half-life function decay). By changing from a production perspective to a consumption perspective, we see even greater annual inflow every single year throughout the period.

Production and consumption of wood products and wood waste (m^3) 2012-2022

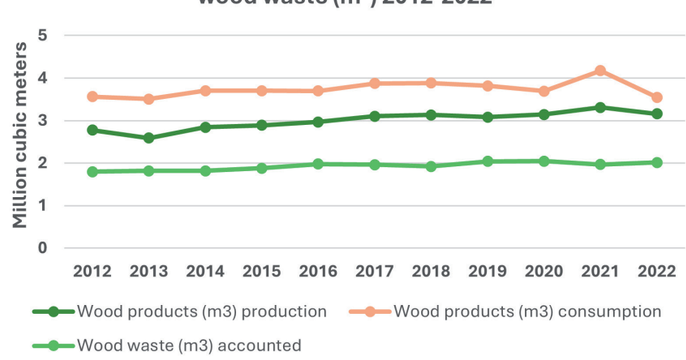


Figure 2: Number of cubic meters of Norwegian production and consumption of wood products (sawnwood and wood-based panels) and recorded wood waste in the period 2012-2022. Numbers are based on FAOSTAT and SSB data.

Carbon stock increase (t CO_2) 2012-2022

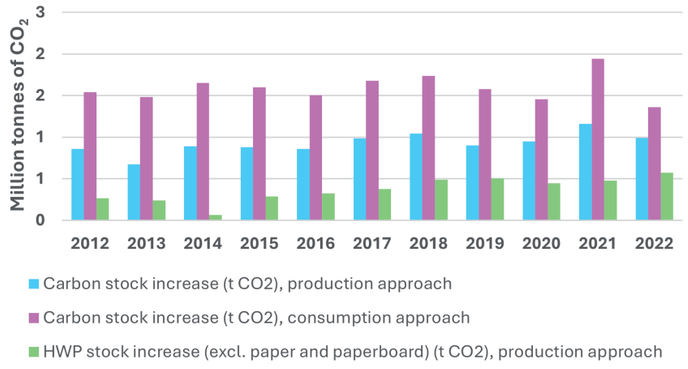


Figure 3: Carbon stock increase estimations based on domestically produced/consumed wood products (sawnwood and wood-based panels) subtracted amounts of wood waste compared to HWP stock increase presented by Mohr et al. (2022). Own carbon stock increase estimations are based on FAOSTAT and SSB data. Mohr et al. (2022) is retrieved from: https://nibio.brage.unit.no/nibio-xmlui/handle/11250/3023928.

Tom Erik Thorkildsen (NMBU), Erik Trømborg (NMBU)

Resources, use and production in the Norwegian forest sector

This simple analysis builds on 2012- 2022 data on waste accounting and fuelwood removals from Statistics Norway (SSB) and Norwegian data on forest production and trade reported to the Food and Agriculture Organization of the United Nations (FAO). The purpose is to provide a quick overview of Norwegian production of forest products and how forest resources are managed.

Norwegian removals have increased fairly steadily from 11.8 million cubic meters in 2012 to 13.8 in 2022 although fuelwood removals were rather declining in this period. The industrial roundwood removal increased significantly from 8.8 to 11.5 million cubic meters, while net export increased even more, from 0.7 to 3.9 million cubic meters. Thus, industrial roundwood removals for domestic use was reduced from 8.1 to 7.6 million cubic meters (see figure 1).

Almost half of the removals were classified as sawlogs, a slightly larger share than pulpwood, while firewood made up less than a fifth on average in the period 2012-2022 (see figure 2). This relative ratio remained stable throughout the period.

Figure 3 illustrates the relative composition of final/intermediate goods from the Norwegian forest sector in 2012-2022. All

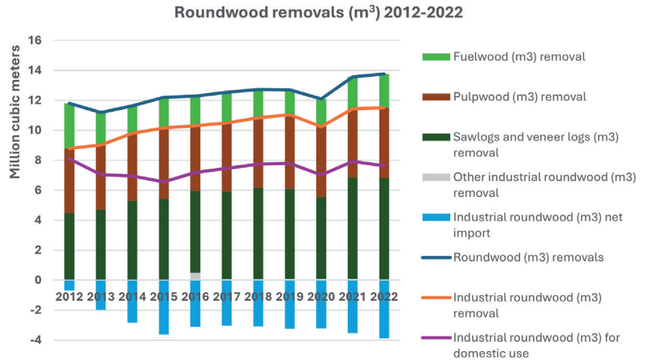


Figure 1: Annual volumes of negative net import (export) of industrial roundwood (blue), sawlogs and veneer logs (dark green), pulpwood (brown), other industrial roundwood (grey), and fuelwood (light green) are stacked to illustrate how they are aggregated to the groups industrial roundwood (orange curve) and roundwood removals (dark blue curve). Industrial roundwood for domestic use (purple curve) represent industrial roundwood removals subtracted net export. Fuelwood data is collected from SSB. All other data presented in figure 1 is retrieved from FAOSTAT.

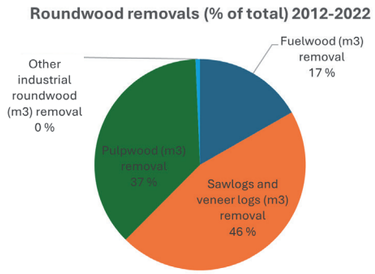


Figure 2: Removals from Norwegian forests in the period 2012-2022 are distributed between sawlogs and veneer logs (46%), pulpwood (37%), fuelwood (17%), and other industrial roundwood (<1%). Based on FAOSTAT and SSB data.

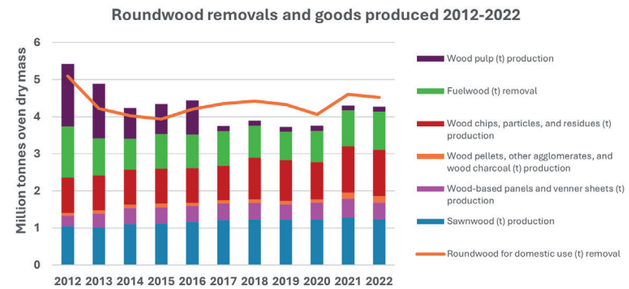


Figure 3: The production of sawnwood (blue), wood-based panels (pink), wood pellets, other agglomerates, and wood charcoal (orange), wood chips, particles, and residues (red), fuelwood (green), and wood pulp (purple) are stacked to illustrate the relative proportions and that they could be aggregated to roundwood removals for domestic use. The discrepancy may be due to inventory changes within wood industry, drought wastage etc. Data is retrieved from FAOSTAT and SSB. All categories are converted to tonnes oven dry mass in accordance with the 2019 IPCC Guidelines.

products have been converted to the same scale, tonnes oven dry mass, in accordance with the 2019 IPCC Guidelines. The production of wood pulp goes from a share of 20-30 percent of the production in 2012-2016 to 3-4 percent in 2017-2022. As already mentioned, fuelwood had a slightly declining supply curve. Even if the overall domestic use of roundwood has decreased by about 10 percent, all other product groups increased production volume from 2012 to 2022. Figure 4 shows the average production distribution of product groups in this period.

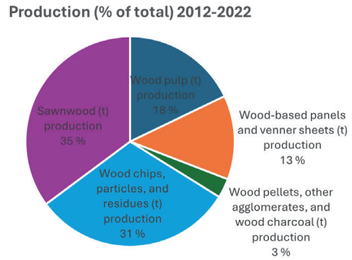


Figure 4: Average production proportions by tonnes oven dry mass of sawnwood (35%), wood, chips, particles, and residues (31%), wood pulp (18%), wood-based panels (13%), and wood pellets, other agglomerates, and wood charcoal (3%). Data collected from FAOSTAT and SSB. Converted to tonnes oven dry mass in accordance with 2019 IPCC Guidelines.

Figure 5 shows a small set of key indicators. The net import share of wood products (sawnwood and wood-based panels) was halved from 22 percent in 2012 to 11 percent in 2022. The import and export shares are expected to fluctuate in line with exchange rates and aggregate international demand. Sawnwood as a share of sawlogs and veneer logs fell from 51 percent in 2012 to 40 percent in 2022. This may be due to the fact that sawlogs account for an increasing share of the roundwood exports, but the data

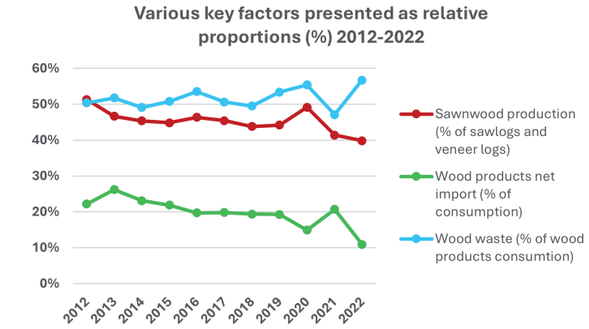


Figure 5: Annual measures of sawnwood production as proportion of sawlogs and veneer logs (red), net import of wood products as proportion of domestic consumption (green), and wood waste as proportion of domestic consumption of wood products (sawnwood and wood-based panels) (blue. Data is retrieved from FAOSTAT and SSB.

analyzed does not provide any explicit insight into this. Wood waste as a share of domestically consumed wood products fluctuates but seems to persist at about 50 percent over time. In order to achieve official environmental and climate objectives, it is required to reduce this share in the near future.

The Norwegian waste accounts are based on several different types of data collection, decided by Statistics Norway. The municipalities are responsible for measuring and reporting wood waste from households. However, wood waste from other sectors relies on different modelling methods based on collected samples and given factors. Wood waste from the construction sector is also linked to three different activities, construction, rehabilitation, and demolition. This distribution is also based on samples and given factors.

Figure 6 shows the average distribution between sectors and mentioned activities. Two elements in particular seem counterintuitive to many. First, households deliver det largest fraction, and more than a third of total wood waste. Secondly, demolition accounts for only a fifth of wood waste from the construction sector, while construction of new buildings account for more than twice the amount.

For anyone who wants to participate in the transition towards a more circular wood industry, and for those who want to facilitate their success, it is beneficial to carefully map the qualities and quantities of wood waste and where it is delivered.

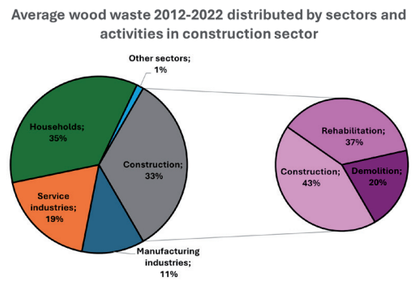


Figure 6: Illustration of distribution of wood waste between sectors and activities within construction sector. Data is collected from SSB.

Tom Erik Thorkildsen (NMBU), Erik Trømborg (NMBU)

How policies can solve the catch-22 situation

Construction material circularity is often associated with numerous barriers such as perception of high costs and uncertain demand. Since currently, the market for such products is non-existent, the manufacturers and suppliers do not see any incentive in supplying used material either. This locks the circular value chain change into a catch-22 situation where both the demand and supply sides are waiting for the other to establish before them. So how do we unlock the vast potential of material circularity in our construction sector? Well, policy intervention may just be the solution.

Policy Analysis: a study

As part of SirkTRE's academic project, CircWOOD, the current policy mix of Norway was scrutinized to explore opportunities and bottlenecks. The research study by Khatri et al. (2024) [Manuscript submitted for publication] found that both the European and national leaderships do not view construction material circularity as a policy objective as yet. However, larger policy goals of climate targets, waste management, and general circular economy play a supporting role. It is suggested that this policy gap can be filled by developing a 'Construction Material Circularity Action Plan' as a national-level goal. Furthermore, the study found that the current policy mix puts forward a multitude of 'ideas' and 'ambitions' that can benefit wood circularity. Unfortunately, only six out of seventy policy instruments (or practical tools) mentioned in our policy documents are actually active in legislation. This is understandable since material circularity is relatively a novel idea for the construction sector; but our understanding need not become an excuse to not do more.

What can our local governments do?

The transformation of the construction sector from a linear to a circular economy cannot be achieved overnight. It will require contributions from a multitude of stakeholders, most importantly from the national, local and regional governments. However, a top-down approach needs to be well thought-out where a transformation can be planned in phases.

National and European level

Since June 2021, Norway has a national strategy for circular economy. However, currently, Norway does not have a national action plan dedicated to the circularity of construction materials. Unsurprisingly, the efforts in the sector are fragmented and often voluntary.

Under the leadership of European Union, the Norwegian government supports actions aimed at carbon emission reduction, waste management and circular economy. However, goals and policies are needed that specifically cater to the construction sector.

What can local and subnational governments do?

The local and regional governments are in a unique position to customize policy efforts according to the needs of the region. In areas of high demand for construction material, the local government can set examples with incorporating used construction material in their new public buildings. With accessible role models, other construction stakeholders can be encouraged to follow suit. Furthermore, in regions of existing buildings-as-material-banks (i.e. buildings that are ready for deconstruction), economic incentives can be provided to smooth out logistics, encourage circular business models and make used material competitive in the market.

Concrete examples in Norway and other countries

In Norway, initiatives such as DIPLOM in Trøndelag, aim to spearhead the twin transformation of digital solutions for reuse of building component. The city of Oslo and the local government programme FutureBuilt cooperates with different actors in providing storage space for reclaimed materials in the Sirkulær Ressurssentral.

In other countries, such as the Netherlands, local and regional governments work together on CircuLaw, a legal knowledge platform, aimed at making relevant and innovative legal information more accessible to policymakers so that they can adequately support the circular transition through policy intervention. Timber construction is one of the first targets. Moreover, in the new national roadmap of circular economy of the Netherlands, launched in February 2023, spatial planning was mentioned for the first time, and the government mentioned their interest in spatial requirements and implications of especially circularity in the construction sector. In general, spatial planning is one of the still-overlooked policy instruments in the circular economy transition.

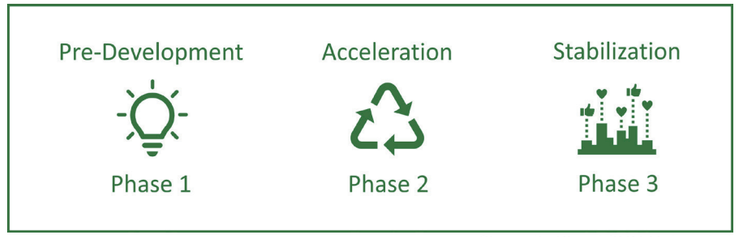
In Belgium, the Flemish government initiated in 2019 the Green Deal on circular construction, which brought researchers, companies and government together to expert and formulate solutions, including policy solutions.

Three phases for transformation

It is important to consider how the governmental actions will be unfolded that can match (and also trigger) market progress. The Transformative Environmental Policy chalks out three phases for dynamic transformations: i) Pre-development, ii) Acceleration, and ii) Stabilisation.

And eventually the new normal of circular economy will need to be maintained in the third phase, where national, local and regional governments can impose carbon limits on new construction,

environmental pricing on primary material, and increased waste sorting. Currently, Norway is in the first or the pre-development phase of bringing circularity of construction material to the mainstream.



Shumaila Khatri (INN University)

In the case of construction material circularity in Norway, the first phase can include pilot projects, dissemination of best practices, green public procurement, and provision of storage spaces.

The second phase can aim for exnovation, or the phasing out (exit-innovation), of old practices (i.e. linear economy in this context) and scale-up successes from the first phase. These can be subsidies and investment for circular businesses, dissemination of knowledge about carbon savings, and accessible storage spaces in all municipalities.

Cooperation between the different governments

Overall, the national government is responsible for larger targets such as national action plan for material circularity, updating building codes, developing national methodology for measuring environmental impact of buildings, and imposing taxes. However, local and regional governments need not wait for a national level guidance and can focus on the solutions that can be developed in their specific regions.

Shumaila Khatri (INN University) and Wendy Wuyts (Omtre)

SirkTRE partners

manufacturing.
technology@sintef.no

kontakt@looping.no

post@skog.no

post@glommen-mjo-
sen.no

postmottak@statsbygg.no

hza@hza.no

info@standard.no

www.nwcluster.no

grape.no

info@omtre.no

firmapost@snsk.no

post@boligpartner.no

forestia.kundesenter@
byggma.no

kundesenter@ragnsells.no

kundesenter@hunton.no

post@nibio.no

firmapost@treteknisk.no

postmottak@ntnu.no

inn.no

post@nmbu.no

firmapost@ringalm.no

emil@ressurssentral.no

futurebuilt@futurebuilt.no

post@landheim.no

post@fragmentoslo.no

info@norskmassivtre.no

post@lyhytta.no

post@viken.skog.no

post@aaneslandtre.no

firmapost@olaroald.no

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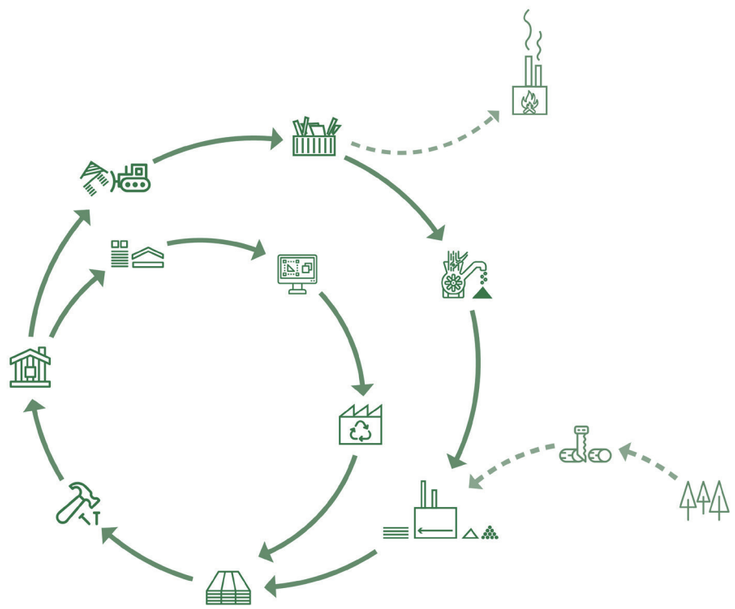


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