



# **Building up wood construction markets with consumer knowledge, industrial and municipal strategies (KnockOnWood)**

**15.5.2023**

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Swedish University of Life Sciences (SLU), Department of Forest Sciences, provides a separate report to the Swedish funder

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## 1. Background

The starting point of the project was to add scientific knowledge on the wooden multi-storey construction (WMC) especially in the residential housing sector to capture its potential to decarbonize the construction sector and add competitiveness of the companies. Since research results and empirical experiences had shown WMC to have potential to bring benefits in housing urban regions, the project also addressed views of citizens and municipalities as localities for WMC.

There was a need to make systematic research on WMC, since despite the rich forest resources, changes in the regulatory frameworks allowing WMC, and strong traditions to build with wood, WMC market diffusion had been slow especially in Finland, but also in Sweden. In addition, systemic knowledge on supply (i.e., companies), demand (i.e., consumers) and land-use management (i.e., urban planning in municipalities) factors to affect the potential of WMC in the housing market was scarce.

To fill this void, KnockOnWood focused on the Nordic construction and housing markets to provide new insights on the factors, which may support and hinder the market diffusion of the WMC especially in the case countries, i.e., Finland and Sweden. The project was designed and carried out by University of Helsinki, Faculty of Agriculture and Forestry, Department of Forest Sciences (UH) (also consortium leader), and Finnish Natural Resources Institute (Luke), and the Swedish University of Lifesciences, Department of Forest Science (SLU).

## 2. Objectives and research questions

The study was structured with three main research objectives and related research questions (RQ), of which each composed one work package (WP):

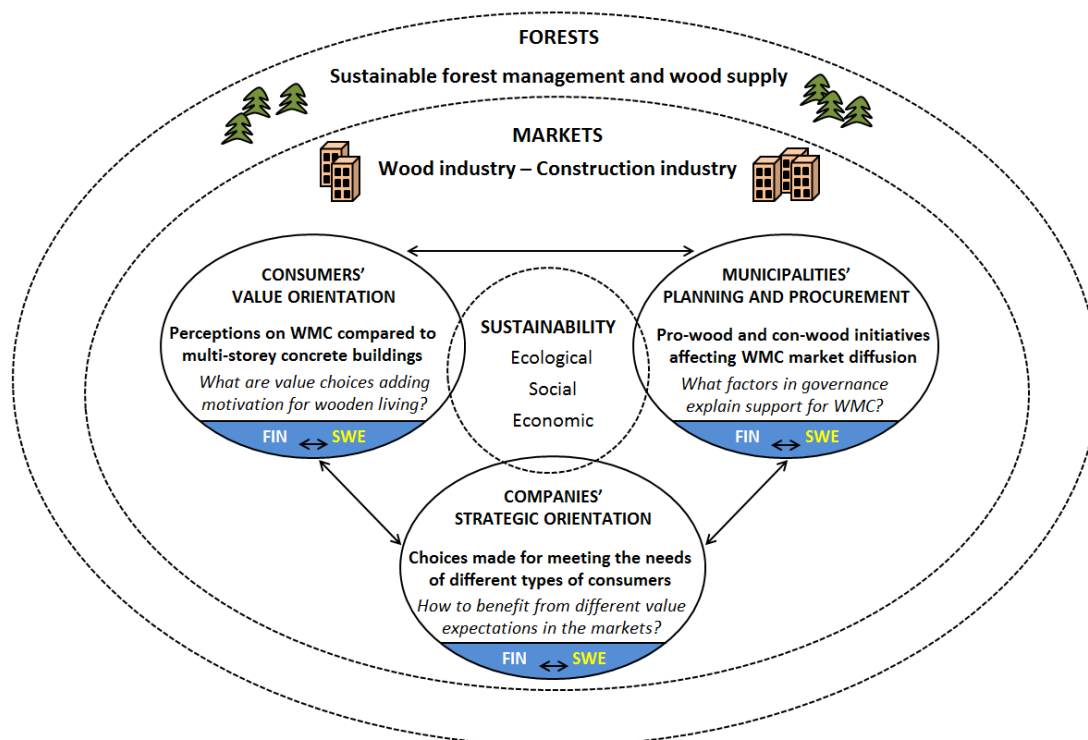
- WP1, consumers (UH): The aim was to explore consumer preferences on and experiences of housing in newly built WMC and concrete-framed apartments. The specific RQ was: *What factors affect customers' preferences when choosing a flat to live in, including the significance of the perceived sustainability aspects of WMC flats (e.g., carbon storage and substitution)?*
- WP2, business actors (SLU): The aim was to investigate wood and construction industries' strategies related to WMC, and the related RQ was: *How can company strategies advance a sustainability transition in residential construction based on carbon storage and substitution benefits, and increased value creation in WMC?*
- WP3, municipalities (Luke): The aim was to investigate municipalities' efforts towards sustainability and carbon neutrality goals in the building and housing sector, and how WMC is incorporated in these plans. The related RQ was: *Which factors in the municipal governance explain the level of support to the adoption of WMC and the effectiveness and legitimacy of the carbon-neutrality strategies?*

By information received through individual WPs, the overall purpose of the project was to identify to identify the connections between the three key actor groups targets and perceptions in the WMC

business ecosystem by synthesizing the scientific results received (see Figure 1. illustrated in original research plan). A special interest was to better understand how the construction sector incorporates the consumer housing needs and municipal targets into their strategies, and how municipalities affect potential of WMC market diffusion through consideration and collaboration with consumers and businesses. When possible, comparisons between Finland and Sweden were carried out.

The outcomes of the project were intended to enhance the competitiveness and growth of the forestry-wood construction value chain in the two countries, and to provide knowledge on how to best support competitive sustainability transitions in the construction and housing sector. In more specific terms, the project results were hoped to support the growth and competitiveness of the Finnish and Swedish forestry-wood construction-value chain, and to support housing solutions that would fulfill the end-users' multiple needs, including sustainability and low-carbon options.

In addition, in the original research plan there was an idea of creating a new platform to collaborate between municipalities on WMC theme. However, this was not realized, since at later phases it became evident that some suitable platforms already existed. Instead of the lack of platforms, more attention was needed on how to attract the municipalities to use these virtual platforms. In the preliminary discussions at early phases of the project, only few municipalities expressed interest in the preliminary discussion to collaborate in this sort of initiative (perhaps overloaded with other more urgent matters during the COVID).



**Figure 1.** Framework of the study illustrating the interlinkages between consumers, businesses, and municipalities in reference to the sustainability goals, and the broader forestry-wood industry value chains (outer circle).

### 3. Data and methods

In the original research plan, the aim was to collect comparable data in relation to all three WPs in an integrated way by focusing in three case municipalities in both countries, i.e., totally 6 municipalities. As a deviation to the original research plan, due to the COVID-pandemic, the operational environment for consumers, businesses and municipalities become more complex and less foreseeable. Resulting from this, for example, abreast with having face-to-face contacts, also making remote contacts become more complex and time consuming. Thus, the data gathering strategy needed to be re-oriented to the new circumstances and to the practices, which by WPs would provide the best result possible and still enable acquirement of information on the WMC in relation to consumers, businesses and municipalities as inter-linked entities.

The project started with the review of scientific literature (see published results in Jussila et al., 2022), and the empirical data collection for WP1, WP2 and WP3 were based on this preliminary analysis. Finally, observations from the literature review, and when applicable, results from other WPs were considered in formulating practical conclusions and suggestions in the individual manuscripts of each of the WPs.

In WP 1 (main responsibility UH), the focus was consumers' housing preferences and experiences. To address the topic, new empirical data was collected from residents in newly built WMC and concrete-framed apartments. In all, material was gathered in 2022 from 5 cities (and included 9 newly built buildings in these) in Finland, and Sweden. As method of data analysis, qualitative approach was used. Abreast with collecting new empirical interview-data, consumer analyses were deepened and supported by using other recently collected (2021) NOFOBE consumer panel data on WMC including respondents from seven European countries (i.e., Finland, Sweden, Norway, Denmark, Germany, Austria, United Kingdom) available for the KnockOnWood researchers. The methods of NOFOBE data comprise qualitative approaches (e.g., statistical tests, regression analysis and exploratory factor analysis).

In WP2 (main responsibility SLU), the target was to add understanding on wood and construction industries' strategies related to WMC. To provide information on the theme, material was gathered in Sweden and Finland using interviews, targeted to wood construction businesses in 2022. Separate data collection and analyses were performed in Finland and Sweden to understand different state of the market development in the countries. While the data in Sweden consists of wood construction professionals focusing on sustainable business models in the wooden multi-storey construction (established actors & practices), the data in Finland consisted of actors involved in three case projects (novelty of the projects).

In WP3 (main responsibility Luke), the focal point was to add knowledge on municipalities' decision-making processes to support or hinder potential for the market diffusion of the WMC combined with the roles and powers of different actors in these processes, the target in material collection were the local decision-makers. According to the original research plan, quantitative survey data were collected though structured electronic survey targeted at urban planners in Finland and Sweden in April 2021 (survey sent in Finland for 1012 recipients in 309 municipalities, i.e., all Finnish municipalities, and in Sweden for 992 recipients and 264/290 municipalities). Let it be mentioned, that acquiring contact information for municipalities (and

urban planners) is much more challenging and less transparent in Sweden, which is the reason for not reaching all the Swedish municipalities in survey data collection. The methods for data analysis were composed of multi-variate methods (e.g., statistical tests, regression analysis and exploratory factor analysis). Instead of acquiring comparable interview data from the Finnish and Swedish municipalities, the focus of supplementary qualitative interviews was Finland, and two case municipalities (i.e., Lahti and Kuopio). The interview data has been and will further be analyzed qualitatively (e.g., thematization).

## 4. Consortium key experts

### 4.1 Researchers

The consortium was composed of highly experienced and recognized academics from the three member institutions, with backgrounds in forest products marketing, business economics, and corporate sustainability, and research on WMC from the perspective of, e.g., climate change mitigation, consumer preferences, and municipality decision-making. The consortium members are experienced in conducting **interdisciplinary** and comparative research, within an **international** setting. The entire research project was implemented in a collaborative and synchronized way regarding both data collection from the two countries and analyzing and preparing the reports. Each researcher contributed to each sub-study and manuscript writing but with varying roles and intensity. The list of key persons in consortium research (e.g., M.Sc. students excluded) is below:

#### *University of Helsinki (UH)*

Dr. Ritva **Toivonen** (f) is a Professor and a dean in the Faculty of Agriculture and Forestry at UH, with a PhD from UH (2011, Forest products marketing). Among the leading experts in forest products markets, marketing and business management in Europe, she has a broad experience in business strategy and quality management in the forest sector, and research on consumer perspectives on wood products. Professor Toivonen acted as the leader of the research consortium.

Dr. Jaakko **Jussila** (m), is a postdoctoral researcher in the Faculty of Agriculture and Forestry at UH. His research interest covers consumer research, marketing and sustainability transition in the wood construction sector. He was the main researcher in WP1 studies and finished his PhD thesis during the project in 2022. The dissertation topic is “Transformation towards sustainability in the construction market: Adoption of wood construction in Finland”.

Dr. Anne **Toppinen** (f) is a Professor and Vice-Dean (research) of Forest economics and marketing at UH since 2008. Her current research interests include analysis of consumer behaviour and corporate sustainability strategies in the context of emerging bioeconomy. She has published over 150 articles in international refereed journals, and she has acted as the director of Helsinki Sustainability Science Institute 2018-2021, enabling fruitful cross-fertilization with the leading interdisciplinary sustainability science community in Finland.

#### *Swedish Agricultural University (SLU)*

Dr. Anders **Roos** (m) is a professor in Forest business administration at SLU since 2009. His research interests includes business strategy, marketing, supply chain management, sustainability

and international forest sector development. Dr. Roos has extensive experience in qualitative and quantitative research methods within the social sciences, and insights about the forest industry value chains.

Dr. Cecilia **Mark-Herbert** (f) is an associate professor in Marketing management at the Department of Forest economics at SLU. She has an interdisciplinary background in agricultural sciences and marketing, research experiences in a wide range of sustainable development related topics (e.g. innovation management, ethical sourcing, corporate responsibility -governance and practise theory).

M.Sc. Emil **Nagy** (m) is a PhD Student at the department of Forest Economics. His interest lies in the research of sustainability transitions in the housing market and the multi-storey building enterprises market strategies. He has a background in the forest industry and has an MSc in forestry from SLU.

#### *Natural Resources Institute Finland (Luke)*

Dr. Katja **Lähtinen** (f) is a Research Professor in Business development and economics and an Adjunct Professor in Forest industry marketing and management at the University of Helsinki. She has focused on in assessing the competitiveness and sustainability of forest sector, but her work has also concerned urban planning and governance especially in the context of municipalities and WMC. She has published over 60 peer-reviewed international articles or book chapters, and is involved actively in societal discussions, e.g., on sustainable built environment and specifically WMC.

Dr. Liina **Häyrynen** (f) is a researcher of forest-based business economics at Luke. She holds a PhD from the University of Helsinki (2019). Her research has focused on, e.g., business ecosystems on WMC, family forest owners, and citizens' nature and forest relationships.

#### **4.2 Advisory Board (AB)**

To gain insights from and enable dialogue with non-academic **stakeholders** in the wood construction industry, and in the related policy-making sector, an **advisory board (AB)** was invited for the project, consisting of **key experts** in Finland and Sweden. Both the research consortium, and the AB, were diverse in terms of gender, age and career backgrounds of the individuals. The members of the AB are listed below:

The advisory board with 5 members was composed by invitation. The AB the chair was Mr. Petri Heino (Ministry of The Environment, Finland).

Mr. Petri Heino (Ministry of The Environment, Finland)

Mr. Dr. Olli Haltia (Chair of the board, Dasos Capital Ltd)

Mr. Mathias Fridholm (Svenskträ)

Ms. Susanne Rudenstam (Träbyggnadskansliet)

Ms. Dr. Kerstin Hemström (Chalmers University)

The Advisory Board had 5 meeting between 12.3.2021 and 27.2.2023, all in remote mode.

## 5. Organization of work and achieved results

### 5.1 Collaboration

KnockOnWood -project was a new initiative between the three research organizations, even though all the organizations were familiar with each other and had had various collaborative actions between each other. Despite the COVID-pandemic and the remote-mode communication, the project created a completely new network of academic experts on the research topic and joined successfully junior researchers and the senior ones.

The communication was systematic and frequent with weekly operative project group morning-coffee -meetings, and approximately monthly consortium seminars. A total of 30 consortium research seminars were conducted during the project all but one in a remote mode. The manuscripts were produced via a system of a lead author, and the other joining based on their expertise. This was supported by using a common platform where documents and manuscripts were available and shared by all. The common understanding between the consortium members was that the work was efficient and systematically provided value-added to the analysis and the project outputs. From this point of view the aim of creating not only new understanding of WMC markets in the Nordics, but also creating value-adding research knowledge capital, was reached well.

### 5.2 Scientific results

Below is the list taken from the original research plan on the key scientific and other outputs planned to be made compared with the final outputs made during the KnockOnWood-project.

- **Original plan of publications:** At minimum 5 peer-reviewed scientific articles including specific articles addressing the consumer perspective, municipality/governance aspects and industry strategies, and a synthesis article including all the three aspects to the theme (all submitted for review by 3/2023). At least two of the articles were promised to be available as open access publications.
- **Outcome of publications:** In total 13 peer-reviewed scientific articles were published or in an evaluation process, and most of them are open access articles. In addition, three manuscripts are under preparation. The list of articles and manuscripts is in Chapter 9.

In all, the target for publishing was reached well. In addition, (not mentioned in the original research plan), there were several academic degrees finalized in the context of the project: One doctoral thesis (Jaakko Jussila), one licentiate thesis (Emil Nagy), and eight M.Sc./B.Sc. theses were produced. This made the project a significant platform in educating new experts on the WMC theme to Nordic countries.

### 5.3 Dissemination

**Case study for educational use** (education material package targeting higher educational institutions in English). The package will be compiled after all the manuscripts are published.



**Policy briefs** (3), **blog texts** (3) addressing the initial findings and the key findings, are still to be produced since the final articles are still under preparation. These are planned to be produced during the year 2023 in the connection of a final seminar of the research group (planned for the fall 2023 in Hyytiälä Forestry Station). Instead, interviews and popular articles were published based on the results of the scientific articles. For example, blogs were written related to consumer views on WMC, sustainability of the built environment (see Chapter 10).

**Oral presentations** in several Nordic and international conferences, seminars and webinars. Scientific and popular events took place during 2020-2023 in Sweden and Finland (see Chapter 10).

A **project website** was established as planned, and it serves in communicating the outputs related to the project. The site will be maintained a minimum of two years after the project ending. [www.slu.se/en/departments/forest-economics/forskning/research-projects/knock-on-wood/](http://www.slu.se/en/departments/forest-economics/forskning/research-projects/knock-on-wood/)

## 6. Benefits for the WMC, forest sector and society in Finland and Sweden

KnockOnWood-project provided new and timely knowledge on consumers' preferences, decision-making and experiences of residential WMC buildings, and addressed views of both the markets of owner-occupied and rental homes from the end-users' points of view. By focusing strongly also on the residential perspectives, the project added knowledge on rather seldom studied dimensions in consumer preferences and choice behaviour in WMC (and in the broader) housing markets. Below are listed main results by WPs:

- **WP1, consumers (UH):** In all, existing research on WMC has dominantly focused on technological aspects and construction phase of the residential buildings, while views on consumers and local land-use managements aspects have largely been by-passed (e.g., Jussila et al., 2021). In addition, consumer expectations have been addressed in a very "traditional" way by concentrating on socio-demographic factors (e.g., family size or age of residents), although in housing studies already in the 1980 individual expectations like values or lifestyle have been found to strongly affect preferences for homes. In KnockOnWood evidence on this was gained in relation to prejudices against building with wood: According to the results (Lähtinen et al., 2021), those consumers in Finland and Sweden (but also in Norway and Denmark) who want to live in urban areas with good reputation have strongest prejudices against building with wood, while those preferring closeness to nature are less likely to have doubts on WMC. In case of Finland, for example results based on data gathered from real-estate agents emphasized the need for WMC apartments with good locations and emphasis of building aesthetics to add their desirability from the perspective of consumers (Lähtinen et al., 2023). Especially in Finland, a high proportion of homes in multi-storey buildings are owner-occupied (i.e., shareholder housing companies). Despite this, financial aspects (e.g., perceived risks, resale value) of WMC from the perspective of homeowners have not been previously studied. According to the results, for example, increasing likelihood of extreme weather conditions caused by climate change (e.g., Toppinen et al., 2022b) may affect Finnish and

Swedish consumer views on WMC especially in the future. Yet, it must be also kept in mind that although consumers do not assess the potential benefits of wood while seeking for homes in new residential multi-storey buildings, at the phase of housing the properties of wood-based solutions become more important and valued (Jussila et al., 2023). All results emphasize the need for communication of the properties of wood for consumers to add their awareness of WMC and add demand-driven potential for the WMC market diffusion in the future.

- WP2, business actors (SLU): Existing research suggest that cost-efficiency gains from industrialized prefabrication and perceived sustainability benefits by consumers and architects have enabled the diffusion of WMC in the housing market. However, the lack of experience in WMC and path dependencies to use concrete and steel continue to be key barriers for increased adoption of WMC. (Jussila et al. 2022). For businesses it's important to note that consumers' beliefs about the environmental impact of using wood as a construction material for multi-story buildings are divided and influenced by various factors such as gender, age, income, awareness about wood building, and beliefs about climate change (Roos et al. 2022). For construction companies, using wood in multi-storey buildings creates sources of tangible and intangible value creation, including faster building processes and lean material use, but no strong sustainability-driven culture was identified among companies. Management and coordination skills are highly important when improving the construction business based on WMC. (Toppinen et al. 2022.)
- WP3, municipalities (Luke): Although the important role of municipalities have been emphasized as a factor of WMC market diffusion for a long time, scientific information on the topic is still scarce. As the land-use management system in Finland and Sweden is very different from the systems in other countries (e.g., municipalities have land-use monopolies in their territories) the lack of scientific knowledge is even more problematic from the perspective of WMC development. Furthermore, since the proportion of WMC in the housing markets is higher in Sweden than in Finland, it has been suggested that Finnish municipalities should imitate Swedish municipalities in their WMC efforts. The KnockOnWood results showed that despite similarities, Finnish and Swedish land-use management systems are not similar enough to enable copying practices from one country to another (Lähtinen et al., 2023a). For example, while Finnish municipalities have through statutory land-use management system power to require specific load-bearing materials to be used in new buildings (i.e., claims to use wood in local detailed land-use management plans), in Sweden this not allowed. In Sweden, WMC promotion efforts are based on informal land-use management approaches (i.e., especially public-private-partnerships between municipalities and businesses), in which municipalities may use power of building developer or customer to affect the use of materials. The active participation of Swedish municipalities in public-private-partnerships is enabled by the dominance of rental apartments - and Swedish municipalities as owners of those buildings - in the multi-storey housing sector. In Finland, municipalities are considerably less seldom customers of the building companies due to the high proportion of private ownership of multi-storey apartments, which explains also why linkages between municipalities, businesses (and residents) are different in the Finnish housing markets, and especially regarding WMC. Yet, from the perspective of promoting WMC, both in Finland

and Sweden informal approaches (e.g., strategies) are important. In addition, regarding sustainability in the goals for land-use management in the built environment in general, in the context of Finland evidence was found that local actions for construction sector innovations are important requiring involvement of both businesses, research and education institutions and co-operation between municipalities (Koskivaara and Lähtinen, 2023). Yet, adding sustainability in the built environment through Finnish municipalities' land-use governance systems is still largely based on other perspectives than views on building materials and new building technologies (Lähtinen et al., 2023b)

## **7. Recommendations for future research, and enhancement policy development**

The results of the project strengthened the original starting point of the research, that consumers, businesses and municipalities are in systemic connections with each other in the context of WMC. Furthermore, compared to the technological viewpoints, the existing information on the business economics perspective (i.e., consumers, businesses and municipalities) is much scarcer. Consequently, in future studies and practical actions, there is both a need to avoid silos in efforts to enhance the WMC market diffusion and address the WMC in the residential building sector in relation to actions of multiple actors in the housing markets.

Related to companies, more information is needed on how technological benefits related to pre-fabrication and modularity could be turned into economically viable businesses through cost-efficiency and value creation. From the perspective of sustainability, it is especially important to address the topics with consideration of life-cycle aspects. This also enables recognition of to whom benefits and disbenefits accrue at the phases of construction, use of buildings, and re-use and demolition of materials, for example. In the future, it might be possible for businesses to extend their value-chains from operations related to construction towards maintenance services in housing (i.e., servitization), which has been seen to important for the development of circular bioeconomy. Furthermore, the role of financial institutions (e.g. banks, investors and insurance companies) in enabling or hindering WMC development is yet largely unmapped.

Connected to consumers, expectations of residents for housing are in a key role for the WMC market diffusion. So far, benefits of wood in building have been the main message for consumers in enhancing WMC, although materials are not focal points for future residents to choose home in any type of building. Like in the housing markets in general, at the phase of choosing home, for example locational aspects and layout of apartments affected by residents' individual values and lifestyle are of critical importance. After the initial decision on home has been made, more attention is paid to the benefits of wood in multi-storey buildings. While the benefits for wood construction has mainly relied on the ecological aspects, future studies could deepen the knowledge related to e.g. perceived health and wellbeing effects, aesthetics and ambiance of wooden apartments. Thus, consideration of consumers' values and housing expectations would both enhance citizens' wellbeing and add opportunities for businesses to create value and seek for new competitive edge in the housing markets.

Linked with municipalities, local land-use governance actions are focal in the development of sustainable built environment, including housing. Statutory practices (i.e., local masterplans and detailed plans) compose the starting point to enhance sustainability initiatives in the municipalities, while informal approaches (e.g., actor collaboration, strategies) are needed to enhance systemic innovations in construction and housing. Like consumers, also municipalities are not alike with each other (e.g., urban vs. rural regions, socio-economic structures) and thus consideration of local circumstances is needed. For example, for municipalities with already existing collaboration with WMC companies, possibilities to use statutory mechanisms to build with wood are more promising than for municipalities without such connection. Thus, for those municipalities without existing WMC business collaboration, informal approaches may be more viable (e.g., common learning and capability building with public-private openings in residential or public building projects).

In all, the results of the project showed WMC to have strong potential to be a solution for decarbonizing construction sector operations in Finland and Sweden, but also in other regions. Yet, to capture the prominent opportunities for economic, environmental and social life-cycle benefits, focus from material points of views should be extended towards systemic scrutiny of what building with wood would bring to different actors at different points of time in different cultural context, and communication of these issues broadly in the society.

## **8. Project finance (cost reports separately from UH and Luke)**

Ministry of The Environment provided funding for the project (Finnish part) totally 199574 €. The funding was divided between the two organizations (as agreed in the project plan): 66525 € Luke, and 133050 € UH. Both UH and Luke used 100% of the funding (difference between the budgeted and realized costs were covered by organizations' own additional contribution to the project). Although UH and Luke implemented the project in a close collaboration with each other (incl. this Final Report), the cost reports by both organizations have been produced separately and attached in this report, and also provided as separate reports.

The project was carried out and realized according to the original project plan, with the exception that due to the COVID-pandemic, the project time-line was stretched already in the beginning of the project (when making the project agreement with the Ministry) to the end of 2022, and the during the fall, 2022, prolonged to February 2023. The original timeline, and the shift of the final date to 28.2.2023, were agreed with the Ministry in written.

The COVID-pandemic started in March 2020, which was the main reason to the changes in time-tables, due to difficulties of hiring researchers and organizing working in the new confusing remote-mode operating environment, without the knowledge of the duration of the exceptional circumstances. This situation also forced to make changes in the original research plan for the empirical data collection (e.g., from face-to-face interviews to online interviews). Organizing the remote interviews was very time-consuming, and thus increased the costs of personnel work, but on the other hand, reduced the costs of travel and related data costs. As total, the original budget was sufficient to carry out the project mainly as planned. Despite the changes in the implementation of the project, the project objectives were well met, e.g., especially in connection

with scientific publishing and societal impact. Although the project has ended, the thematic work will be on-going with other funding sources also in the future.

Abreast with changes in the executing the research, the COVID-pandemic during 2020-2022 made it impossible for the Advisory board and the research group to have the planned face-to-face meetings. Thus, these also needed to be translated into remote mode, which shifted the costs from travel and meetings to personnel costs. As a positive outcome, this resulted in more frequent meetings and probably closer collaboration between the researchers from two countries and three organizations as what would have been the case if the meetings and seminars had been in the traditional physical ones. Considering this force-majeure changes, the project was carried out mainly as planned.

The above-mentioned changes in the realized *modus operandi* of the project vs. the original plan were reported and discussed in the Advisory board chaired by the representative of the Ministry, thus the founder was kept informed of these changes during the project.

## 9. Outputs: Published articles and scientific manuscripts

Aguilar, F., Roos, A., Haapala, A., Lähtinen, K., Kniivilä, M. and Hoen, H. F. (2023), "Dweller Preferences for Wood as a Load-Bearing Material in Residential Buildings", *Journal of Forest Economics*. 38:1, 77-111. <http://dx.doi.org/10.1561/112.00000537>

Jussila, J., Nagy, E., Lähtinen, K., Hurmekoski, E., Häyrynen, L., Mark-Herbert, C., Roos, A., Toivonen, R., & Toppinen, A. 2022. Wooden multi-storey construction market development – Systematic literature review within a global scope with insights on the Nordic region. *Silva Fennica*, 56 (1): 10609. <https://doi.org/10.14214/sf.10609>

Koskivaara, A., Lähtinen, K. 2023. Land-use planning in municipalities as a driver for sustainable residential areas in Finland – A regional innovation system approach. *Journal of Sustainability Research*, 5(2): ;5(2):e230006 (Special issue). [https://sustainability.hapres.com/htmls/JSR\\_1524\\_Detail.html](https://sustainability.hapres.com/htmls/JSR_1524_Detail.html)

Lähtinen, K., Häyrynen, L., Jussila, J., Harju, C., Toppinen, R. & Toivonen, R. 2023. Branding wooden multi-storey construction – Real-estate agents as gatekeepers for enhancing consumer value in housing. *Journal of Forest Economics*, 38(1): 37–76. <https://www.nowpublishers.com/article/Details/JFE-0538>

Lähtinen, K., Häyrynen, L., Roos, A., Toppinen, A., Aguilar Cabezas, F. X., Thorsen, B. J., Hujala, T., Nyrud, A. Q. & Hoen, H. F. 2021. Consumer housing values and prejudices against living in wooden homes in the Nordic region. *Silva Fennica*, 55(2): 1–27. <https://www.silvafennica.fi/article/10503>

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Roos, A., Hurmekoski, E., Häyrynen, L., Jussila, J., Lähtinen, K., Mark-Herbert, C., Nagy, E., Toivonen, R., Toppinen, A., 2023. Beliefs on environmental impact of wood construction. *Scandinavian Journal of Forest Research*. Published online 23.1.2023. <https://doi.org/10.1080/02827581.2023.2168043>. 9 p.

Toppinen, A., Aaltio, A., Lähtinen, K., Jussila, J., Toivonen, R. 2022a. “It all depends on the project”—A business ecosystem in residential wooden multistory construction in Finland. *Frontiers in Built Environment*, 8:1046954. <https://www.frontiersin.org/articles/10.3389/fbuil.2022.1046954/full>

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### **Thesis reports**

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### **Manuscripts in peer-review process**

Heltorp, K., Nyrud, A., Hoen, H.-F. Aguilar, F., Lähtinen, K., Viholainen, N. Berghäll, S., Toppinen, A. Jellesmark-Thorsen, B. Kniivilä, M. Haapala, A., Hurmekoski, E. Hujala, T. Citizens' knowledge of and perceptions of multi-storey wood buildings in seven European countries. *Scandinavian Journal of Forest Research*. (Revised manuscript, submitted with minor corrections 2/2023).

Jussila J., Franzini F., Häyrinen L., Lähtinen K., Nagy E., Mark-Herbert C., Roos A., Toppinen A. & Toivonen R. Consumer housing choices among residents living in wooden multistory buildings. *Housing Studies*. (Revised manuscript, submitted with minor corrections 5/2023).

### **Manuscripts in preparation (to be sent to peer-review process)**

Lähtinen, K., Häyrinen, L., Jussila, J., Toppinen, A., Toivonen, R. 2023a. The effects of land use governance mechanisms in Finnish and Swedish municipalities on local wooden multi-storey construction activities. *Silva Fennica* (Submission 8/2023).

Lähtinen, K., Häyrinen, L., Kanninen, V., Bäcklund, P., Malm, N. 2023b. Land-use policy instruments for sustainable housing: Insights from municipality planners in Finland. *Journal of Housing and the Built Environment* (Submission 5/2023).

Nagy, E. et al. 2023. Sustainable business models in the wooden multi story building sector—what are the key components? (Submission 6/2023).

## **10. Societal impact and dissemination outputs: presentations and other communication to scientific and public audience**

### ***10.1. Oral presentations***

#### ***Scandinavian Society of Forest Economics (SSFE) -seminar Umeå 12/2022***

Lähtinen, K. et al. “Land-use policy instruments for sustainable housing: Insights from municipality planners in Finland”

Jussila, J. et al. “Exploring consumer housing choices in new wooden multistory buildings”

Nagy, E. et al. “Sustainable business models in the wooden multistory construction sector – what are the key components?”

Koskivaara, A. et al. “Regional characteristics of municipal land-use planning. A regional innovation system approach in Finland and Sweden”

#### ***Taloudellisesti kestävä rakentaminen -seminaari (Suomen arkkitehtiliitto) Tampere 10/2021***

Lähtinen, K. “Teollisen puurakentamisen taloudelliset hyödyt ja yhteydet muuhun kestävyyteen – Nykytila ja tulevaisuuden mahdollisuudet”

#### ***European bioeconomy university Scientific Forum 2021 (online) 9/2021***

Jussila, J. et al. “Conditions for a bioeconomy transformation- Increased use of wood in construction”

#### ***Wood from India -seminar (Business Finland) (online) 10/2020***

Lähtinen, K. “Life-cycle benefits of industrial wood construction – Views on different actors and sustainability impacts”

#### ***Puurakentamisen ohjelman ohjausryhmä (Ympäristöministeriö) 10/2020***



Lähtinen, K. “Teollisen puurakentamisen taloudelliset hyödyt ja yhteydet muuhun kestävyYTEEN – Nykytila ja tulevaisuuden mahdollisuudet”

*Scandinavian Society of Forest Economics (SSFE) -seminar (online) 09/2020*

Lähtinen, K. et al. “Branding multi-storey wooden buildings – Real-estate agents as gatekeepers for enhancing end-user value”

## **10.2 Blogs**

- “Ennakkoluuloja puurakentamisesta? Odotukset urbaanille elämäntavalle ja hyvämaineiselle asuinalueelle yhteydessä kuluttajien epäluuloihin” (21.3.2021) <https://www.luke.fi/fi/blogit/ennakkoluuloja-puurakentamisesta-odotukset-urbaanille-elamantavalle-ja-hyvamaineiselle-asuinalueelle-yhteydessa-kuluttajien-epaluuloihin>
- “Ilmastoviisaan rakentamisen ja asumisen monet ulottuvuudet” (2.6.2021) <https://decarbonhome.fi/ilmastoviisaan-rakentamisen-ja-asumisen-monet-ulottuvuudet/>
- “Kuntien maankäytössä epämuodolliset suunnittelumekanismit korostavat innovaatioita ja kestävyystavoitteita” (based on a recently published scientific article results, blog to be published in 5/2023)

The dissemination measures will continue several years after the project has been finished.