sustainability

MDPI

Article

Mind the Gap: A Policy Gap Analysis of Programmes Promoting Timber Construction in Nordic Countries

Martyna Maniak-Huesser [1,2], Lars G. F. Tellnes [3] and Edwin Zea Escamilla [2,4,*]

[1] CFA Society Switzerland, 6300 Zug, Switzerland; martyna.huesser@cfasocietyswitzerland.org
[2] Centre for Corporate Responsibility and Sustainability Zürich, 8001 Zürich, Switzerland
[3] Department of Economics, Innovation and Society, Østfold University College, 1757 Halden, Norway; lars.g.tellnes@hiof.no
[4] Chair for Sustainable Construction, Swiss Federal Institute of Technology ETHZ, 8092 Zürich, Switzerland
* Correspondence: zedwin@ethz.ch; Tel.: +41-44-633-21-53

Abstract: The construction sector is one of the main contributors to greenhouse gas emissions and consumers of energy, making it one of the most relevant sectors when planning reduction strategies and policies. The use of timber in the built environment has been identified as a key strategy to reduce the carbon footprint of the construction sector. In this paper, we use the concept of policy gap analysis to identified underlying challenges in the implementation of timber construction on three Nordic countries, Finland, Norway, and Sweden. We carried out a series of semi-structured interviews with experts from the countries of study. The interviews came from industry, government, and construction companies. The use of the gap analysis approach was useful not only to identify areas that are being targeted but also those areas that were not covered by any programme at the time of study. The results showed that the studied programmes have a large level of coverage and congruence with the identified challenges. Moreover, they also showed that challenges related to fire safety regulations and insurance policies for timber buildings still need to be addressed, whereas the challenges of high price variability and lack of promotion are being addressed by multiple programmes. With this work, we have seen how timber construction is gaining momentum and how the challenges have been addressed systematically.

Keywords: construction; interviews; environmental impact; programmes

Citation: Maniak-Huesser, M.; Tellnes, L.G.F.; Zea Escamilla, E. Mind the Gap: A Policy Gap Analysis of Programmes Promoting Timber Construction in Nordic Countries. *Sustainability* **2021**, *13*, 11876. https://doi.org/10.3390/su132111876

Academic Editor: Antonio Caggiano

Received: 24 September 2021
Accepted: 25 October 2021
Published: 27 October 2021

1. Introduction

Growing concerns about the impact of human activities on climate change are leading governments around the world to reduce emissions in all economic sectors. Due to its size and relevance, emission reductions in the building sector are expected to play a significant role in achieving climate targets. In the European Union (EU), the building sector contributes over 42% of final energy consumption, 35% of total greenhouse gas (GHG) emissions, and 50% of waste [1]. Research in mass timber technologies has shown that timber products and structural systems offer a potential substitute for many mineral-based materials in built environments [2]. One of the most promising applications for timber is timber-frame multi-story construction (TMC). This approach can increase the efficiency of the construction process while creating a lower environmental impact [3]. This advantage is more evident when compared to conventionally framed steel buildings with respect to their carbon footprint [4]. Moreover, the potential emission reduction from timber structures becomes more significant when considering the end-of-life phase of buildings, when timber can be used as an energy source in cogeneration processes [5].

Construction companies take the environmental benefits of timber into account, especially in cases where promotion programmes are in place. The Finnish forest industry, for example, has been criticised for being production-oriented, despite its position of being customer-oriented. However, consumers are becoming more aware of the benefits

associated with timber and choose timber materials over conventional construction materials [6]. For customers, the visual and sensorial aspects of timber construction also play an important role. Thus, one of the key issues for the future competitiveness of the wood products industry is to successfully recognise consumers' diverse aesthetic and design-related needs [7].

The TMC's increasing relevance is driven by environmental policies aiming to reduce environmental impacts from the construction sector [3]. Moreover, changes in building codes and regulations present new opportunities for business models in this field [8]. However, the potential reduction in emissions in the built environment through the promotion of timber is still hindered by barriers in both the market and policies [9]. In Nordic countries, the TMC is central to the development of construction-related opportunities in emerging bioeconomies. In Finland, for example, a built environment based on timber buildings is among the central pursuits [10]. This is evidenced by the fact that the market share of the TMC completed in Finland in 2001 was only 1%, whereas by 2015, it had increased to 10%. A key factor behind this growth is the change in the building regulations that took place in 2011, which allowed for up to eight floors to be built under TMC construction; until then, there had been a limit of three storeys [3]. In Sweden, timber frames are commonly used in buildings of one or two storeys, while concrete frames are prevalent in multi-story buildings of more than two storeys. In many cases, architects find concrete to be the most suitable frame material in multi-story buildings, primarily due to its performance and ease of construction [11]. Nevertheless, as environmental awareness begins to increase, these views are being challenged by more holistic approaches to material selection. The work of Robichaud [12] showed that education, in terms of the architectural and structural application of timber, as well as targeted communication, are drivers of the selection of timber over conventional construction materials, especially for architects. In Norway, for example, the best target group for increasing wood-based housing seems to be young people, who have a strong environmental perception [13]. Roos et al. [14] established that, in Sweden, architects and structural engineers appreciate wood due to its mechanical properties, environmental friendliness, easy handling, and appropriateness for use in combination with other materials. The preference for the material among structural engineers and architects is affected by attitudes concerning the properties of wood, norms, and the complexity of building with timber [15]. Hurmekoski et al. [3] showed that an increase in the use of TMC could be stimulated across Europe if building standards were to focus on the sustainable use of forest resources and climate change mitigation. Moreover, a wider application of TMC could increase its attractiveness, and with a higher share of the market, TMC could increase its competitiveness. Nevertheless, in many countries, the timber industry is still in a vicious cycle, where a lack of installed capacity slows down the production of buildings; consequently, demand is reduced or is supplied by conventional construction materials [16].

In Austria and Finland, the gradual removal of regulatory barriers has had a positive effect on the increased share of timber buildings. From the previous cases, the implementation of demonstration and pilot projects was found to be a valuable strategy. Moreover, in both countries, each government has promoted the use of timber through a national programme [17]. It is important to note that these kinds of programmes generally produce positive impacts, but it is especially difficult for small and medium-sized enterprises (SMEs) to tap into the financial resources required to invest in new technologies for innovative processes and products [18]. Nevertheless, Milestone et al. [19] indicated that there is still work to do in engaging communities and other actors in the wood value chain to increase the use of timber, especially when it is produced and used locally. Moreover, these programmes should aim to advance the use of forest resources in a sustainable way, giving priority to use in construction over the use of primary forest products as energy sources [20]. Wang et al. [21] revealed that, in the UK, the trend in wood construction increasingly includes the use of hybrid structures, such as a combination of wood and steel or composites (e.g., wood and plastic). The use of these hybrid structures can help

to bridge not only the knowledge gap, but also the perception of timber construction as a reliable and safe construction material.

Many unanswered questions and future challenges remain related to using more timber in construction [22]. On one hand, the widespread use of timber in construction in built environments is a promising strategy to reduce carbon emissions and pressure on the natural environment while supporting countries' economic growth. Nevertheless, there are still issues about the allocation of land, the timing of carbon emissions, and the environmental loads and benefits associated with end-of-life of timber products. However, from the life cycle perspective, sustainably produced timber is likely to be preferable to non-renewable mineral materials. Further, the choice of more sustainable materials does not absolve us from the need to sustainably consume those materials [22].

Currently, many countries are starting to develop bio-economy strategies, especially looking at the contribution from forests to their sustainable development. In this context, the research project "Real estate management approaches to promote of timber construction" [23] was commissioned by the Action Plan Wood of the Swiss Federal Office for the Environment [24]. A special emphasis was given to research on lessons learned and the impact evaluation of programmes promoting timber construction within the European context. A first exploration of this field showed that a significant knowledge gap was present on the scientific literature, and that only isolated cases were reported without considering more regional implications of the programmes. Thus, the research behind this paper aimed to provide base information for both policy makers and researchers looking into the wider effect of programmes promoting timber at a national and regional level.

For this article, we explored policies that promote timber as the main construction material in three Nordic countries: Finland, Sweden, and Norway. In addition to a literature review, we conducted 22 interviews with representatives of various bodies responsible for running programmes and projects aimed at increasing the use of timber in the built environment. The participants included representatives of the Finnish Ministry of the Environment, Swedish municipal management, Norwegian governmental organisations, and timber producer associations and construction companies from all three countries. Our main goal was to cross-examine barriers to the implementation of timber-based solutions via the national programmes promoting these constructive systems in order to identify potential policy gaps.

2. Materials and Methods

The concept of gap analysis has its roots in conservation biology and aims to identify unrepresented components of an ecosystem using geographic information systems (GIS) [25]. From this angle, a policy gap analysis follows these same principles but determines how governments provide answers to new challenges through promotion programmes and identifies potential gaps and opportunities [26]. For this paper, utilising a method similar to the one developed by Hoberg et al., we conceptualised the policy gap in terms of challenges and barriers that are not addressed by policies and programmes that encourage timber construction [26]. Following these principles, we defined the policy gap as the absence of coherency between challenges and programmes, thus highlighting unaddressed issues. For data collection, we followed an iterative approach using semi-structured interviews and a literature review, as shown in Figure 1.

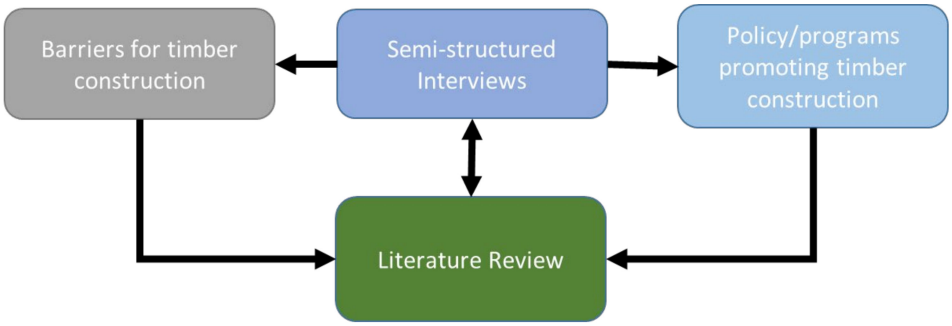

Figure 1. Data collection concept.

We carried out 22 interviews with representatives of various bodies responsible for running programmes and projects aimed at increasing the use of timber in the built environment. The participants included representatives of the Finnish Ministry of the Environment, Swedish municipal management, Norwegian governmental organisations, and timber associations and construction companies from all three countries. Further, the literature review encompassed not only the scientific literature but also reports and policies for the selected countries. Table 1 presents an overview of the participants. The interviews focused on two main areas: (1) the identification of barriers and challenges for the implementation of timber construction in each respective country; and (2) the identification of programmes and policies that promote timber construction.

Table 1. Overview of interviews.

Country	Project/ Programme Manager	Industry or Association	Municipality	Construction Company	NGOs/ Consultants
Finland	2	2		1	3
Sweden	3	2	1	1	
Norway	1	3		2	1

3. Results

In this section, we present the synthesis of the interviews and the literature review in two sections: (1) the identification of challenges for the use of timber in the built environment and (2) the identification of programmes that advance timber construction in each country.

3.1. Barriers and Challenges

3.1.1. Finland

For the case of Finland, the interviewees highlighted the constraining effects of the regulatory environment. In their opinion, some of the costs of timber construction could be reduced if, for instance, fire regulations were to consider that the safety levels provided by timber construction have increased in the last decade. To date, double safety measures are still common to protect a timber building against the risk of fire. These measures contribute to the increased price of a building, as they demand the design and deployment of additional fire-preventing installations. Moreover, municipalities' different interpretations of fire safety create additional uncertainty for developers and construction companies.

The majority of respondents also noted that the sector's small size contributes to its weakness. There is a widespread belief that an increase in the number of orders will stimulate competition in the market and will therefore positively influence the general competitiveness of timber materials. This would also add to the development of the most efficient materials supply chain, thereby helping to solve the problem with material accessibility. Public institutions are still the chief commissioners of timber buildings, but in many cases, they lack knowledge of timber as a construction material and the possibilities

for contracting such buildings. The interviewees recurrently mentioned the need for a wider educational offering at both the vocational and higher education levels. This factor adds to the sector's small size, which contributes to the reduced number of practitioners and labour force in the market.

After conducting interviews, Franzini et al. [10] concluded that civil servants are generally critical regarding the limited support for timber construction. The primary dissatisfaction focused on the lack of a high-level political directive that advocates for TMC within municipalities, the lack of TMC inclusion in city development strategies, and the limited use of zoning plans, which includes TMC. The fact that city areas are largely owned by the public imposes additional obligations on local authorities. For example, in Helsinki, approximately 65% of its administrative zone is in public hands. This results in high expectations for municipalities to serve as an important example, caring for the environment and procuring buildings that meet high standards. The legislation in Finland gives municipalities particular tools to enforce their power and thereby influence the sustainability of their territories. The use of urban planning, zoning, and land allocation procedures can have a great impact. However, in the past, municipalities have often been challenged when requesting timber through public tenders. Such a strategy has mostly been criticised by the cement industry on the grounds of interfering with the law of free competition. These accusations were rejected by the verdict of the Supreme Court of Finland in 2015, which legitimised the decision by the City of Helsinki to zone the Honkasuo neighbourhood to be built with timber. The court verdict encouraged other municipalities to act based on this line. Timber has been set as an obligatory construction material in urban development projects, such as in Myllypuro and Kuninkaantammi.

The reuse of timber materials is considered problematic. Specifications on the standards that timber parts should meet in order to be reused are unavailable. Moreover, there is too little knowledge and too few available examples of timber reuse, especially in structural applications. These factors increase the cost of recycled products, making the reuse of timber more expensive than purchasing a new product. To make matters worse, the respondents admitted that this topic is rarely discussed. The last issue concerns the inclusion of BIM in the construction process. In Finland, building information modelling (BIM) is often used; however, there is no law obliging the application of BIM when fulfilling public orders, even if municipalities increasingly request it. In many cases, the use of BIM gives a competitive advantage to timber companies, but this cannot be realised if competitors are not required to use it.

3.1.2. Norway

The interviewees recognised that public institutions are still the main investors in timber buildings, with a share of approximately 75%. Moreover, municipalities could request the material for construction in their building commissions. Some do it and request exclusively for timber products. In the past, however, it was more common for public projects to call for a particular material. Currently, municipalities tend to focus on performance aspects. They request certain performance standards and pay great attention to the building's environmental impacts. More often, they request 'renewable materials' or 'low carbon materials'. Further, the interviewees acknowledged that an increasing number of municipalities require construction sites in which all activities are free of fossil fuels. That said, emissions linked to transportation are not included.

Currently, the companies that participated in this study self-report their emissions. Notwithstanding, cities have started setting targets to reduce their emissions. They report yearly on their progress. This is still a voluntary practice, which does not have a common framework. The interviewees had strong opinions about the presence of discriminatory practices by some insurance companies about fire safety. Despite fire regulations being applied nationwide, there are still differences in how municipalities apply and interpret them. Fire regulations have always been an issue for timber buildings. What is more alarming is that the industry has to deal with unfounded opinions about the lack of fire safety and the

possibility of introducing even stricter rules. Another important aspect mentioned by the interviewees was that it is not required to estimate the CO_2 footprint by using life cycle assessment (LCA) approaches; nevertheless, this is often requested. Regarding the use of the LCA, the Norwegian government has published official standards that have to be met if the builder/investor wants to refer to it. The interviewees recognised that the main weakness of the LCA approach is that its data are based on the Environmental Product Declaration (EPD), which does not include the carbon storage properties of materials. Thus, the greatest advantage of timber products is overlooked. Regarding BIM, the interviewees pointed out that it is commonly used by the private sector and is quite frequently required to fulfil public procurement projects. However, the interviewees considered that BIM still does not provide timber construction with as many technical solutions as in the case of concrete and steel. Finally, one of the chief reasons for not choosing a timber-based project was the price. Investors rarely consider the fact that the price is not dependent on only the cost of materials. One possible solution for a better market placement of timber would be to pay building investors for CO_2 storage in wood. Notwithstanding, this is still a very controversial idea. However, according to some companies, the timber industry can deliver buildings that are cheaper than those using conventional materials.

3.1.3. Sweden

The interviewees focused on the regulatory environment and its constraining effects, especially insurance policies and fire regulations. In Sweden, insurance companies, in comparison to concrete buildings, often overcharge for timber buildings. Moreover, the insurer can even decline issuing insurance for a timber building. The public procurement regulations in Sweden do not allow for information that suggests material specifications in the procedure itself. Some municipalities, such as Växjö, bypass this limitation by initially providing investors with information about their policies regarding space development and climate goals, which mention plans to increase the use of timber as a construction material. Nationwide, however, it is more common to use LCA-based approaches to choose the projects with the lowest carbon footprint. That said, most officials do not possess enough knowledge of the LCA to request that it be part of public procurement. The interviewees agreed that a better understanding of methods, technology, and public procurement procedures would therefore help to increase the number of timber buildings commissioned. Moreover, this approach would support the growth of the industry and contribute to increasing its competitiveness in the sector. Keeping these points in mind, it is comprehensible that all interviewees expressed high hopes for the introduction in 2022 of the Climate Declaration, requesting reporting on the impacts of construction materials using the LCA. In general, the interviewees pointed out the current knowledge of the LCA method. They acknowledged that public institutions have often been the ones to commission timber construction in the country. An example often mentioned was the urban policies developed in the city of Växjö. This Swedish municipality set an ambitious target of ensuring that 25% of new buildings would be timber-based by 2015, and 50% of them by 2020. Växjö identified four key problem areas threatening the development of timber-based projects; one of these problems was also referred to in an interview: the lack of an easy-to-use LCA tool, which constrains investors' ability to assess the three phases of a building's service life cycle. Along with these constraints, the municipality pointed out limitations that did not come up in the interviews. For instance, the ability to estimate operative and maintenance costs, especially for buildings with a timber facade, issues related to acoustics and vibrations between two floors, and high contractors' costs, which are linked to limited competition. We still do not know if these constraints have been solved since Växjö identified them in 2013. However, the issue of linking cost development with small competition within the sector still arose in the interviews.

From the previous results, we can identify the following as the main barriers and challenges found in all three countries:

- Stricter fire safety regulations than for other materials
- A lack of promotion from local governments regarding their tenures for new buildings
- Discriminatory practices on the part of insurance companies and additional fees for timber buildings
- Insufficient knowledge of carbon accounting methodologies
- A lack of appropriate tools to implement timber construction projects in BIM
- High price variability due to the size and market share of the wood sector
- Educational offer gap, which contributes to the lack of experts available in the field
- A lack of knowledge on the assessment of operation and maintenance costs
- Scepticism regarding the material's durability

3.2. Programmes and Policies

In the following sections, we present an overview of the programmes that promote timber construction in the countries under study. The interviewees mentioned that some of these programmes and others are referred to in the literature. We summarised both the central goals and focus areas for each programme, as well as general information on programme administration and/or management and scope. It is important to note that many of the identified programmes reflect to the political environment at the time of their inception and execution.

3.2.1. Finland

National Wood Construction Programme (2011–2015)

This programme was administered by the Ministry of Employment and Economy and was aimed at the following:

- The development of construction projects that are larger than individual buildings, where wood is used in an appropriate and competitive manner.
- The market share of multi-storey timber buildings will be 10%, and the export of processed timber products will increase by EUR 0.5 billion a year.
- The value of forest industry exports will amount to EUR 13 billion a year.
- The turnover of new products will increase by EUR 1 billion a year.
- The use of domestic wood will total 65–70 million cubic metres a year.

The programme had four focus areas, which included implementing the Finnish Bioeconomy Strategy and thus increasing wood construction; fostering competitiveness, growth and internationalisation in the sector; and deepening Finland's influence in the EU. The programme's impact evaluation revealed the following conclusions:

- The market share of multi-storey timber buildings was approximately 4% in 2014. In 2015, that share was estimated to reach 10%.
- The export of processed wood products has declined, and no efficient way to boost growth and exports in the industry has been found.
- Exports in the forest industry are rising, but overall growth has not reached the target.
- There are no exact numbers on turnover; however, it is likely to be several hundred millions of euros a year.
- The total removal of stem wood, used as a raw material in industry and energy production, increased to 65 million cubic metres in 2013.
- A shared service platform has been established for companies in the business (www.woodproducts.fi) (accessed on 25 October 2018) and a shared 'Story of Wood'.
- Corporate growth and anchor tenant models have been created to improve competitiveness in the field and to combine production, product development, networks, and market knowledge. The promotion of exports has been systematised and enhanced in government corporate cooperation according to the Team Finland approach.
- In 2012–2015, some 4000 people participated in training events.

Wood Building Programme

This programme has been managed by the Ministry of the Environment (2016–2021) and has a budget of EUR 2.5 million aimed at financing 50 projects annually. The programme is funded through two channels: the Bioeconomy and Clean Solutions Key Project (2016–2018) and the Energy and Climate Strategy (2018–2021). From this programme, it was recognised that the engagement of the Ministry of the Environment is fundamental, especially in the development of the regulatory framework and its mobilisation activities. Moreover, the programme supports the development of projects in the areas of research and development (R&D) and the digitalisation of the timber construction sector.

Aims of the programme:

- Increasing the use of wood in urban development
- Promoting the use of wood in public buildings
- Increasing the building of large wood construction
- Strengthening regional skills bases
- Encouraging exports

The programme undergoes an annual impact assessment and is evaluated against the following criteria:

- the increase in the number of timber-framed blocks of flats
- the proportion of industrial wood construction out of all wood construction
- the increase in exports of wood-based construction products
- the amount of carbon bound by buildings
- the increase in the number of non-profit developers active in wood construction

3.2.2. Norway

Wood Based Innovation Programme

This programme was administered by the Ministry of Agriculture and Food in collaboration with the Ministry of Trade and Industry and ran from 2006 to 2016. It had a budget of NOK 347 million (EUR 34 million), 751 projects (445 different participants), and 55% of projects were categorised as project development (this category received 53% of project funding).

Aims of the programme:

- Increased use of wood in products (including buildings)
- Increased profitability (gradually specified as increased value creation) in the woodworking industry

In the first phase of the programme, support was primarily given to industry projects and endeavours aiming to increase competence in diverse various fields; for example, by building up programmes of study at higher education institutions in Trondheim and Ås. In 2006, the strategy changed, and the focus shifted to mobilising measures meant to contribute to companies' growth. Three specific areas of action were defined: (1) industrial construction, which included the development of concepts, solutions, and expertise in the construction sector; (2) wood products, which included new products for the consumer market and traditional products; and (3) innovation systems, which encompassed national and company-specific measures with the potential for increased innovation.

SKOG22: A National Strategy for the Forest and Wood Industry

The Ministry of Agriculture and Food established the SKOG22 strategy in the autumn of 2013. The strategy group included participants from the forest and wood value industries, representing the entire chain and national R&D. Innovation Norway has been responsible for the strategy work of the Secretariat. The programme aimed to create a comprehensive, national strategy to contribute to the short- and long-term expansion of a competitive forestry industry. SKOG22 set a long-term goal, in which value creation from the Norwegian forest and wood industry should quadruple by 2045. The following are the objectives defined for the building sector:

- Increase the competitiveness of wood as a building material to strengthen the wood industry, reduce GHG emissions, and contribute to CO_2 storage in buildings.
- Increase competence, increase the pace of innovation in the timber industry, and find wood-based solutions for high and dense urban growth. Integrated system solutions must be developed that promote industrialisation while remaining adaptable.
- Requirements for life cycle analyses in technical regulations contribute to increased sustainability in the construction sector.
- Introduce requirements in the Plan and the Building Act so that the planning authorities can, through climate and environmental plans, as well as area and regulation plans, set requirements for the use of renewable resources.
- Continue necessary, ongoing restructuring in the industry to ensure sufficient competitiveness.

The National Strategy for the Forest and Wood Industry emphasises the following measures as essential to strengthening the competitiveness of the wood building sector:

- Increase value creation through industrialisation in the construction sector based on the full range of Norwegian wood resources, including by developing standards and digitally based processes.
- Establish requirements for life cycle analyses in the technical regulations (TEK).
- Contribute to a sustainable construction industry by developing solid, unified environmental documentation from the production of materials and the reuse of buildings.
- Identify sustainable building solutions for all sectors of society by strengthening cooperation between the tree industry and R&D environments regarding research, innovation, and competence development.

New Bio-Economic Scheme (2017–2019)

The bioeconomy scheme had a duration of two years and a budget of 30 million NOK. The Norwegian Ministry of Industry, the Ministry of Fisheries, and the Ministry of Agriculture and Food primarily funded this scheme. Priority areas included increasing benefits and employment in the sector. In addition, there was a focus on climate, targeting reductions in GHG emissions and scarcity, aiming for a more efficient use of resources.

The largest part of the scheme is dedicated to timber construction. Applications for funds from the Bioeconomy Scheme are accepted year-round. Projects financed by the scheme have to serve as an example for what is possible in timber construction and prove higher value creation. The scheme's targets also identified obstacles to the sector's development. For instance, fire regulations are still constraining the industry, since they lack standards. The Bioeconomy Scheme invested its resources in financing the project, targeting the introduction of harmonised fire safety rules for the EU. Now, the scheme focuses on supporting Norwegian production and deliveries of solid wood.

3.2.3. Sweden

Industry Research Programme for the Forest and Wood Industry

This programme was executed from 2005 to 2012 and was financed in equal parts by the VINNOVA Swedish Innovation Agency and the industry itself. The programme had a budget of SEK 530 million (EUR 49 million). The programme was based on the priorities of the national research agenda. Sixty projects covered not only wood but also, to a large extent, pulp and paper. The number of innovative and explorative projects was low; they accounted for 15% of the budget and thereby met the programme's statutory objective. The state accounted for almost SEK 260 million. Fifty-one percent of funds were granted to five research institutes, and 42% were granted to nine universities. The most important outcome, according to the midterm evaluation, was the in-depth and broadened collaboration between R&D providers and newly established companies. Although one of the programme's aims was to contribute to Swedish engagement in the EU framework, the empirical evidence showed that it only had a marginal impact on the programme participation of Sweden's framework.

The National Strategic Research Agenda for Forest-Based Industries

NSA Sweden has no financing function. Projects and programmes to implement parts of, or entire, national investment areas are dependent on research financiers. This applies to both normal research funding operations and the result of targeted investments at the national or international level. Through NRA Sweden, a foundation has been created for collaboration between research financiers and the industry. The strategic themes are distributed across four target areas: (1) the bioeconomy (as the forest-based sector in the bio-based social economy); (2) raw materials (the use of forest resources); (3) processes (industrial leadership); and (4) products (customer needs). Unlike industry research programmes, NRA aimed at broader groupings and intended to strengthen the entire innovation chain. The purpose of the initiative was to reinforce long-term collaboration between universities, research institutes, the business sector, the public sector, and society in general. Thus, the endeavour was meant to create conditions for developing sustainable solutions to global societal challenges. Expected results by 2020 include:

- All European building regulations are fully function-based, especially with regard to fire safety.
- These rules are not discriminatory with regard to the use of wood in multi-story buildings or other large buildings.
- Verified systems for tall timber houses (over 20 floors) are available and have been tested.
- Fast, moisture-proof, material-efficient building processes with a high degree of prefabrication have proven economically advantageous, both for new construction and for the renovation and upgrading of older buildings.
- Moisture safety and energy efficiency are continuously verified with the help of advanced embedded sensor technology.
- Wood-based construction has also been accepted and verified by all major environmental classification systems for buildings.
- The possibilities of wood, in terms of architectonic design and aesthetics, have been developed and demonstrated.
- The increased use of wood in construction has contributed to curbing climate change by replacing non-renewable and energy-demanding materials and providing a carbon sink for construction works.

BioInnovation Programme

This initiative is a strategic innovation programme for the forest product industry, the textile industry, and the chemicals industry, with the goal of changing the Swedish economy to a bio-based one by 2050. The programme is financed by VINNOVA, the Swedish Energy Agency, the Swedish Research Council Form, and participating organisations. The programme is structured into three thematic areas: (1) chemicals and energy; (2) materials and construction; and (3) design.

The programme has funded several large innovation projects, of which the two largest are targeting applications of timber materials in construction.

- FBBB, for future bio-based construction and housing projects (2015–2018), cost SEK 56.4 million (EUR 5.2 million). The aim of the project was to create the conditions for increasing the use of bio-based products and services used primarily in the construction sector in Sweden and Europe and to increase the competitiveness of the Swedish wood manufacturing industry.
- Swedish Wood Innovation underscores the potential for a bio-based society. At a cost of SEK 52 million, the project has been ongoing for 3 years. The goal is to see increased demand for Swedish wood within three years, with a focus on pine. Through innovative processes, the properties of timber products must be developed, and their value must be increased. The project consists of four subprojects designed to develop and strengthen Swedish raw materials for different market segments. The project will contribute to generating new, profitable, and industrially produced pine products whose shape and function correspond to consumers' current preferences.

National Forest Programme (NFP)

This programme is managed by the Ministry of Enterprise and Innovation and runs from 2018–2030. The programme aims to boost industrial wood building and to spread knowledge among municipalities and other actors within the construction and real estate industry as a part of the Swedish bio-based economic agenda, with planned budgets of 2,000,000 SEK (180,000 EUR) in 2018 and 2,000,000 SEK (180,000 EUR) in 2019. Objectives involve carrying out knowledge transfer efforts, disseminating good examples, stimulating innovation, and developing new building systems based on wood. The Trästad Sverige-WoodCity Swedish Initiative is co-financed by this programme. Developing Nordic industrial wood construction, the funding includes 2,000,000 SEK (180,000 EUR) per year until 2020. Goals entail increasing Nordic and cross-border cooperation and advancing developed Nordic industrial wood construction, exports, and sustainable solutions. There is support for innovation and sustainable housing construction.

Based on the previous results, the main goals found in all programmes from the three countries include the following:

- Increase profitability in the woodworking industry
- Promote the use of timber in public buildings
- Encourage the harmonisation of fire safety regulations
- Increase profitability in the woodworking industry
- Increase the competitiveness of timber as a construction material
- Promote innovation in the wood sector
- Support the development of methods to conduct LCA and EPDs
- Establish requirements for LCA in the TEK
- Showcase systems for tall timber buildings (over 20 floors)
- Eliminate discriminatory practices or regulations with regard to the use of timber
- Form strategies for monitoring moisture safety and energy efficiency in timber buildings
- Advance environmental benefits related to the use of timber in the built environment
- Promote the development of industrialised timber construction products

4. Discussion

For this research project, we defined the policy gap in terms of challenges to the use of timber in construction projects, and how programmes and policies in the studied countries have dealt with these challenges. We identified a large number of programmes; consequently, the challenges related to these programmes are being addressed. Moreover, most of the target areas were no longer seen as challenging by the interviewees. The objective of this kind of analysis is to determine not only how different countries cope with different challenges, but also which challenges still need to be handled by policy-makers. The results of the policy gap analysis are shown in Figure 2, whereas detailed outcomes are presented in Annex 1. Figure 2 indicates a policy gap between 59 and 69% within the studied countries. This suggests that, even though large amounts of resources are dedicated to the promotion of timber, there is still a significant policy gap. These findings also demonstrate that the focus of these programmes, in all countries, has been the development of the timber industry and its position in the market. This case is a great example, showing that the presence of a promotional programme does not imply that the challenge has been overcome. In contrast, many of the challenges identified will require not only more resources, but also time for the effects of these programmes to bear fruit. On the other side of the spectrum, we find the challenges of C7 and C9, relating to the lack of trained professionals and social acceptance, with a gap of 89%. These problems are difficult to address, as a response to them needs to be multi-sectorial, involving education and formation institutions, as well as industry and policy-makers. Finally, the challenges related to fire safety regulations, and additional fees for insuring timber buildings, are being addressed by several programmes, but their effects are not yet visible.

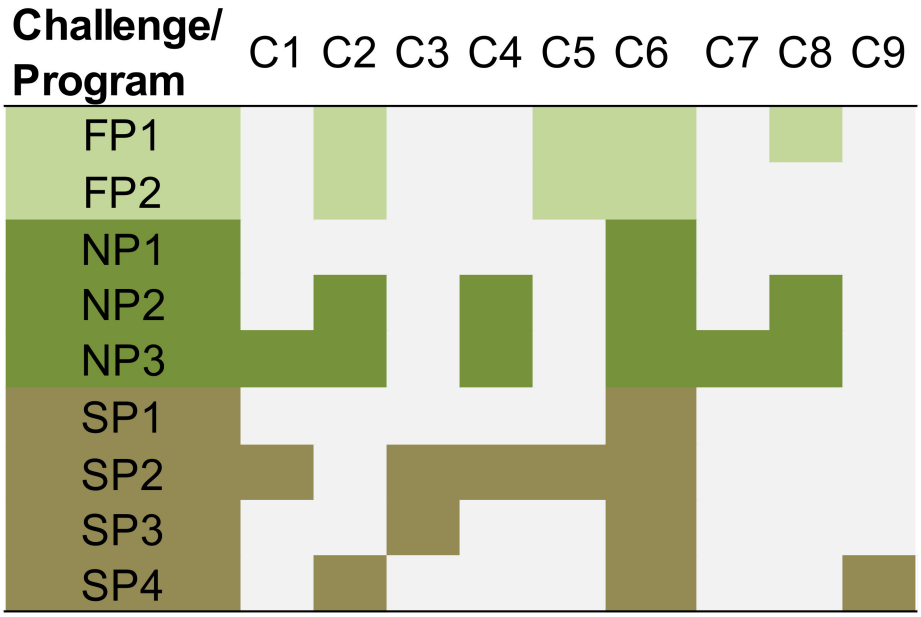

Figure 2. Policy Gap Analysis C1 Stricter fire safety regulations than for other materials; C2 Lack of promotion from the local governments on their tenures for new buildings; C3 Discriminatory practices of insurance companies, additional fees for timber buildings; C4 Insufficient knowledge on carbon accounting methodologies; C5 Lack of appropriate tools to implement timber construction projects in BIM; C6 High price variability due to the size and market share of the wood sector; C7 Educational offer gap contributing to the lack of experts available in the field; C8 Lack of knowledge for the assessment of operation and maintenance costs; C9 Scepticism regarding material's durability. FINLAND: FP1 National Wood Construction Programme; FP2 The Wood Building Programme. NORWAY: NP1 Wood Based Innovation Programme; NP2 SKOG22—National strategy for the forest and wood industry; NP3 Bio-economy scheme. SWEEDEN: SP1 Industry Research Programme for the forest and wood industry; SP2 The National Strategic Research Agenda for the Forest-Based Industries NRA 2020; SP3 BioInnovation.

Based on our results, it is not possible to determine the relative pertinence of each of the challenges identified. Nevertheless, the policy gap analysis indicates not only that progress has been made on several fronts, but also that areas remain that might become priority in the future. Beyond being a critique, policy gap analysis should help policy makers and researchers to pinpoint lessons for the implemented programmes and to plan strategies for the future.

It is important to note that any methodological approach based on interviews will have a limited generalizability, as the results are connected to subjective opinions and contexts. Moreover, the wide scope covered within the research behind the results presented on this paper makes it very difficult to have a total coverage of both experts and to gain in depth information. Thus, the results presented here are an artefact of their time and limited by the information and opinions that we were able to collect within the time frame of the project. Nevertheless, we are confident that the use of a policy gap analysis is a useful strategy to identify unserved areas by programmes at national level. Moreover, this approach can be useful in the development of coordination strategies to avoid overlapping targets and redistribute efforts and resources among different national programmes. Finally, the policy gap analysis can help policy makers and NGOs in the identification of key areas to assess the impact of their programmes.

5. Conclusions

The policy gap analysis showed that the main challenges were related to regulatory and insurance practice. Furthermore, the focus of the studied programmes was the development of their timber industry and the increase in the competitiveness of timber products

in the real estate market. Furthermore, challenges related to education and development of the work force need to be addressed with a multi-sectoral perspective. From the identified challenges, those related to the perception of timber as an appropriate and safe construction material might be one of the most challenging and yet relevant to a successful increase share of timber buildings. From the interviews, it was clear that policy was perceived as both barrier and driver for the use of timber, thus increasing relevance of a positive public opinion on the benefits of timber. We can conclude that the identified challenges were only partial addressed on the studied countries. This was also exacerbated as many of the studied programmes overlapped on their aim, leaving several challenges unaddressed. Finally, it is clear that the implemented programmes are moving the timber industry towards a more relevant state in the European construction sector. It is positive that the priority was given to the development of the timber industry, but it is necessary to address the socio-political challenges as well. This would require a higher level of coordination among institutions but would certainly rebound on a wider coverage of challenges and thus on a faster development of the timber industry.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/su132111876/s1, Annex 1. Detailed Policy Gap.

Author Contributions: Data curation, Writing—original draft: M.M.-H. Conceptualisation, Formal Analysis, Methodology, Project Administration, Writing—original draft, Writing—review and editing: E.Z.E. Validation, Writing—review and editing: L.G.F.T. All authors have read and agreed to the published version of the manuscript.

Funding: The research was partially funded by the Action Plan Wood of the Swiss Federal Office for the Environment (BAFU) through the project "Real Estate Solutions to increase timber in the Swiss built environment.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Further data supporting the reported results can be found at: https://www.researchgate.net/publication/343690404_Programs_and_Policies_Promoting_Timber_Buildings_Finland_Norway_and_Sweden.

Acknowledgments: The Authors would like to acknowledge Diego Peñaloza for his valuable comments and insights for the case of Sweden.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Dean, B.; Dulac, J.; Petrichenko, K.; Graham, P. *The Global Status Report 2016-GABC*; UNEP, GABC: Paris, France, 2016.
2. Churkina, G.; Organschi, A.; Reyer, C.P.; Ruff, A.; Vinke, K.; Liu, Z.; Reck, B.K.; Graedel, T.; Schellnhuber, H.J. Buildings as a global carbon sink. *Nat. Sustain.* **2020**, *3*, 269–276. [CrossRef]
3. Hurmekoski, E.; Jonsson, R.; Nord, T. Context, drivers, and future potential for wood-frame multi-story construction in Europe. *Technol. Forecast. Soc. Chang.* **2015**, *99*, 181–196. [CrossRef]
4. Allan, K.; Phillips, A.R. Comparative Cradle-to-Grave Life Cycle Assessment of Low and Mid-Rise Mass Timber Buildings with Equivalent Structural Steel Alternatives. *Sustainability* **2021**, *13*, 3401. [CrossRef]
5. Liang, S.; Gu, H.; Bergman, R. Environmental Life-Cycle Assessment and Life-Cycle Cost Analysis of a High-Rise Mass Timber Building: A Case Study in Pacific Northwestern United States. *Sustainability* **2021**, *13*, 7831.
6. Karjalainen, M.; Ilgın, H.E.; Tulonen, L. Main Design Considerations and Prospects of Contemporary Tall Timber Apartment Buildings: Views of Key Professionals from Finland. *Sustainability* **2021**, *13*, 6593. [CrossRef]
7. Toivonen, R. Dimensionality of quality from a customer perspective in the wood industry. *Diss. For.* **2011**, *114*, 71. [CrossRef]
8. Tykkä, S.; McCluskey, D.; Nord, T.; Ollonqvist, P.; Hugosson, M.; Roos, A.; Ukrainski, K.; Nyrud, A.Q.; Bajric, F. Development of timber framed firms in the construction sector—Is EU policy one source of their innovation? *For. Policy Econ.* **2010**, *12*, 199–206. [CrossRef]
9. Julin, J.; Säilä, P.; Talonpoika, L.; Aho, M.; Kaarakka, V.; Kyyrönen, K. *The International Promotion of Wood Construction as a Part of Climate Policy*; Working Group Report; Ministry of Foreign Affairs of Finland: Helsinki, Finland, 2010.
10. Toppinen, A.; Röhr, A.; Pätäri, S.; Lähtinen, K.; Toivonen, R. The future of wooden multistory construction in the forest bioeconomy–a Delphi study from Finland and Sweden. *J. For. Econ.* **2018**, *31*, 3–10. [CrossRef]

11. Helles, F.; Strange, N.; Wichmann, L. *Recent Accomplishments in Applied Forest Economics Research*; Springer Science & Business Media: Berlin/Heidelberg, Germany, 2013; Volume 74.
12. Robichaud, F.; Richelieu, A.; Kozak, R. Wood use in nonresidential construction: An exploratory research of the roles of media and content in direct marketing. *Wood Fiber Sci.* **2012**, *44*, 394–411.
13. Høibø, O.; Hansen, E.; Nybakk, E. Building material preferences with a focus on wood in urban housing: Durability and environmental impacts. *Can. J. For. Res.* **2015**, *45*, 1617–1627. [CrossRef]
14. Roos, A.; Woxblom, L.; McCluskey, D. The influence of architects and structural engineers on timber in construction–perceptions and roles. *Silva Fenn.* **2010**, *44*, 871–884. [CrossRef]
15. Hemström, K.; Mahapatra, K.; Gustavsson, L. Perceptions, attitudes and interest of Swedish architects towards the use of wood frames in multi-storey buildings. *Resour. Conserv. Recycl.* **2011**, *55*, 1013–1021. [CrossRef]
16. Karjalainen, M.; Ilgın, H.E. The Change over Time in Finnish Residents' Attitudes towards Multi-Story Timber Apartment Buildings. *Sustainability* **2021**, *13*, 5501. [CrossRef]
17. Vihemäki, H.; Ludvig, A.; Toivonen, R.; Toppinen, A.; Weiss, G. Institutional and policy frameworks shaping the wooden multi-storey construction markets: A comparative case study on Austria and Finland. *Wood Mater. Sci. Eng.* **2019**, *14*, 312–324. [CrossRef]
18. Hildebrandt, J.; Hagemann, N.; Thrän, D. The contribution of wood-based construction materials for leveraging a low carbon building sector in Europe. *Sustain. Cities Soc.* **2017**, *34*, 405–418. [CrossRef]
19. Milestone, S.N.; Kremer, P. Encouraging councils and governments around the world to adopt timber-first policies: A systematic literature review. *Mass Timber Constr. J.* **2019**, *2*, 8–14.
20. Ludwig, G. The Role of Law in Transformative Environmental Policies—A Case Study of "Timber in Buildings Construction in Germany". *Sustainability* **2019**, *11*, 842. [CrossRef]
21. Wang, L.; Toppinen, A.; Juslin, H. Use of wood in green building: A study of expert perspectives from the UK. *J. Clean. Prod.* **2014**, *65*, 350–361. [CrossRef]
22. Hart, J.; Pomponi, F. More timber in construction: Unanswered questions and future challenges. *Sustainability* **2020**, *12*, 3473. [CrossRef]
23. Zea Escamilla, E.; Klippel, M.; Maniak, M.; Cakir, I. *Real Estate Management Approaches to Promote of Timber Construction-Development of DCF and LCCA Models as well as Databases for Timber Construction*; BAFU-AP HOLZ: Bern, Switzerland, 2019.
24. BAFU. Aktionsplan Holz. Available online: https://www.bafu.admin.ch/bafu/de/home/themen/wald/fachinformationen/strategien-und-massnahmen-des-bundes/aktionsplan-holz.html (accessed on 19 October 2021).
25. Jennings, M.D. Gap analysis: Concepts, methods, and recent results. *Landsc. Ecol.* **2000**, *15*, 5–20. [CrossRef]
26. Hoberg, G.; Peterson St-Laurent, G.; Schittecatte, G.; Dymond, C.C. Forest carbon mitigation policy: A policy gap analysis for British Columbia. *For. Policy Econ.* **2016**, *69*, 73–82. [CrossRef]