

Status of public policies encouraging wood use in construction – an overview

Draft Background Paper prepared for the
61st Session of the FAO Advisory Committee on
Sustainable Forest-based Industries, April 2020





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Secretariat of the Advisory Committee on Sustainable
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Cover photo: Interior view of a house under construction home framing
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Contents

9	Acknowledgements
10	Executive Summary
13	Introduction
14	Possible benefits of building with wood
16	Possible challenges to greater adoption of wood as construction material
19	Examples of public policies encouraging the use of wood in construction
30	Conclusions
31	Bibliography

List of Tables

- 19 **Table 1:** Overview of selected WEP.
-
- 20 **Table 2:** Policy objectives common across wood first policies.
-
- 21 **Table 3:** Policy objectives common across wood first policies.
-
- 22 **Table 4:** Sectoral policies that can impact the use of wood in construction.

Acronyms

ACSMI	FAO Advisory Committee on Sustainable Forest-based Industries
CLT	Cross Laminated Timber
EWP	Engineered Wood Product
FAO	Food and Agricultural Organization of the United Nations
FSC	Forest Stewardship Council
GHG	Greenhouse gas
HWP	Harvested Wood Products
IPCC	Intergovernmental Panel on Climate Change
LCA	Life Cycle Analysis
LULUCF	Land Use, Land Use Change and Forestry
MIW	Make It Wood
MTC	Mass Timber Construction
PEFC	Programme for the Endorsement of Forest Certification
UNECE	United Nations Economic Commission For Europe
UNFCCC	United Nations Framework Convention on Climate Change
WEP	Wood Encouragement Policy



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Executive Summary

This report has been prepared for the Advisory Committee on Sustainable Forest-based Industries (ACSFII) of the Food and Agriculture Organization of the United Nations (FAO). It provides an overview of policies encouraging the use of wood as a construction material and thus contributing to the transition towards a bioeconomy.

The overview identifies and collects cases of wood encouragement policies (WEP), i.e. policies formulated at national, regional or local levels, promoting the use of wood as a building material. The report analyses the benefits attributed to the use of wood as a construction material as well as the challenges that may limit wider use of wood as construction material. Selected examples of WEP are presented before the report ends with some overarching conclusions.

WEP commonly recognize the importance of supporting local forest industries, supporting sustainable economic development and contributing to climate change mitigation objectives. They are often justified by their originators with reference to the positive effects of wood as a construction material, including its natural properties, efficiency in construction, impact on health and well-being and contribution to sustainable development, including climate change. Possible direct and indirect benefits from wood use in construction can contribute to the achievement of multiple sustainable development goals (SDGs). Through substitution effects and carbon storage, wood use in construction can also contribute to decreasing the fossil carbon footprint of the construction sector

A number of challenges seem to stand in the way of greater use of wood as a construction material, including hesitant uptake by the construction sector, misconceptions of stakeholders about using wood in construction, focus of WEP on developed countries, restrictions within building codes and economic barriers. At present, tall wood buildings and WEP are concentrated primarily in developed countries. However, much of the future housing demand will be concentrated in the expanding cities of Asia and Africa. Therefore, governmental support is needed to promote green building materials, including wood, to reach a production scale and to close the 'housing gap' affecting urban poors in Asia and Africa.

WEP have been mainly adopted by countries with an economically important forest sector, including Australia, Canada, Finland, France, Germany, Japan, New Zealand, Sweden, Switzerland and the United Kingdom. These policies are applied at varying levels of government, including i) local level (city and district councils), ii) regional level (e.g. district or province); and iii) national level.

WEP are typically designed to encourage increased use of wood products specifically in construction, although they sometimes promote the increased use of wood products in general. At present, they focus primarily on buildings developed through public procurement, but in some jurisdictions also extend to the private sector, encouraging the development of private buildings made of wood. WEP are common to countries, regions or areas with strong forest industries as there is a strong motivation for these jurisdictions to promote wood products when the benefits are wide reaching and multi-faceted.

Many WEP are for public procurement and encourage the increased use of wood products in public buildings, projects and initiatives co-funded by the public administration. They occasionally include wood solutions to heating and the energy requirements of buildings and other infrastructure projects such as bridges.

Examples of WEP and their implementation are presented from Australia, Canada, France, Germany, UK, Sweden and USA. Sweden started the first local WEP in 2005 in Växjö municipality. One of the most prominent examples of a fully-fledged WEP is the Wood First Act of British Columbia in 2009. In Australia, the Latrobe City Council was probably the first local council to adopt a WEP in 2014, and by 2019 at least 15 other Australian councils

had adopted similar policies. Such policies vary greatly in their timeframe: only a few are accompanied by a programme or means of implementation with a dedicated timeframe, such as the Innovate Housing Programme of Wales (2017-2021).

The report concludes that WEP are heterogeneous in their form, scope and budget, and act collectively as an advocate for the increased use of wood in construction. They can target both the public sector promoting the procurement or the private sector, providing incentives to use wood as a construction material.

The underlying strategy of increasing the use of wood in public buildings through public procurement can be to support exemplary projects, including specific research and development that private actors would not undertake alone and in a self-funded manner. These projects aim to show new technical and aesthetic possibilities for wood creating reference projects likely to generate architectural interest, as well as technical and cultural appropriation by the private sector and the broad public.

Enhanced implementation of WEP may require further capacity building, research and development. The long journey of innovations from research to industry and markets requires intensive training and adaptations in production and construction processes. The examples presented show the diversity of policies, policy tools and experiences aiming at increasing the contribution of wood products to sustainable cities while covering the “housing gap” and/or showcasing replicable and innovative demonstration projects for uptake by the private sector. Further analysis would be required to quantitatively assess the impact of WEP on sustainable development (SDGs) and on possible benefits and challenges for upscaling, including in developing countries.



Introduction

This report has been prepared for the Advisory Committee on Sustainable Forest-based Industries (ACSF) of the Food and Agriculture Organization of the United Nations (FAO). It provides an overview of policies encouraging the use of wood as construction material and thus contributing to the transition towards a bioeconomy.

The use of wood in construction differs significantly across countries, cultures and traditions, often depending on climates and resources. Moreover, global data on the most commonly used construction materials are limited, making it difficult to assess relative market shares of concrete, steel, brick, stone and wood.

The majority of residential houses in places such as North America, Australia and Scandinavia have wood frames, although this is very uncommon in other parts of the world such as the Mediterranean. Thanks to recent innovations, potential may exist for further growth in the wood construction sector, in particular for multistorey buildings, although the products involved have not yet been generally adopted into the mainstream.

While wood has been used in many traditional building systems for centuries, technologies have advanced to allow for engineered wood products (EWPs) to effectively substitute other fossil-based materials, including steel and concrete, in large-scale construction. Uptake of these EWPs has been steady (Gosselin, Blanchet, and Lehoux and Cimon, 2017), but market share compared to traditional building materials remains limited. In Germany, for example, timber reaches some 15% of the market share for building materials, while neighbouring countries like Austria and Switzerland reach twice that percentage (Ludwig, 2019).

An enabling policy environment may facilitate an increased uptake from wood as a construction material through WEP in an increasingly climate-conscious era, where the use of wood over fossil-intensive materials can have direct and indirect benefits for climate change mitigation and adaptation as well as sustainable development.

This overview identifies and collects cases of wood encouragement policies (WEP), covering policies formulated at national, regional or local levels promoting the use of wood as building material. It is descriptive rather than prescriptive in nature, and utilises information gathered primarily from secondary literature sources, including reports, news articles, and conference papers. Cases of WEP were identified through Internet searches, and policy documents were accessed directly from government websites when available, or via email requests to the relevant bodies. Policies at all levels of government – local, regional (e.g. district, provincial) and national – were taken into account.

This document begins by analysing the benefits attributed to the use of wood as a construction material, before outlining some of the challenges that may limit wider use of wood as construction material. Selected examples of WEP are then briefly presented before concluding with an outlook on possible future trends related to the use of wood as a construction material.

Benefits of building with wood

Most WEP are justified by their originators with reference to the positive effects of wood as construction material, including its natural properties, efficiency in construction, impact on health and well-being and contribution to sustainable development, including climate change.

Natural properties

Wood has many properties that make it a suitable material to build with, from both a technical and environmental perspective:

- It is a renewable material with a reduced environmental footprint compared to other building materials.
- In addition to substitution for the use of fossil carbon-intensive materials, the use of long life wood products also contributes to carbon storage.
- It has a high strength-to-weight ratio (Ramage, 2017).
- It is flexible and resilient, providing useful characteristics for seismic areas in particular (Evison, Kremer, and Guiver, 2018)
- It has strong thermal and electronic insulation properties.
- It proves effective in terms of fire safety behaviour as it chars slowly, and during intense fires, does not lose its mechanical properties as quickly as steel.

Efficiency in construction

There is evidence to suggest the possibility of efficient use of wood in construction, particularly through timesaving and the related cost-savings of using a variety of WEPs. This is largely attributable to the potential for off-site fabrication, which can lead to the rapid erection of tall wood constructions (Gosselin, Blanchet, and Lehoux and Cimon, 2017). Many wooden buildings are made of prefabricated compounds assembled on site, thus reducing building time significantly and creating less disturbances in cities and other built-up areas.

For end-use of buildings, once constructions are dismantled and materials disassembled, wood can be re-used, recycled and at the end of its life, it can be used as fuel (FAO and UNECE, 2016).

Health and wellbeing

A possible benefit of increased wood use in buildings is its impact on wellbeing, positive feelings and comfort. Literature on the biophilia hypothesis posits the human tendency to seek connection with nature. In an increasingly urbanised society, this includes wood by extension. In Australian workplaces, for example, exposure to wood has been shown to lead to higher levels of concentration, worker satisfaction and increased productivity, as well as reduced sick leave and overall higher wellbeing (Knox and Parry-Husbands, 2018).

Sustainable development

The benefits of sustainable wood-use in construction are far-reaching. They extend through the value chain innovative and technical products derived from a renewable natural resource. Direct and indirect benefits from wood use in construction contribute to the achievement of multiple sustainable development goals (SDGs) including the promotion of sustainable economic growth (SDG 8), sustainable consumption and production patterns (SDG 12), combating climate change and its impacts (SDG 13), and the protection, restoration and promotion of the sustainable use of terrestrial ecosystems (SDG 15).

Through substitution effects and carbon storage, wood use in construction can contribute to decreasing the fossil carbon footprint of the construction sector (Leskinen, Cardellini and Gonzalez-Garcia, 2018). This is significant considering that nearly half of US carbon emissions come from the building sector, largely from steel and concrete production. Similarly, in the UK the construction sector accounts for around 45% of emissions, and in Canada around 30% (Leskinen and Cardellini and Gonzalez-Garcia, 2018). In Europe, scenario analyses suggest that by 2030 emissions' compensation through carbon storage from wood-based construction compared to conventional non-wood building materials could range from approximately 18,000 kilotons CO₂-equivalent to 46,000 kilotons CO₂-equivalent (Hildebrandt, Hagemann and Thran, 2017).

From a policy perspective, certain countries include wood in construction as a part of their emissions reduction schemes. For example, the Scottish Climate Change Plan (The Scottish Government, 2018) has three key aims related to Land Use, Land Use Change and Forestry (LULUCF), one of which relates directly to wood in construction: to increase the use of sustainably sourced wood fibre and encourage the construction industry to use timber by 2030.

Some of the structural properties of tall wood buildings are complementary to certain risk-reduction needs, such as safe housing in earthquake-prone areas. This may serve as another driver for the adoption of pro-wood policies (e.g. Japan and New Zealand).

Robust assessment of the environmental benefits of building with wood is a challenge. Uncertainties in input data or model parameters can lead to imprecise estimates. As well, alternative assumptions and system boundaries across life-cycle analyses (LCA) that estimate total GHG emissions from particular building materials can lead to a wide range of results (Stiebert, Echeverria, Gass and Kitson 2019; Crawford and Cadorel, 2017). The development of methods for accurately comparing environmental benefits between engineered wood and traditional construction materials may increase confidence of stakeholders to identify suitable construction materials in a given context (Crawford and Cadorel, 2017).

Finally, the processing of wood into materials suitable for construction often leads to the availability of small wood pieces as a by-product. These can be harnessed to produce other materials such as particle board, paper products or bioenergy (for example in the form of wood pellets).

Possible challenges to greater adoption of wood as construction material

Despite the previously outlined benefits, a number of challenges seem to stand in the way of greater global adoption of wood as construction material, including hesitant uptake by the construction sector, misconceptions of stakeholders about using wood in construction, insufficient focus on implementation in developing countries, restrictions within building codes and economic barriers.

Uptake by the construction sector

The construction industry is often perceived as being conservative, with limited motivation or incentive to abandon standard techniques, due to the high associated professional risk for engineers and architects (Evison, Kremer, and Guiver, 2018). In particular, uncertainties related to the cost of tall wood building projects and the reliability of cost-savings compared to concrete and steel are obstacles to developers in pushing for a wood-based solution. WEP in their current form may have little impact on mitigating the cost uncertainties and securing a wood alternative solution, as they often include a caveat that wood is the preferred material in government or council projects 'where economically feasible'.

The International Building Code (IBC) limits wood buildings to six storeys, implying that projects over such a height should go through a process with the authority in their local jurisdiction to receive approval. However, the IBC has established an Ad Hoc Committee on Tall Wood which may contribute to changes in the code for 2021 (Think Wood, 2017).

In the meantime, France, for example, decided to organize a national competition to unlock a series of blockages hampering construction of tall wooden buildings (see example 6). A new international Congress (Wood Rise) was also created and organized in 2017 in Bordeaux and in 2019 in Québec, to bring together international actors in economic and technological development in the field of high-rise wood construction. This and similar initiatives aim at changing the perception of stakeholders by showcasing the possible benefits of wood as a construction material.

WEP can also generate pushback from competing traditional building material industries, due to claims of favouritism on the part of the government or public offices. Strong lobbying and even legal action from other materials sectors have taken place in some cases, based on claims of discrimination and the promotion of one material over another.

Misconceptions

In an economic environment with strong competition between materials, construction techniques and companies, many of the barriers to Mass Timber Construction (MTC) derive from a lack of understanding about various aspects of the products used. Many countries in Europe and North America have established promotional campaigns and community education efforts to encourage the use of wood to dispel misconceptions about using wood in construction, usually with the strong backing of local forest industry associations.

For example, in Europe a sustainability campaign entitled "Wood First" launched by the UK timber industries in 2012 argued for planning guidance by local authorities to specify a Wood First rule (Wood For Good, 2019). Similarly, in Canada, a programme of the Canadian Wood Council entitled "*Wood WORKS!*" supports the advancement of the use of wood in commercial, industrial and institutional construction (Canadian Wood Council, 2019). Meanwhile, in Australia, fresh momentum has been generated by the Ultimate Renewable™ – an industry campaign to promote the sustainability and environmental advantages of Australian forestry and wood products, providing a universal positive communications message for the sector to share.² In the European Alpine region, the Triple Wood project

¹ <https://www.woodsolutions.com.au/articles/ultimate-renewable%E2%84%A2-resources>

² <https://www.fwpa.com.au/forwood-newsletters/1809-fwpa-unveils-wood-the-ultimate-renewable.html>

co-financed by the European Union Alpine Region Preparatory Action Funds aimed to promote a sustainable wood building culture in the region that brings social, ecological, and economical benefits to its communities.³

In the meantime, CLT has developed, and the understanding of how to use it has also progressed significantly, leading to an increased number of MTC projects over the last 10 years. Noteworthy examples include the world's tallest timber building "Mjøstårnet" in Brumunddal, Norway, an 18-storey, 85 m high building, "Brock Commons" in Vancouver, an 18-storey student accommodation building at the University of British Columbia, Canada, Forté Building in Melbourne, Australia, a 10-storey residential building; Treet, another 14-storey residential building in Norway and 13-storey residential building "Origine" in Québec-City.

While many projects trigger positive media perceptions, in the case of Hackney Borough in London – a municipality with a concentrated number of tall wood buildings, a significant number of articles and press releases published online suggest contradictions in the public perception of using wood as a construction material. Headlines included:

- *"Hackney clarifies: wood first equal"* ⁴
- *"Hackney leads the way on timber building"* ⁵
- *"Is 'Wood First' a sound policy?"* ⁶

The Council, which does not have a dedicated WEP, confirmed that anecdotally, it is recognized that there are aesthetic and environmental benefits to using wood in new developments, but stated however that they could not advocate one type of building material over another, and do not exclude locally sourced building materials or prevent the use of other sustainable building materials in favour of timber.

Focus on developed countries?

At present, tall wood buildings are concentrated primarily in developed countries, including the USA, Canada, Europe, Japan, and Australia. The USA and Canada have a strong track record of mass timber construction; up to September 2018, 439 structures (multi-family, commercial or institutional) have been constructed or are under design (WoodWorks, 2018). WEP are likely to succeed when the jurisdiction has strong local wood industries, so that increased consumption of wood is seen to support rural economies (Milestone and Kremer, 2019).

However, in developing countries, wood is often perceived as a traditional construction material. Much of the future global housing demand will be concentrated in the expanding cities of Asia and Africa. Therefore, "municipal and national governments [in these regions] must now also balance such immense infrastructure demands with consideration to environmental impacts and emerging resource limitations", including wood as green building material (Global Green Growth Institute, 2019).⁷ The study concludes that governmental support is needed to support up-front costs for green building materials to reach a production scale and to close the "housing gap affecting the global poor, especially those in urban Asia and Africa... while balancing environmental and resource constraints" (*ibid*). In this context, WEP in developing countries could guide national and local governments to establish sound enabling environments for promoting the sustainable use of wood as a green construction material.

³ <https://www.alpine-region.eu/projects/triple-wood-triple-wood-sustainable-wood-building-culture-alpine-region>

⁴ <https://www.constructionmanagemagazine.com/news/hackney-clarifies-wood-first-equal/>

⁵ <http://greenbuilding.co.uk/hackney-lead-the-way-on-timber-building/>

⁶ <https://www.architectsjournal.co.uk/home/is-wood-first-sound-policy/8641701.article>

⁷ Green building material is defined by Global Green Growth Institute (2019) as "construction materials that have lower carbon requirements through their life cycles, relative to conventional materials such as concrete and steel", including wood, bamboo, straw, earth, stone, recycled materials and green concrete

Building codes and technical specifications

Building codes can be an important regulatory barrier to the development of wood-use in large buildings, in cases where they do not demand certain criteria (e.g. better-performing structures) in which wood could outperform traditional building materials (Wimmers, 2017). The previously cited study by Gosselin et al. (2017) looked in detail at the main motivations and barriers to using wood in construction as reported by a variety of projects. In addition to building codes, the main barriers included technology transfer, costs (although also these are also cited as a reason for using wood), technical aspects (e.g. fire, moisture, acoustics) and material availability.

Economic barriers

The cost of using wood in construction is heavily dependent on the availability of products, knowledge, and local technologies. Getting all wood products, including at species level, officially certified and standardized for use in construction, may also constitute a significant cost of market access, as competing sectors such as cement industries and users offer less product diversity.

Examples of public policies encouraging the use of wood in construction

Overview

Globally, many governments have implemented policies that aim to improve the sustainability of their building sectors. This includes WEP. While such policies are widespread, there is limited evidence of their quantitative impact. A joint study by FAO and UNECE (2016) examined leading public policies in Europe and North America designed to promote sustainable building materials, and a recent literature review by Milestone and Kremer (2019) explored ways of encouraging governments to adopt WEP.

WEP include all policies formulated at national, regional or local levels promoting the use of wood, often focussing on wood as a building material. According to FAO and UNECE (2016), policies promoting the use of sustainable building materials, including WEP, mainly aim at

- supporting GHG emission reduction and/or climate change policies;
- reducing environmental impacts of construction materials; and/or
- promoting local wood economy and culture.

WEP have been mainly adopted by countries with an economically important forest sector, including Australia, Canada, Finland, France, Germany, Japan, New Zealand, Sweden, Switzerland, and the UK. These policies are applied at varying levels of government, including the

- local level (city and district councils, e.g. Germany);
- regional level (e.g. Tasmania in Australia or British Columbia in Canada); and
- national level (e.g. Finland, Japan).

An overview of selected WEP is summarized in Table 1.

Table 1: Overview of selected WEP.

Country	WEP	Level of implementation
Australia	Wood encouragement policy	Local (city of East Fremantle)
	Tasmanian Wood Encouragement Policy	Regional (Tasmania)
Canada	Wood First Act in British Columbia	Regional (British Columbia)
	Québec wood charter	Regional (Québec)
	Green Construction through Wood (GCWood) Program	National
Finland	Tall Wood Building Demonstration Initiative	National
France	High-rise wood-based building initiative "ADIVBOIS"	National
Germany	Wood construction support programme	Local (city of Freiburg)
Japan	Act for Promotion of Use of Wood in Public Buildings	National
New Zealand	Wood First Policy	Local (city of Rotorua)
Sweden	Wood promotion in construction and energy	Local (Växjö)
Switzerland	Wood Resource Policy and Wood Action Plan	National
UK	Home-Grown Homes	Regional (Wales)
USA	Wood-use in public buildings	Regional (Oregon, Maine)

WEP are typically designed to encourage increased use of wood products specifically in construction, although they sometimes promote the increased use of wood products in general. At present, they focus primarily on buildings developed through public procurement, but also extend to the private sector, encouraging the development of private buildings made of wood.

There is wide heterogeneity in the institutional and sectoral leadership of WEP, including the Departments or Ministries of Forests or Agriculture, Economic Development, Environment and climate change, Housing, Research, etc.. However, most WEP have similar objectives, which are summarized in Table 2.

It is also frequently stipulated in WEP that wood should be locally sourced where possible. Moreover, caveats usually included in WEP state that wood should be used when deemed a suitable material, and where considered economically competitive or cost effective.

Table 2: Policy objectives common across wood first policies.

Objectives / motivations	Use locally sources products
	Important to local industry
	Rural development and local employment contribution
	Development of value added
	Facilitate or encourage a community culture of wood
	Contribute to climate change mitigation goals
Feasibility	Where deemed a suitable/appropriate material
	Where economically competitive with other materials

Many WEP are implemented in locations with a strong forest industry. For example, Rotorua is at the epicentre of New Zealand forestry, with 40% of the country's wood harvested within 100 km of the city. The city's WEP has a strong focus on supporting and advocating for the local forest industry (Rotorua Lakes Council, 2015).

Many WEP are for public procurement, and encourage the increased use of wood products in public buildings, or projects and initiatives co-funded by the public administration, occasionally including wood solutions to heating and the energy requirements of buildings and other infrastructure projects such as bridges (e.g. city of East Fremantle in Australia). Some WEP are exclusively dedicated to wood use in the private sector (e.g. Freiburg in Germany).

Wood from certified sources is not a universal requirement in WEP. In Europe, there is generally a minimum requirement for legally sourced wood and sometimes for sustainable wood, as defined by legislative rules. Three certification schemes stipulated in some WEP in Australian councils are the Forest Stewardship Council (FSC), the Programme for the Endorsement of Forest Certification (PEFC) and its Australian component entitled "Responsible Wood". In the provincial policy of Tasmania, specific certification schemes are not nominated but wood is rather expected to "comply with relevant Australian standards". This approach to certification requirements is not uncommon. The policy of Powys in Wales also specifies FSC and PEFC, along with Grown in Britain (GiB, a British licensing and certification scheme), and then states "or [...] from local well managed sources." The Wood Construction Support Programme of the city of Freiburg in Germany requires the wood to be sourced locally (maximum of 400 km) and sustainably (certificate of FSC, PEFC, Naturland or comparable certificate).⁸

WEP rarely have related financial instruments or budgets to facilitate implementation and uptake. Table 3 lists some of the few examples of attached budgets or financial instruments.

⁸ https://www.freiburg.de/pb/site/Freiburg/get/params_E-542421055/1486318/Merkblatt_Holzbauforderprogramm_Zusammenfassung_Richtlinie.pdf



Building “Condos Origine”, Québec city, 2017. First wood-based 13 storey building in Eastern-North-America. Winner of Québec Cécobois 2019 wood construction prize. Multiresidential use

Table 3: Programs with budgets or incentives attached to WEP.

Country	Program	Incentive
Canada	Green Construction through Wood (GCWood) Program	Non-repayable contributions of up to 100% of a project’s eligible incremental costs for the demonstration of innovative mass timber products and systems
Wales	Home-Grown Homes	“Home Grown Homes” project, aims to build 250 new residential homes over the next 4 years, using UK and Welsh-grown timber, to boost local supply chains and benefit rural economy of Wales
Japan	Act for Promotion of Use of Wood in Public Buildings	Funding available for a Timber Manufacturing Improvement Plan
Finland	National Wood Building Program	Government subsidies for municipally funded projects, for construction, client engagement and planning phases
Germany	Modernisation of non-residential buildings in Hamburg	Contribution of 0,80 €/kg of wood used in the construction of new non-residential buildings

WEP often relate specifically to the increase of wood use in government buildings. However, given the cross-sectoral nature of the concept, the policies of various other sectors may also impact on the increase of wood-use in construction (Table 4).

The objectives of WEP are inherently cross-sectoral. First, the departments and ministries that have responsibility for WEP identified in this overview vary significantly. Second, the themes dealt with in WEP and the motivations for adopting such policies are multi-dimensional, as the benefits exist for the economy, the environment, local industries, employment and aesthetic maintenance of a town or city.

For the management of the Quebec Wood Charter, for example, an interdepartmental committee has been established that brings together the main ministries and organizations related to construction. The committee is responsible for the implementation of the Wood Charter in both the public and semi-public sectors. For any publicly funded construction in Québec, it is compulsory, for municipalities and other public organizations, to compare different scenarios with at least one using wood as the main material and to rank the different projects according to their low-carbon-emissions balance sheet (based on Cecobois calculation methodology).

Table 4: Sectoral policies that can impact the use of wood in construction.

Policy	Example
<i>Climate change policies</i>	The Scottish Government's Climate Change Plan (report on policies and proposals) states, "In the LULUCF Sector, we aim to: increase the use of sustainably sourced wood fibre and encourage the construction industry to use timber" (The Scottish Government, 2018).
<i>Housing sector policies/ Planning and urban development policies</i>	<p>A Construction Sector Deal as part of the Welsh Assembly's Industrial Strategy sets out a partnership between government and industry that aims to transform the sector's productivity through innovative technologies and a more highly skilled workforce. The three strategic priorities of the deal are positive for the timber industry, providing opportunities for timber supply chains, as they include: optimizing performance and utilizing digital technologies during construction and operation of buildings; offsite manufacturing to reduce waste and inefficiencies; and whole-life asset performance particularly for the life cycle of energy.</p> <p>The Hackney Borough Council's Sustainable Design and Construction planning document specifically references cross-laminated timber (CLT), stating that, "There are successful examples of CLT buildings in Hackney, and the Council seeks to continue to welcome the building of high-quality, low-carbon buildings using CLT or other sustainable materials" (London Borough of Hackney, 2016).</p>
<i>Forest policies</i>	The Scottish Forest Strategy has forestry commitments related directly to wood use in construction (Fig. 1) (The Scottish Government, 2019), specifically setting out to increase the use of Scottish wood products in construction from 2.2 million m ² in 2018 to 3 million m ² by 2031/32.

A survey of international tall wood buildings found that engaging with the relevant authorities early in the design and development stage of a tall wood project enabled faster approvals (Binational Softwood Lumber Council; 2014). When comparing the concerns of stakeholders involved in tall wood building projects, Gosselin *et al.* (2017) noted that many reported problems could have been avoided if insights had been shared between stakeholders from the beginning of the project. This included architects, engineers, developers, builders and suppliers. The engagement of authorities and cohesion amongst key stakeholders could be further improved through WEP that could facilitate such projects.

Examples in action

The Swedish city of Växjö implemented a precursor policy to their eventual WEP as early as 2005 (see example 7). However, one of the earliest and more prominent examples of a fully-fledged WEP is the Wood First Act of British Columbia in 2009. In Australia, the Latrobe City Council was the first local council to adopt a WEP in 2014, and by 2019 at least 15 other Australian councils had adopted similar policies. Such policies vary greatly in their timeframe: only a few are accompanied by a programme or means of implementation with a dedicated timeframe, such as the Innovate Housing Programme of Wales (2017-2021).

The following section summarizes a range of examples of WEP implemented in Australia, Canada, France, Germany, UK, Sweden and USA.

Example 1. Brock Commons Tallwood House (Canada, 2019)

The Tall Wood Building Demonstration Initiative (TWBDI) of Canada (2013-2017) supported two demonstration projects including contributing \$2.33 million to Brock Commons, the tallest modern mass timber construction as of September 2017 (pictured below). The building is a student residence at the University of British Columbia, housing around 400 students.

The TWBDI supported many stages of the development including design, approval, construction, structural and fire testing, protocols for site efficiency and safety. The building is a hybrid structure, with 17 storeys of mass timber construction atop a concrete foundation (18 storeys in total). It utilised Canadian EWPs including CLT floor panels, glulam columns and parallel strand lumber columns. The building was erected in just under ten weeks thanks to the use of prefabricated wood products.

The aim of the initiative was to showcase the applicability, feasibility and environmental benefits of innovative wood-based solutions to large buildings over 10 storeys. A wealth of technical information from research funded through the initiative is being used to support proposed changes to Canadian building codes for 2020.



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Example 2: Make it Wood campaign, Australia

Australia has seen the spread of WEP at local government level thanks to the support of an environmental foundation, PlanetArk and their Make it Wood (MIW) campaign. Councils are encouraged and supported to adopt a WEP based on a pro forma policy. Since 2014, 16 local councils and two local government authorities have adopted policies, and two states, Tasmania and Western Australia, have adopted a state-wide policy.

The MIW campaign communicates with councils to inform them of the benefits of WEP, including via mail-outs, the distribution of a WEP fact sheet, presentations to individual councils and groups of councils, participating in the Australian Local Government Authority National Assembly, and the placement of adverts and editorials in a magazine dedicated to



Local Government. Discussions regarding the policy typically involve mayors, CEOs, planning officers and the purchasing department, although this varies significantly from one organization to the next. Advocacy at grassroots level, connections between local councils and endorsement by local government authorities have been key to the uptake and spread of the WEP.

The rationale behind the policies is to recognise the importance of the forest and wood products industry to regional employment and economic development and demonstrate a commitment to growing the forestry industry on a sustainable basis. The focus of these policies is often then on initial stages of project development, encouraging wood solutions to be included in design briefs.

Latrobe City Council was the first council in Australia to adopt a policy in 2014. It has

since seen the development of a wood-based AUD 30-million performing arts centre and AUD 46-million pool and is considering using wood in the renovation of the basketball stadium.

Example 3. WEP in Canada and the USA

Although there are many exemplary tall wood buildings in North America, both in the USA and Canada, the policy situation is very different between the two countries.

Canada has been at the forefront of Wood First style policies since the introduction of the Wood First Act in the state of British Columbia in 2009. Many cities and municipalities proceeded to adopt resolutions and bylaws in support of the initiative thanks to a strong coalition of Government and industry bodies. There is strong cooperation amongst Canadian provinces, including Quebec, through the work of the Canadian Wood Council's program Wood *WORKS!*, and the Quebec centre of expertise on non-residential wood construction, Cecobois.

Conversely, the USA does not currently have any Wood First legislation. However, the state of Oregon, where the forest industry and related value chains are the third largest trade sector, signed an executive order in 2012 (it expired in 2013) to promote wood products as a green building material. The aim was to identify two significant state construction projects that could feature wood products, both structurally and aesthetically. In addition to Oregon, a handful of other states, for example the state of Maine, have drafted some bills,

but no legislation has been passed. Despite this, there is an increasing share of tall timber buildings. The corporate sector (in particular technology companies) is using tall timber as it commits to increasing sustainability.



Finalized residential 13 storeyed woodframed building "Origine" in Quebec City

Example 4. The United Kingdom

Specific wood first policies are not widespread in the UK.

The municipality of Powys in Wales has a WEP in the form of a four-year programme encouraging the use of wood in innovative housing such as wood-framed multi-storeyed buildings. New briefs for council housing in Powys must demonstrate commitment to the requirement of using wood in both the construction and fit-out of buildings.

No specific WEP has been adopted in England, although campaigns such as Wood For Good suggest positive impacts on the number of tall wood buildings.

In Scotland, where there is no dedicated wood first policy, the Climate Change Plan mentions that since 2013 the government has worked to remove regulatory barriers to increased wood use, and supported the private sector, planners and architects through its national economic development agency with guidance on wood as a construction material and promoting the benefits of wood to developers (The Scottish Government, 2018). Wood for Good has partnered with the Scottish Forestry Commission and sponsored an award that encourages innovation in new timber buildings in Scotland. The annual Timber Awards have run for the last seven years and celebrate the use of diverse Scottish timbers (RIAS, 2019).

Example 5. Germany

The "Charter for Wood 2.0" policy of the German Federal Ministry of Food and Agriculture contributes to the Climate Action Plan 2050 by strengthening climate change mitigation through the targeted use of wood from sustainable forestry, enhancing the contribution of the sustainable use of wood to the climate change targets of the country. A subcomponent

of this policy, entitled “Using wood in urban and rural construction”, aims at:

- increasing the share of wooden buildings in the various building categories;
- increasing the use of wood in building renovations;
- curbing prejudice against wood in leading regulations and guidelines
- more consideration of the effects on climate change mitigation in strategies, programmes, manuals and guidelines for the construction sector” (Federal Ministry of Food and Agriculture, 2018).

The German Government does not unilaterally promote any specific building material, but promotes wood as a climate- and environmentally-friendly resource through programmes and projects, awareness raising and the provision of consumer information (Deutscher Bundestag, 2013).



Germany's tallest wooden multi-storey building in Heilbronn

Examples of WEP in Germany at the local level include:

- The Wood Construction Support Programme of the city of Freiburg, promoting the construction of new and extension of existing buildings with wood and renewable resources and providing additional residential areas. Financial incentives are limited to EURO 1,00 per kilogramme of natural carbon-storing materials or EUR 1,20 per kilogramme of renewable construction material that is regionally sourced (Stadt Freiburg, 2019).
- The pilot project “Prinz-Eugen-Park” in Munich, which is with 570 apartments the largest wooden housing estate in Germany supported by the city of Munich. The support programme with an overall budget of up to EUR 13,6 million provides financial support up to EUR 2,00 Euro per kilogram of renewable resources used as construction material, including wood (muenchen.de, undated).
- The construction of Germany's tallest wooden 34-metre, ten-storey building called “Skaio”, which was built for the Federal Garden Show 2019 in Heilbronn (Bayerischer Rundfunk, 2019).

Example 6. France

At national level, in order to remove technical, regulatory and economic barriers to high-rise wood-based building, the French government through the Ministry of Agriculture and Forest and the Ministry of Housing decided to organize in 2016 a national competition for the construction of tall wooden buildings. The purpose of the strategy was to build flagship buildings for architects, construction companies, real estate agents, showing how innovation now allows a new era for cost-efficient wood construction.

In the framework of the governmental initiative “New Industrial France”, a dedicated organization was created in 2016 (AdivBois) and a call for expression of interest was launched, targeted at stakeholders in urban development holding building land. From a list of potential sites, a national competition selected 13 sites where 48 wood-based demonstrative projects will be built (<https://www.adivbois.org/concours/>). These projects are all in progress at different stages.⁹

- These constructions must comply with the following sustainability goals:
- ecological (landscape, biodiversity, soil protection, social and cultural functions);
- climate (carbon sequestration through increased use of wood as material and as fuel);
- economic (development of bio-based economy and employment in zero-fossil-carbon sectors).



“Capable” building in Nantes-Saint-Herblain

Example 7. Sweden

Since 2005, the municipality of Växjö (90 000 inhabitants) has nurtured the ambition of becoming a fossil-free city, reducing as much as possible its CO₂ emissions, in particular through a Wood-Building Strategy, including wood for construction and heating.

The strategy is based on the municipality selling land to the developers for their construction projects, thereby bypassing the mandatory requirements mentioned in the Public Procurement Act. This development is based on the official Wood-Building Strategy. The land allocation agreements are seen as the most suitable method fulfilling the ambition of increased use of wood in constructions with the municipality (Lindblad, 2018).

As a city with dynamic demographic growth, the need for new housing regularly increases. As Växjö county has a long tradition of small-scale wood construction, the strategy fostered an industrial approach for greater production of wooden houses. The strategy for “More Wood in Construction” was defined according to possible contributions from three groups

⁹ Technical notice for conception and achievement of these projects (addressing all technical and regulatory barriers to be removed) is available at: <https://www.adivbois.org/wp-content/uploads/Vademecum-21-03-2017.pdf>

of actors:

- County wood business sector:
 - Meet market demand for building in wood;
 - Locally transform resource from the local forest.
- Linnaeus University:
 - R&D on construction techniques in wood;
 - Collaboration on pilot projects with industry and municipality.
- Växjö municipality:
 - Cooperation projects with business sector;
 - Municipal companies have to build in wood;
 - Providing to investors test areas for building in wood.

Targets:

Växjö Municipality and the city's municipal companies (Executive Board §317/2012) decided that:

- By 2015 25% of new buildings will be wood-based;
- By 2020 50% of new buildings will be wood-based.

The 2015 target was successfully reached, 2020 data are not available yet.

R&D and challenges for wood-based construction:

Växjö municipality wishes to address numerous challenges associated with the construction of wooden buildings, through further R&D and more pilot projects:

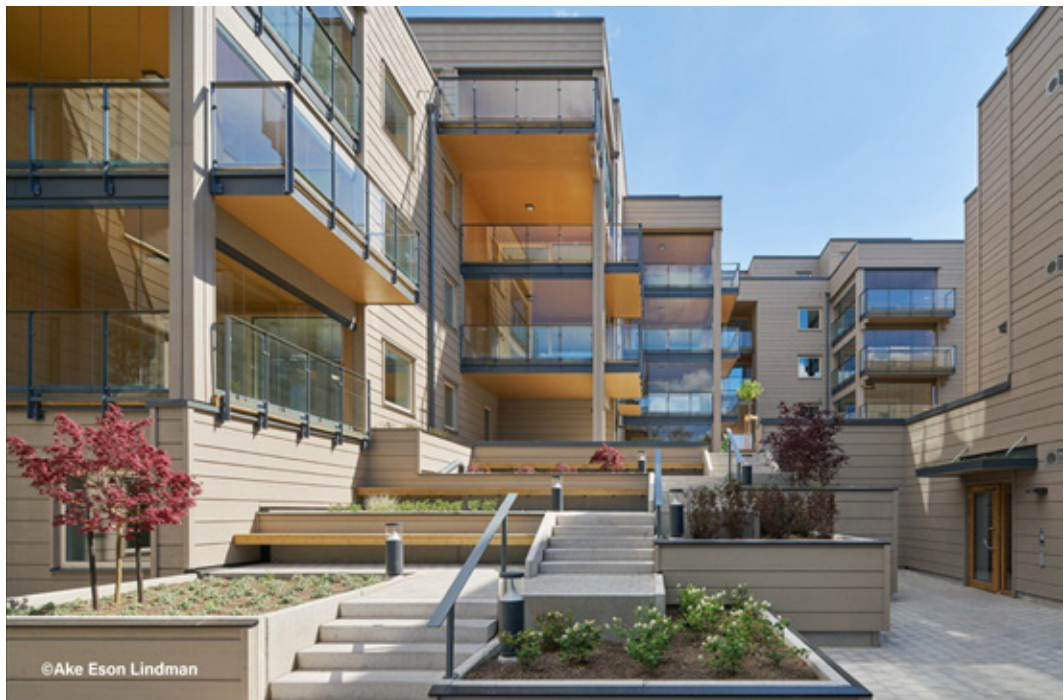
- Life cycle costs: the investment cost of new projects must be based on the production, user and disassembly phases. Tools need to be developed for calculating life-cycle costs for wooden buildings.
- Construction costs: to maintain competition between companies, to avoid risks of higher construction costs, particularly for multi-storey, multi-occupancy properties.
- Maintenance costs: to better take into account operating and maintenance costs, particularly for buildings with wooden façades.
- Sound and vibrations: in order to make wood more competitive, it is important to solve the problem of impact noise between building floors, especially in large office blocks.

Växjö Municipality and the city's municipal companies commission projects that combine wood materials with energy-efficient construction solutions. As a landowner and in order to support positive trends in wood construction, the municipality creates test environments in

the form of sites, where all or part of the land is reserved for wooden buildings.

In addition, the municipality is working with key players in the region, such as Vida, Södra, IKEA, the Centre for Building and Living with Wood (CBBT), the Swedish Trade and Employers' Association of the Wood Processing and Furniture Industry (TMF), the Swedish Construction Federation, the Swedish Forest Industries Federation and Lammhults Design Group.

In order to coordinate the efforts linked to Växjö Municipality's commitment to increase the use of wood in construction, a Wood Construction Council has been established with representatives from various municipal departments and companies. The strategy is monitored on a continuous basis and reviewed each three years.



Wooden architecture in Växjö

Conclusions

WEP are heterogeneous in form, scope and budget, and act collectively as an advocate for the increased use of wood in construction. They can target both the public sector promoting the procurement or the private sector providing incentives to use wood as construction material.

The underlying strategy of an increased use of wood in public buildings through public procurement is to support exemplary projects, including specific research and development, that private actors would not undertake alone and self-funded. These projects aim to show new technical and aesthetic possibilities for wood creating reference projects likely to generate architectural interest as well as technical and cultural appropriation by the private sector and the broad public.

These flagship buildings can then have a ripple effect and contribute to policy objectives such as climate change mitigation, reduced carbon footprint, reduced production of waste by the construction sector, reduced energy consumption by housing sector, rural development, bioeconomy, etc.. They can also be used to prove arguments in favour of wood-based construction, such as low carbon emitter, processed with low energy consumption, attractive and warm interior material for inhabitants, high mechanical performance and competitive economic performance.

The examples presented show that, irrespective of the respective national context, WEP at different levels mainly aim to:

- help stimulate sustainable economic development within the forest and wood products industry and encourage value adding products within the timber industry;
- encourage the public and private sectors to consider the use of wood, particularly in construction;
- encourage the public sector to disseminate information and promote education regarding the benefits of using wood in construction and fit out of buildings and infrastructure;
- encourage the public sector to consider the use of wood in exemplar (demonstration) projects.

Enhanced implementation of WEP may require further capacity building, research and development, including international collaboration and cooperation. The long distance travelled by any innovation from research to industry and markets requires intensive training and adaptations in production and construction processes. In Québec, for example, institutions like Cécobois address this “competence default risk”. Their mission is to accompany and advise actors of the wood construction value chains when they face problems in relation to innovation, new products and new construction standardization requirements.

Policies for enhanced sustainable development of cities and villages are sprouting up throughout the world. Many of them include sustainable housing compounds and as seen in this paper, some of them – known as WEP - promote the use of wood as “green”, renewable and recyclable material, while reducing the material and energy footprint of the construction sector. The examples introduced in this document constitute a small excerpt of the diversity of policies, policy tools and experiences aiming at increasing the contribution of wood products to sustainable cities while covering the “housing gap” and/or showcasing replicable and innovative demonstration projects for uptake by the pilot sector. Further analysis would be required to properly assess the impact of WEP on sustainable development, to the SDG and its possible benefits and challenges for upscaling, including in developing countries.

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