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Strategies and interventions to support the timber industry: literature review

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Strategies and interventions to support the timber industry:
literature review

Author: Zach Shirra

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Views expressed in this report are those of the researcher and not necessarily those of the Welsh Government

For further information please contact:

Aimee Krishan

Social Research and Information Division

Welsh Government

Cathays Park

Cardiff

CF10 3NQ

Email: ClimateAndEnvironmentResearch@gov.wales

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Glossary

Clear felling

The removal of all or most trees in an identified area of woodland at the same time.

Close to nature forestry / Continuous cover / continuous canopy forestry

An approach to forest management where the forest canopy is retained and individual or small groups of trees are removed at certain times to allow light to reach the floor and new seedlings grow (Coillte Nature, 2020)

Life cycle analysis or assessment

A methodology for calculating the environmental impact of products or services throughout their entire life cycle

Productive woodlands

Productive woodlands means any land on which trees are growing or standing, or may be grown, in such quantity and quality as may be commercially harvested on an economical basis (Law Insider, n.d.)

Sustainable forest management

Sustainable forest management is the stewardship and use of forests and forest lands in a way and at a rate that maintains their biodiversity, productivity, regeneration capacity and vitality, and their potential to fulfil, now and in the future, relevant ecological, economic and social functions at local, national and global levels, and that does not cause damage to other ecosystems (Forest Research, 2023)

Sick building syndrome

Sick building syndrome is the name for symptoms you get while you're in a particular building. It usually happens in an office, but you can get it in any building. It's not clear exactly what causes sick building syndrome.

It's probably due to a combination of things, such as:

- poor ventilation or poorly maintained air conditioning systems
- dust, smoke, fumes or fabric fibres in the air
- bright or flickering lights

- problems with cleaning and layout, such as crowded desks

Sick building syndrome mostly happens in open-plan offices. (NHS, n.d.)

Self-build and custom housing

Self-build and custom housebuilding covers a wide spectrum, from projects where individuals are involved in building or managing the construction of their home from beginning to end, to projects where individuals commission their home, making key design and layout decisions, but the home is built ready for occupation (UK Government, 2016)

1. Introduction/background

Background

- 1.1 The Welsh Government has committed to develop a Timber Industrial Strategy in Wales. This is demonstrated in the Programme for Government – Update (Welsh Government, 2021a, p.7) which committed to: “Create a timber based industrial strategy that can develop and sustain the high value production and processing of Welsh wood.”
- 1.2 This commitment aligns with the Woodlands for Wales Strategy which sets out the Welsh Government’s broader vision for woodland, trees and forests (Welsh Government, 2018). Two Woodland for Wales outcomes set out in the strategy relate to the Welsh timber industry:
 - More timber is grown, processed and used in Wales
 - Increased use of timber as a key renewable resource
- 1.3 The Welsh Government (2021b) also published Trees and Timber Task Force: Recommendations, following a deep dive exercise held by the then Deputy Minister for Climate Change. One of the recommendations made by the Task Force was to develop a Timber Industrial Strategy within Wales.
- 1.4 Following the recommendations made by the Task Force, a policy team was created to develop a Timber Industrial Strategy for Wales.
- 1.5 The Timber Industrial Strategy Policy Team commissioned the Climate and Environment Research Team in the Welsh Government’s Knowledge and Analytical Services to undertake a literature review of the available evidence regarding the effective development of a high-value timber industry. Within this literature review, a high-value timber industry relates to high-quality wood being used for high value products i.e. where products have long-lasting uses (for example in construction materials) or have the capacity to be re-used. The literature searches were carried out by the Welsh Government Library Services and the Climate and Environment Research Team.

Aims and objectives

- 1.6 The aim of this literature review was to understand the available evidence on existing strategies and best practice to promote and support a high-value timber industry. The literature review aimed to identify relevant and existing evidence which may inform the development of a Welsh Government Timber Industrial Strategy. The evidence from this review will be considered during the development of the Welsh Government Timber Industrial Strategy and to inform needs for further primary research in the future.
- 1.7 This literature review sought to answer the following five research questions:
1. What have other countries done / what kind of delivery models have other countries adopted that have been effective in improving the productivity of woodlands whilst supporting biodiversity, biosecurity, and carbon sequestration?
 2. What interventions have governments implemented, throughout the supply chain, in other countries to encourage timber for use in high-value products?
 3. How have other countries successfully promoted the use of timber products in the construction industry?
 4. How have other countries effectively supported an increased acceptance and implementation of productive forestry practices amongst farmers?
 5. What does existing literature indicate are the social benefits of a high-value timber industry, including knock-on social benefits resulting from economic opportunities?

2. Methodology

Approach

2.1 This report is based on literature searches undertaken by the Welsh Government Library Services and the Climate and Environment Research Team. An initial search was undertaken in October 2022. The remaining searches were completed between (17/10/2023) and (28/11/2023). Four separate literature searches were conducted for this project.

2.2 The first search, undertaken by the Welsh Government Library Services, was commissioned by the Forest Resources Policy Team in October 2022 and was intended to provide a general background on international timber industries. Using the results from the initial literature search and discussions with the Timber Industrial Strategy Policy Team, five specific research questions were developed – see paragraph 1.7. The research questions covered three broad topic areas:

- International delivery models, examples, and best practice in promoting productive woodlands and encouraging timber for high value products across the supply chain
- The acceptance and implementation of productive forestry practices amongst farmers
- Social benefits of a high-value timber industry

2.3 These three broad areas were used to determine three subsequent literature searches. Two of these searches were undertaken by the Welsh Government Library services and one search was undertaken by the Climate and Environment Research Team. The Climate and Environment Research team undertook the search on international delivery models, examples, and best practice in promoting productive woodlands and encouraging timber for high value use. The searches undertaken by the Welsh Government Library services covered the other two topic areas. The results of the four literature searches were combined into this literature review report.

2.4 The acceptance and implementation of productive forestry amongst farmers was identified as a key area to cover within this literature review as data indicates 90%

of all land in Wales is farmland (Devenish, 2022). This suggests that to develop new woodlands or support existing woodland timber crop, there will likely be some engagement and reliance on farmers and their land.

Scoping

- 2.5 The evidence gathered in this literature review includes research papers, government strategy documents and other grey literature. The search was limited to Europe and Canada for their geographical similarities to Wales. The decision was also taken to include Australia and New Zealand within the literature review due to the prevalence of agricultural land in each country. Fifty five per cent of all land in Australia is used for agriculture (Department of Agriculture, Fisheries and Forestry, 2024) and almost half of all land in New Zealand is used for agriculture or horticulture (New Zealand Government, 2021). The search criteria only included literature that had been published within 10 years of the search. Searches were initially set to identify evidence within the last 5 years with the option to expand to 10 years if not enough literature was available. Literature was excluded if it was not readily accessible in English.
- 2.6 One source, concerning timber promotion in New Zealand in the 1920s (Sveding, 2023), was included despite its findings relating to action occurring 100 years ago. This article was included due to contextual similarities in New Zealand at the time with the current situation in Wales. The source covers actions taken to increase private sector productivity to boost the timber industry which was also suggested by the Timber and Trees Task Force for consideration in Wales (Welsh Government, 2021b). The article and reflections within it were published in 2023.

Search strategies

- 2.7 The first literature search was undertaken by the Welsh Government Library Services between 14/10/2022 and 20/10/2022. This was requested by the Forestry Resources Policy Team. This search requested reports, plans, and strategies into how to develop and grow a timber industry / timber sector. The search terms used in this request were: timber, forestry – (workforce, skills, jobs), trees, wood, industry / economy related to trees / forestry, and green economy.

- 2.8 The second literature search was conducted by the Climate and Environment Research Team and was undertaken between 19/10/2023 and 06/11/2023. This search was related to the research questions:
- What have other countries done / what kind of delivery models have other countries adopted that have been effective in improving the productivity of woodlands whilst supporting biodiversity, biosecurity and carbon sequestration?
 - What interventions have governments implemented, throughout the supply chain, in other countries to encourage timber use for high-value products?
 - How have other countries successfully promoted the use of timber products in the construction industry?
- 2.9 This search covered only grey literature. Grey literature can include academic papers, including theses and dissertations, research and committee reports, government reports, conference papers, and ongoing research (Paez, 2017). This search was conducted using Microsoft Bing search engine, Google search engine, and Google Scholar search engine. The search terms used in this request were: government forestry strategy, government timber strategy, timber industry strategy, timber construction, promoting timber construction, and government intervention in timber.
- 2.10 The third literature search was undertaken by the Welsh Government Library Services between 17/10/2023 and 20/11/2023 and was requested by the Climate and Environment Research Team. This search requested literature regarding the research question:
- How have other countries effectively supported an increased acceptance and implementation of productive forestry practices amongst farmers?
- 2.11 The search strategies used in this search are set out in Annex A.
- 2.12 In addition to these search strategies, where the Library Services identified relevant databases, these were browsed for any publications that may include evidence useful for inclusion within this literature review.
- 2.13 Library services initially identified 39 sources using the search strategies implemented for the third literature search (acceptance and implementation of

productive forestry practices amongst farmers). The Climate and Environment research team then further reviewed these sources against the research aims and identified that 8 included relevant findings. Sources were identified as irrelevant to this work for the following reasons:

- They did not relate to productive woodlands on agricultural land
- They did not relate to actively managed agricultural land
- They did not relate to the promotion of productive woodlands

2.14 The fourth literature search was undertaken by the Welsh Government Library Services between 02/11/2023 and 28/11/2023 and was requested by the Climate and Environment Research Team. This search was related to the research question:

- What does existing literature indicate are the social benefits of a high-value timber industry, including knock-on social benefits from economic opportunities?

2.15 The search strategies used in this search are also set out in Annex A.

2.16 Overall, this literature review included findings from a total of 67 sources.

2.17 The literature review methodology had some limitations which should be considered when reviewing the findings. These are set out below.

Limitations

2.18 The literature identified within this review were limited by the search strategies used. The sources and literature that were identified within this review may not be the only literature that exists on this topic but instead were the ones identified using these search terms. Different search terms may have yielded different sources. This also extends to gaps identified within the literature, these gaps may not exist within the wider literature but existed within the literature identified through these search strategies. This is particularly relevant regarding the limited evaluation sources identified for government strategies through the search terms used. This may not mean that there was limited evaluative evidence within wider literature outside of the search terms used.

- 2.19 During the process of reviewing the literature, each source was assessed to determine the extent to which interventions suggested and explored within the literature had been evaluated for their efficacy or impact. This process identified that most sources suggested actions but did not reflect on how effective these were proven to be in the past. Much of the evidence identified in this report were theoretical, recommending actions and suggesting that these actions would result in growth in the timber industry. In this document, the level of available evidence relating to the effectiveness of each intervention has been stated.
- 2.20 Generally, few evaluations and empirical studies were identified within this literature review. The limited evaluative evidence identified within this review may also be partly due to the relative recency of strategies identified and included. Many of these strategies are still being implemented or have recently commenced, therefore evaluations may take place in the future, be planned or are currently underway. This limited the ability to evaluate the efficacy of actions taken within these strategies at the time this literature review was undertaken.
- 2.21 A final limitation of this review was no literature was identified concerning interventions within the supply chain between timber growing/felling and the end-product. This may have been due to the search terms used which focused on overall government strategies and interventions rather than specific actions at different points of the supply chain. Within government strategies identified within this review, the end of the supply chain was generally the key focus. Further, timber for use in construction products was the most common end-product identified within the literature reviewed but there may be literature available related to other end-products that were not found in this review.
- 2.22 These limitations should be taken into account when reading and interpreting the findings of this literature review below.

3. Findings

International delivery models adopted to improve the productivity of woodlands whilst supporting biodiversity, biosecurity, and carbon sequestration

3.1 This sub-section includes forestry approaches and elements of delivery models, identified within the literature, that intend to improve the productivity of woodlands. Approaches included within this section aim to promote the productivity of forests whilst also supporting biodiversity, biosecurity, and carbon sequestration. This approach can broadly be defined as sustainable forest management (SFM).

3.2 Sustainable Forest Management may be defined as:

“the stewardship and use of forests and forest lands in a way and at a rate that maintains their biodiversity, productivity, regeneration capacity and vitality, and their potential to fulfil, now and in the future, relevant ecological, economic and social functions at local, national and global levels, and that does not cause damage to other ecosystems.” (Forest Research, 2023).

Approaches to growing timber in line with SFM

3.3 One area of SFM identified within the literature search was Close to Nature Forestry (CNF) also referred to as continuous cover / continuous canopy forestry (CCF) – the terms are often used interchangeably in the literature. This report references the term used in the literature source being discussed at the time. CCF can be defined as:

“an approach to forest management where the forest canopy is retained and individual or small groups of trees are removed at certain times to allow light to reach the floor and new seedlings grow” (Coillte Nature, 2020).

3.4 An evidence review by Larsen et al (2022) indicates that Close to Nature Forestry approaches are used widely across Europe. In some countries such as Finland, Portugal, and Sweden the usage rate is lower however, in Denmark, Switzerland, Slovenia, and some German states almost all forestry practices take a closer to

nature approach. CCF practices are present within most European countries, however the extent of these practices varies greatly (Mason et al., 2022).

- 3.5 The literature identified in this review sets out some of the perceived benefits of CCF / CNF approaches. Through increasing the diversity of tree species within forestland, it is suggested the resilience of forests can also be increased as new species may be, for example, resistant to disease and so the likelihood of the forest being wiped out by disease may be decreased (Manatū Ahu Matua, 2022b). Furthermore, increasing the resilience of forestland may result in increased sector resilience through decreasing the likelihood of supply chain disruption from issues such as disease. The increase in species biodiversity may provide opportunity to diversify the production capabilities of forests, with new species introducing opportunities for products that could not be produced by species previously dominating the woodland (Manatū Ahu Matua, 2022b).
- 3.6 As well as disease resistance and opportunities for diversification, it has been suggested that the lack of clear-felling associated with CCF practices may help to increase the net carbon sequestration within woodlands through minimising disturbance to soil (Fern, 2020). However, it is important to note that other approaches outside of CNF / CCF may also provide carbon sequestration benefits through actions such as carbon being stored in high-value products (discussed further in paragraph 3.9 below).
- 3.7 Literature also suggests that CCF practices may support the quality of the timber product itself. Denser annual rings and smaller twig marks associated with longer growth periods (compared to other forest management methods) before harvesting, may result in this timber being worth more (Fern, 2020). In this way CCF practices may provide the opportunity to encourage the use of timber for high-value products to make best use of the high-quality timber. It is important to note that, although CCF may be one way to produce higher quality timber, it produces a lower yield of timber in the first years due to longer growth and harvesting timescales. This can impact the woodland's overall productivity.
- 3.8 Outside of continental Europe, CCF is also being encouraged in New Zealand due to the view that it can bring environmental, social, and economic benefits to the

forestry sector (Manatū Ahu Matua, 2022b). New Zealand's Forestry and Wood Processing Industry Transformation Plan suggests the benefits of CCF may include recreation, carbon sequestration, sustainable year-round employment, and the potential to produce higher value timber. However, no evidence sources were identified within this literature review on the realisation of these benefits in New Zealand.

- 3.9 It is important that any approaches to forest management to support timber production balances the need to support the sustainability of woodlands and the productivity of the woodland and its products. CCF is just one example of an approach that commonly appears in the literature. A report published by Forest Research (Matthews et al., 2022) suggests that other methods of forest management outside of CCF also positively impact carbon sequestration whilst providing increased timber production capabilities. In the report, 12 different forest management scenarios were modelled to identify their capacity for carbon sequestration. These scenarios were chosen to provide a mixture of species type and site management including a range of scenarios with different levels of thinning (continuous cover, thinning, no thinning) and felling approaches. The results of this modelling suggested that over shorter periods of time (2022 - 2050) faster growing softwood plantations, actively managed through thinning, clear-felling and re-stocking, may provide greater carbon sequestration potential than the other methods modelled, with this difference being greater if carbon sequestration through timber products was accounted for. However, over longer periods of time (2022 - 2100) the difference in carbon sequestration between management scenarios was less pronounced. Longer timescales are less sensitive to variations in tree growth rates, thinning practices and changes to soil carbon stock. The report suggests that a combination of management methods may be most effective in boosting carbon sequestration and productivity and recognised the importance of matching methods to sites with the greatest suitability.

Policy action / forestry standards

- 3.10 Sustainable Forestry Management processes have been supported through introducing requirements to promote or use sustainable practices within national

forestry standards. In Denmark, close to nature forest management principles are required within all public forests (Larsen et al., 2022). In some German states, forest law requires nature-based forestry management within all productive forests. In Ontario, forests are managed under the forest policy framework which requires forest practices to conserve ecological processes and biological diversity whilst providing economic opportunities (Government of Ontario, 2020). Evaluations of the extent to which these have been effective in promoting productive woodlands that support biodiversity and nature were not identified within this literature review.

- 3.11 The UK Forestry Standard (Forest Research, 2023) currently applies to forests across the UK including in Wales which sets out requirements and guidance for managing forests sustainably. The UK Forestry Standard (UKFS) is described by Forest Research (2023) as:

“the technical standard for sustainable forest management in the UK. It sets out the approach of the four governments of the UK and defines the requirements and provides guidance for foresters on how to practise sustainable forest management in the UK. In this way, it provides a basis for operating grant schemes and official controls and support for regulatory processes. It also provides the foundation for a number of voluntary certification and quality assurance schemes used in the UK, and for assessing compliance with environmental management standards”

- 3.12 As well as requirements in the UK, there are also voluntary standards which woodlands can be opted in to. For example, the Woodland Carbon Code (Woodland Carbon Code, 2022) is an example of a voluntary standard in the UK that concerns carbon sequestration requirements in woodland creation projects.

Certification of products

- 3.13 In some countries, timber product certifications have been introduced. These certifications are granted to products or raw materials grown in forests that are managed using processes that meet pre-determined sustainability requirements. The intention of providing certification to products is to increase consumer trust in their quality, with the assumption that this will develop the market for this timber (European Commission, 2019). In this way, certification systems have been

introduced with the intention of providing economic incentive to introduce sustainable management practices within managed woodland.

- 3.14 Within the Alpine region of France, a project part-funded by the European Union introduced the certification Bois des Alpes (European Commission, 2019). To gain Bois des Alpes certification, wood is required to be harvested in a specific Alpine region, be fully traceable, and conform to technical and industry standards. Through this, the certification intends to ensure not only the quality of the timber but also the quality of forest management. Following the introduction of the certification, 60 public buildings were built using Bois des Alpes wood up to 2019. This indicates that certification can support timber use in construction and provide economic benefit to those supplying certified wood (European Commission, 2019).
- 3.15 In Ontario the certification of Ontario Wood has been introduced (Government of Ontario, 2020). The Ontario Wood logo is only granted to wood that comes from sustainably managed woodland and is harvested within the Ontario province. Through this certification, the Government of Ontario is hoping to increase sustainable forest management whilst developing a domestic market for timber (Government of Ontario, 2020). No evaluations of the efficacy of the Ontario wood logo in achieving these aims were identified in this evidence search.
- 3.16 Certification schemes also exist in Wales. Grown in Britain is one example of a voluntary certification scheme available to Wales (Grown in Britain, n.d.). This scheme provides certification for timber products that have been grown sustainably and legally in the UK and meet requirements of the UK Government Timber Procurement Policy and the UK Forestry Standard.

Grants / financial incentives

- 3.17 To reduce economic barriers to sustainable forest management, some countries have introduced grants to support productive woodlands to transition to sustainable management processes. In Ireland, as a part of the Woodland Improvement Scheme, funding will be provided for the conversion of existing forests to CCF management over a 12-year transitional period (Department of Agriculture, Food and the Marine, 2024).

- 3.18 Elsewhere in the UK, the Forestry Grant Scheme in Scotland is provided only to those forests that meet UK Forestry Standards for approved forest plans (Scottish Government, 2022). In both examples financial support is granted only to those forests which are managed through sustainable practices or are transitioning to sustainable forest management.
- 3.19 It is important to note that no evaluation of these grants could be identified in this evidence search and so their efficacy cannot be fully determined.
- 3.20 In Wales there are currently a range of woodland planning and woodland creation schemes available through the Welsh Government. These schemes cover developments from under two hectares to larger forests which may have the potential to become part of the National Forest for Wales network.
- 3.21 For instance, in Wales the Timber Business Investment Scheme was implemented between 2014 and 2023 and was available to private forest owners, public sector forest owners (including local authorities) and small to medium sized enterprises involved in forest planting and management and timber harvesting and/or processing (Teifi & Griffiths, 2023). Grants applied for under the scheme could be used for a range of activities including capital expenditure, small scale industrial processing and working operations prior to industrial sawing of wood (e.g. ground preparation, felling etc).
- 3.22 An evaluation of the scheme published in 2023 suggested that the scheme had strong alignment with several Woodlands for Wales strategic targets concerning the development of greater sustainable management of woodlands (Teifi & Griffiths, 2023). No successor scheme was implemented in Wales during the 2023/2024 financial year.

Education and knowledge sharing

- 3.23 A study of CCF usage across Europe (Larsen et al., 2022) found that a lack of knowledge surrounding management techniques is the most common perceived barrier to implementation. To overcome this barrier, some countries have identified the need for greater education and knowledge sharing to promote wider use of sustainable forest management techniques. For instance, Switzerland have

introduced federal measures regarding knowledge sharing and education (Federal Office for the Environment, 2021). One of these measures relates to knowledge sharing on good forest management as part of forest-related education and training, for example including education on how to adapt to changing climates in practice.

- 3.24 Similar actions regarding knowledge sharing are also suggested in the Scottish Forest Strategy Implementation Plan (Scottish Government, 2022). This plan specifically mentions publishing resources and evidence that detail the benefits of sustainable forestry practices to promote sustainable forestry. The plan also highlights the importance of international knowledge sharing to inform and apply international good practice for sustainable forest management.
- 3.25 The governments of Finland (Ministry of Agriculture and Forestry, 2019) and Ireland (Department of Agriculture, Food and the Marine, 2023a; 2023b) also refer to the role of knowledge sharing to aid in meeting sustainable forest management goals. Whilst the New Zealand Government specifically highlight the need to share knowledge on the benefits of CCF specifically to promote its uptake (Manatū Ahu Matua, 2022b).
- 3.26 The role of knowledge exchange has also been recognised in Wales through the Science and Innovation Strategy for Forestry in Great Britain (Welsh Government, 2020). The strategy expresses the importance of effective knowledge exchange between researchers and end users to develop sustainability and productivity within the domestic sector. This strategy applies across the devolved administrations of Great Britain, including within Wales.
- 3.27 Within the literature identified in this review, limited reference was made to how increased education and knowledge sharing would be delivered in practice including any models or approaches for delivery. No evidence was identified through this literature search to determine whether knowledge sharing and education regarding sustainable forestry practices has led to a realised increase in sustainable forest management.

International government interventions throughout the supply chain to encourage timber use for high value products, including in construction

3.28 This sub-section sets out the evidence and sources identified to answer research questions two and three:

- What interventions have governments implemented, throughout the supply chain, in other countries to encourage timber to be used for high-value products?
- How have other countries successfully promoted the use of high-value timber products in the construction industry?

3.29 It covers evidence relating to interventions to encourage timber for high value use across the supply chain as well as the use of high-value timber products in construction specifically. The decision was taken to consider these two questions together, due to the amount of evidence concerning the supply chain that focused on timber production for use within construction.

Investment in research

3.30 Within the evidence search, investment in research was identified as an important tool in driving forward the development of the timber industry. The Governments of Switzerland (Federal Office for the Environment, 2021), Ireland (Department of Agriculture, Food and the Marine, 2023a; 2023b), New Zealand (Manatū Ahu Matua, 2022b), Australia (Department of Agriculture, Water and the Environment, 2021), Ontario (Government of Ontario, 2020), and Scotland (Scottish Government, 2019) all refer to the importance of research to support the future timber industry.

3.31 The Governments of both Ireland and New Zealand have detailed plans to support research and innovation regarding timber in the construction sector. For instance, Ireland's Forest Strategy sets out the goal for new technology, research and innovation to support forest establishment, management, health, the supply chain and the use of timber in construction (Department of Agriculture, Food and the Marine, 2023a). Actions to deliver the strategy's goals are set out in Ireland's Forestry Implementation Plan (Department of Agriculture, Food and the Marine, 2023b) and includes a commitment to develop a facility for forest research and

innovation between 2023 and 2030. A mechanism to support the use of research in New Zealand was the government's investment in a Timber Design Centre (Manatū Ahu Matua, 2022a). The centre was introduced to act as a clear point of contact for advice and information, where key research and developments would be readily available. The intention being that easily accessible advice and information on the latest research and innovation developments would increase the take up of use of timber, particularly in mid-to-high rise buildings. However, it is important to note that no evidence was identified within this literature review to suggest that investment in research has resulted in an increased usage of raw timber for high-value products.

Legislation, agreements, and programmes

- 3.32 In Amsterdam (Amsterdam Institute for Advanced Metropolitan Solutions, 2021), Denmark (Ministry of the interior and housing, 2021), New Zealand (Manatū Ahu Matua, 2023) and Ireland (Department of Agriculture, Food and the Marine, 2023b) government legislation has been passed or is being developed that could encourage an increased use of timber for high-value products.
- 3.33 The metropolitan region of Amsterdam signed the Green Deal Timber Construction in the Metropolitan Region of Amsterdam (Amsterdam Institute for Advanced Metropolitan Solutions, 2021). This agreement requires all new building projects to include at least 20% timber or biobased materials in construction. This agreement has gone beyond generally promoting or encouraging timber use by placing a specific requirement for timber inclusion. However, as the deal requires the 20% threshold on new projects to be in place from 2025 onwards, there is currently no evidence to show its efficacy in increasing timber in construction.
- 3.34 Sustainability requirements for new construction projects have also been introduced in Denmark which could indirectly promote the use of timber in buildings (Danish Energy Agency, 2021). These requirements include an introduction of Life Cycle Analyses (LCA) and the promotion of climate friendly materials – although these materials were not defined in the document. The introduction of LCA of products in construction may encourage increased use of high-value timber in construction. LCAs measure the environmental impact associated with each stage of a product or process' life cycle and therefore favour materials that can be recycled and have the

potential to be useful beyond their initial use. High-value timber products generally perform well in an LCA as they have potential for cascading uses, meaning the wood can be repurposed to make new products once its use in construction is complete (Rogers, 2023).

- 3.35 Rather than introducing requirements on the type of materials used or required material characteristics that might encourage the use of timber (as well as other more sustainable building products), New Zealand have introduced a programme to use timber specifically in construction. This is through a part-funded Government programme, Mid-Rise Wood Construction (Tapuwae Ahuwhenua, 2022). This relates to the use of domestic timber in mid-rise buildings. The most recent evaluation of the programme, at the time of the literature search (Manatū Ahu Matua, 2023), showed that one residential reference building had been completed as a result of the programme and that other commercial reference buildings were under construction. Both building projects were constructed using timber products.
- 3.36 In Ireland, the government is looking to develop a wood-first policy to be integrated into the national housing strategy (Department of Agriculture, Food and the Marine, 2023a; 2023b). The suggested wood-first policy intends to result in buildings constructed from Irish timber becoming the standard within the domestic construction industry and the substitute material of choice to carbon intensive building products. No further information on the details of how this policy will be implemented was identified within this literature review, beyond an action in the Ireland's Forestry Strategy Implementation Plan to establish a forum to explore this.
- 3.37 Through proposed legislation and programmes identified within this sub-section, these Governments are seeking to develop the market for high-value timber products which, if successful, could result in an increase in the supply of timber processed for high-value products to meet demand. However, this literature review highlighted minimal evidence to indicate whether this is happening in practice.

Updating building codes and standards

- 3.38 One method that has been applied internationally to try and promote timber inclusion within new buildings are changes to building codes and standards. In the

Forestry Strategy for Ontario (Government of Ontario, 2020), an action to update local building codes has been included. The aim of updating the building code is to expand the opportunity and ease for timber use within construction with the intention that this will lead to a consequential increase in timber construction.

- 3.39 Similarly in Denmark (Danish Energy Agency, 2021) and New Zealand (Manatū Ahu Matua, 2022b), the governments have been looking at how to adjust building codes to increase the opportunity for sustainable construction materials to be used in new building projects. This would in turn increase the opportunity for high-value timber products to be used within construction projects. The Australian Government has made a commitment to develop and implement new building specifications to encourage timber use in high-rise construction specifically (Department of Agriculture, Water and the Environment, 2021).
- 3.40 Rather than introducing new regulation, the Swiss Government has set out its intention to remove existing regulatory barriers from standards, strategies, and frameworks that restricted the use of timber in construction to allow for the increased opportunity for its use in new buildings and installations (Federal Office for the Environment, 2021).
- 3.41 However, no evidence to show if these interventions have successfully resulted in an increased use of timber in construction was identified within this literature review.

Education and knowledge sharing

- 3.42 Education and knowledge sharing initiatives were commonly identified in the literature reviewed as a way to promote the use of timber in construction. The importance of education and knowledge sharing was also highlighted as a mechanism to support the uptake of sustainable forestry practices for productive woodlands earlier in this review (see paragraph 3.23 – 3.27). During the search of the literature, education surrounding timber in construction featured in documents originating from New Zealand (Manatū Ahu Matua, 2022b), Switzerland (Federal Office for the Environment, 2021), Ireland (Department of Agriculture, Food and the Marine, 2023a; 2023b), Ontario (Government of Ontario, 2020), and the European Union (European Economic and Social Committee, 2023). Some of these education

initiatives aim to promote timber construction through educating industry members and the public on the benefits of using timber within construction (Federal Office for the Environment, 2021; European Economic and Social Committee, 2023; Department of Agriculture, Food and the Marine, 2023a; 2023b).

- 3.43 The Swiss Government's forest policy measures contain an action to increase end users' awareness of the benefits of using Swiss wood products and to support marketing campaigns to promote wood sales (Federal Office for the Environment, 2021).
- 3.44 Ireland's Forest Strategy Implementation Plan focuses on educating construction professionals through including an action to further develop knowledge of timber as a construction material amongst professionals (Department of Agriculture, Food and the Marine, 2023b).
- 3.45 One approach identified which aims to share knowledge with industry professionals is the provision of knowledge services to advise industry professionals on effective use of timber in construction design (Manatū Ahu Matua, 2022a; 2022b). In New Zealand, the Timber Design Centre was established to provide information on timber design guidance to help construction industry professionals to integrate timber more effectively into new construction projects. No publicly available evaluation was identified in this literature review to determine how effective the Timber Design Centre has been in promoting the use of timber in construction.
- 3.46 The consistent theme across all education interventions identified in this review was the idea that unless the workforce has the necessary knowledge, high-value timber production and usage in the construction industry cannot effectively be increased.

Increased wood use for government projects

- 3.47 In some countries, governments have led by example in promoting timber construction through committing to include timber in government and public buildings.
- 3.48 The Forest Sector Strategy for Ontario (Government of Ontario, 2020) specifies that wood will be promoted within construction of public buildings and bridges to lead by example in reducing the carbon footprint of construction. Similarly, New Zealand

has introduced new low-carbon procurement requirements for its own construction projects, which aim to increase the use of wood in Government construction projects (Manatū Ahu Matua, 2022b). The Swiss Government has made a direct commitment to increase the use of Swiss wood in its own buildings and installations (Federal Office for the Environment, 2023).

- 3.49 These interventions aim to deliver a direct increase in timber construction within government building projects, alongside the intention that these projects act as an example to encourage wider adoption of timber construction within their country. However, there no evidence identified in this literature review to suggest an increased use of timber for Government building projects leads to a wide-spread increase in timber construction.

High-value timber and construction

- 3.50 The majority of the evidence concerning the promotion of timber for high-value products identified in the literature search focused on its usage within the construction sector. Limited reference was made throughout the identified literature to the promotion of non-construction related high-value timber products or how it is being promoted throughout other parts of the supply chain. As mentioned in the methodology limitations sub-section, this may have been drawn out if other, more specific search terms were used.

Promoting the acceptance and implementation of productive forestry practices amongst farmers

- 3.51 Recent statistics indicate that 90% of all land in Wales is used as farmland (Devenish, 2022). This large quantity of land used for agricultural practices suggests that to successfully increase the uptake of productive forestry to support the timber industry, encouraging farmers to engage in these practices will be important. This section details actions, identified in the literature, taken by other countries to promote the uptake of productive forestry, including for timber production, by farmers.

Promoting knowledge

- 3.52 A literature review by Staddon et al., (2021) focusing largely on evidence originating from Europe, identified a view amongst some farmers that some agricultural land is “too good for forestry” and should be reserved for agricultural production. The review concludes that sharing best practice with farmers, agricultural advisors, and agents on how to introduce woodlands without interrupting agricultural production, may be helpful in overcoming these concerns. Knowledge sharing on how forestry can provide the maximum benefit to farm productivity may also be beneficial.
- 3.53 An important aspect identified within the literature was the promotion of knowledge on the benefits investing in forestry and increased tree cover can bring to farmers. These benefits include shelter for livestock during extremes of weather conditions (Scottish Forestry, 2019), improved water regulation (Chanarin et al., 2022), and long term potential financial benefits (Forestry Commission, 2023a Manatū Ahu Matua, 2023). The promotion of benefits that trees could bring to farmers was one of the actions taken by the state in New Zealand during the 1920s to increase their timber production and the capacity of their domestic timber market (Sveding, 2023). At the time, New Zealand also introduced forest extension officers and marketing campaigns such as posters promoting financial benefits of managing forests for timber to support knowledge sharing to farmers (Sveding, 2023).
- 3.54 Actions to share knowledge on forestry practice with farmers have been included in documents published by the Soil Association England (Soil Association, 2022) and the Scottish Government (2022b). Evidence from case studies in Scotland (Scottish forestry, 2019) and England (Forestry Commission, 2023a) and an evaluation of action taken in New Zealand (Sveding, 2023) suggests that where this knowledge has been shared with farmers, they have successfully implemented forestry practices to provide timber. However, this evidence did not assess the extent to which increased productive forestry practices amongst farmer could be attributed to these knowledge sharing interventions. Therefore the causal effect of these knowledge sharing interventions were less clear.
- 3.55 A second aspect of knowledge promotion identified within the literature concerned how to implement forestry practices effectively on actively managed agricultural

land. Staddon et al., (2021) identifies a belief amongst some farmers that some of their land is “too good for forestry”, and it was suggested that this could act as a barrier to farmer uptake of productive forestry. Knowledge sharing on the use of marginal land or less productive areas of land for tree planting may help overcome this barrier, by reducing concerns of productive agricultural land being taken over for forestry. A case study from Gascoigne farm in Scotland (Scottish Forestry, 2019) has shown how using less productive agricultural land for forestry can allow for effective productive forestry without sacrificing agricultural productivity. This case study did not assess the scale of forestry required to provide economic benefit in itself. However, it is important to highlight the actions taken on the case study farm that allowed the farmer to yield other economic benefits to understand whether this approach could be replicated on other farms. For instance, the agricultural land converted to forestland was on a hill (that made up around 550 acres of the 850-acre farm). At the same time as planting trees, the farmer was also able to swap from a hill breed of sheep to a lowland breed and halved the number of sheep overall. Despite halving the number of sheep (to 300 ewes), the farm was able to maintain the same income from the sheep due to the lowland breed maturing earlier and producing better quality meat. The farm was also able to receive money in subsidies to support some of the tree planting and maintenance. Not all farms may be in a position to make similar shifts to diversify into forestry whilst maintaining their same agricultural yield, but this case study does identify an example of the kinds of actions that can be taken.

- 3.56 Due to a lack of evaluation-based evidence identified within this search, the relationship between the sharing of knowledge and increased timber production on farms cannot be determined. However, qualitative evidence was found through this review to suggest that increased knowledge around forestry may increase the likelihood of farmers integrating these practices on their land.

Financial support

- 3.57 Planting woodland for productive forestry practices on agricultural land is associated with a large initial cost to farmers (Soil Association, 2022). Productive forestland also does not provide financial returns to farmers for a number of years (Chanarin et

al., 2022). Due to this, some of the literature suggests financial support may be needed to reduce the initial cost to farmers to make forestry a more attractive venture. For instance, the Soil Association highlight the importance of providing farmers with financial support to introduce forestry practices on their farmland (Chanarin et al., 2022; Soil Association, 2022).

- 3.58 Some case studies of farms that have received grants in Scotland and England to introduce forestry practices alongside their agriculture practices have shown successful integration of these practices on their land (Scottish Forestry, 2019; Forestry Commission, 2023b; 2023c; 2023d). However, there was limited evidence identified within this literature review to suggest if financial support in the early stages of woodland development and management leads to the long-term uptake of productive forestry specifically among by farmers.
- 3.59 Historically in Wales, the Welsh Government has delivered agri-environmental schemes, part funded by EU funding until the UK's exit from the EU in 2020. In June 2010, it was announced that the Glastir scheme would extend to include woodland creation and management alongside the three existing agri-environmental schemes it replaced, becoming the single agri-environment scheme in Wales (Wales Audit Office, 2014). The 2014-2020 Welsh Government Rural Communities - Rural Development Programme (WGRC-RDP) included two schemes to support farmers with woodland creation and woodland management funded through Glastir. However, this was not to support productive forestry specifically. A socio-economic evaluation of the 2014-2020 Glastir schemes has not yet been published. Findings exploring the up-take of the Glastir woodlands element in 2007-2013 Rural Development Plan for Wales suggested that the woodland grant schemes had positive effects on Gross Value Added (GVA) and employment but negatively impacted on labour productivity in the short term. The report suggested that this reflected the increased labour required in the short-term to create and manage woodlands compared with the long-term nature of returns. Following the UK's exit from the EU, Wales has explored how to provide domestic funding for farmers – see paragraph 3.64 below.

Direct state action

- 3.60 A recent report concerning New Zealand's promotion of tree planting for timber in the 1920s identified direct state action as one of the main drivers for increased timber production amongst farmers (Sveding, 2023). During the 1920s, the state sold trees and seedlings for planting directly to farmers to facilitate an increase in productive woodland areas on agricultural land. However, this action faced a large amount of pushback from the private sector, due to the State Forestry Service being accused of undercutting private companies on sale prices for seedlings.
- 3.61 The action was also taken by New Zealand's State Forestry Service during the same time period to introduce forest extension officers across the country who acted to advise and share knowledge amongst farmers regarding how to best implement forestry practices on their agricultural land (Sveding, 2023).
- 3.62 Similarly, the Soil Association in England (2018) has recommended action to train new farm and forestry advisors intended to: "break the divide between forestry and agriculture advice and expertise", with the intention that this will reduce the barriers to farmers for introducing forestry practices on their land. The Soils Association in England has also recommended actions for promoting the uptake of productive forestry practices amongst farmers. This includes a suggestion to integrate policy areas concerning forestry and agriculture to help overcome the 'historic separation of forestry and farming'. Another recommended action was to include trees in the UK Agriculture Bill to increase productive forestry by making it a requirement in the Bill.
- 3.63 Legislation related to agriculture has also been introduced in Wales following the UK's exit from the EU: the Agriculture (Wales) Act 2023 (Welsh Government, 2023). The Act sets out Sustainable Land Management (SLM) as the legislative framework for agricultural policy in Wales. The Act includes implications for forestry practices on farms as part of the Act through its four Sustainable Land Management (SLM) objectives:
- Sustainable production of food and other goods
 - Mitigating and adapting to climate change

- Conserve and enhance the countryside and cultural resources and promote public access to and engagement with them, and to sustain the Welsh language and promote and facilitate its use
- Maintain and enhance the resilience of ecosystems and benefits they provide

3.64 The creation of new areas of woodland on farming estates may contribute towards the four SLM objectives set out within the Act, particularly to mitigate and adapt to climate change. The Sustainable Farming Scheme (SFS) is intended to be one of the key delivery mechanisms to meet the SLM objectives in the Act. The SFS intends to encourage tree planting on farms by adopting a land sharing approach in which trees are integrated into the farm landscape. In this way tree planting within the SFS may support the broader aim of increasing carbon sequestration on agricultural land which in turn would feed into supporting the SLM objectives. The Act introduces monitoring and reporting requirements for schemes that support SLM. Indicators will be developed to measure scheme contribution to SLM and support later evaluation. The SFS, as a mechanism for SLM delivery, is still being finalised.

Social benefits of a use of timber for high-value products

Health benefits of biophilic design

3.65 High-value wood products can be used for structural or decorative purposes. For instance, the use of exposed wood within buildings has been suggested to provide both psychological and physiological health benefits (Lee & Park, 2021). The use of exposed wood within buildings is a simple way to incorporate the principles of a concept called biophilic design within modern buildings. A literature review by Zhong et al. (2022) defines biophilic design as:

“a deliberate attempt to satisfy the need of contact with natural systems in the contemporary built environment, and to improve people’s physical and mental health, productivity and wellbeing”.

3.66 A number of studies and reports identified in the literature search include evidence suggesting positive health benefits from biophilic design. Lee & Park (2021) suggest that visual exposure to nature through biophilic design provides the physiological

benefits of reduced blood pressure and heart rate and decreased sympathetic nervous system activity alongside the psychological effects of improved subjective satisfaction, reduced anxiety, tension, frustration, boredom, and fatigue. When used in office buildings, MacNaughton et al., (2017, cited in Lowe, 2020) found exposed wood provided benefits including better worker performance on cognitive function tests, better self-reported sleep quality and fewer symptoms of sick building syndrome¹.

- 3.67 In line with the above findings, Kotradyova et al. (2019) applied controlled experimental methods to test the benefits of wood products to healthcare settings. In a laboratory setting, surface contamination assessments indicated that non-chemically treated wood led to better antimicrobial resistance than wood treated with acrylic or oil finished wood. This antimicrobial resistance was suggested to contribute to a more hygienic environment. Kotradyova et al. (2019) concluded from these findings that exposed wood may be suitable for healthcare settings due to this antimicrobial resistance. The study also suggested that a waiting room with visible wooden construction was associated with a positive effect on participant's nervous systems and more positive emotional and satisfaction responses, compared with waiting rooms with no exposed wood. These findings came from experiments in controlled environments, no testing within real-life environments was identified within this literature search. The identification of literature showing similar findings in real-life settings would be beneficial to strengthen these findings.

Housing supply

- 3.68 Timber in construction has been suggested as an approach to help tackle the housing crisis within the UK (All-Party Parliamentary Group, 2021).
- 3.69 One suggested benefit of timber-framed buildings is a decreased construction time (All-Party Parliamentary Group, 2021; Lowe, 2020). These shorter construction times are in part associated with fewer required deliveries for sufficient material to

¹ Sick building syndrome is the name for symptoms you get while you're in a particular building. It usually happens in an office, but you can get it in any building. Symptoms can include headaches, blocked or runny nose, coughing and wheezing, skin issues and tiredness or difficulty concentrating. The cause is unknown but likely to be due to a range of factors including ventilation, air quality, building layout and lighting (NHS, n.d.)

complete building for cross-laminated timber buildings compared to cement structures (Lowe, 2020). These shorter construction times associated with timber-framed buildings provide opportunity for a greater number of houses to be built over a shorter period.

- 3.70 Other benefits of timber frame construction suggested in a report by the All-Party Parliamentary Group (2021) include producing fewer defects (Davies, 2018), producing up to 90% less waste, and providing carbon sequestration. This same report also suggests that timber construction has large potential for use within custom and self-build housing projects. Self-build and custom housebuilding covers a wide spectrum, from projects where individuals are involved in building or managing the construction of their home from beginning to end, to projects where individuals commission their home, making key design and layout decisions. (UK Government, 2016)
- 3.71 In Wales, quality requirements for affordable housing include maximising efficient use of carbon in construction to increase carbon storage (Welsh Government, 2021c). This is to support meeting an overall requirement that homes should be of high quality, innovative and sustainable and has applied to all publicly funded affordable housing schemes since 2021. Therefore it can be inferred that timber could support opportunities for affordable housing in Wales through this requirement/standard for sustainable and innovative products with the capacity for carbon storage. A report by The Timber Accord (2020) also highlights the opportunity for timber construction within both the private and social housing sectors.
- 3.72 Examples from overseas demonstrate the opportunities for timber use in residential buildings at a large scale. A report published by Timber Development UK (Waugh Thistleton Architects, 2024) identifies that 92% of residential buildings in the USA and 90% of residential buildings in Finland are built using timber. These figures suggest that timber is a construction material with capacity to be used in high volumes within residential buildings.
- 3.73 However, it is important to note that within the literature identified no evaluation-based evidence was found on the extent to which timber has been effectively

utilised to tackle a shortage in housing or to substantially increase the housing supply. Rather, it has been suggested as an option in recently introduced policies and requirements.

Job creation and diversification

- 3.74 As the timber industry grows it brings with it the need for a larger workforce to support increased production. A review of the forestry workforce in Scotland indicates that, to support the growing sector, the size of the workforce would also need to increase by a minimum of 32% from 2017 to 2027 (Glaister, 2019). This report also predicts a 29% uplift in the size of timber haulage workforce specifically between 2017 and 2027 to support development of the timber industry sector.
- 3.75 Similarly, a study was conducted to evaluate the current and predicted future status of the forestry sector workforce in England and Wales (RDI Associates Ltd. et al., 2021). This report provides evidence of a 441% increase in advertised vacancies within the forestry sector from 2016 to 2021, and forecasts a continued increase in demand for members of the forestry workforce in England and Wales up to 2030. The predicted increase in required workforce is based on an assumed increase in demand on the forestry sector as a result of increasing climate and carbon sequestration concerns (RDI Associates Ltd. et al., 2021). These findings, and the review of the forestry workforce in Scotland (paragraph 3.74), provide evidence to suggest there will be an increase of jobs available within the forestry and timber production sector. The UK Timber Market Statement 2021 also showed evidence of a steady gradual rise in employment within the sector, with the only decrease in employment being around 2020, likely an effect of the COVID-19 pandemic (The Research Agency of the Forestry Commission, 2021). Overall, the evidence indicates that a larger timber industry will likely have a positive benefit on the number of jobs in the forestry sector.
- 3.76 Alongside an increase in jobs, a report by the United Nations (2018) suggests that the nature of roles within the timber and forestry sector will change as the technology within the timber industry develops. The report identifies that wood production globally is becoming increasingly mechanised, which has resulted in a noticeable decrease in manual labour jobs as machines and operators replace

them. This mechanisation is reported to offer considerable green job opportunities for machine operators, health and safety specialists and experts in forest management and production. The report concludes that the skills needed by forest workers and machine operators will be different now than in previous decades and may require retraining. The United Nations also suggest other jobs, outside of mechanisation, will be increasingly needed to support a green economy including experts and specialists in forest management, trade, communications and marketing. This report focused on trends and future job opportunities so does not indicate whether these changes to workforce roles are expected to result in an overall net increase or decrease in the overall number of jobs in the timber and forestry sector.

- 3.77 These sources set out forecasts and predictions of future job and skills requirements for the forestry sector going forward. More time is needed to understand how these jobs, and the skills required to undertake them, have been developed and delivered in practice.

Local economy

- 3.78 Increased timber supply chain activity may also provide benefits to local areas. For instance, Hynynen (2016) reviewed existing findings on proposed effects of the timber construction industry on local regions and discussed how this could be applied to Finland. The University of Helsinki (Männistö, 2012, as cited in Hynynen, 2016) suggest developing the timber construction industry may provide a consequential increase in jobs available in each local region, and that an increase in timber sector job availability may be associated with an increase in regional economic growth. It is important to note that this study provided only hypothetical evidence of these effects, and focused on one region in Finland, so these results may not be generalisable to a Welsh context.
- 3.79 The role that forestry and timber may play in supporting the economy of rural communities is emphasised in the Irish Government's Forestry Strategy (Department of Agriculture, Food and the Marine, 2023a). The strategy suggests that this will occur through the industry providing jobs, including highly skilled jobs, to rural communities in Ireland and providing the opportunity for rural communities

to produce timber products. However, evaluation-based evidence to support these suggestions was not included within the strategy document.

- 3.80 Overall, there is limited evidence identified as a part of literature review on impacts on local job availability at present and the extent to which proposed findings can be generalised to other regions is unclear.

4. Conclusions

- 4.1 The aim of this report was to identify international evidence which could inform the development of a Welsh Government Timber Industrial Strategy. This review has discussed evidence concerning existing strategies and best practice to promote and support a high-value timber industry. For the purposes of this review, a high-value timber industry related to high-quality wood being used for high value products i.e. where products have long-lasting uses (for example in construction materials) or have the capacity to be re-used. This report considered approaches, strategies and research across the timber industry supply chain from managing woodlands to the end use of high-value timber products.
- 4.2 The review included research papers, government strategy documents and other grey literature and identified evidence to answer five research questions to help inform a Timber Industrial Strategy in Wales. These concerned international development and delivery of a high-value timber industry, the relationship between agriculture and productive forestry, and the social benefits of a high-value timber industry.
- 4.3 A number of themes consistently appeared within the identified literature across the five research questions explored within the report. These consistent findings may be relevant when considering approaches for developing a high-value timber industry within Wales.
- 4.4 These themes are summarised below.

Timber in construction

- 4.5 The literature regarding timber for high-value uses across all of the key research areas within this review largely focused on the use of timber for construction purposes. This suggests that timber use in construction may be a key area of focus to encourage the growth of a high-value timber industry within Wales. The Welsh Government has also identified the opportunity to promote the use of timber in construction of affordable and social housing, which is supported by findings from

the Timber Accord. Overall, the use of or intention to promote timber in construction was evidenced internationally.

Education and knowledge sharing

4.6 Education and knowledge sharing was a key theme identified within the literature under four of the key research questions. The literature suggested a need for effective knowledge sharing to support the effective development and growth of a high-value timber industry. Areas identified within the literature that could be supported through knowledge sharing included:

- technical skills required across the timber supply chain, including planting practices, forest management practices, and design of timber-based buildings,
- the benefits of high-value timber usage in construction, such as shorter construction times and health benefits of exposed timber, and
- the benefits of growing trees to support farmers in diversifying their income.

Grants, financial incentives and economic benefits

4.7 The suggestion of grants/financial incentives were identified throughout the examined literature as a way to encourage growing high-quality timber. Particularly, the use of grants were frequently identified in the literature as a way to promote of uptake of sustainable forestry practices generally and reducing initial cost of forestry practices for farmers.

Direct State Action

4.8 The literature included within this report frequently mentioned direct government and government agency action to support the use of timber for high value products, particularly in construction.

4.9 Introducing policies and standards were suggested to promote the uptake of sustainable forestry practices generally, the uptake of forestry practices by farmers and the use of timber within the construction industry. The extent of government involvement varied from changes to policies and standards to encourage the use of timber to set requirements (sometimes as part of legislation) for the use of timber in construction projects. Some countries have also tried to lead by example by

introducing requirements for timber-based construction in government or public sector buildings.

Assessment of the evidence

- 4.10 When interpreting the findings of this literature review, the types of evidence identified should be taken into consideration. Within this review, much of the evidence largely related to government strategies, policies and plans. As a result, observable outcomes from these plans are not available yet, therefore the evidence mainly relates to actions taken internationally rather than the effectiveness of these actions. Many of these strategies are also still in effect, consequently, evaluations may be planned but are yet to be undertaken and published.
- 4.11 It is important to note although few evaluations were identified within this search, this does not necessarily mean that there are few evaluations in this area across the evidence generally. It is likely that the sources identified may have been a result of the search terms used, with different search terms having the potential to yield different results.
- 4.12 Much of the sources identified in this report were theoretical, recommending actions and suggesting that these actions would result in the growth of high-value timber industries, but few sources included empirical, experimental or evaluative evidence. This indicates the importance of ensuring any future actions to support a high value timber industry in Wales have clear plans to monitor and evaluate progress to support the evaluative evidence base.

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Annex A: search strategies

Search: How have other countries effectively supported the relationship between the forestry and agriculture sectors, including through education?

Source	Search strategies
Web of Science	<p>(“Agroforestry education” OR “Agroforestry adoption” OR “Sustainable agriculture education” AND “farmer*” OR “Farmer decision making”) AND (“timber” AND “educat*” OR “encourag*” OR “attitud*”)</p> <p>(“On farm timber production” OR “timber production” OR “Farm forestry” OR “wood production” OR “wood management” OR “woodland management” OR “wood product” OR “woodland products”) AND “farmer*” OR “Farmer decision making” OR “Farmer motivations” AND “educat*” OR “encourag*” OR “attitud*”)</p> <p>(“On farm timber production” OR “timber production” OR “planting trees on-farm” OR “on-farm trial” OR “Farm forestry” OR “wood production” OR “wood management” OR “woodland management” OR “wood product” OR “woodland products”) AND (“farmer*” OR “Farmer decision making” OR “Farmer motivations” AND “educat*” OR “encourag*” OR “attitud*”)</p> <p>(“woodland planting” AND “farmer*” OR “Farmer decision making” OR “Farmer motivations” OR “Farm forestry”) AND (“educat*” OR “encourag*” OR “incentiv*” OR “behav*” OR “attitud*”)</p> <p>(“tree planting” OR “land use” OR “woodland creation” OR “Farm forestry”) AND (“farming behaviour Change” OR “Farmer decision making” OR “Farmer motivations” AND “evidence review”)</p> <p>(“afforestation” OR “timber production” OR “Farm forestry” OR “wood production” OR “wood management” OR “woodland management” OR “wood product” OR “woodland products”) AND “farmer*” OR “Farmer decision making” OR “Farmer motivations” AND “educat*” OR “encourag*” OR “attitud*”)</p>

Science Direct	As above
Scopus	As above
Ingenta	As above
Directory of Open Access Journals	As above
British Library On Demand	As above
Bielefeld Academic	As above
ETHOS	As above
The Soil Association	Browsed publications
Forestry Commission	Browsed publications
Forest Research	Browsed publications
The Woodland Trust	Browsed publications
Analysis and Policy Online (APO)	Browsed publications
National Library of New Zealand	Searched catalogue
Rothamstead Research	Browsed publications
Scottish Forestry	Browsed publications
Department of Agriculture, Food and the Marine, Ireland	Browsed publications

Search: What does existing literature indicate are the social benefits of a high-value timber industry, including knock-on social benefits from economic opportunities?

Source	Search Strategies
British Woodworking Federation (BWF)	Searched: publications / news / resources When prompted used keywords: 1. Wood products / timber livelihoods / Wood based jobs / timber used in communities / community wellbeing / community investment / By products of a timber industry / skills in the timber industry / projects in timber communities / biophilic design /
Confederation of Forest Industries (Confor)	As Above
Structural Timber Association (STA)	As Above
Timber Decking and Cladding Association (TDCA)	As Above
Timber Packaging and Pallet Confederation (TIMCON)	As Above
Timber Research and Development Association (TRADA)	As Above
Timber Trade Federation (TTF)	As Above
Trussed Rafter Association (TRA)	As Above
UK Forest Products Association (UKFPA)	As Above
Wood for Good	As Above
NHS forest.org	As Above
Woodland Trust	As Above
The Nature Conservancy	As Above
Forestry Commission	As Above

Forest Research	As Above
Scottish Forestry	As Above
Scottish Forest and Timber Technologies	As Above
Climate Smart Forest Economy Program	As Above
Google Scholar	<ol style="list-style-type: none"> 1. local communities benefitting from timber 2. employment benefits of a high value timber industry benefits of biophilic design [searched years 2023 – 2018] 3. social benefits of timber industry products
Natural Resources Wales	Timber industry
Web of Science	<ol style="list-style-type: none"> 1. timber industry (All Fields) AND benefits (All Fields) 2. Timber (All fields) and industry* (All fields) or Production (All fields) and soci* (All fields or econom* (All fields) and benefit* (All fields) 3. As above adding Employment; Skills 4. Timber (All fields) and industry (All fields) or career development (All fields) Timber industry (All fields)
EconLit	<ol style="list-style-type: none"> 1. social benefits of timber industry 2. timber industry benefits 3. timber industry socioeconomic effects
Social Science Premium Collection	<ol style="list-style-type: none"> 1. timber industry community benefits Filter: 2015-2024 UK 2. timber industry benefits Filter: 2015-2024 UK 3. high value timber industry benefits Filter: 2015-2024 UK 4. community benefits from timber Filter: 2010-2029 > 2015-2024 United Kingdom--UK OR Canada OR Europe OR Australia OR England OR France OR British Columbia Canada OR Germany OR New Zealand OR Sweden OR Italy OR Ukraine OR Scotland OR Spain OR Appalachia OR Finland 5. timber industry impacts on wellbeing Filter: 2010-2029 > 2015-2024 United Kingdom--UK OR Canada OR Europe OR Australia OR England OR France OR British Columbia Canada OR Germany OR New Zealand OR Sweden OR Italy

	<p>OR Ukraine OR Scotland OR Spain OR Appalachia OR Finland</p> <p>6. timber industry AND employment OR jobs OR training Filter: 2010-2029 > 2015-2024 United Kingdom--UK OR Canada OR Europe OR Australia OR England OR France OR British Columbia Canada OR Germany OR New Zealand OR Sweden OR Italy OR Ukraine OR Scotland OR Spain OR Appalachia OR Finland</p>
APO – Analysis & Policy Observatory	<ol style="list-style-type: none"> 1. Timber industry 2. Timber by products 3. Timber products 4. Timber communities 5. Wood products
ProQuest Publicly Available Content Database	<ol style="list-style-type: none"> 1. timber industry benefits 2018-2024 Filter subject: sustainable development 2. timber industry AND communities 2018-2024 Filter country: Europe 3. timber industry AND social benefits 2018-2024 Filter country: Europe
Welsh Government Publications and Internal Library Catalogue	<ol style="list-style-type: none"> 1. Timber industry 2. Timber industry by products (also by – products / byproducts)
GreenFile	<ol style="list-style-type: none"> 1. timber industry AND social benefits 2. timber AND social benefits 3. timber products 4. timber products AND communities OR employment OR skills 5. high value timber industry AND social benefits 6. high value timber 7. timber industry benefits 8. timber industr* AND benefit* OR social 9. timber industry AND social benefits OR communit*
Agricola	<ol style="list-style-type: none"> 1. timber industry benefits 2. timber industry AND benefits AND Canada 3. timber industry AND benefits AND New Zealand 4. timber industry AND benefits AND Europe
Construction Information Services	Timber; wood; wood products
DEFRA	<ol style="list-style-type: none"> 1. Timber benefits 2. timber industry social benefits wood products
Directory of Open Access Journals	<ol style="list-style-type: none"> 1. timber industry benefits 2. timber industry 3. timber

	4. wood products [searched within journals for Energy from wooden biomass / design of furniture and wood products]
ScienceDirect	<ol style="list-style-type: none"> 1. timber industry social benefits 2. social benefits of lumber 3. social benefits of lumber on communities 4. social benefits of lumber on wellbeing 5. social benefits of timber on children 6. social perspectives of timber industry 7. social impacts of timber industry [Subject: social sciences] 8. social benefits of timber industry Germany
Sociological Abstracts	(timber industry) AND communit* AND benefit* Date: After 2018; Language: English