The timber industry

Net Zero Roadmap

How the timber sector can address the climate crisis and build a Net Zero future

Supported by:

Timber Development UK · BWF British Woodworking Federation · NMBS · tdca Timber Decking and Cladding Association · TRA · WPA Wood Protection Association · Wood Panel Industries Federation · ASBP The Alliance for Sustainable Building Products · Confor Promoting forestry and wood · STA Structural Timber Association · timcon timber packaging and pallet confederation · wra Wood Recyclers' Association

Executive summary

Timber Development UK (TDUK), in collaboration with other key UK timber trade associations has launched the Timber Industry Net Zero Roadmap. This sets out the causes of emissions within the supply chain and proposes steps the industry could take to reduce these and what the journey to Net Zero could look like.

The industry has long advocated the use of timber to reduce the embodied carbon impact of construction. However, until now, there was very little information available to show the wider impacts of the supply chain.

As part of the development of this Roadmap, the timber industry's appointed consultants for this project, Energise, have assessed the carbon footprint of the industry. The Roadmap includes this carbon footprint of the Timber Industry, as well as a Net Zero emissions trajectory to 2050 and policy recommendations with sub-sectoral action plans to deliver the reductions.

Table 1 shows the emissions footprint of the timber industry, which concludes that the timber related industries in the UK (excluding paper, cardboard, pulp, and imported biomass for the energy industry) are responsible for 1,575,356 tonnes CO_2e territorial emissions, which equates to 0.35% of UK emissions. This is very low compared to other manufacturing industries such as UK steel production, which is responsible for 12 million tonnes CO_2e, 2.7% of UK emissions[1], and concrete which is responsible for 7.3 million tonnes CO_2e, 1.5% of UK emissions[2].

The timber industry is also responsible for 3,655,715 tonnes CO_2e of imported embodied emissions from the processing of wood products in the country of origin.

Scope	Basis	Total (tCO_2e)	% of UK footprint (respective basis)
Timber (exc. Paper/Cardboard/Pulp/ Imported Biomass)	Territorial	1,575,356	0.35%
Timber (exc. Paper/Cardboard/Pulp/ Imported Biomass)	Consumption	5,231,071	0.68%
Timber (inc. Paper/Cardboard/Pulp, exc. Imported Biomass)	Territorial	3,340,107	0.71%
Timber (inc. Paper/Cardboard/Pulp, exc. Imported Biomass)	Consumption	10,748,277	1.39%

Table 1. Emissions footprint of the Timber Industry

In all cases, the amount of carbon absorbed and stored (sequestered) by timber products is greater than that emitted via industrial processes. However, all figures in this Roadmap exclude any sequestered (stored) carbon within the timber product, as the document is focused on reducing the industrial emissions from timber processing and transportation.

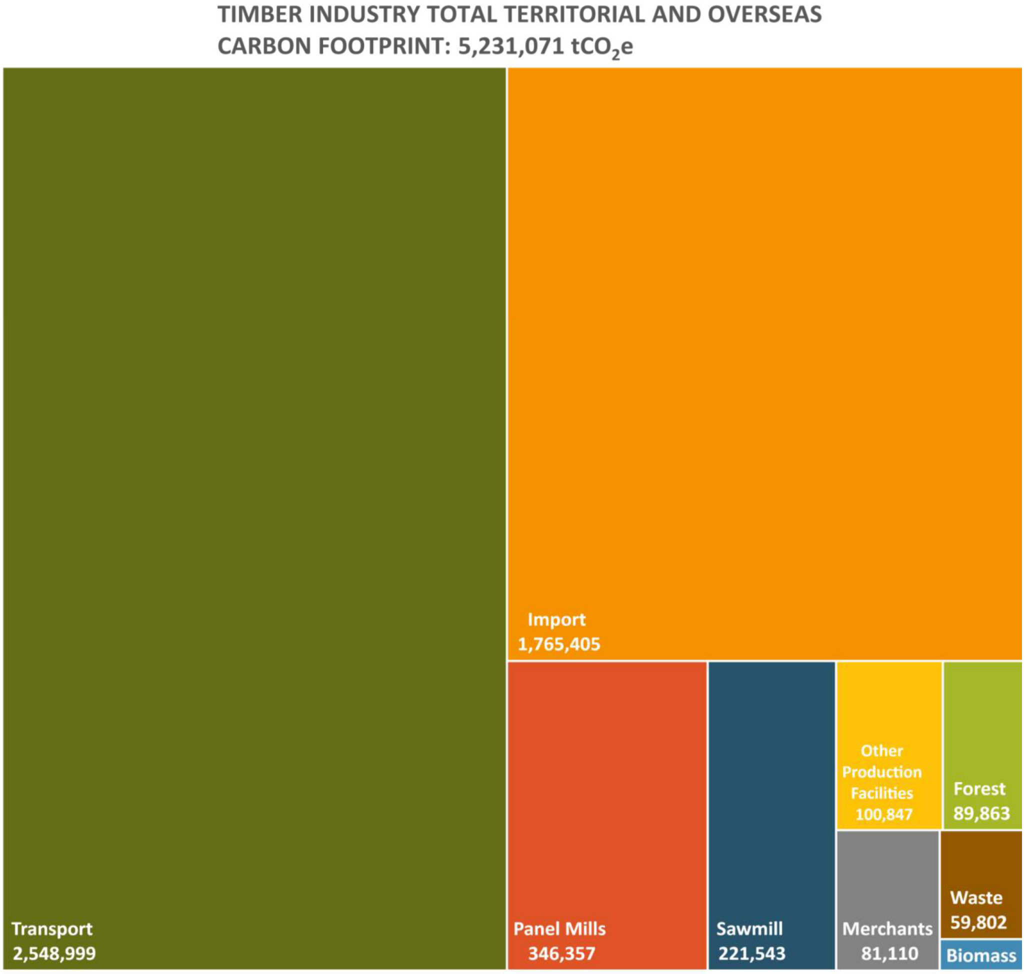

Figure 1. Emissions footprint of the Timber Industry (Territorial and Overseas) excluding Pulp, Paper & Board and Imported Biomass (tCO_2e).

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The timber related industries carbon footprint can be broken down as shown in the tree map above (Figure 1). This highlights the importance of action in relation to emissions from transport (49%), imported materials (34%) and general action to decarbonise the production processes within the industry.

Please note that 2019 data has been used for most of the analysis, and all calculations of the industry footprint, to minimise any potential effects of COVID-19 and Brexit on the industry footprint, which both presented barriers to trade and temporarily changed the demand for timber products in the UK.

The industry can make a significant contribution to address the challenges of climate change by undertaking the actions outlined within this Roadmap. It is important that a strong, action-oriented approach is taken to reduce emissions and that these actions align to a 1.5°C scenario.

The Timber Industry's carbon footprint was analysed to identify the priority hotspots that require action, with a particular focus on the actions that relate to material emissions sources and those that had the greatest potential for reduction. Recommendations were developed through a set of workshops with stakeholders from across the industry that identified further potential opportunities and discussed the viability of these.

Energise has explored scenarios to identify a range of ways to achieve Net Zero by 2050 at the very latest. This Roadmap presents a Net Zero Pathway for the Timber Industry alongside a set of high-level policy recommendations.

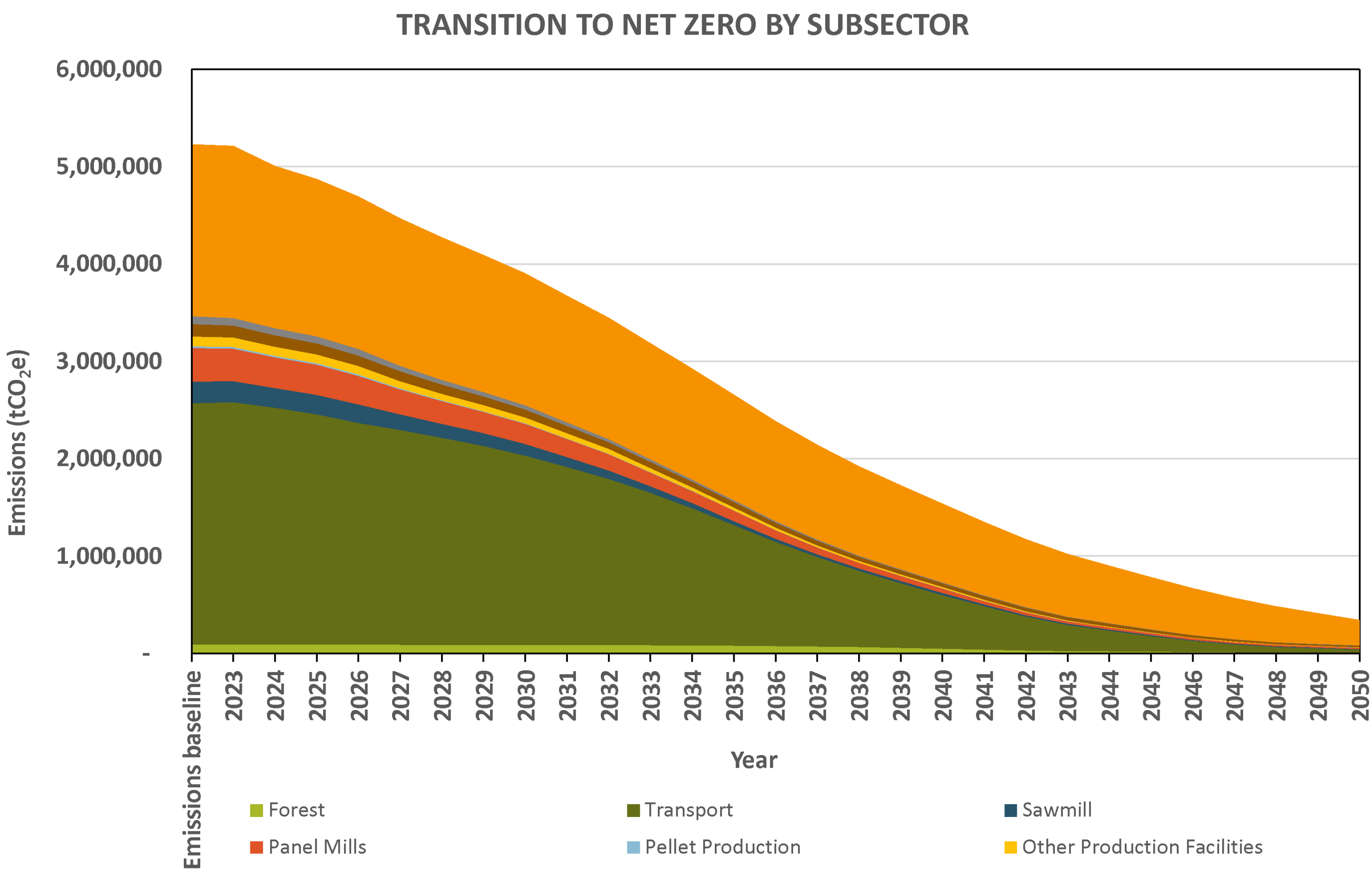


Figure 2. Timber Industry transition to Net Zero by subsector.

There are some immediate issues with data quality in respect of both Corporate carbon accounting and the production of EPDs that need to be addressed by improving data standards and transparency.

The most significant areas of emissions that will require the greatest attention are created by transport (both road-going and off-road), heat, and imported products (including their transportation and distribution).

Policy recommendations

1. Industry should align to GHG protocol to report Scope 1 & Scope 2 emissions by all non-SME operators by 2023
2. Set industry standard to compile full scope carbon footprints (inc. Scope 3) by 2025
3. Reduce road going transport emissions intensity by 25% by 2030, and 50% by 2035
4. Reduce processing/manufacturing emissions intensity by 50% by 2030
5. Reduce forestry emissions intensity by 50% by 2040
6. Reduce Scope 1 & 2 carbon intensity of the industry by 90% by 2045
7. Reduce Scope 3 carbon intensity of the industry by 90% by 2050
8. The industry will develop a specific circularity/resource efficiency roadmap by 2024 to accelerate the activity in this key area
9. Nature-based solutions (combined with the above reductions) focused on permanent carbon removals to be used for offsetting
10. The industry will support targets/initiatives to increase domestic production and expansion of the domestic woodland stock.

In order to deliver the roadmap that has been proposed, actions can be taken immediately to progress reduction of emissions in these areas, as well acknowledging that some technology maturity is required. Opportunities also exist to lead developments in creating a circular economy. Alongside, clear and robust standards for carbon offsets have been set out.

This roadmap also contains a toolkit to support operators in delivering on their commitments, as well as some examples/benchmark data sets for comparison as operators begin/improve their Net Zero journeys. The Roadmap is the start of a journey for the sector and a common reporting platform for ongoing disclosure is proposed.

The Industry contains a collection of subsectors, and a roadmap has been detailed for each of these within the Appendices.

Contents

Introduction

The Timber Industry Net Zero Roadmap was commissioned by Timber Development UK (TDUK) as a cross-industry collaboration alongside other key UK Timber Trade Associations: Alliance for Sustainable Building Products (ASBP), British Woodworking Federation (BWF), Confederation of Forest Industries (Confor), National Merchant Building Society (NMBS), Structural Timber Association (STA), Timber Decking and Cladding Association (TDCA), The Timber Packaging and Pallet Confederation (Timcon), Trussed Rafter Association (TRA), Wood Protection Association (WPA), Wood Panel Industries Federation (WPIF), Wood Recyclers Association (WRA).

TDUK commissioned Energise to develop the Timber Industry Roadmap following discussions with a number of specialist consultants. Energise are a leading sustainability consultancy supporting customers in being a force for good, with a focus on environmental/Net Zero consultancy. They have been operating for 15 years and in 2022 were working on projects covering over 5% of the UK's carbon footprint. Their 40-strong team has experience across multiple sectors, with specialist experience in construction, transport and manufacturing. More information on Energise can be found at energise.com

Energise has worked with this cross-industry group to develop the Timber Industry Net Zero Roadmap. It aims to identify how the Timber Industry will progress towards Net Zero and what that journey looks like. The Roadmap includes: a carbon footprint of the Timber Industry; a Net Zero emissions trajectory to 2050; and policy recommendations with sub-sectoral action plans to deliver the reductions.

The project has undertaken the following analysis:

- Resource/energy level assessment of activity within the Industry
- Carbon emissions calculation for the EPD phase A1-A4, C2-C4 emissions
- Assessment of the carbon reduction opportunities for the Industry

The project is producing the following outcomes:

- A roadmap to Net Zero for the Industry
- A Net Zero Toolkit for the Industry
- Guidance on certain topics (e.g. carbon accounting) for the Industry

Acknowledgements

Timber Development UK would like to thank the representatives from the key timber industry associations involved in supporting the development of this roadmap, along with their members for providing the key information to enable the development of the emissions profiles within.

We would also like to thank the members of the TDUK Sustainability Committee and TDUK Carbon Sub-Committee for their valued input and support in developing and reviewing the document. Last, but not least, we would like to thank the team at Energise for the detail they have gone into to ensure a full and accurate picture of industry's emissions is portrayed, and I would like to thank the TDUK team for their help in pulling together the final document for publication.

Charlie Law, Sustainability Director, Timber Development UK

General context and policy

The Climate Challenge

Climate change is arguably the greatest environmental challenge facing the world, with many countries now experiencing unprecedented and increasingly frequent extremes of weather. Coordinated international action to decarbonise the global economy and adapt to climate change is rapidly gaining momentum. The landmark Paris Agreement on climate change was approved in 2015, aiming to limit Greenhouse Gas (GHG) emissions urgently and keep global temperature increase to "well below" 2°C, preferably to 1.5°C.

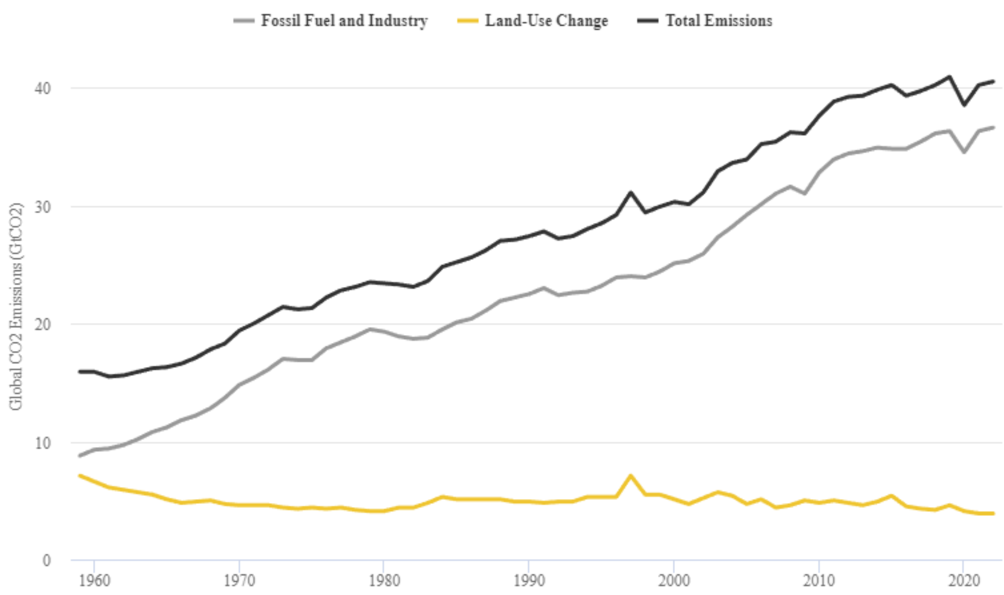


Figure 3. Global CO_2 emissions (black line) separated out into fossil (grey) and land-use change (yellow) between 1959-2022 ($GtCO_2$) (World Economic Forum)[3].

In 2018, the Intergovernmental Panel on Climate Change issued a scientific report on the potential impacts of global warming and how the rise in global temperature should be limited to 1.5°C. It concluded that to limit warming to 1.5°C, policy needs to be bought in faster and needs to be more ambitious – both in terms of technological changes to energy and food production, and behavioural change to human lifestyle.

In 2019, the UK became the first major country to legislate for net zero emissions, aiming to end the negative impact on climate change as a result of UK economic production activities over the next 30 years. Many other countries and trading blocs have followed, in the hope that the worst effects of climate change can be avoided. The Climate Change Act commits the UK government, by law, to reduce greenhouse gas emissions by at least 100% compared to 1990 levels by 2050. This includes reducing emissions from the devolved administrations (Scotland, Wales and Northern Ireland), which currently account for about 20% of the UK's emissions.

The Climate Change Act requires the government to set legally binding 'carbon budgets' in the run-up towards the 2050 target. A carbon budget is a cap on the amount of greenhouse gases emitted in the UK over a five-year period. The budgets are intended to reflect a cost-effective way of achieving the UK's long-term climate change objectives. Once a carbon budget has been set, the Climate Change Act imposes an obligation on the Government to prepare policies to ensure the budget is met.

In October 2021, the methodology of how to achieve Net Zero by 2050 was set out by the UK government in its Net Zero Strategy: Build Back Better document. This set out its 'Ten Point Plan for a Green Industrial Revolution', covering how the country intends to decarbonise all sectors of the UK economy, from transport to agriculture. The plan focuses on increasing ambition in the following areas:

1. Advancing offshore wind
2. Driving the growth of low-carbon hydrogen
3. Delivering new and advanced nuclear power
4. Accelerating the shift to zero-emission vehicles
5. Green public transport, cycling and walking
6. 'Jet zero' and green ships
7. Greener buildings
8. Investing in carbon capture, usage and storage
9. Protecting our natural environment
10. Green finance and innovation

The Construction Leadership Council (CLC), a joint BEIS/Sector council co-chaired by the Minister for Business and Mark Reynolds, Group Chairman and CEO of Mace, is leading the sector's response to the Net Zero challenge, through Construct Zero (CZ), the sector's zero carbon change programme. The CLC has engaged industry to develop the CZ Performance Framework, which sets out, through 28 metrics, how the sector will commit to and measure its progress towards Net Zero.

The CLC publishes quarterly updates to the Framework, aimed at encouraging, motivating and influencing businesses to transition to Net Zero. They have over 200 Business Champions and Partners sharing information and measuring progress in a consistent way. CZ is working with the wider industry to co-ordinate its initiative, overcome challenges and seize opportunities. The role of timber in reducing the collective carbon emissions is important and the industry will continue to engage with CZ as part of the pan-industry drive to Net Zero.

What is Net Zero?

Net zero refers to drastically reducing GHG emissions and then balancing the remaining emissions with removals so that no more emissions are being added to the atmosphere. In the international scientific community, it is agreed that to prevent irreversible damage to our planet, global emissions need to fall by about 45% from 2010 levels by 2030, and Net Zero should be achieved by 2050.

Net zero versus carbon neutrality

Carbon neutrality refers to reaching a position where the greenhouse gases emitted into the atmosphere are exactly equivalent to the greenhouse gases being removed from the atmosphere. This can be achieved through carbon offsets (e.g. planting trees). This is different to Net Zero because no emission reductions are required in order to achieve carbon neutrality.

To achieve Net Zero means to go beyond removals and prevent emissions being produced in the first place and to limit global warming to 1.5°C. Additionally, a Net Zero target includes scope 1, 2 and 3 emissions, whereas carbon neutrality only requires scope 1 and 2, with scope 3 emissions encouraged but not mandatory.

Term	Scope Of Climate Forcers	Definition From IPCC Sr15
Carbon neutrality or Net Zero carbon dioxide emissions	CO_2 emissions	Carbon neutrality or Net Nero carbon dioxide emissions are achieved when human-caused CO_2 emissions are balanced globally by human-caused CO_2 removals.
Net-zero emissions	All GHG emissions	Net zero emissions are achieved when human-caused emissions of greenhouse gases to the atmosphere are balanced by human-caused removals over a specified period. Where multiple greenhouse gases are involved, the quantification of net zero emissions depends on the climate metric chosen to compare emissions of different gases (such as global warming potential, global temperature change potential, and others, as well as the chosen time horizon).

In general, when companies claim carbon neutrality, CO_2 emissions are being counterbalanced with carbon offsets without necessarily having reduced emissions by an amount consistent with reaching Net Zero at the global or sector level (see Figure 4). This may conceal the need for deeper emissions reductions that are in line with what is required for the world to keep global warming to 1.5°C.

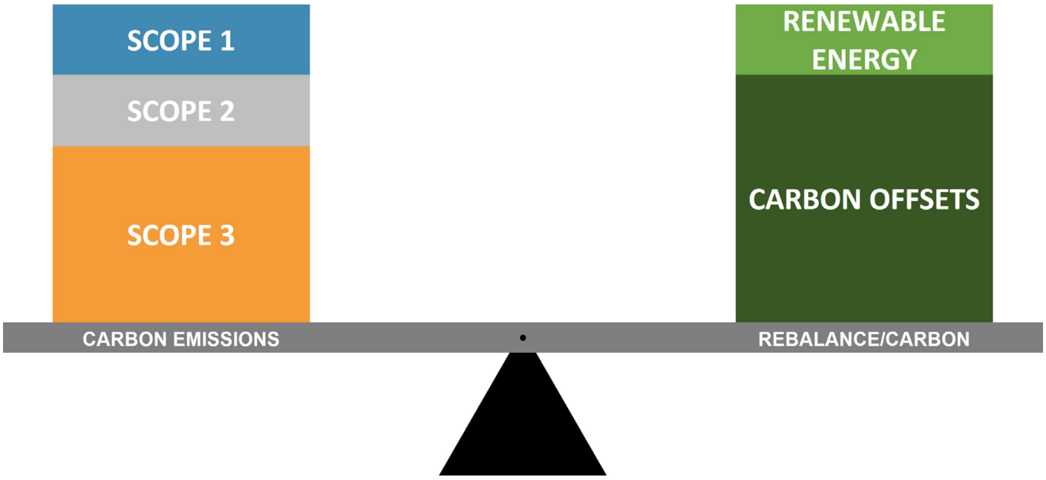


Figure 4. Carbon Neutral explainer.

Carbon neutrality claims also do not necessarily cover non-CO_2 Greenhouse Gases (GHGs).[4]

The Science-based Targets initiative (SBTi) summarises the scope of climate forcers for each of these terms based on the definitions from the IPCC in the table above[5]. An illustration of how Net Zero can be achieved is is shown in Figure 5.

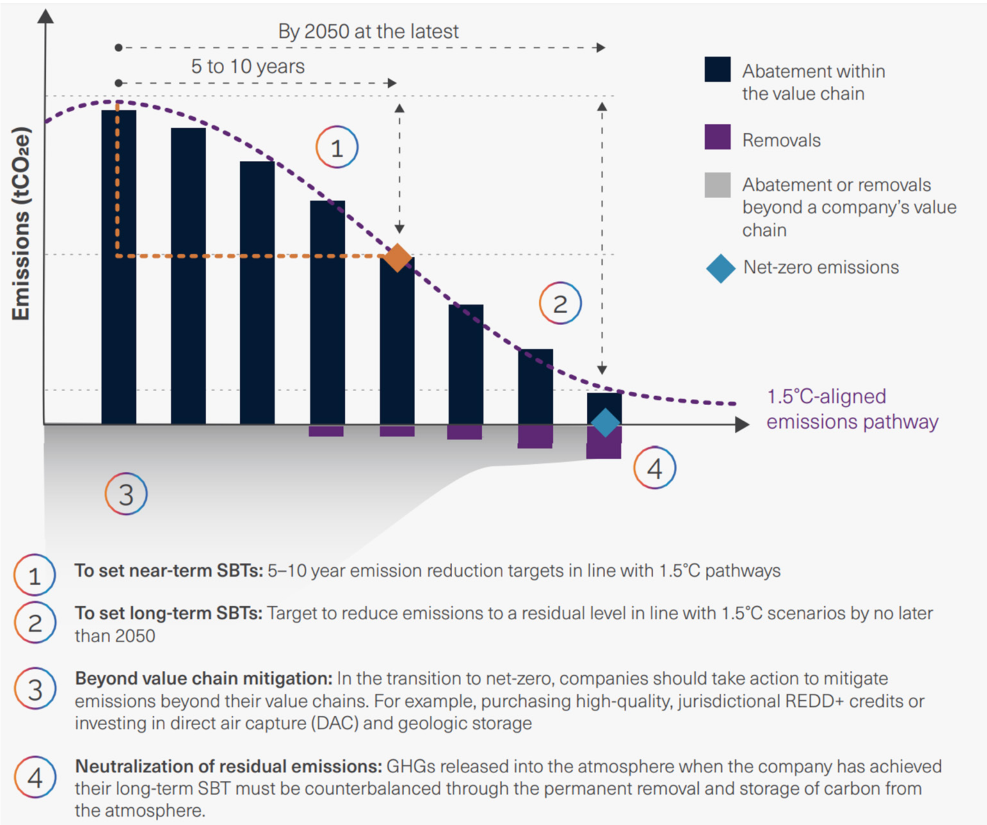


Figure 5. Net Zero Illustration (SBTi).[6]

UK timber in context

Timber is one of the world's most renewable building materials and is widely used in construction. The World Bank estimates that global demand for wood products will treble by 2050, driven by an increasing population, which will rise from today's 7.8 billion to 10 billion in less than 30 years.[7]

The Department for Environment, Food and Rural Affairs (DEFRA) is implementing a range of measures to tackle the issues such as illegal logging, deforestation and sustainable forest management, and since 2000 has had a sustainable timber procurement policy in place.

Energise calculates that the UK timber industry is responsible for around 0.35% of the territorial emissions of the United Kingdom of Great Britain and Northern Ireland (2019 emissions vs the UK GHG emissions inventory). This comes to a total of 575,356

tCO_2e, out of the total territorial emissions of the UK and NI of 454,800,000 tCO_2e. The industry can therefore make a significant contribution (as an individual industry in the context of the UK economy) to address the challenges of climate change by undertaking the actions outlined within this Roadmap. It is important that strong action is taken to reduce emissions and align to a 1.5°C scenario by taking a science-based, action-oriented approach.

Where does UK timber come from?

The Confederation of Forest Industries (Confor) recently warned that the UK faces declining supplies of homegrown wood due to a lack of productive tree planting. The UK needs to urgently increase productive tree planting as 80% is currently imported, and only about 20% of its wood requirement is currently homegrown[8].

Sawn softwood	Particle-board	Fibreboard	Paper and paperboard	Sawn hardwood	Wood pulp	Plywood	Wood pellet
Sweden (35%) Latvia (21%) Finland (13%)	Germany (20%) Latvia (14%) Belgium (12%) Ireland (11%)	Ireland (35%) Germany (19%)	Sweden (17%) Germany (16%) Finland (15%)	The USA (19%) Latvia (14%) Cameroon (10%) Estonia (7%)	Norway (28%) Brazil (24%) Sweden (22%)	China (40%) Brazil (20%)	USA (60%)

Table 2. Key statistics regarding the source of UK timber imports for 2021[11]

The UK was the second largest net importer (imports less exports) of forest products in 2020, behind China[9]. That year, the UK imported 48 million cubic metres of wood products, of which 22% was sawn wood and wood-based panels destined for use by the building and construction industry.

In 2021, the UK imported an average of one million cubic metres of timber and panel products every month[10].

Timber and Net Zero ambitions

In both the UK Government's Clean Growth Strategy and its 25 Year Environment Plan, it has committed to increasing the use of timber in construction. There are multiple benefits of using timber as opposed to other CO_2-intensive materials such as concrete, steel and other major construction materials.

Firstly, each 1m^3 of wood grown by a tree holds up to 0.9 tonnes of CO_2 sequestered from the atmosphere[12], and using wood instead of other materials saves CO_2 emissions, both through the carbon captured and stored in the wood product and the avoidance of using alternative CO_2-intensive materials.

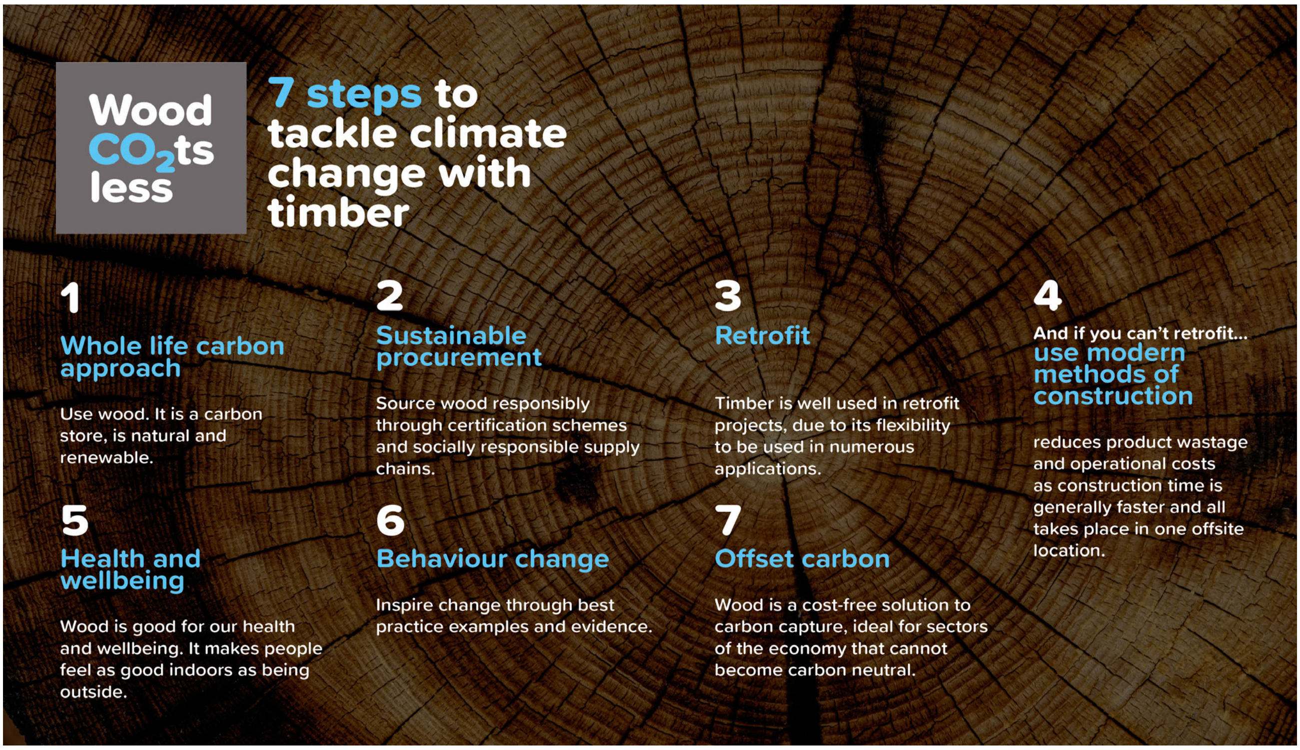


Figure 6. Infographic outlining benefits of Timber (Wood For Good).

Timber systems have the potential to contribute to curbing GHG emissions by reducing buildings' embodied carbon and by storing sequestered carbon. At the individual building level, the reduction in embodied emissions for substituting timber frame for masonry is approximately 20%.

A greater reduction (~60%) is seen for cross-laminated timber (CLT) and concrete structures[13]. Wood products, such as tables, chairs, doors, stairs, and timber products used in construction, all carry stored carbon for its entire life.

Embodied carbon

Embodied carbon is the carbon footprint of a material or product. It considers the impacts associated with the extraction of the raw material (cradle) through production (to gate), and spans through to the end-of-life route for the product, which for timber may include reuse, recycling (cradle) or energy recovery, with less than 1% ending up in landfill (grave).

Sustainable timber has the lowest embodied carbon of any mainstream building material, performing far better than steel, concrete, or aluminium if used efficiently. Figure 7 below shows the outcomes of the assessment of the carbon footprint of a 6-storey apartment block, constructed in traditional concrete vs CLT, which demonstrates the carbon benefit of the use of timber.

Therefore, increasing the use of timber in buildings has the potential to make a huge impact as the embodied carbon in the average building accounts for 30-50% of its whole carbon footprint. The storage of carbon within sustainable timber used in buildings is beneficial, as it keeps this carbon out of the atmosphere for a long period of time.

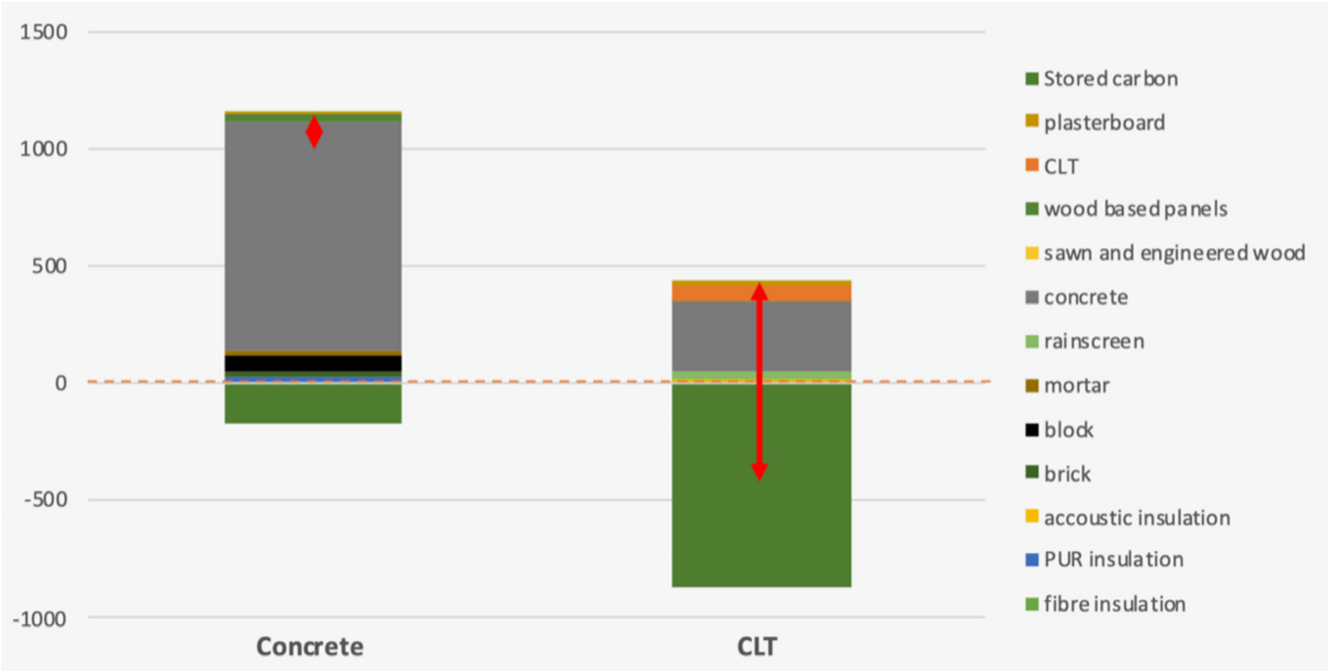


Figure 7. Carbon footprint of 6 storey apartment block comparing Concrete to CLT (Buildings and Cities).[14]

Accounting for sequestered carbon is often done inconsistently. By accounting correctly for the sequestration of carbon, and its emission or transfer at end of life, this benefit can be clearly shown within an Environmental Product Declaration (EPD), and within an embodied or whole life carbon assessment of buildings or infrastructure.[15]

Calculating and assessing the carbon-related impacts of timber is complex. The 2021 TDUK guide to measuring the embodied carbon in timber construction provides a clear explanation of the approach set out in relevant European Standards and in the RICS Professional Statement on Whole Life Carbon Assessment for the Built Environment.[16]

Forestry

Land Use, Land-Use Change And Forestry (LULCF) Carbon

Activities in the LULUCF sector provide a way of offsetting emissions, either by increasing the removals of greenhouse gases from the atmosphere by sustainably planting trees or managing forests, or by reducing emissions by reduced forest degradation and deforestation. LULUCF is one of the sectors under the United Nations Framework on Climate Change that measures and accounts for emissions and removals of CO_2 from land and forests.

It is an essential part of EU climate policy which aims to reduce EU greenhouse gas emissions to at least 40% below 1990 levels by 2030. Additionally, carbon reduction activities in the LULUCF sector also tie in with a number of the UN's Sustainable Development Goals (SDGs), such as enhancing biodiversity and ecosystem functions, employment and local livelihood.[17]

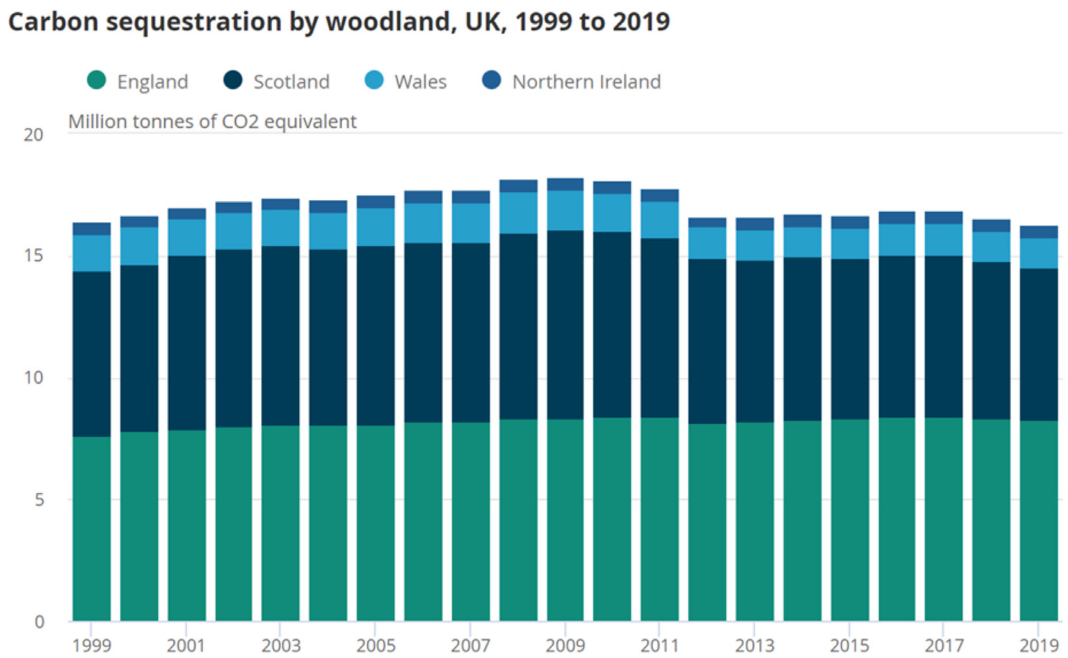


Figure 8. UK woodland sequestered around 16.3 million tonnes of carbon in 2019 (National Atmospheric Emissions Inventory, ONS).

We need to drive/implement higher planting rates to be able to achieve goals that have been set for the sector to meet the increase in the demand for timber. Currently, around 13% of the UK is covered by woodland. To increase this, the UK Government has declared an ambition to increase woodland cover to 17-19% by 2050.[18] The National Atmospheric Emissions Inventory estimates that in 2019 UK woodland sequestered 16.3 million tCO_2e (Figure 8).

Analysis

As part of the development of this Roadmap, Energise has assessed the carbon footprint of the industry. This analysis builds on previous work done by Forest Research looking at 2019 data on UK wood production and trade. In addition, 12 Timber Trade Associations covering the industry were engaged in a data collection process to capture Scope 1, 2 & 3 emissions footprints of members at the individual company level.

To accurately determine the carbon footprint of the Timber Industry it is necessary to define an appropriate boundary. The boundary relates to emissions within the operational control of participants within the UK Timber Industry and its logistics partners. This scope is chosen to reflect the EPD stage A1-4, C2-4 emissions.

There is not sufficient data available on stage B or C1 to compile the data into this analysis, and it has been excluded because of that, and because the industry has less influence over the ability to decarbonise it. Figure 9 explains the EPD phases:

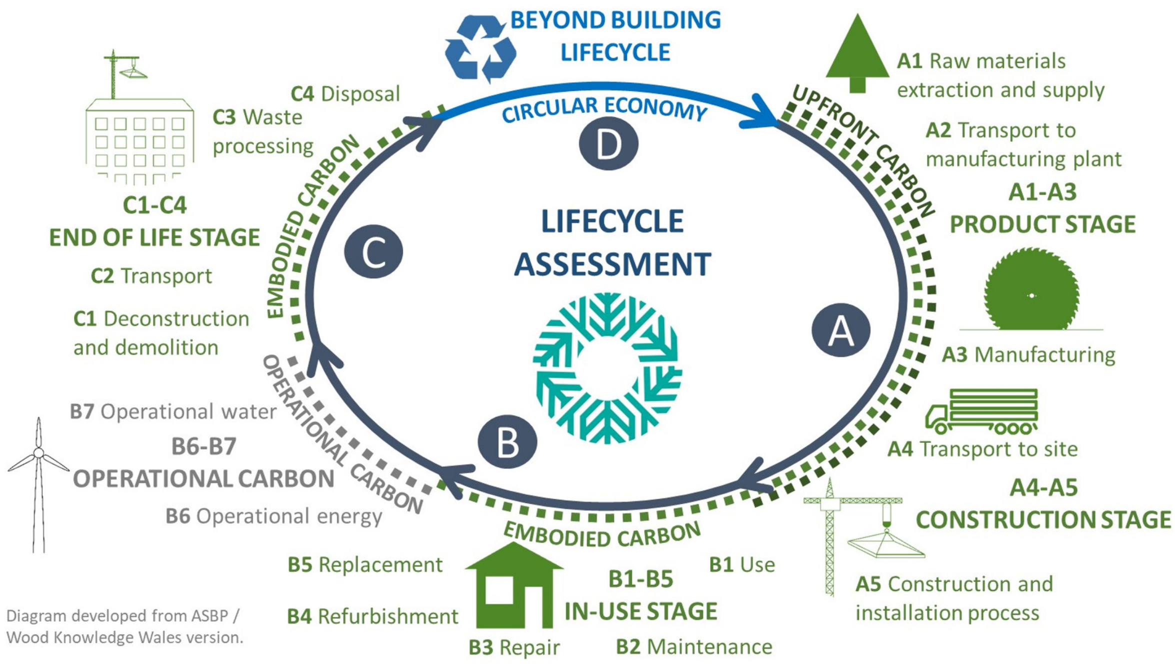


Figure 9. EPD Phase Diagram, Timber Development UK

To undertake the analysis, the energy flows of the industry have been compiled (e.g. fuel rates/volumes into harvesters, energy use per m³ in a sawmill, energy use in panel mills, fuel/energy used in transportation). The compiled resource flow has then been converted to emissions calculations and scaled using the Forest Research statistics dataset for 2019.

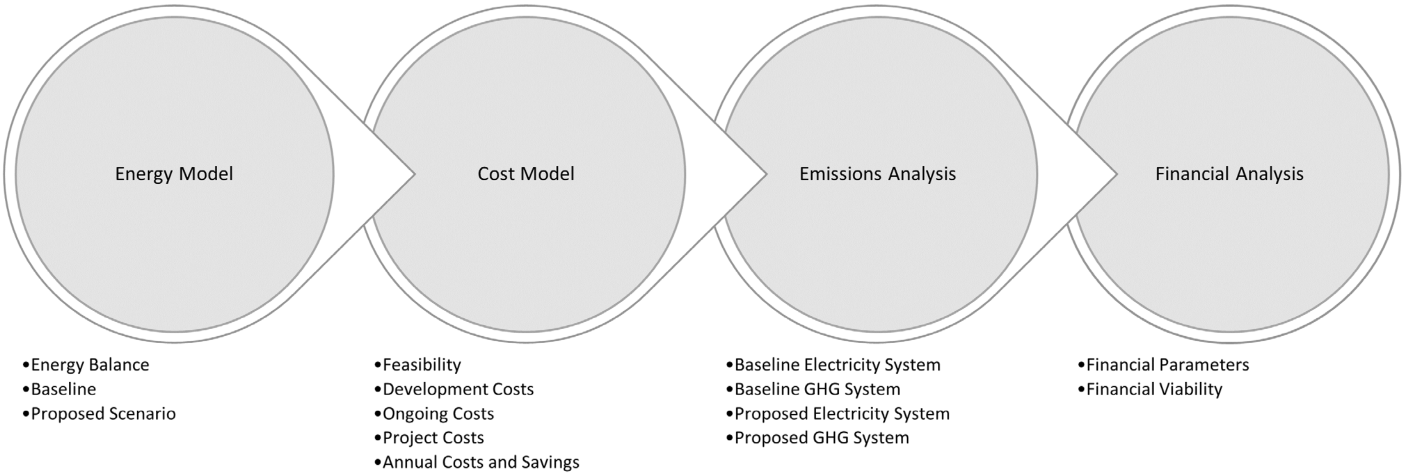


Figure 10. Approach to compiling analysis.

The same dataset has then been used to derive information relating to the carbon reduction opportunities. Energise has explored scenarios to identify a range of ways to achieve Net Zero by 2050 at the very latest. This Roadmap presents a Net Zero Pathway for the Timber Industry in the following sections of this document.

Timber Industry Resource Balance

Figure 11 below shows the resource balance of the UK Timber Industry in tonnes from inputs/ production on the left through to the various outputs on the right. It should be noted that this also includes pulp, paper and imported biomass.

When studying the Sankey diagram it is important to note that the Timber Industry is more circular than comparable industries producing durable products, meaning that frequently timber passes through different subsectors before reaching its final use. For example, wood packaging which is repaired and reused multiple times in a product's lifetime before being recycled into wood chips used for further products or renewable fuel.

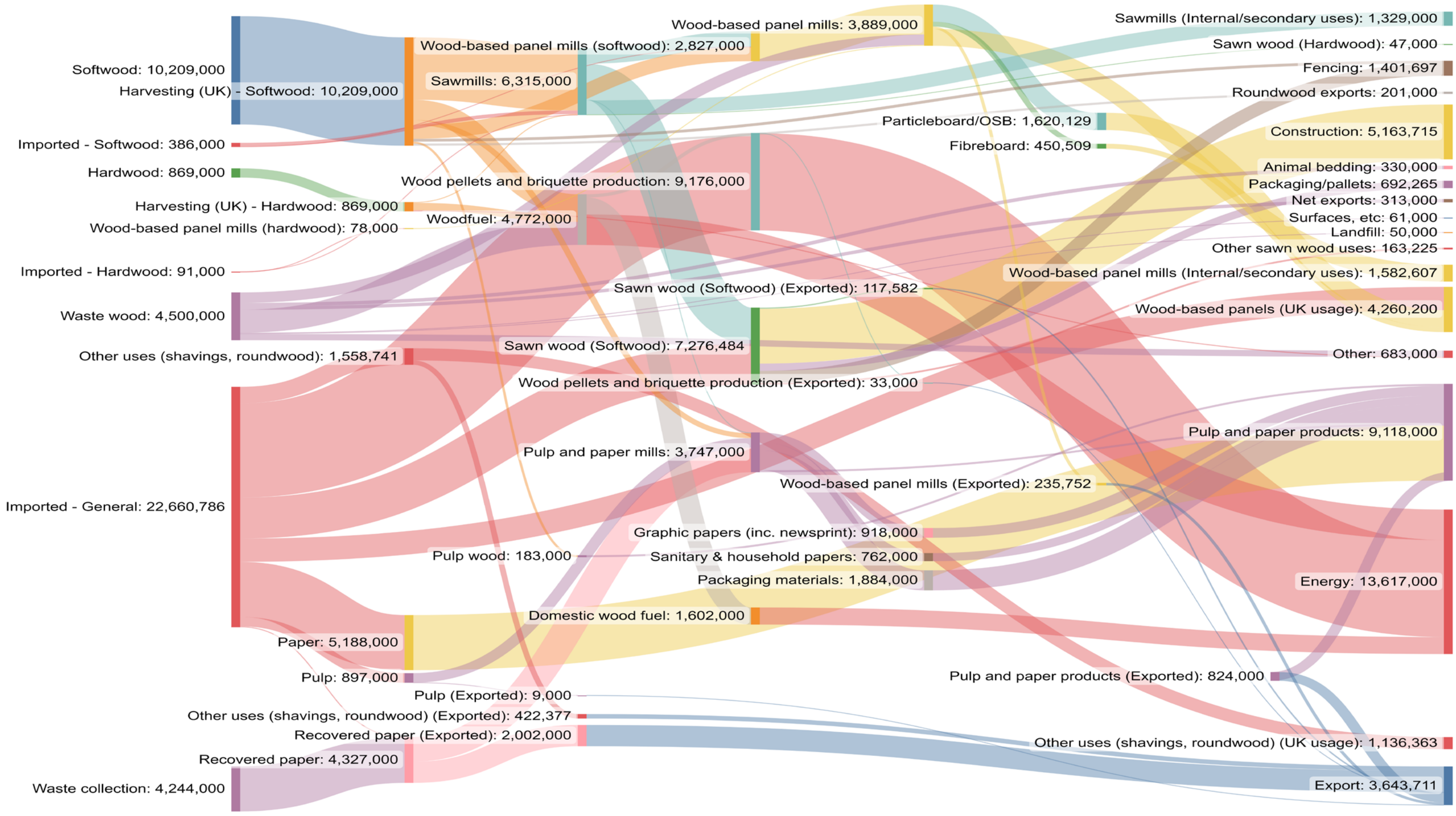


Figure 11. Resource balance of the UK Timber Industry in tonnes (2019).

This Roadmap focuses on the Timber Industry. Therefore activities associated with Pulp, Cardboard & Paper have been excluded from the remainder of this document. Imported biomass is also excluded as this is associated purely with energy production.

Emissions Footprint of the Timber Industry

As part of the development of this Roadmap, Energise has assessed the carbon footprint of the Timber industry. The territorial emissions of the Timber Industry have been previously outlined in Table 1. This Roadmap focuses on the Timber Industry, therefore the emissions associated with Pulp, Board & Paper have been excluded from this document. Figure 12 shows the total territorial and overseas footprint of the UK Timber Industry.

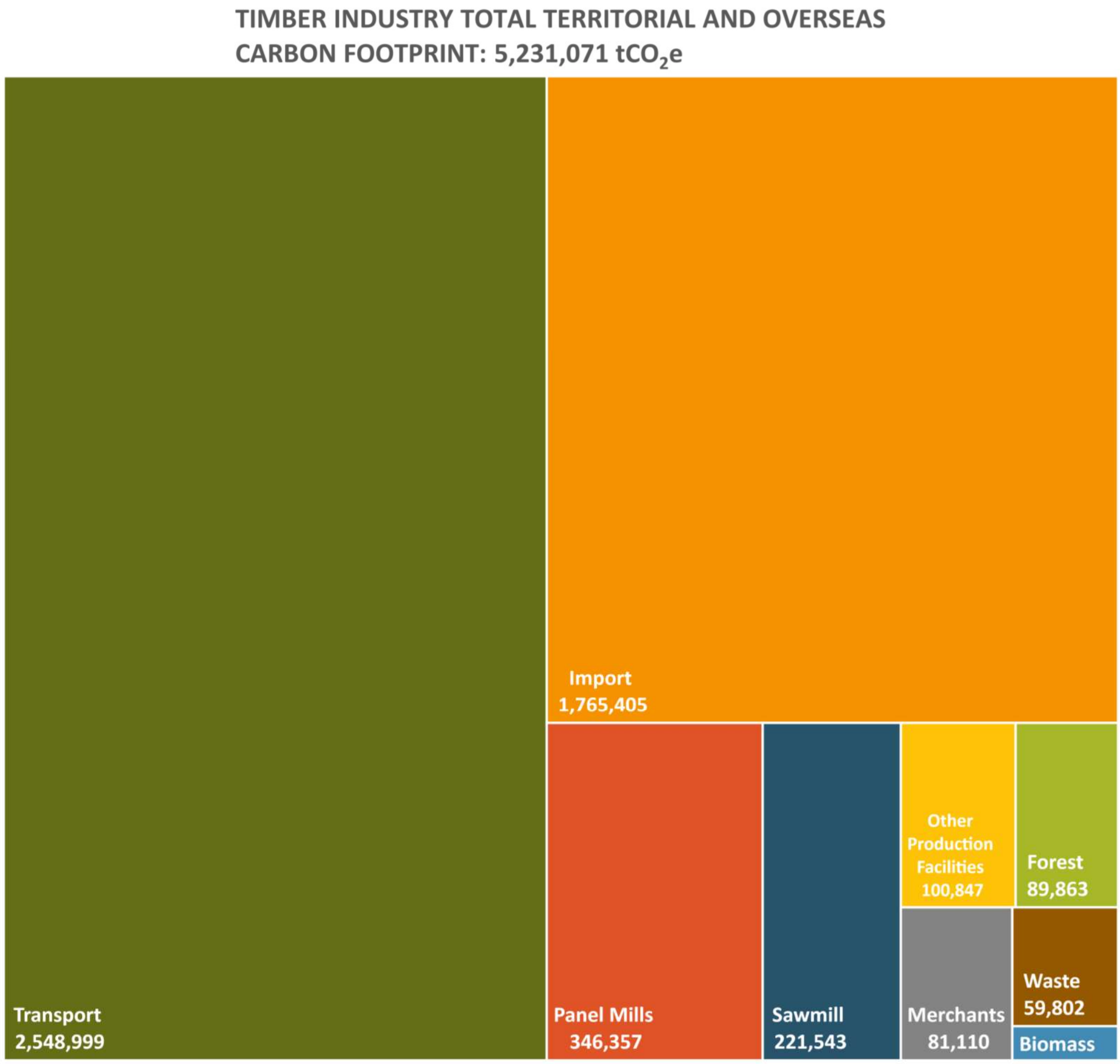


Figure 12. Emissions footprint of the Timber Industry (Territorial and Overseas) excluding Pulp, Paper & Cardboard and Imported Biomass (tCO_2e).

The largest proportion of emissions comes from transport (49%) closely followed by imports (34%) (Figure 13). When combined these make up 83% of the total.

Excluding overseas emissions (imports) and the transport associated with imports, the emissions footprint drops significantly from 5.2 million tCO_2e to 1.5 million tCO_2e (Figure 14).

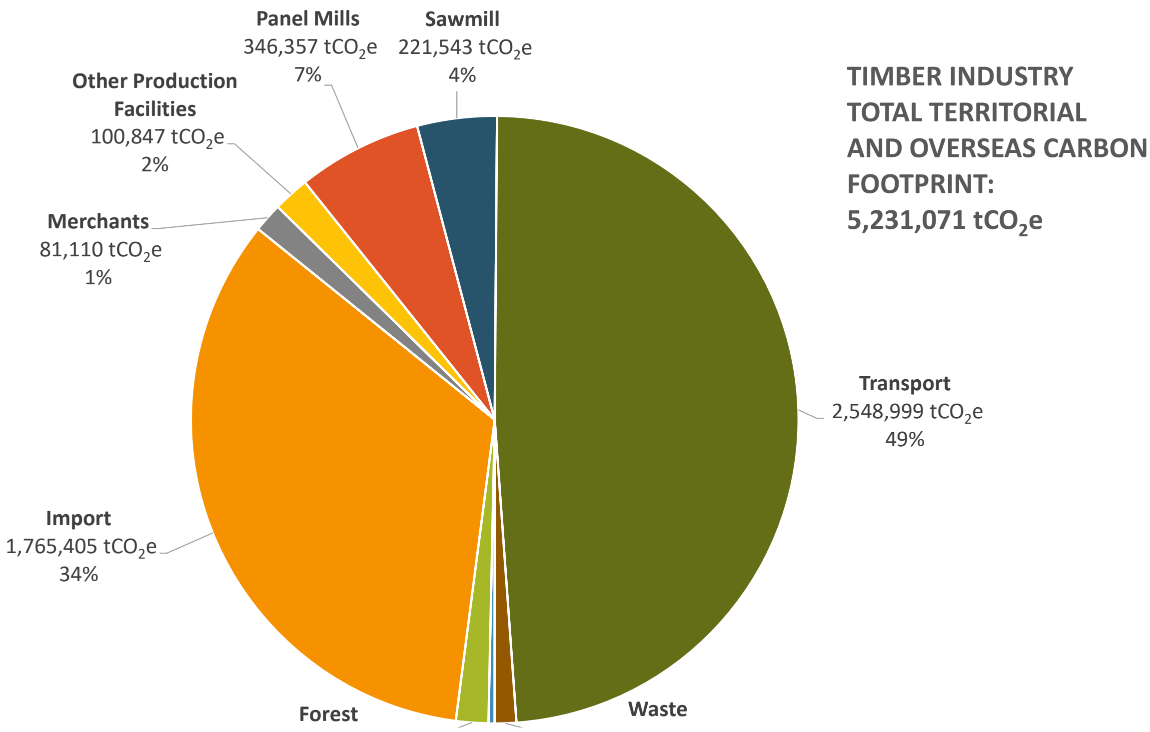


Figure 13. Emissions footprint of the Timber Industry (Territorial and Overseas) excluding Pulp, Paper & Board and Imported Biomass.

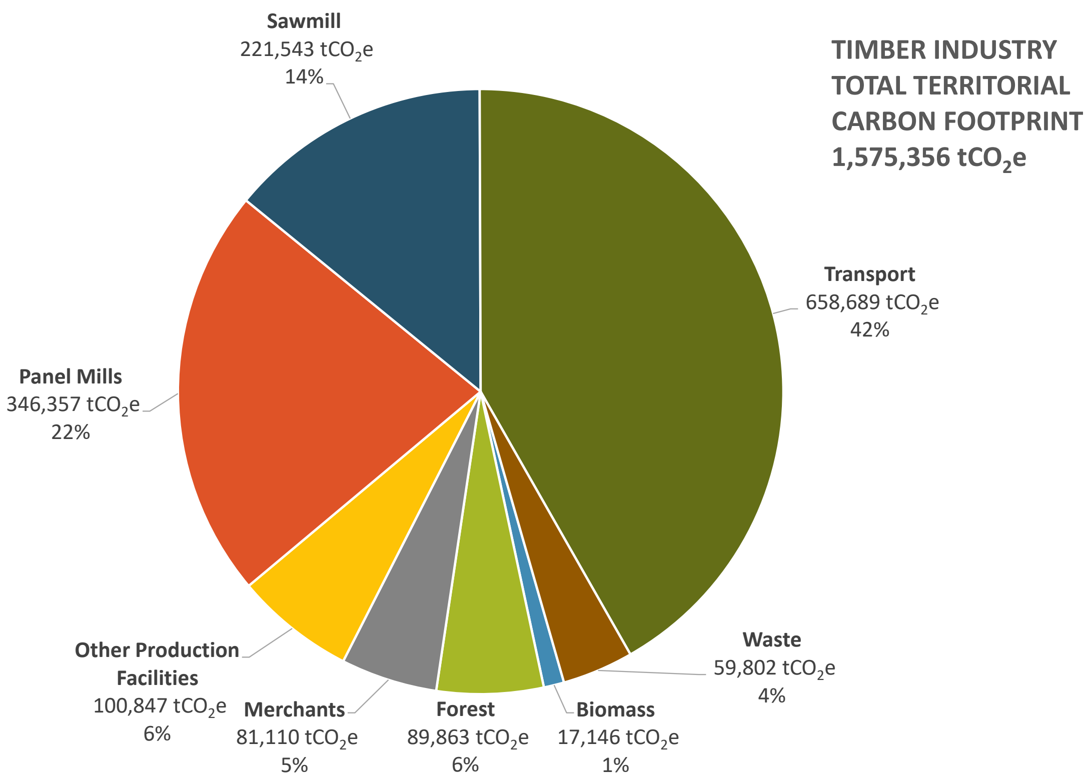


Figure 14. Emissions footprint of the Timber Industry (Territorial) excluding Pulp, Paper & Cardboard.

Sub-sector profiles

Imports

The emissions footprint associated with Timber Industry imports is 1,765,405 tCO_2e, the second largest proportion of the total footprint at 34% (Figure 13).

Figure 15 shows that the majority of these emissions (53%) can be attributed to Particleboard imports. The analysis includes A1-A3 EPD phases emissions as its scope.

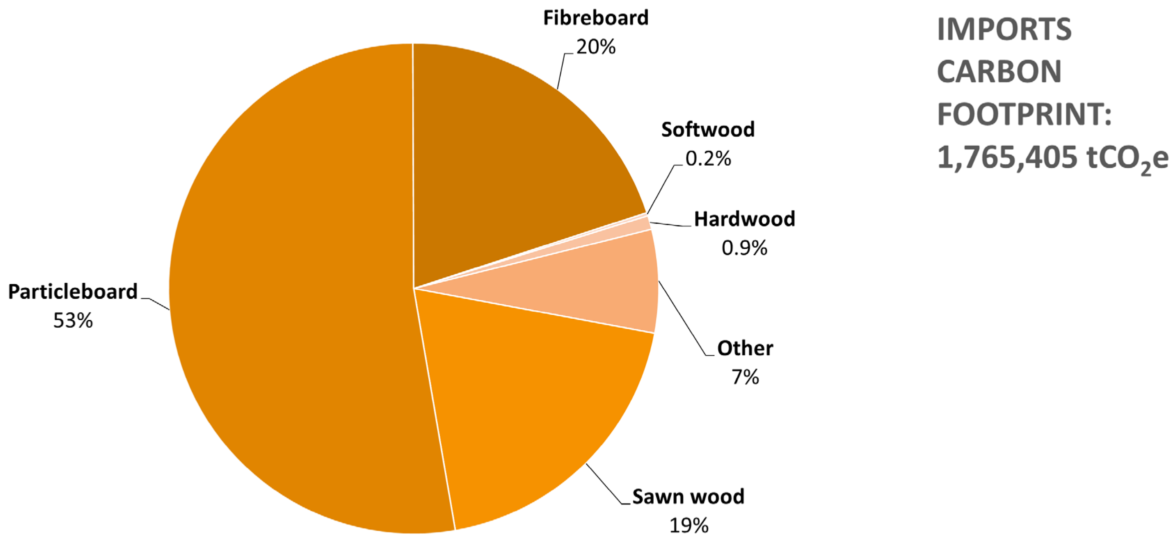


Figure 15. Timber Industry Import emissions.

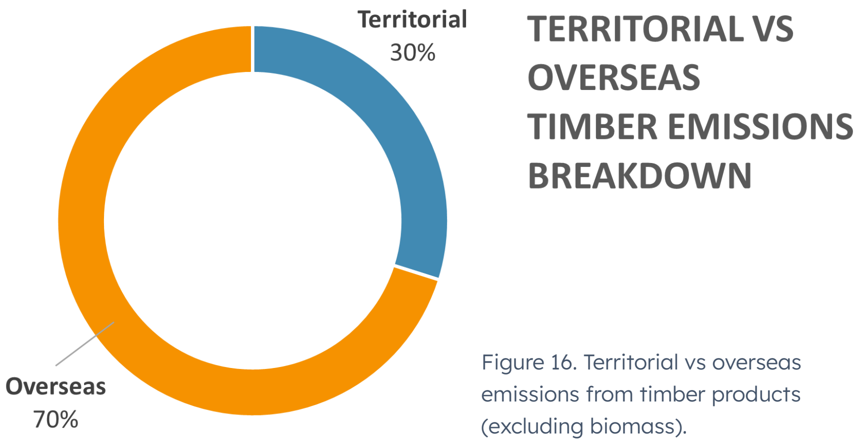


Figure 16. Territorial vs overseas emissions from timber products (excluding biomass).

The UK is the second largest net importer of forest products in the world. Looking specifically at emissions associated with timber products (excluding biomass), 70% of emissions come from overseas (Figure 15).

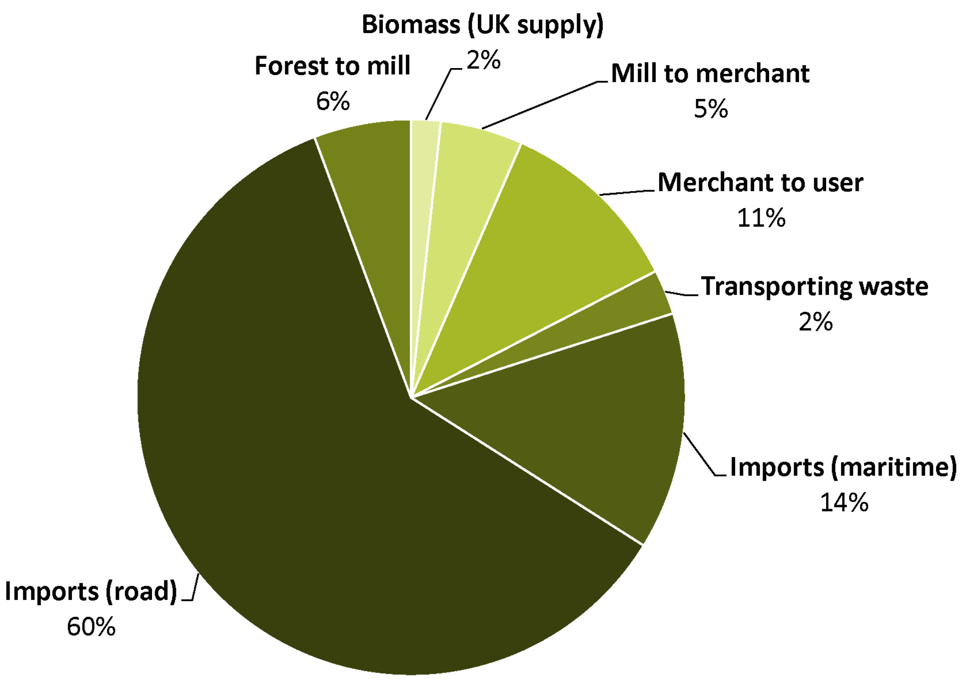
The Confederation of Forest Industries (UK) (Confor) recently warned that the UK faces declining supplies of homegrown wood due to a lack of productive tree planting. The UK needs to urgently increase productive tree planting as the UK currently grows only about 20% of its wood requirement, meaning that 80% is imported.

Excluding biomass from the figures, if all other imported timber products were UK grown this would lead to a 20% emissions reduction.

Transport

The transport carbon footprint of the Timber Industry includes emissions associated with both maritime and road imports of timber, the transport of timber products throughout the value chain (from forest to mill, mill to merchant, merchant to user), emissions associated with transporting waste as well as UK-supplied woodfuel used for biomass.

The emissions associated with timber transport represent 49% of the total carbon footprint of the Timber Industry (Figure 13). When looking at the emissions from transport (Figure 17) the majority of the carbon footprint (74%) comes from road and maritime transport of imported timber products. These emissions are related to the transportation of those imported timber products, rather than the embodied carbon of the imported timber products themselves, which is included in the imports section of this analysis.



TRANSPORT CARBON FOOTPRINT: 2,548,999 tCO_2e

Figure 17. Timber Industry Transport emissions.

The Timber Transport Forum conducted a timber transport survey which found that the UK timber haulage fleet consists of 690 vehicles[19]. In addition, studies show that emissions are around 35% higher on forest roads compared with public roads.

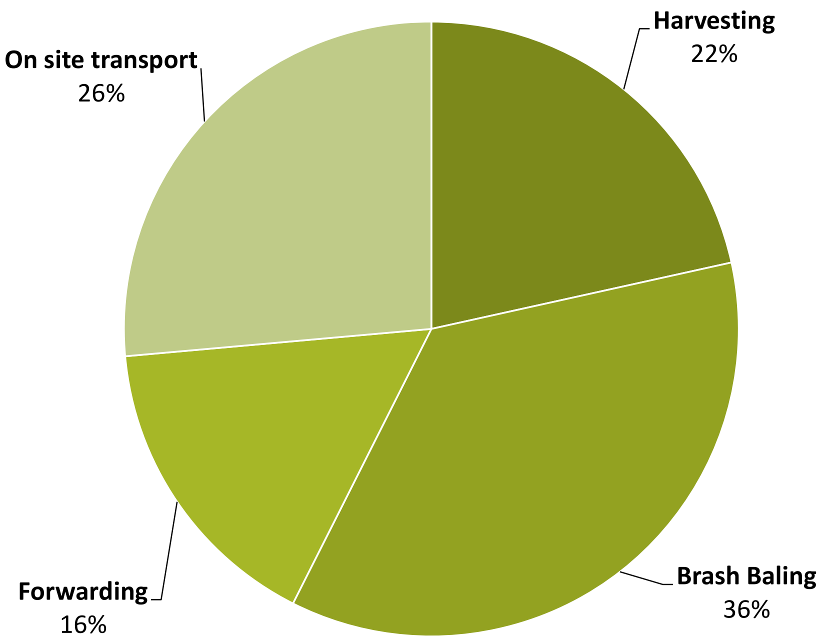
Within the value chain, the highest transport-related emissions are associated with transporting timber products from merchants to user (11%). This is due to the average journey length being highest for this leg of the journey.

The smallest category of transport emissions is associated with the transportation of UK-supplied woodfuel used for biomass at 2% of the total.

Forestry

The emissions footprint associated within the forest is 89,863 tCO_2e, representing just 1% of the total footprint of the Timber Industry (Figure 13).

Figure 18 shows the breakdown of emissions within the forest split into 4 categories: Forwarding (16%), Brash Baling (36%), Harvesting (22%) and On site transport (26%).



FORESTRY TOTAL CARBON FOOTPRINT: 89,863 tCO_2e

Figure 18. Timber Industry Forest emissions.

Panel mills

The emissions footprint associated with panel mills is 346,357tCO_2e, at 7% of the total footprint of the industry (Figure 13).

Figure 19 shows the breakdown of emissions within panel mills. The majority of these come from natural gas (57%) and electricity (33%).

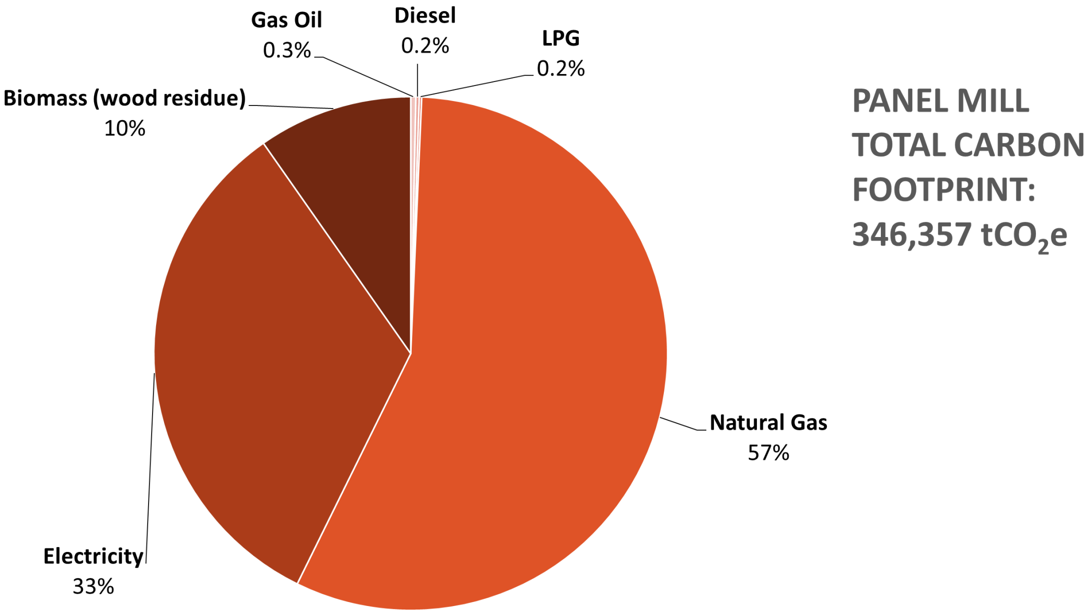


Figure 19. Timber Industry Panel Mill emissions.

Sawmills

Sawmills make up 4% of the Timber Industry emissions footprint at 221,543 tCO_2e. 56% of this is attributed to the electricity use within the sawmill, primarily used for drying and sawing. The remaining 44% is attributed to heat use, primarily used for drying (Figure 20).

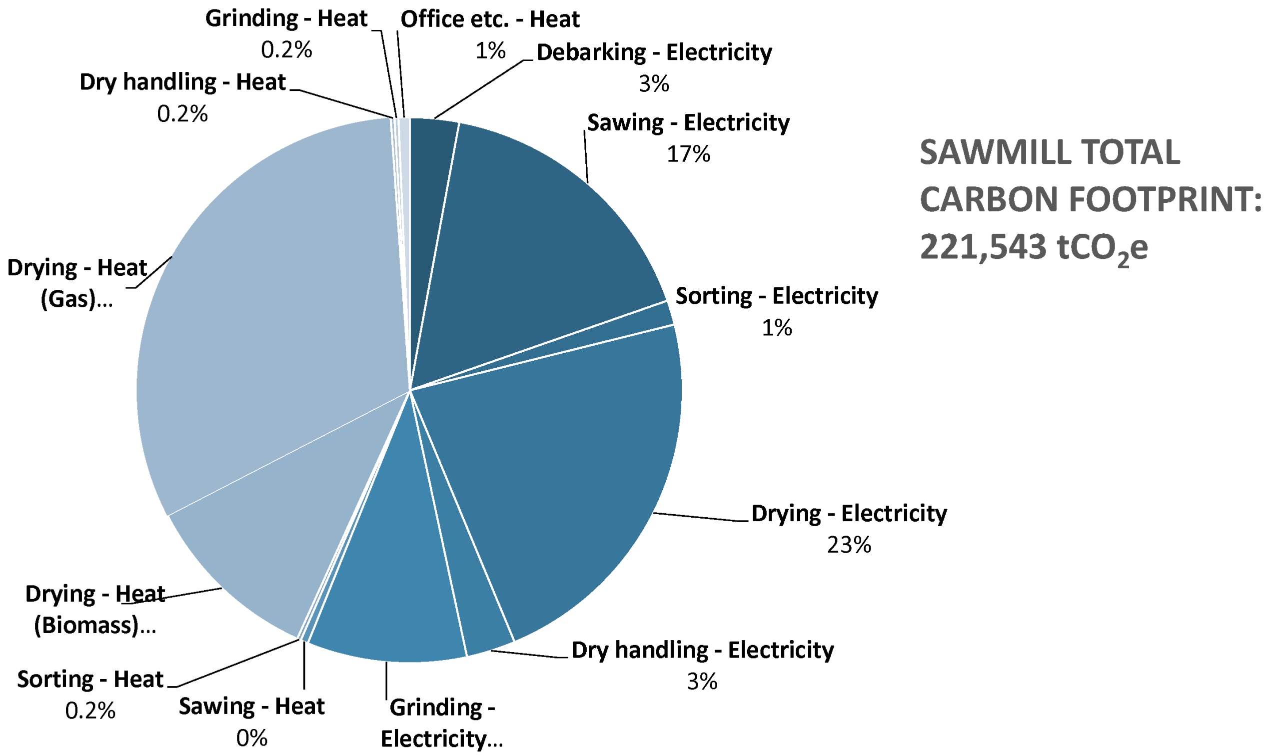


Figure 20. Timber Industry Sawmill emissions

Figure 21 shows the emissions profile calculated from actual data received from Sawmill operators. Only 27% of emissions were from electricity.

Of the main emissions sources within a sawmill, there is potential to improve energy efficiency of processes however it will be difficult to reach net zero without moving away from gas fuelled drying systems.

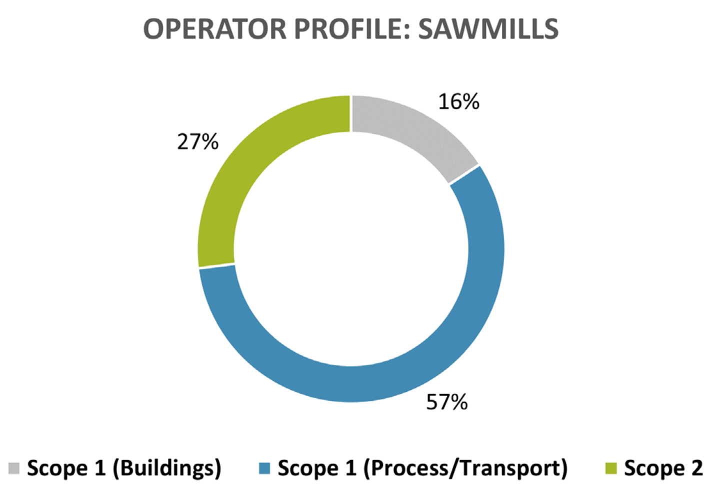


Figure 21. Sawmill operator profile.

Other production facilities

Other production facilities includes joinery, wood protection, timber frame systems, trussed rafters, other engineered timber products, and pallets and packaging. This category represents 2% of the total Timber Industry emissions footprint at 100,847 tCO_2e. The majority of this is from natural gas (63%) and the remainder is from electricity (37%) (Figure 22).

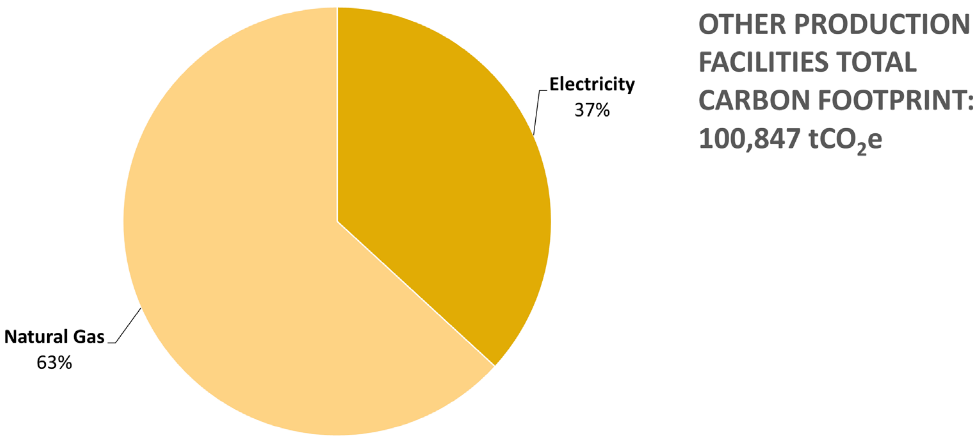


Figure 22. Timber Industry: other production facilities emissions

Due to the nature of the 'other production facilities' category, operator profiles have been split into packaging operators and construction-related products operators as shown above.

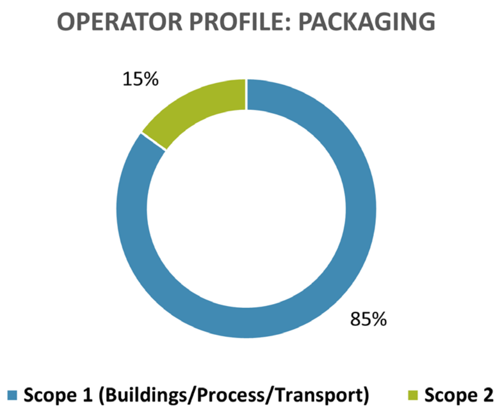


Figure 23. Packaging operator emissions profile

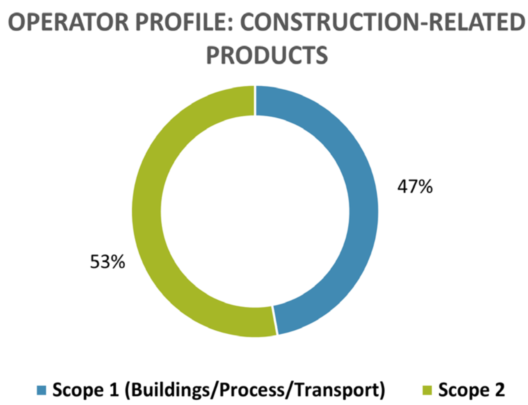


Figure 24. Construction-related products operator emissions profile

Timber merchants

The emissions footprint associated within timber merchants is 81,110 tCO_2e, representing just 1% of the total footprint of the Timber Industry (Figure 13).

Figure 25 shows the breakdown of emissions within timber merchants. The majority of these come from electricity (67%) and the remainder is from natural gas (33%).

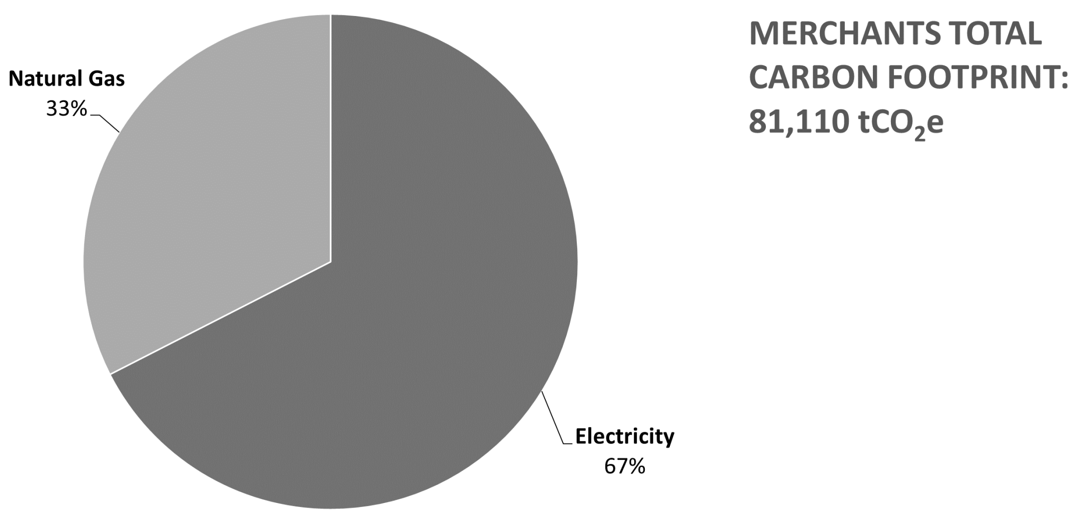


Figure 25. Timber Industry Merchants emissions.

Raw data collected from operators in the Merchant sector showed that 75% of emissions came from Scope 1. The majority of these emissions were related to fuel used in vehicles (58%). Scope 2 emissions made up 17% of the emissions footprint (Figure 26).

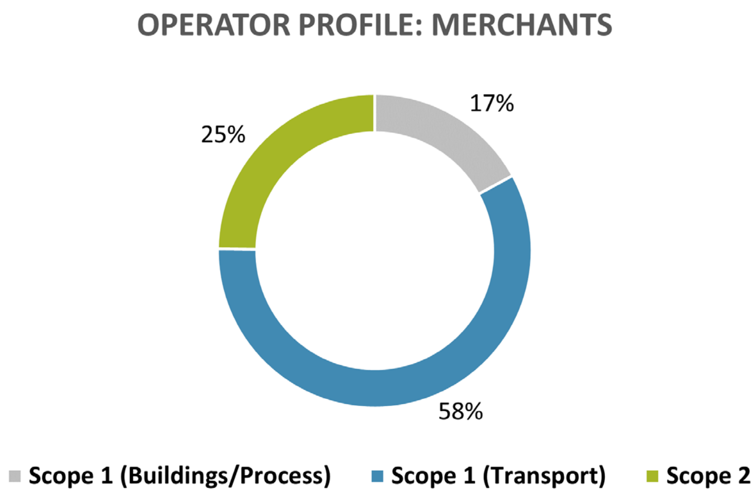


Figure 26. Merchants emission profile

Waste

The Timber Industry has significant circular elements and frequently timber passes through different subsectors before reaching its final use.

The emissions footprint of the waste sub-sector represents 1% of the total footprint of the Timber Industry (Figure 13) at 59,802 tCO_2e. The majority of waste within the Timber Industry is diverted from landfill (99%), either within the sector or to other sectors.

This will include being used for biomass energy production or recycling into panel boards and animal bedding. (Figure 27). It should be noted that the emissions related to the processing and use of the diverted product is covered within the relevant using sector, for example, the above does not include energy used for processing biomass for the energy sector (as this is out of scope for this project), processing of material for panel boards (as this is included with the panel board emissions) or processing material for animal bedding. This leaves the emissions associated with the transport and initial processing of waste from use (e.g. construction), the processing and transport of recycled material to other use (e.g. surfacing), and landfill.

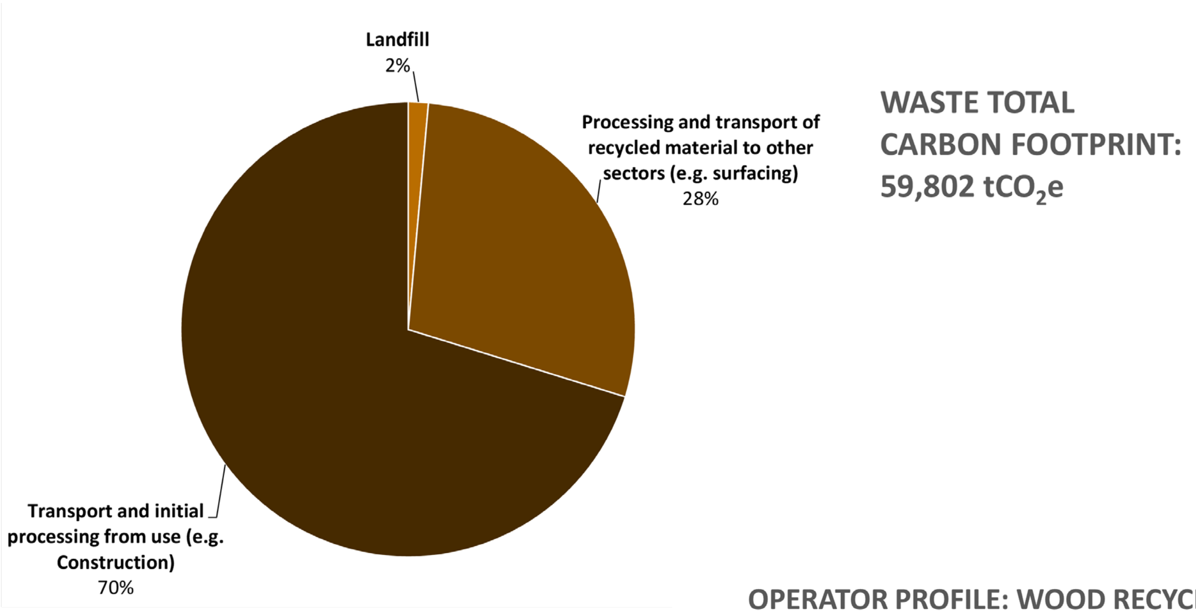


Figure 27. Timber Industry waste emissions.

Raw data collected from operators in the Wood Recyclers sector showed that 87% of emissions came from Scope 1. The majority of these emissions were related to fuel used in vehicles and processes (65%). Scope 2 emissions made up 13% of the emissions footprint (Figure 28).

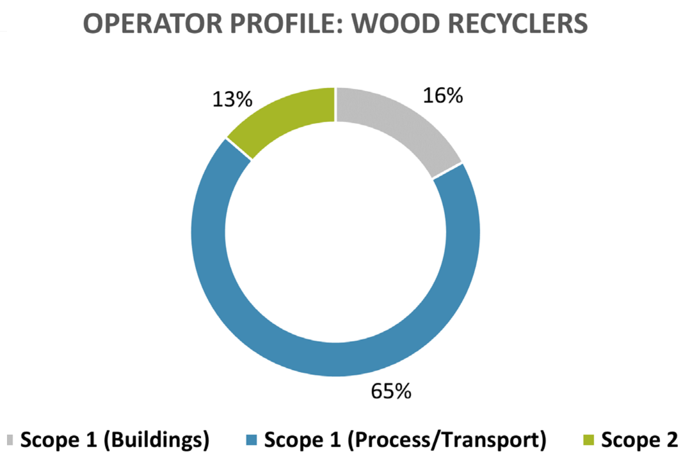


Figure 28. Wood recyclers operator emissions profile.

Biomass

Biomass emissions are shown in Figure 29. However only 1% of these emissions (domestic biomass) can be attributed to the timber industry - the remaining 99% being imported biomass for the production of energy, and therefore accounted for within the energy sector.

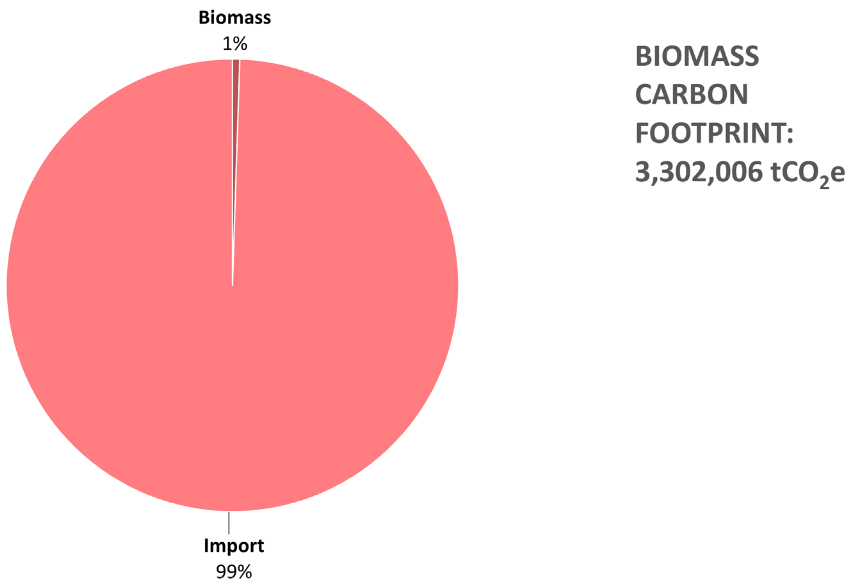


Figure 29. Timber Industry biomass emissions (including imported biomass).

This includes the biomass imports shown in Figure 15 to enable a comparison between the biomass emissions from imported wood fuel and UK-produced wood fuel. Emissions from imported wood fuel make up 99% of emissions from biomass.

Raw data collected from biomass operators shows that only 7% of the emissions footprint comes from electricity, with the remainder coming from Scope 1 emissions associated with buildings, processes and transport (Figure 30).

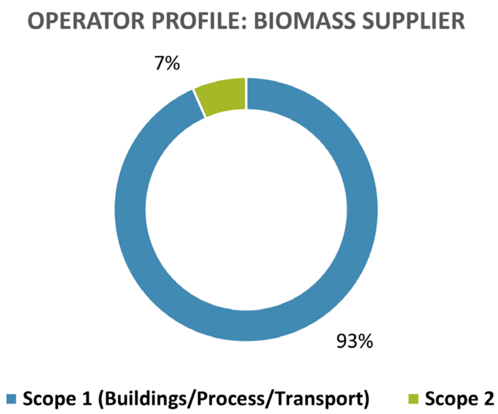


Figure 30. Biomass operator profile.

Biomass and waste produced 11% of UK energy in 2021 (Figure 31). The majority of wood pellets consumed in the UK are imported. In 2021, imports of wood pellets totalled 9.1 million tonnes, with around three quarters of this quantity imported from North America.[20]

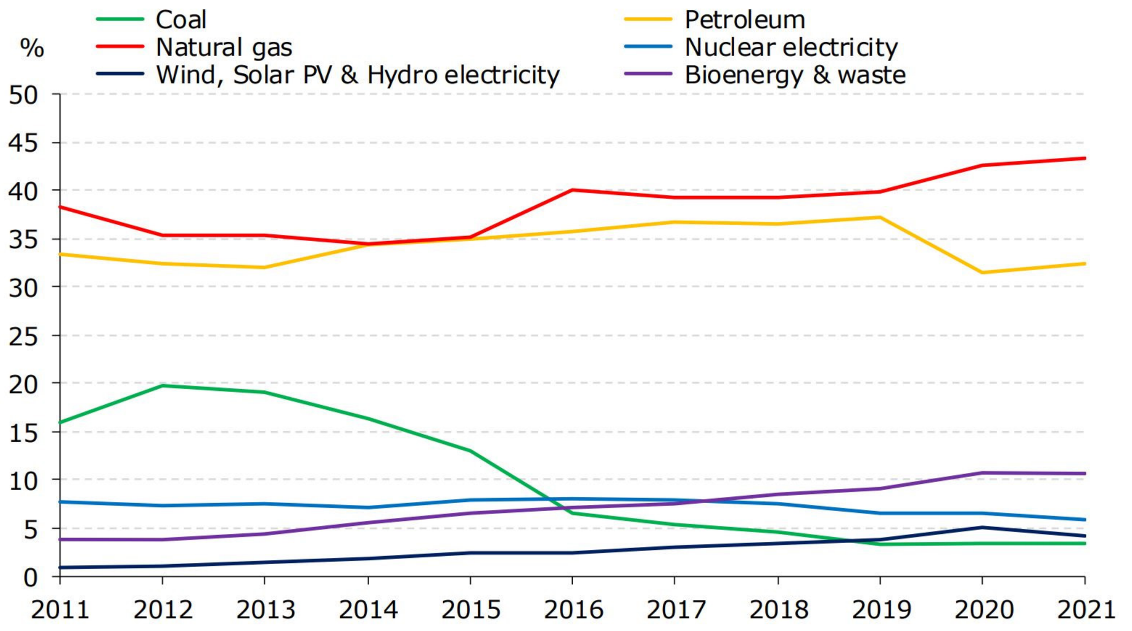


Figure 31. Consumption of primary fuels in the UK, 2011 to 2021 (Department of Business, Energy and Industrial Strategy.[21]

Currently, the carbon intensity of producing biomass energy is less than that of electricity and stands at 120 (gCO_2e/kWh). This is the fourth highest after oil, coal and gas. However, as grid decarbonisation continues to progress, the carbon intensity of using electricity will continue to fall until a tipping point is reached where electricity will be less carbon intensive than biomass energy, and therefore it will become greener to use direct electricity. Below is a graph created from a model that used the latest Future Energy Scenarios (FES) 2022 data from the National Grid ESO, to illustrate a timeline of how current biomass factor performs against the projected electricity factor until 2030.

All analysis has been produced based on BEIS and/or National Grid datasets.

It is acknowledged that other analysis exists of the pace/effectiveness of grid decarbonisation, but as the central government department responsible and the network operator, we've elected for these datasets to be used to avoid any discrepancies from official statistics reporting.

As seen in Figure 32, the point at which using electricity will be less carbon intensive than biomass is after 2027, and will continue to fall year on year after that based on the current grid decarbonisation projections.

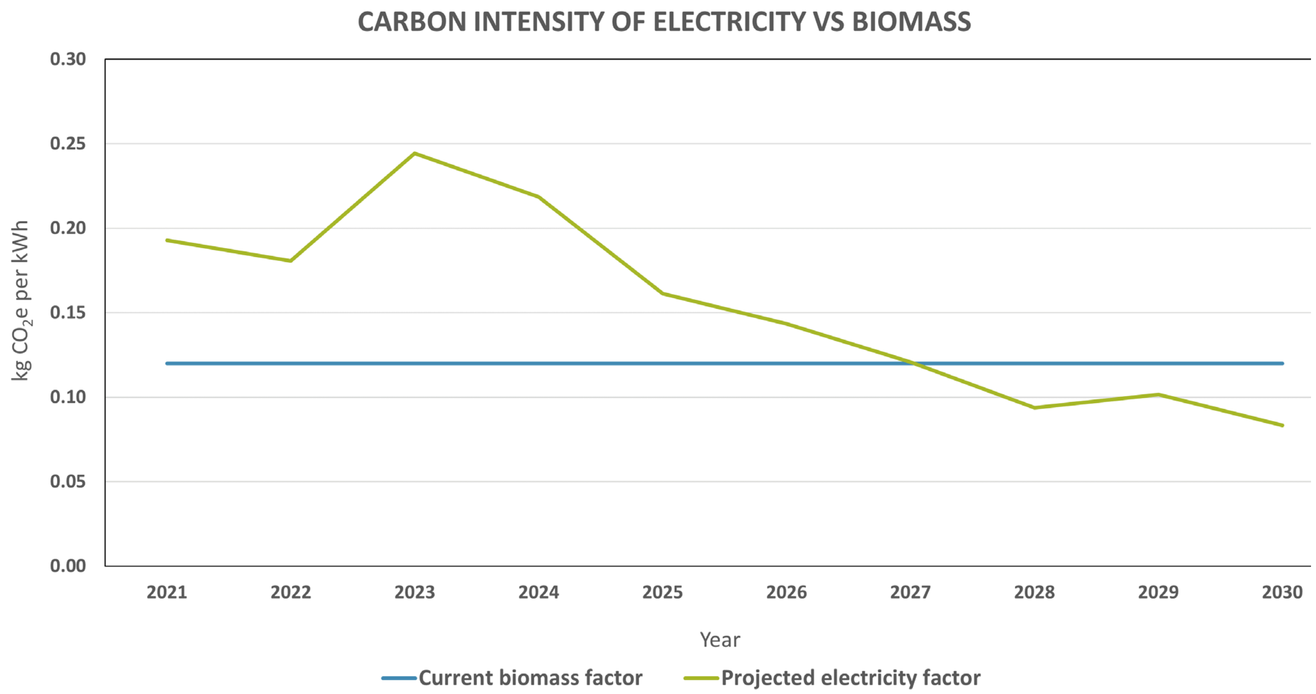


Figure 32.. Graph illustrating the biomass and electricity emissions intensity from 2021-2030.

Product Level Analysis

As part of this project, we have sought to assess the relative importance of certain EPD phases to certain product groups. The products modelled are as follows:

- 1 m^3 - OSB
- 1 m^3 - Chipboard
- 1 m^3 - MDF
- 1 m^3 - Plywood
- 1 m^3 - Sawn Timber (Softwood)
- 1 m^3 - Sawn Timber (Hardwood)
- 1 m^3 - Engineered Timber
- 1 m^3 - Biomass
- 1 m^3 - Paper/Cardboard

The methodology for calculating these models has been detailed in the Methodology Statement (Appendix A). For each of the models, they have been assumed to be manufactured in the UK, using UK grown timber, except for Biomass and Paper/Cardboard where the vast majority of product is imported. They have therefore been calculated on the volume weighted basis based on their typical country of origin (e.g. for Biomass, North America). Note that Biomass and Paper/Cardboard are not considered Timber Industry emissions - the data is only included here for comparison.

This section details the percentage split by EPD phase as a percentage of the total, without accounting for the sequestered carbon. The reason for this is the primary focus of this document is to support in decarbonisation, and as such, the focus of the calculation is where the emissions are coming from, rather than where they are sequestered.

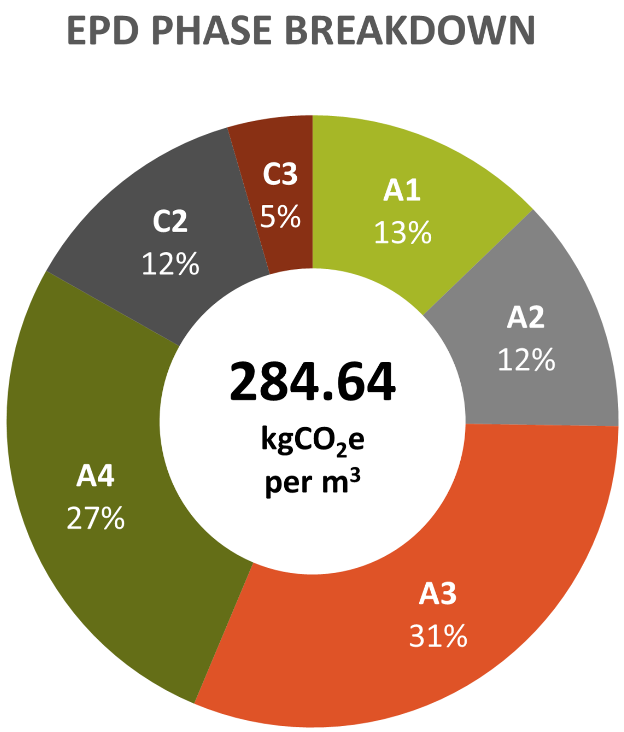
The table for each product group provides the values with the sequestration accounted, for transparency and completeness.

OSB

The below pie chart and table summarise the data for typical production for OSB (A1-A4, C2, C3). The assumptions are detailed in the Methodology Statement.

Carbon model	$kgCO_2e$ per m^3
A1	36.46
A2	35.40
A3	88.46
A4	76.45
C2	35.05
C3	12.81
Grand Total	284.64

The average sequestered carbon from the EPDs reviewed was 270 $kgCO_2e$ per m^3, this has not been included in the analysis above.

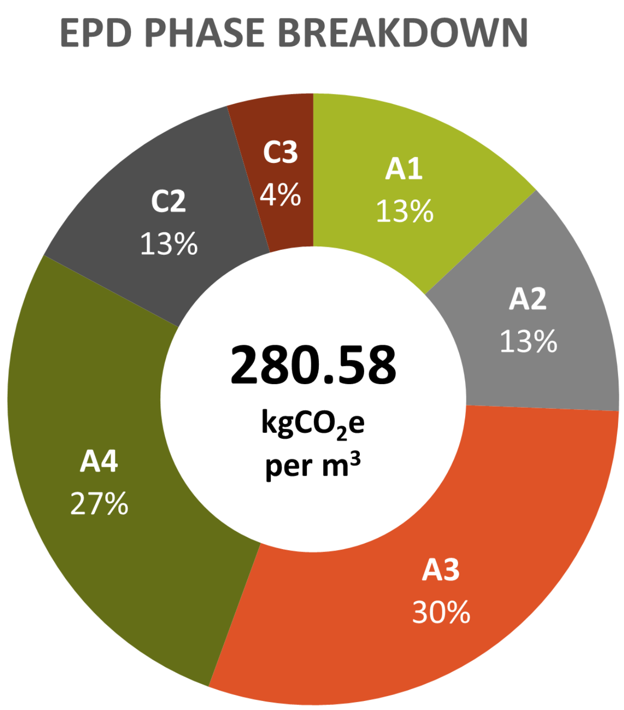


CHIPBOARD

The below pie chart and table summarise the data for typical production for Chipboard (A1-A4, C2, C3). The assumptions are detailed in the Methodology Statement.

Carbon model	$kgCO_2e$ per m^3
A1	36.46
A2	35.40
A3	84.05
A4	76.45
C2	35.40
C3	12.81
Grand Total	280.58

The average sequestered carbon from the EPDs reviewed was 290 $kgCO_2e$ per m^3, this has not been included in the analysis above.

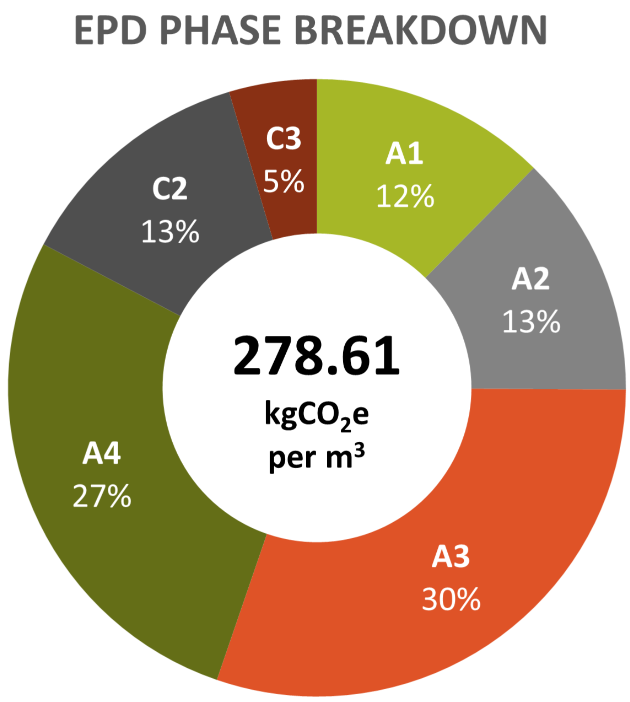


MDF

The below pie chart and table summarise the data for typical production for MDF (A1-A4, C2, C3). The assumptions are detailed in the Methodology Statement.

Carbon model	$kgCO_2e$ per m^3
A1	34.50
A2	35.40
A3	84.05
A4	76.45
C2	35.40
C3	12.81
Grand Total	278.61

The average sequestered carbon from the EPDs reviewed was 320 $kgCO_2e$ per m^3, this has not been included in the analysis above.

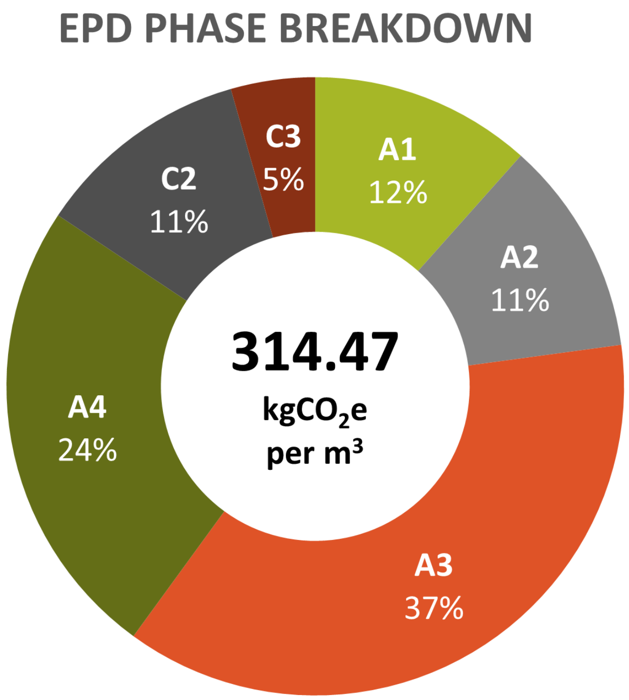


PLYWOOD

The below pie chart and table summarise the data for typical production for Plywood (A1-A4, C2, C3). The assumptions are detailed in the Methodology Statement.

Carbon model	$kgCO_2e$ per m^3
A1	36.46
A2	35.40
A3	116.88
A4	76.45
C2	35.40
C3	13.87
Grand Total	314.47

The average sequestered carbon from the EPDs reviewed was 230 $kgCO_2e$ per m^3, this has not been included in the analysis above.

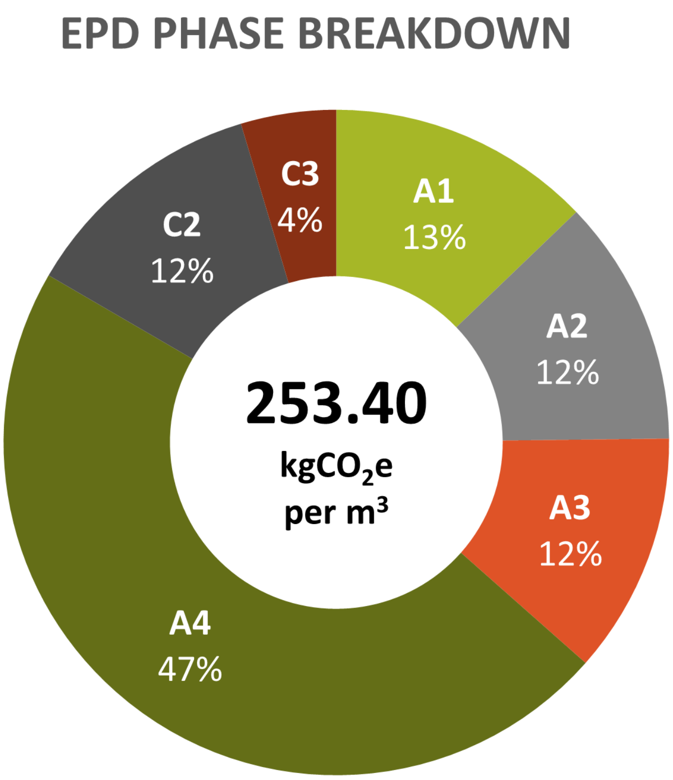


SAWN TIMBER (SOFTWOOD)

The below pie chart and table summarise the data for typical production for Sawn Timber (Softwood) (A1-A4, C2, C3). The assumptions are detailed in the Methodology Statement.

Carbon model	$kgCO_2e$ per m^3
A1	32.49
A2	30.38
A3	29.68
A4	118.72
C2	30.38
C3	11.73
Grand Total	253.40

The average sequestered carbon from the EPDs reviewed was 712 $kgCO_2e$ per m^3, this has not been included in the analysis above.

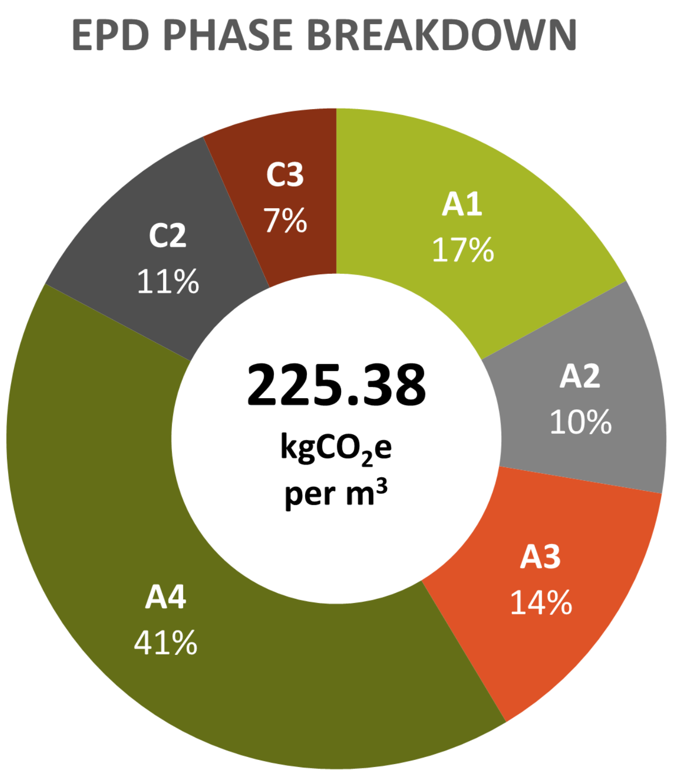


SAWN TIMBER (HARDWOOD)

The below pie chart and table summarise the data for typical production for Sawn Timber (Hardwood) (A1-A4, C2, C3). The assumptions are detailed in the Methodology Statement.

Carbon model	$kgCO_2e$ per m^3
A1	38.45
A2	23.87
A3	30.96
A4	93.28
C2	23.87
C3	14.93
Grand Total	225.38

The average sequestered carbon from the EPDs reviewed was 878 $kgCO_2e$ per m^3, this has not been included in the analysis above.

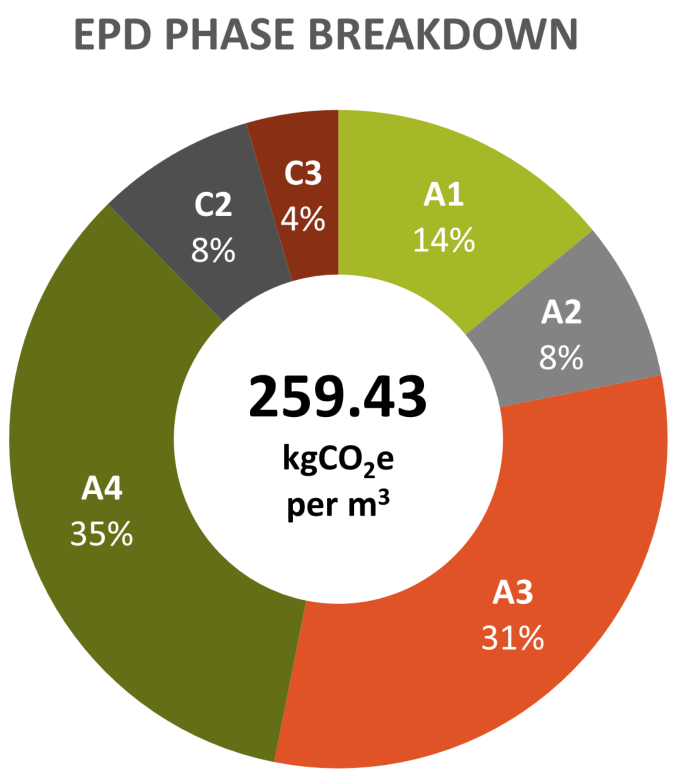


ENGINEERED TIMBER

The below pie chart and table summarise the data for typical production for Engineered Timber (A1-A4, C2, C3). The assumptions are detailed in the Methodology Statement.

Carbon Model	$kgCO_2e$ per m^3
A1	36.46
A2	20.30
A3	81.07
A4	89.57
C2	20.30
C3	11.73
GRAND TOTAL	259.43

The average sequestered carbon from the EPDs reviewed was 818 $kgCO_2e$ per m^3, this has not been included in the analysis above.

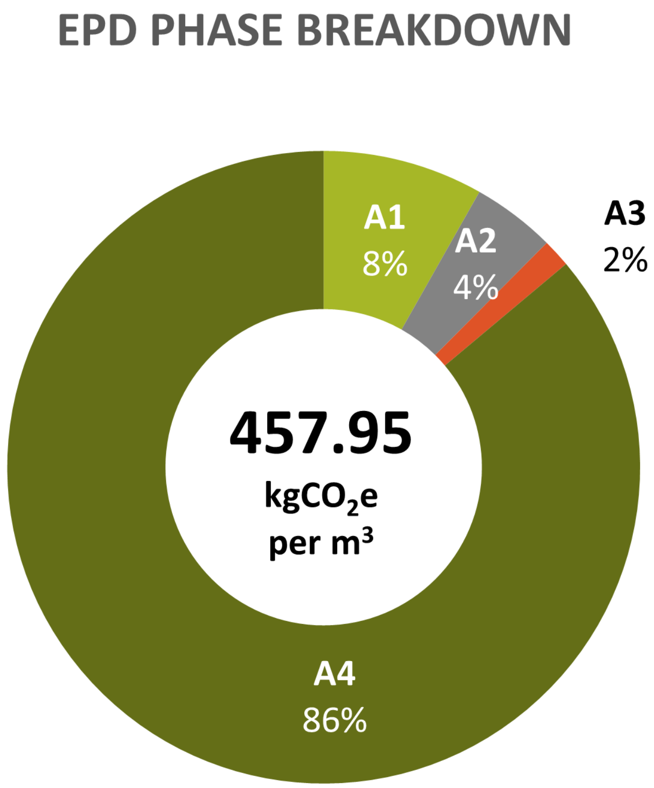


BIOMASS (WOOD CHIPS)

The below pie chart and table summarise the data for typical production for Biomass (Wood Chips) (A1-A4). The assumptions are detailed in the Methodology Statement.

Carbon model	$kgCO_2e$ per m^3
A1	37.51
A2	19.51
A3	6.59
A4	394.33
Grand Total	457.95

The average sequestered carbon from the EPDs reviewed was 240 $kgCO_2e$ per m^3. This has not been included in the analysis above.

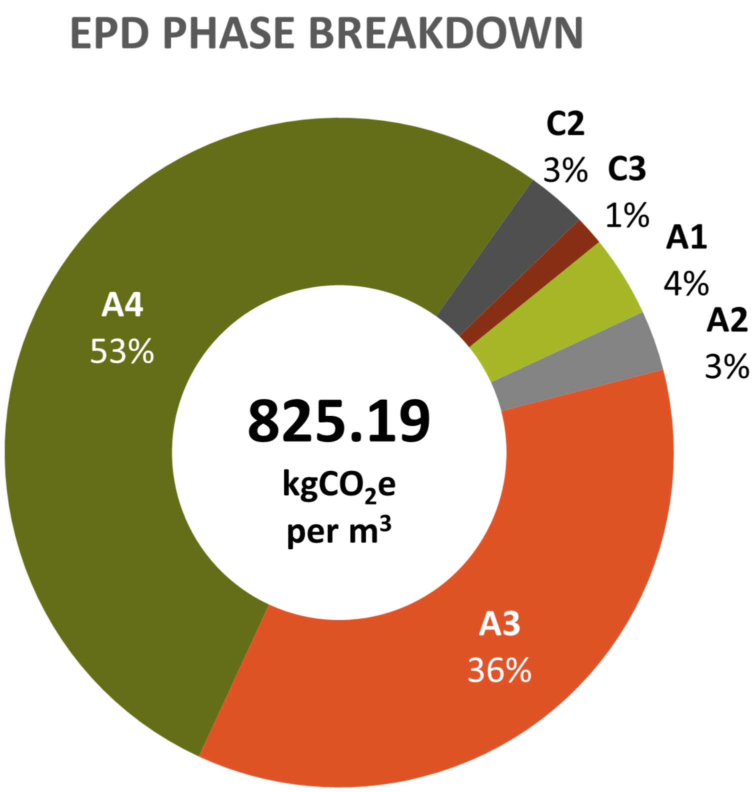


PAPER/CARDBOARD

The below pie chart and table summarise the data for typical production for Paper/ Cardboard (A1-A4, C2, C3). The assumptions are detailed in the Methodology Statement.

Carbon model	$kgCO_2e$ per m^3
A1	32.49
A2	23.99
A3	296.10
A4	436.88
C2	23.99
C3	11.73
Grand Total	825.19

The average sequestered carbon from the EPDs reviewed was 420 $kgCO_2e$ per m^3, this has not been included in the analysis above.



Scope 3 Analysis

Introduction

Scope 3 emissions are generally the largest part of an organisation's carbon footprint. Scope 1 covers direct emissions from owned or controlled sources. Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company. Scope 3 includes all other indirect emissions that occur in a company's value chain. This means it covers areas such as:

- Purchased goods and services
- Business travel
- Employee commuting
- Waste disposal
- Use of sold products
- Transportation and distribution (up- and downstream)
- Investments
- Leased assets and franchises

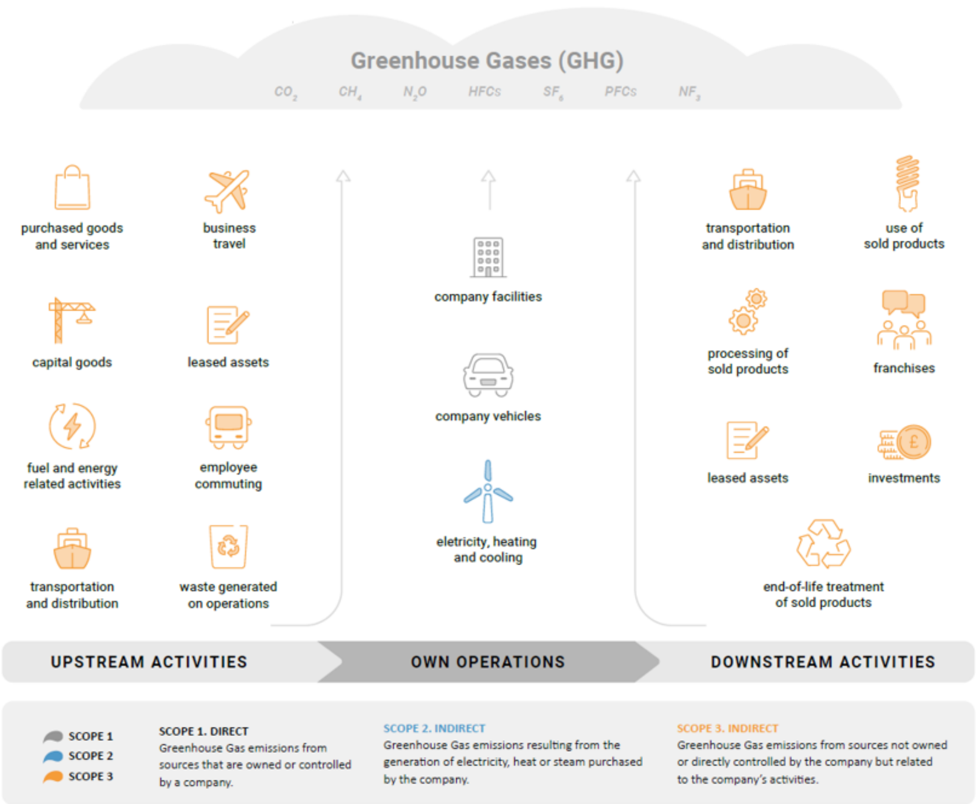


Figure 63. GHG Protocol carbon accounting scopes.

There is limited data within the sector to be able to present detailed analysis of Scope 3 emissions, but it is important to acknowledge that the development of Scope 3 emissions reduction strategies must feature in the sector and operator Net Zero pathways.

Data quality analysis

As is outlined in the next section on data observations, there are material gaps in data in relation to Scope 3 for operators within the sector. Most significantly around purchased goods and services, and transportation and distribution emissions where the majority of emissions are likely to be originating from. The reducing supply chain emissions section later in this document details how operators could improve this area including what data sources should be used/worked upon.

Conceptual analysis

Using some of the data obtained during the project, we have prepared a conceptual analysis of the impact of scope 3 emissions at an operator level (Figure 33). It is important to note that you cannot simply extrapolate this figure to the industry as a whole as many of the scope 3 emissions of the manufacturer/production operator will already have been accounted for in the scope 1 & 2 emissions earlier in the industry in terms of resource flow.

To progress this area it should be included within the respective Net Zero roadmaps of operators within the sector. We would propose that each operator address this by conducting a Scope 3 screening exercise; this is detailed further in Appendix F: Standards and Guidance.

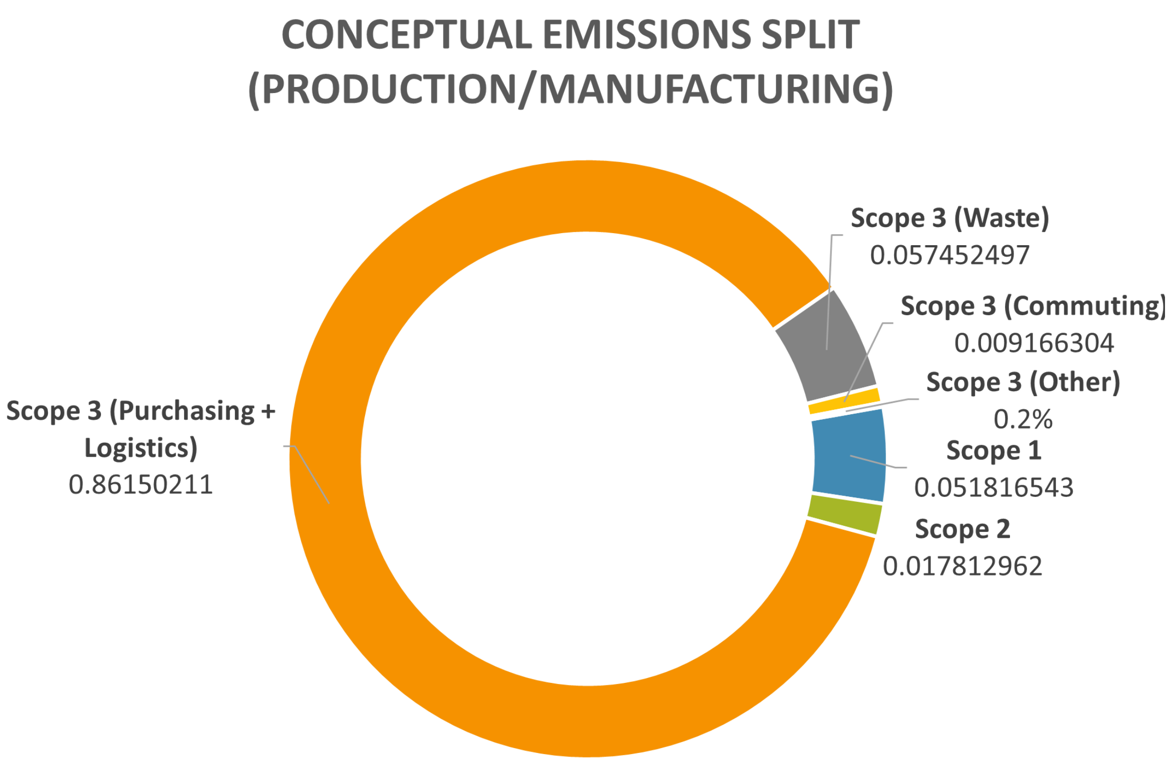


Figure 33. Conceptual emissions split for the production/manufacturing subsector.

Data observations

Policy recommendations

1. Industry should align to GHG protocol to report Scope 1 & Scope 2 emissions by all non-SME operators by 2023
2. Set industry standard to compile full scope carbon footprints (inc. Scope 3) by 2025

During the process of compiling the Corporate carbon footprinting analysis for the Operator Profiles, some key findings were observed which has led to a recommendation to create a reporting standard/framework for the sector. These are summarised within the key headlines below:

Scope 1

- c. 70% of respondents have no record of their fugitive emissions available
- c. 25% of respondents were unable to provide sufficient gas/fuel data (when those fuels are used)

Scope 2 - No concerns were identified with scope 2 data

Scope 3

- c. 40% were unable provide sufficient data on purchased goods and services
- c. 60% were unable provide sufficient data on capital expenditure, business travel and employee commuting
- c. 80% of respondents did not have sufficient data to calculate their transportation and distribution emissions

Furthermore, the EPD section of this document contains additional observations relating to life cycle analysis.

Data considerations

The Timber Industry emissions footprint has been calculated based on the Forestry Commission data on 2019 UK wood production and trade. In addition to this, analysis from the UK Government, TDUK, the Timber Transport Forum, Forest Research, the University of Bangor has been utilised to build an accurate representation of the Timber industry resource balance.

Material flows were modelled for the following sub-groups:

- OSB
- Chipboard
- MDF
- Plywood
- Sawn Timber (Soft)
- Sawn Timber (Hard)
- Engineered Timber
- Biomass
- Paper/Cardboard

Within this, a number of assumptions have been made which are detailed in Appendix A. It should be noted that these figures are correct at the time of publication. Future changes to these will affect the baseline scenario. If any future changes have a material effect on the emissions footprint it is recommended that the footprint is recalculated and re-baselined.

Assumptions that have been made when calculating the total industry usage are provided in Appendix A.

The resource flow for the Timber Industry was calculated to produce the total resource usage. This activity data was then converted to GHG emissions using UK Government conversion factors.

Where individual company-level emissions footprints have been compiled, the operational control approach for determining the organisational boundary was used. Therefore data was included where the company has the ability to implement policies and procedures at the operation.

The reporting period used was for 12 months, typically aligning with the individual company's financial year. The data collection period related to 2019 activity. Therefore, in accordance with the GHG Protocol, the UK conversion factors used are those published by the Department for Environment, Food and Rural Affairs (DEFRA) annually.

The rationale for using 2019 data was to minimise any potential effects of COVID-19 and Brexit on the industry footprint which both presented barriers to trade. The UN reported that COVID-19 caused a temporary reduction in carbon emissions worldwide and changed the demand for timber products in the UK.

The temporary shift in consumer demand towards landscaping products, DIY and home improvement products combined with supply issues led to demand outstripping supply across the 2020-2021 period. Supply patterns have since returned to more pre-pandemic levels in most areas of the industry. Brexit also impacted the supply chain and impacted the ability to get goods into the UK and to market and also had an impact on availability of drivers.

Opportunities have been calculated based on a set of cost and fuel type assumptions. These will be provided alongside the roadmap document for users to amend to suit their own calculations.

Net Zero Pathway

Policy recommendations

3. Reduce road going transport emissions intensity by 25% by 2030, and 50% by 2035
4. Reduce processing/manufacturing emissions intensity by 50% by 2030
5. Reduce forestry emissions intensity by 50% by 2040
6. Reduce Scope 1 & 2 carbon intensity of the industry by 90% by 2045
7. Reduce Scope 3 carbon intensity of the industry by 90% by 2050

The Timber Industry's carbon footprint was analysed to identify the priority hotspots that require action, with a particular focus on the actions that relate to material emissions sources and those that had the greatest potential reduction.

Recommendations were developed through a set of workshops with stakeholders from across the industry that identified further potential opportunities and discussed the viability of these.

In addition to this, calculations from the National Grid Future Energy Scenarios and the Committee on Climate Change's Sixth Carbon Budget were used to identify decarbonisation pathways for relevant sub-sectors.

Figure 34 shows the Timber Industry transition to Net Zero by subsector. Overall emissions must decrease by >90% to reach Net Zero by 2050. Any remaining emissions must be offset using credible carbon offsets from projects that focus on permanent removals.

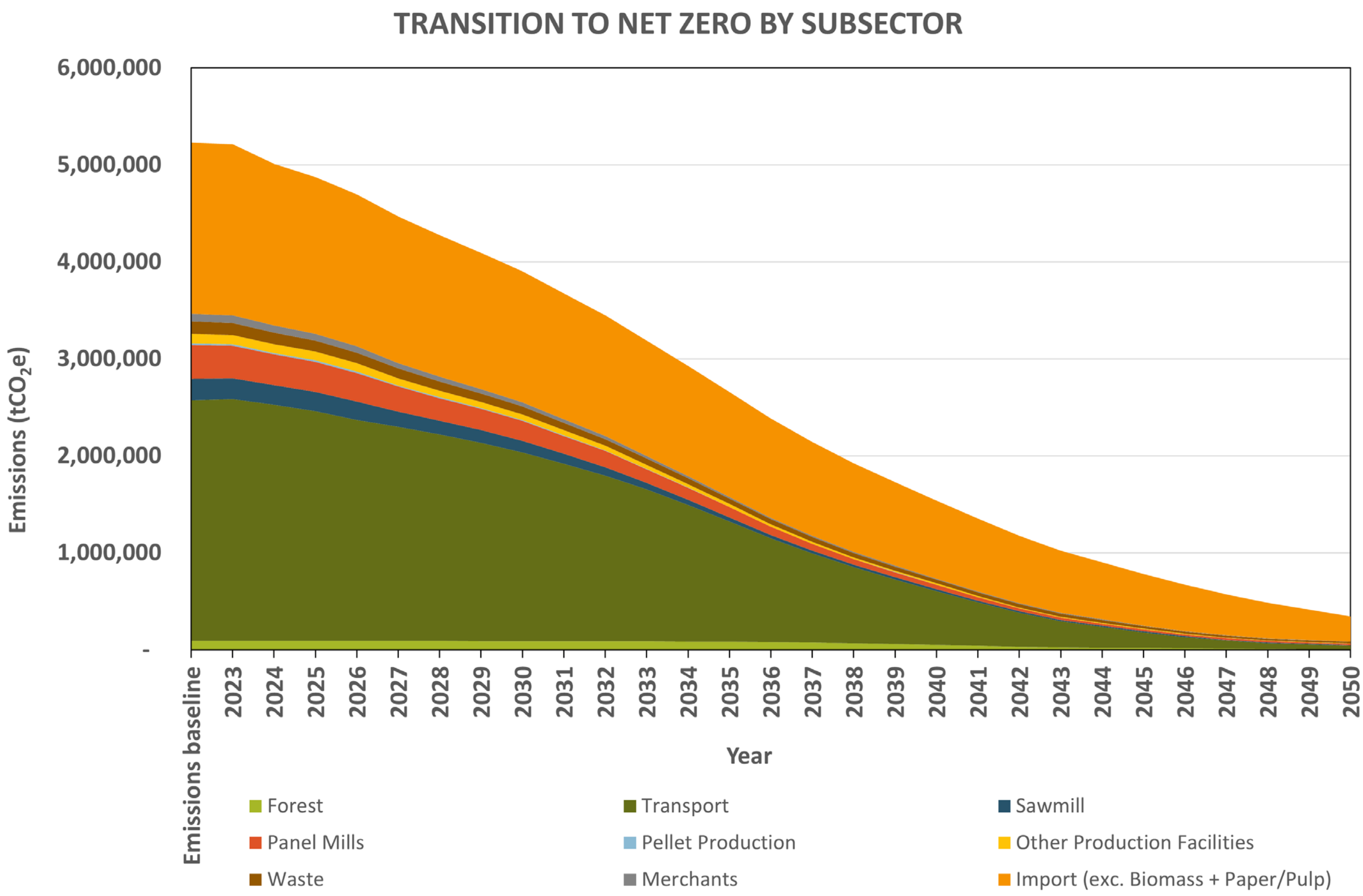


Figure 34. Transition to Net Zero for the UK Timber Industry.

Emissions reduction opportunities

Emissions reduction opportunities have been grouped by theme into 4 categories:

- Reduce operational emissions
- Reduce supply chain emissions
- Creating a circular economy
- Increase carbon removals

Appendix D includes tables summarising a list of key opportunities for the industry to reduce its emissions related to the above categories. These have been prepared using modelled "average" business cases by Energise, to derive a typical range of costs and paybacks on a per-site basis. The software used for the modelling is RETScreen Energy Management Software that allows assessment of low-carbon planning, implementation, monitoring and reporting, which is published by Natural Resource Canada, and used around the world. The datasets used are from UK Weather Stations/UK buildings. A selection of physical audits have been undertaken as part of the project to validate the assumptions used.

Appendix D outlines the following information:

- Category/description
- EPD stage
- Action timeframe/economic viability
- Cost range from low/no cost to significant capital
- Payback range

COST	£
Low/no cost	<£1k
Very small	£1k-£5k
Small	£5k-20k
Medium	£20k-£50k
Large	£50k-£100k
Significant capital	>£100k

PAYBACK	RANGE
Immediate	Less than 3 months
Quick	Over 3 months, less than 1 year
Short term	1-3 years
Medium term	3-7 years
Long term	> 7 years

Reducing the industry's emissions will require a clear focus on the following (which represent areas of potential action, that also represent significant sectoral emissions).

Reducing operational emissions

Transport

Timber transport, especially by road, is a significant contributor to the carbon footprint of the industry. The decarbonisation of Heavy Goods Vehicles (HGVs) used in the industry can be a key catalyst that enables the reduction of carbon emissions from timber transport. HGVs produced 16% of domestic transport greenhouse gas emissions in 2019 in the UK.

This will need to be reduced to zero by 2050 as set out in the Department for Transport's 'Decarbonising Transport: Setting the Challenge', which is preparing for the Transport Decarbonisation Plan. Large, long-haul HGVs are difficult to decarbonise as they are in use for long periods and require high levels of power and energy for their operations. Larger articulated vehicles are driven significantly further than rigid vehicles, and on average, a HGV travels more than 400km per day, mostly at high speed.[22]

Key equipment in the forest

Generally, forest and timber supply chains rely on diesel to power forestry equipment and vehicles. The equipment being used have long, hard duty cycles and therefore consume considerable power. These will need to shift to alternatives such as biofuels, biogas, battery electric, or hydrogen fuel cells if the industry is to decarbonise. Figure 35 shows a range of equipment used at different stages of the timber process:

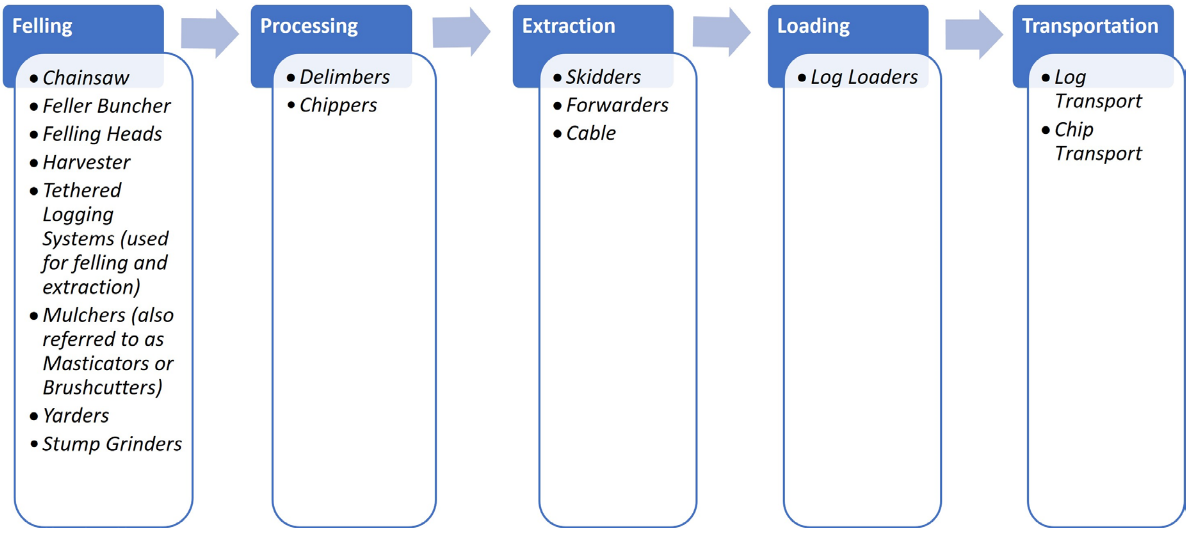


Figure 35: Infographic showing key timber equipment used at different stages of the timber production process

Forestry processes rely on the use of high-tech equipment, and so the next generation of forestry equipment is likely to incorporate numerous innovative technologies such as advanced operating systems and software, sensors and automation that are transforming their capabilities to deliver the outcomes required more efficiently (e.g. accessing challenging/difficult to reach areas). The widespread implementation of smarter and more advanced equipment offers long-term opportunities for the forestry industry by making it easier for timber industry operators to use sustainable practices that enable the transition to a cleaner carbon future. The deployment of this technology will evolve as innovation occurs, supporting the sector in reducing emissions and contributing to delivering a lower carbon operation.

Importantly, the use of drones to survey terrain will enable operators to identify where machines will be most effective and identify ideal trees for cutting. The widespread implementation of smarter and more advanced equipment offers long-term opportunities for the forestry industry by making it easier for timber industry operators to use sustainable practices that enable the transition to a cleaner carbon future.

Off-road vehicles

The emissions of off-road vehicles are hard to decarbonise. Electrified equipment is not available, nor is it likely to be as provision of the electrical infrastructure for charging is unlikely to be a barrier which it is economically viable to resolve. This means that the reduction of emissions in this area needs to be addressed through non-electric solutions.

Forestry processes rely on the use of high-tech equipment, and so the next generation of forestry equipment is likely to incorporate numerous innovative technologies such as advanced operating systems and software, sensors and automation that are transforming their capabilities. Hybrid-powered harvesting and forwarder machines are entering the market.

Harvesters/Forwarders

A forest harvester is a type of heavy forestry vehicle employed in logging operations for felling, delimbing and bucking trees. It is usually used in conjunction with a forwarder that hauls the logs to a roadside landing. Forwarders are purpose-built machines equipped with a loading crane or log bunk, and are used to pick up and transport logs out of forests, travelling long distances between felling points and timber depots.

Due to the heavy work that these machines do on difficult terrain, the machines consume large amounts of fuel and they generally use a diesel engine to power both the vehicle and the harvesting or loading mechanism through a hydraulic drive.

Case Study: sustainable innovation in the forwarder market

The EV1 concept developed by PONSSE features a fully electric powertrain, which operates solely with battery energy, and a diesel engine to charge the generator. It is the result of three years of development alongside Epec, a system supplier of 'advanced electrics'. Both firms say the concept, which will be available commercially in the near future, paves the way for technological growth and sustainable harvesting solutions, and is part of Ponsse's "tangible step" towards the goal of carbon neutrality.

Case study of sustainable innovation in harvesters

Since 2016, Logset have introduced two timber harvesters that use hybrid technology, with the range expanding to include the smaller 8H GTE Hybrid harvester. The hybrid system's two main operative units are the electric motor and the super capacitors used as energy storage. The system provides up to 100 kW of additional power. According to Logset, fuel consumption in a hybrid is reduced by around 25 percent compared to a similar diesel engine application setting a new benchmark for the forest machine industry.

Hybrid powered harvesting and forwarder machines are starting to enter the market, as they have clear benefits in terms of lowering the consumption of fuel. Electric power is used for heavy loads, such as sawing and crane operations, whilst hybrid power reduces peak loads for the diesel engine because all maximum power needs are aided by electric power. As a result, it puts less stress on the diesel engine and in turn reduces fuel consumption. It also has the added benefit of cutting down noise pollution.

Haulage road design and management

Haul road haulage is the predominant form of timber transport, as the first leg of the journey out of the forest is usually by lorry. The fuel consumption from lorries transporting timber is typically higher than the average lorry because of the need to navigate rural and gravelled forest road and hilly terrain, all of which require more fuel consumption.

In 2010, the Timber Transport Forum commissioned a study which found that subsequent direct greenhouse gas emissions for timber transport were found to be between 33% and 35% higher on forest roads compared with public roads.[29]

Due to the rough terrain, timber lorries also generally have a shorter lifespan than the average road haulage vehicle, resulting in more frequent manufacture and maintenance of timber lorries. Furthermore, smaller, single-track roads leading to timber forests frequently experience heavy loads, resulting in greater wear and tear and more regular repair. All these factors cause greenhouse gases to be emitted.

The Timber Transport Forum noted that a recent 2022 survey found that the UK timber haulage fleet consists of 690 vehicles. The transport of timber from the forest to primary milling facilities in particular can create carbon emissions which make up a significant portion of the overall carbon footprint of the timber industry.

Hydrogen

Hydrogen appears to be the most promising long-term energy store for transporting large quantities of renewable energy. The transport and logistics sector can significantly benefit from hydrogen trucks in particular, once the production and use of hydrogen becomes more cost effective than fossil fuels. It is expected that hydrogen trucks will be able to operate in a similar way to diesel vehicles. This will be possible through fast refuelling, in under 15 minutes, with some being capable of working in ranges in excess of 800km even for the heaviest loads.

This will enable operational efficiency and mean that a reduced number of refuelling stations will be needed. It will also reduce the total cost of ownership compared to battery alternatives with fast charging. However, the charging infrastructure is exceptionally inaccessible for businesses as there are currently just six hydrogen filling stations open in the UK, making it difficult for drivers to refuel as and when it’s needed.

The availability of hydrogen stations is therefore far too limited in the short term. There are plans to introduce more hydrogen stations in the UK and these will focus on accommodating larger vehicles and the latest technology. With a wider selection of refuelling sites available, we can expect to see more hydrogen vehicles on the road in the near future.[36]

It is reasonable to consider hydrogen a vital fuel for the future of the logistics sector. Work has already underway to accelerate the industrialisation of hydrogen fuel cell HGV technology and the associated refuelling network and field support mechanisms. The H2Accelerate collaboration is committed to facilitate the rapid deployment of hydrogen HGV’s and the required supporting infrastructure at scale, to achieve an acceptable ownership cost proposition and easy operation for end users.

This will help facilitate the penetration of renewable energy generation. By 2030, the infrastructure deployed will allow hydrogen to become a key solution for long-haul road transport across Europe, allowing the sector to achieve climate goals.[23]

	Hydrogen	Electric Road System
Advantages / Opportunities	Short refuelling time. Long vehicle range between refuelling. Can be operationally similar to conventional vehicles. Hydrogen availability is likely to increase as it becomes useful in other sectors (e.g. heating, aviation, maritime, industry). Hydrogen can be a useful storage vector for surplus renewable energy.	High 'windmill to wheel' efficiency (>80% reported), enabling low operating costs, and benefitting the overall energy system. Reduces operating time spent on refuelling, potentially to zero for certain operations. Technology well developed for railways, trams, trolleybuses, etc, with UK-based expertise and supply chains available.
Disadvantages / Risks	'Windmill to wheel' efficiency is relatively low compared to other zero-emission options. A vehicle may need over twice as much primary energy to cover the same distance as an electric equivalent. Requires an extensive network of HGV hydrogen refuelling stations, which may be costly and/or delayed by land constraints and planning regulations. Fuel cost may remain high for zero-emission hydrogen from electrolysis. High specification materials are required for fuel cells and onboard hydrogen storage, making these components significant drivers of cost.	Requires major upfront infrastructure investment, and uncertainty over installation costs including electricity network connections and reinforcements. Achieving high utilisation could be challenging without an extensive network of ERS routes. Potential objections to visual impact of catenaries. Safety, operational and disruption risk in case of overhead line equipment failure. Risk of delays or restrictions to infrastructure deployment due to planning regulations.

Figure 36. The Advantages and Disadvantages of Hydrogen vs ERS (Connected Places Catapult).[27]

Electrification

Transport makes up 23% of energy-related carbon emissions globally and businesses have a critical role to play in leading by example and encouraging an uptake of EVs within their own fleet.[34] The first step on any electric vehicle (EV) journey is to develop and implement an electrification strategy. The strategy should be cost inclusive, future proof, and data driven. Below are 8 steps that should be taken when electrifying a fleet[35]:

1. EV suitability assessment
2. Choosing the right EVs for the business
3. Charging infrastructure assessment
4. Electrical site survey
5. Executing installation plan with hardware implementation

6. Charge point management - programming and operating the installed hardware
7. Maintenance and servicing
8. Enabling the power of telematics

Significant progress is being made to electrification of large logistic vehicles such as HGVs. However, scaling battery technology for the larger long-distance HGVs has several challenges.

These challenges are due to the substantial quantities of both energy and power needed for the commercial operation of long-distance HGVs. Finding a deployable solution for all long-distance HGVs is vital for achieving Net Zero as they currently represent about 5% of UK's total GHG emissions.[24]

According to the Timber Transport Forum (TTF), there are currently no electric vehicles on the market that can replace or compete with traditional internal combustion engine HGV on a TCO (total cost of ownership) basis.

This is mainly due to the high procurement cost and weight of the batteries. Battery cost is expected to drop by 58% percent by 2030, which is expected to make a difference to the overall price, as the battery can account for up to a quarter of the cost of electric vehicles.

With the help of EV incentives, along with tax and fuel savings, the total cost of owning an electric vehicle can be lower than that of a diesel vehicle. Future advances in battery-specific energy and cost could increase the importance of battery electric vehicles in the haulage industry.[25] An 'Electric Road System' (ERS) is a strong contender to deliver the energy needed by the UK's long-distance HGV fleet. Electric road systems are road transportation systems based on technologies that support electric power transfer from roads to vehicles whilst they are in motion.

ERS deploys roadside infrastructure that allows the most efficient direct use of zero-carbon electricity and hence the lowest societal cost. This approach is scalable and quick to deploy, using known and available technologies. Existing road bodies such as National Grid, Highways England and the UK's construction industry and infrastructure supply chains have all considered the potential of the solution.

Additionally, HGV manufacturers such as Scania have indicated they can deliver the modified vehicles and have delivered numerous prototypes for demonstration trials around Europe.[26]

Hydrogen vs electrification

Both hydrogen and electric vehicles have great potential to move our dependency away from oil for transport. However, as of now, electric vehicles appear to have an advantage over hydrogen, due to multiple factors such as cost, availability, ease of charging, and efficiency. The lack of hydrogen vehicle infrastructure means that there is a lack of refuelling stations, and hydrogen power is currently significantly more expensive.

Therefore, for many industries, at least in the short term, hydrogen vehicles are currently not a viable option yet compared to electric vehicles. This may change when the hydrogen vehicle industry is given the required level of investment needed in future innovations to bring down the costs associated with hydrogen.

According to a study conducted by the Stockholm Environment Institute, electric HGVs may be more economically viable provided a fast-charging network is available. While they are available now, the cost may discourage businesses for the next few years. Electric HGVs are undergoing trials currently and are expected to enter the popular market shortly before 2030, when it is expected that electric vehicles will be more affordable and more widely adopted.[28]

Figure 37 and Figure 38 show the adoption rate of electric HGVs and hydrogen HGVs as set out by National Grid in their 2022 update of the Future Energy Scenarios (assumed model of System Transition).

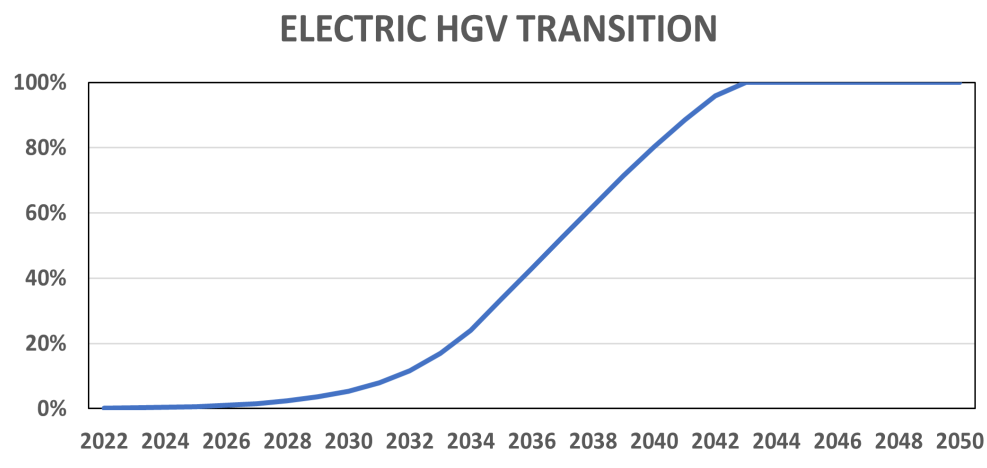


Figure 37. Electric HGV transition (National Grid Future Energy Scenarios).

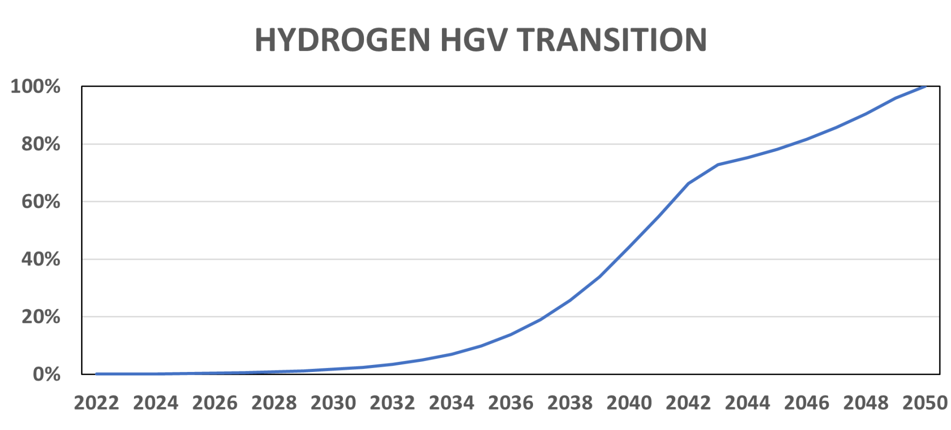


Figure 38. Hydrogen HGV transition (National Grid Future Energy Scenarios).

It can be noted that hydrogen (which will be required to decarbonise some elements of the industry) achieves 80% adoption around seven years later than electric HGVs are forecast to, and reaches 100% adoption by 2050.

Energy Efficiency (Transport)

Transport is the second largest element of the industry's carbon footprint (30%) behind imports (59%). To understand where the current emissions from transport come from it is useful to understand where the typical usage goes in a vehicle. This is detailed below in Figure 39, showing the energy flow into and out of a typical HGV.

Reducing emissions from transport can be split into two main opportunity areas:

1. Reducing emissions from off-road vehicles within the Forest

2. Reducing emissions from road going vehicles:
    - Mainly HGVs in the Forest, Sawmill, Panel Mill, Other Production and Waste areas
    - A mix of HGVs and smaller vehicles for Merchants

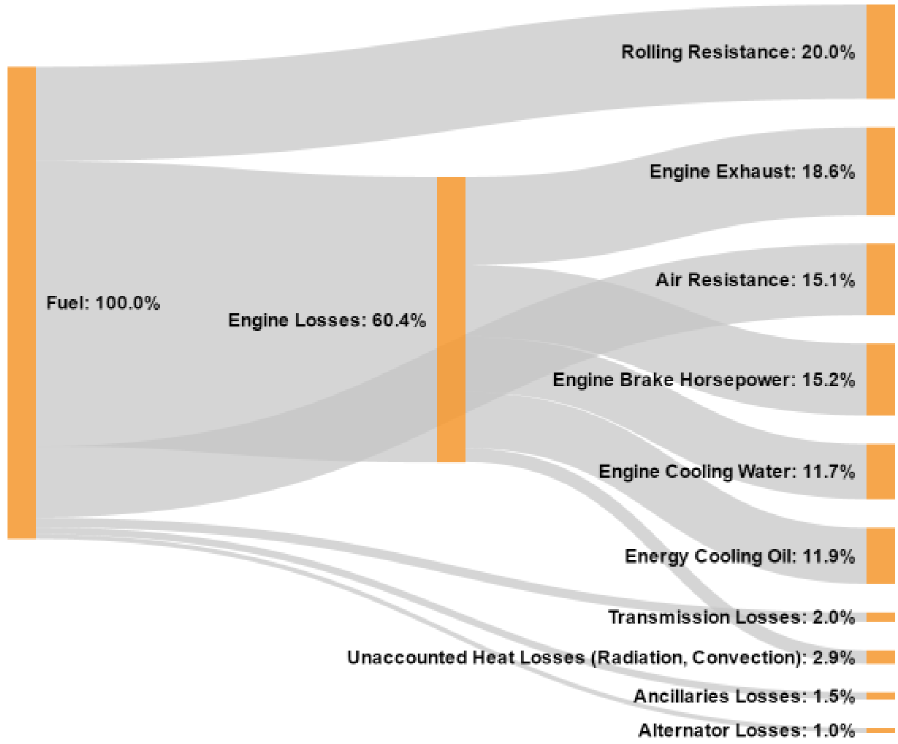


Figure 39. The energy flow into and out of a typical HGV.

Road going vehicles

The decarbonisation of HGVs is a key part of the industry's roadmap to net zero. Currently, 99% of the industry's haulage fleet is fossil-fuel based, and 1% is LNG.

Numerous measures can reduce the energy usage from an HGV, these are detailed below. Table 3 summarises measures for operational actions to reduce HGV emissions. Table 4 summarises actions that can be taken by adjusting the aerodynamics of the vehicle, split by vehicle type, to reduce HGV emissions.

Typical Energy Savings (as a % of total usage)	Cars	Truck
Tyre Replacement to A class	1.67%	2.65%
Tyre optimal inflation pressure	3%-5%	3%-5%
Driver style (training)	5-10%	5-10%
Reduce idle time	2%	2%
Aerodynamics (Cab roof deflectors, air dams, cab sun visors, cab side-edge turning vanes)		5%-10%
Wheel alignment	2.00%	4.50%
Turn off air conditioning	1%-10%	1%-10%

Table 3. Operational savings in an HGV.

Estimated fuel savings on trucks for cab features	Rigid	Articulated	Drawbar	Drawbar Trailer	Drawbar Tractor
Cab Roof Deflector	2.40%	2.40%	1.20%		
Cab Roof Fairing	4.80%	3.70%	2.30%		
Cab Collar and Roof Fairing	6.50%		3.20%		
Cab Side-edge Turning Vanes	0.50%	0.30%	0.30%		
Air Dam	0.70%	0.30%	0.30%		
Cab Side-edge Fairings		0.60%			
Estimated fuel savings on trucks for chassis features	Rigid	Articulated	Drawbar	Drawbar Trailer	Drawbar Tractor
Tractor Side Panels		0.60%			
Tractor Chassis Filler Panels		0.00%			
Chassis/Trailer Side Panels	1.00%	0.40%	0.70%		
Estimated fuel savings on trucks for body features	Rigid	Articulated	Drawbar	Drawbar Trailer	Drawbar Tractor
Gap Seals or Vortex Generators/Stabilisers		0.60%		0.80%	
Container/Trailer Roof Tapering	0.50%	0.30%		0.30%	0.10%
Trailer Roof Height Reduction				0.80%	
Container Front Fairing	3.60%	1.80%		0.70%	1.60%
Aerodynamically Sloping Front Roof					
Estimated fuel savings on trucks for Effect of Ancillary (Add-on) Features	Rigid	Articulated	Drawbar	Drawbar Trailer	Drawbar Tractor
Cab Roof Rim	1.00%	1.50%	0.50%		
Cab Visors	3.60%	1.60%	1.90%		
Low-drag Mirrors	0.20%	0.10%	0.10%		

Table 4. Savings from aerodynamics for road going HGVs (not applicable to flat beds), split by type.

Production facilities

Sawmills

Sawmill processes require electricity and heat which is normally supplied through a furnace, fired with the biomass produced by the sawmill itself, or it is bought from nearby biomass industries. A major part of the heat is used during the drying process, and the remaining part is used for room heating. Sawmill operators are increasingly looking for technologies that enable them to efficiently process sawn timber into value-added products, increasing output and reducing carbon impact. Furthermore, in an effort to be more sustainable, many sawmills, boardmills and paper mills now use forest residues and offcuts to provide heat and electricity in their processes. Sawmills are looking to develop new environmentally friendly systems and machinery for maximising sawn timber yield and detecting key characteristics in individual timbers and logs, and also by increasing the biocomponent ratio of the diesel used by machinery to decrease emissions.

Sawmilling operations are now utilising visible, infrared or X-ray imaging techniques. Sawmilling machinery is increasingly equipped with the latest sensor and laser technology, that take account of the tool's behaviour or the blade's passage through the wood in order to assist and optimise manual control. Further developments are expected in the areas of data and information gathering on the milled product such as surface quality or precision of sawing.

Debarking is the process of removing bark from wood and helps to speed the drying process. A potential alternative to the wet debarking process is dry debarking. In dry debarking, process water is consumed only for log washing and de-icing and is reused effectively with little generation of waste water and water pollutants. Although the process may increase the energy consumption, it results in better energy balance for the mill due to reduced water content of the barks, which are used for energy recovery. The amount of biochemical oxygen demand (BOD) and chemical oxygen demand (COD) is substantially reduced compared to wet barking. Dry debarking can be applied in both new and existing mills and for most debarking purposes and for all pulping processes.

Case Study of sustainable innovation in sawmills (from Finland)

UPM Timber as fully transitioned to fossil-free production at its sawmills by using both thermal energy and renewable electricity at their sawmills. The Korkeakoski sawmill produces thermal energy from bark and wood chips at its own bio-heating plant, whilst the Seikku sawmill uses renewable energy product from its own side streams by the Pori Energia power plant. At the sawmills located in the Pietarsaari and Lappeenranta mill, only renewable energy produced onsite at the pulp mills is used.

Panel Mills

The wood panel industry as represented by the Wood Panel Industries Federation (WPIF) in the UK and Republic of Ireland and its membership is comprised of four companies operating 8 main production sites. The industry takes virgin wood (small forest roundwood and sawmill residues) and certain grades of recycled wood (composition of wood inputs varies according to board type and location) and combines with resin in a mechanical and thermal process, to produce Particleboard (e.g. chipboard), Medium Density Fibreboard (MDF which uses virgin wood only) and Oriented Strand Board (OSB) largely for the building and furniture markets. The main carbon emissions from these processes are due to energy consumption in the form of grid electricity, natural gas and other fuels.

Transitioning equipment/technology to new technologies

Decarbonising kiln drying

The kiln process involves the drying of wood in a chamber where air circulation, relative humidity and temperature can be controlled so that the moisture content of wood can be reduced to a target point without having any drying defects. The most commonly used kilns are conventional and dehumidification kilns.

Energy efficiency in kilns, which are highly energy-intensive, can be improved with technological solutions that comply with current requirements. Shifting to the use of synchronous reluctance (SynRM) motors can have result in considerable carbon reduction, as these motors are manufactured in an environmentally friendly process without the use of permanent magnets.

These motors have a coil temperature of up to 30 °C and bearings up to 15 °C lower in temperature than those of induction motors. Due to the lower temperature, the winding insulation lasts much longer, and the bearing lubricant lifespan doubles, making them an ideal solution for the harsh conditions of drying plants. As the life span of the motors is extended and the need for downtime and maintenance is reduced, the operating costs and environmental impact of the sawmills as a whole are reduced.[30]

Moving away from conventional drying kilns to alternatives such as dehumidification kilns can have numerous environmental benefits. Dehumidification kilns continuously recycle heat within the kiln rather than the discharging of heat from the kiln as in the case of conventional kilns.

The majority of water is condensed on the coils of the dehumidifier and removed as liquid rather than being ventilated to the outside of the kiln. Although dehumidification kilns use electricity, which is more expensive than gas, they are still more economical than conventional kilns because they recycle heat and also are more environmentally friendly.[31]

Electrification of heat (buildings)

Heating accounts for 37% of total UK carbon emissions, with heating buildings responsible for over half of that figure at around 20%, and heating homes contributing about 14%. To achieve our 2050 Net Zero emissions targets, analysis by the Committee on Climate Change suggests we need to decarbonise all heat in buildings by 2050.[32]

Heat pumps are very efficient heating and cooling systems. Replacing fossil fuel gas boilers with heat pumps can significantly reduce energy cost. There are different types of heat pumps available that can be adopted fairly easily to lower carbon heating. These include air-to-air and air-to-water heat pumps as well as ground-source heat pumps.

Alongside heat pumps, the adoption of wider energy reduction solutions is important. District Heating schemes offers an efficient solution for the supply of low carbon heat to homes, businesses and public buildings across the UK. District Heating (also known as heat networks) provides heat to homes and businesses via insulated pipes, through hot water or steam which is generated at an energy centre. It is often more efficient than individual fossil fuel heating systems and thereby provide low carbon heat. There is considerable support from government for the expansion of such heating networks.

Another opportunity is the conversion of the natural gas grid to deliver hydrogen. Hydrogen can be injected into existing natural gas pipelines without too much difficulty and delivered to a wide range of end-point applications. 'Britain's Hydrogen Blending Delivery Plan' sets out how all five of Britain's gas grid companies will meet the Government's target for Britain's network of gas pipes to be ready to deliver 20% hydrogen to homes and businesses around the country from 2023, as a replacement for up to a fifth of the natural gas currently used. It will also mean that Britain's fleet of gas-fired power plants will be able to use blended hydrogen to generate cleaner electricity.[33]

Reducing emissions from fugitive and process emissions

Fugitive emissions are leaks or unwanted releases of gases into the atmosphere. These emissions come from storage tanks, pipelines, wells, appliances or other pieces of pressurised equipment typically used in industrial activities. Most fugitive emissions are from refrigerants and natural gas and these emissions have been linked as the primary driver of climate change.[37]

There are a variety of preventative measures and technologies that can be applied to reduce the release of these fugitive gases. Firstly, proper installation, preventative maintenance and repair is critical. These emissions can occur at all stages in the hydrocarbon value chain. At the well, gases can escape through the casing during operations or even through the soil after a well has been completed.

During transportation, gases can escape at valve fittings or small leaks in pipes. Therefore, after installation, operators should always perform thorough inspection procedures to ensure a proper “leak-free” installation. Furthermore, implementing a preventative maintenance and monitoring program can help to prevent older infrastructure from leaking.[38]

An optical gas imaging camera is a specialised version of an infrared or thermal imaging camera, which allows the user to see various industrial gases that would otherwise be invisible to the naked eye. In the event of a gas leak from the operators’ systems, the user will be able to identify and fix the source of the emission.

Alternatively, light detection and ranging (LiDAR) technologies allow users to visualise the presence of gas leaks. These LiDAR technologies use lasers to create topographic or atmospheric imagery, as opposed to infrared or thermal imaging.[39]

Ultimately, it is important to replace hydrofluorocarbon (HFC) as a refrigerant, with alternative refrigerants which have significantly lower global warming potential (GWP).

This includes refrigerants such as ammonia, carbon dioxide, propane, and isobutane Emissions from refrigerants can be reduced in five main ways[40]:

1. Lower the demand and use of appliances and thereby production of refrigerants
2. Replace refrigerants with low-warming HFCs/new cooling agents/non-HFC substances
3. Increase the refrigeration efficiency in appliances, thereby lowering the use of refrigerants
4. Control leakages of refrigerants from existing appliances by good management practices
5. Ensure recovery, reclaiming/recycling, and destruction of refrigerants at end of life.

Heat

Energy efficiency (heat)

Companies can save 20% on heating costs by being more efficient with how heating systems are managed and operated. Setting the thermostat to the recommended temperature, checking time schedules and making sure heating is off when the building is empty can save up to 10% of heating costs. Table 6 outlines the recommended internal temperatures as set by CIBSE.

LOCATION	RECOMMENDED TEMPERATURE
Offices	19-21 °C
Workshops	16-21 °C
Heavy work	11-14 °C
Stores	15 °C

Table 6. Recommended internal temperatures (CIBSE).

Heat recovery

The benefits associated with heat recovery have been referenced earlier in this document. Measures to recover and re-use waste heat should be explored and implemented, including as preheating feedstock or a mains water feed, or as space heating in a workshop.

Decarbonising heat generation

Decarbonising heat generation will be key to the Timber Industry reaching Net Zero. Biomass generation is lower carbon than fossil fuel alternatives and presents an opportunity for the UK to meet its renewable energy and GHG commitments. When installing a biomass energy system, the following questions should be considered:

- Is a biomass system suitable for this application?
- Is the heat demand likely to be suitable
- Where is the fuel to be sourced from, and what are its characteristics?
- Where can the fuel be stored and how can it be delivered to the store?[41]

Combined Heat & Power (CHP) Systems

A CHP plant consists of an electrical generator combined with equipment for recovering and using the heat produced by that generator. The generator may be a gas turbine, an engine, or it may be a steam turbine generating power from high-pressure steam produced in a boiler.

Combined heat and power (CHP) is a highly efficient process that captures and utilises the heat that is a by-product of the electricity generation process. By generating heat and electricity simultaneously, CHP can reduce carbon emissions by up to 30% compared to typical generation via a boiler and power station. It is clearly more energy efficient and has economic benefits too.

CHP can provide flexible grid support to help balance an increasing amount of variable renewable generation on electric grids and has been proven to provide a reliable and resilient solution to the grid and facilities.

For many industries including the timber industry, utilising CHP provides a very effective opportunity to reduce energy costs and to improve environmental performance with existing users of CHP typically saving around 20% of their energy costs. As the timber industry has access to abundant fuel sources on site, there is great potential to fully utilise CHP technology to maximise decarbonisation opportunities. A CHP system can economically provide heat and electricity for a facility with a steady source of woody biomass.

Energy efficiency (process)

Reduce the energy intensity of key processes in buildings/processing facilities (e.g. Sawmill, Panel Mill, Other Production) such as drying.

There are 4 main areas to consider:

- Motors and Fans
- Pumps
- Compressed Air
- Process Heat

Motors and fans

Ensure motors are the right size for the required load. When motors need to be replaced, consider the whole lifecycle cost and replace them with energy-efficient motors.

Carry out regular maintenance checks that review lubrication schedules, cleaning, belt tensioning and alignment. Share information with staff regarding when a motor should be in use vs when it can be turned off.

Pumps

Inspect pumps regularly and ensure maintenance is completed. Avoid oversizing to ensure operation is close to best efficiency point. Utilise variable speed drives to reduce energy use of oversized pumps. Eliminate unnecessary use by implementing a control system to shut down pumps when not required.

Compressed air

Where compressed air is used, ensure the system is thoroughly checked for leaks. This should be carried out at least once every three months. Produce a policy as guidance for employees to understand where and when compressed air should be used vs other alternatives such as a low-pressure blower. It may be possible to reduce the air pressure, as long as the system meets the requirements of the machinery. Consider whether the heat generated can be reused to heat water or air.

Process heat

Process heating is an important part of the timber industry and covers a wider range of systems. This section provides a general overview of how to improve the energy efficiency manufacturing processes. Further detail on heat recovery is provided in the Heat Recovery section of the report.

Reduce the carbon intensity of the production of heat for key processes in buildings/ processing facilities (e.g. Sawmill, Panel Mill, Other Production) such as drying.

Consider whether schedules can be changed to shorten operating hours and increase capacity to ensure full loads are used.

Dryers and ovens should be well maintained to ensure they are operated efficiently. This includes checking for signed of damaged insulation and air filters, checking for leaks and improving scheduling. Product quality should be audited to ensure the appropriate controls are being used.

Energy Efficiency (Buildings)

Decarbonising buildings (e.g. office areas/depots) can be done in both the design and operation of the building. Focussing on operational emissions there are 4 areas to consider:

1. Lighting
2. Heat/Cooling/Thermal Performance
3. Small Power
4. Hot Water

Lighting

Lighting is typically the greatest energy consumer in most commercial facilities. Ensure lights are switched off when premises are closed, and rooms are not in use. Replace inefficient lighting (switching to LEDs) and automate lighting controls via movement sensors, timers or daylight-linked sensors. Consider how natural lighting sources can be optimised, including by cleaning windows and ensuring blinds are open during the day (except if there is solar glare). Lighting measures tend to have a short payback.

Heat/cooling/thermal performance

The thermal performance of a building is intrinsically linked to the building fabric and building controls. The building fabric should be inspected regularly. Maintenance and housekeeping actions are often low-cost with high energy reduction potential. The most cost-effective measure to improve the building fabric is by improving roof and wall insulation.

Building controls and building management systems should be configured based on the actual use of the building to reduce unnecessary use. It may be necessary to conduct an audit of sensors and detection devices to identify problem areas. Temperature controls should be reviewed to ensure heating and cooling systems are not competing with each other via a temperature gap or deadband between the set temperatures.

Ventilation systems should be reviewed to ensure they are not running unnecessarily and controls should be automated where possible with the use of timers and occupancy sensors.

Small power

Any new office equipment should consider energy efficiency as a key factor in decision making. Consider smart devices or smart sockets that can be remotely switched off via Wi-Fi. Where this is not possible, encourage behaviour change initiatives led by senior managers, which include switching off appliances when not in use.

Renewable Energy

Purchasing low/zero carbon energy

Organisations should switch to purchasing renewable energy. The use of Power Purchase Agreements (PPAs) provides secure, long-term clean energy to corporates by allowing corporates to purchase electricity at pre-agreed prices for pre-agreed periods. The also enables investment in additional renewable energy development

The drivers for corporate renewable PPAs include[42]:

1. **Economics** - long-term electricity affordability and price visibility;
2. **Sustainability** - reduced carbon emissions and progress towards renewables targets; and
3. **Leadership** - recognition for renewable electricity achievements and climate leadership.

The purchase of renewable energy should be properly accounted for in an organisation's corporate emissions inventory using the GHG Protocol Scop 2 Guidance.

Generating renewable electricity

Increase the self-generation of renewable electricity through solar photovoltaics (PV) and wind. Modelling and testing should be undertaken to select the most appropriate fuel source, location, generating capacity, installation, operation and maintenance costs.

On site generation will also reduce emissions from fuel- and energy-related activities as the transmission and distribution losses will be reduced.

Combining on site generation of renewable energy with battery energy storage will be the most viable method for high energy users.

Using low/zero carbon energy sources for heat

Processes that rely on natural gas will need to transition over to low/zero carbon fuels for heat. These include solar thermal and electricity.

Existing solar thermal technology would not be able to generate 100% of a business's energy requirements in most cases, but may reduce reliance on the boiler for hot water. Solar thermal technology is available immediately. Due to the significant capital investment required, the payback period is long.

As the electricity grid continues to decarbonise, an increasing proportion of heat will need to be powered by electricity rather than fossil fuels. Biomass will be lower carbon than electricity until 2027, at which point electricity will be the preferable option in terms of emissions intensity.

Combined heat and power generation

Combined heat and power (CHP) is a highly efficient process that captures and utilises the heat that is a by-product of the electricity generation process. Existing users of CHP typically save around 20% of their energy costs. As the timber industry has access to abundant fuel sources on site, there is great potential to fully utilise CHP technology to maximise decarbonisation opportunities. Use of wood for heat and good quality CHP is more carbon efficient than virgin timber for biomass. CHP is a significant capital investment but has a medium range payback.

Grid decarbonisation

To decarbonise electricity, a common approach is to introduce into the grid more zero or low carbon emissions generation sources, such as wind, solar and hydro power. For electricity systems with higher emissions intensities, like those with more coal fired power, reducing the amount of electricity we use helps to decarbonise the system. This is known as improving energy efficiency.

The power sector can play a leading role in cost effective, economy-wide and industry-wide emission reductions because it can reduce emissions at lower costs than any other major sector, and it can enable other sectors like transportation and buildings to substantially decarbonise through electrification. Three key strategies can help forestry and wood industry meet energy needs with zero-carbon emissions::

1. Optimise - Reduce energy use through improved efficiency
2. Electrify - Shift energy demand to electricity and away from combustion of fossil fuels
3. Decarbonise - Shift entirely to zero-carbon technologies to generate electricity

Over the past decade, and with government support, the amount of renewable capacity connected to the grid has increased from 8GW in 2009 to 48GW at the end of June 2022 which is an increase of 500 per cent. The share of low-carbon electricity generation has risen to 54% in 2019, with renewables at a record 37%[43].

By 2030, the UK is expected to have a power mix with a significant proportion of wind and solar power, and it expected that the UK will be scaling up flexible electricity markets and technologies[44].

Decarbonising the grid will have multiple positive impacts on the key carbon drivers of the industry such as transport. It is expected that decarbonising the grid will act as an enabler for electric vehicles to become fully Net Zero and also support the accessibility of hydrogen HGVs in the long run.

Reducing supply chain emissions (Scope 3)

Take clear action to reduce the supply chain emissions outside of the scope of EPD phases A1-A4 (e.g. Purchased Goods and Services, Water Use, Business Travel, Employee Commuting)

Business travel and employee commuting

Business travel is category 6 of the GHG Protocol and includes emissions from the transportation of employees for business-related activities in vehicles owned or operated by third parties, such as aircraft, trains, buses, and passenger cars.

Business travel emissions can be calculated with the fuel-based method, the distance-based method, or the spend-based method. Employee commuting is category 7 of the GHG Protocol and includes emissions from the transportation of employees between their homes and their worksites.

There are numerous ways in which emissions from these two categories can be reduced - the avoid, shift, improve hierarchy is usually recommended:

- Avoid or reduce the need to travel, implement workplace travel planning and utilise virtual meetings where possible
- Shift to more energy efficient modes, consider whether a vehicle is required or if there are alternative ways or travelling (think about what is your lowest-cost competitor doing).
- Improve the efficiency through vehicle technology. Optimising vehicle efficiency is detailed in the 'Emissions Reduction Opportunities' section.

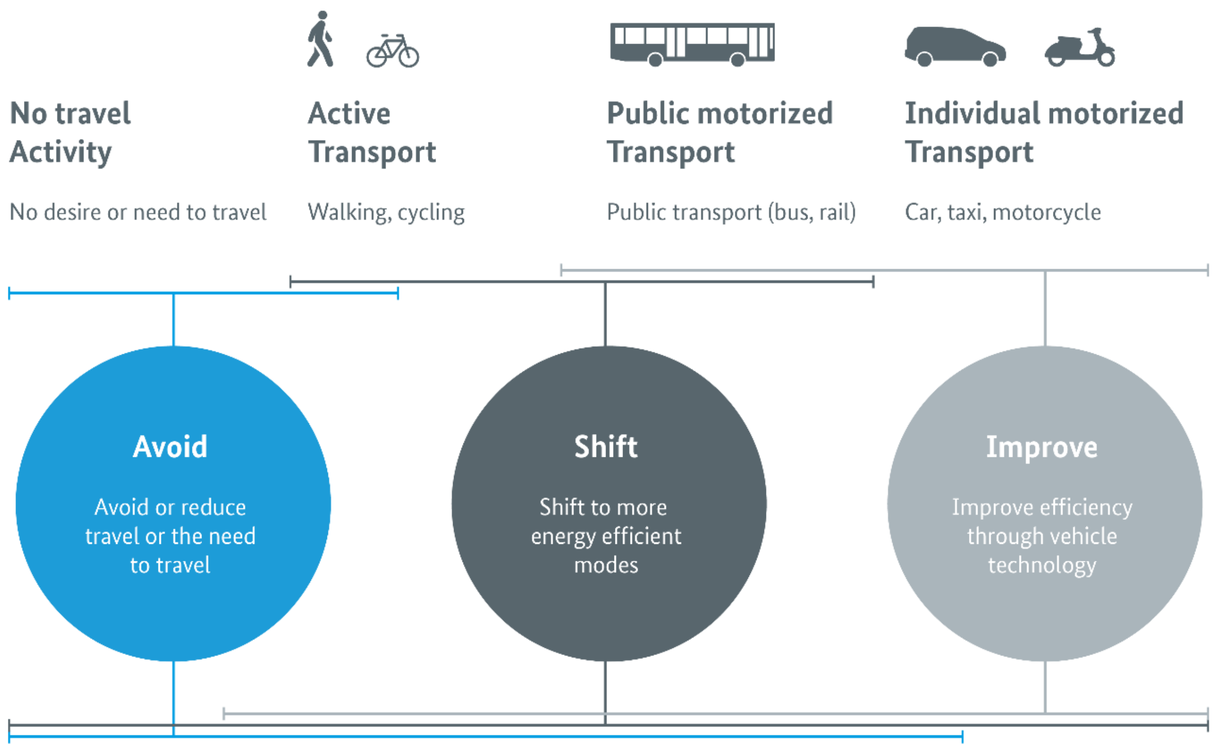


Figure 43. Avoid-Shift-Improve framework for business travel (TUMI).

Accurately measure and calculate emissions from business travel as the first step in understanding how to reduce emissions. Utilise the Avoid-Shift-Improve approach outlined in Figure 43, which presents a framework to structure policy measures around. Some key considerations are:

- Encouraging remote working and virtual meetings
- Encouraging walking or cycling
- Encouraging the use of public transport
- Incentivising car sharing or the use of electric cars
- Stopping air travel or flying economy class only
- Where business travel and employee commuting are necessary, utilise the Energy Saving
- Trust Sustainable Travel Hierarchy (Figure 44) to identify the most sustainable form of transport.

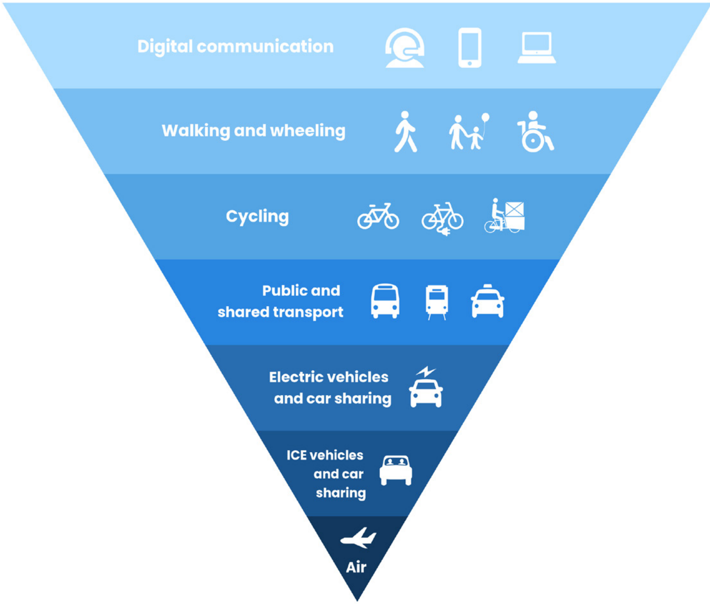


Figure 44. The Energy Saving Trust Sustainable Travel Hierarchy (Energy Saving Trust).

The Energy Saving Trust Sustainable Travel Hierarchy (Fig 44) places modes of transport in a hierarchy from the most sustainable option to the least sustainable.

Digital communication and walking and wheeling are at the top as the most sustainable modes. Internal combustion engine vehicles, which includes petrol and diesel cars and air transport are at the bottom as the least sustainable. A flight from Edinburgh to London, for example, emits around 159 kg of CO_2 per passenger, compared to as little as 23.5 $kgCO_2$ if you made the journey by train.

Supply chain

Purchased goods and services

GHG Protocol supplies the world's most widely used greenhouse gas accounting standards. In their Technical Guidance for Scope 3 emissions, Category 1 is Purchased Good and Services, out of 15 different categories.

This category includes all upstream emissions ("cradle to gate") from the production of products purchased or acquired by the reporting entity in the reporting year. Products include both goods (tangible products) and services (intangible products).

The methods listed below can be used to calculate scope 3 emissions from purchased goods and services. The first two methods, supplier-specific and hybrid, require the reporting company to collect data from the suppliers, whereas the second two methods, average-data and spend-based, use secondary data, or industry average data.

These methods are listed in order of how specific the calculation is to the individual supplier of a good or service. However, companies need not always use the most specific method as a first preference.

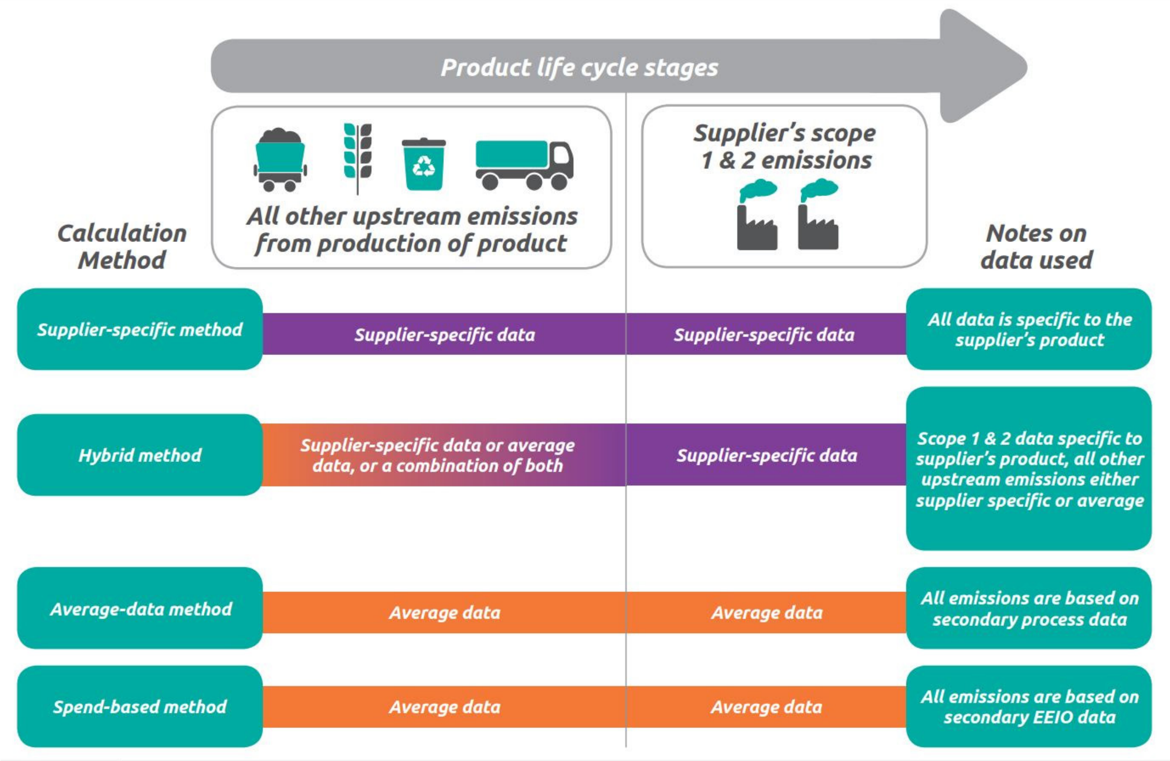


Figure 42. Methods of calculating Scope 3 Emissions (GHG Protocol)[48]

1. **Supplier-specific method** - Collects product-level cradle-to-gate GHG inventory data from goods or services suppliers.
2. **Hybrid method** - Combines supplier-specific activity data and secondary data to fill the gaps. This method involves:
   a. Collecting allocated scope 1 and scope 2 emission data directly from suppliers;
   b. Calculating upstream emissions of goods and services from suppliers' activity data on the amount of materials, fuel, electricity used, distance transported, and waste generated from the production of goods and services and applying appropriate emission factors;
   c. Using secondary data to calculate upstream emissions wherever supplier-specific data is unavailable.
3. **Average-data method** - Estimates emissions for goods and services by collecting data on the mass, for example, kilograms or pounds, or other relevant units of goods or services purchased and multiplying by the relevant secondary (e.g., industry average) emission factors (e.g., average emissions per unit of good or service).
4. **Spend-based method** - Estimates emissions for goods and services by collecting data on the economic value of goods and services purchased and multiplying it by relevant secondary (e.g., industry average) emission factors (e.g., average emissions per monetary value of goods)[47].

As Scope 3 emissions are indirect, it can be challenging to address these emissions. However, scope 3 emissions can be addressed in various ways, such as choosing which materials or vendors businesses rely on, making informed transportation decisions, or encouraging their suppliers to reduce their own emissions.

Below are some steps that can be undertaken to reduce emissions from purchased goods and emissions:

1. **Leveraging buying power to drive transparency**
Leading companies in an industry can use their position ask their strategic suppliers to disclose data on GHG emissions, environmental risks, and corporate governance. By collecting and sharing data, purchasers can create a more transparent supply chain and better manage their scope 3 footprint.
2. **Setting clear expectations and targets**
Reducing carbon emissions across the value chain requires suppliers and customers to commit to agreed emissions targets, which can be challenging depending on the supplier's maturity, knowledge, and resources. Where possible, science-based carbon emissions reduction targets should be preferred in order achieve the collective goal to keep global warming below 1.5 degrees Celsius.
3. **Strategically engaging with vendors to drive action**
Once stakeholders are on board with shared emissions reduction targets, companies must be ready to guide suppliers through the decarbonisation process by creating strong relationships with suppliers and through education, particularly for those suppliers that are smaller or short on resources.

Purchased goods and services & capital goods

Effective actions might include:

- Continue purchasing the same products, but from suppliers with lower carbon footprint. Products can sometimes initially cost more but may have a lower lifecycle cost (e.g. Battery Electric Vehicles).
- Engage with suppliers so that they reduce their emissions, ideally in line with climate science. Suppliers reducing their emissions (scope 1 & 2) reduces your scope 3 emissions, reducing the long term cost of offsetting/insetting.
- Identify key suppliers to engage and maintain a collaboration via two-way communication channels, monitor progress regularly, and create incentives for action. Participate in projects/programmes that the supplier is operating which provide a direct opportunity to shift to lower carbon products/services/logistics/outcomes. Circular economy opportunities often exist here where there is an opportunity to collaborate across businesses for example, suppliers may be operating a waste take back scheme, which reduces your costs of waste and their costs of buying new materials (see the section on Circular Economy).
- Request strategic suppliers to disclose data on GHG emissions, environmental risks and corporate governance to create a more transparent supply chain and better manage scope 3 emissions.
- Develop operational policies including supply chain management standards, which can reduce unnecessary waste in the supply chain (e.g. food). Often the cost benefit is in not buying rather than in reduced waste costs.

Best practice in construction

UK Green Building Council (UKGBC)

The built environment is directly responsible for 25% of UK emissions. UKGBC was launched by the construction and property industry in 2007, and was originally established to offer clarity, cohesion, and leadership within the sector, whilst also working towards the future of a sustainable built environment.

The UKGBC has created a roadmap[49] that identifies five key priorities:

1. Nation-wide retrofitting of existing homes to transform UK housing so it is efficient, warm, and cheaper to heat, whilst phasing out fossil fuel heating.
2. Energy performance disclosure for non-domestic buildings to ensure that the real-world performance of assets is visible to the market, and can influence asset valuation, market transactions, and management
3. To shift away from the theoretical "notional building" approach and to focus on how energy-intensive buildings will be in practice from the outset of construction, alongside other key Net Zero enablers such as peak demand limits.
4. Whole life carbon measurements and agreed limits: To start with mandatory measurement, followed by the phased introduction of embodied carbon limits for new buildings to reduce demand, alongside changes to planning and VAT to incentivise the re-use of existing buildings.
5. National infrastructure investment bag asked on the net emissions impact: To consider all forms of carbon, alongside a policy framework and investment to drive industrial decarbonisation of key construction supply chains.

Whole life carbon encompasses all carbon emissions that arise as a result of the energy used in the construction, operation, maintenance and demolition phases of a building. The figure below shows the operational carbon reduction stages on the left, and the embodied carbon reduction stages on the right.

Low Energy Transformation Initiative (LETI)

LETI is a voluntary network of over 1,000 built environment professionals looking to support the zero carbon transition in the built environment and develop the actions needed to meet the UK climate change targets. They have suggested the following actions to meet climate change targets[50]:

1. Low energy usage across residential, commercial and industrial buildings
2. Annual energy use and renewable energy generation on-site must be reported and independently verified in-use each year for the first 5 years.
3. Embodied carbon should be assessed, reduced and verified post-construction.
4. Heating and hot water should not be generated using fossil fuels.
5. A carbon balance calculation (on an annual basis) should be undertaken and it should be demonstrated that the building achieves a net zero carbon balance.

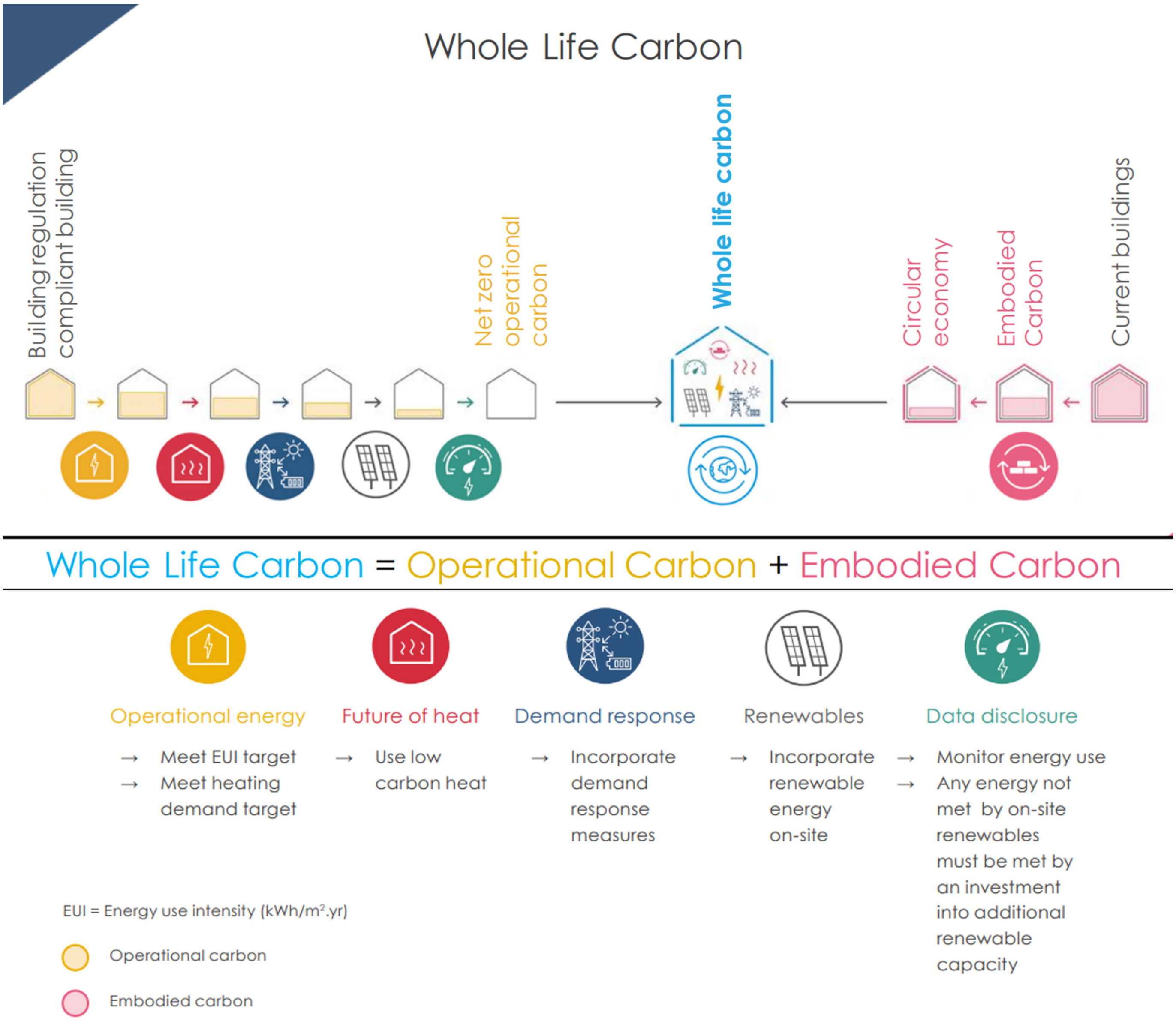


Figure 45. Whole life carbon explained (LETI).[51]

.Fuel and energy-related activities

Fuel and energy-related activities include upstream emissions of purchased fuels and electricity and the losses within the transmission and distribution system. To reduce emissions from this category, see sections on reducing energy use, increasing energy efficient and replacing carbon-intensive fuels with alternative fuel sources (e.g. renewable energy).

The wider transportation system

Beyond road transport, the UK timber industry is reliant on the wider global transport system, with a particular focus on both rail and maritime freight transport. The shift towards Net Zero in these sectors will have an impact on the timber industry's ability to achieve Net Zero.

In 2022, the industry saw an increase in pilot projects related to the shift from timber freight by road to rail, with support from major players in the industry. Success is dependent on multiple factors including regular deliveries of timber, access to multiple timber suppliers, good quality railway rolling stock that can handle full train loads and optimising the supply chain. Challenges still exist around securing cooperation and collaboration from across the sector to coordinate supply.

Rail sector

The rail sector represented 1% of the UK emissions in 2019. The sector is committed to delivering a Net Zero rail network by 2050, with sustained carbon reductions in rail along the way. Between now and 2050 Great British Railways will deliver a programme of further electrification, alongside use of battery and hydrogen trains.

- 2020-2030s: Policies to incentivise take up of low carbon traction by rail freight operators
- 2040: All diesel-only trains (both passenger and freight) will be removed from the network by 2040
- 2050: Rail network will be Net Zero.[52]

Maritime sector

The maritime sector is responsible for 5% of domestic GHG emissions. The UK government is updating the Clean Maritime Plan and during 2022 it consulted with the industry on the Net Zero pathway for UK domestic maritime vessel emissions. In the current scenario, close to Net Zero is achieved by 2050 with minimal reliance on GHG removals. This consultation seeks to identify whether this date can be brought forward to 2040.

- 2020-2030: minimal GHG emissions reductions are made in the period up to 2030
- 2030: Deep cuts in GHG emissions during the early 2030s
- 2030-2050: Continued emissions reductions
- 2050: Maritime industry to achieve close to zero by 2050.[53]

Logistics

Rail and waterborne transport have the lowest emissions per kilometre and unit transported, while aviation and road transport emissions are significantly higher.

Optimise the routing of imported products to reduce the overall emissions per m^3 of product. Improve capacity management and utilise sophisticated route planning capabilities to ensure vehicles are full and the number of drops is reduced. Consider switching to local products/suppliers for example food grown locally, which would reduce logistics emissions.

Waste

Reduce emissions from waste, both in manufacturing and across the rest of operations by utilising the waste hierarchy (Figure 46). Wood recycling has undergone a boom in the UK, from less than 2% of wood waste in 1990 to more than 99% in 2020, but there are still reuse opportunities being missed. The waste hierarchy ranks waste management options in the following order according to what is best for the environment: Prevent, Reduce, Reuse, Recycle, Recover, Dispose. Prevention is given top priority, which includes using less material in design and manufacture, keeping products for longer and sing less hazardous materials. Recovery, including incineration with energy recovery and anaerobic digestion, is towards the bottom of the hierarchy above Dispose. For wood, the grade of the material should be taken into consideration as in some instances energy recovery will be preferable to recycling for lower grade materials.

Figure 46. The waste hierarchy.

Leased Assets

Where assets are leased from other organisations, engage with landlords to identify emissions reduction opportunities related to energy efficiency and explore options for switching to renewable energy. Where assets are leased to other organisations, engage with customers to support the reduction in emissions by changing their behavioural patterns. This can be done directly through education, collaboration or compensation, or indirectly through company regulation or customer motivation via marketing and choice architecture.

Green leases are an effective way in which both tenants and landlords can agree to share data and collaborate to reduce leased asset emissions.

Sold Products

Ensure product emissions are actively managed from design, seeking to design products that are more efficient so that the lifecycle emissions intensity is lower. Where customers are a significant element of scope 3 emissions, lower lifecycle emissions in use will support the reduction in emissions in your organisation. Further guidance can be found within the Circularity section and EPDs/LCAs section.

Franchises

If any franchises are owned, engage with franchisees to support the accurate calculation of emissions. Then utilise guidance outlined within the 'Reduce Operational Emissions' section of this report to reduce emissions.

Investments

Invest in low-carbon projects and companies and resilient development, and shift investment away from fossil fuels (including within pensions), accelerating the transition to a low-carbon economy. Investing within the supply chain, through insetting, into a supplier's approach to Net Zero to allow them to reduce their emissions will in turn reduce your emissions.

Creating a circular economy

Policy recommendations

8. The industry will develop a specific circularity/resource efficiency roadmap by 2024 to accelerate the activity in this key area

Circular Economy

The principles of the circular economy should be factored into decision making:

1. Eliminate waste and pollution
2. Circulate products and materials (at their highest value)
3. Regenerate nature

Design with the reuse of materials in mind. Reuse materials rather than requiring new ones, or create biological cycles which provide "renewable sources" of materials.

The Circular Design Guide provides resources to support understanding, designing, making and releasing circular products.

Figure 47. Cradle-to-Cradle Standard (C2C).

Frameworks including the Cradle-to-Cradle Standard[54] which provides an independent, science-based, third-party, multi-attribute product standard, can drive efficiency in new products and lead to more sustainable products that ultimately do not compromise the environment. The principles are shown in Figure 47. Cradle-to-Cradle Standard (C2C).47 and focus on ensuring materials are safe for humans and the environment, enabling a circular economy through product and process design, generating clean energy and protecting the climate, safeguarding air, water and soil resources and embracing safe, fair and equitable labour practices that advance human rights and strong communities (MBDC).[55]

Lifecycle Assessments (LCA) and Environmental Product Declarations (EPDs) should be utilised for products to enable emissions reductions. Reducing scope 3 emissions will be challenging without these tools. See the standards/guidance section for further details.

Circularity and the forest sector

Circularity transforms our "take-make-use-dispose" economy model into one where the focus is to eliminate waste, circulate resources, and adopt resource and carbon efficient systems and actions. The current linear economy continually increases its demands of scarce natural resources. By using and consuming in a more circular way, we can substantially reduce the impacts of economic activities on the environment, including on biodiversity. Therefore, the circular economy is based on three principles, driven by design:

1. Eliminate waste and pollution
2. Circulate products and materials (at their highest value)
3. Regenerate nature

Circular economy principles are well aligned with general practices in the forest sector and in the manufacturing of forest-based products. Minimising waste and maximising efficiency enable the goals of sustainable forest management.

Many aspects of the circular economy are already applied in the forest sector. In construction, the use of wood products contributes to a lower carbon footprint of buildings, and sustainable wood products are a viable substitute for non-renewable materials. For example, engineered wood products have increasingly been used in the construction of office and residential buildings.

Also, it is a common practice in the forestry sector to reuse and repurpose materials through lumber salvage and to recycle paper.[45]

A good example is wood packaging which can be repaired and reused multiple times in a product's lifetime before being recycled into wood chips used for further products or renewable fuel, leaving no trace of product behind.

Many companies in the industry are already recording environmental data to help prove the credentials of a product. The Lifecycle Database is based on generic wood products in the UK including structural products, panel products, solid timber products and windows. The data collected is based on Lifecycle Assessments (LCA) and Environmental Product Declarations (EPDs). LCA covers cradle to grave, including forestry, harvesting, transportation, processing, and manufacturing, through to the various end of life options[46].

The integration of circularity principles into this sector can further contribute to a transition towards a sustainable, low carbon economy which reduces waste across the sector. Forests and forest-based products can play a key role in the circular economy by providing a renewable source of raw materials and be a key pillar of the circular economy, underpinned by a transition to renewable energy and materials.

Increasing carbon removals

Policy recommendations

9. Nature-based solutions (combined with the above reductions) focused on permanent carbon removals to be used for offsetting

10. The industry will support targets/initiatives to increase domestic production and expansion of the domestic woodland stock

There are multiple ways to mitigate the worst effects of climate change as summarised in Figure 48. These should be considered alongside emissions reduction targets in the order listed below.

Emissions Abatement

When a company chooses to prevent, reduce or eliminate emissions from within its value chain (sometimes referred to as insetting) this allows a company to embed emissions reduction activities within its supply chain. Companies should look internally at which nature-based measures such as reforestation, agroforestry and renewable energy will reduce emissions and support in achieving emissions reduction targets.

This should be a priority ahead of any other type of action or investment. Investing in insetting will be the quickest way for an organisation to achieve Net Zero and may mean that organisations can reach Net Zero more quickly than the targets of 2045 for Scope 1 & 2 and 2050 for Scope 3 that are outlined within this roadmap.

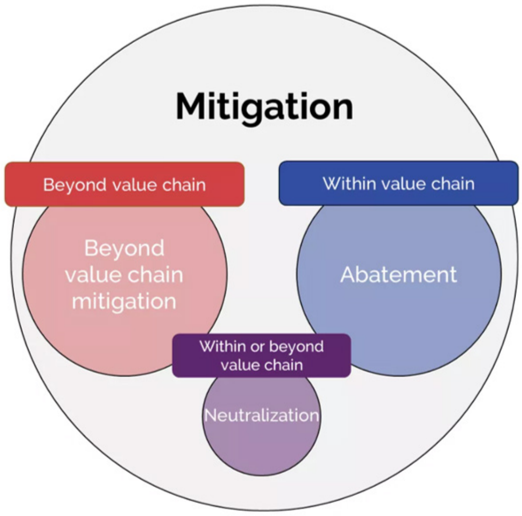


Figure 48. A visualisation of key terms to aid understanding of how they are connected (SBTi).

Insetting

A significant proportion of a company or industry's carbon footprint occurs in its supply chain, and therefore insetting is the financing of projects along a company's value chain. It is aimed at reducing or sequestering emissions to achieve a positive carbon impact on areas affected by the value chain, such as communities, landscapes and ecosystems. Interventions are usually based on regenerative agriculture practices and agroforestry programmes, which re-establish natural carbon sinks through the conservation and restoration of landscapes including forests.

Insetting currently does not require verification or certification against agreed global standards. However, many organisations undertaking insetting projects choose to work with an independent verifier to certify their results according to existing standards, as verification gives an insetting project more credibility. These standards are chosen by the company, and generally, resources are used from well-known standards such as Gold Standard, Verra, Rainforest Alliance, Plan Vivo, the IPI's Insetting Program Standard and others.

Beyond Value Chain Mitigation

Beyond value chain mitigation refers to mitigation action or investments outside of a company's value chain. It includes activities that avoid or reduce greenhouse gas emissions, and those that remove and store greenhouse gasses from the atmosphere (SBTi). It should be noted that this is not limited to carbon removals, for example, this could include purchasing high-quality, jurisdictional REDD+ credits or investing in direct air capture.

Neutralisation

Above all else, efforts should be focused on reducing Scope 1, 2 and 3 emissions (emissions abatement). Any emissions which remain after an organisation has implemented all technically and economically feasible opportunities to reduce emissions are often referred to as residual emissions.

These residual emissions can be neutralised (offset) via measures that remove carbon from the atmosphere and permanently store it.

Timing of Offsetting

There may be organisations that wish to invest in offsetting before they have achieved their emissions reduction targets. This approach should be taken with caution and should not detract from emissions abatement.

Figure 49 shows the best practice approach to offsetting as set out by the Oxford Offsetting Principles.

Figure 49. Best practice offsetting principles.

What makes a good quality offset?

Carbon offset projects can cover a variety of activities that reduce GHG emissions, including renewable energy development, the capture and destruction of high potency greenhouse gasses such as HFCs or N2O, and avoided deforestation. Projects range in scale from very small (e.g., reducing a few hundred tonnes of CO_2e per year) to very large (e.g., millions of tonnes reduced per year).

A good quality offset credit must represent at least one metric tonne of additional, permanent, and otherwise unclaimed CO_2 emission reductions or removals. It is important to look for projects that produce environmental and social benefits beyond just GHG reduction, for example, benefits to the local community through increased employment opportunities, or biodiversity, air or water quality improvements. Good quality carbon offset credits must be associated with GHG reductions or removals that are:

- Additionality
- Not overestimated
- Permanent
- Not claimed by another entity
- Not associated with significant social or environmental harms

When selecting how to offset emissions, projects can be selected to either avoid or reduce emissions compared to a business-as-usual scenario, known as avoidance, or they can remove existing carbon from the atmosphere, known as removals. There needs to be a shift from avoided emissions and emissions reduction with short-lived storage towards carbon removals with long-lived storage over time.

Offset Options

It is important to define an offset strategy upfront that covers what types of offsets the organisation wishes to purchase, the standards acceptable, environmental and social safeguards that will be put in place, acceptable locations and vintage, and what the journey looks like from avoidance towards removals.

Figure 50 provides an example of building a portfolio of offsets which becomes 100% carbon removal (5) with long-lived storage by 2050 to align with net zero goals. This portfolio is made up of 5 types of offsets:

1. Avoided Emissions
2. Emissions Reduction (short-term)
3. Carbon Removal (short-term)
4. Emissions Reduction (long-term)
5. Carbon Removal (long-term)

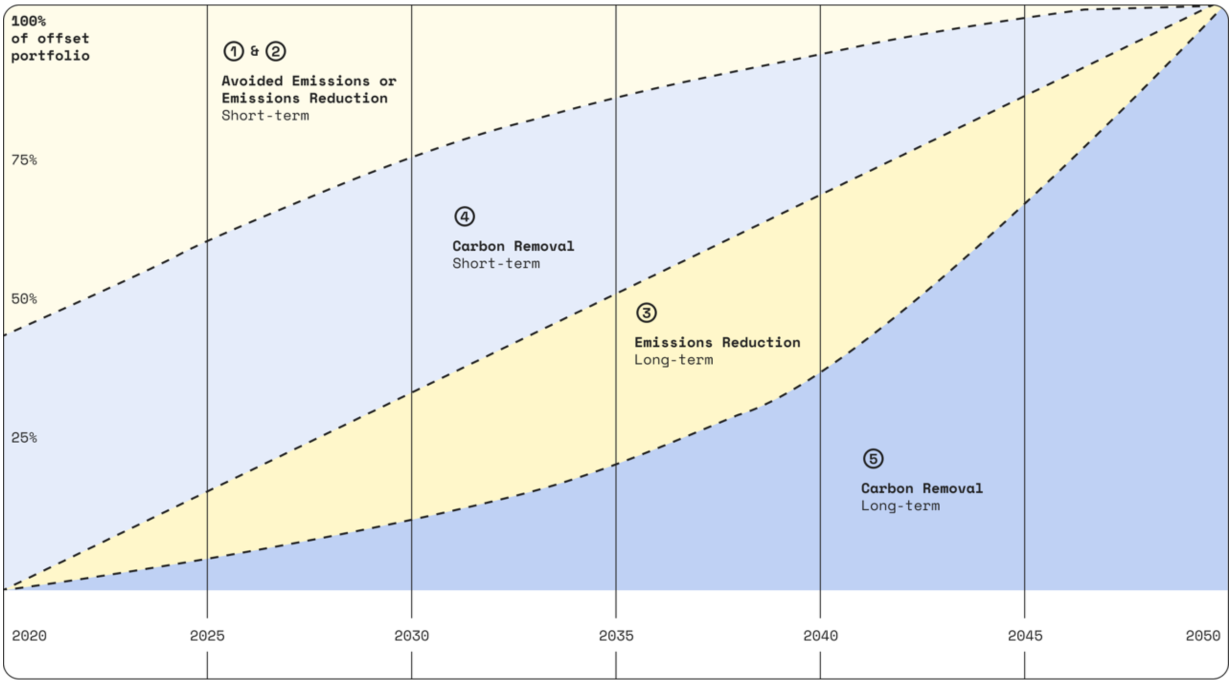


Figure 50. Building an offsetting portfolio (Oxford Offsetting Principles).

There are multiple factors to consider when selecting which offsetting projects to invest in. Table 7 (opposite): A summary of carbon offsetting approaches (Environment Agency). opposite provides a summary of key measures, whether they are reduction or removal offsets, approximate costs, current technology and certification readiness, the speed of impact, longevity and confidence in the science.

Cost per tCO_2e varies significantly, from around £15-30/tCO_2e for projects related to hedges and trees outside woodlands, to over £1000/tCO_2e for soil management projects. There is uncertainty and fluctuation in cost for lowland peat restoration, constructed wetlands, saltmarsh restoration and seagrass restoration.

In cases where the technology does not yet exist, these should not be ruled out but instead considered as part of longer-term offsetting strategies.

In the UK, certification schemes only exist for Woodland and Peatland in the form of the Woodland Carbon Code (WCC) and Peatland Code (PC) respectively, however, a certification scheme for seagrass and kelp restoration is currently in development, as well as a few working groups being currently active on soil carbon.

Projects where the speed of impact is short and the life span is long should be favoured, for example, Biochar projects, over those where there is uncertainty.

Finally, whilst the ability to quantify the impacts of offsets is increasing and the science is evolving, there is still often disagreement related to some early technologies. Therefore, areas where the level of evidence agreement is low should be considered as part of a diverse portfolio of offsets, rather than a single offsetting approach.

Table 7 (opposite): A summary of carbon offsetting approaches (Environment Agency).

Key:

‘Per unit’ refers to per hectare for the natural environment, per household for the built environment

For ‘national abatement potential’: ‘Low’ corresponds to 0-1 $MtCO_2e$, ‘Moderate’ corresponds to 1-5 $MtCO_2e$, ‘High’ corresponds to 5-10 $MtCO_2e$ and ‘Very high’ corresponds to more than 10 $MtCO_2e$

For biochar, per unit assumes a biochar application rate of ~30t/ha/year, which is judged to be realistic but lower than any theoretical maximum. This value also assumes that biochar is 60% carbon and 65% of this carbon lasts over 100 years.

Table 7: A summary of carbon offsetting approaches (Environment Agency).

Measure	Measure type	Cost approximate	Removal/reduction potential		Readiness		Speed of impact	Longevity	Confidence in science	
	Reduction/removal	£/tCO_2e	Per unit per year	Nationwide	Technology	Certification method	Years	Short/med/long	Evidence volume	Evidence agreement
Upland peat restoration	Reduction & potential removal	10-100	2-20	Very high	Ready	Ready	>10	Long	Med	High
Lowland peat restoration	Reduction & potential removal	Uncertain	5-20	High	Ready	Not ready	>10	Long	Med	Low
Woodland	Removals	20-80	11	Very high	Ready	Ready	-10	Long	High	High
Grassland	Removals	n/a	2	n/a	Ready	Not ready	<10	Short/Med	Low	Low
Flood plain restoration	Removals	>1000	10	Moderate	Ready	Not ready	>10	Med/Long	Low	Low
Constructed wetlands	Removals	Uncertain	Uncertain	Uncertain	Ready	Not ready	Uncertain	Uncertain	Med	Low
Saltmarsh restoration	Removals	Uncertain	2-8	Low	Ready	Not ready	<10	Long	High	Med
Seagrass restoration	Removals	Uncertain	1.6	Low	Not ready	Not ready	>10	Uncertain	Low	Low
Kelp restoration	Removals	n/a	2.15	n/a	Not ready	Not ready	Uncertain	Uncertain	Low	Low
Soil management: Arable	Removals	100-1000+	0.5-1	Moderate	Not ready	Not ready	<10	Med/Long	Med	Med
Soil management: Pasture	Removals	10-1000+	0.2-4	Very high	Ready	Not ready	<10	Med/Long	Med	Low
Hedges and trees outside woodlands	Removals	15-30	2-7	High	Ready	Not ready	>10	Long	Med	High
Enhanced weathering	Removals	40-360	6	Very high	Ready	Not ready	>10	Med/Long	Low	Low
Biochar	Removals	70-270	44	High	Ready	Not ready	Immediate	Long	Med	Low
Household insulation	Reduction	100-300	1	Very high	Ready	Not ready	Immediate	Short	High	High
Household low carbon heating	Reduction	200-300	1	Very high	Ready	Not ready	Immediate	Short	High	High

Challenges/Collaboration Opportunities

To deliver this Net Zero Roadmap, the Industry will need focus on/collaborate in the following areas:

1. Consistent treatment of data to ensure that the reporting is accurate and transparent. A working group on data quality/integrity should be established.
2. The industry needs to put immediate attention to both carbon accounting and emissions reduction in relation to Scope 3 emissions (outside of the sector itself). A working group on this area should be established.
3. The industry should focus its efforts on ensuring that it remains on track to reduce transport emissions. Existing collaborations are already active in this area (e.g. Timber Transport Forum). The industry should review the level of collaboration and participation in an initiative like this to ensure it has the maximum possible impact.
4. The industry needs to identify/implement more efficient ways of generating heat (specifically in industrial/production processes). A working group on data quality/integrity should be established.

The key challenges that will require further review by the sector are:

1. The ongoing improvement of data quality.
2. The industry needs to engage with target setting bodies (e.g. SBTi).
3. The industry will need to engage in the wider developments in relation to Carbon Offsetting to ensure standards/guidance are fit for purpose for the industry.
4. The industry is reliant on some technical change/innovation/maturity (e.g. hydrogen) to decarbonise in line with this Roadmap, and the industry should ensure it is an active participant in the development of this.
5. The industry needs to ensure that it is an active participant in the ongoing improvement of waste handling to ensure that emissions in this area remain low as timber volumes increase over time.
6. There is likely to be an individual challenge for operators in implementing electrification, specifically about ensuring that sufficient grid capacity is available. We would recommend any operator begin to review any strategic risks in this area.
7. Few operators in the sector have full scope carbon footprinting, or defined/detailed Net Zero strategies, and efforts should be made to ensure that as many operators as possible have this as soon as possible.
8. The industry needs to review the balance of imported/UK grown timber as a consideration as part of reducing its emissions.

Appendices

Appendix A: Methodology Statement

Introduction

This document accompanies the Net Zero roadmap prepared to summarise the methodology applied to calculating the emissions detailed within it. This methodology statement covers the approach to the calculation of emissions (at an industry level, for a typical subsector operator and at a product/product type level – the three ways in which emissions data is summarised within the Roadmap).

Calculations conducted

The calculations that have been prepared within the Roadmap are detailed as follows:

1. Industry
   a. Overall
   b. Consumption based emissions
   c. Territorial emissions
2. Subsector
   a. Benchmarks by operator type
3. Product
   a. 1 m^3 - OSB
   b. 1 m^3 - Chipboard
   c. 1 m^3 - MDF
   d. 1 m^3 - Plywood
   e. 1 m^3 - Sawn Timber (Soft)
   f. 1 m^3 - Sawn Timber (Hard)
   g. 1 m^3 - Engineered Timber
   h. 1 m^3 - Biomass
   i. 1 m^3 - Paper/Cardboard

Scope of analysis

The scope of each calculation is defined as follows. A decision was made as part of this project to exclude B1-B7 emissions because they fall outside of the industry's direct influence. It should also be noted that if this decision had not been made, there is not sufficient data to accurately include these emissions at this time within the industry:

Table 8. Scope summary.

EPD Phase Equivalent	Industry	Subsector	Product
A1	Scope 1 & 2 emissions included emissions; before forest (e.g., seedlings) excluded because of data availability.	Excluded as only mapping scope 1 & 2 emissions	All A1-A5 typical aspects are included in the example models
A2	Scope 1 & 2 emissions included	Where applicable to typical operator profiles these have been included	
A3	Scope 1 & 2 emissions included	Where applicable to typical operator profiles these have been included	
A4	Scope 1 & 2 emissions included	Where applicable to typical operator profiles these have been included	
A5	Excluded as outside of sectors operational control	Excluded as only mapping scope 1 & 2 emissions	
B1-B5	Excluded as outside of sectors operational control	Excluded as only mapping scope 1 & 2 emissions	This phase has not been calculated within the product level models because the emissions largely occur outside the sector (e.g., in construction or other sectors)
B6-B7	Excluded from calculations	Excluded as only mapping scope 1 & 2 emissions	Excluded from calculations
C1	Excluded as outside of sectors operational control	Excluded as only mapping scope 1 & 2 emissions	All C1-C4 typical aspects are included in the example models
C2	Scope 1 & 2 emissions included	Where applicable to typical operator profiles these have been included	
C3	Scope 1 & 2 emissions included	Where applicable to typical operator profiles these have been included	
C4	Scope 1 & 2 emissions included	Where applicable to typical operator profiles these have been included	

Calculation approach

The calculation approach for the three areas of this data set are split into two main categories of calculation:

1. Subsector operator profiles
2. Industry and product level models

Subsector operator profiles

The subsector operator profiles have been compiled based on the submission of a data questionnaire to a selection of participants who have volunteered across the industry to provide their data and the return of that questionnaire to Energise.

The data collection process has been supported by a member of the team at Energise, with data validation checks of completeness/applicability occurring on receipt of the data. Once validated, the data was compiled, and the scope 1 and scope 2 emissions of the operator calculated (for each category that the data has been provided for). In total, eighteen organisations responded to the call for participants have provided data used in the analysis.

The data has, where appropriate, been supplemented with publicly reported carbon emissions data for some subsectors for organisations who have prepared their carbon emissions aligned to an industry standard (e.g., have a statement of external verification contained within their report or conformity with an appropriate standard e.g., ISAE 3410).

The compiled dataset has then been consolidated to prepare a total emissions profile by category for each subsector. Where multiple organisations exist within the data set, a median value is taken.

The data is then presented in percentage (%) of total emissions for that organisation to provide the overall profile of emissions for that subsector.

Industry and product level models

To support the calculation of the Industry and Product level models, the following steps were undertaken:

1. Mapping resource flows within the industry
2. Mapping activities (within resource flows)
3. Mapping emission sources (scope 1 emissions & scope 2 emissions generating activities within those resource flows)
4. Calculating activity (per unit resource flow)
5. Calculating carbon (applying carbon factors/intensity to the known activity)

Details of each of these activities is detailed in the next sections of this document.

Mapping industry resource flows

To ensure the full scope of the industry is accounted for in the assessment, and to ensure the full scope of activities is accounted for within each resource flow, a mapping exercise was undertaken to review resource flows through the industry. All figures were compiled in tonnes or converted to tonnes using the standard conversions provided by Forest Research. These are detailed below for completeness:

Product	m^3/ tonne
Fuelwood, including wood for charcoal	1.380
Wood chips, sawdust, etc	1.480
Industrial roundwood (wood in the rough) – softwood	1.430
Industrial roundwood (wood in the rough) – hardwood	1.250
Sawnwood – softwood	1.820
Sawnwood – hardwood	1.430
Veneer sheets	1.330
Plywood, particleboard	1.540
Hardboard	1.053
MDF (medium density fibreboard)	1.667
Insulating board – density 0.35-0.5 g/cm^3	1.667
Insulating board – other	4.000

Product	tonne/m^3
Fuelwood, including wood for charcoal	0.725
Wood chips, sawdust, etc	0.676
Industrial roundwood (wood in the rough) – softwood	0.699
Industrial roundwood (wood in the rough) – hardwood	0.800
Sawnwood – softwood	0.549
Sawnwood – hardwood	0.699
Veneer sheets	0.752
Plywood, particleboard	0.649
Hardboard	0.950
MDF (medium density fibreboard)	0.600
Insulating board – density 0.35-0.5 g/cm^3	0.600
Insulating board – other	0.250

The data was compiled into 76 resource flows into and out of parts of the sector. The data presented is from 2018 or 2019, for two reasons:

1. To avoid bias in the dataset from the impacts of the pandemic
2. There is better quality data for some areas of the sector (e.g., waste) from this time period than there is for time periods that have occurred since

This was undertaken using the following data sets:

1. 2019 calendar year
   a. Forest Research – UK Wood Production and Trade, 2019 Provisional Figures [63 records taken from this document]
   b. Forest Research – Forestry Facts and Figures 2022 (2019 values) [5 records taken from this document]
2. 2018 calendar year
   c. TRADA WIS 2/3-59 [4 records taken from this document]
   d. Research provided by the University of Bangor on resource flows to Fencing, Woodfuel, and Roundwood Exports [4 records taken from this document]

The outcome of this analysis is visually displayed below in the form of a Sankey diagram

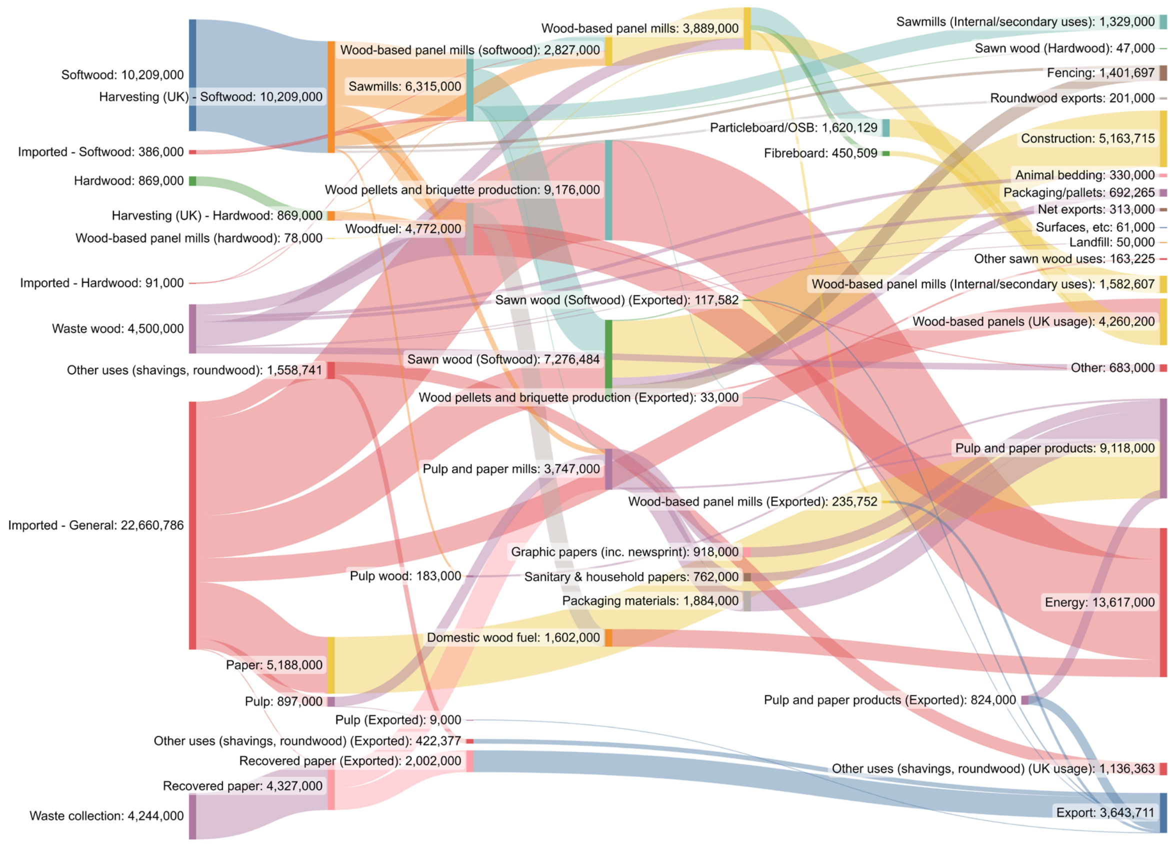


Figure 51. Industry resource flows.

Mapping activities (within resource flows)

The next stage of the assessment was to compile a list of activities within each stage of the resource flow. There is a difference at this stage between the activities that are included within the industry model and the Product models as the purpose of the industry model is to map the scope 1 & 2 emissions of the sector on a territorial and consumption basis, and the purpose of the Product model is to provide a benchmark approach aligned to carbon elements of an Environmental Product Declarations (EPDs).

A territorial carbon footprint includes all emissions that are generated within a defined geographical area, including those from industry, agriculture and transport activities. A consumption-based footprint includes upstream and downstream emissions from consumption of manufactured goods, and transport activity, regardless of where the emissions occur.

The below list provides an example of the detail of the breakdown of the processes allocated to each model and the split between them based on the boundaries outlined.

Mapping emission sources

After the activities have been assessed, as outlined in the example above, through each resource flow across the industry, the assessment then proceeds to identify the carbon emissions that would be generated from the activities, which was done by assessing their typical source of energy/fuel and applying that to the model (e.g. diesel is the typical fuel for a HGV providing the transportation and distribution stage).

EPB Phase	Timber Map Taxonomy (Section)	Timber Map Taxonomy (Phase)	Industry	Product
A1	Forestry	LULUCF	N	Y
A1	Forestry	Public road construction and maintenance	N	Y
A1	Forestry	Forest road construction and maintenance	N	Y
A1	Forestry	Site preparation	N	Y
A1	Forestry	Soil disturbance	N	Y
A1	Forestry	Vehicle Const.	N	Y
A1	Forestry	Harvesting	Y	Y
A1	Forestry	Brash Baling	Y	Y
A1	Forestry	Forwarding	Y	Y
A1	Forestry	On site transport	Y	Y
A2	Forestry	Transportation and distribution	Y	Y
A3	Sawmill	Debarking	Y	Y
A3	Sawmill	Sawing	Y	Y
A3	Sawmill	Grading	Y	Y
A3	Sawmill	Sawing	Y	Y
A3	Sawmill	Trimming	Y	Y
A3	Sawmill	Kiln drying (electricity)	Y	Y
A3	Sawmill	Kiln drying (heat)	Y	Y
A3	Sawmill	Packing and loading	Y	Y
A3	Sawmill	Grading	Y	Y
A3	Sawmill	Sawmill general	Y	Y
A4	Sawmill	Transportation and distribution	Y	Y

Figure 52. Example map of emission sources.

Calculating activity (per unit resource flow)

After the activities have been mapped, each activity needs to be able to be calculated per m^3 or per tonne. This requires an assessment of the total resource flowing through processes and the total resource/energy/fuel used in them.

The data compiled for this was mapped using activity data/energy data from various sources:

1. Forestry – Timber Transport Forum analysis
2. Sawmills – Energise own datasets/Academic research
3. Panel Mills – WPIF Report
4. Transport (outside Forestry) – Various EPDs (as stated in Assumptions)
5. Other subsectors are compiled from a collection of:
    a. EPDs
    b. EcoInvent datasets

To allow calculations to be derived the following assumptions were made:

Forest assumptions are based on the Timber Transport Forum analysis:

- Forest rotation length of 50 years with 6 harvesting/thinning events per rotation has been assumed
- Moisture content of harvested logs is estimated to be 50%
- Where data exists in green tonnes, this has been converted using Forest Research conversion factors for softwood and hardwood respectively into cubic metres then metric tonnes
- Transportation within the forest is based on an average Gross Vehicle Weight (GVW) of 44 tonnes that uses diesel fuel
- The average distance travelled on forest roads is 16.42 km and 131.32 km on public roads

Hardwood assumptions:

- Distance assumptions for hardwood have been calculated using the Imported Materials calculation accounting for the country of origin of the major supply routes and then calculating the average distance based upon ISO port references and typical maritime shipping distances. For roadgoing transport assumptions have been taken from Wood for Good EPDs as examples/reference assumptions.

Softwood assumptions:

- Distance assumptions for softwood have been calculated using the Imported Materials calculation accounting for the country of origin of the major supply routes and then calculating the average distance based upon ISO port references and typical maritime shipping distances. For roadgoing transport assumptions have been taken from Wood for Good EPDs as examples/reference assumptions.

Saw log production is based on the Timber Transport Forum analysis:

- Moisture content of harvested logs is estimated to be 50%, reducing to 12% after drying timber

In the kiln drying process, it is assumed that kilns with heat recovery are uncommon, and energy is used as follows: Transmission Losses (5%), Leakage (4%), Evacuation Losses (78%), Lumber Warming (6%), Melting Heat (7%).

Fuel wood production are based on the Timber Transport Forum analysis:

- Moisture content when fuel wood is chipped estimated to be 25%

Imported Panels:

- Distance assumptions for panels have been calculated using the Imported Materials calculation accounting for the country of origin of the major supply routes and then calculating the average distance based upon ISO port references and typical maritime shipping distances. For roadgoing transport assumptions have been taken from Wood for Good EPDs as examples/reference assumptions.

OSB:

- The Norbord Europe Ltd EPD (via West Fraser) has been to benchmark the OSB analysis

Chipboard:

- The Wood for Good Particleboard EPD has been used to benchmark the Chipboard analysis

MDF:

- LCA datasets from the EcoInvent database have been used to identify the average material losses in MDF production (29.97% material losses)
- Distance assumptions for MDF have been taken from Wood for Good EPDs

Packaging:

- Data from industry operators participating within this project

Biomass:

- Resource flows for Biomass are taken from Forest Research analysis
- Energy use associated with Biomass is taken from the Woodchip production for softwood wood chips LCA dataset from the EcoInvent database

Waste:

- Typical waste routes for waste material generated have been modelled from TRADA WIS 2/3-59 and the Timber Development UK report “Assessing the carbon related impacts and benefits of timber in construction”

Imported materials:

- An average of the available EPD data on https://www.environdec.com/library relevant to the modelled resource flow, applicable to any country that provides more than 5% of UK imports were compiled and split into the respective EPD stages to ensure the comparable activities to the domestic emissions can be compared. Where this data was not available, LCA datasets from the EcoInvent database have been used.
- For transport distances

Calculating carbon (applying carbon factors/intensity to the known activity)

The data collection period related to 2019 activity. Therefore, in accordance with the GHG Protocol, the UK conversion factors used are those published by the Department for Environment, Food and Rural Affairs (DEFRA) annually.

Where individual company-level emissions footprints have been compiled, the operational control approach for determining the organisational boundary was used. Therefore, data was included where the company has the ability to implement policies and procedures at the operation. The reporting period used was for 12 months, typically aligning with the individual company’s financial year.

Any carbon intensity data not available from the UK conversion factors was compiled using data from EcoInvent.

Scenario modelling

The data sets used for scenario modelling were taken from the Climate Change Committee 6th Carbon Budget and the National Grid Future Energy Scenarios (2022 version).

The scenarios used for modelling are:

1. Committee on Climate Change 6th Carbon Budget
    a. Balanced Net Zero Pathway
        i. United Kingdom
        ii. All Sectors
    b. Data available from: https://www.theccc.org.uk/publication/sixth-carbon-budget/#supporting-information-charts-and-data
    c. Data used from Sixth Carbon Budget – Dataset (Version 2 – December 2021)
    d. Metric Index 40 used
2. National Grid Future Energy Scenarios (2022 version)
    a. System Transition
    b. Data available from: https://www.nationalgrideso.com/document/263876/download
    c. Full library of materials from National Grid Future Energy Scenarios (2022 version) is available here: https://www.nationalgrideso.com/future-energy/future-energy-scenarios#fullsuite

In each case where the data was used, to provide a projection, the data was interpolated from the starting position to provide a relative percentage change from the baseline period (e.g. the baseline year = 0%, a 10% reduction would be presented as 10%. Figures are calculated using the destination carbon value (e.g. 2050 where that is the lowest) and interpolated between the baseline and the destination carbon value. Where calculations are derived from values other than carbon (e.g. the adoption of technology in National Grid Future Energy Scenarios datasets) the same approach has been applied using the respective data.

Methodology Frequently Asked Questions

This section responds to questions that were posed during the consultation period which are not otherwise addressed directly within the rest of the methodology statement:

In using EPDs as a data source, how has double counting been avoided?

EPDs have only been used as a source of data/information, the calculations from EPDs themselves have not been directly used in any of the Industry or Product Model calculations. To avoid double counting, the process of each has been mapped and the data sourced from various sources, including EPDs has been used to provide the necessary data to complete the calculation at a process level.

Note in relation to Operators, the scope is defined by the Corporate Accounting Standard of the GHG Protocol and data was collected through a different route, avoiding double counting by default as only Scope 1 & 2 emissions were compiled into the Roadmap analysis.

How are the allocation of different product types assigned?

The product type assignment has been matched to the Wood for Good categories:

Engineered products
- CLT
- Glulam
- LVL
- Timber Frame
- Trussed Rafters

Panel Products
- HDF
- MDF
- Particleboard
- Plywood
- OSB

Solid Timber
- Sawn softwood
- Sawn hardwood
- Other forms of softwood
- Galvanised steel sheet
- Adhesive mix

Other
- Others inc. windows

Has embodied carbon within the wood been included in the calculations?

It has not been included in the industry or operator profiles. There is reference to the data available in the product models, but there is not a uniform inclusion due to data quality.

Appendix B: Stakeholder Action Plans

Introduction

The Timber Industry Net Zero Roadmap aims to identify how the Timber Industry will progress towards Net Zero and what that journey looks like. To support the high-level policy recommendations at the industry level, a number of sub-sectoral summaries have been prepared. These are intended as guidance only and break down the recommendations and timelines further, to enable stakeholders to play their part in achieving the Roadmap's objectives.

The Net Zero pathways have been broken down into 9 stakeholder groups. These are presented in Table 10. Trade Associations engaged in the Roadmap against the relevant stakeholder group. alongside the trade associations engaged as part of developing this Roadmap. Due to the interconnected nature of the Timber Industry, it may be necessary to review and utilise multiple stakeholder summaries to build a pathway to net zero.

<table>
<tr><th colspan="2">STAKEHOLDER GROUP</th><th>TRADE ASSOCIATION</th></tr>
<tr><td>Forest</td><td rowspan="12">Transport</td><td rowspan="2">Confederation of Forest Industries (Confor)
Timber Development UK (TDUK)</td></tr>
<tr><td>Sawmill</td></tr>
<tr><td>Panel Mills</td><td>Wood Panel Industries Federation (WPIF)</td></tr>
<tr><td rowspan="2">Other Production Facilities</td><td>British Woodworking Federation (BWF)</td></tr>
<tr><td>Wood Protection Association (WPA)
Timber Development UK (TDUK)</td></tr>
<tr><td>Packaging</td><td>The Timber Packaging and Pallet Confederation (Timcon)</td></tr>
<tr><td rowspan="4">Construction Related Products</td><td>Alliance for Sustainable Building Products (ASBP)</td></tr>
<tr><td>Structural Timber Association (STA)</td></tr>
<tr><td>Trussed Rafter Association (TRA)</td></tr>
<tr><td>Timber Decking and Cladding Association (TDCA)</td></tr>
<tr><td>Merchants</td><td>National Merchant Building Society Limited (NMBS)
Timber Development UK (TDUK)</td></tr>
<tr><td>Waste</td><td>Wood Recyclers Association (WRA).</td></tr>
</table>

Table 10. Trade Associations engaged in the Roadmap against the relevant stakeholder group.

Industry breakdown

Figure 53 shows the key targets and milestones to Timber Industry subsector to reach Net Zero. Action plans for the subsectors are shared in the tables below.

	BEFORE 2025	2025	2030	2035	2040	2045	2050	NOT TIME BOUND
INDUSTRY	Align sector to GHG protocol, scope 1 & scope 2 full reporting by all non-SME operators by 2023	Set sector standard to compile full scope carbon footprints (inc. Scope 3) by 2025	Reduce road transport emissions intensity by 25% by 2030	Reduce road transport emissions intensity by 50% by 2035	Reduce forestry emissions intensity by 50% by 2040	Reduce scope 1 & 2 emissions intensity of the sector by 90% by 2045	Reduce scope 3 emissions intensity of the sector by 90% by 2050	Nature-based solutions (combined with target reductions) focused on permanent carbon removals to be used for offsetting
			Reduce processing/ manufacturing emissions intensity by 50% by 2030					

Figure 54. Forestry sector Net Zero action plan to 2050.

Figure 53. Timber Industry Net Zero action plan to 2050.

Forest

The emissions footprint associated with the Forest subsector is 89,863 tCO_2e, representing just 1% of the total footprint of the Timber Industry. The breakdown of emissions within the forest split into 4 categories: Forwarding (16%), Brash Baling (36%), Harvesting (22%) and On site transport (26%).

Figure 54 shows the key targets and milestones to enable the Forestry subsector to reach Net Zero.

	BEFORE 2025	2025	2030	2035	2040	2045	2050	NOT TIME BOUND
FORESTRY	Align sector to GHG protocol, scope 1 & scope 2 full reporting by all non-SME operators by 2023 Commit to sector-specific roadmap	Set sector standard to compile full scope carbon footprints (inc. Scope 3) by 2025	Reduce road transport emissions intensity by 25% by 2030	Reduce road transport emissions intensity by 50% by 2035	Reduce scope 1 & 2 emissions intensity of the sector by 50% by 2040	Reduce scope 1 & 2 emissions intensity of the sector by 80% by 2045	Reduce scope 1 & 2 emissions intensity of the sector by 90% by 2050	Nature-based solutions (combined with target reductions) focused on permanent carbon removals to be used for offsetting

Transport

The emissions footprint associated with the Transport subsector is 2,481,553 tCO_2e, representing 30% of the total footprint of the Timber Industry. The majority of the carbon footprint (74%) comes from road and maritime transport of imported timber products (including biomass). These emissions are related to the transportation of those imported timber products, rather than the embodied carbon of the imported timber products themselves. Within the value chain, the highest transport-related emissions are associated with transporting timber products from merchants to user (11%), the lowest is from transporting UK-supplied woodfuel used for biomass at 2% of the total.

Figure 55 shows the key targets and milestones to enable the Transport subsector to reach Net Zero.

	BEFORE 2025	2025	2030	2035	2040	2045	2050	NOT TIME BOUND
TRANSPORT	Align sector to GHG protocol, scope 1 & scope 2 full reporting by all non-SME operators by 2023 Commit to sector-specific roadmap	Set sector standard to compile full scope carbon footprints (inc. Scope 3) by 2025	Reduce scope 1 & 2 emissions intensity of the sector by 20% by 2030	Reduce scope 1 & 2 emissions intensity of the sector by 50% by 2035	Reduce scope 1 & 2 emissions intensity of the sector by 80% by 2040	Reduce scope 1 & 2 emissions intensity of the sector by 95% by 2045	Reduce scope 3 emissions intensity of the sector by 90% by 2050	Nature-based solutions (combined with target reductions) focused on permanent carbon removals to be used for offsetting

Figure 55. Transport sector Net Zero action plan to 2050.

Sawmill

The emissions footprint associated with the Sawmill subsector is 211,543 tCO_2e, representing 3% of the total footprint of the Timber Industry. 56% of this is attributed to the electricity use within the sawmill, primarily used for drying and sawing. The remaining 44% is attributed to heat use, primarily used for drying.

Figure 56 shows the key targets and milestones to enable the Sawmill subsector to reach Net Zero.

	BEFORE 2025	2025	2030	2035	2040	2045	2050	NOT TIME BOUND
SAWMILLS	Align sector to GHG protocol, scope 1 & scope 2 full reporting by all non-SME operators by 2023 Commit to sector-specific roadmap	Set sector standard to compile full scope carbon footprints (inc. Scope 3) by 2025	Reduce scope 1 & 2 emissions intensity of the sector by 50% by 2030	Reduce scope 1 & 2 emissions intensity of the sector by 75% by 2035	Reduce scope 1 & 2 emissions intensity of the sector by 85% by 2040	Reduce scope 1 & 2 emissions intensity of the sector by 95% by 2045	Reduce scope 3 emissions intensity of the sector by 90% by 2050	Nature-based solutions (combined with target reductions) focused on permanent carbon removals to be used for offsetting

Figure 56. Sawmill sector Net Zero action plan to 2050.

Panel mill

The emissions footprint associated with the Panel Mill subsector is 346,357 tCO_2e, representing 4% of the total footprint of the Timber Industry. The majority of emissions come from natural gas (57%) and electricity (33%).

Figure 57 shows the key targets and milestones to enable the Panel Mill subsector to reach Net Zero.

	BEFORE 2025	2025	2030	2035	2040	2045	2050	NOT TIME BOUND
PANEL MILLS	Align sector to GHG protocol, scope 1 & scope 2 full reporting by all non-SME operators by 2023 Commit to sector-specific roadmap	Set sector standard to compile full scope carbon footprints (inc. Scope 3) by 2025	Reduce scope 1 & 2 emissions intensity of the sector by 50% by 2030	Reduce scope 1 & 2 emissions intensity of the sector by 65% by 2035	Reduce scope 1 & 2 emissions intensity of the sector by 85% by 2040	Reduce scope 1 & 2 emissions intensity of the sector by 95% by 2045	Reduce scope 3 emissions intensity of the sector by 90% by 2050	Nature-based solutions (combined with target reductions) focused on permanent carbon removals to be used for offsetting

Figure 57. Panel Mill sector Net Zero action plan to 2050.

Other production facilities

The emissions footprint associated with the Other Production Facilities subsector is 100,847 tCO_2e, representing 1% of the total footprint of the Timber Industry. The majority of this is from natural gas (63%) and the remainder is from electricity (37%)

Figure 58 shows the key targets and milestones to enable the 'Other Production Facilities' subsector to reach Net Zero.

	BEFORE 2025	2025	2030	2035	2040	2045	2050	NOT TIME BOUND
OTHER PRODUCTION FACILITIES	Align sector to GHG protocol, scope 1 & scope 2 full reporting by all non-SME operators by 2023 Commit to sector-specific roadmap	Set sector standard to compile full scope carbon footprints (inc. Scope 3) by 2025	Reduce scope 1 & 2 emissions intensity of the sector by 45% by 2030	Reduce scope 1 & 2 emissions intensity of the sector by 70% by 2035	Reduce scope 1 & 2 emissions intensity of the sector by 90% by 2040	Reduce scope 1 & 2 emissions intensity of the sector by 95% by 2045	Reduce scope 3 intensity of the sector by 90% by 2050	Nature-based solutions (combined with target reductions) focused on permanent carbon removals to be used for offsetting

Figure 58. Other Production Facilities sector Net Zero action plan to 2050.

Packaging

Figure 59 shows the key targets and milestones to enable the Packaging subsector to reach Net Zero.

	BEFORE 2025	2025	2030	2035	2040	2045	2050	NOT TIME BOUND
PACKAGING	Align sector to GHG protocol, scope 1 & scope 2 full reporting by all non-SME operators by 2023 Commit to sector-specific roadmap	Set sector standard to compile full scope carbon footprints (inc. Scope 3) by 2025	Reduce scope 1 & 2 emissions intensity of the sector by 50% by 2030	Reduce scope 1 & 2 emissions intensity of the sector by 70% by 2035	Reduce scope 1 & 2 emissions intensity of the sector by 85% by 2040	Reduce scope 1 & 2 emissions intensity of the sector by 95% by 2045	Reduce scope 3 emissions intensity of the sector by 90% by 2050	Nature-based solutions (combined with target reductions) focused on permanent carbon removals to be used for offsetting

Figure 59. Packaging sector Net Zero action plan to 2050.

Construction-related products

Figure 60 shows the key targets and milestones to enable the 'Construction-related products' subsector to reach Net Zero.

	BEFORE 2025	2025	2030	2035	2040	2045	2050	NOT TIME BOUND
CONSTRUCTION RELATED PRODUCTS	Align sector to GHG protocol, scope 1 & scope 2 full reporting by all non-SME operators by 2023 Commit to sector-specific roadmap	Set sector standard to compile full scope carbon footprints (inc. Scope 3) by 2025	Reduce scope 1 & 2 emissions intensity of the sector by 50% by 2030	Reduce scope 1 & 2 emissions intensity of the sector by 70% by 2035	Reduce scope 1 & 2 emissions intensity of the sector by 85% by 2040	Reduce scope 1 & 2 emissions intensity of the sector by 95% by 2045	Reduce scope 3 emissions intensity of the sector by 90% by 2050	Nature-based solutions (combined with target reductions) focused on permanent carbon removals to be used for offsetting

Figure 60. Construction-related Products sector Net Zero action plan to 2050.

Merchants

The emissions footprint associated with the Merchants subsector is 81,110 tCO_2e, representing 1% of the total footprint of the Timber Industry. The majority of these come from electricity (67%) and the remainder is from natural gas (33%).

Figure 61 shows the key targets and milestones to enable the Merchants subsector to reach Net Zero.

	BEFORE 2025	2025	2030	2035	2040	2045	2050	NOT TIME BOUND
MERCHANTS	Align sector to GHG protocol, scope 1 & scope 2 full reporting by all non-SME operators by 2023 Commit to sector-specific roadmap	Set sector standard to compile full scope carbon footprints (inc. Scope 3) by 2025	Reduce scope 1 & 2 emissions intensity of the sector by 50% by 2030	Reduce scope 1 & 2 emissions intensity of the sector by 75% by 2035	Reduce scope 1 & 2 emissions intensity of the sector by 90% by 2040	Reduce scope 1 & 2 emissions intensity of the sector by 95% by 2045	Reduce scope 3 emissions intensity of the sector by 90% by 2050	Nature-based solutions (combined with target reductions) focused on permanent carbon removals to be used for offsetting

Figure 61. Merchants sector Net Zero action plan to 2050.

Waste

The emissions footprint associated with the Waste subsector is 59,802 tCO_2e, representing 1% of the total footprint of the Timber Industry. The majority of waste within the Timber Industry is diverted from landfill (99%), either within the sector or to other sectors including for animal bedding.

Figure 62 shows the key targets and milestones to enable the Waste subsector to reach Net Zero.

	BEFORE 2025	2025	2030	2035	2040	2045	2050	NOT TIME BOUND
WASTE	Align sector to GHG protocol, scope 1 & scope 2 full reporting by all non-SME operators by 2023 Commit to sector-specific roadmap	Set sector standard to compile full scope carbon footprints (inc. Scope 3) by 2025	Reduce scope 1 & 2 emissions intensity of the sector by 35% by 2030	Reduce scope 1 & 2 emissions intensity of the sector by 55% by 2035	Reduce scope 1 & 2 emissions intensity of the sector by 70% by 2040	Reduce scope 1 & 2 emissions intensity of the sector by 80% by 2045	Reduce scope 3 emissions intensity of the sector by 90% by 2050	Nature-based solutions (combined with target reductions) focused on permanent carbon removals to be used for offsetting

Figure 62. Waste sector Net Zero action plan to 2050.

Appendix C: Data Tables

In	Volume	Out	Units
Softwood	10,209,000	Harvesting (UK) - Softwood	Green tonnes
Hardwood	869,000	Harvesting (UK) - Hardwood	Green tonnes
Harvesting (UK) - Softwood	5,883,000	Sawmills	Green tonnes
Imported - Softwood	343,000	Sawmills	Green tonnes
Harvesting (UK) - Hardwood	76,000	Sawmills	Green tonnes
Imported - Hardwood	13,000	Sawmills	Green tonnes
Sawmills	1,329,000	Sawmills (Internal Use)	Green tonnes
Sawmills	3,410,000	Sawn wood (Softwood)	Green tonnes
Sawmills	47,000	Sawn wood (Hardwood)	Green tonnes
Sawmills	1,468,000	Wood-based panel mills (softwood)	Green tonnes
Harvesting (UK) - Softwood	1,316,000	Wood-based panel mills (softwood)	Green tonnes
Imported - Softwood	43,000	Wood-based panel mills (softwood)	Green tonnes
Imported - Hardwood	78,000	Wood-based panel mills (hardwood)	Green tonnes
Wood-based panel mills (softwood)	2,827,000	Wood-based panel mills	Green tonnes
Wood-based panel mills (hardwood)	78,000	Wood-based panel mills	Green tonnes
Waste wood	984,000	Wood-based panel mills	tonnes
Wood-based panel mills	1,620,130	Particleboard/OSB	tonnes
Wood-based panel mills	450,510	Fibreboard	tonnes
Particleboard/OSB	1,620,130	Wood-based panels (UK usage)	tonnes
Fibreboard	450,510	Wood-based panels (UK usage)	tonnes
Harvesting (UK) - Softwood	464,000	Pulp and paper mills	Green tonnes
Sawmills	61,000	Pulp and paper mills	Green tonnes
Pulp and paper mills	918,000	Graphic papers (inc. newsprint)	tonnes
Pulp and paper mills	762,000	Sanitary & household papers	tonnes
Pulp and paper mills	1,884,000	Packaging materials	tonnes
Pulp and paper mills	183,000	Pulp and paper products	tonnes
Graphic papers (inc. newsprint)	918,000	Pulp and paper products	tonnes
Sanitary & household papers	762,000	Pulp and paper products	tonnes
Packaging materials	1,884,000	Pulp and paper products	tonnes
Pulp wood	183,000	Pulp and paper products	tonnes
Harvesting (UK) - Softwood	262,000	Fencing	Green tonnes
Harvesting (UK) - Softwood	1,900,000	Woodfuel	Green tonnes
Harvesting (UK) - Softwood	183,000	Pulp wood	Green tonnes
Harvesting (UK) - Softwood	201,000	Roundwood exports	Green tonnes

Woodfuel	298,000	Wood pellets and briquette production	tonnes
Woodfuel	1,602,000	Domestic wood fuel	tonnes
Harvesting (UK) - Hardwood	700,000	Woodfuel	Green tonnes
Harvesting (UK) - Hardwood	93,000	Other	Green tonnes
Imported - General	1,558,741	Other uses (shavings, roundwood)	tonnes
Imported - General	8,878,000	Wood pellets and briquette production	tonnes
Imported - General	3,866,484	Sawn wood (Softwood)	tonnes
Imported - General	2,189,562	Wood-based panels (UK usage)	tonnes
Imported - General	5,188,000	Paper	tonnes
Imported - General	897,000	Pulp	tonnes
Imported - General	83,000	Recovered paper	tonnes
Paper	5,188,000	Pulp and paper products	tonnes
Pulp	888,000	Pulp and paper mills	tonnes
Recovered paper	2,325,000	Pulp and paper mills	tonnes
Pulp and paper products	824,000	Pulp and paper products (Exported)	tonnes
Pulp	9,000	Pulp (Exported)	tonnes
Recovered paper	2,002,000	Recovered paper (Exported)	tonnes
Other uses (shavings, roundwood)	422,378	Other uses (shavings, roundwood) (Exported)	tonnes
Wood pellets and briquette production	33,000	Woodfuel	tonnes
Sawn wood (Softwood)	117,582	Sawn wood (Softwood) (Exported)	tonnes
Wood-based panel mills	235,753	Wood-based panel mills (Exported)	tonnes
Waste collection	4,244,000	Recovered paper	tonnes
Waste wood	330,000	Animal bedding	tonnes
Waste wood	313,000	Net exports	tonnes
Waste wood	2,172,000	Woodfuel	tonnes
Waste wood	61,000	Other uses (inc. surfacing & reuse)	tonnes
Waste wood	50,000	Landfill	tonnes
Waste wood	590,000	Other (inc. unreported)	tonnes
Pulp and paper products (Exported)	824,000	Export	tonnes
Pulp (Exported)	9,000	Export	tonnes
Recovered paper (Exported)	2,002,000	Export	tonnes
Other uses (shavings, roundwood) (Exported)	422,378	Export	tonnes
Wood pellets & briquette production (Exported)	33,000	Export	tonnes
Sawn wood (Softwood) (Exported)	117,582	Export	tonnes

Wood-based panel mills (Exported)	235,753	Export	tonnes
Sawn wood (Softwood)	5,163,715	Construction	tonnes
Sawn wood (Softwood)	692,266	Packaging/pallets	tonnes
Sawn wood (Softwood)	1,139,697	Fencing	tonnes
Sawn wood (Softwood)	163,225	Other sawn wood uses	tonnes
Woodfuel	700,000	Energy	tonnes
Wood pellets & briquette production	11,243,000	Energy	tonnes
Domestic wood fuel	1,602,000	Energy	tonnes
Wood-based panel mills	1,582,607	Wood-based panel mills (Internal Use)	tonnes
Other uses (shavings, roundwood)	1,136,364	Other uses (shavings, roundwood) (UK usage)	tonnes

Table 11. Timber Industry resource balance.

EPD	Section	Energy user	Total industry use	Unit	Carbon factor ($kgCO_2e$/unit)	Total carbon footprint (tCO_2e)
A1	Forest	Harvesting	7,460,440	litres	2.59411	19,353
A1	Forest	Brash Baling	12,434,066	litres	2.59411	32,255
A1	Forest	Forwarding	5,595,330	litres	2.59411	14,515
A1	Forest	On site transport	181,900,760	tonne.km	0.13051	23,740
A2	Transport	Forest to mill	1,118,878,000	tonne.km	0.13051	146,025
A3	Sawmill	Debarking - Electricity	25,260,000	kWh	0.2556	6,456
A3	Sawmill	Sawing - Electricity	145,245,000	kWh	0.2556	37,125
A3	Sawmill	Sorting - Electricity	12,630,000	kWh	0.2556	3,228
A3	Sawmill	Drying - Electricity	195,765,000	kWh	0.2556	50,038
A3	Sawmill	Dry handling - Electricity	25,260,000	kWh	0.2556	6,456
A3	Sawmill	Grinding - Electricity	82,095,000	kWh	0.2556	20,983
A3	Sawmill	Sawing - Heat	63,150,000	kWh	0.01563	987
A3	Sawmill	Sorting - Heat	31,575,000	kWh	0.01563	494
A3	Sawmill	Drying - Heat (Biomass)	1,508,945,580	kWh	0.01563	23,585
A3	Sawmill	Drying - Heat (Gas)	379,239,420	kWh	0.18385	69,723
A3	Sawmill	Dry handling - Heat	31,575,000	kWh	0.01563	494
A3	Sawmill	Grinding - Heat	31,575,000	kWh	0.01563	494
A3	Sawmill	Office etc. - Heat	94,725,000	kWh	0.01563	1,481
A3	Panel Mills	Gas Oil	4,293,000	kWh	0.25676	1,102
A3	Panel Mills	Diesel	3,027,000	kWh	0.24462	740
A3	Panel Mills	LPG	2,463,000	kWh	0.21447	528
A3	Panel Mills	Natural Gas	1,066,353,000	kWh	0.18385	196,049

A3	Panel Mills	Electricity	446,989,000	kWh	0.2556	114,250
A3	Panel Mills	Biomass (wood residue)	2,155,235,000	kWh	0.01563	33,686
A3	Other Production Facilities	Electricity	145,271,425	kWh	0.2556	37,131
A3	Other Production Facilities	Natural Gas	346,564,725	kWh	0.18385	63,716
A3	Merchants	Electricity	214,163,200	kWh	0.2556	54,740
A3	Merchants	Natural Gas	143,430,400	kWh	0.18385	26,370
A2	Transport	Biomass (UK supply)	338,000,000	tonne.km	0.13051	44,112
A4	Transport	Mill to merchant	948,011,090	tonne.km	0.13051	123,725
A4	Transport	Merchant to user	2,129,378,756	tonne.km	0.13051	277,905
C2	Transport	Transporting waste	512,769,218	tonne.km	0.13051	66,922
C4	Waste wood	Landfill				1,263
C2-C3	Waste wood	Processing and transport of recycled material to other sectors (e.g. surfacing)				16,845
C2-C3	Waste wood	Transport and Initial Processing from use (e,g, construction)				41,693
A4	Transport	Imports (maritime)	26,605,182,597	tonne.km	0.01323	352,040
A4	Transport	Imports (road)	11,786,609,698	tonne.km	0.13051	1,538,270
A1-A3 (Imported)	Import	Softwood	3,802	tCO_2e	1	3,802
A1-A3 (Imported)	Import	Hardwood	16,029	tCO_2e	1	16,029
A1-A3 (Imported)	Import	Other	119,958	tCO_2e	1	119,958
A1-A3 (Imported)	Import	Sawn wood	341,850	tCO_2e	1	341,850
A1-A3 (Imported)	Import	Particleboard	929,714	tCO_2e	1	929,714
A1-A3 (Imported)	Import	Fibreboard	354,052	tCO_2e	1	354,052
A3	Biomass	Electricity	67,080,000	kWh	0.2556	17,146
A1-A3 (Imported)	Import	Biomass	3,284,860	tCO_2e	1	3,284,860

Table 12. Timber Industry carbon footprint (excluding Pulp & Paper).

Appendix D

The tables in this section outline the following information:

- Category/description
- EPD stage
- Action timeframe/economic viability
- Cost range from low/no cost to significant capital
- Payback range

CATEGORY	HIGH LEVEL MEASURE	DESCRIPTION/CONSIDERATIONS	EPD STAGE	AVAILABILITY OF SUPPLIERS	ACTION TIMEFRAME/ ECONOMIC VIABILITY	COST RANGE (PER SITE/ VEHICLE)	PAYBACK RANGE (£, PER SITE/ VEHICLE)
Industrial process emissions	Process equipment replacement	As technology evolves there may be more efficient technology or technology that uses a different fuel/energy source to operate. You should consider opportunities to reduce your emissions by equipment replacement, particularly at stages where the equipment requires replacement due to age/ performance/faults.	A3	Specialist	Available immediately	Medium	Medium term
Industrial process emissions	Process material substitution	Consider replacing the materials in your process with those which have a lower environmental impact	A3	Specialist	Available immediately	Large	Medium term
Industrial process emissions	Process material efficiency	Consider the efficiency of the use of materials in your processes	A3, C3	Specialist	Available immediately	Medium	Medium term
Industrial process emissions	Carbon capture and storage/ utilisation	Carbon capture and storage (CCS) is technology to remove carbon dioxide after burning gas, oil, coal or biomass before it enters the atmosphere, and to store it.	A3	Emerging	From 2030	Significant capital	Long term
Industrial process emissions	Fuel switching/ electrification	Increasing technology is available that uses a different fuel/energy source to operate. You should consider opportunities to reduce your emissions by equipment replacement, particularly at stages where the equipment requires replacement due to age/ performance/faults.	A3	Specialist	Available immediately	Large	Long term
Industrial process emissions	Smart control systems	Smart control systems can improve operational efficiency. The correct structure and use	A3	Readily available	Available immediately	Large	Short term

Industrial process emissions	Waste heat recovery	Many processes produce heat, but often this heat is allowed to escape rather than captured and reused. Heat recovery solutions allow the heat to be reused elsewhere in a building/ process.	A3	Specialist	Available immediately	Large	Medium term
Industrial process emissions	Process optimisation	Industrial processes can often be optimised to be more efficient. This process typically can be led within an organisation as a review of opportunities for continual improvement, which can deliver energy/carbon emissions savings.	A3	Readily available	Available immediately	Low	Short term
Fugitive emissions (refrigerants)	Alternative refrigerants	Refrigerants can make a significant contribution to global warming. The selection of lower GWP refrigerants for new equipment and implementing drop-in replacements for existing systems is a way to reduce your carbon footprint.	A1, A2, A3, A4	Readily available	Available immediately	Medium	Medium term
Fugitive emissions (refrigerants)	Refrigerant leakage reduction	Refrigerants are meant to be used in sealed systems, but occasionally they leak. Ensuring that leaks are checked, and maintenance is sufficient to prevent them are effective carbon reduction measures.	A1, A2, A3, A4	Readily available	Available immediately	Low	Medium term
Fugitive emissions (refrigerants)	Leak detection	Leak detection can be automated. These kinds of systems are effective for larger systems and help to reduce the risk of accidental fugitive emissions.	A1, A2, A3, A4	Readily available	Available immediately	Medium	Medium term

Purchased electricity	Control systems	Control systems can improve the performance of heat systems by ensuring that demand is delivered to the right place, at the right temperature, at the right time. Ensuring you have a good control system which is well operated is a basic energy management action which any organisation should have in place.	A1, A3	Readily available	Available immediately	Low	Short term
Purchased electricity	Heating efficiency (heat pumps)	Heat pumps are a high efficiency way to heat space. They use electricity to move hot or cold air from one place to another, rather than to generate it.	A1, A3	Readily available	Available immediately	Medium	Medium term
Purchased electricity	Cooling efficiency (absorption)	Absorption chillers collect waste heat from other processes and equipment to drive thermodynamic processes that allows water to be chilled and distributed for HVAC needs. Absorption chillers do not use mechanical compressors, instead making use of the absorption refrigeration cycle.	A1, A3	Readily available	Available immediately	Medium	Medium term
Purchased electricity	Cooling efficiency (compressor)	Chillers are machines that removes heat from a liquid coolant via a vapor-compression, adsorption refrigeration. They are becoming increasingly efficient as technology evolves and you should consider how efficient your current equipment is and whether economically viable improvements can be achieved through replacement.	A1, A3	Readily available	Available immediately	Medium	Medium term
Purchased electricity	Cooling efficiency (heat pump)	Heat pumps are a high efficiency way to heat space. They use electricity to move hot or cold air from one place to another, rather than to generate it.	A1, A3	Readily available	Available immediately	Medium	Medium term

Purchased electricity	Building envelope	The energy performance of a building envelope is influenced by a number of factors. For example, these may include design elements such as the physical orientation of the building and the amount of sunlight that penetrates into the interior living or work spaces. Other factors may also include the heat transfer characteristics (both losses & gains) and the location of the building envelope components, including walls, windows, doors, floors and the roof. And the energy performance of a building may also be influenced by any natural air infiltration through the building envelope (e.g. cracks)	A1, A3	Readily available	Available immediately	Large	Long term
Purchased electricity	Ventilation	The energy performance of a ventilation system is influenced by a number of factors. For example, these may include design elements such as the air flow rate, the amount of fresh air introduced in the system, the presence of a reheat coil and a heat recovery device, the type of fan and ventilation control, and the leakiness of the intake air damper. The design of ventilation systems depends on the type of application. For example, it may include applications such as controlling the injection of fresh air, controlling air redistribution, room diffusion and stratification, maintaining comfort standards, maintaining air quality within acceptable limits of carbon dioxide, oxygen and odour content, removing airborne contaminants produced by processes and occupants and maintaining special environment for specific equipment or processes.	A1, A3	Readily available	Available immediately	Medium	Short term

Purchased electricity	Lighting	The energy performance of a lighting system is influenced by a number of factors. These typically include the illumination level required for the type of space being lit (e.g. classroom vs. gymnasium), the lamp and fixture type selected (e.g. incandescent vs. compact fluorescent), the luminous efficacy and electricity load for each lamp, the total number of fixtures installed, and finally, the operating hours of the lamps.	A1, A3	Readily available	Available immediately	Medium	Short term
Purchased electricity	Electrical equipment	The energy performance of appliances (or plug loads) and other electrical equipment is influenced by a number of factors. These typically include the number of hours that the equipment is operating, the electricity load of the equipment itself and the duty cycle (on/off cycling) for each appliance or other electrical equipment	A1, A3	Readily available	Available immediately	Medium	Quick
Purchased electricity	Hot water	The energy performance of a hot water system is influenced by a number of factors. These typically include the amount of hot water used on a daily basis by the application or facility under consideration (flow rate), the duration of each use of hot water, the end-use water temperature required, as well as the supply temperature of the water available, and the use of a heat recovery device.	A1, A3	Readily available	Available immediately	Low	Short term

Purchased electricity	Pumps	The energy performance of a pump system is influenced by a number of factors. These typically include the pump efficiency, the flow rate (e.g. variable vs. constant), the type of flow control (throttling vs. variable speed) and the number of hours that the pump is operating. Other factors also include the motor efficiency at full load, which depends on the type of motor (i.e. standard efficiency, energy efficient or premium efficiency), the motor capacity, and the load factor (i.e. the ratio of the average load during operating hours over the full load capacity)	A1, A3	Readily available	Available immediately	Low	Short term
Purchased electricity	Fans	The energy performance of a fan system is influenced by a number of factors. These typically include the fan efficiency, which depends on the type of fan (i.e. forward curve, radial blade, backward inclined or airfoil fan), the air flow rate (e.g. variable vs. constant), the type of air flow control (i.e. variable speed, discharge damper, inlet damper or inlet guide vane) and the number of hours that the fan is operating. Other factors also include the motor efficiency at full load, which depends on the type of motor (i.e. standard efficiency, energy efficient or premium efficiency), the motor capacity, and the load factor (i.e. the ratio of the average load during operating hours over the full load capacity).	A1, A3	Readily available	Available immediately	Low	Short term

Purchased electricity	Motors	The energy performance of an alternative current (AC) electric motor system is influenced by a number of factors. These typically include the motor efficiency at full load, which depends on the type of motor (i.e. standard efficiency, energy efficient or premium efficiency), the motor capacity, the load factor (i.e. the ratio of the average load during operating hours over the full load capacity), the motor speed, the load type (i.e. standard or centrifugal), the number of hours that the motor is operating and the electricity load of the motor.	A1, A3	Readily available	Available immediately	Medium	Short term
Purchased electricity	Process electricity	The energy performance of a process electricity system is influenced by a number of factors. These typically include the number of hours that the process is operating, the electricity load of the process itself and the duty cycle (on/off cycling) for each process	A1, A3	Readily available	Available immediately	Significant capital	Medium term
Purchased electricity	Compressed air	The energy performance of a compressed air system is influenced by a number of factors. These typically include the compressor type (rotary screw, reciprocating or centrifugal) and its capacity. The performance also depends on the air intake location (indoor vs. outdoor), the pressure required in the compressed air system, the capacity control strategy (i.e. on/off, inlet throttle, load/unload, turn valve, throttle/low unload, turn valve/low unload, variable speed), the useful capacity of compressed air, the average air leakage, the number of hours that the motor-compressor system is operating and the number of hours that compressed air is being used. Other factors also include the motor efficiency at full load, which depends on the type of motor (i.e. standard efficiency, energy efficient or premium efficiency) and the motor capacity.	A1, A3	Readily available	Available immediately	Large	Short term

Purchased electricity	Refrigeration	The energy performance of a refrigeration system is influenced by a number of factors. These typically include the number of hours that the process is operating, the cooling load of the refrigeration system itself and the duty cycle (on/off cycling) for each system	A1, A3	Readily available	Available immediately	Medium	Medium term
Purchased heat	Control systems	Control systems can improve the performance of heat systems by ensuring that demand is delivered to the right place, at the right temperature, at the right time. Ensuring you have a good control system which is well operated is a basic energy management action	A1, A3	Readily available	Available immediately	Low	Short term
Purchased cooling	Control systems	Control systems can improve the performance of cooling systems by ensuring that demand is delivered to the right place, at the right temperature, at the right time. Ensuring you have a good control system which is well operated is a basic energy management action	A1, A3	Readily available	Available immediately	Low	Short term
Purchased heat	Heating combustion efficiency (district heating)	Combustion efficiency is a measure of how effectively the heat content of a fuel is transferred into usable heat. Stack temperature and flue gas oxygen levels are the primary ways to monitor. Efficiency can be achieved through managing the fuel, fuel type, temperatures, air levels and numerous other points. Specialist contractors can support in this area.	A1, A3	Readily available	Available immediately	Medium	Long term
Purchased heat	Process heat efficiency	The energy performance of a process heat system is influenced by a number of factors. These typically include the number of hours that the process is operating, the heating load of the process itself and the duty cycle (on/off cycling) for each process.	A1, A3	Readily available	Available immediately	Medium	Medium term

Purchased heat	Heat recovery	Opportunities generally exist where significant heat generation occurs for heat recovery. The energy performance of a heat recovery system is influenced by a number of factors. These typically include the (energy-to-energy, steam-to-steam, steam-to-water, water-to-water, or other fluid-to-other fluid) flow rate, temperature, pressure, density and/or heat capacity. Other factors will also include the heat recovery efficiency and the number of hours that the heat recovery system is operating.	A1, A3	Readily available	Available immediately	Medium	Medium term
Purchased steam	Control systems	Control systems can improve the performance of steam systems by ensuring that demand is delivered to the right place, at the right temperature, at the right time. Ensuring you have a good control system which is well operated is a basic energy management action	A1, A3	Readily available	Available immediately	Medium	Short term
Purchased steam	Combustion efficiency	Combustion efficiency is a measure of how effectively the heat content of a fuel is transferred into usable heat. Stack temperature and flue gas oxygen levels are the primary ways to monitor. Efficiency can be achieved through managing the fuel, fuel type, temperatures, air levels and numerous other points. Specialist contractors can support in this area.	A1, A3	Readily available	Available immediately	Medium	Short term
Purchased steam	Process steam efficiency	It is important to ensure that where steam is used in processes, it is used efficiently given that it is an expensive secondary form of energy to produce.	A1, A3	Readily available	Available immediately	Medium	Short term

Purchased steam	Steam losses	The energy needs associated with steam losses are influenced by a number of factors. These typically include the number of hours that the process is operating, the plume or leak size, and the steam flow, pressure and temperature	A1, A3	Readily available	Available immediately	Medium	Medium term
Purchased steam	Heat recovery	Opportunities generally exist where significant heat generation occurs for heat recovery. The energy performance of a heat recovery system is influenced by a number of factors. These typically include the (energy-to-energy, steam-to-steam, steam-to-water, water-to-water, or other fluid-to-other fluid) flow rate, temperature, pressure, density and/or heat capacity. Other factors will also include the heat recovery efficiency and the number of hours that the heat recovery system is operating.	A1, A3	Readily available	Available immediately	Large	Long term
Generation of electricity (fossil fuel)	Combustion efficiency	Combined heat and power plant efficiencies can typically range between 65% and 80% efficient. The performance can be improved through numerous parts of the efficiency including combustion efficiency and the conversion efficiency to electricity).	A1, A3	Readily available	Available immediately	Low	Quick
Generation of heat (fossil fuel)	Control systems	Control systems can improve the performance of heat systems by ensuring that demand is delivered to the right place, at the right temperature, at the right time. Ensuring you have a good control system which is well operated is a basic energy management action which any organisation should have in place.	A1, A3	Readily available	Available immediately	Low	Quick
Generation of heat (fossil fuel)	Biogas	There is an increasing availability of gas from bio sources. Specialist suppliers are available.	A1, A3	Specialist	Available immediately	Medium	Medium term

Generation of heat (fossil fuel)	Combustion/ operational efficiency	Combustion efficiency is a measure of how effectively the heat content of a fuel is transferred into usable heat. Stack temperature and flue gas oxygen levels are the primary ways to monitor. Efficiency can be achieved through managing the fuel, fuel type, temperatures, air levels and numerous other points. Specialist contractors can support in this area.	A1, A3	Readily available	Available immediately	Low	Short term
Generation of heat (fossil fuel)	Temperature management	Appropriate control of temperature, using thermostatic control devices is important in delivery efficient heating systems.	A1, A3	Readily available	Available immediately	Low	Short term
Generation of heat (fossil fuel)	Thermal insulation	Reducing the amount of heat lost lowers your emissions and fuel bills; insulation throughout heating systems and buildings where economically viable is a sensible energy efficiency measure.	A1, A3	Readily available	Available immediately	Low	Medium term
Generation of steam (fossil fuel)	Combustion efficiency	Combustion efficiency is a measure of how effectively the heat content of a fuel is transferred into usable heat. Stack temperature and flue gas oxygen levels are the primary ways to monitor. Efficiency can be achieved through managing the fuel, fuel type, temperatures, air levels and numerous other points. Specialist contractors can support in this area.	A1, A3	Readily available	Available immediately	Medium	Short term
Generation of steam (fossil fuel)	Steam trap management	A healthy steam trap population allows condensate to be removed from the steam system effectively. This means that process efficiency can be optimised, equipment is protected and the condensate can be re-used.	A1, A3	Readily available	Available immediately	Medium	Quick

Generation of steam (fossil fuel)	Steam system maintenance	Steam systems can be energy intensive. They should be managed through daily checks, regular inspections, servicing that includes flue gas analysis, regular water treatment services/ chemical dosing, and periodic preventative maintenance.	A1, A3	Readily available	Available immediately	Medium	Quick
Transportation (road - car)	Carpooling	Carpooling is the sharing of car journeys so that more than one person travels in the car so as to prevent another separate journey occurring	A2, A4	Readily available	Available immediately	Low	Quick
Transportation (road - car)	Electric cars	Electric vehicles operate much like traditional cars but with electric powertrains and require charging points to charge their batteries	A2, A4	Long Supply Chain	Available immediately	Medium	Short term
Transportation (road - car)	Tyre management	Poor management of tyres causes increase resistance when moving a vehicle. Managing tyres well (pressure, tread, wall quality, energy rating in procurement) will reduce your energy use/emissions).	A2, A4	Readily available	Available immediately	Low	Quick
Transportation (road - car)	Load management	Greater/excess loads require more energy to move them. Load management can deliver energy savings.	A2, A4	Readily available	Available immediately	Low	Quick
Transportation (road - car)	Monitoring/ optimisation of performance (inc. telematics)	The route planning of a journey can reduce emissions. This can be achieved from basic tools like Google Maps, through to specific route optimisation software/services.	A2, A4	Readily available	Available immediately	Low	Immediate
Transportation (road - car)	Behaviour change	Driver behaviour makes a material difference to emissions. Implementing training with your drivers could deliver immediate and low/no cost savings. This is achieved through more efficient acceleration/braking as well as other behaviours.	A2, A4	Readily available	Available immediately	Low	Immediate

Transportation (road - LCV)	Electric LCVs	Electric vehicles operate much like traditional cars but with electric powertrains and require charging points to charge their batteries	A2, A4	Long Supply Chain	Available immediately	Large	Short term
Transportation (road - LCV)	Aerodynamics	Vehicles that exceed 40 mph in their use benefit from aerodynamic management. Cars are generally designed with this in mind, but other vehicles it needs to be considered day to day as over 40 mph, the air resistance becomes the predominant force on the vehicle. Further details have been provided in this document of the aerodynamic measures that can be taken.	A2, A4	Specialist	Available immediately	Low	Quick
Transportation (road - LCV)	Tyre management	Poor management of tyres causes increase resistance when moving a vehicle. Managing tyres well (pressure, tread, wall quality, energy rating in procurement) will reduce your energy use/ emissions).	A2, A4	Readily available	Available immediately	Low	Quick
Transportation (road - LCV)	Load management	Greater/excess loads require more energy to move them. Load management can deliver energy savings.	A2, A4	Readily available	Available immediately	Low	Quick
Transportation (road - LCV)	Monitoring/ optimisation of performance (inc. telematics)	The route planning of a journey can reduce emissions. This can be achieved from basic tools like Google Maps, through to specific route optimisation software/services.	A2, A4	Readily available	Available immediately	Low	Immediate
Transportation (road - LCV)	Behaviour change	Driver behaviour makes a material difference to emissions. Implementing training with your drivers could deliver immediate and low/no cost savings. This is achieved through more efficient acceleration/braking as well as other behaviours.	A2, A4	Readily available	Available immediately	Low	Immediate
Transportation (road - HGV)	Efficient trucks	HGVs are significant energy users, purchasing vehicles/engines with high performance will make a significant contribution to reducing energy use/ emissions.	A2, A4	Readily available	Available immediately	Low	Quick

Transportation (road - HGV)	Electric HGVs	Electric vehicles operate much like traditional cars but with electric powertrains and require charging points to charge their batteries	A2, A4	Emerging	From 2025-2030	Significant capital	Medium term
Transportation (road - HGV)	Hydrogen HGVs	Hydrogen is emerging as a solution for large vehicles where electricity is unlikely to be viable due to the challenges of deploying the infrastructure required for charging or because the energy density of batteries will not be sufficient. Hydrogen infrastructure is in development across the country and vehicles are in development/ emerging onto the market from manufacturers.	A2, A4	Emerging	From 2025-2030	Significant capital	Medium term
Transportation (road - HGV)	Aerodynamics	Vehicles that exceed 40 mph in their use benefit from aerodynamic management. Cars are generally designed with this in mind, but other vehicles it needs to be considered day to day as over 40 mph, the air resistance becomes the predominant force on the vehicle. Further details have been provided in this document of the aerodynamic measures that can be taken.	A2, A4	Specialist	Available immediately	Low	Quick
Transportation (road - HGV)	Tyre management	Poor management of tyres causes increase resistance when moving a vehicle. Managing tyres well (pressure, tread, wall quality, energy rating in procurement) will reduce your energy use/ emissions).	A2, A4	Readily available	Available immediately	Low	Quick
Transportation (road - HGV)	Load management	Greater/excess loads require more energy to move them. Load management can deliver energy savings.	A2, A4	Readily available	Available immediately	Low	Quick

Transportation (road - HGV)	Monitoring/ optimisation of performance (inc. telematics)	The route planning of a journey can reduce emissions. This can be achieved from basic tools like Google Maps, through to specific route optimisation software/services.	A2, A4	Readily available	Available immediately	Low	Immediate
Transportation (road - HGV)	Behaviour change	Driver behaviour makes a material difference to emissions. Implementing training with your drivers could deliver immediate and low/no cost savings. This is achieved through more efficient acceleration/braking as well as other behaviours.	A2, A4	Readily available	Available immediately	Low	Immediate
Transportation (offroad - mobile plant)	Alternative fuels (inc. hydrogen)	Hydrogen is emerging as a solution for large vehicles where electricity is unlikely to be viable due to the challenges of deploying the infrastructure required for charging or because the energy density of batteries will not be sufficient. Hydrogen infrastructure is in development across the country and vehicles are in development/ emerging onto the market from manufacturers. Other fuels are also emerging/being reviewed (e.g. HVO). In cases, the viability/sustainability of these solutions needs to be under review until the technology matures.	A1, A2	Emerging	From 2025-2030	Significant capital	Long term
Transportation (offroad - mobile plant)	Fuel additives	Fuel additives can improve combustion efficiency.	A1, A2	Specialist	Available immediately	Low	Short term
Transportation (offroad - mobile plant)	Tyre management	Poor management of tyres causes increase resistance when moving a vehicle. Managing tyres well (pressure, tread, wall quality, energy rating in procurement) will reduce your energy use/ emissions).	A1, A2	Readily available	Available immediately	Low	Short term

Transportation (offroad - mobile plant)	Load management	Greater/excess loads require more energy to move them. Load management can deliver energy savings.	A1, A2	Readily available	Available immediately	Low	Short term
Transportation (offroad - mobile plant)	Monitoring/ optimisation of performance (inc. telematics)	The route planning of a journey can reduce emissions. This can be achieved from basic tools like Google Maps, through to specific route optimisation software/services.	A1, A2	Readily available	Available immediately	Low	Short term
Transportation (offroad - mobile plant)	Behaviour change	Driver behaviour makes a material difference to emissions. Implementing training with your drivers could deliver immediate and low/no cost savings. This is achieved through more efficient acceleration/braking as well as other behaviours.	A1, A2	Readily available	Available immediately	Low	Short term
Photovoltaic	Photovoltaic	Solar electricity panels, also known as Photovoltaics (PV) capture the sun's energy and convert it into electricity than can be used within buildings/processes/transport	A1, A3	Readily available	Available immediately	Significant capital	Medium term
Solar thermal power	Solar thermal power	Solar water heating systems, or solar thermal systems, use energy from the sun to warm water. This water can then be used to provide thermal energy within buildings/processes	A1, A3	Readily available	Available immediately	Significant capital	Long term
Wind turbine	Wind turbine (onshore)	A wind turbine is a device which converts the power of the wind into electricity.	A1, A3	Specialist	Available immediately	Significant capital	Medium term
Combined heat and power	Combined heat and power	Combined heat and power (CHP) is a highly efficient process that captures and utilises the heat that is a by-product of the electricity generation process. It can be particularly effectively used in this industry when the fuel used for combustion is waste wood from other processes.	A1, A3	Specialist	Available immediately	Significant capital	Medium term

Appendix E: Net Zero Toolkit

Typical Net Zero journey

The steps to Net Zero can be summarised into four stages:

1. **Review**

The first stage of any strategy is to know your current position. With Net Zero, that is knowing what your emissions sources are, how much you emit and how they can be reduced.

This is a really important step in achieving Net Zero, so it's good to spend a bit of time getting this right and having an accurate answer set as your foundations.

2. **Reduce**

Once your carbon baseline is known and you have an adopted Net Zero Strategy in place, it's time to take action to ensure your annual emissions reduce in line with your targets.

Reduce actions will provide the carbon reductions required to achieve Net Zero and produce financial savings to reinvest in future projects. Options to reduce emissions vary across industry sectors and your type of operation.

3. **Renew**

Alongside taking action to reduce your carbon footprint, it's key to identify options for renewable generation, innovative solutions and technology to further provide net carbon reductions.

As we all progress on our journeys to Net Zero, manufacturers and suppliers will create new solutions to help achieve the common goal. It's key to monitor these advancements and include in ongoing Net Zero action plans.

4. **Rebalance**

It's unlikely that we'll be able to achieve Net Zero through Reduce and Renew actions alone so we need to look at options to remove carbon from the atmosphere.

Offsetting is commonly seen as tree-planting however options are much more varied with sequestering carbon through forestation, carbon reductions by investing in projects and direct removals via carbon capture.

Actions to Net Zero

Using the logic of the four steps (Review, Reduce, Renew, Rebalance) we can consider examples of some of the actions you might take to develop and deliver a plan for Net Zero. The following table outlines a conceptual Net Zero plan for an organisation. You would need to review your own footprint and opportunities to develop an equivalent for your organisation.

Review	Reduce	Renew	Rebalance
Carbon Footprint: • Complete a carbon footprint for all scope 1, 2 & 3 emissions, using this as your carbon baseline • Establish your data collection processes and improvements Net Zero Pathway: • Undertake audits to identify options in moving from business as usual to Net Zero • Model the costs, carbon savings and financial benefits of all available options Net Zero Strategy: • Compile the Pathway and Scenario Models into a Net Zero Strategy, supported by relevant action plans • Potentially seek validation from SBTi (Science-based Target Initiative)	Buildings: • Energy reporting • Setting carbon budgets • Engagement and behaviour change • Retrofit energy efficiency projects • Water conservation projects Purchasing & Material Use: • Supply chain engagement • Purchasing standards • Purchasing preferences for sustainability Travel & Transport: • Travel avoidance • Preference for low carbon travel • Fleet efficiency • Route planning Waste: • Resource efficiency • Recycling engagement and behaviour change	Buildings: • Green-by-design refurbishments and new buildings • On-site renewable generation • Lifecycle purchasing decisions Purchasing & Material Use: • Supply chain engagement • Purchasing standards • Purchasing preferences for sustainability Travel & Transport: • Electrification of fleet • Installation of electric vehicle charging points Waste: • Supply chain waste reduction programmes • Circular economy measures	Carbon Sequestration: • Afforestation (non-forested land to forest) • Reforestation (previously forested land returned to forest) Carbon Reduction: • Investment in carbon reduction projects (e.g. clean stoves rollout) • Investment in renewable energy projects Carbon Capture: • Direct carbon capture from your operations • Investment in carbon capture projects

Contents of toolkit

To accompany the roadmap the following has been provided as a toolkit to help you achieve your Net Zero goals:

- Carbon calculator/reporting tool
    - Timber Associations involved in the roadmap will be able to subscribe to an online emissions reporting framework using the **Net Zero Club** at a discounted rate. This will allow members to calculate and track their carbon footprint, benchmark performance and manage their Pathway to Net Zero. The interface will allow data to be submitted in at least the following breakdown:
        - Scope 1 (breakdown by emission type)
        - Scope 2 (breakdown by energy type)
        - Scope 3 (breakdown by the 15 scope 3 categories of the GHG Protocol)
    - An industry standard carbon calculator in Microsoft Excel will allow offline use to allow an organisation to calculate its emissions (in summary form) aligned to the GHG Protocol.
- Opportunity checklists provide a simple excel format of the outputs of the opportunity assessments which can be used by users to select from the list of opportunities that they wish to implement.
- Action plan template in a simple excel format which can be used by organisations to record their summary action plan for Net Zero covering:
    a. Data and carbon footprinting actions
    b. Opportunities and implementation actions
    c. Residual emissions pathway actions
- A company Net Zero Pathway template document in a simple word/PowerPoint format template which is can be used by organisations to summarise their Net Zero plan to summarise and communicate to their organisation the activities they will have undertaken in the rest of the toolkit.

Appendix F: Standards/Guidance

Corporate carbon accounting

The GHG Protocol is one of the most widely recognised accounting and reporting standards for measuring and managing organisational GHG footprints. The Corporate Standard provides a comprehensive, global, standardised framework that categorises greenhouse gasses into Scope 1, 2 and 3 based on the emissions source.

The GHG Protocol is developing new Forestry, Land and Agriculture (FLAG) guidance on how organisations should account for GHG emissions and carbon removals from land use, land use change, bioenergy and related topics in their GHG inventories.

This new guidance is particularly relevant to the Timber Industry as it will provide details of how to account for carbon emissions and removals from land use including forest management, from deforestation and afforestation, provide guidance on storage in

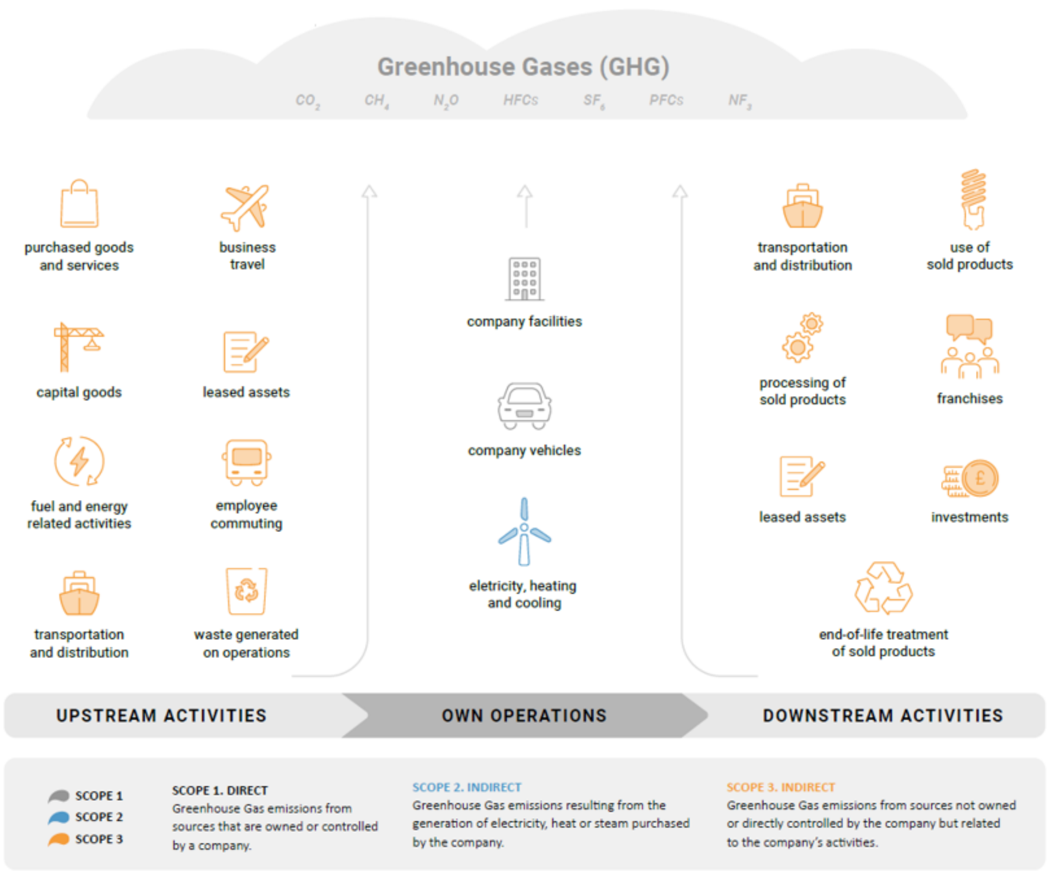


Figure 63. GHG Protocol carbon accounting scopes.

biogenic products including furniture and building materials and biomass, biofuels and biogas.

The GHG Protocol Land Sector and Removals Guidance will be published in Q1/Q2 2023.

SCOPE 3

Scope 3 often represents the largest source of emissions for companies and therefore has the greatest potential for material emissions reductions.

Where raw data from organisations was requested, the data returned was of mixed quality. Data quality for Scope 1 & 2 emissions was high, but there was a challenge around the completeness and accuracy of Scope 3 data. The GHG Protocol splits Scope 3 emissions into 15 categories.

A Scope 3 screening should be undertaken to identify which of the 15 Scope 3 categories should be reported within the Scope 3 inventory. The criteria for identifying relevant Scope 3 activities is shown in Figure 64 below.

Criteria	*Description of activities*
Size	They contribute significantly to the company's total anticipated scope 3 emissions
Influence	There are potential emissions reductions that could be undertaken or influenced by the company
Risk	They contribute to the company's risk exposure (e.g., climate change related risks such as financial, regulatory, supply chain, product and technology, compliance/litigation, and reputational risks)
Stakeholders	They are deemed critical by key stakeholders (e.g., customers, suppliers, investors or civil society)
Outsourcing	They are outsourced activities previously performed in-house or activities outsourced by the reporting company that are typically performed in-house by other companies in the reporting company's sector
Sector guidance	They have been identified as significant by sector-specific guidance
Spending or revenue analysis	They are areas that require a high level of spending or generate a high level of revenue (and are sometimes correlated with high GHG emissions)
Other	They meet any additional criteria developed by the company or industry sector

Figure 64. Criteria for identifying relevant scope 3 activities (GHG Protocol).

Companies should follow the principles of relevance, completeness, accuracy, consistency, and transparency when deciding whether to exclude any activities from the Scope 3 inventory.

Once a Scope 3 screening has been undertaken, the guidance in Table 13 can be used to understand the data needed to calculate emissions from key Scope 3 categories. In absence of the best quality dataset, something is always better than nothing.

Scope 3 Category	Definition	Relevant Activities	Initial Quality	Best Quality
Category 1: Purchased Goods & Services	Extraction, production, and transportation of goods and services	Purchasing of goods and services (i.e., staff costs, costs of goods sold)	Spend-based: Data estimates emissions for goods and services based on expenditure	Supplier-specific: Product-level GHG inventory data collected from goods and service suppliers
Category 2: Capital Goods	Extraction, production, and transportation of capital goods	Purchasing of capital goods (> £1000)	Spend-based: Data estimates emissions for capital goods based on expenditure	Supplier-specific: Product-level GHG inventory data collected from capital goods suppliers
Category 3: Fuel and Energy-Related Activities	Extraction, production, and transportation of fuels and purchased energy	T&D of electricity and WTT of fuels and travel	Average-Data: Data estimates emissions from industry average fuel and energy consumption data (incl. electricity, natural gas, other fuels, business travel)	Supplier-specific (actual): Non-estimated fuel and energy consumption data from suppliers (incl. electricity, natural gas, other fuels, business travel)
Category 4: Upstream Transportation & Distribution	Transportation and distribution of purchased products and services (incl. inbound and outbound logistics)	Purchasing of goods (i.e., electrical equipment, laptops, office equipment, PPE)	Spend-based: Data estimates emissions based on expenditure for each mode of transport	Fuel-based: Data includes the quantity of fuel consumed (i.e., litres)
Category 5: Waste Generated in Operations	Disposal and treatment of waste generated	Office waste generated and water consumption	Average-data: Data estimates emissions from total waste going to each disposal method	Supplier-specific: Data includes waste-specific emissions directly from waste treatment company
Category 6: Business Travel	Transportation of employees for business-related activities	Business travel of employees (i.e. site audits, meetings)	Spend-based: Data estimates emission based on expenditure for each mode of business travel	Fuel-based: Data includes the quantity of fuel consumed during business travel (i.e., litres)
Category 7: Employee Commuting (incl. Homeworking)	Transportation of employees between their homes and worksites (incl. emissions from homeworking)	Employees commuting to the office	Average-data: Data estimates emissions based on average commuting patterns (i.e. national, regional)	Fuel-based: Data includes the quantity of fuel consumed during commuting (i.e., litres)
Category 8: Upstream Leased Assets	Operation of leased assets not included in scope 1 & 2	Scope 1 & 2 emissions of office space (or other assets) that are leased from other organisations	Average-data: Data estimates emissions by average data (i.e., emissions per asset type or floor space)	Asset-specific: Data includes the asset-specific fuel use, energy use, and fugitive emissions from each leased asset

Category 9: Downstream Transportation and Distribution	Transportation and distribution of products sold to end consumer in vehicles and facilities not owned or controlled (inc. retail and storage)	Sending goods to other locations (not paid for by the organisation)	Spend-base: Data estimates emissions based on expenditure for each mode of transport	Fuel-based: Data includes the quantity of fuel consumed (i.e., litres)
Category 10: Processing of Sold Products	Processing of intermediate products sold by downstream companies	Emissions attributed with processing of a product sold by the organisation into another product	Average-data: Data estimates emissions of sold intermediate products using average secondary data	Site-specific: Data includes the amount of fuel and electricity used and waste generated from processing sold intermediate products
Category 11: Use of Sold Products	End use of goods and services sold	Emissions associated with use of goods and services sold by reporting company	Indirect & direct use-phase (estimated): Data estimates emissions using quantity and product type to estimate expected usage of sold products	Indirect & direct use-phase (actual): Data includes specific use profiles, product lifetimes, etc. to determine the emissions relating to use of sold products
Category 12: End-of-Life Treatment of Sold Products	Waste disposal and treatment of products sold at the end of their life	Waste disposal and treatment of products sold	Average-data: Data estimates emissions from total waste going to each disposal method	Supplier-specific: Data collects waste-specific emissions directly from waste treatment company
Category 13: Downstream Leased Assets	Operation of assets owned and leased to other entities not included in scope 1 & 2	Scope 1 & 2 emissions of office space (or other assets) leased out to other organisations	Average-data: Data estimates emissions by average data (i.e., emissions per asset type or floor space)	Asset-specific: Data includes the asset-specific fuel use, energy use, and fugitive emissions from each leased asset
Category 14: Franchises	Operation of franchises not included in scope 1 & 2	Scope 1 and scope 2 emissions of franchisee	Average-data: Data estimates emissions for each franchise using average secondary data	Franchise-specific: Data includes site-specific scope 1 and scope 2 emissions from franchisees
Category 15: Investments	Emissions associated with investments	Typically applicable to investors and companies providing financial services	Average-data: Data estimates emissions using revenue data and spend-based factors to estimate scope 1 and scope 2 emissions of investee company	Investment-specific: Data includes scope 1 and scope 2 emissions from the investee company based on share of investment

Table 13. Data quality guidance for the 15 Scope 3 emissions categories.

EPDs/Lifecycle assessment preparation

Whilst guidance in this area is extensive, and there are clear standards already in place, the work undertaken in the production of this roadmap has identified inconsistencies in the data quality that the industry uses to compile EPDs/lifecycle assessments (LCAs). This section therefore will consolidate existing guidelines and provide detail on improving the industry's data quality/consistency.

Lifecycle assessment (LCA)

Life Cycle Assessment (LCA), sometimes referred to as Life Cycle Analysis, is a methodology for assessing the environmental impacts associated with all the stages of the life cycle of a commercial product, process, or service.

It allows you to optimise your products/services sustainability by modelling their life cycle and comparing alternative scenarios. A completed LCA could be used for Product development and improvement, Sustainability strategy planning, Supply chain engagement, Marketing and communications

To accurately map the environmental impacts associated with a product, process or service, you must first determine the scope of the exercise: cradle-to-gate, cradle-to-customer, or cradle-to-grave.

Cradle-to-gate means looking at the impacts associated with the resource extraction of the raw material ('cradle') to the factory gate ('gate'), as represented by the first 3 blue boxes in Figure 65. Life cycle stages from cradle-to-gate and cradle-to-grave. Cradle-to-customer includes the above as well as transportation to the customer. Whereas cradle to grave represents the full life cycle assessment from resource extraction ('cradle') to the use phase and disposal phase ('grave').

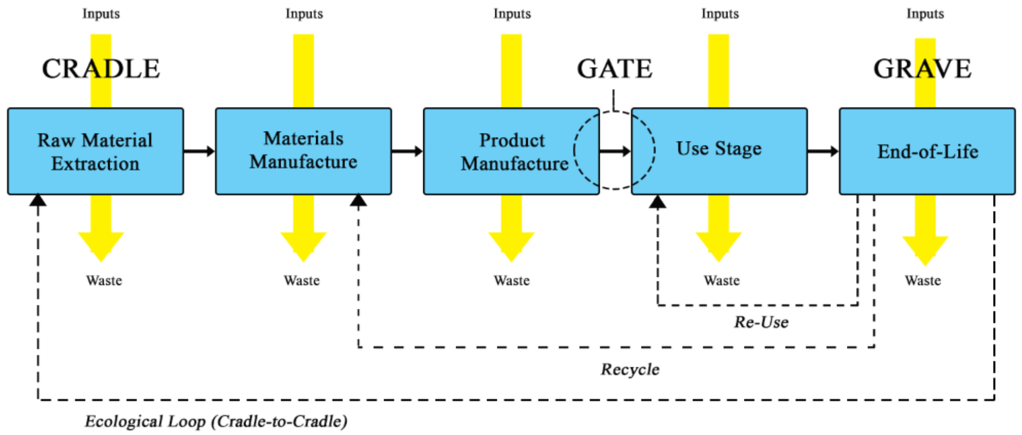


Figure 65. Life cycle stages from cradle-to-gate and cradle-to-grave.

There are three tactical approaches to conducting LCAs:

1. Purchasing data/logistics data
2. Detailed supply chain engagement
3. Hybrid where EPDs are available

EPDs

An Environmental Product Declaration (EPD) intends to provide an objective, comparable and transparent data set about products/services environmental performance across their lifecycle. The EPD is the final report, and the foundation of any EPD is an associated life cycle assessment (LCA). This LCA is undertaken to evaluate the environmental performance over the life cycle. An EPD is a type III environmental declaration that is compliant with the EN15804 or ISO 14025 standard. Type III declarations are registered with a programme, such as the International EPD System, which houses a database of EPDs available online at this URL: https://epdweb3.azurewebsites.net/library.

EPDs are an essential part of Net Zero journey for Timber, as they allow:

1. The carbon intensity of a product to be measured
2. An assessment of the opportunities to reduce emissions to be identified as part of the associated LCA
3. The ability to assess/compare performance
4. Transparency in reporting of emissions

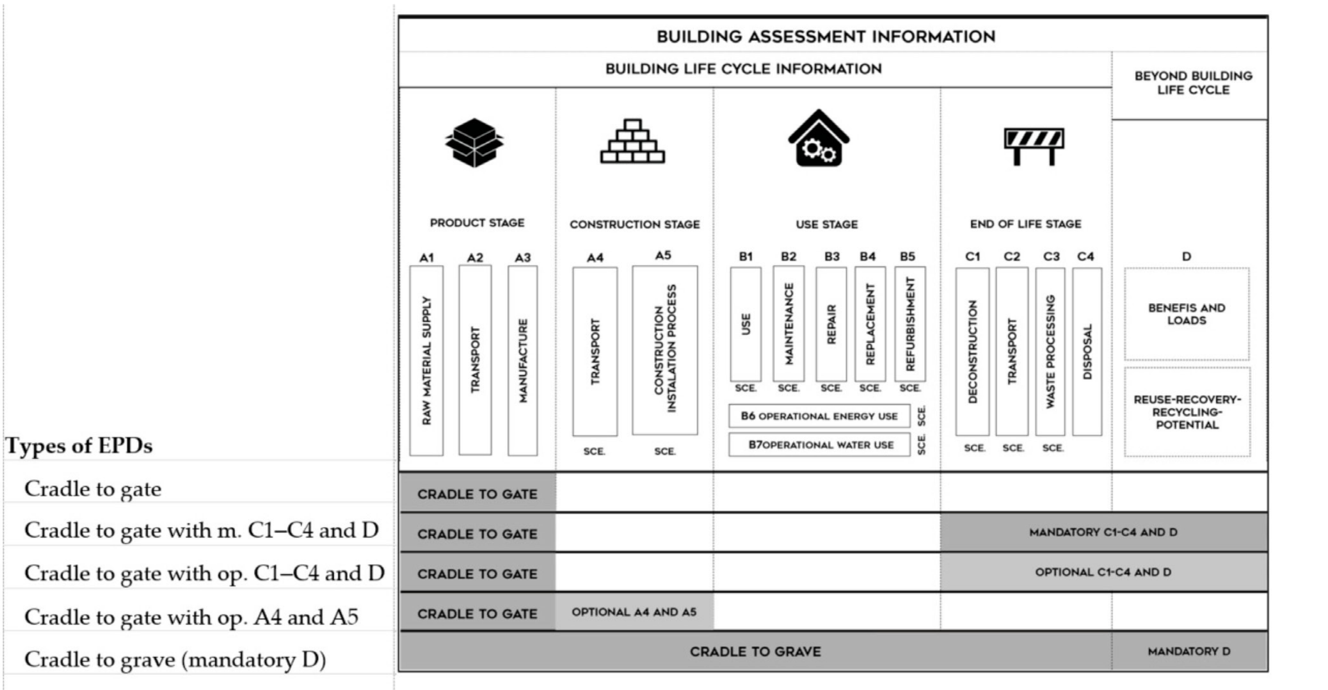


Figure 66. How to Obtain Accurate Environmental Impacts at Early Design Stages in BIM When Using Environmental Product Declaration. A Method to Support Decision-Making, Palumbo et al, Institute of Sustainability in Civil Engineering (INaB), Germany

Within the Construction industry, EPDs support carbon emissions reduction initiatives by making it possible to compare the impacts of different materials and products. This allows the most sustainable option to be chosen by architects, engineers and designers.

There are a wide range of EPDs already available, though the use of them is not uniform, with some only declaring a defined scope, meaning they are not always as directly comparable as required. The below diagram summarises the scope options that typically exist for EPDs.

An EPD is usually valid for five years, and is generated according to the relevant standard (ISO14025, ISO14040/14044, EN15804 or ISO21930).

Phases of an EPD and their creation

The phases of an EPD are summarised as:

Product and Construction Process stage

- A1 – A3 – Raw materials supply, transport, manufacturing
- A4 – Transport to the site
- A5 – Construction installation process

Use stage

- B1 – Use
- B2 – Maintenance
- B3 – Repair
- B4 – Replacement
- B5 – Refurbishment
- B6 – Operational energy use
- B7 – Operational water use

End-of-life stage

- C1 – Deconstruction, demolition stage
- C2 – Transport
- C3 – Waste processing
- C4 – Disposal

They are typically created using the following steps:

1. Collect data
    a. Raw material
    b. Resource consumption
    c. Waste data
    d. Other relevant sources
2. Conduct life cycle assessment
3. Prepare background report detailing methodology, assumptions and approaches employed
4. Third party verification
5. Publication

Benchmarking performance

As part of this project, we have completed a set of benchmark product models. These are available for review to understand a high level typical emissions profile of the non-sequestered emissions per EPD phase.

Learnings from this project for EPDs by Phase

This project has used a variety of EPD data, provided by contributors or available from public databases. As part of that work, learnings have been derived which are presented below in recommendations for the improvement of EPDs for the Industry over time:

EPD PHASE	OBSERVATIONS\ RECOMMENDATIONS	RECOMMENDATIONS
A1 – A3 – Raw materials supply, transport, manufacturing A4 – Transport to the site A5 – Construction installation process	There is inconsistent transparency in the disclosure of the transport distances within EPDs. The industry does not have consistent data records within the manufacturing sector.	The total distance and weight travelled should be disclosed as an industry standard for each phase of transport. A data exchange within the sector of the transported distance of a product (from its point of origin, or start of last phase of life cycle journey) would be significantly beneficial in lieu of a complete library of EPDs as this would significantly reduce the challenge of completing LCAs. A standard should be set for all operators to have scope 1 and scope 2 emissions reporting (a recommendation has been made within this roadmap). Please refer to the Operator Profile analysis data maturity observations for the basis of this recommendations.
B1 – Use B2 – Maintenance B3 – Repair B4 – Replacement B5 – Refurbishment B6 – Operational energy use B7 – Operational water use	Data associated with this phase is almost non-existent within EPDs.	A working group should review how to improve the availability of data in partnership with the relevant stakeholder industries (e.g. Construction)
C1 – Deconstruction, demolition stage C2 – Transport C3 – Waste processing C4 – Disposal	Data for this section is inconsistently presented/ disclosed in terms of underlying assumptions.	A standardised approach to the declaration of assumptions should be adopted.

Notable recommendations/collaboration opportunities

This guidance note outlines three key areas of focus for improvement of EPDs:

1. To resolve the material gap in B phase data, a working group should review how to improve the availability of data in partnership with the relevant stakeholder industries (e.g. Construction)
2. A standardised approach to the declaration of assumptions should be adopted to ensure sufficient transparency of data/comparability within the sector on EPDs.
3. A standard should be set for all operators to have scope 1 and scope 2 emissions reporting (a recommendation has been made within this roadmap).

SBTi guidance

Alongside the developments in the GHG Protocol, the SBTi has released guidance related to the Forestry, Land and Agriculture sector known in the scientific community as the Agriculture, Forestry, and Other Land Use (AFOLU) sector.

FLAG SBTs are science-based targets that apply to a company's GHG emissions from AFOLU, including GHG emissions associated with land use change (LUC) (i.e., biomass and soil carbon losses from deforestation, conversion of coastal wetlands, conversion/draining and burning of peatlands, conversion of savannas and natural grasslands); emissions from land management (i.e., nitrous oxide and methane from enteric fermentation, biomass burning, nutrient management, fertilizer use and manure management); and biogenic removals (i.e., forest restoration, silvopasture, improved forest management, agroforestry and soil carbon sequestration)[56]

- FLAG targets must cover at least 95% of FLAG-related scope 1 and 2 emissions and 67% of FLAG-related scope 3 emissions
- Offsets are not included
- Ambition is determined by the company's non-FLAG target
- All land use change and conversation emissions are included
- Land use change and conversation emissions must be in the company's inventory looking 20 years back from the baseline year.

In addition, the guidance requires companies to set a zero deforestation commitment across their primary deforestation-linked commodities, no later than 2025.

The Timber Industry should align to the SBTi FLAG guidance for target setting to ensure emissions reduction targets are aligned to the latest climate science and stand up to scrutiny.

Offsetting standards

Standards and certifications are helpful to ensure that offsetting schemes are being run properly and provide assurance that the offsetting portfolio selected delivers the intended carbon neutralisation planned.

High-quality carbon credits adhere to a strict set of standards. You can check this by ensuring the projects you invest in are registered with a third-party internationally-recognised verification standard, such as the Gold Standard, Verra's Verified Carbon Standard (VCS), Social Carbon and Climate, Community and Biodiversity Standards (CCBS), or standards verified by the UNFCCC.

Schemes such as PAS 2060, BIS's carbon neutrality standard and certification, provide a framework for organisations to demonstrate carbon neutrality of their organisation or a specific activity. It should be noted that many offset programs have their own standards, as part of their program, that outline requirements and guidance for offset projects using their specific system.

For the Timber industry, relevant certification schemes include those related to woodland creation and peatland restoration (Table 7 (opposite): A summary of carbon offsetting approaches (Environment Agency).), which both have recognised validation codes in the UK through the Woodland Carbon Code (WCC) and Peatland Code (PC) respectively.

These schemes ensure that projects registered under the codes are validated and verified by an independent body and provide assurance for greenhouse gas mitigation claims. The WCC and PC provide carbon units in the form of Pending Issuance Units (PIUs), Woodland Carbon Units (WCUs) and Peatland Carbon Units (PCUs) which support these claims.

These represent measurable amounts of carbon dioxide removed from the atmosphere by trees and peatlands as they grow – one unit is 1 tonne of carbon dioxide equivalent removed from the atmosphere. Because there is a natural lag in the time it takes for woodland and peatland to sequester carbon, a PIU can be issued that acts as a promise to deliver on a WCU or PCU in future as the woodland/peatland develops.

Typically there is a 15 year lag for WCUs and a 5 year lag for PCUs (Figure 67. Timescales for validated carbon and verified carbon under the Woodland Carbon Code and Peatland Carbon Code (Scottish Woodlands).) from the beginning of the project until the carbon is sequestered.

The SBTi has focused its requirements on final and interim targets relating to the amount of greenhouse gas removal undertaken, although it also recommends that companies start using other offsets in the short term to complement the greenhouse gas removals.

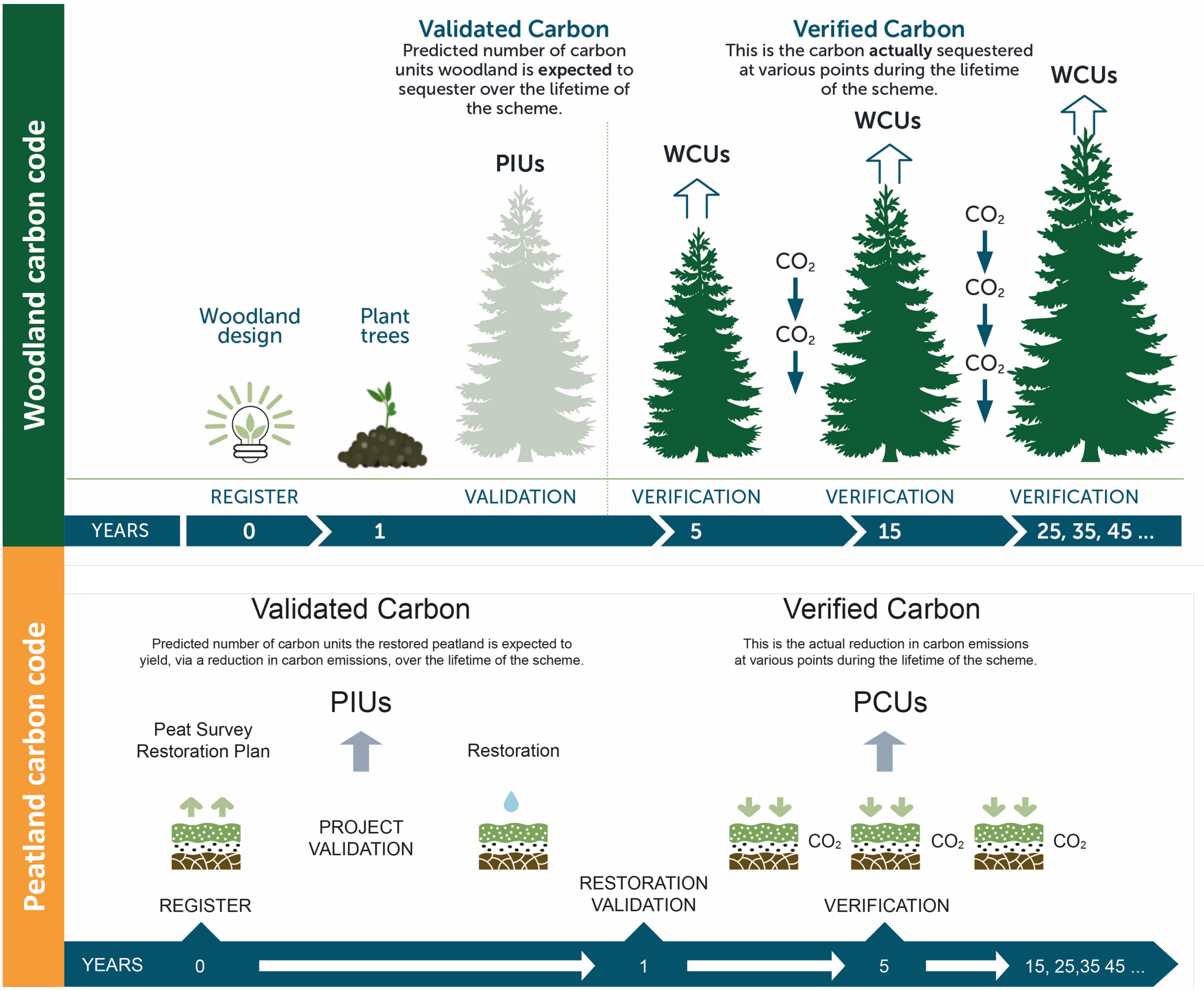


Figure 67. Timescales for validated carbon and verified carbon under the Woodland Carbon Code and Peatland Carbon Code (Scottish Woodlands).

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