

A Traditional Material with a Modern Future

Timber's Present & Potential Contributions to the Scottish Economy & Low Carbon Construction



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**A Paper prepared for the Scottish Forest & Timber Technologies Industry
Leadership Group**

by

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Photograph Acknowledgements

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Page 9: Pretek Precision Homes, Lancashire. Photo from Magazine of the Chartered
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CONTRIBUTIONS OF TIMBER TO THE SCOTTISH ECONOMY

- Some £7bn of timber and primary processed timber products were used in the UK in 2013 which is significantly more than the £4.3bn of Scotch whisky exported from the UK in the same year
- The imported and domestic forest and wood processing sector is estimated to contribute about £980 million in direct gross value added (GVA) to the Scottish economy with an induced impact of an additional £356 million. Some 41,000 jobs are provided in forestry and primary wood processing in Scotland with significantly more provided by secondary processing and the imported timber sector
- Timber is a very widely used building product both in Scotland and the rest of the UK and construction activity accounts for 10% of GVA in Scotland and 6.3% of GVA in the UK. Using timber in construction offers the opportunity to lower whole life building costs, lower emissions and faster delivery
- An additional 0.5 million new homes are forecast to be needed in Scotland over the next 25 years and approximately 7.25 million additional homes in England. Timber framing is the fastest growing method of building houses in the UK and Scottish companies have considerable expertise in providing timber framed houses in Scotland
- In 2015 the timber frame market in the UK is estimated to be worth about £535 million at manufacturers' selling prices and is forecast to grow to about £640 million in current price terms by 2019 - a growth rate of around 5% in constant price terms. The open panel system is estimated to account for 70% of timber frame construction in 2015 and to be valued at over £372 million
- The value of the off-site sector to the Scottish economy in 2012 was £125 million with the potential to grow to £230 million by 2018 without additional facilities. It offers an opportunity to grow capacity by at least 400% to £500 million, based on current market share, within the UK alone
- Timber can make a significant contribution to meeting the Scottish & UK Governments' climate change targets. Timber frame has the lowest embodied CO² of any commercially available building material, while delivering up to a 33% reduction in energy consumption for large detached houses and up to 20% for apartments

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- The use of engineered or manufactured timber products, such as I Joists, Cross Laminated Timber (CLT) and Glulam beams, is growing rapidly, with the use of CLT, for example, increasing at a rate of 25% year on year
 - Global timber and timber product markets are changing. Research overseas has identified that new alternative high value end products chemicals and materials can be made from using timber as a feedstock. Scotland needs to ensure that the forest sector is well placed to remain economically competitive in future years as existing markets will undoubtedly change
 - Sourcing timber and timber products through the established supply chain in Scotland, where price and quality allow, rather than importing them, has a significant impact on the size of the contributions that timber and timber products make to Scotland's economy both in terms of GVA and employment. It also has the potential to strengthen and diversify Scotland's rural economy
 - The contributions that the domestic forest sector can make to the Scottish economy will fall after about 2025 unless new areas of commercial coniferous woodlands are planted and the productivity and quality of its existing woodlands area are improved.

A Traditional Material with a Modern Future

Timber's Present & Potential Contributions to the Scottish Economy & Low Carbon Construction

Introduction

Some £7bn of timber and primary processed timber products were used in the UK in 2013¹ which is significantly more than the £4.3bn of Scotch whisky exported from the UK in the same year. The £7bn of timber and timber products used takes no account of the value that is added in the subsequent use of timber and timber products.

Timber and timber products, as materials, are therefore of considerable economic importance to the Scottish and UK economies as well as having impressive environmental credentials. The imported and domestic forest and wood processing sector was estimated to contribute about £980 million in direct gross value added (GVA) to the Scottish economy with an induced impact of an additional £356 million based on a SIC code analysis in 2011². This may be an underestimate of timber and timber products contributions as there are many small companies that may not be VAT registered, nor does the estimate include social and environmental related activities. Some 41,000 jobs are provided in forestry and primary wood processing in Scotland with significantly more provided by secondary processing and the imported timber sector³

Advances in science, technology, innovation and supply chain management over the last 10 years have resulted in greatly increased understanding of timber properties and improvements in more accurately measuring and predicting timber performance, and these have led to new opportunities and ways of using timber. This has, for example, resulted in the acceptance and increased use of engineered or manufactured timber products in construction in the UK. Within the EU wood and wood products had the highest patent specialisation in 2008 and 2009 relative to the world, and the wood, paper and printing sector had the fourth highest labour productivity in the EU⁴.

Timber markets are changing globally. The most notable change in Europe and North America is the reduced consumption of pulp and paper products because of the internet and electronic communications as well as greatly increased re-cycling. This has stimulated significant research into the chemical composition and structure of wood and this has

¹ Forestry Commission, 2014: Forestry Facts & Figures. Value of imports of all timber and timber based products plus value of domestic production based on average unit costs per category of imported wood products

² Scottish Enterprise, *The Economic contribution of the Forestry and Timber Technologies Sector in Scotland*, 2011

³ Forestry Commission, Forestry Facts & Figures 2014

⁴ European Commission, 2013: Towards Knowledge Driven Reindustrialisation. European Competitiveness Report 2013. Commission Staff Working Document SWD(2013)347final.

revealed that there are potentially many more new market opportunities for timber as a feedstock than have been recognised previously.

The key parts of the Scottish economy where timber is making, or has the potential to make, the greatest contributions are in the construction, energy and chemical sectors, but significant contributions are also made by timber in the pallets, packaging, fencing, garden products and wood energy markets. The scale of the sector's economic contributions is significantly increased if the timber is grown and processed in Scotland.

Timber and the Construction Industry

The construction industry contributes about 6.3% to the UK's GVA⁵ and 10% to Scotland's GVA⁶. The industry is therefore a major component of the Scottish and UK economies. Sawn timber and wood panel products, along with cement, concrete, metal and brick are the main materials used in the fabric of buildings, or in the repairs, maintenance and improvements (RMI) to buildings. Approximately 70% of the timber and timber products consumed annually are used in house building. In 2013 the value of all sawn timber and wood panel products used in the construction industry amounted to about £3.7 billion⁷.

Opportunities for Timber in the Construction Market

Housing: In 2013 new housing starts in England totalled 108,000, of which 80% were in the private sector, and it is estimated that some 240,000 to 250,000 houses per annum will be required in England alone up to 2031⁸. This amounts to 4.25 million new homes over this period. In Scotland new housing starts to year end 31st March 2014 were 15,028⁹ and of this total about 66% were for private housing. Audit Scotland forecast that Scotland will need 21,230 additional homes per year between 2011 and 2035; that is more than 0.5 million homes over 25 years¹⁰. Small house builders are expected to have provided approximately 30% of new homes in the UK in 2014; down from over 60% in 1990¹¹. Meeting future targets for building new houses may require a greater focus on supporting small house builders.

Primary & Secondary Schools: In addition, the UK's Priority School Building Programme (PSBP) is a centrally managed programme set up to address the needs of the schools most in need of urgent repair. Through the programme, 261 schools will be rebuilt or have their condition needs met by the Education Funding Agency (EFA). The first school will be

⁵ Dept for Business, Innovation & Skills, 2013. UK Construction. An Economic Analysis of the Sector. July

⁶ Construction Scotland, 2013. Building for the Future. The Scottish Construction Industry's Strategy 2013 - 2016

⁷ Estimate of value of imports of sawn timber & panel products plus UK production less exports

⁸ http://www.savills.co.uk/_news/newsitem.aspx?intSitePageId=0&intNewsSitePageId=173224-0 & A Holmes 2013 New Estimates of Housing Demand and Need in England 2011 - 2031. Cambridge Centre for Housing & Planning Research

⁹ <http://www.scotland.gov.uk/topics/statistics/browse/housing-regeneration/hsfs/newbuild>

¹⁰ Audit Scotland, 2013. Housing in Scotland

¹¹ Press Release. Dept. for Communities and Local Government. December 2014

completed in 2014. All schools within the programme will be delivered by the end of 2017¹². A number of schools have already been successfully replaced in Scotland and England using timber and timber products as the main materials for the fabric. There is therefore another major market for Scottish based companies to penetrate.

Nursery Schools: There are some 2,450 nurseries in Scotland. Although there is no national standard for nursery buildings, a large number of these are thought to be in inadequate condition. Replacing these with off-site manufactured timber buildings could be done to a high standard as well as meeting the tight timescales for completing building when the school is shut so as to minimise the health and safety risks by not having children on-site.

Health Service: The Health Service has a continuing need for new buildings, particularly if plans being discussed for de-centralising services from major hospitals come to fruition.

Other potential opportunities for using timber are in the construction of hotels, offices, sports and leisure facilities and student accommodation.

Timber's Economic Contributions through Increasing Productivity & Cutting Costs in the Construction Industry

The UK Government's Construction Strategy was published by the Cabinet office on 31 May 2011. The report announced the Government's intention to require collaborative 3D Building Information Modeling (BIM) (with all project and asset information, documentation and data being electronic) on its projects by 2016¹³. Some of the data on timber and timber products for use with BIM software are available as a result of work carried out at Napier University. Further information is still needed but timber and timber products are well positioned to support the delivery of that strategy.

In 2013 the UK Government and the construction industry published a joint strategy called 'Construction 2025'¹⁴ which sets out how industry and Government will work together to put Britain at the forefront of global construction over the coming years. The global market is forecast to grow by over 70% by 2025 and by that time the Government and industry jointly aspire to achieve the targets set out in table 1 by 2025.

¹² <https://www.gov.uk/government/publications/psbp-overview/priority-school-building-programme>

¹³ BIM Task Group. <http://www.bimtaskgroup.org>

¹⁴ HM Government. Global Construction 2025: Industrial Strategy: government and industry in partnership. April 2013

Table 1 Joint UK Government and Construction Industry Delivery Targets by 2025

<p>Lower Costs: 33% reduction in the initial cost of construction and the whole life costs of built assets</p> <p>Lower Emissions: 50% reduction in greenhouse gas emissions in the built environment</p> <p>Faster Delivery: 50% reduction in the overall time from inception to completion, for new build and refurbished assets</p> <p>Improvement in Exports: 50% reduction in the trade gap between total exports and total imports for construction products and materials</p>
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Source: Construction 2025

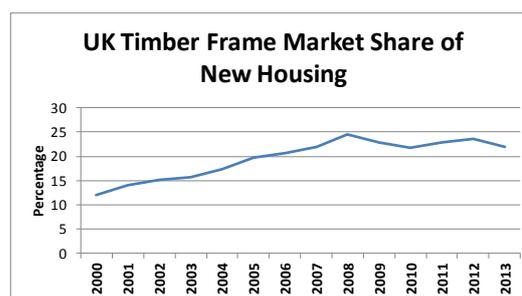
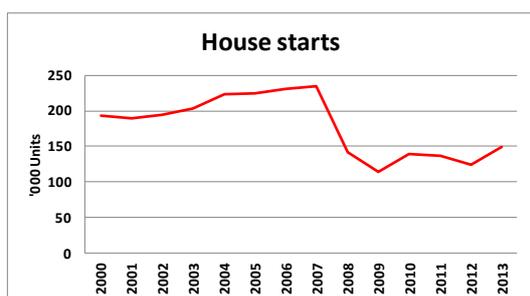
Timber and timber products can help the construction sector deliver on all these targets. Their ability to do this arises from the nature of timber as a material which is allowing the introduction of new building methods and the manufacturing of an increasing number of components or sections off-site resulting in the delivery of higher building standards. These aspects are expected to also become of increasing importance because of the difficulty of recruiting skilled on-site construction workers in the UK as a result of an ageing skilled, often self employed workforce and the increased demand for both skilled labour and materials for major national projects, such as the Queensferry Crossing, the Aberdeen Western Peripheral Route, HS2 and the Hinkley Point C nuclear power station.

Timber Frame House Building: Traditionally in Scotland houses and single story buildings were built on-site with their fabric usually being made of 'brick and block'. Fitting-out the building using all the other trades was done on site. This is labour intensive and the speed of construction was heavily affected by weather conditions. The quality of the finished buildings was also influenced by the skills and experience of the employees or contractors used, and the level of supervision. To improve construction methods, roof trusses started to be manufactured off-site and trucked to site and this led on to the development of timber framed housing where many more of the components are manufactured off-site; developments that have been pioneered by companies in Scotland over the last 20 years.



Over the last 30 years innovations in wood processing, timber engineering, manufacturing and design has resulted in timber and panel products providing a number of innovative solutions for the house building industry. Most of which have come through the introduction of manufacturing off-site. All of which have resulted in increased productivity, cut costs, reduced waste and much quicker on-site construction times.

Timber frame is the fastest growing method of construction in the UK.



Source: Structural Timber Association

It is estimated that 76.7% of all new homes built in Scotland in 2012 were timber framed¹⁵. In England, by contrast, only 16.3% of the 125,000 new houses built in 2012 were of timber framed construction. The Institute of Sustainable Construction estimate that the percentage will rise to 30% by 2020¹⁶. In 2015 the timber frame market in the UK is estimated to be worth about £535 million at manufacturers' selling prices and is forecast to grow to about £640 million in current price terms by 2019 - a growth rate of around 5% in constant price terms¹⁷. The open panel system, using components manufactured off-site, is estimated to account for 70% of timber frame construction in 2015 and to be valued at over £372 million¹⁸.

With just under 5 million homes forecast to be required in the UK in the next 25 years or so this opens up major opportunities for Scottish timber frame manufacturers, particularly through exporting to England. The majority of the extra houses may be built by the volume house builders, but timber frame construction also accounts for about 75% of the custom or self-build market.

Off-Site Manufacture (OSM): The manufacture of roof trusses and timber frames for building has resulted in other innovations in timber processing such as the development of building cassettes or 'pods' manufactured off-site. With bathroom pods, for example, more than 30 trade activities can be transferred off-site, leading to fewer people on-site, easier commissioning and less re-work. Further innovation led on to using off-site manufacturing methods to design and build houses in factories using closed panel sections before transporting them to a construction site and then using a crane to lift the sections into position for fixing and quick assembly. Some of the larger companies in the construction industry, such as Laing O'Rourke¹⁹ and Corus, have recently come to recognise the advantages offered by OSM, such as the speed of construction on site, reduced

¹⁵ Structural Timber Assn., 2013: Market Report 2012 Issue 11

¹⁶ Smith, S., 2014: Pers. com.

¹⁷ MTW Research, 2015

¹⁸ MTW Research, 2015

¹⁹ Ray O'Rourke, 2014. Talk at the Construction conference, Glasgow

environmental impact during building construction, less on-site waste and less difficulties in recruiting skilled on-site construction workers who are often self employed.

The current value of off-site construction in the UK is £1.5bn and it is projected to grow to £6bn²⁰. This equates to a 7% share of construction's £90bn annual contribution to the UK economy²¹. The value of the off-site sector to the Scottish economy in 2012 was £125 million with the potential to grow to £230 million by 2018 without additional facilities²². Scotland therefore currently has an 8% share of the UK offsite sector but, based on current projections and available capacity, and without further investment this percentage would fall 4% overall. There is therefore an opportunity to grow capacity by at least 400% to £500million, based on current market share, within the UK alone²³.

Within the growing off-site sector, Scotland has a regional emphasis on timber platform frame construction. At present the vast majority of the timber products used are imported and had a UK market value of £400 million in 2012. This market could grow to £720 million by 2016, which would equate to a consistent UK market share of 30%¹⁶.

Manufacturing timber buildings in a factory has a number of advantages, both in terms of building quality and employment for the Scottish economy. It allows all the components of



the building to be manufactured very precisely using Modern Methods of Construction (MMC) in a safe and controlled environment compared with many building sites. This also allows houses to be built to a very high quality. Any off-cuts of timber and timber products arising from OSM can be easily re-cycled or used a fuelwood. Most of the people employed in the manufacturing process are direct employees in contrast

to most traditional building sites where most are self employed contractors. One innovative larger Scottish company called CCG, based in Glasgow, has already started off-site manufacturing of whole houses using timber, as have some very small Scottish companies, such as Makar Construction. Examples of CCG's buildings can be found in the houses that were used for the athlete's village at the Commonwealth Games.

Fears over the standardisation of the look of houses both internally and externally as a result of OSM are now being addressed through CAD/CAM integration with manufacturing activities which has enabled a degree of mass customisation to be achieved at relatively low volumes – giving house builders the flexibility they need to meet client demands. CAD / CAM software allows customers to design their own houses prior to production starting.

²⁰ UK Commission for Employment & Skills, 2013. Technology and Skills in the Construction Industry Evidence Report 74

²¹ Department for Business, Innovation & Skills, 2013. UK Construction. An Economic Analysis of the Sector

²² Smith, S., Hairstans, R., Macdonald, R. Sanna, F., 2012 : Strategic Review of the Offsite Construction Sector in Scotland. Institute for Sustainable Construction

²³ Hairstans. R, 2014. Institute for Sustainable Construction. Pers. com.

Further innovation in the OSM process is undoubtedly possible and this will help to reduce costs and increase productivity.

With off-site manufacturing of buildings the time taken to erect them on site is significantly reduced which is particularly important during winter time when weather conditions can slow, or prevent, site working. Reducing the on-site construction time increases productivity and saves money. Labour productivity in OSM is reported to be 3 times that of on-site labour, and working conditions are significantly safer.

Construction is a major component of the Scottish economy and timber is one of the materials that is widely used. It is forecast that some *additional* 150,000 homes above present levels will need to be built each year in England and Scotland. The use of timber can therefore be expected to increase in the future.

In 2015 the timber frame market in the UK is estimated to be worth about £535 million at manufacturers' selling prices and is forecast to grow to about £640 million in current price terms by 2019 - a growth rate of around 5% in constant price terms. The open panel system is estimated to account for 70% of timber frame construction in 2015 and to be valued at over £372 million.

The off-site component of the construction industry is growing rapidly which has been estimated to be growing at 25% per annum. Its value to the Scottish economy in 2012 was £125 million and it has potential to grow to £230 million by 2018 without additional facilities. Opportunity exists for capacity to grow by at least 400% to £500million, based on current market share, within the UK alone.

More specifically:

- **Scottish companies already have considerable knowledge and experience with timber frame construction and therefore have a competitive advantage over many house builders in England and Wales**
- **There is a potentially very large export market for Scottish companies in England and Wales that Scottish companies in the timber frame house building supply chain could deliver with the appropriate support**
- **Timber is also ideally suited for OSM of buildings using modern methods of construction as has been successfully demonstrated by Scottish companies and there is considerable potential for Scottish companies to increase their share of the large house building programmes being planned in both Scotland and England using OSM, if they have the appropriate support**
- **There are also potential global export opportunities for Scottish companies using OSM technology and expertise globally**

- **Further innovation within the OSM process itself is potentially possible with the appropriate support and this will allow further major productivity increases in the building industry and hence lower costs**
- **More information on the structural performance of timber and timber products is still required**
- **OSM can assist in overcoming the reported shortage of skilled and experienced construction and building site tradesmen in Scotland and the rest of the UK.**

Timber's Contributions to Energy Saving & Low Carbon Construction

The Scottish Government has a vision of Scotland as a low carbon society and, to achieve that, it has set ambitious annual targets for reductions in carbon emissions to 2022, including a 42% reduction in emissions by 2020 compared to 1990²⁴.

By 2030 the Scottish Government envisages that there will be 'a step-change in provision of energy efficient homes to 2030 through retrofit of existing housing and improved building regulations for new build homes. We will also have made significant progress in transforming energy use in industry, business and the public sectors by 2027, through energy efficiency, the use of low carbon electricity and our ambition in Scotland for a largely decarbonised heat sector by 2050, with significant progress by 2030'.²⁵

Timber as a Low Embodied Energy Building Material

One way of reducing carbon emissions, given the Government's ambitious carbon reduction targets, is to seek to maximise the use of materials that use the minimum amount of energy to produce them. The energy used to create the materials that make up a building is typically 22% of the total energy expended over the lifetime of the building²⁶. The most widely used building materials, either when building new houses or retrofitting existing ones, are cement, concrete, brick and timber and the relative amounts of energy used to produce 1 tonne of each of the materials²⁷ are:

Wood:	1
Brick:	4 x more than wood
Concrete:	5 x more than wood
Steel:	24 x more than wood

In reality most buildings will require a combination of these materials, but there is an obvious advantage in maximising the use of the materials that take the least energy to produce them, particularly if the material, like timber, can be supplied from sources that are

²⁴ Scottish Government, 2011. Low Carbon Scotland: Meeting the Emissions Reduction Targets 2010-2022. The Report on Proposals and Policies

²⁵ Scottish Government, 2013: Low Carbon Scotland: Meeting the Emissions Reduction Targets 2013 - 2027. Second Report

²⁶ Pohlmann, C. M. 2002, Ökologische Betrachtung für den Hausbau – Ganzheitliche Energie – und Kohlendioxidbilanzen für zwei verschiedene Holzhauskonstruktionen, Dissertation zur Erlangung des Doktorgades an der Universität Hamburg achbereich Biologie.

²⁷ S Goodall, 2014. Confederation of Forest Industries UK. Source: 'Facts behind the Ads'

sustainable. Timber's thermal efficiency means walls can be slimmer, releasing up to 10% more space than other building methods²⁸.

In the UK "if the market for wood construction products continues to grow at its current rate over the next 10 years, there is the potential to store an estimated additional 10 million tonnes (Mt) of carbon (equivalent to 36.7 Mt CO²) in new and refurbished homes by 2019"²⁹.

In addition brick and concrete were traditionally thought to have superior insulation and passive solar heating properties compared with wood. However recent work has shown



that timber's cellular structure provides outstanding thermal insulation: 15 times better than concrete, 400 times better than steel and 1,770 times better than aluminium. A 2.5cm timber board has better thermal resistance than an 11.4cm brick wall³⁰.

Timber's Ability to Deliver Low Carbon Buildings and Higher Standards of Sustainable Design

In 2006 the UK Government introduced the Code for Sustainable Homes with the aim of achieving higher standards of sustainable house building practices. These requirements became encapsulated in the UK Government's Code for Sustainable Homes which is being superseded. The UK's target for all new homes is to meet the Zero Carbon Standard from 2016 comes in advance of the Energy Performance of Buildings Directive (EPBD) target for all new buildings in the EU to be 'Nearly Zero-Energy Buildings' from 2020. This has meant increased attention being given to the carbon footprint of building materials, whole life building costs, the quality of the buildings being constructed and the energy use of buildings once constructed. Of all the building materials presently used, timber has the best characteristics for most easily meeting these higher standards.

New Buildings: Some of the first homes to reach Code levels 5 and 6 of the Code for Sustainable Homes were timber frame buildings produced mainly through using manufacturing processes. Timber frame fits very well with the low carbon agenda because it is much easier to achieve very high insulation levels, fewer defects and increased air tightness, as well as extremely low embodied energy combined with much quicker on-site construction times. Timber has the lowest embodied CO² of any commercially available building material and timber framed buildings with closed panels can deliver up to a 33% reduction in energy consumption for large detached houses and up to 20% for apartments³¹.

In the UK a brick-faced timber frame house will save 1.55 t CO² per 50m² wall, compared with brick and block, while facing the timber frame with softwood weatherboarding will

²⁸ www.cei-bois.org. Tackle Climate Change: Use Wood. 2nd edition 2011

²⁹ Read D.J., Freer Smith P.H., Morison J.I.L., Hanley N., West C.C., West C.C., Snowdon P, 2009. Combating Climate Change. A Role for UK Forests.

³⁰ www.cei-bois.org. Tackle Climate Change: Use Wood. 2nd Edition 2011

³¹ Fabric First : <http://www.fabricfirst.co.uk/index.html>

result in savings of up to 3.45 t CO². This means that a typical UK timber frame house could save around 5 t CO² even before its lower running costs are considered. Wood for Good used their lifecycle data to calculate that a three-bed, timber-framed house typically stores 19 tonnes of CO². By scaling this up to a housing target of delivering 22,000 homes annually in Scotland, this means an additional 440,000 tonnes of the greenhouse gas every year could be stored and for the UK a total of 4 million tonnes if the 200,000 new homes are built per annum. The potentially increased thermal efficiency of these homes could take 4 - 5 years of the mortgage pay-back period from a standard 25 year mortgage.

Every cubic metre of wood used as a substitute for other building materials reduces CO² emissions to the atmosphere by an average of 1.1 t CO². If this is added to the 0.9 t of CO² stored in wood, each cubic metre of wood saves a total of 2 t CO². Based on these figures, a 10% increase in the percentage of wooden houses in Europe would produce sufficient CO² savings to account for about 25% of the reductions prescribed by the Kyoto Protocol³⁴.

In the correct conditions timber and timber products can last up to 200 years or more and during that time they continue to store carbon. If they need to be replaced, timber and timber products can be re-cycled, for example in panel board manufacture, or used as a bio-fuel which will reduce the use of non-renewable fossil fuels.

Retrofitting Buildings: Homes and non-domestic buildings are, together, responsible for around 37% of the UK's greenhouse gas emissions³⁵. The majority of the buildings existing today will still be standing in 2050, which means that there is a potentially major programme to green retrofit these buildings to reduce their energy consumption if Scotland, and the rest of the UK, are to:

- Meet their climate change goals
- Improve energy security
- Tackle fuel poverty
- Create green jobs

In Scotland many of the ideas and practices for retrofitting the existing buildings are linked through the Edinburgh Centre for Carbon Innovation (ECCI). The ECCI is a collaboration of individuals, networks and teams from many different disciplines, expertise and backgrounds. The Edinburgh Centre is hosted by Edinburgh's three largest universities, with financial backing from the Scottish Government and the European Regional Development Fund.

Timber and timber products are building materials that have potential to help with the delivery of retrofitting because of their low carbon credentials. With innovation, timber could have a bigger role to play than it does at present as retrofitting is a relatively new development in the UK.

Woodfuel and Climate Change

³² BRE (Building Research Establishment), 2004, 'Environmental Profiles'.

³³ Hopkins, D., Construction News November 2014

³⁴ Frühwald, Welling, Scharai-Rad, 2003, 'Comparison of wood products and major substitutes with respect to environmental and energy balances'. ECE/FAO Seminar: Strategies for the Sound Use of Wood, Poiana Brasov, Romania. 24-27 March 2003

³⁵ Green Building Council. <http://www.ukgbc.org/content/retrofit>

Timber is a renewable natural resource and, when used as fuelwood in the form of roundwood, sawmill co-products, pellets or recycled wood, can produce both electricity and heat. Timber can therefore help to meet the Government's climate change targets as its use in this way is almost carbon neutral as the carbon released from burning it can be captured over time by trees that are grown to replace the ones cut down. The use of coniferous roundwood alone in the UK for this market has grown from 100,000 green tonnes in 2006 to 1.25 million green tonnes in 2013³⁶.

The greater use of timber and timber products has the potential to make a significant contribution to Scottish Government's carbon reduction targets. Timber frame has the lowest embodied CO² of any commercially available building material, while delivering up to a 33% reduction in energy consumption for large detached houses and up to 20% for apartments. An average 3 bedroom timber-framed house sequesters and stores roughly 19 tonnes of CO² in its timber products. By scaling this up to a housing target of delivering 22,000 homes annually in Scotland, this means an additional 440,000 tonnes of the greenhouse gas every year could be stored and for the UK a total of 4 million tonnes if the 200,000 new homes are built per annum. Scottish companies are potentially well placed to help deliver that target and, with support, could increase their contributions. Using timber as a renewable source of fuel can also contribute to the climate change targets.

Opportunities for Increasing Timber's Contributions to Scotland's Economy through Further Innovation in Engineered Timber Products

Timber has long been regarded as a material associated with craft based activities, but in the UK over the last 10 years or so timber has become recognised as being a very versatile material with considerable engineering and design potential as well as offering a wide range of environmental benefits. This has come about as a result of:

- Being able to measure the strength and stiffness of individual pieces of timber with much greater precision as a result of research and innovation in Scotland and elsewhere
- Changes to building regulations that have allowed timber and timber to be used in a wider variety of situations
- The development, manufacture and use of engineered timber products such as Glulam, I-Joists and Cross Laminated Timber
- Advances in computer and programming

Many of these innovative new engineered products have originated from mainland Europe or North America. Floor and roof joists, which were historically made of solid timber, have now been mainly replaced by web and engineered joists, such as I-Joists, which are being manufactured in Scotland. These are



³⁶ Forestry Commission: Facts and Figures 2009 and 2014.

engineered products manufactured from Orientated Strand Board (OSB) with flanges made of high-grade finger jointed softwood. This has made joists easier to handle on site and to duct pipes and wires thus significantly speeding up construction times.

In total the UK imported some £133 million of laminated products in 2011. Markets for them are growing rapidly. Hannu Kasurinen EVP of Wood Products at Stora Enso said *“the European CLT market has been growing by almost 20% per year over the past decade, and we expect the demand of CLT-based solutions to continue increasing rapidly”*³⁷. For example, the UK imports of over 30,000m³ of Cross Laminated Timber (CLT) from Europe annually and this has been increasing at a rate of 25% year on year.

All these products are manufactured off-site and have excellent low carbon credentials and they also offer developers much faster on-site construction times. At present no significant quantities of these products are made in Scotland or the rest of the UK; they are all imported so at present the benefits to the Scottish economy from using them are not as high as they potentially could be.

Other engineered products originating from the USA that have the potential to be incorporated into the design and construction of new building in Europe, and the UK are:

- Orientated Strand Lumber (OSL)
- Parallel Strand Lumber (PSL)
- Laminated Veneer Lumber (LVL)
- Laminated Strand Lumber (LSL)

In parallel with the development of engineered timber products especially, structural engineers have had access to greatly increased computing power, which, combined with better data on the structural performance of timber and timber products has allowed them to be confident in using timber and timber products in a much wider range of uses than in the past. Two striking examples are the grid shells covering the new Canary Wharf Cross Rail Station and the Savill Garden Visitor Centre at Windsor.

There are opportunities to further increase the contributions that timber can make to Scotland's economy and carbon targets in the following areas:

- **Starting production of engineered or manufactured products in Scotland as almost all these engineered products are made in mainland Europe and trucked to the UK. This would result in value being added to timber in Scotland**
- **Most engineered timber products are used by the major construction companies and house builders, but there may be opportunities for their wider use by custom or small scale builders which would widen the economic benefits**

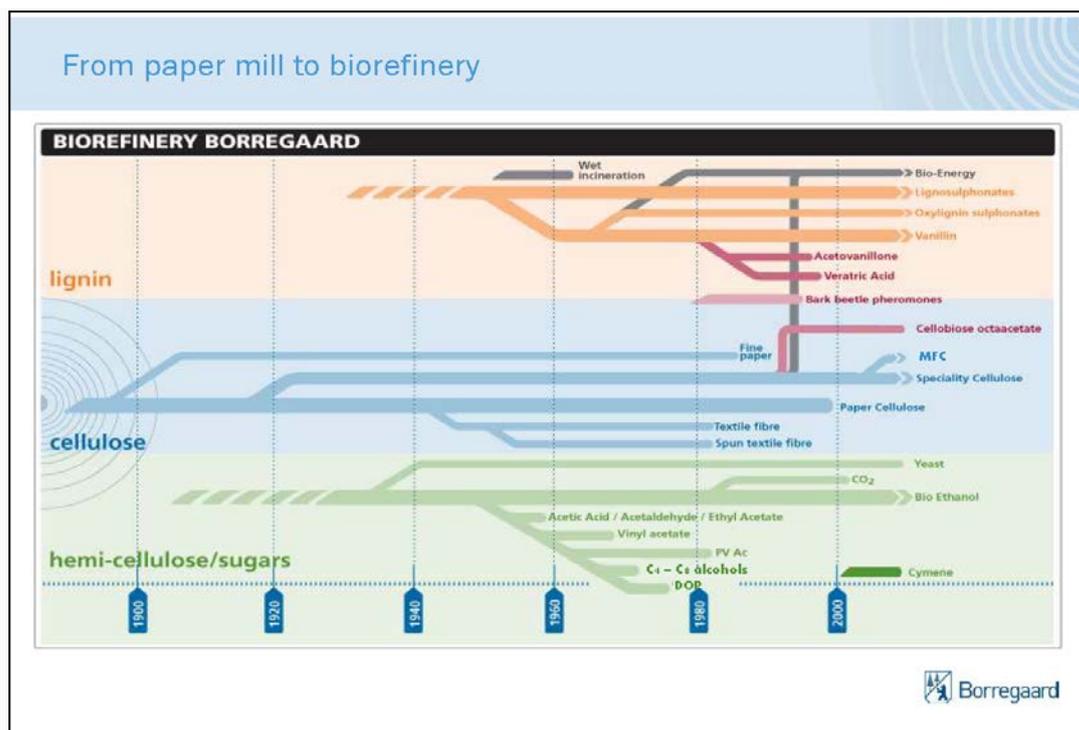
³⁷ Forestry Commission Scotland, 2012. Potential Market for UK Manufactured Cross Laminated Timber

- **Further innovation in the products themselves and in the way they are used or fastened may open up further market opportunities in the UK construction market for them**
- **Another important building product is insulation material which can be made from timber, although at present most insulation materials are man-made so there may be opportunities for developing this product in Scotland. This could add value**
- **The market for timber products has the potential to be further widened through the use of finishes, foils, paints and preservation products, fastenings or through timber modification which extends its life in exposed situations.**

Timber as a Feedstock for Producing Higher Value Added Chemicals and Products

Trees have traditionally been converted into either a variety of solid wood products, such as sawn timber or panel boards, or into cellulose fibres that are used for making paper and paper based products. Over the last 20 years the market for small roundwood for pulp and paper making has diminished fairly rapidly in developed economies as a result of the growth in use of the internet, computers, and smart phones, and increased re-cycling of paper. At the same time advances in science have allowed a much better understanding of the physical composition of the cell structure and the chemical constituents of wood. The latter has been shown to comprise cellulose, hemi-cellulose / sugars and lignin.

Research institutes, universities and the major pulp and paper companies in Europe and North America are increasingly identifying ways of converting wood into a variety of new value added chemicals and products. One company in Norway, called Borregaard, converted its pulp and paper making plant to produce chemicals some 10 years ago. It now operates 15 different chemical plants in the same building producing up to 500 different products. The quantities of some of the chemicals are quite small, but the value is high.



Other researchers have identified nano-cellulose which has the potential to provide saleable products such as nanofilters that can clean gases, industrial water and drinking water. It can also be used to make tissues and other paper products stronger and softer. Another product is nano crystalline cellulose which is getting close to being produced at production scale and its development is being supported by the US National Science Foundation and similar research into these products is being supported by the Government of Japan.

Another example is Dow Wolf Cellulosic that produce water-soluble methylcellulose and hydroxypropyl methylcellulose polymers such as Texture Enhancement (METHOCEL™ and Clear+Stable™) food ingredients that improve the appearance of products for the consumer and have the right texture when they reach the consumer's kitchen table. They also enable pharmaceutical developers to create formulas for tablet coatings, granulation, controlled release, improved solubility and controlled viscosity in liquid formulations.

Very little research has been carried out in Scotland up to now into identifying the potential for producing new chemicals and materials out of timber grown in Scotland. Research being conducted in other parts of the world suggest that timber has considerable potential to produce new value added chemicals and materials. The feedstock for these types of processes is relatively undemanding and is likely to be of low quality thus it would not compete with roundwood used for sawn timber and higher value board products presently being produced in Scotland.

While the domestic timber industry supply chain is highly efficient and competitive at present, the global timber and timber product markets are changing, and Scotland therefore needs to research what new alternative high value end products might be made from timber so that it is well placed to remain economically competitive in future years.

Increasing Timber's Contributions to Scotland's Economy by Sourcing Timber from Scotland

As a construction material, softwood timber has been shown to be contributing to Scotland's economy and to Scotland's climate change targets and to have significant potential to increase its contributions to both. Where the timber and timber products are sourced from can also make a significant impact on the size of these contributions to Scotland's economy.

Although the markets for timber in Scotland are relatively small, because its population is only just over 5 million people, there is a large export market in the rest of the UK for businesses operating in Scotland. The scale of the opportunities is evident from the fact that the UK was the third largest net importer (imports less exports) of forest products in 2012, behind China and Japan³⁸.

Timber & Timber Products Supply Chains: As Scotland, and the rest of the UK have open economies, many timber and timber products can be sourced either from trees that have been grown overseas, or from trees that have been grown in Scotland's forests and woods. At the level of the individual company or customer, the sourcing is often not a significant consideration; it is more often matters such as price, quality, certification of sustainability, delivery times and credit availability that influence purchasing decisions.

However Scotland has 1.5 million hectares of woods of which almost 75% is coniferous. The rest are broadleaved. The coniferous woodlands are producing some about 6.8 million tonnes of roundwood per annum on a pro rated area basis from UK figures and at the same time providing some 26,000 jobs on a similar pro-rated area basis³⁹ in production and primary processing. Production from the 368,000 hectares of broadleaved woods is very much less because the quality is not sufficiently good for many uses. It is processed by very small sawmills who sell on to furniture makers or builders, and the poorer quality is sold as firewood.

From an economic perspective, and with all other things being equal, the benefits that Scotland's economy can potentially derive from using timber and timber products produced

³⁸ Forestry Commission, 2014 : Forestry Statistics 2014 - International Trade

³⁹ Forestry Commission, 2014. Forestry Facts & Figures

from Scotland's forests and woods is very much greater than from using imported timber and timber products because the supply chain for the latter starts from the time the timber reaches a Scottish port, or from when timber and timber products cross the Border having been trucked up from England. Once the timber enters Scotland, it moves down a short supply chain to a distributor or retailer and then on to the final customer.

By contrast if the timber and timber products that are used are made from trees grown in Scotland the supply chain is very much longer and the value added that is captured, and the employment created, from the time trees are planted through their management, harvesting, processing is very much greater. One notable feature of the supply chain is that it is predominantly based in the rural parts of Scotland where the economy is often relatively fragile. Using more timber grown in Scotland will therefore diversify and strengthen Scotland's rural economy and potentially help to create more jobs

Growth of the Scottish Supply Chain: The contributions of the domestic forest sector to Scotland's economy, in terms of value adding and the creation of higher paying jobs, have increased very significantly since the early 1970s. At that time the UK's domestic forest sector was supplying some 12% of the UK's softwood market for wood and wood products with the majority of the material being produced as sawn timber and used in relatively low value added end uses such as fencing, pit props, pallets and packaging. At the present time the domestic forest sector's product range is much wider and the percentages supplied to the UK market are approximately as follows:

- Sawn timber: 44%
- Particleboard: 77%
- Medium Density Fibreboard (MDF): 79%
- Orientated Strand Board (OSB): 55%

These growths in market shares have been achieved while competing with imports. This clearly demonstrates that Scotland has a highly competitive forest sector that is using the latest technology. As a result the sector is making a major contribution to Scotland's economy as well as producing products that are sustainable and they are also contributing to meeting Scotland's carbon targets. The broadleaved wood supply chain contracted when the market for mining pit props disappeared, but it is starting to slowly develop again⁴⁰ and has been further boosted by the recent increased demand for fuelwood and firewood.

Indicative Economic Contributions of Scotland's Forest Sector

There are no national statistics readily available that will allow Scotland's forest sector's Gross Value Added to be calculated with any accuracy. Its contributions, based on a SIC code analysis in 2011⁴¹ are included in the estimated £980 million in direct gross value

⁴⁰ www.ashs.co.uk

⁴¹ Scottish Enterprise, *The Economic contribution of the Forestry and Timber Technologies Sector in Scotland, 2011*

added (GVA) contributed to the Scottish economy arising from timber and timber processing in Scotland and the induced impacts of an additional £356 million. It provides some 41,000 jobs.

Wider Carbon Benefits for Scotland from Using Scottish Grown Timber

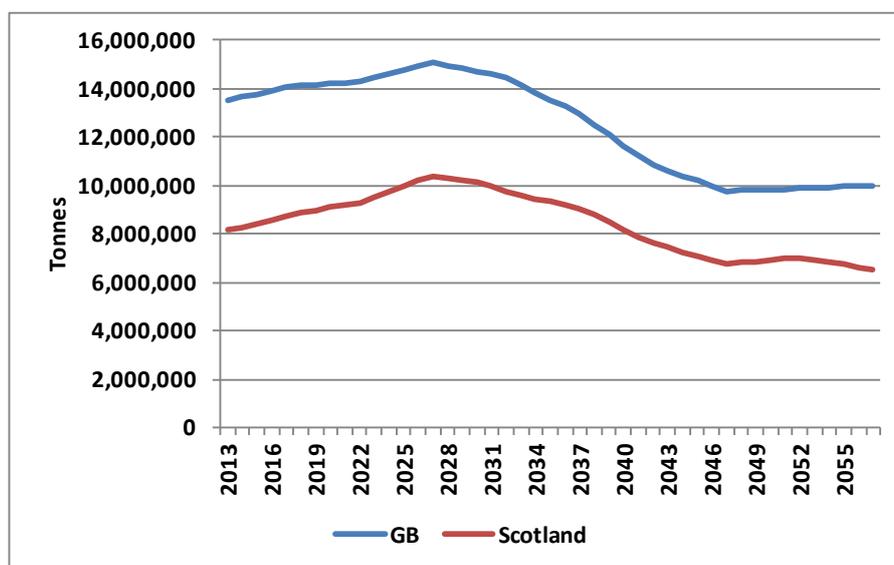
When trees are felled they are normally replaced by natural regeneration, or by re-planting, so their felling and replanting can be regarded as carbon neutral over time. However if **additional** trees are planted to meet future supplies this will provide a natural way of capturing additional carbon from the atmosphere through photosynthesis. This is way of capturing carbon compares very favourably with some of the technological solutions that are being proposed or trialled where the technology is uncertain and the costs could be up to twice or three times the cost of capturing and storing carbon in mixed woodlands⁴². Small sized coniferous and broadleaved trees and sawmill co-products, and other forms of woody biomass also make a very good sustainable source of fuelwood as a last resort. Using this type of fuelwood helps to reduce the use of non-renewable fossil fuels such as oil, coal and gas.

Provision of Additional Environmental & Social Benefits: If timber is sourced through the domestic supply chain rather than from imports, Scotland has the potential to derive additional environmental and social benefits in addition to the economic benefits from the productive woods and forests that are created. These additional benefits are often now identified under the broad heading of ecosystem services. For any one wood the exact balance between the three will depend on a number of factors such as site type, elevation and location of a wood. The delivery of these ecosystem services also often creates a significant number of additional jobs.

Maintaining & Growing the Sector's Contributions to the Scottish Economy: In spite of the impressive growth of the forest sector in Scotland over the last 40 years, and the consequential growth in the contributions it has made to Scotland's economy, the domestic forest sector will be reaching the limits of the domestically available coniferous roundwood in about 2025 and thereafter coniferous roundwood availability is forecast to fall as is shown in Table 2. As a result the growth in the sector's contributions to Scotland's economy will begin to slow down, and might even start falling. This situation has come about because the rate of planting of new productive woods dropped considerably at the end of the 1980s and the rate of new planting has been at a low level since then.

⁴² D Hopkins, 2014. The Message is Clear: Build with Carbon. TTJ Magazine October Issue

Table 2 Forestry Commission National Forest Inventory 50 Year Coniferous Roundwood Availability Forecast



Source: NFI, Forestry Commission, 2014

The sector's contributions to Scotland's economy would have the potential to grow again after about 2025 if the planting of a significant new area of productive woods began again and continued up to 2025 as these woods would be starting to reach maturity as wood availability is forecast to start falling. Resuming the planting of more new productive woodlands would have the added benefit that it would also contribute to meeting Scotland's carbon reduction targets because these trees would capture additional carbon from the atmosphere as well as providing other environmental and social public benefits.

The potential availability of both coniferous and broadleaved roundwood for Scotland's forest sector could also be improved in the longer term if trees used for re-stocking sites and in planting new woods were genetically improved both in terms of quantity and timber quality through tree breeding programmes.

Scotland has a well established and competitive forest and wood processing sector:

- It is one of Scotland's most notable success stories. Its share of the UK's solid wood products market has increased from about 12% thirty years ago to approximately 44% now
- Sourcing timber and timber products through the established supply chain in Scotland, where price and quality allow, rather than importing them, would significantly increase the contributions that timber and timber products make to Scotland's economy both in terms of GVA and employment
- The growth in contributions to the Scottish economy are going to be gradually constrained up to 2025 as the availability of supplies reduces and then falls after that date. The rate of carbon capture by trees will gradually reduce as well

- With reducing coniferous roundwood availability the sector will need to focus on increasing the efficiency with which it uses timber it has domestically and will need to find ways of maximising the value it can add to it
- The Scottish forest sector's contribution to the Scottish economy could be resumed in the longer term if the proposed planting of an additional 100,000 ha of productive woodlands is achieved in the period up to 2022
- Improving the timber quality and growth rates of trees through tree breeding would also help to open up opportunities for the sector to increase its contributions to the Scottish economy in the longer term.

Summary & Conclusions

The imported and domestic forest and wood processing sector is estimated to contribute about £980 million in direct gross value added (GVA) to the Scottish economy with an induced impact of an additional £356 million. Some 41,000 jobs are provided in forestry and primary wood processing in Scotland with significantly more provided by secondary processing and the imported timber sector

Timber is a very widely used building product both in Scotland and the rest of the UK and construction activity accounts for 10% of GVA in Scotland and 6.3% of GVA in the UK. In 2013 the total value of the timber and timber products used in the UK amounted to approximately £7 billion.

A major use of timber is in house building and the value of timber used is estimated to be approximately £3.7 million per annum in the UK. An additional 0.5 million new homes are forecast to be needed in Scotland over the next 25 years and approximately 7.25 million additional homes in England. Timber framing is the fastest growing method of building houses in the UK. It is estimated that 76.7% of all new homes built in Scotland in 2012 were timber framed. In England, by contrast, only 16.3% of the 125,000 new houses built in 2012 were of timber framed construction. It has been forecast that this will rise to 30 percent by 2020. There are other opportunities for using timber in the construction of educational and other public sector buildings. There are therefore major opportunities for Scottish businesses to expand their activities to the rest of the UK.

In 2015 the timber frame market in the UK is estimated to be worth about £535 million at manufacturers' selling prices and is forecast to grow to about £640 million in current price terms by 2019 - a growth rate of around 5% in constant price terms. The open panel system is estimated to account for 70% of timber frame construction in 2015 and to be valued at over £372 million

The current value of off-site construction in the UK is £1.5bn and it is projected to grow to £6bn; this equates to a 7% share of construction's £90bn annual contribution to the UK economy. The value of the off-site sector to the Scottish economy in 2012 was £125

million with the potential to grow to £230 million by 2018 without additional facilities. Scotland therefore currently has an 8% share of the UK offsite sector but, based on current projections and available capacity, and without further investment, this percentage would fall 4% overall. There is therefore an opportunity to grow capacity by at least 400% to £500 million, based on current market share, within the UK alone. Scotland is also developing a capacity for the off-site manufacturing of houses which will increase productivity, help overcome labour and skills shortages, offer safer working conditions and create direct employment opportunities.

The greater use of timber and timber products has the potential to make a significant contribution to Scottish Government's carbon reduction targets. Timber frame has the lowest embodied CO² of any commercially available building material, while delivering up to a 33% reduction in energy consumption for large detached houses and up to 20% for apartments. An average 3 bedroom timber-framed house stores roughly 19 tonnes of CO² in its timber products. By scaling this up to a housing target of delivering 22,000 homes annually in Scotland, this means an additional 440,000 tonnes of carbon could be stored every year and for England a total of 4 million tonnes per year if the required 200,000 new homes are built per annum. Scottish companies in the forest sector are potentially well placed to help deliver major Government climate change targets.

The use of engineered or manufactured timber products is growing rapidly both in the UK and Europe. In total the UK imported some £133 million of laminated products in 2011. In the case of Cross Laminated Timber (CLT) the European market has been growing by almost 20% per year over the past decade, and is expected to continue to increase rapidly. At present the UK imports of over 30,000m³ of CLT from Europe annually and this has been increasing at a rate of 25% year on year. At present none of these engineered products are made on any scale in Scotland or the rest of the UK, so there are potential opportunities for Scottish timber businesses to enter this fast growing market.

While the domestic timber industry supply chain is highly efficient and competitive at present, global timber and timber product markets are changing. This is recognised in Scandinavia and North America where research is underway to identify what new alternative high value end products can be made from using timber as a feedstock for new chemicals and new materials. Scotland needs to be part of that research so that the forest sector is well placed to remain economically competitive in future years as existing markets will undoubtedly change.

The UK's forest sector, which is largely based in Scotland and the North of England, has increased its share of the UK's solid wood products market from about 12% thirty years ago to approximately 44% now; showing that it is both modern and competitive. Sourcing timber and timber products through the established supply chain in Scotland, where price

and quality allow, rather than importing them, significantly increases the contributions that timber and timber products make to Scotland's economy both in terms of GVA and employment.

The sector has the potential to add value to the available domestically grown timber up to 2025. After that date coniferous roundwood availability is forecast to fall without significant additional new planting of productive woodlands over the period 2012 - 2022. Additional planting on new productive woods would at the same time help to meet Scotland's long term climate change targets as these trees would capture additional carbon as they grow. At the same time potential timber availability could also be increased by improving timber quality and tree growth rates through tree breeding.

April 2015