INTEGRATED STRATEGIES FOR THE WELSH TIMBER INDUSTRY

Considering the potential of an integrated timber technology and economic development strategy

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THOMAS STONEY BRYANS

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0.0 Introduction

The relatively poor-quality of the majority of Welsh softwood timber, mostly Sitka spruce, results in large quantities being used for low-grade products such as fencing, pallets, paper pulp, and biomass. This research proposal hypothesises that it is possible to extract greater value from the original felled timbers, through the strategic analysis and redesign of the supply chain, and through the development of new timber-technologies, effectively moving Welsh timber products up the value chain.

The UK government has committed to introducing new regulatory standards requiring all new homes to be zero carbon by 2016; this study will propose that the Welsh timber sector is well placed to take advantage of that emerging market. The existence of large softwood plantations, along with regional industrial expertise, and the proposed development of a skills academy in Ebbw Vale, could provide the ideal conditions for the development of a new industry that would be socially, economically, and ecologically sustainable.

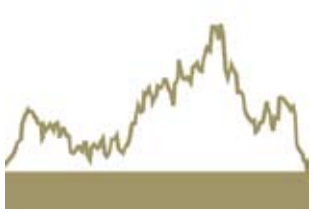
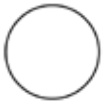
The relatively small coverage of Welsh forest, and the resultant low-volume of timber output compared to other major timber producing countries such as Finland, Sweden, and Austria, requires the Welsh timber industry to become far more innovative in adding value to its product across the entire supply chain. With an already strong secondary processing sector, it is possible for Wales to develop a fully integrated supply and processing chain, enabling local production from forest to end-user.

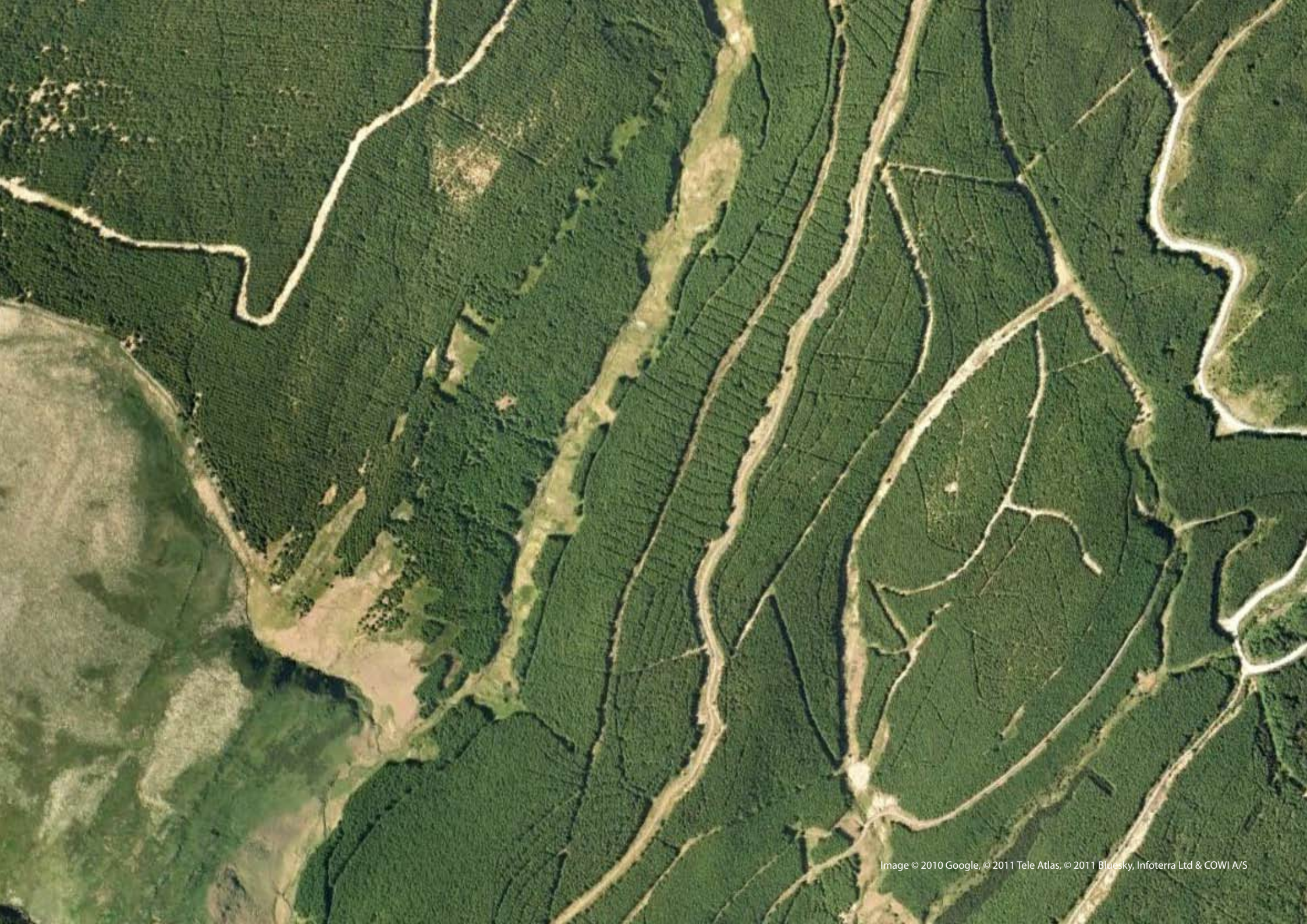
Previous research, such as the development of the Sitka spruce box beam for the *Ty Unnos* affordable housing project by Design Research Unit Wales (part of the Welsh School of Architecture), and the manufacture of the UK's first PassivHaus certified windows for bere: architects' *Lime House*, has already demonstrated the capability of both Welsh timber and the manufacturing industry to meet the requirements for the construction of zero-carbon housing, with locally sourced material. It is proposed that the further development of these, and other, low-carbon timber construction products, within an integrated supply chain, could enable the flow of timber from forest to construction site, with zero wood-wastage.

1.0 STEEP Analysis

As a means of understanding the broader context of the Welsh timber industry the STEEP analysis has been used to consider the Social, Technical, Economic, Environmental, and Political factors that both affect and are affected by the industry. Such a model enables the consideration of a wide range of issues, from the social benefits of woodland for recreational purposes, through to pest and disease research, and global climate change policy. Beyond the five STEEP categories a secondary layer of analysis is applied in the form of a Hardware, Software, and Network (HSN) assessment of each sector. The HSN analysis breaks down the STEEP categories into the physical - Hardware - such as machinery and trees, the theoretical -Software - such as research, patents etc., and the systems of implementation - Networks - such as job creation programs through to the international timber trade.

The combined STEEP and HSN analyses enable full consideration of the industry context, and bring to light relationships that may not previously have been considered, such as that between social networks and carbon credits for instance, which could result in greater community involvement in woodlands through the financial benefits that standing woodland could bring to the local populations.

	 SOCIETY	 TECHNOLOGY	 ECONOMY	 ENVIRONMENT	 POLITICS
HARDWARE 	• People • Housing • Community facilities	• Tree felling and transportation infrastructure: chainsaws, trucks etc • Sawmills • Factories	• Forests as capital reserves • Timber harvesting and processing infrastructure	• Forests • Waterways and water supply • Animals	• National infrastructure
SOFTWARE 	• Studies on the benefits of woodland and forest to people • Social and Demographic data • Employment rates	• Patents • New technologies for manufacturing • Research on new timber construction products	• Studies on land productivity	• Silvicultural systems • Ecosystem and forestry research • Pest and disease research and predicted shift in coverage • Global climate change predictions	• Projected demand for housing
NETWORKS 	• Social Networks • Community groups • Labour laws • Education • Jobs creation programmes	• Digital communication networks	• Financial systems • Carbon credits • International timber trade	• Emissions limitations • Carbon credits • Ecosystem networks	• Building regulations and energy standards • Forestry and woodland policy • Environment and climate change policy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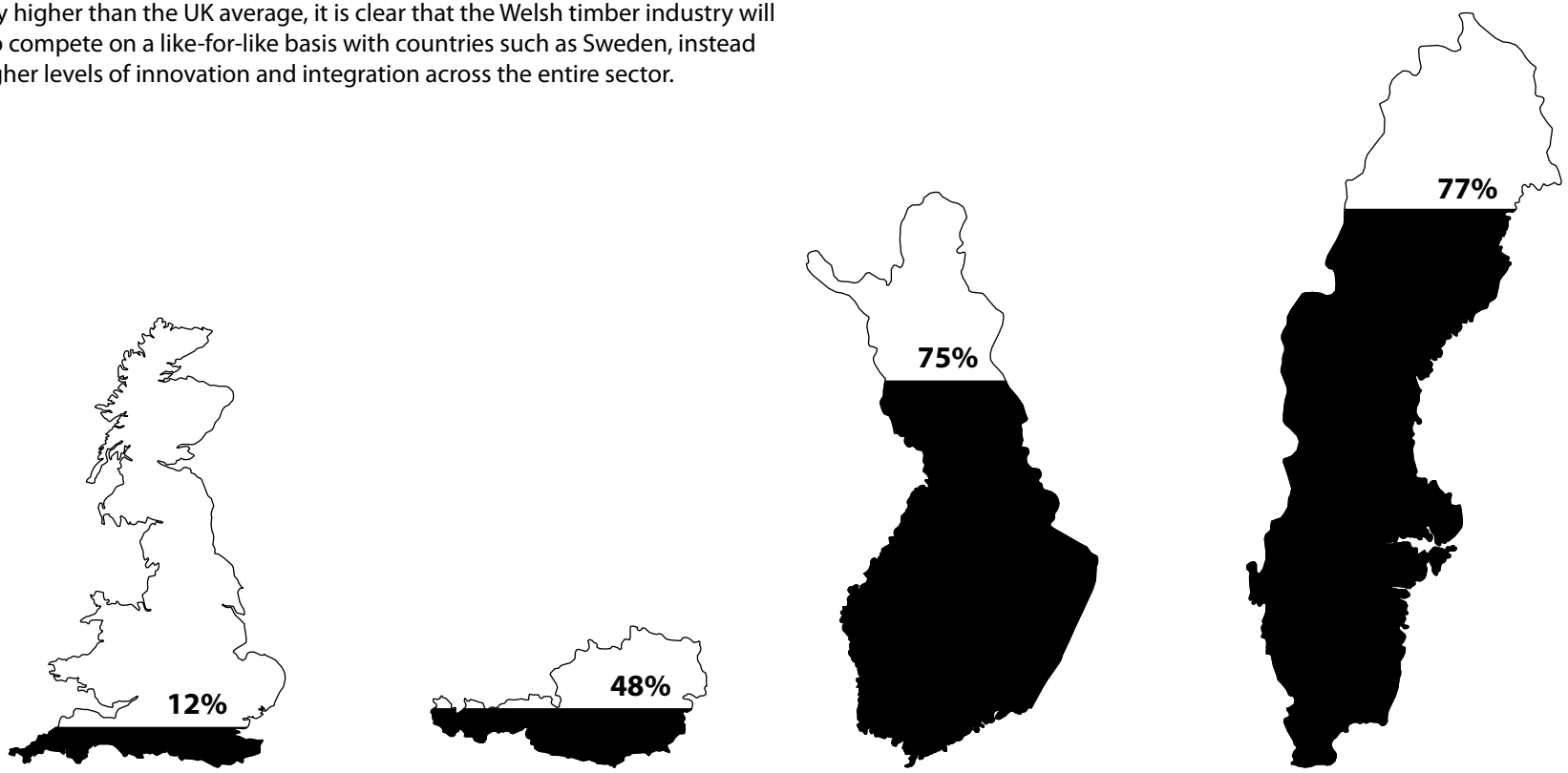
2.0 Welsh Forests

2.1 AREAS

Compared to the rest of the European Union, the UK has a relatively low proportion of forest coverage as a percentage of total land area, with the average for Great Britain being just 11.6%[1], placing it fourth lowest compared to its European neighbours[2], with an EU average of 37% overall[3]. Contrasted against leading timber producing nations such as Finland at 77% coverage, Sweden at 75%, and Austria at 48%[4], the British timber industry is at a distinct disadvantage in shear quantity of supply. Although Welsh forestry coverage at 14% is slightly higher than the UK average, it is clear that the Welsh timber industry will never be able to compete on a like-for-like basis with countries such as Sweden, instead requiring far higher levels of innovation and integration across the entire sector.



2.1.1 Key Statistics:

2.1.1.1 Total Forest and Woodland Coverage

- Woodlands occupy about 14% of Wales (290,000 ha) (only counting areas of woodland of 0.1 ha and over)[5]
- Scotland covers 7.8 million hectares, 17% of which (1.2 million ha) is forested; aspirational target of 25% by mid-21st century
- England has 8.4% woodland cover (1.1 million ha)[6]
- Great Britain has an average forest coverage of 11.6%[7]

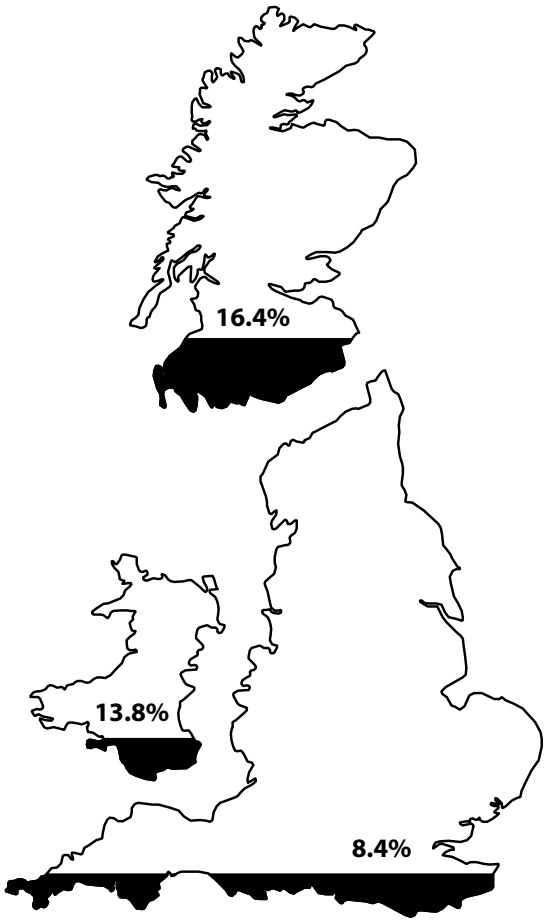
- The 20th Century saw a major expansion of woodlands in Wales, from a low point of 5% of land area after the First World War, to a level of 14% today[8]. Woodland land cover increased by over 45 000 hectares from 11.6% to 13.8% of the land area between 1980 and 1997[9]
- Woodland coverage in Great Britain increased from an average of 9.2% to 11.6% between 1980 and 1998[10]

2.1.1.2 Area by Species

- Almost one third of the total woodland area in Wales consists of Sitka spruce plantations[11].
- Conifer woodland is the dominant forest type in Wales representing 47.9% of all woodland. Broadleaved woodland represents 37.3%, and Mixed woodland 7.7% [12]
- The main conifer species in Wales is Sitka spruce covering 83,891 hectares or 56% of all conifer species
- Conifer woodland is mostly single-species, single-age plantations, which are generally managed by clearfelling[13]
- The main broadleaved species is oak covering 42,918 hectares or 37% of all broadleaved species[14]
- Sitka spruce is the largest individual species in Wales, accounting for almost ⅓ (31.5%) of all woodland. Second largest individual species in Wales is oak with 16.1%. Conifers in total account for 55.9%[15]
- Sitka spruce in the UK accounts for 29.1% of all woodland, with the second largest individual species being Pine at 17.2%, with oak accounting for only 9.4% of all woodland UK-wide[16]
- Planting of Sitka spruce began in 1930s, peaking in 1960s + 1980s[17]

2.1.1.3 Public and Private Ownership

- The Forestry Commission Wales (FCW) controls 44% of Welsh forests and woodland (127,600 ha)[18]



• The Scottish Executive's Forestry Department manages almost 40% of Scottish forest (467,000 ha)[19]
• FCW woodland is dominantly coniferous: 73.6% (88,287 ha), whereas private forests are majority broadleaved: 55.7% (83,603 ha)[20]
• Vast majority of Sitka spruce is in Forestry Commission woodland: 55,322 hectares (68%), as opposed to 25,993 hectares (32%) in private or commercial ownership[21]
• Of FCW Sitka, 50,137 ha (91%) is High Forest Category 1[22] - "Stands which are, or could become, capable of producing wood of a size and quality suitable for sawlogs"[23]. Ratio is the same - 91% - in private Sitka plantations.

2.2 SALES AND ECONOMICS

2.2.1 Key Statistics:

2.2.1.1 Sales Figures:

Sales volumes 2010-2011:
• England total 1.5 million m^3
• Scotland total 3.2 million m^3
• Wales total 770,000m^3 [24]
• Wales direct production: 330,000m^3
• Standing sales: 440,000m^3 [25]

Scotland produces 4 times the amount of Wales, roughly equivalent to the area of forest. England about half the relative produced volume, considering its area of forest coverage is similar to that of Scotland.

2.2.1.2 Economy and Jobs:

• Around 9,000 people are directly employed by the Welsh timber industry[26]
• 2009 data from the ONS calculates the forest sector in Wales to contribute £429 million to national economy[27]

2.3 TIMBER QUALITY

One of the most significant factors influencing the development of the Welsh timber industry is the relatively low quality of the softwood timber produced. The mild and damp climate results in fast growth periods, particularly for Sitka spruce, which in turn produces a low-density and therefore a low strength-grade product.

The visual grading of Sitka spruce produces two strength grades: GS (equivalent to C14) and SS (equivalent to C18), with mechanical grading giving reject, C16, and C24 grades[28]. The majority of Welsh timber is of C16 quality, with small amounts of C24, but in too small a quantity to make it economically viable when compared to foreign imports. Whilst there is the potential for a significant supply of C16 graded timber, it is noted by Dennis Jones of *Woodknowledge Wales* that the majority of timber processed by Welsh sawmills is never strength graded, and as such can not be used to its full potential and only for lower grade uses[29].

In addition to issues of strength, factors such as the maximum available sawn timber sizes also pose challenges for the development of the industry. This is particularly relevant when considering the production of timber framing systems for energy efficient buildings, with higher quantities of insulation demanding a greater wall thickness. PassivHaus standards for example typically requires a minimum insulation thickness of 300mm, which is most economically produced within a single panel. With upper limits for Welsh sawn timber at around 215mm, it is clear that greater levels of innovation in engineered systems will be required. Examples of this are discussed later on.

CLEARCUTTING IN THE YSTRADFFERNOL FOREST IN THE RHONDDA VALLEY

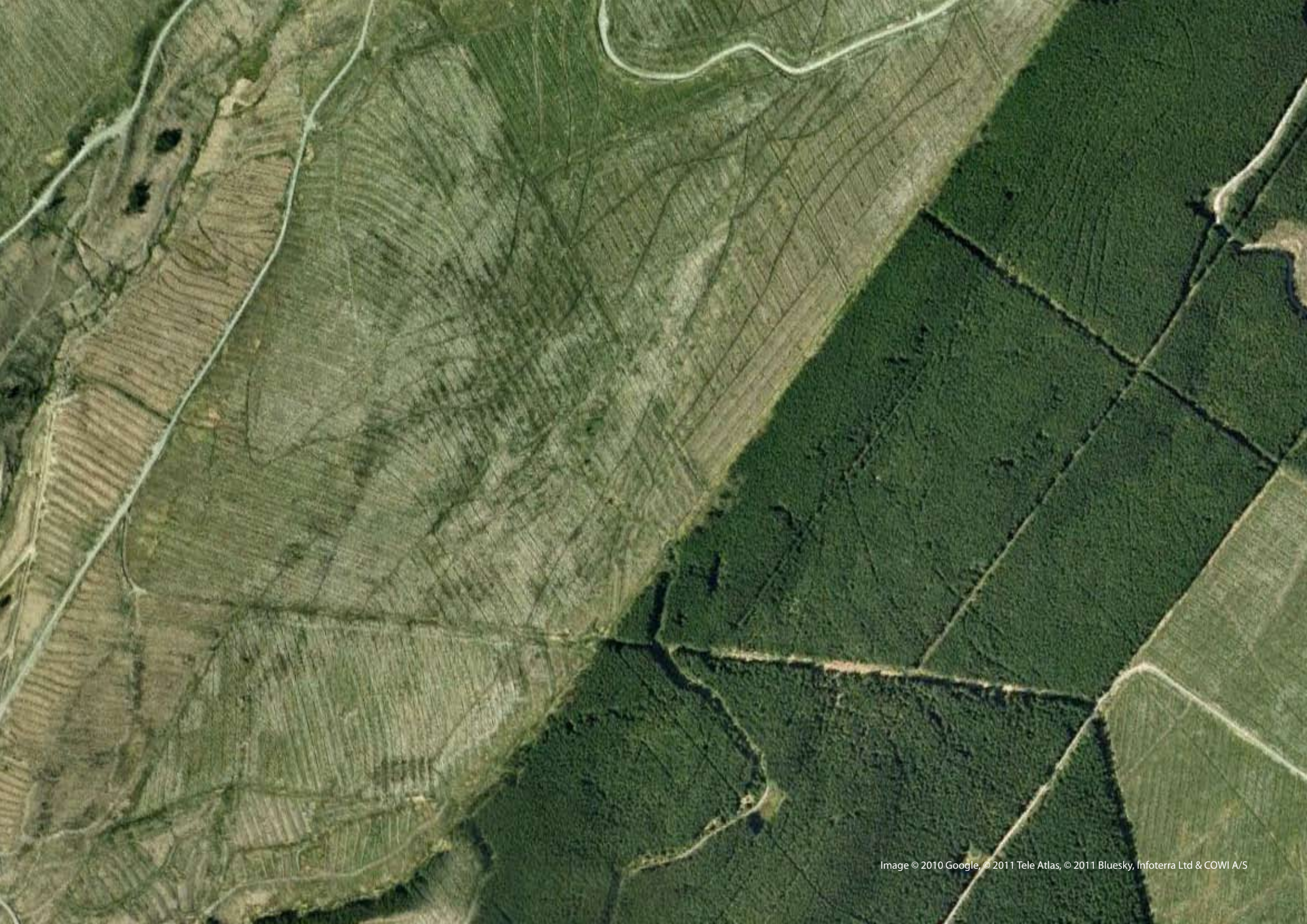
Image courtesy of Forestry Commission Wales

2.4 FUTURE ADAPTATION AND SUSTAINABLE FORESTRY

Critical to the development of the forestry and timber industry in Wales is the need to ensure a sustainable future for the sector as a whole, incorporating not just economic and business concerns, but also environmental, ecological, and social considerations as well.

One of the major challenges likely to be confronted by the industry is the need to adapt to a changing climate. Although the impact of climate change may bring some limited benefits to the sector, such as the probability of longer growing seasons and the increase in production potential that will result, the challenges that it will bring will be significant, and need to be addressed if they are not to far outweigh any benefits. Increases in both the intensity and frequency of extreme weather events, such as storms, drought, and fire are likely, as is the emergence of pests and diseases not previously seen in Wales, that have migrated with the changing climate. As stated in *The National Assembly for Wales strategy for Woodlands and Trees*, changes in the pattern of outbreaks for such pests and diseases will pose a particularly serious threat to single species woodlands[30].

The commercial advantages of single species woodlands and a clearfelling strategy is clear: they produce even-aged trees of the same species, with maximum timber yields, and maximum efficiency. The detrimental ecological impact however is significant, and taken over a longer period of time these are likely to far outweigh any short-term benefits. As with any mono-crop plantation, the repeated cultivation of a single species will gradually drain necessary nutrients from the soil, resulting in less productive plantations. The clearfelling of forests has further ecological impact, including issues of sediment runoff, erosion, and water quality. The implementation of alternative silvicultural techniques such as continuous cover forestry (CCF) should therefore be encouraged. Although this is likely to result in lower revenues and higher administrative costs in the immediate future, it will aid in the development and long-term viability of the industry.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3.0 Welsh Timber Supply Chain

3.1 CURRENT SITUATION

One of the key strengths of the Welsh timber industry is the breadth of expertise, suppliers and manufacturers that it encompasses. From forests, to both primary and secondary processing, the range of production across the industry is significant, incorporating everything from sawn timber, low-grade products such as pallets, fencing, and biomass, through to sheet material, and high value-added items such as furniture, and craft products[1].

Although the potential for the integration of both the supply chain and the industry in general is significant, the current reality is one that is largely disconnected. As a report by *Jaakko Poyry Consulting* stated in 2004 "there is a growing disconnection between the current Welsh resource and processing. Around 90% of the hardwood and 65% of the softwood raw material flowing into the Welsh industry is imported"[2]. As an example, Premier Forest Products, based in Newport and one of the UK's largest timber and panel wholesalers, sells no Welsh timber; they do supply a minimal amount of Irish timber (around 5%), which is classified as domestic. The vast majority of Welsh sawmills however rely on Welsh timber, with an estimated 75% of their demand being supplied by Welsh forests, and two-thirds of their output remaining in Wales[3]. Although the Welsh market is dominated by imports, and is therefore very competitive, there is significant potential for the expansion of domestic production, particularly when considering the lower environmental impact and lower transportation costs that a more regional supply and production chain would benefit from. It is notable that in interviews conducted with Welsh forestry industry businesses for the Jaakko Poyry report, that "the market was very rarely mentioned… as a barrier to growth"[4].

One of the significant challenges facing the industry is a general lack of confidence in the Welsh wood supply chain[5], with the relatively small scale nature of forestry businesses, from forests through to primary processing, being unable to guarantee long-term supply.

3.2 ECONOMICS AND STATISTICS

Across all businesses within the Welsh timber sector, the industry currently generates a revenue stream of over £1.7 billion per year. This rises to more than £4 billion with the inclusion of the construction industry[6]. With government commitment to new regulatory standards requiring all new homes to be zero carbon by 2016[7] the market for low-cost and low-energy timber framing systems will expand considerably, and the Welsh timber sector is well placed to take advantage of that emerging market, and add considerable value to the industry.

3.2.1 Key Statistics

- The total number of businesses in the Welsh forest industry is estimated at around 1750. Within this, there is a large, strong and dynamic secondary processing business of close to 1500 businesses.[8]
- The total wood chain value (the annual wood market transactions in domestic and imported wood) is £315 million p.a. of softwood and £105 million p.a. of hardwood (including the wood equivalent of pulp, paper and recycled fibre used in paper processing)[9]
- Value added and employment at each stage[10]:

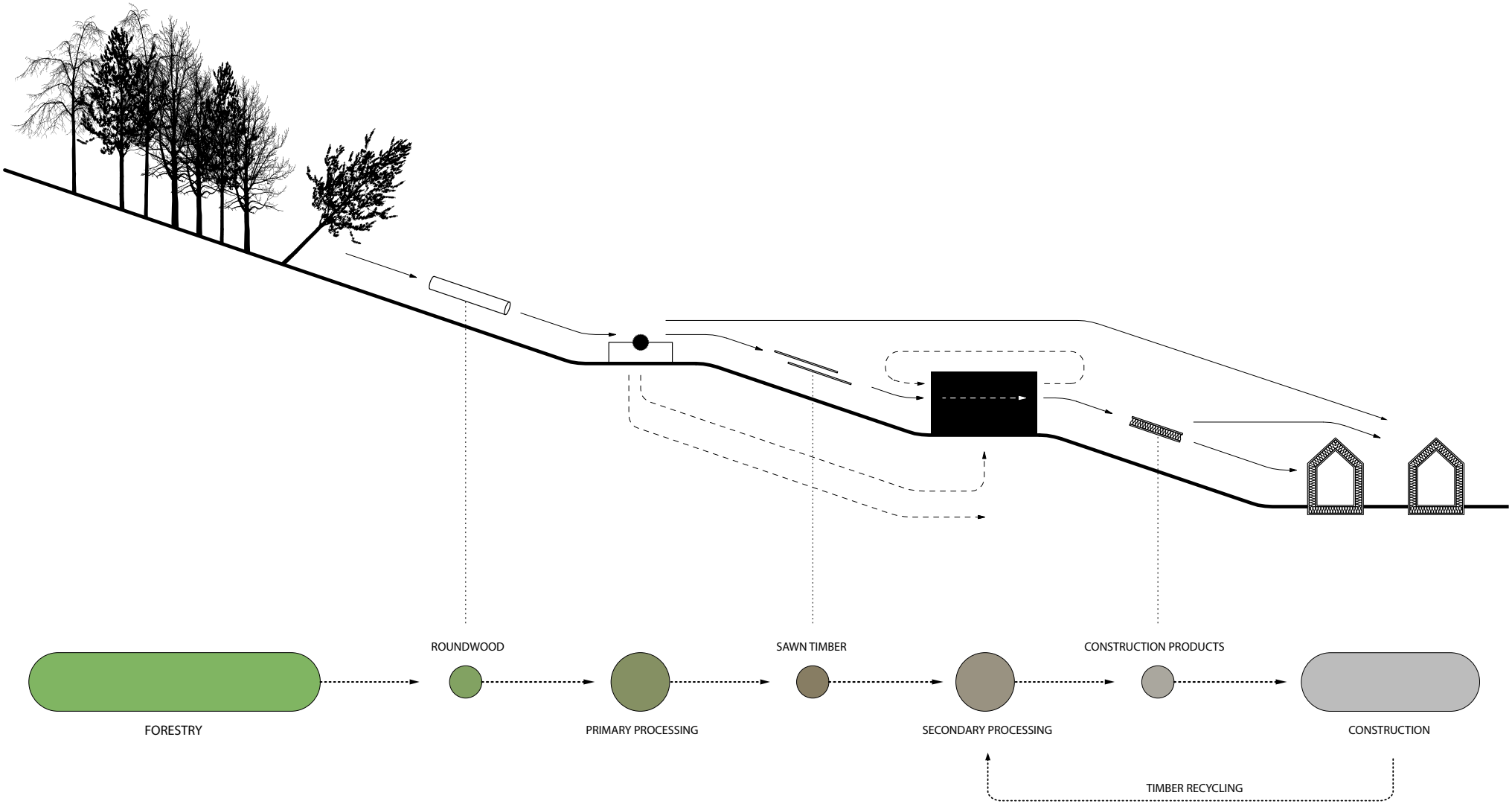
Forestry and harvesting	£26m	1300 people
Primary processing	£167m	1600 people
Secondary processing	£236m	6000 people

3.3 INTEGRATED VISION

As previously stated, the relatively small scale of the Welsh forestry industry, when compared to leading European producers such as Finland, Sweden, and Austria, places it a distinct disadvantage when considered purely in terms of supply and primary processing. Its competitive advantage must therefore be found elsewhere, and requires greater levels of innovation across the entire sector. The development of a highly integrated supply chain, across all aspects of the Welsh timber industry, would harness the major strengths that the sector currently displays. In doing so it would provide a clear framework for innovation, enable the development of high-value products, and significantly increase the value that is added along the entire chain. The benefits of such a strategy were clearly stated in the 2004 Jaakko Poyry report:

The emerging Welsh forest industry is able to consider, over time, a highly integrated chain from resource to end-user, due to; the current strong secondary wood businesses, the opportunity to establish a high value resource, and the proximity to major markets, in particular the UK. This structure will have neither the single focus on secondary wood businesses, such as Danish furniture, nor the predominance of primary processing such as Nordic countries, Scotland and New Zealand. It will be unique to Wales.[11]

Through the closer integration of the timber supply chain, it would be possible to develop a zero-wood-wastage strategy, enabling the unused material from various processing



INTEGRATED SUPPLY CHAIN DIAGRAM

stages to be reused as the raw material for other higher-value products. According to Edward Sternhouse of InWood Developments; there is typically an average of 70% wastage from the initially felled tree to final product, material which clearly has both economic and production potential. In primary processing alone, figures available for the BSW Timber sawmill in Newbridge on Wye indicate a 42% wastage from roundwood input to sawn timber output[12]. The harnessing of this material enables the timber be used to its fullest capacity, extracting maximum value and creating higher revenues for the industry, which in turn would be returned to the local economy.

Such an approach requires a clear analysis of wood-based products, from sawn timber to paper-pulp, to develop strategies for integrated supply chains. Products such as wood-fibre insulation and charcoal would be able to harness the by-product of primary processing businesses, but this requires both sufficient by-product to make the relationship viable, as well as the close proximity of the two firms.

In addition to the target of zero-wood-wastage for virgin timber, the industry should also strive to integrate greater quantities of recycled timber into the manufacture of new products. This both creates significant added-value, but also acts to create a more sustainable industry as a whole. The timber panel manufacturer, Kronospan, currently uses about 60% recycled fibre in their chipboard manufacture, including sawmill residue, but with the potential to raise this to around 80%[14].

Over time, the use (and correct grading) of home-grown timber would lift the primary processing sector, which in turn could supply and be supported by an already strong secondary processing and construction industry.

3.4 FUTURE DEVELOPMENT

The long-term development of an integrated timber supply-chain requires three critical factors:

[1] Increased collaboration and communication between all sectors:

This is essential for the development and success of the industry as a whole, and covers a large range of factors including:

- Education programs, both within the industry, and for architects and designers who specify construction products
- Collaborative research and development, leading to new products and production systems that are beneficial to the entire industry
- Creation of larger supply companies through the networking of smaller organizations. This particularly relates to sawmills and other primary processors as a means of guaranteeing long-term secure supply, modeled along the lines of the BioRegional Charcoal initiative, through which small regional charcoal producers supply national retailers under a single brand name.

[2] Investment in the long-term evolution of the industry:

Forestry, by its very nature, is a long-term operation. Trees, particularly in long-rotation, take years to grow and mature before they are harvested. The development of more sustainable forestry practices to replace the existing Sitka spruce mono-crop plantations will take decades, and requires gradual and long-term change. The development of the Welsh timber industry needs to take place alongside this, requiring flexibility within the supply stream.

The reliance on imported timber need not be a threat to the industry, but rather a means of supplying and enabling the development of primary and secondary processors, whilst a domestic supply-chain is established.

[3] Focus on adding value through the supply chain, rather than just increasing the volume of output:

Given the relatively small volume of supply and production within the industry, it is critical to add value throughout the supply chain, rather than simply increasing overall output. This can be done at every stage of the supply chain, from the manufacture of timber cladding systems by primary processors, the fabrication of more complex building products within the secondary processors, through to the production of furniture and other high-value high-skill items.

Added value also includes innovative uses of recycled and previously discarded materials. Examples of this includes the use of small-section timber in window frames and development of end-grain flooring by Coed Cymru[15]. There is also the possibility to develop contacts with organisations such as BioRegional mini-mills for small-scale paper production, and BioRegional Charcoal.

BSW TIMBER, NEWBRIDGE ON WYE

KRONOSPAN, WREXHAM

PREMIER FOREST, ALEXANDRA DOCK, NEWPORT

INWOOD DEVELOPMENTS, SUSSEX

Image courtesy of the author

4.0 Welsh + Imported Timber Price Comparison

The issue of cost competitiveness is critical to the development of any industry. For the vast majority of clients, architects, and contractors it is the principal issue that matters in specifying timber, and factors such as the lower environmental impact of domestic timber versus imported timber, although important, are typically less of a concern.

For a quick analysis we here compare the price of specifying C16 and C24 timbers. Although this does not directly relate to domestic/imported timber, it is assumed to be comparable to the dominance of C16 timber supply within Wales and the UK, and the relative lack of C24. Clearly further analysis is needed based on costs that are estimated from domestic sawmills and suppliers.

4.1 TIMBER PRICES (From Premier Forest)

C16 (SC3): £180/m^3
C24 (SC4): £195 /m^3

4.2 C16 + C24 COMPARISON

C16 (SC3):	50x195mm	450mm centers	4m span	Potential Domestic Timber
	9.9m length building		= 22 timbers	
	0.858m^3		= £154.44	
C24 (SC4):	50x195mm	600mm centers	4m span	Imported Timber
	10.2m length building		= 18 timbers	
	0.702m^3		**= £136.89**	**11% cheaper**

40m2 building (as above)	C16	= £154.44	
	C24	**= £136.89**	**11% cheaper**
400m2 building	C16	= £1,565.44	
	C24	**= £1,277.64**	**18.4% cheaper**
4,000m2 building	C16	= £15,605.46	
	C24	**= £12,667.54**	**18.8% cheaper**

4.3 CONCLUSIONS

It must be noted that these are very rough calculations based on likely comparative figures rather than actual figures, despite this however they appear to clearly indicate the price competitiveness of higher grade (imported) C24 timbers, based on the savings gained through the reduction of material required. Savings coming from reduced labour time and time on site would further emphasize this result.

More analysis on cost comparison between imported and domestically sourced timber is clearly required, however there could well be an argument for government subsidies on domestic timber, or some other financial balancing measure that could be lobbied for to benefit the timber industry, the construction industry, and broader environment in general.

5.0 Potential Products and Manufacturing

As previously discussed one of the strengths of the Welsh timber industry is the diversity of expertise, suppliers and manufacturers it encompasses, from forestry, through both primary and secondary processing. Already the range of production of timber products within Wales is significant, from small-scale furniture and fencing producers, through to large-scale industrialised facilities such as the Kronospan wood-panel factory near Wrexham.

The potential exists for the production of a far wider range of timber products, which, if conceived as part of an integrated supply and manufacturing chain, could transform the industry and help develop a sustainable regional economy.

Their range of potential products is extensive; a limited number are considered on the following pages.

Finger jointed timber for long-length cladding mid-manufacture at Inwood Developments, Sussex

5.1 Primary Processing: Finger Jointing / Cladding Systems

At its most basic, value added production occurs at primary processing stage, where roundwood becomes sawn timber. With a little extra investment in timber grading and finger jointing machinery it is possible to produce higher value products, such as stable, long-length cladding systems.

Image courtesy of the author

Glulam beams in use in the Sumika Pavilion by architect Toyo Ito

Lightweight I-Joists installed in place of traditional solid timber joists

5.2 Structural Systems: Laminated Timber Beams / Glulam / Endless Beams

Comprised of layers of small section dimensioned timber, bonded together with adhesive under heat and pressure, glue-laminated (glulam) beams are relatively straightforward to produce. Manufactured with either horizontal or vertical laminates, the individual timbers are typically finger joined at each end to give continuity to the laminations, enabling the production of 'endless beams', with few limitations on size. The automation of the manufacturing process has the potential to significantly increase efficiency and production speed, resulting in a far more price competitive product.

The primary benefits of glue-laminated timber beams are their strength, dimensional stability, and large section sizes and long lengths, particularly in comparison to the relatively small sections that they are composites of.

5.3 Structural Systems: I-Joists

Compared to solid timber sections, I-Joists use significantly less quantities of material, and have a high strength to weight ratios for equivalently dimensioned sections. Typically comprised of solid timber flanges with oriented strand board (OSB) webs, they are both lightweight and materially efficient.

Given the extensive production of oriented strand board in the UK, the potential for the development and expansion of domestic I-Joist manufacturing is significant. It should be noted however that the timber products manufacturer James Jones & Sons has invested significantly in two I-Joist plants in Forres, Scotland, and now dominate the market. A similar investment in Wales may now be prohibitive.

Ladder Trusses used on bere:architects' Larch House in Ebbw Vale, South Wales

Box Beams being assembled at the Welsh School of Architecture

5.4 Structural Systems: Ladder Truss

Ladder trusses are a type of parallel chord truss utilising stress-graded timber chords, pleated together either with timber, or with a metal web. As with I-Joists, ladder trusses provide a lightweight, dimensionally stable alternative to solid timber, particularly where the dimensions required would either be unavailable, or cost-prohibitive in solid timber form. The open nature of the ladder truss also provides a benefit over the I-Joist of being able to run services directly through the structure.

The utilisation of low-grade timber in a high-strength product, along with a relatively simple manufacture process, ensures that the potential for the development and manufacture of ladder trusses within the Welsh timber industry is significant.

5.5 Structural Systems: Box Beams

Significant research capital has been invested in the development of box beams in Wales particularly through the Welsh School of Architecture at Cardiff University, and through Coed Cymru's Ty Unnos project. Conceived as a structural system that can make use of the low-grade Sitka spruce available, along with simple manufacturing processes such as those used for pallet fabrication, the box beam was originally envisaged as part of a complete package that could provide both the structural frame and a system of infill panels.

Since developed by the construction and development company Elements Europe as a modular pre-fabricated system, the box beam has clear market potential.

Image courtesy of bere:architects

Image source: Coed Cymru

CLT construction of the MK40 tower by de Rijke Marsh Morgan Architects

Prototype illustrating Brettstapel wall build-up

5.6 Solid Core Systems: CLT Panels

Cross-Laminated Timber (CLT) is a solid-core construction system that enables rapid construction times due to large panel sizes and limited numbers of joints. The panels consist of single layer boards, each board made up of individual planks finger jointed for strength, with layers of boards cross-laminated with adhesives for bonding. The cross-lamination and gluing ensures minimal shrinkage and settlement over time, with the higher thermal mass of solid core construction produces greater thermal stability when compared to standard timber-faming systems.

The manufacturing process for CLT panels is relatively complex however, requiring a large-scale automated production line for the planing, sizing, gluing, laying up, and pressing of the panels, with even vertical and side pressure applied to each panel. The manufacture of CLT panels and similar products also requires considerable quantities of timber with guaranteed supply, on a scale that the UK is unlikely to be able to meet at current rates of productions.

5.7 Solid Core Systems: Brettstapel

Brettstapel is a solid timber construction system fabricated from low-quality small-dimension softwood timber posts that may not otherwise be suitable for construction. Connected with hardwood timber dowels brettstapel uses neither glue nor nails, unlike other solid core systems such as CLT panels, arguably producing a better-quality internal environment.

As with all solid-core construction, brettstapel requires considerable quantities of timber, and although it may be suitable for limited numbers of projects in Wales and across the UK, a large-scale implementation is unlikely due to limitations on the supply of domestic timber available.

Image source: Flickr user daisybush, licensed under a creative commons licence 2.0

Image source: http://www.brettstapel.org, © James Henderson

Installation of woodfibre insulation

Image source: Actis

5.8 PassivHaus Products: Woodfibre Insulation

Produced entirely from woodfibre, and bonded from the natural adhesiveness of the lingin resin within the wood itself, woodfibre insulation is an entirely natural material, and can be produced from the waste material of other timber processing. The potential for the development of woodfibre insulation manufacturing as part of a zero-wood-wastage strategy is significant, but inevitably dependent on quantities of production, and quality of supply of waste-wood as a raw material.

Section through PassivHaus certified window unit

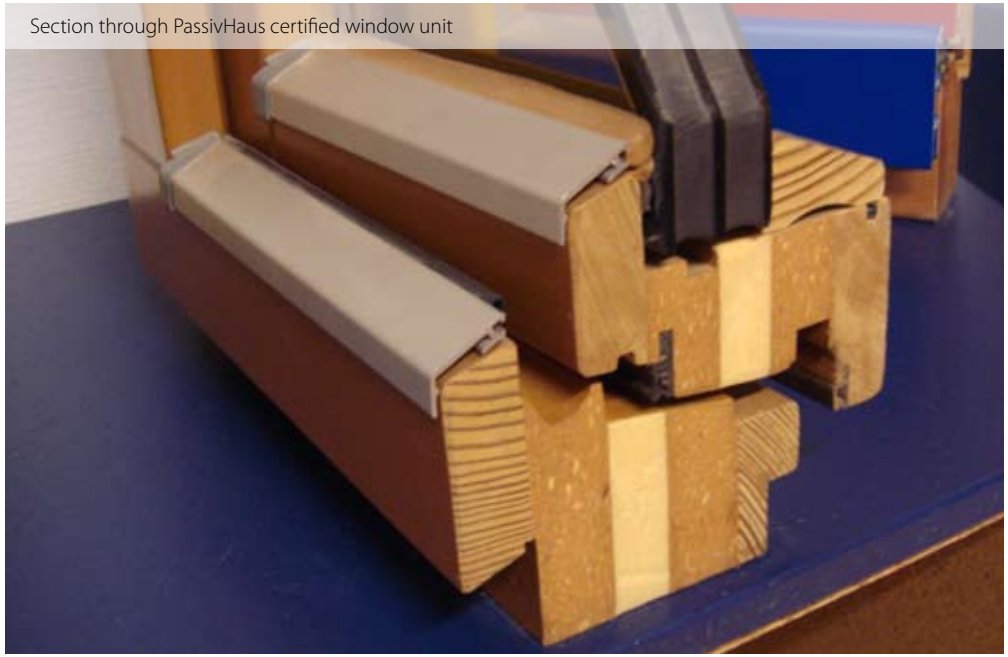


Image courtesy of bere:architects

5.9 PassivHaus Products: PassivHaus Windows

High-value products such as window frames that make use of small-section timbers could prove particularly valuable to the Welsh timber and manufacturing industries. The development of the UK's first PassivHaus certified windows for bere:architects' Lime House at Ebbw Vale, by the Vale Passive Window Partnership - a consortium of Welsh joinery firms brought together by Woodknowledge Wales - proved the potential for the manufacture of high-quality, high-tolerance timber products.

6.0 Existing Welsh Timber Studies

Several significant studies have already been completed into the development of Welsh timber and it is critical that these be incorporated into any future integrated development strategy. These studies include the Ty Unnos project by Coed Cymru and the Welsh School of Architecture, and the development of certified PassivHaus windows for bere:architects' Ebbw Vale PassivHaus. In addition to these, it is worth considering the outcomes of projects such as GATE - Gaining Added Value for Timber in Europe -, where the Forestry Commission Wales was lead partner, as well as possible collaboration with organisations such as the Prince's Foundation for the Built Environment, which is currently undertaking a study of regional supply chains in Wales for a number of construction materials, including timber and slate.

7.0 Case Studies and Benchmarking

There are a number of regional and business case studies that would be useful to analyse, and benchmark the Welsh timber industry against. These include:

7.1 REGIONAL

VORARLBERG [AUSTRIA]
The westernmost region of Austria, Vorarlberg has, over the past 10 years, become a significant centre for the development and production of high-quality low-carbon technologies. In order to develop a similar regional specialty within Wales it is critical to understand the Vorarlberg model, and how it developed, to see if there are lessons or experiences that can be applied to Wales.

7.2 BUSINESS AND TRAINING FACILITIES

INWOOD DEVELOPMENTS [SUSSEX, UK]
A private manufacturing facility, InWood Developments produces glulam beams and high-quality timber cladding, along with a number of other timber products. They specialise in finger jointed timber and have the largest finger-jointing facility in the UK.

KRONOSPAN [WREXHAM, UK]
Based in Chirk near Wrexham, the wood panel manufacturer Kronospan is one of the top 10 manufacturing companies in Wales, employing over 600 people. All of Kronospan's products are made from domestically-sourced timber and include significant quantities of recycled timer. As part of the Austrian-based Kronospan Worldwide, Kronospan collectively is the leading manufacturer of paticleboard, medium density fibreboard and oriented strand board globally.

SMARTLIFE CENTER [CAMBRIDGE, UK]
SmartLIFE and the SmartLIFE Low Carbon Center (to be opened October 2011 as part of the hive enterprise and education park), is a joint collaboration between Cambridgeshire County Council and Cambrige Regional College, to teach skills needed for building low carbon homes and installing renewable energy solutions.

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