



Working with what we have got: The potential for modification of home-grown timber

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- UK forest resource and the current construction market
- An overview of timber modification
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The BioComposites Centre

- Bangor University
- College of Natural Sciences



BC origins

- Established 1989
- Original focus on wood based panels, pulp and paper, and novel products from agricultural residues
- Pilot plant for particleboard and MDF production
- Long natural fibres in non-woven mats for composites and insulation
- Resins from plant oils and extracts
- Bio-derived products in a wide range of applications
- New Technology Transfer Centre at Mona on Anglesey opened in 2006





INNOVATION IN BIO-MATERIALS FOR INDUSTRY



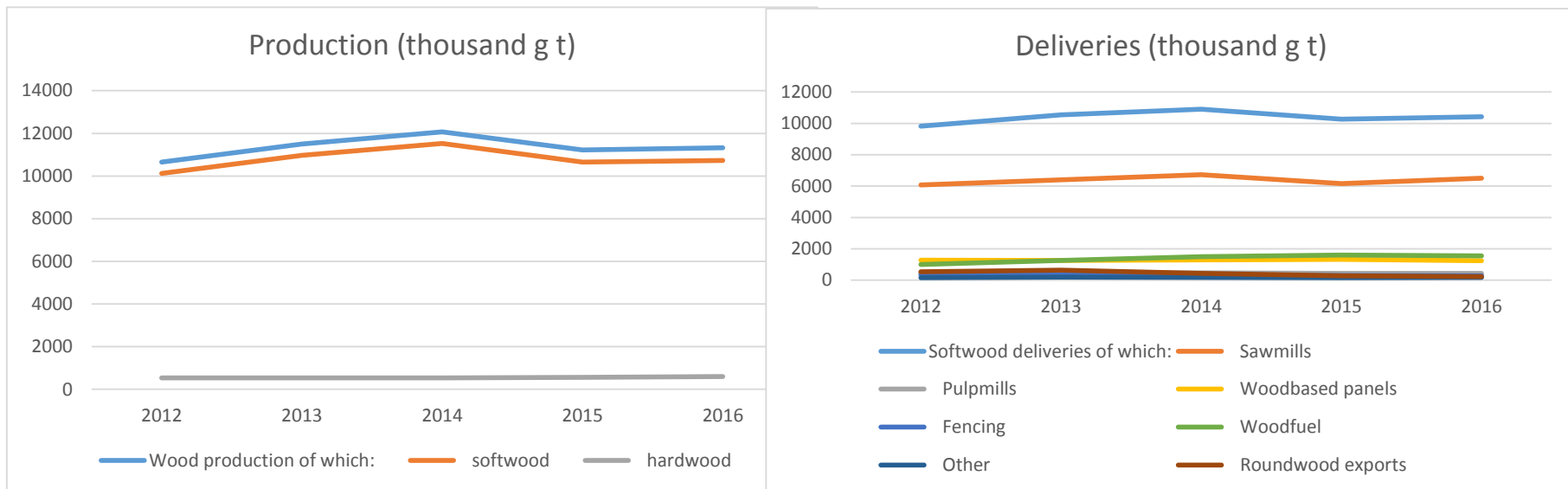
BC Materials

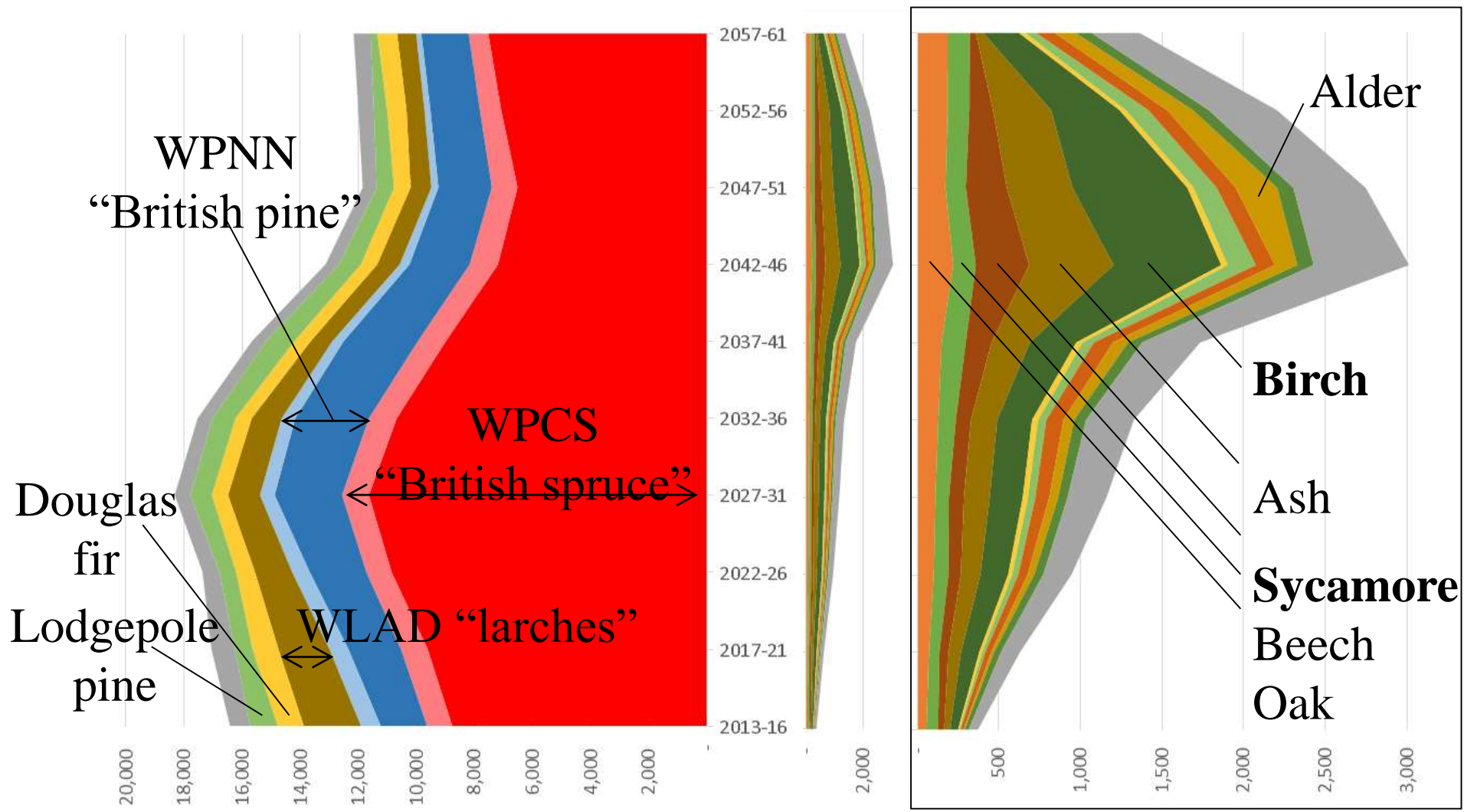




Forest resource and the demand from construction

UK biomass - forest





Timber frame housing

UK	2005	2007	2009	2011	2013	2015
Housing starts	224210	233770	115420	138810	149670	179450
Timber frame	17%	23.3%	25.6%			c. 28%



Timber in construction

	House Brick and block	House TF	House TF Tim clad	Flat CLT
Wood (Burnett 2006)	7.1 m ³	10.31 m ³	14.93 m ³	
Wood (CEI-bois)	4.3 m ³	7.8 m ³		21.3 m ³
Wood (John Gilbert Arch. 2005)		10 m ³ to 27 m ³		
Engineered wood				28 m ³ to 38.4 m ³

Model house

- Typical composition for single 4 bed detached dwelling
- Other components e.g. roof tiles, assumed to be equal as shape identical

	Masonry	Timber
Solid wood	8.82 m ³	14.55 m ³
WBPs	3.36 m ³	5.99 m ³
Aerated block	309.2 m ²	0
Brick	222.1 m ²	222.1 m ²

Timber in construction

- Been driven by the devolved governments and Westminster
 - Clean Growth Strategy
 - *We will work with industry to increase the amount of UK timber used in construction, creating a conveyor belt of locked-in carbon in our homes and buildings.*



What is 'Timber Modification'

- *[Timber] modification involves the action of a chemical, biological or physical material, resulting in a desired property enhancement during its service life (Hill, 2006)*









Timber modification

- Three current commercial forms of timber modification
 - Acetylation
 - Resin Impregnation
 - Thermal Modification

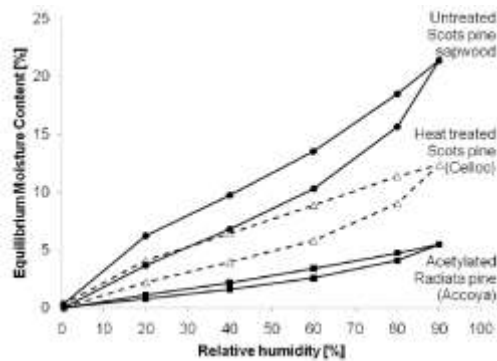
Timber modification

How does Timber modification work

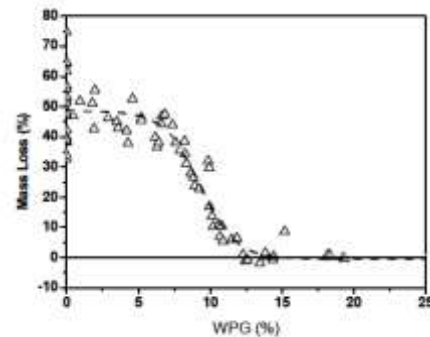
Lumen filling	Cell wall filling	Cross linking – internal	Cross-linking	Reaction with wood polymers	Degradation of cell wall
					

Chemical modification – acetylation

- Modification of timber with acetic anhydride



Dimensional Stability				
Wood Species	Tangential Shrinkage	Radial Shrinkage	Volume Shrinkage	Dimensional Stability
A Accoya® wood	1.5%	0.8%	2.3%	97.7%
B Teak	4.2%	2.2%	6.5%	93.5%
C Radiata Pine	6.0%	3.3%	9.5%	90.5%
D Dark Red Meranti	7.3%	3.8%	11.4%	88.6%
E Scots Pine	7.7%	4.0%	12.0%	88.0%
F Southern Yellow Pine	8.0%	6.1%	14.6%	85.4%



Chemical modification – acetylation

- Commercial undertaking manufacturing 40,000 m³ per year and expanding

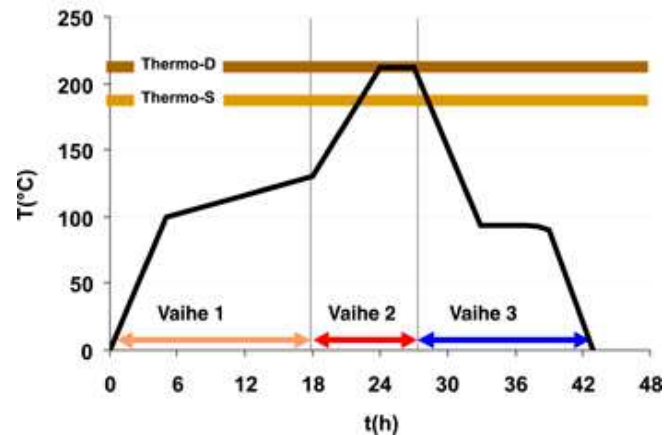
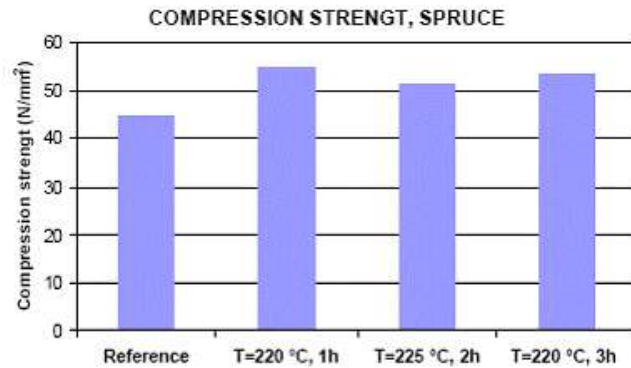


Impregnated timber

- Impregnated with different resins
 - Some have been commercialized
 - Including Kebony and furfuryl alcohol impregnation



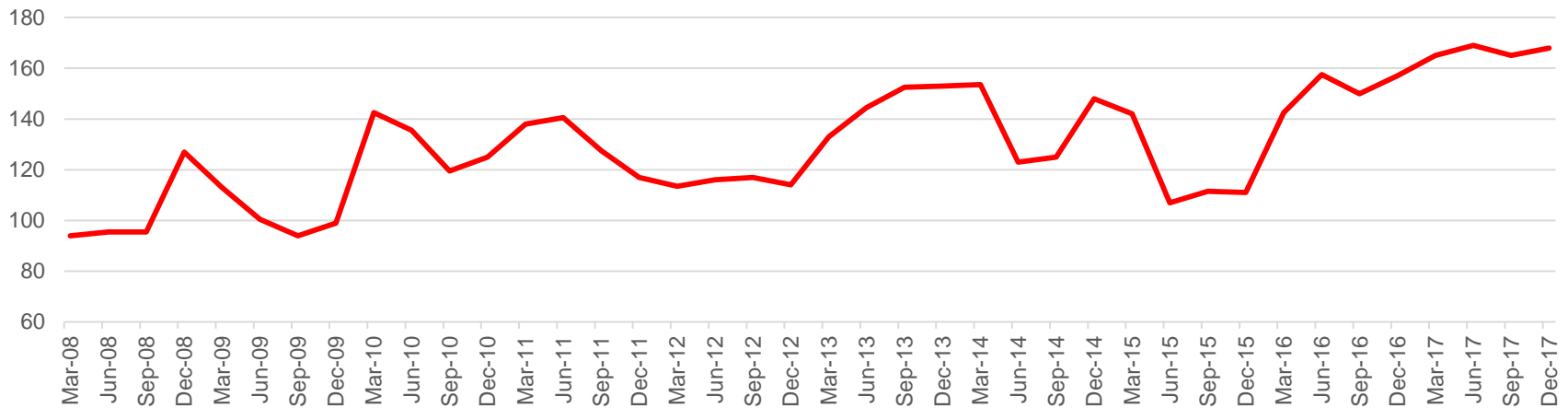
Thermally modified wood





Rise in price of Grade A Radiata pine

Cost of Grade A exported Radiata pine from New Zealand





Potential for UK forestry

It is possible to modify UK timber

- **Acetylation** – whilst possible much of the technology is tied up in patents and licensing agreements from Accoya, However Tricoya chips set to be modified in Hull
- **Resin impregnation** – New company set up in South Wales – Fibre 7
- **Heat treatment** – Pilot scale work undertaken at Bangor with 2 kilns in North and South Wales. Brimstone producing in South of England

Acetylation in the UK

- Scheduled to open 2019
- Employ ~30 permanent employees
- Take spruce / pine / fir similar to trad. MDF plants



Resin Impregnation in the UK

- Located in Barry, South Wales
- Currently trading small amounts of treated timber
- Up scale production Q2 2018



Resin Impregnation in the UK

- Currently using traditional *'modification timber'*
- Current projects to investigate UK species including *Laser incising* to be able to treat non-permeable species



Heat treatment in the UK

- Brimstone, South England
 - Heat treatment of hardwoods
 - Ash
 - Poplar
 - Sycamore
- Pilot scale kilns
 - Treated both hardwoods and softwoods
 - Inc. larch and pine



Heat treatment in the UK





Conclusions

- There is a fledgling TM industry in the UK working across all three major modification types
- There is the demand. The UK is looking to invest in clean technologies including timber and timber in construction
- There is a wood science R&D base in the UK and this needs to be exploited
- We need to match the technologies with the available timber and visa versa



Thanks for listening, come and see us?

