SIRT

Strategic Integrated Research in Timber

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Equipping ourselves for

future forests & timber

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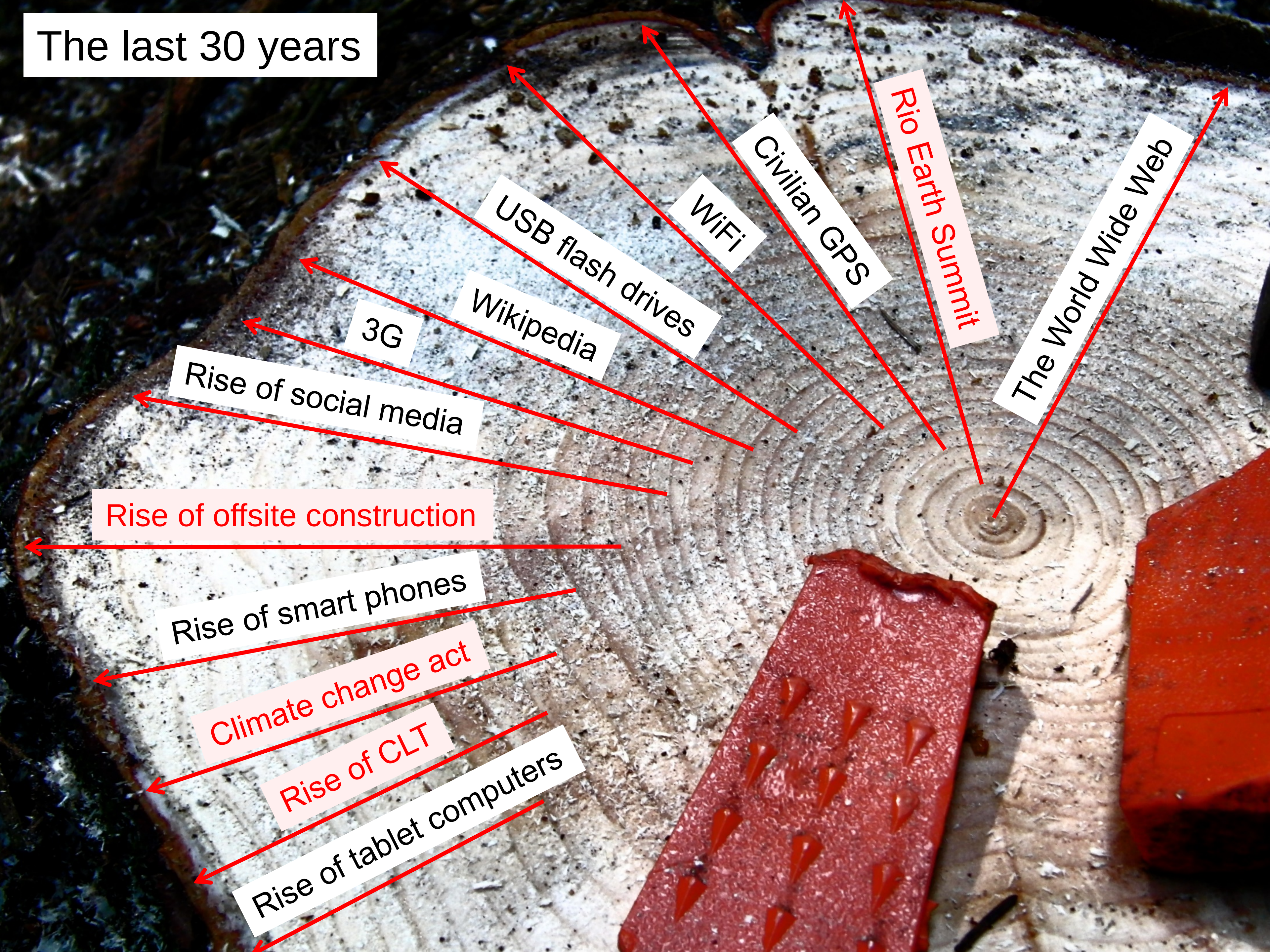
Centre for Wood Science & Technology, Edinburgh Napier University

“Innovation for change – New drivers for tomorrow’s forestry”

Institute of Chartered Foresters National Conference — Edinburgh 2-3 May 2013

The last 30 years

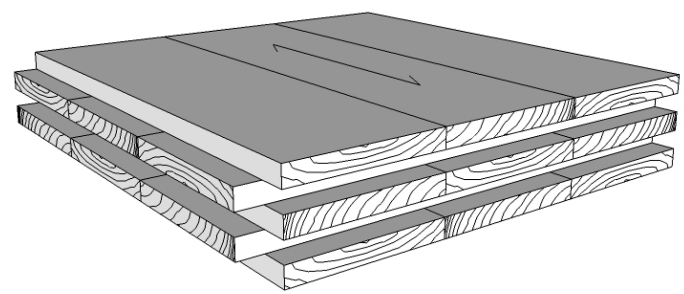


Dalston Works (Dalston Lane)

http://www.ramboll.co.uk/projects/ruk/dalston-lane

Hackney, London
Completed 2017
Claimed to be the world's largest CLT building by wood volume

Claimed 50% less embodied carbon compared to concrete frame



121 apartments, 3850 m^3 of CLT
This is 0.1% of the sawn softwood production of the UK in 2016
UK could produce 1000 of these buildings per year (121,000 apartments)
But that's only 40% of the home building target (300,000 a year)

Cross laminated timber (CLT)

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- Invented (in the 1990s) as a way to use lower grade timber
- Now, increasingly, demanding higher grade timber as a matter of routine
- Limited number of species permitted (and wanted)
- And how much (real) thought to end of life?
- Is this a very different story from our other uses of timber?

LETTER

doi:10.1038/nature25476

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Processing bulk natural wood into a high-performance structural material

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environmental impact (for example, steels and alloys) or complex manufacturing processes and thus high cost (for example, polymer-based and biomimetic composites)[1–8]. Natural wood is a low-cost and abundant material and has been used for millennia as a structural material for building and furniture construction[9]. However, the mechanical performance of natural wood (its strength

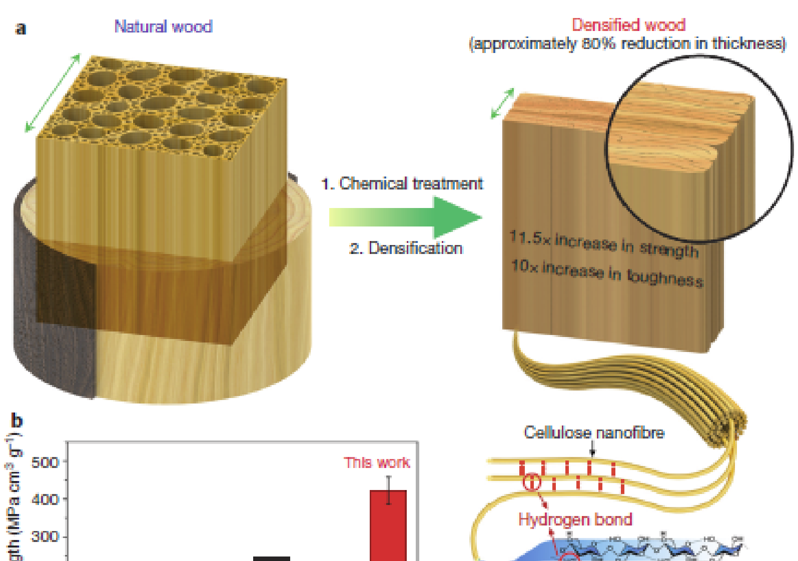
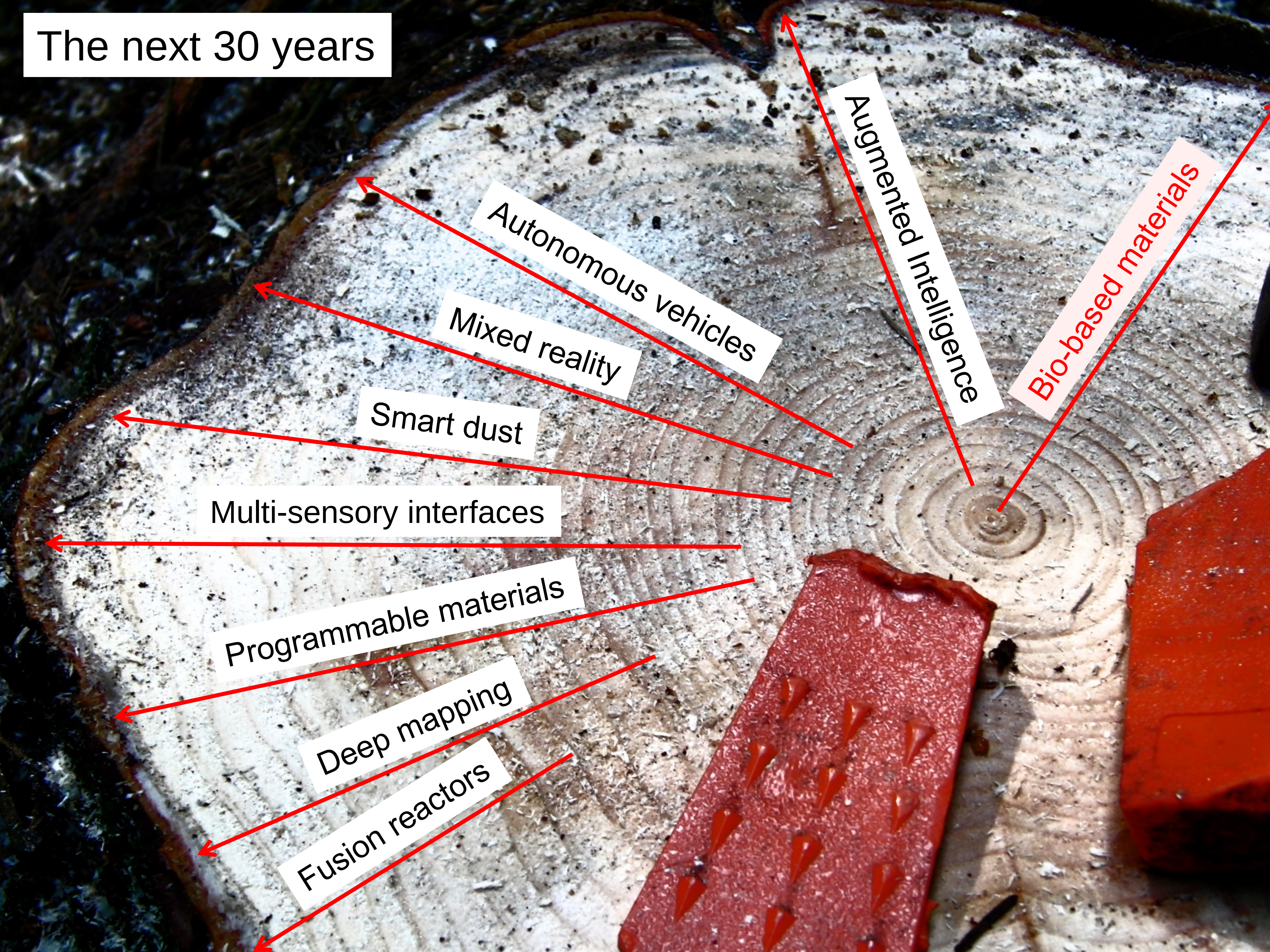


Figure 1 | Processing approach and mechanical performance of densified wood. a, Schematic of the top-down two-step approach to transforming bulk natural wood directly into super-strong and tough densified wood. Step 1, chemical treatment to partially remove lignin/hemicellulose; step 2, mechanical hot-pressing at 100 °C, which leads to a reduction in thickness of about 80%. Most of the densified wood consists of well aligned cellulose nanofibres, which greatly enhance hydrogen bond formation among neighbouring nanofibres. **b,** Specific tensile strength of the resulting densified wood (422.2 ± 36.3 MPa $cm^3 g^{-1}$, mean ± standard deviation) is shown to be higher than those of typical metals (the Fe-Al-Mn-C alloy, TRIPLEX and high-specific-strength steel, HSSS), and even of lightweight titanium alloy (Ti6Al4V). Error bars in Figs 1–4 and Extended Data Figs 1–10 show standard deviation with $n = 5$ repeats, unless noted otherwise.


The next 30 years
Augmented Intelligence
Bio-based materials
Autonomous vehicles
Mixed reality
Smart dust
Multi-sensory interfaces
Programmable materials
Deep mapping
Fusion reactors

The next 30 years

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- An aging population in UK (and similar countries)
- Increased world population & affluence
- Increased living standards & expectations
- Urbanisation
- Climate change
- Legislation on environment, carbon reduction etc
- Changing public ideas on what forests are for

GB volume forecast (FC)

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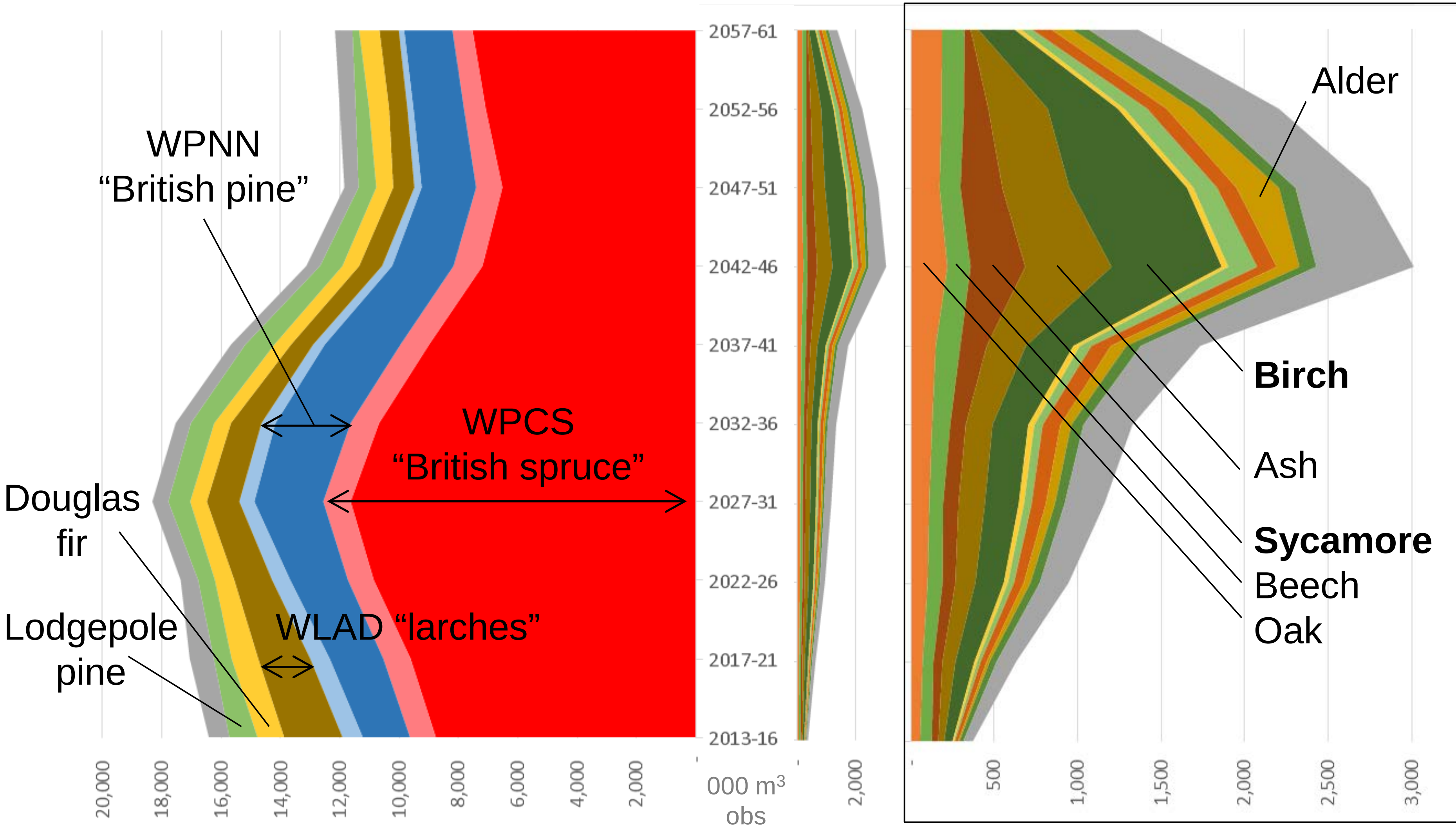

Future forests

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- Different species
  - New planting
  - Using more of what we already have (hopefully)
- Familiar species but changed
  - By climate change, pests and diseases
  - By forest management
  - By seed selection and tree breeding
    - Especially now with genomic selection

Need to change our thinking

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- “Wood is abundant”
- “Industry can focus on just a few species”
- “We can continue to expect rising quality”
- “Price will remain low for basic products”
- So we will need ways of dealing with more variety and less information from past experience and extensive testing
- We need to be better at directing to the right value streams – even before forest matures

Where we expect changes

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- The human is now the bottleneck to increased productivity
  - Working rate
  - Supply
- So offload work tasks to machines
  - Semi autonomous harvesters?
  - Autonomous forwarders?
  - Another way of working?

Where we expect changes

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- Used to be new mechanisation to replace the muscle work
- Will be new mechanisation to replace the brain work
  – Are we prepared for that?
- Robotics and AI
- New industries
  – Using forest products (e.g. bio-refineries)
  – Competing biotic materials (e.g. seaweed, fungi)
  – Plus replacement of plastics, bioenergy …

VERAM roadmap 2050

- a Roadmap for European Raw Materials in 2050 – covering raw materials research and innovation (R&I) coordination.
- ETP SMR (Sustainable Minerals Resources)
- FTP (Forest Technology Platform)

- Published April 2018
  - 2030 medium-term vision
  - 2050 long-term strategic R&I roadmap

VERAM roadmap 2050

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- Better resource efficiency
- Circular economy
- Sustainable development
- Reduced import dependency

- Emerging technologies
- Environmental challenges
- Societal changes

The forestry perspective

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- Raw materials are the backbone of industrial development
  - Linked to well-being, health, standards of living
- Forestry is chief among the sources of biotic materials (includes natural rubber too)
- Foresters *right now* are influencing the supply for 2050
- Also depend on the abiotic materials supply
  - Metals, minerals, fuel, aggregates

Sustainable supply

- Currently, forest increment > harvest
- Yet forest rich countries are net importers
  - Economic reasons
  - “Limited availability of the required wood varieties”

No! *Correct* quality

Biotic sector

To maintain and strengthen the competitiveness of the European forest-based sector, it is crucial to secure an efficient, sustainable and high-quality wood raw material supply while following the principle of right wood to the right end use. The provision of raw materials in the context of sustainable forest management and the further development of efficient and environmentally friendly forest operations are core activities of the forest-based sector.

Sustainable supply

- IT for harvesting already being developed
- But societal acceptance (public, politicians, environmental groups) is more significant barrier

Biotic sector

The intelligent and efficient production and use of biotic raw materials and further development of climate-smart silviculture and precision forestry[7] for efficient and environmentally friendly operations, transport systems and management models for biomass supply chains, are core activities of the biotic value chains. Improving technology for managing and utilising growing forest resources can be achieved through measurement and planning systems adding value with a minimum environmental load. These systems would also contribute to the development of highly productive harvesting and transport systems that are closely integrated with general and specific industry requirements. In addition, there are opportunities to improve resource use and value through segregation, sending wood fibre to the most appropriate markets, improving the use of wood fibre from undermanaged forests as well as the use of a wider range of species.

Sustainable supply - tasks

- Communication of information along the value chain
- ICT, big data, real-time
  - Increased automation for productivity & safety
  - Quantification & characterisation, forecasting
  - Smart harvesting, sorting and logistics
  - Not mentioned: forest health, wind risk etc
- Knowledge around societal acceptance, policy and governance, new ways of planning and managing green infrastructure

Sustainable supply - tasks

- Technology and methodologies
  – Lower impact on soils, biodiversity, transport
  – Forest management for climate change, other uses
  – Solutions for hard-to-reach stands
  – Routes to market, business models
  – Tree breeding, genomics, genetics
  – Higher profits, reduced wastage

The other elements

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- Resource efficient processing
- New products and applications
- Reuse and recycling

- To read, go to
  http://veram2050.eu/category/news/
  (April 17th)

Summary

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- Wood is the material of the future (whatever we do)
- Renewable is not the same as limitless
  - New planting
  - Planning ahead
  - Availability needs to be an impact assessment parameter
  - Need to be better at “forest fractionating”
  - Can our biobased economy be “techno-commensalism”?

Summary

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- Need also to think about abiotic raw materials
- Foresters are the ones with most influence on future timber characteristics (and 2050 is now)

- Need also to think about society at large
- How do we get journalists (& other opinion formers) to talk more frequently with foresters?

Summary

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- Forests are vulnerable to change, when they cannot adapt quickly enough
- We are the same