NXTGENWOOD

Development of an Ecosystem for Delivery of Next Generation Wood Products

BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

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apc Microbiome Ireland
Interfacing Food & Medicine

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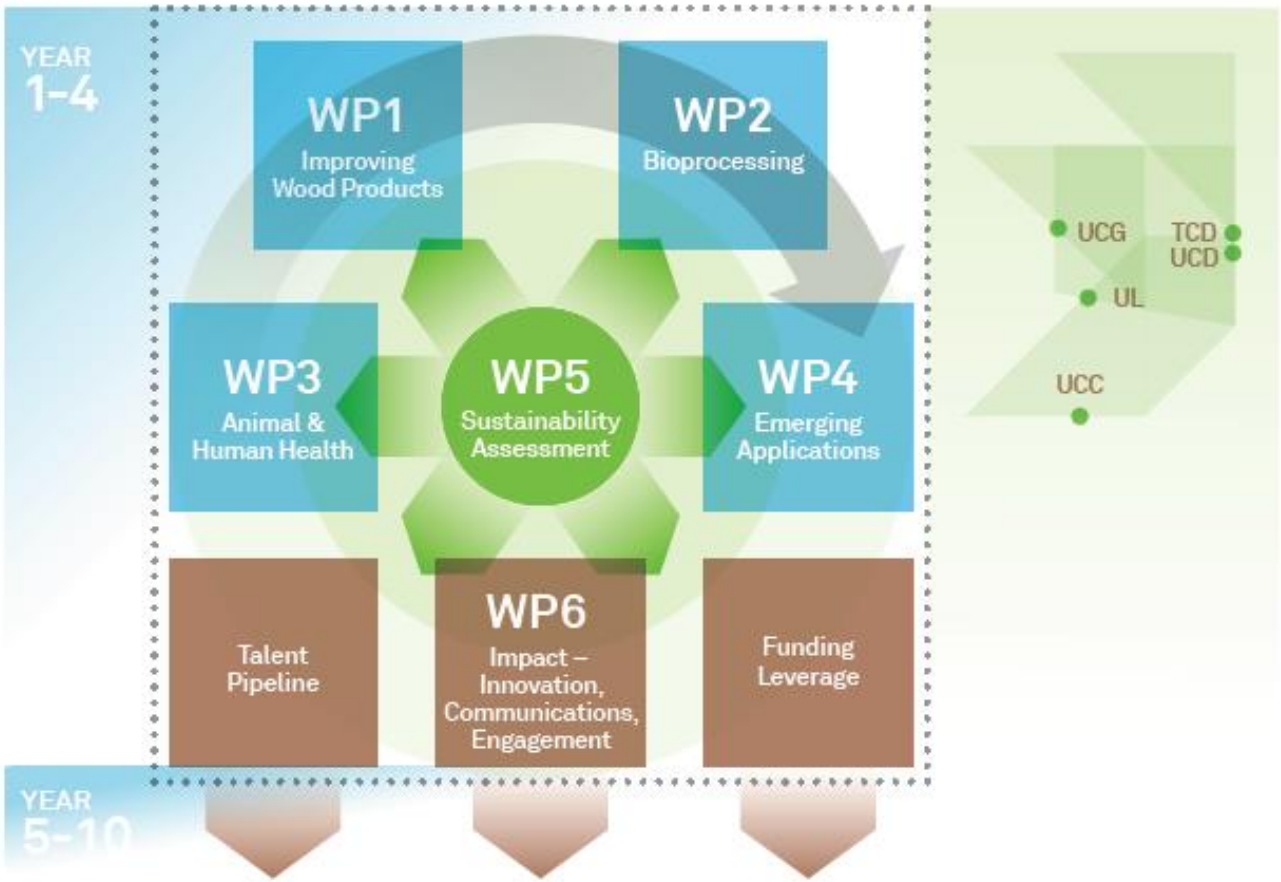
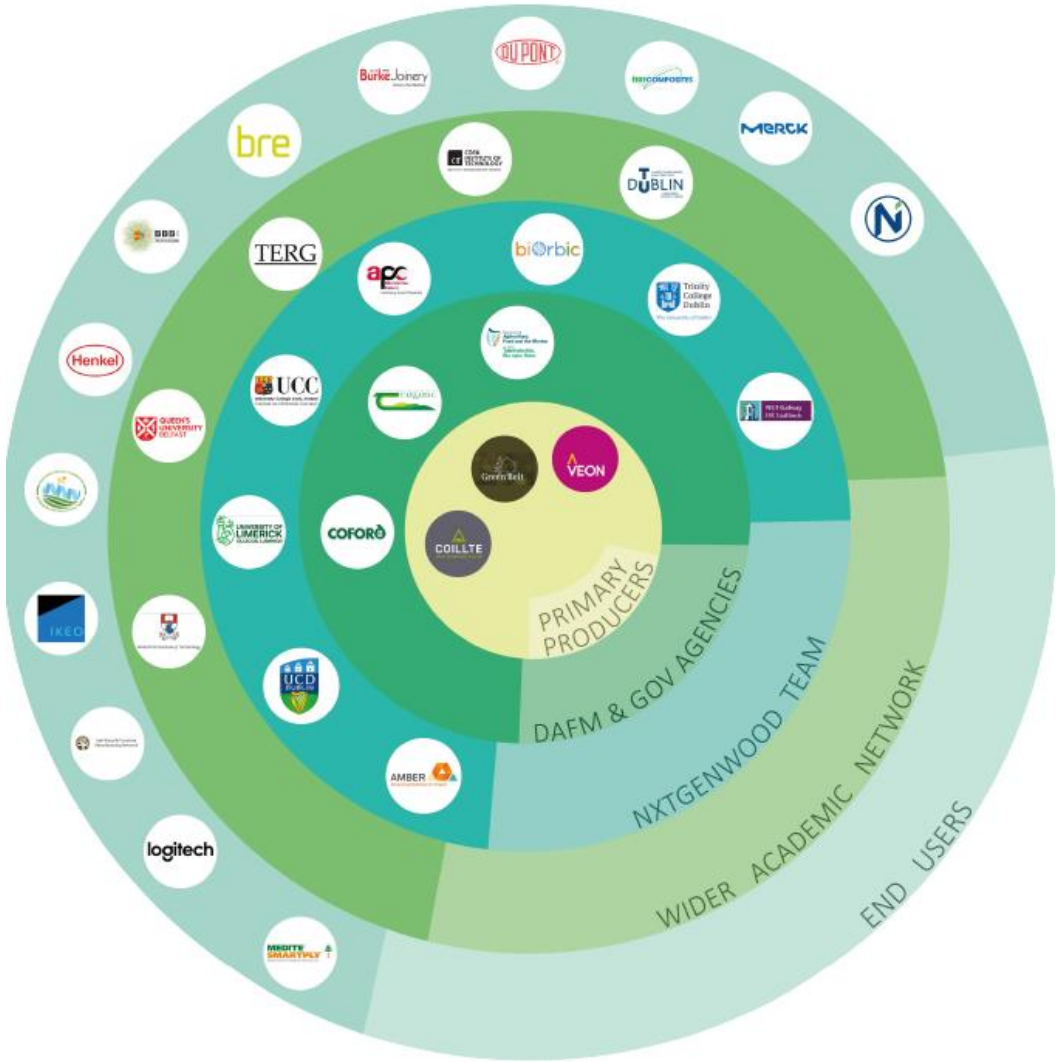
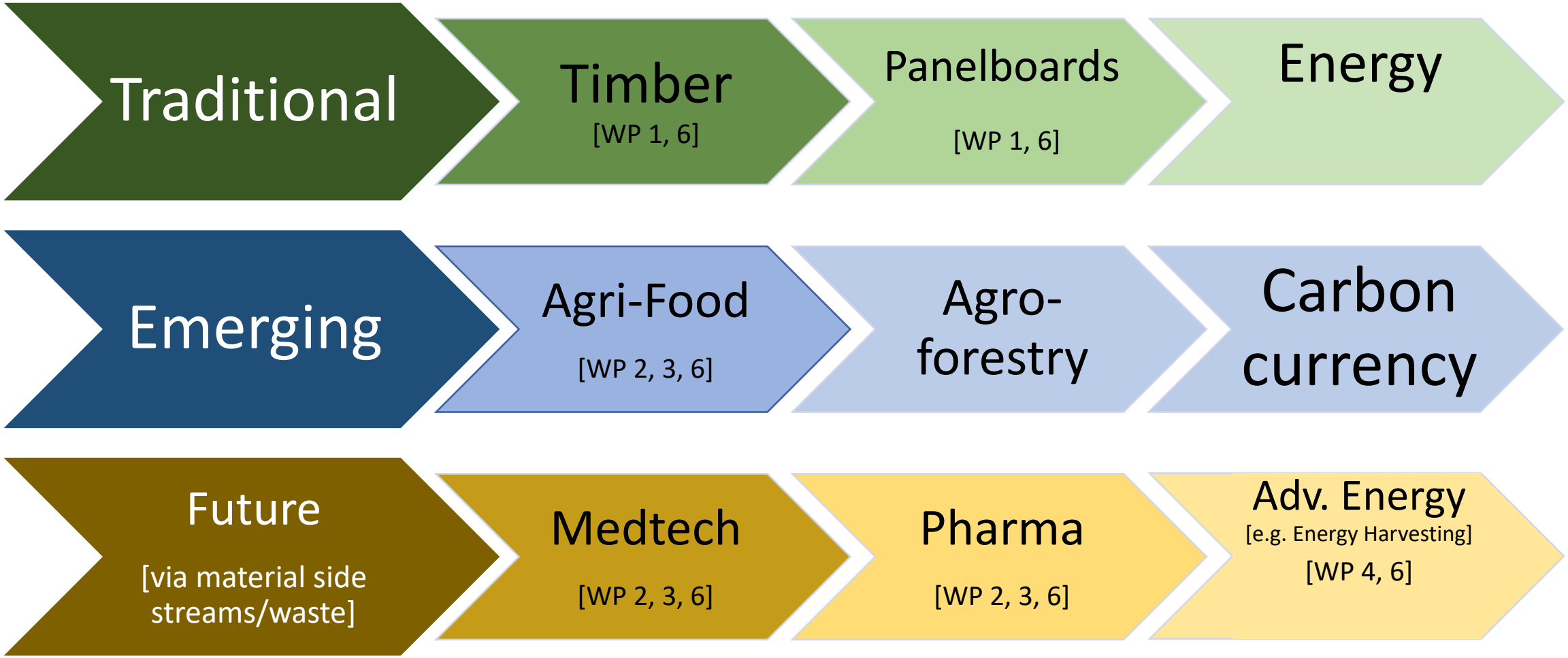
NXTGENWOOD – Ecosystem Development





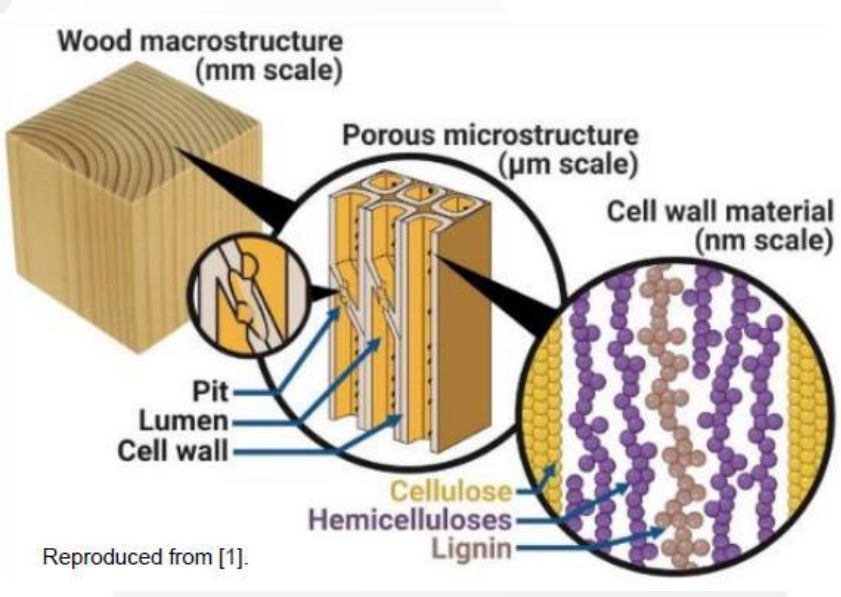
Addressing the challenge of wood mobilisation through a systemic innovation lens: The Irish forest sector innovation system, K Kilcline, A Ní Dhubh´ain, K Heanue, C O'Donoghue, Mary Ryan, Forest Policy & Economics, 102461, **128** (2021)

Irish Wood – Growing the Bioeconomy



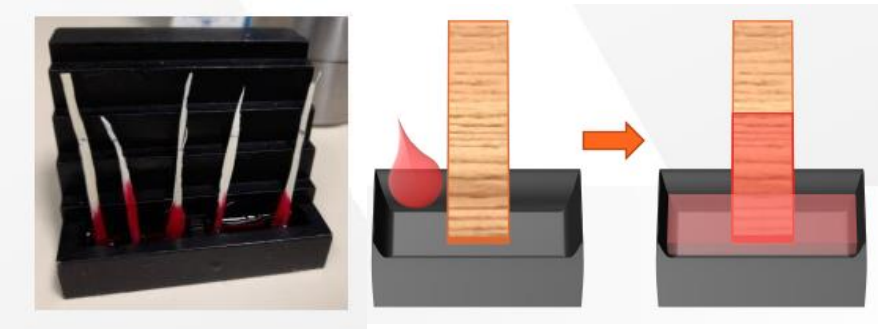
COFORD – Growing the Irish Forest Bioeconomy (2017); *Forest Products in the Global Bioeconomy*, FAO UN (2022); *Finnish bioeconomy on the global product market in 2035*, A Arasto, A Asikainen, A Kaukovirta LUKE/VTT (2021); *Developing a Sustainable and Circular Bio-Based Economy in EU: By Partnering Across Sectors, Upscaling and Using New Knowledge Faster, and for the Benefit of Climate, Environment & Biodiversity, and People & Business, Review*, L Lange, K O'Connor et al., Frontiers in Bioengineering & Biotechnology, **8**, 619066 (2021)

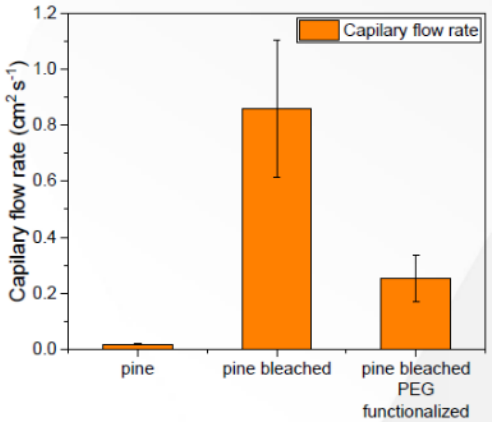
WP 1 – Composites: Transparent Wood



Major Polymers:
Cellulose [Most abundant biopolymer]
Hemicellulose
Lignin [2nd most abundant biopolymer]

Extractives: Resin & Tannin





[1] Wood Modification as a Tool to Understand Moisture in Wood, EE Thybring, M Fredriksson, *Forests*, **12(3)**, 372. (2021) [2] *High Performance, Fully Bio-Based, and Optically Transparent Wood Biocomposites,* C Montanari, Y Ogawa, P Olsén, LA Berglund, Science Advances, 2100559 (2021)

WP 1 – Green Chemistry - Extractives

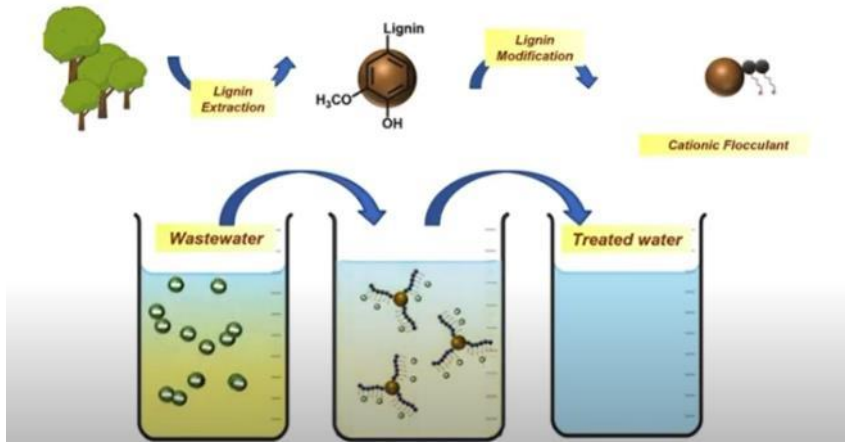
Tannins [1]

Potential Applications:

- Leather
- Pharmaceutical
- Biological
- Adhesive [low VOC] [2]

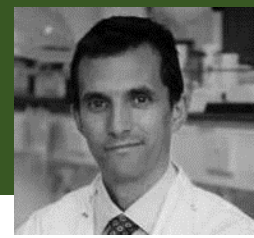
Student Innovation

Lignin based flocculants for dairy waste water treatment. Removing phosphate and nitrates from waste water.



[1] Tannin: a new insight into a key product for the bioeconomy in forest regions, M Pagliaro, L Albanese, A Scurria, F Zabini, F Meneguzzo, R Ciriminna, *BioFPR, **15**, 973 (2021);* [2] *Green Nanosilicas for Monoaromatic Hydrocarbons Removal from Air,* AM Ewlad-Ahmed, MA Morris, JD Holmes, DJ Belton, SV Patwardhan, LT Gibson, Silicon, **14**, 1447 (2002)

WP 2 – Biochemistry 2 High Value Chemicals



Pretreatment Defibration & Filtration

Cellulose

Micro Crystalline Cellulose

Nano Crystalline Cellulose

Hemicellulose

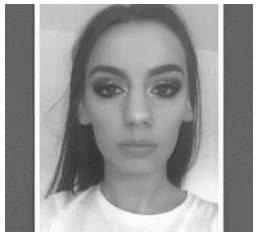
XOS

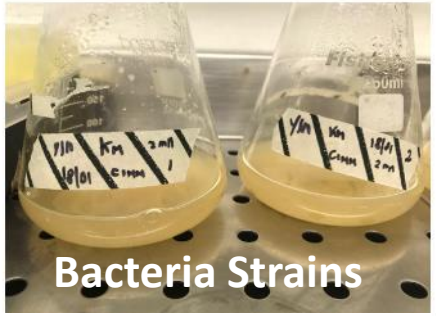
Lignin

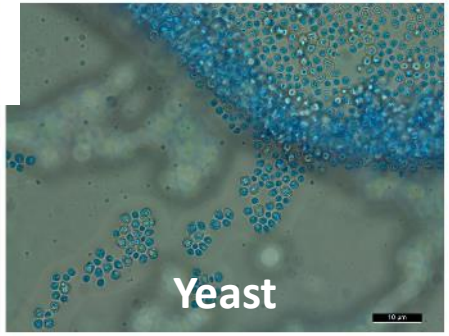
Yeast

Protein

Bioactives







Depolymerisation

Microbiology / Bacteria

Platform Chemicals

Medicinal Applications

Lactic Acid

J Nikodinovic-Runic, M Guzik, ST Kenny, RP Babu, A Werker, KE O'Connor, *Carbon-Rich Wastes as Feedstocks for Biodegradable Polymer (Polyhydroxyalkanoate) Production Using Bacteria*, **84**, 139, Advances in Applied Microbiology (2013)

WP 3 – Animal / Human Health - Wood products as prebiotics for human and ruminant health

- **Xylan is the major hemicellulose polysaccharide.**
- **XOS [Xylo-Oligosaccharides] are produced from breakdown of xylan.**
- **Various XOS function as prebiotics, supporting lactobacillus and bifidobacteria.**
- **Non-cariogenic, anti-inflammatory, anti-microbial, nutritional properties.**

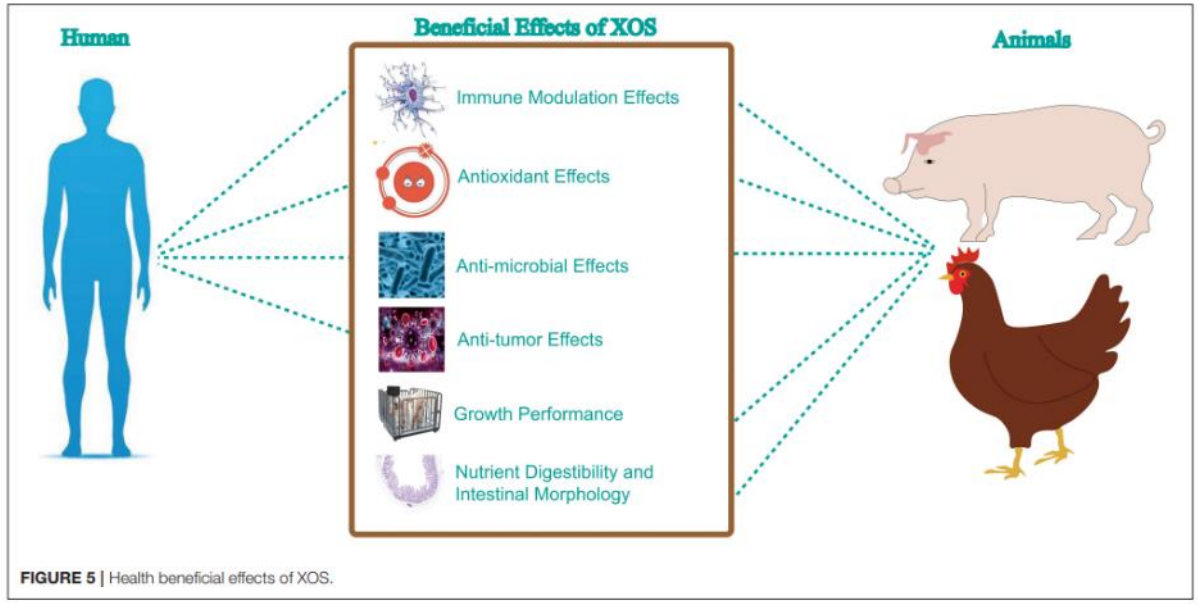
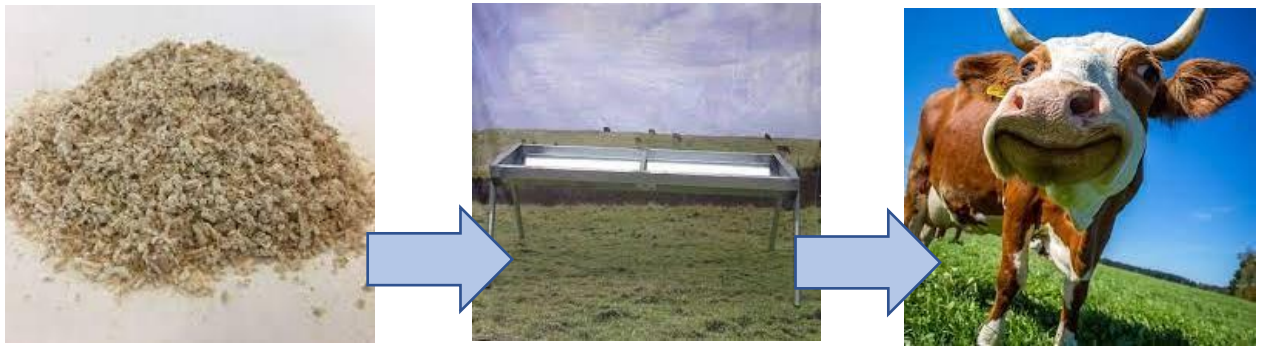


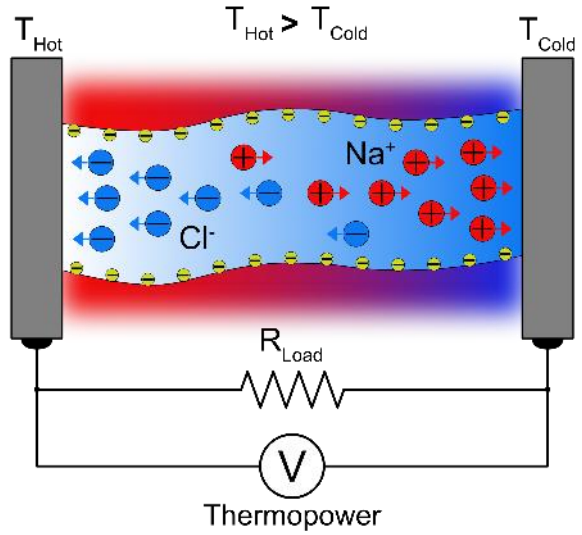
FIGURE 5 | Health beneficial effects of XOS.

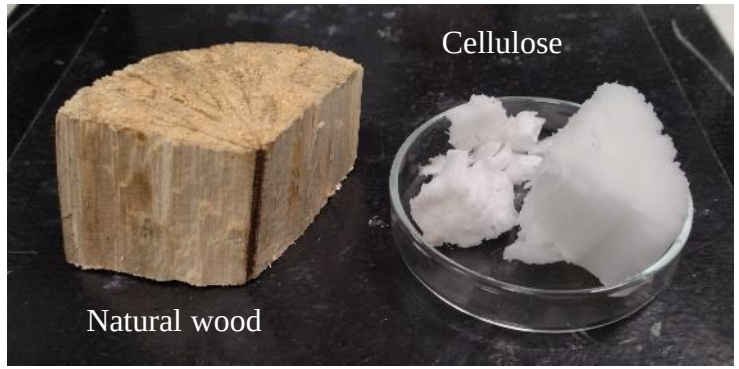


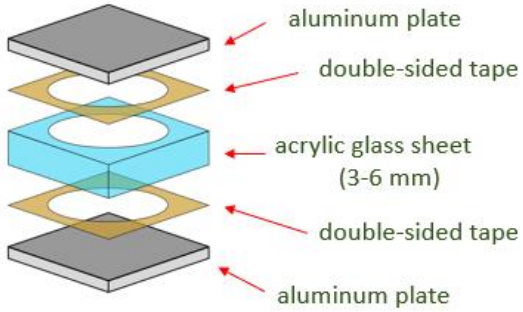
Xylo-Oligosaccharides, Preparation and Application to Human and Animal Health: A Review, X Chen, Y Xie, KM Ajuwon, R Zhong, T Li, L Cheng, H Zhang, Y Beckers, N Everaert , Frontiers in Nutrition, **8**, 731930 (2021)

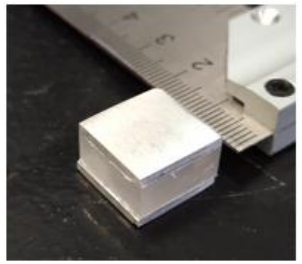
WP 4 – Emerging Applications / Energy

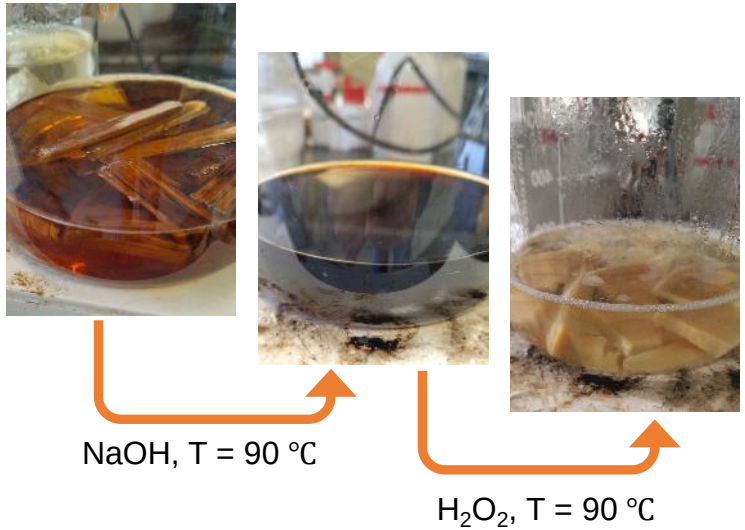
iTEG – ionic thermoelectric generator



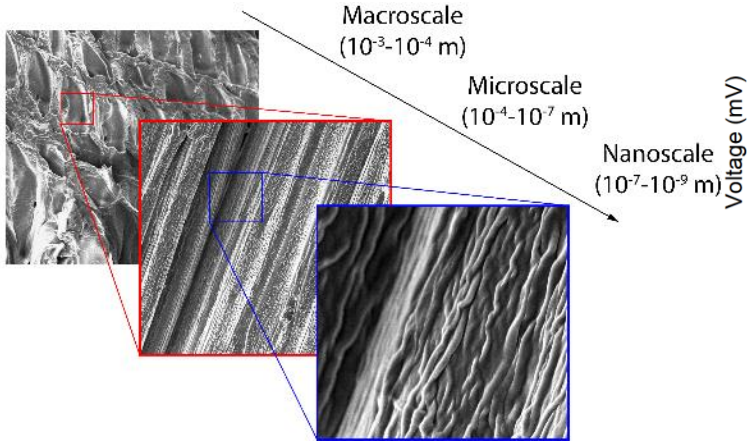


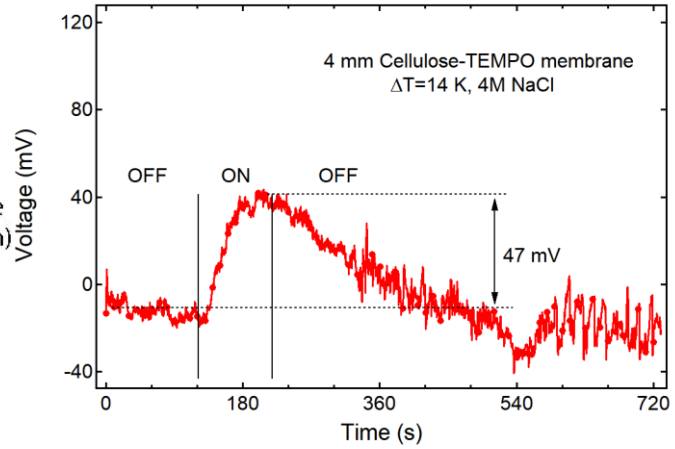




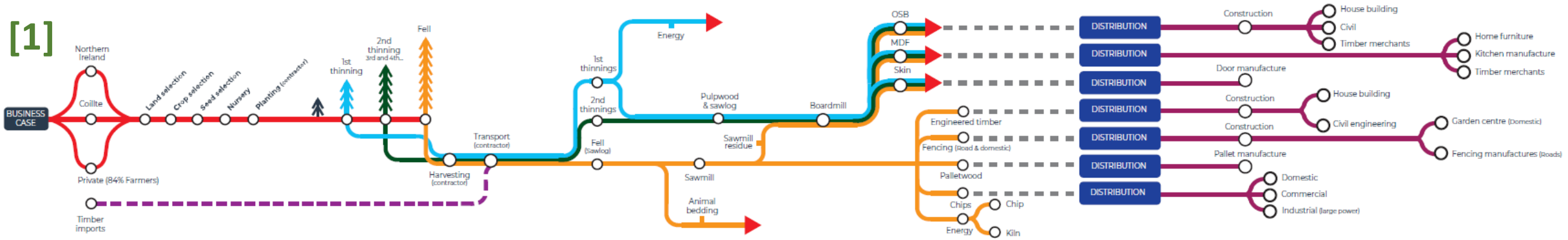


Manufacturing of wood-based nanofluidic membranes



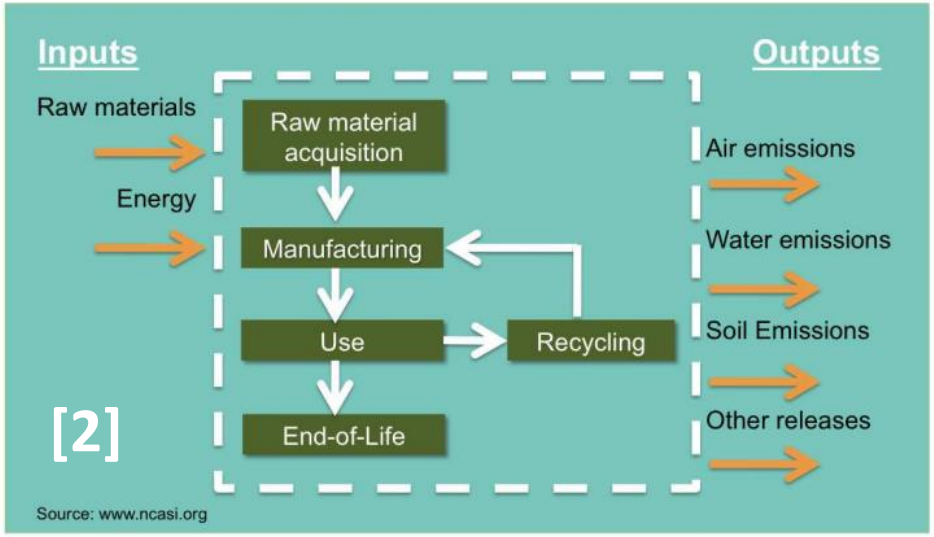


WP 5 – Life Cycle Assessment [LCA]



Forest Operations → Roundwood Transport → Mill Processing → Product Distribution

LCA [3-5] is embedded in all NXTGENWOOD WPs to underpin sustainability, circularity & climate objectives.



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WP 6 – Impact - € - Funding Diversification

TRANSLATE

European Commission | CORDIS EU research results

English EN

HORIZON 2020

The Recycling of waste heat through the Application of Nanofluidic ChannelS: Advances in the Conversion of Thermal to Electrical energy

UNIVERSITY COLLEGE CORK - NATIONAL UNIVERSITY OF IRELAND, CORK

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VIBES

Improving recyclability of thermoset composite materials through a greener recycling technology based on reversible bio-based bonding materials.

Project details

Type of action: Research & Innovation Action

Feedstock Other

Prof. MA Morris

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Press release

Tánaiste announces new Construction Technology Centre

From Department of Enterprise, Trade and Employment
Published on 21 July 2022
Last updated on 27 July 2022

- new Technology Centre will be hosted by NUI Galway
- broad-based consortium will leverage research talent and expertise to support vital sector

IDA Ireland

WP 6 – Impact – Key Findings

Review

The role of lignin and lignin-based materials in sustainable construction – A comprehensive review

Patryk Jędrzejczak [a], Maurice N. Collins [b,c], Teofil Jesionowski [a], Łukasz Klapiszewski [a,*]

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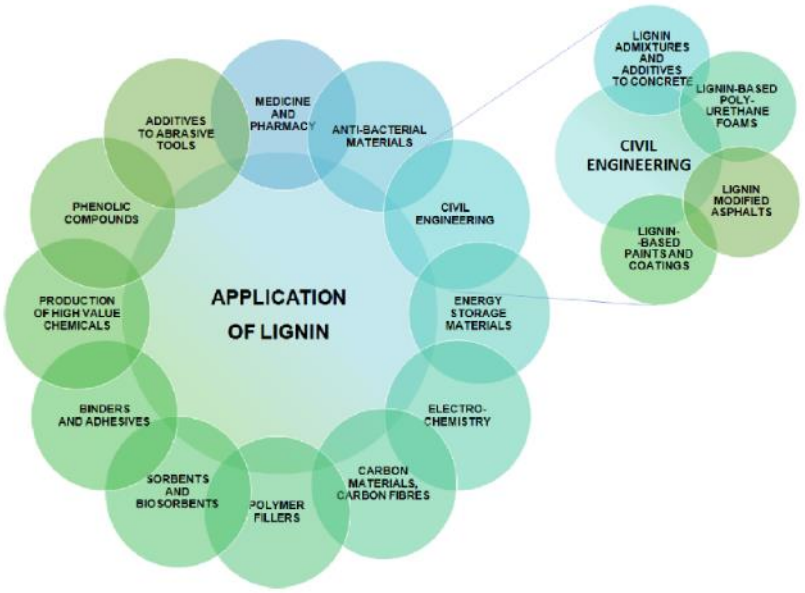
ARTICLE INFO

Keywords:
Functional materials
Sustainable construction
Lignin and lignin-based materials
Concrete additives

ABSTRACT

The construction industry in the 21st century faces numerous global challenges associated with growing concerns for the environment. Therefore, this review focuses on the role of lignin and its derivatives in sustainable construction. Lignin's properties are defined in terms of their structure/property relationships and how structural differences arising from lignin extraction methods influence its application within the construction sector. Lignin and lignin composites allow the partial replacement of petroleum products, making the final materials and the entire construction sector more sustainable. The latest technological developments associated with cement composites, rigid polyurethane foams, paints and coatings, phenolic or epoxy resins, and bitumen replacements are discussed in terms of key engineering parameters. The application of life cycle assessment in construction, which is important from the point of view of estimating the environmental impact of various solutions and materials, is also discussed.



Lignin Construction: *The role of lignin and lignin-based materials in sustainable construction – A comprehensive review*, P Jedrzejczak, MN Colins, T Jesionowski, Ł Klapiszewski, Macromolecules, **187**, 624 (2021)

Lignin Membranes / Filters: *Room Temperature Fabrication of Macroporous Lignin Membranes for the Scalable Production of Black Silicon,* N Prochukhan, SA O'Brien, A Davó-Quiñonero, A Trubetskaya, E Cotter, A Selkirk, R Senthamaraikannan, M Ruether, D McCloskey, MA Morris, Biomacromolecules, **6**, 2512 (2022)

Lignin Energy Materials: *Sustainable lignin precursors for tailored porous carbon-based supercapacitor electrodes, A Beaucamp, M Muddasar, T Crawford, MN Collins, M Culebras,* Int, J. Bio. Macromolecules, **221**, 1142 (2022)

Cellulose Energy Materials: *Cellulose: Characteristics and applications for rechargeable batteries*, M Muddasar, A Beaucamp, M Culebras, MN Collins, Int, J. Bio. Macromolecules, **219**, 788 (2022)

Acknowledgements & Additional Thanks

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- Joe Friel [WoodConnect]
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WP 1/6: Industry Stakeholder Engagement

Towards a R&D Roadmap for Irish Forest Processes & Products

Academic/Industry Workshop

Wednesday Sept 15th

Online Event

9:00-11:00 am

https://us02web.zoom.us/j/82995610518?from=addon

Meeting ID: 829 9561 0518

Speakers include: Ed Suttie, Director of Research at BRE Group, & Prof. Cathal O'Donoghue Chair of Social & Public Policy, NUIG/BiOrbic.

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ÉIRECOMPOSITES

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Irish Wood & Furniture Manufacturing Network

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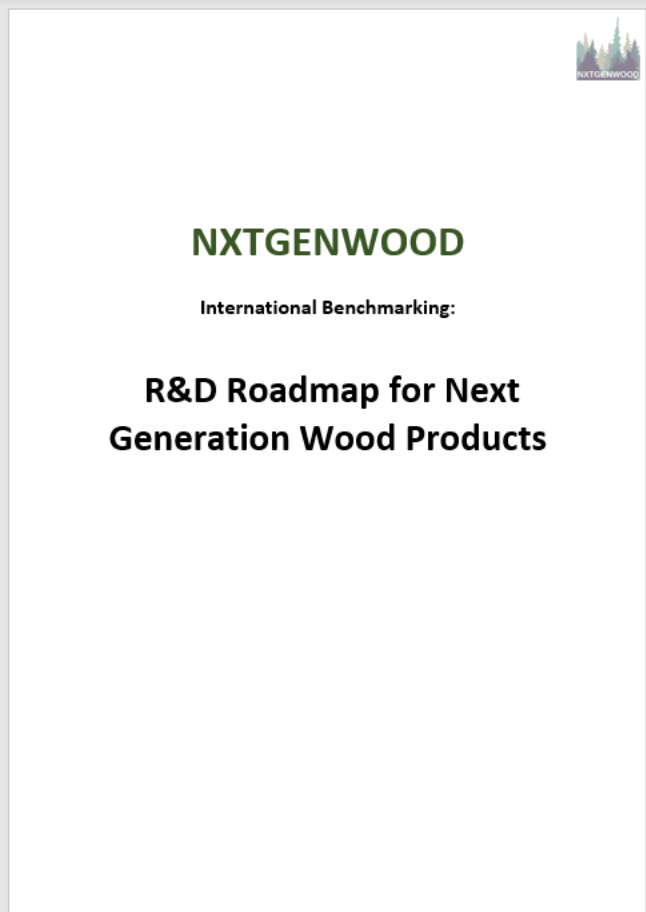
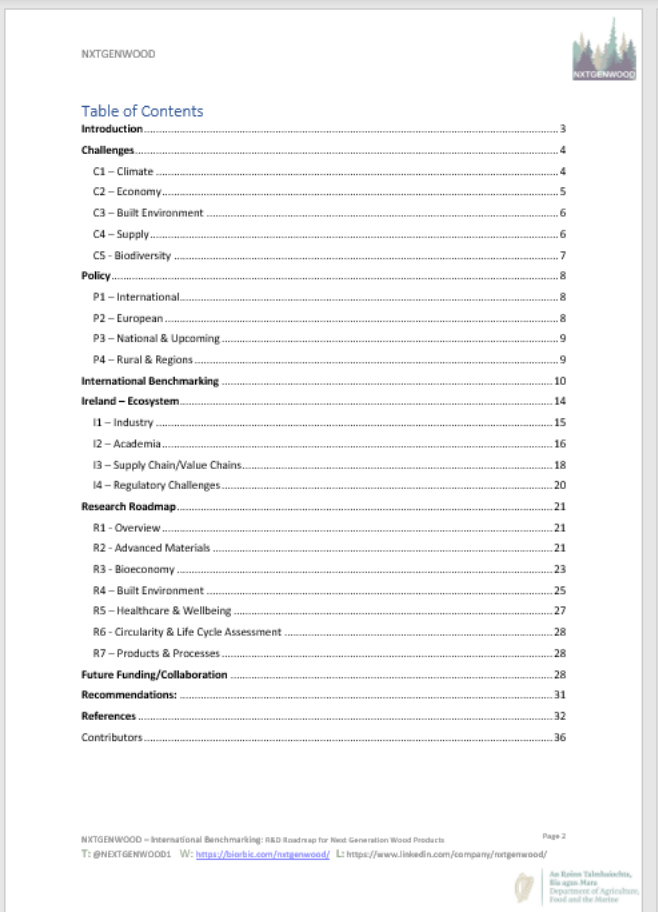
WP 1/6: Industry Alignment & Policy



NXTGENWOOD

International Benchmarking:

R&D Roadmap for Next Generation Wood Products



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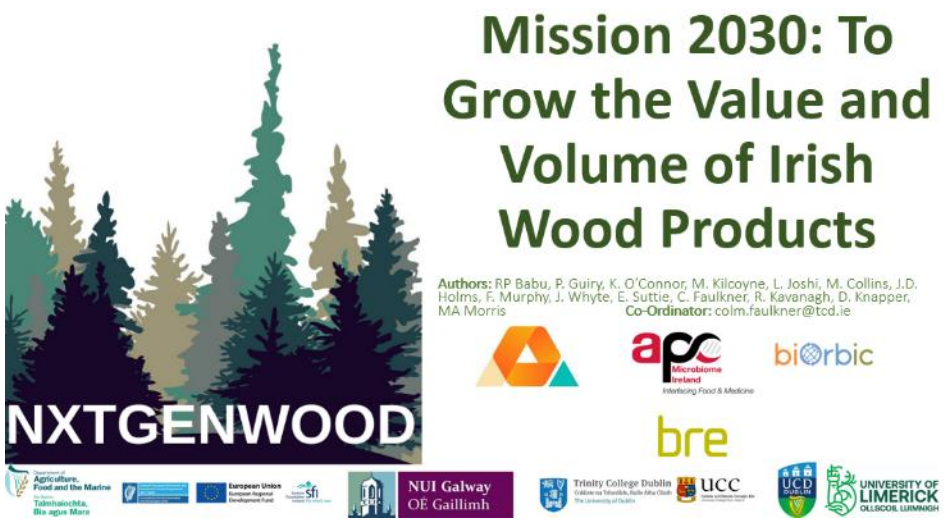

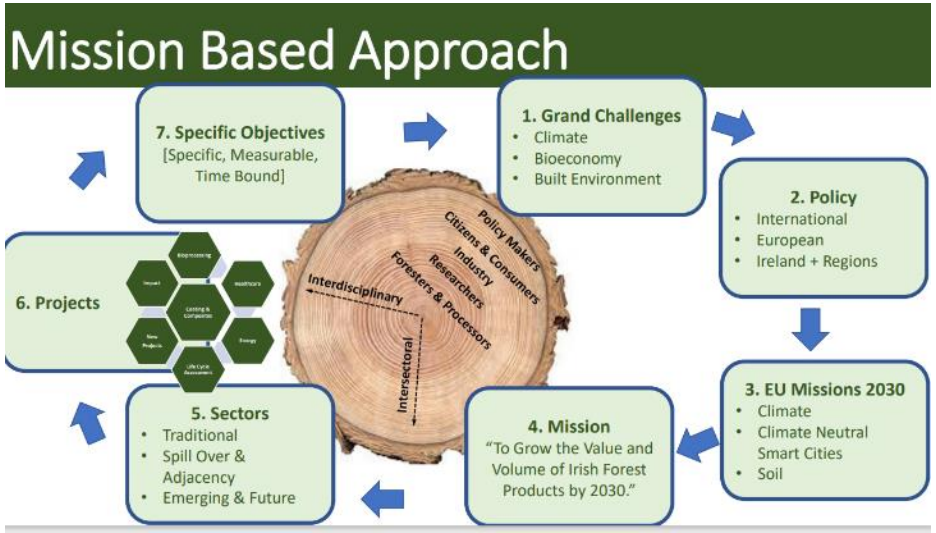

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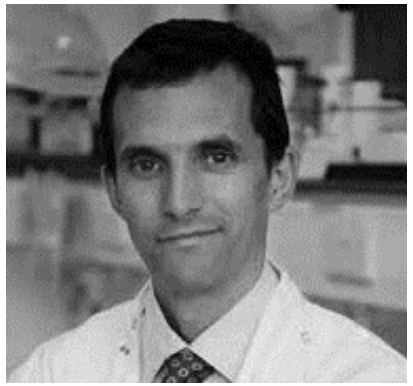

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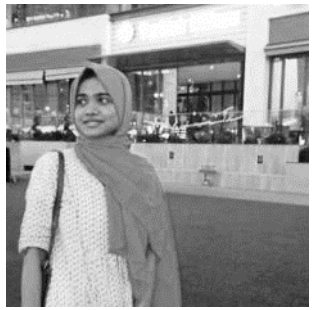

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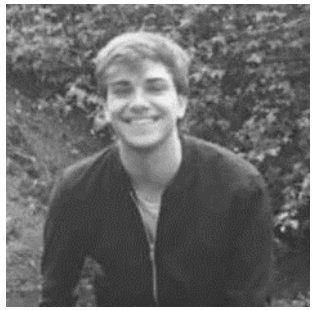

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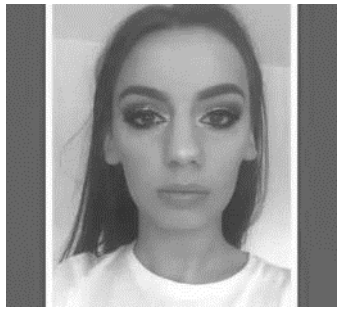

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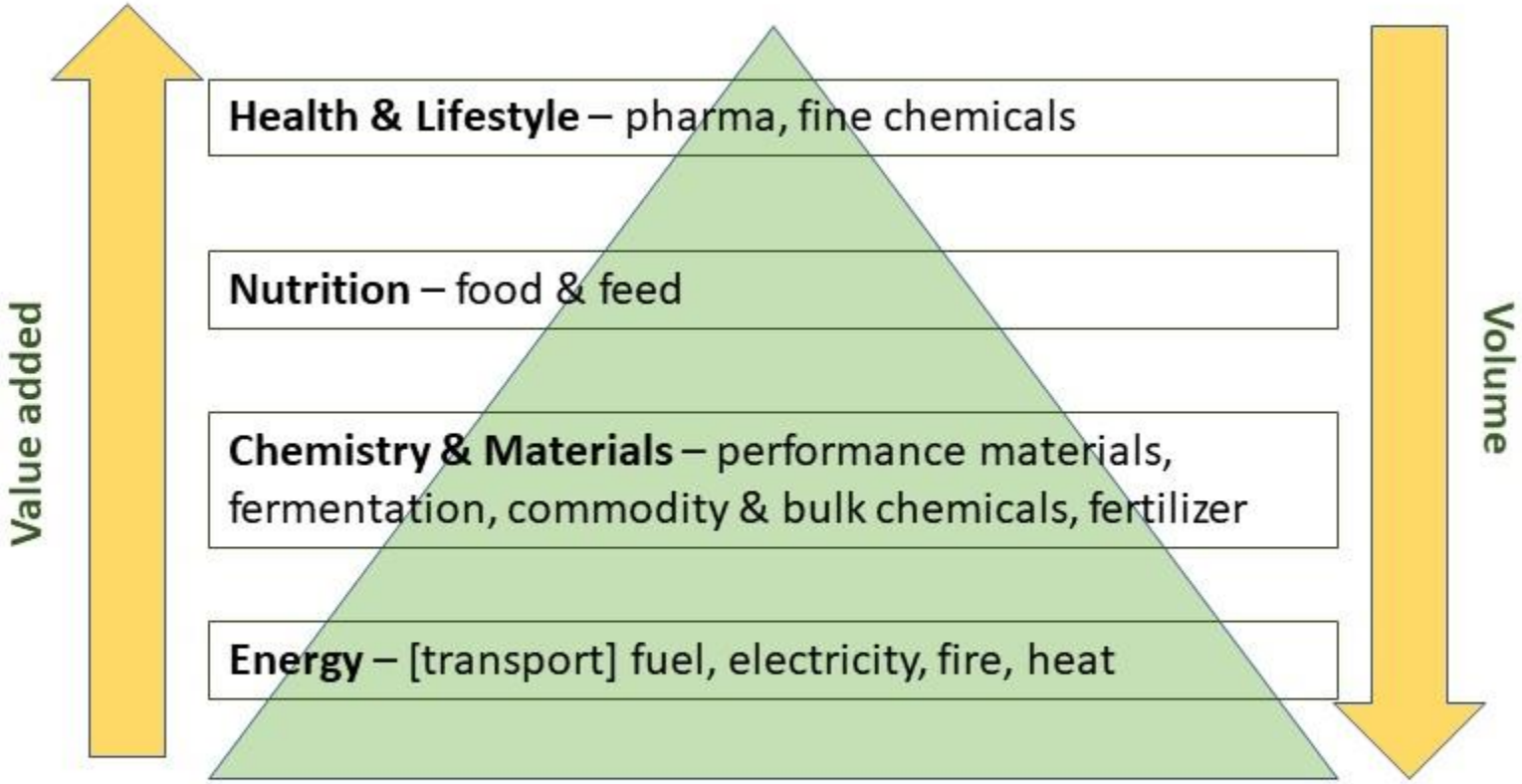
Biomass Value Pyramid



Source: Asveld L., R. van Est & D. Stemerding (Eds), Getting to the core of the bio-economy: A perspective on the sustainable promise of biomass. The Hague: Rathenau Instituut, 2011

NXTGENWOOD: Draft SAB/IAB

SAB:

LUKE – Prof. Antti Asikainen [Wood Science]

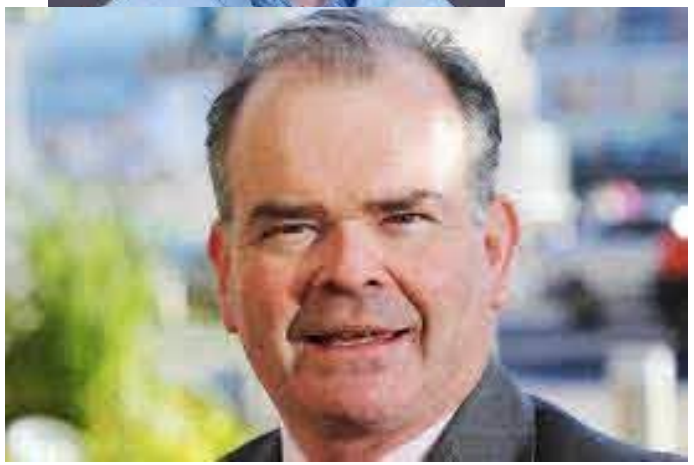
NUIG - Prof. Annette Harte [Wood Science] confirm

Teagasc – Dr. Nuala Ni Fhlatharta [Forestry Development]

Coillte - Kenneth Joyce [Commercial]

UCD – Dr. Charles Harper

MEDITE SMARTPLY
INNOVATIVE TIMBER PRODUCTS



IAB:

BBB - Eamon Blair [Adhesives]

BRE - Ed Suttie [Wood Science]

Medite SmartPly [Rory Rice] [Sustainability]

AMBER – Dan Knapper Business Development [IP/Impact]

Enterprise Ireland - Neil Kerrigan [Commercial]