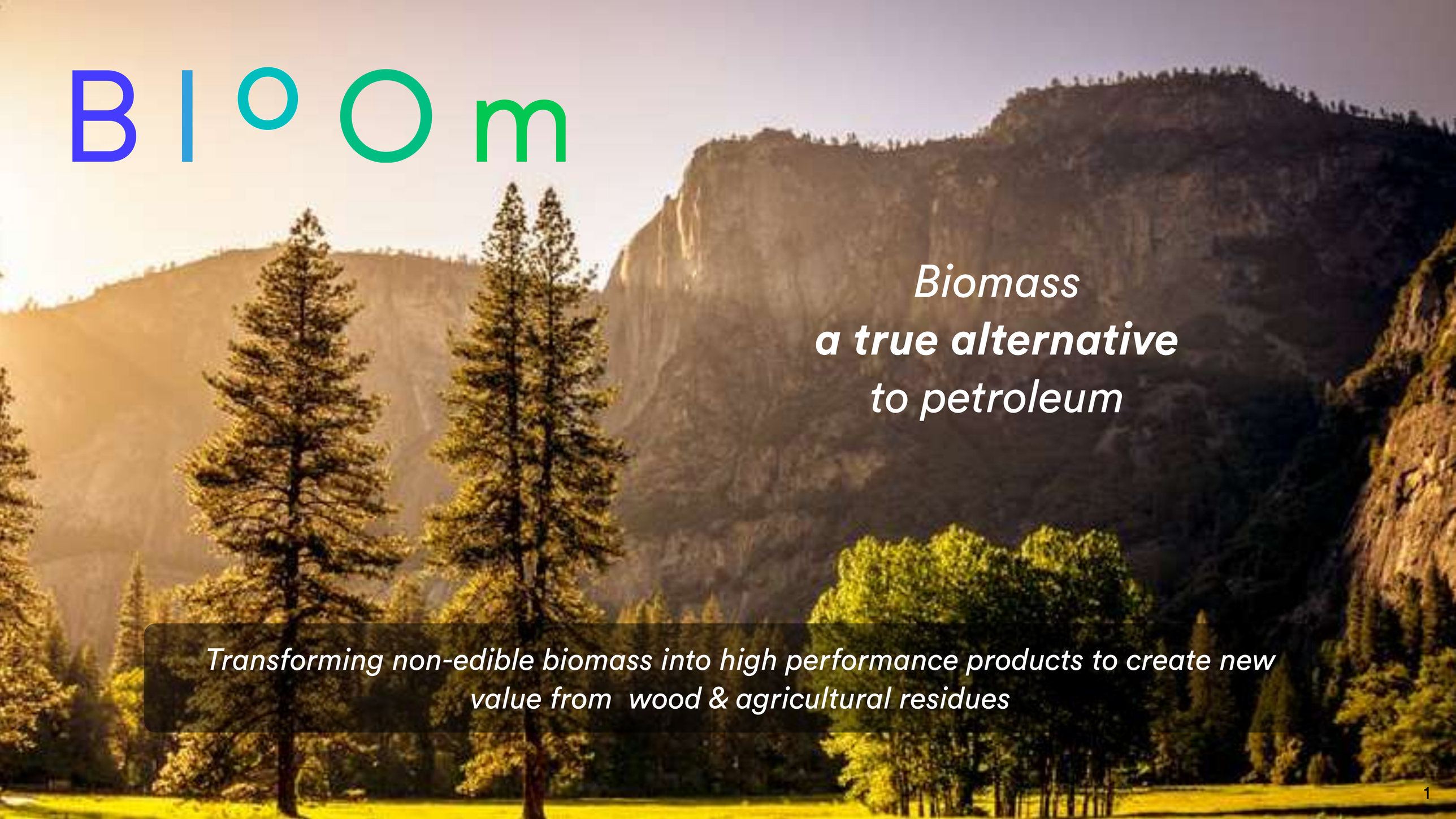


BIOm

Biomass
a true alternative
to petroleum

Transforming non-edible biomass into high performance products to create new value from wood & agricultural residues


100 million barrels
Every Day!

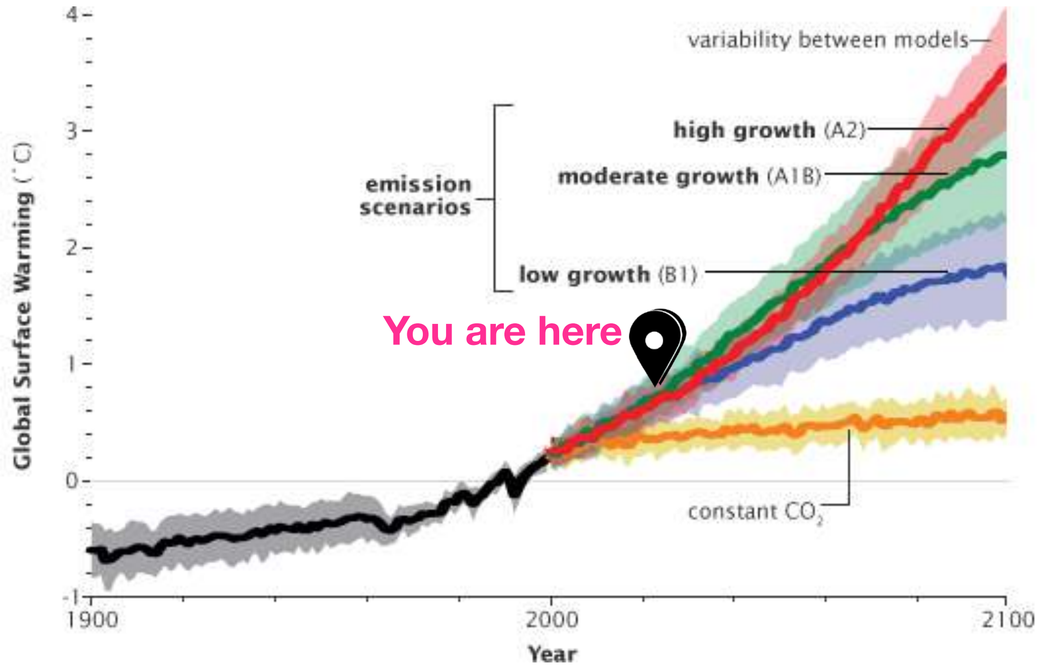

100 million barrels
Every Day!


100 million barrels
Every Day!
MISIA
CHANEL
PARIS
ARIEL
ORIGINAL


100 million barrels
Every Day!
Fossil resources
=
Modern life!
MISIA
CHANEL
PARIS
ARIEL
ORIGINAL

Challenge

Where do we stand?

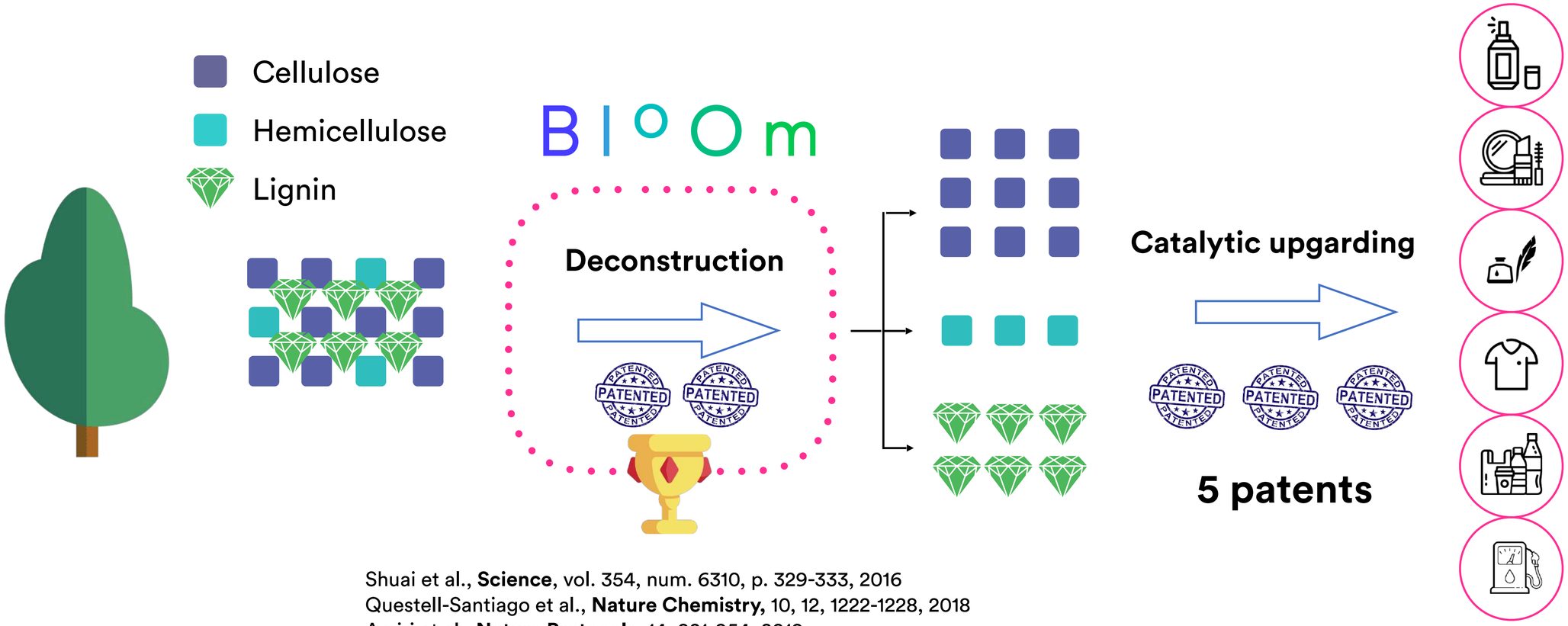


©2007 IPCC WG1 AR-4

Catalytic upgarding

Fossil resources = Modern life!

Challenge



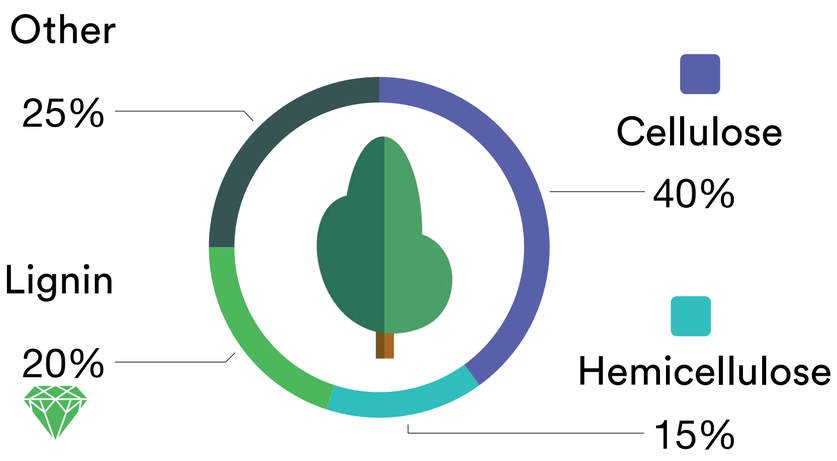
Shuai et al., **Science**, vol. 354, num. 6310, p. 329-333, 2016
Questell-Santiago et al., **Nature Chemistry,** 10, 12, 1222-1228, 2018
Amiri et al., **Nature Protocols**, 14, 921-954, 2019

Modern life!

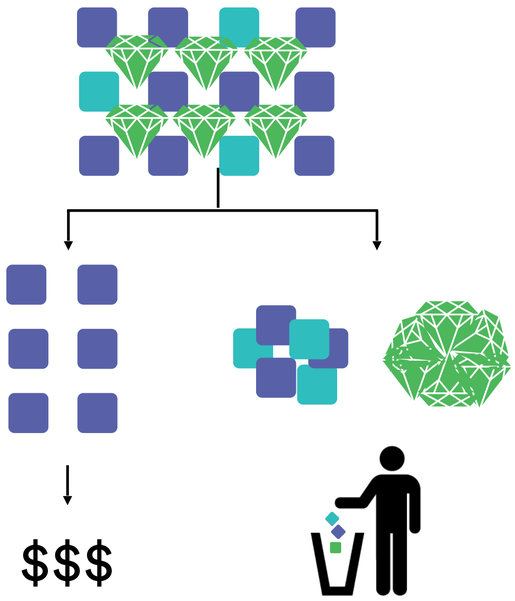
Biomass as a starting material

Using Aldehyde Assisted Fractionation (AAF), Bloom can - for the first time - stabilise and/or functionalise natural polymers.

Biomass composition



Today

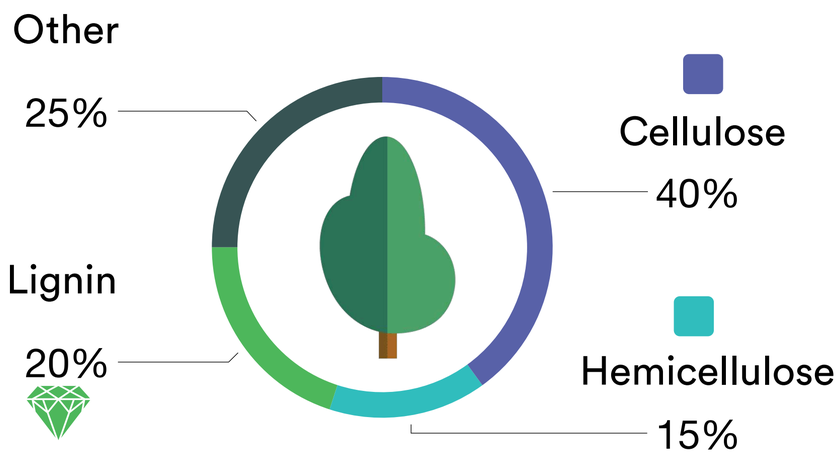


Chemical details in supplementary slides

Biomass as a starting material

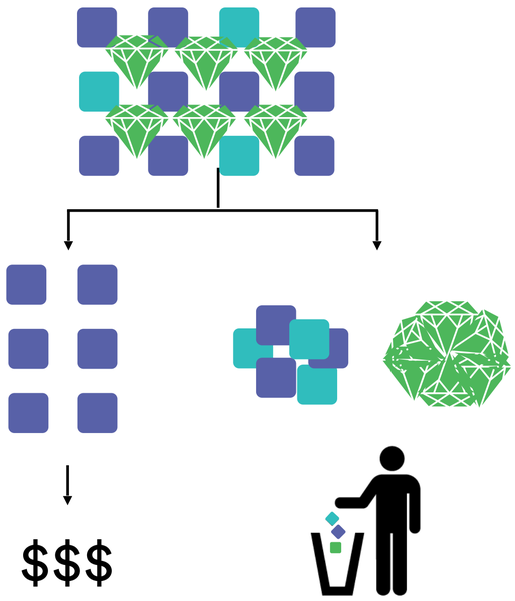
Using Aldehyde Assisted Fractionation (AAF), Bloom can - for the first time - stabilise and/or functionalise natural polymers.

Biomass composition

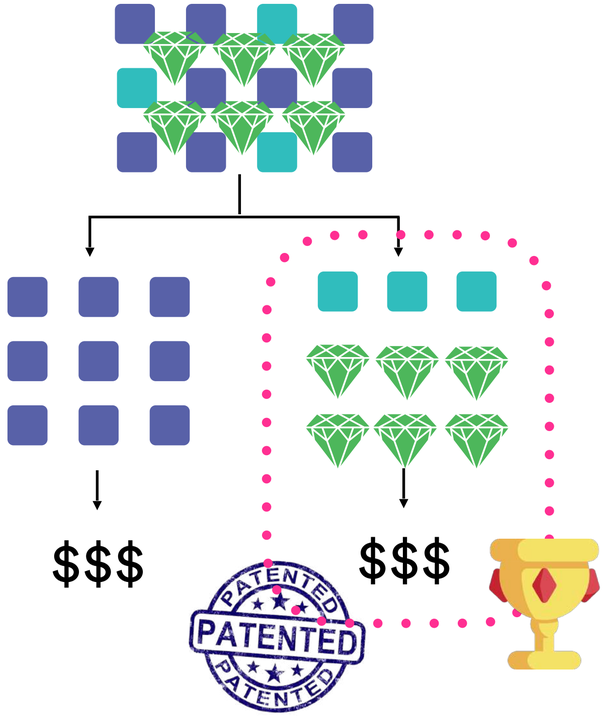


Chemical details in supplementary slides

Today



Tomorrow

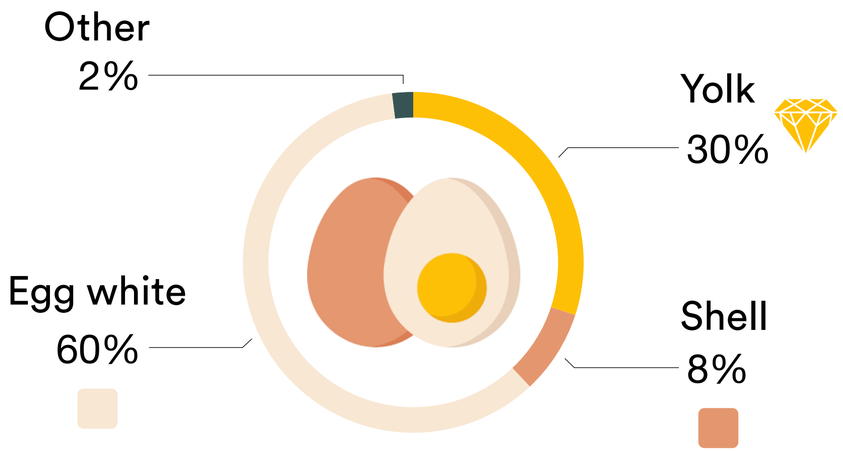


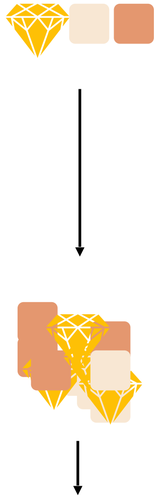
5 patents

Allegory of the egg

Aldehyde Assisted Fractionation (AAF) can be compared to the fractionation of part of an egg, if done right.

Egg composition	Today	Tomorrow



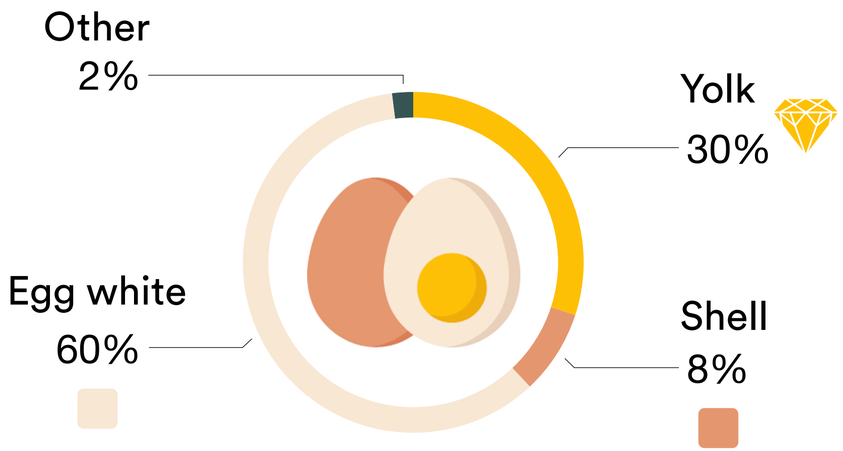


Products

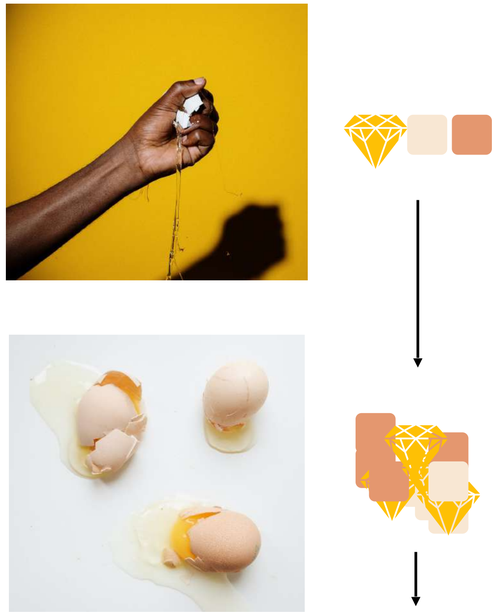
Allegory of the egg

Aldehyde Assisted Fractionation (AAF) can be compared to the fractionation of part of an egg, if done right.

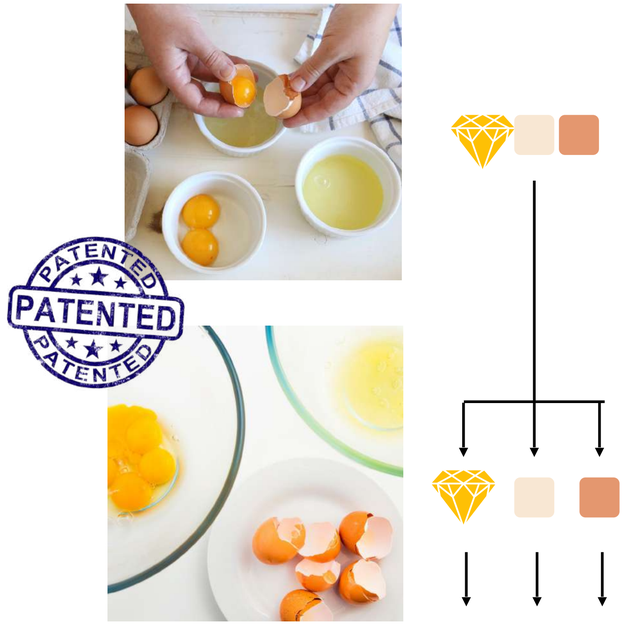
Egg composition



Today



Tomorrow



Products

Products enabled - selected list

	Cellulose	Hemicellulose	Lignin			
Global Market	Textile fibbers (13 B€)	Bioplastic (PET-like) (22 B€)	Bunker fuels (>100 B€)	Cosmetics (69 B€)	Inks (3 B€)	Fragrances (24 B€)
	ooo More	ooo More				ooo More
Customers	✓	✓	✓	✓	✓	✓
Partners	✓	✓	✓	✓	✓	✓
		PATENTED				PATENTED

Roadmap

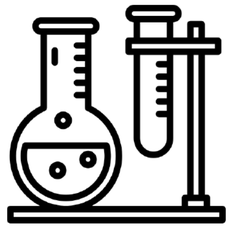
BIOOm

Licensing

Manufacturing

Technology

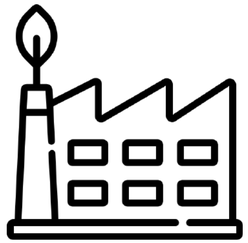
Proof of Concept
1g



Lab-scale
1kg

Pilot
50t/y

Demo
10’000t/y



Commercial
100’000t/y

2016 | 2018 | 2020 | 2022 | 2024 | 2026

Pre-seed
€0.5M

Seed
€3.9M

Technology licensing
Series B

Fundraising

Grant & Prize
44%

Equity
56%

YOKOGAWA

Breakthrough Energy

CLOSED

Series A + grants
€30-55M

Let’s join forces

Dr. Remy Buser
Co-founder & CEO

Route de l’Ancienne Papeterie 106
1723 Marly
Switzerland

Supporters

Target SDGs

2016 2017 2018 2019 2020

Supplementary slides

Team

*Hired by either EPFL or HEIA

15 FTEs

Serial entrepreneurs

Scientific excellence

Industry expertise

Management

Operations

Dr. Florent Héroguel

Strategy

Dr. Remy Buser

Board Members

EPFL

Prof. Jeremy Luterbacher

Roche Givaudan

Matthias Währen

Breakthrough Energy

Gaetan Bonhomme

DANONE Givaudan

Sophie Rouzeau

Sales

Sofia Antunes

Production and scale-up

Pilot operation

Chloé Wegmann*

Vincent Pilloud*

Lucien Blanchard

Romain Aquoise

Antoine Bourgeois

Process

Dr. Etienne Gatt

Marie Jones*

Safety

Ruoxing Liao

Products development

Lignin products

Dr. Monique Figueirêdo

Dr. Ydna Questell

Christèle Rayroud*

Dr. Arpa Gosh*

Justine Charmillot

Biomaterials

Dr. Philip Scholten

Maxime Hedou*

Thibault Rambert*

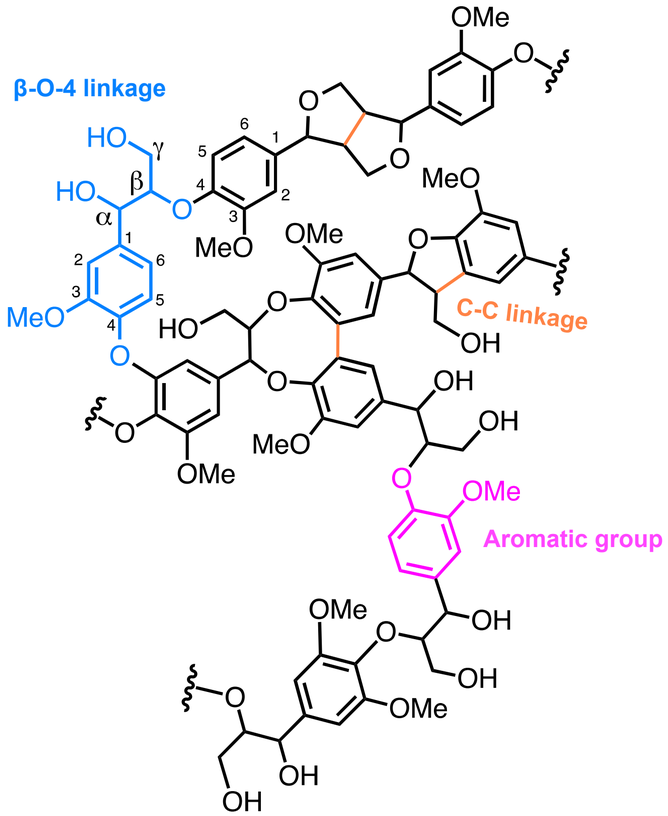
Mariella Vieli

Cellulose products

Gwendal Prigent

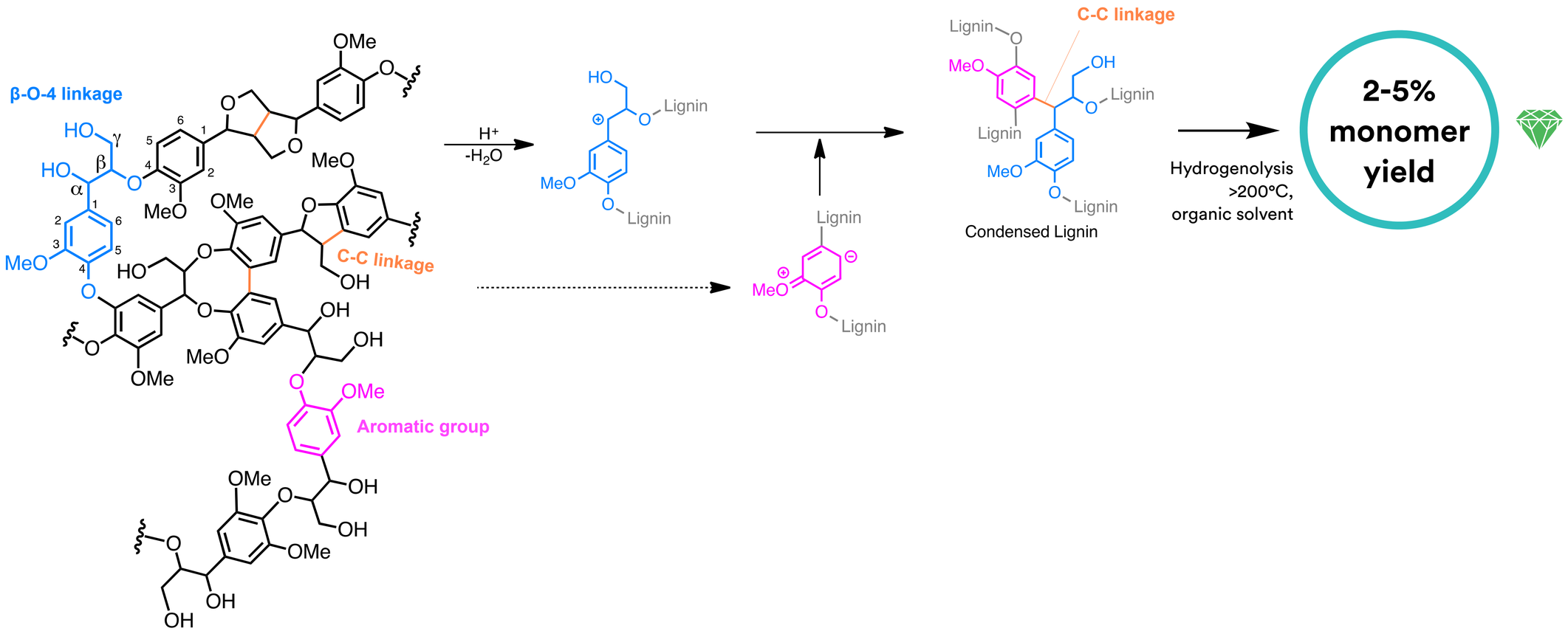
Unfair advantage

Shuai, Luterbacher et al., *Science*, **2016.**



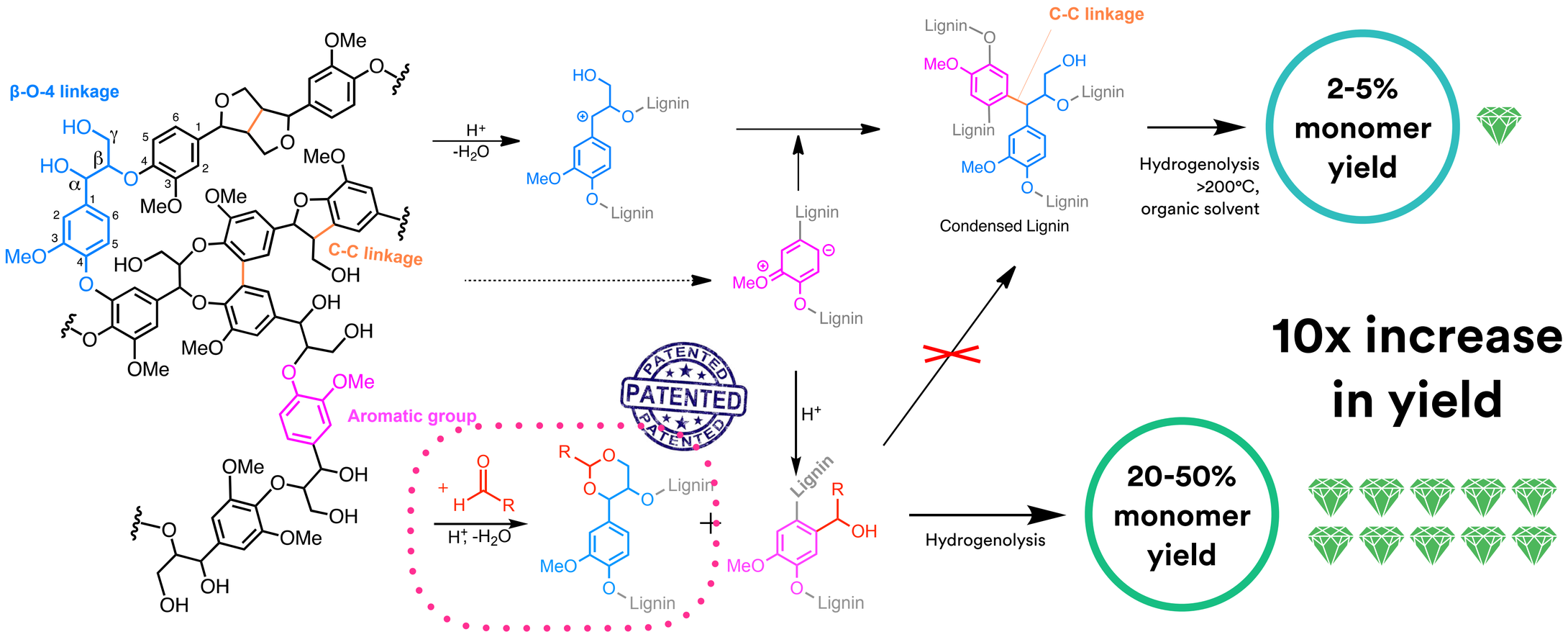
Unfair advantage

Shuai, Luterbacher et al., *Science*, **2016.**



Unfair advantage

Shuai, Luterbacher et al., *Science*, **2016.**



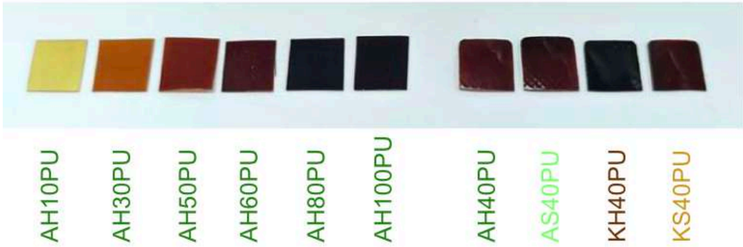
Unfair advantage for applications

BioMACROMOLECULES
pubs.acs.org/Biomac Article

Aldehyde-Assisted Lignocellulose Fractionation Provides Unique Lignin Oligomers for the Design of Tunable Polyurethane Bioresins

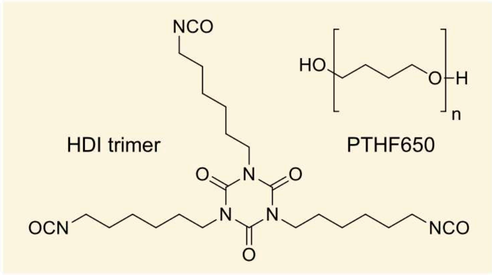
Richard Vendamme,* Jean Behaghel de Bueren, Jaime Gracia-Vitoria, Florence Isnard, Mikael Monga Mulunda, Pablo Ortiz, Mohan Wadekar, Karolien Vanbroekhoven, Chloé Wegmann, Raymond Buser, Florent Héroguel, Jeremy S. Luterbacher, and Walter Eevers

Cite This: *Biomacromolecules* 2020, 21, 4135–4148 Read Online

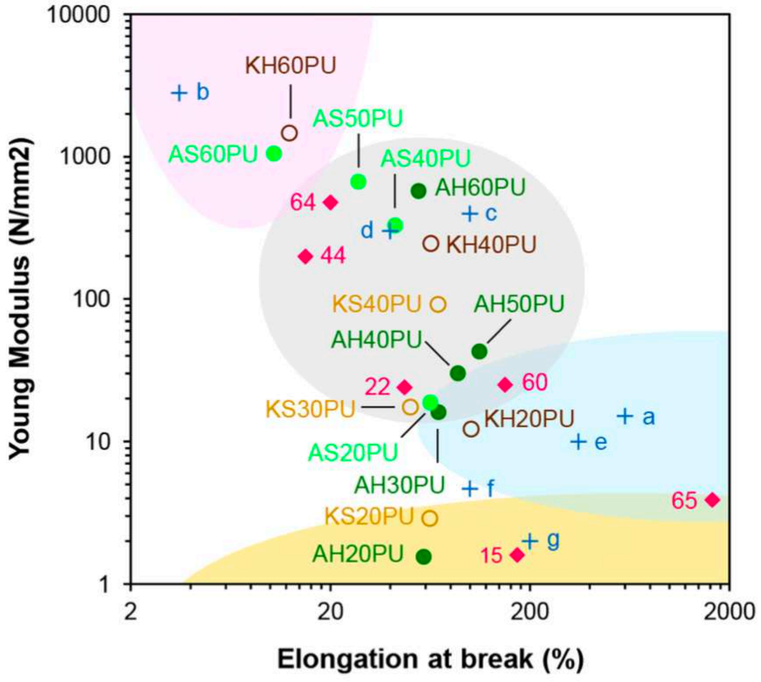


Formulation of Lignin PU Thermosets

A H 50 PU



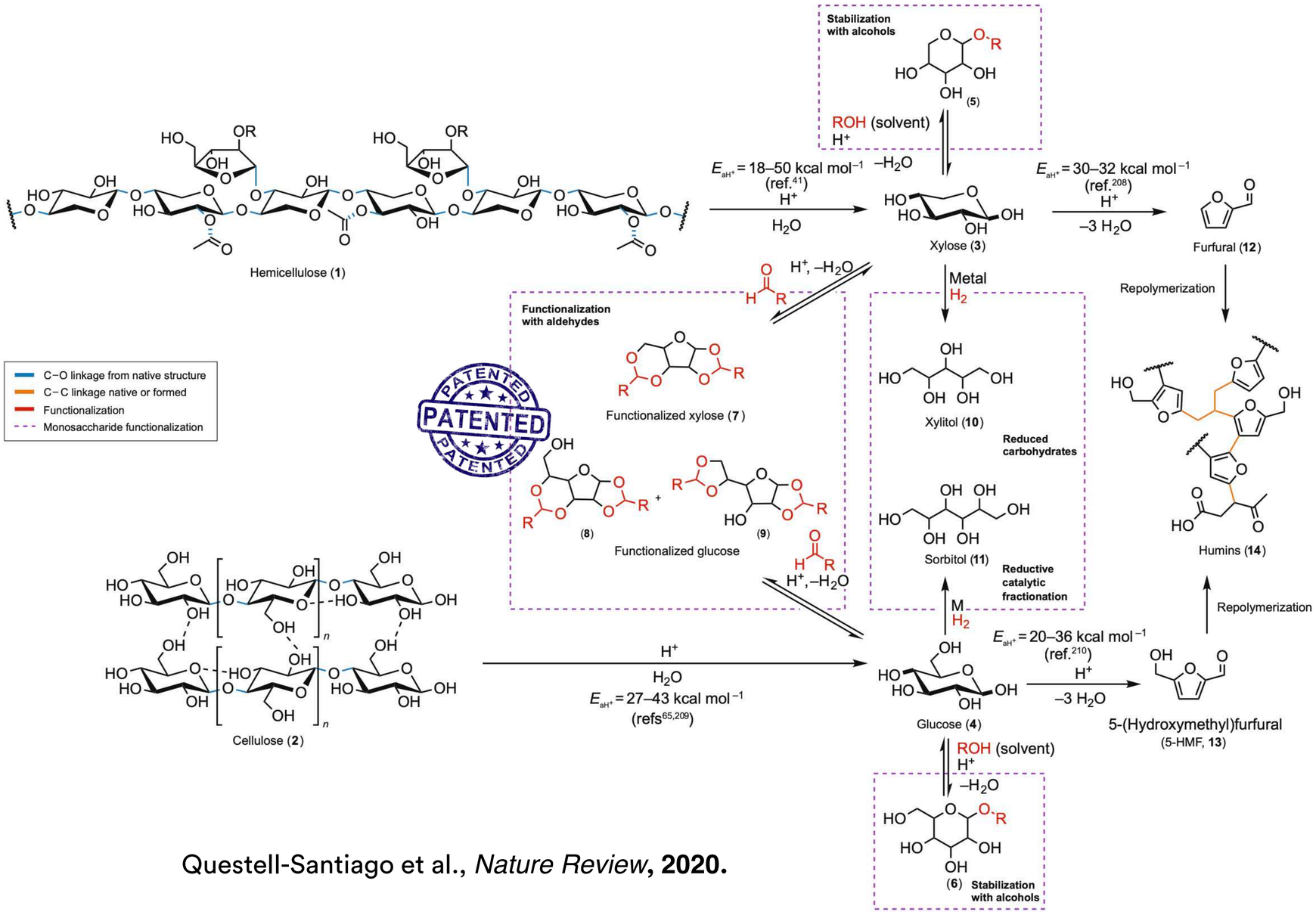
- Biorefining process: A=AAF; K=Kraft extracted
- Lignin botanical origin: H=Hardwood; S=Softwood
- Substitution ratio: weight% of lignin in the polyol mix
- Crosslinked material with 0.9 molar NCO/OH ratio



« Hard » Materials	« Elastomeric » Materials
« Super soft » Materials	« Hyperelastic » Materials

◆	Lignin-based biopolymers from sci. literature
44	LPU with 20% non-fractionated Kraft
15	LPU from chemically modified lignin and fatty acids
64	LPU from Kraft lignin and castor oil (20%lignin)
60	Thermoplastic nano-structured lignin elastomers
65	High-elongation & high-strength elastomer (30% lignin)
22	Epoxy resins from fractionated Kraft (38% lignin)
+	**Commercial products (focus adhesives/sealants)**
a	Polyether-based TPU for injection molding: IROGRAN® A 92 P 4851 (Huntsman Corp.)
b	Tough and high strength assembly epoxy adhesive: SikaPower®-1200 (Sika AG)
c	2K PU adhesive combining strength and flexibility: SikaForce®-840 (Sika AG)
d	Paint shop sealant based on flexibilized epoxy resin: SikaPower®-4508 (Sika AG)
e	2K PU with high elasticity for structural bonding: SikaForce®-7550 (Sika AG)
f	2K silicone UV resistant insulating glass sealant: Sikasil®-IG25 (Sika AG)
g	1K PU elastic adhesive for flooring applications: SikaBond®-T8 (Sika AG)

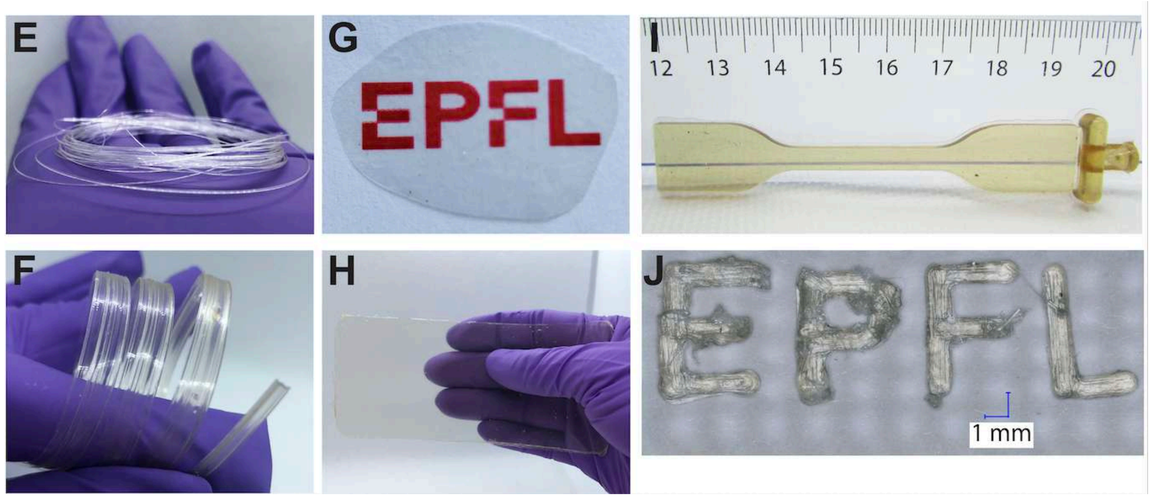
Unfair advantage



Questell-Santiago et al., *Nature Review*, **2020.**

PAX - a new family of renewable polymers

Properties
- Excellent mechanical properties
- Good barrier properties (better than PLA, PHB & PBS)
- Transparent
- Chemically recyclable & (bio)degradable
- Compatible with existing production facilities



Potential of lignin monomers