

# LignoCOST - Pan-European Network on the Sustainable Valorisation of Lignin (CA17128)

Duration 4-10-2018 - 3-10-2022

Online NWBC conference, October 13-15 2020, Stockholm, Sweden

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# Grant holder Wageningen Food & Biobased Research

Applied research for sustainable innovations

- In-depth knowledge of the entire agri-food chain
- Market oriented R&D approach
- Multi-disciplinary applied R&D project teams; 250 employees
- Up-scaling: from lab to pilot
- Connection with the University of Wageningen



Sustainable Food Chains



Biobased Products



Healthy & Delicious Foods

# Need for pan-Europe network

- Lignin has large potential, is underexploited, but has also large challenges
- Industry is now more convinced of valorisation of side streams (e.g. lignin)
- Last 5 years industrial lignin production increased
- Knowledge is scattered in Europe
- To overcome challenges, hurdles
- Multi-actor network needed to connect whole development-deployment chain
- Development knowledge to built new value chains including industrial valorisation of lignin
- Not only focusing on connecting Academic persons but also on SMEs and industry
































# Recent developments on lignin

- Suzano/Fibria is running a demoplant Limeira for Kraft lignin production
- Klabin started a pilot plant production of Kraft lignin
- Avantium opened a LC fractionation pilot plant to produce HCl extracted lignin
- Clariant started a precommercial plant on LC ethanol generating a lignin side stream
- The SWEETWOODS project, a BBI Flagship project, is establishing a first-of-a-kind wood fractionation demo plant in Estonia that uses sustainable hardwood biomass as raw input material to produce high quality sugars and lignin
- In the Netherlands several demonstration roads (15) have been paved with up to 50% lignin based bituminous binders
- Trespa/Arpa launched a new production line on board materials in which 50% lignin based PF resins in the core are used. Also UPM, Stora Enso announced these for plywoods.
- New collaborations within the biorefinery / lignin field started: SEKAB + Vertoro, Praj + SEKAB, Fortum + Chempolis, ....



# Participants (269)

- 36 countries
- 4 NNC
  -  Ukraine (UA)
  -  Lebanon (LB)
  -  Georgia (GE)
  -  Algeria (DZ)
- 4 IPC accepted
  -  Canada (CA) *Dr. Zhirun Yuan, FP Innovations*
  -  Colombia (CO) *Prof. Ramon Colmenares, Uni Colombia*
  -  South Africa (SA) *Prof. Annegret Stark, Uni SKwazulu-Natal*
  -  New Zealand (NZ) *Dr. Daniel van de Pas, Scion*

 Austria [AT]	
 Belgium [BE]	
 Bosnia and Herzegovina [BA]	
 Bulgaria [BG]	
 Croatia [HR]	
 Cyprus [CY]	
 Czech Republic [CZ]	
 Denmark [DK]	
 Estonia [EE]	
 Finland [FI]	
 France [FR]	
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	 Netherlands [NL]
	 Norway [NO]
	 Poland [PL]
	 Portugal [PT]
	 Romania [RO]
	 Serbia [RS]
	 Slovakia [SK]
	 Slovenia [SI]
	 Spain [ES]
	 Sweden [SE]
	 Switzerland [CH]
	 Turkey [TR]
	 United Kingdom [UK]
	 Macedonia [MK]

# Objectives

- To establish a whole chain network focusing on sustainable lignin production, conversion and valorisation
- To deliver answers for the main scientific, technical, engineering and market deployment questions on lignin valorisation
- To create a platform for the actors to cooperate and exchange know-how of experienced and young researchers and other (industrial) stakeholders

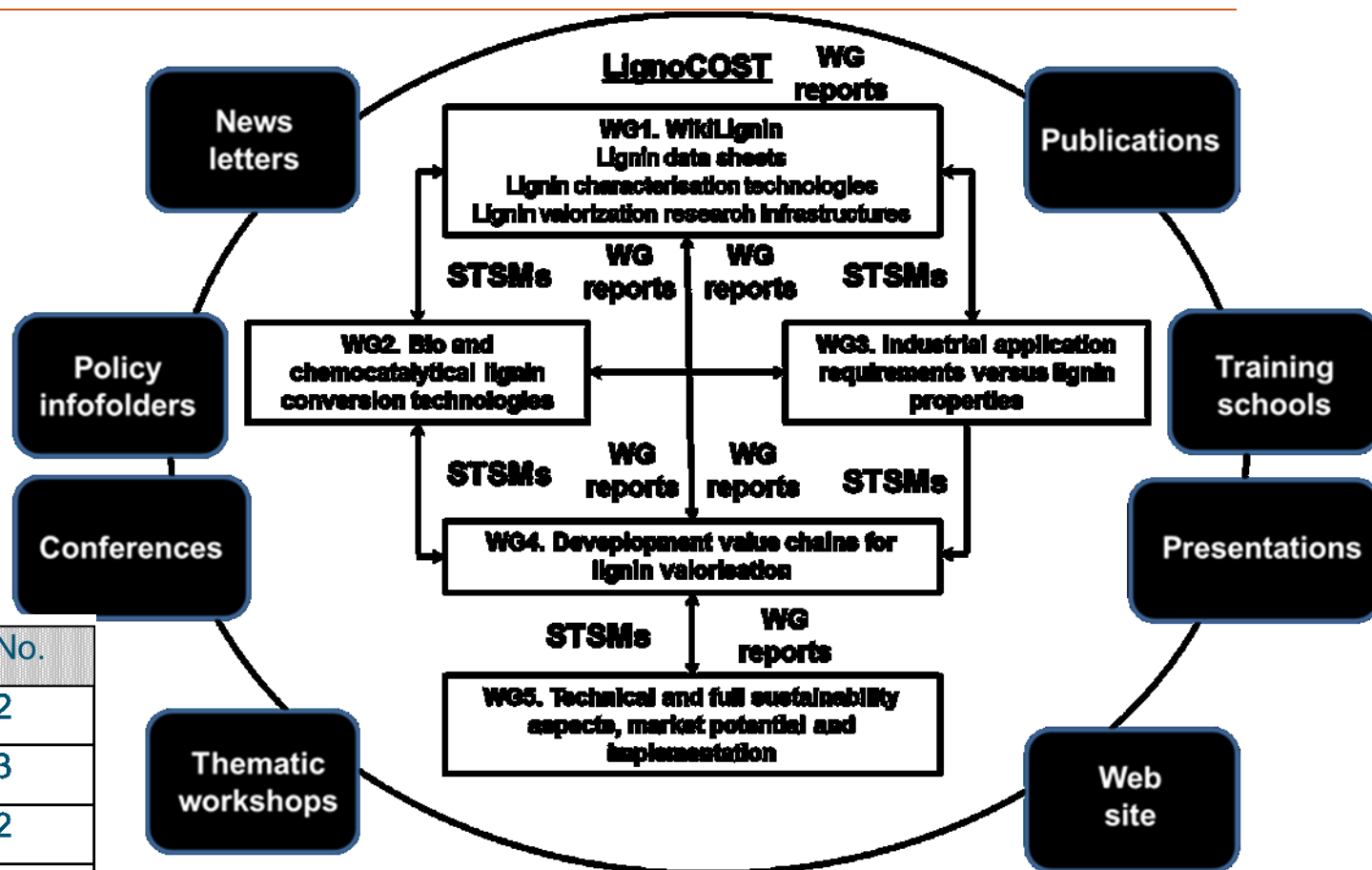
# Secondary objectives

- Develop a web tool-based lignin information portal (**WikiLignin**)
- Develop knowledge on standardisation, regulation (REACH), improvement of lignin's intrinsic properties by innovative processing
- Assess the international state-of-the-art (lignin providers, technologies, stakeholders) as reference to support European lignin-based business development
- Set-up an inventory of industrial market application requirements versus lignin properties
- Assess the performance of lignin conversion processes at relevant technology readiness levels (TRLs)
- Evaluate **technical and sustainability** aspects, market potential and implementation potential, of most promising lignin valorisation routes



# Deliverables

Deliverable	No.	Deliverable	No.
Website	1	Training schools	2
WG reports	13	Conferences	3
Progress reports	15	Thematic workshops	2
Policy infolders	8	Publications	> 4
STSMs	30	Presentations	> 6
Newsletters	8		



# Management core group

Role	Nominated person	Company	Country
Action chair	Richard Gosselink	WFBR	NL
Action vice-chair	Tarja Tamminen	VTT	FI
Grant Holder scientific representative	Richard Gosselink	WFBR	NL
Grant Holder manager	Ted Slaghek	WFBR	NL
STSM grant coordinator	Filomena Barreiro	Instituto Politécnico de Bragança (IPB)	P
Science communication manager	Konstantinos Triantafyllidis	Aristotle University of Thessaloniki	GR
ITC conference grant manager	Marta Goliszek	Maria Curie-Skłodowska University (UMCS)	PL

# Working groups

Working Group	Title	Nominated WG Leader
1	WikiLignin, lignin infrastructure	Bernard Kurek, INRAE (FR)
2	Production and catalytic conversion technologies, incl. TRL assessment	Pieter Bruijninx, Utrecht University (NL)
3	Industrial application requirements versus lignin properties	Karolien Vanbroekhoven, VITO (B)
4	Development of value chains for lignin valorisation	Per Tomani, RISE (SE)
5	Technical and full sustainability aspects, LCA, market deployment potential and implementation	Apostolis Koutinas, Agricultural University of Athens (GR)

# Networking tools

- Meetings
  - Workshops
  - Short term scientific missions (STSM)
  - Inclusiveness Target Countries (ITC) conference grant
  - Support publication fee
- 
- Only budget for travel & subsistence costs (fair distribution among participants)
  - No budget for R&D activities

# Major achievements GP1+GP2

- Participants (269)
  - Increase from 80 till 269 in 2 years (11/2018 – 10/2020)
  - Distribution over 36 European countries, 4 Near Neighbour Countries (NNC), 4 International Partner Countries (IPC)
  - Gender balance: 43% female
  - 21 companies and associations (incl. SMEs)
- 20 STSMs organized
- 2 ITC conference grants accepted
- Meetings
  - Kick off Brussels (47 participants)
  - Core group meeting Cordoba: Exchange LigniVAL and LignoCOST (27 participants)
  - Co-located joint WG + MC meeting Wageningen (122 participants)
  - Co-located joint WG + MC meeting Régua (106 participants)
- Dissemination
  - Many joint papers (info on website)
  - Presentations on promotion of lignoCOST
  - Poster LCA
  - Website [www.lignocost.eu](http://www.lignocost.eu) + [www.cost.eu/actions/CA17128](http://www.cost.eu/actions/CA17128) + social media channels



# Achievements GP1+GP2

## Collaboration with IEA Task 42 Biorefineries with ENEA Italy

- Joint publication on the state-of-the-art on lignin valorisation (in progress)
- Joint activity on techno-economic evaluation and LCA with ENEA and WG5 (led by Apostolis Koutinas)

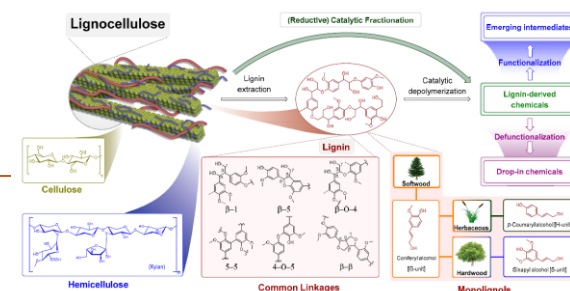
# Goals and achievements working groups

## WG1 Wiki lignin and lignin producers survey:

- A first set up of the structure and information needed to fill the **Wiki lignin database** has been defined
- Via WUR library a strategy is under development to use published data via specific keywords in the database
- Wiki lignin will first become available for LignoCOST participants; later on the website
- A deliverable report is expected by October with an **Overview of existing lignin production and valorisation research infrastructure**

## WG2 Lignin production and catalytic conversion technologies

- **Upstream lignin fractionation:** 5 families identified with task leaders nominated
  - 1) Lignin-first 2) Pulping processes 3) Organosolv 4) Bio-tech E.g: enzymatic, microorganisms
  - 5) Ionic liquid and deep eutectic solvents
- **Downstream from lignin to chemicals:** 6 families identified with task leaders nominated
  - 1) Hydrogenolysis (e.g. Metal catalysed), 2) Biotech, 3) Base catalysed 4) Pyrolysis / Combustion / Gasification, 5) Oxidative, 6) Lignin modification
- Information on lignin production and lignin catalytic conversion, including TRL, is collected
- A **Review paper** on “Development of ‘**Lignin-First**’ Approaches for the Valorization of Lignocellulosic Biomass” published by Tamás I. Korányi, Bálint Fridrich, Antonio Pineda, and Katalin Barta, *Molecules*. 2020 Jun; 25(12): 2815. Published online 2020 June 18. doi: [10.3390/molecules25122815](https://doi.org/10.3390/molecules25122815). Contributions from Budapest, Groningen, Cordoba and Graz.



## WG3 Industrial lignin applications versus lignin properties

- 7 priority value chains / applications have been selected for WG3 / WG4
  - 1) Resins (chosen as first model value chain)
  - 2) Marine fuels
  - 3) Commodity & fine chemicals
  - 4) Polymer blends
  - 5) Bitumen – asphalt
  - 6) Adsorbents - Water treatment
  - 7) Carbonized materials
- Task (co)leaders appointed for 7 taskforces and Factsheets have been prepared
- The factsheets will be compiled to form the 1<sup>st</sup> deliverable (2021)
- There is a strong link to WG4. The same value chains / products were selected for both WGs.

## WG4 Value chain development for lignin valorization

### Selected value chains

- 1) Resins (chosen as first model value chain)
- 2) Marine fuels
- 3) Commodity & fine chemicals
- 4) Polymer blends
- 5) Bitumen – asphalt
- 6) Adsorbents - Water treatment
- 7) Carbonized materials
- Detailed template for 1<sup>st</sup> value chain on PF resins for panels have been prepared and filled. Information will be complemented by interviews with companies to validate and update results.
- Next templates for carbon fibres and asphalt.



## WG5 Techno-economic and LCA aspects

- A literature review on TEE and LCA is ongoing
- Definition of scope and data collection on promising value chain for industrial application has been done
- Third step is the integration in existing biorefinery concepts
- Value chains resins will be first model value
  - Interaction needed for getting input data and evaluate the results
  - LCA and TEA require common input data. A template for Data on mass and energy balances will be distributed to WG4 partners. Info on of legislation, regulations and certifications will be included. This information is hard to get from the network.
  - Both studies can be combined to get an overall result (environmental impacts can be converted into cost)
  - Social economic aspects could be incorporated
- Collaboration with IEA Task 42 Biorefineries with ENEA Italy
  - Joint activity on techno-economic evaluation and LCA with ENEA and WG5 (led by Apostolis Koutinas)

# Outlook for GP3 (01/05/2020-30/04/2021)

- Due to COVID-19 physical meetings were postponed or re-scheduled in online events:
- **Monday October 12, 2020** ONLINE workshop entitled 'Current status of lignin valorisation in Europe' organised by RISE/WUR
- **Friday October 23, 2020** ONLINE TRAINING SCHOOL – 'Modified Lignin Materials for Reactive Polymer Composites: Processing and Characterization', organised by the University of Belgrade, Faculty of Technology and Metallurgy (TMF)
- **December 2020**, Half day ONLINE workshop – 'Upscaling technologies for lignin use' – organised by VITO/WUR (to be confirmed)
- **February 2021** – co-located WG and MC meetings in Pisa (to be confirmed)
- Short Term Scientific Missions (STSMs) on hold
- ITC Conference Grants on hold

## Future perspectives

Lignin research and valorisation is hot

Industrial commitment is increasing

Lignin production is increasing

Lignin applications are growing

Collaboration by connecting different sectors works  
(e.g. pulp&paper sector AND asphalt infra sector)

- Making Lignin Great Again!!

About Making Lignin Great Again—Some Lessons From the Past  
Prof. Wolfgang G. Glasser, Sustainable Biomaterials, Virginia Tech,  
Blacksburg, VA, United States (2019)

- # Acknowledgement

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