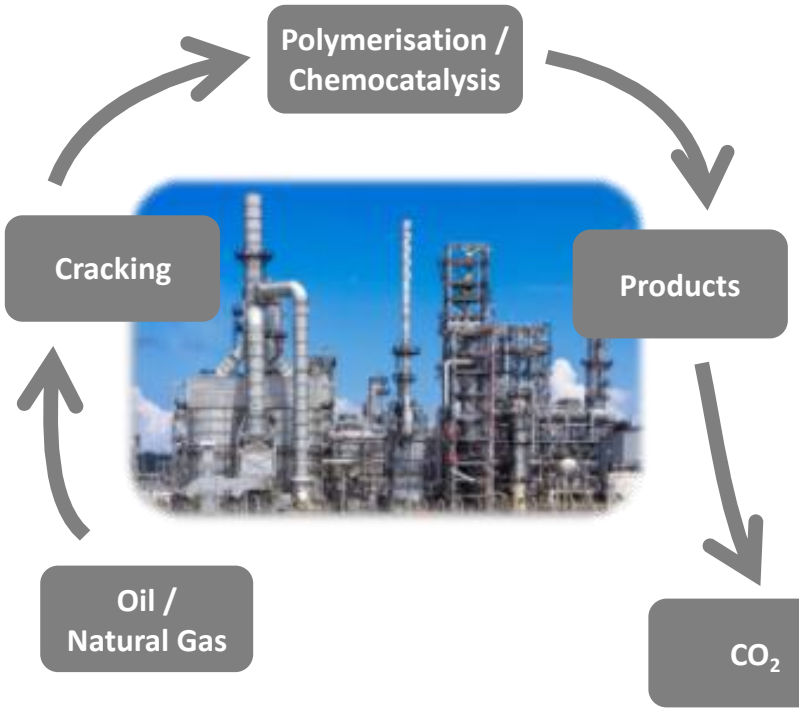
LXP GROUP

Disrupting the 2G Biomass Value Chain

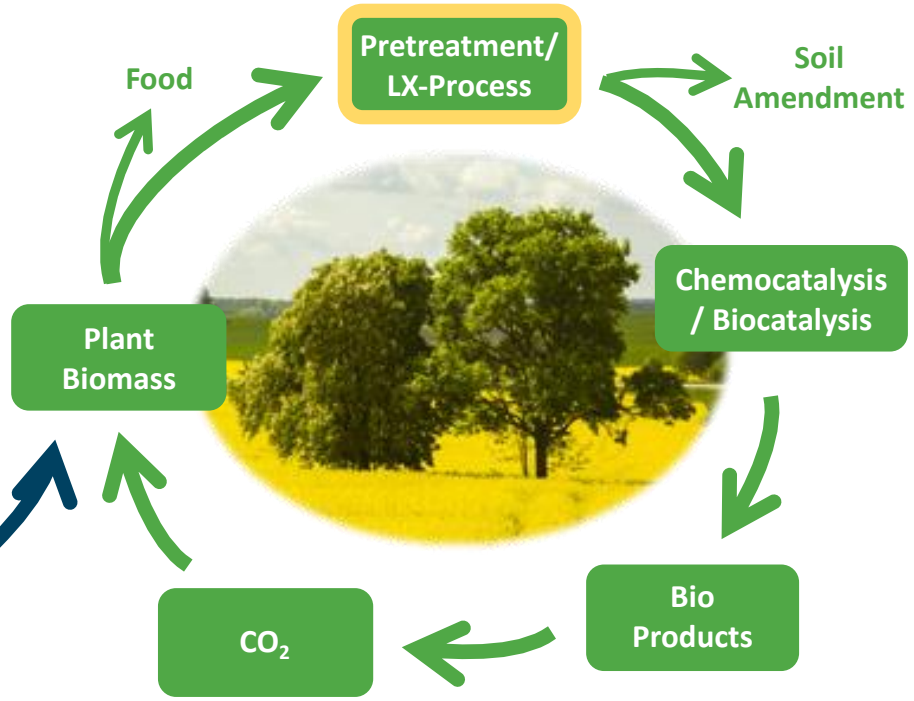
– Proprietary technology that "gently" cracks 2G biomass –

COMPANY

The fossil economy



The circular, bio-based economy



We are committed to the advancement of 2nd-Generation (2G) biomass waste utilisation

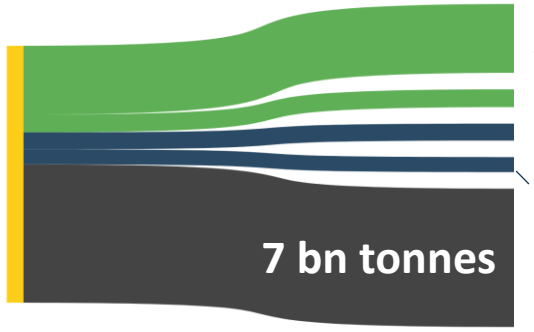
We enable decentralized implementation of Biomass waste pretreatment to:

- Generate a transition to a circular economy
- Bind CO_2 through multiple industry cycles
- Transition to greater bio-based chemical production

THE PROBLEM

→ **7 billion tonnes of biomass is insufficiently utilized every year**

~13 billion tonnes of forestry and agricultural biomass worldwide



Animal feed
Food
Industrial products
Energy
Waste

Food vs. Fuel conflict
First generation (1G) biofuels compete with food crops

Opportunity for second generation (2G) biofuels and biomaterials

Renewable Energy Directive

- At least 14% renewable energy usage in the transport sector
- Need to minimise the amount of biofuel produced from energy crops

→ **Need to increase production of 2G biofuels from unused biomass waste**

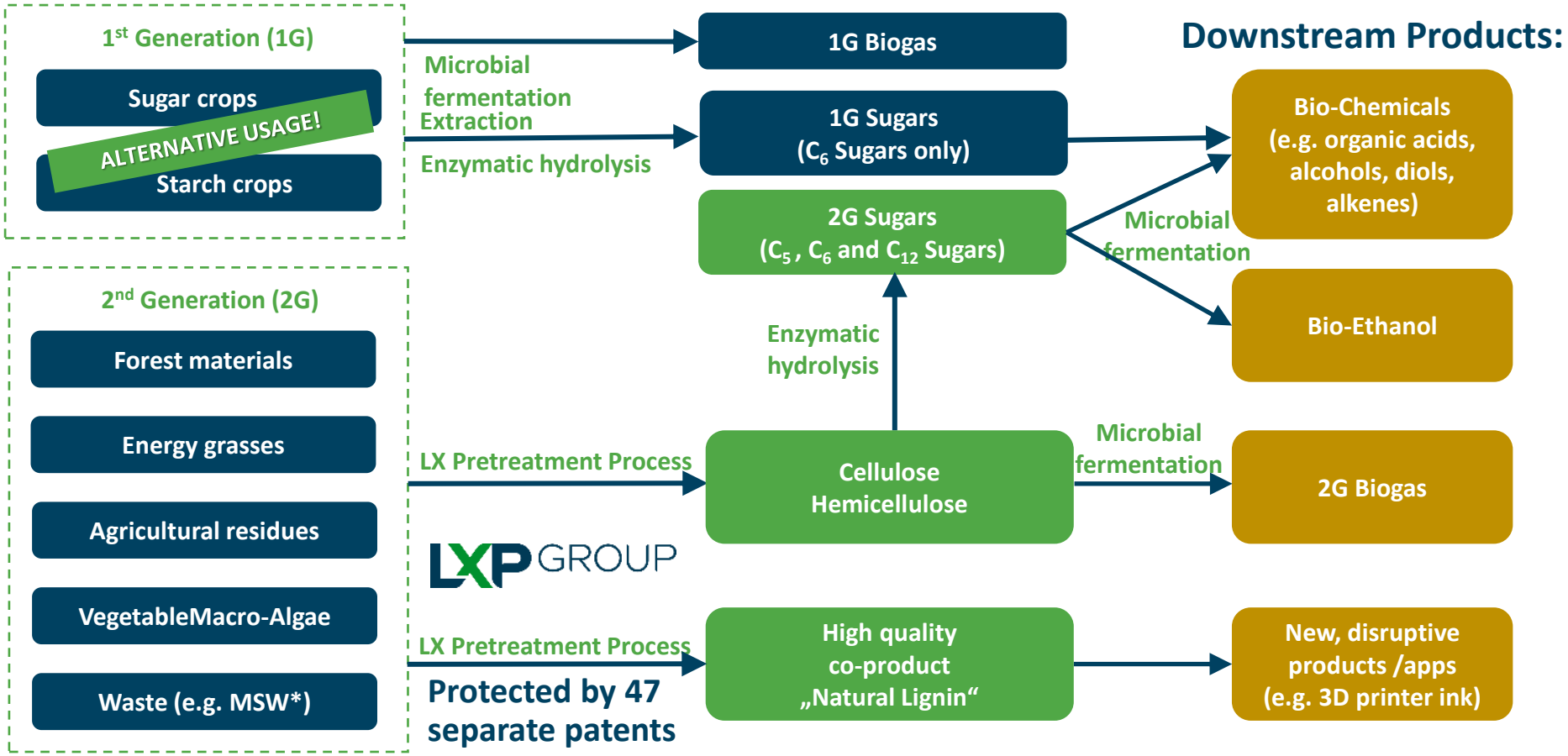
- **Lignocellulose in woody material prevents full conversion of sugars**

BUT: biomass pre-treatment plants to date typically fail at scale up due to high CAPEX and OPEX demands

THE SOLUTION

We have developed and patented a proprietary technology that “gently” dissolves the structural bonds of 2G biomass, making available the main components cellulose, hemicellulose (both complex sugars) and natural lignin. The lignin can be extracted, and the sugars processed to bio-fuels and bio-based chemicals.

LXP converts biomass waste residues to high value-added bio-fuels and bio-based chemicals.



VALUE PROPOSITION

2G Biofuels

- 2G feedstocks improves feedstock flexibility
- Extends the economic lifetime of existing biogas plants
- Processing biomass waste provides opportunities for new biogas plants
- Can reduce substrate costs by 50%

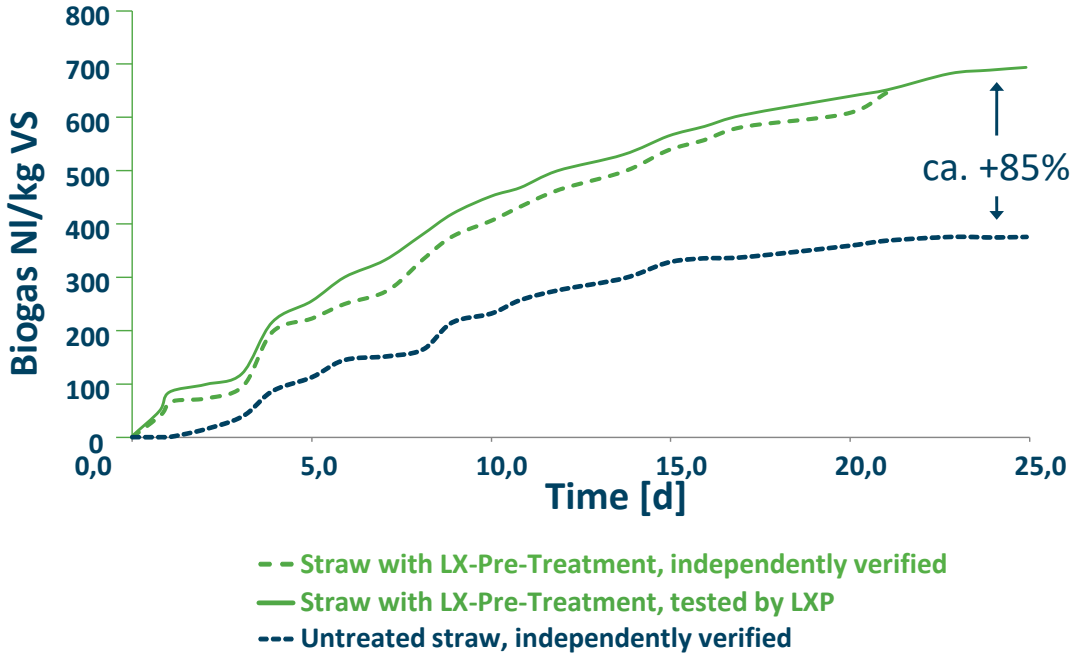
2G Bio-Chemicals

- Major investments by key players in development of bio-based, “drop-in” petrochemical replacements
- LX-Technology is ideal for bio-processing (combined hydrolysis and fermentation)
- Multitude of major markets can be accessed

Natural Lignin

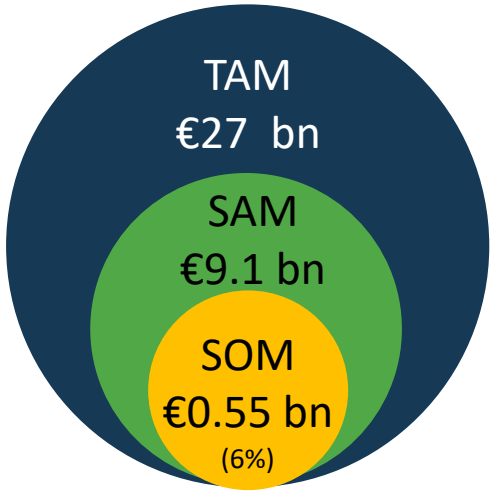
- Unique quality not commercially available today
- Existing markets only for low quality lignin (i.e. lignosulfonates)
- High value creation with disruptive technologies (e.g. 3D ink or natural vanillin)

Increased biogas production with LX-Pre-Treatment

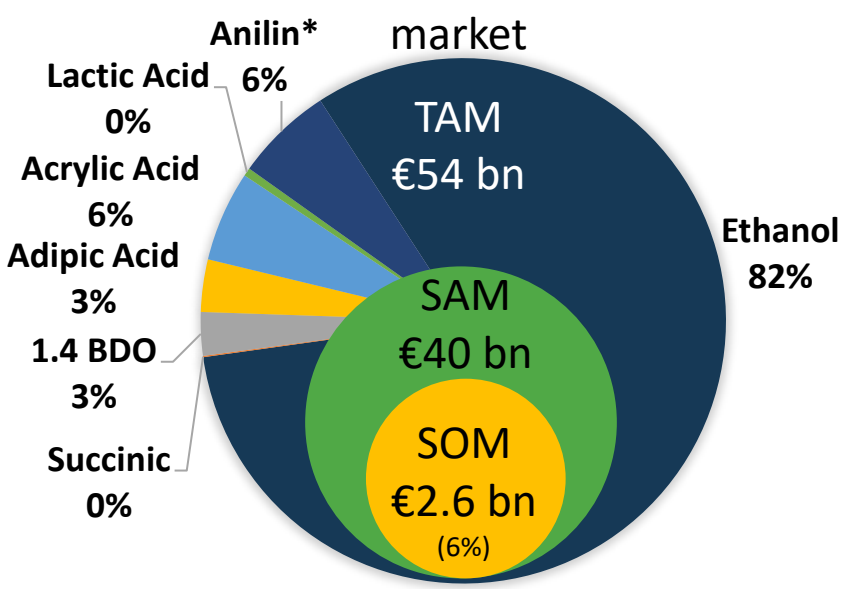


MARKET OPPORTUNITY & RISKS

Biogas market



Biochemical market



Disrupts petrochemicals market

High margin markets for natural lignin:

3D printer ink - €20 bn by 2028
Sun care - €24 by 2024
Adhesives - €2 bn by 2022
Vanillin – €750 M

Risks and mitigations

- Small variations in R&D or budget can cause problems / delay development
  - ✓ Additional funding rounds sought
  - ✓ Seeking EIB investment to support
- Commercialization of other solutions for 2G biomass.
  - ✓ Continually monitor IP situation; very large market
- Low oil price threatens competitiveness of biofuel
  - ✓ The recovery of the oil price post-Covid19 crisis is unknown but long-term trend for CO_2 Pricing will become driving force for conversion.
- Insufficient supply of biomass waste for plants
  - ✓ Flexibility of feed use allows us to switch biomass waste suppliers if needed
- Technical delay in commissioning/Operation of demo plant does not meet expectations.
  - ✓ Commissioning is ongoing, full installation running
  - ✓ Optimization of capacity utilization ongoing

COMPETITION

Pre-Treatment Technology	Commercial status today	Inhibitors / Toxicity	Amorphouse Cellulose	Natural Lignin	Full Sugar Conversion	Biomass Flexibility	Viable at Small Scale	Company Examples
Steam Explosion	✓	✗	✗	✗	✗	✓	–	Clariant AG
Organosolv	–	✗	✗	✓	✗	–	✗	Fibria Cellulose S.A
Acid Hydrolysis	–	✗	✗	✗	✗	–	✗	Avantium NV
Alkaline Hydrolysis	–	✗	✗	✗	✗	–	✗	Verbio AG
Supercritical Water	–	✗	✗	✗	✗	–	✗	Renmatix Inc.
LX-Technology	–	✓	✓	✓	✓	✓	✓	

LX-Process eliminates the creation of inhibitors and the need for custom enzymes, significantly lowering OPEX to ensure successful scale-up where other competitors have failed

↓ Toxicity

Low cost enzymes

↓ Inhibitors

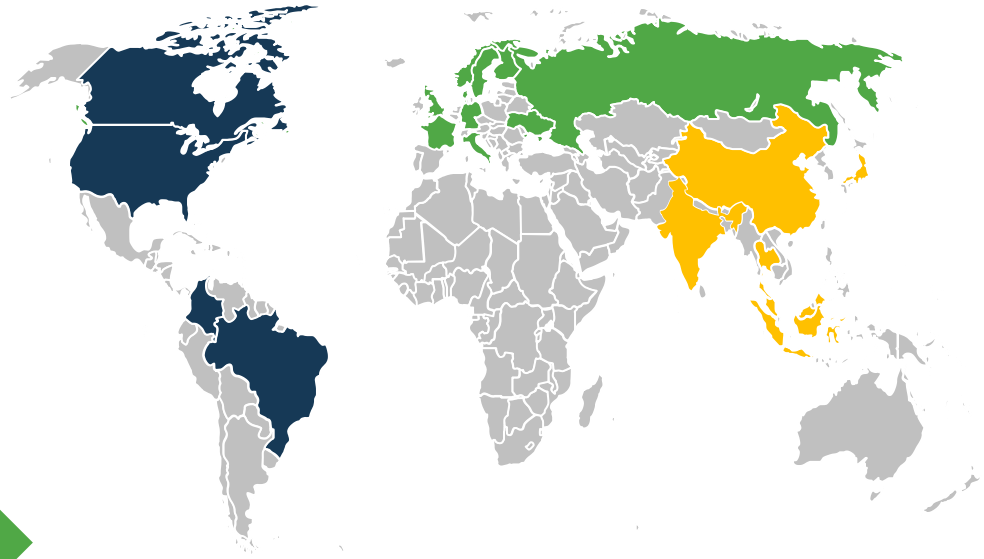
COMMERCIALISATION STRATEGY

Construction of LX-Prototype Demonstrator

Operating, Optimization, Feedstock Testing…

Upscaling to a 10,000 t Pilot Plant (Basic Engineering)

Industrial / Strategic Partnerships / Exit



Construction and commissioning of 10 kt p.a. Pilot Plant

Construction of commercial biogas plants (Europe market)

Expansion to Americas market

Expansion to APAC market

Construction of commercial biorefinary plants (EU market)

Existing relationships:

Nordmethan · SÜDZUCKER · ADM · Corbion · ENERTEC Biogas Genthin GmbH

2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028

CONCLUSIONS

Excellent value creation for a wide variety of products / applications

- LX-Technology enables full 2G utilization of plant biomass by breaking up lignocellulosic structures.
- LX-Technology improves yields and economics of any biogas plant.
- LX-Technology is ideal platform for downstream LX-Technology produces a “blockbuster” co-product – natural lignin.

Patented, scalable, simple and flexible de-risked technology

- 47 patents granted in major global markets.
- Highly scalable, simple process (low temp, normal pressure) reducing capex
- Extreme high feedstock flexibility.

Fantastic downstream opportunities - biochemicals

- Major opportunities to implement LX-Technology in bio-based chemicals / polymers.
- Applicable for Combined Bio-Processing, decreasing downstream economics.
- LXP already working with partners (i.e. Fraunhofer, chemical corporates) on several initiatives..

Multiple opportunities to monetize investment

- Good opportunity before value shift in 2022/2023 after successful operating of demo plant.
- Excellent cash flow generation (licensing/royalties).
- Next exit window when “scale-proven” in 2024-2027 / highly attractive for secondary placement!

“Preliminary testing confirms LX-Lignin/PLA combinations can be used as biodegradable compounds in 3D printing”
Fraunhofer IZI-BB

“Successful fermentation to succinic / lactic acid with similar performance as 1G sugars“
Leibniz ATB

“Our results confirm high conversion rates to biogas for the tested lignocellulosic biomass”
SGS Institut Fresenius

“Micro-organism activity on LX-Cellulose is significantly higher compared to that from other pretreatment processes”
University RWTH Aachen

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