METGEN

LIGNIN BIOREFINERY
JOURNEY FROM INNOVATION TO MARKET READY PRODUCTS

ALEX MICHINE, CEO

OUR INSPIRATION

What will happen if we remove oil based materials from our lives?

Look at this

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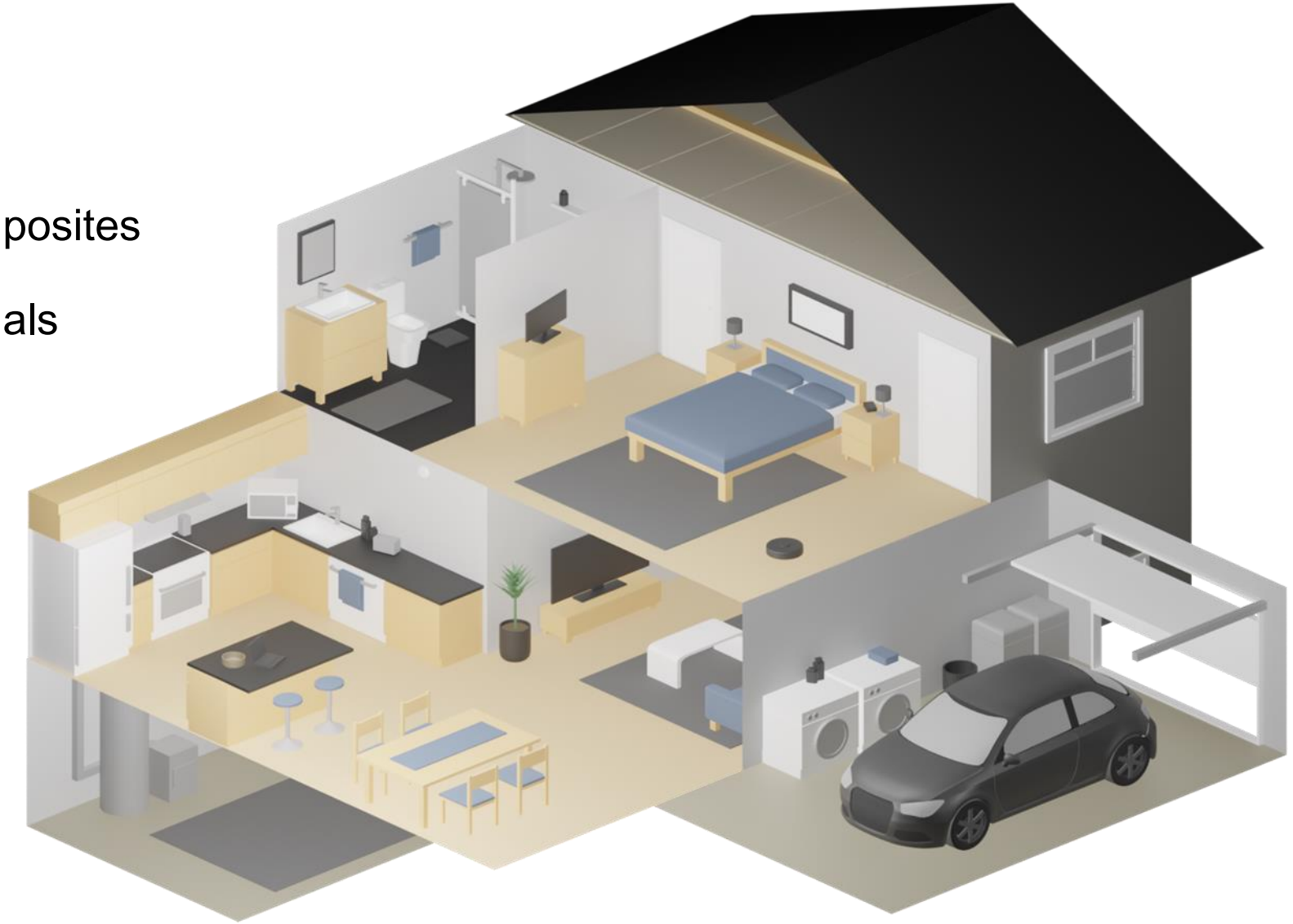
THAT'S EVERYTHING TO REPLACE OIL BASED CHEMICALS

Bio-based :

- Surfaces and materials
- Insulation foams and composites
- Resins and adhesives
- Wood fibres based materials
- Bioplastics
- Carbon fibres



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LIGNIN – THE NEW PETROLEUM?

- Lignin, which represents up to 30 percent of the lignocellulose biomass, is an unexploited treasure.
- Approximately 50 million tons of lignin from pulp & paper industry is burnt for energy purposes today.
- Lignin has aromatic basic building blocks similar to ones extracted from petroleum
- METNIN™ lignin processing technology is lignin agnostics, it fractionates and activates lignin
- Specific lignin fractions are suitable for replacing oil based chemicals in various industries
- The potential upside of lignin refining technology is similar to discovery of oil refining technology.

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MULTI BILLION MARKET OPPORTUNITY

- The global lignin market reached € 0.78 billion **in 2019**. By 2027 it is expected to grow steadily to € 0.92 billion.
- Commercialization of METNIN™ refining and conversion technology will boost the market potential of lignin.
- METNIN™ expands the scope of lignin applications in resins and adhesives, emulsifiers and dispersants, sizing and coatings, foams and composites.
- Even with relatively low replacement percentages of fossil based chemicals by lignin fractions - it is market opportunity of significant order.

Applications	Existing market value (Billion €)	Potential market value for METNIN™ (Billion €)*
Resins and adhesives	11	1.1
Emulsifiers and dispersants	6	0.6
Sizing and coating	5	0.5
Foams and composites	2	0.2

*assuming 10% replacement as potential for lignin

Source: MetGen Oy, Grandview Research, Imarc, Data Bridge Market Research

LIGNIN BIOREFINERY

1. The aim is to demonstrate the process, scalability re-production and more importantly to make fractions available for off-takers.
2. MetGen has designed a 3 kton METNIN™ Demo plant. The project requires investment of 6 MEUR
3. Followed by this project MetGen plans to sell commercial licenses and replicate solution around the world
4. Strategic collaboration with major engineering company in place to provide EPC.
5. MetGen has received LoI and MoU from potential off-takers for the METNIN™ products

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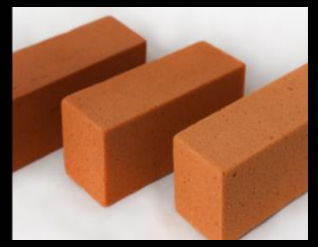
LIGNIN BIOREFINERY PRODUCTS

	END PRODUCTS	VALUE GENERATION	VALUE PROPOSITION FOR THE CUSTOMERS
METNIN™ SHIELD (Strength and humidity resistance additive)	CARDBOARD BOXES 	Fully bio-based solution for high humidity strength (creep resistance) and sizing improvement	Improvement of recycled and virgin fiber board properties. Savings includes fiber cost, basis weight reduction, removing conventional sizing chemicals and synthetic dyes
METNIN™ NANOPOLYOL (Lignopolyol)	POLYURETHANE FOAM 	Equal quality specs to oil-based polyol with improved hydrophobicity and fire retardancy	Full replacement of polyols (market price of 3000 - 4000 EUR/ton) with lignin fraction
METNIN™ RESIN (Phenolic resin)	PLYWOOD 	Equal quality specs to phenol and low viscosity with renewable compounds	50 – 80% replacement of phenol with more affordable and sustainable material

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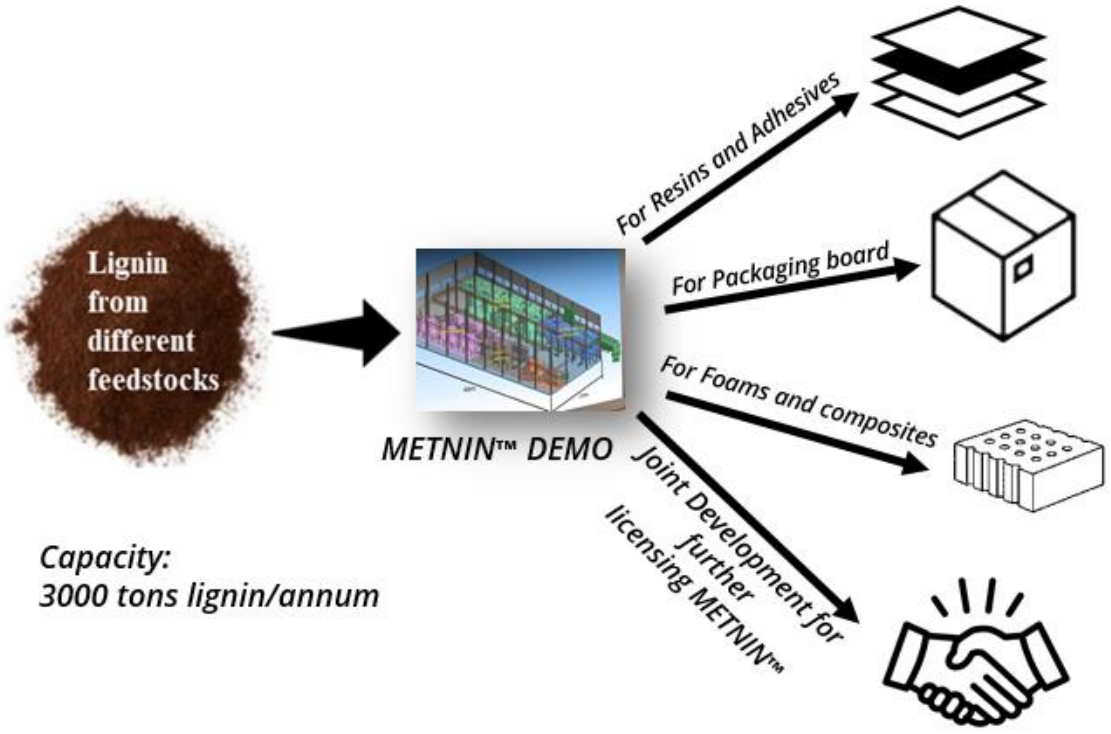
LIGNIN BIOREFINERY SUMMARY



Lignin agnostic	Sustainable concept & Zero waste	Refining lignin for end-user specific needs
Operates both as commercial facility and industrial demonstration unit	Technology can be integrated to all types of P&P mills and biorefineries	Basic engineering package available
Technology available for licensing and industrial scale up	CAPEX approx. **6 M€**	Pay-back in **3.6 years** after commissioning

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METNIN™ SHIELD COMPETITIVE ADVANTAGE

Property	Current Solutions	SHIELD Benefits
Repulpable, Recyclable, Biodegradable	X	✓
Strong in high-humidity	X	✓
Plastic-free and fully bio-based	X	✓
Raw material savings	X	✓
Allows for lightweight packaging	X	✓
Strength and water-resistance in one solution	X	✓
All paper and box properties equal or better	X	✓

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METNIN™ NANOPOLYOL COMPETITIVE ADVANTAGE

Property	Current Solutions	NanoPolyol Benefits
Biobased material	X	✓
Light weight foam	X	✓
Improved water resistance	X	✓
Improved fire retardancy	X	✓
Cost competitive	X	✓
Multifunctional properties	X	✓

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METNIN™ RESINS COMPETITIVE ADVANTAGE

Property	Current Solutions	METNIN™ Resin Benefits
Better film properties	X	✓
Low viscosity	X	✓
Low formaldehyde content	X	✓
Biobased material	X	✓
Cost competitive	X	✓

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LIGNIN PROCESSING UNIT SETUP

ROI – 3.6 years

> 80% GHG Reduction

Customer: Pulp Mill

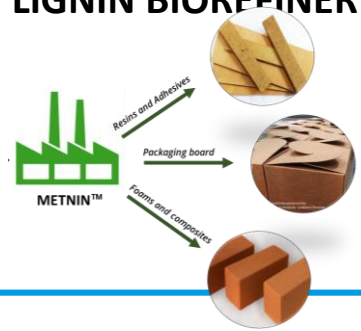
Paper Mill

METNIN™ SHIELD

Improved packaging board properties at lower cost

FENCE

LIGNIN BIOREFINERY



METNIN™ ULTRA & NANO products to Off-takers at >1500 EUR/ton

Black liquor lignin

Initially < 2% with expandability option

Integrated Recovery Boiler with Paper Mill Production

Provides increased throughput

FENCE

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SIDE STREAMS to be recycled back to Pulp Mill

Recycling of insolubles, salts, water, NaOH

LIGNIN PROCESING UNIT– IMPORTANT FACTS

1. Do Not Significant Harm

We are not supporting or carrying out economic activities that do significant harm to any environmental objective, where relevant, within the meaning of Article 17 of Regulation (EU) 2020/852.

2. Emission reduction potential

LCA study has been carried out using third party services. METNIN™ technology demo plant with 3 selected products shows an emission reduction potential of > 80% greenhouse gases (GHG) reduction compared to the fossil based manufacturing of the same products.

3. Lignin processing unit

- can use biomass as energy source and can adapt changing climate, will not pollute water sources and do not utilize marine resources
- is practically zero waste process which significantly limits the pollution
- uses only the waste streams coming from pulp mills and do not directly utilize forest or agriculture resources

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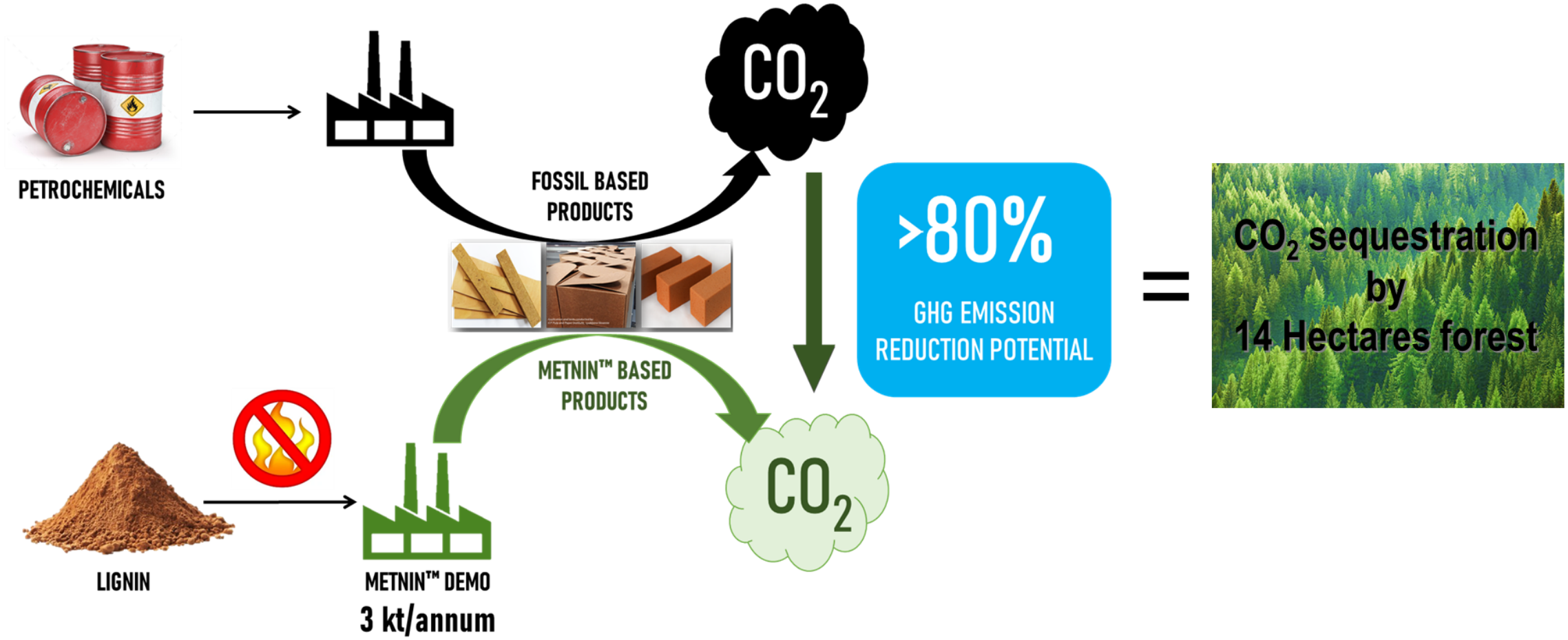
STRONG CONTRIBUTION TO GHG EMISSION REDUCTION



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POTENTIAL AREAS FOR COOPERATION

- Packaging : SHIELD
- Elastomers and Plastomers: lignin-polymer composites
- Emulsions, Fluids, Blends and Dispersions: lignin dispersions
- Gels, Encapsulants and Conformal Coatings: lignin-based hydrogels
- Intermediates and Feedstocks: intermediate sugars: fructose and glucosone
- Polyurethanes: lignin-based polyols
- Resins, Binders and Film Formers: lignin-based PF resins
- Surfactants, Emulsifiers and Polyglycols: lignin-based surfactants
- Automotive interiors : lignin-based polyols

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CLOSING REMARKS

Our mission is to maximize the value of renewable feedstock

Largest and fastest growing opportunity in biobased materials

The replacement of fossil-based products by renewable resources is our core environmental objective

>80%

GHG reduction

Building lignin biorefinery is crucial step in our mission

We are looking for strategic investors/collaborators

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